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
Artificial Intelligence

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Climate Change • Data Analysis • Electrical Resistivity Tomography
Time Domain Reflectometry • BioSciences • Ground Movement
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Mapping • Software Analysis Tools
Artificial Intelligence

July 2017
Edition 146

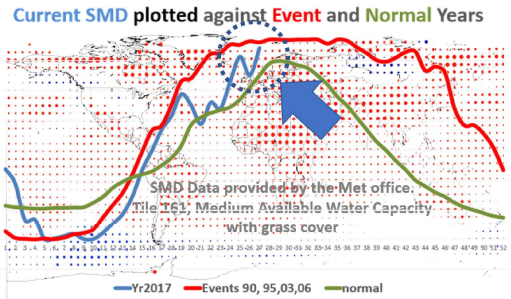
The Clay Research Group

CONTENTS

Issue 146, July, 2017

NEXT MONTH
Modelling Root Overlap for OS Tile TQ29 and comparing with Canopy Cover

2017 - Event Year?



The Soil Moisture Deficit continues to fluctuate and the irregular profile is usually an indicator of a year that will deliver normal claim numbers.

Tree Canopy Study

This month's edition contains a preliminary study of tree canopy cover in Barnet and Finchley, NW London, using our 2005 LiDAR dataset. The study measures canopy cover for the 1km square OS tile TQ29 to deliver granular information, allowing comparison with the geology and claims history.

This is an extension of previous articles relating to the TDAG discussion topic on whether new houses built on clay soils should have a piled foundation given the target set by the former Mayor of London, Boris Johnson, that canopy cover in the city should be increased from 20% to 25%. An increase in tree planting to achieve this goal would inevitably increase the subsidence risk. The possible answer could be to press for all new houses, on clay soil, to be constructed off a piled foundation.

TDAG are looking at this proposal primarily in terms of environmental benefits but also to resolve the threat of subsidence when trees are planted close to houses.

Thanks to Optera Limited

Our thanks this month go to the contractor, Optera Limited, for attending to the level stations at the site of the Aldenham willow. The covers became displaced and Chris White, Technical Manager at Optera Limited attended at very short notice and saved the day – more inside.

Gold Status

Congratulations to Birmingham, Keele and Aston Universities on being awarded gold status in the latest UK-wide Teaching Excellence Framework (TEF) rankings.

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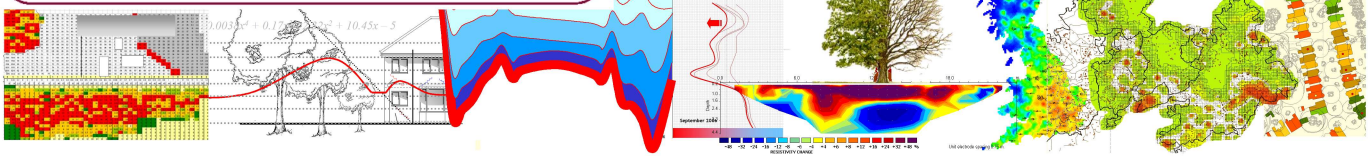

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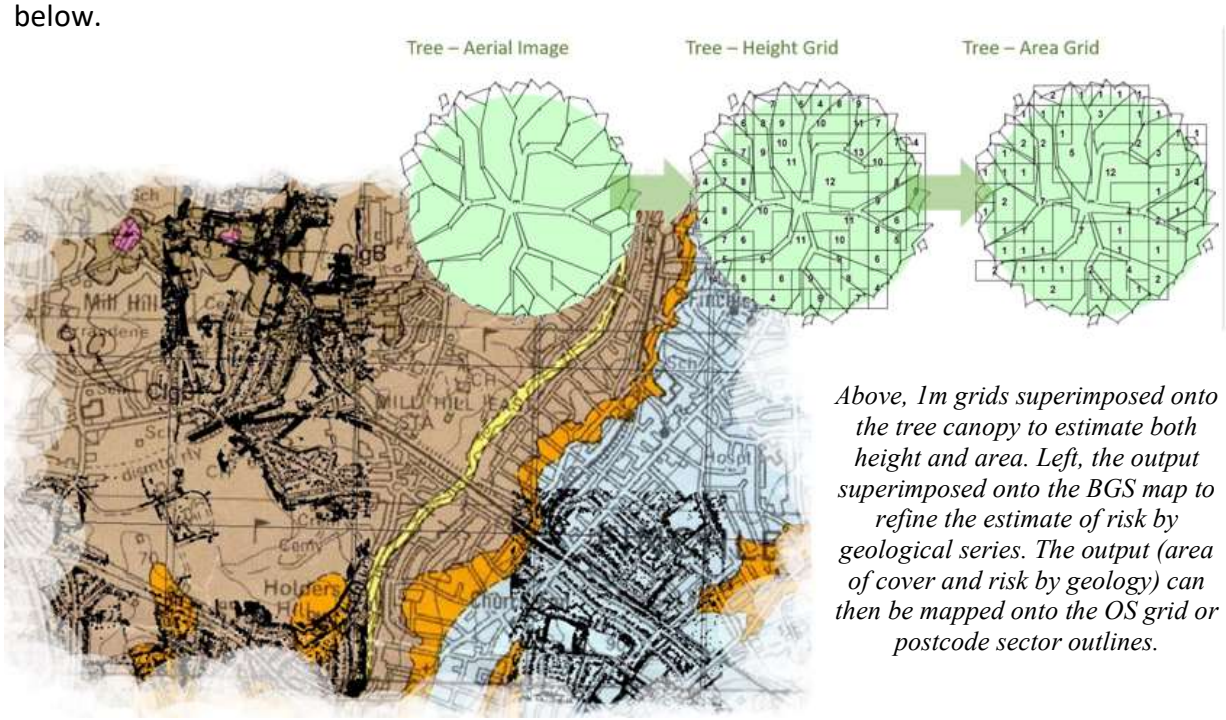
Measuring Tree Canopy Area in London

In his role as Mayor of London, Boris Johnson set a target to increase canopy cover in London from 20% to 25%, with a delivery date of 2025. As mentioned in last month's edition of the newsletter, a publication covering the methodology is aptly entitled "Measuring Tree Canopy Cover in London", available for download at:

https://www.london.gov.uk/sites/default/files/measuring_tree_canopy_cover_2015.pdf

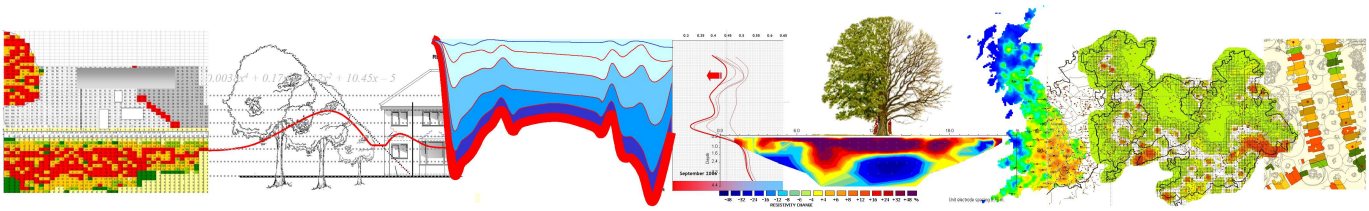
The team behind the study have sampled aerial imagery periodically to assess the baseline against which future values can be compared.

In the following study, CRG have used a LiDAR dataset compiled from a survey in 2005. LiDAR uses the return interval from lasers to determine the height of trees, buildings and to model ground contours. It provides rapid cover and the output is digitised, allowing analysis as shown below.



Above, 1m grids superimposed onto the tree canopy to estimate both height and area. Left, the output superimposed onto the BGS map to refine the estimate of risk by geological series. The output (area of cover and risk by geology) can then be mapped onto the OS grid or postcode sector outlines.

For this study, London has been divided into tiles using the OS grid as a background. The tree canopy has been divided into 1m square tiles, each containing height (centre image in the above row) and area (right) data. In this example, the output has been superimposed onto the 1:50,000 scale BGS map using the OS grid as a locator.



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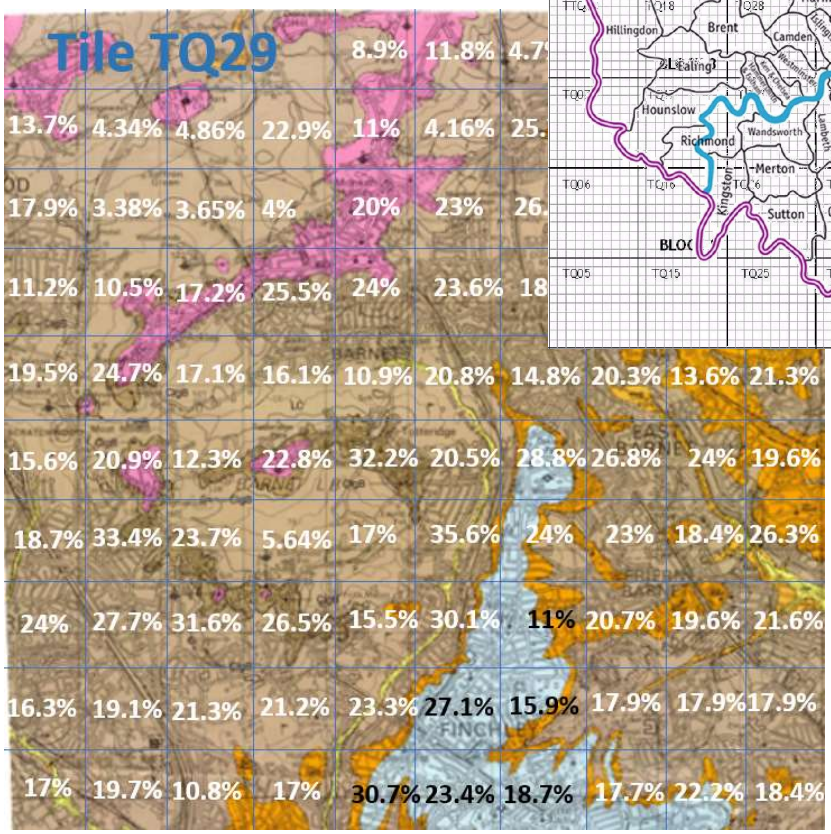
Measuring Tree Canopy Area in London *... continued*

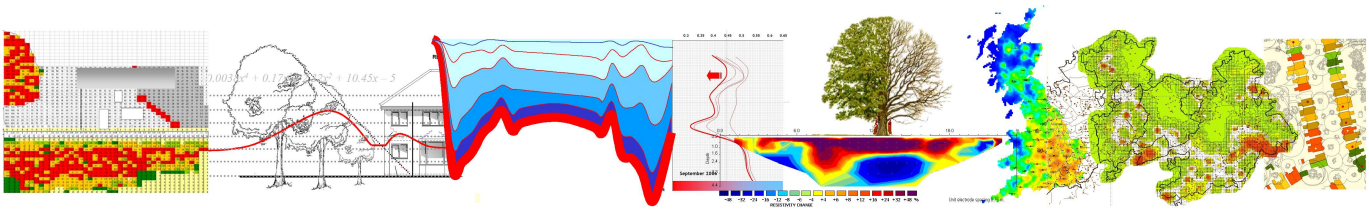
The OS Tiled map, right, with the London boroughs superimposed. In addition, postcode sector boundaries have been added (see page 6) to aid comparison and location.

Below, Tile TQ29 covering the Barnet/Finchley area superimposed onto the 1:50,000 scale BGS map showing drift and solid deposits for the area. Canopy cover expressed as a percentage of each 1km grid are indicated.



The canopy cover estimates so far undertaken are in the range 3.38% (TQ2917) to 35.63% (TQ2593), with an average of 17.66%. Interestingly, and from this very limited and preliminary study, there are fewer trees in some of the 'open' areas - parkland and fields.

Conversely, some of the urban areas have tree canopy cover that are amongst the highest values. Plotting data onto the underlying geology is of interest in identifying areas at risk from root induced clay shrinkage. Increases in tree planting on gravels and mixed beds (pink and blue) represents a lower risk than planting on outcropping London clay.



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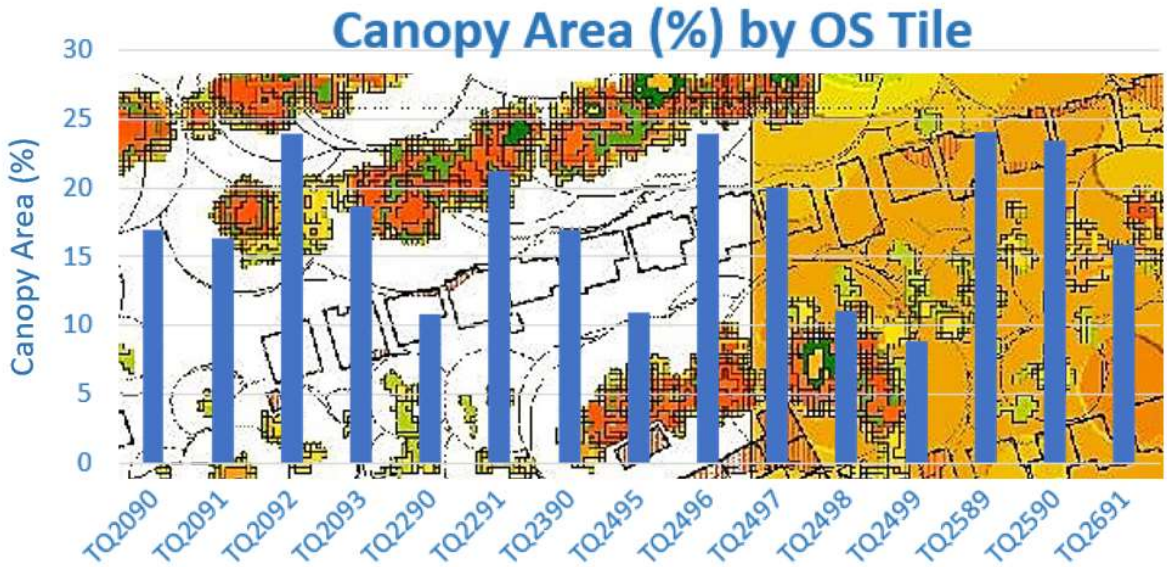
Measuring Tree Canopy Area in London *... continued*

The graph below records canopy cover for a selection of OS grids, using the results of the LiDAR survey data. The study will continue, with the objective of plotting the outcome both by OS grid and postcode sector to improve our understanding of risk, both present and projected.

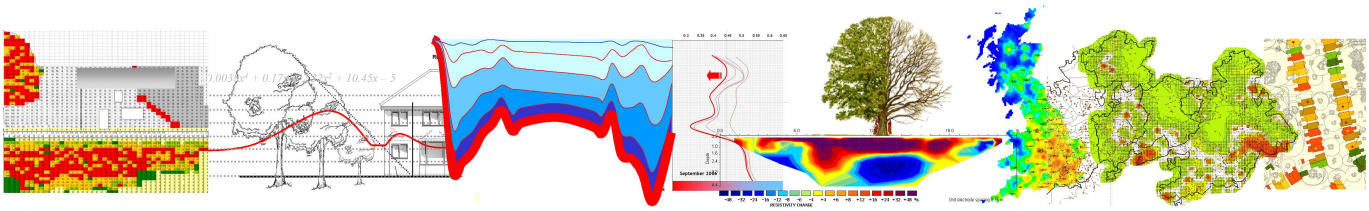
Plotting the outcome in relation to geology, risk (claims frequency) and location (land use) will allow us to better understand the relationship between the various elements. Are there more claims where there are more trees? What effect do the mixed geological deposits (predominantly sands and gravels) have?



By mapping by location, further tree planting might be better directed. Several questions arise.

We see from this very small study that open spaces sometimes have, perhaps perversely, less canopy cover than the urban environment. There appear to be spaces available to plant trees to achieve the objective without increasing the subsidence risk. Will the 'open spaces' referred to be swallowed by housing development? Probably not but there is pressure from developers and local authorities to achieve government targets.

Would a 'pile all new housing' initiative hurt those most vulnerable – social housing? Can councils and housing associations afford to build to a higher specification? Will people pay more on clay to avoid the risk of subsidence? Will it be difficult to sell identical houses, on differing geologies, one on clay and the other on gravel, with differing prices. Or are sales driven more by area and location? People perhaps don't compare like-for-like. Rather, location, location, location.



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Measuring Tree Canopy Area in London *... continued*

Using Google Earth and Street View, snapshots from the highest and lowest canopy areas are shown below. Road names in the area with the highest canopy cover, TQ2593, provide a clue to planting density. The area includes “The Oaks”, “Woodside Park Road”, “Lime Avenue”, “Woodside Avenue”, “Green Bank”, “Little Cedars” etc.

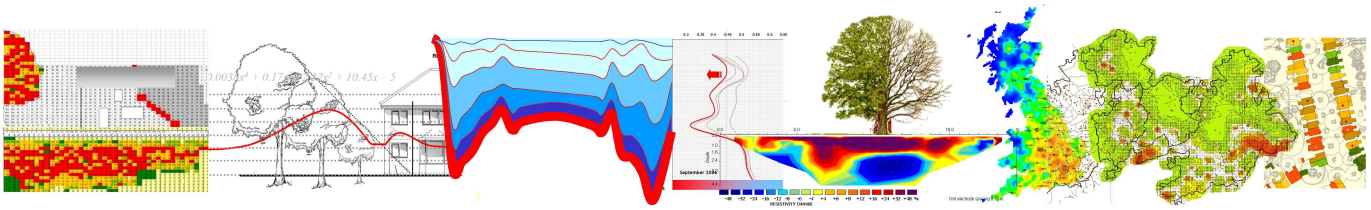
Woodside Avenue

Woodside Park Road

In contrast, below, views from the areas with least canopy cover in the study, situated in OS Tile 2917 and just to the north east of Cockfosters, bordered by Potters Bar to the north west and Cheshunt to the north east.

Woodside Avenue

Woodside Grange Road



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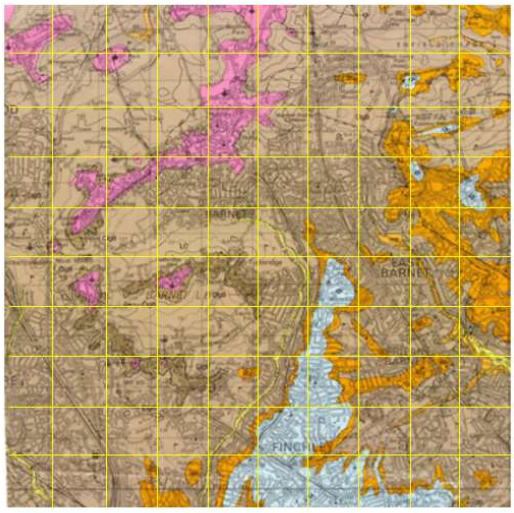
Measuring Tree Canopy Area in London *... continued*

The heat map (below, left) plots the OS tiles by canopy cover corresponding to the percentage values on page 3. The image allows quick visual comparisons with the underlying geology and urbanisation over wide areas.

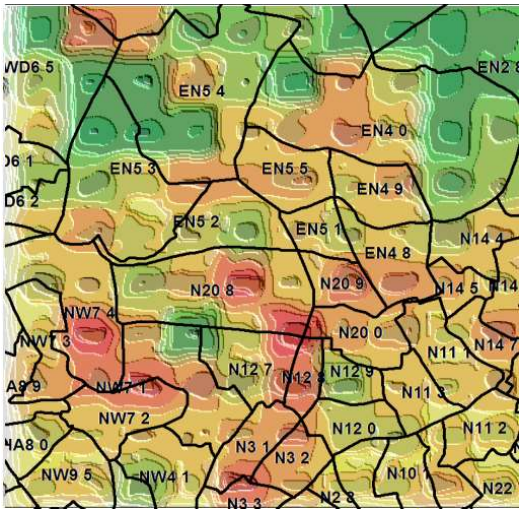
OS GRID - TILE TQ29

	0	1	2	3	4	5	6	7	8	9
9	3.7	28.14	24.99	7.28	8.9	11.86	4.7	3.71	3.4	5.2
8	13.7	4.34	4.86	22.9	11	4.16	25.7	14.76	3.4	5.6
7	17.99	3.38	3.65	4	20	23.17	26.38	19.86	3.8	10.5
6	11.2	10.5	17.24	25.58	24	23.65	18.36	24.64	7.63	12
5	19.56	24.73	17.11	16.19	10.9	20.8	14.8	20.33	13.67	21.3
4	15.56	20.97	12.37	22.89	32.19	20.5	28.8	26.84	24	19.6
3	18.7	33.45	23.73	5.64	17.01	35.63	24	22.96	18.4	26.3
2	23.9	27.72	31.64	26.58	15.47	30.17	11	20.7	19.6	21.6
1	16.3	19.13	21.3	21.26	23.29	27.14	15.9	15.5	17.9	17.9
0	17	19.72	10.8	17	30.71	23.4	18.17	17.7	22.2	18.4

Underlying Geology
BGS 1:50,000 Scale



Light green tiles have comparatively low areas of canopy cover. Darker orange indicates areas with canopy cover exceeding 25%.

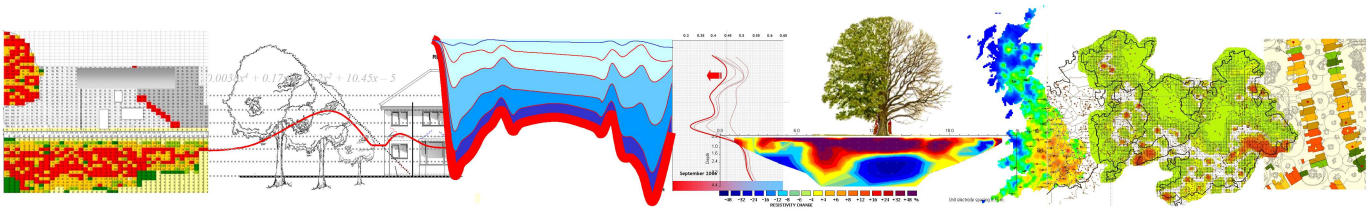


Left, data displayed on a postcode sector map showing the distortions associated with averaging over wider areas.

Canopy cover exceeding 25% can be seen in areas of postcode sectors N20 8, N20 9, NW7 4 etc.

Areas with canopy cover below 14% are located in postcode sectors EN2 8, EN5 4 and elsewhere. Many sectors have a range of values, as would be expected.

The OS grid provides the more granular output.



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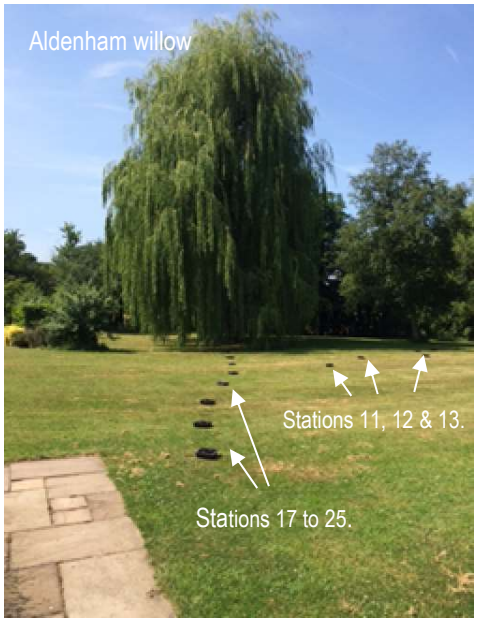
Aldenham Research Site Update



The Aldenham level stations were originally installed by MatLab Limited in 2006. Each of the ground rods has a clay pot and stainless-steel cover to protect it.

On the last visit to site to take level readings, Fran O'Neill from GeoServ Limited reported damage to some of the covers.

Inevitably, over time the covers have suffered some damage as a result of seasonal root induced ground movement (70mm annually in some instances) and lawn mowing etc.

Following a call to Harvey Hunt, the owner of Optera Limited, their Technical Manager, Chris White, visited site and carried out the necessary reinstatement.

New assemblies and covers have now been fitted, and the site left clean and tidy – see above.

Our thanks to Hugh Bailey and James Fowler from Aldenham school for allowing access, Fran from GeoServ for reporting the damage and Harvey and Chris from Optera Ltd., for arranging reinstatement.

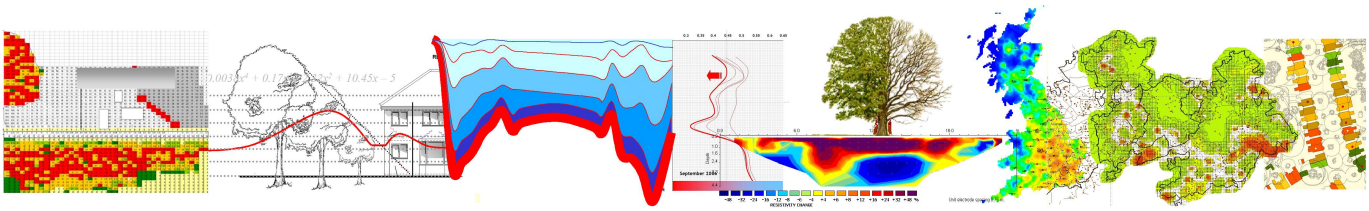
The next set of readings may need adjustment to take account of this maintenance.

Our thanks to …

Aldenham SCHOOL

optera STRUCTURAL SOLUTIONS

GEO-SERV



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TDAG Discussion Document

The Tree Design Action Group (TDAG) discussion document has generated interest in the subsidence community and last month's newsletter included feedback from several recognised experts.

One of the items TDAG are discussing is whether it would be a good idea to require developers building houses on clay soil to incorporate a piled foundation that would cater for future tree planting.

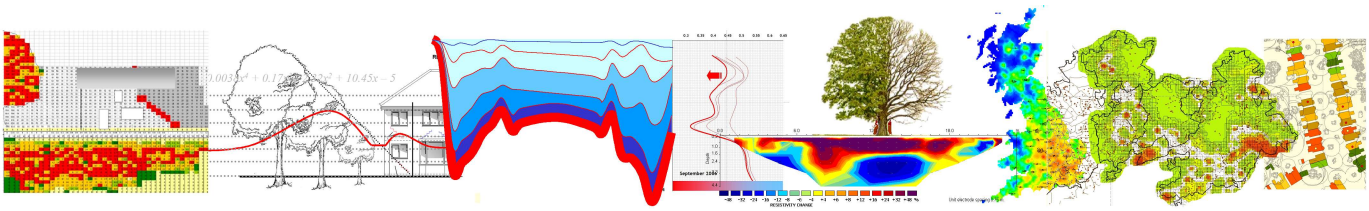
As the species and location would be unknown at the time of construction any foundation design would have to be based on a high-risk species. There would for example be little financial benefit in installing such a foundation to cope with the planting of say a silver birch, conifer or privet hedge. Based on an analysis of claims data, 30% of root induced subsidence involve conifers, privet hedges and so forth with little value. Only 2% (3.2 trees from our sample of 160 trees) would be plane trees. The real cost of saving each plane tree might be regarded as disproportionate.

The question arises, how many trees, how close to houses do homeowners want? As pointed out by one of the expert contributors in last month's edition of the CRG newsletter, branch and leaf fall, access to natural light, loss of garden, reduced flower planting area, damaged patios and drives may reduce the eagerness to have a few oaks, a willow and ash tree canopies overhanging the roof.

Is the proposal any different to the NHBC guidelines on foundation depths when building near to trees, or where trees have been removed prior to development? The adoption of the NHBC recommended depths for foundations in clay soils taking account of vegetation has delivered a measurable improvement in reducing the number of subsidence/heave claims. What's the difference – why would anyone object to protecting the home from future risk? Particularly in high risk areas.

The major beneficiary would be the environment and in terms of cost savings, local authorities in terms of claims in nuisance relating to damage caused by trees in their ownership. Homeowners purchasing new properties would fund that saving. It might be regarded as a disproportionate method of funding amounting to a geology/tree tax.

The drawbacks of improving foundations for new houses? Social housing and purchasers of new homes on clay soils are the losers.



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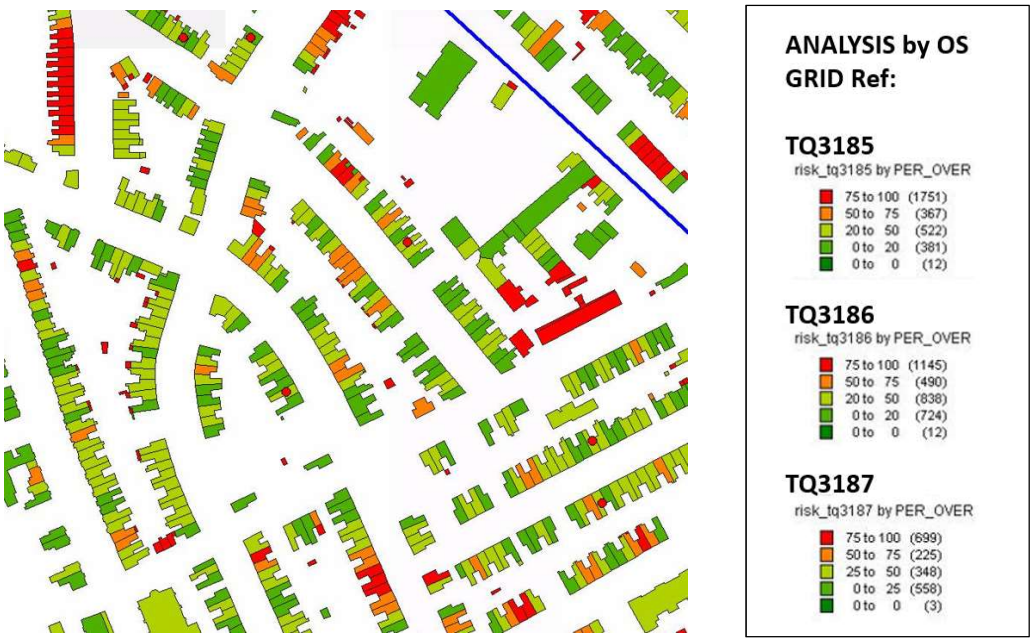
TDAG Discussion Document … *continued*

Insurers? They derive income from providing protection from risk of damage by unforeseen events. They would lose revenue from premium income and reduce losses in high risk areas. Probably cost neutral, depending on the year and climate. In fact, they may benefit as costs associated with root induced clay shrinkage claims are higher than for 'other' perils.

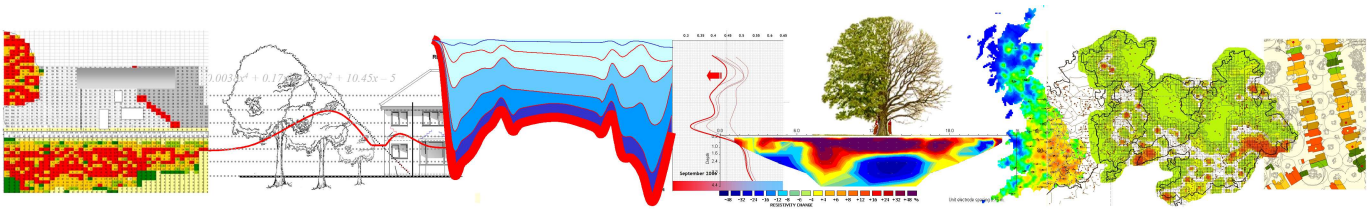
Developers simply want access to land. A recent article in the Times reported that Persimmon homes are pressing for a review of the Green Belt, and particularly in the south east. They say "If that review isn't undertaken there are a lot of areas that will not and cannot meet their local housing requirements."

TDAG – wider area analysis

Last month's issue contained a random snapshot of an area in north west London, plotting the exposure of individual houses within influencing distance of vegetation using the modelled root zone. Below, an illustration of the percentages by Ordnance Survey grid for a different area. How many houses per tile, on clay soil, are at risk?



By modelling root zone overlap as above, tree planting layouts might better directed using a "Select species from drop down menu" and "drag and drop to location", style of input. Plans for new developments might use the technique, and tree planting could become a matter for Town Planners with a tweak to the legislation.



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TDAG – wider area analysis *... continued*

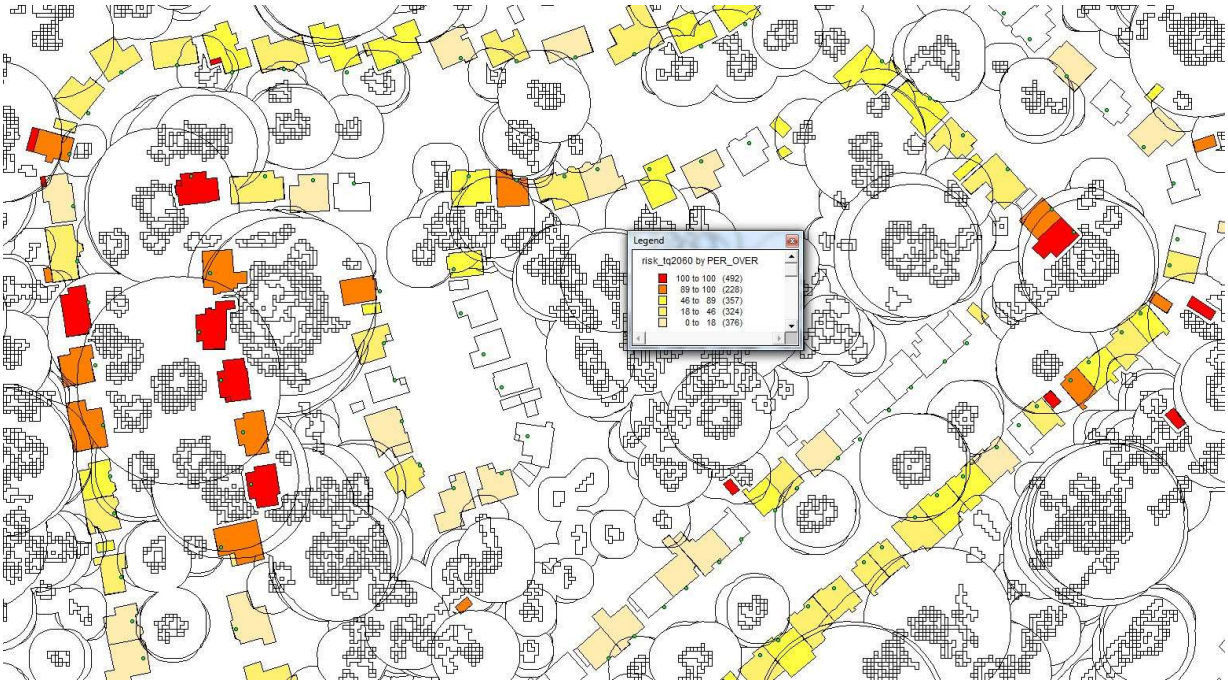
Totalling the figures in the right-hand table from the previous page delivers the following:

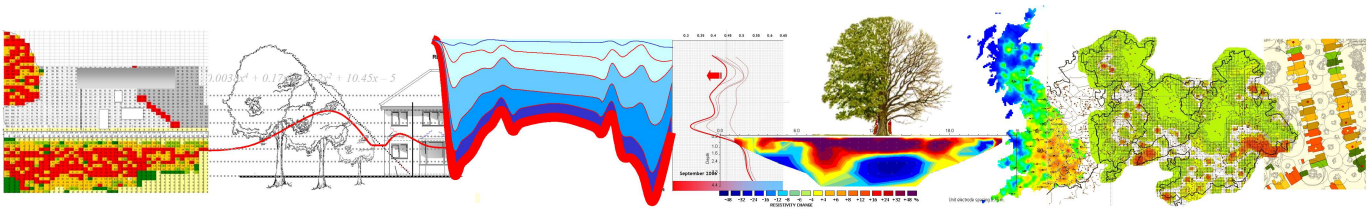
% Root Olap	TQ3186	TQ3185	TQ3187	TOTAL	%
0	12	12	3	27	0%
0 - 20%	724	381	558	1663	21%
20 - 50%	838	522	348	1708	21%
50 - 75%	490	367	225	1082	13%
75 - 100%	1145	1751	699	3595	45%

A table showing the results of the analysis of modelled root overlap based on tree height. It has a number of limitations outlined in the body text below, but forms the starting point to evaluate the TDAG proposals in the previous edition.

The sample from mature housing stock reveal a high proportion – 45% - have modelled root zone overlap of between 75 – 100%. Of course, this is a model and does not take account of significant variations between species, maintenance regimes, canopy density or environment – paving, grass cover etc.

Below, a snapshot of a small area within OS tile TQ 2060. Around 22% of the properties fall outside the zone of any root influence of trees taller than 4mtrs.





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Trees in the news …

Celebrity Trees

Bill Oddie, Daniel Craig, Rachel Weisz and Bill Nighy have been joined by Dame Joan Bakewell on the list of celebrities whose homes have suffered damage as a result of root induced clay shrinkage.

Apparently, her home in Primrose Hill, Camden, suffered damage in 1990 and insurers underpinning the whole house at a cost of £70,000 (1991 prices – the cost today would be over £145,000). It was agreed at the time that the tree should be maintained regularly – which it has been.

A recent application by a property management company to have the tree felled is being met with fierce resistance by some locals, including Dame Joan who is reported as saying the tree "is fine and flourishing, a thing of considerable beauty. Each spring it comes into pale green leaf and thereafter casts sunlit shadows on surrounding gardens. In the autumn it carpets my garden with golden leaves. One day it will begin to die naturally, but that day is not yet."

She is concerned that chopping it down would destabilise the nearby houses.

Camden are considering the application.

Council Trees

Bristol Council have confirmed that their street tree management budget is to be cut from £187,000 to £53,000. They have 16,000 street trees under their control and the question is, can one arborist possibly manage them, and if so, can it be done safely?

From a subsidence point of view, claims in the Bristol area tend to have a 50/50 split between clay shrinkage and escape of water. The absence of regular maintenance might lead to an increase in root induced clay shrinkage claims and a reduction the defence put forward of regular maintenance.

In contrast, Sheffield Council have begun a tree felling programme on the grounds that trees damage pavements.

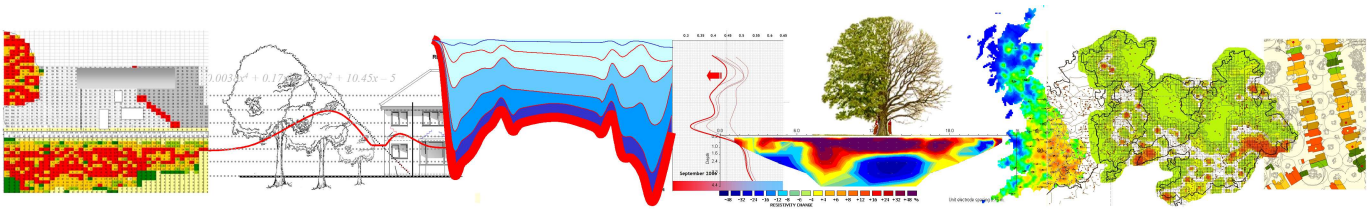
Reports in the press record 300 trees felled in a week. Not an area where root induced clay shrinkage claims predominate, so neutral for insurers beyond the environmental concerns.

Tranquillity Formula

Most publications on trees point to the benefits of greenery. Local cooling, cleaning the air of pollutants, cheering up pensioners, shielding us from rainfall, reducing noise, longevity etc.

Now we have a formula to calculate the tranquillity index. Researchers from the University of Bradford have developed the Tranquillity Rating Prediction Tool (TRAPT).

https://www.researchgate.net/publication/281400420_Tranquillity_rating_prediction_tool_TRAPT



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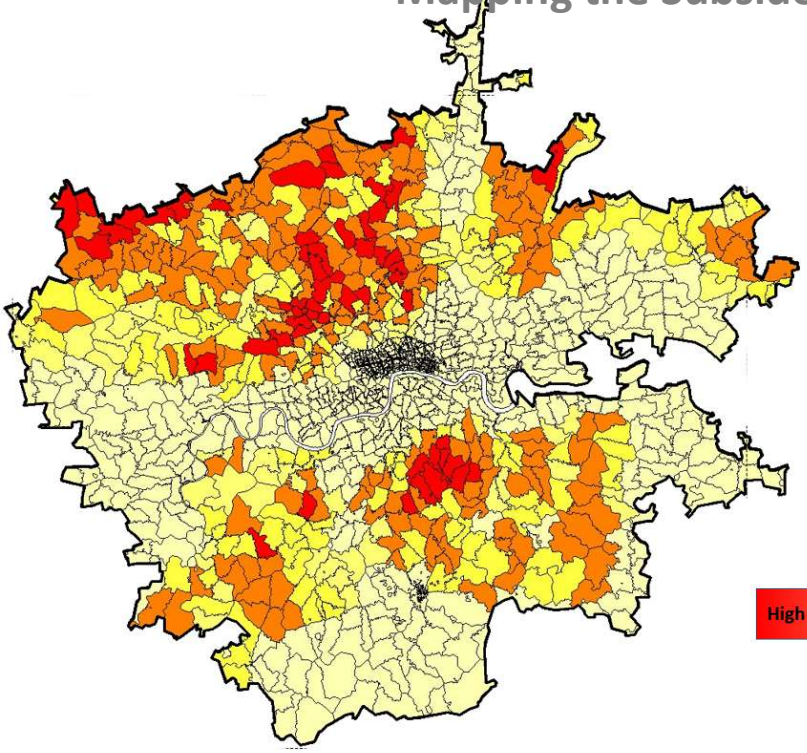
Mapping the Subsidence Risk



Sector Claim Frequency

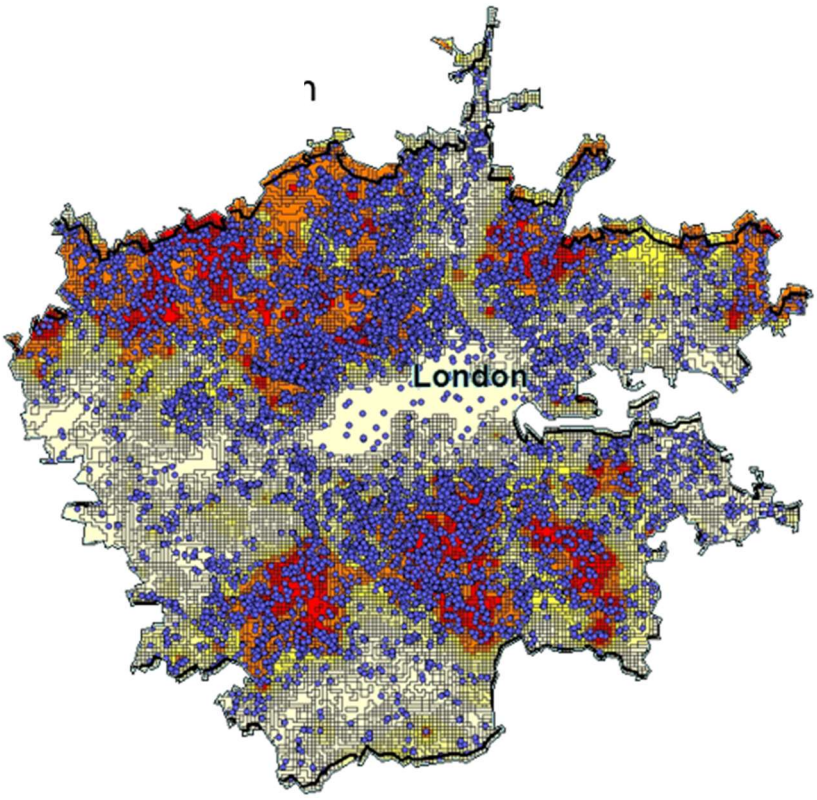
Postcode sector map with high risk subsidence claim frequencies shaded red.

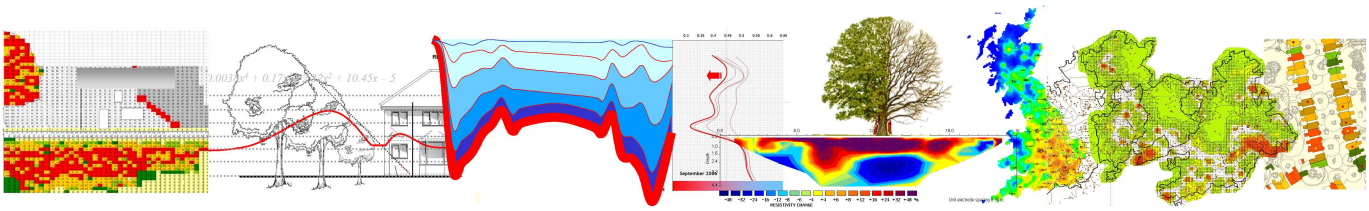
The higher frequency plot corresponds to the outcropping London clay series, revealing the close link between subsidence claims and geology. See maps in previous editions.

Claim Distribution

Right, plotting a sample of claims by full postcode onto the CRG map of geology derived from site investigations undertaken.

The relative density of claims on the clay belt (shaded orange and red) illustrates the risk relative to the primarily EoW claims on the 'non-clay' geology, shaded yellow.





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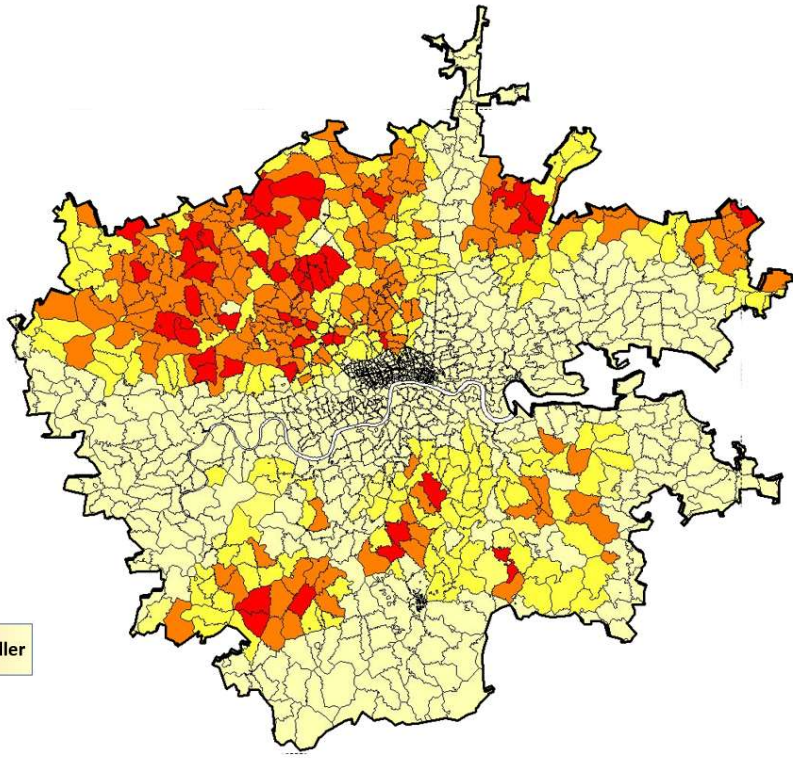
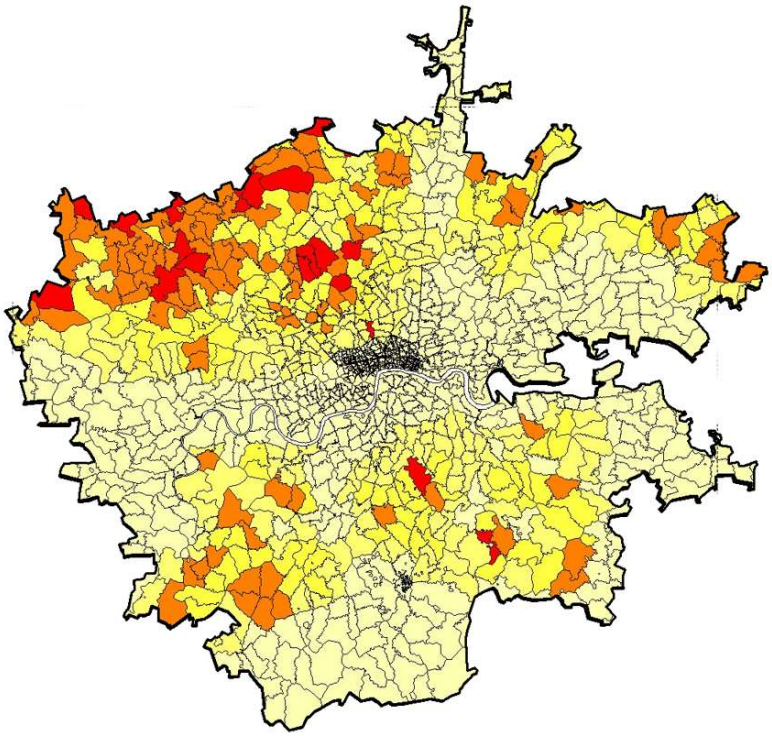
Public Trees

Distribution of trees in public ownership, by height, on clay soils and within influencing distance of a building.



Taller — Intermediate — Smaller



Private Trees

Distribution of trees in private ownership, by height, on clay soils and within influencing distance of a building.

Note: these maps do not include trees on non-clay soils and only include trees exceeding 4m in height.