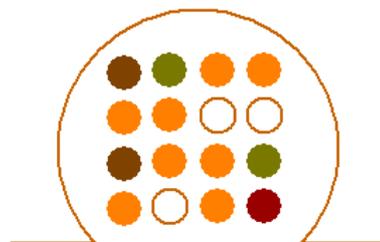


# The Clay Research Group

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## 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



The Clay Research Group

January 2014

# The Clay Research Group

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## In the News

2013 turned out to be a normal year in terms of subsidence claims, and although the final count has yet to be published, it looks as though we will be talking about fewer than 30,000 claims.

We take a look at the weather patterns behind this figure on the following page. Higher than average (the 30 year average from 1981 – 2010) temperatures and sunshine combined with lower than average rainfall did threaten for a short time around July/August, before fading away as quickly as they came.

Recent extreme events – high winds combined with high tides causing predominantly coastal flooding – will present a challenge to insurers and coincided with an announcement that the budget of the Environment Agency is to be cut back.

This was preceded by a plan to release ancient woodland to developers on the basis that they would be required to plant 100 trees for every one felled, but elsewhere on a site to be agreed. It's difficult to imagine why a developer would consider this and particularly if the site comprised a shrinkable clay.

Just imagine the fun designing foundations on a soil with a persistent deficit after felling hundreds of trees, and planting thousands elsewhere.

Why the developer wouldn't choose the open site is a mystery yet to be explained.

That aside, 2014 looks to be another changeable year in terms of climate, and the suggestion so far is that claim numbers will probably remain fairly benign.



## Subsidence Conference

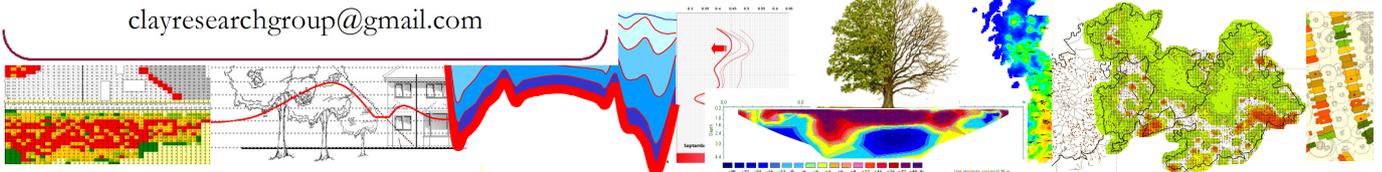
The Aston University Subsidence Conference takes place on the 26<sup>th</sup> June, 2014 and attached is a Call for Papers.

We would also welcome suggestions about topics that readers would find interesting – please respond to Aston direct, or to the CRG at the E-mail address below.

## THE CLAY RESEARCH GROUP

[www.theclayresearchgroup.org](http://www.theclayresearchgroup.org)

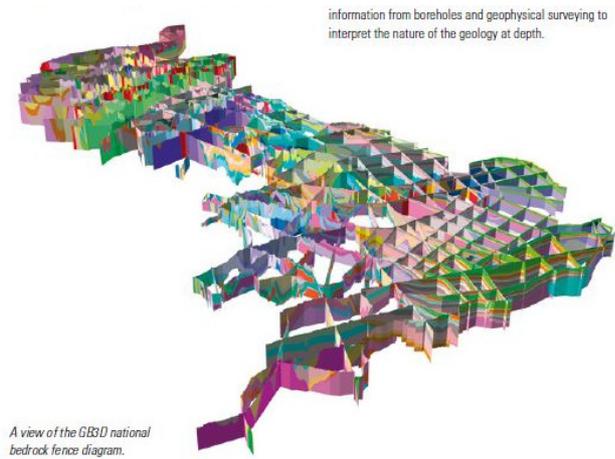
[clayresearchgroup@gmail.com](mailto:clayresearchgroup@gmail.com)



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## British Geological Survey

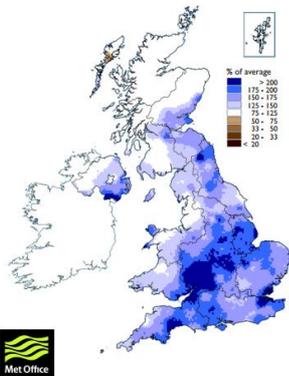
The BGS have produced what they have termed a 'fence diagram' geological map of the UK, illustrating not just the surface geology, but also that at depth.



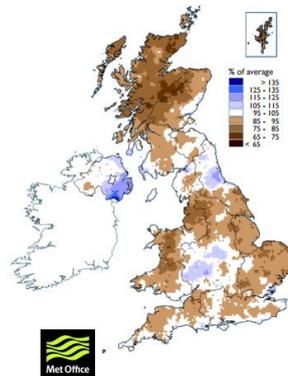
## 2013 Weather Review

The Met Office anomaly maps reveal that October 2013 was slightly wetter than the 30 year average, but that the period January through to October was, on average, drier. More on page 3.

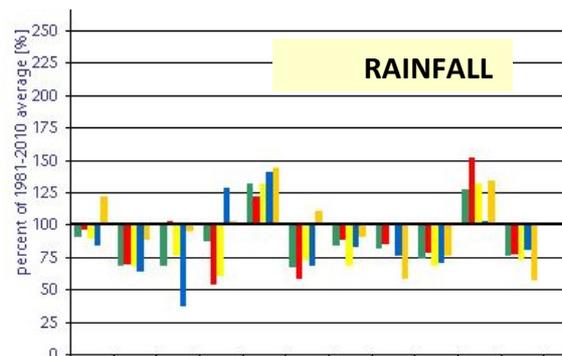
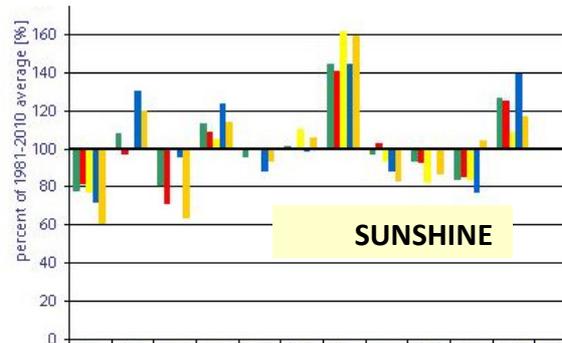
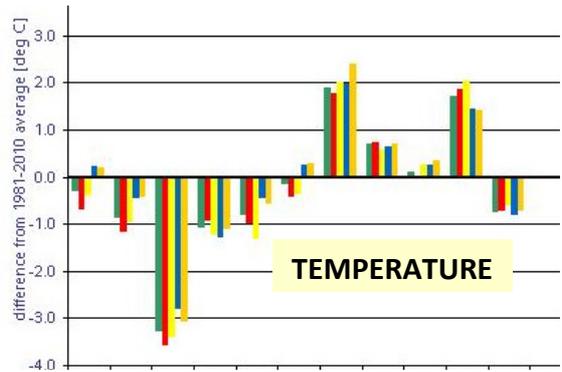
October 2013 rainfall as % of 1971-2000 average



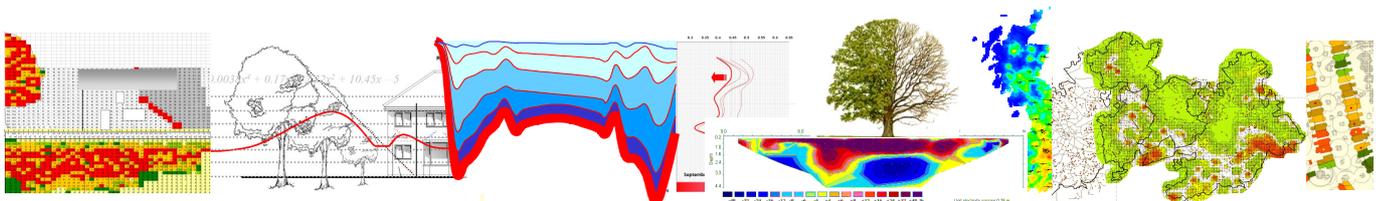
January 2013 - October 2013 rainfall as % of 1971-2000 average



## Met Office Weather Data for 2013



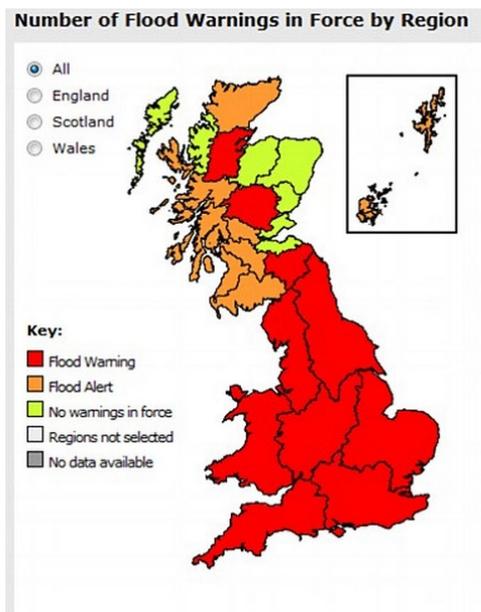
Anomaly graphs from the Met Office, plotting the difference for each element (rain, sun etc.) against the mean for the period 1981 – 2010. The increase in temperature and sunshine, and reduced rainfall drove the sharp increase in SMD.



# The Clay Research Group

## January 2014

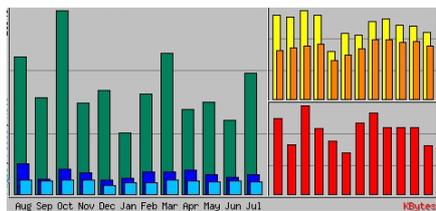
The following map represents areas at risk from flooding as published on the Floodline site of the Environment Agency.



Predominantly a coastal issue due to the combination of high tides and strong winds.

## CRG Update

The web site continues to receive in excess of 10,000 visits a month – twice that figure at times.



Visitors come from around the world and in 2013 we welcomed new readers from the Russian Federation.

## HORTLINK II

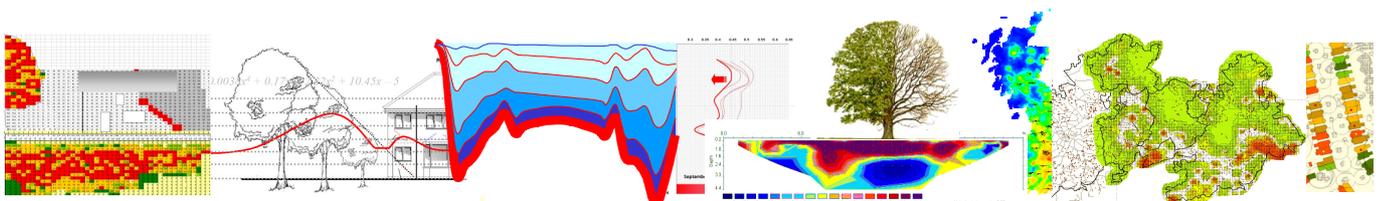
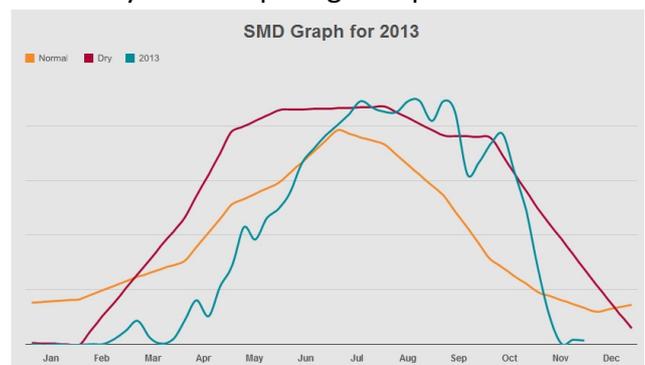
Neil Hipps has completed his initial review entitled “Pilot study to determine the feasibility of using existing claims data to determine the impacts of tree pruning on subsidence incidents on swelling clay soils” and is to present his findings on Friday, 24<sup>th</sup> January 2014 at the offices of Freeth Cartwright in London.

The report will be presented by Dr Neil Hipps and Professor Chris Atkinson and the meeting will cover the following:-

- Review of scientific peer reviewed and public domain literature on tree water use impacts of pruning on soil drying
- Compilation and analysis of tree pruning versus subsidence data for five London Boroughs
- Case studies of tree pruning v foundation movement for individual properties.

## SMD for 2013

Below, the SMD for 2013 showing a late but steep soil drying commencing around late July and dissipating in September.



# The Clay Research Group

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## How Many, Where, When and How Much?

The newsletter contains disparate sets of information and data, and sometimes the sheer volume can confuse rather than clarify.

Here are some headlines from 2013 – in a nutshell.

**January** : Evidenced the statement ‘time is money’ using claims data to reveal that the longer a claim is open, the greater the cost.

Studied the valid/repudiated balance for a number of years and intervals, plus a ‘by City’ comparison showing probabilities of a claim being valid, by city, and by season. The area within the M25 was further divided into quarters to show NW as being the highest risk, and by how much.

**February** : Modelling the effect of climate change on claim numbers, arriving at the conclusion that it may not be linear after all. More likely, the numbers would increase, but at a slower rate with any increase in temperature.

A series of graphs showing ‘Claim Notifications by Month’, ‘Adequacy of Sum Insured’ and ‘Crack Width Categorisation’ as well as a ‘Peril by Geology’. It also looked at the increase in notifications by geological series. Just how much riskier is London clay than say, the Lias?

Using our LiDAR dataset we listed tree heights by District for a small selection of Councils.

**March** : estimated the burning rate – the actual cost of subsidence claims to insurers compared with the premium income – and asked what account was taken of social housing, which is often self-insured. Risk models would need to take this into account going forward.

**April** : clarified the actual risk posed by public and private trees by identifying those on clay soils, within influencing distance of buildings.

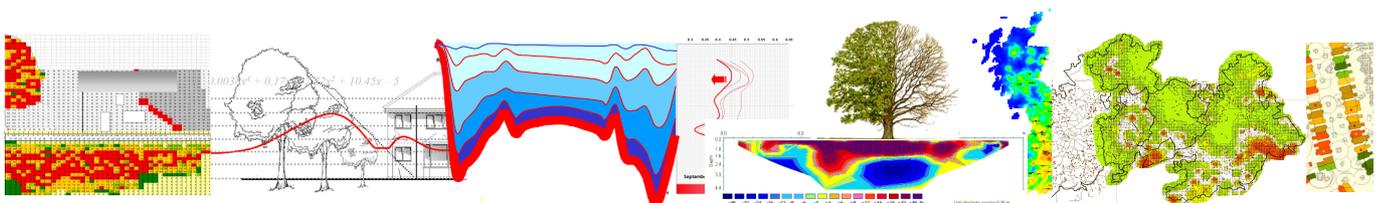
By our estimate, and using the above criteria, the risk presented by trees was 35 higher than the London Government had suggested.

The study found there were 1.42 houses per private tree and 10.48 houses per public tree.

**May** : not only is NW a risky postcode, but the initial suggestion that the modelled root zone of 20% overlap posed a higher risk than houses with 100% overlap was due to the fact there were simply more of them.

In fact, if the root zone overlapped the entire building footprint it was very risky indeed, and looking at Edition 96, we could see by how much.

By looking at a sample of actual claims we recorded that whilst only 8% of the population had 100% overlapping root zones, the sample recorded 14%. 100% overlap was over 70% riskier than might be expected if there was no difference. In the same edition, we saw that the CRG risk model correctly identified all of the claims in the sample as ‘at risk’.



# The Clay Research Group

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We also found that public trees in this postcode (NW) were a little riskier than their population would explain. Is this related to the age of house and tree metrics as discussed elsewhere in this newsletter?

**June** : a visit to N2 0 to understand why it was less risky than NW11 6, but riskier than N2 8, and the answer turned out to be quite simple. The difference was accounted for by the geology. A busy month arranging and attending the Aston Subsidence Conference.

**July** : reporting on the conference. Jake Tibbets, LTOA Chair and Tree Officer for Islington gave us an insight pressures faced by the Local Authorities. Katy Freeborough from the BGS explained the position relating to landslides following the wetter weather in 2012. Anthony Davies from Eversheds outlined the implications following the Berent decision. Birmingham University PhD student Tom Clinton bought us up to date regarding his research into ‘fixing’ soils using EKO and Nic from MatLab explained the new suction test, developed by Clive Bennett as part of his PhD studies.

**August** ; devoted to exploring weather and building a predictive model using a normalisation technique – to be developed later in the November edition.

**September** : Reporting on the Khan –v– Kane case. Looking at the ‘probability of a valid claim’ triage model, and considering the value of combining geology and time.

Identifying geology and claims to build a table categorising the various geological series into the rank order of the risk they pose and ascribing a value to that risk.

Further work on the effect of social housing on risk rates.

**October** : putting the average risk into perspective by identifying the outliers.

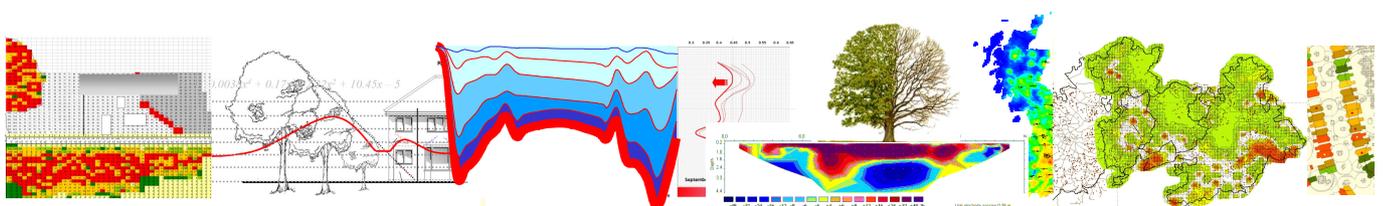
Postcodes sectors that exceed the average, and by how much. Maps showing high risk sectors, by city, and including Manchester, Leicester, Leeds & Bradford, Liverpool etc.

Reviewing the Intervention Technique, illustrating what we mean by a ‘digital geology’ and graphing the distribution of soils according to their shrink/swell potential.

**November** : plotting the temperature, rainfall and hours of sunshine for a variety of years, and arriving at the suggestion that surge might be a function of  $[(temp+hours\ of\ sunshine) - rainfall]$ , using normalised data.

**December** : It’s all about the tree. Ownership, height and distance to damaged property, by species, with data taken from actual claims.

More trees will be covered in a future edition.



# The Clay Research Group

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In addition, the newsletters have reported on published work in the academic press and provided updates on weather and climate. In particular, tracking the SMD by month.

Much of the current work of the CRG is devoted to data analysis.

This is because risk is an expression of how the components (weather, soils and trees) come together to produce claims. We are dealing with combined probabilities with a huge spatial variation – hence the reliance on mapping and distribution.

The subsidence practitioner will also come across a fourth element - the expectations and disposition of homeowners. The variation in demographics and interaction between individuals play important roles.

Handling similar claims in different locations can produce different outcomes and sometimes dependant not on the level of damage, but house values, expectations and attitudes.

Claim outcomes reflect these, although not directly. There is no data capture field that rates the house sale index for example, or the occupants employment, although both play a subtle part in the outcomes.

A postcode sector in North London might have a high claims frequency simply because the owners are less tolerant of minor damage. What might be a “I’ll fill that crack when I next decorate” in one part of the UK could be seen as a catastrophe elsewhere.

Data capture and risk analysis reflects the interaction of all of these elements, and our efforts are directed to understanding the relative weighting of each.

Over the years, the CRG and their academic colleagues have hopefully increased the awareness of the individual components.

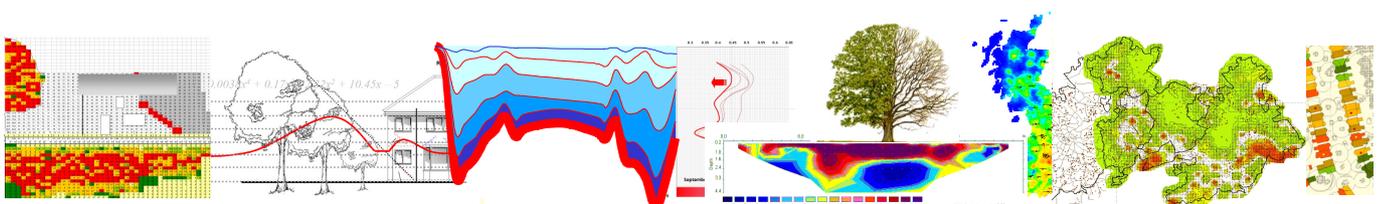
Southampton University have contributed to our understanding of climate change and the implications for insurers in coming years. The CRG have been able to combine these predictions with their unique geological map to understand the risk in terms of subsidence numbers and cost.

Keele’s work on ERT not only earned Glenda Jones her PhD, but shone light on moisture change beneath the Aldenham oak and willow, over time, in a fine grained soil.

Birmingham University have also been involved with the development of ERT and are currently working on ways to ‘fix’ clay soils using electro kinesis osmosis (EKO), providing what may be a quick and economic method of resolving root induced clay shrinkage claims.

The EKO project is being part sponsored by Foundation Piling Limited.

Aldenham has been an excellent research site, allowing the measurement of ground movement over 8 years and the testing and validation of remote monitoring of moisture change using TDR sensors.



# The Clay Research Group

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This research, and work carried out elsewhere by experts in various fields, has culminated development of the Intervention Technique. The objective is to retain trees whenever possible and allow insurers to provide a ‘see and fix’ repair for homes that have been damaged as a result of root induced clay shrinkage.

If this can be achieved, we have a response to the challenges posed by climate change, but also the proposed increase of tree canopy in London. Boris Johnson’s plans to increase the tree canopy in London by 20% is something we need to be taking into account when considering risk.

Removing the litigation surrounding such claims will relieve the public purse in some instances and may reduce the number of disputes.

As a side issue, it could also signal a reduction in the processes, costs and delays that characterise such claims. It will reduce the number of arboricultural reports, site investigations, soil tests and monitoring visits that inevitably lead to delays.

Not all root induced claims can be treated using the technique. In some instances, the trees are too close to the damaged building, or the root zone cannot be accessed due to land ownership.

Trials running over 4 years and involving in excess of 50 sites have illustrated the value of the approach which is now the subject of a patent application.

Where next? The CRG have been developing intelligent applications for many years. The engineering deductive process behind diagnosis and remedy isn’t guesswork – it has to be logical and lends itself to systematic approach for the more mundane footwork at least.

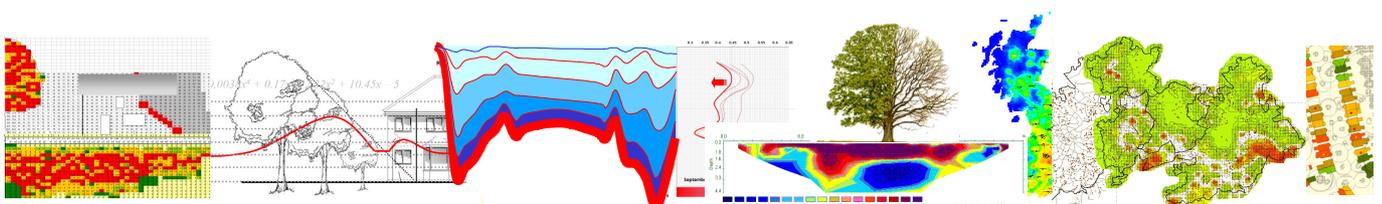
Over the years we have built software to capture, analyse, interpret and report on data in many forms – monitoring, soils etc.

The Disorder Model brings these components together enabling us to sit a virtual building onto a clay soil, with a tree nearby of defined height, distance and species and run various scenarios to determine the most likely position of cracking plus the risk for future years should the tree grow or the climate change.

The next step is building an application that can access these unique datasets and continue to learn from experience, adding demographic data and driving a certain class of claim.

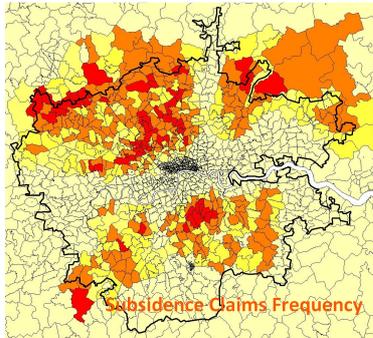
Getting systems to deliver value, rather than simply consume time with endless requirements to enter ever more data for no immediately obvious benefit will be welcomed by many engineers and surveyors no doubt.

The aim with the next generation system is catering for uncertainty. From the initial telephone conversation, the first site meeting, reviewing the various sets of data all contain elements of uncertainty that we hope to capture and resolve.

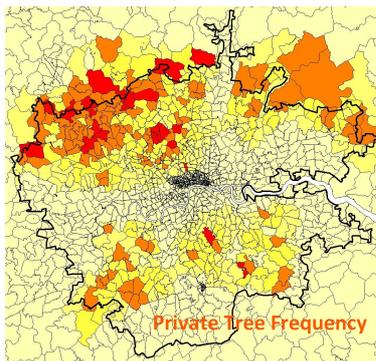


# The Clay Research Group

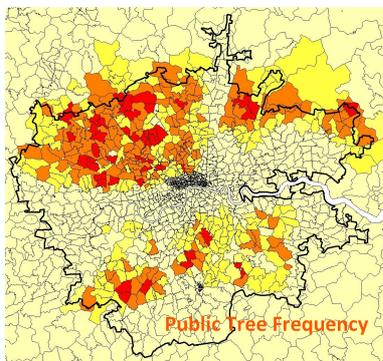
## Frequency Data



**Claims /  
Number of Houses**



**Private Trees /  
Number of Houses**



**Public Trees /  
Number of Houses**

## Does Tree Frequency Influence Risk?

Is it the case that Boroughs with more trees receive more claims when expressed as frequency? Do they present a higher risk than neighbouring Boroughs with fewer trees?

If not, why?

For this exercise we have counted trees on clay soils and within 1.2 times the tree height of any building. Trees and houses not on clay, and away from houses, have not been included.

The result? We could find no relationship. The correlation was around 0.4 – 0.5 (running private and public trees separately), indicating there is no meaningful link with either.

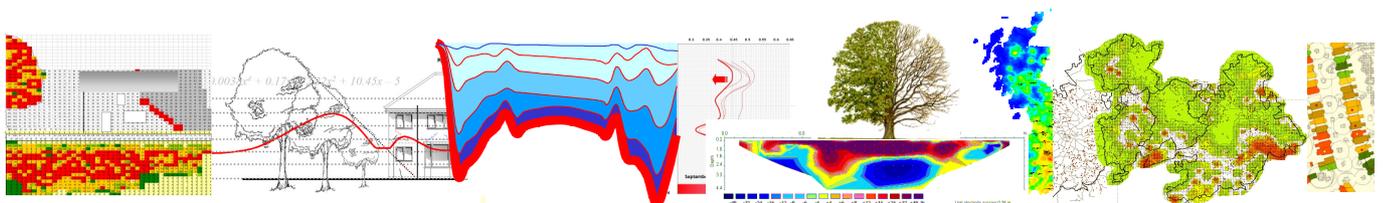
It does seem to be the case that ‘trees take their victims as they find them’ and root induced clay shrinkage is largely a game of chance.

If that is so, why? Trees are the dominant cause of subsidence on shrinkable soils. If there is no link in terms of frequency, then we assume other factors are at play. Tree species, age of property and perhaps tree metrics as reviewed in earlier editions.

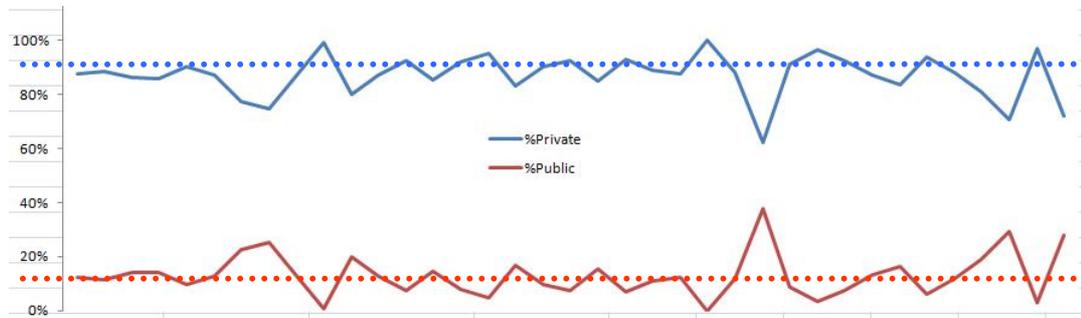
The next phase might be twofold.

First, restrict the exercise to all trees with an H/D ratio of less than 0.6 or so – an area we have already identified as high risk. Second, undertake the exercise knowing the tree species and age of house.

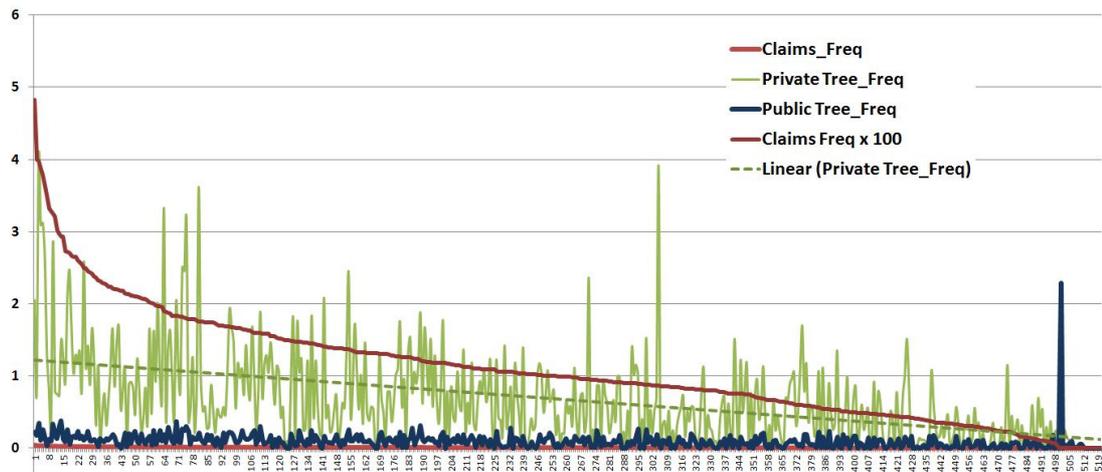
This would improve the correlation significantly. How many London Plane trees half the distance to the property of the tree height have caused damage, taking into account the age of property?



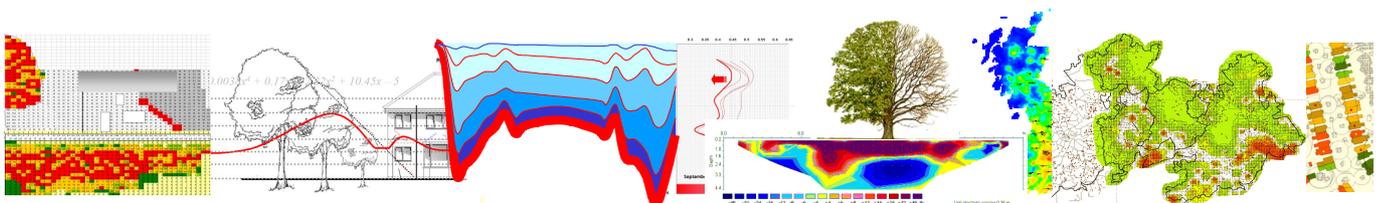
# The Clay Research Group



Graph showing the percentage of trees by ownership, by postcode sector. On average, 90% of trees are in private ownership, and 10% under the control of the Local Authority.

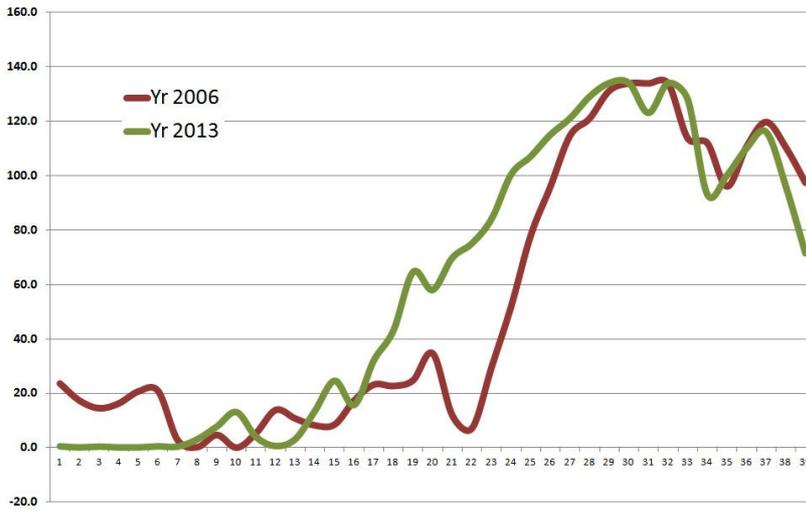


In the graph above, top red line is the claim frequency per postcode sector, x 100. The riskiest sector is to the left of the graph and the risk diminishes to the right. The green line represents the frequency of private trees, and the blue line, the frequency of public trees. This analysis only deals with trees and buildings situated on a clay soil, within modelled influencing distance of a building.



# The Clay Research Group

## 2006 SMD



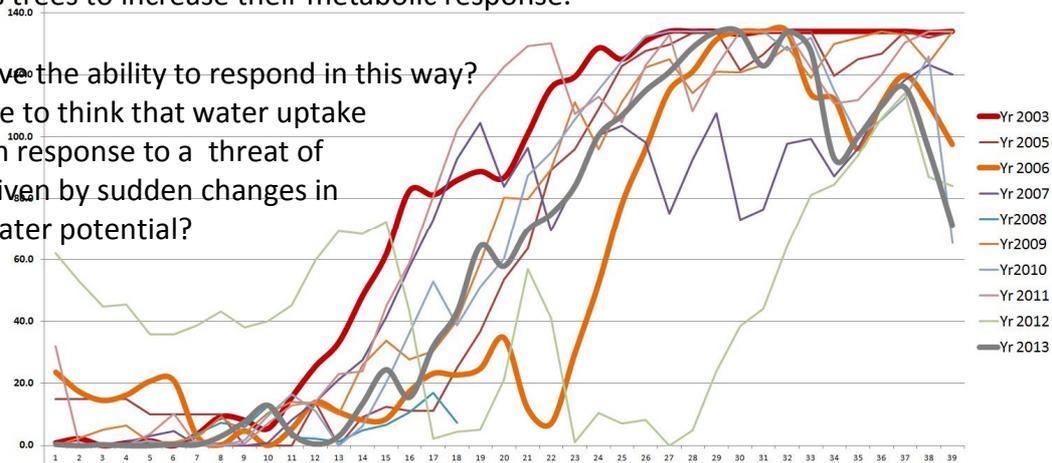
2006 remains something of a puzzle in terms of claim numbers. It produced a mini-surge and yet ran counter to most busy years because the SMD started very late in the year. The launch pad was week 22, as can be seen left.

It peaked at a 138mm deficit for a few weeks before rehydration commenced.

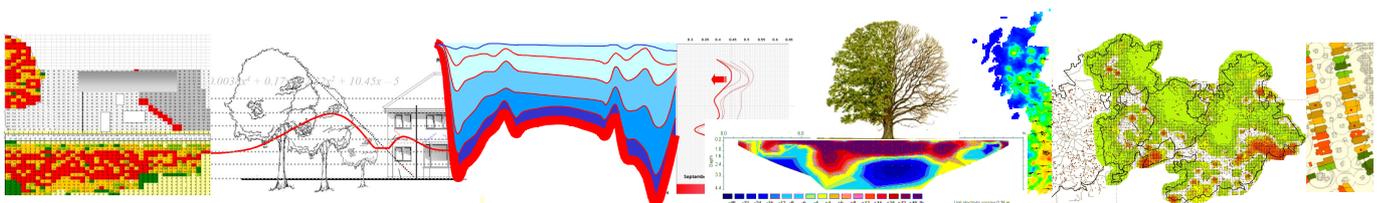
The graph below shows 2003 in red and the SMD starts early, and is maintained for a few months before declining. It is no surprise that this profile is associated with high claim numbers. Other less busy years are shown. Most starting later, or simply not maintaining a high deficit for long enough to produce claims.

2013 probably falls into this category. It started too late to cause a problem. So why would 2006 deliver high claim numbers? Our theory – totally untested and without support in the world of plant physiology – is that the stress brought about by rapid drying triggered a hormonal response that causes trees to increase their metabolic response.

Do they have the ability to respond in this way?  
 Is it sensible to think that water uptake increases in response to a threat of drought driven by sudden changes in negative water potential?



If so, then we need to consider the slope of the deficit over time. 2006 went from a zero deficit to 138mm in 7 weeks. Less busy years take around 14 weeks or so. An increasing deficit of around 20mm per week for 2006 compared with 10mm for ordinary years. On that basis, 2006 was unusual but identifies a profile that we can add to the library.





**Aston CPD Centre**  
BIRMINGHAM

ANNUAL SUBSIDENCE CONFERENCE AT ASTON  
UNIVERSITY ON 26<sup>th</sup> June 2014

**CALL FOR PAPERS**



As one of the UK's leading proponents of improvements to knowledge in the field of subsidence, Aston CPD is pleased to invite submissions for presentations/papers at this years Subsidence Conference to be held on **26<sup>th</sup> June 2014**. The conference will seek to highlight and address the emerging issues.

If you would like to give a presentation at this conference, please let me have a title and a short summary by **24<sup>th</sup> of January 2014**.

Please send your abstract or paper to Dr M Sadeghzadeh by email to; [m.sadeghzadeh@aston.ac.uk](mailto:m.sadeghzadeh@aston.ac.uk) or by post to The Conference Secretary, Aston CPD Centre, Aston House, 6 Greville Drive, Birmingham B15 2UU