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

May 2010

The Clay Research Group

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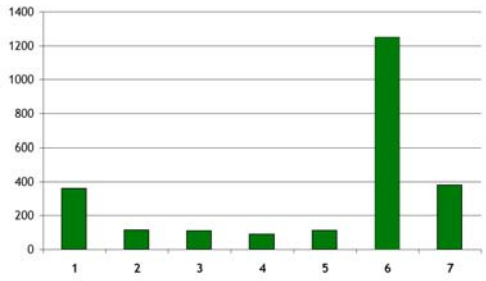
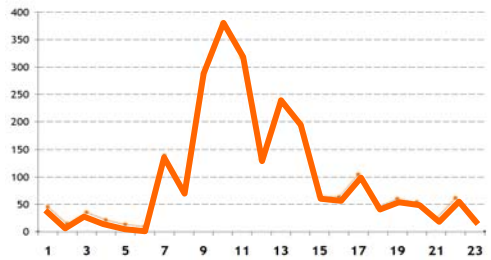
CRG Website

~ Visitors Log ~



"Visits by Day" analysis. First 7 days of April. Most visits to the CRG web site take place early in the month, following release of the newsletter.



"Time of Day" analysis from one months data. Most visits to the CRG web site take place at around 10.00am.

The Clay Research Group
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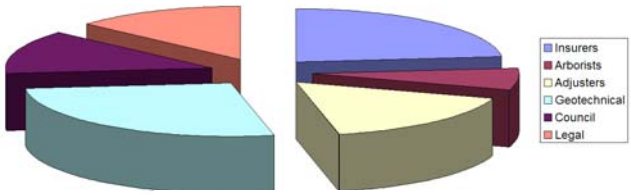
ASTON CONFERENCE

19TH May, 2010

Some excellent speakers including John Parvin (Zurich Insurance), Gary Strong (RICS) and Nigel Cassidy (Keele University) should make this an excellent day. Book by phone – Helen Mallinson 0121 204 3593.



Attendees by Category

THIS MONTH

Contributions from Mike Crilly and Tony Boobier in this months edition. Both are well known figures in the world of subsidence. Mike allows us to reproduce his findings from a study at the Chattenden Research site, and Tony provides insight into the business benefits of analytics.

ELECTROKINESIS UPDATE

Grant funding has been approved by EPSRC, and we are awaiting confirmation. Regular updates will be available via the newsletter.

SYNTHETIC TREE

Discussions ongoing with our colleagues to develop a suitable methodology and understand the potential benefits. It is a complicated experiment that is going to need funding. The principle is to develop a 'tree' that moves water through a fine grained soil allowing us to measure changes (in terms of stress) that occur following a series of treatments.

ERT IMAGING

Dr Nigel Cassidy has suggested using ERT to track moisture movement in the root zone over a 24 hour period.

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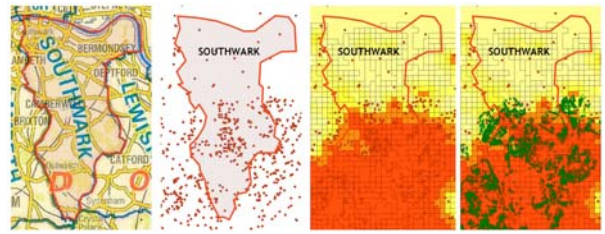
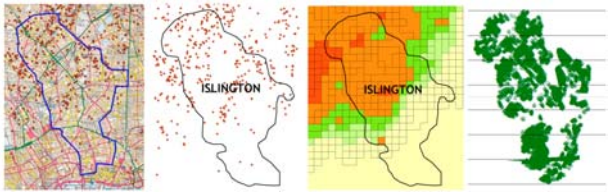
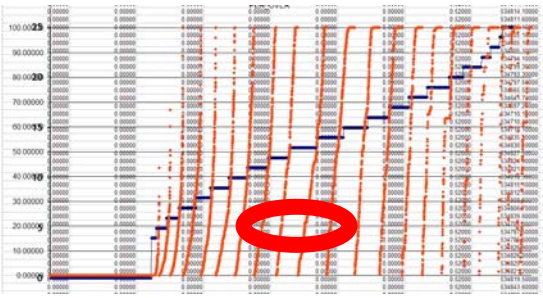
SOUTHWARK STUDY

We have recently completed a study of Southwark, London for one of our members and were struck by the resemblance to Islington. Both border the Thames and the distribution of soils and claims is very similar – compare below.





Comparing the claims with the geology serves to illustrate just how important geology is in terms of risk. Southwark have outcropping clay to the south of the Borough, and Islington, to the north. Claim distribution aligns almost exactly.



Understanding which trees cause damage, and looking at the recent study at Sidcup Road, the 'red zone' above outlines trees from the LiDAR survey that present the greatest risk in terms of height and distance from nearby buildings.

Ordnance Survey Launch Free Maps for Insurers

Ordnance Survey has launched OS OpenData, an online portal that will provide insurance companies with free and unrestricted access to a large range of mapping and geographic information (GI).

OS OpenData allows insurers to download a wide range of mapping and geographic information for free reuse direct to their computers; view maps and boundary information for the whole country; and develop web-map applications using Ordnance Survey's OS OpenSpace API (Application Programming Interface).

The following datasets are included in OS OpenData:

- OS Street View
- 1: 50 000 Gazetteer
- 1: 250 000 Colour Raster
- OS Locator
- Boundary-Line
- Code-Point Open
- Meridian 2
- Strategi
- MiniScale
- Land-Form PANORAMA
- OS VectorMap District

OS Streetview is currently used by insurance companies for background mapping over which other data, such as Flood extents or their own information, can be overlayed.

Insurers are becoming increasingly aware of the power of mapping, and this move by Ordnance Survey will make them more accessible.

For further information, go to:
www.ordnancesurvey.co.uk/oswebsite/freefun/outlinemaps/

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Disorder Modelling

Below are screenshots from the Disorder Model, linking tree growth to the tensile stress of masonry and ground movement over time to reveal the dynamic and interactive role of each. The objective is to improve our understanding of the statistical relationship between structural damage and trees of a certain height and distance.

Running hundreds of iterations in minutes, it can be seen that crack propogation is a random happening, linked to the interaction of the various components.

Not every hot, dry summer results in damage. The crack propagation zone (red area of masonry) appears and disappears, suggesting some form of cyclical distress may - or may not — result in damage.

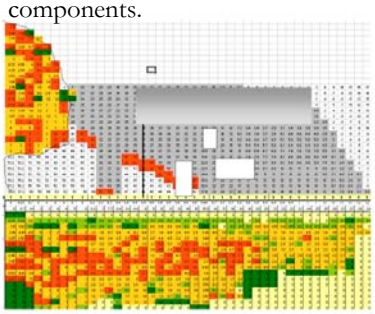
Building stiffness and some (very limited) tensile resistance as the masonry flexes may be sufficient to cope with the bending moment induced by root activity.

Perhaps persistent movement weakens the structure over time, leaving it vulnerable to the next cycle.

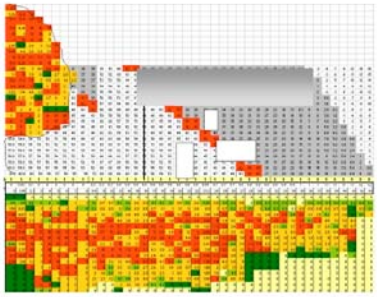
Self-evidently, not all houses near to trees suffer damage.

Then we have the rather odd idea that taller trees might present less of a risk than their smaller counterparts - depending on the H:D ratio.

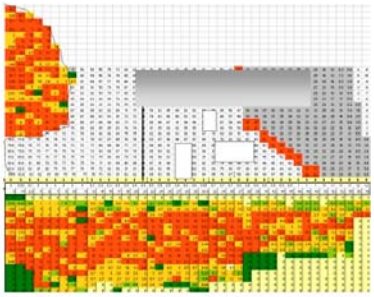
As we can see below, right, tall trees with roots that extend beneath the entire building footprint (rather than simply 'catching the corner') create a fulcrum much further back, making the appearance of cracks less likely.



12m High Tree, 10m Distant.

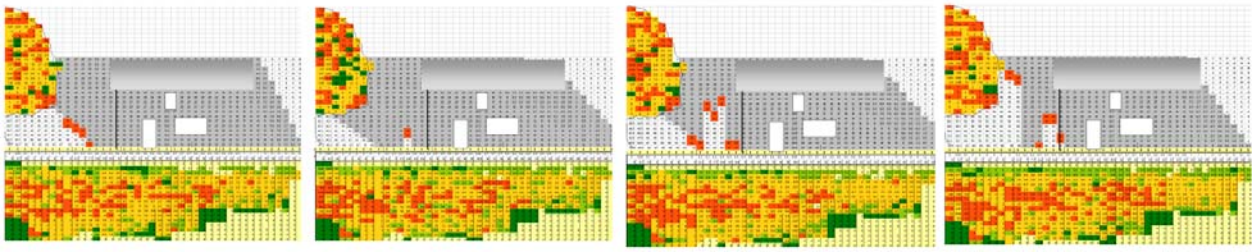


18m High Tree, 10m Distant



24m High Tree, 10m Distant.

The image to the left shows the high-risk category of tree height and distance, ignoring species. A taller tree (in this case, 24m high, 10m away from the structure) produces a different - and apparently less risky - pattern.



Tree H = 12m, D = 10m. Several Iterations Revealing Random Nature of Crack Propogation.

Modelling four summers with no damage to the building. By adjusting the model to emulate actual conditions, we develop our understanding of the relationship between trees, soils and climate. The output assists in 'what if' modelling of climate change. Iterating can't tell us which trees will cause what damage, and when, but they can improve our understanding of vulnerability and risk.

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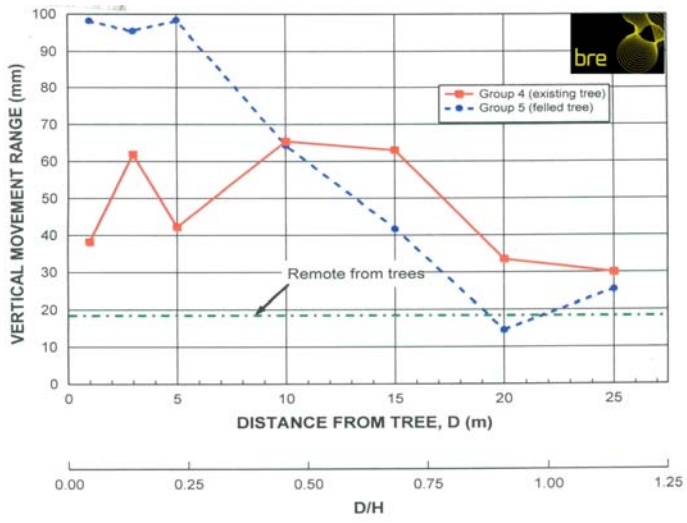
Ground Movement at Chattenden

Previously Unpublished Data from the BRE Research Site.

Mike Crilly
(Reproduced with Permission)

Ground rod group 4 comprises a line of rods, all of which are anchored at 1m bGL, emanating radially from a retained Lombardy Poplar tree. The rods are at distances of 1m, 3m 5m 10m and 25m from the tree. Group 5 is identical, except that the tree at the focus of these rods was felled as part of the mass tree felling in September 1990. Both trees were approximately 22m tall. The depth of these rods was taken as 1m because this is the current standard foundation depth for most new low-rise building on shrinkable clays in open ground. The rods were placed placed at varying distances from trees in order to compare the results obtained with the 'safe' distances of buildings from trees given in BRE Digest 298. Reading of these rods commenced at about the same time as the trees were felled.

In Figure 1, below, the results from these rods are shown as maximum movement range (i.e. for each rod, the difference between the rod's highest and lowest levels over the period from felling the trees to the most recent reading) against distance from the tree; the results from the 1m ground rod remote from the trees is is also shown for comparison. The results are plotted against both the distance from the tree, D, and against the ration D/H, where H is the tree height.



Interestingly, for both sets of rods, the greatest movements do not appear to occur at the point nearest the tree, but a few metres away. This is particularly noticeable for the rods emanating from the existing tree, where maximum magnitude of movement has occurred some 10m away from the tree.

The pattern measured from the rods by the felled tree indicate that movements are relatively constant, though slightly increasing, up to about 5m from the tree, after which the movements reduce until about 20m from the tree, where the movements are similar to those remote from the trees.

The data from the rods near the existing tree represent a seasonal movement pattern over a period of nine years which includes the every dry years of 1995 and 1996: the results therefore are useful for checking current guidelines. According to BRE Digest 298, a 'safe' separation distance for Lombardy Poplar trees is the tree's height. At that distance, this guidance was adequate during any one given annual cycle.

However, since the tree has been maturing, there has been a gradual downward movement of the ground year on year as the tree's zone of persistent water deficit has developed. Consequently, the overall ground movement range at a separation distance of 1H has been approximately 30mm; this suggests that a separation of 1H would be inadequate on this site, though more data is required to verify this conclusion more generally.

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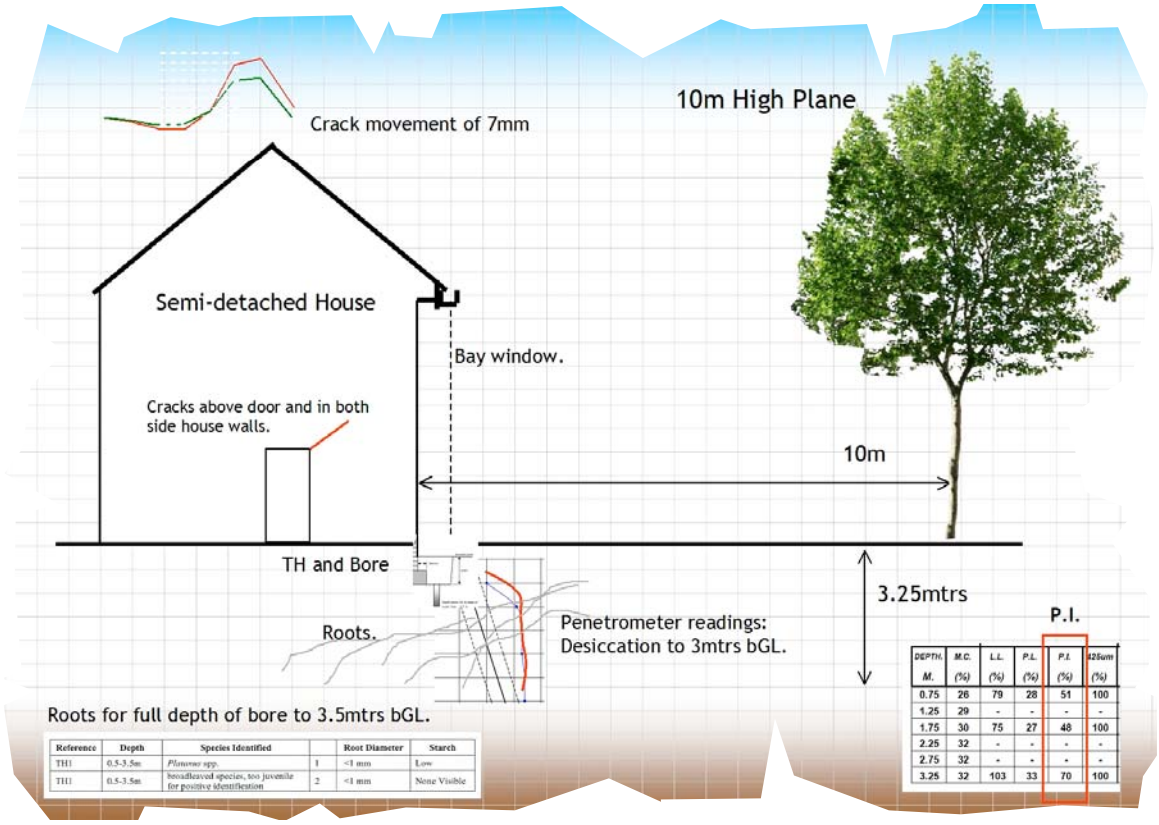


DEPTH M.	M.C. (%)	L.L. (%)	P.L. (%)	P.I. (%)	425um (%)
0.75	26	79	28	51	100
1.25	29	-	-	-	-
1.75	30	75	27	48	100
2.25	32	-	-	-	-
2.75	32	-	-	-	-
3.25	32	103	33	70	100

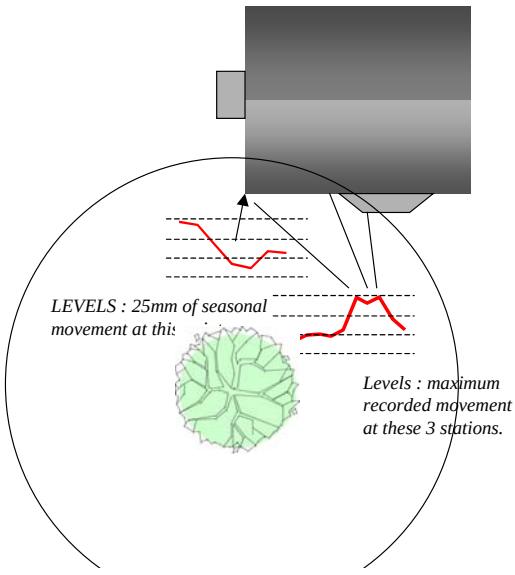
Reference	Depth	Species Identified		Root Diameter	Starch
TH1	0.5-3.5m	*Planerus* spp.	1	<1 mm	Low
TH1	0.5-3.5m	broadleaved species, too juvenile for positive identification	2	<1 mm	None Visible

SIDCUP ROAD - INVESTIGATIONS

Investigations recorded roots from the Plane beneath the front house wall to a depth of at least 3.5mtrs. Penetrometer readings confirmed desiccation to a similar depth and crack monitoring recorded seasonal movement of 7mm. The soil has a P.I. of around 50%.

Precise levels (right) recorded 25mm at Station 7, the one nearest to the tree. This is moving more than others. Full recovery still hasn't taken place, which suggests the beginnings of a persistent deficit.

In response to the engineers notification of damage, the tree was crown reduced and thinned (see following page) but given the presence of roots and the levelling evidence, this is unlikely to resolve the problem in the long term.



Precise levels confirm movement in the root zone, with maximum of 25mm at the front left hand corner, followed by stations adjoining the bay window.

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ALTERNATIVE SOLUTIONS TO TREE SURGERY, WITHIN BUDGET?

The Sidcup Road tree (see elsewhere in the newsletter for SI data) had a severe crown reduction in February as we can see below. The question is, how can we retain the tree canopy without leaving the house vulnerable, and at a reasonable cost?

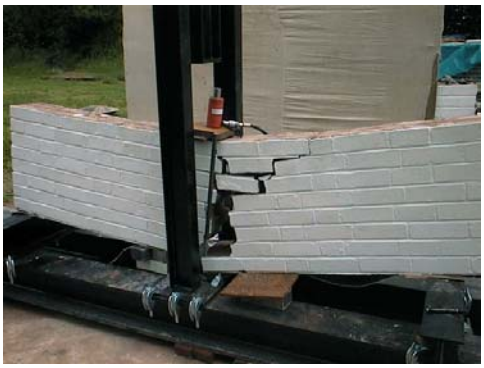
Local Authorities have a budget - could a treatment be applied within this? How much would the application of a foliage transpirant cost for example? They certainly reduce transpiration whilst leaving the tree healthy.

Before and after tree surgery

Used in conjunction with some form of ground treatment (the Intervention Technique or electrokinesis perhaps) might produce a sensible and safe solution at a reasonable cost.

Our developing view is that any solution will involve combining several approaches. Intervention might be one, soil treatment another and quite possibly the use of superstructure strengthening methods. Excess movement of the magnitude that causes damage to domestic dwellings isn't huge. If each of the 3 elements we have listed copes with say 20mm of movement, buildings will be able to withstand the most commonly encountered amplitudes of ground movement safely.

This may lead to a table of repairs listing repairs appropriate to the level of damage much like those contained in the BRE Digest.



We already have parameters of masonry reinforcement and limiting tensile stresses from the work of Burland, Wroth, Skempton and others, plus the more recent research at the premises of C.P. Bennett in Solihull where masonry panels have been tested to destruction (left).

Reducing ground movement by 20% using the Intervention Technique, enhancing the tensile stress by a similar amount and changing the soil properties should cater for a majority of situations where there is limited seasonal movement producing small cracks, allowing us to retain nearby trees.

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The Business Case

Tony Boobier
BEng, CEng, FICE, FCILA, FCIM. MCIPS
Insurance Leader EMEA, IBM Business Analytics

Business Intelligence is viewed by many as the top item in insurers buying agenda, providing insight into claims and underwriting trends, sales and marketing behaviours, and productivity of both individuals and branches. In its most simple terms, it helps translate data into useful information. It helps tell organisations why they have received the results they have got, and what is happening in real time to their businesses.

In many ways, Business Intelligence, or BI, is a process where organisations are looking through the rear view mirror when in fact what they really need to do is to be able to anticipate what is likely to happen next, and to plan specifically. We call this crystal ball gazing 'Predictive Analytics'. It is a process which helps organisations not only look out through the front windscreen, but more importantly what is around the next bend.

In its purest form, predictive analytics takes historic and real-time data and with the benefit of statistical modelling, identifies outliers, or anomalies, which give a clue as to likely events or behaviours at a customer level.

Of course, this isn't new in the world of insurance – catastrophe modellers have been doing this for years, and insurance actuaries base their company's rates on probability analysis. What is different is that insurers and intermediaries are beginning to figure out how predicting the future helps cut cost in many of the processes they currently adopt.

For many of us, it is no accident when we are canvassed by an insurer – by phone, or internet, or mail – offering us competitive prices or new offers of products. Price, product and placement are all critical in the buying cycle, and with UK insurance churn rates approaching 25% (the highest in Europe), being able to manage buying behaviour is a critical success factor for many insurers.

Predictive analytics helps better understand the 'customer journey' and their buying propensity.

With almost all insurers looking for operational efficiency, the ability to effectively deploy the most appropriate resource to the point of claim becomes increasing critical, as does their ability to fast-track claims in a 'friction free process' – deploying directly into the supply chain without losing control.

The idea of triage has been with the insurance industry for a while – but may now be on the cusp of moving to a new level.

If there have been concerns in the past about supplier 'opportunism', the new generation of business intelligence allows that to be identified and captured in real time, reducing audit costs. With insurers in recent years having relied on leveraging their supply chain to obtain competitive rates (often without having adequate scoping controls in place), the use of both business intelligence and predictive analysis will, jointly, be the catalyst for a shift to what some describe as the 'dynamic supply chain'.

Some might ask whether predictive analytics can ever provide an infallible solution but insurance has never been about certainty but probability. Tolerable inaccuracy is acceptable, provided that the level of inaccuracy is known in general terms, and can be managed for.

These are not research issues, not hypothetical arguments. The name of the game is to use Business Intelligence, and / or Predictive Analysis, to help insurers save money.

In focussing on predicting the impact of trees on property, some might say that the Clay Research Group are tackling one of the more complex areas of the claims and underwriting environment.

The interaction of trees on buildings seems at the very least to be a function of species, distance, height, crown size, crown shape, ground conditions – and that is before the vulnerability of the property to subsidence movement has been taken into account.

Throw in the vagaries of the weather and perhaps exact prediction of damage becomes impossible, as one very famous tree expert described it, and it is difficult not to have some sympathy for his viewpoint – even if the counter view is that surely we can estimate the likelihood of damage occurring with a higher rate of success than just simply tossing a coin.

So the million-dollar dollar question is whether we will continue to improve our capability to predict damage by trees and improve the level of certainty, or whether our predictive knowledge of subsidence is beginning to reach a plateau?

Let's be brutally honest – role the clock forward five years, or even ten, and will we by then be able to predict with absolute certainty whether a tree will cause damage or not?

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Or is predictive analytics forever likely to be confined to identifying whether a prospective customer will buy an insurance product, or whether an existing policyholder has submitted a fraudulent claim.

So there's the nub of the issue. For all it's complexities – tree size, type, distance and the rest – do we really think that it's easier to predict the buying behaviour of an individual than it is to predict the effect of a tree? Probably not – but with a much clearer Return on Investment, much of the interest in predictive analytics is focussed on sales, (with customer fraud coming a close second.)

When the Clay Research Group was formed many years ago, when subsidence was viewed as being a 'big issue', few would have predicted that subsidence would all but drop off the agenda. And in doing so, it becomes very difficult to calculate an ROI, when there are few returns on investment to be had in the current claims environment. But this doesn't mean that the current activities of CRG are irrelevant – to everything there is a time and a season.

I'm pretty sure that, at some time in the future, the work of CRG and Predictive Analytics will converge – with heightened commercial awareness driving a clearer and stronger strategy for subsidence claims and underwriting, driven by tangible commercial benefits of implementation.

Some have never stopped believing in the £1Bn subsidence year – with the effects exacerbated by a virtual collapse of the subsidence industry as we know it over the past decade and beyond .

So maybe the big question is not one of asking whether or not such convergence will actually happen – but rather who amongst us are brave enough to predict a likely date for when this will occur?

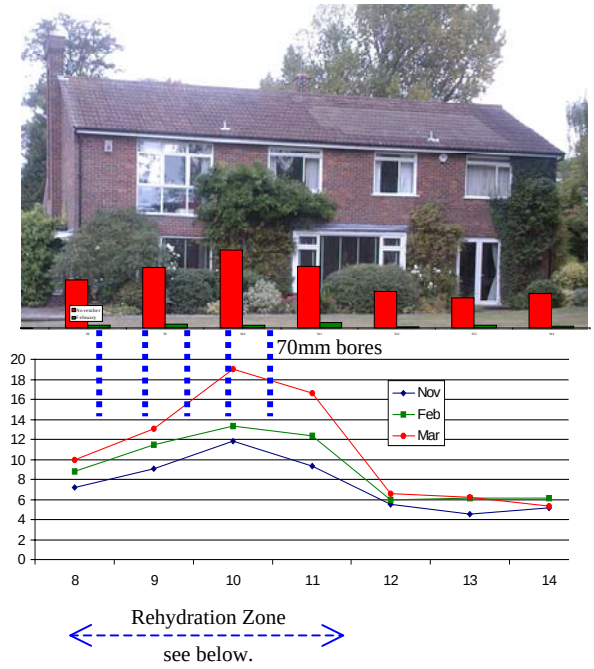
Tony Boobier has considerable experience in the world of domestic subsidence, both from his early days of handling claims as a dual qualified adjuster/engineer to setting up a specialist technical unit for one of the largest insurers in the UK.

He was on the Committee of The Subsidence Forum at its formation and became known as "Mr Subsidence" in the industry press for his contribution. Since leaving, Tony has had important roles in two of the largest Business Intelligence corporations in the world, including Pitney Bowes and now, IBM where he has responsibility for Analytics relating to Insurance. Visit his web site at www.tonyboobier.co.uk *for more information.*

The Headmaster's House

Precise levels continue to demonstrate their worth in identifying which items of vegetation are causing what movement. The general form of recovery directly mirrors the subsidence that has taken place allowing us to distinguish between in-built (construction) distortions and recent movement.

"Speed of Recovery by Week, by Station"



Douglas Pierie, the surveyor appointed by the school to advise on the subsidence that has taken place, arranged for the Wisteria to be cut back and adjoining shrubbery to be removed in February. In addition, he sank 70mm dia. bores at 1m ctrs along the left one-third of the rear elevation (see above and plan on last page) and the school arranged for them to be topped up with water.

The combined action of cutting back the Wisteria (Station 10) and shrubs and introducing water explains the recovery profile – see above graph.

Over the last month there has been 6mm of recovery directly associated with the Wisteria. Elsewhere, recovery has slowed but is ongoing.

It remains to be seen whether the Willow is making a contribution, and levelling through the summer will provide conclusive evidence.

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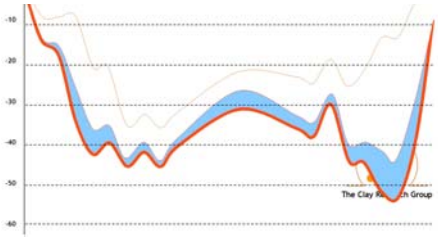
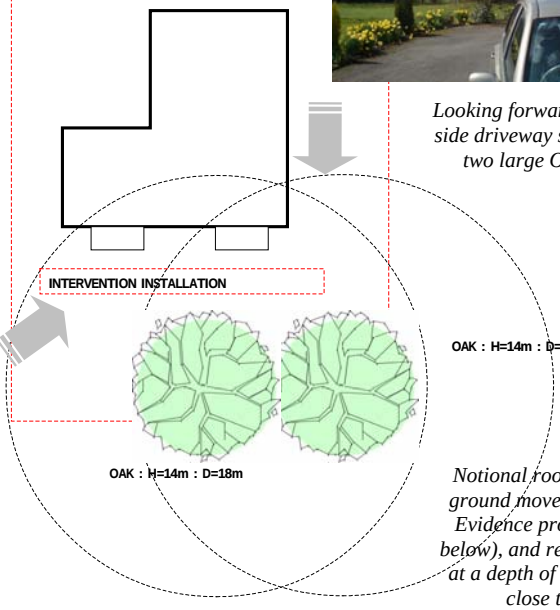
INTERVENTION TECHNIQUE

Dr Allan Tew is carrying a new installation at a site in Essex, with help and co-operation from the homeowner who is an engineer.

Looking forwards from the side driveway showing the two large Oak trees



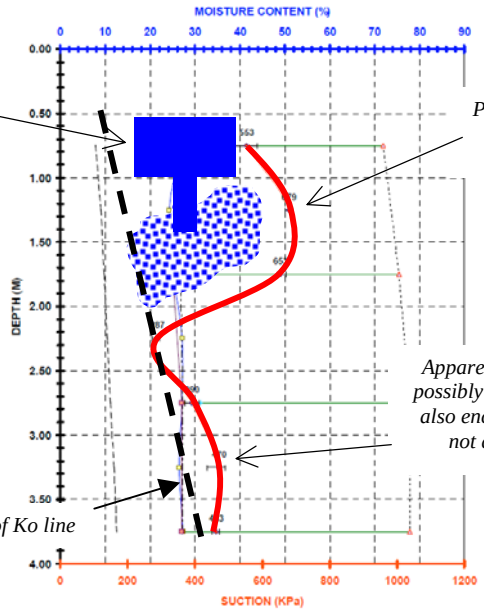
The trees are similar in height to the Aldenham Oak, the ground movement profile from which is shown above, revealing amplified movement at the root periphery.



Notional root zones "sufficient to cause ground movement resulting in damage". Evidence provided by soil suctions (see below), and recovering roots from the Oak at a depth of 4mtrs in the boreholes sunk close to the front elevation.

View to front elevation of property. Damage predominantly to the front wall and two bay windows, following the damp proof course.

Harvesting chambers with short stub pipes discharging to the point of maximum recorded desiccation.



Peak suctions of nearly 700 kPa at 1.5mtrs bGL.

Moistures generally close to PL reflecting stress history of the soil, but they do dip below the PI where there is evidence of desiccation as determined using the suctions.

Apparently naturally occurring high suctions possibly linked with soil mineralogy/gypsum as also encountered in the Control borehole and not associated with reduced moistures.

Adjusted position of Ko line