

# **Kahikatea Forest Green Wheel: Guide to applying botanical sub- attributes**



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# Abstract

The Waikato Regional Council has created a “Kahikatea Forest Green Wheel<sup>1</sup>” tool to help landowners and resource managers assess the health of their kahikatea forest and its recovery over time. The wheel measures how similar a given kahikatea forest fragment is to the most healthy, functioning example we could expect in the contemporary ecological and economic setting.

It allows users to score thirty-one abiotic or biotic features that assess the health and functioning of Waikato kahikatea forest fragments, and reflect changes in ecosystem condition along a continuum from degraded to intact (or vice versa). Each is accorded a score from a five-star ranking system, and visually presented on a wheel graphic, to enable landowners or site managers to quickly identify areas that need improvement and track restoration progress towards a higher or lower functioning state over time.

A landowner guide has been developed to assist with application of the Kahikatea Green Wheel. However, many require botanical expertise. This technical guide aims to help experts consistently apply the botanical sub-attributes developed for the Kahikatea Green Wheel, and includes field datasheets and a completed example.

Separately from this document, a tool has been developed to automatically generate botanical scores from a species list, which can be entered directly into a spreadsheet in the field.

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<sup>1</sup> Adapted from the Green Wheel developed by the Society for Ecological Restoration Australasia (McDonald *et al.* 2016)

## 1 Introduction

Kahikatea (*Dacrycarpus dacrydioides*), an ancient podocarp, is New Zealand's tallest native tree species. Kahikatea stands are the characteristic forests of fertile floodplains, lake margins and riverbanks throughout the Waikato Region and elsewhere in New Zealand. They are a classic landscape feature of the contemporary Waikato lowlands.

Before humans arrived in the Waikato, kahikatea-dominant forests grew in the wet areas beside lakes and swamps, and formed extensive areas of the great floodplains of the Waikato, Waipā, Piako and Waihou rivers. It is estimated that some 189,772 hectares of kahikatea-dominant forest was present in the Waikato Region prior to human occupation<sup>2</sup>.

Today these forest types occupy 2760 hectares (1.5 % of their pre-human extent), including some that are so fragmented they are classified as treelands (less than 80% canopy closure). They occur as small fragments, between 0.01 and 35 hectares, over half of the mapped 3060 patches are less than 5 hectares. Many are secondary forests, grown anew on land previously cleared by early settlers. Most occur on the river floodplains of the Waikato Basin, Hauraki Plains and Mōkau River. Kahikatea forest remnants provide core habitat and stepping stones for native lowland fauna, however, introduced pests, edge effects, and intensification of pastoral farming threaten the health and sustainability of these remnants.

The Waikato Regional Council (the council) has taken steps to encourage protection and restoration of these iconic indigenous forest stands, including monitoring, research, financial incentives, education and information. To encourage and measure restoration efforts at individual sites, the council has developed the Kahikatea Green Wheel<sup>3</sup>, a tool that ranks any given kahikatea stand on a 1 to 5 star ranking basis for a range of attributes relevant to kahikatea forest health and functioning.

## 2 Developing a Waikato Kahikatea Green Wheel

The Kahikatea Green Wheel (KGW) is a tool for landowners or site managers interested in assessing the health of their forest patch. It helps to identify management needs and measure progress towards a best state possible for the patch (within the limitations of the contemporary landscape setting, depleted native flora and fauna, and land use pressures).

The Kahikatea Green Wheel was derived from the Ecosystem Recovery Wheel (ERW), a tool designed by the Society for Ecological Restoration Australasia (SERA) to assist restoration managers evaluate the degree to which an ecosystem under treatment is recovering over time (McDonald *et al.* 2016).

The ERW compares a suite of ecosystem-relevant attributes against the state of a reference “healthy” ecosystem:

1. Absence of threats
2. Physical conditions
3. Species composition
4. Structural diversity
5. Ecosystem function
6. External exchanges

Each attribute comprises sub-attributes, to which are assigned a recovery level score based on a 1-5 star ranking system. Five-star recovery is defined as being “*where the ecosystem is on a*

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<sup>2</sup> Data generated from maps of pre-human vegetation developed by Waikato Regional Council. This is likely to be a slight underestimate as it does not include small patches of kahikatea-dominant forest mapped as a kahikatea forest-wetland mosaic.

<sup>3</sup> Based on the Ecosystem Recovery Wheel developed by the Society for Ecological Restoration of Australasia (McDonald *et al.* 2016)

self-organising trajectory to full recovery based on an appropriate local indigenous reference ecosystem...” (McDonald et al. 2016).

The tool was developed with the intention that a “practitioner with a high level of familiarity with the goals, objectives and site-specific indicators set for the project and the recovery levels achieved to date can assign the value for each sub-attribute after formal or informal evaluation.” (McDonald et al. 2016).

The average score of the sub-attributes will return the star rank value for that attribute. The summed value of all attributes will return a single measure of recovery outcome. The results can be graphically portrayed in the form of a wheel (see Figure 1), with the length of the green “spoke” indicating progress towards the ideal end state (a 5-star rating).

Utilising the framework of the SERA Ecosystem Recovery Wheel, a set of attributes and sub-attributes, with specific ranking standards has been developed for kahikatea forest fragments in the Waikato Region. These form the basis of a Kahikatea Green Wheel.

In developing a Green Wheel for Waikato kahikatea fragments, we retained the full list and structure of the SERA attributes, but we also considered it useful (and important) to include a “response” attribute, indicating management efforts made towards restoration. This helps track progress towards planning and implementation, and provides a reward feedback for attributes that may be very slow to respond, such as re-vegetation.

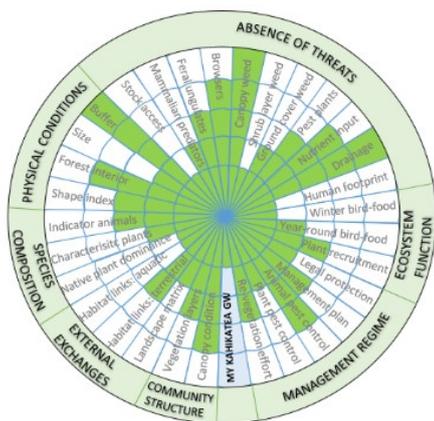


Figure 1: Simulation of a completed ecosystem recovery wheel (WRC 2019)

## 2.1 KGW sub-attributes

The KGW was developed by determining sub-attributes most relevant to the health and functioning of lowland Waikato kahikatea forests that can provide timely and measurable information regarding the approximation of a given stand to a healthy “reference” site. They focus on aspects of kahikatea forest health that are within the ability of landowners or site managers to control.

The sub-attribute ranking system (1-5 stars) has been designed to follow a trajectory towards a restored state. While the ranks can be used to show deterioration (if a score drops over time), the trajectory from restored to a degraded state can be quicker than the pathway towards restoration. For instance, forest size can be reduced very quickly (hours or days) via fire or felling, while forest establishment takes decades if not centuries.

The final standards for the 5-star ranking system are detailed in Appendix 1. The ranking system includes a target at the 5-star end of the spectrum based on evidence from actual kahikatea stands, where possible, and takes into account the current landscape structure and processes. Data from published and unpublished sources were used to develop descriptive and, in most cases, quantitative standards for each sub-attribute. For instance, a list of reference species (those that most frequently occur in healthy kahikatea forest remnants) was generated from published species lists, to assist with assessing species composition. A simple tool (KGW Spreadsheet) has been developed with built-in calculations to allow quick and automated assignment of relevant rank to species-related sub-attributes (flora and fauna). Some of the standards are subjectively applied based on visual clues or local knowledge. Others rely on collection of field data, including species lists for indigenous and exotic vascular plants.

A large number of sub-attributes (31) are included, however:

- many can be quickly applied,
- some can be measured and scored for all kahikatea sites by the council (spatial sub-attributes), and
- several attributes can be scored from a single dataset (such as a vascular plant species list).

For spatial sub-attributes, the council has used a map of kahikatea-dominant forest types<sup>4</sup> to calculate size, shape, proportion of interior forest and distance to nearest large forest patch metrics for every mapped stand in the region. Regular updating and publishing of this information online means landowners need only look up the relevant spatial data for their site.

Field testing (Smale 2018) has shown that the botanical sub-attributes are relatively quick and easy to apply, and the interactive KGW spreadsheet provides for efficient data entry, storage and analysis. Supporting products include an illustrated landowner guide. Future products may include a smartphone application.

The final set of Waikato Kahikatea Green Wheel attributes and anticipated assessors is given in Table 1<sup>5</sup>. The botanical sub-attributes covered in this guide have been highlighted in bold.

**Table 1: Waikato Kahikatea Green Wheel attributes and anticipated assessors**

PSR framework	Attribute	Sub-attribute	Assessor
<b>Pressure indicators:</b>	Attribute A: Threats	(1) stock access	Landowner/ Site manager and contractor
		(2) feral ungulates	
		(3) browsers	
		(4) mammalian predators	
		<b>(5) canopy weeds</b>	
		<b>(6) shrub layer weeds</b>	
		<b>(7) ground cover weeds</b>	
		<b>(8) pest plant presence</b>	
		(9) nutrient input	
		(10) drainage	
		(11) human footprint	
<b>State indicators:</b>	Attribute B: Physical conditions	(12) size	Waikato RC
		(13) shape	
		(14) forest interior	
		(15) buffering	
		Attribute C: Species composition	
Attribute D: Community structure	<b>(19) vegetation layers</b> <b>(20) canopy condition</b>	Contractor	
Attribute E: Ecosystem function	<b>(21) winter bird food</b> <b>(22) all season bird food</b>	Contractor	

<sup>4</sup> Created by visual analysis and digitising over 2012 air photographs (WRAPS) supplemented by 2016-17 oblique aerial photographs

<sup>5</sup> An optional fauna indicator for presence of long-tailed bats was later added, but does not form part of the core attributes.

		<b>(23) plant recruitment</b>	
	Attribute F: External exchanges	(24) landscape matrix (nearby habitat) (25) habitat links - terrestrial (26) habitat links - aquatic	Waikato RC/ Landowner (for #26)
<b>Response indicators</b>	Attribute G: Management regime	(27) legal protection (28) management plan (29) animal pest control effort (30) invasive plant control effort (31) re-vegetation effort	Landowner/ Site manager/ Waikato RC for #27

## 2.2 Botanical sub-attributes

The star system developed for the KGW is somewhat plant-centric because:

- Most plants are present year-round and easy to encounter.
- They indicate a range of factors (representation, drainage, browsing pressure, bird food resources, natural character).
- Information on floristic data of kahikatea forest is more readily available in the literature than other attributes.

Botanical sub-attribute standards were derived using multiple sources of data from contemporary Waikato kahikatea fragments, supplemented with expert knowledge and incorporating anticipated recovery trajectories. For these sub-attributes, we based the highest scores on a slightly better than average condition of the best thirteen<sup>6</sup> Waikato kahikatea forest remnants (reference sites). The lowest scores were based on the state of a site that is still recognisable as a kahikatea fragment, but in the worst possible state in terms of the relevant ecological criteria.

### 2.2.1 Kahikatea reference sites

From a set of 13 fenced and relatively intact Waikato kahikatea fragments, a set of floristic attributes were derived and used to calculate the “average” condition for a relatively healthy site (see Table 2).

The maximum recorded values for floristic sub-attributes were not used to define the 5-star standard because they may be extreme outlier values for various reasons – e.g. unusually large size, close proximity to seed source, or species lists that include adjacent ecosystems. They could therefore establish unachievable targets. Further, our reference site flora lists may include species that are “vagrants” (outside their normal range) or only present as unestablished seedlings that may not have survived in the site. Slightly higher than the average values were used to define a 5-star score – meaning that a 5-star site is *better than the average of the best set of reference sites we have*. This reflects that even our best remaining sites are degraded, and a 5-star site is among the top 50% of the best sites remaining.

It was considered appropriate to include, in the floristic counts, species that have been planted if they are ecologically appropriate to the site. Active planting is a key restoration technique undertaken to counter the isolation and reduced bird distribution that otherwise limits plant species establishment in a small fragment. As such, planted species that are appropriate to the site should be included when assessing sub-attributes.

To define a representative suite of kahikatea plant species (as a measure of how “typical” the species composition is), we identified plant species that were reported in more than half of our reference stands and called them “characteristic” species. However, these are the *most* representative, and it should not be assumed that less frequently recorded species are

<sup>6</sup> A set of Waikato kahikatea forest stands known to the authors to be relatively intact and fenced, including the larger known sites. They include sites that remain in a swampy condition, along with some that were drained in last century. See Table 3.

ecologically inappropriate. We found 63 vascular plant species that occurred in more than half of our reference sites (62 of them found in one site).

**Table 2: Floristic attributes of 13 representative Waikato Kahikatea Fragments**

Kahikatea stand	Area (ha)/ Hydrol.	# native vascular plants	# exotic vascular plants (RPMS in brackets)	% native	# charact. species <sup>7</sup>	# winter bird food species	# bird food species	Info Source
Awaroa	Wet	120	46 (5)	72	53	18	52	Reeves 2012
Kopuatai	Wet	80	29 (6)	73	38	12	32	Wildlands 2017
Pehitawa	Wet	105	34 (7)	76	50	18	54	Lusk 2015
Rotopiko	1.2 ha / Damp	73	28 (6)	72	40	18	38	Denyer, unpub. list, 2017
Orini	7 ha/ Dry	103	no data	n/a	59	15	47	de Lange 1989
Burbush	1 ha/ Damp	42	23 (3)	65	37	3	17	de Lange and Champion 1998
Gordonton	2 ha/ Drained	37	28 (2)	57	31	4	15	Smale <i>et al.</i> 2005
Claudelands	5.2 ha/ Drained	107	18 (6)	86	62	21	66	Whaley <i>et al.</i> 1997, Smale <i>et al.</i> 2005
Marychurch Rd	3.1/ Drained	109	15 (4)	88	59	9	30	Smale <i>et al.</i> 2005, de Lange 2014
Whewell's Bush	9.9 ha/ Drained	39	13 (5)	75	56	7	25	Smale <i>et al.</i> 2005, de Lange 2014
Yandleys	Drained	67	54 (8)	55	49	8	24	Burns 1998
Arnold's Bush A	3.8 ha/ Drained	53	22 (2)	71	35	8	25	Smale <i>et al.</i> 2005
Arnold's Bush B	3.8 ha/ Drained	63	7 (1)	90	44	12	32	Smale <i>et al.</i> 2005
MAX		120	(RPMS 8)	90	62	21	66	
MIN		37	(RPMS 1)	55	31	3	15	
Mean		77	(RMPS 4.5)	<b>73</b>	<b>47</b>	<b>12</b>	<b>35</b>	

## 2.2.2 Setting 5-star standards for vascular plants

The following five-star standards were applied to five floristic sub-attributes:

- Sub-attribute 8 Pest plants.** No Regional Pest Management Strategy (RPMS) species within the site or within 50 m of it. An estimated 20-30 RPMS species could potentially occupy kahikatea stands, particularly near gardens or abandoned homesteads. In the reference sites, 16 RPMS species were recorded in total, with a maximum 8 at one site. It is unlikely that more than 10 RPMS species would be present in one site, but as these are judged to have the greatest potential invasion impact in the region the bar has been set relatively low for this indicator (a minimum of 6 species is sufficient to trigger the lowest star rating).

<sup>7</sup> Those species found in > 50% of our reference sites. Excludes planted non-local native species.

For regional pest plants (RPMS species) distribution is not limited to within the actual stand, but also within a 50 m radius around the stand, to provide early warning of potential infestation of a managed invasive plant species near the stand. For sub-attribute 8 we focused on the number of invasive (RPMS) species, not their abundance. The more species present, the bigger the management task to prevent their spread. A 50 m radius was applied because weeds in the vicinity pose an invasion risk (assuming some shade-tolerance). While plant pests can be dispersed to the site from more than 50 m away, this radius was considered a practical distance for field assessment because it is close enough to be checked easily with a visual assessment and is more likely to be on the same property (under landowner's control). The Regional Pest Management Strategy includes almost 80 plant pest species, but many are not likely to be found in kahikatea forest (e.g. estuarine, light-demanding, or not yet recorded in the region).

- **Sub-attribute 16 Dominance of native species:** 80% or more of the species present are native species that are appropriate for kahikatea forest. A list of appropriate species has been generated from a literature review, however it is unlikely to be exhaustive, and suitably qualified botanists are able to add species they consider appropriate to the site. Note that the list of ecologically appropriate species is broader than the list of "characteristic" species, which are those found in >50% of the best 13 sites for which data were available. This indicator is focussed on the ratio of appropriate native species to exotic and non-local native species.
- **Sub-attribute 17 Characteristic species:** More than 50 of the 63 characteristic species are present (based on the reference site average of 47 rounded up). To simplify the process the KGW was amended in 2022 creating a limited set of 'scorable' species, those more likely to be easily identified by a less experienced botanist. The KGW values for sub-attribute 17 were halved to match the reduced number of scorable species. Other botanical sub-attributes were not affected by the change and were not adjusted. Skilled botanists are able to record a full species list, but only the sub-set of scorable species will contribute to the KGW scores.
- **Sub-attribute 21 Winter bird food:** 15 species. Note there is variation in the literature (and likely in the field) on fruiting/flowering times for species that provide high energy food to forest passerines, so there may be some debate around whether a given plant species provides winter food. The objective of this sub-attribute is to encourage, and reward planting of native species typical of kahikatea forest that will improve the winter food resources in the site for native passerines.
- **Sub-attribute 22 All season bird food:** 40 species (rounded). The 5-star target number is set at above the average because some qualifying species may be present in very low numbers or as non-fruiting immature plants only. To discourage planting of inappropriate native species only those species typically found in kahikatea remnants will "count" towards this score. The KGW does not limit this attribute to species present as mature plants (i.e. capable of producing nectar or fruit), because there is little that managers can do to improve that (it is largely a factor of time rather than management action). It also simplifies application of the KGW to base the score on presence/absence rather than maturity level for bird-food plants, and high threshold is applied to the 5-star standard to account for the potential that some qualifying species may not be established or mature.

### 2.2.3 KGW scoring justification and visual clues

As described above, for each of the 31 sub-attributes, a set of 5 standards was generated to enable consistent application of a ranking score (see Appendix 1). The standards divide each sub-attribute into a range from a degraded to highly restored state with three intermediary

steps. Real data was used as far as possible to justify the standards for each star ranking. Justification for division of the star rankings, along with visual clues and methods for application of the score are summarised in Table 3 for the botanical sub-attributes.

Botanists who have been engaged by a landowner or site manager to assess the botanical sub-attributes may also be asked to assess additional vegetation related sub-attributes, such as buffer condition, stock/ungulate damage and browser damage. See Appendix 1 for the full list.

**Table 3: Visual clues and justification for the ranking standards of botanical sub-attributes**

Sub-attribute	Visual clues/ explanations	Anticipated trajectory: 1 to 5	Scientific basis/ justification/ notes	Method/ frequency
5. Canopy weed abundance	Look for vine or tree weeds in kahikatea forest e.g. bindweed, morning glory, ivy, gums, willows. Wattles etc. View the site from different sides (inside and outside the stand) and make assessment also based on abundance of vine stems seen on trunks inside the forest.	Natural log: depending on effort, easier to drastically reduce initially, slower to eradicate fully.	This is about assessing potential for canopy collapse to occur and competition for space between exotic and native species.  Measured as % of the tier space (planar i.e. birds eye view), not % of the biomass. While a dense area over a continuous 25% of the site is easier to deal with from a management perspective than 25% thinly spread across the whole site, it was deemed too complicated to separate the scenarios. Sub-attribute # 8 deals with number of weed species rather than abundance /cover. [The same applies to shrub and ground weeds]	Annual Visual check
6. Shrub layer weed abundance	Potential shrub layer weeds in kahikatea forest include privet species, hawthorn, woolly nightshade, barberry.	Natural log: depending on effort, easier to drastically reduce initially, slower to eradicate fully	This is about competition for space between exotic and native species.  To simplify application, this is as % of the tier space in planar (i.e. birds eye view), not % of the vegetation biomass, so ignore where one exotic species lies directly above another.	Annual Visual check
7. Groundcover weed abundance (< 30 cm)	Potential groundcover weeds in kahikatea forest include, e.g. reed sweetgrass, ginger, wandering dew, ivy, honeysuckle, <i>Carex divulsa</i> .	Natural log: depending on effort, easier to drastically reduce initially, slower to eradicate fully	This is about assessing potential for regeneration to be hampered.  This is as % of the tier space (planar i.e. birds eye view), not % of the vegetation biomass - so for instance in a relatively bare ground layer, with <50% ground cover of <u>any</u> species you cannot get a 1 or 2 star for ground weeds. This is to reflect the management effort required, rather than the <i>proportion</i> of native to exotic species. It is likely impractical to ever be able to achieve zero ground cover weeds so 5 star allows for up to 5% exotic cover. Where there is <5% cover of <u>any</u> vegetation type on the forest floor the score will be 5. Ignore minor (non-threatening) herbs e.g. cat's ear, wall lettuce.	Annual Visual check
8. Pest plant presence	Use checklist from the current Regional Plant Pest Plan/Strategy. The KGW Spreadsheet will automatically identify Waikato RPMS species (2014-2024).	Linear: some species will be easy to eradicate, others harder so have "averaged" the trajectory.	This is about the <u>number</u> of invasive species, not their abundance. The more invasive species present, the bigger the management task to prevent their spread. A 50 m radius applies, because invasive weeds in the vicinity pose a more immediate risk (assuming some shade-tolerance). While plant pests can be dispersed to the site via wind or birds from more than 50 m away this radius it is a practical distance for field assessment (visual check of site surrounds), and more likely to be a on the same property (under landowner's control). RPMS includes almost 80 plant pest species, but many are not likely to be found in kahikatea forest (e.g. estuarine, light-demanding, or not yet recorded in the region). Weeds tend to have patchy distribution, and a higher diversity is most likely near gardens or abandoned homesteads. It is unlikely to find more than 10 of the RPMS species at one site,	5-yearly Species list

Sub-attribute	Visual clues/ explanations	Anticipated trajectory: 1 to 5	Scientific basis/ justification/ notes	Method/ frequency
			but given these species have the greatest potential invasive impact the bar has been set relatively low for this indicator. It is possible to achieve a zero presence, as indicated by 5 stars.	
16. Dominance of native plants	Based on vascular plant species list (natives and exotics/inappropriate natives), ratio of the two.	Variable though probably natural log as you can remove the easy exotics and plant many natives to quickly improve the score, but some exotics will be harder to eradicate	Based on flora lists from a set of kahikatea forest stands in reasonable health (fenced).  Based on native:exotic ratio for <u>number</u> of species (not abundance, see weeds in Attribute A). 100% indigenous likely no longer possible in lowland kahikatea forest, given the almost ubiquitous occurrence - even well inside intact forest - of some exotic species e.g. wall lettuce. Trajectory also depends on whether site has been grazed (will get an initial weed pulse when fenced) or has canopy gaps (light source for weeds), and quality of seed bank and seed sources.	5-yearly Species list
17. Characteristic plant species	Based on number of pre-defined "characteristic species" that are present – compare site species list with checklist of characteristic species. The KGW Spreadsheet will automatically identify these when data is entered.	Treat as linear. Trajectory depends on degree of human input, proximity to seed source, bird movements etc.	Based on flora lists from a set of reference kahikatea forest stands in reasonable health (fenced). Characteristic species were deemed to be those present in > half of the reference stands.  Characteristic species is a more informative measure than species richness, as many native species may not be typical of kahikatea forest, and encouraging planting of a more diverse mix of native species may not be appropriate.	5-yearly Species list
19. Vegetation layers	Visual guides showing examples of intact vs degraded tiers would be helpful. Ground cover is <30 cm, canopy is the top layer excluding canopy gaps.	Linear: depends on which tier is missing. Slower to replace upper tiers, faster to regain ground layers if remove browsers/grazers.	Qualitative division into 5-star system  Based on the number of tiers that are relatively intact. Will need experienced field workers to distinguish native vegetation from weeds that may make a layer appear intact. In very wet sites ground cover may be naturally sparse, but will likely still be some cover of sedges or aquatic herbs. Should not be surveyed during or after flood as water could obscure ground cover.	5-yearly Visual check
20. Canopy condition	Die-back/yellowing of canopy foliage, standing dead trunks with no foliage. Assess for indigenous species only.	Exponential: varies with cause of dieback (e.g. microbial, altered hydrology, microclimate, browsing, herbicide). Recovery likely slow at first, then rapid as canopy recovers if the cause is removed (particularly if plants have been able to survive and re-sprout).	Measure of tree health, and can also assist in noticing biosecurity risks (e.g. soil borne pathogens or species specific diseases which might affect canopy trees).  Very little published data is available to generate a star system for this attribute. Ranking has been based on % values spread along exponential trajectory. Baseline mortality seems to be conservatively around 1% (Richardson <i>et al.</i> 2009).  Based on indigenous species only – does not include weeds that have been sprayed. Landowner may have limited ability to affect this score.	Annual Visual check

Sub-attribute	Visual clues/ explanations	Anticipated trajectory: 1 to 5	Scientific basis/ justification/ notes	Method/ frequency
21. Winter bird-food availability	Comparison of site species list with reference list of winter bird food species (pre-determined list of native plant species that naturally occur in kahikatea forest and that provide winter fruit, flowers or nectar for common forest birds).	Exponential: slow for species that are planted by landowner, but fast for recovery of browsed mature plants following pest control.	<p>Presence of bird food is an indicator of the ability of a stand to provide resources for wildlife, and therefore a measure of ecosystem function. Birds have been selected as the indicator because knowledge of bird food preferences is more advanced than for invertebrate and lizard taxa. Further, birds are more effective seed dispersers than other taxa.</p> <p>Ranking is based on reference site species lists and Waikato-relevant flowering/fruited calendars.</p> <p>Winter is a bottleneck, few native species produce winter fruit or nectar, so a vital attribute for forest birds. Ideally this would be based on a group of mature (reproductive age) plants, however to simplify the attributes application we adjusted the required number per standard upward to account for the likelihood that some species will only be present at immature plants or in low numbers. The reference site list includes 24 winter fruit or nectar providers (some only into early June), with a maximum of 21 and mean of 11. We have set a conservative target of 15 species present. The requirement is that qualifying species be those that occur naturally in kahikatea forests, to avoid encourage planting of inappropriate well-known bird food species (e.g., puriri, kohekohe).</p>	5-yearly Species list
22. All season bird-food availability	Comparison of species list with reference list of bird food species - species naturally occurring in kahikatea forests that provide fruit, flowers or nectar for common forest birds.	Exponential:slow for species that are planted by landowner, but fast for recovery of browsed mature plants following pest control.	<p>Reference site species lists and Waikato-relevant flowering/fruited calendar</p> <p>Native only. Exotics can provide food but threaten natural character so should not be encouraged. The reference list of plant species typical of kahikatea forest that provide bird food is 90. Not all will be present in the same fragment, and in our reference sites the maximum was 66, mean 35. We set a 5-star target as more than 40 (i.e. better than average for good quality sites and greater than 1/3<sup>rd</sup> of all possible species likely to be found in kahikatea forest).</p>	5-yearly Species list
23. Plant recruitment	Determined from a species list for the site that notes which are present as established seedlings (> 5 cm < 30 cm). Assess for woody species (trees and shrubs) only. The KGW Spreadsheet will calculate this automatically.	Linear: averaged to account for high variation in response. Could be natural log or s-curve, e.g. if remove browsing pressure may get mast response, but for some species will also need pollinators (birds/moths). Also confounded by stock presence, and climate (rain at the right time).	<p>Seedling presence is an integrated measure for a range of processes (pollination, germination, growth, dispersal, recruitment). The focus is on woody species (trees and shrubs) only as they are easier to find/ identify, and on self-regeneration - i.e. presence/ abundance of seedlings of those species in the stand. Note that kahikatea themselves rarely regenerate under their own canopy, the recruiting species will mostly be shade-tolerant species present as established seedlings, unless there are large canopy gaps.</p> <p>Also useful to note the presence of species that are <i>only</i> present as seedlings - an indication of dispersal into the forest fragment. As that process is largely beyond a landowners' control, this will be supplementary information - not used as an assessment of plant reproduction processes within the stand.</p>	5-yearly  Species list/ seedlings noted

### 3 Applying the KGW botanical sub-attributes

Several tools have been developed by Waikato Regional Council to assist with applying the KGW.

These include:

- A webpage hosting the relevant tools and background information.
- An illustrated landowner guide.
- This botanical guide including datasheets for manual data recording in the field, and a quick guide for botanists who don't need the full technical guide.
- The KGW Spreadsheet, which allows for electronic data recording in the field on phone or tablet (using and MS Excel compatible apps), and automated generation of many sub-attribute values. Alternatively, the spreadsheet can be completed in the office from the hard copy datasheets available in Appendix 3.
- An online tool for landowners to store and share their scores and compare with regional statistics (in development).

### 3.1 KGW Spreadsheet

A vascular plant species list for a site will be required to assess several of the KGW sub-attributes.

A spreadsheet<sup>8</sup> with pre-set formulas has been created to help users calculate the score for sub-attributes # 8, 16, 17, 21, 22 and 23. Users need only indicate by entering a "1" in the blank column if a species on the native or unwanted (exotic/non-local native) list is present in their site, and whether it is present as a seedling, where relevant (See

Figure 2). Extra rows allow users to enter species not in the pro-forma list.

The spreadsheet ("Botanical" tab, see Figure 3) automatically calculates the sum of:

- all RPMS<sup>9</sup> species,
- all exotic/non-local species,
- all native species,
- all characteristic native species,
- all winter bird food
- all bird food species, and
- the proportion of vascular plants that are local indigenous species.

It returns the relevant KGW star value automatically in the "My Green Wheel" tab (Figure 4).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Indigenous Species (local to Waikato kahikatea forest)	Common name	Type the number 1 if this species is in your site	Type the number 1 if present as established seedlings/white boxes only	Scorable native?	Characteristic kahikatea species	Tree or shrub species	Winter bird food species	Bird food species	Scorable natives present	Characteristic species present	Tree/shrub species present	Winter bird food present	Any season bird food present
1	<i>Adiantum species</i>	Kidland								0	0	0	0	0
2	<i>Adiantum cunninghamii</i>	Maiden hair fern								0	0	0	0	0
3	<i>Aletrisyon excelsus</i> subsp. <i>excelsus</i>	Tiaki			1	1	1	1	1	0	0	0	0	0
4	<i>Akaroa macrophylla</i>	Toropapa			1					0	0	0	0	0
5	<i>Akaroa x quercifolia</i>	Toropapa			1	1	1	1	1	0	0	0	0	0
6	<i>Araucarioxylon lanceolatum</i>	Lance fern								0	0	0	0	0
7	<i>Aristoidea serrata</i>	Wineberry			1	1	1	1	1	0	0	0	0	0
8	<i>Asplenium adnigrum</i>	Jointed fern								0	0	0	0	0
9	<i>Asplenium bulbiferum</i>	Hen and chicken fern			1					0	0	0	0	0
10	<i>Asplenium bulbiferum</i> x <i>A. flaccidum</i>	Hen and chicken fern								0	0	0	0	0
11	<i>Asplenium flaccidum</i>	Hanging spleenwort			1					0	0	0	0	0
12	<i>Asplenium gracillimum</i>	Hen and chicken fern								0	0	0	0	0
13	<i>Asplenium longipetiolatum</i>	Hen and chicken fern								0	0	0	0	0
14	<i>Asplenium polyodon</i>	Sickle spleenwort			1					0	0	0	0	0
15	<i>Asplenium polyodon</i>	Sickle spleenwort			1					0	0	0	0	0
16	<i>Astelia flagellata</i>	Kakaha							1	0	0	0	0	0
17	<i>Astelia grandis</i>	Swamp astelia							1	0	0	0	0	0
18	<i>Astelia hastata</i> (syn <i>Coloclerium hastatum</i> )	Tank lily						1	1	0	0	0	0	0
19	<i>Astelia microcarpa</i> (syn <i>Coloclerium microcarpum</i> )	Kakaha			1			1	1	0	0	0	0	0
20	<i>Astelia solandrii</i>	Kawharawhara						1	1	0	0	0	0	0
21	<i>Austroblechnum flavida</i>	Torone								0	0	0	0	0
22	<i>Azolla filiculoides</i>	Floating fern								0	0	0	0	0
23	<i>Blechnum chamerisii</i> (syn <i>Austroblechnum lanceolatum</i> )	Lance fern			1	1	1	1	1	0	0	0	0	0
24	<i>Blechnum discolor</i> (syn <i>Lomaria discolor</i> )	Crown fern								0	0	0	0	0
25	<i>Blechnum filiforme</i> (syn <i>Isaria filiformis</i> )	Thread fern								0	0	0	0	0
26	<i>Blechnum fluviatile</i> (syn <i>Ceratophyllum fluviatile</i> )	Thread fern			1					0	0	0	0	0
27	<i>Blechnum membranaceum</i> (syn <i>Austroblechnum membranaceum</i> )	Fern								0	0	0	0	0
28	<i>Blechnum minus</i> (syn <i>Parablechnum minus</i> )	Swamp kiokio								0	0	0	0	0
29	<i>Blechnum novae-zealandiae</i> (syn <i>Parablechnum novae-zealandiae</i> )	Kiokio				1				0	0	0	0	0

Figure 2: KGW Spreadsheet – example electronic data entry for plant species list

<sup>8</sup> Available for download from: <https://www.waikatoregion.govt.nz/environment/biodiversity/kahikatea-green-wheel/>

<sup>9</sup> RPMS = Regional Pest Management Species

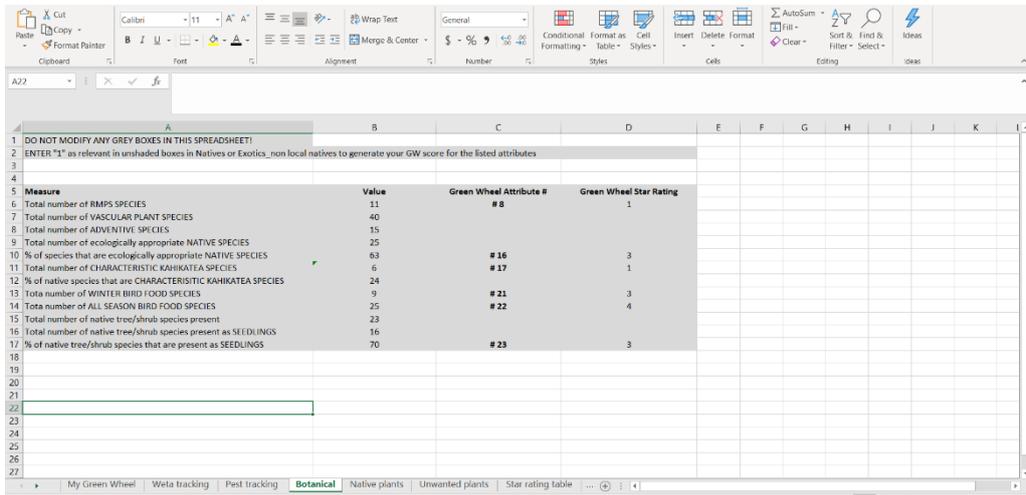


Figure 3: KGW Spreadsheet - example of automated star ranking generated for botanical scores

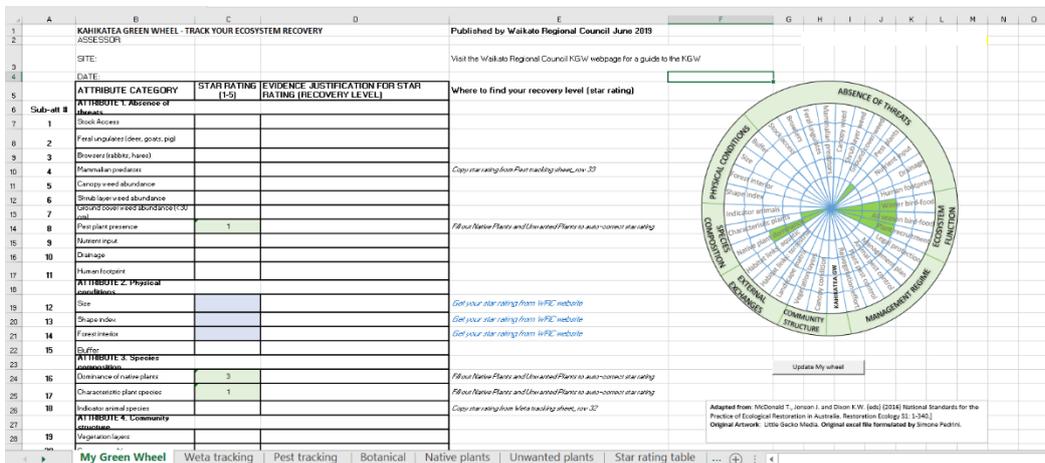


Figure 4: KGW Spreadsheet - example of automated KGW Wheel with botanical sub-attributes automatically entered

## 3.2 Recommended field methods

To apply the KGW it will be necessary to conduct a site visit to generate an up-to-date species list. As the tool was developed to assess change, it is essential that current data be used, although older species lists may help ensure a thorough check. The KGW should be re-assessed every 5 years. A supporting 'Botanical Quick Guide' has been developed for regular reference.

A **KGW Site datasheet** (Appendix 3A) has been developed to record scores for all 31 sub-attributes, and will be a useful field tool to capture notes to justify subjective scores, such as canopy weed cover %. A completed example of a **KGW Site datasheet** is presented in Appendix 2. It has been developed from a publicly accessible site, at Lake Rotopiko/Serpentine, 15 mins south of Hamilton. Users are encouraged to take the example to the site to see how sub-attributes have been applied. A blank copy is available in Appendix 3 (A) or from the WRC website<sup>10</sup>.

A full set of field cards (datasheets) and reference cards is provided in Appendix 3, including a **Photopoint record sheet** to record important supplementary information for photos taken, and a series of species lists (native, exotic/non-local, and RPMS species).

<sup>10</sup> <https://www.waikatoregion.govt.nz/environment/biodiversity/kahikatea-green-wheel/>

Botanical assessors can either use the field datasheets, or enter data directly into the **KGW spreadsheet** using the tabs Native plants and Unwanted plants (exotic and ecologically inappropriate native plants, i.e., not naturally found in kahikatea forest or outside their biogeographic range).

## Recommended approach

### 1. Before you start

- Download the **KGW spreadsheet** to your device, and/or print the **Star ranking table** and field datasheets (A, B, C, D). Ask the landowner if they have any existing species lists as a double check, but don't enter any species you do not see during the visit (they may no longer be present).
- Confirm with the landowner/ site manager which of the sub-attributes you will score. There are several that could be easily included in a botanical assessment, but the landowner/site manager may prefer to assess those themselves. The full set of sub-attributes and their star ranking standards are presented in the **Star ranking table 1** (and also in the **KGW Spreadsheet**).
- Ensure you have a suitable site safety plan. It is highly recommended that you undertake your visit accompanied by the landowner / site manager, they will help you stay safe and it's a good way for them to learn some of the more important plants (e.g. threatening weeds or rare native plants) and vegetation features.
- Use the **Star ranking table** to assign a score from 1 to 5 for the attributes listed below. Familiarise yourself with the visual clues in the **Landowner guide** (available on the WRC website, or see s2.2.3 of this report).

### 2. In the field – outside the forest stand

	Relevant sub-attribute
Note on <b>Unwanted Plants Datasheet D</b> any Regional Pest Management plant species within 50 m of the site (but within the property boundary).	8
<i>Optional, this may be undertaken by the landowner/site manager.</i>	5, 20
Look at the condition of the canopy from outside the forest, add notes to the <b>Site Datasheet A</b> . Reconfirm your KGW star rank value after looking inside the forest.	15
Assess the extent of any buffer (adjoining native or planted forest) and edge vegetation in the dripline (vegetation margin).	
<i>Optional, this may be undertaken by the landowner/site manager</i>	1, 2, 3, 9, 10, 11, 25
Look for signs of stock, animal pests, human damage, nutrient enrichment, drainage, and waterway links. Add notes to the <b>Site Datasheet A</b> . Re-confirm star rank values after checking inside the forest.	
<i>Optional, this may be undertaken by the landowner/site manager</i>	General record
Take photos to record the items above – establish at least one permanently marked photopoint. Record details on <b>Photopoint Record sheet B</b> .	

3. In the field – inside the forest stand	Relevant sub-attribute
<p>Generate a full vascular plant species list. Record details on <b>Native Plants Datasheet C</b>, and <b>Unwanted Plants Datasheet D</b> or directly into the <b>KGW Spreadsheet</b> (Native plants and Unwanted plants) on your mobile device. By moving through the entire stand to create a full species list you will gain familiarity with the site, helping you to then apply other sub-attributes.</p>	8, 16, 17, 21, 22, 23
<p>Indicate on the species list if a native tree or shrub species is present as a seedling. As an optional extra you can also add a code for relative abundance or to indicate if a species is only present as a seedling (suggesting that seeds are recruiting into the stand from another site or from the seed bank).</p>	23
<p>For exotics, give a total % cover class (in planar view) for <u>all exotics combined</u> for each vegetation tier. Ground tier is &lt; 30 cm. Use the <b>Unwanted Plants Datasheet D</b> or enter star rank and notes directly into the <b>Site datasheet A</b>.</p>	5, 6, 7
<p><i>Optional - this may be undertaken by the landowner/site manager</i></p> <p>Look for signs of stock, animal pests, human damage, nutrient enrichment, drainage. Add notes and star rank value to the <b>Site Datasheet A</b>.</p>	1, 2, 3, 9, 10, 11,
<p>Assess the condition of the canopy and intactness of each vegetation layer (canopy, shrub, ground &lt;30 cm). Mentally exclude exotic species when assessing how intact a layer is in planar view. Add notes and star rank value to the Site Datasheet and <b>Native Plants Datasheet C</b>.</p>	19, 20
<p>Take photos to record the items above – establish at least one permanently marked photopoint. Record details on <b>Photopoint Data record B</b>.</p>	General record
<h4>4. Back in the office</h4>	
<p><b>If you did not enter your species list into the KGW spreadsheet in the field, complete one of the following steps (Option 1 or 2) to enter botanical data:</b></p>	Relevant sub-attribute
<p>Option 1: Open the <b>KGW spreadsheet</b>, enter your species list into the “Native plants” and “Unwanted plants” tabs and these values will automatically put the star rank value into the “My Greenwheel” tab.</p>	8, 16, 17, 21, 22, 23
<p>Option 2: If you do not wish to use the KGW Spreadsheet auto-calculator, complete your botanical datasheets (C and D), adding up numbers and filling in the summary tables. Then use the <b>Star Rank</b> table in Appendix 1 to apply the star ranking to <b>Site Datasheet A</b> for the botanical sub-attributes.</p> <p>If you want to create a Green Wheel graphic, the next step is to enter the star rank value from <b>Site Datasheet A</b> directly into the “My Green Wheel” tab of the <b>KGW spreadsheet</b>. Note that if you do enter botanical values manually into any green coloured boxes in “My Green Wheel” you will delete the formula that auto-calculates these scores.</p>	8, 16, 17, 21, 22, 23
<p>Complete other relevant sections of <b>Site Datasheet A</b> as requested by the landowner/site manager ideally via discussion with them, and enter all of the indicators you assessed into the <b>KGW spreadsheet</b> “My Green Wheel” tab. While you can enter this information directly into the spreadsheet we recommend also completing the Site datasheet so you can add extra information and sketches or maps and keep that as a master document. Take a screen shot or use the snip tool to get a copy of the Green Wheel graphic and add it to the Site datasheet.</p>	As requested by landowner. Note GIS sub-attributes are on the WRC website

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## Appendix 1: Star ranking table for Waikato Kahikatea Green Wheel

ATTRIBUTE CATEGORY	1*	2*	3*	4*	5*	Methods/Who
<b>ATTRIBUTE A. Threats</b>	<b>PRESSURE INDICATORS</b> – main pressures are introduced plants/animals, nutrient input, deliberate human damage					
<b>1. Stock access</b>	No fences and heavily grazed throughout - signs include bare or mainly unpalatable plants in ground layer, heavily pugged, abundant cattle dung.	No fences and moderately grazed - minor amounts of dung, many unpalatable plants, some pugging, but site not heavily grazed throughout.	Fenced but not complete, or ineffective, or livestock are placed in the stand and site is heavily or moderately grazed.	Not or incompletely fenced, but site has minor signs of stock presence, livestock access is infrequent or does not penetrate more than 10 m into the site because of impediments e.g. blackberry, wet ground, drains, thick exposed roots, dense woody vines.	No stock have access, e.g. securely fenced or not in grazing land.	<i>Annual Visual check Landowner</i>
<b>2. Feral ungulates (deer, goats, pigs)</b>	Abundant sign of feral ungulates, dung pellets or signs of shrub browse across 75% or more of the site.	Ungulate dung pellets or sign of shrub browse across 50-74%.	Faecal pellets or shrub browse across 25-49% of the site.	Minor sign, e.g. some hoof prints or dung but little sign of vegetation damage.	No evidence of feral ungulates.	<i>Annual Visual check Landowner with contractor at first to train landowner</i>
<b>3. Browsers<sup>11</sup> (rabbits, hares)</b>	Abundant sign of rabbits or hares, faecal pellets or signs of browse across 75% or more of the site.	Faecal pellets or signs of browse across 50-74% of the site.	Faecal pellets or signs of browse across 25-49% of the site.	Minor sign. Very old or just a few piles of pellets or minor browse seen.	Fully pest fenced or pest-free island, or no sign rabbits or hares have been recently in the site.	<i>Annual Visual check Landowner</i>
<b>4. Mammalian predators</b>	Very high pest numbers, detection on 9 or 10 out of ten chew cards or tracking tunnels.	Moderately high pest numbers, detection on 5 to 8 out of ten chew cards or tracking tunnels.	Moderate pest numbers, detection on 1 to 4 chew cards or tracking tunnels.	No evidence of predators, zero detection on chew cards or tracking tunnels but site is not fully pest fenced.	Fully pest fenced or pest-free island and monitoring shows pests are absent, or at best recorded only infrequently (incursions).	<i>Annual Chew cards/ tracking tunnels Landowner with contractor at first to train landowner. Archive the used detection devices for expert verification</i>

<sup>11</sup> Note that possums can be treated as mammalian predators and measured using detection devices. Kahikatea trees do not show signs of possum browse and possum browse indicator species (e.g. totara) may be infrequent.

<b>5. Canopy weed abundance</b>	75% or more of the canopy (where visible or estimated from vine stems) comprises or is covered in exotic species.	Exotic species cover or comprise 50-74% of the canopy.	Exotic species cover or comprise 25-49% of the canopy.	Exotic species cover or comprise 5-24% of the canopy.	Exotic species cover or comprise less than 5% of the canopy.	<i>Annual Visual check</i>  <i>Landowner with contractor at first to train landowner</i>
<b>6. Shrub layer weed abundance</b>	Exotic species cover 75% or more of the mid-tier zone of the forest stand.	Exotic species cover 50-74% of the mid-tier zone.	Exotic species cover 25-49% of the mid-tier zone.	Exotic species cover 5-24% of the mid-tier zone.	Exotic species cover less than 5% of the mid-tier zone.	<i>Annual Visual check</i>  <i>Landowner with contractor at first to train landowner</i>
<b>7. Ground cover weed abundance (&lt;30 cm tall)</b>	75% or more of the forest floor is covered with exotic species (include vine thickets).	Exotic species comprise 50-74% of the forest floor.	Exotic species cover 25-49% of the forest floor.	Exotic species cover 5-24% of the forest floor.	Exotic species cover less than 5% of the forest floor.	<i>Annual Visual check</i>  <i>Landowner with contractor at first to train landowner</i>
<b>8. Pest plant presence</b>	More than five regional pest plant species in the site or within 50 m of it within the property.	Four or five regional pest plant species in the site or within 50 m of it within the property.	Two or three regional pest plant species in the site or within 50 m of it within the property.	One regional pest plant species in the site or within 50 m of it within the property.	No regional pest plant species present in the site or within 50 m of it within the property.	<i>5-yearly Species list Contractor</i>
<b>9. Nutrient input</b>	Site is subject to constant high nutrient enrichment. Examples: septic wastewater pipes or year-round effluent disposal, and/or is permanently stocked with grazing animals and dung heaps are abundant, and/or year-round high numbers of roosting birds and guano obvious.	Site is subject to regular, but not constant, high nutrient enrichment. Examples: grazed on a rotational basis, regular fertiliser application or heavy grazing on adjacent paddocks, or periodic / seasonal high number of roosting birds.	Site is regularly subject to small amounts of nutrient enrichment. Examples: slopes above moderately grazed, and/or moderate number of birds, and/or lightly grazed (e.g. sheep).	Site is occasionally subject to small amounts of nutrient enrichment. Examples: never grazed but subject to run-off from lightly grazed slopes above.	No obvious human-derived sources of nutrient input on the property. Examples: fertiliser not applied within 300 m radius, no upslope grazing land, no septic tanks within 300 m, no stock grazed in the stand.	<i>Annual Visual check/local knowledge Landowner</i>
<b>10. Drainage</b>	Site has been, and still is, subject to severe drainage with evidence of active, regularly maintained drains through, around or near the forest stand.	Drains affecting the stand are present but have not been actively maintained in the past 5 years. Landowner has no plans to restore formerly higher water levels.	Site is subject to a plan to restore water levels.	Drains are in the process of being blocked or filled in, although some drains remain active.	Site has never been drained and is still subject to regular flooding, or former flooding regime has been completely restored (e.g., all drains filled in). Or site was never subject to flooding.	<i>Annual Visual check/local knowledge Landowner</i>

<b>11. Human footprint</b> ( <i>litter, tracks, huts, clearance, inappropriate plantings of non-local natives or exotic species</i> )	Damage is moderate to intense across 75% or more of the site.	Damage is moderate to intense across 50-74% of the site.	Damage is moderate to intense across 25-49% of the site.	Damage is moderate to intense across 5-24% of the site. Or minor damage is evident across 25% or more of the site.	Minimal or no visual evidence of human presence (e.g. few structures or litter). Minor damage in <25% of the stand.	<i>Annual Visual check Landowner</i>
<b>ATTRIBUTE B. Physical conditions</b>	<b>STATE INDICATORS</b>					
<b>12. Size</b>	The kahikatea forest area is < 1 ha	The kahikatea forest area is 1 to <5 hectares	The kahikatea forest area is 5 to <10 hectares	The kahikatea forest area is 10 to <20 hectares	The kahikatea forest area is 20 hectares or more	<i>5-yearly GIS analysis Waikato RC – add to web map</i>
<b>13. Shape index</b>	Shape index is 3 or more (very convoluted or narrow)	Shape index is 2.5 to <3 (somewhat convoluted)	Shape index is 2 to <2.5 (blocky but stretched out)	Shape index is 1.5 to <2 (oval or round with some slight protrusions)	Shape index is less than 1.5 (very round or square)	<i>5-yearly GIS analysis Waikato RC – add to web map</i>
<b>14. Forest interior</b>	None of the kahikatea forest vegetation is more than 60 m from a native forest edge.	Less than 10% of the kahikatea forest vegetation is more than 60 m from a native forest edge.	From 10 up to 25% of the kahikatea forest vegetation is more than 60 m from a native forest edge.	From 25 up to 30% of the kahikatea forest vegetation is more than 60 m from a native forest edge.	30% or more of the kahikatea forest vegetation is more than 60 m from a native forest edge.	<i>5-yearly GIS analysis Waikato RC – add to web map</i>
<b>15. Buffer</b> (>3 m tall, 10 m wide, 80% cover to qualify)	Less than 25% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 25 to 49% of the site is protected from to edge effects by a dense margin and/or forest buffer.	From 50 to 74% of the site is protected from edge effects by a dense margin and/or forest buffer.	From 75 to 94% of the site is protected from edge effects by a dense margin and/or forest buffer.	95% or more of site is protected from edge effects by a dense margin and/or forest buffer.	<i>5-yearly GIS analysis OR field analysis Waikato RC – add to web map</i>
<b>ATTRIBUTE C. Species composition</b>	<b>STATE INDICATORS</b>					
<b>16. Dominance of native plants</b>	Fewer than 20% of species present are indigenous species that naturally occur in kahikatea forest.	From 20 to 49% of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	From 50 to 69% of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	From 70 to 79% of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	80% or more of the plant species in the forest are indigenous species that naturally occur in kahikatea forest.	<i>5-yearly Species list Contractor</i>
<b>17. Characteristic plant species</b>	Up to 10 characteristic species are present.	11-15 characteristic species are present.	16-20 characteristic species are present.	21-25 characteristic species are present.	More than 25 characteristic species are present.	<i>5-yearly Species list Contractor</i>

<b>18. Indicator animal species</b>	No wētā tracks recorded in seven nights.	10% weekly tracking rate (wētā tracks in one of 10 tunnels).	20% weekly tracking rate (wētā tracks in two of 10 tunnels).	30% weekly tracking rate (wētā tracks in three of 10 tunnels).	Greater than 30% weekly tracking rate (wētā tracks in four or more of 10 tunnels).	<i>Annual (winter) Tracking tunnels (20 at 20 m spacing) unbaited, grills on to deter larger pests, left out 7 nights. Landowner –trained by contractor.</i>
<b>ATTRIBUTE D. Community structure</b>	<b>STATE INDICATORS</b>					
<b>19. Vegetation layers</b>	No vegetation tier is intact (all layers have <50% cover of indigenous vegetation).	One tier is relatively intact (50% or more indigenous cover).	Two tiers are relatively intact (50% or more indigenous cover).	All tiers have 50% or more indigenous cover, but at least one of them has less than 75% cover.	All layers have >75% cover comprising indigenous species. Emergent trees may or may not be present.	<i>5-yearly Visual check Contractor</i>
<b>20. Canopy condition</b>	75% or more of the native foliage in the canopy is showing signs of yellowing or defoliation.	From 50 to 74% of the native foliage in the canopy is showing signs of yellowing or defoliation.	From 25 to 49% of the native foliage in the canopy is showing signs of yellowing or defoliation.	From 2 to 24% of the native foliage in the canopy is showing signs of yellowing or defoliation.	Up to 1% of the canopy is showing signs of yellowing or defoliation.	<i>Annual Visual check Contractor</i>
<b>ATTRIBUTE E. Ecosystem function</b>	<b>STATE INDICATORS</b>					
<b>21. Winter bird-food availability<sup>12</sup></b>	No winter bird food species are present.	1-5 winter bird food species are present.	6-10 winter bird food species are present.	11-15 winter bird food species are present.	More than 15 winter bird food species are present.	<i>5-yearly Species list Contractor</i>
<b>22. All season bird-food availability<sup>13</sup></b>	Fewer than 5 bird food species are present.	5-9 bird food species are present.	10-19 bird food species are present.	20 to 40 bird food species are present.	More than 40 bird food species are present.	<i>5-yearly Species list Contractor</i>
<b>23. Plant recruitment</b>	Fewer than 25% of the native trees or shrubs in the stand are present as established seedlings.	25 to 49% of native trees or shrubs in the stand are present as established seedlings.	50 to 74% of native trees or shrubs in the stand are present as established seedlings.	75 to 90% of native trees or shrubs in the stand are present as established seedlings.	Over 90% of native trees or shrubs in the stand are present as established seedlings.	<i>5-yearly Species list/ seedlings noted Contractor</i>

<sup>12</sup> Applies only to indigenous plant species that naturally occur in kahikatea forest – a list is available in Appendix 3.

<sup>13</sup> Applies only to indigenous plant species that naturally occur in kahikatea forest – a list is available in Appendix 3.

ATTRIBUTE F. External exchanges	STATE INDICATORS					
<b>24. Landscape matrix</b> <i>(within 1 km radius)<sup>14</sup></i>	There is no indigenous forest, scrub, fernland or shallow freshwater wetland within a 1km radius of the site.	Less than 25% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	From 25 up to 50% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	From 50 up to 75% of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	75% or more of the land within a 1km radius of the site is in indigenous forest, scrub, fernland or shallow freshwater wetland.	<i>5-yearly GIS analysis Waikato RC – add to web map</i>
<b>25. Habitat links - terrestrial<sup>15</sup></b>	Site is 4 km or more from another patch of indigenous forest and/or scrub > 25 hectares.	Site is from 2 up to 4 km of another patch of indigenous forest and/or scrub > 25 hectares.	Site is from 500 m up to 2 km from another patch of indigenous forest and/or scrub > 25 hectares.	Site is from 100 up to 500 m of another patch of indigenous forest and/or scrub > 25 hectares.	Site is < 100 m from another patch of indigenous forest > 25 hectares.	<i>5-yearly GIS analysis or visual check Waikato RC – add to web map</i>
<b>26. Habitat links - aquatic</b>	No natural links remain, site no longer inundated.	Partial links to nearby stream or wetland via extreme flood events.	Streams or drains flow through or beside the stand, but most of them are un-vegetated, and/or have perched culverts on the property. Partial links via moderate to extreme flood events.	All waterways are connected up and down stream (with no perched culverts on the property) but some have breaks in riparian cover on the property. Partial inundation via surface flows/flood events.	All waterways in the stand (if any) fully connected with continuous riparian buffers and no perched culverts or other fish barriers between the site and property boundary. Regular inundation via flooding or surface flows. Or was likely never connected to a waterway.	<i>5-yearly Visual check Contractor</i>
<b>ATTRIBUTE G. Management regime</b>	RESPONSE INDICATORS					
<b>27. Legal protection</b>	No formal legal protection or plans for such.	Legal protection is being pursued (e.g. application lodged with QEII National Trust or Ngā Whenua Rāhui).	Site is not a reserve or covenant/kawenata, but it listed on a district or regional council schedule of significant areas. Or the site is partly or fully	From 50 to 90% of the stand on this property is legally protected as a gazetted reserve or private covenant or kawenata.	Over 90% of the stand on this property is legally protected in perpetuity as a gazetted reserve or private covenant or kawenata.	<i>5-yearly Waikato RC – add to web map for QEII, NWRK, reserve, schedule.</i>

<sup>14</sup> This measures the amount of indigenous habitat within a fixed distance from the kahikatea stand (providing additional resources for mobile species and seed/gene transfer).

<sup>15</sup> This measures how isolated (distant) the stand is from a decent sized area of indigenous vegetation for species of limited mobility (including plants for pollen/seed/ spore dispersal).

			protected via a council management agreement. Or, up to 50% of the stand on this property is protected as a gazetted reserve or private covenant or kawenata.			
<b>28. Management plan</b>	No management plan exists or intended.	Informal (unwritten) plan exists for the site, or a plan is in preparation.	Site is subject to a wider farm or reserve plan, but with minimal specific reference to the site.	Site is subject to a wider farm or reserve plan with specific reference and action points.	Professionally prepared management plan exists specifically for the fragment.	<i>5-yearly Landowner knowledge/ records Landowner</i>
<b>29. Animal pest control effort</b>	No animal pest control is conducted, and no plans are in place to implement animal pest control.	No animal pest control is conducted but professional pest control plans are being or have been developed though not yet implemented.	Animal pest control has been implemented but is irregular or does not target all major animal pest species present.	Site is subject to an ongoing programme of predator monitoring and control for all major pest species likely to be present.	Site is fully pest-fenced or on a pest-free island, and animal pests are absent or managed in the event of an incursion.	<i>Annual Landowner knowledge/ records Landowner</i>
<b>30. Invasive plant control effort</b>	Site is highly or moderately degraded (scoring average <=3 stars for sub-attributes #5, 6, 7, 8) and no invasive plant /weed control has been planned or undertaken.	Site is highly or moderately degraded (scoring average <=3 stars for sub-attributes #5, 6, 7, 8) but plant pest control is planned or being implemented.	Site is slightly degraded (average >3 to <5 stars for sub-attributes #5, 6, 7, 8) and no invasive plant /weed control has been planned or undertaken.	Site is slightly degraded (average >3 to <5 stars for sub-attributes #5, 6, 7, 8), but plant pest control is planned or being implemented.	Site has relatively few plant pests, scoring 5 stars for all sub-attributes #5, 6, 7, 8, so plant pest control is not needed or is being highly effective.	<i>Annual Landowner knowledge/ records Landowner</i>
<b>31. Re-vegetation effort</b>	Site scores an averaged <=3 stars for sub-attributes #15, 16, 17, 19, 21, 22, 23, but no revegetation has been planned or recently undertaken.	Site scores an averaged <=3 stars for sub-attributes #15, 16, 17, 19, 21, 22, 23, but replanting is underway.	Site scores an averaged >3 to <5 stars for sub-attributes #15, 16, 17, 19, 21, 22, 23) and no revegetation has been planned or recently undertaken.	Site scores an averaged >3 to <5 stars for sub-attributes #15, 16, 17, 19, 21, 22, 23), and replanting is underway.	No revegetation is required – scoring 5 stars for all of sub-attributes #15, 16, 17, 19, 21, 22, 23.	<i>Annual Landowner knowledge/ records Landowner</i>

## Appendix 2: Completed example of a KGW

# Evaluation of Kahikatea Forest Recovery<sup>16</sup>

Site name: *Rotopiko/Turney Bush*

Site UKID number:<sup>17</sup> *not available*      Date: *5 Aug 2018*

Assessor: *Karen Denyer*      Date of last assessment: *n/a*

Location (district): *Waipa*

Location (NZTM): E 1803749 N 5796849

Soil type: Peat       Gleyed Silt Loam       Pumice       Other(state): .....

Landform: Flat       Gentle slope  Basin       Steep slope   
(tick all that apply and circle the predominant one)

Original forest type<sup>18</sup>: *Not mapped in Waikato RC pre-human but nearest examples are WF8: Kahikatea-pukatea forest*

Birds noted during visit: *Tui, fantail, grey warbler, morepork, falcon and exotic passerines*

Special features (e.g. threatened species): *Planted swamp maire, swamp astelia*

Tree/shrub species present only as seedlings: *Pokaka, Melicytus micranthus, white maire (planted)*

Site sketch/location<sup>19</sup>

*20-30 year old planted kahikatea stands*

*Turneys' Bush (mature kahikatea/pukatea forest)*



<sup>16</sup> Adapted from: "Society for Ecological Restoration Australia (SERA-evaluation-wheel, 2016)" tool

<http://www.seraustralia.com/standards/NationalRestorationStandards-RestorationEcologyWithCaseStudies.pdf>

<sup>17</sup> Obtain UKID number from the WRC website :

<https://waikatomap.waikatoregion.govt.nz/Viewer/?map=49a72640c5474484b156d453144044a3>

<sup>18</sup> Provided by Waikato RC via Singers and Rogers original vegetation type map.

<sup>19</sup> Draw a sketch map to show kahikatea fragment distribution at the site, if more than one name them as Unit 1, Unit 2 etc. Mark and label each unit on an aerial photograph.

ATTRIBUTE CATEGORY	RECOVERY LEVEL (1-5 or n/a) <sup>20</sup>	EVIDENCE FOR RECOVERY LEVEL	Method <sup>21</sup>
<b>ATTRIBUTE A. Absence of threats</b>			
1. Stock access	5	<i>No stock – securely fenced since 2008</i>	Visual check
2. Mammalian predators	5	<i>Fully pest-proof fenced since 2011</i>	Tracking tunnels, chew cards
3. Feral ungulates (deer, goats, pigs)	5	<i>Fully pest-proof fenced since 2011, unlikely to have had feral browsers – too isolated and small</i>	Visual check
4. Browsers (rabbits, hares)	5	<i>All ground browsers eradicated in 2011</i>	Visual check
5. Canopy weed abundance	5	<i>No canopy weeds present</i>	Visual check
6. Shrub layer weed abundance	5	<i>Virtually no shrub layer weeds present, occasional tree privet seedling</i>	Visual check
7. Ground cover weed abundance (<30 cm)	4	<i>Adventives in light- gaps (Yorkshire fog, cock's foot) and sparsely under full canopy (some blackberry, Jerusalem cherry, stinking iris, arum) – all subject to regular control</i>	Visual check
8. Pest plant presence	2	<i>Five species: Hedychium species (not flowering) – one specimen has been found and dug out, tutsan, Taiwanese cherry (seedlings only) several large-leaved and Chinese privet trees/seedlings have been found and will be progressively removed.</i>	Species list
9. Nutrient input	2	<i>Subject to run-off from grazed slopes above and high numbers of roosting birds following mammalian pest exclusion – though mostly only at the edge.</i>	Visual check
10. Drainage	2	<i>Subject to past drainage which has lowered soil surface up to 1 m, no plans to re-flood (would require pumps)</i>	Visual check/ local knowledge
11. Human footprint	4	<i>Tracks and activity stations installed for visitors</i>	Visual check/ local knowledge
<b>AVERAGED SCORE</b>	<b>4</b>	<b>KEY ISSUES:</b> <i>Excessive nutrient input from large bird roost and limited ability to repair past drainage, also RPMS weeds</i>	
<b>ATTRIBUTE B. Physical conditions</b>			
12. Size	2	<i>1.3 ha (Waikato RC)</i>	GIS analysis
13. Shape index	5	<i>1.3 (Waikato RC) – relatively compact</i>	GIS analysis
14. Forest interior	1	<i>None of the kahikatea forest is more than 60 m from the native forest edge</i>	GIS analysis
15. Buffer	3	<i>About 40 % of the stand has a dense planted buffer and most of the remaining edge has dense vegetated margin planting.</i>	Visual check

<sup>20</sup> n/a = not applicable or not able to be assessed

<sup>21</sup> <sup>21</sup> E.g. Visual check | Landowner knowledge | Species list | Tracking tunnels | WRC website

ATTRIBUTE CATEGORY	RECOVERY LEVEL (1-5 or n/a) <sup>20</sup>	EVIDENCE FOR RECOVERY LEVEL	Method <sup>21</sup>
AVERAGED SCORE	2.8	<b>KEY ISSUES:</b> <i>This stand is very small and has no interior forest, with time as adjacent planted forest matures and planted this will improve to some extent. At this stage there are few management options other than time.</i>	
<b>ATTRIBUTE C.</b>		<b>Species composition</b>	
16. Dominance of native plants	4	<i>73% of species present are indigenous species that naturally occur in kahikatea forest (74 of 102 species)</i>	Species list with relative abundance
17. Characteristic plant species	4	<i>42 species of highly representative kahikatea forest plants are present in the stand.</i>	Species list with relative abundance
18. Indicator animal species	4	<i>Weta in 3 of 10 tunnels (equivalent rate as 6 out of 20) deployed 8 July to - 20 July 2018</i>	Tracking tunnels
AVERAGED SCORE	4	<b>KEY ISSUES:</b> <i>The site is scoring relatively highly, there is scope to improve attribute 18 through eradication of the 5 RMPS species, and of #19 through further planting.</i>	
<b>ATTRIBUTE D.</b>		<b>Community structure</b>	
19. Vegetation layers	4	<i>Relatively dense canopy and shrub layer, but ground layer bare under dense mahoe, some canopy gaps in exotic grass</i>	Visual check
20. Canopy condition	5	<i>Little evidence of dieback when viewed externally or using aerial images</i>	Visual check
AVERAGED SCORE	4.5	<b>KEY ISSUES:</b> <i>Ground layer depauperate or exotic-dominant in places</i>	
<b>ATTRIBUTE E.</b>		<b>Ecosystem function</b>	
21. Winter bird-food availability	5	<i>17 winter bird-food species are present, most of them as established individuals</i>	Species list with relative abundance
22. All season bird-food availability	5	<i>46 bird food plant species are present, some are only as young planted specimens</i>	Species list with relative abundance
23. Plant recruitment	3	<i>39 shrub/tree species are present, of which 21 (54%) have established seedlings. Many native shrub/tree species have been recently planted and not yet reproducing.</i>	Plot data
AVERAGED SCORE	4.3	<b>KEY ISSUES:</b> <i>Just needs time for planted species to mature</i>	
<b>ATTRIBUTE F.</b>		<b>External exchanges</b>	
24. Landscape matrix	2	<i>5.8 % - Less than or equal to 25% of the land within a 1 km radius of the site is in indigenous forest or indigenous scrub.</i>	GIS analysis
25. Habitat links - terrestrial	2	<i>4160 m from nearest patch of indigenous forest and/or scrub &gt; 25 hectares</i>	GIS analysis
26. Habitat links - aquatic	1	<i>A drain runs along the edge of the stand, it is fully planted and connected with the peat lake downstream. However there are minimal links between the stand and the incised drain.</i>	Field analysis
AVERAGED SCORE	1.7	<b>KEY ISSUES:</b> <i>Distant from large stands of native vegetation, broken hydrological connection, in a pastoral catchment – limited ability to improve this score as relies on actions by other landowners.</i>	
<b>ATTRIBUTE G.</b>		<b>Management regime</b>	

ATTRIBUTE CATEGORY	RECOVERY LEVEL (1-5 or n/a) <sup>20</sup>	EVIDENCE FOR RECOVERY LEVEL	Method <sup>21</sup>
27. Legal protection	5	<i>District council reserve</i>	Landowner knowledge
28. Management plan	4	<i>Part of a plan for the East Lake complex within the pest fence.</i>	Landowner knowledge/ records
29. Animal pest control effort	5	<i>Within predator fence, all mammalian predators excluded, no mice recorded here since 2012</i>	Landowner knowledge/ records
30. Plant pest control effort	5	<i>Regular annual control of exotics</i>	Landowner knowledge/ records
31. Re-vegetation effort	4	<i>Some understory and buffer planting to improve structure and diversity</i>	Landowner knowledge
AVERAGED SCORE	4.6	KEY ISSUES: Weeds	
TOTAL SCORE <sup>22</sup> score/max	27 /35		

Key positive features / changes since last visit:

*n/a – first assessment*

Key issues that could be addressed to improve the health of this forest:

*Increase weed control and focus efforts on reducing exotic bird roost. Limited scope to reconnect the forest to the peat lake as unfeasible to raise water levels by the 1 m or more that would be required.*

<sup>22</sup> Total score is the sum of the averaged scores A-G.

## **Appendix 3: KGW datasheets**

**A: SITE DATASHEET**

**B: PHOTOPOINT RECORD SHEET**

**C: NATIVE PLANTS DATASHEET**

**D. UNWANTED PLANTS DATASHEET**

# Kahikatea Green Wheel datasheet

## A: SITE DATASHEET<sup>23</sup>: *To assess Kahikatea Forest Recovery*

Site name:

Date:

Site UKID number:<sup>24</sup>

Assessor:

Date of last assessment (n/a if first one):

Location (district):

Location (NZTM): E \_\_\_\_\_ N \_\_\_\_\_

Soil type: Peat  Gleyed Silt Loam  Pumice  Other(state): .....

Landform (tick all that apply and circle the predominant one):

Flat  Gentle slope  Basin  Steep slope

Original forest type<sup>25</sup>:

Birds noted during visit:

Special features (e.g. threatened species):

Tree/shrub species present only as seedlings:

General site description (brief notes):

Site sketch/location<sup>26</sup>

<sup>23</sup> Complete a separate datasheet for each individual kahikatea stand

<sup>24</sup> Obtain UKID number from the WRC website:

<https://waikatomap.waikatoregion.govt.nz/Viewer/?map=49a72640c5474484b156d453144044a3>

<sup>25</sup> Provided by Waikato RC via Singers and Rogers original vegetation type map. Use to assess representative plant species

<sup>26</sup> Draw a sketch map or inset an air photo to show the kahikatea fragment (you can take a screen shot from the WRC website).

Site Name:

Date:

SUB-ATTRIBUTES	RECOVERY LEVEL (1-5 or n/a) <sup>27</sup>	EVIDENCE FOR RECOVERY LEVEL (notes)	Method <sup>28</sup>
<b>A: Absence of threats</b>			
1. Stock access			
2. Feral ungulates (deer, goats, pigs)			
3. Browsers (rabbits etc)			
4. Mammalian predators			
5. Canopy weed abundance			
6. Shrub layer weed abundance			
7. Ground cover weed abundance (<30 cm)			
8. Pest plant presence			
9. Nutrient input			
10. Drainage			
11. Human footprint			
<b>AVERAGED SCORE</b>			
<b>B: Physical conditions</b>			
12. Size			<i>WRC website</i>
13. Shape index			<i>WRC website</i>
14. Forest interior			<i>WRC website</i>
15. Buffer			
<b>AVERAGED SCORE</b>			

<sup>27</sup> n/a = not applicable or not able to be assessed. Recovery level is the KGW star value.

<sup>28</sup> E.g. Visual check | Landowner knowledge | Species list | Tracking tunnels | WRC website

Site Name:

Date:

SUB-ATTRIBUTES	RECOVERY LEVEL (1-5 or n/a) <sup>29</sup>	EVIDENCE FOR RECOVERY LEVEL (notes)	Method <sup>30</sup>
<b>C: Species composition</b>			
16. Dominance of native plants			
17. Characteristic plant species			
18. Indicator animal species (weta)			
AVERAGED SCORE			
<b>D: Community structure</b>			
19. Vegetation layers			
20. Canopy condition			
AVERAGED SCORE			
<b>E: Ecosystem function</b>			
21. Winter bird-food availability			
22. All season bird-food availability			
23. Plant recruitment			
AVERAGED SCORE			
<b>F: External exchanges</b>			
24. Landscape matrix			<i>WRC website</i>
25. Habitat links - terrestrial			<i>WRC website</i>
26. Habitat links - aquatic			
AVERAGED SCORE			

<sup>29</sup> n/a = not applicable or not able to be assessed. Recovery level is the KGW star value.

<sup>30</sup> E.g. Visual check | Landowner knowledge | Species list | Tracking tunnels | WRC website

Site Name:

Date:

SUB-ATTRIBUTES	RECOVERY LEVEL (1-5 or n/a) <sup>31</sup>	EVIDENCE FOR RECOVERY LEVEL (notes)	Method <sup>32</sup>
<b>G: Management regime</b>			
27. Legal protection			
28. Management plan			
29. Animal pest control effort			
30. Plant pest control effort			
31. Re-vegetation effort			
<b>AVERAGED SCORE</b>			
<b>TOTAL SCORE<sup>33</sup></b> score/max	/35		
<b>BONUS – LONG-TAILED BATS</b> – if you have been monitoring bats each year enter your score here			

**Key positive features / changes since last visit:**

**Key issues that could be addressed to improve the health of this forest:**

**Paste a screen shot of your completed Green Wheel from the KGW spreadsheet here:**

<sup>31</sup> n/a = not applicable or not able to be assessed. Recovery level is the KGW star value.

<sup>32</sup> E.g. Visual check | Landowner knowledge | Species list | Tracking tunnels | WRC website

<sup>33</sup> Total score is the sum of the averaged scores A-G.



# Kahikatea Green Wheel datasheet

For KGW sub-attribute #s  
17, 19, 21, 22, 23

## C: NATIVE PLANTS

If you enter species data directly into the Kahikatea Green Wheel spreadsheet "Native Plants" tab you will not need to complete this datasheet and the scores will be automatically calculated for you.

Enter '1' for all listed species present (whether seedlings or established plants) in column 3 of the DATA TABLE. Also enter 1 in col 4 if present as seedlings. Circle Y if the species present is a characteristic and/or bird food species. Sum the 1's and circled Y's at the bottom of each page and sum all together on the last page of the DATA TABLE to complete Table A. In Table B, indicate percent cover class per tier for all natives combined (estimate as bird's eye view).

Species are sorted by common names to assist less experienced botanists. Only species that contribute to KGW scores are listed - use the blank spaces in Table C to add additional native plant species.

Site name:

Date:

Site UKID number:<sup>35</sup>

NZTM:

Assessor:

### A: from your data table

Total listed native species (to calc #16)	
Total characteristic species (# 17)	
Total winter bird food species (# 21)	
Total all season bird food species (# 22)	
Total tree/shrub species present that occur as seedlings (# 23)	

### B: estimate in the field

% cover indigenous vegetation per tier (# 19)	
Canopy (< 50%, 50-75% or >75%)	
Mid-tier (< 50%, 50-75% or >75%)	
Ground (< 50%, 50-75% or >75%)	

DATA TABLE		# 16	# 23	# 17	# 21	# 22
Common name	Scientific name	Enter '1' if this species is in your site	Also enter 1 if seedlings present	Circle Y if species is present		
		Scorable native species	Seedlings present	Characteristic kahikatea species	Winter bird food species	All season Bird food species
Black maire	<i>Nestegis cunninghamii</i>					Y
Broom	<i>Carmichaelia australis</i>					
Coprosma	<i>Coprosma rhamnoides</i>					Y
Coprosma	<i>Coprosma rigida</i>				Y	Y
Five-finger	<i>Pseudopanax arboreus</i>				Y	Y
Flax, harakeke	<i>Phormium tenax</i>		n/a			Y
Gully fern	<i>Cyathea cunninghamii</i>					
Hangehange	<i>Geniostoma ligustrifolium</i> var. <i>ligustrifolium</i>			Y		Y
Hīnau	<i>Elaeocarpus dentatus</i>					Y
Houhere	<i>Hoheria sexstylosa</i>					Y
Houhere (nth Waikato)	<i>Hoheria populnea</i>					Y
Houpara	<i>Olearia rani</i>					Y
Kahikatea	<i>Dacrycarpus dacrydioides</i>			Y		Y
<b>COUNT PAGE 1</b>						

<sup>35</sup> Obtain UKID number from the WRC website: [waikatoregion.govt.nz/vegetation-biodiversity-map](http://waikatoregion.govt.nz/vegetation-biodiversity-map)

**DATA TABLE**

		# 16	# 23	# 17	# 21	# 22
		Enter '1' if this species is in your site	Also enter 1 if seedlings present	Circle Y if species is present		
Common name	Scientific name	Scorable native species	Seedlings present	Characteristic kahikatea species	Winter bird food species	All season Bird food species
Kaikōmako	<i>Pennantia corymbosa</i>					Y
Kanono	<i>Coprosma grandifolia</i>				Y	Y
Kānuka	<i>Kunzea robusta</i>					
Karamu	<i>Coprosma robusta</i>				Y	Y
Kawakawa	<i>Piper excelsum (syn Macropiper exc var. ex)</i>			Y	Y	Y
Kiekie	<i>Freycinetia banksii</i>		n/a	Y		Y
Kohekohe	<i>Dysoxylum spectabile</i>				Y	Y
Koromiko	<i>Hebe stricta var stricta (syn Veronica)</i>					Y
Kōwhai	<i>Sophora microphylla</i>					Y
Lancewood	<i>Pseudopanax crassifolius</i>			Y	Y	Y
Lowland ribbonwood	<i>Plagianthus regius</i>					
Lowland tōtara	<i>Podocarpus totara var. totara</i>			Y	Y	Y
Māhoe	<i>Melicytus ramiflorus subsp. ramiflorus</i>			Y		Y
Mamaku, black fern	<i>Cyathea medullaris</i>			Y		
Māmāngi	<i>Coprosma arborea</i>				Y	Y
Mangeao	<i>Litsea calicaris</i>			Y		Y
Mānuka	<i>Leptospermum scoparium</i>					
Māpou	<i>Myrsine australis</i>			Y	Y	Y
Matai	<i>Prumnopitys taxifolia</i>			Y		Y
Mingimingi	<i>Coprosma propinqua</i>				Y	Y
Mingimingi	<i>Coprosma propinqua x C. robusta</i>				Y	Y
Mingimingi	<i>Leucopogon fasciculatus</i>					Y
Miro	<i>Prumnopitys ferruginea</i>				Y	Y
Narrow-leaved māhoe	<i>Melicytus lanceolatus</i>				Y	Y
Narrow-leaved maire	<i>Nestegis montana</i>					Y
Nīkau	<i>Rhopalostylis sapida</i>					Y
Northern rātā	<i>Metrosideros robusta</i>		n/a			Y
Patē	<i>Schefflera digitata</i>			Y	Y	Y
Pigeonwood	<i>Hedycarya arborea</i>			Y	Y	Y
Poataniwha	<i>Melicope simplex</i>			Y		Y
Pōkākā	<i>Elaeocarpus hookerianus</i>			Y		Y
Ponga, silver fern	<i>Cyathea dealbata</i>			Y		
Poroporo	<i>Solanum aviculare var. aviculare</i>					Y
Pukatea	<i>Laurelia novae-zelandiae</i>			Y		
Putaputawētā	<i>Carpodetus serratus</i>			Y	Y	Y
Ramarama	<i>Lophomyrtus bullata</i>					Y
Rangiora	<i>Brachyglottis repanda</i>					Y
Raukawa	<i>Pseudopanax anomalus (syn Raukawa)</i>					Y
Rewarewa	<i>Knightia excelsa</i>			Y		Y
Rimu	<i>Dacrydium cupressinum</i>			Y		Y
Rōhutu	<i>Neomyrtus pedunculata</i>					Y
	<b>COUNT PAGE 2</b>					



# Kahikatea Green Wheel datasheet

## D: UNWANTED PLANTS

If you enter species data directly into the Kahikatea Green Wheel spreadsheet “Unwanted plants” tab you will not need to complete this datasheet.

For all listed species present, enter 1 (non-Regional Pest Management species inside the stand) or circle Y (for RPMP species inside or within 50 m of the stand on same property). Sum the 1's and circled Y's at the bottom of each page and sum all together on the last page of the DATA TABLE to complete Table A. Only species that contribute to KGW scores are listed - use the blank spaces in Table C to add additional unwanted plant species.

In Table B, indicate percent cover class per tier for all exotics combined (estimate as bird's eye view).

Site name: \_\_\_\_\_ Date: \_\_\_\_\_

Site UKID number:<sup>36</sup> \_\_\_\_\_ NZTM: \_\_\_\_\_

Assessor: \_\_\_\_\_

**Table A: from your data table**

# RPMP species inside or within 50m of site but on same property (for <b>sub-attribute 8</b> )	
# Unwanted species (from this datasheet)	
# Native species (from datasheet C)	
# All vascular species – add the two numbers above	
% native [#Native/#All vascular plants x 100] (for <b>sub-attribute 16</b> )	

**Table B: estimate in the field**

% Total exotic cover in the canopy (for <b>sub-attribute 5</b> )	
% Total exotic cover in the mid-tier/shrub layer (for <b>sub-attribute 6</b> )	
% Total exotic cover in the ground layer (for <b>sub-attribute 7</b> )	

DATA TABLE		# 8	Non RPMP unwanted species
Common name	Unwanted Species	Circle Y all RPMP species <sup>37</sup> in or within 50 m of your site <sup>38</sup>	If NOT an RPMP species enter '1' if species is within your site
African feather grass	<i>Cenchrus macrourus</i>	y	n/a
Alligator weed	<i>Alternanthera philoxeroides</i>	y	n/a
Arum lily	<i>Zantedeschia aethiopicum</i>		
Asparagus fern	<i>Asparagus setaceus</i>	y	n/a
Australian sedge	<i>Carex longibrachiata</i>	y	n/a
Banana passionfruit	<i>Passiflora tripartita/ P. mixta</i>	y	n/a
Barberry	<i>Berberis glaucocarpa</i>		
Bat-wing passion flower	<i>Passiflora apetala</i>	y	n/a
Beggars' tick	<i>Bidens frondosa</i>		
Bindweed	<i>Calystegia silvatica</i> (and hybrids)		
Blackberry	<i>Rubus sp. (R. fruticosus agg.)</i>		
Boneseed	<i>Chrysanthemoides monilifera</i>	y	n/a
	<b>COUNT PAGE 1 (ALL CIRCLED Y AND ALL '1's)</b>		

<sup>36</sup>Obtain UKID number from the WRC website: [waikatoregion.govt.nz/vegetation-biodiversity-map](http://waikatoregion.govt.nz/vegetation-biodiversity-map)

<sup>37</sup> Regional Pest Plant species as of 2018 - Check current RPMP for updates

<sup>38</sup> Within 50 m but on same property – landowner has no control over pest plants not on their land

**DATA TABLE**

		# 8	Non RPMP unwanted species
Common name	Unwanted Species	Circle Y all RPMP species <sup>37</sup> in or within 50 m of your site <sup>38</sup>	If NOT an RPMP species enter '1' if species is within your site
Broom	<i>Cytisus scoparius</i>	y	n/a
Broom corn millet	<i>Panicum miliaceum</i>	y	n/a
Broom sedge	<i>Carex scoparia</i>		
Bushy asparagus	<i>Asparagus aethiopicus</i>	y	n/a
California bulrush	<i>Schoenoplectus californicus</i>	y	n/a
Californian privet	<i>Ligustrum ovalifolium</i>	y	n/a
Cathedral bells	<i>Cobaea scandens</i>	y	n/a
Chilean flame creeper	<i>Tropaeolum speciosum</i>	y	n/a
Chinese knotweed	<i>Persicaria chinensis</i>	y	n/a
Chinese privet	<i>Ligustrum sinense</i>	y	n/a
Chocolate vine	<i>Akebia quinata</i>	y	n/a
Climbing asparagus	<i>Asparagus scandens</i>	y	n/a
Climbing spindleberry	<i>Celastrus orbiculatus</i>	y	n/a
Common privet	<i>Ligustrum vulgare</i>	y	n/a
Contorta pine	<i>Pinus contorta</i>	y	n/a
Crack willow	<i>Salix fragilis/Salix x fragilis</i>	y	n/a
Creeping buttercup	<i>Ranunculus repens</i>		
Darwin's barberry	<i>Berberis darwinii</i>	y	n/a
Eel grass	<i>Vallisneria australis</i>	y	n/a
Eleagnus	<i>Eleagnus x reflexa</i>		
Evergreen buckthorn	<i>Rhamnus alaternus</i>	y	n/a
Fatsia	<i>Fatsia japonica</i>		
Fox sedge	<i>Carex vulpinoidea</i>		
Freshwater eel grass	<i>Vallisneria australis (syn V. gigantea and V. spiralis)</i>	y	n/a
Fringed water lily	<i>Nymphoides peltata</i>	y	n/a
Giant gunnera	<i>Gunnera manicata</i>	y	n/a
Giant gunnera	<i>Gunnera tinctoria</i>	y	n/a
Giant knotweed	<i>Fallopia sachalinensis</i>	y	n/a
Gorse	<i>Ulex europaeus</i>	y	n/a
Grey sedge	<i>Carex divulsa</i>		
Grey willow	<i>Salix cinerea</i>	y	n/a
Gum	<i>Eucalyptus sp. eucalyptus</i>		
Gypsy wort	<i>Lycopus europaeus</i>		
Hawthorn	<i>Crataegus monogyna</i>		
Horse nettle	<i>Solanum carolinense</i>	y	n/a
Horsetail	<i>Equisetum species</i>	y	n/a
Hydrilla	<i>Hydrilla verticillata</i>	y	n/a
Ivy	<i>Hedera helix</i>		
Japanese cherry	<i>Prunus serrulata</i>	y	n/a
Japanese honeysuckle	<i>Lonicera japonica</i>		
Japanese knotweed	<i>Fallopia japonica</i>	y	n/a
Japanese spindleberry	<i>Euonymus japonicus</i>		
Japanese walnut	<i>Juglans ailantifolia</i>	y	n/a
Jerusalem cherry	<i>Solanum pseudocapsicum</i>		
	<b>COUNT PAGE 2 (ALL CIRCLED Y AND ALL '1's)</b>		

DATA TABLE		# 8	Non RPMP unwanted species
Common name	Unwanted Species	Circle Y all RPMP species <sup>37</sup> in or within 50 m of your site <sup>38</sup>	If NOT an RPMP species enter '1' if species is within your site
Kahili ginger	<i>Hedychium gardnerianum</i>	y	n/a
Kiwifruit	<i>Actinidia deliciosa</i>	y	n/a
Kudzu	<i>Pueraria montana</i>	y	n/a
Lantana	<i>Lantana camara</i>	y	n/a
Large leaved privet	<i>Ligustrum lucidum</i>	y	n/a
Macrocarpa	<i>Cupressus sp. cypress</i>		
Manchurian wild rice	<i>Zizania latifolia</i>	y	n/a
Marshwort	<i>Nymphoides geminata</i>	y	n/a
Mercer grass	<i>Paspalum distichum</i>		
Mexican devil	<i>Ageratina adenophora</i>	y	n/a
Mexican water lily	<i>Nymphaea mexicana</i>	y	n/a
Mignonette vine	<i>Anredera cordifolia</i>	y	n/a
Mile-a-minute	<i>Dipogon lignosus</i>	y	n/a
Mistflower	<i>Ageratina riparia</i>	y	n/a
Monkey apple	<i>Syzygium smithii</i>		
Montbreccia	<i>Crocosmia x crocosmiiflora</i>		
Moth plant	<i>Araujia hortorum /Araujia sericifera</i>	y	n/a
Nasella tussock	<i>Nasella neesiana</i>	y	n/a
Nasella tussock	<i>Nasella trichotoma</i>	y	n/a
Nodding thistle	<i>Carduus nutans</i>	y	n/a
Noogoora burr	<i>Xanthium strumarium</i>	y	
Old man's beard	<i>Clematis vitalba</i>	y	n/a
Oval sedge	<i>Carex ovalis</i>		
Pale willow weed	<i>Persicaria lapathifolia</i>		
Pampas	<i>Cortaderia jubata</i>	y	n/a
Pampas	<i>Cortaderia selloana</i>	y	n/a
Parrots feather	<i>Myriophyllum aquaticum</i>		
Phoenix palm	<i>Phoenix canariensis</i>		
Plumeless thistle	<i>Carduus acanthoides</i>	y	n/a
Pokeweed	<i>Phytolacca americana</i>		
Prickly willow weed	<i>Persicaria strigosa</i>		
Purple loosestrife	<i>Lythrum salicaria</i>	y	n/a
Purple nut grass	<i>Cyperus rotundus</i>	y	n/a
Ragwort	<i>Jacobaea vulgaris</i>	y	n/a
Reed canary grass	<i>Phalaris arundinacea</i>		
Reed sweet grass	<i>Glyceria maxima</i>	y	n/a
Rhododendron	<i>Rhododendron ponticum</i>	y	n/a
Royal fern	<i>Osmunda regalis</i>	y	n/a
Rum cherry	<i>Prunus serotina</i>	y	n/a
Sagittaria	<i>Sagittaria species (except S. subulata)</i>	y	n/a
Salt water paspalum	<i>Paspalum vaginatum</i>	y	n/a
Sea spurge	<i>Euphorbia paralias</i>	y	n/a
Selaginella	<i>Selaginella krausiana</i>		
Senegal tea	<i>Gymnocoronis spilanthoides</i>	y	n/a
	<b>COUNT PAGE 3 (ALL CIRCLED Y AND ALL '1's)</b>		

