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

November 2009

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In the News

Marishal Thompson hope to provide funding to assist our ongoing program. The last few years have been relatively quiet in terms of claims, and we were gratified at the continued level of interest from our sponsors. Paul Thompson has been a supporter of the CRG from the beginning in 2005.

Mike Lawson from OCA gave a nicely balanced interview on Radio Essex, explaining the need for trees and how they influence buildings – sometimes … not very often.

Claim numbers increased sharply when the sun came out, but balanced with the rainfall in earlier months it looks like being an average sort of year for total claims notified. Richard Rollit reviews 2009 looking at the influence of the Jet Stream and our prediction in May.

One of the buildings at Aldenham has moved slightly – nothing very much, but on a point of interest, it could involve the Willow that we have been monitoring for the past four years. A potentially fascinating study exploring what happens prior to damage occurring.

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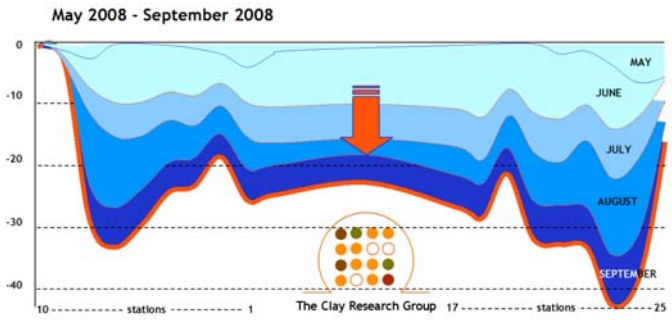
Movement by Season

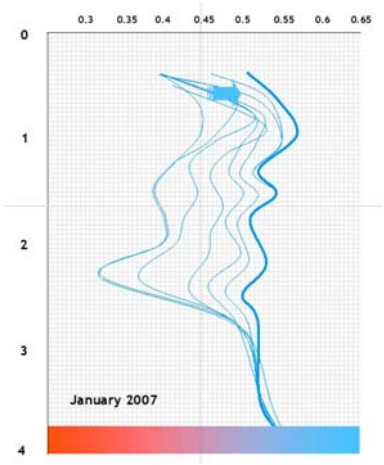
Seasonal ground movement across the root zone of the Willow at Aldenham from June 2006 to September 2009 forms the subject of a supplement this month, profiling both wet and dry years.



The 'development profile by month' provides an interesting insight into root induced clay shrinkage at a specific site, beneath a specific tree – the Aldenham Willow.

Download "Ground Movement Profiles" from the web site.

Next month we explore moisture change profiles based on the Neutron Probe, as recorded by Southampton University (see below), plus some articles on infiltration looking at how quickly soils rehydrate, based on earlier work at Birmingham University with Dr. Ron Barker.



Future editions will cover our recent work on the penetrometer as well as new maps of soil distribution plus of course, updates on both the Intervention Technique, and what investigations reveal about movement to the Headmasters House at Aldenham.

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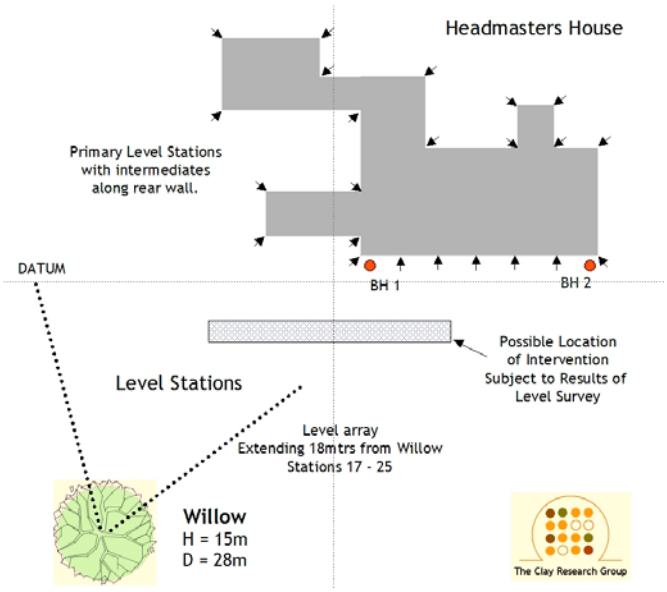
Aldenham School

~ Movement to a Building ~

It isn't very often we have the opportunity of gathering data prior to the event but the building closest to the Willow tree site at Aldenham has suffered some low level movement and hopefully this will provide an opportunity to test the Intervention Technique.

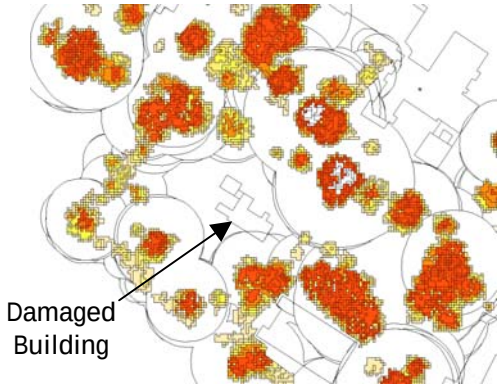
We have been gathering ground movement data over the last three years, and Crawford & Co., have agreed to continue with the exercise, supplementing precise levels with electrolevels so that we can gather data daily using telemetry.

MatLab have agreed to undertake further investigations and to install the Intervention Technique subject to the results of the levelling exercise and the receiving the agreement of the school.

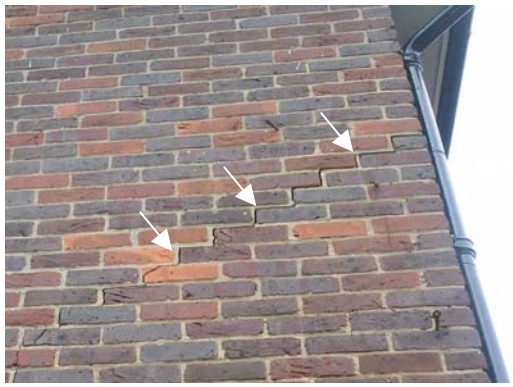


Above is the site layout illustrating the position of the tree in relation to the building (the Willow is 15m high and about 30m from the building), the proposed level stations and the possible location of the rehydration trench – subject to the results of the levelling exercise.

Further investigations are being undertaken including sinking boreholes and a range of soil tests including penetrometers, suctions and oedometers to supplement the levels.

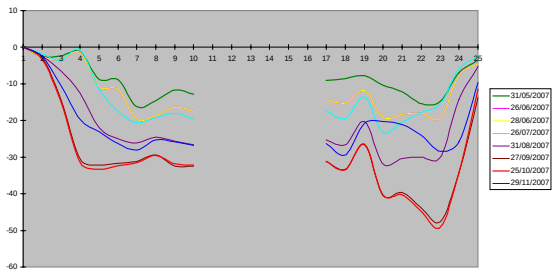


The model also suggests there may be trees on the opposing corner and matters are complicated by the presence of substantial shrubs growing against the rear wall, in the vicinity of damage.



Levels and investigations will help distinguish the contribution of each.

Willow Root Zone



Movement across the root zone of the Willow. Maximum amplitude towards the end of array 17 – 25 – see plan, left – nearest to the building.

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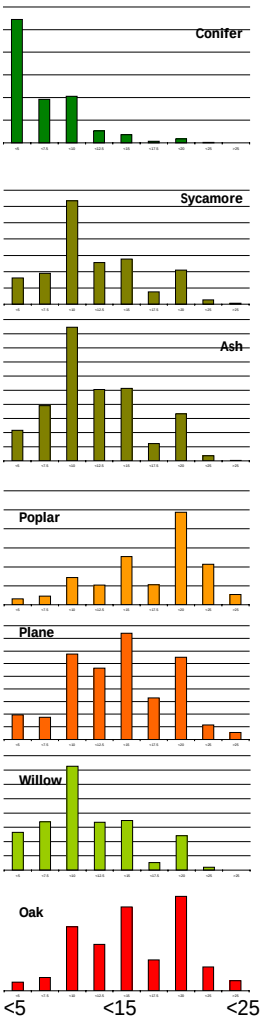
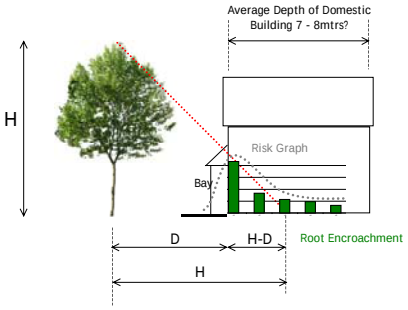


Distribution Profiles

The graphs (left) show the height distribution of trees, by species, from 30,000 claim records.

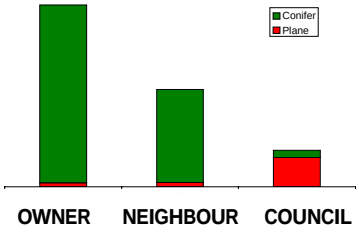
Obvious outliers – poor data – were excluded by plotting the height and distance values to detect odd entries. For example, 2m Oak trees, 300mtrs from the building, or 30m tall Oaks, 0.001mtrs away. Around 8% of the sample were omitted.

It is also worth noting that the tree species has been (in most cases) identified by adjusters and engineers, and not arborists.



Root 'Danger Zone'

Ownership classes for Conifers and Plane trees.



Using H – D (see below) and working on a uniform H = R (where R = the root radius) we have some notion of the risk zone presented by root encroachment – see previous edition for case studies.

Although the values will change, the general form will (in nearly all cases) be similar. The model automatically accounts for projecting and vulnerable parts of the building – bay windows, porches and conservatories etc.

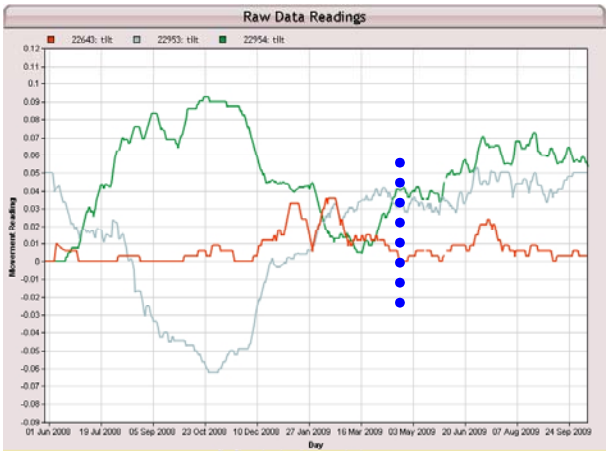
Intervention Technique Update

~ Movement recorded by Electrolevel Sensors ~

This case has been described in detail before, and the data, right, is for the period 28th May 2008, through to 10th October 2009. Treatment was applied towards the end of April, 2009.

Even though 2009 has been drier overall than 2008, and the SMD for the last four months has recorded deficits in excess of 120mm, movement appears to have been significantly reduced.

Precise level data is being gathered and a full report will appear in the next edition.



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A Slow Burn

Richard Rollit

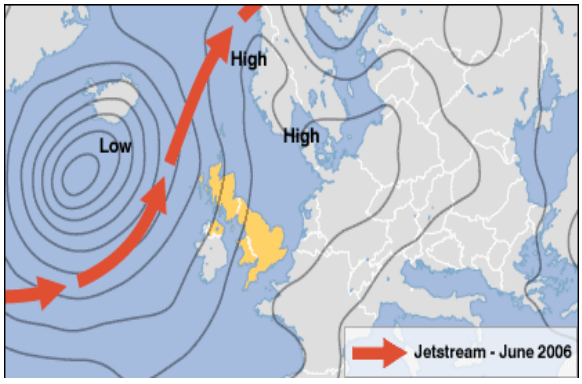
In August the Meteorological Office's prediction of a 'barbeque summer' was pillared in the press and almost became as infamous as Michael Fish's ill-advised dismissal of hurricane warnings in 1987.

But remember June? Temperatures over 30^{0}C, no need for the new roof at Wimbledon and Glastonbury was almost mud-free. Then came July with 122mm of rain almost twice the annual average, and the first summer flooding.

A dismal August followed but then a fine September. Perhaps a 'barbeque summer' isn't a bad description after all.

To bring us a long hot summer, the jet stream needs to pass to the north of the UK. This allows the Azores High, an area of high pressure situated in the mid-Atlantic, to bring us warm and settled weather, a 'blocking high'.

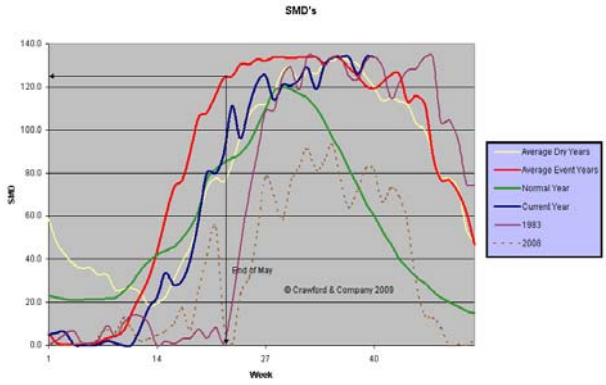
Blocking highs divert the normal track of incoming low pressure systems. Once established within this mode, the blocking situation can go on for a week, a month or even a season, bringing us prolonged spells of dry weather.



Recently, the jet stream has moved north of the UK, as it did during 2006, and there has been a corresponding change in our weather to a settled period of dry weather and this has seen the first uplift in subsidence claim numbers since 2006.

The Meteorological Office provides an estimate of the Soil Moisture Deficit using a system known as MORECS (Meteorological Office Rainfall and Evaporation Calculation System). Essentially the higher the reading the drier the soil is.

Clay shrinkage subsidence is all about ground movement. Trees on clay soils can cause shrinkage or ground movement of 20mm – 200mm but it takes a huge amount of energy - cracking buildings isn't easy. Equally extracting water from the ground and sucking it to the top of a tall tree isn't easy either. Get a straw that is 20mtrs long and give it a try. It's a little like the high jump, you need a good, unhindered run-up if you are going to clear the bar; it's no good pausing or slowing down. So if you want to reach a high value in September start early and make sure the run up is clear.



If we apply the 'high jump' analogy to trees then generally 'event years' need a solid run-up or a soil moisture deficit at the end of May of around 120mm. If you look at this year, whilst it was above average, the run-up was not totally smooth, which promoted our assessment in May to state;

"Although the weather has been warmer than usual recently, we have no evidence to suggest 2009 will be anything other than a normal year in terms of claim numbers."

The recent influx of claims should compensate for the wet July and Aug but overall we a surge seems unlikely; the 'run up' was too short and too late to clear the bar; but the SMD remains a useful way to assess surge.

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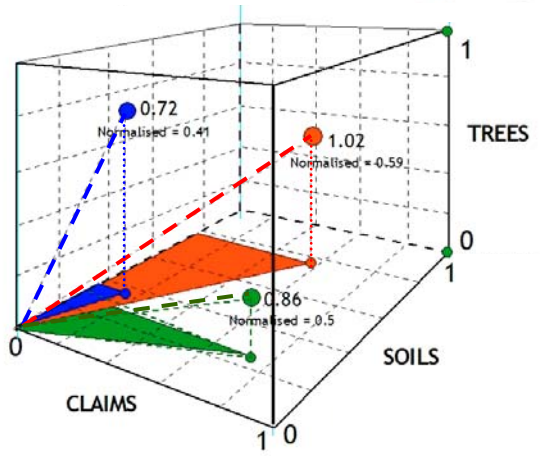
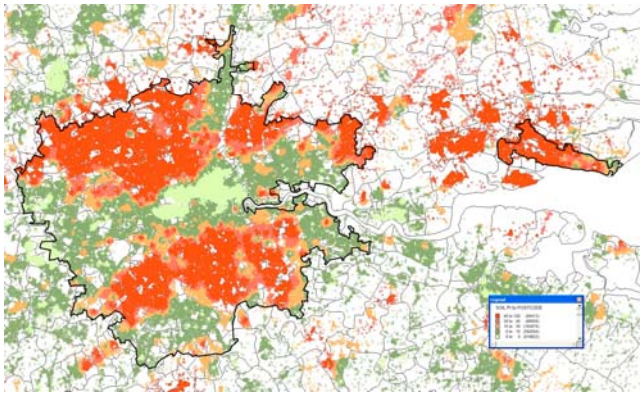
Combining the Risk Elements

One of the problems we encounter when combining trees with weather with soils etc., is the fact we live in a 3 dimensional world, and 2 dimensional graphs don't resolve the interaction between them.

Each of the elements can be scaled, which means each can be weighted according to its contribution. Taking trees as an example, we know the number of trees that cause damage in any one year is low in terms of frequency, but costs can be high for this class of claim.



Geology



Our most recent project has involved the integration of the claim elements, as described under "Combining the Risk Elements", left, and we were struck by the visual appeal of the maps.

Above is an extract from our unique 'shrink/swell' map of the UK, showing London and the South East, at full postcode level.

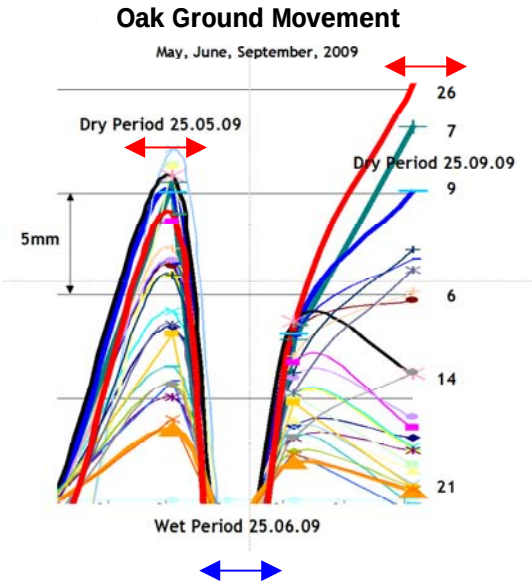
'Trees by Height' map of North West London.

Oak Water Uptake

~ by Month by Station ~

Right, an extract from the 'ground movement by month' graph for the Aldenham Oak. Roots in some locations contribute significantly to the water requirements of the tree whilst others take less, and this is dynamic. Some of the variability is the result of the heterogeneous soil type – the mixture of sand and clay which is illustrated in the graph right.

The speed of response to dry/wet weather is a function of the hydraulic conductivity. The sand lenses allow fairly rapid rehydration of the clay fraction, which isn't seen on the Willow site because it has a more uniform clay composition and change takes longer.



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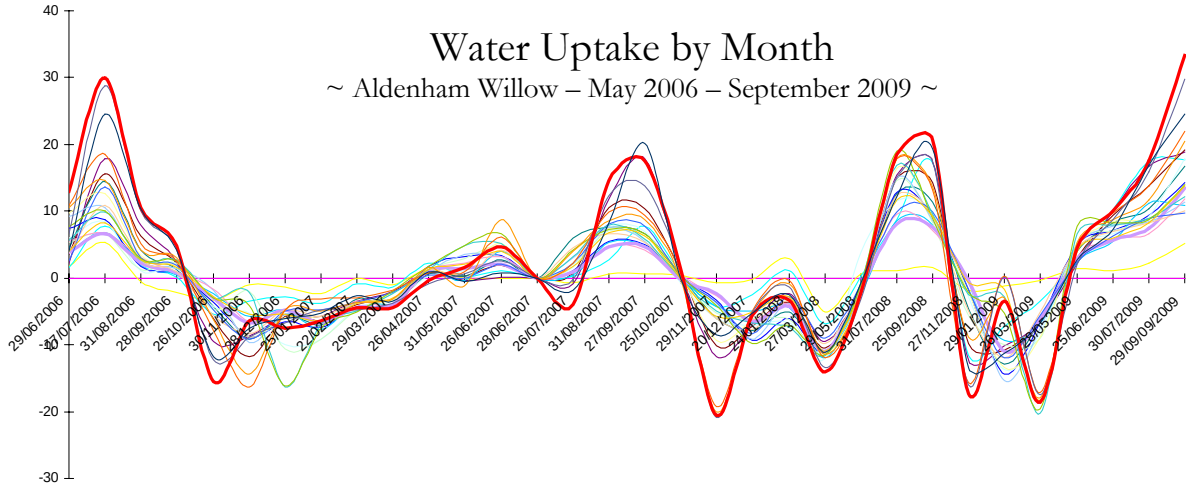
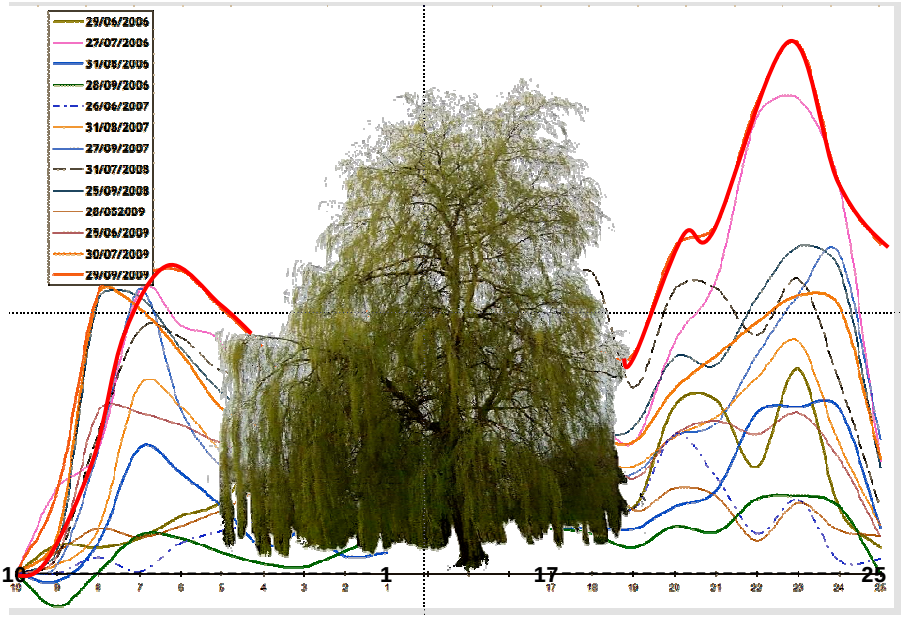


Using positive differences in ground movement by month as a proxy for moisture uptake the above graph plots the variation in consumption between stations 2mtrs apart, over time. 2006 (left) shows the water uptake in a dry year. 2007 and 2008 were wetter, and 2009 has been mixed. Interestingly, at the Aldenham site and in the vicinity of the Willow, movement has been greater in 2009, rising towards the end of the year.



Moisture uptake/ground movement across the root zone for summer months over the same period is shown above. There is considerable variability and the roots beneath Stations 17 to 25 appear to be working harder – contributing more moisture - than their neighbours running beneath array 1 - 10.

We can also see the increased water uptake in September 2009 on both arrays. See also following page.

The ground beneath the canopy is dry and has less available water – hence the reduced uptake in the peripheral zone. The root zone is dynamic and can change month by month and year by year as moisture availability changes.