Subsidence Management Services

ENGINEERING REPORT

Name of Engineer:	Peter Moore MCIOB Dip CII (Claims)
SMS Reference:	IFS-AVI-SUB-15-0056124
Name(s) of property Owners:	Mr & Mrs Kieron Johnson
Address of Property:	23 The Drove, Horton Heath, Eastleigh, Hants, SO50 7NX
Date of Report:	01/12/2015



Figure 1 – The property with vegetation adjacent.

1. Scope of instructions:

In late February 2015 Subsidence Management Services (SMS) were instructed by Aviva to investigate subsidence damage to the above property. A survey of the damage subsequently took place on the 6th of March 2015.

This report has been prepared to support an application to remove statutory protection on implicated vegetation and removal of the same to stabilise the property and prevent future damage occurring warranting sub-stabilisation measures.

2. Documents considered

The key documents considered in the report are listed below.

Table 1 – Documents considered

ID	Produced by	Description	Date
1	SMS	Engineer's Report	11/03/2015
2	SMS	Site Investigation Report including heave calculation	23/03/2015
3	EPSL	Root ID report	18/03/2015
4	Environmental Services	Consultant report on trees	17/03/2015

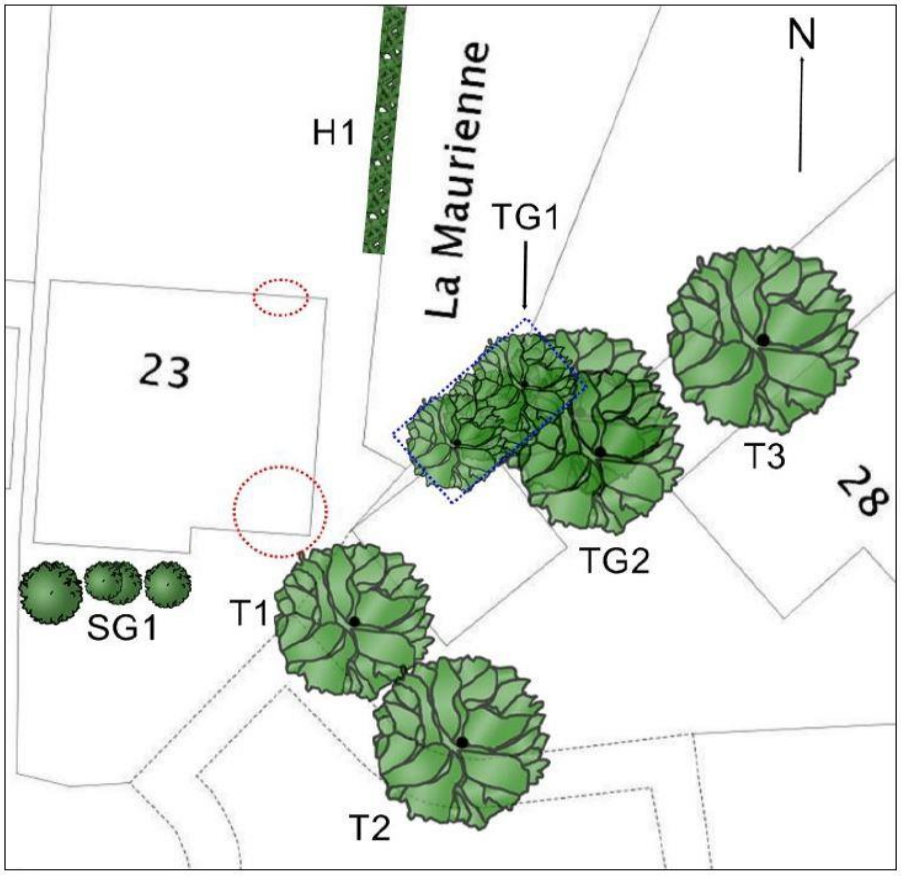

Figure 2 – Sketch taken from Environmental Services survey showing location of the principal vegetation in relation to Property.

3. History and background

The property is a two storey detached house of traditional construction with part rendered brickwork walls surmounted by a gabled and ridged tile covered roof. The elevations are part rendered with decorative timber strut work. The property has no garage; but a timber car port for two vehicles. The property has 4 bedrooms. The property was purchased by the owner and Insured, Mr & Mrs Kieron Johnson, in 2008.

Damage first occurred in August 2009 to the front right corner of the main house. Loss Adjusters Crawford & Company were appointed by Insurers to investigate the likely cause of the damage, arrange mitigation and ultimately arrange repairs once the property was deemed stable. However, it would appear that no geotechnical investigation was undertaken as it was considered that the underlying sub-strata was of non-cohesive material. A CCTV camera survey of the underground drainage system in close proximity to the area of damage was commissioned; but this did not identify any defects.

In light that the underlying substrata may in fact be cohesive clay an Arboricultural Survey of all vegetation within influencing distance of the property was commissioned from Arboricultural Consultants, Marishal Thompson & Company. Marishal Thompson subsequently considered that the principal cause of the subsidence movement was a group of Hawthorn trees; sited within the boundary of the domestic neighbour's property at 2 Dumpers Drove. Marishal Thompson also considered that a nearby Pyracantha, Elder and Cypress Lawson trees were also significant factors to the movement. The neighbour removed the Hawthorn group together with their Elder tree. The Insured removed their Pyracantha; plus some Ivy growing against the neighbour's garage. The domestic neighbours at 28 The Drove did not remove their sizeable Cypress Lawson tree or a small group of the same species as there was no evidence that their vegetation was a contributory factor. There is also a Cypress hedge along the rear right boundary which was not mentioned on the original survey. This vegetation is however unlikely to be within influencing distance.

The property was monitored for approximately three years in which time some seasonal movement occurred; although it is anticipated that the degree of movement in the summer and autumn months may not have been as progressive due to higher than average rainfall. Eventually, Crawford & Company considered that the property was stable enough for minor repairs to take place. These included minor crack repairs externally to the brickwork at the affected corner; plus minor cosmetic repairs internally and redecoration works. However, it would appear that not all works were completed in accordance with the scope of repairs and some minor external repairs remain. It would appear that externally the damage was not severe enough to warrant stitching of the brickwork using Helibar reinforcement; or resin.

Since the claim was deemed as concluded by Crawford & Company there has been periodic seasonal reopening of the damage at the original front right hand corner.

4. Description of Damage

The following is a summary of the damage relating to the Insurance claim.

Internal:

At this juncture the damage internally is very minor. In the front right lounge there are minor stress fractures to front elevation plastered and painted wall. We are advised by the Insured that the fractures open and close throughout the seasons; being at their widest in the late summer and autumn and closing over the winter. The most severe of these fractures being to the left of front elevation window (as facing) extending for approximately 1m in length and with a maximum crack width at the height of the movement of approximately 3mm. Below this window there are minor hairline stress fractures.

Also in this room is a stress fractures along right hand flank wall close to the front right corner. This fracture follows the line of the coving and it is evident from the pattern of movement that periodically the front corner drops. On the first floor and in the front right master bedroom there are similar stress fractures to the front elevation wall and again along the line of the coving to the flank wall. Again suggesting periodic downwards rotational movement at the front right corner.

At the time of our visit we were also made aware of damage in the first floor rear right hand bedroom. Here there is a fairly recent vertical fracture to rear elevation wall to the left of rear window (as facing looking out the window). This fracture extends for approximately 1m and has a crack width of no more than 2mm. An external survey of the area did not identify any evidence of damage through the rendered decorative panel; or stress fractures to the brickwork below. We were also made aware of a minor vertical hairline fracture to left hand wall bathroom above wall tiles. This fracture does not extend through the wall tiles or grout and is discounted as very minor thermal movement.

External:

Externally, the damage is focused around the front right corner of main house and front elevation. This is easily within influencing distance of the Insured's two protected Silver Birch trees; and possibly the neighbour's mature Conifer group. Here there is a fractured facing brick to the top right of the lounge window. This apparently was included within the previous repair schedule by Crawford & Company, but was simply not completed. Other very minor stress fractures were noted below the lounge window extending through the brick mortar joint and there is clear evidence of previous minor re-pointing works. Currently the fractures are no more than 1mm in width. In front of the affected corner the tarmac has clearly been disturbed either by ground movement or root action from the nearby vegetation. There is also a previously missed repair to the small brick dwarf wall to a glower bed.

5. Evidence of root encroachment

A geotechnical investigation comprising an external trial pit and borehole at the front right corner of the property identified the foundation arrangement to be 70mm of brickwork sited upon 0.88m of concrete projecting 0.2m from the elevation. The overall
foundation depth was estimated at a depth of 0.95m below ground level. A borehole was hand augured to a depth of 4m below ground level. Soil and tree root samples were recovered at various depths and forwarded to the laboratory for analysis.

Tree roots recovered from below foundation depth were identified as originating from the Birch (*Betula*) species to a depth of 1.8m.

6. Soil Conditions

The soil analysis has identified the underlying substrata to be of brown slightly gravelly sandy clay. The moisture contents indicate vegetation induced moisture depletion at all depths below the underside of the foundations. This is supported by the in-situ soil tests which show that the clay is dry, stiff and compacted to 4m.

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. This matches the rooting depth of the nearby Silver Birch trees.

Oedometer tests have been carried out to assess ground heave should the vegetation within influencing distance be removed. The results show only minimal heave potential of 19.9mm which is well within acceptable limits.

7. Drains

A survey of all waste and surface water drainage at the property has taken place. The results are that the drainage is free from defects. Water escaping from defective drainage is not therefore the cause or contributory to the movement.

8. Monitoring

Level monitoring involves fixing pins around the perimeter of the building from which levels are taken to determine where the external walls and hence by implication the foundations are moving and by how much.

Level monitoring was set up in April 2015 and readings have been taken at approximately 8 week intervals. We have results up to and including October 2015. The monitoring results, which are presented in below, show that the property is affected by seasonal downward movement at the front right corner of the property; particularly at point 3.

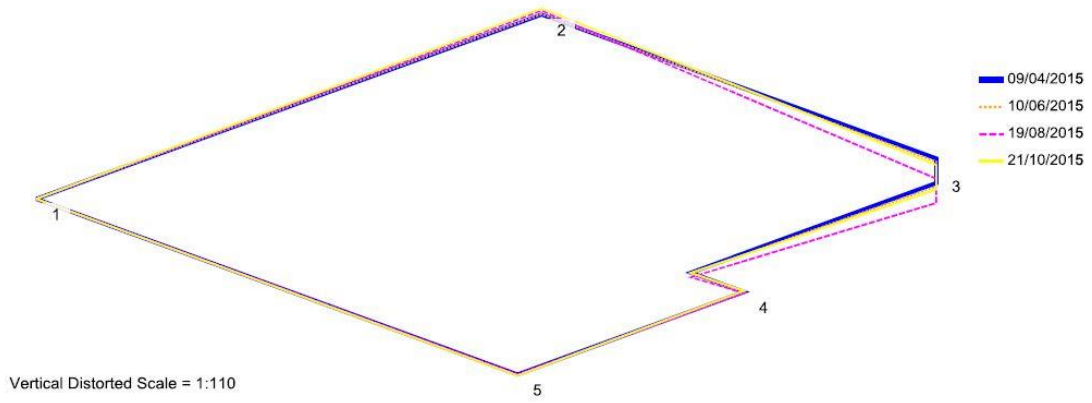

Figure 3 – Monitoring location positions.

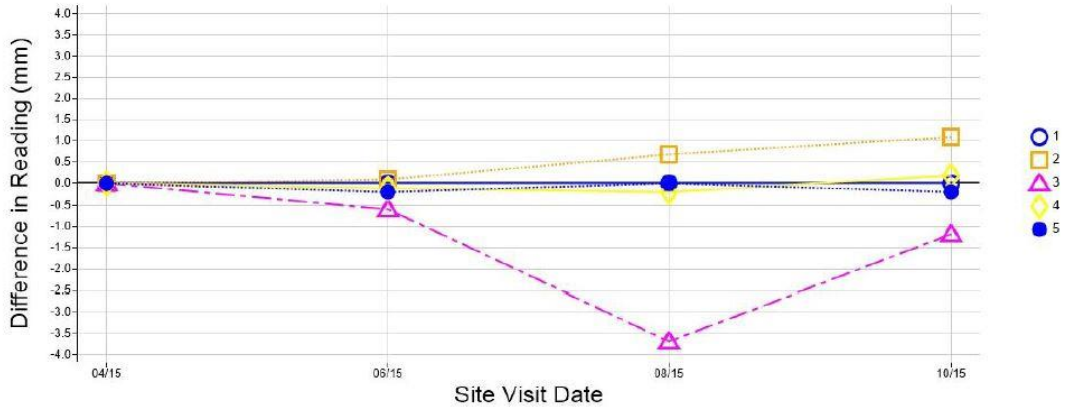

Figure 4 – Level monitoring results.

9. Cause of Damage

In my opinion, the evidence points conclusively towards the damage reported in February 2015 having been caused by root-induced shrinkage in the subsoil. Specifically, we have:

- Reoccurrence of damage in the same area as previously.
- The movement and damage is focussed to the front right corner within influencing distance of the vegetation; namely the Silver Birch trees (T1 & T2).
- Evidence of root activity to 1.8m below ground level from the Birch (*Betula*) species with abundant levels of starch.
- No evidence of roots from any other species; other than the Birch species.
- Presence of a heavily desiccated clay subsoil; as confirmed by the borehole log and the depleted levels of moisture in the clay to 4m.
- Level monitoring showing seasonal movement over the summer/autumn period; particularly at the height of what has been a dry summer.

Given their size, proximity and the presence of *Betula* roots in the subsoil, the Silver Birch trees (T1 & T2) are the only plausible explanation for the seasonal movement recorded at the front right hand corner of the property. The heave analysis has confirmed that all vegetation significantly older than property; including the Birch trees T1 & T2 can be removed without ground heave occurring.

There is no evidence that water escaping from defective drainage has contributed materially to the damage under consideration.

The monitoring results (*Figure 4*) clearly indicate an unacceptable scale of seasonal foundation movement of the property. Movement is most pronounced at the front right corner of the property at point 3 which is in closest proximity to the position of Silver Birch trees T1 & T2.

Where trees are causing movement at a corner (in this case the front right) 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. This explains some of the damage not in the immediate vicinity of the downwards rotational movement.

10. Remedial options

Although the damage is relatively minor in structural terms, should further seasonal movement be allowed then the damage will no doubt become more pronounced and wide spread and ultimately become more expensive to repair. If the influence of the implicated vegetation is not eliminated, an engineering solution will be needed to stabilise the property.

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 2.8m in respect of the Silver Birches; where roots were identified at 1.8m below ground level.
Thus making this an unacceptable risk from a health and safety perspective and should be discounted.

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. In this instance it would be essential to pile all supporting walls that could be within influencing distance of the root systems from T1 & T2 and as such piling could extend into the property and along the external elevations.

In this instance, I would discount 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 piling would provide as a long term solution.

In the light of the depth of the roots found, to undertake piling to the property costs could reach in the region of £40,000.00 exclusive of VAT and professional fees. Plus ancillary costs in respect of alternative accommodation; removals and storage or around £12,000.00.

I have considered whether T1 & T2 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. In my view it would be impractical to place the burden of annual tree management on the owners; especially when this tree can be felled without risk of ground heave. 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.

11. Summary of Conclusions

The nature and distribution of the cracking again reported in 2015 was indicative of subsidence with the focal point of the movement at the front right corner of the property. Root samples recovered from below foundation level and identified as *Betula spp* indicate that roots from the Silver Birch trees T1 & T2 encroached into the soil underlying 23 The Drove, Horton Heath, Eastleigh, Hampshire, SO50 7NX.

Soil testing has found conclusive evidence of heavy deep seated desiccation in the underlying soils, and the heave predictions would not preclude the removal of the

tree. There is no evidence to suggest that water escaping into the soil from defective drainage or other sources caused any movement to the foundations or otherwise contributed materially to the reported damage.

The level monitoring has confirmed that the foundations are moving seasonally and with greater movement at the front right corner of the property close to T1 & T2.

The submitted evidence therefore points conclusively towards the Silver Birch trees T1 & T2 being the substantial and effective cause of the damage that re-appeared in 2015. It also indicated the scale of the movement associated with the tree to be unacceptable.

If the implicated trees, T1 & T2 are not removed, it will be necessary to underpin the property to prevent a recurrence of the damage. The only possible and effective scheme is likely to be piling. The cost of the scheme is likely to be in the region of £40,000.00 exclusive of VAT and professional fees. With estimated ancillary costs of £12,000.00 being incurred.

The current cost of superstructure repairs is a mere £2,633.63 + VAT (£3,160.36). It therefore makes economic sense for T1 & T2 to be felled over the winter of 2015/2016 so as to stabilise the property and allow complete rehydration of the underlying clay.

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: Peter Moore MCIOB Dip CII (Claims)

Dated: 01/12/2015