ARBORICULTURAL CONSULTANTS

REPORT ON ARBORICULTURAL IMPLICATIONS OF SUBSIDENCE

INVESTIGATION AT

42 ELSWORTHY ROAD,
LONDON,
NW3 3DL.

REF: B1507326

PREPARED FOR

GAB ROBINS UK LTD
BUILDING SERVICES
1ST FLOOR,
REGENT HOUSE,
HUBERT ROAD,
BRENTWOOD,
ESSEX CM14 4JE

By

ARBORICULTURAL SOLUTIONS LLP.

13TH JUNE 2015

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REPORT ON ARBORICULTURAL IMPLICATIONS OF SUBSIDENCE INVESTIGATION AT 42 ELSWORTHY ROAD, LONDON, NW3 3DL.

REF: B1507326

1. Introduction

1.1. Instructions

1.1.1. We are instructed by GAB Robins Building Services of 1st floor, Regent house, Hubert Road, Brentwood, Essex CM14 4JE on behalf of AXA Insurance, to visit the above premises and report on trees within influencing distance of the front of the property, more particularly, to consider the possible effects of tree root action on the sub-soil beneath the foundations. We are instructed to make recommendations to minimize any threat where appropriate.

1.2. Background Information

1.2.1. Damage of a type normally associated with foundation movement has been noted internally in the main house and in the hallway over the door in the rear part of the house. Insurers were advised and, as a result, appropriate investigations were put in hand.

1.2.2. In this respect we confirm sight of:

- Site Investigations by CET Safehouse dated 8th May 2015.
- Root identification letter from EPSL dated 13th May 2015.

1.3. Drawings

1.3.1. Drawings showing trial pit locations were provided with the report by CET this has been amended to show the tree locations and is appended to this report.

2. Summary of Investigations to Date

2.1. General

2.1.1. Data considered relevant has been taken from the documents detailed above.

2.2. Foundations

2.2.1. Results from trial pit 1 noted the footings of the property to be 225mm brick on a concrete base founded at 995mm below ground level with a step of 180mm.

2.3. Root identification

2.3.1. Root samples were taken from trial pit / borehole 1. Roots of between 1.0 and 1.5mm diameter were sampled from the underside of the foundation and to a depth of 2.2 metres. These were identified as being *Cedrus* and *Platanus.* All the roots sampled tested positive for starch indicating that they were recently alive at the time of sampling.

2.3.2. Surveyor's notes for TP1 recorded numerous roots of live and dead appearance of 3mm diameter in the made ground to 0.6 metres depth and numerous roots of live and dead appearance of 1 to 1.5mm diameter to 2.2 metres depth. No roots were recorded below 2.2 metres.

2.4. Soil plasticity

2.4.1. Samples from the borehole 1 subjected to laboratory analysis showed soils with Plasticity Indices of 51 to 54%. These figures indicate soils of high shrinkage potential.

2.4.2. The surveyor's notes recorded made ground to 0.6 metres depth with the property founded on firm mid-brown orange grey veined silty clay with partings of orange silt and fine sand to 1.6 metres depth. Between 1.6 metres and 3 metres the ground is described as stiff mid-brown orange grey veined silty clay with partings of orange silt and fine sand and occasional crystals.

2.4.3. The bore hole was terminated at 3 metres depth.

2.5. Soil desiccation

2.5.1. Samples recovered from Borehole 1 were tested, the Attenberg Limits were determined for three samples taken at underside of foundation (0.99 metres), 2.0 and 3.0 metre depths. The results from samples at 2.0 metres depth were found to be close to onset of significant desiccation.

3. Report on Site Inspection

3.1. General

3.1.1. The site was visited by our representative, Fiona Critchley B.Sc. (Sp Hons), RFS (Cert Arb), F. Arbor. A. on 11th June 2015. Appropriate measurements were taken and a risk assessment carried out. Weather conditions were sunny with light winds.

3.2. Disclosure of Interests.

3.2.1. We have no connections with any of the parties involved in this case which could influence the opinions expressed in this report.

3.3. Trees and Other Vegetation

3.3.1. A number of trees were identified within the gardens to the side and rear of the property. Data on these trees is included in Appendix 1.

3.3.2. The information contained in this report covers only those trees that were examined, and reflects the condition of these specimens at the time of inspection. No samples of wood, roots, or soils were taken for analysis.

3.3.3. As the inspection was visual only, no guarantee, either expressed or implied, of the internal condition of the wood of the tree can be given? Furthermore, no warranty that problems or deficiencies may not arise in the future can be given.

3.4 Tree Preservation Orders and Conservation Areas

3.4.1. The Town and Country Planning (Tree Preservation) (England) Regulations 2012 allows for trees either as groups, or individuals, or as woodlands, to be protected by Tree Preservation Orders (TPO). These have the effect of preventing the cutting down, topping, lopping, uprooting, wilful damage or wilful destruction of trees except in certain circumstances, other than with the consent of the local planning authority.

3.4.2. A Conservation Area is an area designated by the Local Planning Authority as one of "special architectural or historic interest, the character or appearance of which it is desirable to reserve or enhance". Special controls exist with regard to demolition and alteration of buildings; Listed Building Consent must also be obtained for any demolition, even if the building is not itself listed. Similarly, trees are given some protection with the requirement for the local authority to be given six weeks written notice before carrying out any work on trees; this gives the authority time to decide if a TPO is necessary.

3.4.3. The property lies within Elsworthy Conservation Area. London Borough of Camden has confirmed that the London Plane tree (tree 3 of this report) is the subject of a TPO reference 32H-T70.

3.5 Site Specific Observations

3.5.1. 42 Elsworthy Road is a detached residential property. The property was constructed circa 1870. It is brick built under a pitched slate roof. There is a four storey bay window to the front elevation and a three storey bay window to the rear elevation. 42 ½ Elsworthy Road consists of a two storey annexe with conservatory and a single storey extension.

3.5.2. The house is approximately southeast facing and constructed on an approximately level plot of land. The garden area wraps around the west and north sides. It is mainly patio and lawn areas around the house with mature shrub beds and trees towards the perimeters.

3.6 Visual Inspection of Damage

3.6.1. The following should not be construed as comments on the structural integrity of the property and it should be noted that I am not professionally qualified to comment on the mechanical effects of movement on any building.

3.6.2. The external damage noted was mainly cracking around the ground floor rear elevation windows. We are informed that the main area of damage is internal towards the rear part of the five storey section of the house and incudes movement in the hallway over the lounge door.

4. Discussion

4.1. Trees and clay soils

4.1.1. Soils lose moisture by natural evaporative processes during the summer, and it is generally accepted that in average climatic seasons, the loss will be to depths of approximately 1.0m. It is for this reason that house foundations are recommended to be at depths of at least 900mm below ground level so they are at or below the level where natural seasonal moisture loss will have an influence on soil shrinkage.

4.1.2. In conditions of drought the degree of moisture loss will extend to far greater distances, often more than 1.5m producing conditions that may lead to movement of the foundations.

4.1.3. The hot dry Summer conditions of 2003, 2004 and 2006 and the dry Autumn and Winter conditions of 2009/2010 are generally considered to have given rise to an increased number of claims for subsidence damage and do not represent the expected average summer temperatures and rainfall.

4.1.4. Much of the published data regarding the role of different tree species In cases of subsidence damage to buildings and the distance from the building is taken from The Kew Root Survey 1989 by Cutler & Richardson.

4.1.5. However, Gasson PE & Cutler DF 1998 in a paper published in the Arboricultural Journal, noted ""There is increasing concern that data on tree root spread in 'Tree Roots and Buildings' (Cutler and Richardson, 1989) are open to misinterpretation by insurers, home owners and arboriculturists. Insurers have tended to use maximum root spread figures, which we believe to be statistically and biologically unsound."

4.1.6. They note that the maximum distance between tree and damage is statistically unlikely to happen with any regularity. Their conclusion suggests that very different figures are appropriate as safe distance - in general the distance which includes 75% of damage attributed to a particular species. For smaller species the 50% boundary is more appropriate whilst for particularly large growing species the 90% figure is sufficiently cautious.

5. Potential influence of species present

The following descriptions refer to only those trees considered to be within potential influencing distance of the front of the property.

5.1. Tree 1 – Honey Locust (*Gleditsia spp.)*

5.1.1. *Gleditsia* species is considered by a number of authorities as being of low water demand and moderately deep rooted on clay soils, growth rate is medium under good conditions. Young trees tolerate heavy pruning and old trees only light pruning.

5.1.2. Cutler & Richardson 1989 note that the maximum tree to damage distance involving *Gleditsia* species was 15 metres, however this data is based on only one sample.

5.1.3. Tree 1 is planted at 4.6 metres from the nearest point of the annexe building. Published data indicates that this tree is within the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil. This tree is early mature in age and has the capacity to significantly increase in size if not managed by crown pruning.

5.2. Tree 3 – London Plane (*Platanus spp.)*

5.2.1. London plane (*Platanus* species) are recognised by a number of authorities as being of moderate water demand and moderately deep-rooted on clay soils. They can grow fast in good conditions and have a life expectancy well in excess of 100 years. Both young and old trees will tolerate heavy pruning and crown reduction.

5.2.2. Planes are predominately used as street trees. The Kew Root data (Cutler & Richardson 1989) noted that the distances at which a high proportion of reported damage occurred was short, 50% of cases of damage occurred with a tree closer than 5.5 metres, which probably reflects the average combined pavement and front garden measurements. Cutler &

Richardson 1989 note that the maximum tree to damage distance involving London plane was 15 metres, in 90% of reported cases the tree was closer than 10 metres and in 50% of cases the tree was within 5.5 metres.

5.2.3. Tree 3 is planted close to the property boundary on the Lower Merton Rise frontage at a distance of 11 metres from the nearest point of the annexe. Published data indicates that this tree is towards the periphery of the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil. Live roots of this species were recovered and identified in the site investigations.

5.3. Tree 4 – Blue Atlantic Cedar (*Cedrus spp.)*

5.3.1. Data on the rooting characteristics of Cedars is limited due to infrequent street planting, however, the proportion of conifers reported to have damaged buildings in relation to all trees is low. Cedars are noted by National House Building Council to be of moderate water demand (NHBC Standards Chapter 4.2 Building near Trees April 2003.

5.3.2. NHBC Standards Chapter 4.2 Building near trees notes that for moderate water demand conifers planted over 6 metres from the property and standing less than 16 metres in height there are no special requirements for foundation design and a minimum foundation depth of 1 metres can be used.

5.3.3. Tree 4 is planted 6.2 from the rear elevation of 42 Elsworthy Road. Published data indicates that this tree is towards the periphery of the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil. Live roots of this species were recovered and identified in the site investigations. This tree is early mature in age and has the capacity to significantly increase in size if not managed by crown pruning.

5.4. Tree 6 – Père David's Maple (*Acer spp.)*

5.4.1. Data on the rooting characteristics of Père David's Maple is limited due to infrequent street planting and much of the data is based on the larger growing species (Sycamore and Norway Maple). *Acer* species are recognised by a number of authorities as being of moderate water demand and large *Acer* species are deep rooting on clay soils. Life expectancy can exceed 100 years. Both young and old trees tolerate heavy pruning and crown reduction. Young trees tolerate heavy pruning and old trees only light pruning. Père David's Maple is a smaller growing species than Sycamore generally attaining heights of up to 15 metres in the UK.

5.4.2. Cutler & Richardson 1989 noted that the maximum tree to damage distance recorded for *Acer* species was 20 metres, and in 90% of cases the tree was closer than 12 metres; in 50% of cases the tree was closer than 6 metres.

5.4.3. Tree 6 is planted at 11.6 metres from the rear elevation of 42 Elsworthy

Road. Published data indicates that this tree is at the periphery of the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil.

5.5. Group 8 – Himalayan Birch (*Betula spp.)*

5.5.1. Birch trees are recognised by a number of authorities as being of low water demand. Growth rate is medium in good conditions. Life expectancy is between 50 and 100 years.

5.5.2. Cutler & Richardson 1989 note that the maximum tree to damage distance involving Birch was 10 metres, and in 90% of reported cases the tree was closer than 8 metres.

5.5.3. Group 8 includes three Birch trees the closest planted at 6.8 metres from the rear elevation of 42 Elsworthy Road. Published data indicates that this group of trees is within the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil. These trees are early mature in age and have the capacity to increase in size if not managed by crown pruning.

5.6. Tree 9 – Cherry Laurel (*Prunus spp.)*

5.6.1. Common laurel (*Prunus laurocerasus*) are generally classified as a shrub species. There is limited data on the rooting structure and water demand of Common laurel as *Prunus* species cannot be distinguished from each other on root structure alone.

5.6.2. Laurel is recognised by a number of authorities as being of moderate water demand. Cutler & Richardson 1989 note that *Prunus* species are shallow to moderately deep rooted on clay soils, but that shrubs are often shallower rooted and have a less vigorous root system.

5.6.3. Tree 9 is planted at a distance of 1 metre from the rear elevation of 42 Elsworthy Road and is considered to be within the theoretical zone of influence for the roots to potentially have a detrimental effect on the foundations due to the extraction of water from the soil.

5.7. Other vegetation

5.7.1. 42 Elsworthy Road occupies a corner plot on the junction of Elsworthy Road and Lower Merton Rise with mature landscaped gardens wrapping around the side and rear elevations.

5.7.2. It is difficult to assess the contribution of shrubs when grown together with larger trees but it should be noted that groups of shrubs can dry soils considerably and so will contribute to localised soil drying. In addition, the dense crowns are likely to restrict the infiltration of rainwater around the foundation of the property.

6. Tree management

6.1. Options

6.1.1. Where trees or shrubs have been implicated in, or are suspected to have contributed to, or have the potential to cause foundation damage, there are two alternatives open to the tree owner: either removal of the plant to prevent further water demand, or management of the crown to reduce water demand. (By restricting leaf area available for transpirational water loss to the atmosphere.)

6.2. Felling

6.2.1. In considering this option, the age of the trees vis-à-vis the damaged structure must be assessed. Removal of a tree whose root system was occupying land prior to construction of a building may, if there is deep-seated and persistent desiccation, result in a re-wetting of the underlying soil to a volume greater than it held at the time of construction. This is known as 'soil heave' and can seriously damage foundations.

6.3. Crown Management

6.3.1. Crown management aimed at reducing a tree's water demand may be considered where building movements are mainly seasonal – indicating that the soil moisture deficit is not persistent, or where the soil moisture deficit is slight and likely to be rectified by water inputs (such as rainfall) over a comparatively short period of time. However, research shows that pruning does not permanently reduce soil water uptake. Many trees are able to quickly regenerate new leaves, and leaves remaining following pruning can increase their rate of transpiration.

6.3.2. In some cases water uptake can recover to pre-pruning levels within weeks. Only a regular pruning regime, carried out at short intervals, and over an extended period of time, can significantly reduce the long-term water uptake of trees.

6.3.3. The following criteria are also useful in assessing the potential efficacy of this type of management:

- That building foundation depth is sufficiently deep to cope with the decreased water demand resultant on pruning.
- That the foundations are close to the existing outer sphere of root influence.
- That the amenity value of the tree is considered adequate following pruning.
- That the tree is amenable to such treatment.
- Structural movement is mainly seasonal

6.3.4. In this instance, the size of the trees close to the building indicates that trees 1, 2 and 4 to 9 were planted after the property was constructed. It is considered likely that tree 3 (London Plane) was planted around the time the main house was constructed and significantly pre-dates the construction of the annexe (42 ½ Elsworthy Road).

6.3.5. Any risk of ground recovery must be a matter for the expertise of a structural engineer; however, from observations and reading of available information we feel that the danger of structural damage or heave consequent on soil recovery should not be a significant one, and that trees 1, 2 and 4 to 9 and other vegetation could therefore be removed if necessary. However, we feel that the danger of structural damage or heave consequent on soil recovery if tree 3 were to be removed may be significant and that the removal of tree 3 may result in further damage.

6.4. CAVAT Evaluation Tree 3 – London Plane

6.4.1. The Town and Country Planning Act 1990 (section 198) itself does not specify how amenity is to be assessed, leaving it open for the value of trees to be expressed in the most appropriate way for the intended purpose, not necessarily in monetary terms. CAVAT is a nationally recognised asset management tool for amenity trees and a means of expressing value in monetary terms in a way that is directly related to the benefits that trees provide.

6.4.2. The full CAVAT assessment is used in situations when a more detailed and precise assessment of the value of trees as individuals is required. In relation to cases of subsidence, according to the Joint Mitigation Protocol the levels of evidence to be submitted in cases involving public trees will be set by reference to a full CAVAT valuation, to be undertaken by the Local Authority. Application of the full CAVAT valuation to Tree 3 produces a final value of £135,161.00.

7. Conclusions

7.1.1. The observed damage is mainly internal and indicates rotational movement at the rear on the western side of the house.

7.1.2. The site investigations have established that the soils around the foundations are of a shrinkable nature. Attenberg Limit testing indicated the onset of desiccation at 2 metres depth.

7.1.3. Numerous roots were sampled within borehole 1, and these were identified as being from both *Cedrus* and *Platanus* species. Examples of both are growing within the gardens of the property. All roots tested were alive at the time of sampling.

7.1.4. The CAVAT evaluation of the London Plane produces a final value of £135,161.00. This reflects the condition of the tree, its appropriateness within the landscape.

7.1.5. We are of the opinion that due to the high value of the London Plane (tree 3) that an engineered solution is the best option however; this is a matter for the engineers and insurers.

8. Recommendations

8.1. Tree 3: London Plane – Reduce crown by 15 % and manage at new smaller size by crown reduction on a three year cycle.

Tree 4: Blue Atlantic Cedar – Fell to ground level and grind out stump.

Tree 5: Laurel – Fell to ground level and grind out stumps.

Trees 1, 7 & 8 – Maintain at existing size by regular light pruning

8.2. General

8.2.1. Following implementation of the arboricultural recommendations detailed above, a period should be allowed for soil recovery, during which time the building should be monitored. Once it is felt that an acceptable degree of structural stability has been achieved, appropriate repairs should be put in hand. It is advised that monitoring (following repairs) be carried on over a full growing season to confirm that the measures are succeeding and whether additional vegetation management will be necessary.

8.3. Arboricultural Standards.

8.3.1. Implementation of works: Any tree works should be done in accordance with the British Standard Recommendations for Tree work, BS 3998 as modified by later research. Works should be undertaken by properly qualified and experienced tree contracting company as recommended by a local authority or one approved by the Arboricultural Association. A Register of Contractors is available from The Arboricultural Association. The Arboricultural Association The Malthouse, Stroud Green, Standish, Stonehouse, Gloucestershire GL10 3DL, UKTel +44 (0) 1242 522152 Fax +44 (0) 1242 577766 Email: admin@trees.org.uk.

8.3.2. Statutory wildlife implications: Wildlife in this country is afforded protection under the Wildlife and Countryside Act 1981 as amended by the Countryside and Rights of Way Act 2000. Statutory protection is given to birds, bats and other species that inhabit trees. Tree work is governed by these statutes and advice should be sought from an ecologist before undertaking any works that may constitute an offence.

Report by: Fiona Critchley B.Sc. (sp. Hons), RFS (Cert Arb), Arbor. A. Tech Cert., F. Arbor. A.

Checked by: G. M. Causey B. Sc. (Hons), RFS (Cert. Arb), F. Arbor

Appendix 1: Tree Data – 42 ½ Elsworthy Road NW3 3DL.

Tree No.	Species	Height (m)	Crown Radius (m)	DBH (mm)	Distance to Nearest Point of Building (m)	Age Class	Vigour	Comments	Recommended Works
1	Honey Locust	9	3	240	4.6	EM	Normal	Bark wounds on surface roots. Previously crown reduced.	Maintain at existing size
2	Yew	10	6	550	14.2	EM	Normal	Average condition. Unable to inspect stem due to Ivy. Stem divides below 1.5m. Crown becoming sparse. Light deadwood in crown.	
3	London Plane	25	10	1350	11	M	Normal	Re-grown pollard. Root spread restricted. Decay pockets in pruning wounds. Previously crown reduced.	Reduce crown by 15%

4	Atlantic Cedar	15	5	420	6.2	EM	Normal	Average condition. Bark wounds on surface roots.	Fell to ground level & grind out stump
5	Locust Tree	18	6.5	900	19.3	EM	Declinin g	Basal decay present. Soil levels raised around base. Unable to inspect stem due to Ivy. Trunk decay present. Cavity on stem. Stem divides above 1.5m. Dieback in crown. Broken branches in crown. Major deadwood in crown. Previously crown reduced.	
6	Père David's Maple	9	3	180	11.5	EM	Normal	Root spread restricted by boundary wall. Included bark present in main fork. Crown distorted due to group pressure.	
7	Southern beech	7.5	2.5	130	11.2	SM	Normal	Average condition. Exposed roots. Root spread restricted by boundary wall. Crown distorted due to group pressure.	Maintain at existing size

8	Himalayan birch	11	6	250	6.8	EM	Normal	Group of 3 trees. Exposed roots. Included bark present in main fork. Crown distorted due to group pressure.	Maintain at existing size
9	Laurel	4	2	120	1	M	Normal	Multi-stemmed from ground level Recently reduced in height	Fell to ground level & grind out stumps

Appendix 2: References

1. Tree No.

Given in numerical order, commencing at "1".

2. Species

Names given are 'common names' followed by the Latin name.

3. Height.

Measured approximately with the aid of a clinometer, given in millimetres.

4. Crown radius.

Measured approximately with the aid of a tape measure, given in millimetres.

5. Trunk diameter.

Measured at 1.5m above ground level using a diameter tape, given in millimetres. (If access is not possible the trunk diameter will be estimated and noted in the Tree Schedule).

6. Age class.

1. Young
2. Early mature
3. Mature

7. Distance from Structure.

Centre of trunk to nearest face or point of the building, (given in metres) measured using a laser rangefinder.

8. Estimated Safe Life.

Short	Less than 10 years
Medium	10 to 40 years
Long	Over 40 years

9. Vigour.

Based on the species in question

10. Comments.

Comments have been made relating to the following:

- Health or condition of the tree
- Safety of the tree, particularly close to actual or proposed public access
- Aesthetics of the tree where appropriate

11. References

The Kew Root Survey 1989 Cutler & Richardson
National House-Building Council Standards, Chapter 4.2., "Building near trees"
Arboricultural Practice Note 4, "Root Barriers and Building Subsidence" Marshall, Patch & Dobson 1997. *Arboricultural Advisory and Information Service*)
British Standard Recommendations for Tree work BS 3998: 1989
British Standard for Trees in relation to construction BS 5837: 1991
Tree Root Damage to Buildings 1998 P. G. Biddle
Arboriculture Research Note 36 89 TRL Tree Roots & Underground Pipes, G. Brennan, D. Patch & F.R.W. Stevens. 1989

Appendix 3: Legal Protection of Trees

Before work is carried out on any of the trees mentioned in this report, it is essential that the owner satisfy himself as to whether or not they have legal protection. Such protection is summarised briefly below:

Conservation Areas.

Before work is carried out work on any tree over 7.5 centimetres in diameter (measured at 1.5m from ground level), growing in a Conservation Area designated under the Tree Preservation (England) Regulations 2012, the Local Planning Authority must be notified in writing. The Authority then has six weeks to consider the matter during which time Officers may make a Tree Preservation Order in respect of any trees that are the subject of the notification. After the six weeks has expired, if the Authority has made no objection, work can proceed.

Tree Preservation Orders.

Before any work is carried out on a tree which is the subject of a Tree Preservation Order made under the Tree Preservation (England) Regulations 2012, the permission of the Local Planning Authority must be obtained. Such application for permission must generally be by way of a formal Planning Application, which may necessitate consideration by the Planning Committee of the Authority (although many Authorities delegate powers to deal with routine matters to their professional Officers).

There are exceptions to the above broad outlines; however, in the current instance these do not apply.

Appendix 4: Tree Roots on Shrinkable Clay Sub-soils

Certain soils containing high proportions of the montmorillonite or miceaceous clays have the capacity to change in volume according to their water content. This is because water is absorbed into the inside of the clay particles when the soil is wetted and can be withdrawn by various outside factors.

One of the most important ways in which water is withdrawn is as a result of the action of plant roots. Roots extract water from the soil and convey it through the plant to the leaves where at is lost to the atmosphere - a process known as transpiration. All plants do this to varying degrees; even grass extracts considerable quantities of moisture from the soil.

By virtue of their large size, trees have both a large rooting volume from which to extract water, and a large leaf area through which to lose it to the atmosphere. (Note: some trees, however, have developed in such a way as to minimize their water demand).

Problems arise when a tree which has a high water demand is growing on a soil containing a high proportion of shrinkable clay when there is a building close enough to be affected by the changes in soil volume consequent on increase and decreases in the soil water content.

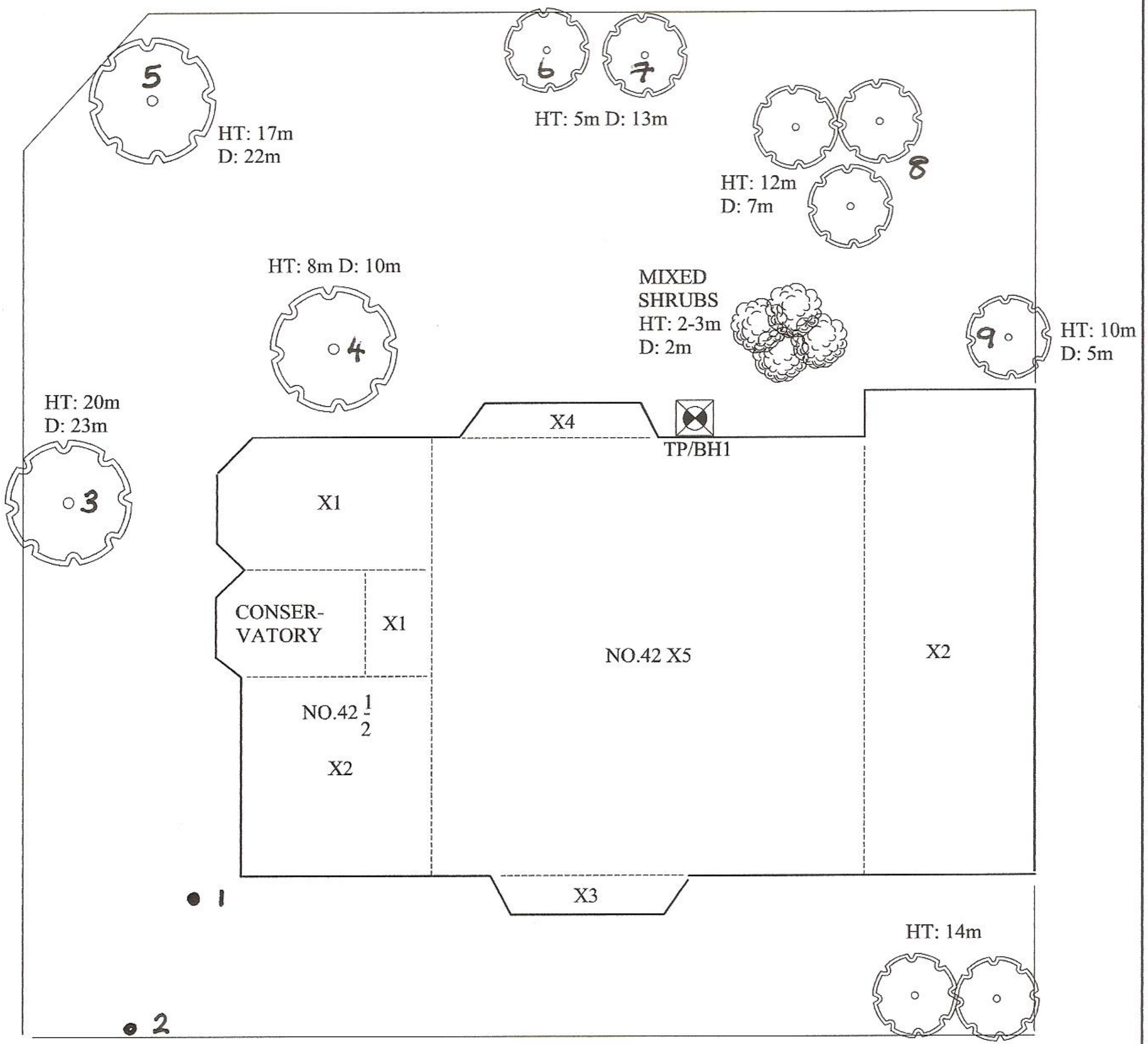
Decreases in volume will lead to a settling effect during dry periods, causing structural damage to buildings in severe cases. This is known as subsidence. Felling the offending tree is not always the simple answer as an established tree may have been desiccating the soil on which a structure stands for many years before building took place. When the tree is felled, the drying stops, the soil re-wets and expands. This may cause a phenomenon known as 'ground heave', which can be very damaging to buildings.

Careful observations and monitoring over a period are often necessary to establish the causes of subsidence or heave in cases where a tree or trees may be implicated. The close proximity of a tree to a building will not necessarily result in structural damage to that building.

In many cases where trees have been implicated in such structural damage, it has been found that the structures had been built on foundations, which were unsuitable for shrinkable clay soils.

Investigation Layout Plan

Sheet: 1 of 1 Job No: 263148 Date: 08/05/2015	Site: 42 Elsworthy Road, NW3	
SP (SI) · SE (Checked) · AR (Drawn)	Weather: DRY	Work carried out for: GAB Robins UK Ltd - BRICS



ON SITE TREE IDENTIFICATION FOR GUIDANCE ONLY. NOT AUTHENTICATED.

Remarks:

Access to rear of 42 is through the side gate of 42 $\frac{1}{2}$

Key:

Combined Gulley	RWWG	Surface Water Drain	– – → – – –
Manhole	MH	Foul Water Drain	——→——
Rain Water Pipe	RWP	Tree / Bush (approx. ht in m)	
Rain Water Gulley	RWG	Trial Pit	
Soil Vent Pipe	SVP	Borehole	
Waste Gulley	WG	O/D - Open Discharge	
Waste Pipe	WP		

Scale: N.T.S.