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

March 2024
Issue 226

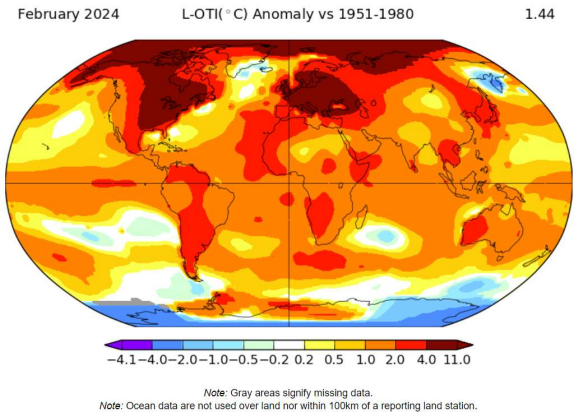
The Clay Research Group

CONTENTS

Issue 226, March 2024
Pages 2 and 3
ISE Publication "**Subsidence**"
Escape of Water Damage
Page 4
The Crooked House
Met Office Anomaly Data
Pages 5 - 12
Subsidence Risk Analysis by District
COLCHESTER

GISS Update

The graph below has been reproduced from the NASA Goddard Institute for Space Studies data plotting anomaly data comparing February 2024 with the average for the period 1951-1980.



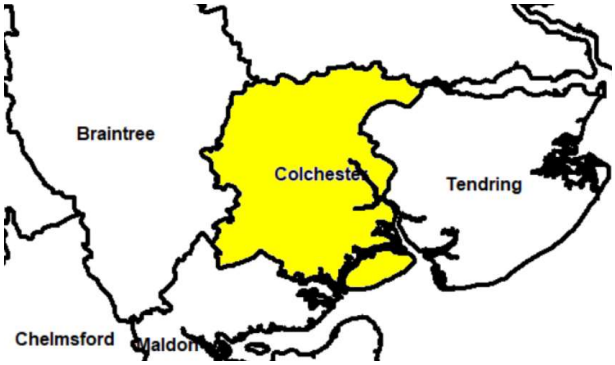
Contributions Welcome

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

Colchester is the subject of the 'Risk by District' series in this month's edition. Situated in Essex, it has superficial deposits of sand and clay overlying London clay – see Page 6.



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

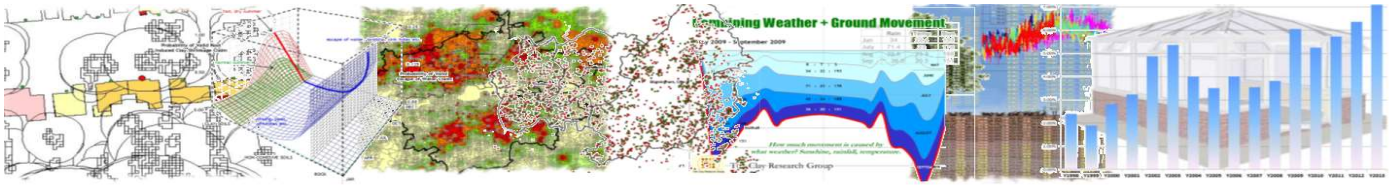
Warmer and Wetter

The Met Office have confirmed that 2023 was the warmest year, and February 2024 both the warmest and wettest month on record.

What does the future hold? The Met Office explain, *"Climate projections indicate that on average, winters will continue to become wetter and summers drier, though natural variability will mean we will continue to see individual years that don't follow this trend."*

Duty to Consult Felling of Trees

Thanks to Keiron Hart of Tamla Trees for providing a copy of the **Duty to Consult – Felling of Trees** guidance. Apparently, the guidance is now live and can be accessed on the CRG site by selecting 'Monthly Newsletters'.

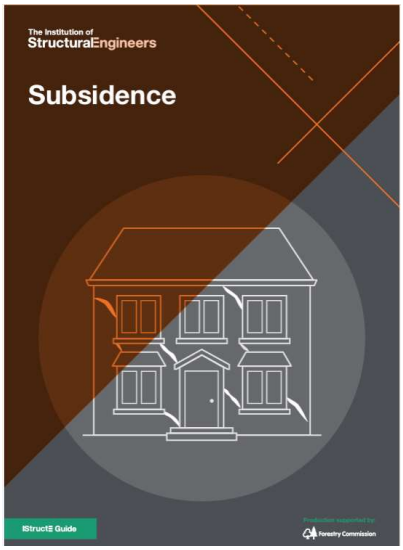


The Clay Research Group

ISE Publication - 'Subsidence'

Tony Boobier has reminding us that the book "**Subsidence**", published by the Institute of Structural Engineers in November 2023, is available for purchase at:
https://www.istructe.org/resources/guidance/subsidence/

John Patch, the Chair of the group behind the publication, explains, "I've been working with a wide group of subsidence experts as part of the IStructE's Taskgroup to publish a new guide simply called 'Subsidence'." See following page for a list of contributors.



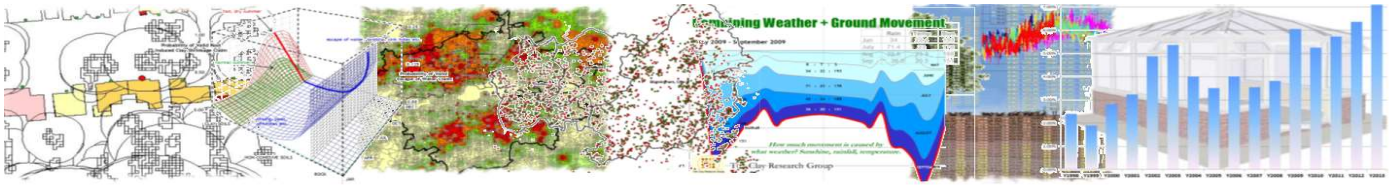
The book covers a wide range of topics including climate change, the use of data and modelling risk digitally, remote assessment etc. It then goes on to consider new technologies – alternatives to underpinning, trees, soils etc.

John explains *"Hotter, drier summers and warmer, wetter winters mean we can expect increases in properties at risk from ground movement. The hot and dry summers we've recently experienced have resulted in subsidence claim 'surge years', especially in parts of the UK where there are shrinkable soils.*

"Physical site visits are undergoing change too. COVID-19 led to more use of remote imagery and virtualisation, with ambitions to continue to reduce the number of site visits by using electronic communication and digital evidence collection. Remote methods can ultimately affect the way that subsidence is managed, both at a risk and claims level."

"This digital intelligence is essential because subsidence involves lots of players — the homeowner, the insurance industry, mortgage lenders, surveyors, engineers, and builders. As such, digital records with robust and shareable data make this process more interconnected and manageable." We conclude in our Subsidence guidance that increased sharing of subsidence data, tools, and learning can help the construction, insurance and remediation industries to meet the challenges ahead. After all, subsidence is a cross-industry activity, where collaboration between academics, businesses and other specialists outside the subsidence community is essential to the further mitigation of the issue."

John Patch BSc FICE is the Director of Teampatch Ltd and Tony Boobier is an independent consultant focusing on insurance analytics. Both contributed to IStructE's guide Subsidence.



The Clay Research Group

ISE Publication, 'Subsidence' – List of Contributors

Authors

J C W Patch	BSc FICE (Technical Consultant ASUC) *Chair*
A Boobier	BEng (Hons) CEng FICE
O Brooker	BEng CEng MICE MIStructE MCS (Structronix)
A Bussey	BSc (Hons) DipArchCons FRICS C.Build E MCABE (Gateley Smithers Purslow)
G Carter	BEng (Hons) CEng MICE DipCII (Claims)
B N Deakin	BSc (Hons) CEng MICE FCILA (RSA Insurance)
S Dee Shapland	BSc (Hons) MRICS C.Build E FCABE (MD Group)
T Farewell	PhD MSc BSc (Hons) M.I.SoilSci SFHEA (MapleSky Ltd)
S James	RIBA FICFor (Hon) (Trees and Design Action Group)
D Johnson	BEng (Hons) FGS (Roger Bullivant)
R King	BSc Hons (Falcon Structural Repairs Ltd)
A M Lee	BSc MSc CEng MIMMM CGeol FGS (Geobear Global)
R Mace	IEng IMIStructE (Shire Structures)
M MacQueen	BSc CBiol MRSB MICFor CEnv MAE MEWI (Property Risk Inspection Limited)
P Noble	BTech (Hons) CEng MIStructE (Premier Guarantee)
S Odunmbaku	MSc CEng MIStructE (NHBC)
A Parkinson	MRICS MIRPM (RICS)
T Pither	CEng MICE ACILA AaPS MAPM (Subtilis Consulting Ltd)
Z Rose-Higgins	MEng PhD (Coal Authority)
M Shum	BSc (Hons) C.Build E MCABE (LABC)
J C Smith	MICFor (Forestry Commission)
G Strong	BSc (Hons) FRICS FCIArb C.Build E FCABE FCILA FUEDI-ELAE (RICS)
A D Thompson	MScEDM(Open) CEnv FRICS FCInstCES (Anglia Ruskin University/RICS)
R Withers	(ASUC)

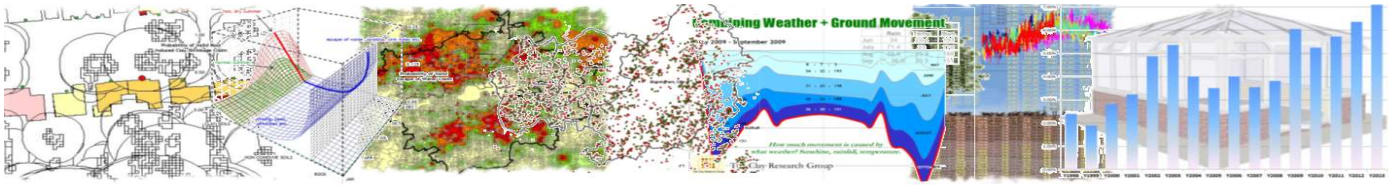
Escape of Water Damage

Allan Tew, Head of Engineering at Innovation, sent these photographs of damage related to water escaping from a leaking drain.

The photograph on the right shows the damage. The red arrow indicates the crack in the collar joining two pipes. Water escaping from the system softened and eroded the ground in the vicinity, resulting in subsidence of the brickwork (brown arrow).

Subsidence damage (brown arrow) to the brickwork above the leaking drain (red arrow).

Allan designed a reinforced pad (left) to span the relatively short distance, spreading the load across adjoining walls.



The Clay Research Group

The Crooked House

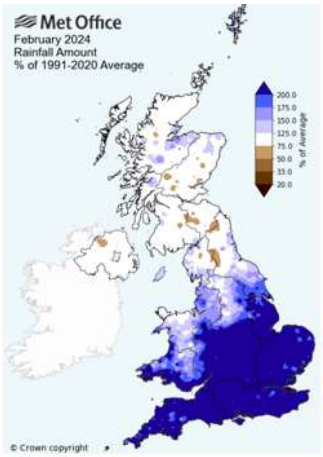
The Crooked House was built in 1765 as a farmhouse, but one side of the building gradually began to sink due to mining in the area during the early 19th Century. It was scheduled for demolition in the 1940s before it was made safe with reinforcements and buttresses. It has been reported in the press as having subsided 1.2mtrs across its frontage.

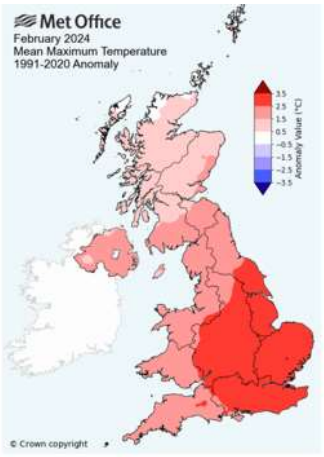
It was gutted in a fire on 5th August last year in what was suspected to be an arson attack, nine days after being purchased by its new owners. The rest of the building was demolished without permission less than 48 hours later. South Staffordshire Council served an enforcement notice, requiring them to rebuild the pub. The Crooked House was not listed at the time it was destroyed, but was a non-designated heritage asset registered in the Historic Environment Records as a building of local importance.

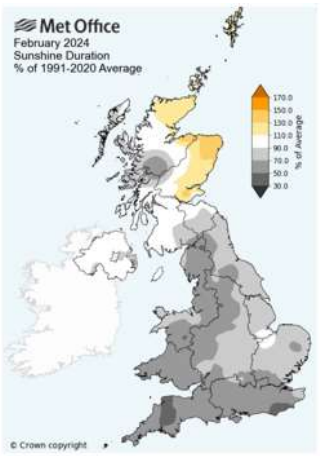
Just imagine trying to build a gable wall that leans outwards by around 600mm, founded on mineworking's and making and fitting distorted door and window frames etc.

Met Office February 2024 Update.
Anomaly Data, 1991 – 2020

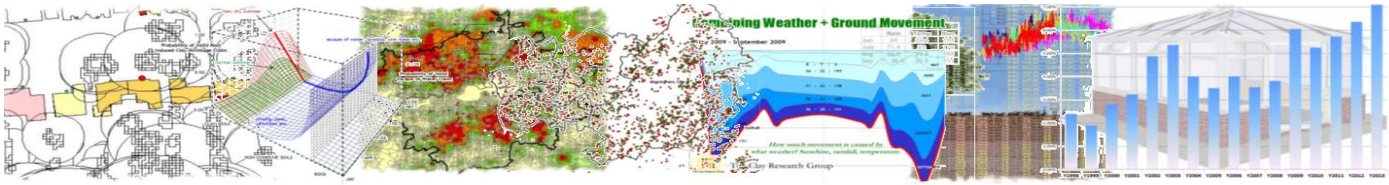
Anomaly maps from the Met Office web site for the month of February 2024 reproduced below. The month can be summed up as being warmer and wetter than the average for February.







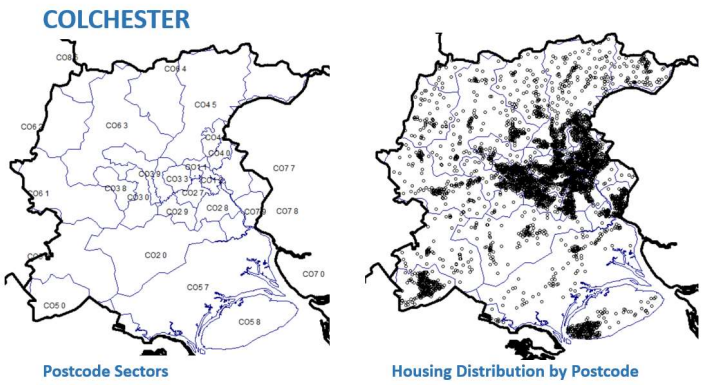
https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps



The Clay Research Group

Subsidence Risk Analysis – COLCHESTER

Colchester is located in Essex, occupying an area of 31.5km^2 with a population of around 122,000.



Distribution of housing stock using full postcode as a proxy. Each sector covers around 2,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

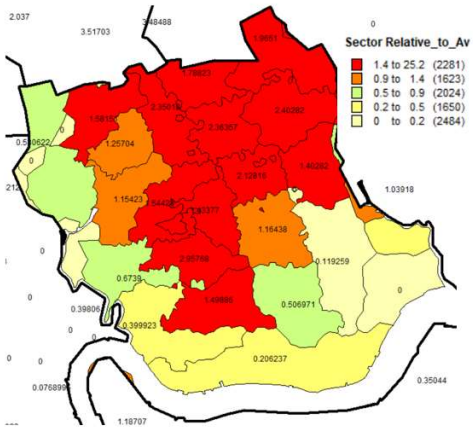
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

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.

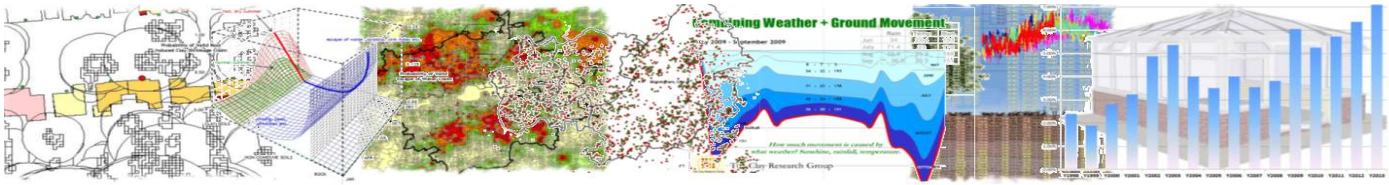
From the sample we hold sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Colchester is rated 66th out of 413 districts in the UK from the sample analysed and is around 1.59x the risk of the UK average, or 0.413 on a normalised 0 - 1 scale.

There is a varied risk across the borough as can be seen from the sector map, right. The varied geology across the district (see pages 7 and 8) comprises non-cohesive drift deposits overlying London clay.



Sector risk compared to UK average from the sample analysed including all properties by ownership.

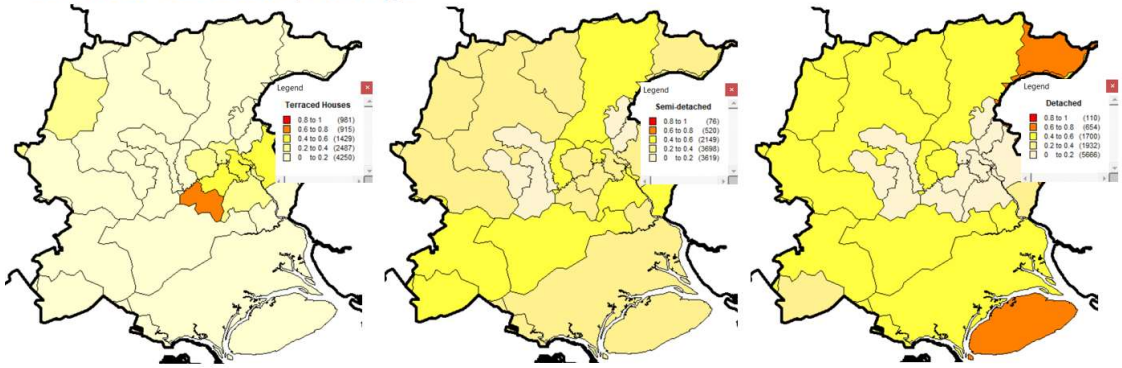


The Clay Research Group

COLCHESTER - 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.

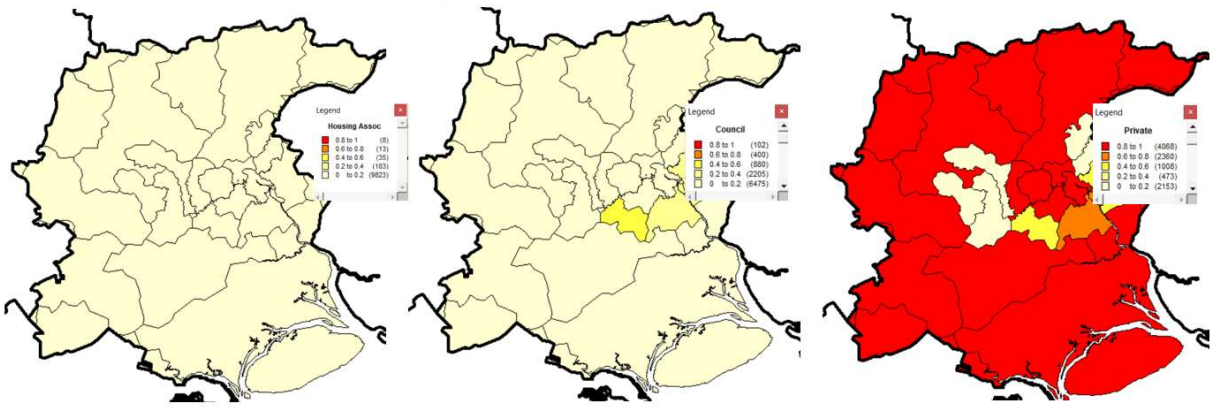
COLCHESTER - Distribution by House Type



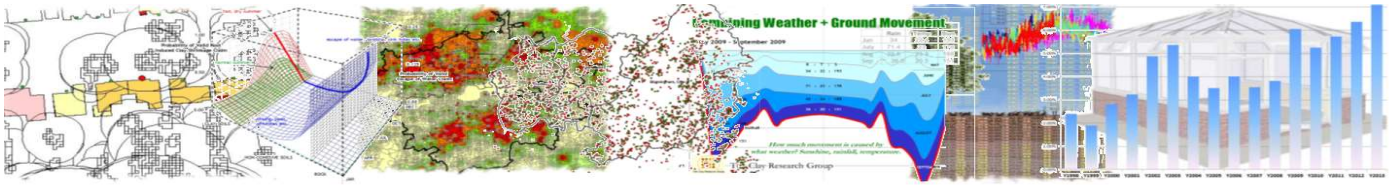
Terraced Semi-Detached Detached

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

COLCHESTER - Distribution by Ownership



Housing Association Council Ownership Private Ownership



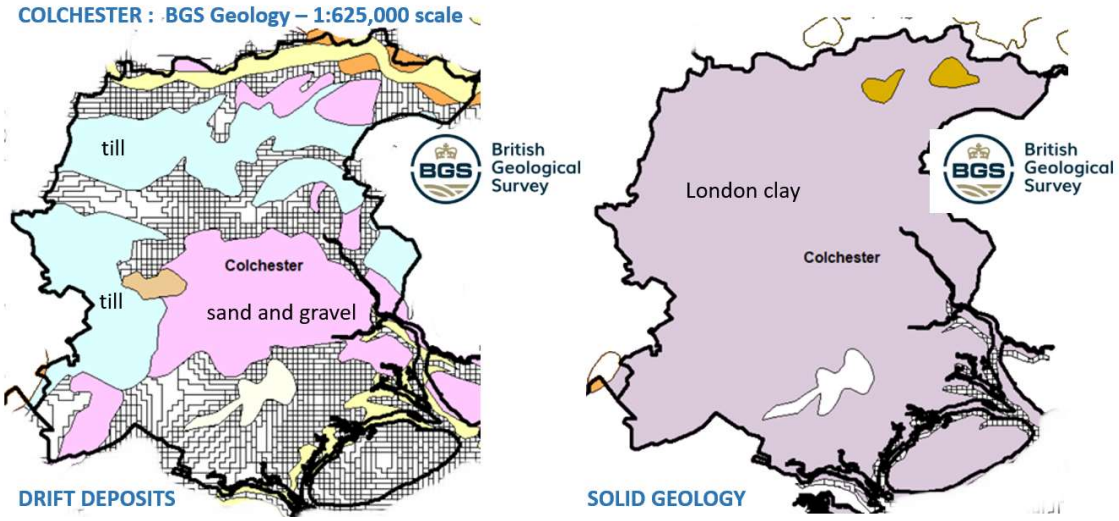
The Clay Research Group

Subsidence Risk Analysis – COLCHESTER

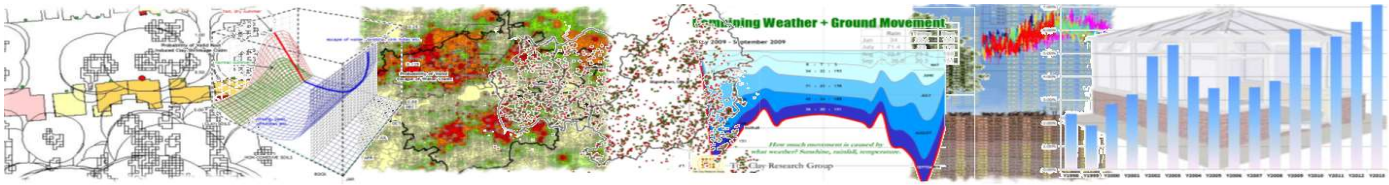
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is around a 60% probability of a claim being valid in the summer and, of the valid claims, there is around a 60% chance that the damage will have been caused by clay shrinkage, with escape of water accounting for the remaining 40%. In the winter the likelihood of a claim being valid remains at around 60%. Of the valid claims there is a 40% chance of the cause being clay shrinkage and 60% chance of the cause being an escape of water.

Maps at the foot of the following page plot the seasonal distribution with shrinkable deposits encountered following investigations associated with claims.



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.

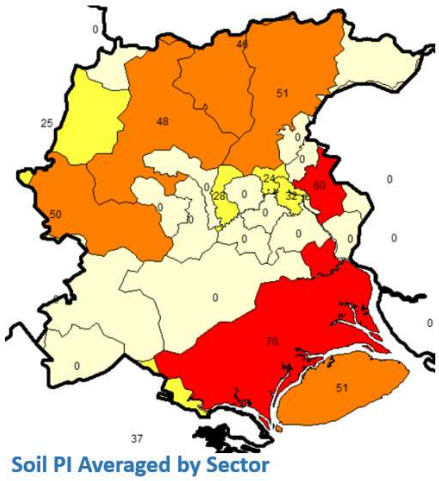


The Clay Research Group

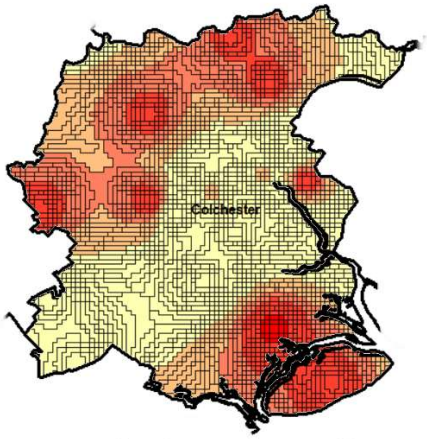
Liability by Geology and Season

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.

COLCHESTER – Soil Plasticity Index



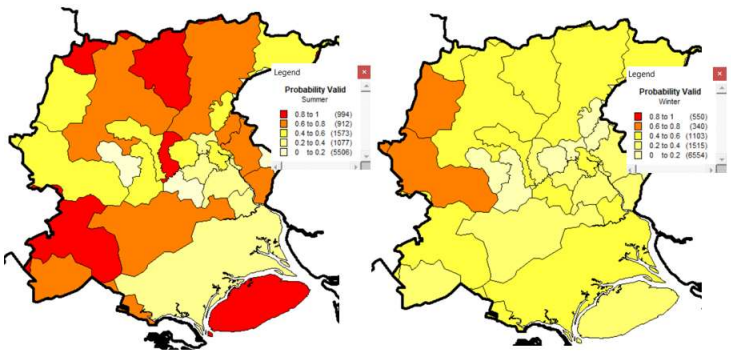
Soil PI Averaged by Sector



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.

COLCHESTER– by season



Probability Valid, Summer

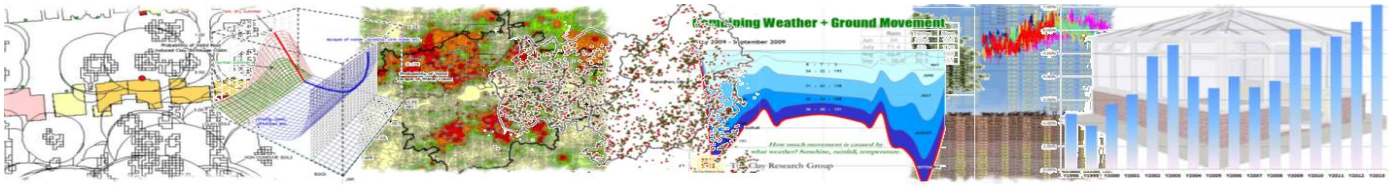
Probability Valid, Winter

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.

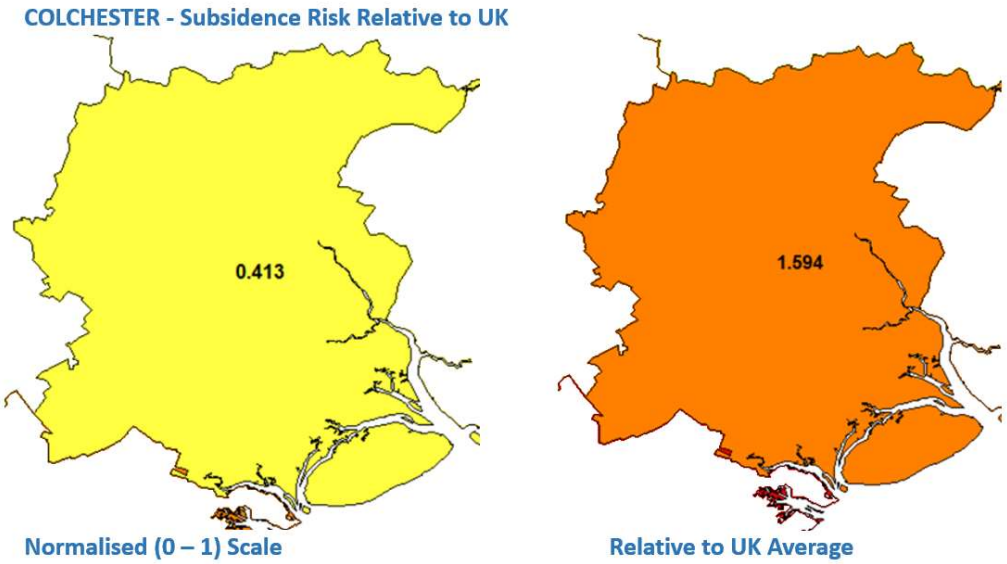
Clay is recorded as a significant cause of subsidence in the summer months which reflects the distribution of the housing population relative to the clay series.

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.



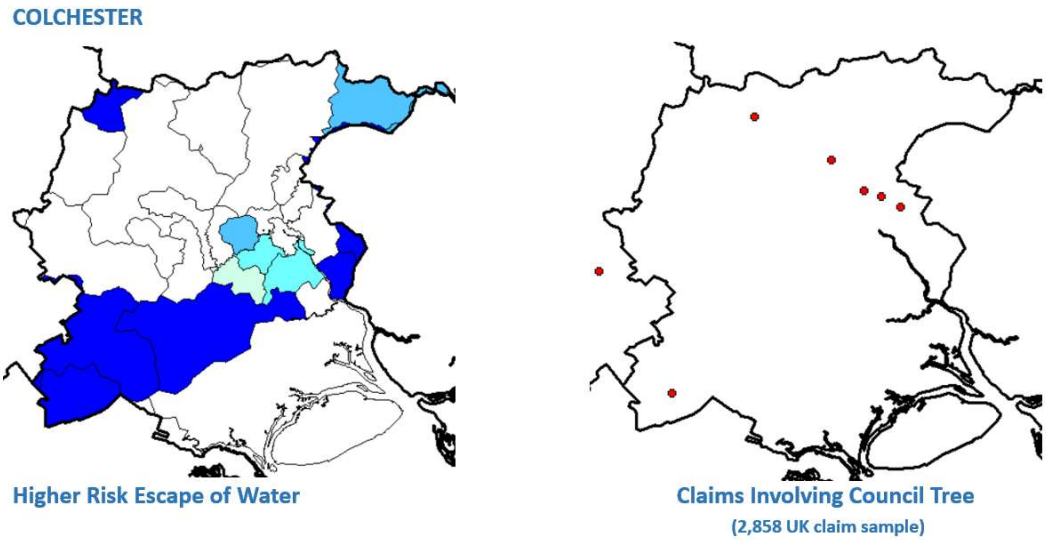
The Clay Research Group

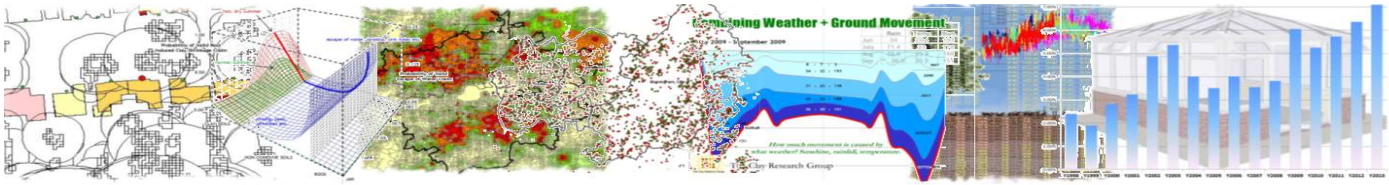
District Risk. EoW and Council Tree Risk.



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 drift deposits of till, sand and gravel. 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.



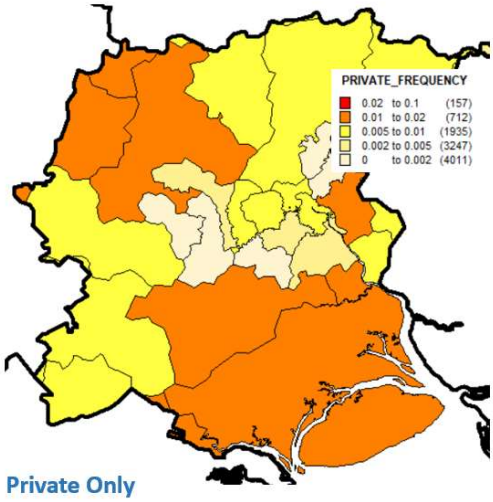


The Clay Research Group

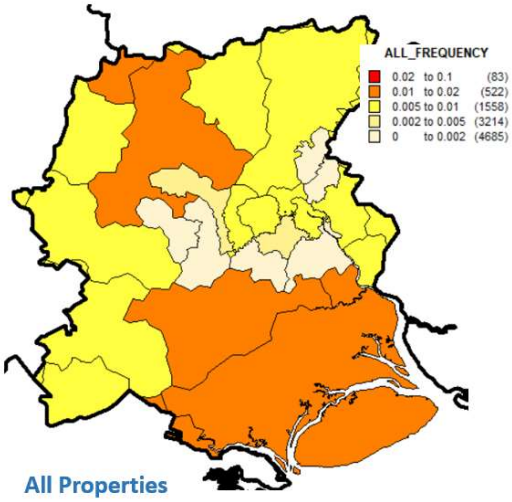
COLCHESTER - Frequencies & Probabilities

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.

COLCHESTER - Sector Risk Compared with UK Average



Private Only



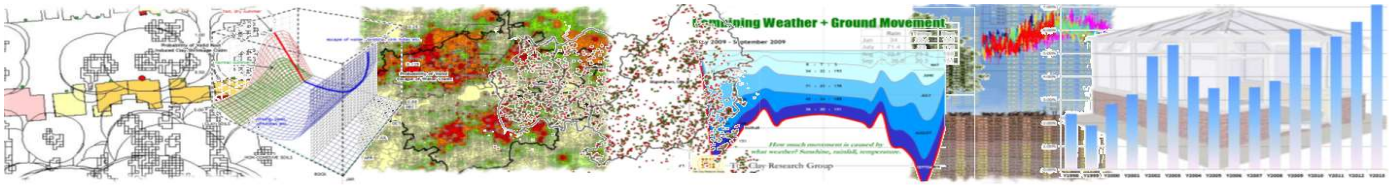
All Properties

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 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 fairly steady throughout the year.

Liability by Season - COLCHESTER

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Colchester	0.391	0.239	0.37	0.23	0.38	0.382

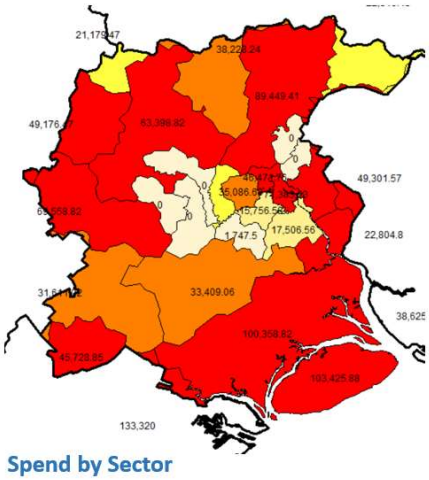


The Clay Research Group

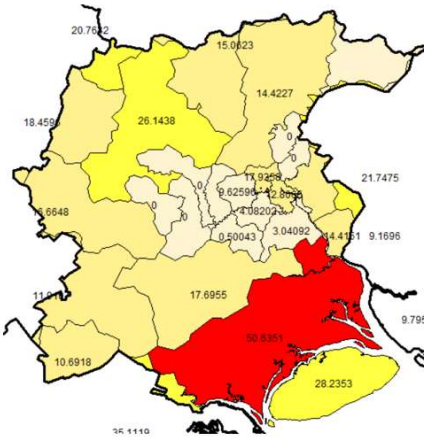
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

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 of course.

NORMAL YEAR SPEND – COLCHESTER



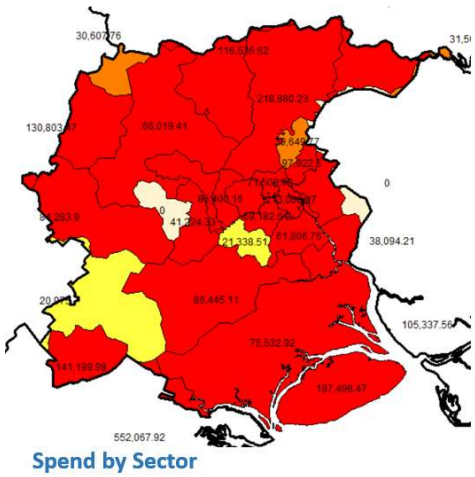
Spend by Sector



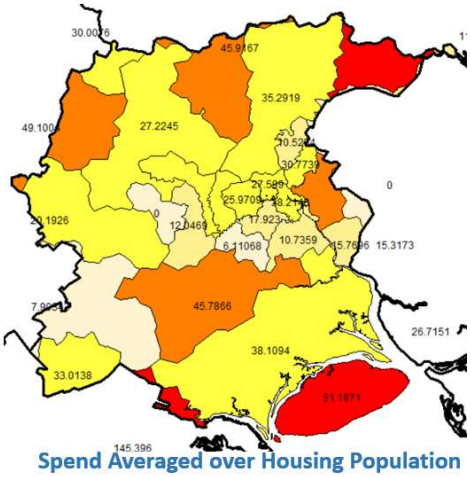
Spend Averaged Over Housing Population

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.

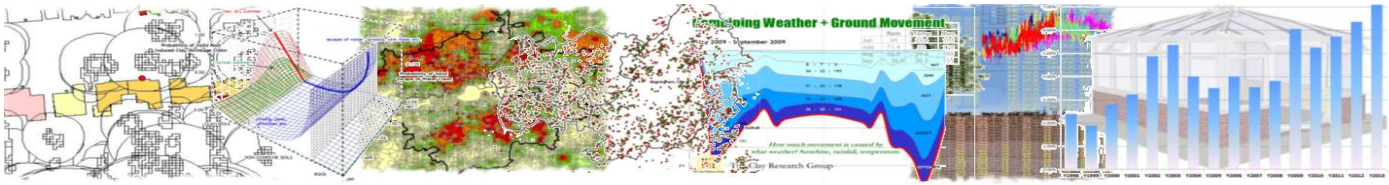
SPEND in SURGE – COLCHESTER



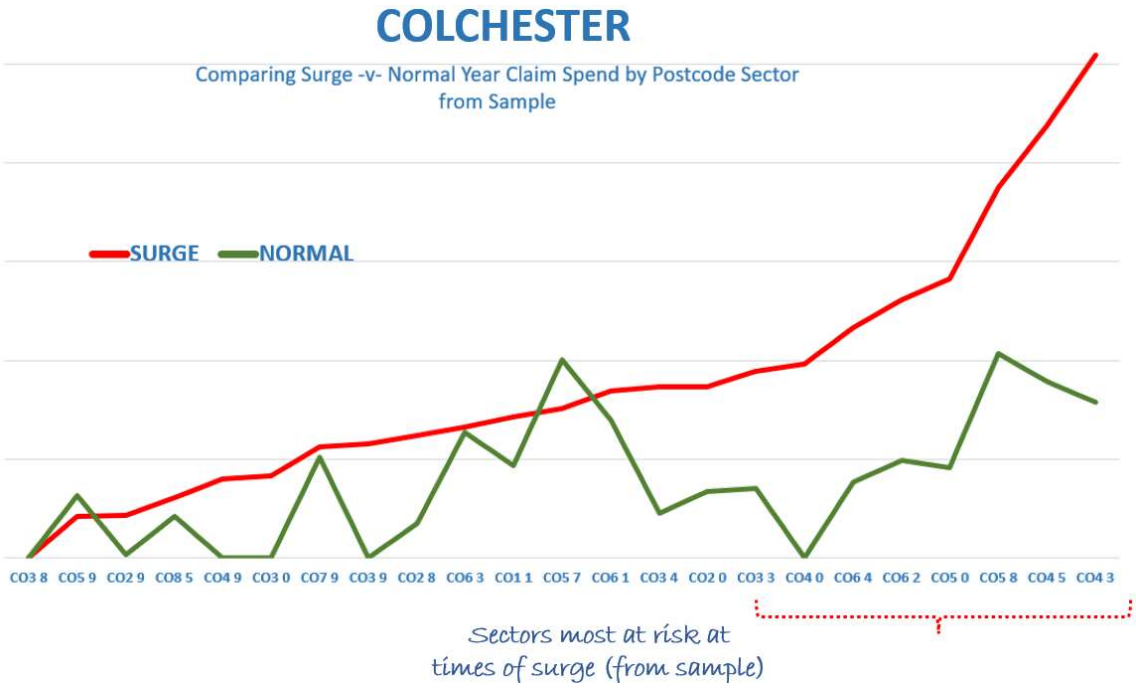
Spend by Sector



Spend Averaged over Housing Population



The Clay Research Group



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.