

Subsidence management Services

ENGINEERING ADDENDUM REPORT

Name of Engineer: David Crean BSc (Hons) MCIOB MRICS

Infront Innovation Reference: IFS-DLG-SUB-13-0044404

Name(s) of property Owners: Mrs E. Potter

Address of Property: 25 Galaxie Road, Waterlooville, Hampshire, PO8 9AT

Date of Report: 15th July 2015

1. Scope of Instructions:

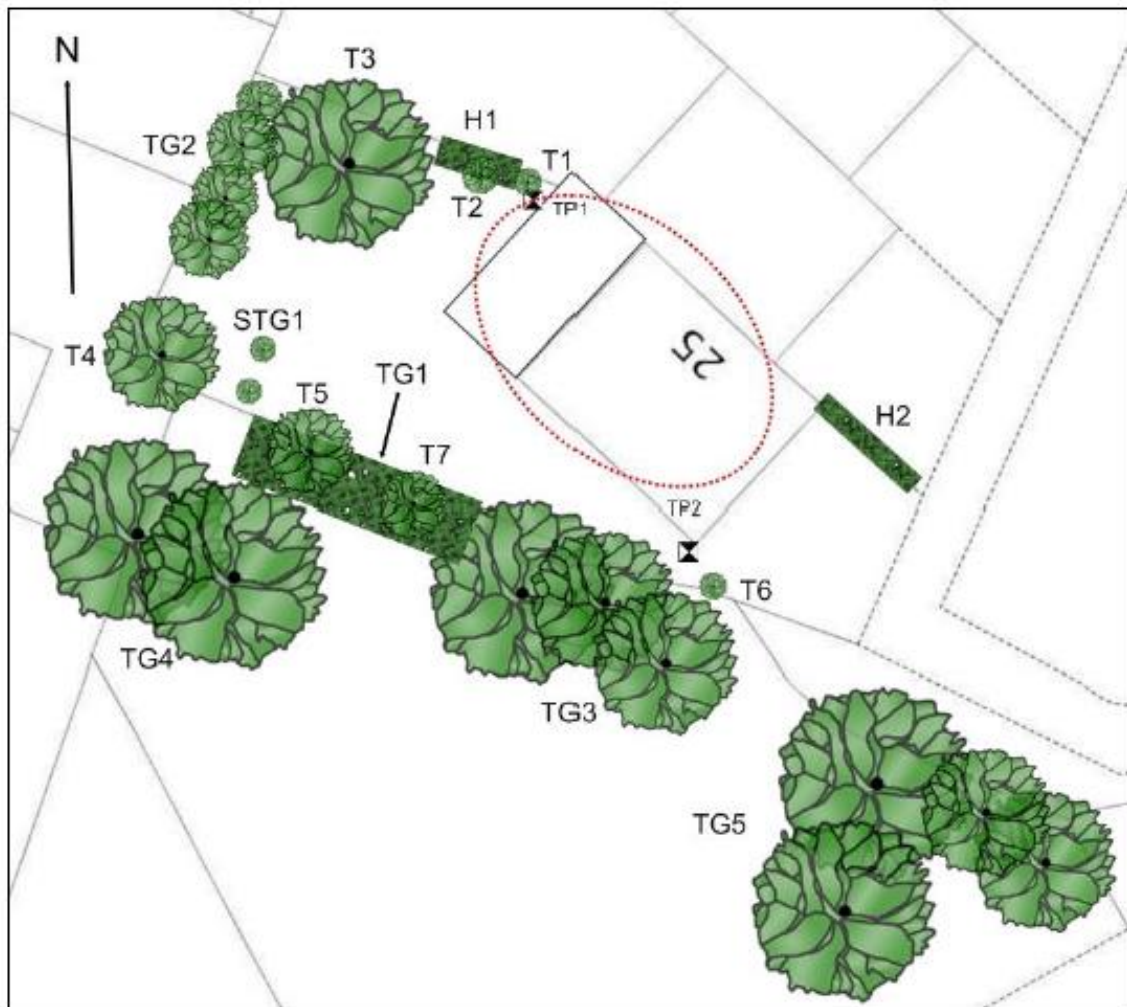
- 1.1. In October 2013 SMS were instructed by Direct Line Group to inspect and report on suspected subsidence damage to the risk address. Upon validating the claim SMS have been project managing the claim.
- 1.2. This report has been prepared to support the Application to remove the Tree Preservation Order so that the implicated vegetation can be removed.
- 1.3. The focus of this report is in relation to the damage and its cause to the area located on the left hand side of the main dwelling. The reason for stating this is due to the fact additional damage was observed to the rear of the conservatory which is related to the influence of vegetation within the Policyholder's own rear garden.
- 1.4. The trees identified for removal in relation to the damage associated with the left hand side of the main dwelling, with reference to the Arboriculturalist Revised Report dated 4th March 2015 (ref: LS/0710131219/JS-REV1) are T1 (cypress -Insured), T2 (ash - Insured) & TG3 (oak x 3 – Third Party trees). It is understood that TG3 has a TPO. For reference the trees (T1 & T3) which were said to be influencing the conservatory were removed in February 2014.

2. Documents Considered

The key documents considered in the report are listed below.

ID	Produced by	Description	Date
1	Spencer Caizley	Engineer's Report	04/10/2013
2	Subsnet UK	Site Investigation Report	30/10/2014
3	Subsnet UK	CCTV Drainage report	13/10/2014
4	Marishal Thompson Group	Arboricultural Report (revised)	04/03/2015
5	Subsnet UK	Level Monitoring	18/05/2015
6	Jose Lopez	Re-visit Report	12/06/2015

Figure 1 – Documents considered



Please note that this plan is not to scale. OS Licence No. 100043218

Figure 2 – Sketch taken from Marishal Thompson Group survey showing location of the principal vegetation in relation to Property

3. History and Background

- 3.1. The property is a two storey semi-detached house of traditional construction with cavity brickwork part clad with timber panels at first floor level. The walls are surmounted by a pitched tile covered roof. The property has 3 bedrooms. The Insured purchased the property in 2008 and the age of construction is circa 1970. The property has an extension to the rear which was constructed prior to the Insured's purchase.
- 3.2. The insured had noticed damage progressing over a period of circa 1 year and prior to notification to Insurers on 24th September 2013.

- 3.3. Site investigations were carried out in October 2013 by Subsnet from which it was concluded that the property had been affected by clay shrinkage subsidence. Marishal Thompson Group have subsequently recommended removal of the Oak trees (reference TG3) at the left hand side of the property which are believed to be the primary influence of the damage to the left hand side of the property.
- 3.4. Tree roots obtained from the boreholes undertaken in October 2013 were subsequently examined by industry experts, EPSL Botanical Identifications and roots obtained between 3.0m and 3.7m below ground level were positively identified as belonging to Quercus spp which are oaks.

4. Description of Damage

- 4.1. The damage present in October 2013 is described in the Engineering Report prepared by Spencer Caizley. Since then it is clear from level monitoring and subsequent engineering revisit reports that the property has suffered seasonal downward movement (particularly to the left hand side elevation) during the drier summer months and subsequent recovery during the wetter winter months. This has impacted upon the structural integrity of the building.
- 4.2. The cracking to the left hand side of the main dwelling is indicative of an episode of subsidence and the pattern of cracking suggests there has been a downward rotational movement towards the left hand side of the property.
- 4.3. Subsidence is characterised by diagonal tapered cracks at the corners of window and door openings and corresponding internal and external damage. In my opinion, the relevant damage described in the Engineering Report has the hallmarks of damage caused by subsidence. The location and nature of the internal cracking present in 2013 indicated that the left hand side of the property was mainly affected. Moreover, the area of damage to the property is consistent with the focal point of the movement being consistent with the radial influence of the oak trees.
- 4.4. Given knowledge of the local area it is considered that the damage to the property is attributable to clay shrinkage subsidence exacerbated by the effects of the nearby vegetation and in particular the oak trees.

5. Evidence of Root Encroachment

- 5.1. A site investigation report was produced in October 2013 by Subsnet UK. The site investigation comprised of two external trial pits/boreholes (TP/BH). TP/BH 1 was located at the rear right corner of the conservatory whilst TP/BH2 was located at the front left corner of the main dwelling. TP/BH2 revealed the house was noted to have a 500mm thick concrete strip footing sitting onto stiff brown gravelly clay at a depth of 1.3 m below ground level.
- 5.2. Roots of live appearance were discovered within the trial pit and borehole to a depth of 3.7m and were later analysed under microscope as belonging to Oak

trees. These roots are consistent with vegetation located to the left hand side of the property identified as TG3 within the Arborist report.

6. Soil Conditions

- 6.1. With reference to the 1:50,000 scale British Geological Survey Map of the area it suggests the drift geology of the site is No drift geology recorded overlying a solid geology of Oldhaven, Blackheath, Woolwich, and Reading and Thanet beds. The suggested soil plasticity is high.
- 6.2. Laboratory tests on the soil samples confirm that the clay is of high/medium plasticity, meaning that the soil has a high/medium shrinkage potential in accordance with chapter 4.2 of the NHBC guidance of building near trees. The soil also appears desiccated when applying industry accepted formula to the Atterberg limit tests.
- 6.3. Oedometer testing of the soil indicates a free surface heave potential of the soil within TP/BH2 to be 0.0 mm which obviously would not form any barrier to prevention of tree removal.
- 6.4. It is universally accepted that moisture contents generally decrease with depth due to the effects of overburden pressure (the weight of soil above squashes the clay below and thus reduces its moisture content). It is expected that a soil with equilibrium moisture content will have a linear reduction in moisture content with depth. The borehole profile (BH2) shows that the moisture content actually increases at 3.0m to 14% and increases more so at 4.0m to 17%.
- 6.5. Atterberg Limits Testing allows interpretation of results in the terms of Driscoll's assessment of desiccation (soil dryness). This compares the soil's actual moisture content with its liquid and plastic limits. It is acknowledged that Driscoll's theory is unreliable in isolation and is mainly only applicable to London Clay. However, it is suggested that if the moisture content exceeded 50% of its liquid limit there was no desiccation. At 50% the onset of desiccation occurred and below 40% the soil sample had attained significant desiccation. The results suggest the onset of desiccation within BH2 even though the samples were taken in October.

7. Drains

- 7.1. At the time of trial pit excavation it was noted that there was no evidence of liquid ingress during any of the ground investigations which warranted inspection of the drainage system. The timing of the damage and the seasonal movements observed does not implicate an escape of water as a potential of contributory cause.

8. Monitoring

- 8.1. Level monitoring involved fixing pins around the perimeter of the building from which levels were taken to determine where the external walls and hence by implication the foundations are moving and by how much.
- 8.2. Level monitoring was set up in February 2014 and readings have been taken at approximately 6-8 week intervals and results up to and including May 2015. The monitoring results, which are presented below, show that the property is affected by seasonal downward movement with particular reference to points 2, 3 and 4 which are located along the left hand side elevation. The maximum degree of seasonal downward movement has occurred to point 2 (front left corner) which saw a decrease in level between February 2014 and August 2014 of -6.2mm.
- 8.3. The monitoring shows the affected parts of the property moving down during the summer months when the tree is in leaf, demanding larger amounts of water and rainfall is lower and the net moisture content within the clay soil below the property decreases. Recovery or upward movement is then witnessed during December 2014 when the trees begin to shed their leaves, demands less moisture and the rainfall events increase, allowing the soil to rehydrate to some degree and swell, causing upward movement and consequential closing of cracks within the property.
- 8.4. While climate alone can cause some small changes in the surface soil (to a depth of 500 mm or so), the foundations of the house, being some 1300mm below ground level are beyond this zone and seasonal movements can be dismissed, with the damage being indicative of root-induced shrinkage associated with a large tree.
- 8.5. In this instance, the only significant vegetation within influencing distance of the left of the property are the oak trees (TG3).
- 8.6. For reference the trees (T1 & T3) which were said to be influencing the conservatory were removed in February 2014. The monitoring results to the two points set up on the conservatory located at the rear left and rear right corners (points 5 & 6 respectively) have levelled out indicating relative stability since this date.

Level Monitoring Displacement Map

The following image shows an isometric representation of the movement of the property, based on the Level Monitoring Stations that were installed.

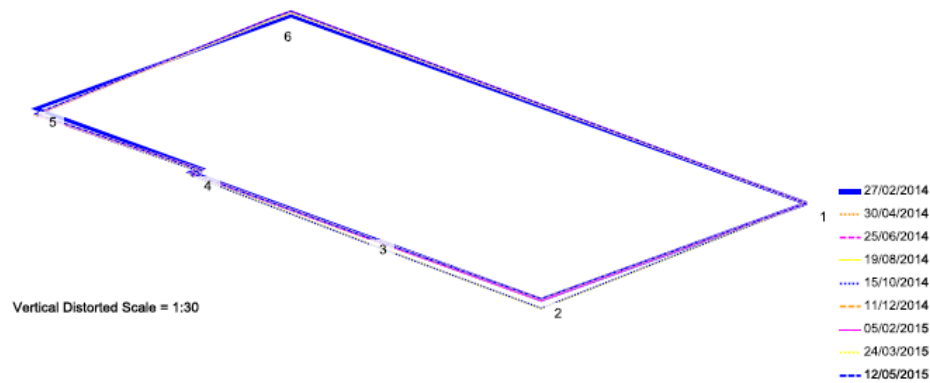


Figure 3– Level monitoring displacement map

Level Monitoring Difference Graphs

The following graphs display the progressive movement that each Level Monitoring Station recorded at each separate site visit date to give an overall look at how much the property is moving.

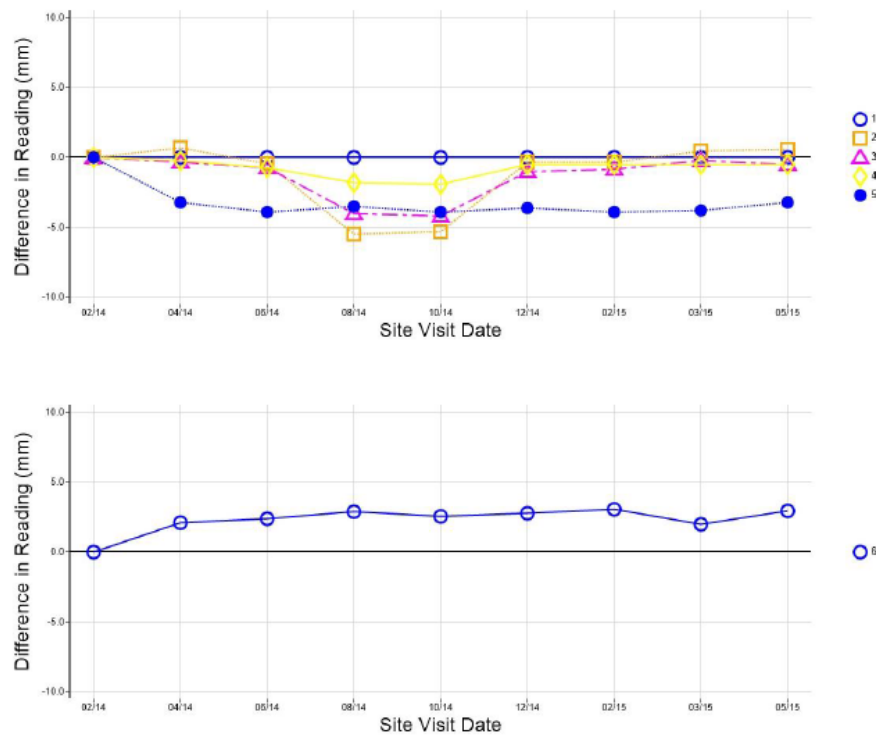


Figure 4 – Level monitoring results

9. Cause of Damage

- 9.1. In my opinion, the evidence points conclusively towards the damage reported in October 2013 having been caused by root-induced shrinkage in the subsoil. Specifically, we have:
- Damage characteristic of subsidence.
 - The damage is evident on the left side elevation.
 - Damage appearing during late summer.
 - Evidence of root activity to 3.7m below ground level in BH2.
 - Presence of a clay subsoil with a high shrinkage potential.
 - Level monitoring showing seasonal movement (upward in winter, downward in summer).
- 9.2. Given its proximity and the presence of *Quercus* roots in the subsoil, the oak trees (TG3) are the only plausible explanation for the seasonal movements recorded at the property.
- 9.3. There is no reason to suspect that drainage defects have contributed materially to the damage under consideration and there are no other credible explanations for the evident foundation movement.
- 9.4. The monitoring results (*Figures 3 & 4*) clearly indicate an unacceptable scale of seasonal foundation movement of the property.
- 9.5. Where a tree is causing localised movement to a house it is common for the effects to be transmitted throughout the superstructure and for cracks to appear at weak points, such as the junctions of walls and ceilings or the ends of lintels. In my opinion, the seasonal movement associated with the oak trees TG3, is now the only plausible explanation for the movement.

10. Remedial Options

- 10.1. Although the damage is relatively minor in structural terms, structural repairs will be needed to rectify the defects.
- 10.2. Even if there were some doubt as to the extent of the damage that can be reasonably attributed to the influence of the adjacent oak trees, the current recorded seasonal foundation movements are unacceptably significant. If the influence of the implicated tree is not eliminated, an engineering solution will be needed to stabilise the property.
- 10.3. A range of underpinning solutions is available depending on the area that requires stabilisation and the depth required. Traditional, mass concrete, underpinning is generally the most economical solution where the required depth is relatively shallow. It has the added advantage that the underpinning also acts as a root barrier. However, it tends to become uneconomical, and the Health & Safety considerations become increasingly onerous, where the required depth exceeds 2.5m. Most underpinning is

extended to a metre below the last discovered root and this is 3.7m making this an unacceptable risk from a health and safety perspective and should be discounted.

- 10.4. Pile-based underpinning solutions tend to be more economical where (i) the required depth exceeds 2.5 m and (ii) it is necessary to stabilise internal walls as well as external walls. A common variant is the piled-raft which consists of a reinforced concrete slab under the entire footprint of the property supported on driven or bored piles.
- 10.5. It is very difficult to partially underpin a property with a piled raft as the transition between stabilised and un-stabilised parts of the property is very vulnerable to cracking as a consequence of the minor seasonal fluctuations which might be expected in the traditionally founded part relative to the very stable piled section.
- 10.6. In this instance, I would have some reservations about the use of traditional underpinning because of the depth of the root activity indicated in the Geotechnical Report. In addition, the potential benefits of the barrier provided by the traditional underpinning are likely to be outweighed by the advantages that a piled raft offers in providing a long term solution particularly if all of the property was stabilised although there is no technical justification beyond the avoidance of differential movement.
- 10.7. In the light of the depth of the roots found, to undertake a substructure scheme to the conservatory could cost in the region of £15,000.00 exclusive of the professional fees.
- 10.8. I have considered whether the implicated trees could be controlled by regular pruning. However, recent research indicates that even heavy canopy reduction is likely to be effective for no more than one growing season. Annual management, in any case, would destroy most of the amenity value of the tree which would be the only impediment to its removal. It would also leave the property susceptible to damage in an exceptional summer such as 2003 when even recently-pruned trees can cause significant soil shrinkage.

11. Summary of Conclusions

- 11.1. The nature and distribution of the cracking first reported in October 2013 was indicative of subsidence with the focal point of the movement at the left side of the property.
- 11.2. Root samples recovered from below foundation level and identified as *Quercus spp* that indicate that roots from the oak trees (TG3) have encroached into the soil underlying 28 Galaxie Road.
- 11.3. Soil testing found evidence of the onset of desiccation in the surface soil even though samples were taken in October, and the heave predictions would not preclude the removal of the tree.
- 11.4. There was no evidence to suggest that water escaping into the soil from defective drainage or other sources caused any significant movement to the foundations or otherwise contributed materially to the reported damage.

- 11.5. The level monitoring confirmed that the foundations were moving seasonally and with greater movement at the rear elevation
- 11.6. The submitted evidence therefore points conclusively towards the oak trees TG3 being the substantial and effective cause of the damage that appeared in 2013 to the left hand side of the property. It also indicated the scale of the movement associated with the tree to be unacceptable.
- 11.7. If the implicated trees, TG3, are not removed, it will be necessary to underpin the property to prevent a recurrence of the damage. The most cost effective scheme is likely to be a piled raft scheme. On further consideration of the depth at which roots were found, the extent of the underpinning scheme envisaged previously would suffice. The cost of the scheme is likely to be in the region of £15,000 inclusive of VAT, but exclusive of professional fees.
- 11.8. The cost of superstructure repairs is in the region of £3,432.84 but exclusive of professional fees. A recent visit to site in June 2015 has detailed the associated works within a schedule of repair.
- 11.9. Alternative methods of reducing the influence of the implicated tree, such as annual pruning or the installation of a root barrier are not practical in this instance.

12. Statement of Truth:

I confirm that insofar as the facts stated in my report are within my own knowledge I have made clear which they are and I believe them to be true, and that the opinions I have expressed represent my true and complete professional opinion.

Signed:

Name of Engineer: David Crean BSc (Hons) MCIOB MRICS

Dated: 15th July 2015