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

The Clay Research Group
www.theclayresearchgroup.org

April 2009

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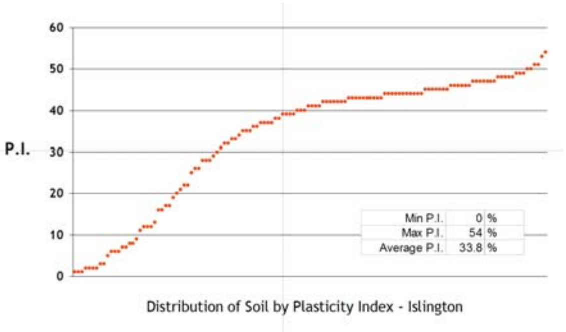
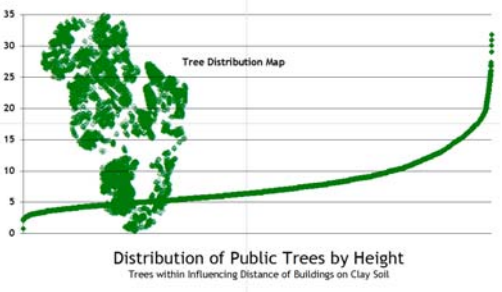
ISLINGTON - Soil Risk



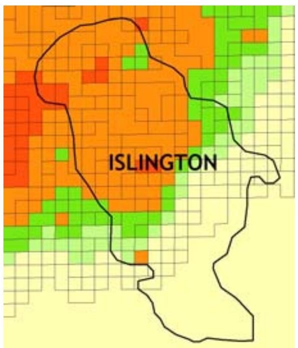
ISLINGTON - Tree Risk



ISLINGTON STUDY AREA

Islington provides an interesting study area due to the variable nature of soils and the claims distribution as we see below. It has a claims frequency of around 0.0038.

The Plasticity Index varies in the range of 0% (South East) to 54% (North West) and the claims correspond with the volume change potential as we see below, right.



Soil P.I.

Claims Distribution

Graphing the distribution of the soils (left) we see a significant proportion (just under half) have a P.I. greater than 40% and there are a few grids (red tiles in above map) where the P.I. exceeds 50%.

Are claims a result of frequency (i.e. there are simply more houses to the North West), or geology? Looking at the plot of postcodes below, left, housing density is greater to the South East where there are fewer claims suggesting that Geology plays a significant role in Islington.

Postcode Distribution

Tree Distribution

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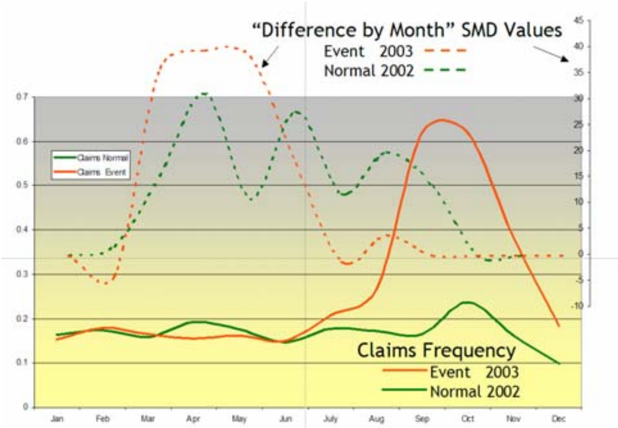
Ground Movement –v- Damage

Using 'change by month' values, rather than cumulative ones, for SMD, ground movement and so forth might throw some light on the mechanism that produces damage.

We have described before how ground movement data has led to a method of estimating 'water uptake by month'. The output suggests that most ground movement takes place around June and July, and yet claim notifications increase in September and October.

Applying this technique to SMD values reinforces the view that what happens early in the year influences claim numbers several months later.



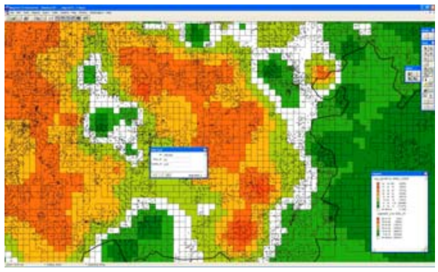
SMD values are commonly viewed cumulatively, but to make a useful comparison with claims, a 'by month' value is more meaningful. For example, if the SMD is 100mm in August and September, the change value is zero.

Is it the case that movement sufficient to cause damage is in fact 'the straw that breaks the camels back'. Does the building accept initial movement early in the year of say 15 – 20mm, but on a temporary basis, with some form of masonry 'cohesion' being overcome by gravity after a few months? Or is it the case that masonry accepts the initial flexure, and the amount of additional movement that causes cracking can be quite small?

Certainly the paper mentioned in last months edition, by Tim Freeman of GeoServ Ltd., suggests relatively small movement above say 15mm or so can tilt the balance, resulting in structural damage.

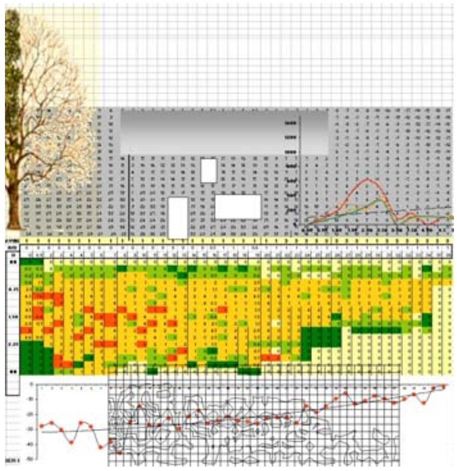
Intervention & HBOS plc

Our thanks to the team at HBOS for offering a test site for the Intervention Technique. Our appraisal correctly identified the soil P.I., the location of the house and the height and distance of nearby trees.



The Site Geology

Mapping Tree Canopy and Root Zones



Modelling Movement and Damage

The bad news was the fact that the site wasn't suitable – we estimated that there was 100% root encroachment beneath the building, and partial rehydration was likely to cause more problems than it solved.

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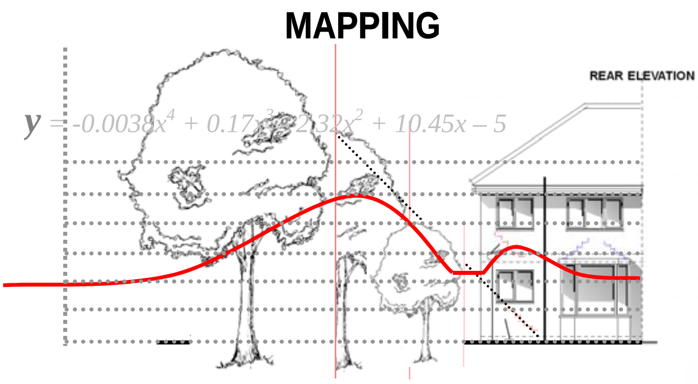
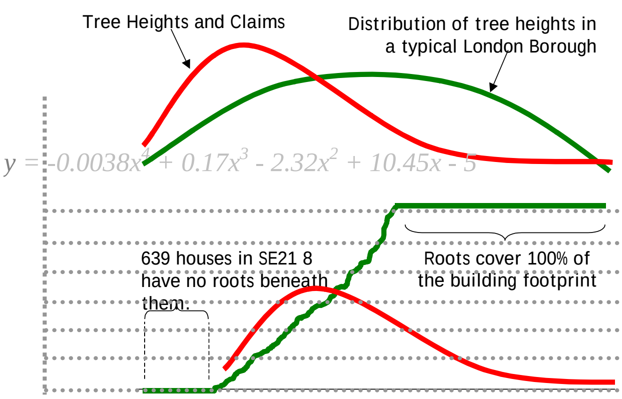


Expressed as frequency and ignoring species, trees of a certain size present more of a risk than others, even when 'others' might be taller and the modelled zone of root encroachment is the same.

Similarly, our "root encroachment sufficient to case ground movement" model supports the view that buildings have an inherent vulnerability, making them weaker under specific stress conditions.

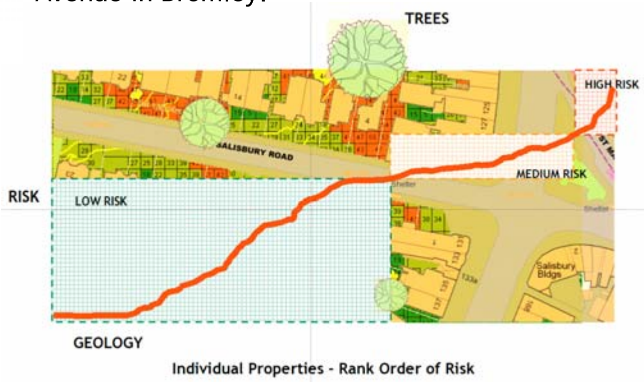
The relationships can be complex as we see from the risk profiles reproduced below. High risk trees in terms of height category with low risk 'root overlap zones', or vice versa and understanding which factors carry the highest weighting have to be resolved.



Risk from Tree Height (top) **and Root Encroachment** (bottom)

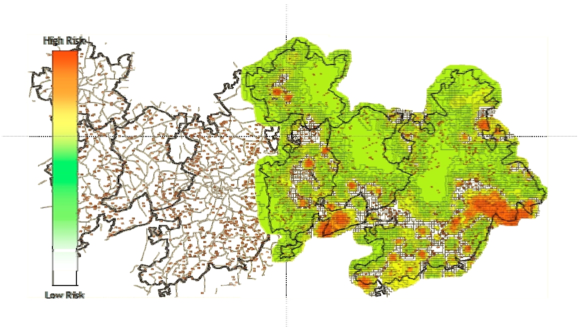
Combining the two means we can build a 'rank order of risk', resolved to individual house level, taking account of both the geology, modelled tree root overlap and vegetation.

The approach is unique in allowing us to compare, say, "HA5 2", with a 250sq. m. tile in Hull, with The Elephant & Castle, with 13 Acacia Avenue in Bromley.



An extract from the UK model showing the Birmingham map (below), uses the geology to factor claim costs.

Root induced clay shrinkage claim have a higher value than, for example, escape of water claims on average, and the red zones will cost more than claims notified elsewhere.



For insurers who prefer a refinement on sector level data we have a 250m tiled grid across the UK delivering comparison risk scores. The grid enhances the granularity of the postcode sector by a factor of between 5 – 20.

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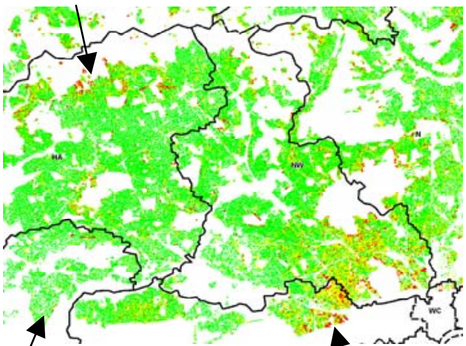
Trees – High Level Mapping

Below we reproduce an image from one of the risk map layers, showing trees located on a clay soil, within influencing distance of a domestic building (i.e. excluding parkland trees), thematically plotted in terms of height in the range 5 mtrs upwards. Red trees are the tallest band, followed by yellow and then green.

Localised 'pockets' of tall mature trees close to domestic buildings.



Groups of smaller (younger?) trees.

High concentrations of mature trees, close to buildings.

Looking at ... SE21 8

There are 4,705 trees in this Postcode Sector, on clay soil and in influencing distance of a building. Of these, 489 are in Council ownership, and 4,216 are in private ownership. 639 houses have no trees in influencing distance. The maximum tree height is 25mtrs.

Of the houses on clay soil, 1,213 have an estimated 100% root overlap from adjoining trees.

With a claim frequency of 0.5% (distorted towards the London profile in a dry year) we might anticipate around 15 claims.

If we use the BRE figures relating to 70% of claims involve vegetation, and taking account of repudiations and "other causes" around 10 of these claims might involve a tree.

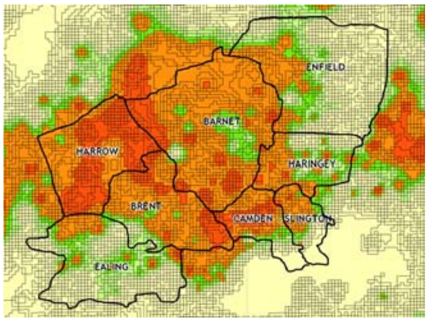
This would deliver a 'damage to tree population' frequency of 0.0023, or 0.23% of all of the trees cause damage.

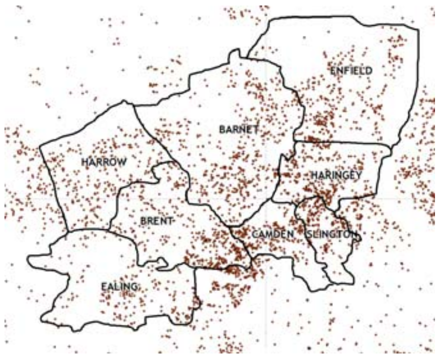
Put another way, in Postcode Sector SE21 8, out of a total of 4,705 trees near to houses on a clay soil and within influencing distance, 10 will probably cause damage to nearby buildings in any year.

Taking account of the 'Private:Council' ratio of trees, only 1 Council tree is likely to be involved out of the 489 under their control – in influencing distance of a house built on a clay soil. For one particular sector, in any one year.

Distribution

The North London Boroughs are predominantly clay soils, some of which are highly shrinkable.





Top we have the geology risk map, and beneath it, claim distribution. Although South Brent, Camden and North Islington look exceptionally busy, this is sometimes (not always as we have seen at Islington) a function of housing density.

We will be looking at Harrow next month.

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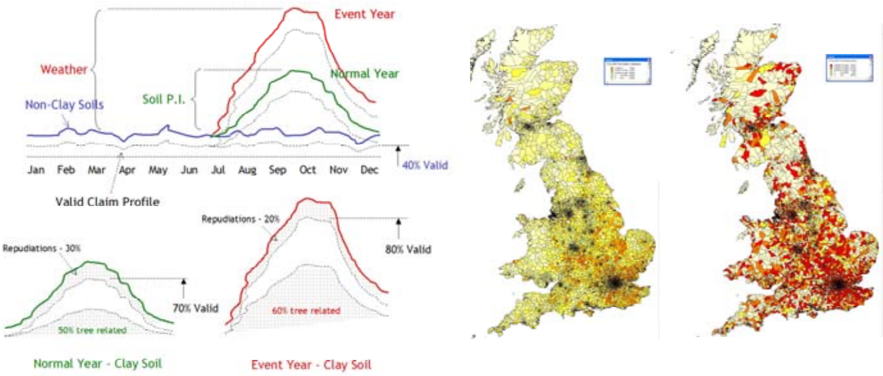
EVENT PREDICTION MODULE

We recognise 1989, 1995 and 2003 as event years and Dr Pugh* included subsequent years (1990, 1991 and 1996, 1997) as having high claim numbers, which agrees with the more recent article in an OCA newsletter when they talk of periods, rather than specific years. That aside, some method of predicting the onset of these, early enough in the year to take action operationally, would be very useful and although we have outlined this method before (it was developed following the 1989 event) it is useful to consider in the context of Climate Change.



First we recognise the geological imperative and the fact the influence of a soil moisture deficit (SMD) will vary across the country in response to the soil type. We are talking about clay soils, and linking the model to the Plasticity Index as we see above.

Using the SMD data supplied by the Meteorological Office for Tile 161 with grass cover and Medium Available Water Content there appear to be two robust indicators. The 'busy' years are outlined in orange and we can see that ALL event years have an SMD at the end of May of around 100mm or more.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Jan	0	0	0	7.5	78.2	8	3.1	0	19.3	68	8.6	0.6	0.6	0.0	0.0	3.9
Feb	10.6	10.6	0.8	0.7	81.5	12	0.3	0	1.6	44	30.0	0	0	0.0	1.7	0
Mar	2.3	29.2	39.1	18.6	83.7	34	6.2	17.3	9.5	83	19.6	16.9	16.9	4.2	17.0	36.0
Apr	23.3	13	68.6	22.7	87.1	20	29.2	65.9	50.7	128	9.7	25.7	25.7	1.8	48.1	75.4
May	62.4	97.9	115.9	77.8	96.6	68	28.9	122.7	106.7	134	83.6	67.8	67.8	61.9	59.0	113.5
Jun	87.3	117.4	121.5	52.4	125	97	95.4	134	134	96	73.0	50.8	50.8	117.6	86.7	131.1
Jul	93.4	125	125	68.6	125	113.6	121.5	134	134	128	121.3	126.9	126.9	133.8	98.6	130.0
Aug	84.9	125	125	110.4	109.6	122.1	119	134	134	127	134.0	80.2	80.2	98.5	118.5	134.0
Sep	106.5	125	111.7	98.9	81.8	45	100.5	100.6	124.4	134	79.5	33.6	33.6	90.3	131.8	134.0
Oct	77.9	102.8	99.4	109.9	41.5	18.1	56.8	130.7	130.9	112	0	25.6	25.6	4.8	97.6	112.0
Nov	72.1	95.6	91	75.5	0	1.8	39.8	125.1	64.9	78	0.4	14.6	14.6	0.0	0.0	8.7
Dec	77.9	2.4	51.3	75.6	3.6	0.5	0.5	46.4	67.6	47	0	0	0	1.7	0.0	0.0

The second indicator is the amount of change from the lowest winter reading to the value in May. All event years have high 'difference' values. To illustrate this, 1992 was not an event year, and yet the May value was high at 96.6mm. However – and this is the determining factor here - the 'difference' value is low at around 30mm only.

This goes against the suggestion that it is what happens in the summer that dictates events. Of the 16 years listed, 12 would be considered as event years if we used the August readings. It also disproves the often used 'event years follow dry winters' – quite the contrary.

To summarise a combination of (a) the SMD at the end of May and (b) the difference between January and May appear to provide a robust indicator of an event year several months in advance.

** Pugh, (2002) "Some Observations on the Influence of Recent Climate Change on the Subsidence of Shallow Foundations." Geotechnical Engineering*

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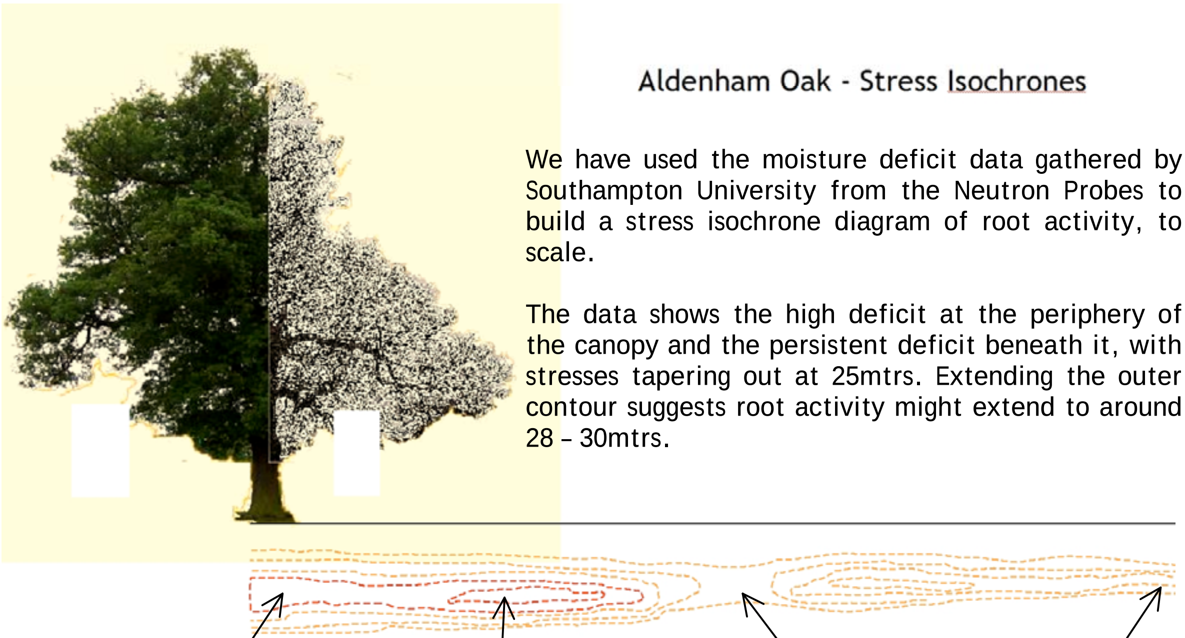
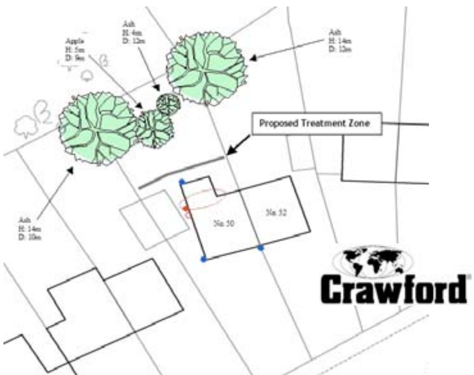
Aldenham Oak - Stress Isochrones

We have used the moisture deficit data gathered by Southampton University from the Neutron Probes to build a stress isochrone diagram of root activity, to scale.

The data shows the high deficit at the periphery of the canopy and the persistent deficit beneath it, with stresses tapering out at 25mtrs. Extending the outer contour suggests root activity might extend to around 28 – 30mtrs.



Intervention Technique



Crawford have completed their first claim using the Intervention Technique – it was featured in an earlier edition.

The installation was undertaken by hand due to difficulties gaining access to the site, and took two days with minimal disruption at a cost of £3,100.

Electrolevel sensors were set up prior to work commencing and data is being transmitted to them via the DataREADER application over the web.

The cost included drainage work, installing self-checking regulators and feeders plus adding a slow release mineral to ensure water is retained until a certain suction is established to avoid loss via gravity and/or evaporation Triggering the tree to mild stress is part of the treatment.

Two Ash trees are implicated, around 14mtr high and around 10 – 12m distant from the damaged structure. See plan, left.