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

June 2009

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CONTENTS

Education & Training

Until recently there has been very little material to help newcomers to our profession further their understanding and it is encouraging to see so many companies producing newsletters to share their knowledge.

Over the last few weeks we have received copies of the OCA newsletter, information from the Marishal Thompson web site, purchased the Tree News journal and seen the excellent discussion document from Giles Biddle as well as the regular update from Plexus.

Event Prediction

May was warmer and drier than usual with the SMD rising sharply and the slope of the line resembling July 2006, before levelling out over the last week.

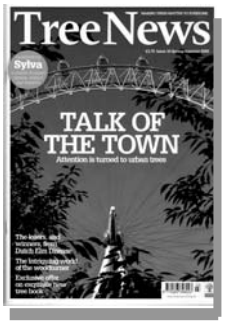
The risk of an event year increased slightly, but we see no evidence of an alert at the moment. Data is being tracked weekly and updates can be viewed on our web site by accessing 'Newsletters' and selecting 'Weather Watch'.

Giles Biddle

Giles Biddle has delivered his report to the Subsidence Forum and hopefully discussions will take place about the use of precise levels as preferred item of evidence between practitioners in the insurance and arboricultural world. For copies contact Giles on <biddle@willowmead.co.uk>

Tree News

Good luck to a new journal that has appeared on the bookstands. We purchased our copy at W.H. Smith no less, and saw Jim Smith from the JMP delivering his views on the topic. It's an excellent read and very well presented.



CRG Website

The site currently enjoys in excess of 51,000 'hits' a year with visitors accessing the newsletter most of all, followed by the pages on plant physiology, soil testing and then remote monitoring. Risk modelling appears to be less interesting to our readers.

Growth has been steady, with numbers increasing every month. We have already added a selection of documents to make it more useful, including a Photograph Album and a Weather Watch page.

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The Clay Research Group

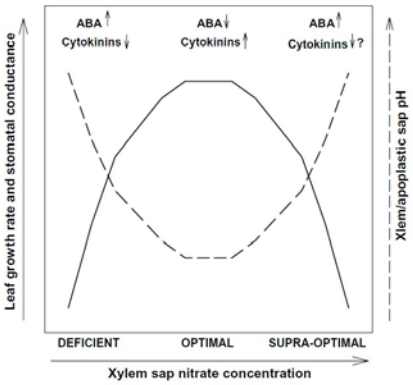
ABA

A recent paper from Lancaster University[1] explores the relevance of ABA, and in particular the role of the 'root and shoot' production mechanism, and the means by which the signal can be enhanced at the receptor site.

The authors note that *"foliar apoplastic pH … can be directly manipulated to increase the intensity of the ABA signal … by applying foliar sprays or root drenches"*. They report a 20% reduction in water uptake resulting from this treatment, in relation to crops and small flowering species of plant. They have no data on trees.

Foliar sprays aren't a sustainable solution for subsidence claims but reinforce the work we are doing on the Intervention Technique around pH manipulation.

The authors reproduce the figure below, taken from Wilkinson et al., (2007) Journal of Exp. Botany., showing the diagrammatic relationship between xylem pH and ABA production.



ABA production increases as the xylem sap concentration of nitrates increases or decreases beyond the optimal condition. This increase is accompanied by a raising of the pH following the accepted position. All of this is accompanied by a reduction in stomatal conductance.

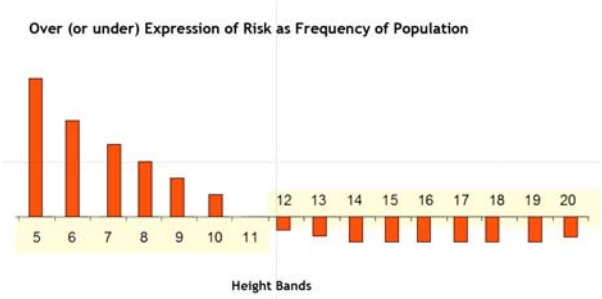
(1) Sally Wilkinson & Wolfram Hartung *"Food Production: Reducing Water Consumption by Manipulating Long-Distance Chemical Signalling in Plants"*. J. Exp. Bot. 2009 60: 1885-1891

Dr. Wilkinson tells us that raising the soil pH doesn't mean it will translate into a beneficial increase in the xylem. She says "if you alkalise soil this does not always translate into an alkalisation of the xylem sap as the sap is often buffered against such change".

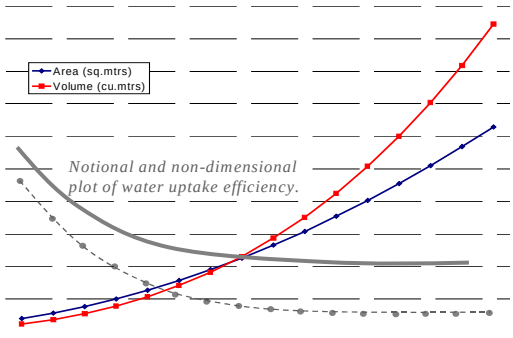
In short, ABA is most effective in parts of the vegetation with a raised pH.

Small Trees are Riskier than Tall Trees. Why?

Why would smaller trees present a greater risk than taller trees? From our earlier reports we saw that trees 10m high presented a greater risk than trees 20mtrs high, expressed as frequency of population.



Is it the case that smaller trees are more vigorous and extract moisture from a smaller area of ground, thus enhancing their effectiveness? Does this make them more likely to cause localised ground movement than the taller tree, which takes moisture from a much larger area before raising it a considerable height with some associated loss of efficiency?



We anticipate that a 20m tall Oak works exceedingly hard to extract moisture from a root area of say 1,500 mtrs^2 and a volume of maybe 2,200 mtrs^3, before lifting it 20mtrs to reach the canopy.

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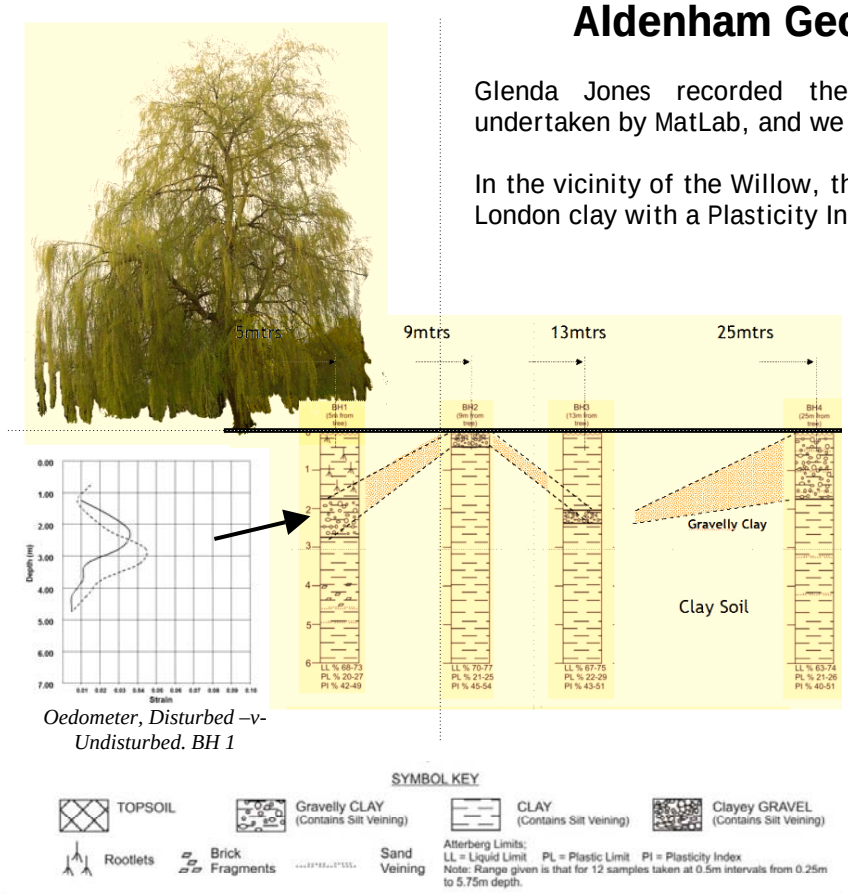
Aldenham Geology – Willow Site

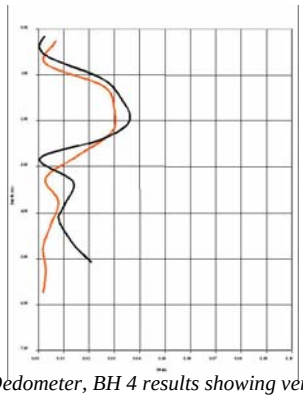
Glenda Jones recorded the site geology from investigations undertaken by MatLab, and we can see how the two locations differ.

In the vicinity of the Willow, the ground is predominantly a cohesive London clay with a Plasticity Index in the range 40 – 54%.

There is a relatively shallow band of gravel, of variable thickness, running across the site at fairly shallow depth.



Oedometer, Disturbed –v- Undisturbed. BH 1

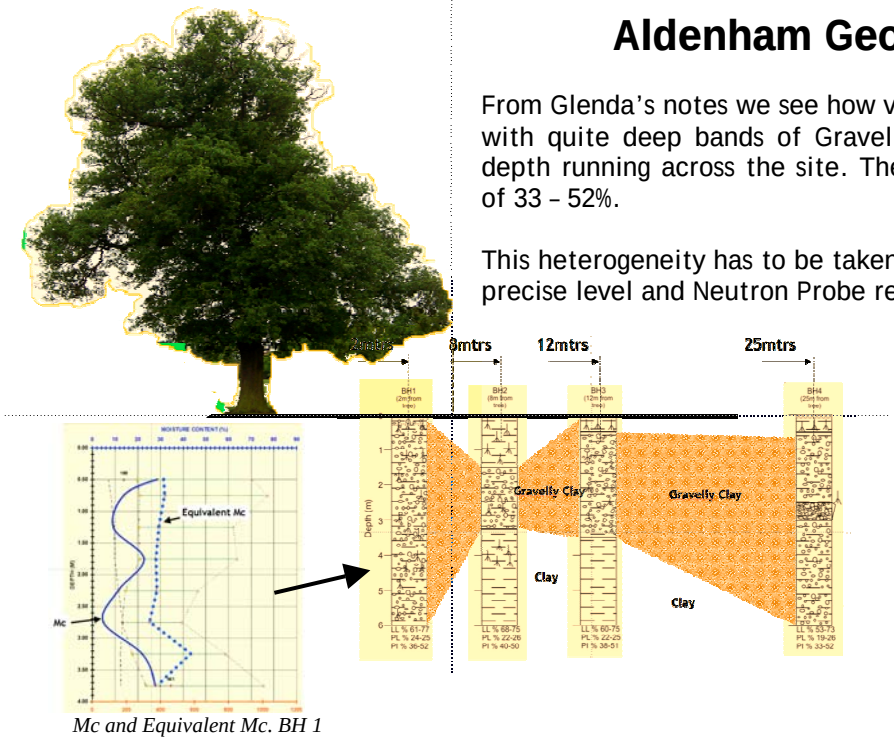


Oedometer, BH 4 results showing very little difference even though one sample is disturbed and the other is undisturbed.

Aldenham Geology – Oak Site

From Glenda's notes we see how variable the soil beneath the Oak is, with quite deep bands of Gravelley Clay of variable thickness and depth running across the site. The P.I. is also variable, in the range of 33 – 52%.

This heterogeneity has to be taken into account when considering the precise level and Neutron Probe readings.



Mc and Equivalent Mc. BH 1

Had the soil been a consistent London Clay we would have expect more movement.

Possibly twice as much in some locations - i.e. particularly BH 1 & BH3.

Roots were retrieved to a depth of 5.5mtrs bGL in BH 1, and 4.25mtrs in BH 2.

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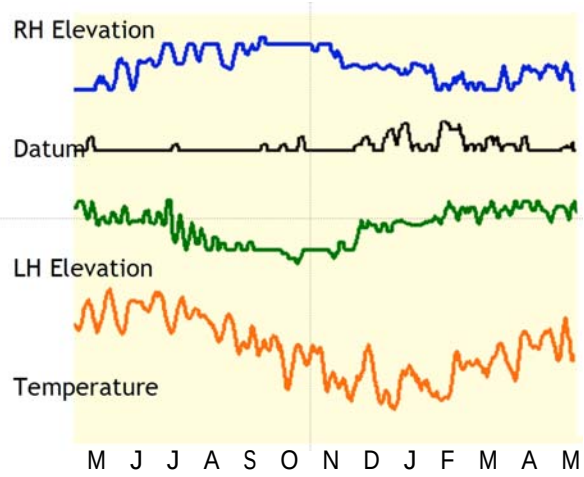
Electrolevels

We have published these results before – the red and green lines represent movement of a single storey extension, and the red line plots the temperature changes over a 12 month term, May 2008 to May 2009.



The black line is the datum, fixed to the LH side wall of the house. It is also being influenced by tree root activity, although less than the electrolevels fixed to the LH side wall of the extension, nearer to the trees.

The sensors have a resolution of 0.0025 degrees but as is always the case, calibration is essential. Readings of around 0.05 are probably related to "background noise" and temperature change, whereas a signal of 0.1 degrees confirms structural movement, although the proportions of a structure are a significant factor that makes absolute values far less meaningful than traditional techniques.

Over a 3mtr length of building, 0.1 degrees equates to around 5mm of vertical movement from the horizontal plane.

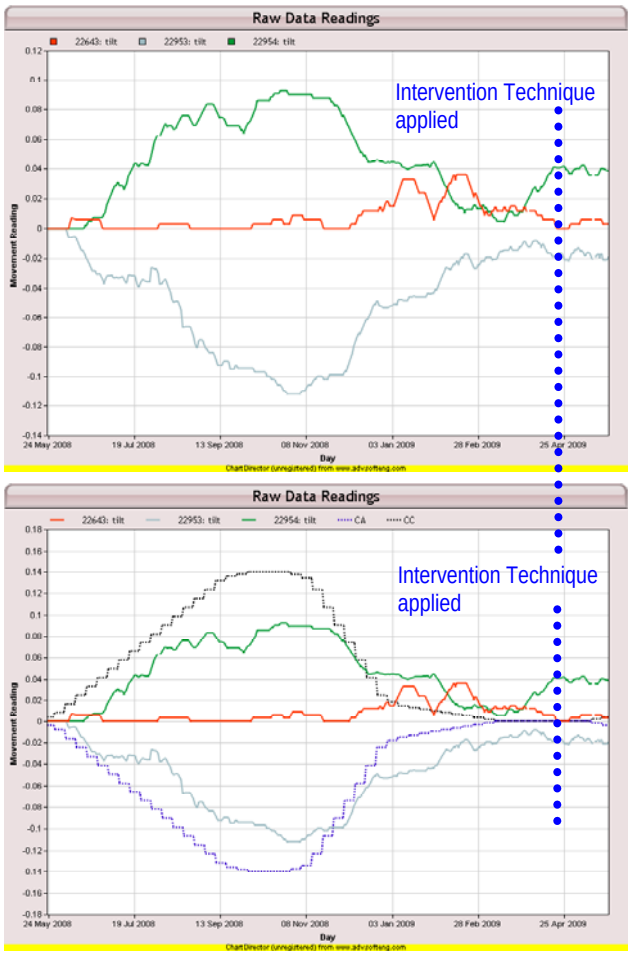
This is not usually regarded as sufficient movement to cause significant damage although the abutment of an extension to a two storey building (as is the case in this example) would make it more vulnerable.

Electrolevels

The data can look a little irregular initially, with occasional signal interference and minor changes related to diurnal temperature change.

Taking 5 readings every hour can also make interpretation difficult.

We 'clean' the data, using a moving average function, sampling one reading in say 20 to deliver the plot shown below.



The underlying algorithm that "pattern matches" to arrive at a probability of the data being root induced clay shrinkage has been superimposed on the lower image – there is a greater that 85% probability that movement here is root induced.

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Distributions

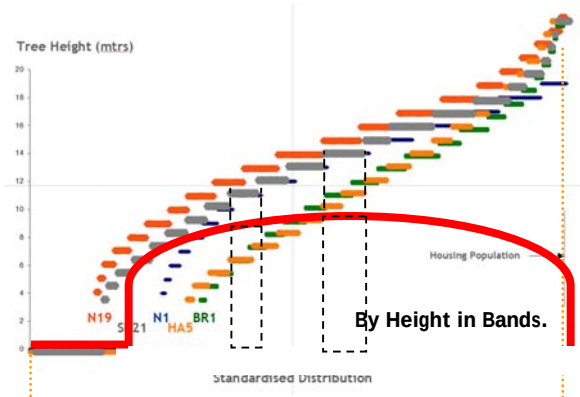
Below is the distribution of houses in various postcodes with trees nearby, expressed in height bands of the trees within influencing distance.

The flat line to the bottom left of the plot are houses with no nearby trees.

Each 'flat line' represents the number of houses with trees of the stated height (see 'y' axis) in influencing distance.

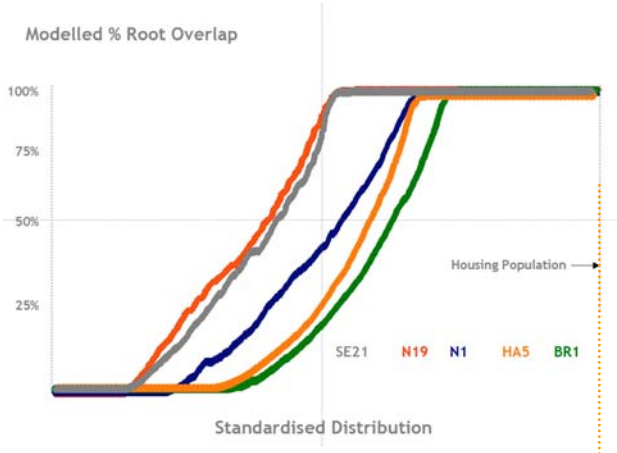
As we have seen previously in the newsletter, there are more trees in the mid-height range as confirmed by the length of the horizontal bars at around 12 – 14mtrs, and this appears to be fairly consistent across postcodes.

There are fewer trees at either end of the plot (i.e. the horizontal 'bars' are shorter). Claims data revealed a higher frequency of smaller trees (i.e. less than 12mtrs) were involved, suggesting taller trees present a reduced risk when expressed in terms of the tree population.



By Height in Bands.

Averaged Characteristic Signature.



Averaged Characteristic Signature.

Above is the 'percentage overlap' estimate based on the statistical assessment of root zones encroaching beneath a building derived from claims data.

We have used the term 'standardised' because not all postcodes have the same number of properties. The 'x' scale has been adjusted to make comparisons between postcodes easier.

The signature is similar for every postcode with the proportions of non-overlap and 100% overlap properties varying.

In other words, the slope of the line is consistent.

This study takes no account of species or any changes in geology. It is based on the results of the LiDAR survey data.

Next month we see the results of further comparisons with actual claims.

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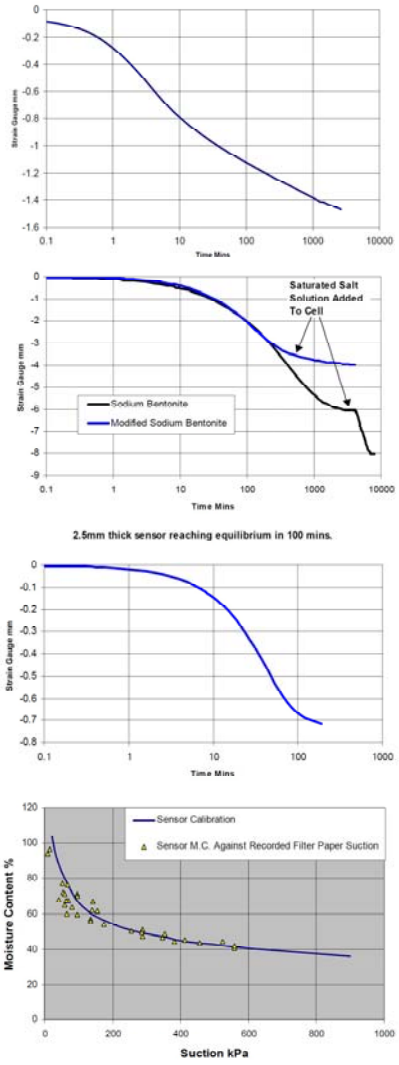
Suction Test

Clive Bennett's (MatLab) work continues as he researches new methods for measuring soil suction.



He hopes to develop a more robust test that is both quicker and cheaper than the Whatman's filter paper method, by using a different sensor. Clive is about 12 months into the project and has identified a material that has delivered encouraging results.

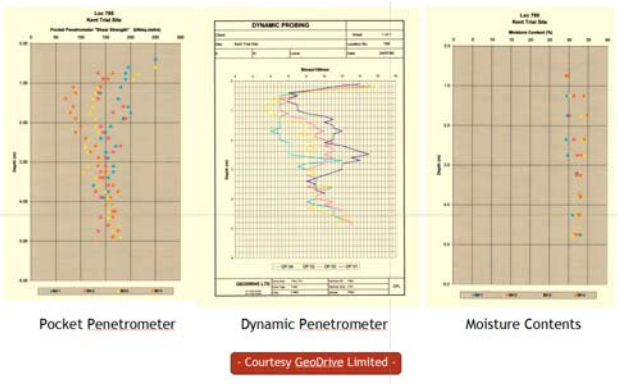
One of the findings is the role played by Relative Humidity. It is essential to reduce the time between removing the drying filter papers from the oven, and testing. Any delay can influence the outcome.

Penetrometers

Penetrometers are a useful method of detecting desiccation. Earlier work by Pugh *et al* describes the use of the pocket penetrometer when combined with window sampling.

We are carrying out tests with Dick Scarff of GeoDrive at a site in Richmond where other soil tests (oedometer and suctions) have also been undertaken for comparison purposes. Above we see the 3 grouped readings taken at regular intervals to assess shear strength.

They offer the advantage of gathering data on-site and passing them back to the engineer over the web within a few hours. This would speed up the investigation and reporting process considerably.



Above we reproduce the results from tests undertaken at the BRE research site at Chattenden. The characteristic bulge of root induced clay shrinkage is clearly visible. The rig penetrometer matches the profile obtained using the neutron probe at Aldenham. At shallow depth we see the influence of ground evaporation, and at around 2mtrs bGL is the root induced bulge, each diminishing with distance from the row of Poplars.