



## **Town and Country Planning Act 1990**

**Application by the Secretary of State for Housing, Communities and Local Government**

**Proposed UK Holocaust Memorial and Learning Centre, Victoria Tower Gardens, Millbank, London SW1P 3YB**

**Proof of evidence**

**of**

**Mark Mackworth-Praed**

**in respect of arboriculture**

**on behalf of**

**Westminster City Council**

**Planning Inspectorate reference: APP/X5990/V/19/3240661**

**Westminster City Council reference: 19/00114/FULL**

**Date: September 2020**

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# 1. Introduction

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## 1.1 Experience and qualifications

- 1.1.1 My name is Audley Mark Mackworth-Praed, and I am instructed on behalf of Westminster City Council ('WCC') to give evidence in relation to the arboricultural issues that arise in this call-in Public Inquiry. The date of my instruction was the 5th February 2020.
- 1.1.2 I am a Senior Arboricultural Consultant of David Archer Associates. I have been employed within this practice for five years, since September 2015. I am a Chartered Arboriculturist, a Member of the Expert Witness Institute, and a Fellow and a Registered Consultant of the Arboricultural Association.
- 1.1.3 Details of my qualifications and experience are set out at **Appendix 8** to this proof of evidence.
- 1.1.4 The evidence that I have prepared and provide for this Inquiry, as set out in this proof, is true, and I confirm that the opinions expressed are my true and professional opinions.

## 1.2 Scope of evidence

- 1.2.1 My evidence comprises an assessment of the arboricultural implications of the proposed construction of the United Kingdom Holocaust Memorial and Learning Centre ('UKHMLC') within Victoria Tower Gardens ('VTG'), London SW1P 3YB; and a review of the arboricultural information prepared and submitted on behalf of the applicant in support of the proposal.
- 1.2.2 The planning application (reference 19/00114/FULL) was called in for determination by the Secretary of State on the 5<sup>th</sup> November 2019. On the 11<sup>th</sup> February 2020, the Planning Applications Sub-Committee of the City Council resolved that, although the principle of a national memorial and learning centre to the Holocaust was supported, had the application not been called in, it would have refused the proposals.
- 1.2.3 Of the three grounds (I to iii) for the Sub-Committee's resolution, ground (ii) relates to trees. This states as follows:

*"Inadequate and conflicting information has been submitted which is not sufficient to permit a proper assessment of the impact of the proposed development on trees within Victoria Tower Gardens, together with the effectiveness of suggested mitigation. As such it has not been satisfactorily demonstrated that unacceptable harm to, and/or loss of, trees would not arise as a result of the proposed development. Damage to or loss of trees would be contrary to policies S25 and S38 of Westminster's City Plan (November 2016), ENV 16 and DES 9 of our Unitary Development Plan that we adopted in January 2007, 7.12 of the London Plan (2016) and G7 of the Intend to Publish London Plan 2019. Moreover, damage*

*and/or loss to trees would be detrimental to the visual amenities of the area, and would have a further adverse effect on the significance of heritage assets (as referred to within reason (i) above).”*

- 1.2.4 My evidence sets out a description of the trees on the site, and considers the likely effects or implications on them of the proposed UKHMLC itself, of its ancillary or consequential features. As well as the long-term or permanent effects of the proposal, my evidence also considers the likely effects arising from the temporary period of its construction.
- 1.2.5 At the date of preparation of this proof, a draft Statement of Common Ground ('SoCG') on tree issues is in the course of being agreed between WCC and the applicant. Following a telephone approach on the applicant's behalf by Mr Donncha O'Shea of Gustafson Porter & Bowman on the 20<sup>th</sup> August 2020, a meeting to discuss the contents of the draft SoCG took place (via Teams) on Thursday the 3<sup>rd</sup> September 2020. At the meeting, the applicant's representatives identified a number of points of disagreement with the draft SoCG, and a revised proposed draft is expected from them.
- 1.2.6 On the evening before the meeting (2<sup>nd</sup> September at 21.45hrs), the applicant provided a draft Arboricultural Method Statement ('AMS') relating to the relocation of the Spicer Memorial and the re-surfacing of the existing footpath network within VTG. Given the deadline for submission of proofs of evidence, there has not been sufficient time to consider this document, and a supplemental proof will be provided as appropriate.

### **1.3 Site description and proposals**

- 1.3.1 Victoria Tower Gardens is an area of public open space situated immediately to the south of the Palace of Westminster, bounded by Millbank to the west and by the River Thames to the east. It comprises mostly open, level amenity grass, in a narrow 'V' shape which tapers from its widest extent to the north, to its narrowest point in the south, just north of Lambeth Bridge. Its southern end is occupied by the Horseferry Playground, which is under a variety of hard surfacing materials. There are hard surfaced pathways within the open space, the principal ones being a tarmac pathway running parallel to the western boundary, and another, broader, tarmac path along the eastern boundary adjacent to the river wall, with connections between the two both at the northern end of the area, and across its approximate centre.
- 1.3.2 The park contains a number of important memorials and monuments, including the Buxton Memorial, the statue of Emmeline Pankhurst, the Burghers of Calais sculpture by Auguste Rodin and the Spicer Memorial. Details of these, and of their heritage significance and status, are set out in the Council's proofs of evidence by its planning and heritage witnesses.
- 1.3.3 The principal arboricultural feature of the site is the two rows of large mature London Plane trees (*Platanus X acerifolia*) which line the western and eastern boundaries of the park. The western row contains 25 such trees, and the eastern row also 25. Within the

western row, there is a smaller, semi-mature London Plane towards the northern end, making 26 trees of this species in the row in total. There are also several trees of other species within the body of the park, but these are smaller and towards its northern end.

- 1.3.4 The proposed development comprises the installation of the United Kingdom Holocaust Memorial and Learning Centre, including excavation to provide a basement and basement mezzanine for the learning centre (Class D1); erection of a single storey entrance pavilion; re-provision of the Horseferry Playground and refreshments kiosk (Class A1); repositioning of the Spicer Memorial; new hard and soft landscaping and lighting around the site; and all ancillary and associated works. Details of each of the components of the scheme are set out in other proofs of evidence and in the application documents. For brevity's sake I therefore do not describe them exhaustively here, but discuss them in the ensuing sections of my evidence as necessary.

#### **1.4 Documents considered**

- 1.4.1 A number of reports were submitted on the applicant's behalf during the period of the application, which relate to the arboricultural aspects of the proposal. A full list of those considered is given at **Appendix 7**. In summary, the principal documents comprise:

- ) Arboricultural Impact Assessment by Bartlett Consulting December 2018 (CD 6.5)
- ) Arboricultural Impact Assessment Addendum April 2019 (CD 6.22)
- ) Root Radar Investigations by Sharon Hosegood Associates (CD 6.35)
- ) Root Investigation Reports by Canopy Consulting (Appendix 4 to CD 6.5 & Appendix B to CD 6.22)
- ) Structural Methodology Statement by WSP December 2018 (CD 6.7)
- ) Revised Construction Management Plan (Appendix C to Volume 5 of Environmental Statement) (CD 6.30)
- ) Report by Dr Frank Hope August 2019 and appendices (CD 6.36)

#### **1.5 Site visit and tree re-survey**

- 1.5.1 I visited the site in order to familiarize myself with it, and to undertake a general appraisal of the trees, on Thursday the 13<sup>th</sup> February 2020. On this visit I was met and accompanied by Barbara Milne, David Dorward, the Planning Case Officer, and by Robert Ayton, the Council's Head of Design and Conservation. Between them, they described the proposal and pointed out where its various component elements would be situated within the site.
- 1.5.2 Prior to my visit, I had noted that the tree survey underpinning the arboricultural documents submitted on the applicant's behalf was undertaken in February 2018, two growing seasons previously (CD 6.5). In view of this, in order to ensure our assessment was

based on up to date information, I advised that the tree survey should be re-done by ourselves, so that any changes in relevant dimensions or condition of the trees since the original survey could be accurately recorded.

- 1.5.3 The trees on the site were accordingly re-surveyed by Michael Roberts, an experienced arboricultural surveyor within my practice, on Monday the 24<sup>th</sup> February 2020. On my instructions, the re-survey extended to include all the trees present within Victoria Tower Gardens, whereas the applicant's February 2018 survey had omitted a number of the London Planes towards the northern end of the site, and had not included any of the smaller trees growing within the body of the park.
- 1.5.4 The results of the survey, undertaken in accordance with the recommendations given in British Standard BS 5837: 2012, *Trees in relation to design, demolition and construction – Recommendations* ('BS 5837') (CD 4.16), are set out in the tree schedule at **Appendix 1** to this report. Definitions and measurement conventions used in the survey are set out in the notes which preface the schedule.
- 1.5.5 For consistency, and in order to facilitate comparison of the findings of our assessment with those within the documents submitted on the applicant's behalf, we have assigned the same numbers to the trees as were used in the Bartlett Consulting February 2018 survey. Additional trees (i.e. those not included in the Bartlett Consulting survey) have either been assigned appropriate numbers in the same logical sequence, or have been numbered according to the tree tag present on the tree itself at the date of survey.
- 1.5.6 In some cases, we found that the tag numbers present on some trees on the west side differ from the numbers assigned in the Bartlett Consulting survey, and moreover duplicate with numbers given to trees on the east side. To avoid confusion therefore, in these cases the numbers assigned are in the same logical sequence as the majority of those on the west side; and in these instances, for clarity and completeness, the relevant tag number is recorded in the second column of the schedule.
- 1.5.7 The numbering of trees shown on the plans we have subsequently produced follows that of the schedule, with tag numbers also shown (in smaller font and in orange lettering) where they differ from the number assigned in the schedule.

## **1.6 General findings and observations**

- 1.6.1 The key arboricultural features of this site are, self-evidently, the two rows of mature London Planes along its west and east boundaries. The overwhelming majority of these (46 out of 51 trees) are graded as category 'A' specimens under the categorization system set out in BS 5837, for both their arboricultural quality and landscape value, with only five graded slightly lower, as category 'B' trees, due to minor impairments of structure, form or quality. Notwithstanding the latter, the category 'B' trees nevertheless are integral components of the two linear groups, contributing to their visual unity, coherence, and landscape value within their context.

1.6.2 All parties appear to be in agreement as to the significance of the London Plane trees on the site. Within the report to WCC's Planning Sub-Committee (CD 5.11), this was expressed, correctly in my view, as follows:

*"The London plane trees within VTG are protected by virtue of being within the Westminster Abbey and Parliament Square Conservation Area. They are of very high amenity value, as individuals, as a group, and in their contribution to the wider townscape and to the significance of heritage assets. They frame Victoria Tower Garden (VTG) which is a grade II listed garden on Historic England's Register of Historic Parks and Gardens, and are part of the green ribbon of plane trees in central London which line the Thames. They contribute to the setting for the Houses of Parliament within the adjacent Westminster World Heritage site. Their safe retention is essential on the basis of their very high amenity value and in their townscape contribution."*

1.6.3 This assessment is not contested within documentation submitted on behalf of the applicant, and in particular in its statement of case. Paragraph 4 of the AIA Overview included as Appendix 4 to the applicant's statement of case (CD 5.24) states:

*"The trees are of a mature age classification, with high public visibility and amenity value, and a significant life expectancy. All of the trees were considered to be healthy and in good structural condition at the time of the tree survey."*

1.6.4 As would be expected, in the case of those trees included within the Bartlett Consulting February 2018 survey, our re-survey recorded increases in the trees' trunk diameters which reflect their growth over the two growing seasons which had elapsed, mostly of between 10mm to 20mm (max. 40mm) in the case of trees on the west side, and between 5mm to 10mm (max. 20mm) for trees on the east side. Whilst impossible to draw firm conclusions from such a limited sample size (and given likely variances due to measurements having been taken by different surveyors), these differences could be an indication that the trees on the east side may not be growing as vigorously as those to the west. This observation is also reflected in an average difference of approximately 120mm in overall trunk diameter between the trees on the west side, at around 1058mm, compared to those to the east, which average 935mm<sup>1</sup>, despite the trees all being of approximately the same age (120-130 years).

1.6.5 The re-survey also recorded minor differences and increases of lateral canopy spreads, which overall are consistent with normal lateral branch growth for trees of this species and age. However, due to variance between different surveyors and inherent limitations on the accuracy of crown spread measurement, no specific conclusions can be drawn or inferred from the differences recorded.

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<sup>1</sup> These figures differ slightly from those given in my original report of March 2020, in which I stated the difference as being approximately 100mm, between an average of 1030mm for the trees to the west, and 930mm for those to the east. This is because my initial calculation was based only on the 46 London Plane trees which had been included within the Bartlett 2018 survey, whereas the figures here reflect a recalculation which is based on all 51 Planes present.

- 1.6.6 Although the recorded increases in trunk diameters involve only relatively small measurements, they are not without significance, in that for trees of the size and maturity present in this case, they typically translate into appreciable increases in the sizes of their root protection areas ('RPAs') as calculated according to BS 5837. Taking tree 71017 as an example, one of the London Planes on the west boundary, its increase in trunk diameter of 20mm from two years before results in an increase in its RPA from 537.5m<sup>2</sup> to 557.4m<sup>2</sup>, an increase of just under 20m<sup>2</sup> (equivalent to a square of sides of 4.47m length).
- 1.6.7 Apart from our inclusion of the London Planes towards the northern end of VTG and of smaller trees within the body of the park, two other main differences between our re-survey and the Bartlett Consulting February 2018 survey should be mentioned. As is noted on page 19 of their AIA report of December 2018 (CD 6.5), trees 70000 to 70002 were not surveyed by Bartlett Consulting due to bad weather conditions and loss of daylight. However, in view of these trees being within a proposed service corridor, they were depicted on Bartlett Consulting's tree constraints plan as having the maximum RPA extent allowed for under BS 5837 (707m<sup>2</sup>). Also, trees 71006 to 71008, on the west boundary of the park, were not surveyed due to their being inaccessible within a site compound at the date of their survey. However, these trees were not depicted on their tree constraints plan as having either canopies or RPAs, and they appear to have been omitted from many of the drawings and plans subsequently produced and submitted on the applicant's behalf. The omission of these trees is of relevance to consideration of the potential scheme impacts arising from the Hostile Vehicle Mitigation measures (considered at Section 2.6 below), the soil build-up or new landform (Section 2.9), and the site set-up arrangements (Section 2.10).
- 1.6.8 More recently (3<sup>rd</sup> July 2020), I have seen a revised tree constraints plan by Bartlett Consulting (TCP 01 Rev 04, dated 14.04.2020), which includes the trees previously omitted, and three of the smaller trees (70026, 71027 and 71028) within the body of the park (and within the red-line application site area). Tree 71001, the northernmost London Plane in the line on the west side of VTG, however, is not shown on this drawing.

## **1.7 Statutory protection and tree management**

- 1.7.1 As is noted in the extract from the WCC Planning Sub Committee report cited above, all the trees within Victoria Tower Gardens enjoy statutory protection by virtue of being within the Westminster Abbey and Parliament Square Conservation Area. The provisions of the Town and Country Planning Act 1990 (as amended) therefore apply to them (Sections 211 to 214, and Section 210 in relation to any contravention of these provisions).
- 1.7.2 Management of the trees is the responsibility of The Royal Parks. From information kindly provided by The Royal Parks' Arboricultural Manager, The Royal Parks operates a programme of regular inspections of the trees in Victoria Tower Gardens according to their tree management health and safety policy. Victoria Tower Gardens is defined as a 'Zone 1'

site, so the trees are inspected a minimum of once a year, but the London Planes are usually inspected three to four times per year to check for Massaria disease (see below).

- 1.7.3 I am informed that a full inspection of the London Planes by the Royal Parks took place on the 8<sup>th</sup> August 2019, as a result of which 21 trees were identified as requiring deadwood removal, and that this work was completed subsequently. I am further informed that this year (2020) a walk-through inspection took place on the 15<sup>th</sup> April, with 17 trees being deadwooded on the 28<sup>th</sup>-30<sup>th</sup> April, and that a further walk-through inspection was scheduled during the week beginning the 8<sup>th</sup> June.
- 1.7.4 The trees are therefore subject to regular inspections, and are in active and responsible management to ensure their continued health and well-being, as befits their condition, location and importance.

## 1.8 General characteristics of London Plane

- 1.8.1 London Plane (*Platanus X acerifolia* or *Platanus X hispanica*) is, as its name suggests, inherently, or perhaps even iconically, associated with the city of London, it being one of the few tree species capable of surviving and thriving in densely built urban environments, and tolerating high levels of atmospheric pollution. It is a tree of vigorous growth, capable of growing to very great size (48.6m currently being the tallest recorded<sup>2</sup>), and similarly great age, with many specimens in excess of 200 years and even possibly 300 years old still in full health and vigour. Although the origin of the tree is still uncertain, the prevailing consensus view is that it is a hybrid between American Buttonwood (*Platanus occidentalis*) and Oriental Plane (*Platanus orientalis*), native to south-eastern Europe. If correct, London Plane is thought to be probably the first intercontinental hybrid tree to arise<sup>3</sup>, but is thought more likely to have arisen in southern Europe (hence "*X hispanica*") rather than in the UK.
- 1.8.2 The first trees of the species to have been planted in London are those in Berkeley Square, said to have been planted in 1789, and by mid-Victorian times London Plane was accepted as being the tree best able to cope with the atmospheric pollution then prevalent, as well as being easy to propagate<sup>4</sup>. The tree has a reputation for being remarkably robust and wind-firm, being rarely known to blow down, and capable of withstanding regular and severe pruning or pollarding. It has the additional (and unusual) benefit of its ability to exfoliate its bark in patches or strips, thereby shedding sections clogged by atmospheric pollutants and allowing its trunk to continue to respire freely.
- 1.8.3 Being so widely planted and so well adapted to the pressures of the urban environment, London Plane is thus a crucial component of the city's tree canopy cover, in its streets, squares and parks throughout, reliably making up the largest possible trees within these

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<sup>2</sup> At Bryanston School, Dorset - Johnson, O. (2011), *Champion Trees of Britain & Ireland*, Kew Publishing.

<sup>3</sup> Mitchell, A. & Jobling, J. (1984), *Decorative Trees for Country, Town and Garden*, Forestry Commission, HMSO.

<sup>4</sup> Johnson, O. (2015), *Arboretum – A history of the trees grown in Britain and Ireland*, Whittet Books.

spaces, and of an importance to the city's visual character and quality which is hard to overstate.

- 1.8.4 London Plane is generally late to come into leaf (typically mid-May depending on average temperatures). Its fruit comprises balls of seeds which break up during the spring, releasing hairy seeds which, along with the hairs from the surfaces of new leaves, are wind-dispersed and can cause asthma attacks, eye irritation and hay fever in susceptible people.
- 1.8.5 The tree's foliage is frequently affected (with varying degrees of severity from year to year), by a fungal condition known as London Plane Anthracnose (*Apiognomonina veneta*). In recent years, the fungal condition known as Massaria (*Splanchnonema platani*) has increasingly affected trees in London, causing death and/or shedding of small- to larger-diameter branches, and frequent regular inspections, (rendered more difficult by the fact that the fungal lesions occur on the upper sides of branches and are thus hard to see from the ground), are necessary in order to manage this.
- 1.8.6 Although generally robust as a species, London Plane is not immune to becoming infected by various species of parasitic decay fungi which also occur on other broadleaved tree species, including *Inonotus hispidus*, various *Ganoderma* species, and occasionally *Meripilus giganteus*. It can also be infected by *Fomitiporia mediterranea*, a severe but apparently slow-acting wood decay agent, instances of which have been found within London dating from around 2012, and prevalence of which is thought likely to increase with climate change.
- 1.8.7 Although not yet present in the UK, a major biosecurity risk to London Plane exists in the form of Plane Wilt or Canker Stain of Plane ('CSP') (*Ceratocystis platani*), a pathogen which has spread through much of mainland Europe and caused the death of many thousands of Plane trees (of all species). In 2014, the European Union awarded the UK Protected Zone Status for CSP, with controls imposed on movement or importation into the UK of potentially infected nursery stock or plant material. As in other areas relating to plant biosecurity, however, continued efficacy or persistence of these arrangements post-Brexit may not be altogether clear.
- 1.8.8 The status, role and importance of the London Plane trees in VTG, therefore, should be considered and evaluated against this general background and context. With all this in mind, I consider the implications of the proposed UKHMLC in the following section of this proof below.

## **2. Arboricultural Impact Assessment (AIA)**

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### **2.1 Principles of assessment: BS 5837 and the RPA**

- 2.1.1 BS 5837 (CD 4.16) is recognized as being the industry standard publication for providing guidance and recommendations on all aspects of development on sites where trees are present or on immediately adjoining land, and in proximity to trees. It is accepted and used

throughout the arboricultural profession, and more widely within the development industry. Importantly, it is the document used, relied upon and applied by most, if not all, local planning authorities within the UK when considering or assessing proposed developments or planning applications where trees may be affected.

- 2.1.2 The Foreword to BS 5837, under the heading “Use of this document” (page iii) explains that it takes the form of guidance and recommendations. As such, it goes on to state that *“Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations”*.
- 2.1.3 The key process set out within BS 5837 as the basis for both designing, and assessing, developments in proximity to existing trees is the calculation of the extent of each tree’s root protection area (RPA). At Section 3.7, under “Terms and definitions”, the RPA is defined as *“layout design tool indicating the **minimum** area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree’s viability, and where the protection of the roots and soil structure is treated as a priority”* (emphasis added).
- 2.1.4 For a single-trunked tree, the RPA is calculated as being an area equivalent to a circle with a radius 12 times the trunk diameter, measured at 1.5m above ground level. At para. 4.6.2, the standard states *“The RPA for each tree should initially be plotted as a circle centred on the base of the stem. Where pre-existing site conditions or other factors indicate that rooting has occurred asymmetrically, a polygon of equivalent area should be produced. Modifications to the shape of the RPA should reflect a soundly based arboricultural assessment of likely root distribution.”* The following paragraph (4.6.3) then lists the factors which should be taken into account in deviating the RPA from the original circular plot: these include the morphology and disposition of the roots, when influenced by past or existing site conditions; topography and drainage; the soil type and structure; and the likely tolerance of the tree to disturbance and damage.
- 2.1.5 It is important to recognize that the extent of the RPA is not intended to represent, enclose or protect the entirety of a tree’s *root system*, since as research shows<sup>5</sup>, the full extent of a tree’s lateral root system frequently extends considerably beyond the limit of its canopy, to distances of up to 1.7 to 3 times the canopy spread, depending on species, soil type and other factors<sup>6</sup>. For many broadleaved tree species of typical canopy shape, the extent of a tree’s RPA, as calculated according to the formula in BS 5837 and plotted as a circle, tends to conform, at least approximately, to the extent of its canopy. In most cases, therefore, a greater or lesser proportion of the tree’s total root system will typically lie beyond the limit of the tree’s RPA.

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<sup>5</sup> Gilman, E.F. (1989), *Predicting root spread from trunk diameter and branch spread*, *Arboricultural Journal* 13, 25-32; Perry, T. O. (1982), *The Ecology of Tree Roots and the Practical Significance Thereof*, *Journal of Arboriculture* 8 (8) 197-211; Perry, T.O. (1989), *Tree roots: facts and fallacies*, *Arnoldia* 49, 1-21; Roberts, J., Jackson, J., & Smith, M. (2006), *Tree Roots in the Built Environment*, Research for Amenity Trees No. 8, TSO.

<sup>6</sup> Helliwell, D. R. & Fordham, S.J.(1992), *Tree Roots and tree growth*, Reading Agricultural Consultants; Crow, P. (2005), *The Influence of Soils and Species on Tree Root Depth*, Forestry Commission.

- 2.1.6 The RPA is also not to be confused with the concept of a tree's *structural root-plate*, which can be defined as the central mass of structural roots and soil which is considered critical to a tree's anchorage and stability. This will typically be much smaller than the RPA, extending to a radius of 3.5 to 4 times the tree's trunk diameter, as other research has shown<sup>7</sup>. The RPA thus has a very specific meaning, representing a judgment as to how much of a tree's root system, and equally importantly, how much of the soil within which it is rooting, must be retained and protected *as a minimum* in order to keep it viable. Put a different way, the assumption is, in effect, that even if all parts of a tree's root system lying beyond its limit were destroyed or severed, the proportion of its remaining root system, and the soil volume, enclosed by the RPA would be sufficient to enable the tree to continue to survive and grow. Estimations of the proportion (by volume) of a tree's total root system which is typically enclosed within the RPA will vary, but are broadly considered to range from around 50-60% down to as little as only 25-30%.
- 2.1.7 The means by which the appropriate minimum distances between trees and excavations (now known as the RPA) are determined have evolved over time, through successive versions of BS 5837 (1980, 1991, 2005 and 2012), from a simple specification based on tree height class, tree type (coniferous or broadleaved), and depth of excavation required, in the 1980 standard, then to a more nuanced system based on tree age, tree type and vigour in the 1991 version, and finally to the 12 X multiplier of trunk diameter system (in the 2005 and 2012 versions<sup>8</sup>).
- 2.1.8 The adoption of a system based on a function of a tree's size (trunk diameter) responds to the logical consideration that the larger a tree's size, in general, the greater will be the extent of its root system, and the larger will be the volume of soil correspondingly required to support its physiological functioning. Through a combination of practitioner experience, observation, and published work<sup>9</sup>, in 1995 the National Joint Utilities Group published its guidance NJUG 10, *Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees* (CD 4.15), which specified a method for defining a 'precautionary area' around trees, within which installation or repair of utilities should avoid the use of conventional mechanical trenching, and only be carried out with trenchless methods, or manual excavation with appropriate supervision, limitations on sizes of roots pruned, and other safeguards. The extent of the 'precautionary area' was (and continues to be in the later 2007 edition of NJUG 10) defined as a circular area of a radius equal to four times the tree's circumference. This method of calculation yields a

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<sup>7</sup> Mattheck, C. & Breloer, H. (1994), *The body language of trees - A handbook for failure analysis*, Research for Amenity Trees No. 4, HMSO; Cutler, D.F., Gasson, P.E. & Farmer, M.C. (1990), *The Wind Blown Tree Survey: Analysis of Results*, *Arboricultural Journal* 14 (3), 265-286.

<sup>8</sup> Note, however, that the 2005 version specified a 10 X basal diameter calculation for multi-stemmed trees, and allowed a '20% reduction' of the RPA on one side of the tree if rooting area was available in other directions. Neither of these features was carried through to the 2012 version of BS 5837; in the latter case, reportedly due to perceived widespread abuse of the provision.

<sup>9</sup> See Matheny, N. & Clark J.R. (1998), *Trees and Development: A Technical Guide to Preservation of Trees during Land Development*, International Society of Arboriculture.

‘precautionary area’ of similar, but slightly greater extent than that of the RPA for a tree of the same size, as calculated under BS 5837 (approximately 9% larger)<sup>10</sup>.

- 2.1.9 Past studies of the effects of trenching and root severance on tree vitality have validated the necessity for the definition of an appropriate protective zone around trees in which such activities should not occur, but there has been a lack of applied research into the extent of such protective zones required. This has led to the suggestion that the extent of the RPA as defined by BS 5837 is no more than a ‘rule of thumb’ without empirical backing or validity.
- 2.1.10 More recent work<sup>11</sup>, however, has found that trenching and root severance at defined distances from established trees up to and including 12 times their trunk diameter negatively impacts on trees over a range of physiological indicators including tree growth (trunk diameter, shoot extension growth and leaf area), as well as causing significant moisture stress, which in the study concerned persisted for more than one growing season. A further significant finding of the research was that a tree protection zone defined at 12 times trunk diameter was actually insufficient to adequately avoid short-term physiological perturbations, leading to the papers’ authors’ recommendation that tree protection zones should be set at 15 times trunk diameter to protect trees adequately.
- 2.1.11 The importance of the RPA as the fundamental principle of BS 5837 is hard to overstate, as references to the importance of safeguarding it from disruption, excavation, soil compaction or other construction-related disturbance abound throughout the guidance. The “default position” taken within the standard is that structures, excavations, underground services, and construction activity should be located outside the RPAs of trees to be retained; and that the most reliable way to ensure satisfactory tree protection is to preserve the RPA completely undisturbed. In addition to the findings of past research and experiential observations in practice, this principle derives further empirical support from the recent research findings referred to above.
- 2.1.12 It is worth noting, in this context, that at no point does BS 5837 refer to, or recommend, the use of intrusive trial excavations as a means of seeking to determine the extent of a tree’s root system, or as a means of assessing the likely effects of development upon it. Similarly, there are no references in the document to, or recommendations for, the use of any non-invasive means of determining the extent or location of a tree’s root system, such as root radar (although this may be due to the latter only having been developed in recent years).

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<sup>10</sup> Roberts, J., Jackson, J., & Smith, M. (2006), *op. cit.*

<sup>11</sup> Benson, A., Koeser, A. K. & Morgenroth, J. (2019a), *A test of tree protection zones: Responses of live oak (Quercus virginiana Mill) to root severance treatments*, Urban Forestry & Urban Greening 38: 54-63; Benson, A., Morgenroth, J. & Koeser, A. (2019b), *Responses of mature roadside trees to root severance treatments*, Urban Forestry & Urban Greening 46; both summarized and reported by Benson, A., in *The Arb Magazine*, Issue 189, Summer 2020.

- 2.1.13 The centrality of the concept of the RPA within BS 5837 reflects the fact that the part of a tree most susceptible to damage is its root system. Damage to, or death of, the root system affects the health, growth, life expectancy and, potentially, the safety of the entire tree. The effects of damage may manifest themselves relatively quickly, but in some cases, the effects of such damage may only become evident several years afterwards. Tree species differ in their ability to tolerate root damage, or to regenerate new root growth from severed roots, but all tend to become less tolerant after they have reached maturity, or if they have suffered previous damage or physiological stress.
- 2.1.14 On construction sites, damage to tree root systems is normally attributable to one of four main causes (or all in combination), namely (a) direct damage through root severance, cutting or removal by excavations, piling, soil level reductions or topsoil stripping; (b) soil compaction leading to root death through asphyxiation, caused by construction traffic, construction of hard surfaces, raising of soil levels, or storage and stockpiling of materials; (c) chemical toxicity from uncured cement or concrete, diesel or hydraulic oil spillage, vehicle or mixer washings etc; and (d) alterations of hydrology or soil water availability to tree root systems. In each case, the tree's growth is impacted by impaired uptake of water, reduced absorption of mineral nutrients, and reduced synthesis of growth-regulating hormones.
- 2.1.15 If recovery, or the remediation of damage, is not possible or is prevented, the effects will typically be evident in the tree's decline, commencing with arrested or impeded shoot growth, dieback of distal branch ends, progressively leading to dieback and death of larger lateral branches or of leading stems. In more severe cases, dieback or death of larger branches can occur rapidly. Such damage is not usually sufficient to kill the tree outright, but the progressive depletion of its carbohydrate reserves as a result of reduced photosynthetic capacity resulting from dieback renders it more susceptible to pathogens or fungal decay, either resulting in eventual tree death, or (often) the need to remove it for safety reasons prior to mortality<sup>12</sup>.
- 2.1.16 In addition to protection of tree root systems, the safeguarding of an appropriate area around trees from construction traffic or operations is essential to prevent other causes of harm to trees in the form of (a) direct damage to tree trunks from impacts of construction vehicles or machinery, causing wounding or trunk instability; and (b) damage to tree crowns (canopies) caused by cutting back or reduction of branches, or by accidental impacts from vehicles or machinery. Avoidance of construction of permanent structures or built features within the RPA also acts as a safeguard against the potential for long-term damage to trees as a result of microclimatic effects resulting from environmental changes in their near vicinity.

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<sup>12</sup> A highly simplified summary of a complex subject, for which reference and research sources abound.

## 2.2 Tree constraints plan

- 2.2.1 In order to provide the basis for an updated assessment of the implications of the proposed UKHMLC, and thereby to enable comparison with those assessed and presented on behalf of the applicant, the findings of our survey have been transcribed onto a recent topographic survey plan of VTG, in line with the recommendations of BS 5837, to produce a tree constraints plan ('TCP'). This is attached as **Appendix 2**. The drawing depicts the trees' locations, numbers, canopy spreads, and the extents of their RPAs, coloured according to the assessed category of the tree concerned (lime green for category 'A', blue for category 'B', and grey for category 'C' trees).
- 2.2.2 The trees' canopy spreads, based on their measured extents, are shown by the irregular shapes hatched light green and bordered by a darker green line.
- 2.2.3 The depictions of the RPAs on the TCP, initially as circles of the required radii under the BS 5837 formula, are indicated by light broken circles of the relevant colours centred on each tree's trunk. However, in line with BS 5837 advice, these initial circles have been modified, to take account of the obstructions or barriers to root growth represented by the river wall on the east side of VTG, and by the carriageway of Millbank to the west. The areas of the parts of the circles lying beyond these root barriers or obstructions have been added to the remaining part of each circle, which has then been expanded to occupy the required area as defined by the initial calculation. The resulting modified RPA shapes are shown by the heavier solid lines of the relevant colours (lime green for category 'A', and blue for category 'B'), according to tree category.
- 2.2.4 To comment on the differences between our depictions of the trees' RPAs and those shown in the applicant's submitted reports is appropriate. In the Bartlett Consulting AIA of December 2018 (CD 6.5), the RPAs of the trees along the eastern boundary are plotted as squares of equivalent area to those of initial circular plots, aligned to the river wall. At 5.2.1 of their report, it is stated that *"In this zone the RPA for these trees has been plotted as a square to allow better protection of root growth parallel to the retaining wall as well as a better liner area of protection within the open space. This notional representation of the RPA meets the recommendations of Clause 4.6.2 and 4.6.3 of British Standard BS 5837: 2012 providing adequate levels of protection for the entire root system and root environment."*
- 2.2.5 Whilst in agreement with the RPAs for the eastern trees being terminated at the river wall on their east side, I do not agree that depiction of the trees' RPAs as squares reflects a sound arboricultural appraisal of the likely disposition of their root systems, as the nature of root growth is naturally radial from the trunk, thereby being likely to result in a generally circular disposition (subject to underlying obstructions or other factors). I also do not agree that the depiction of the RPAs in this way would result in protection *"for the entire root system and root environment"* for the reasons given above, namely that the RPA for any

tree would rarely, if ever, enclose the entirety of its root system, which can normally be expected to extend further than the limit of the RPA, and often considerably so.

- 2.2.6 Turning to the trees on the west side, the Bartlett Consulting AIA depicts their RPAs as circles centred on the trees' trunks, with no modification. The circles therefore extend across the pavement and carriageway of Millbank, in the case of the latter to half its width or further, thereby denoting that the soil volumes beneath the carriageway of Millbank are considered to represent a functioning proportion of the trees' RPAs. This is accounted for in their report as follows: *"This was deemed reasonable before the appointment of Bartlett Consulting, and maintained throughout, as the proximity of these London Plane trees to the pavement means that a proportion of each root plate will be found under the pavement. Although it will be an inhospitable growing environment for feeding roots under Millbank, root growth for stability and anchorage is entirely possible.....The notional RPA plotted in this manner will protect the entire tree root system around each tree stem....."* I note that this extract refers only to the "pavement" of Millbank, and does not advance any justification for the inclusion of the area beneath its carriageway within the trees' RPAs, despite their depictions as circles extending as far across it as they do.
- 2.2.7 I disagree with Bartlett Consulting's assessment for a number of reasons. First, it seems apparent from the wording of the extract quoted above that the judgment made as to the trees' RPAs extending under the carriageway of Millbank was not Bartlett's judgment, but was arrived at prior to their involvement.
- 2.2.8 Secondly, it is highly unlikely, in my view, that any roots of the trees will be present under the carriageway of Millbank, as the depth of typical roadway construction, the high bulk density and absent nutrient content of road construction materials, the compaction of both the construction formation and underlying soil layers, and the impermeability of the road surface to moisture percolation or gaseous exchange would all combine to render that environment hostile, indeed impenetrable, to any root growth. Studies of the architecture of tree root systems show that even when planted within pavements close to, or even adjacent to, carriageways, trees typically do not extend root growth under the road<sup>13</sup>; and in this case, the trees are located some 3m or more from the carriageway edge.
- 2.2.9 Thirdly, the suggestion that the trees may be growing structural roots in an environment where these cannot be, or have not been, preceded by feeding roots, makes little sense in terms of tree biology, as structural roots can only develop as a result of the progressive thickening of roots which initially grow as feeding roots, and later support an extensive and ramified network of the latter.
- 2.2.10 I do however agree that a proportion of the trees' rooting systems can be expected to be beneath the pavement along Millbank, as conditions beneath a paved footway and a road carriageway are very different. Typically, footway surfacing is laid on a lesser depth of sub-

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<sup>13</sup> Nicoll, B.C. & Armstrong, A. (1998), *Development of Prunus root systems in a city street: pavement damage and root architecture*, *Arboricultural Journal* 22, 259-270, amongst others.

base which is less heavily compacted. Interstices between paving slabs allow some permeation of moisture and oxygen to underlying soil, and condensation from the soil onto the lower surfaces of paving materials frequently provides a layer of available moisture which roots can utilize. However, whilst roots of the trees are likely to be beneath the pavement, to what extent these may have been traversed, severed or impacted over the years by underground services and utilities beneath the footway is unknown.

- 2.2.11 Lastly, again, Bartlett Consulting's contention that the plotted RPAs would "*protect the entire tree root system*" is not the case, for the reasons previously explained. In my opinion, therefore, Bartlett Consulting's depiction of the western trees' RPAs extending under the carriageway of Millbank is an inaccurate depiction of their disposition, and under-represents the extent to which they should be considered to occupy, and rely upon, the open grassed areas within VTG. It follows that their assessment of the impacts of the proposal, in terms of the extent to which it would encroach or impinge upon the RPAs as they have drawn them, cannot be considered reliable.
- 2.2.12 For these reasons, we have modified the RPAs of the London Planes along the western boundary of VTG to reflect the assessment that there is little, if any, likelihood of any functioning proportion of their root systems being beneath the Millbank carriageway. This results in the RPAs extending further into the open grassed areas of VTG than is shown to be the case in the applicant's submissions. I consider that the RPAs we have depicted are drawn in proper compliance with the relevant advice in BS 5837, and therefore represent a more correct basis for assessment of the UKHMLC's implications for the trees lining the west side of VTG.
- 2.2.13 There appears to be no clear justification within Bartlett Consulting's AIA for adopting an inconsistent approach to the depiction of the RPAs of the trees on the west side of VTG as circles, and of those on the east side as squares. In my opinion, there appears to be no clear reason for them being treated inconsistently, and differently from each other. We have therefore applied the same principles and process to the depiction of the RPAs of the eastern trees as we have for the western, that is to say as modified circular areas as described above in para. 2.2.3, more closely reflecting the normal radial disposition of tree root growth.
- 2.2.14 In my opinion, this is a more consistent approach, and therefore represents a more rational basis for assessment of the UKHMLC's implications for the trees lining the east side of VTG. It is right to acknowledge, however, that approached in this way, our depictions of the eastern trees' RPAs do not extend quite as far into the open areas of VTG on this side of the park as the square representations adopted by Bartlett Consulting, although they extend further to the north and south, along the line of the trees, in each case.

## 2.3 Tree impacts plans

2.3.1 Based on the tree constraints plan described and discussed above, we have undertaken an assessment of the UKHMLC proposals through a series of overlay drawings of the scheme's main elements, as a sequence of five tree impacts plans ('TIPs') which are attached as **Appendix 3**. With the exception of the last in the sequence, each drawing is presented in two formats, the first showing the relevant application drawing overlaid onto our TCP showing the trees' RPAs, and the second showing the relevant elements traced or drawn, with the application drawing removed for clarity. This was necessary due to our only having access to the pdf versions of the application plans as submitted, rather than to the original drawing files in Revit or AutoCAD. The drawings consist of the following:

**TIP 01:** Overlay showing relationship to RPAs (in four panels from left to right): 1. Tree constraints plan; 2. HMLC footprint (visitor entrance building, memorial courtyard, basement outline); 3. Hostile vehicle mitigation ('HVM') features; and 4. Main and secondary service routes, café relocation, Spicer Memorial relocation.

**TIP 02:** As above, but with the pdf scheme drawings removed and the relevant elements traced or drawn.

**TIP 03:** Overlay showing relationship to RPAs (in four panels from left to right): 1. Tree constraints plan; 2. Area of soil build-up/raising to the north of the proposed memorial fins; 3. Site set-up plan Phase 1 (Horseferry Playground); 4. Site set-up plan Phase 2 (Main site).

**TIP 04:** As above, but with the pdf scheme drawings removed and the relevant elements traced or drawn.

**TIP 05:** Drawing showing (in two panels): 1. Tree constraints plan; 2. UKHMLC footprint with tree canopies.

## 2.4 Incursions into root protection areas (RPAs)

2.4.1 For each of the TIPs 01 to 04, from the overlays we have calculated the percentage of each tree's RPA which would be occupied or impacted by the elements of each stage of the scheme proposals. The results of this exercise are set out in the table presented as **Appendix 4**. On this table, each set of columns gives the figures for the occupation or incursion by each element, the first six (from left to right) relating to: 1. The UKHMLC scheme footprint (including basement) itself; 2. The HVM measures; 3. The main and secondary services routes; 4. The Spicer Memorial relocation; 5. The relocation of the café; and 6. The soil build-up/raising to form the slope leading up to the memorial fins.

2.4.2 The seventh set of columns first presents the aggregated total percentages of each tree's RPA occupied or affected by the scheme's elements, without the element of the soil build-up/raising. The next column gives the percentage RPA infringements as assessed in Dr

Hope's report (CD 6.36) on the applicant's behalf; and the next a comparison between the applicant's figures and ours. In this column, in the case of trees where our assessed percentage is greater than the applicant's, the difference is given as a positive number in black text; in cases where our assessment is less, the difference is given as a minus figure in red text. After this, the next two columns show the aggregated total percentages including the soil build-up, followed by the resulting differences from the applicant's calculations, the text coloured according to the same convention.

- 2.4.3 For ease of comparison the results of these assessments are presented graphically in the form of the bar charts presented at **Appendix 5**. The first of these presents the results for the assessed impacts, without the soil build-up/landscaping to form the mound/slope leading up to the memorial fins. The results of our assessment are represented by the blue bars, and compared with the figures derived on behalf of the applicant and presented in Dr Hope's report, which are shown in red.
- 2.4.4 The second bar chart includes the results for all trees where we have identified a percentage occupation or impact within the RPAs, including the percentages represented by the occupation of the RPA by the soil raising/build-up, again compared with the applicant's figures.
- 2.4.5 The final three sets of columns in the table at **Appendix 4** present the assessed figures for the percentages of RPAs which will be occupied temporarily by the proposed site set-up arrangements, respectively for Phases 1 and 2 of the scheme (as set out in the Revised Construction Management Plan), with the resulting total in the final column. These are considered separately from what can be characterised as the "permanent" impacts, i.e. those which result or arise from actual physical elements or features of the scheme.
- 2.4.6 It is apparent from the results presented for the "permanent" impacts in the table and bar graphs that there are clear differences between our assessment of which trees' RPAs are likely to be affected by the proposed development, and between the relative percentages of RPA occupation and/or impact, from those presented by Dr Hope on the applicant's behalf. There are two principal reasons for these differences.
- 2.4.7 The first reason relates to the difference between the extents of the trees' RPAs as we have derived and drawn them, and those relied on by Bartlett Consulting and the subsequent reports produced on the applicant's behalf, (and by Dr Hope). As described and discussed above, our plotting of the RPAs of the London Planes on the west side of VTG results in their extending further into the open grassland of VTG than the Bartlett Consulting RPAs. In the case of the trees on the east side, however, our plotting of the RPAs, done consistently and in accordance with BS 5837 recommendations, results in their RPAs not extending as far as the square representations relied on by the applicant's advisors.

- 2.4.8 As a result of this difference, the extent of the incursions of the UKHMLC development into the RPAs of relevant trees on the west side of VTG is considerably greater than has been assessed by Dr Hope, whilst by contrast, for affected trees on the east side, it is less. Notably, however, the extents of incursion we have recorded are considerably greater, to a maximum of 29.5% encroachment, contrasting with Dr Hope' maximum figure of 13%.
- 2.4.9 The second reason for the differences between the two assessments is that the percentage RPA incursions arrived at by Dr Hope (based on plans and figured provided by Gustafson, Porter and Bowman, and reproduced in his August 2019 report) take only the UKHMLC footprint and the HVM measures into account. They do not appear to allow for, or take account of, the incursions into RPAs of trees likely to arise from the provision of the main and secondary service routes, the relocation of the refreshment kiosk/café in the Horseferry Playground, or the relocation of the Spicer Memorial, all of which elements will entail the need for excavations, to a greater or lesser extent, being required within the RPAs of a number of the London Planes, notably those within the southern part of the site bordering the Horseferry Playground.
- 2.4.10 Moreover, no account is taken in the figures presented by the applicants' advisors of the proportion of the trees' RPAs which will be subject to soil level raising to form the mound/slope rising from present levels at the north end of the site up to the memorial fins, following completion of the main construction. This is considered in more detail in Section 2.9 below.
- 2.4.11 This analysis has focussed on analysing the proportions, in area and percentage terms, of the RPAs of the trees which, on the basis of the plans and other documentation submitted, will be subject to encroachments, incursion, disturbance or other environmental alterations within them. Clearly, not all elements of the scheme will necessarily result in the same type or degree of impact, and it is therefore necessary to consider the likely implications of each, in conjunction with considering the measures identified within the applicant's submission documents aimed at mitigating their effects or impacts.
- 2.4.12 In considering these elements, however, the advice in Paras 7.1.1 and 7.1.2 of BS 5837 is pertinent, and should be firmly borne in mind. These state:
- "7.1.1. Construction within the RPA should accord to the principle that the tree and soil structure take priority, and the most reliable way to ensure this is to preserve the RPA completely undisturbed. Soil structure should be preserved at a suitable bulk density for root growth and function (of particular importance for soils of a high fines content), existing rootable soil retained and roots themselves protected.*
- 7.1.2. The ability of a tree to tolerate some disturbance and alteration of its growing conditions depends on specific circumstances, including prevailing site conditions, and in general, the older the tree, the less successfully it will adapt to new conditions."*

2.4.13 The precautionary approach adopted within BS 5837 to mature trees is reflected also in Para. A.2.2, under the heading “Extent and form of the root system”, where it states: *“All parts of the root system, but especially the fine roots, are vulnerable to damage. Once roots are damaged, water and nutrient uptake is restricted until new ones have grown. Mature trees recover slowly, if at all, from damage to their woody roots.”*

## 2.5 UKHMLC footprint and basement

2.5.1 The construction of the UKHMLC, and notably of its subterranean element, is described in the Revised Construction Management Plan (‘RCMP’) at Appendix to Volume 5 of the Environmental Statement (CD 6.30). This explains that the basement construction will require the initial excavation of the basement footprint to 1m depth in order to allow for construction of a piling mat, with the basement walls being formed by secant piling, undertaken from within the footprint outline. As the secant piling wall will be continuous, evidently any roots emanating from the trees (either to the west or to the east of the footprint) which are encountered as piling progresses will be severed, in addition to all roots which are encountered in the initial 1m excavation to form the piling mat being pruned back to the face of the excavation.

2.5.2 Although there are no references to any requirement for it in the applicant’s documentation, I understand that continuous secant piling, as proposed, normally requires the initial construction of a reinforced concrete “guide wall” on either side of the line of the proposed piles<sup>14</sup>, in order to ensure the correct spacing and verticality of the latter. I understand that the construction of the “guide wall” on the outer side of the line of piles would require excavation, to between 600mm and 1m in depth, along a line closer to the trees, severing any roots encountered within that depth. The additional proximity to the trees of the excavation required for the guide wall I believe likely to be of the order of some 500mm, or possibly more. This would increase the extent of encroachment into the RPAs caused by the excavations associated with the construction of the proposed UKHMLC basement.

2.5.3 On our assessment, based on the outer lines of the piled basement walls as shown on the application plans, and ignoring any requirement for an initial guide wall, eleven of the trees on the west side of VTG will be subject to encroachments into their RPAs as a result of the basement and courtyard excavations of between 2% up to 17.8%, contrasting with a maximum encroachment of 13.04% (tree 71018) as presented in the applicant’s documentation. On the east side, our depiction of the trees’ RPAs suggests that the excavations will lie just beyond their limits, but this contrasts with a maximum encroachment of 11.55% of the RPA, (for tree 70006) as assessed on behalf of the applicant, based on the applicant’s differing depiction of the trees’ RPAs on this side of

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<sup>14</sup> As illustrated diagrammatically in the following examples: <https://www.youtube.com/watch?v=UF9FLUioZv8>; <https://www.youtube.com/watch?v=oTCXN39PONY>; <https://www.youtube.com/watch?v=IKrQwF4f3Pg>.

VTG as squares or rectangles. Taking account of the likely additional need for an initial guide wall, these encroachments would increase to between 3.2% and 20.1%.

2.5.4 BS 5837 advice on the siting of structures within RPAs is clear. It states:

*“5.3.1. The default position should be that structures (see 3.10) are located outside the RPAs of trees to be retained. However, where there is an overriding justification for construction within the RPA, technical solutions might be available that prevent damage to the tree(s) (See Clause 7). If operations within the RPA are proposed, the project arboriculturist should:*

*a) demonstrate that the tree(s) can remain viable and that the area lost to encroachment can be compensated for elsewhere, contiguous with its RPA;*

*b) propose a series of mitigation measures to improve the soil environment that is used by the tree for growth.”*

2.5.5 In my opinion, what has not been demonstrated in this case is that the requirements of clause (a) above, namely that the extent of the areas lost to encroachment as a result of the excavations for the UKHMLC into the RPAs of the affected trees on either side of VTG can be compensated for by the existence or provision of contiguous rooting volume elsewhere. There are no available compensatory rooting areas available to the trees contiguous with their RPAs away from the areas of encroachment, as they are prevented from being so by the presence of the River Thames and its retaining wall on the east side, and by the carriageway of Millbank on the west side. I am of the opinion that in the circumstances of this site, the recommendations of para. 5.3.1 (a) of BS 5837 cannot therefore be satisfied.

2.5.6 Much is made, in the applicant’s submissions and in Dr Hope’s report in particular, of the capacity of London Plane to tolerate disturbance and to pruning of its crown and roots, and experience shows that the species is more tolerant than many in these respects. However, in my opinion this does not provide adequate support for Dr Hope’s assertion, in para. 6.50 of his report, that *“As mentioned throughout this review the use of RPAs should only be used as guidelines, i.e. to aid design. As such, it is reasonable to provide some flexibility into the encroachment of construction in relation to trees. The typically accepted flexibility is between 10% and 20% of the overall Root Protection Areas.”*

2.5.7 I consider the first sentence of this paragraph is manifestly incorrect, as the provisions of BS 5837 in respect of the RPA run as a golden thread through the entirety of the guidance, from design through to the practical implementation of schemes on sites, and all the protective recommendations embodied within the document are expressed in terms of the safeguarding of the RPA, as has been shown. Secondly, Dr Hope’s contention as to 10%-20% of the RPA being *“typically accepted”* as being capable of being impacted upon without risk is also not correct, as the relevant recommendations cited above make clear, in relation to the necessity for adequate contiguous rooting volume to be provided in order

to compensate for significant RPA encroachments. In this case, the “flexibility” of 10%-20% of the RPA suggested by Dr Hope as being acceptable for encroachment by excavation or construction is simply not available, as has been shown.

- 2.5.8 It is fair to note, however, that Bartlett Consulting has proposed a programme of soil improvement and treatment measures designed to mitigate the impact of the anticipated root pruning/severance and promote the recovery of the trees thus affected, thereby responding to the requirements of para. 5.3.1 (b) as cited above. However, for the reasons given below and discussed in a later section, it is not clear that these measures will be sufficient to provide adequate assurance of the trees’ continued viability.
- 2.5.9 Irrespective of the assessed degrees of RPA encroachment arising from the excavations for the UKHMLC basement and courtyard, in any event the physical evidence reported and presented in the Bartlett Consulting AIA indicates that roots of diameters of over 25mm will be severed, emanating from trees both on the west and east sides of the park.
- 2.5.10 Within the Bartlett Consulting AIA and AIA Addendum (CD 6.22) (on page 19 of the latter), a schedule of the roots likely to be encountered and requiring pruning within the first 1m depth of excavation is set out, based on Canopy Consulting’s trial excavation trench investigations undertaken in September 2018. The schedule identifies a range of roots of diameters ranging between 15mm up to 100mm (10cm), but most within the range 30mm to 50mm, which will require to be cut back, and a note beneath it suggests that roots of similar sizes and depths would be encountered emanating from five other trees on the east side of VTG which were not encompassed within the scope of the trial excavations. As the trial excavation trenches were dug to a depth of 1m, clearly any roots of appreciable diameter deeper than this are not specifically identified.
- 2.5.11 The roots of larger diameters than 25mm recorded and listed in the Bartlett Consulting AIA as emanating from the trees on the east side of VTG (trees 70006 to 70015) occur at or just beyond the perimeters of the RPAs of trees on this side of the park, as we have depicted them. This confirms the distinction made in the earlier discussion between the overall extent of a tree’s root system, as opposed to the extent of its RPA, and also suggests that the extent to which the root systems of the London Planes are relying on the open areas within VTG beyond their RPAs is greater than might be expected. In the case of the trees on the west side of VTG, the roots identified by Bartlett Consulting are well within the trees’ RPAs as we have depicted them, and to a greater extent than has been assessed by the applicant’s advisors.
- 2.5.12 It is normally considered that the pruning of roots of 25mm diameter or less in the course of excavations is unlikely to result in any significant impact on a tree’s health or vitality, unless they are in large numbers or in dense clusters, and this is reflected in BS 5837 advice at para. 7.2.3., which states “*Roots occurring in clumps or of 25mm and over should be severed only following consultation with an arboriculturist, as such roots might be essential to the tree’s health and stability*”. This is logical, as it can be reasonably assumed that a

tree root of, say, 50mm diameter will only have achieved that size as a result of it supporting, and being supported by, a substantial branching network of finer roots emanating from points more distally along its length. The severance of the larger root would obviously therefore deprive the tree of the sustenance, in terms of moisture and nutrient uptake, being provided to it by that network; and the larger the network interrupted, the longer it would take the tree to recover the loss by growing new roots from the severed end, assuming (a) it was capable of doing so, and (b) there remained an available soil volume in which to do it.

- 2.5.13 Within the AIA and AIA Addendum, Bartlett Consulting acknowledge that *“Where the larger roots (10 centimetre diameter) will be pruned, or where there are a higher number of roots pruned in the area of the basement box, it would be reasonable to expect some dieback and decline in the parent tree.... As mature trees, these London Plane trees may be more susceptible to physiological stress due to root pruning.”* This is at variance with Dr Hope’s optimistic prognosis that the affected trees would be able to tolerate the extent of root severance required without any harm at all, a contention for which no real evidence is advanced in its support.
- 2.5.14 On this basis, I consider that the piling and excavations required for the construction of the UKHMLC basement and memorial courtyard represent a clear risk of causing harm, in the form of dieback and possible decline, to the London Planes on the western boundary of VTG which would be affected by them, due to the significant encroachments into their RPAs which the proposed excavations would entail. As well as causing direct severance and loss of significant roots within their RPAs, the presence of the basement walls would represent a permanent loss of available rootable soil volume for these trees, which would inhibit their capacity to recover effectively from injury through new root growth. Although on our assessment the excavations would be beyond the limits of the RPAs of trees on the east side of VTG, the evidence presented on the applicant’s behalf suggests that the possibility of harm to them cannot be fully discounted.

## **2.6 Hostile Vehicle Mitigation (HVM) measures**

- 2.6.1 The proposed Hostile Vehicle Mitigation (HVM) measures, and their siting within the RPAs of all the London Planes along the west boundary of VTG, are illustrated in the third panel on our drawings TIP 01 and 02. Based on the description and dimensions provided in the AIA Addendum, the areas of occupation of the trees’ RPAs by the foundations for each number and type of bollard, line post and raft foundation proposed as part of the system have been calculated and added into the relevant columns in the appended schedule.
- 2.6.2 As is correctly noted in the Bartlett Consulting AIA, the layout of VTG means that all the features required for the HVM system will be sited, and thus require excavations, within the RPAs, and in the majority of cases, within the radii of their structural root plates (which I believe is what is referred to by the term ‘critical rootzone’ within the Bartlett Consulting AIA). It is maintained by Bartlett Consulting that the obvious scope for direct damage being

caused to tree roots very close to the trees' trunks can be mitigated by a degree of flexibility as to the exact positioning of the intermediate bollards, and that as currently proposed, the foundation slabs or rafts will not exceed 400mm depth for the intermediate and line posts (types C1 and C2), and 600mm depth for the collapsible bollards (type B). The suggestion is that if limited to these relatively shallow depths, the risk of the foundations encountering, or requiring the severance of, larger structural roots is reduced.

- 2.6.3 These dimensions are shown in the schematic sections presented at page 47 of the AIA Addendum, although in the case of the collapsible bollard Type B, a raft depth of 400mm rather than 600mm is illustrated, and there is no cross-section shown for the proposed end posts (type C3), which one might suppose may require a more robust foundation, as they are proposed to act as the anchors for the steel cable slings to be strung along the line of intermediate posts. The page of these indicative sections also carries the caveat that *"The detailed structural design of the foundations is to be completed at the next stage of work"*, which suggests the possibility of design changes being evolved which could result in increases in sizes or depths of the foundations required.
- 2.6.4 Protective measures proposed within the Bartlett Consulting AIA include supervised hand excavation for the foundation slabs, and lining of the excavations with an impermeable membrane prior to concrete being laid or poured, to prevent the risk of toxic leachate into the trees' rooting zones. The proposals are also supported by a programme of further trial excavations, in the form of trenches and trial pits, having been undertaken by Canopy Consulting in numerous locations along the proposed line of the HVM and at the proposed vehicle entrances, which, it is stated, did not reveal significant numbers of larger roots within the depths to which they were dug (600mm) (Appendix B to CD 6.22).
- 2.6.5 Notwithstanding these considerations, as the Bartlett Consulting AIA notes, *"This aspect of development, through the loss of soils and rooting environment, as well as the potential for root pruning, will have impacts on the London Plane trees and their growing environment. However, the overall design can be altered to suit the existing site conditions by utilizing existing areas of hard standing and to purposely avoid tree stems and any identified tree roots lessening potential impacts."* I agree with the first sentence of this extract; but in relation to the second, it has not been demonstrated in any document I have seen how, given the priority likely to be demanded by the need to ensure satisfactory security to the site's perimeter, flexibility over the siting and construction of the HVM elements would be achieved in practice, if the scheme were to proceed. In my opinion, therefore, whilst their total area is not large, the provision of the HVM measures falls to be considered as an impact which cumulatively adds to those assessed in previous and subsequent sections, and as a potentially significant risk to the wellbeing of the trees along the west boundary of VTG, due to their centrality within the trees' RPAs and root plates, and proximity to their trunks.

## 2.7 Underground services

- 2.7.1 Two service routes or corridors for underground utilities and drainage runs are proposed to serve the UKHMLC. As shown on pages 44 and 45 of the AIA Addendum (CD 6.22), these comprise a main service route commencing from the extreme southern end of the site, thence running northwards centrally to connect with the memorial at the Entrance Pavilion, and then running along the east side of the Memorial Courtyard into the Learning Centre Basement. A secondary service route is also proposed on the west side of the UKHMLC, connecting to existing services within the public footway and roadway of Millbank, exiting the site between trees 71017 and 71018.
- 2.7.2 In the AIA Addendum (page 19), Bartlett Consulting describe the main service route as requiring a 2m width and 1m depth of excavation, to contain six principal services. It is stated that the services concerned would not require rigid conduits, but would be capable of remaining flexible to allow for tree roots. It is further stated that in order to avoid damage to the roots of trees through whose RPAs the service route would pass, a suitable excavation technique – the “hand-dug broken trench technique” described in the National Joint Utilities Group (‘NJUG’) publication Volume 4: Issue 2, *Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees* (CD 4.15) would be required<sup>15</sup>.
- 2.7.3 The secondary service route is described as being also 2m in width and 1m in depth, enabling installation of two communications, two electricity, and one mains water services. It is stated that the route of emergence to Millbank is within an area of existing hard surfacing, but at a proposed depth of 1m, the route would almost certainly require excavation beneath the depth of the existing hard surface, so the presence of the hard surfacing is not a factor that would mitigate any potential impact of the excavation on any roots of trees 71017 and 71018, within their RPAs, present beneath it. As with the main service route, Bartlett Consulting state that the use of the specified NJUG technique would be required, and that *“Final working details will be provided in the Construction and Arboricultural Method Statement”*. As far as I am aware, this is not a document that has been submitted during the application process, and possibly it does not yet exist. The Revised Construction Management Plan (CD 6.30) is silent on how the services are to be installed, so it is not clear to what extent this document can be relied upon to ensure that the services are installed in a manner that prevents damage being caused to the trees concerned.

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<sup>15</sup> The “hand-dug broken trench technique” is described in the NJUG document as follows: *“This technique combines hand dug trench sections with trenchless techniques if excavation is unavoidable. Excavation should be limited to where there is clear access around and below the roots. The trench is excavated by hand with precautions taken as for continuous trenching as in (c) below. Open sections of the trench should only be long enough to allow access for linking to the next section. The length of sections will be determined by local conditions, especially soil texture and cohesiveness, as well as the practical needs for access. In all cases the open sections should be kept as short as possible and outside of the Prohibited Zone.”* The “Prohibited Zone” in the NJUG guidance is an area within 1m of a tree’s trunk, within which no excavations should be dug at all, *“unless full consultation with the local authority Tree Officer is undertaken”*.

- 2.7.4 The details described by Bartlett Consulting are, moreover, at variance from those illustrated on the plans and schematic cross-section at pages 44 and 45 of the AIA Addendum (CD 6.22), (these being the drawings on which we have based our assessment). The plan on page 44, in addition to the services for the secondary route as described by Bartlett Consulting, also show a proposed foul drainage run emerging from the UKHMLC footprint opposite a point between trees 71014 and 71015, and running along the outside of the basement footprint, then turning at right angles to exit the site between trees 71017 and 71018, and thus within the RPAs of a total of five of the London Planes (71014 to 71018 inclusive). It is not stated at what depth this drainage run would be required to be installed. However, it can reasonably be inferred that it would require a further trench excavation outside the footprint of the basement box of the UKHMLC, thereby further exacerbating potential impacts on the root systems of trees 71014 to 71017, over and above the incursions already calculated as resulting from the secant piling wall of the UKHMLC basement (ignoring any requirement for an initial guide wall).
- 2.7.5 It is worth also noting also that the plans presented on both pages 44 and 45 of the AIA Addendum omit depiction of trees 70000, 70001 and 70002 on the east side of the Horseferry Playground, notwithstanding that the RPAs of these three trees will inevitably be traversed by the main service route. Moreover, the text on these pages makes no reference to the need for any special techniques for their installation, stating merely that the route *“will be surveyed prior to construction by a suitably qualified arboriculturist.”* Also, and worryingly, it is stated that notwithstanding the proposal being for a corridor confined to a 2m width, each service will be *“independently laid, allowing routes to be surveyed, proven and changed.”* (Emphasis added). This suggests the possibility of different services being provided along different routes by different service providers, and a risk of multiple excavations being required within these RPAs as a consequence. I consider that this does not provide adequate assurance that potentially serious damage to the roots of the trees, whose RPAs are intersected by the proposed main service route, can be appropriately prevented or mitigated.
- 2.7.6 The details provided in the AIA Addendum therefore fall significantly short of the recommendations in BS 5837 relating to the installation of underground services, and it is worth citing these for comparison:
- “7.7.1. Mechanical trenching for the installation of underground apparatus and drainage severs any roots present and can change the local soil hydrology in a way that adversely affects the health of the tree. For this reason, particular care should be taken in the routeing and methods of installation of all underground apparatus. Wherever possible, apparatus should be routed outside RPAs. Where this is not possible, it is preferable to keep apparatus together in common ducts. Inspection chambers should be sited outside the RPA.*
- 7.7.2. Where underground apparatus is to pass within the RPA, detailed plans showing the proposed routeing should be drawn up in conjunction with the project arboriculturist. In such cases, trenchless insertion methods should be used (see Table 3), with entry and*

*retrieval pits being sited outside the RPA. Provided that that roots can be retained and protected in accordance with 7.2.2, excavation using hand-held tools (see 7.2.1) might be acceptable for shallow service runs.”*

- 2.7.7 For these reasons, and in the light of the calculated areas of encroachment into the RPAs of trees towards the south end of the site affected by the main service route (trees 70000-70002, 71023, 71024 and 71026), and the additional encroachments into the RPAs of five trees to the west of the UKHMLC (trees 71014 to 71018), I consider that the proposed service routes pose a risk of significant damage being caused to them, either in themselves or cumulatively when considered in conjunction with other impacts. It has not been demonstrated that the NJUG “broken trench” technique would be suitable or feasible for each of the different service types proposed, or that it would provide sufficient assurance that damage could be satisfactorily averted. I therefore consider that appropriate or adequate safeguarding against this risk has not been provided for, in the documentation submitted on behalf of the applicant.

## **2.8 Relocation of Spicer Memorial and refreshment cafe**

- 2.8.1 In order to accommodate the UKHMLC in its proposed siting, the proposals require the relocation of the Spicer Memorial to a position southward of its present location, and replacement of the existing refreshment kiosk/café with a new structure located at the southern end of the Horseferry Playground, which is to be re-configured within a reduced area.
- 2.8.2 The relocation of the Spicer Memorial is considered by Bartlett Consulting in the AIA Addendum (CD 6.22) (page 16). In relation to the dismantling of the Memorial in its current location, Bartlett Consulting recommend that all plant and equipment are restricted to working from areas of existing hard surfacing around it, and that its present foundations below ground are either left *in situ* and covered over, or carefully broken out using hand tools only, to prevent damage to any tree roots which are either present immediately adjacent to it or beneath it, or which have grown into the foundations. I agree that these recommended measures are sensible and appropriate.
- 2.8.3 Bartlett Consulting also recognize that the proposed location to which the Spicer Memorial is to be moved will require excavations to provide new foundations for it, and that these will be within the RPAs of London Planes both to the west and east (specifically trees 70002, 70003, 71023 and 71024), thus posing a risk of roots of these trees being encountered. Accordingly, they acknowledge that the new foundations would need to be “*of a low impact and bespoke design, utilising modern building techniques*” and that they will need to be “*loadbearing to prevent any new soil compaction or disturbance*”. However, no detailed recommendations are given, and no consideration appears to be given to any potential implications of the provision of the replacement café.

- 2.8.4 Some further information, however, is presented later in the AIA Addendum (page 39), which shows an indicative cross-section of the proposed foundation for the relocated Spicer Memorial (and another of proposed benches around the Buxton Memorial). In the accompanying text, it is stated that “Any foundations for low benches, street furniture, railings and the Spicer Memorial have been minimised by the use of cell web to form the sub base”, but this conflicts with what is shown in the cross-sections, which show the Spicer Memorial structure being founded on what appears to simply be a 300mm deep concrete foundation (although this is not actually labelled as such). The text goes on to say that further detailed design will be undertaken for the depths of the various foundations but that it is “*anticipated*” that they will not need to be deeper than 300mm. No cross-section detail is shown for the foundation of the replacement café.
- 2.8.5 In my opinion, the measures outlined are ill-defined, vague, and do not provide satisfactory assurance that potentially appreciable root damage would not occur as a result of the excavations necessary for the construction of these features, particularly when considered in combination with other identified impacts. In the case of tree 70000, for example, the proposed café footprint occupies 7.2% of its RPA, which when combined with the 10.7% occupation of its RPA by the main service corridor, brings the total of its RPA affected by the proposals to almost 18%, which is a significant proportion. There is no basis for assuming that larger roots would not be encountered at shallow levels beneath the existing hard surfacing within the areas proposed; and indeed there are factors relating to tree rooting behaviour under pedestrian hard surfacing which can render this more likely, as discussed in para 2.2.8 earlier in this report<sup>16</sup>. Although the features themselves are relatively small components of the proposals, therefore, their construction nevertheless has the capacity to result in harm to the trees affected.
- 2.8.6 Finally, it is worth remarking that issues relating to the HVM, the provision of services to the UKHMLC, or the relocation of the café and of the Spicer Memorial do not appear to be considered or discussed anywhere in Dr Hope’s report of August 2019.
- 2.8.7 For these reasons, in my opinion the proposed relocation of the Spicer Memorial and construction of the replacement café present a risk of damage being caused to the root systems of trees 70000, 71023 and 71024 in the southern section of the site, which in combination with other impacts could adversely affect their physiological health and viability.
- 2.8.8 As noted earlier, late on the 2<sup>nd</sup> September 2020 a draft Arboricultural Method Statement (‘AMS’) relating to the relocation of the Spicer Memorial was provided by the applicant. At the date of writing, there has not been sufficient time to consider this document, or to conclude whether it satisfactorily addresses any of the concerns identified. If appropriate, a supplemental proof will be provided on this matter.

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<sup>16</sup> And in Roberts, J., Jackson, J., & Smith, M. (2006), *Op. cit.*; Nicoll, B.C. & Armstrong, A. (1998), *Op. cit.*

## 2.9 Soil build-up/ new landform

- 2.9.1 Following completion of construction of the built elements of the UKHMLC, the proposals envisage the alteration of the landform of VTG northward of the Memorial fins by the soil levels being progressively raised from their present levels to form a sloping profile up to them. Within the AIA Addendum, this is illustrated in plan on page 36, with indicative cross-sections on page 37. From comparison of the existing and proposed levels on the plan shown, it can be inferred that the extent of soil raising will be to a maximum of around 5.7m above existing levels, although this will be gradual and progressive over the area concerned. The rate of rise, and steepness of resulting gradients to the east and west, will be greatest at the southernmost end of the area affected, as illustrated in the cross-sections on page 37.
- 2.9.2 Build-up or raising of soil levels (grade) above existing levels within the rooting zones of trees can have damaging, and in some cases even fatal effects. Symptoms of damage caused typically appear as progressive crown decline over varying periods of between several months to several years. Depending on the severity of damage, this may be followed by dieback of large branches, and eventual tree death. This may occur because the raising of soil levels essentially causes root asphyxiation – the addition of soil fill compacts the soil, reducing the amount of soil pore space, inhibiting gaseous exchange between the roots and soil pores, thus preventing normal root respiration. The severity of effects will vary according to the type and depth of soil used for the fill, the extent of any associated root or soil disturbances, and the age and species of tree, with (as ever) mature or over-mature trees being most susceptible and less easily able to adapt to the changed conditions<sup>17</sup>.
- 2.9.3 The extent the RPAs of the London Planes in VTG proposed to be affected or occupied by the raising of soil levels is not assessed or quantified in the AIA Addendum. The only comment made in respect of any potential impact occurs in the Bartlett Consulting text on page 22, which simply says: *“The proposed landforms will include a network of French Drains, as well as a SUDS, to ensure the continued filtration of water through to the original soil level and tree root system, as well as continued exchange of gases with the original soil. These will also be finalised in the Construction and Arboricultural Method Statement.”* No consideration appears to be given to the potential effects of the nature of the fill material to be used, the extent of compaction likely to arise over the affected area as a result of the varying depths of additional fill, and associated levelling or grading operations (which can be expected to increase compaction, as it will be necessary to produce a surface useable by pedestrians and, presumably, grounds maintenance vehicles subsequently); or to the extent to which the proposed soil raising could compound other adverse effects

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<sup>17</sup> Smiley, E.T. (undated), *Preventing Grade Change Damage to Trees*, Research Laboratory Technical Report, Bartlett Tree Experts; Helliwell, D.R. & Fordham S.J. (1992), *Op. cit.*; Roberts, J., Jackson, J., & Smith, M. (2006), *Op. cit.*

arising from construction (such as root severance from excavations etc.). This seems surprising, particularly in view of the provenance of the first of the references cited above.

- 2.9.4 Dr Hope also treats the matter lightly. At paragraph 10.11 of his report, he states: *“The minor increased height level will not affect the roots of the trees, as they will be outside the RPAs. It is recommended that any additional soil placed on the current ground level should be free-draining so as to allow adequate moisture and air to percolate, thus preventing any adverse impact on the trees. Appropriate soil textural analyses could be identified prior to the construction commencing so as to ensure that the trees are not harmed.”*
- 2.9.5 It is not correct that the area of soil raising will be *“outside the RPAs”*, as the second panels on our drawings TIP 03 and TIP 04 clearly show. The proportions of the RPAs occupied are in most cases significant – of the 22 trees identified, nine will be affected over between 20%-30% of their RPAs, seven to between 30% and 40%, and one to over 40% (tree 70015, at 44.6%). It is acknowledged that in the case of trees towards the northern end of VTG the degree of level raising may be relatively small, but further southward it will be progressively more substantial.
- 2.9.6 It is also not clear from the applicant’s submissions what is proposed in respect of trees 71027 and 71028, which stand on the inner side of the perimeter pathway on the west side of VTG, and thus will be entirely within the area proposed for the landform alterations and soil raising. These two trees (a Wild Cherry and a Crab Apple) do not feature on any of the applicant’s drawings or plans, although they are clearly present as landscape features within VTG. Comparison of the existing and proposed levels suggests that the soil fill would raise levels around their trunks by between 0.12m and 0.27m, covering the full extent of the RPA in the case of tree 71028, and the great majority in the case of tree 71027 (78.9%, with the remainder of its RPA being beneath the adjacent path), with fill extending to their trunks. No reference is made to these trees, and no measures are proposed in respect of protecting them, so it is reasonable to infer that either they are proposed to be removed<sup>18</sup>, or, alternatively, that they have simply been overlooked throughout the entire process of the UKHMLC’s design evolution<sup>19</sup>.
- 2.9.7 Of the 22 trees potentially affected by the proposed landform alterations (24 if one counts trees 71027 and 71028), eleven can be identified where the occupation of their RPAs by the soil raising adds cumulatively to the proportion of their RPAs encroached upon or impacted by other elements of the scheme. These are trees 71005 to 71015, along the west boundary of VTG, all of which are variously affected by the basement and courtyard excavations, and/or by the proposed HVM measures. I therefore consider that the proposed alterations of the landform increase the risks of long-term harm being caused

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<sup>18</sup> The initial draft SoCG on tree issues received from the applicant on the 3<sup>rd</sup> July 2020 stated that this is indeed the case (although the two trees were not identified by their numbers). However, to the best of my knowledge, there is no reference to this proposal in any earlier arboricultural documentation submitted with the application.

<sup>19</sup> This was confirmed by the applicant’s advisors at the meeting on the 3<sup>rd</sup> September 2020 to discuss the draft Trees SoCG.

already identified. In the case of the affected trees on the east side of VTG, the soil raising poses a risk of adversely affecting the trees' growing conditions, to an extent that could impair their long-term health.

- 2.9.8 Whilst the measures suggested in Dr Hope's report could potentially mitigate the additional risks to some extent, these do not appear to have been embodied within other plans or documentation submitted on the applicant's behalf. Within the Bartlett Consulting AIA and AIA Addendum, there is reference to suitable measures being embodied within the "*Construction and Arboricultural Method Statement*", but as noted previously, this is not a document that has been submitted during the application process, and possibly it does not yet exist.

## **2.10 Construction site set-up and management**

- 2.10.1 Details of proposed site set-up and management are described in the RCMP (CD 6.30), with illustrative plans of the proposed arrangements. We have considered these as a separate exercise from the assessment of likely "permanent" impacts of the UKHMLC scheme, as the occupation period of the relevant parts of VTG will be of a temporary nature. However, as is well known, significant adverse effects on trees can be caused by temporary operations or activities within construction sites. Principal among these is root damage arising from trafficking by plant and vehicles, either resulting from tracking on unprotected or unsurfaced ground causing direct root severance by wheel or track rutting, or indirectly, through soil compaction resulting in root asphyxiation and consequent tree decline or death. Soil compaction is also frequently caused by stockpiling of heavy materials (particularly spoil or loose materials) on ground within RPAs which is not adequately protected by suitable temporary measures. Adverse effects are also frequently caused by uncontrolled spillages of phytotoxic materials, including diesel, oils, wet cement/concrete, and others.
- 2.10.2 In this context it is important to bear in mind how quickly and easily soil compaction can be caused. In recommending the installation of effective temporary ground protection on construction sites (in addition to protective barriers or fencing) from the very outset of site occupation, para. 6.2.3.5 of BS 5837 warns: "*In all cases, the objective should be to avoid compaction of the soil, which can arise from the single passage of a heavy vehicle, especially in wet conditions, so that tree root functions remain unimpaired.*" Similar emphasis is given to the importance of avoiding and preventing soil compaction at other relevant points within the document.
- 2.10.3 In order to consider the potential effects of the temporary occupation of VTG for the purposes of construction of the UKHMLC, we have overlaid the two site set-up plans illustrated in the RCMP onto our TCP, and calculated the extents of the trees' RPAs which they are proposed to occupy. The results are tabulated in the final three columns of the schedule at **Appendix 4**.

- 2.10.4 Phase 1, as proposed, involves the construction of a temporary vehicle access from Millbank, close to the junction with Horseferry Road and Lambeth Bridge, between trees 71025 and 71026. It is proposed that this is constructed using a temporary form of roadway using a cellular confinement system such as Cellweb. Details of whether the relative levels will be suitable for use of this type of surfacing, or of the depth of Cellweb required for the loadings anticipated, are not specified.
- 2.10.5 The indicative layout of the proposed Phase 1 site shown in the RCMP, as with some other drawings of this end of the site which have been submitted, ignores the presence of trees 70000, 70001 and 70002 on the east side of the Horseferry Playground, and therefore also their RPAs. Materials storage is shown to be on this side of the site, close to the trees concerned, and it would therefore appear that their RPAs have not been taken into account. This is confirmed by the statement that: *“an area for unavoidable material storage has been identified in the above figure, avoiding RPA’s.”* I accept that the majority of the Phase 1 area is under existing hard surfacing, which in itself will provide a degree of protection to underlying roots, but depending on the loadings of plant, machinery or materials required, additional reinforcement of temporary ground protection may be necessary, and it is concerning that those drafting the RCMP seem not to have appreciated the presence, or significance, of three large mature London Plane trees on this side of the site.
- 2.10.6 The statement that *“This phase will not require significant excavation”* also appears at odds with the fact that, in addition to any changes to hard surfacing required for the reconfiguration of the playground, this phase includes excavations for the foundations of the replacement café, excavations for the relocated Spicer Memorial, and (presumably) will include excavations for the main service route(s) to the UKHMLC, the potential impacts of which have been considered above.
- 2.10.7 The indicative plan for the Phase 2 construction site also proposes a temporary vehicle access, but utilizing and widening an existing pedestrian access between trees 71009 and 71010. A Cellweb form of construction is again invoked as the means whereby this can be achieved without adverse impacts on the trees either side, but similarly little detail is given. Due to the incorrect representation of the RPAs of the London Planes along the west boundary of VTG within the applicant’s AIA and other plans submitted, the western hoarding line of the proposed Phase 2 site intersects greater proportions of these than is assumed in the RCMP. From the drawing presented, it appears that the western line of the proposed site hoarding is drawn immediately abutting the western edges of the proposed memorial courtyard and UKHMLC basement. I consider this is unlikely to prove to be practical in reality, given the likely requirements for construction working room associated with the secant piling operation, and particularly if (as seems very likely) the construction of an initial guide wall is required for this.
- 2.10.8 To the east, significant parts of the RPAs of trees on the east boundary are included within the construction site, as the RCMP states: *“These areas of ‘exposed’ eastern RPAs will also*

*be required for construction access, however they will be appropriately protected as discussed in subsequent sections.”* It is not made clear why such a broad swathe of ground down the eastern side of the site would be required for this access, involving as it does encroachments of up to 28.7% (tree 70010) of the RPAs of trees on this side of the site. Construction of a Cellweb surface is again proposed as the solution, but again insufficient specification is given to allow one to conclude that this will be adequate to prevent significant compaction of the underlying soil within the trees’ RPAs, or inhibition of their root functioning, over the duration of the proposed construction period of 32 months overall (equivalent to two full growing seasons and possibly three).

- 2.10.9 Towards its north-west corner, the proposed disposition of the Phase 2 site as shown also fails to take into account the presence of the London Plane trees 71006 to 71008, the trees omitted from the Bartlett Consulting February 2018 survey, as it both encroaches into their RPAs, and the site welfare facilities are also proposed in this location. Similarly, the presence of tree 71027 has not been accounted for, and it is likely that erection of the hoarding along the line proposed would require it to be (at least) severely cut back in order to allow for the hoarding.
- 2.10.10 I recognize that in both cases (Phases 1 and 2) the proposed construction site plans could be amended or adjusted to rectify these deficiencies, and thereby provide a greater level of assurance that the RPAs of the trees could be satisfactorily protected and safeguarded during the construction period. However, the question which would then arise is whether an area reduced in this way, and in the locations identified as being necessary, would still yield a sufficient area for the UKHMLC construction operations to be feasible or practical, particularly in the context of the large volumes of soil excavation in Phase 2 which are anticipated to be required, and their export from the site (be this by road or by river, which as yet does not seem to have been finally determined).
- 2.10.11 As currently indicated, therefore, in my opinion it is not possible to be satisfied that the construction site arrangements would not result in adverse effects on the trees within VTG, thereby posing the risk of compounding or exacerbating the impacts of the permanent elements of the scheme already discussed.

## **2.11 Above-ground effects – tree canopies**

- 2.11.1 The extent of overhang of the canopies of the London Planes over the footprint of the UKHMLC footprint, based on the crown spread measurement of our re-survey, is illustrated on our drawing TIP 05. Comparing this with the specification for canopy pruning required set out by Bartlett Consulting in the AIA Addendum (page 15), I agree that the trees listed as being likely to require some crown lifting in order to facilitate access and overhead clearance for construction purposes are correctly identified, although on our analysis, the addition of trees 71012 and 71018 on the west side of VTG appears also likely to be necessary. By contrast, it seems unlikely that trees 70011 and 70012, on the east side of VTG, will require any facilitative pruning.

- 2.11.2 In terms of the extent of pruning necessary, I also agree that this is unlikely to be significantly damaging or disfiguring to the trees concerned. However, this appears to be dependent on the commitment in the RCMP to utilise a type of low headroom piling rig that can be deployed beneath the trees' canopies, thereby reducing the likelihood of contact between the piling rig and the outlying branches of trees above it. This is referred to in the RCMP as the 'Martello technique', although it appears that Martello is in fact a company which offers a wide range of rigs and techniques for piling of differing types and for different situations. On page 28 of the RCMP, within a schedule of the plant and equipment to be deployed in the construction of the UKHMLC, a MP4000 Martello Piling Rig is specified. From Martello Piling's website, this appears to refer to a series of rigs (MP4001 to MP4004) of heights between 3.5m and 5.8m, which operate an "open hole" rotary bored piling system.
- 2.11.3 However, within the applicant's Structural Methodology Statement by WSP (CD 6.7, Part 1, pages 18-20), it is stated that the secant piled wall for the UKHMLC basement would be formed using 900mm diameter piles at 650mm centres, extending to a depth sufficient for the c.11m depth of the basement excavation, using cased CFA (continuous flight auger) piles. On page 28 of the RCMP, a Bauer MBG12 piling rig is also specified (in addition to the MP4000 rig). According to a product sheet found online for this piling rig<sup>20</sup>, for CFA piling this rig has an operating height of 15.4m. This operating height would appear to conflict with the overhanging canopies of the trees on the west side of VTG to a greater extent than appears to have been envisaged by Bartlett Consulting.
- 2.11.4 From case studies presented and discussed on Martello's website, it is not clear that the use of cased CFA piles is compatible with the deployment of a low headroom piling rig, and it appears likely that the taller piling rig would be necessary. It also seems clear, moreover, that irrespective of the precise piling technique utilised (CFA or "open hole" rotary bored piling), a guide wall would be required, the adverse implications of which for the extent of excavations necessary (and concomitant additional incursion into RPAs) are considered earlier.
- 2.11.5 It is not clear, therefore, whether the use of the low headroom piling rig, as proposed in the RCMP, is compatible with the engineering requirements for the use of cased CFA piles, as proposed in the Structural Methodology Statement. However, if indeed it is so, the use of a low headroom piling should be guaranteed, in the event of the scheme being permitted, through the imposition of appropriate conditions, or via a suitable undertaking on the developer's part. If on the other hand it is not, the potential impacts on the overhanging trees' canopies need to be re-assessed accordingly.
- 2.11.6 A further aspect of potential impact on tree canopies, however, relates to the Phase 2 construction site plan discussed in the preceding section. The intended provision of a broad strip of construction access down the eastern side of the scheme, in my opinion,

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<sup>20</sup> <http://pile-design.com/Pictures/Bauer.pdf>

might result in the need for additional pruning or crown lifting of trees overhanging this access (trees 70009 to 70015, and possibly also those southward of the Buxton Memorial), depending on the clearance height or headroom of the plant or vehicles for whose use it is intended. This does not appear to have been assessed. This concern was also reflected in the Planning Sub-Committee report, where it was stated: *“While the proposals for pruning are not contentious, the need for additional pruning for operational, site logistics and construction management reasons, or in order to account for dieback or dysfunction in the tree canopies as a result of the cumulative impacts of the proposal, are likely to be greater than identified.”* In the absence of more detailed information relating to the need for and use of this proposed access, this remains a concern (in addition to effects on the RPAs of the trees in question).

### 3. Other considerations

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#### 3.1 Root investigations

- 3.1.1 Information has been submitted with the application documents relating to investigation of the disposition of the roots of the London Planes within VTG, and this is relied upon in large measure by the applicant’s advisors to justify the proposals (and particularly the basement excavations). It is therefore appropriate to briefly review the findings of these, and to consider their usefulness or relevance to the assessment of the likely impacts of the UKHMLC proposals.
- 3.1.2 The principal investigations undertaken were a comprehensive root radar survey by Sharon Hosegood Associates (‘SHA’) in February 2018. This plotted a systematic series of scan lines at a series of distances from the London Planes on the west and east sides of the park, each series progressively moving outwards from a distance of 0.5m from the trees to a distance of approximately 12m. Overlaying SHA’s plot of the radar scan lines onto our TCP shows that with only a few very short linear exceptions on the east side, all the scan lines fall within the trees’ RPAs as drawn, but in some cases, do not extend as far as their perimeters.
- 3.1.3 The conclusions of SHA’s report, dated 23<sup>rd</sup> of March 2018 (CD 6.43), are reproduced below:

*“The results show that the trees along the western boundary are rooting in medium densities at a depth of 15-240cm beneath the footpath and at moderate to very high densities at a depth of 10-150cm beneath the grass area (but most concentrated within the top 10cm of soil).*

*Along the eastern boundary the trees are rooting in bands between 20-150cm deep beneath the hard surfacing and 20-100cm deep beneath the grass. Beneath the hard surfaces roots were found to extend deeper, as far as 240cm deep. The rooting density was initially high beneath the footpath, staying moderate and high with occasional areas of*

*moderate/low rooting density beneath the grass before rising to high and very high in the furthest two lines of scanning lines. The areas of lower rooting densities are beneath the path crossing the grass area and around the Buxton Memorial where it is likely that disturbance to the soil has affected its structure or where pedestrian traffic has compacted the soil structure.*

*In summary, the trees are rooting in a typical manner and any alteration to the use of the site or construction of new structures should respect the structural integrity and function of the roots.”*

- 3.1.4 Trench excavations were undertaken by Canopy Consulting in September 2018, excavating a series of eleven trenches along the lines of the envisaged UKHMLC footprint, and recording the positions, diameters and depths of roots found within them. I am informed that these were undertaken with WCC’s Head of Arboricultural Services, Barbara Milne, in attendance. The conclusions of Canopy Consulting’s report (Appendix 4 to CD 6.5) are reproduced below:

#### *“4.1 Observations*

*43 roots with a diameter of 1cm or more were uncovered and recorded within the 11 trenches. Of the 43, 17 (40%) had a diameter of 2.5cm or less and 26 (60%) had a diameter of more than 2.5cm.*

*The majority of the roots recorded were found below a depth of 60cm. Fibrous roots were noted in all of the trenches in low numbers at various depths. None were noted in the top 10cm.*

#### *4.2 Analysis*

*The compacted nature of the excavated material provides a poor rooting environment, even for trees suited to the urban environment such as London planes. This is shown by the lack of roots within the top 60cm where the majority of roots would be expected to be located. It appears the trees have taken advantage of the looser material beyond 100cm depth.*

*Paragraph 7.2.3 of British Standard 5837: 2012 states “Roots smaller than 25mm diameter may be pruned back, making a clean cut with a suitable sharp tool (e.g. bypass secateurs or handsaw), except where they occur in clumps. Roots occurring in clumps or of 25mm diameter and over should be severed only following consultation with an arboriculturist, as such roots may be essential to the tree’s health and stability.”*

*40% of the roots uncovered have a diameter of 2.5cm or less which suggests they can be pruned if necessary without the need for further analysis. The remaining 60% of roots uncovered are deemed to be significant. Their size suggests they are likely to be the start of a substantial rooting area used for the uptake of water and nutrients.*

*The root protection area (RPA) to the west of the western trees comprises a main road which does not provide an adequate rooting environment. The size of the roots uncovered in trenches 3 to 6 show that the trees in this area are reliant on the rooting environment within the park and as such, their RPAs should be offset to take this into consideration.*

*As the majority of the roots are below 60cm, shallow foundation structures and shallow landscaping works may be acceptable, subject to consultation with the project arboriculturist.”*

- 3.1.5 A further report by SHA dated the 1<sup>st</sup> November 2018 (described as a “companion report” to the March 2018 report) (Appendix 3 to CD 6.5) stated that the original radar data had been re-analysed using new software, which had allowed the removal of what were termed “false positives” within the original data, and that what had previously been identified as roots at greater depth were now considered to be clay nodules holding water at higher concentrations than the soil around them. The conclusions of the original report were therefore amended, as below:

*“Findings*

*The analysis of the data found that the trees are not rooting below a depth of 1m along any of the proposed building lines and trenches, with roots rarely found beneath the paths which cross the grass area.*

*Along the proposed building lines roots are found in very low rooting densities, though at a slightly higher density than found in the Root Survey Report. This is likely due to clusters of fine roots, which can be detected by the TreeRadar, but which are blown away by the airspade and as such would not be recorded. These detections are predominantly in the region of 20-40cm deep.*

*Very few detections are found in the upper 20cm of soil along any line, and the soil horizons below show a very homogenous layer, indicating that the soil level has been raised slightly, likely to help level the site.”*

- 3.1.6 SHA later submitted a third report, dated the 7<sup>th</sup> June 2019 (CD 6.35), following borehole and trial pit investigations undertaken by Ground Engineering Ltd. in a number of locations within VTG. SHA’s report concludes as follows:

*“4.10 To conclude, evidence of the investigations show that most tree roots are in the top 1.2m. It seems likely that there will be more roots at and around 2m based on one trial pit, but the boreholes which are further from the trees, found no deep roots. Aside from evidence, there is reason based on biological principles. Given the good rooting environment of the park, why would the trees go to the expense of rooting very deeply when all their needs are found in the top 1-1.5m (note the ‘Park soil’ depth observations in table 2)? The trees have a good vitality with no noticeable deficiencies. Their biological needs are being met. In my opinion, this is within the top 2-2.5m of soil, and mostly within*

*the top 1.2m. I therefore conclude that further root investigations are neither necessary or practical.”*

- 3.1.7 I have quoted extensively from the conclusions of the various reports, as in my opinion they raise or demonstrate a number of important points. The first point which jumps out is the extent of contradiction between the (first) root radar investigation and the trench investigation, whereby the former claimed the highest densities of roots to be in the top 10cm of soil, but the trench investigation found none there. The ranges of depths suggested in the first root radar report (20cm-100cm, and 10-150cm) are also not borne out in the trench investigations which found most roots to be below 60cm.
- 3.1.8 Subsequently, the three root radar reports all contradict each other, with an almost complete reversal of the findings of the first report by the second, in terms of both depths and densities of roots (following the re-analysis with different software), and attributing the absence of roots in the upper soil horizons of 20-40cm, clusters of which the apparatus had detected in its readings, to these having been “*blown away*” by the airspade used in the trench investigations. I am informed by Barbara Milne (who was in attendance at the time) that this simply did not occur, as she has explained in the note attached at **Appendix 6**. The third SHA root radar report appears to attempt a middle course between the contradictions of their first two reports, by concluding that “*most*” roots are in the top 1.2m, but with some being “*likely*” at 2m.
- 3.1.9 Certain observations within Canopy Consulting’s conclusions, however, are of significance. The first relates to their recording of an observable level of surface soil compaction in the upper soil horizons, resulting in rooting from the trees being predominantly recorded in depths below 60cm, where looser soil bulk density was observed. The second relates to their acknowledgment of the reliance of the trees on the west side of the park on the open areas within VTG, leading to the presence and number of larger roots (of 25mm diameter or greater) being recorded, particularly within trenches 3 to 6, which were within the western series of trenches, at a distance of approximately 12.5-13m from the trees. This finding prompts their recommendation that the RPAs of the trees on this side should be appropriately offset to take account of the likely extent of active rooting within the open grass areas within the body of the park.
- 3.1.10 The first of these findings suggests that as a greater proportion of the trees’ roots are below a depth of 60cm than would normally be expected, severance of roots below 60cm, as a result of the deeper excavations proposed, would be likely to impact on the trees’ moisture and nutrient absorbing capacity to a greater degree than would normally be associated with severance of roots at such depths. The second finding also implies that severance of roots within the open grass areas of VTG, at the distances from the trees required for the construction of the UKHMLC, can be expected to have a proportionately greater potential impact on the trees’ viability than would be considered likely to result in the case of trees with more equally or normally distributed root systems. Finally, it should be noted that Canopy Consulting’s recommendation resulting from their findings (that the

RPA of the western trees should be appropriately adjusted and offset to take account of them) has not been acknowledged or adopted by the applicant.

- 3.1.11 Overall, however, and notwithstanding these conclusions, in my opinion the conflicting findings of the investigations tend to suggest they are of limited usefulness in undertaking a meaningful and reliable arboricultural implications assessment of development proposals. This consideration, in my view, is reflected in the absence, within BS 5837, of any recommendation for either invasive investigations (trial trenching) or non-invasive investigations (root radar). This leads to the heart of the basis on which Bartlett Consulting, and the applicant's other advisors, have approached their analysis of the UKHMLC scheme. To quote from page 14 of the AIA Addendum:

*"Known Tree Root System Information vs Tree RPA: This development project and updated Impact Assessment is guided and informed by three types of detailed root investigations which are referenced and detailed in the introductory sections above. These investigations have provided 'real-life' information with regards to the distribution and morphology of the tree root systems within particular areas of Victoria Tower Gardens.*

*With reference to this detail root investigation information, any tree RPA, regardless of how plotted on the Tree Constraints Plan, on balance, is considered to be superseded as a notional suggestion of where roots **may** be present, by the **known** location, depth and diameter of the identified tree roots. Information which can also be applied with some certainty around the remainder of the site.*

*It is also worth noting here that the calculation for determining the tree root protection area (12 X Ø) as set out in British Standard 5837:2012 is not based on any scientific research, but an artificial construct when compared to field studies which have shown that a mature tree's critical root zone can be significantly less (4 X Ø). Whilst this discussion is not meant to devalue a notional tree RPA, it does mean that the RPA cannot be applied with any excessive rigidity but used simply as a guide allowing for an assessment on a site specific basis."*

- 3.1.12 It will be apparent from the various extracts of BS 5837 that I have previously referenced in this report that there is in fact no basis or authority given within the British Standard for this type of approach to the significance of the RPA, or to its application in practice. Moreover, the third paragraph of the extract above is misleading, as it appears to be attempting to conflate, or confuse, the concepts of 'root protection area' and 'structural root plate', (the reference to 'field studies' cited being to the research in respect of the latter); the clear and fundamental distinctions between these concepts being as I have explained earlier in this proof of evidence.

## **3.2 Proposed replacement of surfacing and soil mitigation measures**

- 3.2.1 In the AIA Addendum (CD 6.22), Bartlett Consulting set out a series of compensation and mitigation measures to be undertaken during the UKHMLC construction, briefly referred

to at paragraph 2.5.8 above. At Section 5.4, specifications for treatments to roots pruned or severed in order to enable the construction of the UKHMLC walls and basement are given, designed to maintain the affected roots' vitality, promote their defensive responses to potential entry of fungal decay pathogens, and to stimulate the regrowth of lateral and fibrous roots from their cut ends. Some of the treatments proposed are topical (i.e. applied to the affected root itself), whilst others are proposed as drench treatments "along the interface of proposed development and the RPA".

- 3.2.2 Whilst the treatments suggested are beneficial in nature, it will be apparent that those involving the topical treatment of the ends pruned or severed roots imply direct access to the roots concerned in order to apply them. From the RCMP (CD 6.30), however, it appears that open excavation for the formation of the piling mat would be to 1m in depth (and this would also be the likely depth of excavations required for a guide wall for the secant piling, which seems likely to be required). The implication is therefore that any roots beneath 1m depth, if present as is suggested in the various investigation reports, would not be accessible for such remedial treatments, as these would simply be severed by the piles as they are driven or bored. It may be, therefore, that the topical remedial measures suggested would only be available for a proportion of the roots likely to be severed as a result of the construction.
- 3.2.3 Bartlett Consulting also suggest that there will be available re-imported soil horizons above the capping beam and roof of the basement box of the UKHMLC, into which pruned roots within the uppermost 500mm of soil will be able to regrow. Despite having been requested by WCC in March 2019 for *"Details of soil depth, soil specification and profile above basement, including likely restriction on re-rooting as a result of below ground constraints from below ground structures such as proposed memorial fins, piling and pile caps, reduction in levels and security measures – to include annotated measurements on the submitted planning drawings"*, I understand that no such details have been provided to date. It is not clear, therefore, whether the trees could re-root above the basement, or whether the soil medium would be suitable. Bartlett Consulting's suggestion also conflicts with Canopy Consulting's finding very limited root growth within the upper 600mm of the soil surface, due to the compacted nature of the surface horizons; and as Bartlett Consulting concede (at 5.4.2), *"Regrettably, deeper roots may never re-establish themselves"*. To address this, reliance is placed on the *"soil treatments and improvements to the footpath network...and within the existing borders (sic)"* for the recovery of the affected trees.
- 3.2.4 The measures specified in the latter regard include the breaking-up and removal of the existing hard-surfaced tarmac paths, and the removal of their sub-bases, followed by decompaction of the exposed underlying soil by air-spading, compressed air fertiliser injection, and reinstatement of the path network using a cellular confinement system and permeable surfacing.

- 3.2.5 In general terms, and subject to their being undertaken correctly and with appropriate safeguards<sup>21</sup>, these measures can be expected to result in improvement to the rooting environment underlying the existing pathways. However, it is not clear that the benefits of any improvements to the trees' rooting environments gained as a result of these measures would adequately compensate for or outweigh the disbenefits to the functioning of the trees' root systems caused by the effects of the development, particularly in the case of trees subject to direct root loss or severance.
- 3.2.6 The embodiment of the compensation measures proposed within the Bartlett Consulting AIA Addendum suggests, on their part, an inherent and uncomfortable recognition of the unsatisfactory relationship between the development of the UKHMLC as proposed, and the constraints to that development which are represented by the London Plane trees lining the boundaries of VTG. On our analysis, there are grounds for uncertainty or doubt as to their likely effectiveness. In circumstances where a proposed development raises the prospect of harm to, or loss of, existing trees of high value such as those present on this site, the normal, indeed correct, approach would be to amend the scheme to design out the identified impacts, or to locate it elsewhere, rather than seek to rely on mitigation measures of uncertain or speculative efficacy in the long term.

### **3.3 Chlorophyll content and fluorescence investigations**

- 3.3.1 I have been informed by Barbara Milne that in line with their recommendations in the AIA Addendum, Bartlett Consulting have recently undertaken an assessment of the vitality of the London Planes at VTG, utilizing the techniques of chlorophyll content and fluorescence testing. This required a sample of five or six leaves to be taken from various points within the crown of each tree being tested, which will be examined by instruments which test the physiological characteristics of the leaves, providing readings of their chlorophyll content and chlorophyll fluorescence respectively. These can be compared with reference sets of values for the tree species concerned, thereby providing an indication of the tree's physiological vitality and performance.
- 3.3.2 I understand that samples were collected from the 18 trees identified by Bartlett Consulting as requiring "root pruning" as a result of the UKHMLC proposals (nine on each side of VTG), and on two "control trees", by which, I assume, Bartlett Consulting mean trees considered unlikely to be affected by the scheme (although these were not identified). The objective, I believe, is to provide a "baseline" assessment of the trees' vitality in order that this can be compared with values obtained from the same trees later, during or following the construction of the UKHMLC.

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<sup>21</sup> Again, measures which one would normally expect to be embodied within an Arboricultural Method Statement – the removal of hard surfaces is an operation which itself poses risks of causing damage to roots underlying the surfacing, and would normally be specified to be done using hand tools only, or very carefully controlled excavator use, under arboricultural supervision in both cases, and in the latter particularly so. As noted previously, a draft AMS relating to the replacement of the pathways was received on the evening of the 2<sup>nd</sup> September 2020, but there has been insufficient time to consider this at the time of writing.

- 3.3.3 I am informed by Barbara Milne, who attended site on the day, that the first batch of leaf samples was gathered using a Mobile Elevating Work Platform ('MEWP'), on the 23<sup>rd</sup> July 2020.
- 3.3.4 In view of it only involving the removal of the required leaves or small twigs using secateurs, WCC did not require a formal Section 211 Notification to be submitted for the works, but has requested that they are informed of the results of the tests when these are available. However, at the time of writing, I do not know if the applicants have agreed to this request.

## 4. Conclusions

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- 4.1.1 The systematic assessment we have undertaken of the principal elements of the UKHMLC scheme in accordance with BS 5837, in terms of the extent to which each element impacts or encroaches upon the RPAs of the London Planes within VTG, demonstrates that in relation to the trees lining the west boundary in particular, the likely impacts of the scheme proposals are significantly greater than as assessed and reported in the Bartlett Consulting AIA, the AIA Addendum, or in Dr Hope's report.
- 4.1.2 In large measure, this is due to the RPAs of the trees on the west side having been incorrectly and inappropriately represented as circles extending under the carriageway of Millbank in the documents submitted on the applicant's behalf. In relation to certain elements, other differences are accounted for by trees having been omitted from key relevant plans (trees 70000 to 70002, and 71006 to 71008), or simply whose presence has been overlooked throughout (71027 and 71028).
- 4.1.3 In other cases, the differences in the potential significance of particular impacts are attributable to insufficient attention having been given to the implications of certain elements and/or insufficient consideration of BS 5837 recommendations (service routes), lack of consideration of potential adverse effects of other elements (landform changes/soil raising), and over-reliance on the assumed tolerance of London Plane to root severance (piling and excavation of basement within RPAs, in the absence of available contiguous compensatory rooting volume). When assessed in the light of proper application of the precautionary approach espoused and enshrined in BS 5837, the levels of assessed impact are considerably greater than those presented in the documentation submitted for the applicant.
- 4.1.4 When further considered in conjunction with likely temporary effects of the construction site proposals as currently envisaged in the RCMP, the risks to the trees' future viability and longevity are magnified. Consideration of this aspect is justified, as BS 5837 states:
- "5.4.2. The assessment should take account of the effects of any tree loss required to implement the design, and any potentially damaging activities proposed in the vicinity of retained trees.....In addition to the impact of permanent works, account should be taken of*

*the buildability of the scheme in terms of access, adequate working space, and provision for the storage of materials, including topsoil.”*

- 4.1.5 For these reasons, I conclude that it has not been adequately or satisfactorily demonstrated that the UKHMLC can be constructed in its proposed siting within VTG without there being a clear risk that the London Plane trees lining the boundaries of the park will suffer significant harm, which could be of a sufficient extent or degree to result in their loss, as a result of decline and dieback induced either by the effects of the proposal, or by the process of its construction.

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8<sup>th</sup> September 2020