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Arboricultural Report

KiwiRail Wiri to Quay Park

on
Notice of Requirement

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Contents

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1 Introduction

1.1 The Tree Consultancy Company has been commissioned to provide arboricultural input to a proposal to construct a third rail line between Middlemore Station and Wiri Junction. The purpose of this document is to accompany a package of information for a notice of requirement (NoR). The scope of services we have been asked to provide is as follows:

- A summary of the existing environment
- Consideration of both the construction and operational effects of the works
- Identification of any affected parties and
- Identification of mitigation required

1.2 In addition, we have undertaken a notable tree assessment for several trees outside of the current designation and in proximity to the proposed works.

2 List of appendices

- Appendix A – Tree inventory
- Appendix B – Drawing 1642_001 and 002 rev B
- Appendix C – Site photographs
- Appendix D – Notable tree scoring schedule

3 Statutory context

3.1 Outside of the already designated areas of the rail corridor, the following rules of the Auckland Unitary Plan affect the protection of trees on public land.

E16 – Trees in Open Space zones

E16.4.1

(A5) Tree trimming or alteration
(A6) Tree trimming or alteration that does not comply with Standard E16.6.1
(A7) Works within the protected root zone
(A8) Works within the protected root zone that do not comply with Standard E16.6.2
(A9) Tree removal of any tree less than 4 m in height and less than 400 mm in girth
(A10) Tree removal of any tree greater than 4 m in height or greater than 400 mm in girth

E17 – Trees in roads

E17.4.1

(A5) Tree trimming or alteration
(A6) Tree trimming or alteration that does not comply with Standard E17.6.1
(A7) Works within the protected root zone
(A8) Works within the protected root zone that do not comply with Standard E17.6.3
(A9) Tree removal of any tree less than 4 m in height and less than 400 mm in girth
(A10) Tree removal of any tree greater than 4 m in height or greater than 400 mm in girth
(A11) Planting over network utilities with trees with a mature height of more than 4 m
(A12) Tree trimming, alteration or removal not otherwise provided for

4 Scope and limitations of the tree survey

4.1 The scope of our assessment is from Wiri Station Road to Middlemore Station. All observations and information were gathered either from public land (e.g. roads and parks) or from video footage taken from the train during normal passenger travel.

4.2 Trees were surveyed (including GPS points ± 1 m) in June 2020 by Mr Matthew Clifford of the Tree Consultancy Company in line with the limitations outlined in 4.1. The notable tree assessment was undertaken by Dr Andrew Benson of The Tree Consultancy Company in June 2020. The survey and assessment of effects have focussed on trees associated with the NoR land take areas which were readily accessible (as outlined in 4.1) and also worthy of individual record (e.g. shrubs, pest plants and juvenile vegetation in and around the rail corridor are not discussed). A general description of the existing environment is provided based on the observations we were able to make from public land. The NoR land take requirements were provided to us on the following Jacobs / KiwiRail drawings:

- IZ233800-SK103 (A) – 28/4/20
- IZA233800-SK104 to SK140 (A) – 28/4/20

4.3 In addition to the access limitations, construction activity and private ownership of various land parcels precluded access and visibility to some areas of the corridor. For example, Puhinui Station and a pocket of public reserve south of Onslow Avenue bounded by private properties, respectively.

4.4 Where trees were accessible, trunk diameter measurements were taken for the purposes of establishing structural root zone radii (Coder, 1996) and tree protection zone radii (Benson et al., 2019a). Trunk diameter is a more reliable predictor of root system spread than crown size or tree height (Day et al., 2010).

5 Notable tree assessment

5.1 Auckland Council's latest assessment method for scoring trees for notable status has four criteria for awarding points: *age and health, character or form, size* and *visual contribution*. Trees must achieve at least 20 points in these four criteria (combined) to be considered for notable status. There is also a special criterion, for which a tree must meet at least one of the categories to make it worthy of notable status. For our assessment, all trees scored in the '*Intrinsic*' category, because all trees have intrinsic values. A copy of the scoring system is included as an appendix to this assessment.

5.2 The method is entirely subjective and does not clearly set out guidance on how to objectively award points in each of the criteria, and several of the subjective terms are not sufficiently qualified so as to eliminate or limit ambiguity. In order to address this, we have used a single assessor to score the trees (to remove inter-appraiser variability), used our expert knowledge of trees, conservatively estimated tree age (an older tree will score higher than a younger tree) and systematically set out a criteria from which to establish average dimensions of other trees of the same species nearby (e.g. whether a tree is larger than the average tree expected in a particular location – the '*size*' criterion).

5.3 In order to establish the average dimensions for trees 'in a particular location', we surveyed an area of 3 square kilometres (two areas of 1.5 square kilometres, one for each location where we have located trees worthy of notable status) from public land and recorded the dimensions of trees of the same species as those which we believed were suitable for inclusion as notable trees. The dimensions recorded were trunk diameter at 1.4 m (DBH), tree height (recorded using a digital laser hypsometer) and canopy spread.

5.4 Only trees visible from public land were recorded and no private property was entered. It is possible to record height and canopy spread dimensions from trees in private property without entering it, but access to the tree is required to measure the trunk. Once the average dimensions ‘in a particular location’ of trees for each species are established, it is then possible to compare the size of the proposed notable trees so as to award points correctly, and defensibly.

6 Existing environment

6.1 The existing environment is a rail corridor, with multiple lines in a north to south direction and is designated as strategic transport corridor. Between Wiri Station Road and Puhinui Station, the surrounding land use is industrial, and the rail corridor and adjacent sites are largely devoid of trees worthy of mention. Puhinui Station was undergoing construction work during our site assessment window, and so we were unable to view the trees here in detail. A group of four or five Himalayan cedars abuts the northbound line which look to be growing on land occupied by an early childhood education centre. A parcel of land zoned as road abuts the southbound line, and site aerial photographs show trees present, although we are unable to confirm what these are due to access limitations.

6.2 North of Puhinui Station, the surrounding sites become residential, and whilst the rail corridor remains devoid of trees worthy of comment, mature trees in various private properties on both sides of the corridor overhang and abut the north and southbound lines. We provide no comment on these trees including species identification owing to the access constraints. Should homeowners have specific concerns over these trees during a notification process, then access to the trees would need to be provided to an assessing arboricultural expert to address any comments raised.

6.3 North of Puhinui Station, the land use remains largely residential, with the addition of a pocket of recreation land abutting the southbound line (Alan Brewster Leisure Centre and the Papatoetoe RSA Bowling Club). Various trees (mainly titoki, 4 – 6 m high) abut the southbound line, presumably providing some screening to the bowling club.

6.4 Papatoetoe Station abuts a pocket of council-owned reserve land (open space – informal recreation) in which trees of various species, origins (native and exotic) and age classes are present. On inspection, it appears from the tree cover and vegetative characteristics that the reserve continues north, beyond a narrow footbridge which services the station, whereas, the planning maps indicate that the pocket of land to the north is in fact within the current transport corridor designation. The designated land pocket is home to a number of good-quality indigenous and exotic trees in a mature age class. These trees are contributing positively to local ecosystem service[1] provision.

6.5 Between Papatoetoe Station and Middlemore Hospital, the surrounding land use is once again residential and the same sporadic private trees are observed abutting the rail corridor boundary, and the rail corridor itself remains largely devoid of vegetation. At the Middlemore Station, various trees are present, including a row of 49 mature Japanese red cedar (≈ 16 m high).

[1] Ecosystem services are defined as the direct and indirect contributions of ecosystems to human well-being.

7 NoR land take areas

7.1 Between Wiri and Middlemore, ten land parcels (or portions thereof) will be subject to the NoR for the purposes of permanent occupation. Eleven land parcels (or portions thereof) will be subject to the NoR for the purposes of temporary occupation. Given our access restrictions, we were only able to access and appraise the trees in two of these locations. Those being; Papatoetoe Station (temporary occupation, currently open space land) and Middlemore Station (permanent occupation, currently zoned healthcare facility and business use). The parcels (or portions thereof) of land subject to the NoR are shown on the aforementioned Jacobs drawings as well as our site drawings appended to this report.

8 Arboricultural description

8.1 At the two accessible locations, we undertook a tree survey to identify tree species, locations, and dimensions, and to undertake the notable tree assessments. An inventory of these trees is appended to this assessment with the corresponding tree numbers depicted on the site aerials (1642_001 and 002, rev B).

8.2 At Middlemore, trees 1 (Monterey cypress), 2 (49 x Japanese red cedar) and 3 (Himalayan cedar) were recorded as being worthy of notable status. Within the 1.5 km^2 area surrounding these trees, the dimensions were recorded for n = 0 Monterey cypress, n = 4 Japanese red cedars and n = 12 Himalayan cedars, to establish the average dimensions for these species in this location. Tree 1 will not be affected by the NoR land take, although looks to be growing within the rail corridor (based on the location of a fence). Tree group 2 is within an area of permanent occupation (a new station platform) and will therefore require removal unless an alternative can be found. It is unclear where these trees are growing precisely (either within the current designation or within hospital land). Appropriate remedial measures should be adopted to address the environmental impact and loss of local amenity which will occur as a result of removing these trees. Tree 3 is outside of the land take area at Middlemore, yet the alterations for the new platform will be within the tree's root zone area. Given the tree's current growing environment (road reserve), making inferences about the effects of the land take and later construction would be conjectural at best (see 9.8).

8.3 At Papatoetoe Station, 56 trees were recorded in the area of contiguous tree cover. Thirty-nine of these trees are located in the northern parcel of land which falls within the current designation. The precise location of the designation boundary is unclear from site observations, and our GPS survey device carries up to 1 m of error. One tree (tree 45; titoki) scored high enough to achieve notable tree status, and because we are unsure of its precise position relative to the designation boundary (i.e. it may or may not be within the current designation area), we have conservatively included it in our assessment.

8.4 In the open space area to the south, 17 trees were recorded which achieve protective status by virtue of their dimensions. Four of which (44, oriental plane; 46, totara; 49; Japanese red cedar and 54, London plane) scored highly enough to be considered for notable status. Within the 1.5 km^2 surrounding area, the dimensions were recorded for n = 13 titoki, n = 14 totara, n = 0 Japanese red cedar, n = 0 oriental planes and n = 14 London planes, to establish average dimensions for these species in this location. Only tree 54 will be affected by the (temporary) land take footprint, although the specifics of this remain unknown at this stage. Tree 53 (rimu) is within the footprint of the (temporary) land take and we suspect that it will require removal to accommodate the temporary occupation. The tree is juvenile and supressed, and inappropriately positioned under tree 54 to ever achieve its optimum final dimensions. Remediating the removal of this tree can be achieved over a short temporal scale with a minimum of three new 45-L grade trees.

9 Effects

9.1 '*Effects*' can be interpreted and analysed in one of two ways in this context. There are those effects which relate to the Resource Management Act (RMA), e.g. '*effects to protected trees*', as assessed using predetermined statutory criteria. There are also measurable environmental effects, expressed in biological terms and analysed using a science-based approach, e.g. the loss of habitat when non-protected trees are removed. We have considered both in our assessment below, to provide a clear picture of the environmental impacts of the project, and to assist the planning team in their RMA assessments.

9.2 The NoR may affect trees in one of two ways. Direct effects, i.e. those which encroach directly into a tree's growing location thereby necessitating its removal, and indirect affects, i.e. those which result in incursions into a tree's root zone area which may result in a). tree removal owing to collateral damage to root systems or b). have the potential to negatively affect tree health and stability through damage to root systems and the surrounding soil environment. The latter (b) can often be managed through tree management protocols and preservation methods to limit damage to within tolerable limits. Most trees will tolerate some degree of root loss if this is undertaken carefully (Hamilton, 1988; Watson, 1998; Watson et al., 2014).

Effects in the context of the RMA (protected trees only)

9.3 At Middlemore Station, the land-take area occupies 34m^2 of tree 3's (Himalayan cedar) AUP-defined protected root zone[2] area (8%). Without invasive methods, e.g. exploratory excavation, it is impossible to confidently state the diameters of roots which would likely be encountered in this footprint, and so conservatively, this encroachment must be considered under E16.4.1 (A8). Operationally, the tree is likely to require live crown removal to achieve required clearances from the rail corridor and associated infrastructure. Conservatively, E16.4.1 (A6) needs to be considered.

9.4 At Papatoetoe Station, the land-take area directly conflicts with the growing location of tree 53 (rimu) which will therefore need to be removed. The tree is of sufficient size to achieve protective status in this location, and its removal must be considered under E17.4.1 (A10). Appropriate remedial planting will be required to address the removal of this tree in line with RMA and Unitary Plan requirements.

9.5 The NoR temporary occupation footprint also encroaches into tree 54's (London plane) AUP-defined protected root zone area. The level of encroachment is 35 m^2 (11%). Given that the incursion is on the periphery of the tree's structural root zone, the likelihood of encountering roots meeting the descriptions outlined in E16.6.2 is considered very high, and therefore this activity must be considered under E16.4.1 (A8). Similar to tree 3, live crown removal is conceivable to achieve harmonious operation of the rail corridor, which would need to consider E17.4.1 (A6).

9.6 With reference to 9.3 and 9.5, the activities trigger Unitary Plan infringements. However, understanding the actual effects needs to be considered objectively in biological terms and in consideration of tree surroundings. We have discussed this as follows, including non-protected trees for completeness.

[2] Established using branch spread

Effects in biological terms (all trees)

9.7 In terms of direct effects of the NoR, tree group 2 (49 x Japanese red cedar) and tree 53 (rimu) will need to be removed. In consideration of the ecosystem services provided by trees, and specifically carbon sequestration, we consider that the loss of these trees requires appropriate remedial planting, to achieve sustainability goals and align with KiwiRail's 'Carbon Zero Programme' and Auckland Council's 'Low Carbon Strategic Action Plan'. We have discussed this later in section 11.

9.8 In terms of indirect effects, i.e. root zone incursions, for open-grown trees (i.e. where root growth is unimpeded by structures etc.), there are reliable tools available to make reasonably accurate predictions about the extent of lateral root spread (Day et al., 2010; Benson et al., 2019a), and hence the level of incursion, from which an understanding of the effects can be established (Benson et al., 2019c). These tools use various multiplications or manipulations of trunk diameter measurements to establish these values. However, it is almost impossible to accurately predict root system spread on modified urban sites, since the presence of infrastructure (e.g. kerbs, roads, buildings and retaining walls) can affect root system architecture and morphology (Čermák et al., 2000; Jim, 2003), and asphalt surfaces can affect sub-terranean environmental conditions (Nicoll and Armstrong, 1998; Grabosky et al., 2001; D'Amato et al., 2002) and roots may form in unexpected locations (e.g. deeper or shallower than an open-grown field environment). Additionally, surface permeability is already highly modified in contrast to an unmodified site, and so the effects of site changes and construction on tree health (hydrological strain) are difficult to establish. For these reasons, it is very difficult to make inferences about actual and potential effects when trees are modified in this way. The only way to fully understand this would be with a thorough understanding of root system architecture (e.g. after exposing roots by way of an excavation) and ascertaining the extent of root system loss arising from construction. This requires expert knowledge and a great deal of experience.

9.9 At Middlemore, the new platform will be within, or in close proximity to the root zone of tree 3 (Himalayan cedar). We do not believe that surface permeability and the tree's access to available soil water will be greatly affected as much of the root zone is covered in asphalt, but the detailed design of the platform will need to consider root structures. The use of piles is an effective way of constructing elevated structures in tree root zones, where the piles are positioned strategically around roots.

9.10 At Papatoetoe Station, trees 51, 52, 54 – 57 (inclusive) are in the region of the open space reserve where temporary occupation is required. These are open-grown trees, with largely unimpeded root zones (aside from the rail corridor), and so inferences about the effects of incursions can be made. The occupation footprint is firmly within the root zone area (including the structural root zone area) of tree 54 (London plane). Damage to structural roots can have dire consequences to trees, both in terms of tree stability (Smiley, 2008) and tree health (Benson et al., 2019a; Benson et al., 2019c).

9.11 The scope and magnitude of the temporary occupation footprint is unknown, but by definition because it is a transient activity, tree 54 (and its neighbours) should be actively preserved, as these are long-lived organisms that will provide many benefits into the future, long beyond the duration of the corridor upgrade. Negative effects which could arise as a result of root losses, or damage to surrounding soils include water stress symptoms and compromised physiological function (Benson et al., 2019a; Benson et al., 2019b, c), which can predispose trees to future, co-occurring stresses (e.g. drought) (Fini et al., 2020).

9.12 We have discussed tree preservation methods in section 11. In general, these need to include trunk protection (to prevent impact injuries) and ground protection (to prevent root damage) as well as soil improvement (such as wood-chip mulch) to help offset the effects of soil disturbance and changes to hydrology.

9.13 It is unclear whether the land take area also includes the space above the land, and if so, to what height. That is; we are unclear on what the activities will be in the temporary occupation area and whether this will affect the above-ground tree parts, e.g. a crown pruning requirement. Tree 54 overhangs the rail corridor at present and its crown is firmly within the temporary occupation footprint. Some degree of crown pruning is acceptable, but not to the extent that the tree becomes disfigured, or structurally compromised as a result.

9.14 In terms of the operational needs of the rail corridor and the associated ongoing effects to trees, providing the detailed design and engineering for the platform at Middlemore are prepared in acknowledgement of the tree's root system, the ongoing effects are expected to be negligible, and limited only to regular maintenance of the crown, i.e. pruning to achieve required clearances. At Papatoetoe Station, trains running on the new line will be pushed closer to the trees than at present. The ongoing effects of which are likely to include a requirement for crown pruning, to achieve required clearances. Overhead pylons would need to be strategically positioned to avoid conflict with the tree(s). For the purposes of the NoR, this is not a material consideration, but will need to be addressed later when the design is progressed and methods to work around and preserve trees are considered.

9.15 Because we were unable to access the rail corridor or private properties, any comment on specific effects to vegetation in the affected properties would be conjectural, which we prefer to avoid. Specific comment on these matters can be addressed during the notification process if submissions are made. Access to the properties would be required in order to provide this detail.

10 Affected parties

10.1 We make no specific comment about privately owned trees, e.g. those in private properties. Consultation with council's urban forest specialist (as an affected party) would be necessary when considering the trees at Papatoetoe Station in the council-owned public reserve. The precise ownership of tree group 2 (Japanese red cedar) is unclear, as it appears to border the rail corridor and the adjacent hospital-owned facility. Consultation with the hospital is advised, unless KiwiRail's ownership of these trees can be confirmed.

11 Mitigation

11.1 By definition, mitigation acknowledges a lasting negative effect, and so we prefer to adopt an approach which remedies these impacts, particularly as this relates to tree removals. When trees are removed, the remedial planting needs to account for lost future benefits, as all benefits up to the date of removal have already been received (Nowak and Aevermann, 2019), e.g. sequestered carbon. We have used i-Tree Eco's (Nowak and Crane, 2000; The i-Tree Development Team, 2020) forecasting tool to estimate the lost future benefits arising from the proposed tree removals. The i-Tree software quantifies ecosystem services provided by trees based on input dimensions, known species characteristics and growth rates. It has been developed through peer-reviewed science over the last 20 or so years with international collaborations, and recently, New Zealand. Using the same tool, and with known dimensions of 45-L grade nursery trees, the benefits of these nursery trees are forecast in the same way. The remedial planting therefore needs to match or exceed the value of total stored carbon which would have been achieved by the existing asset at the end of the forecast period.

11.2 We used the dimensions of the trees being removed and forecast the carbon sequestration values for 30 years. A value of 30 years was chosen because a). this was a realistic life span for each of the trees in their current location and b). a goal has been set for carbon neutrality by the Climate Change Response (Zero Carbon) Amendment Act (2019) by 2050. The estimated resulting carbon footprint arising from tree removals is shown in the table on the following page.

Tree #	Species	Carbon footprint (T)	Value of stored carbon ($)[3]	Number of new trees required to reach carbon neutrality
2*	*49 Cryptomeria japonica*	8.4	$2,090	9
53**	*Dacrydium cupressinum*	1.8	$441.74	3
Total		10.2	$2,531.74	12

* - currently non-protected trees
** - currently protected trees

11.3 It can be seen that the carbon footprint of removing protected trees is 1.8 metric tonnes, and of removing non-protected trees is 8.4 metric tonnes. This is equivalent to manufacturing 10.2 tonnes of cement (Kenai et al., 2014), or between 2.5 and 5 tonnes of concrete, depending on loading capacity. This, of course, does not take into account the carbon footprint of the construction activities associated with the rail corridor improvements itself.

11.4 The remedial planting therefore needs to achieve this same value of stored carbon by 2050 if carbon neutrality is to be achieved, and the actual effects of tree removal are to be addressed in a sustainable fashion. Allowing for 3% mortality, this equates to 12, 45-L trees planted in a such way that they can achieve optimum final dimensions. Planting locations and the long-term future development of the trees is critical to the success of the carbon offsetting. Trees which are incapable of achieving large dimensions in the given time period will not achieve the required value of stored carbon and thus not achieve carbon neutrality. Given the spatial constraints of the rail corridor, planting this number of trees to meet this specification may be unachievable. Ideally a nearby public reserve would be identified and through negotiations with Auckland Council's Community Facilities department, one or more locations could be selected for planning.

11.5 In terms of remediating, or rather avoiding if possible, negative effects associated with root zone incursions, much of this needs to be achieved through strategic design and engineering. For example, a structure on piles allows for roots to be preserved, whereas a structure on a strip footing inherently severs roots. The former scenario is obviously a better outcome, but still requires arboricultural measures to preserve trees during construction. This type of input would come during detailed design and would consist of a suite of measures to be implemented on site. For example, procedures to preserve roots, protect the ground and improve or maintain soil structures and hydrology.

11.6 The same is true where live crowns need to be pruned. Much of the negative effects of live crown removal can be avoided if structures are positioned strategically. Live crown pruning needs to be carried out by trained and competent arboricultural professional.

[3] Based on modelling from the New Zealand Productivity Commission (2018) to achieve carbon neutrality by 2050

12 Conclusions and recommendations

12.1 The KiwiRail NoR project requires that parcels (or portions thereof) of land be taken for temporary and permanent occupation, to service the future operation of the rail corridor. This necessitates tree removal (e.g. tree 53) and incursions into tree root zones (e.g. tree 54). Remedial measures are required to address the loss of ecosystem services arising from tree removals (e.g. carbon sequestration deficits). It is recommended that a detailed appraisal of the trees with removal requirements be undertaken during detailed design, and for each tree which needs to be removed, an appropriate planting specification be developed based on lost future benefits (e.g. sections 11.1 and 11.2). At present, a minimum of three, 45-L grade trees need to be planted to address the RMA requirements of tree removal, and a further nine trees need to be planted to address the wider effects of tree removal (i.e. all trees, including those which are not protected) as these relate to carbon sequestration deficits.

12.2 Incursions into the root zone areas of trees has the potential to elicit negative effects on tree health if not managed correctly. These negative effects can compromise tree function, predispose them to future stress and reduce longevity. It is recommended that the detailed design be prepared strategically with arboricultural input, and that an appropriately qualified and experienced arboricultural consultant be engaged to prepare a site-specific set of tree preservation measures, to be implemented during physical works, for both temporary and permanent occupations. This is to include above (e.g. tree crowns) and belowground (e.g. roots and soil) tree structures.

12.3 We provide no comment on private trees not accessible during our assessment. It is recommended that if tree-related concerns are raised by the occupiers of private properties during the notification process, that an arboricultural consultant be given the opportunity to visit these properties to inspect the tree(s) and make comment on the potential impacts as necessary.

Please contact the author for further information.

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Appendix A – Tree inventory

Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
1	***Cupressus macrocarpa***	**Monterey cypress**	**20**	**-**	**-**	**-**	**Good**	**Fair**	**Good**	**Mature**	**Looks to be on KiwiRail land. Some pruning to clear gantry has occurred. Limited visual inspection owing to access constraints. Signs of previous pruning and occasional limb shedding**
2	**49 x *Cryptomeria japonica***	**49 x Japanese red cedar**	**16.8**	**35.0**	**1.9**	**5.3**	**Good**	**Good**	**Good**	**Mature**	
3	***Cedrus deodara* ***	**Himalayan cedar**	**18.4**	**125.7**	**3.9**	**18.9**	**Good**	**Good**	**Fair**	**Mature**	**Road reserve tree.**
4	*Corynocarpus laevigatus*	Karaka	4.5	31.8	1.8	4.8	Good	Good	Good	Early-mature	Trunk girth measured at base
5	*Metrosideros excelsa*	Pōhutukawa	9.5	94.2	3.3	14.1	Good	Good	Good	Mature	
6	*Corynocarpus laevigatus*	Karaka	4	19.1	1.4	2.9	Poor	Good	Good	Early-mature	Tree is almost dead
7	*Corynocarpus laevigatus*	Karaka	5	37.7	2.0	5.7	Poor	Fair	Fair	Mature	Crown dieback throughout Cavity at base of tree. Heartwood decay present
8	*Metrosideros excelsa*	Pōhutukawa	11	76.4	2.9	11.5	Good	Good	Good	Mature	
9	*Metrosideros excelsa*	Pōhutukawa	11	97.7	3.4	14.7	Good	Good	Good	Mature	
10	*Metrosideros excelsa*	Pōhutukawa	11	71.3	2.8	10.7	Fair	Good	Good	Mature	Deadwood present throughout crown. Sparseness also present throughout sections of the crown

DBH = [trunk] diameter at breast height (1.4 m)   SRZ = structural root zone radius (Coder, 1996)   TPZ = tree protection zone radius (Benson, 2019a)

Trees in **bold** scored highly enough to be considered for notable tree status   * = Currently protected tree

Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
11	*Vitex lucens*	Pūriri	9.5	55.8	2.5	8.4	Fair	Fair	Good	Early-mature	Deadwood and dieback present throughout crown Lots of sprouting present along the stems
12	*Corynocarpus laevigatus*	Karaka	7	32.5	1.8	4.9	Poor	Good	Fair	Early-mature	Tree is in decline with major dieback present throughout
13	*Metrosideros excelsa*	Pōhutukawa	9	33.2	1.9	5.0	Fair	Good	Fair	Early-mature	Dieback present upper crown
14	*Corynocarpus laevigatus*	Karaka	4.2	43.0	2.1	6.4	Fair	Fair	Fair	Mature	Deadwood and dieback present
15	*Metrosideros excelsa*	Pōhutukawa	11	74.4	2.9	11.2	Fair	Good	Good	Mature	Sparseness and dieback present throughout crown
16	*Metrosideros excelsa*	Pōhutukawa	6	52.7	2.4	7.9	Good	Good	Fair	Early-mature	Due to suppression from adjacent trees. The crown spreads towards the footpath
17	*Alectryon excelsus*	Titoki	8.5	58.6	2.5	8.8	Fair	Good	Good	Mature	Large pieces of deadwood throughout crown. Sparseness throughout tree.
18	*Podocarpus totara*	Tōtara	14	56.3	2.5	8.5	Good	Good	Good	Mature	
19	*Corynocarpus laevigatus*	Karaka	6.5	37.4	2.0	5.6	Poor	Good	Good	Early-mature	Major dieback and sparseness throughout crown
20	*Corynocarpus laevigatus*	Karaka	8	47.4	2.3	7.1	Fair	Fair	Good	Mature	Two stems at base which are in contact with each other. Deadwood and dieback present throughout crown

DBH = [trunk] diameter at breast height (1.4 m) SRZ = structural root zone radius (Coder, 1996) TPZ = tree protection zone radius (Benson, 2019a)

Trees in **bold** scored highly enough to be considered for notable tree status * = Currently protected tree † = Protective status unclear due to growing position

Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
21	*Vitex lucens*	Pūriri	9	81.2	3.0	12.2	Fair	Fair	Fair	Mature	Large section at base of tree to a height of 2 m decaying. Roots on one side of tree also decaying, although healthy elsewhere. Deadwood, dieback and sparseness present throughout crown
22	*Corynocarpus laevigatus*	Karaka	9.5	40.7	2.1	6.1	Fair	Good	Good	Early-mature	Deadwood within upper crown. Lots of sprouting regrowth present at base of tree
23	*Alectryon excelsus*	Titoki	9.5	34.5	1.9	5.2	Good	Fair	Good	Mature	Multi-stemmed near base.
24	*Metrosideros excelsa*	Pōhutukawa	13	131.5	4.0	19.7	Good	Good	Good	Mature	
25	*Podocarpus totara*	Tōtara	9	32.5	1.8	4.9	Fair	Good	Fair	Early-mature	Very small crown due to suppression from adjacent trees.
26	*Alectryon excelsus*	Titoki	8	55.5	2.5	8.3	Good	Good	Good	Mature	Minor crown dieback present Wound present on second largest stem near base, 800 mm in length, 200 mm in width
27	*Podocarpus totara*	Tōtara	13	60.2	2.6	9.0	Good	Good	Good	Mature	Very little root flare present. Ground level may have been altered
28	*Corynocarpus laevigatus*	Karaka	2.5	9.5	0.9	1.4	Good	Good	Good	Early-mature	All that remains is a cluster of sprouting regrowth and old decaying stump
29	*Podocarpus totara*	Tōtara	13	86.3	3.2	12.9	Good	Fair	Good	Mature	Large surface roots present with visible damage. Multi-stemmed tree with tight union at 1.8 m. Cavity at base of tree 1.2 m in height, 100 mm width. Visible heartwood decay
30	*Alectryon excelsus*	Titoki	12	64.9	2.7	9.7	Good	Good	Good	Mature	

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Trees in **bold** scored highly enough to be considered for notable tree status * = Currently protected tree † = Protective status unclear due to growing position

Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
31	*Corynocarpus laevigatus*	Karaka	10	80.5	3.0	12.1	Good	Good	Good	Mature	Overhanging railway areas
32	*Corynocarpus laevigatus*	Karaka	7.5	38.2	2.0	5.7	Good	Good	Good	Early-mature	Understory vegetation
33	*Metrosideros excelsa*	Pōhutukawa	13	71.1	2.8	10.7	Good	Good	Fair	Mature	Tree has been suppressed from adjacent trees and has gone in search of light. Overhangs railway areas
34	*Podocarpus totara*	Tōtara	12	63.3	2.7	9.5	Good	Good	Good	Mature	Mushrooms growing around roots
35	*Alectryon excelsus*	Titoki	11	34.1	1.9	5.1	Good	Good	Good	Mature	
36	*Vitex lucens*	Pūriri	10	81.3	3.1	12.2	Fair	Good	Good	Mature	Sparseness and minor dieback throughout crown deadwood within lower crown overhanging footpath
37	*Podocarpus totara*	Tōtara	14	74.5	2.9	11.2	Fair	Good	Good	Mature	
38	*Metrosideros excelsa*	Pōhutukawa	14	65.0	2.7	9.7	Good	Good	Good	Early-mature	
39	*Alectryon excelsus*	Titoki	10	50.3	2.3	7.5	Good	Fair	Good	Mature	Smaller stem has three pruning wounds close together wounds are callusing over although hollow points are present in area.
40	*Corynocarpus laevigatus*	Karaka	8	92.0	3.3	13.8	Good	Good	Good	Mature	Girth measurements taken from base

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Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
41	*Vitex lucens* *	Pūriri	13	92.0	3.3	13.8	Good	Good	Good	Mature	Lower crown deadwood overhanging footbridge
42	*Corynocarpus laevigatus* *	Karaka	10	63.7	2.7	9.5	Good	Good	Good	Mature	Lots of sprouting at base of tree
43	*Podocarpus totara*	Tōtara	14	67.5	2.8	10.1	Good	Good	Good	Mature	
44	***Platanus orientalis* ***	**Oriental plane**	**15**	**85.3**	**3.1**	**12.8**	**Good**	**Good**	**Fair**	**Mature**	**Crown form dynamic crown with adjacent trees in this area**
45	***Alectryon excelsus* †**	**Titoki**	**11**	**60.5**	**2.6**	**9.1**	**Good**	**Fair**	**Fair**	**Mature**	**Fruit bodies largest stem at 1.3m from ground. Used hammer to sound for hollow spots. Deadwood present within upper crown**
46	***Podocarpus totara* ***	**Tōtara**	**12**	**64.6**	**2.7**	**9.7**	**Good**	**Good**	**Good**	**Mature**	**Roots lifting footpath**
47	*Vitex lucens* *	Pūriri	8	64.2	2.7	9.6	Poor	Poor	Good	Mature	Majority of tree is dead although small areas of sprouting is present. Cavity at base of tree
48	*Metrosideros excelsa* *	Pōhutukawa	5	40.7	2.1	6.1	Good	Good	Good	Early-mature	Multi-stemmed from base. Both stems have large areas of exposed heartwood
49	***Cryptomeria japonica* ***	**Japanese red cedar**	**12**	**57.0**	**2.5**	**8.5**	**Good**	**Good**	**Excellent**	**Early-mature**	**Worthy of notable tree status**
50	*Tristaniopsis laurina* *	Water gum	7.5	49.0	2.3	7.4	Good	Good	Good	Early-mature	Multi stem from base

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Trees in **bold** scored highly enough to be considered for notable tree status * = Currently protected tree † = Protective status unclear due to growing position

Tree #	Species	Common name	Height (m)	DBH (cm)	SRZ (m)	TPZ (m)	Overall vitality	Branch structure	Form	Age class	Arboricultural comments and observations
51	*Malus sp.* *	Apple	4	37.9	2.0	5.7	Good	Good	Good	Early-mature	Phototropic form due to suppression. Overhanging into railway area
52	*Fraxinus sp.* *	Ash	10	47.1	2.3	7.1	Good	Good	Good	Early-mature	
53	*Dacrydium cupressinum* *	Rimu	8	34.4	1.9	5.2	Fair	Good	Fair	Early-mature	Suppressed by adjacent trees. Appears to be suffering from recent drought
54	***Platanus x acerifolia* ***	**London plane**	**15**	**113.0**	**3.7**	**17.0**	**Good**	**Good**	**Good**	**Mature**	**Overhanging into railway area**
55	*Tristaniopsis laurina* *	Water gum	5	35.3	1.9	5.3	Good	Good	Good	Early-mature	Suppressed by adjacent trees
56	*Salix fragilis* *	Crack willow	8	59.7	2.6	9.0	Good	Fair	Fair	Early-mature	Suppressed from adjacent trees. Stem closest railway has a large strip approximately 1.6 m of decaying heartwood.
57	*Fraxinus sp.* *	Ash	6	44.3	2.2	6.7	Good	Good	Fair	Early-mature	Suppressed by adjacent trees. Deadwood with crown over 100 mm in diameter
58	*Corynocarpus laevigatus* *	Karaka	5.2	33.7	1.9	5.1	Good	Fair	Fair	Early-mature	Multiple pruning wounds on main stem. Unbalanced crown with small amount of dieback. Cavity at base able to probe to a depth of 500 mm
59	*Metrosideros excelsa* *	Pōhutukawa	5	43.3	2.2	6.5	Good	Good	Good	Early-mature	
60	*Taxodium distichum* *	Swamp cypress	12	-	-	-	Good	Good	Excellent	Mature	Viewed from adjacent roadside and appears to be in good condition. Check works nearby

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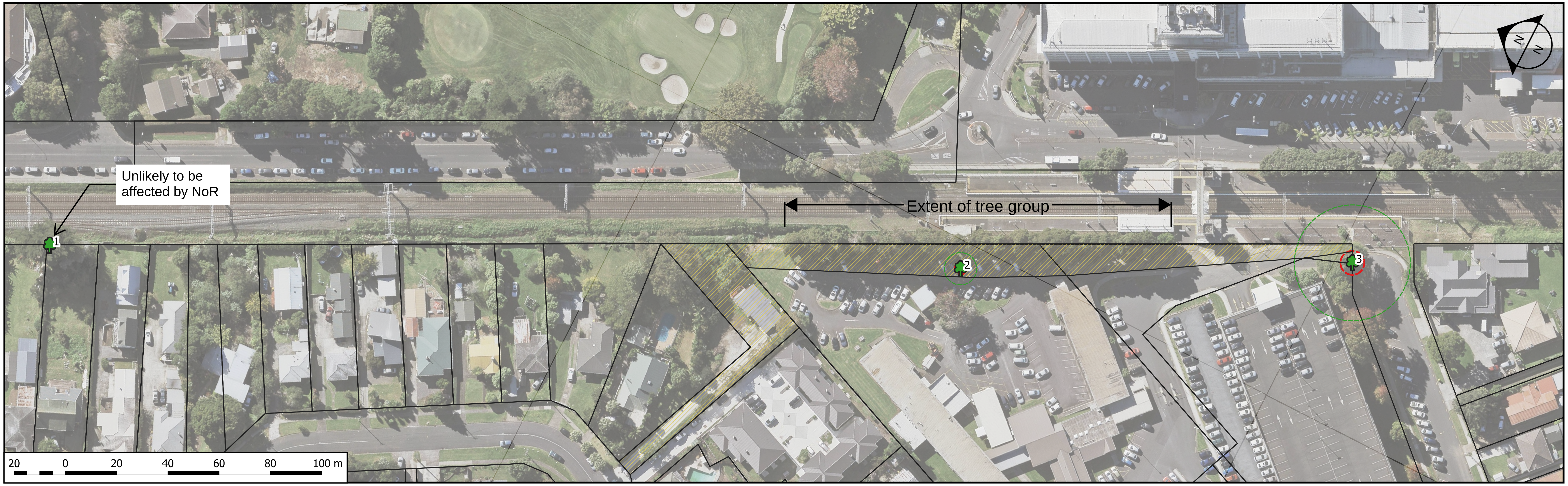
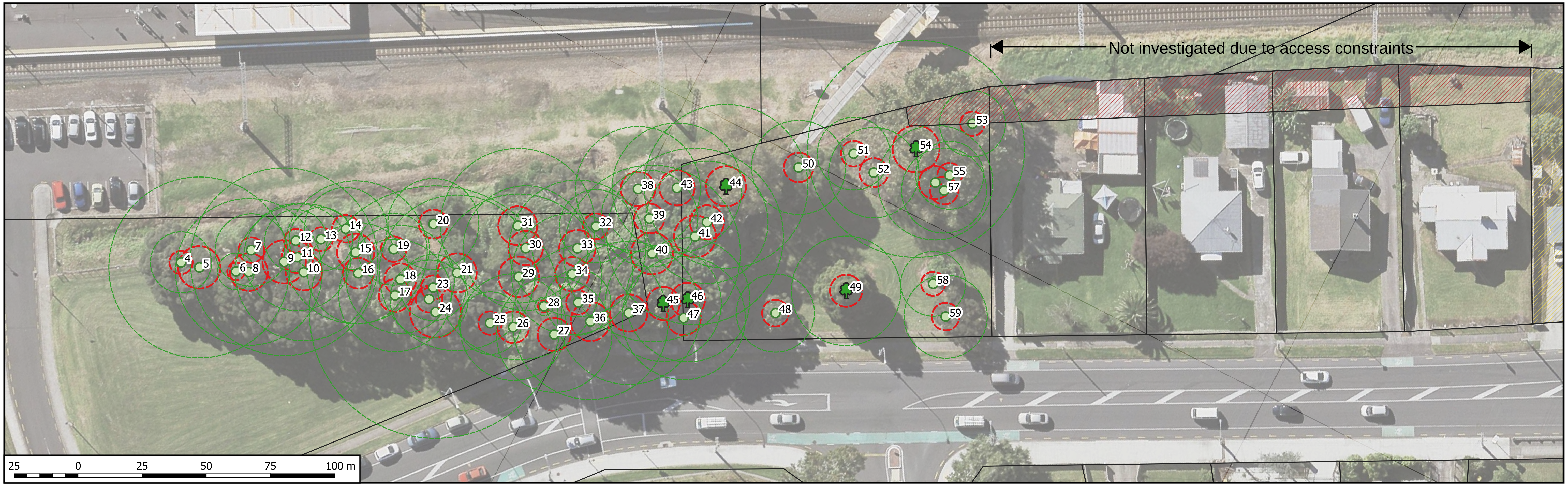
Trees in **bold** scored highly enough to be considered for notable tree status * = Currently protected tree † = Protective status unclear due to growing position

Appendix B – Drawings 1642_001 and 002, rev B





Trees

- Trees worthy of notable status
- All other trees
- Structural root zone (Coder, 1996)
- Tree protection zone (Benson, 2019)
- Permanent occupation
- Temporary occupation

KiwiRail

Wiri to Quay Park Notice of Requirement
Tree location and land requirement plans

The TREE CONSULTANCY COMPANY

Job ref	1642		
Drawing	001	Rev	B
			16/06/2020

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Drawing	002
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Appendix C – Site photographs

Photo 1: Tree 1 (Monterey cypress)

Photo 2: Tree 3 (Himalayan cedar)

Photo 3: Tree 2 (49 x Japanese red cedar). Tree 3 can be seen in the background (arrow)

Photo 4: Trees 45 (titoki, left) and 46 (totara, right)

Note: The dead tree in the foreground is not tree 46

Photo 5: Tree 49 (Japanese red cedar)

Photo 6: Tree 54 (London plane)

Appendix D – Notable tree scoring schedule

Table 1: Notable tree scoring

Tree number	Species	Age and health	Character or form	Size	Visual contribution	Total score
1	*Cupressus macrocarpa*	6	5	5	10	26
2	*Cryptomeria japonica* x *49*	4	5	5	10	24
3	*Cedrus deodara*	4	5	10	10	29
44	*Platanus orientalis*	4	5	5	10	24
45	*Alectryon excelsus*	4	5	10	10	29
46	*Podocarpus totara*	4	5	5	10	24
49	*Cryptomeria japonica*	5	5	5	10	25
54	*Platanus x acerifolia*	4	5	10	10	29

Table 2: Average tree dimensions ± one standard deviation at Middlemore location (1.5 km^2)

Species	DBH (cm)	n	Height (m)	n
Cupressus macrocarpa	NA	0	NA	0
Cryptomeria japonica	60.47	1	13.2 ± 1.8	4
Cedrus deodara	62.6 ± 3.2	3	15 ± 3.2	12

Table 3: Average tree dimensions ± one standard deviation at Papatoetoe location (1.5 km^2)

Species	DBH (cm)	n	Height (m)	n
Alectryon excelsus	37.9 ± 18.7	17	7.7 ± 2.3	17
Podocarpus totara	63.6 ± 24.4	14	11.9 ± 2.4	14
Cryptomeria japonica	NA	0	NA	0
Platanus x acerifolia	42.9 ± 33.9	11	9.1 ± 3.9	11
Platanus orientalis	NA	0	NA	0