

**Document No:** 392447**File No:** 401/0588473000**Report To: Council****Meeting Date:** 31 May 2016**Subject:** Redwood Trees Te Kuiti Esplanade**Purpose of Report**

- 1.1 The purpose of this business paper is to present to Council the findings of an Arboricultural Report undertaken on the stand of Redwood Trees located at 120 Esplanade, Te Kuiti.

**Background**

- 2.1 The stand of Coast Redwoods located at Te Kuiti Esplanade are unique conifer trees native to the southwest Pacific coast of North America. The stand, comprising around 215 trees was planted approximately 50 years ago.
- 2.2 In 2010 Treescape Environmental were commissioned to complete an investigation with regards to removal of dead trees and prepare an Arboricultural Report relating to the die back of several trees in the stand.
- 2.3 The 2010 report identified 29 trees in total that were affected by die back and made recommendations that eleven dead trees and one partially dead tree be removed as they were posing major hazards. This work was completed in 2014.
- 2.4 A follow up report was requested from Treescape Environmental in March 2016. The purpose of this report was to provide an arboricultural evaluation of the trees current state of health and safety and to seek advice on the shading effect of residential properties in the immediate area.

**Commentary**

- 3.1 The 2016 Arboricultural Report makes reference to concerns raised regarding the Health and Safety of the trees during the past decade and the shading effect to a property west of the stand during the winter months.
- 3.2 These concerns form the basis of the assessment to ensure the grove of trees remains harmonious with the surrounding community.
- 3.3 The 2016 report has shown that further decline of the trees appears to have slowed greatly since 2010 and the overall health of the stand is good.
- 3.4 It was observed during the 2016 inspection that there are dead branches in the upper canopy of trees at the northern perimeter of the grove. These branches require removal to prevent impact to possible targets below. It is recommended that this be carried out at three yearly intervals.

- 3.5 Climbing ivy vines are prevalent at ground level within the stand and it is recommended that these be removed to prevent damage to tree health. This would be addressed as a standard site maintenance task.
- 3.6 The historical shading effect onto a residential property across the river from and to the west of the stand could be addressed only with the removal of a large portion of the stand (up to 50% or more).
- 3.7 This shading effect is not a new condition. As both the stand and the residential houses are of significant age (circa 50 years) and the shading effect is very seasonal (3 winter months).
- 3.8 Treescape Environmental advised that partial stand removal is not recommended as stand dynamics would be greatly changed and there would be an increased risk of failure to the remaining newly exposed trees. Trees that grow on the outer of a stand become more resilient to changing weather patterns. If these trees are removed weaker trees become exposed.
- 3.9 Reducing the height of the trees to stop the shading of the property is also not a recommended practice. The large pruning wounds left do not heal well in mature trees which assists in the unwanted introduction of decay and rot. Removing the top quarter of the tree could compromise the health and longevity of the trees as well as open up inner trees to exposure. The re-growth is often fast growing and weak which raises further safety concerns to the trees and anything at ground level. The trees would require regular pruning to maintain the desired height.
- 3.10 As part of a management plan to ensure the ongoing health and safety of the trees and the stand, a ground based visual inspection will be undertaken in three years time to assess the health and condition of the trees and to document any further changes to their condition over this time.

### Suggested Resolutions

- 1 That the Business Paper on the Redwood Trees at Te Kuiti Esplanade be received.

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May 2016

Attachment: Treescape Environmental Arboriculture Report (doc 395491)



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## ARBORICULTURAL REPORT

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<b>Title</b>	<b>Te Kuiti Coast Redwoods (Sequoia) Assessment</b>
<b>For</b>	<b>Liz Riley - Waitomo District Council</b>
<b>Site</b>	<b>120 Esplanade, Te Kuiti</b>
<b>Prepared By</b>	<b>Erika Commers - Treescape Environmental</b>
<b>Reviewed By</b>	<b>Jon Redfern - Treescape Environmental</b>
<b>Brief</b>	<b>Health and safety assessment of a redwood grove</b>
<b>Date</b>	<b>22 April 2016</b>

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### ***Executive Summary***

*A one-hectare grove of coast redwood trees (Sequoia sempervirens) were planted approximately 50 years ago toward the south end of the town of Te Kuiti, in the Waikato. The trees have quickly grown into an iconic towering stand of young giants that can be spotted from the nearby highway. There have been some concerns raised about the health and safety of the trees during the past decade as some of the northern trees have begun to show signs of decline with branch loss. Due to height, they are now a permanent source of shade to the west on nearby residences during winter months. These concerns are the basis for this assessment, the resulting management recommendations have been made to ensure that this grove of young Redwoods is harmonious with the surrounding community.*

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## 1. Introduction

- 1.1. This report was prepared by *Treescape Environmental Ltd* at the request of *Liz Riley* of *Waitomo District Council*. The information in this report has been prepared in accordance with site information supplied by Waitomo District Council. A health and safety assessment of an all-aged stand of coast redwood trees (*Sequoia sempervirens*) in mid-maturity has been carried out within a Council reserve at 120 Esplanade, Te Kuiti.
- 1.2. The purpose of this report and assessment is to provide an arboricultural evaluation of the trees' current state of health and safety with the intention of assisting the Council in making informed decisions for management planning with regard to the trees.
- 1.3. A site visit with Visual Tree Assessment (VTA) was conducted from ground level on 21 March 2016. Site access was unrestricted and weather conditions were fine. All measurements herein are approximations unless otherwise noted.
- 1.4. An assessment report of the trees was produced in July 2010 by Jacob Sewell of Treescape Ltd. This report provided reference information with regard to the trees' conditions and observations made at that time.
- 1.5. Appendices are included with site assessments and photographs.

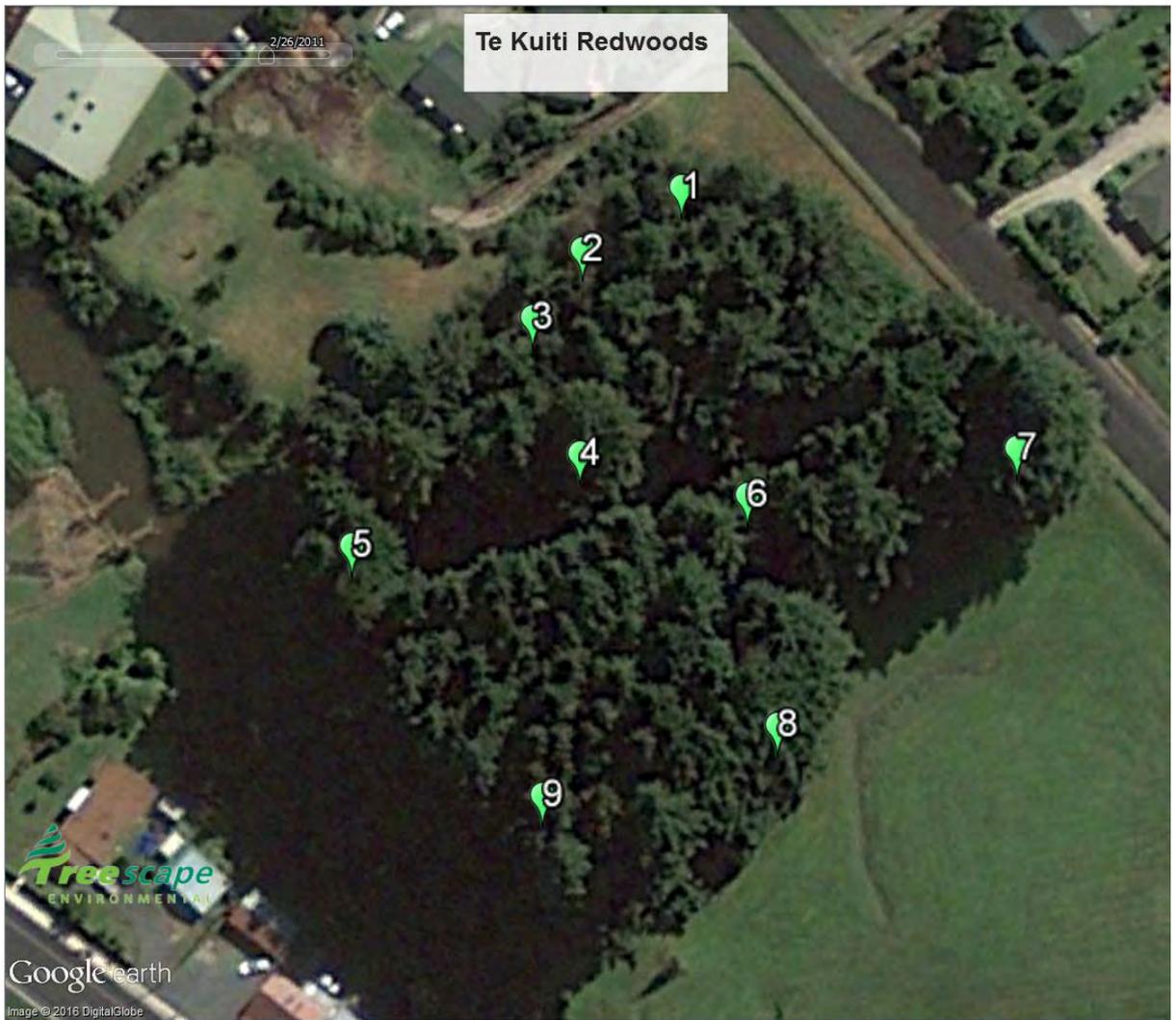
Figure 1



## 2. Location and Site Characteristics

- 2.1. The all-age cohort of redwood trees assessed in this report is located within a parcel of Council Reserve land that lies between the Mangaokewa Stream and the Esplanade, at the south end of Te Kuiti's town centre. The immediate surrounds are grass covered open space on three sides and a stream. Retirement housing lies approximately 15 metres to the north, a sealed carriageway lies 7-15 metres to the northeast, and an open lawn covers the southeast region to a distance of 90 metres. The southwest is bordered by the stream with two private residential dwellings approximately 30 metres southeast of the trees. It is not known exactly when the trees were planted or for what purpose.

Figure 2 - Area locations created for description detail



- 2.2. The immediate site on which the trees are growing is bisected by an east-west overland flow path that creates a slight topographical depression (valley) through the stand. There are no trees growing within this flow path valley, which appears ephemeral and is predominantly covered in wandering jew (*Tradescantia fluminensis*). The immediate site may be periodically used by light foot traffic; there are a few noticeable paths through the understory of the trees. The site is overall relatively flat; a very slight slope extends upward from the centre of

the stand to the north and south. The total elevation change is approximately two metres from the low to high points.

### 3. Arboricultural Assessment

#### 3.1. *Sequoia sempervirens* Species Profile:

- A. *Sequoia sempervirens* are unique conifer trees native to the southwest Pacific coast of North America. They naturally occur in very close proximity to one another in the coastal forest environment, for resource maximization and protection. With the potential to be very long living forest trees, they tolerate heavy shade when young and grow with a typical excurrent form during their early years. Known to be some of the tallest trees in existence, as the redwood reaches toward the top of the surrounding canopy line, it sheds its lower shaded branches in exchange for new growth nearer to the light. Canopy tissues within the same tree have the ability to join together for increased strength and resource allocation.
- B. The roots remain rather shallow in the upper 8-10 feet of soil, and are sensitive to site conditions and disturbance. *S. sempervirens* is susceptible to damage from soil compaction in areas of heavy foot traffic.
- C. The wood of *S. sempervirens* is known to be moderately strong and rather light in weight with a moderate resistance to decay. The bark is very thick and fibrous and can easily be several centimetres thick.
- D. Very unique amongst conifers, the *S. sempervirens* has the ability to vegetatively reproduce when stressed or in decline by producing adventitious buds in the cambium that sprout from the trunk and root crown when additional energy is required.
- E. Lignotuber development is a specialized form of carbohydrate storage that *S. sempervirens* will produce in response to environmental triggers, often dubbed burl. Occurring at the base of the trunk accompanying root collar development, lignotubers appear as a pronounced swelling at ground level, and function to support the growth and proliferation of suppressed buds throughout the life of the tree, as well as facilitate vegetative reproduction following traumatic disturbance. When redwood trees die in the forest, a ring of new trees often occurs surrounding the original stump, often referred to as a fairy ring, these trees are the product of the lignotubers, and utilize the same root system as the original tree.
- F. Damaging agents in the redwood's native range include insects, branch canker (*Coryneum spp.*) and heart rots (*Poria sequoiae*, *P. albipellucida*). Known fungal rot pathogens will opportunistically affect redwoods in their native range. Heart rots cause extensive cull in native redwood forest. The insects associated with redwoods cause no significant damage, branch canker may girdle stems and branches.
- G. Brown-rot fungi have been known to colonize the heartwood of *S. Sempervirens*. Brown-rots primarily decay the cellulose and hemicellulose (carbohydrates) in wood, leaving behind the brownish wood lignin. Wood affected by brown-rot usually is dry and fragile, readily crumbles into cubes because of longitudinal and transverse cracks, and commonly forms a solid column of rot in wood, sounding hollow when decay is

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present. Brown-rots cause unpredictable stem failure, and are often hard to detect and measure.

### 3.2. **Te Kuiti Stand Characteristics:**

This assessment is based on conditions present and observations made at the time of the site visit. There are approximately 215 redwood trees in the Te Kuiti cohort. The spacing between individuals is highly variable and ranges from one metre to several metres. There is a 10-12 metre wide tree-less valley running east-west through the approximate middle of the grove; this appears to be an ephemeral overland flow path which creates a natural division in the stand and allows for greater light penetration to the centre and nearby trees. The average overall height of the cohort is approximately 30 metres, the tallest trees are at the eastern-most region of the stand and may reach approximately 35m. The perimeter trees are largest in diameter with denser foliage than the inner trees; the branching is asymmetrical favouring the outer perimeter where sunlight availability is greatest. The exact age of the cohort is unknown, however, it is thought to be between 45-55 years.

The individual forms of the trees are demonstrative of a typical excurrent young redwood. Inner trees have sparse branching and foliage, especially on the lower shaded stems. Natural branch pruning is a common response to shade resulting in less energy production and in turn reducing the growth and diameter of inner cohort trees.

A basic visual assessment was administered from ground level throughout the stand with attention given to variation and anomaly; branches, twigs, foliage, and form were evaluated. The overall health and condition of the stand can be summarised as good. I have divided the grove into areas with regard to characteristics and location. The trees will be addressed in greater detail by area, as labelled on Figure 2. Please refer to Appendix A for further photos and details.

### 3.3. **Area 1- Northern Corner**

- i. There are seven redwood trees primarily addressed at the northern corner area of the grove, four of which have been diameter measured for record keeping purposes. It is believed that the perimeter trees along the northern boundary of the grove have endured a grade change to the north, thus affecting their root systems; fill and debris appear to have been piled over the roots up to and against the main stems. The exact grade change event is unknown and occurred no less than eight years ago. Evidence of this has been documented in the 2010 report and can still be seen at the trunks of a few of the trees. Additionally, it appears arson was attempted at the northern face of three trunks, visible by burn scars. The appearance of canopy stress and decline in the last seven years is consistent with root system and/or stem cambium loss. The top dieback, dead limbs, and weak leaders are evidence of the stress this area of the cohort has been enduring.
- ii. Removal of lower outer limbs and dead leaders to some of these trees has been carried out post-2010 as a result of the decline recorded at that time. The Area 1 trees appear to have decreased in decline since the previous 2010 evaluation and are currently in fair condition. The foliage density is fair to sparse on individuals, some foliage is slightly chlorotic in areas with light browning on previous years growth. A stump from a previously removed tree remains with lignotuber shoots around its perimeter. The prior removal of declining branches and an entire outer

tree has created an increase in sunlight availability to the inner trees in this area resulting in heavy epicormic shoot production on the main stems. Epicormic shoots demonstrate a tree's ability to generate energy on demand from dormant buds beneath the bark. The shoots may be stimulated by stress and/or new light exposure.

- iii. Main stems appear entirely intact on each of the trees in this area; there is one noticeable region of bark loss on the smallest tree, it was likely caused by the removal of the neighbouring tree and appears to be fairly superficial with no cambium exposure. There are no further detected cavities, splits, cracks, or cankers amid the trees of Area 1.
- iv. The presence of pest plants is very heavy in this area. Wandering jew covers the ground in a very thick knee-deep mat. Climbing ivy vines (*Hedera sp.*) have grown to various heights on many of the nearby trees, some trunks are fully surrounded. There are young privet (*Ligustrum sp.*) and Elaeagnus (*Elaeagnus sp.*) saplings growing sporadically throughout the forest floor.

#### 3.4. **Area 2 - Northwest**

- i. There are six redwood trees addressed in this area immediately west to the trees in Area 1, most of which are located along the outer perimeter of the stand. An individual tree within Area 2 demonstrates a stem reiteration due the loss of its lead, this was also noted in the 2010 assessment. Four of the trees have previously lost their tops. In addition, there are several upper dead branches remaining in tact primarily on one individual. Alike the trees in Area 1, the trees along the outer perimeter of Area 2 have endured a grade change to the northern region of the soil environment. Fill to an unknown depth has been added over the root system at the north and up to the main stems. The appearance of canopy stress and decline is consistent with root system disruption resulting in energy and resource loss.
- ii. A crown failure of a live top from a tree within this area was reported to have occurred during a weather event in 2015. A possible explanation for this occurrence could be a change of exposure coupled with root system stressors. It is known that several trees surrounding this tree have had previous decline, dieback, and subsequent pruning or removal. Abrupt changes to the wind dynamics of remaining exposed limbs may contribute to newly exposed stems failing during abnormal wind and weather events.
- iii. Removal of lower limbs and dead leaders has been carried out post-2010 as a result of branch decline. Apart from a single tree, the trees appear to have ceased declining and are currently in good overall condition. Foliage density is fair to good and normal in colour. The prior removal of an entire tree from this area in addition to dead and declining branches has allowed an increase in sunlight availability to the lower branches and inner stems resulting in heavy epicormic shoot production to some.
- iv. There are no noticeable cavities, splits, cracks, or cankers amid the bark of the trees. It is recommended that dead branches in the upper canopy of an individual be removed.
- v. The presence of pest plants is very heavy in Area 2. Wandering jew covers the ground in a thick knee-deep mat. Climbing ivy has grown to various heights on

many of the nearby trees fully covering the stems of some. There are young tree privet saplings growing sporadically and arum can also be found in patches.

### 3.5. **Area 3 - Central Northwest**

- i. There are approximately seven trees included in Area 3 located along the north west region of the stand, and west of Area 2. There are four trees along the perimeter and an additional bunch further in (south). The largest tree within this area is located alongside a foot track leading to/fro the grove. This perimeter tree is also missing its leader, which was likely removed after being recorded as dead in 2010. The tree now appears in good health and has ceased declining. All others in the area appear in good health and condition, there may have been additional trees with removed dead leaders which are no longer easily visible from ground.
- ii. It appears that the grade change and extent of fill observed at the northern boundary has dissipated nearing Area 3. The appearance of canopy stress and decline has decreased continuing westward along the north cohort perimeter.
- iii. Foliage density on the trees in Area 3 is fair to average. Natural competition is the primary factor in growth habit for most of the trees; the inner trees have clear lower boles with limited branch extension and density due to shading. The upper tree canopies appear healthy in vigour and moderate in density. The perimeter tree's are asymmetric in form due to increased light availability at the outer face. This behaviour is consistent among the perimeter trees throughout the stand. Previously recorded dead standing trees have been removed, stumps remain.
- iv. The presence of wandering jew completely covers the ground in a very thick mat throughout this area, as depicted in Appendix A photos.

### 3.6. **Area 4 - Inner Stand Trees**

- i. There are approximately sixty trees included in Area 4. There are 102 trees to the north of the overland flow path valley that passes through the cohort. The trees included in Area 4 consist of the abundant inner stand to the north of the described valley. These trees have consistent characteristics among them due to their growing conditions, density, soil conditions, and age class, resulting in similar form and habit. All trees within this region are in good to average health and condition with predominantly clear lower stems and foliage concentrated in along upper quarter portion of the main stem. Some have epicormic shoots, most are rather sparse in foliage density on the whole.
- ii. An east-west walking track traverses through this region inviting occasional foot traffic, burn scarring to the base of one tree is evident; the tree appears to be in fair condition otherwise.
- iii. The presence of pest plants over the forest floor is heavy throughout the area as they encroach westward. Wandering jew covers the ground throughout much of the understory and climbing ivy is present in patches. Tree privet and Elaeagnus saplings grow sporadically throughout.

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### 3.7. **Area 5 - West Perimeter**

- i. There are approximately fifteen trees included in Area 5 which is located in the western corner region of the cohort. Four of the trees along the river perimeter taper rapidly toward the top, a few of which appear to have indefinite leaders. The perimeter trees are again asymmetrical with outer branches remaining to the ground at the sun exposed face.
- ii. A rather severe burn scar remains at the base of one tree in from the edge of the stand. The damage persists to the cambium. The tree appears to be in fair health and condition. Redwood trees can demonstrate some resiliency to fire events due to species adaptation.
- iii. There is one tree that is predominantly taller than the others in this area. It has a dense upper canopy growing above its surrounds, most trees in this stand are slightly shorter than those to the east side of the cohort. This is likely due to the heavy shading that the western aspect endures throughout a large part of the year.
- iv. The forest floor remains primarily leaf litter cover. Ivy and wandering jew are sparse and encroaching from the east.

### 3.8. **Area 6 - Overland flow path valley**

- i. Area 6 is the central east-west lowland valley through the centre of the grove and includes the trees growing along its 'banks'. The ground throughout the tree-absent region is very soft, shaded and saturated in places. The redwoods alongside the valley are elevated 1-2 meters on the banks. The entire valley is covered in wandering jew to knee depth and includes many juvenile weed trees with some native plants such as *Coprosma sp.*, *Pittosporum sp.* and ferns.
- ii. The trees along both sides of the valley reflect the absence of trees through the middle and have grown a bit larger due to the increase in sunlight penetration through the small gap in the cohort. Trees along this area appear healthy, are slightly larger in diameter than those further in, and many have retained branches on the lower stems.
- iii. The presence of pest plants is very heavy throughout this area. Wandering jew covers the ground in a very thick knee-deep mat. Climbing ivy has grown to various heights on many of the nearby trees, fully surrounding some. There are privet, Chinese fan palm and *Elaeagnus* saplings growing sporadically throughout.

### 3.9. **Area 7 - Eastern Corner**

- i. There are several trees in Area 7, the four redwoods at the eastern corner of the grove have been measured for record keeping purposes. The perimeter trees along the eastern boundary appear to be the tallest and possibly the largest in the grove. They are in excellent health and form. An open grass lawn extends to the south for a fair distance. The trees are in an advantageous location for year-round sunlight exposure. The foliage density is high among the exposed individuals.
- ii. There is one tree growing in the northern most region of the area, and adjacent to the valley, that appears to have historic lightning strike damage and has lost its top. There are a few remaining dead limbs visible in this tree.

- iii. The presence of pest plants are encroaching toward this area, currently light in ground coverage. Wandering jew enters from the north. Climbing ivy has grown to various heights on some trees. There are young weed saplings growing sporadically throughout.

### 3.10. **Area 8 - South Central**

- i. There are approximately thirty trees included in Area 8. There is a total of 113 trees on the south side of the grove, south of the overland flow path valley. There are several trees included in this area because the trees are generally consistent in character and condition, there has been little required previous maintenance, and there are no recorded or observed changes that instigate closer attention.
- ii. The inner stand trees are fairly consistent in form, health, and condition, similar to Area 4. Characteristics of these trees are straight, tall and clear lower stems with natural lower branch shed from shading. Foliage concentration is among the top quarter of the main stem. One tree in this area has received a bit of fire scarring to the lower trunk which appears to affect only the bark.
- iii. The outer trees at the south perimeter are consistent with the perimeter tree characteristics previously described. They exhibit heavy asymmetrical branching at the outer face, with foliage present to nearly ground level.
- iv. A walking path is visible from the southern lawn, there are three trees immediately to the west of the path entrance that has barbed wire wrapped around them which is recommended to be removed.
- v. This area is almost entirely free of the pest plant ground cover that is plaguing the northern region of the cohort.

### 3.11. **Area 9 - Southern**

- i. There are approximately sixty trees included in Area 9. There are a total of 113 trees on the south side of the overland flow path valley. There are several trees included in this area because the trees are generally consistent in character and condition, there has been little required previous maintenance, and there are no recorded or observed changes that instigate closer attention. There are few specific remarks to be made about the trees as individuals in this broader south area.
- ii. Similar to the characteristics in Area 8, the inner trees in the stand are characteristic of those in a close growing forest stand. Overall, the trees appear to be in good health with well-developed buttress formation, nice foliage density and colour, and there is few weeds and vines present.
- iii. The outer trees along the perimeter are consistent with the perimeter tree characteristics previously described. They have heavy asymmetrical branching at the outer face, with foliage to nearly ground level. This region of the cohort receives heavy shading throughout a large part of the year, and therefore the trees are slightly shorter than those to the east. There are stumps remaining from the removal of a few dead standing snags noted in the 2010 report.
- iv. A heartwood-rot fungus may be present in one or two of the inner trees due to the presence of fruiting bodies observed previously. There are no further signs of

decline among the trees. It should be noted to evaluate the possible progression of this condition with regular site assessment.

- v. This area is almost entirely free of the vines and weeds present in the north and east of the grove, although they appear fast approaching.

#### 4. Cohort Assessment

- 4.1. Tree's inherently pose a certain degree of risk and hazard due to failure, breakage, or other causes. Conditions affecting trees change constantly. Any recommendations that are made here are intended to minimize or reduce hazardous conditions that may be associated with trees, however, there can be no guarantee or certainty that efforts to correct unsafe conditions will prevent breakage or failure of the trees on this property. The assessment intends to reduce the risk of failure but cannot eliminate such risk, especially in the event of a storm or act of nature.
- 4.2. The northern perimeter of the redwood cohort is known to have a history of branch and canopy failures during abnormal weather events. Reasons for this may relate to historic root system disturbance causing decline coupled with a domino effect of upper stem loss leading to changes in wind dynamics and new exposure for remaining trees. It is less likely that the south and west aspects of the cohort will undergo branch failures due to the prevailing wind direction and common conditions.
- 4.3. The northern perimeter trees in labelled Areas 1, 2 and 3 have partially buried buttresses at the north with prior root system disruption and observed crown decline. It is in this region that the trees should be monitored regularly for changes to vigour, branch attachments, and overall condition.
- 4.4. Branch attachments among the majority of the redwoods appear to have normal development and may not pose a great risk of failure when live tissue is present. Branch senescence and dead branch shed are likely to naturally occur. The most likely targets associated with branch failure are limited to persons and structures up to five metres beyond the dripline of the subject tree.
- 4.5. The risk associated with trees is generally measured using a set of values including; the presence and frequency of targets, the likelihood of failure, the likelihood of impacting the target and the consequences of the impact. It can be determined that the likelihood of a branch failure in this stand to impact an immovable target is low if a failure were to occur. The likelihood of a branch failure is possible yet it is unlikely that a failure will have an impact on a non-movable target.
- 4.6. There are very few signs present which could indicate that a tree may be vulnerable to root crown failure or trunk failure resulting in whole tree failure. These signs can include: the development of lignotubers and reduced buttress flare expansion; hollows sounded in the root crown and lower trunk; absence of identifiable structural roots; full canopy branch dieback, fruiting bodies, and soil environment alteration. The presence of any of these signs can be indicative of some amount of wood rot in the lower trunk, buttress (butt rot) or roots.
- 4.7. The plant cover over the forest floor should not be a great detriment to the health of the trees, however, the ivy vine growing on the bark and trunks can become detrimental and should be removed. If pest plant control is undertaken caution should be used if applying herbicides as some can be persistent and detrimental to the soil biology and therefore, to the trees.

- 4.8. The heavy shading that results to the west of the stand could be addressed only with removal of a large portion of the cohort at the west side, possibly 50% or more, as shadow cast can extend metres beyond the true height of the trees. Partial stand removal is not recommended, there is an increased risk for failure potential to newly exposed remaining trees. The stand dynamics would be greatly changed, jeopardising remaining trees.

Additionally, reducing the height of the trees is not a viable long-term option. The practice of topping is not a sound arboriculture pruning method and the natural excurrent form of the redwood trees would be greatly compromised. Large pruning wounds do not seal and compartmentalise well, they allow for the introduction of decay fungi and rot to progress. Many of these trees would not have any branches remaining if the top quarter or more of height was reduced. This practice would not only compromise the health and longevity of the trees, it would compromise the structural integrity of individuals as well and alter the stand exposure dynamics. Twig re-growth from this practice of pruning is often aggressive in length and weak at the attachment site. Furthermore, pruning would require ongoing maintenance pruning to maintain the height reduction and desired outcome.

## 5. Management Options

- 5.1. Decisions for mitigating the risk associated with possible failure are dependent on the risk tolerance of the tree owner/manager. In considering tree management options a tree owner/manager must balance the risk and benefits associated with trees. Suggested options are as follows, and can be considered in combination for the development of a suitable site management plan.
- 5.2. Accept the low risk level for damage potential based on the provided information and regularly monitor the trees for further changes. A self-monitoring programme can be implemented between arborist assessment so that any changes to the trees or failure events are documented with photographs. Close attention should be paid to further dead and declining branches around the cohort perimeter, and to any development of fungal fruiting bodies amid the bark, buttress, or roots of trees. If fruiting bodies become present, take samples and photos; this information will assist in identifying what type of wood rot may be at work, and therefore, the risk it may pose. With the self-monitoring option, an assessment of the tree's health and safety should be undertaken every three years by a qualified arborist experienced in assessment and risk analysis.
- 5.3. Dead branches in the upper canopy of the north perimeter trees should be removed on a three yearly cycle. Branch senescence is a normal occurrence and dead branches have the potential to cause damage if people are present passing beneath.
- 5.4. Upper canopy branch attachments on the perimeter trees at the north should be inspected on a five yearly cycle to detect and address the potential for weak unions and foreseeable failure in weather events.
- 5.5. Removing and/or reducing the height of trees at any location around the perimeter of the redwood cohort should be avoided. Trees grow in response to their immediate environment and conditions. Out of necessity, trees that grow with wind exposure become strong enough to tolerate the normal wind forces they are subject to. Trees sheltered by these perimeter trees do not develop the same strength and resilience and will be vulnerable to failure if exposed.
- 5.6. Climbing ivy vines should be removed from the trunks of the trees. The ivy can have detrimental effects on the health and vigour of the trees. The ivy can inhibit adventitious

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buds from sprouting along the stems as well as inhibit natural bark shed, it will hold moisture in contributing to the potential for rot, and add unnecessary weight as it grows quite thick over time.

## 6. Summary

- 6.1. The above-evaluated cohort of redwood trees has been growing for approximately fifty years within the Council reserve site at 120 Esplanade in Te Kuiti. The trees have been enjoyed and predominantly left undisturbed to grow to their current stature. Trees at the north have been observed to be in declining condition with lost limbs over the past eight years. The worst of the decline has been reported to have occurred in 2009 and 2010.
- 6.2. Measures have previously been undertaken by the Council to have the branch failure and decline concerns addressed. A previous arboricultural assessment has been conducted in 2010; dead tree removal and branch pruning were carried out shortly thereafter. Further declining of the trees appears to have slowed greatly since.
- 6.3. Inspection to the upper stems and branches has not been conducted amid the canopy of the trees since 2010. It has been observed from the ground that there are dead branches in the upper canopy of trees at the northern perimeter of the grove. These branches shall require removal to prevent impact to possible targets below.
- 6.4. It is recommended that this Te Kuiti redwood cohort undergoes a ground-based visual inspection in three years time to assess the health and condition of the trees and to document any further changes to their condition during this time. If results determine no further decline at the northern side of the grove, assessments may be carried out on a less frequent basis to manage the overall health and safety of the trees.
- 6.5. A management plan based on this report's findings and information shall be created by the tree asset manager/owner with consideration for the trees' benefits and risk tolerance of the tree owner/manager.

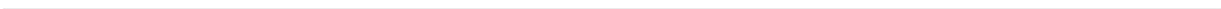
For further information please contact the author.



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**Appendix A - Site evaluations and photos**



## 1, Sequoia sempervirens- coast redwood

Created	2016-03-21 12:22:01 NZDT by Erika Commers
Updated	2016-04-21 10:17:32 NZST by Erika Commers
Location	-38.3376937173664, 175.171272587194
Item number	1
Tree Species	Sequoia sempervirens- coast redwood
Weed species	Ivy, Tradescantia, Privet
Height in m	30
Form/Balance	Average
Condition/Health	Average
Notes	Section of seven trees, the outer 3 of which have been obstructed with back fill to thier main stems over 7 years ago. Two of these larger outer trees have lost their top in recent years. A removal has opened light access to inner trees resulting in epicormic trunk shoots.

### Photos



Crown cleaning occurred to the lower bole of the outer trees here due to dieback.



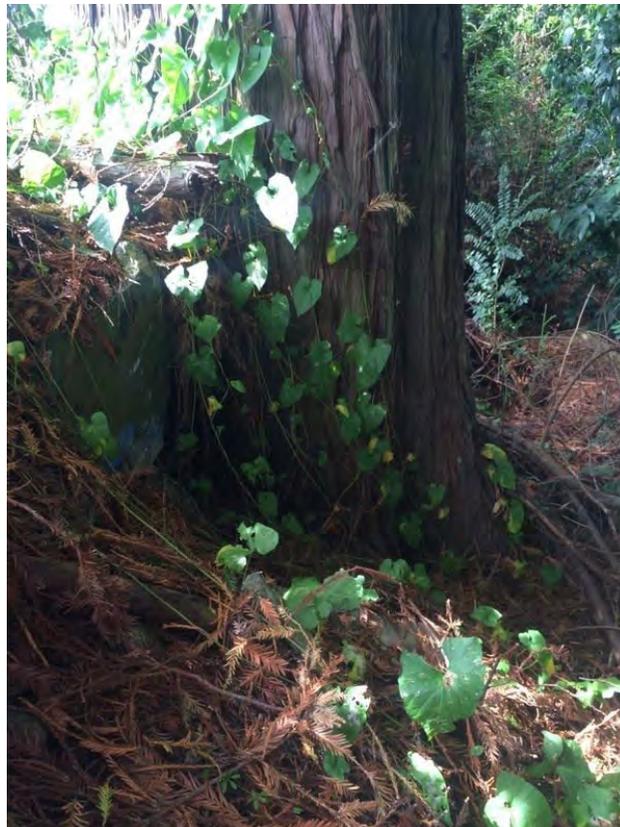
View from northeast



Large concrete debris and backfill to 70 cm at the north side of this stem



Possible burn scar and backfill at the north



Fill level depicted at right (north) with large debris resting against tree's main stem.



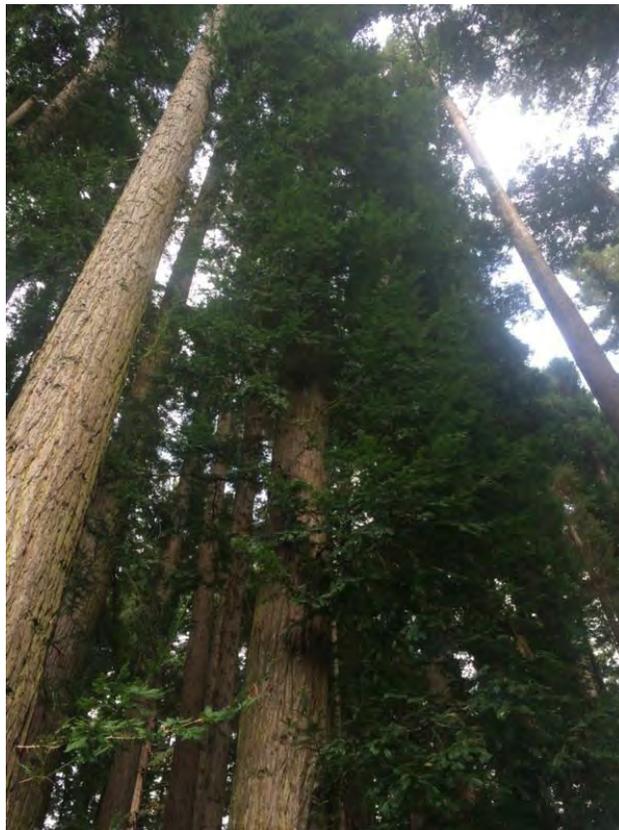
Stump of a removed tree with 'fairy ring' shoots from the lignotuber



Bark damage to small inner tree, stump in foreground



Buttresses from inside stand



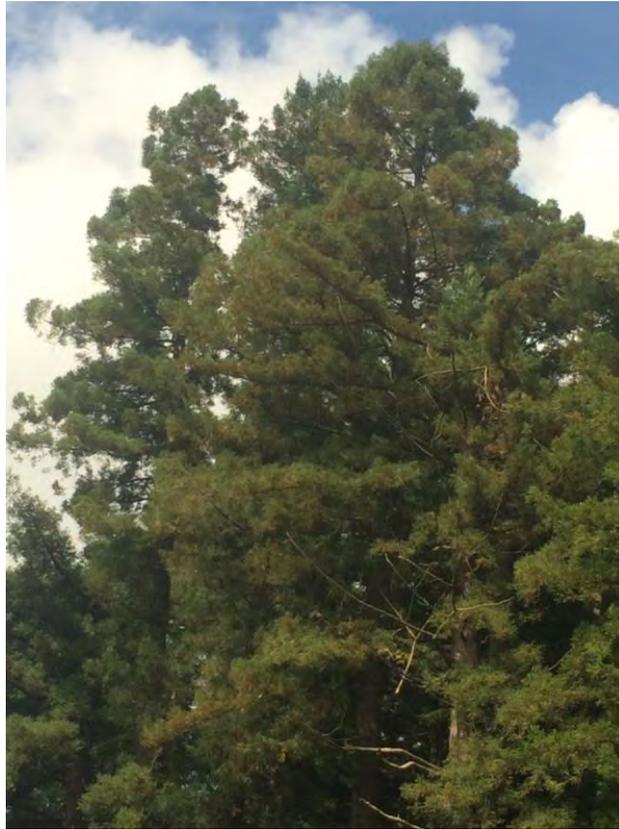
Exposed trunk of inner tree after outer tree removal, light penetration stimulated epicormic sprouting



Diameter in inches



Diameter of the corner tree



Upper canopy foliar health, some dead branched remain



Canopy view from northwest

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Location	120 Esplanade Te Kuiti, Waikato 3910
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## 2, Sequoia sempervirens- coast redwood

Created	2016-03-21 12:40:53 NZDT by Erika Commers
Updated	2016-04-21 12:01:49 NZST by Erika Commers
Location	-38.3377820207163, 175.171094723209
Item number	2
Tree Species	Sequoia sempervirens- coast redwood
Notes	Six trees in this Clump. Four of which, at outer perimeter, have a lost top and many dead upper branches still attached, potential for failures which are not particularly large but could travel in wind. The lower stems of two inner trees have many Epicormic sprouts due to sunlight becoming available from recent outer tree branch removal.

Photos



Lower stems of trees



Dead attached branches in upper canopy at outer aspect



Buttresses



View from within stand



Foliage density



Upper canopy foliage, lost tops



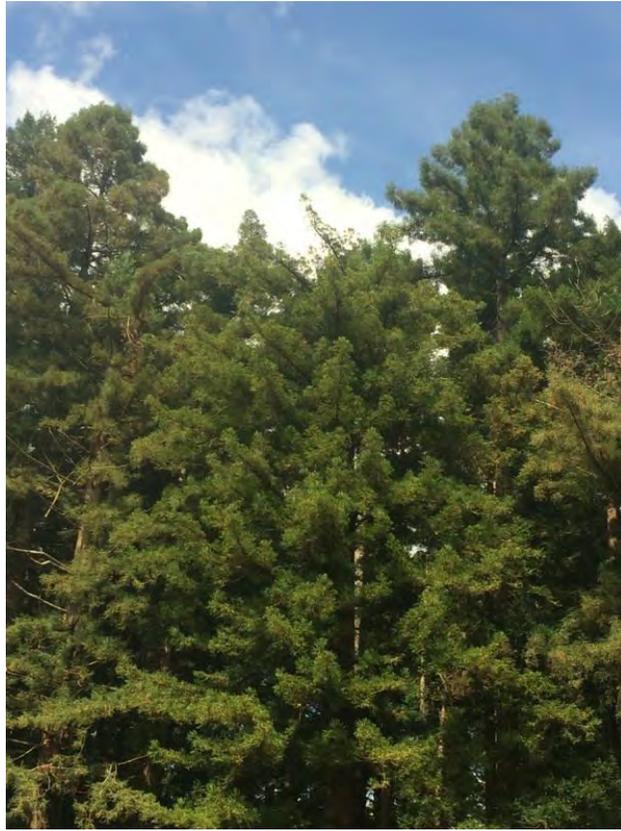
Lost top and reiterated trunk



Canopy view from north



View from northwest



View from north



Declining upper stem in centre frame



Declining stem

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Location

120 Esplanade  
Te Kuiti, Waikato 3910

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## 3, Sequoia sempervirens- coast redwood

Created	2016-03-21 12:41:53 NZDT by Erika Commers
Updated	2016-04-21 12:55:40 NZST by Erika Commers
Location	-38.337878329964, 175.17100520432
Item number	3
Tree Species	Sequoia sempervirens- coast redwood
Notes	Approx 7 trees in this region. One perimeter tree with a lost top, good taper. Several surrounding trees in good condition.

Photos



Canopy, tree with lost top



Perimter tree



Base of trees

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Location

120 Esplanade  
Te Kuiti, Waikato 3910

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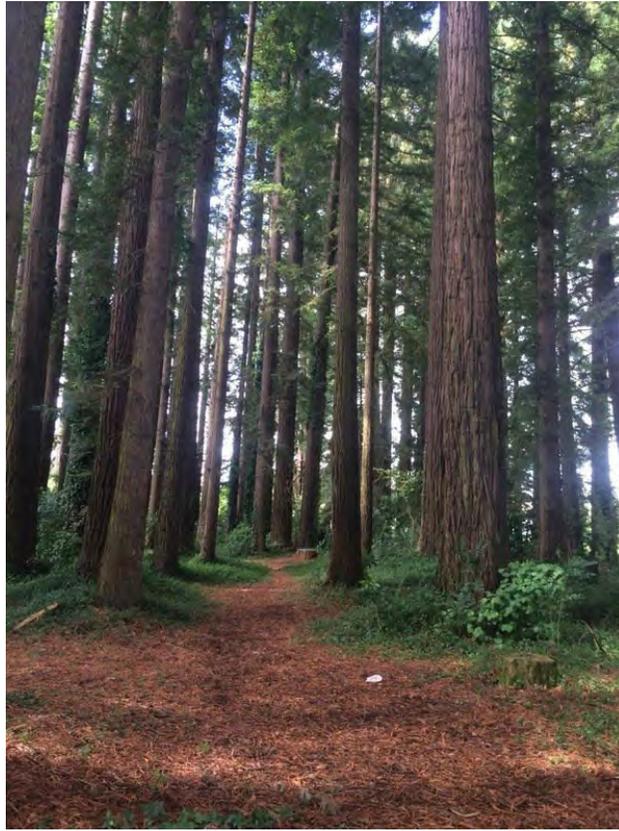
#### 4, Sequoia sempervirens- coast redwood

Created	2016-03-21 14:21:19 NZDT by Erika Commers
Updated	2016-04-21 14:56:01 NZST by Erika Commers
Location	-38.3380713565494, 175.171090364456
Item number	4
Tree Species	Sequoia sempervirens- coast redwood
Notes	Approx. 60 trees; middle of northern side of grove. Tradescantia and ivy have encroached west. Overall health and vigor of trees is good. Previously removed dead trees as stumps.

Photos



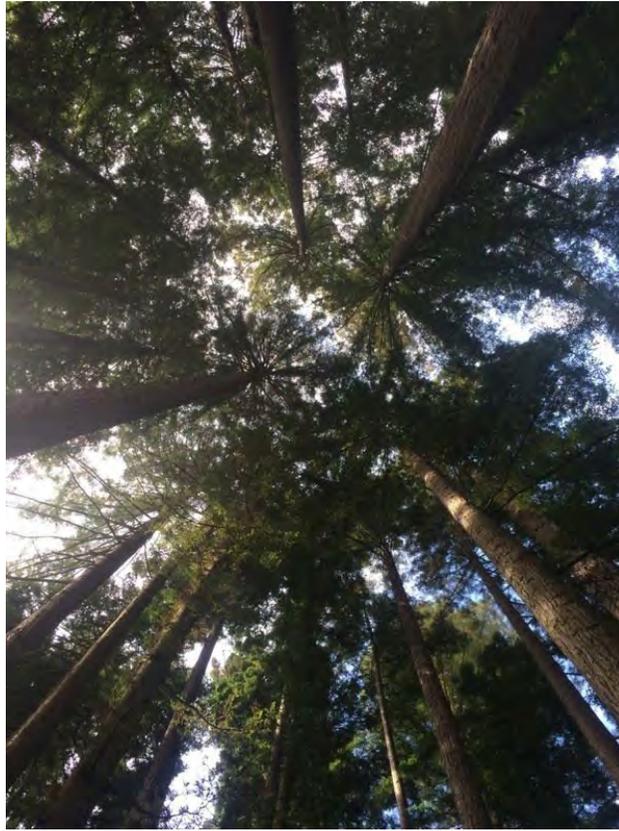
View of area from within



View from within, path travels through



Clear straight boles, foliage in upper quarter.



Upper canopy

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Location

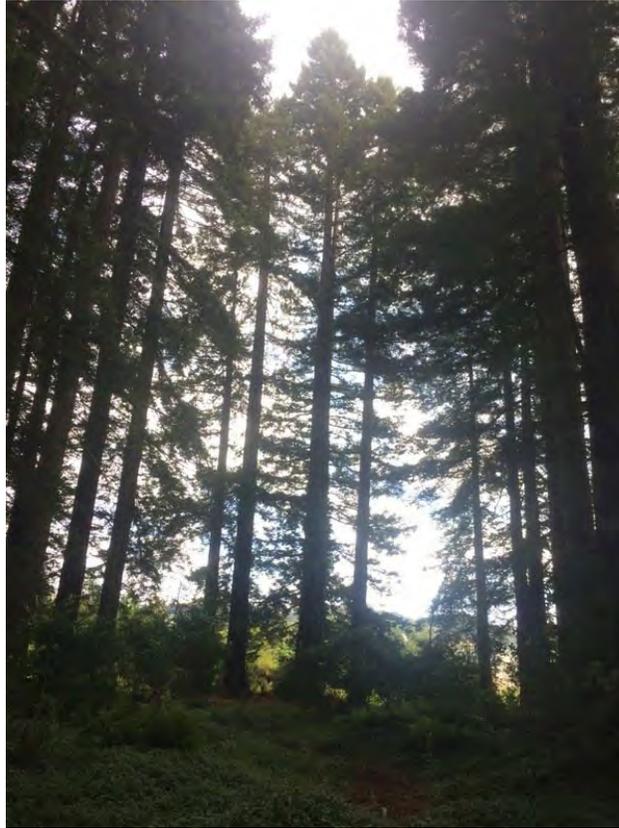
120 Esplanade  
Te Kuiti, Waikato 3910

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## 5, Sequoia sempervirens- coast redwood

Created	2016-03-21 14:18:04 NZDT by Erika Commers
Updated	2016-04-21 14:58:20 NZST by Erika Commers
Location	-38.3382015308636, 175.170680992305
Item number	5
Tree Species	Sequoia sempervirens- coast redwood
Notes	Western corner area near river. Four outer perimeter trees rapidly taper and appear to have lost tops, foliage density and color is good. Outer trees shorter than other perimeters due to heavy shading predominantly cast toward west.

Photos







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Location

120-153 Esplanade  
Te Kuiti, Waikato 3910

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## 6, Sequoia sempervirens- coast redwood

Created	2016-03-21 14:13:01 NZDT by Erika Commers
Updated	2016-04-21 15:22:27 NZST by Erika Commers
Location	-38.3381302637428, 175.171390771866
Item number	6
Tree Species	Sequoia sempervirens- coast redwood
Notes	Lowland and overflow valley from river. Very soft soil, saturated in places. Sequoia alongside this valley are growing elevated 1-2 meters above. The entire overland flow path is covered in wandering jew to knee deep, including other small weed trees.

Photos



Slope of depression into valley: wandering jew, eleagnus, ivy cover



bank slope and ground cover: ivy, lemonwood



Valley covered in regrowth - pest plants. Facing east



Sight line toward east



Valley sight line west and vegetation cover



Veg cover and sight line west

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Location

120-153 Esplanade  
Te Kuiti, Waikato 3910

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## 7, Sequoia sempervirens- coast redwood

Created	2016-03-21 13:41:51 NZDT by Erika Commers
Updated	2016-04-21 15:58:13 NZST by Erika Commers
Location	-38.3380637301682, 175.171874240041
Item number	7
Tree Species	Sequoia sempervirens- coast redwood
Notes	Southeast corner trees. One appears to have lost top and lightning strike damage. All others good. Likely the tallest area. Some ivy.

### Photos





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Location

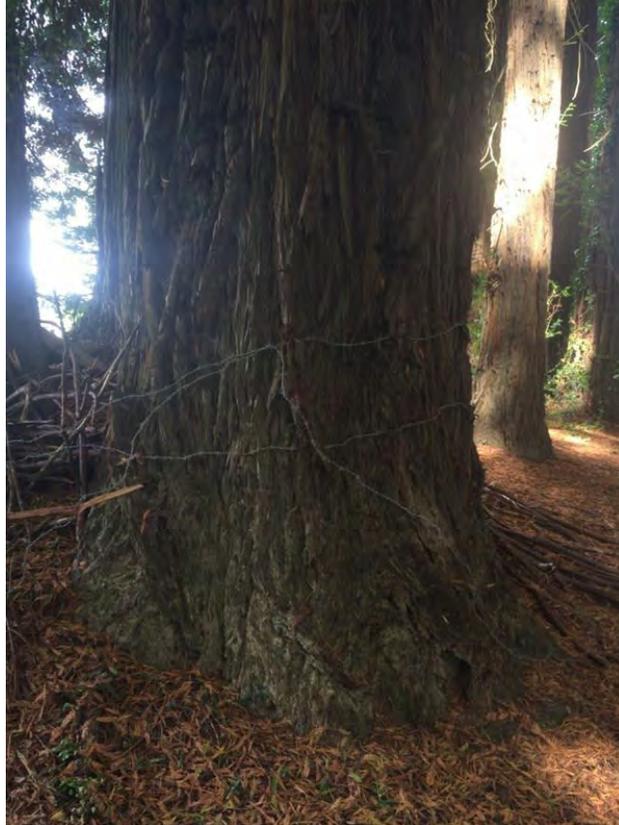
120-153 Esplanade  
Te Kuiti, Waikato 3910

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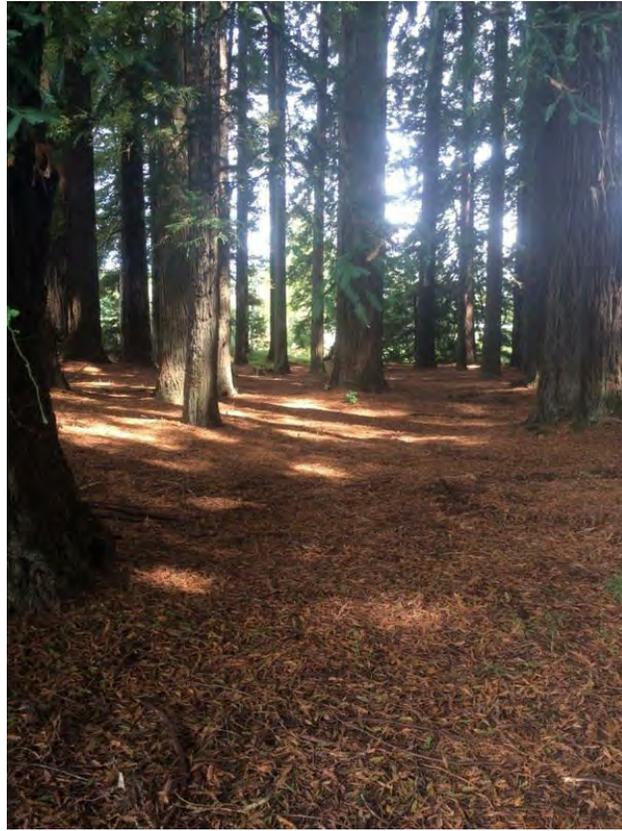
## 8, Sequoia sempervirens- coast redwood

Created	2016-03-21 14:00:37 NZDT by Erika Commers
Updated	2016-04-21 16:04:28 NZST by Erika Commers
Location	-38.3384560932911, 175.171444751322
Item number	8
Tree Species	Sequoia sempervirens- coast redwood
Notes	Majority of the south side of the grove, includes no less than 80 trees. Overall, trees in this area of the stand are very healthy with lush green thick foliage and a fair amount of branching. There are no ground covering weeds in this part of the stand, although the ivy is nearly here. Remove barbed wire wrapped around three trees near edge.

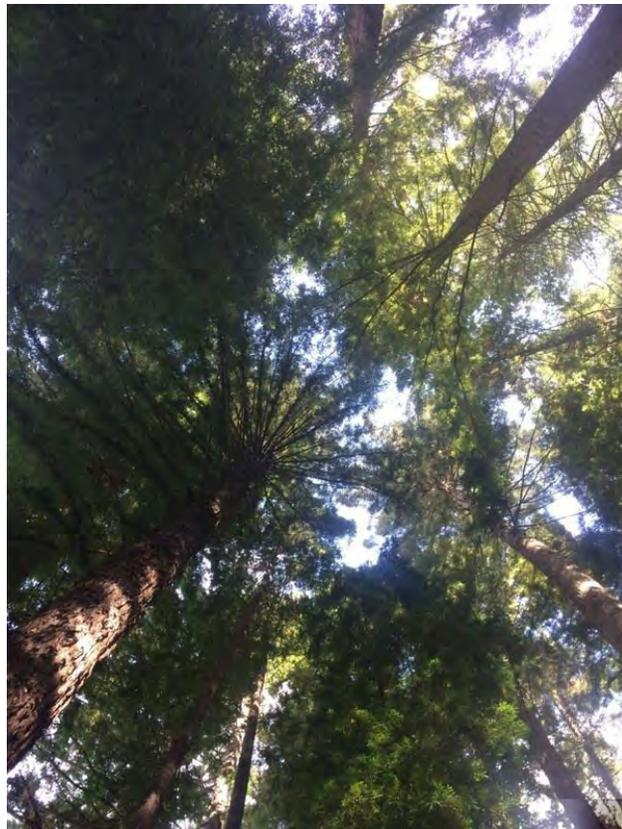
### Photos



Barbed wire



Weed free



Good foliage health and colour



Variable sizes and density

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Location

120-153 Esplanade  
Te Kuiti, Waikato 3910

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## 9, Sequoia sempervirens- coast redwood

Created	2016-03-21 13:55:33 NZDT by Erika Commers
Updated	2016-04-21 16:20:57 NZST by Erika Commers
Location	-38.3385554986243, 175.171022973955
Item number	9
Tree Species	Sequoia sempervirens- coast redwood
Notes	South corner region of stand, south of valley and west of barbed trees. Good health, foliage, buttress formation, few weeds and vines. Approximate 60 trees to this region.

### Photos



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Location

120-153 Esplanade  
Te Kuiti, Waikato 3910

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