Ministry for Primary Industries
Manatū Ahu Matua

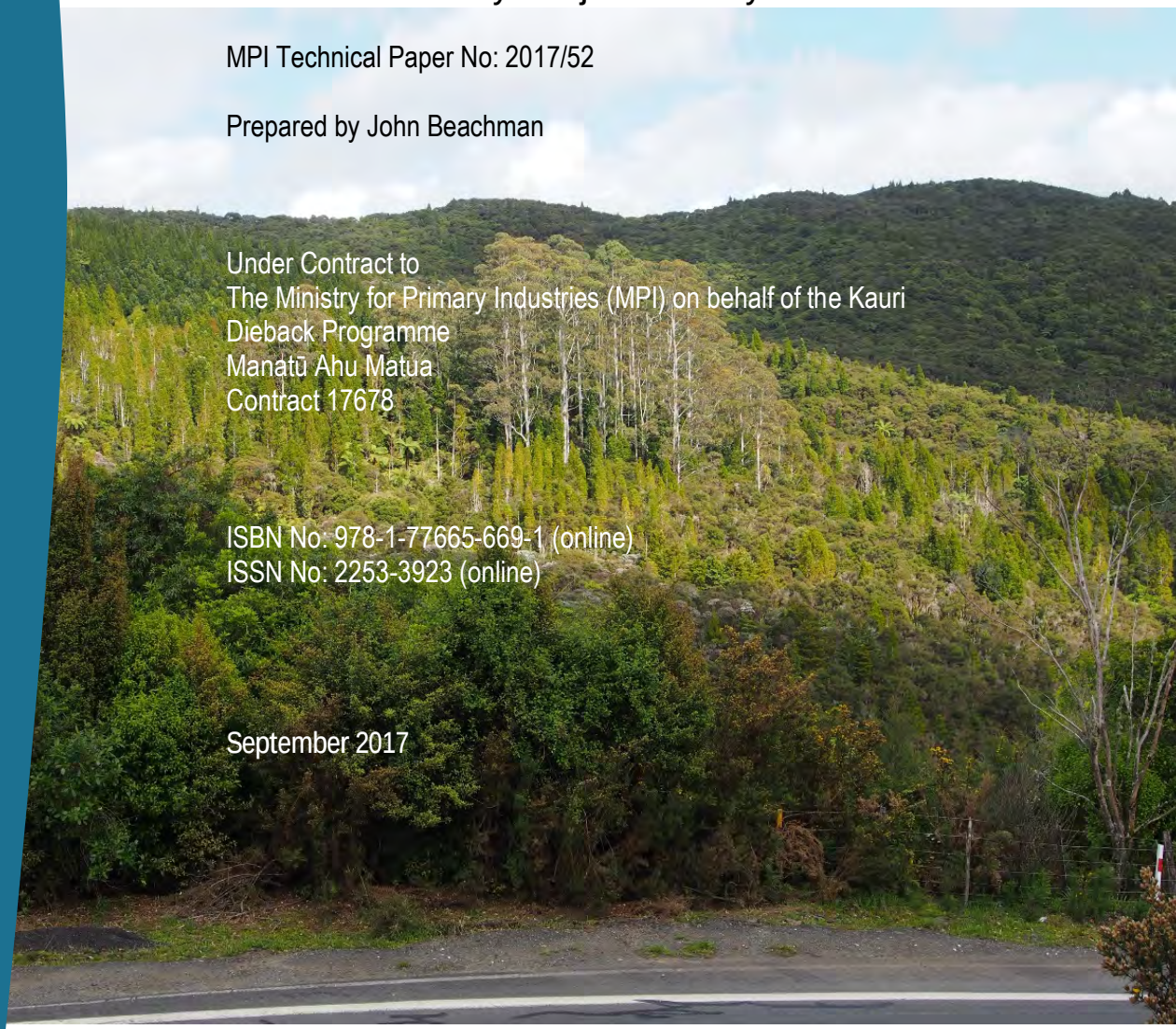
The Introduction and Spread of Kauri Dieback Disease in New Zealand

Did Historic Forestry Operations Play a Role?

A Historical Pathways Project: Forestry

MPI Technical Paper No: 2017/52

Prepared by John Beachman



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Glossary of Terms

Term	Definition
Arboretum	A botanical garden where trees and shrubs are grown
Blanking	Blanking is replanting where the originally planted trees have died
Control plan	The plan under which the sample plot (SP) is proposed and authorised
CRI	Crown Research Institute
DBH	Diameter at breast height
DOC	The Department of Conservation. In 1987, DOC was established and assumed the environmental functions of the NZFS, the NZ Wildlife Service and the Lands and Survey Department. These government agencies were disestablished
DSIR	Department of Scientific and Industrial Research, now no longer in operation
Forester	An NZFS employee responsible for the technical soundness of forest management programmes
Forest Ranger	An NZFS employee with responsibility for implementing forest management programmes
FRI	The Forest Research Institute, an NZFS forest research entity based in Rotorua. Its assets and functions have now been assumed by the Crown Research Institute (CRI) SCION
GBI	Great Barrier Island
HQ	Headquarters
KDP	The Kauri Dieback Programme
LandS	The Department of Lands and Survey
Log scaling	Measuring saw logs to establish their sales volume
NZ	New Zealand
*NZFS	*The New Zealand Forest Service
PA	*Phytophthora agathidicida*. The pathogen that causes kauri dieback disease. Previously had the tag name Phytophthora taxon agathis, or PTA
Production thinning	Selecting trees from within stands and cutting them down, where logs from the felled trees are harvested
Release cutting	The practice of cutting away competing vegetation from planted seedlings to promote their growth and to prevent their suppression
Seed lot number	An NZFS system of cataloguing batches of tree seed by year and geographic source area (conservancy). Also used to define subsequent plantations derived from the seed batch
Silviculture	The cultivation of forest trees, or the management of woodlands to produce timber

SF	State forest
SP	Sample plot. A forest plot established to monitor the performance or response of the plant species being studied. Sometimes called SPA
The Programme	The Kauri Dieback Programme (KDP)
Thinning	The practice of removing trees to favour the growth of the selected residual trees
Thinning to waste	The practice of thinning without recovering any timber from felled trees
TSI	Tree stand improvement/timber stand improvement. The forest management practice of removing competing vegetation to promote faster and better growth of the residual favoured tree, usually a kauri. Competing woody plants were usually ring-barked
Thinning from above	A thinning strategy where dominant or canopy trees are felled
Thinning from below	A thinning strategy where sub-canopy trees are felled
Timber cruising	Measuring merchantable trees for sale purposes. Sometimes simply called cruising
TTT	Tāne's Tree Trust is a non-profit charitable trust focused on encouraging the use of indigenous tree species
Working plan	An NZFS management plan

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Acknowledgements

An enquiry into an aspect of the history of a big influential organisation like the NZ Forest Service allows a focus on important and under acknowledged areas of NZ's development and cultural history.

NZ Forest Service forest stations were set in remote locations and were managed by men who were often very isolated from support. They had the responsibility of managing all aspects of forestry work generated by their stations and also the social responsibility of integrating themselves and their staff into local rural communities. Visits from mangers were infrequent and often these managers had high expectations and autocratic styles.

The main focus of this report has been on the post -World War 2 era especially the 1950's. Three individuals' works have been looked at in some detail. They are;

The late Ron Lloyd who developed kauri silvicultural systems while he was based on Great Barrier Island in the early 1950's. Ron led the Kauri management unit in the 1970's and 1980's.

The late Frank Morrison who led kauri management enquiry at Waipoua Forest from 1950 to the early 1960's. The scale and scope of his work there is very impressive.

The late Joe Levy was based at Waipoua and Kaikohe in the early 1950's. His work in the Waipoua nursery, review of early Waipoua trials, and field work at Omahuta and Raetea provided well recorded information for this report.

I wish to record here my respect and admiration for these three men. I knew Frank Morrison and Ron Lloyd when I worked in Kaikohe in the 1960's. My report could at times be interpreted as criticising their work. I am in no way critical of them. They were not always correct in their judgements but they were required by their circumstances and their managers to make and act on judgements and that is what they did.

There are many former NZ Forest Service staff who provided comment and perspective for this report. I'll mention a few names. Jim Norris, Wally Pita, Don Woodcock, Max Johnston, John Halkett.

Staff in the Archives NZ Mangere facility were very helpful.

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Executive Summary

This contract required "the description of the role New Zealand Forest Service (NZFS) management activities may have (had) in the introduction and spread of *Phytophthora agathidicida* (PA) in New Zealand".

Main Points

1. Despite wide review, the Kauri Dieback Project (hereafter named "the Project" or "KDP") has not identified the pathway that brought PA into New Zealand (NZ).
2. There are four infected kauri plantation sites where PA was (almost certainly) introduced via contaminated seedlings brought to the sites from the Waipoua Forest Nursery.
3. There is a further small, unrecorded amenity plantation at Omahuta Forest, which is infected with PA. Its seedling source has not been identified, but is almost certainly Waipoua Forest Nursery, as no other NZFS nurseries were producing kauri seedlings at that time (mid–late 1950s).
4. Most plantations that used Waipoua Forest Nursery seedlings are not infected with PA.
5. There is no evidence that any PA infection was conveyed to plantation sites via seedlings from Sweetwater Nursery.
6. The numerous establishment trials at Waipoua Forest do not display symptoms of PA.
7. The extensive practice of tree stand improvement (TSI) does not seem to have spread PA or introduced it to new sites.
8. Early kauri logging activities in Waipoua Forest have most likely exacerbated the spread of PA.
9. There is no kauri logging site in any other state forests where PA has been found. But there are some risks at former logging sites, which should be monitored.
10. There is no evidence that extensive engineering works of roading, quarrying and land clearing conveyed PA to any new site.
11. There is very little likelihood that circulations of NZFS staff conveyed PA to new sites.

Introduction of PA to NZ

Phytophthora agathidicida is judged to be a foreign organism. Its effects were first noted in the late 1960s and early 1970s. It was initially misidentified, and its status as a new organism was not clarified until 2008.

Identifying the source of PA was not a central part of this project; rather, kauri dieback's NZ origin was an issue that surfaced from time to time as enquiry uncovered archival material that illuminated questions of its origin.

Possible Introductory Pathway: The Northern Arboretum, Waipoua Forest

The Northern Arboretum project ran from the early 1940s to c. 1952. It proposed an extensive arboretum within Waipoua Forest, housing the world's entire range of species of *Agathis* (kauri),

Araucaria (monkey puzzles) and *Phyllocladus* (celery pines). Seed of many tree species from these three genera was imported and sown at Waipoua Forest Nursery. In a few cases, seedlings were imported and either held in the nursery before being planted at the arboretum site, or were planted there directly. Some significant biosecurity risks were taken.

Close examination of the arboretum site reveals:

- No manifestation of symptoms of PA in NZ kauri on the site
- No surviving foreign *Agathis* (except some *A. robusta*, also free of PA symptoms)

The arboretum site appears to be "clean", and it therefore appears that either PA was never introduced there, or it has faded out.

It is less certain whether PA was introduced to the Waipoua Forest Nursery on the arboretum-bound foreign plant material, thereby infecting the nursery and leading to the consequent later infection of plantation sites that sourced their seedlings from the nursery.

Other Potential Introductory Pathways

It is possible that PA was introduced to Waipoua much earlier than this project was asked to consider. The project has focused on the post-1940s era in its enquiry as to the possible source of the disease. There were some significant disruptions to Waipoua prior to the 1950s, which may have offered the disease a pathway. These are:

- Kauri gum collection. Kauri gum was harvested by itinerant diggers or gathered via direct collection from deliberately bled trees by climbers. In 1908, Dr. Leonard Cockayne expressed disquiet at the activities of the diggers, who operated within the kauri forests and dug gum from the roots of live kauri trees. The climbers moved from tree to tree, cutting notches in the live tree trunks to force the tree to exude gum, which was later collected. Both methods offer multiple disease pathways.

- Dead kauri. Early records refer to the numbers of dead kauri in Waipoua. What killed them? Dead, mature kauri trees often stand for many decades, yet the sites where the old photographic records show dead kauri are clear of them now. It is likely that these dead trees were harvested by the NZFS. There may be merit in further and systematic examination of archived photographs to assess how the distribution of the dead kauri relates to current patterns of PA infection and patterns of NZFS harvesting.

- Waipoua Forest Road (State Highway 12). The road through the forest was constructed in the late 1920s and was opened in 1929. It was a major engineering project that employed large numbers of men and equipment, any one of which could have brought PA to Waipoua. Subsequent road maintenance activity like road grading, slip clearance, spoil dumping, etc. would have further spread PA. Evidence today indicates that the road is an infected artery running through some of the most prime stands of kauri.

- Kauri logging within the Waipoua Forest Sanctuary. Prior to a large part of the old-growth forest being declared a forest sanctuary in 1952, the NZFS had harvested kauri from Waipoua. This activity was quite intense during World War II (WWII), when large quantities were taken "for essential war purposes". Even after this wartime emergency, harvesting of dead and dying trees continued intermittently. Two areas within compartment 55 (just outside the sanctuary) were logged in 1961 and 1962.

  Much of NZ's 1940s and 1950s logging equipment was re-purposed heavy equipment previously used in the Pacific theatre of the war. It is possible that one or more logging venture introduced PA to Waipoua, and it is very likely that the logging activities widened the distribution of PA if it had already found a foothold there.

  Note that a similar scale of wartime logging occurred at Omahuta Forest without leaving a legacy of kauri dieback.

Summary

The Project has found no single defining event that can be labelled the source of PA in NZ. It has reviewed the development of the Northern Arboretum at Waipoua and found no evidence that PA was introduced with the foreign kauri and other tree species central to the arboretum. Note, however, that the Project has failed to prove that the arboretum project was *not* the source of PA.

Waipoua has had a long history of disturbance, experimentation and introductions. It, along with Waitakere, is the most likely introduction site for the disease. But there is no defining evidence of how and when PA arrived at Waipoua. Today, PA's very wide distribution in Waipoua suggests that it has been there a very long time, and that over time, it has been spread by many human-assisted pathways, leading to its current distribution.

Spread of PA

The Project has examined the management activities and practices of the NZFS in an attempt to trace how these activities relate to the current distribution of PA and to provide an indication to current managers about sites where PA might be expected to manifest itself in the future.

Herein, the Project examines various historic management activities on a site-led basis, because this approach allows coherent examination of past forest work, and furthermore, informs current site managers about management history and potential kauri dieback risks, which may be active or latent in various forests.

Below, in brief, is a summary of historic NZFS kauri-associated management practices, a commentary on how significant the activities may have been as PA vectors and a synopsis of current risks at known kauri sites.

- TSI. This was a very widespread silvicultural practice on Great Barrier Island (GBI) and at Russell Forest. It was also practiced in a limited way in coastal shrublands at Waipoua. The practice required gangs of forest workers to traverse the forests and shrublands and to release young kauri from overtopping vegetation. The releasing was usually achieved by felling (but more often ring-barking) the overtopping forest canopy. Canopy species were usually mānuka or kānuka but also included other hardwoods and tree ferns. Tree stand improvement is seen as a possible PA vector because the work covered whole landscapes and was often carried out in wet and muddy conditions.

  The very limited current distribution of PA compared with the very widespread use of TSI on GBI probably indicates that TSI has not exacerbated the occurrence of PA on GBI. However, this is a view based on the absence of PA symptoms in GBI areas known to have been TSI treated. Soil testing for PA presence across a range of TSI sites on GBI could be considered to bring some certainty to this perception.

  Tree stand improvement was also very widely practiced in Russell Forest. The Programme's soil testing of sites within Russell Forest's Punaruku Valley has revealed a wide distribution of PA infection. Infected trees generally display no symptoms of the disease. This absence of kauri dieback symptoms at Russell Forest means that it is not possible to draw any conclusion re the forest's overall distribution of PA based on symptoms. Hence, the visual assessment of former TSI sites, possible on GBI, cannot inform the situation at Russell Forest. Because the Punaruku Valley was subject to a very wide range of forest management practices and experiments, it would be necessary to sample away from that area to be able to judge if TSI has exacerbated the occurrence of PA in Russell Forest. It may be advisable to sample across a wider area of Russell Forest to gain a clearer picture of PA distribution there. When/if this sampling is done, sampling should include some known TSI sites outside the Punaruku Valley as a sampling control.

- Tree seed. It is judged that seed is not a vector of PA. Seed is mentioned here because the system of labelling batches of seed has been useful as an identifier of different batches of seedlings. The NZFS harvested seed annually from kauri trees, mostly in Waipoua Forest. Each batch of seed was given a seed lot number. For example, seed harvested at Waipoua in 1953 was given the seed lot letters/number AK (for Auckland Conservancy), 53 (for 1953, the year it was collected) and 661 (the next seed lot number available and a number unique to that batch, making it seed lot AK 53/661. This system provided each batch of seeds, seedlings and even plantations a unique identifier; seed lot numbers were used in this project to trace batches of seedlings through their subsequent use in plantations and trials in order to trace patterns of PA infection.

- Nursery practices. Virtually all kauri seedlings produced by the NZFS from about 1930–1965 were grown at the Waipoua Forest Nursery. Virtually all kauri seedlings grown from 1968 to the closure of the NZFS in 1987 were grown at Sweetwater Nursery. This project has focussed on the Waipoua Forest Nursery because of its dominance, but also because all known PA-infected plantations were planted with seedlings from 1949–1959, and all of these seedlings came from the Waipoua Nursery.

- Kauri establishment trials. Many of the 1940s and 1950s kauri plantation efforts had an element of trial about them. Generally, formal trials were undertaken via the control plan/sample plot (SP) system. The establishment trails at Omahuta Forest were each of moderate to large scale and robustly set up. They were well mapped and signposted, and are easily identified today. There are no symptoms of kauri dieback in any of them.

  Most other trial work was undertaken at Waipoua Forest, and virtually all of this was led by Forester Frank Morrison. Some of these SPs were large, involving thousands of trees planted on sites of up to 0.8 ha. Others were small (some only five trees) and designed to answer simple questions quickly. This project's success rate at relocating many of these trial plots was variable. Some have been obliterated and over-planted with pines. Others are in remote locations with inadequate information about their whereabouts. Some cannot be found because natural regeneration of kauri is sufficiently advanced to mask the locations of planted trees.

  In the trial plots examined, only one SP (SP 62/2) planted in 1950 displayed PA symptoms. However, this is not to say that other SPs are not infected. Indeed, the Waipoua Forest Nursery-sourced SPs may be carrying PA. These SPs are located across Waipoua Forest from SH 12 through the forest to Kawerua on the coast. Most are recorded as spot locations in the map data because they are below the size needed to derive map polygons.

  Compartment 58 trials. From 1950–1963, Forester Frank Morrison led trial plantings in compartment 58. The project was unable to locate a project plan for these trials. The compartment 58 trials were inserted into a landscape dominated by reasonably advanced, second-growth hardwood forest on the assumption that the better quality soils under this forest type would encourage enhanced growth of kauri seedlings. The compartment 58 trial plantings were quite extensive and employed a very wide range of land preparation and planting techniques, including felling, felling and burning, strip felling and burning, canopy releasing using herbicides, line planting, group planting, planting groups including grafted kauri, fertiliser trials and so on. At the Waipoua Forest Nursery, seedlings being prepared for compartment 58 planting were also subject to extensive experimentation.

  Concern in the KDP has been that many potentially PA-contaminating agendas converged on compartment 58 and that the site might be very infected with kauri dieback. This project's inspection of the site revealed no kauri dieback symptoms. Obviously, the whole sight could not be examined, but the whole compartment was easily observed from the south side of the Waipoua River, and this view revealed no crown symptoms of PA.

  In general, survival of kauri in compartment 58 is low. Surviving kauri trees are growing quite well and will ultimately make up a portion of the forest canopy. Compartment 58 is in a remote location and is seldom visited. Managers considering long-term options for managing compartment 58 may want to formalise this isolation to achieve a degree of quarantine for the area.

- Thinning trials. Thinning trials were started at Herekino Forest (by Forester C. T. Sando, 1936–1937), on GBI (in the 1950s and 1960s) and at Papakauri in Russell Forest in 1963. They are of interest to the Programme because this intrusive practice had the potential to bring infection to the site being treated. A 1958 Forest Research Institute (FRI) thinning trial at GBI (SP 173/3) straddles the large Kaitoki PA site first noted in 1971. It has been postulated that the workers felling the trees for this trial may have introduced the disease to the site. In any case, this trial currently offers the Programme the opportunity to track the spread of PA within a natural stand of kauri.

  The thinning trial in the Papakauri area of Russell Forest (SP 314) was of moderate scale, bulldozers extracting several hundred cubic metres of kauri. However, the site was not assessed as part of this enquiry. In future, the site may require inspection and soil sampling.

- The Herekino trial. This trial (SP A211) is of possible interest to the Programme.

- Kauri logging. This report traverses post-1950 kauri logging in Northland. It and the vector profile and risk assessment identify sites in Herekino, Warawara, Omahuta, Puketi, Waipoua and Russell Forests as potentially infected with PA. It may also be worth perusing pre-1950 logging sites in Waipoua and correlating these NZFS logging sites with early photographic landscape depictions in which the dead tops of mature kauri are visible.

- Forest engineering. This subject is covered in detail in Appendix 8, "Vector Profiles and Risk Assessments". Appendix 8 identifies the activities involved in equipment sharing, the work of the Glenbervie Road maintenance gang, the engineering works associated with land clearing for exotic afforestation and the activity of quarrying as the main areas where transfer of PA may have occurred. The Project uncovered no evidence that any of these activities caused the spread of kauri dieback, however. Nevertheless, the scale and risk of some activities such as land clearing is high, and the risk assessment predicates some follow-up actions.

- Circulation of NZFS staff. This topic is also covered in Appendix 8, "Vector Profiles and Risk Assessments". The risk assessment concluded that the scale of staff circulation was very large, the distribution of PA in former state forests is currently extremely limited, and therefore, staff circulation was an unlikely cause of kauri dieback spread. A collateral conclusion may be that PA is more difficult to spread than previously imagined. Overall, circulation of NZFS staff between sites appears to have offered a low risk of circulating PA.

Summary

- Only the Waipoua Forest Nursery has produced PA-infected seedlings.
- It is likely that only seedling batches dispatched from 1953–1956 carried PA to plantation sites and that only a very few of those batches carried PA.
- There are 20 former state forests where kauri plantations were established.
- There are four plantation sites where trees are currently infected with PA (Raetea, established [est.] 1956–1959), Waipoua (est. 1956), Glenbervie (est. 1949–1955) and GBI (est. 1953).

- There is also one small un-recorded amenity plantation at Omahuta Forest, which is infected with PA.
- Kauri establishment trials were carried out at Omahuta and Waipoua. The Omahuta trials appear PA free.
- One of the Waipoua trials is PA symptomatic, but there is evidence of currently active vectors at this site.
- The compartment 58 trial area in Waipoua is (possibly) free of PA symptoms. This absence of PA is rather extraordinary, considering its era (1950–1963) and the wide range of treatments applied there.
- The thinning trial in Russell Forest (SP 314) should be site checked for PA.
- Former kauri logging sites at several Northland state forests are judged as vulnerable to PA and warrant further monitoring.
- The scale of forest engineering was very large in the past, and there are some PA transfer risks now, especially in land clearing-related activities.
- The circulation of NZFS staff is an unlikely PA vector.

NZFS Forestry Practices on GBI

TSI

Tree or timber stand improvement was a forestry practice that was refined on GBI under the control of Assistant Forester Ron C. Lloyd, who was employed by the NZFS as Officer-in-Charge, Great Barrier Forest from January 1950–1955.

Silviculture of kauri had been practiced on GBI prior to Lloyd's arrival. Diary entries of Ranger Wallace in 1945 refer to "cleaning" of kauri. A 1949 diary note of J. D. Lysaght records a crew under the direction of Paddy McGeady carrying out kauri silviculture in the Whangaparapara area. The annual report for 1949 refers to 15 acres of kauri regeneration being release cut.

However, it was under Lloyd's management that the process was refined and then applied (under Lloyd and succeeding Officers-in-Charge) to most suitable state forest areas on the island. The *Great Barrier Island (GBI) Working Plan* (1965–1975) records a total TSI treatment of 6619 acres (2648 ha) completed in 10 years, 1955–1964. The plan set the platform to continue the programme at the minimum rate of 250 acres (100 ha) per year in the future.

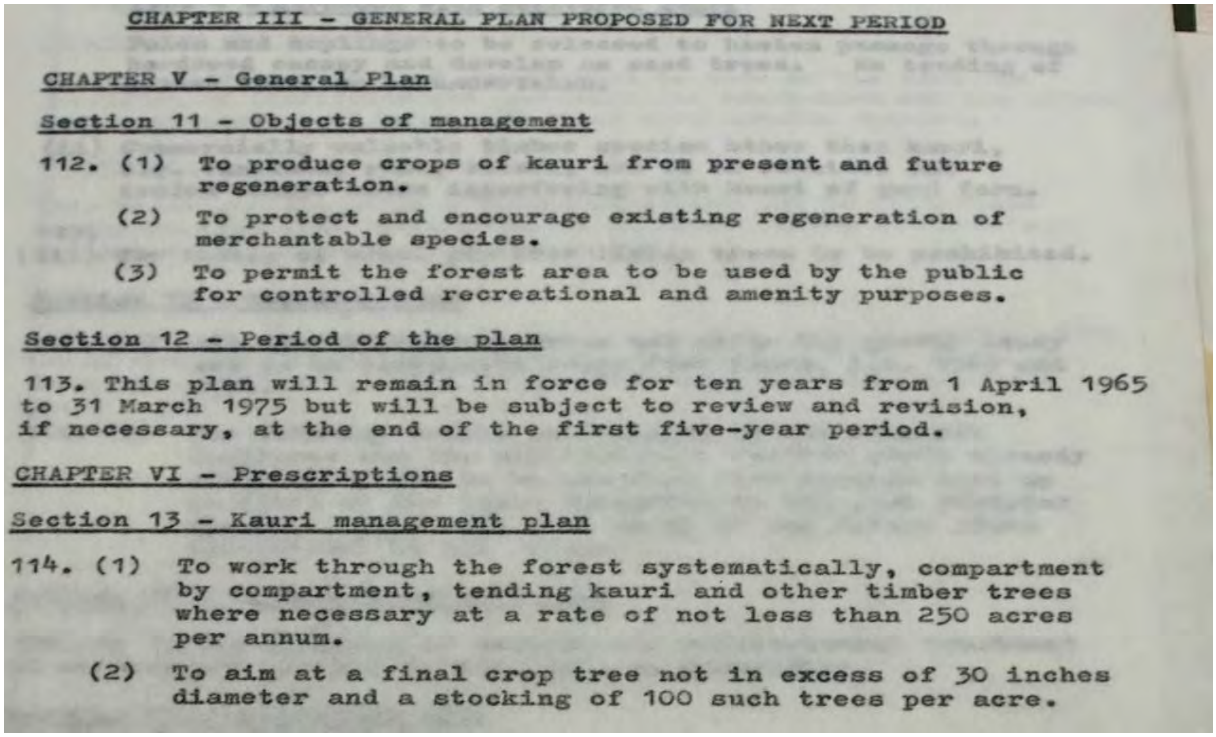
Actual TSI Practices

Tree stand improvement is based on the very simple forestry principal that if you remove competing vegetation from a selected tree, that tree will survive and grow faster. In forestry thinking, faster growth is usually better growth. A further consideration in the application of TSI in NZFS days was the observation that a kauri tree, when endeavouring to pierce the "nursing" canopy of mānuka and kānuka, often has its growing tip damaged or distorted, thereby devaluing the potential saw-log through putting a bend or crook in the trunk. Creating a light well for the kauri to progress through the canopy by ring-barking the canopy vegetation kept the form of the tree true and straight and retained growth momentum.

It is interesting to note that although a considerable investment went into TSI at GBI and Russell Forest, no proof of its effectiveness was ever produced, despite investment in surveys and SPs. Instead, TSI was based on simple, accepted truths as perceived by Foresters:

- Thinning enhances the growth of residual trees.
- Removal or reduction of overhead cover improves growth and form of favoured tree species.
- Kauri forests respond positively to silvicultural manipulation.

The 1965 working plan (Figure 1) describes TSI as follows.



CHAPTER III - GENERAL PLAN PROPOSED FOR NEXT PERIOD

CHAPTER V - General Plan

Section 11 - Objects of management

112. (1) To produce crops of kauri from present and future regeneration.

(2) To protect and encourage existing regeneration of merchantable species.

(3) To permit the forest area to be used by the public for controlled recreational and amenity purposes.

Section 12 - Period of the plan

113. This plan will remain in force for ten years from 1 April 1965 to 31 March 1975 but will be subject to review and revision, if necessary, at the end of the first five-year period.

CHAPTER VI - Prescriptions

Section 13 - Kauri management plan

114. (1) To work through the forest systematically, compartment by compartment, tending kauri and other timber trees where necessary at a rate of not less than 250 acres per annum.

(2) To aim at a final crop tree not in excess of 30 inches diameter and a stocking of 100 such trees per acre.

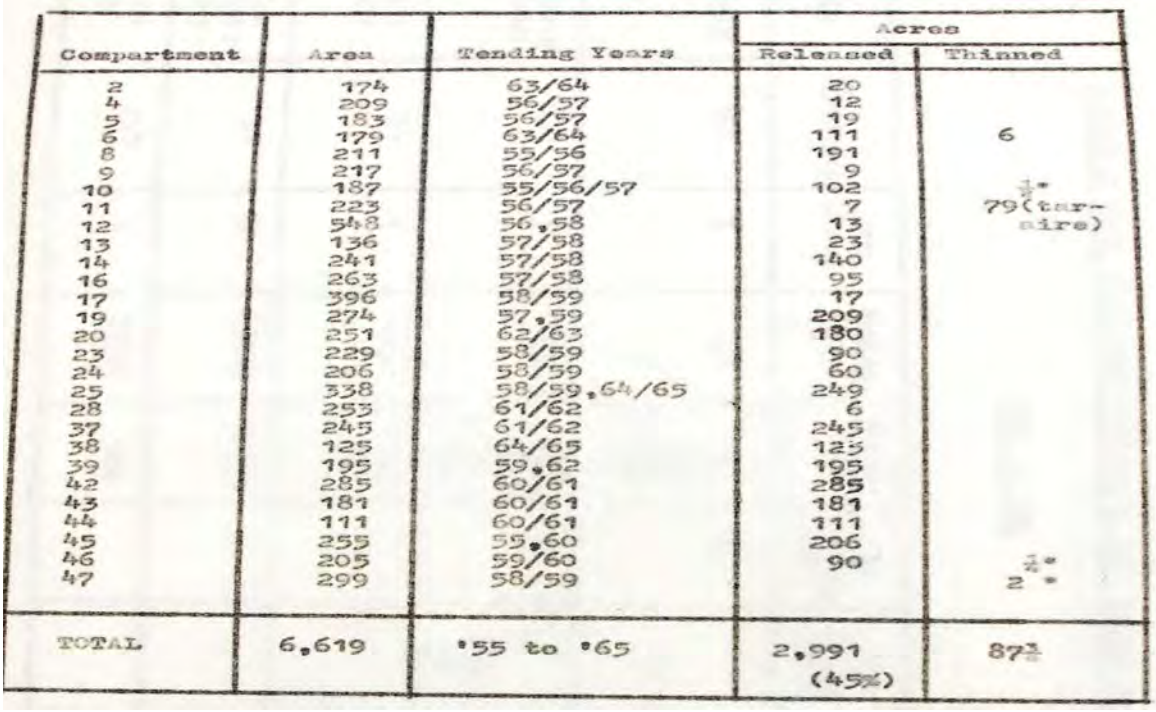
Figure 63. Table on p. 13 of the Great Barrier Island (GBI) Working Plan (1965–1975) describing management objectives and tree stand improvement (TSI) prescriptions.

In practice, forestry workers using modified slasher-like hand tools ring-barked and felled native vegetation that was overtopping the favoured species of merchantable tree, the most favoured tree species being kauri, and the most common overtopping vegetation being kānuka and tree ferns.

Other potentially merchantable native conifers favoured by the TSI prescription were rimu, tōtara, tānekaha, miro and mataī, but these always took second place to kauri. The NSFS workmen became efficient at the TSI task and, apart from the central uplands, most GBI areas of state forest carrying kauri regeneration were treated in this manner.

Schedule of TSI on GBI, 1955–1964

The GBI TSI schedule is shown below in Figure 2, and spanned approximately 10 years.



Compartment	Area	Tending Years	Acres Released	Acres Thinned
2	174	63/64	20	
4	209	56/57	12	
5	183	56/57	19	
6	179	63/64	111	6
8	211	55/56	191	
9	217	56/57	9	
10	187	55/56/57	102	½*
11	223	56/57	7	79 (tar-aire)
12	548	56,58	13	
13	136	57/58	23	
14	241	57/58	140	
16	263	57/58	95	
17	396	58/59	17	
19	274	57,59	209	
20	251	62/63	180	
23	229	58/59	90	
24	206	58/59	60	
25	338	58/59,64/65	249	
28	253	61/62	6	
37	245	61/62	245	
38	125	64/65	125	
39	195	59,62	195	
42	285	60/61	285	
43	181	60/61	181	
44	111	60/61	111	
45	255	59,60	206	
46	205	59/60	90	½*
47	299	58/59		2 *
TOTAL	6,619	'55 to '65	2,991 (45%)	87½

Figure 64. Schedule of tree stand improvement (TSI)-treated areas (1955–1964), taken from p. 19 of the Great Barrier Island (GBI) Working Plan (1965–1975).

The TSI programme continued through to the wind-up of the NZFS on GBI in March 1987. The Department of Conservation (DOC) did not take up this work when it assumed management responsibility for all of the former state forest lands on GBI, viewing manipulation of natural areas for timber production objectives as being out of step with the protection mandate of the Conservation Act (1987).

Kauri Dieback and TSI

Kauri dieback disease (PA) is conveyed from infected to uninfected areas through PA fragments, spores and oospores lodging in soil particles that subsequently "hitch-hike" by various means to new territory. Any movement of soil has the potential to convey PA and spread the infection. There are three infected sites on GBI. One of these (Kaiaraara) was a hub area for NZFS management activity. The other two sites (Upper Kaitoke and Okiwi) are visited infrequently. (The Okiwi site was never state forest and was never managed by NZFS).It is quite easy to postulate that NZFS workers picked up infected material at Kaiaraara on their boots, tools, clothing or vehicles, and conveyed it to the vulnerable kauri forests where they were carrying out TSI silvicultural prescriptions.

Evidence of Transfer of PA

However, there is very little evidence that NZFS workers transferred PA via TSI operations, with one possible exception (see below; penultimate paragraph in this section). In saying this, only physical symptoms were examined in the current project. The disease is found quite consistently in soil tests in non-symptomatic kauri stands at Glenbervie Forest and Punaruku in Russell Forest, so clearly, "no symptoms" does not necessarily mean PA is absent. Great Barrier Island kauri, with the exceptions of trees in the three infected sites, consistently display health and growth consistent with the quality of sites the trees are occupying. Widespread aerial survey and relatively widespread soil testing for PA in

kauri-forested areas on GBI tends to support what the observations of lack of symptoms are indicating — no PA is present.

The ground-truthing of indicative "unthrifty" areas of kauri discovered by aerial survey was carried out by Auckland Council 2 years ago and identified only one new site at approximately E1817743.4 / N5988041.8. This was judged to be an outlier of the Gadgil site in the upper Kaitoke catchment. However, this "new site" was TSI treated in 1958–1959, so it is possible that a transfer of PA material occurred then.

Other than the Gadgil site, all of the formerly TSI-treated kauri stands observed displayed consistently good health. The areas the author observed were in Kaiaraara, Kiwiriki and parts of the Whangaparapara and Kaitoke areas.

Confidence in PA-free Diagnostic on GBI

There has been no formal sampling done within the KDP to provide assurance of the likely PA-free status of areas formerly treated under the TSI prescription on GBI. Healthy trees appear everywhere, as shown in Figure 3 below. Indications within the Punaruku Valley of Russell Forest are that, within a large landscape of formerly TSI-treated, regenerating kauri forest showing no kauri dieback symptoms, PA has appeared in most soil samples. The Punaruku Valley was a hub area for kauri silvicultural activities including TSI. A vector of some type spread the PA across this part of Russell Forest, and although this vector may not have been TSI, the Programme should give consideration to implementing soil testing on GBI in areas known to have been TSI treated. If PA is not found in any of these samples, then the Programme and the public can have some confidence that the superficial "good health" of kauri on GBI is more assured.

Figure 65. Typically sympton-free, apparently healthy tree stand improvement (TSI)-treated kauri stand in compartment 45 adjacent to Forest Road, Whangaparapara end, Great Barrier Island (GBI).

GBI Kauri Plantations

Waipoua Forest Nursery Seedlings

Kauri planting started on GBI in 1949, when seed lot AK 47/533 seedlings from Waipoua Forest Nursery were shipped to GBI and planted in compartment 3. Further batches of Waipoua seedlings arrived as follows:

- 1953 (seed lot AK 50/616, planted in Kaiaraara Valley, 1.8 acres, compartment 5),
- 1954 (seed lot AK 51/640, planted in Kaiaraara Valley, 2.0 acres, compartment 5),
- 1954 (seed lot AK 51/640, planted in Kaiaraara Valley as a trial of 1.0 acre, compartment 5 [not mapped]), and
- 1955 (seed lot AK 51/640, planted in Kiwiriki, compartment 44, approximately 2.0 acres [not mapped]).

PA and GBI Kauri Plantations

Kauri dieback disease (PA) is spread via soil movement, whereby fragments and spores of the PA organism are moved from site to site via their inclusion in soil being transferred. It is very likely that the PA found at Omahuta headquarters (HQ) and at Raetea Forest kauri plantations made its way to these sites with the soil packed around seedlings grown at the Waipoua Forest Nursery. It is therefore also possible that the PA found in the Kaiaraara kauri plantation has its origin in seedlings grown at Waipoua and deployed to GBI. To endeavour to make sense of the current situation re these GBI Waipoua Forest Nursery-sourced plantations, each plantation is described below.

1949 Plantation at Akapoua

Located not far from the old NZFS/DOC HQ at Akapoua Bay, this plantation in compartment 3 is currently described as 0.1 ha. It was originally described as 1 acre (0.4 ha). The seed lot used there was AK 47/533. At the time of the writing of this report, the trees appeared small but were doing reasonably well on a fairly infertile site. There was no sign of kauri dieback in this plantation.

1953 Plantation at Kaiaraara

This was originally described as a 1.8-acre plantation and was assigned the sub-compartment number 8/2. The seed lot used was AK 50/616. Current compartment records describe it as a 0.6-ha plantation in compartment 24. Great Barrier Island compartment layout was reviewed and changed, probably in the 1960s, making the compartment numbering system across all NZFS operations more difficult to follow. All of the individual trees in this plantation have been mapped and measured as part of SP 424, established in 1969. This plantation is quite heavily infected with kauri dieback disease. Interestingly, the kauri trees on the site have grown well despite PA, with many of them are over 40 cm diameter at breast height (DBH).

The plantation sits on alluvial soil in the lower Kaiaraara Valley. The topography is flat. The site is flood-prone, and several flooding events have occurred since it was established. The massive weather event of 2014 caused severe damage in the Kaiaraara and inundated the plantation site with water, silt, rocks, mud and debris. Parts of the plantation were disrupted by the big weather event, and the sheer volume of silt and debris has partially buried some of the tree butts, possibly obscuring any PA symptoms that might have otherwise been visible, such as basal lesions.

1954 Plantation at Kaiaraara

This Kaiaraara planting was originally described as a 2.0-acre plantation in compartment 8 and was assigned the sub-compartment number 8/3. Current compartment records place it in compartment 5. It was sown with seed lot AK 51/640. This plantation has been hugely impacted by the 2014 weather event and it is difficult to estimate how many trees were ripped out in the flood. Debris has piled up to a great depth around many of the trees (Figure 4). Again, as in the 1953 plantation, the bases of the trees are difficult to assess for lesions because of debris. Nevertheless, the author found no dead or symptomatic trees in this plantation. Again, growth of these 1954 plantation kauri has been very strong indeed, with most trees being in the 40 cm DBH class.

This plantation is upstream and on the other bank of the river from the1953 woodlot, which could indicate that the disease has been unable move up and across the river from the PA-positive plantation and into this 1954 plantation. No access is available to soil test information for GBI, but it is probably important in terms of managing PA on GBI to establish whether the 1953 plantation marks the upstream limits of PA in the Kaiaraara Valley.

Figure 66. Flood debris in the 1954 Kaiaraara Valley plantation.

1954 Trial Plantation in Kaiaraara

This trial plantation was planted in 1954 as a 1-acre trial in dense 12 ft. (3.6 m) mānuka. The seed lot used (AK 51/640) was the same as the non-trial plantation described above. It was deliberately not mapped. The only record of the trial is in a 1955 Ron Lloyd entry in the forest register. Not enough information is provided to find its actual location. The precise instruction in the forest register is "not to be touched during period of plan". If the need arises to locate it on the ground, the *Great Barrier Forest Journal Volume 3*, held in Archives NZ, Mangere (Archives reference: AFIU A1683 1124 Box 42 Item reference b) might hold more information re its precise location.

There are a few kauri trees which look to be of plantation origin across the river and downstream of the 1953 plantation described above. These would fit the general location, i.e., Kaiaraara, and given the density of competing vegetation (3.6 m high manuka), the specific instruction not to "touch" them; i.e., no release cutting was permitted. It is likely that only edge trees would have grown well on the site. Of the trees noted during an inspection by the author, none displayed kauri dieback symptoms, although silt and debris were piled up around the lower trunks, potentially obscuring any basal lesions.

1955 Plantation in Kiwiriki

This plantation was planted on an alluvial site in the lower Kiwiriki Valley. The plantation covered 2 acres (0.8 ha), and the trees were planted in 30 ft. (9.0 m) circles, five trees per circle (Figure 5). The seedlings came from four selected Waipoua seed trees (seed lot AK 51/640), and the plantation was laid out to enable each tree to be traced back to its source tree.

The plantation was not placed on the stock maps. Record of it can be found in the 1956 GBI annual report, in some very clear 1955 forest journal (volume 3) entries by Ron Lloyd (one shown in Figure 5 below), including a detailed sketch map and in various file and diary notes.

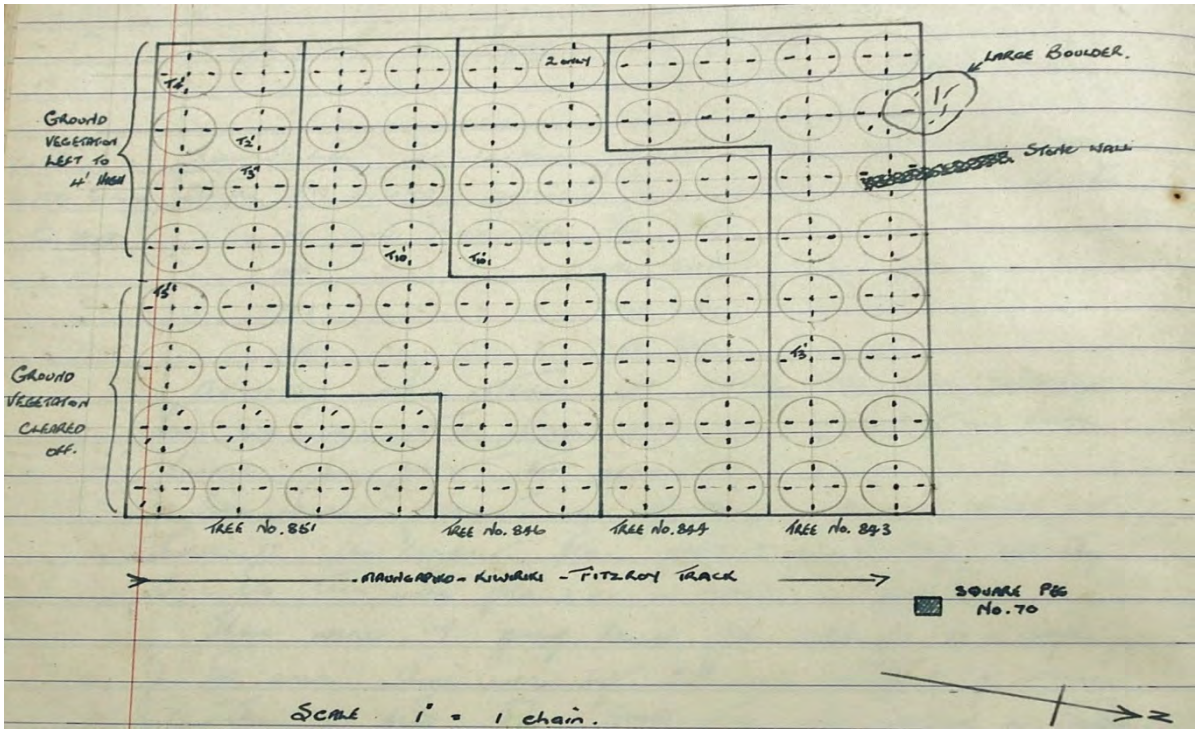


Figure 67. Part entry in the June 1955 GBI forest journal mapping Kiwiriki kauri plantation. Note the handwritten references to the Waipoua Nursery seed trees.

The trees did not grow well, and a 1958 diary note by Forester Malcolm Conway describes survival as 10–20%, which he believed was caused by the wet site and the heavy removal of the kānuka cover, which, in his estimation, had lifted the water table, exacerbating the wetness of the site. This plantation was listed as "failed" in later management documents.

The author visited the site on August 9th, 2016. Failed plantations are of some interest to the KDP, as it is possible that their failure had a pathological cause. The author relocated the stone wall noted in Ron Lloyd's sketch map. It is at grid reference E1812107 / N5990102. It is quite a well-built and well-preserved wall. There is a stone and brick chimney nearby, indicating an old house site. These remnants are worth recording for their historic significance. The author also located the "large boulder" shown on Lloyd's sketch map. It is located at grid reference E1812107 / N5990081.

Kauri on the Site

The Kiwiriki Track runs along the true left bank of the Kiwiriki Stream. The 1955 plantation is to the inland or western side of the track. The track on the plantation edge is close to dead straight. There is some kauri regeneration between the track and the stream, indicating that, as is the case just about everywhere in forested areas on GBI, natural regeneration of kauri is occurring. There are kauri throughout the plantation site, but it is hard to judge what, if any of this, is of plantation origin.

Near the large boulder located at E1812107 / N5990081 is a line of three pole kauri (Figure 6), approximately 10 cm DBH at grid reference E1012108 / N5990064. They are approximately 4 m apart,

which is consistent with the original planting spacing. Their size is small for 61-year-old trees, but it needs to be noted that kauri do not grow well without release cutting in these sub-canopy situations. The author believes these three trees are from the original plantation.

Figure 68. Line of three pole kauri, possibly originating from the 1955 Kiwiriki plantation site.

There are other kauri poles of similar size throughout the site. A few of these are growing in very wet sites and are therefore very unlikely to be natural regeneration. Thus, it is possible that there are a few survivors of the original planting within the plantation site.

PA at Kiwiriki

No symptoms of kauri dieback were found by the author at Kiwiriki. The growth of kauri on and off the plantation site is exactly what would be expected in a sheltered site with low numbers of wild animals and a very long period without site disruption. Soil testing would provide some further assurance that the site is PA free. That is a matter for the Programme to decide on. The site is notably free from disturbance. No domestic livestock are present, and only minor pig sign is visible. The track is free of mud.

Summary

- The 1953 plantation in Kaiaraara is definitely infected with PA.
- The 1954 plantation of 0.8 ha upstream of the 1953 area appears to be uninfected (no visible symptoms).
- The 1954 plantation of 0.4 ha has not been located due to lack of mapped information. An educated guess made by the author at the time of his investigations as to its location indicates that it might also be PA free.

- The 1955 Kiwiriki plantation has mostly failed. The few likely residual plantation trees appear to be free of kauri dieback symptoms. The Programme could consider soil sampling within the plantation site.

Seed Lot Information

The seed lot number for the infected 1953 plantation is AK 50/616. A total of 1200 trees from this seed lot were planted at Waipoua in some of the SPs and trials done by Frank Morrison. The PA status of these SP trees is unknown at the time of the writing of this report. In 1956, 139 of these AK 50/616 trees were planted in a 0.7 ha plantation at Waipoua Forest in compartment 4. This plantation is heavily PA positive. However, trees from other Waipoua-raised seed lots were also planted in this area, i.e., approximately 80 trees from seed lot AK 51/640 and approximately 235 trees from seed lot AK 52/654. Therefore, it is difficult to judge which, if any, of these seedlings brought the infection to the 1956 Waipoua plantation.

In terms of assigning the source of the PA infection in the 1953 GBI plantation, the correlation back to the Waipoua Forest Nursery is also imprecise. It needs to be noted, however, that forest nurseries were dynamic places, with many nursery practices potentially bio-insecure. There could be many pathways to partially infecting part of a batch of seedlings. So the field performance of the same batch of seedlings in different locations may reflect variations in nursery exposure to pathogens within that cohort.

GBI-lifted Wilding Kauri Plantings

Apart from the 1955 Kiwiriki Plantation, from 1955 onwards until the early to mid-1970s, kauri planting on GBI utilised locally lifted wilding kauri; i.e., local, naturally regenerated kauri were dug up and planted in new sites. Some were transplanted directly. Others were held in a bush nursery to harden and acclimatise before being planted out at the destination site. Some sites where these trees were planted were recorded on the stock maps in 1956 and 1957. The 1955 plantings of wildings were not mapped. Most subsequent plantings of wildings (enrichment planting) were not mapped, and often the best clue to their final locations will be an annotation in the relevant forest journal, annual report or station diary. In other words, sites are very hard to find. Also the fact that they were enrichment planted and not subsequently tended indicates that it will now be impossible to differentiate between these planted wilding trees and naturally occurring kauri regeneration.

In general, wilding kauri were planted into areas where natural regeneration of kauri was judged to be absent or poorly stocked. Such areas were often identified during implementation of the TSI silvicultural prescription; supplementary planting with wilding kauri was a natural aspect of managing the whole kauri forest landscape. Wildings were usually planted out in groups rather than line planted. In terms of precise information on wilding planting, the 2 years that were mapped and entered in the compartment records were 1956 and 1957.

1956 Wilding Kauri Plantation

This 2.4-ha plantation lies largely between where the two forks of the Kaiaraara Stream join, i.e., North Branch and South Branch. The area is under heavy kānuka with a few emergent kauri showing above

the canopy. All appear healthy. The author did not have the opportunity to look closely within the stand to judge if the planting pattern is discernible or to check on whether any of the trees are showing kauri dieback symptoms.

The area is worth further checking for kauri dieback as it is possible that PA is absent upstream of the 1953 plantation. If PA is indeed absent in upstream areas, management of the disease vectors on GBI will be simpler.

1957 Kauri Plantation

This plantation, originally described as 0.8 acres (0.3 ha) is now described as 0.1 ha. It is bound to the east and west by a 1980 kauri plantation and to the North by the Kaiaraara Road. It shows up quite clearly on Google Maps and does not appear to reach as far as the flood zone of the Kaiaraara Stream.

The author was unable to locate and inspect it u, so its PA status remains unknown. Again, it is worth field checking for PA symptoms. The plantation is downstream of the infected 1953 Waipoua-sourced plantation and is enfolded within a 1980 Sweetwater seedling-sourced plantation, so consideration of its PA status should be part of a general consideration of the lower Kaiaraara.

Later Plantings

The workplan below (Figure 7) shows part of the GBI picture. Interestingly, there are discrepancies in this workplan schedule in that the 1957 plantation described above is missing, yet it is well documented in the compartment records.

Kauri Kauri Kauri		8 11 11/2	1955 1955 1956	7 7 6.5	Lifted wilding stock planted in groups - enrichment planting.
Kauri Kauri Kahikatea		11 11 11	1961 1961 1961	4	Tubed wilding stock (1959) planted in groups and lines - enrichment planting.
Kauri Kauri Kauri Kauri Kauri		13 18 24 24 45	1963 1963 1963 1964 1963	2 2 1 12 3	Tubed wilding stock (1959) + lifted in groups wildings Tubed wildings in groups Lifted wilding stock in groups.

Figure 69. The 1965–1975 working plan for GBI showing wilding kauris were planted from 1955–1963. Note that the programme of wilding planting continued into the mid-1970s.

Interestingly too, the working plan does not provide a prescription for enrichment planting of kauri. The last record the author has of wilding planting on GBI is 2.8 ha planted in compartment 3 in 1976.

Kauri Dieback in GBI Wilding Plantings

These plantings offer kauri dieback transfer risks at several levels.

- Risk through soil transfer on tools, boots, clothing and vehicles of forest workers carrying out the prescription.
- Risk of transfer of PA in soil from the lifting site to the planting site.

- Risk of transfer of contaminated material occurring in the bush nurseries used to hold and harden the lifted planting stock.

These risks are compounded by the lack of records about lifting sites and the areas planted. Even if the risks are seen as very significant, it is difficult to postulate an adequate management investigation or response. It is probable that the wilding plantings on GBI pose an ongoing latent risk, but it is a risk that cannot be documented with sufficient adequacy to provide management with enough information to provide a response.

Sweetwater Nursery-raised Seedlings on GBI

Waipoua Forest Nursery ceased production in the late 1960s. The main NZFS production of kauri seedlings was taken up at the Sweetwater Nursery, approximately 10 km north of Kaitaia. From 1976–1985, annual NZFS kauri plantings on GBI were carried out using seedlings shipped in from the NZFS nursery at Sweetwater. These plantations were mapped and formally recorded in the GBI compartment register.

Sweetwater plantings total some 113 ha and are in four general locations:

1. Port Fitzroy NZFS/DOC HQ area (77.2 ha)
2. Kaiaraara area (12.5 ha)
3. Whangaparapara (4.6 ha)
4. Claris/Okupu (18.3 ha)

Some of the plantations have been under-planted within exotic forest plantations but most are within the mānuka/kānuka mantle, which forms the forest canopy for much of the island.

Current Condition of Sweetwater Plantations on GBI

These plantations were not given annual or periodic release cutting from competing vegetation from 1987 onwards when DOC assumed management responsibility for former state forest areas on GBI. Consequently, many of the Sweetwater-sourced plantations have been suppressed by competing native vegetation such as mānuka/kānuka, tree ferns, scrub hardwoods, etc. The effects of this absence of management are generally low stocking of kauri and, where kauri is present, growth is very much inhibited. Surviving 36-year-old kauri trees growing on fertile sites in the Kaiaraara Valley, for example, are usually in the 5–10 cm DBH range, with many of these flattened by the recent floods.

Kauri Dieback in Sweetwater Plantations on GBI

No indications of kauri dieback were seen in any of the plantations when they were inspected for the purposes of this report. Some Sweetwater-sourced kauri plantations elsewhere have become infected with kauri dieback, but it is believed that these were cross-infected from nearby older infected areas through cattle, pig and human traffic between the sites.

Recommendations for Sweetwater Plantations on GBI

Staff on GBI should have knowledge of the locations of these plantations and should monitor them for PA symptoms. Maps of all these plantations are contained in records available to the KDP. The most

vulnerable to infection are those in the Kaiaraara Valley around and down-stream of the infected 1955 plantation. Table 1 shows a full list of GBI plantations sourced from Sweetwater.

Table 1 Location and age of Sweetwater Nursery-sourced kauri plantations

Location	Year planted	Hectares (ha)	Total hectares (ha)
Compartment 1	1980	0.8	
	1981	1.5	
	1982	1.0	
	1983	5.1	
	1984	5.1	
Total			13.5 ha
Compartment 2	1978	4.6	
	1979	2.0	
	1979	3.3	
	1980	2.3	
	1981	6.0	
	1982	1.6	
	1984	6.0	
	1985	5.7	
Total			31.5 ha
Compartment 3	1976	3.6 (potentially wildings)	
	1977	9.0	
	1977	5.3	
	1978	3.6	
	1978	0.7	
	1980	2.0	
	1981	0.7	
	1982	7.3	
Total			32.2 ha
Compartment 4	1978	2.2	
Total			2.2 ha
Compartment 5	1980	2.2	
	1980	1.5	
	1980	3.8	
Total			7.5 ha
Compartment 24	1979	2.7	
	1980	0.1	
Total			2.8 ha
Compartment 52	1981	0.3	
	1982	0.9	
	1983	1.5	
	1984	0.8	
	1985	1.1	
Total			4.6 ha
Compartment 66	1979	4.0	
	1979	3.0	
	1980	2.4	
	1980	3.0	
	1981	5.4	
	1983	0.5	
Total			18.3 ha
Grand total			112.6 ha

GBI Bush Nurseries

There are two known nursery sites from the NZFS era of management of Great Barrier State Forest.

Kaiaraara Nursery

This nursery site was situated on the terrace west of the 1953 kauri plantation and inland of the Bush's Beach Track, which at this point in time runs along the left bank of the Kaiaraara Stream. The site has gone back to native vegetation, and there are no residual elements of the nursery. Immediately west of the 1953 plantation there are four clumps of 1956 wilding-origin planted kauri. These show up on the map that accompanies SP 424, which covers the entire 1953 plantation. Presumably, the nursery site lies to the west of these trees. There are records going back to 1949 describing this nursery's early gestation.

Figure 70. Kaiaraara Nursery site to the right of Bush's Beach Track.

Kaiaraara Nursery Practices

Only hearsay information on how the nursery was managed is available today. If lifted wildings were to be held in the nursery, they were placed with soil in metal tubes and so housed in the nursery for the holding or hardening off period, which could be of some months' duration. Note, metal tubes were also used at Waipoua Forest Nursery. There was no water laid on at the nursery, and there were some losses in dry periods. The nursery continued in to be used to hold and on-grow wilding kauri until the mid-1970s, when Sweetwater Nursery stock became available and the Kaiaraara Nursery was no longer needed to support the GBI kauri planting programme.

Risks of PA Transfer from Kaiaraara Nursery

The Kaiaraara Nursery operation offers several risks of possible PA transfer.

- If the nursery site became contaminated with PA, healthy wildings coming in to the nursery could have picked up the disease during their period in the nursery and thereby contaminated a new site when they were planted out.
- The metal tubes were recycled until they rusted out. Unless the nursery had stringent cleaning protocols, the tubes themselves could have harboured and spread PA material from one batch of wildings to another.

- The nursery was most likely a minor hub area for various forest operations. Workers could have possibly picked up PA material on tools, clothing and vehicles, and could have spread it to the parts of the forest where they were operating.

Recommended Actions at Kaiaraara Nursery

The Programme may decide the site needs to be soil sampled. If this decision is made, it would be advisable to get Brownie Walker to advise MPI samplers as to the exact location of the nursery site. The clumps of 1956 wildings between the nursery site and the 1953 plantation should be monitored for PA symptoms from time to time to judge if the disease is moving out of the 1953 site. The 1976 plantations in compartment 3 used wildings. If PA had accumulated in the Kaiaraara Nursery, then it would possibly manifest itself in these plantations. They should be checked for PA symptoms.

Whangaparapara Nursery

The other nursery was at Whangaparapara on the flats down below the DOC house. Stan McGeady told me the details of this site. This nurseries' primary purpose was the growing of exotic seedlings such as *Pinus pinaster* for the early NZFS plantation work on the island. (There are plantations of *P. elliottii* and *P. palustris* on former state forest land at Whangaparapara dating from as early as 1938. It is possible these early plantations were planted by NZFS or a prior agency, but definitive information is not available, and it is unclear if the seedlings for them were grown on GBI or imported from the mainland. The earliest NZFS records for GBI are from 1945.

According to Stan McGeady, the Whangaparapara Nursery only grew exotics. It was never, in McGeady's reckoning, used to hold or on-grow kauri. Kauri planting done from Whangaparapara Nursery involved directly transplanted wildings without giving them a hardening period in the nursery. If this was the case, the Whangaparapara Nursery site is of no interest to the KDP, as there will be no residual risks to the island's kauri from the site. Currently the old nursery site is in rank pasture (Figure 9).

Figure 71. Whangaparapara Nursery site. The site is beyond the fence and to the left of the small, isolated clump of red guava trees showing in the mid-ground.

Sample Plots and Thinning Trials on GBI

Introduction

The NZFS *Working Plan for Great Barrier State Forest 1965–1975* has three management objectives:

1. To produce crops of kauri from present and future regeneration
2. To protect and encourage existing regeneration of merchantable species
3. To permit the forest area to be used by the public for controlled recreation and amenity purposes

Like many management documents, this working plan tended to formalise and legitimise management practices already in place. The first two objectives were squarely at the centre of the silvicultural practice of TSI, which had already been implemented across many thousands of hectares on GBI. The third objective, relating to public recreational usage, recognised and accepted the public's interest in using many of the walking tracks that the NZFS had reopened or developed for management-related access. In terms of providing a technically sound basis for the later logging of the silviculturally treated, mainly kauri regeneration, the NZFS established a series of thinning trials, and in the main, established SPs within these.

GBI Thinning Trials and PA

The first incidence of kauri dieback disease was noted in the upper Kaitoke catchment on GBI in 1971 and was assessed by FRI scientists Doctors Gadgil and Bassett in February 1972. Kew Gardens taxonomists identified the pathogen (which the FRI scientists had isolated) as *Phytophthora heveae*, a

misdiagnosis not corrected until Dr. Ross Beever reviewed the original samples in 2008 and concluded the cause of the disease was a new-to-science *Phytophthora*, which became known as PA.

The considerable area of kauri dieback on GBI is centred at an FRI thinning SP established in 1956 and actually thinned in 1958. The thinning was carried out by GBI NZFS personnel. In terms of speculating on the origins/causes of this original area of kauri dieback, the general consensus has been that the disease arrived there on the clothing, tools or equipment of the forest workers who carried out the thinning and had unknowingly picked up kauri dieback disease fragments while working in the (at that stage) non-symptomatic but PA-infected 1953 kauri plantation at Kaiaraara, and unfortunately, they transferred PA to the Kaitoki site. If this is indeed how the disease got to Kaitoke, then it is prudent to assess whether similar transfers occurred in other thinning works and to establish if there is kauri dieback disease at other thinning trial sites. Where these trials are associated with SPs, very detailed information is available on the locations of the trials and the tree distribution within them.

The author of this report, John Beachman, visited GBI and assessed some of the thinning trial sites. The assessed SPs are as follows.

SP 173/1 on GBI

The author did not visit this site as the location map available at that time did not adequately identify its location. The author scanned the treetops in its vicinity with binoculars and could see only healthy crowns. With newly available, better information as to its location, it can now be found if the opportunity arises. The plot proscription is shown in Table 2 below.

Table 2 Sample plot (SP) 173/1 prescription

Parameter	Assessment
Establishment objective	Thinning of kauri pole stand. Growth response/regeneration
Location	Kaiaraara block
Size (acres)	0.336 ac
Date established	1956. Thinned February 1957
Established by	FRI (Doctors Cameron and Bekhuis)

Abbreviation. FRI, Forest Research Institute.

SP 173/2 on GBI

The author relocated this plot by tracking to coordinates E1816540 / N5488357 towards the Whangaparapara end of Forest Road and found the plot slightly to the east. The plot corners were marked with white-painted, tanalised timber pegs (Figure 10), some of which were scribed with peg numbers showing on the detailed SP plan.

Figure 72. Peg number 2 marking the northeast corner of SP 173/2, Great Barrier Island (GBI).

Sample trees were originally marked with white-painted tree numbers, some of which are still visible (Figure 11). In any case, the plot was a small one (only 26 trees) and the trees are readily identifiable from the detailed SP sheet. The occasional visible tree numbers provided accurate reference points.

Figure 73. Sample plot (SP) 173/2 contains a tree painted with the number 20, Great Barrier Island (GBI). The marking has survived almost 60 years, indicating slow growth of a dominant tree.

The plot was thinned in 1957. Occasionally in thinned kauri stands, remnant stumps will remain alive because their root systems are “captured” by neighbouring, root-grafted kauri. There are no such live kauri stumps in the plot. All traces of the original thinning are gone, and the plot displays a natural look. One or two mossy mounds may mark old stumps.

The author did not find the pegs marking the adjacent control plot. They appeared to be absent at the time of inspection. In general, 173/2 was set on a tough site, and although the growth of the kauri appeared to be slow, the tree condition was as expected at such a site. No traces of kauri dieback symptoms were present. The absence of kauri dieback on this site weakens the case for the SP 173/3

kauri dieback infection being brought about by NSFS workmen carrying out thinning. If transfer occurred at SP 173/3, why did it not occur also at SP 173/2?

Plot information is displayed in Table 3 below.

Table 3 Sample plot (SP) 173/2 on Great Barrier Island (GBI)

Parameter	Assessment
Establishment objective	Thinning of kauri pole stand. Growth response/regeneration
Location	Kaitoki 2 Whangaparapara
Size (acres)	0.140 (thinned plot); 0.047 (control plot)
Date established	1956. Thinned February 1957
Established by	FRI (Cameron and Bekhuis)

Abbreviation. FRI, Forest Research Institute.

Value of SP 173/2

This plot seems very valuable to the KDP, because it can be easily re-measured and used to indicate realistic forest growth; dynamics are also immediately comparable with SP 173/1 at Kaiaraara and the big, infected SP 173/3 in the more remote part of Kaitoki. Both SPs 173/1 and 173/3 are equally well documented.

SP 336/6 on GBI

This plot was easily relocated, as the Mt. Hobson Track cuts across the toe of the ridge it occupies. It appears that the whole of the 7-acre (2.4 ha) ridgetop stand was thinned and set up as an SP. Plot data has yet to be examined, but it may be available at Scion. Trees were individually numbered with aluminium tags affixed to the uphill side of the trees. These were initially attached with copper nails driven into the trunk at about breast height. At some later stage, many of these were removed, and the tree numbering tag looped through a wire holder, which was spiked into the ground at the base of the tree. Some trees also have white-painted numbers on them, although how these relate to the aluminium tag numbers is not known. Details of the prescription for SP 336/6 can be viewed in Table 4 below.

Table 4 Prescription for sample plot (SP) 336/6

Parameter	Assessment
Establishment objective	To determine response of thinning of pole stands
Location	Compartment 6, upper Kaiaraara
Size (acres)	6 (includes a 0.25-acre control)
Date established	1963
Established by	R. C. Lloyd

Thinning in SP 336/6 was initially quite heavy, with canopy trees reduced from 363 per acre to 60 trees per acre. Trevor Cooper, a Kauri Management Unit technician, visited the plot in 1975 and commented that the thinning had been too extreme, with height growth curtailed and many of the trees producing epicormic growth as a result of the sudden light influx arising from the thinning. Currently, the condition of the trees on the ridge appears quite natural, but more open than one would expect of an unmodified

stand. There are patches of very dense kauri regeneration, presumably brought about by the heavy thinning. The author did not walk the whole ridge so cannot comment on its entirety, but on the whole, it looked healthy, with no sign of the epicormic growth commented upon by Trevor Cooper. No sign appeared anywhere of kauri dieback symptoms. A sign within the plot was visible, perhaps marking a control sample area (Figure 12).

Figure 74. Sign within SP 336/6. Great Barrier Island (GBI). This sign may mark the location of the 0.25-acre control, as it was well within the thinned stand.

Value of SP 336/6

This SP is quite large (2.4 ha), and if the data are retrievable and sound, the information may offer the opportunity to study an entire, reasonably accessible natural area. Its modification history may subvert the purity of this opportunity, but there may be wider merit in looking at it alongside the 173/1, 2 and 3 SPs.

SP 332 on GBI

Trevor Cooper described this plot as being established in 1962. The Scion plot sheet records it as established in 1972. The plot sheet describes its purpose as "growth study of naturally established kauri/rimu pole stand (mixture)".The location map is very imprecise. The plot was installed after the large kānuka on the site were ring-barked. Unless the plot data, once recovered, is compelling, the author can see no need for follow-up on this site beyond a quick inspection, as the treatment it received (ring-barking of kānuka) was little different from the standard TSI treatment received on most of GBI's regenerating kauri.

Large Thinning Trial on GBI

The old map below (Figure 13) shows a 16-acre area labelled "Kauri Thinning Area" in compartment 31 in Kiwiriki. The same area has been carried forward onto newer maps, showing the new compartment numbers, where it is listed as being within compartment 48. This is a big trial area. If there is any concern as to possible transfer of PA as an outcome of thinning activity, then this thinning trial area should be visited and checks made for PA symptoms.

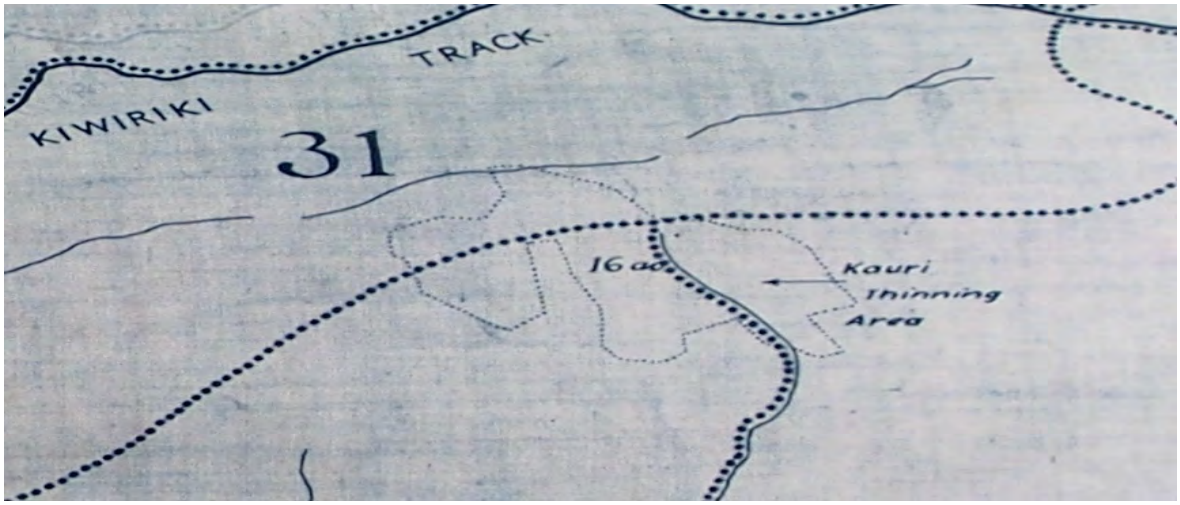


Figure 75. Kauri thinning area in compartment 3 at Kiwiriki, Great Barrier Island (GBI).

SP 173/3 on GBI

This is the original Gadgil PA infection site. It is quite a big plot with three sub-plots: a control where no thinning was done, a sub-plot where light thinning was applied and a third plot where a heavier thinning regime was applied. As in SPs 173/2 and 173/1, these plots are clearly laid out, and individual trees are easily identified today. The author did not visit this plot, as its PA status is already established.

It is recommended that the Programme should review the learning opportunities these FRI plots offer. The review should be untaken with a view to deciding if the plots should be re-measured and their tree numbers refreshed.

NZFS Forestry Practices at Waipoua Forest

Kauri Establishment Trials at Waipoua Forest

This report focuses on the work at Waipoua of Forester Frank Morrison, 1950–1962. Most of his early trial work at Waipoua was within a control plan and SP framework. The large-scale trials he led in compartment 58 from 1955–1961were outside the SP framework, although they were assigned the title SP A431/9 when they were written off by Ron Lloyd in 1972.

Kauri Dieback at Waipoua

The establishment trials are located across Waipoua Forest from the state highway westward through the exotic forest, into the former kauri management and research area, and south to the coast near Kawerua. The trials deployed seedlings from the Waipoua Forest Nursery (also described within this report as Waipoua Nursery) to a large range of sites within the forest. There is an association between Waipoua Nursery kauri seedlings used in the establishment of some plantations and the presence in these plantations of PA. In other words, the disease travelled to these plantation sites with the nursery seedlings. Therefore, it is prudent to:

- identify the sites where trials used nursery seedlings;
- describe, if possible, which seed lot numbers the batches of nursery-raised seedlings carried, as some seed lots seem to pose a greater likelihood of PA transfer;
- assess, if possible, the current condition of surviving kauri in relation to PA symptomology;
- inform managers of the degree of risk these sites pose to further spread of PA.

This report will therefore briefly describe each Waipoua trial/SP and provide information on sites' current condition, if known.

The Trials

Appendix 10 lists all SPs at Waipoua associated with Forester FT Morrison. Frank Morrison presented a 10-page report to the Second Kauri Conference held in Auckland in May 1953 describing the Waipoua trial work. The report is titled *A Summary of Kauri Investigations at Waipoua Forest* (1949–1953) by Assistant Forester FT Morrison. In this report, he describes the trial work within each control plan and signals the interim visual results. He is careful not to jump to any conclusions.

Morrison did not attend the Third Kauri Conference held in Auckland in May 1954. He was based at Kaingaroa Forest at that time. A10-page report titled *Review of Kauri Investigations Waipoua and Omahuta Forests* 1953–1954 *Control Plans A1–A10 (A7 Only at Omahuta)* was written and presented by Assistant Forester J. W. Levy at that third conference. There are further reports to subsequent conferences from both Morrison and Levy, and these provide some information on the establishment and progress of the various Waipoua trials.

General Comment on Trials

Frank Morrison had a tendency to add possibly superfluous complexity to his trial work. Evidence of this can be seen in trial descriptions below. A simple trial was often made more complex through the

addition of an extra layer of testing, such as utility assessments of different planting tools or the testing of whether planter A achieved a higher survival of his planted seedlings than planter B. This tendency looks to have run rampant in the work carried out in compartment 58, where, for example, trees such as red beech from well outside their natural range were planted out with kauri seedlings.

Seed Lot Numbers

Seed lot numbers were not always provided in the early trials. Where they were not provided, the author of this report has made an educated guess as to the seed lot number. If, for example, the archival information indicates that 3-year-old nursery seedlings were used, the seed lot number from 3 years prior to the establishment date of the trial was assigned. The full seed lot records for kauri are held in the Scion archive.

Locations

Where possible, GPS references for plot locations are provided below in the "Trial Descriptions" section. These GPS references are taken from NZTopo Maps (m.nztopomaps.com) satellite views and are educated guesses about location, not accurately pinpointed reference points.

Trial Descriptions: Control Plan A3.

Control plan A3 '(site 1) the artificial establishment of kauri. The layout of this control plan is designed to test the following parameters.

1. Line cut direction and extent
2. Seed bed and lined-out bush house stock
3. The effect of the human factor (two different planters)'

SP A63/1: Compartment 56

This plot was established in 1950. It was approximately 1 acre (0.4 ha) in size. A total of 1056 seedlings were planted from Waipoua Nursery. Seed lot number is not known, but most likely it was AK 46/514. No compartment number was indicated on the SP register sheet, but this location was described on the sheet as "West of Huaki". There is no map in the locality plan. Ken Wright's sketch map of c. 1980 locates this plot at the northern end of the westernmost finger of the Huaki shelterbelt pines planted by Frank Morrison in 1957. Jim Cox's site plan provides great detail of the layout of the plot, but does not key this information to a location plan.

A 1953 report indicates 85%+ survival. There are no further reports on this site. It was relocated by Ken Wright in 1980 and put on his sketch map, but he did not produce a written report, or at least none has been found. Nothing shows up on satellite view in terms of trees on the ground. Note that lines of kauri show up strongly for SP 63/2 in compartment 30, which is a virtual duplicate of SP 63/1. A site visit may find something. Ken Wright's map is the best cue re location. Wright's map centres at approximately E1644914.93 / N6058984.30.

The site was visited by John Beachman (the author) and Laurie Joseph on October 10th, 2016. They walked up the Huaki Track and then walked north along the first line of *P. elliottii* shelterbelt encountered. They came to a squared post approximately 75 mm^2 with the number 1 scribed on it; the

post was close enough to the grid reference indicated for the SP (pictured in Figure 14). This post may refer to SP 63/1, however (note that the nearby SPs 181 and 182 were marked with 3-inch squared, white-painted tōtara posts, so the peg first encountered could be from those plots). No discernible planting lines were visible in this area, perhaps due to the density of natural regeneration of kauri. This regeneration was quite remarkable throughout the area and may have been enhanced by the presence of the *P. elliottii* shelter belts, in that kauri and other native forest regeneration is denser, and individual trees are bigger both around and under the pines.

Figure 76. Marker peg for sample plot (SP) A63/1, approximately 75 mm² at the northern end of the westernmost Huaki shelterbelt (E1644943 / N6058962), Waipoua Forest.

John Beachman (the author) and Laurie Joseph walked west from the north end of the shelter belt in the hope of encountering SP 63/1. This is a very harsh gumland site with only scattered mānuka, *Cyathodes* and *Pimelea*, yet there is quite a good density of kauri regeneration, which declines only in wet areas of dense *Gleichenia* and Wīwī. No trace of SP 63/1 (or 181 or 182) were encountered in this traverse.

Risk of PA Spread

There is no sign of PA on any of the kauri observed. Trees were small and growing slowly. The site was windswept; there were mature kauri producing seed adjacent and regeneration of kauri was continuing to accumulate. Some of the kauri regeneration was carrying seed, so over a long timeframe, a very large area of well-stocked kauri forest will develop.

The main long-term agenda for the land manager at this site (Te Roroa Iwi) in terms of kauri dieback will be to prevent the spread of kauri dieback into this area. The main risk vectors are likely to be pigs and pig hunters, 4WD enthusiasts and marijuana growers. It is a very remote area of little interest to visitors, and the roads are deteriorating, so visitation should always be light.

Control Plan A3 (Site 2) See previous entry for description of purpose.SP A63/2: Compartment 30

This SP was established 1950, and is approximately 1 acre (0.4 ha). Seedlings (1056) came from Waipoua Nursery; seed lot number is not known, but it is most likely AK 46/514. A plot shows on an old

stock map, and the SP is clearly visible in satellite view at E1644356.61 / N6057898.59. Jim Cox's site map provides details if a close analyses is desired.

A 1953 report indicates approximately 90% survival of kauri. In satellite view, the area looks to be very well stocked. This site was not visited due to its remote location and absence of an access track. The plantation is not visible from any viewpoints, but potential viewpoints allowed enough visibility to see that there has been frequent and healthy regeneration of kauri throughout this area. Some of the nearby 1970s kauri plantations looked to be doing well, too.

Risk of PA Spread

This site, although a remote location in heavy scrub, is worth inspecting given the high survival rate of kauri. Why has it survived when its virtual duplicate appears to have faded out? If Te Roroa Rangers are in the area, this site will be worth inspecting.

Trial Descriptions: Control Plan A4

The artificial establishment of kauri was tested in control plan A4. The layout of this experiment was designed to test the following parameters.

1. Kauri planted in open conditions
2. Kauri planted under high mānuka
3. Growth from seed bed and lined out (from bush-house) stock
4. The effect of the human factor (two different planters used)

SP A64: Compartment 14/5

This SP was established in 1950. It was 0.4 acres (0.16 ha) in size. Seedlings were from Waipoua Nursery (224 seedlings). Seedlings were recorded as 1/1 and 2/0, so most likely they were seed lot AK 48/571. Compartment 14/5 is adjacent to the Waipoua River. The locality plan on the register sheet is poor, but J. Cox's map is detailed. Ken Wright has the SP clearly marked on his sketch map. The approximate grid reference is E1645601.08 / N6055877.42.

The survival rates reported in 1953 were approximately 50% in the open and approximately 70% under tea tree. Interestingly, Sandy Rae reported on it as part of his 1972 *Review of Artificial Establishment of Kauri in Compartment 58 Waipoua Forest*. He found quite good survival (41% in the open and 70% in the shade) and good growth (mean height 13.0 ft. in the open and 8.5 ft. in the shade).

The area was inspected on October 21st, 2016 by John Beachman and Laurie Joseph. Trees were growing very well on a small terrace above the Waipoua River and below the Papatea Road (Figure 15). The above GPS reference is adequate for finding the plot. The downstream part of the plantation was the open-planted area, and the tea tree area was upstream. At the time of inspection, the trees were growing very well on what looked to be a fertile site. Stocking was sufficient to allow identification of rows. Tree size ranged up to 46 cm DBH in the open-planted part, and up to 34 cm DBH in the areas planted under tea tree. It was a sheltered spot and the trees were tall at the time of viewing.

Risk of PA Spread

There was no symptom of PA visible in this stand. Trees were healthy and some were growing rapidly. Size range was from 10 cm DBH to 46 cm DBH. The stand was isolated and most likely seldom visited. Pig numbers were low, and there was no cattle sign at the time of inspection. If the management authority (Te Roroa) maintains awareness of the area and monitors its condition every few years, this should be adequate to provide protection from PA.

Figure 77. Sample plot (SP) A64, compartment 15/5, Waipoua Forest. Kauri are planted under tea tree (mānuka). Grid reference: E1645666 / N6055926.

Trial Descriptions: Control Plan A2

The artificial establishment of kauri by various planting techniques was tested in control plan A2. A total of six methods were analysed: normal planting using spade (control); seedlings rolled singly with soil in newspaper; seedlings rolled singly with soil in hessian; seedlings rolled singly with soil in veneers immediately prior to planting; seedlings rolled singly with soil in veneers and lined out for a season prior to planting; and cotyledinous seedlings raised in un-waxed cardboard flower pots.

SP A62/1: Compartment 2

This plot was created in 1950 and again in 1952. It measure 2.2 acres (0.9 ha), and seedling source was not described on the SP registration sheet. However, it is reasonable to assume seed lot was most likely AK 48/571. A total of 4752 seedlings were planted, so it is probable that 2376 seedlings were used in each SP. Exact plot location is not known, but it is somewhere in compartment 2. Ken Wright has not noted it on his 1982 map, despite the plot's large size. He does note on that map that the adjacent plots 68/1 and 68/2 were destroyed. Jim Cox's site map is very accurate but does not tie this particular plot to the wider landscape.

This plot was not inspected, so its current condition is unknown. Given its large size and detailed site map, this plot should be locatable if any of the trees have survived. If an old stock map showing compartment 2 is found, this plot should show on that map. However, it is probable this plot has been obliterated along with the adjacent SPs 68/1 and 68/2. Its general location can be deduced from the

portions of maps available, and there are no kauri plantations in these vicinities. If a more accurate map showing its location is uncovered, then a further field check should be undertaken to assess plot condition.

Risk of PA Spread

This is a big plot whose twin (SP 62/2) has PA-symptomatic trees. It needs to be found and inspected if it exists.

SP 62/2: Compartment 14

This plot was designed in 1950 and 1952. Its total area is 2.2 acres (0.9 ha). Seedling source is not described on any SP registration sheet. Most likely, seed lot AK 48/571 was used to plant 4752 seedlings under this control plan, so about 2376 seedlings were probably used in each SP.

The plot is in compartment 14, adjacent to Road No. 2, which is visible on stock maps. It was marked by Ken Wright on his 1980 map, although he records it as SP 62/5. It lies on the road edge at approximately E1644836.47 / N6055464.51.

This SP was inspected August 23rd with W. Ngakuru, Tony Beauchamp (DOC Technical Advisor) and Te Roroa Rangers Laurie Joseph and Dawn Birch. Quite good survival of planted trees was evident, and some of the white-painted marker pegs were intact. Trees were small for their age. Form was good, but groups of dead kauri trees were seen in at least three locations, possibly killed by PA. The largest group of dead trees was associated with an old marijuana plot (Figure 16).

Figure 78. Sample plot (SP) 62/2, Waipoua Forest, with an abandoned marijuana cage and dead kauris in the foreground (E1644857 / N6055409).

Risk of PA Spread

Tony Beauchamp has recommended the area be sampled to indicate its PA status. In the meantime, the area should be managed as if it was PA positive. It might be an advantage to signpost the area as PA positive as well. Caution should be exercised when adjacent pines are harvested.

Trial Descriptions: Control Plan A5

This trial's aim was the artificial establishment of kauri by various planting techniques. The layout of this experiment was designed to test the following.

1. Cotyledinous seedlings raised in locally made, soil-filled cardboard cones
2. Seeding growth rates for those planted with a spade (i.e., normal planting methodology, the control) versus seedling growth rate for trees planted using a special planting tool (locally made)

SP A65: Compartment 1

This plot was established over 3 years, from 1950–1952, and its total area was 0.5 acres (0.2 ha) upon completion. Seedling source is not known, but trees were probably sourced from seed lot AK 48/571. A total of 594 seedlings were planted under this control plan. The SP is in compartment 1 adjacent to SP A61, not far up the hill above an old NZFS office, at approximately E1650291.66 / N6054116.41.

The presence of planted trees can be confirmed, but the site was not assessed to separate SP A61 from SP A65. There was no sign of PA, and trees were growing well at the time of the inspection. The inspection was carried out on October 21st, 2016 by the author and Ranger Laurie Joseph. There was a general area of plantation kauri but no pegs found identifying the plots. The trickle irrigation soakage field from the camp was spread among the trees. Stocking was quite light, and trees were modest in size (Figure 17). There was no sign of kauri dieback.

Figure 79. Interior of sample plot (SP) 61, Waipoua. Note trickle irrigation of treated sewage from Waipoua camp in centre back of photo.

Risk of PA Spread
No PA symptoms were observed. This SP is very close to the Waipoua HQ village, so it is very exposed to casual ingress.

Trial Description: Control Plan A6

This trial was set up to study the artificial establishment of kauri. This experiment was designed to test the following.

1. The establishment of kauri under untouched forest cover
2. Variations in planting techniques, i.e., normal planting methodology using a spade versus trees planted with a special planting tool (locally made)

SP A66: Compartment 1
This plot was set up in 1950 and 1952. And was only 0.225 acres (0.1 ha). Seed lot number is not known, but a total of 264 seedlings were planted under this control plan. The plot lies in compartment 1. Location is shown on the sketch map on the register sheet. There is no indication of it on the ground, however. Ken Wright's 1982 map lists it as "destroyed". Given that it was a planting trial under undisturbed native bush, it is very unlikely that any of the planted trees would have survived anyway.

Risk of PA Spread
The passage of time and unlikely seedling survival has removed any risk of spread from this site.

Trial Descriptions: Control Plan A1

This control plan was originally set up to assess various fertiliser treatments for seedlings lined out in the nursery. It was extended into the field.

SP A61: Compartment 1
This trial plot was planted out in 1951, and it contained 432 trees planted in 24 lines of 18 trees each, most likely sourced from the Waipoua Nursery seed lot AK 48/571. The area was planted in line-cut mānuka to the south of the HQ dwellings. It is adjacent to SP 65 and is marked on old stock maps (E1650288.01 / N6054157.05).

The site was not closely assessed, but good numbers of well grown, surviving trees were visible on the site when it was inspected on October 21st, 2016 by the author and Ranger Lauri Joseph. The soakage field from the current camp covered part of the plantation plots. Trees were average–small for their age, and stocking was quite light. There was no sign of kauri dieback.

Risk of PA Spread
No PA symptoms were observed, and PA is therefore unlikely to be present.

Trial Descriptions: Control Plan A8

This trial was an experiment to gain information on the establishment and growth of kauri planted under scrub cover (mainly mānuka), which had been treated prior to planting with Weedone® (a Nufarm herbicide product).

SPs A68/1 and A68/2: Compartment 2

These two plots were prepared in 1951, and each measured 0.21 acre (0.1 ha). Seedlings were derived from an unknown seed lot, and 528 trees were planted. The plots could not be found, but are supposed to be in compartment 2, immediately adjacent to SP 62/1. Ken Wright's 1982 map lists SP 68 as "destroyed".

Risk of PA Spread

There is low-to-zero risk of PA spreading from this area, given that a great deal of time has elapsed since plot destruction.

Trial Descriptions: Control Plan A9

This was an experiment to gain information on the survival and growth of red-leafed and green-leafed kauri following their artificial establishment, and to gain information on the establishment of large-sized planting stock (2/2) under untouched scrub cover (mainly mānuka).

SP A181: Compartment 56

This plot was organised in 1951 (this establishment date does not make sense, however, given that in 1948 sown 2/2 seedlings were planted out). Size is not stated in the records. Seedlings are described as Waipoua Nursery 2/2 seedlings, which would indicate seed lot AK 48/571 as their likely source. The plot is located in compartment 56, but no detailed description is provided and no sketch map, either. Ken Wright, in his 1982 map, has located SP 181 near the (also missing) SP 63/1, adjacent to the shelter belts planted by Frank Morrison in the Huaki area in 1957 (E1644789.67 / N6058809.84). Current condition is not known. Survivals in 1953 were 90%+. The plot does not appear in a satellite view of the site sketched by Ken Wright. The site was visited on October 21st, 2016 by the author and Ranger Laurie Joseph, but the plot was not located. There was quite dense kauri regeneration in this area at the time, which made it very difficult to identify plantation trees.

Risk of PA Spread

Inspection revealed no indications of PA presence. The area is remote and infrequently visited. It is more a matter of having measures in place to protect this area from kauri dieback than perceiving it as a source of risk for other kauri stands.

Trial Description: Control Plan A10

This control plan was an experiment to compare growth and survival of 2/0 seed stock treated in two ways in the nursery (1952).

1. Seed stock was rolled singly in hessian.
2. Seed stock was puddled and packed in soil-filled boxes of 50 seedlings each.

SP A182: Compartment 56

This plot was set up in 1952 and is approximately 0.24 acres (0.1 ha). It is planted out with Waipoua Nursery seedlings (264), which are described as 2/0, or seed lot AK 50/616. The plot is in the Huaki area, compartment 56 (E1644789.67 / N6058809.84). A sketch map on the SP register sheet shows its location. Ken Wright's 1982 map shows the plot as north of the Huaki Track. The register sheet shows it south of the Huaki Track. However, it looks as if the Huaki Track has been realigned since, so Ken Wright's map is probably reliable. The plot's current condition is not known. The site was visited on

October 21st, 2016 by the author and Ranger Laurie Joseph, but the plot was not located. There was quite dense kauri regeneration in this area, which made the identification of plantation trees very difficult.

Risk of PA Spread

This plot needs to be located to assess condition and risk. It was marked with white-painted 75 mm square tōtara posts, which may still exist. Seed lot AK 50/616, used in this plot, was also the cohort used to establish the 1953 PA-positive plantation on GBI. The area is remote and infrequently visited, however, so it might be worth having measures in place to protect this area from kauri dieback, rather than perceiving it as a risk area for other stands of kauri.

Trial Descriptions: Control Plan A12/2/1

This control plan is not described in any material available to date. The whole control plan of seven SPs is described as a kauri fertiliser trial in the site plan.

SP A209/1: Compartment 1

This plot was set up to investigate the effects of various fertilisers on the growth and survival of planted kauri. Block one was open-planted. It was established in established 1956 and re-established in 1957, and was 0.067acres. A total of 80 trees were planted in five sub-plots of 16 trees each with seed lot AK 53/661. The site is located in compartment 1, but could not be found.

Risk of PA Spread

It may be worth some effort to relocate, as cohorts in compartment 4 (SPs 209/3 and 209/4) are PA positive.

SP A209/2: Compartment 1

The idea behind this plot was to investigate the effects of various fertilisers on the growth and survival of planted kauri. Block II was open-planted in crushed mānuka. This plot was put in in 1956 and re-established in 1957. Total size is 0.067 acres, and the plot contains 80 trees planted in five sub-plots of 16 trees each using seed lot AK 53/661. The site was not defined and could not therefore be found.

Risk of PA Spread

It may be worth some effort to relocate this plot, because cohorts in compartment 4 (SPs 209/3 and 209/4) are PA positive.

SP A209/3: Compartment 4

The NZFS aim was to investigate the effects of various fertilisers on the growth and survival of planted kauri. Block III was open-planted. This plot was constructed in 1956 and re-established in 1957, and today measures 0.067 acres; it was planted with 80 trees laid out in five sub-plots of 16 trees each. The seed lot used was AK 53/661. The plot is PA-positive and stands on a road edge (E1647919.37 / N6054540.45), the generic location of the stand, not the exact plot location. There were several different seed lots planted in this stand, so it is not necessarily AK 53/661 seedlings that brought the infection to this area.

Risk of PA Spread
This plot is close to the road edge and logging traffic. Its infected status is well known locally. The recommendation is to remain alert to PA appearing in other plantations where seed lot AK 53/661 was used.

SP A209/4: Compartment 4
This plot (0.067 acres) was also set up to investigate the effects of various fertilisers on the growth and survival of planted kauri. Block IV was open-planted in 1956 and re-established in 1957 with 80 trees planted in sub-plots of 16 trees each (seed lot AK 53/661). It is located in compartment 4 and is a PA-positive stand on the road edge (E1647919.37 / N6054540.45; generic location of stand, not plot location). There have been several different seed lots planted in this stand, so it is not necessarily AK 53/661 seedlings that brought the PA infection to the area.

Risk of PA Spread
This plot is close to the road edge and logging traffic. Its infected status is well known locally. The recommendation is to remain alert to PA appearing in other plantations where the seed lot AK 53/661 was used.

SP A209/5: Compartment 58
This plot (0.067 acres) was set up to investigate the effects of various fertilisers on the growth and survival of planted kauri. Block V was indigenous forest and was planted in 1956 and re-established in 1957 with 80 trees planted in five sub-plots of 16 trees each (seed lot AK 53/661). This SP is most likely located in area Q on the compartment 58 map (the 1956 plantation of 5 acres on the old stock map). The 1956 planting in this plot failed and it was replanted with seed lot AK 53/661 seedlings in 1957. Its current condition remains unknown at the time of the writing of this report.

Risk of PA Spread
It may be worth some effort to relocate this plot, as cohorts in compartment 4 (SPs 209/3 and 209/4) are PA positive.

SP A209/6: Compartment 58
This plot (0.067 acres) was set up to investigate the effects of various fertilisers on the growth and survival of planted kauri, as were many others. Block VI was indigenous forest and was planted in 1956 with 80 trees planted in five sub-plots of 16 trees each (seed lot AK 53/661, 40 trees; and seed lot AK 51/640, 40 trees). This SP is most likely located in area Q on the compartment 58 key map (the 1956 plantation of 5 acres on the old stock map). Its current condition remains unknown.

Risk of PA Spread
It may be worth some effort to relocate this plot, as cohorts in compartment 4 (SPs 209/3 and 209/4) are PA positive.

SP A209/7: Compartment 58
This plot (0.067 acres) was set up to investigate the effects of various fertilisers on the growth and survival of planted kauri, as were other blocks in this compartment. Block V was indigenous forest and was planted in 1957 and re-established in 1957 with 80 trees planted in five sub-plots of 16 trees each (seed lot AK 53/661). This plot is most likely located in area N on the compartment 58 key map. The

stock map shows two areas of plantation, a 2.5-acre plantation installed in 1957 and to its west, another 2.5-acre plantation established in 1958. However, reading Frank Morrison's description of these plantings, it appears that, due to a shortage of seedlings that year, the whole area was planted at a wide spacing in 1957, and then the gaps were filled in 1958 as more seedlings became available. Current condition is not known. But it is likely that the author visited part of area N during an August 2016 inspection of compartment 58. Kauri were sparsely stocked at the time of the inspection, but those surviving were growing well.

Risk of PA Spread
It may be worth some effort to relocate this plot, as cohorts in compartment 4 (SPs 209/3 and 209/4) are PA positive.

Trial Descriptions: Control Plan A18

This control plan was not found. The three SPs all shared the same objectives, i.e., to find out if kauri could be successfully planted in sandy country near the western coastline.

SP 214/1: Compartment Unknown
This plot was established in 1958, and consisted of five trees (seed lot AK 55/698) planted in deep pits. The plot can be found in *P. pinaster* near Kawerua. As of 1973, all kauri were dead.

Risk of PA Spread
There is no risk of PA spread from this plot.

SP 214/2: Compartment Unknown
This plot was established in 1958 (E1641304.07 / N6056372.75) and consisted of seven trees (seed lot AK 55/698). The plot was planted in mānuka on the edge of a 1950 *P. elliottii* stand. As of 1973, four kauri were alive. A good site map can be found on the register sheet. Current condition is not known.

Risk of PA Spread
It is worth finding this plot and checking the PA status of any surviving trees.

SP 214/3: Compartment Unknown
This plot was established in 1958 and consisted of eight trees (seed lot AK 55/698) planted in deep pits. The plot was planted in *P. pinaster* south of Kawerua paddocks. As of 1973, all kauri were dead.

Risk of PA Spread
There is no risk of PA spread from this plot.

Trial Descriptions: Control Plan A19

A control plan descriptor was not found. The objectives listed on the SP register sheet were as follows:

1. To find out the effect on kauri survival and growth of deeply dug planting pits, which were prepared approximately a year before planting
2. To compare the survival and growth of tubed and open-rooted kauri stock

SP 215: Compartment Unknown
This plot was set up in 1958, and its size appears to be approximately 30 m x 20 m according to a scaled site map on the register sheet. A total of 55 trees from seed lot AK 55/698 were planted at

spacing's of 6 ft. x 6 ft. (1.8 m by 1.8 m). The plot is located on the river bank north of the present-day Waipoua camp (E1649911.44 / N6054637.30). The plot was inspected on October 11th, 2016. The site appeared to have been completely cleared, and was a riverside picnic area associated with the camp at the time of inspection with no residual kauri surviving.

Risk of PA Spread
There is no risk of PA spread from this plot.

Trial Descriptions: Control Plan A20

This control plan was not found. Objectives listed on the register sheet were to compare growth and survival of planted kauri with an obvious taproot at the time of planting versus kauri treated as under current practices, i.e., not selected on the basis of having a taproot.

SP A216: Compartment Unknown
This plot was set up in 1958 in Puketurehu, and it comprised 20 trees planted from seed lot AK 54/681. A detailed survey plan appears in records, but its current condition is not known. Enough survey data exists to enable relocation, but finding it would take some effort.

Risk of PA Spread
Puketurehu is quite infected with PA, so this small plantation probably does not add measurably to risk of spread.

Trial Descriptions: Control Plan A21

This control plan was not found. Objectives listed on the register sheet were:

1. To find out if the physical conditions of the soil itself, rather than nutrient content, were responsible for superior kauri growth
2. To find out information on various methods of raising kauri in the nursery
3. To find out if kauri could be successfully planted as 2-year-old stock

SP 217/1: Compartment 41
This plot was set up in 1958 and consisted of 50 trees from seed lot (2/0) AK 55/698. No map exists to show this compartment. There is little clue as to this plot's location except a reference to Pawakatutu Trig east–west grid line and the fact that the survey line follows a *P. elliottii* shelter belt. The plot's current condition remains unknown, because the plot cannot be found without further information as to its location. Given the prolific kauri regeneration in the western former heathlands of Waipoua, it is likely that it will be difficult to discern the planted trees from regeneration.

Risk of PA Spread
This tiny plot lies in a remote location. Risk of spread cannot be assessed without locating it.

SP A217/2: Compartment Unknown
This very small plot was set up in 1958 and was made up of 40 trees from seed lot AK 56/716. It is located on the road edge of State Highway 12. It is easy to find the site, as there is a good map on the SP register sheet. The plot is shown on Ken Wright's 1982 map (E1650957.51 / N6054727.59). Viewed from the road edge, the area is densely vegetated with some kauri, possibly of plantation origin.

Risk of PA Spread

This plot is in an area where kauri dieback is well established. It is therefore worth assessing to see if any identifiable planted trees remain and to assess their PA status.

Trial Descriptions: Control Plan A22

This control plan was not found. Objectives listed on the register sheet were to assess five items:

1. Information on various methods of raising kauri in the nursery
2. If kauri can be planted successfully as 2-year-old stock
3. If light, sandy soil has any benefit on kauri survival and growth
4. If molybdenic, serpentine superphosphate has any effect on kauri survival and growth
5. The reactions of planted kauri to variations in light intensity

SP 218: Compartment Unknown

This small plot was set up in 1958 and carried 40 trees from seed lot 2/0 AK 57/716 planted 12 ft. x 12 ft. (3.6 m x 3.6 m) in sub-lots of 10 trees each. The map on the register sheet is misleading in that what it labels as Waipoua River is actually the Waipoua River Road. The SP is under or beside a large hardened area at the junction of Waipoua River Road and Katui Road (E1647382.70 / N6053982.51). There were reasonable numbers of live trees in 1972 when the SP was the topic of correspondence between Waipoua HQ and Ron Lloyd. It was abandoned in 1976, so it was likely planted over with pines. This SP was inspected by the author and Ranger Laurie Joseph on October 21, 2016. No trace of kauri remained. All that could be found was *P. radiata*.

Risk of PA Spread

There are no kauri, so there is no risk of spread from this area. The SP was converted to pines many years ago.

Trial Descriptions: Control Plan A23

The control plan was not found. The SP 219 register sheet describes plan objectives as follows, which were to study:

1. The effect of deep-planting pits on the growth and survival of planted kauri
2. The effect of certain fertilisers on growth and survival
3. The effect of applying fertiliser to deep pits
4. The effects of the incorporation of kauri litter (“pukahu” or “bookow”) in planting sites

SP 219: Compartment 1

This plot was set up in 1958, and its size appears to be approximately 0.197 acres. Seedlings from seed lot AK 55/648 were planted at spacing’s of 8 ft. x 8 ft. (2.4 m x 2.4 m). The SP is immediately above the road, not far from the Waipoua Visitor Centre (E1650251.48 / N6054397.05). The survey plan on the register sheet is accurate and the SP stands on up-hill side of the road. Note that the stock map shows this as A22.

Surviving kauri are mostly at the bottom of the plot adjacent to the small stream (Figure 18). Growth is quite good. Sizes range from 10 cm DBH to 45 cm DBH. The stand was damaged when adjacent exotic conifers and eucalypts were felled. One large dead kauri near the creek appears to have had its top knocked out. Trees are generally in good health.

Figure 80. Sample plot (SP) 219, control plan A23. This photo has been taken from near the creek (E1650285 / N6054393), Waipoua Forest. Kauri were planted here in 1958.

Risk of PA Spread

The stand appears to be PA free. It is very close to visitor hubs and residents, so protective measures operating around the site should apply.

Trial Descriptions: Control Plan A24

SP 220: Compartment 1

This very small SP (20 m x 14 m) was established in 1958, with seedlings planted in six pits. Seedling source is not stated. As they were cotyledinous, they were likely seed lot AK 58/769. This plot is immediately adjacent to SP 219 (E1650249.96 / N6054385.93). The site was inspected October 11th, 2016. It was very unlikely that anything would have survived from this trial, and this has proved to be the case. There is no surviving evidence of this trial.

Risk of PA Spread

There is no risk of PA spread from this plot.

Compartment 58 Trials

Trial Description: Unknown Control Plan

No control plan for the trial work carried out under Frank Morrison's supervision in compartment 58, Waipoua Forest, was evident at the time of the writing of this report. Under the section "Kauri Research and Investigations", contained in his annual report for 1955–1956, Morrison explained the move to compartment 58 as follows:

"A broadleaf area has been selected for kauri planting trials at Waipoua Forest for these reasons:

1. It appears that the area has not carried kauri for a long period; indeed, it is possible that the area never carried kauri at any stage.
2. The soil type is a medium clay, probably derived from a basaltic or andesitic origin. The soil should have received a benefit from the mull-type of leaf litter. There is no sign of any podzolisation.
3. The planted trees are not exposed to the prevailing westerly winds."

In 1955, the then Director General of the NZFS, Alex R. Entrican, had issued a policy directive that kauri plantings were to be significantly increased, and foresters were scoping out suitable land areas. If Frank Morrison's plan to convert relatively unproductive hardwood areas for kauri plantations worked well, there were many such areas available within northern state forests.

The trials were extensive and covered several years. An explanatory map and key were developed covering the whole trial area. In terms of archival records that have been curated (e.g. kauri conferences records, annual reports), some significant information gaps exist. For example, in the 2 (important) years in the development of the compartment 58 trials, 1957 and 1958, Frank Morrison's annual reports are inexplicably missing from the records. References to these reports exist, but not the reports themselves.

SP Numbers

In terms of the SP records, Ron Lloyd assigned the number SP A431/9 to all of the compartment 58 trials when he was writing off the trials in 1972.

Purpose of the Compartment 58 Trials

Objectives for these trials are not cohesively stated in one document. However, it is apparent throughout all the kauri works carried out by the NZFS that there was an underlying dissatisfaction among professional foresters with the growth rates kauri were showing on the various sites where NZFS was applying efforts to manage kauri as a crop species. This dissatisfaction with natural growth rates underlies the TSI silvicultural work done in Great Barrier Forest and Russell Forest. The idea of TSI was that if competing vegetation could be removed, the trees would grow faster and their form would be better, the actual areas growing kauri would be extended, greater and better annual increments of wood would be produced, and overall, the forests would achieve a greater wood production performance.

In the late 1940s and early 1950s, Morrison had carried out quite extensive establishment trial work in the gumlands to the west of the main body of Waipoua Forest. Most of the control plans and SPs had the stated purpose of getting kauri to grow faster. Faster growth meant less years of expensive release cutting the competing vegetation from around seedling kauri and, ultimately, more wood produced in less time. Generally, these trials produced quite good survival rates, but on the gumlands, growth itself was slow. The quality of the soil itself was judged to be the growth inhibiting factor. Foresters such as Morrison, Levy and Lloyd had the view (supported by Department of Scientific and Industrial Research (DSIR) Soil Bureau and senior NZFS managers), that on some of the poorer gumland soils, which had been heavily modified and podzolised through growing successive generations of kauri, the soil was "played out" and would not be able to sustain further generations of kauri forest. It was time to take a bold new approach.

Looking around Waipoua for a site with more suitable soils, Morrison was attracted to the compartment 58 land to the north of the Waipoua River, where soils of a younger and "better" structure were carrying young hardwood forest with species such as taraire, kohekohe and pūriri, as well as some areas of kānuka and mānuka. He focussed his efforts on this landscape, beginning in 1955. He was quite prepared to use technologies current in exotic forest management. These included felling, crushing and burning the current cover of native vegetation, use of chemical weedicides, introducing exotic species as companion plants, using grafted seedlings with grafts from "superior" kauri trees and applying a wide range of fertilisers to boost growth.

The Compartment 58 Trials

In total, there were 21 trials where artificial establishment of kauri was the main thrust. There were two trials where manipulation of natural regeneration was the dominant objective. The trials do not fit the workplan/SP analysis model. The trials from 1955–1962 were mapped and coded on an undated Auckland Conservancy map labelled 18/82.This plan can be found below (Figure 19). That map was used as a key when Forester Sandy Rae carried out field inspections in 1972 and wrote up what he found. His work is titled *Review of Artificial Establishment of Kauri (AGATHIS AUSTRALIS) In CPT 58 Waipoua Forest.* His report was completed in December 1972.

The trials were partially inspected by Tony Beauchamp, Will Ngakuru, Te Roroa Rangers Dawn Birch and Laurie Joseph, and the author on August 23rd, 2016.

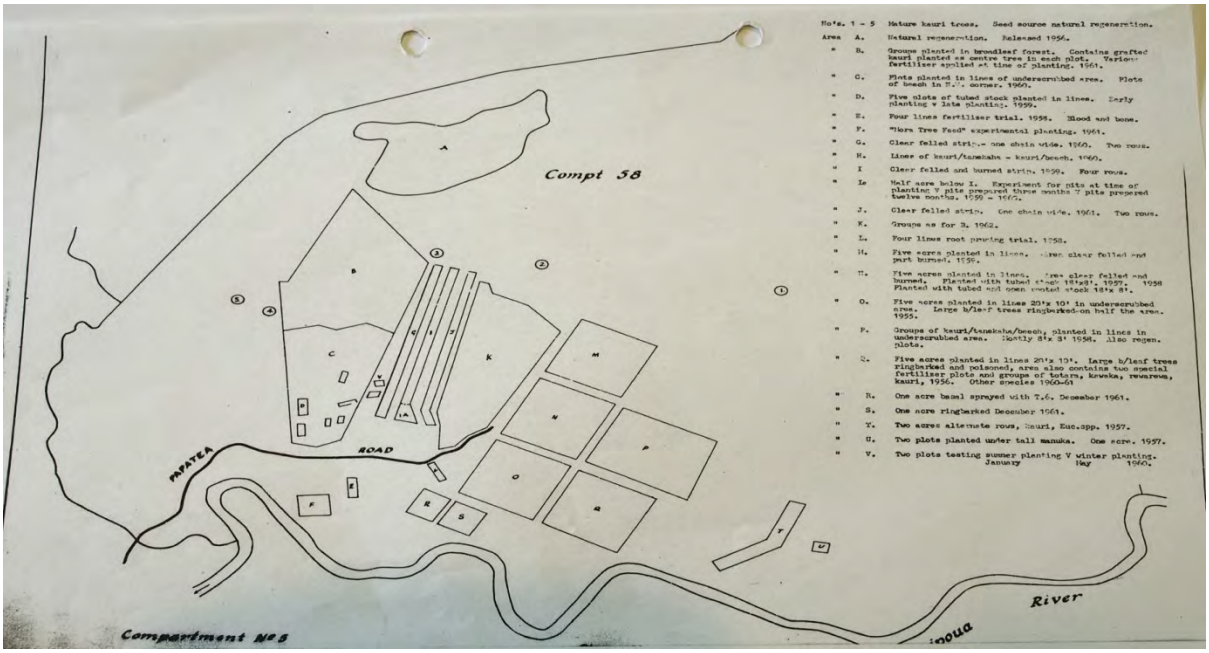


Figure 81. Key map and management information about compartment 58, Waipoua Forest.

The information in the sections below explains the intention of the trial, any relevant supporting information gleaned from the archival records such as seed lot numbers, contemporary comment and survival surveys, a summary of what Sandy Rae found in 1972 and any additional perspective gleaned from the field visit. The map above (Figure 19) and Table 5 below (are essential keys for understanding compartment 58 discussion and Figure 19.

Index to the Trials from the Key Map

Kauri trials based on key map information are summarised in Table 5.

Table 5
Kauri trials in compartment 58, Waipoua Forest

Area by alphabetical code	Description of area	Year established	Area size (ac)
A	Natural regeneration released	1956	Unknown
B	Groups planted in broadleaf forest. Contains grafted kauri as centre trees in each plot. Various fertilisers applied at time of planting	1961	13.4
C	Plots planted in lines of under-scrubbed area. Plots of beech in northwest corner	1960	9.2
D	Five plots of tubed stock planted in lines. Early planting versus late planting	1959	0.8
E	Four lines — fertiliser trial. Blood and bone	1958	Unknown
F	“Mora tree feed”. Experimental planting	1962	0.6
G	Clear-felled strip — one chain wide. Two rows	1960	1.8
H	Alternating lines of kauri/tānekaha–kauri/beech	1960	1.8
I	Clear-felled and burned strip. Four rows	1959	1.6
I(a)	Below area I. Experiment for pits at time of planting versus pits prepared 3 months	1959	0.5
J	Clear-felled strip. One chain wide. Two rows	1961	1.8

Area by alphabetical code	Description of area	Year established	Area size (ac)
K	Groups as for B (see above in this table)	1961	10.2
L	Four lines, root-pruning trial	1958	Unknown
M	Kauri planted in lines. Area clear-felled and part burned	Unknown	5.0
N	Kauri planted in lines. Area clear-felled and burned. Planted with tubed stock 18 ft. x 8 ft. (1957). Planted with tubed and open-rooted stock 18 ft. x 8 ft. (1958)	1957–1958	5.0
O	Kauri planted in lines 20 ft. x 10 ft. in under-scrubbed area. Large broadleaf trees ring-barked on half the area	1955	5.0
P	Groups of kauri/tānekaha /beech, planted in lines in under-scrubbed area. Mostly 18 ft. x 8 ft., with some regenerated kauri in plots	1958	Unknown
Q	Planted in lines 20 ft. x 10 ft. Large broadleaf trees ring-barked and poisoned, area also contains two special fertiliser plots and groups of to tōtara, kawaka, rewarewa, kauri (1956). Other species planted (1961)	1956, 1961	5.0
R	Basal sprayed with T.6, December 1961	1961	1.0
S	Ring-barked, December 1961	1961	1.0
T	Alternate rows kauri, *Eucalyptus* spp.	1957	2.0
U	Two plots planted under tall mānuka	1957	1.0
V	Two plots testing summer planting versus winter planting, January–May 1960	1960	0.1

Note. Numbers 1–5 on the map (Figure 19) denote mature kauri trees, seed sources for natural regeneration.

Area Descriptions

Numbers 1–5

These are mature kauri trees. They are seed sources for natural regeneration. Forester Frank Morrison described this work to the 1958 Kauri Conference as follows:

"Areas of approximately one chain radius were cleared round five mature kauri trees in broad leaf forest of compartment 58. The soil was grubbed in patches to form a seed bed. Recent counts showed the average density of seedlings from the 1958 seed dispersal to be at the rate of 300 per acre. All these seedlings have been ringed with pieces of plastic hose to see if they persist or not."

Morrison provided updated figures to the 1959 conference, which showed a very wide range of survival rates.

This area was also referred to in a memo from Ron Lloyd to Mrs. Skudder of FRI, file reference 28/2/0/12, dated December 13th, 1972. "This experiment implemented by the late Forester Morrison in 1958 has been reported on. Attached please find a detailed report by Forester Rae." This other report by Sandy Rae is not currently known to the author, but it may be held in a Scion archive. Lloyd judged that the Rae report demonstrated that cotyledinous kauri seedlings were ephemeral in this type of habitat and that the experiment could be closed, along with all of the other trials in compartment 58.

Area A

Area A is a site of natural regeneration that was released in 1956. It is not covered in Sandy Rae's report. Archival records show that area A was described by Frank Morrison on page 9 of the Waipoua annual report as follows:

"Eleven acres of natural regeneration in compartment 58, mostly comprising kauri but also containing sapling stages of rimu, monoao and tōtara, were treated by the removal of the minimal amount of competing vegetation, usually mānuka up to 20 ft. high. Some thinning and cleaning was carried out within these species. Adjacent to the treated area, significant amounts of natural regeneration exist without interference from the other vegetation. Here, no treatment was carried out and it is anticipated that none will be required before 5 years. Small malformed taraire and kohekohe were cut with object of obtaining a tree of good form from the coppice regrowth."

The site was not visited by the author.

Area B

Groups of kauri were planted in broadleaf forest. Plantings contained grafted kauri as centre trees in each plot. Various fertilisers were applied at the time of planting (1961). Area B is approximately 13.4 acres.

In the Sandy Rae report, area B is also referred to as area K. Throughout this area, group plots of kauri were established. This was done by felling one canopy tree and planting the group plot in the resulting gap. A number of groups were found, but survival and growth were generally poor. The centre tree in each group was originally a graft, the idea being that this would constitute a seed source. Most grafts had died, and those remaining were of poor form. Most trees found by Rae were less than 3 ft. high and survival rarely greater than 33%. In all but a few cases, the canopy had closed over again, covering the gap. The canopy species were taraire and kohekohe. Rae comments that the canopy gaps created had led to dense regrowth of understory species.

Archival records show seed lots used in area B were: AK 55/698 (262 open-rooted trees plus 36 trees in plastic bags), seed lot AK 57/731 (1037 trees), and in area K, seed lot AK 57/810 (1494 trees). These seed lots can be identified by their source tree. The 121 grafts were likely to be AK 56/716, but no official records show this information.

The author did not visit Area B, but did inspect area K. Kauri 30 cm DBH+ were present in the area but were very scattered, and there was no ability to recreate the plot layout due to the very low survival rates. No trees that may have had an origin as a graft were seen. Surviving trees were healthy and likely to survive as dominant elements.

No PA symptoms were apparent in area K.

Area C

Area C (9.2 ac) consisted of plots planted in lines of under-scrubbed area in 1960. Plots of beech were planted in the northwest corner. The Sandy Rae report describes how this area was planted in lines of kauri and how the entire area was under-scrubbed. The canopy was not opened up. However, this proved to be an unsuccessful method of establishment because in the entire area, only very occasional kauri were found. It was presumed that these rare, single and stunted kauri were remnants of the planted lines. No beech trees could be located by Rae, even after concentrated inspection. The canopy

species were the same as in area B, taraire and kohekohe. Probably due to the heavy under-scrubbing, there was quite a dense understory in this area.

Archival records show the following seed lots and numbers of seedlings (Table 6) were used in area C.

Table 6 Seed lots and numbers of seedlings planted in area C, Waipoua Forest

Seed lot	# of seedlings	Packaging method
AK 55/698	650	Open-rooted
AK 55/698	760	Open-rooted
AK 55/698	114	Open-rooted
AK 56/716	123	Open-rooted
AK 57/731	595	Tubed
AK 57/731	275	Tubed

Abbreviation. #, number.

Frank Morrison, now based in Kaikohe as the District Forester, contributed his account about area C to the Kaikohe District Annual report for 1960–1961 (page 10) as follows:

"*Kauri planting*. All planting results in the compartment 58 broadleaf forest were masked by wild cattle damage. The animals had been apparently attracted by regrowth of secondary species after clearing for group and strip planting. Cattle tend to follow lines even if they are indistinct. Unfortunately, they trampled and destroyed many kauris. It is proposed to make groups smaller this year, up to half a chain in diameter. Trees will be planted at 8 ft. x 8 ft. in diamond patterns of 5 or 13. Under-scrubbing will only apply to planting site. The steeper slopes will be selected. Regrowth of secondary species is certain to be less on smaller areas and should not be so attractive to wild cattle. The trees on the perimeter of the groups will be girdled to reduce root competition. A further half-chain-wide strip is being cleared, and this will be planted in April (1961). This is area J on the key map."

Morrison's comments probably understate the scale of the impact of the cattle. Cattle are immensely destructive to understory species, including kauri. It is almost certain the cattle had an adverse impact on all of the compartment 58 trials. The fact of their incursion may partly explain the generally poor stocking of kauri noted by Sandy Rae in 1972. Cattle are also heavily implicated in the movement of PA in some landscapes.

A copy of the May 3rd, 1960 packing note #80586 shows that the following trees were dispatched to area C: *A. australis* (AK 57/731; 275 special tubed stock). Notes suggest these were planted in six groups in a 6-acre under-scrubbed area. The trees were tubed at 2-month intervals from 15/1/1960–13/3/1960. This activity may relate to some of the uncoded plots shown within the area C on the key map.

Area C was not inspected by the author for the purposes of this report.

Area D

Area D (0.8 ac) consisted of five plots of tubed stock planted in lines in 1959. The objective was to compare early planting versus late planting. The Rae report did not comment on area D. Area D

consists of small plots within the larger line-planted area C. Given the poor survival throughout this area, it is not surprising that trees were not encountered by Sandy Rae. No other records relating to area D were evident at the time of the writing of this report. The 1959 Waipoua annual report is missing from the archives. These plantings would almost certainly been adversely affected by the 1960 cattle incursion. This area was not inspected by the author.

Area E

Area E is only four lines planted for a fertiliser trial in 1958. Blood and bone was used. The Sandy Rae report describes the experiment as follows:

"*Treatmen*t. This plot was established in 1958 as four lines of kauri for a fertiliser trial. Blood and bone was the fertiliser being tested. It was established under mānuka canopy. Four pegs were found for the start of each row, but there was no information written on the pegs. *Kauri*. Two kauris were found on the whole plot 3 ft. and 4 ft. high."

No information on this plot is contained in archival records. Like area F, this plot looks to have been located in a 1950 kauri plantation. It was not inspected by the author.

Area F

Area F (0.6 ac) was an experimental 1961 planting using "Mora" tree feed. The Sandy Rae report describes the area as follows:

"This plot was established in 1961, and 11 rows of kauri were planted as a fertiliser trial. 'Mora' tree feed was the fertiliser used. Plot pegs were numbered from 1/13/1 to 5/20/4. *Kauri*. Enough kauri were found to follow the rows, but survival was generally poor. Trees ranged from 2–4 ft., with an occasional one up to 6 ft. *Canopy*. A fairly dese canopy was present 25–35 ft. high. Species were mānuka, lemonwood, rewarewa."

The archival records hold no information about this trial. It is located within a 1950 plantation of 11 acres. The author inspected this plantation and encountered a low stocking of trees in the 15–25 cm DBH range, which were most likely of plantation origin. It was not possible to recognise area F; no marker pegs were encountered. All the kauri encountered were healthy. No PA symptoms were noted.

Area G

Area G (1.8 ac) was a clear-felled strip one chain wide planted in two rows in 1960. The Sandy Rae report describes this area as follows:

"*Treatment*. A strip one chain wide was clear-felled and two lines of kauri planted in 1960. *Kauri*. Only a few kauri were found on this plot. They were near the north end and could have been from seed tree 3 nearby. There were not enough to discern lines. The trees were between 2 and 4 ft. high. *Canopy*. There was a dense canopy of māhoe, patē and wineberry from 20–25 ft., with frequent emergent mamaku."

Archival records show two seed lots were used: seed lot AK 55/698 (262 open-rooted stock; 38 plastic-bagged stock) and seed lot AK55/698 (100 open-rooted trees; 100 plastic-bagged trees). No other records of this trial exist.

No inspection was carried out by the author. From the viewpoint south of the Waipoua River, the clear-felled strips are still faintly visible.

Area H

This area (1.8 ac), planted in 1960, consisted of lines of kauri/tānekaha and kauri/beech. This plot is not shown on the key map for the compartment 58 trials. As it is a one-chain strip, it is likely to be between the strips G and I. The Sandy Rae report describes area H in detail:

"*Treatment*. Lines of kauri/tānekaha and kauri/beech were planted under broadleaf forest on a one-chain-wide strip. *Kauri*. Not enough kauri were found to determine the lines. The few kauri present were about 2 ft. high. *Other species established*. There was quite good survival of tānekaha, enough to follow the lines, but height growth was poor, most less than 2 ft. Only two beech found; these were both *Nothofagus menziesii* and barely surviving. *Canopy*. A continuous canopy of taraire and kohekohe occurred.

Archival records hold no information about area H. The author did not visit the area.

Area I

This area (1.6 ac) was clear-felled and strip-burned in 1959. Four rows of kauri were planted. The Sandy Rae report gives a full description:

"*Treatment*. This strip plot had similar treatment to plots J and G, except that the area was burned after clear-felling and four rows of kauri instead of two were planted. *Kauri*. The additional burning in this area had little effect on kauri survival and growth, which once again was very poor. *Canopy and understorey*. The situation here was the same as the other two strip plots, except that the incidence of bracken was marginally greater."

Archival records indicate seed lot number is most likely to be AK 56/716. No other records could be found. The author did not undertake an inspection.

Area I (a)

This area (0.5 ac) is below area I. It was an experiment to test pits at time of planting versus pits prepared 3 months and 12 months ahead of time, and it was established over a 2-year period, 1959–1960. The Sandy Rae report describes area I(a) as follows:

"*Treatment*. This half-acre plot immediately south of plot I was established 1959–1960 to test the effect of pre-dug pits. *Kauri*. A few kauri were found in this area, but as these were not enough to locate planting lines, and as no plot pegs were found, no useful information could be derived from this plot. *Canopy*. This plot was contiguous with plot I and resembles it closely in all respects except that some mānuka was present near the southern edge associated with a dense understory of *Gleichenia microphylla*."

Archival records offer no specific references to this plot. Cattle damage was commented upon in the 1960 annual report and would also have impacted on this plot. Area I(a) was not inspected by the author of this report.

Area J

This area was a clear-felled strip once chain wide planted in two rows (1.8 ac) of kauri in 1961. The Sandy Rae report is as follows:

"Treatment. This plot had the same treatment as plot G — a one-chain-wide strip clear-felled and planted with two rows of kauri. Plot pegs were located at the south end of each row. *Kauri*. Very few kauri were found on this plot. Those found were about 2–5 ft. high. *Canopy and understorey*. This plot possessed the same characteristics as plot G — frequent *Cyathea medullaris* in the canopy and similar dense *Geniostoma* and *Melycytus* coppice-like growth in the understorey."

Archival records show 600 trees from seed lot AK 57/731 were used to populate this plot. No other references show. The area was not inspected for the current report.

Area K

Kauri were planted in groups, as for area B, in a space of 10.2 acres. The Sandy Rae report is similar to his description of area B:

"*Treatment*. Throughout these areas, group plots of kauri were established. This was done by felling one canopy tree and planting the group plot in the resulting gap. *Kauri*. A number of groups were found but survival and growth were generally poor. The centre trees in each group were originally a graft, the idea being that this would constitute a seed source. Most grafts had died, and those remaining were of poor form. Most trees found were less than 3 ft. high, and survival rarely greater than 33%. *Canopy*. In all but a few cases, the canopy had closed over again, covering the gap. The canopy species were taraire and kohekohe. *Understory*. The canopy gaps created have led to dense regrowth of understory species."

Archival records do not mention the area as adversely affected by cattle. Seed lot AK 57/810 (1494 seedlings) was identified on packing note #43767, and this information was tied to seed tree number as shown in Table 7.

Table 7 Seed tree and number of seedlings planted in area K, Waipoua Forest

Seed tree #	# of trees planted
20	267 (tubed stock)
843	496
Soil block	111
16	44 (open-rooted stock)
24	50
243	260
15	120
58	146

Total planted	1494

Note. All trees came from seed lot AK 57/810–814. A total of 1494 trees were planted.
Abbreviation. #, number.

Another packing note (#43775 for 121 grafted stock for compartment 58 planted centre tree in group planting) exists (in the author's possession). Interestingly, no seed lot number is quoted for the grafted material. Note that the large number of grafts done in 1960 (300 grafts) were scion wood grafted onto AK 56/716 stock. These are the likely source for the area K plantings.

Area L
This area consisted of four lines put in as a root pruning trial in 1958. The Sandy Rae report comments as follows:

"*Treatment*. Four lines of kauri were established in 1958 as a root pruning trial. One rotted plot peg was found on the ground. *Kauri*. Survival poor except for a short distance of the plot, where all four rows could be seen. However, even in this place, which was more open than elsewhere, height growth was poor, ranging from 2–5 ft. Insufficient kauri remained for the trial to yield any meaningful results. *Canopy*. A 40–50 ft. canopy of taraire, kohekohe and tōwai were present. *Understorey*. A fairly open understorey existed at 8–20 ft. high."

Archival records yield no data. The author of this report did not complete an inspection.

Area M
This area consisted of 5 acres planted in lines. Area M was clear-felled and part-burned in 1959. The Sandy Rae report yields a detailed description:

"*Treatment*. This 5-acre area was clear-felled a partly burned prior to planting in lines of kauri in 1959. Plot pegs were found along the southwestern side but contained no markings. *Kauri*. Kauri scarce, not enough to follow the lines. Kauri ranging from 2–6 ft. *Canopy.* The canopy ranged from 20–30 ft., with frequent emergent mamaku up to 40 ft. Other canopy species included lemonwood, wineberry, māhoe, and nīkau. *Understorey*. A dense understorey of hangehange, māhoe and karamū was found.

Archival records show seed lot AK 56/716 (850 trees; some may have gone to area I) were planted. The author most likely visited the south end of this plantation, but boundaries were unclear. Vegetation was dense, with a few emergent kauri 30 cm+ DBH. Insufficient kauri were visible to discern a planting pattern. Trees were healthy and vigorous. The altered vegetation, which has regenerated from a past fire, showed up quite strongly from the viewpoint to the south of the Waipoua River. It was also strongly apparent when on site.

Area N
This area was 5 acres planted in lines. It was clear-felled and burned and was planted with tubed stock at 18 ft. x 8 ft. intervals in 1957. In 1958, it was planted with tubed and open-rooted stock at 18 ft. x 8 ft. intervals. The Sandy Rae report is consistent with other area descriptions:

"*Treatment*. This area of 5 acres was clear-felled and burned; half was planted with tubed stock in 1957, while the remainder was planted with tubed and open-rooted stock in 1958. Plot pegs were found along the southwest side, showing treatments of each row. The area is generally drier than plot M and has consistently heavy bracken growth. *Kauri*. Kauri survival was poor in general, most trees being 2–4 ft. high. A few good kauri were found from 10–15 ft. high, where the bracken had been penetrated. One particular 1958 planted kauri had about 5 mature female cones on it, showing that kauri can bear cones at this age. This tree was 12 ft. high. *Canopy*. A scattered canopy of mamaku, lemonwood, kōhūhū and māhoe occurred 20–40 ft. high.

Frank Morrison recorded the following in the *1957 Annual Report for Waipoua* about the artificial establishment of kauri, in particular the open-planting project. The purpose of the project was to find out the most suitable conditions for the growing of kauri.

"After 5 acres of broadleaf forest was clear-felled and burned in compartment 58, the first major open-planting of kauri was carried out at Waipoua Forest in early June 1957. As insufficient nursery stock was available to plant the whole area, at a proposed espacement of 9 ft. x 8 ft.; spacing was set at 18 ft. x 8 ft.

"Overall survival was 77%; survival of tubed trees was 86%, while the survival of non-tubed trees (open-rooted) was 75%. In addition, the tubed trees appeared to be healthier and were growing more actively than the others. It was noticeable that the heaviest mortality occurred where the aspect was northerly and where the country was flat or nearly flat. On the other hand, the best trees were found on the steeper slopes with a southerly aspect. Most of the tree deaths had taken place just prior to mortality survey in in early February 1958 and were due to drought conditions prevailing throughout January. A further 5 acres of broadleaf forest has been clear-felled for future planting in the open.

"*Future work*. The 5 acres clear-felled in 1957 will be burned during 1958 and planted at 9 ft. x 8 ft. spacing in 1959. The 5 acres planted at 18 ft. x 8 ft. in 1957 will be planted at the same espacement during 1958 to give an overall spacing of 9 ft. x 8 ft." [Author comment: This means the whole area of 5 acres was planted in the alternate years, 1957 and 1958, row by row].

The 1957 annual report records the 1957 plantings as using 1000 AK 53/661 seedlings. The 1958 planting comprised seed lots AK 55/698 and AK 56/716 (tubed and open-rooted). Interestingly, the table showing the planting shows all trees as coming from seed tree 700.

The author traversed part of this area. From the viewpoint to the south of the Waipoua River, emergent kauri showed up quite strongly, some of which were located by the author. They were insufficient in number to reveal the original planting pattern, but those remaining were often 30 cm+ DBH and growing strongly. There was some gum ooze from the bases of some of these kauri, but the author did not judge that this was PA symptomatic. These trees can be found at grid reference E1646407 / N6056614. All kauri had healthy crowns.

Area O

This area (5 ac) was planted in lines 20 ft. x 10 ft. in an under-scrubbed area in 1955. Large broadleaf trees were ring-barked on half the area. Sandy Rae reports:

"*Treatment*. This 5-acre area was ring-barked and under-scrubbed before planting with lines of kauri in 1955. Plot pegs were found with seed tree numbers on them. *Kauri*. This area was almost a total failure. Very few kauri were found, and these were stunted and unthrifty. *Canopy*. A broken canopy of taraire and rata, which had not been killed by ring-barking, was present. A sub-canopy at about 30 ft. also existed. This comprised mamaku, patē, kohekohe and taraire."

Archival records yield further information. On page 12 of his annual report for 1955, Frank Morrison describes the preparation of this area as follows:

"In the broadleaf forest area, one-half of this area has had the understorey, comprising mainly pongas and nīkau, entirely removed. The standing trees have been girdled. In the other half, the standing trees have not been girded, but the under-storey has been removed. The kauri were planted in the open to obtain further information on the reaction of this species to such treatment. The survival is 92%, but the trees have not made much growth during the year." [Author note: This refers to a half-acre trial in compartment 14]. "The survival of the under-planted kauri is 80%. Here, many of the trees have grown appreciably during the year." [Author note: This refers to the compartment 58 planting, i.e., area O]. Seed tree numbers and number of trees planted are shown in Table 8below.

Table 8 Seed trees and number of seedlings planted in area O, Waipoua Forest

Seed tree #	# of trees planted
843	200
844	200
846	200
848	200
853	200
Mixed	200

Note. All trees came from seed lot AK 51/640.

Abbreviation. #, number.

The author (most likely) traversed part of this area without encountering any kauri likely to have been of plantation origin. Some healthy, naturally regenerated rickers were encountered on a steep area on what was judged to be the southern part of this plantation. These were growing well.

Area P

This area was planted as groups of kauri/tānekaha/beech in lines in an under-scrubbed area, mostly 18 ft. x 8 ft. (in 1958). Regeneration kauri were also in plots. The Sandy Rae report does not cover area P.

Archival records are nil. The 1958 annual report for Waipoua has not been archived. Seed lot information was not found. Area P was not visited by the author due to lack of information.

Area Q

Area Q (5 ac) was planted in lines 20 ft. x 10 ft. in 1956. Large broadleaf trees were ring-barked and poisoned. The area also contains two special fertiliser plots and groups of tōtara, kawakawa, rewarewa, kauri and other species were planted in 1961. The Sandy Rae report is as follows:

"*Treatment*. This 5-acre area was ring-barked and poisoned. Kauri were then planted in lines in 1956. Spacing was 20 ft. x 10 ft. About half-way along the southwest side and about two chains in from the edge, an enclosure was found. That was about one chain by two chains and was surrounded by two strands of barbed wire. Within the enclosure, planting of kauri was much closer about 8 ft. x 8 ft. *Kauri*. Outside the enclosure fence very few kauri were present. Inside, kauri survival was good, and height was also quite good. Thirty-eight trees occurred inside the enclosure, with an average of 0.7 DBH and average height of 9.2 ft. Range in height was 2.5–23.0 ft., and DBH ranged from 0–2.2 in. *Other species established*. Within the enclosure, wire pegs were found in the ground, indicating different species of natural regeneration. As these pegs were not found outside the enclosure, it was assumed that the enclosure was erected for the purpose of this regeneration trial. This trial was to have been recorded each year for at least 5 years, so presumably the kauri within the plot were released at the same time. This would provide a reason for the superior kauri survival and growth within the enclosure. [Author note: The barbed wire enclosure would also have excluded cattle].

"*Canopy*. An open canopy of mamaku and kohekohe occurred 20–25 ft. high. *Understory*. There was a dense 10–20 ft. understory of māhoe, hangehange and nīkau, with considerable supplejack present. In places, this understorey gave way to very dense nīkau, where there was almost complete darkness on the forest floor."

Archival records (a 1956 annual report) identified seed lots as AK 51/640 and AK 52/654 (1050 trees). Also, 570 AK 53/661 blanks were planted in 1957 (this information came from the annual report, 1957). Although there is a very full annual report for 1956, this planting was not described in the narrative. This area was not visited by the author.

Area R

Area R (1 ac) was basal sprayed with the T6 chemical in December 1961. Sandy Rae described the area as follows:

"*Treatment*. This was an area of 1 acre on a steep south face on which the canopy species were basal sprayed with T6 to kill them. The area was then planted with kauri in 1961. No plot pegs were found, but the area was quite easily recognisable. *Kauri*. No remaining kauri were found. *Canopy*. There was a broken canopy of 60 ft. (and higher) of taraire and rata, which had not been killed by the spray. *Understorey*. A fairly dense understorey … was present. *Forest floor*. Fallen poisoned trees covered much of the plot."

Archival records yield no information on this area. It is not clear if areas R and S were planted in 1961 or 1962.

Area S.
Area S (1 ac) was ring-barked in December 1961. Sandy Rae records this area's condition as follows:

"*Treatment*. This area was a replicate of plot R, but here, the canopy trees were ring-barked instead of poisoned. Ring-barking was only marginally more effective than poisoning, as some large trees still resisted death. The plot was also established in 1961. *Kauri.* Again, no kauri were found. *Other species established.* Towards the eastern end of the plot, topography was flatter and drier; *Uncinia* replaced *Elatostema* as ground cover, and several *Libocedrus plumosa* group plots were found, but still no kauri. *Libocedrus* survival was very good, up to 100%, but height growth was poor in places (2–3 ft.). These group plots were superimposed on plot S in 1964."

No archival records could be found, and the author of this report did not visit the site.

Area T
Area T (2 ac) was planted as alternate rows of kauri and *Eucalyptus ssp*. in 1957. The Sandy Rae report yields a good level of detail:

"*Treatment.* In this plot, 2 acres were clear-felled along a ridge top, and alternate rows of kauri and *E. saligna* were established in 1957. No pegs were found, but the extent of the plot could be quite easily identified by the eucalypts. *Kauri.* Kauri survival was very poor indeed; only one kauri was found. This measured 2 ft. in height. *Other species established*. *Eucalyptus* survival was good, particularly in the southwest part of the plot. The eucalypts were 6–10 in DBH and about 40 ft. high. *Canopy*. There was a light scattered canopy of eucalypts 40 ft. high. *Understorey*. A dense understorey from 10–20 ft. high was present."

Archival records show 100 trees from seed lot AK 53/661 were planted. This information was recorded for compartment 58 for a 0.3-acre area in the 1957 annual report table, so most likely this was the stand.

There is an allusion to this work on page 12 of the *1957 Waipoua Annual Report* as follows:

"Trials will also include the planting of *Eucalyptus* species on cleared broadleaf forest areas and the under-planting of kauri at a later stage."

Morrison reported to the 1958 Kauri Conference held in Waihi about the kauri/gum mixture as follows:

"To simulate conditions, which would probably follow utilisation of kauri, particularly of isolated trees, approximately 1 acre of broadleaf forest was clear-felled and partially burnt. Kauri have been planted at 16 ft. x 8 ft. spacing, and it is proposed to interplant with *E. saligna* at the same spacing to give a kauri/eucalyptus alternate line mixture at 8 ft. x 8 ft. spacing."

The eucalypts were observed by the author from the viewpoint on the south side of the Waipoua River. The site was not visited.

Area U

This area (1.0 ac) was planted in 1957 and was conceived as two plots planted under tall mānuka. The Sandy Rae report gives some detail as to its purpose:

"*Treatment*. One acre was under-scrubbed under kānuka, and group plots of kauri were established in 1957. The presence of kānuka rather than mānuka usually indicates a superior soil type. Thus, the poor growth of kauri in this area was disappointing. *Kauri*. Four group plots of kauri were located in this area. On one of these, survival was greater than 50% (five of nine trees survived); the remaining plots contained only one or two kauri and growth of 2 ft.–4 ft. was poor. *Canopy*. A continuous canopy of kānuka was present, ranging in height from 30–50 ft. *Understorey*. A medium-dense understorey occurred.

Archival records show seed lots, but they are not clearly recorded in tables. No other references to this plot exists. The site was not visited by the author.

Area V

This tiny area (0.1 ac) consists of two plots testing summer planting versus winter planting (done in January and May 1960, respectively). The Sandy Rae report contains no mention of area V. Archives also contain nil records. The author did not visit the site.

Long-term Management of Compartment 58

From what has been uncovered in archival searches and from what has been observed during the compartment 58 inspections, there are some kauri management lessons to be learned from these trials, and there are some issues there for Te Roroa from a kauri dieback perspective.

Kauri Management Lessons

Compartment 58 yields five main lessons for the future. A lot of effort was put into a mostly failed venture at the time, as can be seen from the 1960s era stock map (Figure 20), and it would be a shame to repeat the errors.

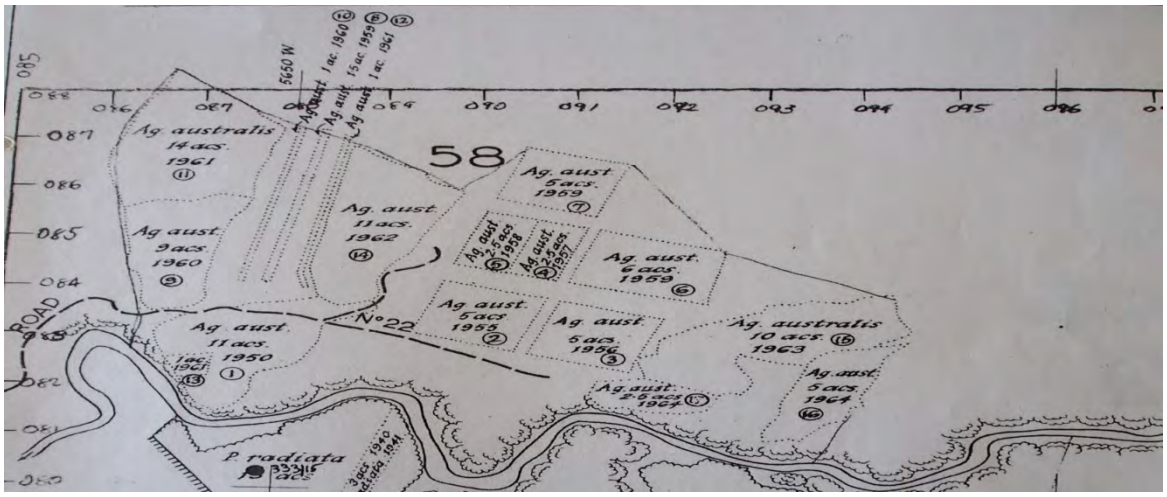


Figure 82. A 1960s era stock map of compartment 58, Waipoua Forest.

These lessons are as follows.

1. Plant kauri on sites where kauri have grown previously.

2. Follow up with blanking as required.
3. Commit to many years of release cutting of competing vegetation.
4. Exclude stock (cattle, etc.).
5. Keep management prescriptions simple.

Comments for Te Roroa as Forest Manager

A summary of main points about compartment 58 may also be helpful for the future forest managers.

1. Inspectors did not observe kauri dieback on the parts of the site visited, but it is very likely to have been introduced in the development of the compartment and may still be present, so precautionary management of the site is recommended.
2. The site is naturally protected by its isolation and further protected by its wāhi tapu status.
3. The natural forest processes are restoring the site. Although compartment 58 management agendas disrupted the natural rhythm of the area, Waipoua Forest has endured many disruptions in its history.
4. No livestock have been in the area for some time, although cattle badly damaged some of the trials back in the late 1950s.

The above observations are represented visually in viewing the actual trees (Figures 21 and 22).

Figure 83. Compartment 58, Waipoua Forest. Emergent kauri in centre of photo are most likely areas M and N, which were clear-felled and burned prior to planting. These scattered trees are probably the most successful part of the compartment 58 venture.

Figure 84. Partial panorama of compartment 58, Waipoua Forest. Clear-felled strips G, I and J are in the centre of the photo, rising up the hill.

Waipoua Forest Kauri Plantations

Early Plantings

Kauri seedlings were grown in the Waipoua Forest Nursery from as early as 1930. The Scion seed register for kauri commences in 1935, with seed lot AK 35/359 and records the 1938 planting of 150 of these trees in SP XXC, presumably a Waipoua SP. No copies of this SP record exist today. The register also records planting 93 trees of seed lot AK 35/360 at the same site (SP XXC). In 1936, 10 lbs of seed lot AK 36/364 seed were planted, 21500 seedlings from the same seed lot went to the Waitangi Endowment Forest in 1937 and a further 5600 seedlings were designated blanks in 1938. These trees would have been planted out as 1/0 seedlings, their tiny size limiting their chances of survival. Of those Waitangi plantings, only 0.6 ha survive today.

In 1937, 5200 seedlings from seed lot AK 36/365 were planted on 2.3 acres in compartment 1, Waipoua. A total of 30.5 lbs of seed from seed lot AK 37/387 was sown in 1937. The register shows 1975 of these being used as blanks in SPs 10 and 15 in 1939, and a further 180 being planted in 1940 in compartment 1. A total of 15 lbs of seed lot AK 40/453 seed were sown in 1940. Exactly 12 trees from this seed lot were planted in compartment 12 at Waipoua Forest. A further 2470 were recorded as planted in 1943 in compartments 8 and 9, Omahuta Forest. These numbers tally almost exactly with the figures for the 1944 establishment of SP 205A in compartment 9, Omahuta, and the seed lot number aligns with this site. Blanking of this site with 220 seed lot AK 41/465 seedlings occurred in 1945.

Of seed lot AK 45/506, 3114 seedlings were planted at Wairangihau in Waipoua Forest in 1947. No map appears to show this plantation. The Wairangihau area covers compartments 2 and 3 of Waipoua. Finding old stock maps covering these compartments has been impossible to date. The Wairangihau plantations are worth tracking, as they are Waipoua's first substantial kauri plantings.

In 1948, 1100 seed lot AK 46/514 seedlings were used to plant the NZ kauri area of 0.4 ha in the Northern Arboretum, Waipoua Forest. This is the oldest kauri plantation in Waipoua for which a map exists. The register records a further 5280 seedling from this seed lot as being planted at various sites in compartment 1. Unfortunately, there is no map of these plantings. However, a 1950s era stock map shows a 1949, 4-acre plantation carrying this seed lot number within compartment 15, so there are probably some inaccuracies in the records of planting in the seed register.

The stock map shows an adjacent 1949 plantation of 1 acre from seed lot AK 47/533. These two 1949 plantations are assigned the sub-compartment number 15/6 on this map. Five other 1949 plantations from three different seed lots totalling 13 acres are assigned the sub-compartment number 15/7. Sub-compartment 15/8 is an adjacent 5-acre plantation derived from seed lot AK47/533 seedlings. In a later adjustment all these plantations, sub-compartments15/7 and 15/8 were categorised as compartment 58/1 and were recorded as having an establishment date of 1950. Sub-compartment 15/6 disappeared entirely from the subsequent map records. The above information brings us to a point in time from whence map information on kauri forests becomes relatively trustworthy.

Descriptions of Waipoua Forest Kauri Plantations

Table 9 below outlines the plantations. The Northern Arboretum plantation of 0.4 ha is described in the "Northern Arboretum" section of this report in more detail. Old compartment 15 plantations are described in the section above. The compartment 58 plantations are described in the "Kauri Establishment Trials" section.

Table 9 Waipoua Forest kauri plantations

Location	Year established	Area (ha)	Condition	# of plants	Seed lot #	Information source	Nursery	Comments
Arboretum area 1	1948	0.4	Good survival	1100	AK 46/514	Arboretum map	Waipoua	
	1949	7.2				WP table	Waipoua	No other record. See next seven records below and section 'Early Plantings' above.
Old compt 15	1949	0.4	Natural forest		AK47/537	Old map	Waipoua	
Old compt 15	1949	2.0	Natural forest		AK46/514	Old map	Waipoua	
Compt 58	1949	2.4	Pt 58/1		AK 48/573	Old map	Waipoua	Old compt 15
Compt 58	1949	0.8	Pt 58/1		AK 47/533	Old map	Waipoua	Old compt 15
Compt 58	1949	0.4	Pt 58/1		AK 46/514	Old map	Waipoua	Old compt 15
Compt 58	1949	1.2	Pt 58/1		AK47/533	Old map	Waipoua	Old compt 15
Compt 58	1949	0.4	Pt 58/1		AK48/571	Old map	Waipoua	Old compt 15
Compt 58	1950	2.0			AK 47/533	WP table Old map	Waipoua	Old compt 15
Compt 58	1952	1.0				WP table	Waipoua	
Compt 58/1	1950	4.4				Map	Waipoua	
Compt 4	1956	0.3	PA infected	139 148 160 160	AK 50/616 AK 52/654 + AK 51/640 AK 52/654 + AK 53/661	Stock map. SP information: SP 209/3 + 209/4	Waipoua	Complex area, impossible to separate seedling batches on ground
Compt 58/2	1955	2.0				Map + WP	Waipoua	
Compt 58/3	1956	2.0				Map + WP	Waipoua	

Location	Year established	Area (ha)	Condition	# of plants	Seed lot #	Information source	Nursery	Comments
Compt 58/4	1957	1.0				Map + WP	Waipoua	
Compt 58/5	1958	1.0				Map + WP	Waipoua	
Compt 58/6	1959	2.4				Map + WP	Waipoua	
Compt 58/7	1959	2.0				Map	Waipoua	
Compt 58/8	1959	0.4				Map	Waipoua	
Compt 58/9	1960	3.6			AK 55/698 + AK 57/731 + AK 56/716	Map	Waipoua	
Compt 58/10	1960	0.4		500	AK 55/698	Map	Waipoua	
Compt 58/11	1961	5.6		1037	AK 57/731	Map	Waipoua	
Compt 58/12	1961	0.4				Map	Waipoua	
Compt 58/13	1961	0.4				Map	Waipoua	
Compt 58/14	1962	4.4		1494	AK 57/810	Map	Waipoua	
Compt 58/15	1963	4.0		1509	AK 60/841 + AK 60/844 + AK 59/810	Map	Waipoua	
Compt 55/1	1962	0.8		527 214	AK 58/769 AK 59/810	Map	Waipoua	
Compt 55/2	1963	2.8		600 1275	AK 58/769 AK 59/810	Map	Waipoua	
Compt 58/16	1964	2.0				Map	Waipoua	
Compt 58/17	1964	1.0				Map	Waipoua	
Compt 30/1	1958	0.1				Map	Waipoua	Strip planting?
Compt 30/1	1959	0.1				Map	Waipoua	Strip Planting?
Compt 30	1977	7.3 (11.8 on KMU table)		1600		Composite species map + KMU table	S'water	

Location	Year established	Area (ha)	Condition	# of plants	Seed lot #	Information source	Nursery	Comments
Compt 30	1978	10.5 (12.6 on KMU table)		3200		CS map + KMU table	S'water	
Compt 30	1979	5.4		1900		CS map + KMU table	S'water	
Compt 30	1980	12.3 (6.0 on KMU table)		2760		CS map + KMU table	S'water	Possibly kauri/podocarp mix
Compt 30	1981	8.0		4030		CS map + KMU tables	S'water	
Compt 30	1982	15.3		5000		KMU table	S'water	
Compt 30 & Lookout	1983	15.5		4728		Map + KMU table	S'water	
Compt 30 & Lookout	1984	6.0				Map	S'water	

Abbreviations: compt, compartment; CS, Composite Species map ; KMU,Kauri Management unit records ; PA, *Phytophthora agathidicida*; Pt, part; S'water, Sweetwater Nursery; WP,Working Plan .

Waipoua Forest Nursery-sourced Plantations

1956 Plantation: Compartment 4

This plantation of 0.4 ha is PA positive. This is a heavily infected, small plantation adjacent to the arterial Waipoua River Road. Many trees have died, and many of the residual trees are showing early to advanced PA symptoms.

Clarity on the seedling source of the plantation's infected trees is clouded by the fact that four different seed lots, AK 50/616, AK 51/640, AK 52/654 and AK 53/661 from three different nursery years were used in its establishment. Also, the plantation contains two fertiliser SPs (209/3 and 209/4) of 80 trees each, adding to the difficulty of ascertaining the plantation's history on the ground. The plantation is surrounded by an actively managed exotic forest. There are naturally occurring, second-growth kauri in a forest enclave immediately across the road. The author's opinion is that this plantation needs a formal plan to monitor its deterioration, but more importantly, to prevent it spreading PA to nearby natural kauri.

1957 and 1958 Plantations: Compartment 30

These two narrow strips (0.1 ha each) were described by Ken Wright in 1981 as "unofficial trial ripped with 24 in pick Morrison planted 1958–1959". The area they are within was viewed by Laurie Joseph and the author in late 2016. No sign of kauri dieback was present at the time of the inspection, but if opportunity arose, the area should be re-inspected.

No seed lot information re this planting can be located. This tiny plantation does not need a discreet plan re PA. Rather, it is within a very large area of regenerating and kauri plantation shrubland for which a general plan should be developed and implemented.

1962 and 1963 Plantations: Compartment 55

These two plantations (0.8 ha, 1962; 2.8 ha, 1953) are in a very remote site to the north of the Pawakatutu Road and close to the forest sanctuary boundary. Mature kauri are evident to the west, north and east of these plantations. It is almost certain that the site will be regenerating very prolifically with kauri, given the number of adjacent mature trees. The author has not inspected these plantations. If opportunity arose, an inspection may be of value. Some of the surrounding, mature kauri are showing kauri dieback symptoms. Any plan developed for this area should have low disturbance/visitation and low wild animal numbers as key strategies.

Sweetwater Nursery-sourced Plantations

1977 Plantation: Compartment 30

Mapped on a 1981 composite species map, this plantation (7.3 ha) lies to the west of the Pawakatutu Road (Figure 23). It was viewed by Laurie Joseph and the author in October 2016. There was no sign of kauri dieback in the canopy at the time of the inspection. Trees looked to be growing quite well on this harsh gumland site. There was quite prolific kauri regeneration in this area, and the whole shrubland was developing as a kauri-dominated forest. These trees were carrying cones, which will add

to the regeneration development. The plantation should be considered within a general protective plan to halt/limit the impact of kauri dieback across this landscape.

Figure 85. The 1977 kauri plantation, compartment 30, Waipoua Forest.

1978 Plantation: Compartment 30

This plantation (10.5 ha) was mapped on a 1981 composite species map. It lies to the west of the 1977 plantation and is bound to the west by the Kawerua Road. It was viewed by Laurie Joseph and the author in October 2016. Comments re the 1977 plantation apply equally to this one.

1979 Plantation: Compartment 30

Mapped on a 1981 composite species map, this plantation (5.4 ha) lies to the south of the 1977 and 1978 plantations described above. A detached portion of it lies to the south of the 1978 stand above and is also bound to the west by the Kawerua Road. It was viewed by Laurie Joseph and the author in October 2016. Comments re the 1977 and 1978 plantations apply equally to this one.

1980 Plantations: Compartment 30

The 1980 site was mapped on a 1981 composite species map (12.3 ha).

1981 Plantations: Compartment 30

These plantations (8.0 ha together) have not been inspected. The sites look harsher than the other compartment 30 plantations described above, but a site visit would add more value than such speculation. Note that there are many enclaves of mature kauri in the vicinity of these plantations, and some of these trees are displaying kauri dieback symptoms. Again, the long-term management of kauri dieback issues associated with these plantations should be part of a larger protective plan.

1982–1984 Plantations: Compartment 30

There is a composite species map of the compartment's three plantations (15.3 ha, 1982; 15.5 ha, 1983; 6.0 ha, 1984). No reliable map of the Lookout plantations can be found. Some sketch maps do exist, but the information on them is contradictory. Plantation kauri are visible in shrublands in this

vicinity. The fire to the north of the Lookout c. 2015 killed some of these trees. They looked to be making reasonable growth up to the fire event. If a reliable map is found (it would need to be a composite species map from the mid-1980s, or a specific kauri plantation map), then a detailed inspection of the sites would be justified. In general though, the Sweetwater Nursery-sourced seedlings are not judged to be likely to have carried kauri dieback to the plantation sites.

Waipoua Forest Nursery

Nursery Roles in PA Spread

The historic NZFS nurseries and work activities at these sites may have played a role in introducing and spreading kauri dieback. Information sources about the nurseries are multiple.

- A key document is Frank Morrison's paper, *Nursery Propagation of Kauri at Waipoua Forest,* which was presented at the Eighth New Zealand Science Congress, Auckland 1954. The paper was also published in the *NZ Journal of Forestry* (1955). It is available via an internet title search.
- Historic NZFS files and other records relating to Waipoua Forest are mostly missing from the archival records. Information for this report has been gleaned from lateral sources such as annual reports, period reports, and the papers and proceedings of the kauri conferences held between 1950 and 1961. The formal nursery records, which would inform the details of how the nursery was laid out, the issues arising with each batch of seedlings, the timing of activities like lining out, wrenching, disease issues, hardening, lifting, puddling/bagging/veneering/tubing, etc., are all lost.
- The main period of interest in terms of this examination of NZFS nursery practices and their possible association with the spread of kauri dieback is the 1940s, and especially the 1950s and early 1960s.
- Most or all of the key personnel who worked in the Waipoua Nursery in this era have passed away, so there has been no opportunity to source first-hand comment on how the nursery functioned.
- The seed lot numbering system can be used to trace the movement of seedlings from seed collection through the various stages of nursery production to their dispatch to plantation sites.
- Kauri were also grown in other NZFS nurseries within the Auckland Conservancy in the period of interest and, where relevant, this report will include comment on these.
- The section of the report covering the Dunemann frame trials in the 1950s carries information that adds value to this nursery section.

History of the Waipoua Forest Nursery

Frank Morrison's paper, *Nursery Propagation of Kauri at Waipoua Forest,* refers to the Waipoua forest Nursery commencing operation in 1945. This date must refer to the Waikohatu site on the northern side of the Waipoua River, as a nursery has existed at Waipoua Forest since at least 1931, the year after the establishment of the Waipoua Experimental Station (in 1930). The experimental station closed in 1933 due to the Depression, but the nursery must have continued, because kauri seed lot records from the 1930s, which record the growing of kauri seedlings at Waipoua, still exist. These records indicate that a nursery was operating at Waipoua through the 1920s, 1930s and early 1940s. In terms of the actual start date, archival material recording a 1926 planting of seven species of exotic trees at Waipoua and indicating that two of those species came from "the experimental beds" is on record. A further record, dated 1928, of the sowing of over 26 lbs of 12 species of exotic trees including 1.5 lbs of

P. canariensis seed "from Spain" is available to support historic accounts. 26 lbs of seed is a very substantial amount and indicates a nursery operation of some scale. No date for the first sowing of kauri has been recorded, but it is likely to be associated with the experimental station.

Other records show seeds of several exotic *Agathis* species destined for the Northern Arboretum were dispatched to the Waipoua Nursery in 1941. A c.1930 photo shows nursery plantings on the Waipoua River terrace with the Waikohatu site in the background, still an undeveloped paddock. Initially, as well as kauri and other indigenous species, the nursery produced exotic conifers for plantation purposes at Waipoua. This production of exotics tapered off, so that by 1952, virtually all seedling production was of indigenous, or niche exotic species. By then, the Northern District's nursery at Kaikohe was producing all of the district's exotic afforestation need, and small "station" nurseries such as Waitangi, Puhipuhi and Glenbervie had closed.

The Waipoua Forest Nursery continued as an indigenous specialist facility but declined as the policy thrust towards plantation kauri weakened and production reduced. A big, new NZFS nursery at Sweetwater near Kaitaia was started in the mid-1960s, and by 1969 was growing all of the Northern District's exotic and indigenous seedlings, including kauri. Waipoua Nursery's last documented kauri seed sowing was in 1965. The nursery was closed, and its key person, (Sid Maioha) transferred to Sweetwater. The Kaikohe Nursery was also closed in the late 1960s as exotic plantation species production at Sweetwater ramped upwards into the 1970s, an era in which there was another policy review and a subsequent increase in kauri plantation establishment.

Kauri Dieback and the Waipoua Forest Nursery

There is powerful circumstantial evidence that plants from the Waipoua Nursery conveyed kauri dieback disease to some of the destination plantation sites.

- This evidence of transfer is most unequivocal at Raetea Forest in the Victoria Valley plantations, a few kilometres south of Kaitaia.
- The PA-positive 1953 plantation in the Kaiaraara Valley of GBI was planted with Waipoua Nursery-sourced seedlings.
- The diseased stand at the Omahuta Forest HQ site is most likely a footnote to the Raetea situation.
- The presence of the kauri dieback pathogen in the Glenbervie Forest plantations also points back towards the Waipoua Nursery. The Glenbervie kauri plantations generally produce PA-positive soil samples, but the trees themselves generally do not display any PA symptoms.
- There is an isolated 1956 plantation in compartment 4 at Waipoua heavily infected with the disease.
- The probably widespread infection in the Punaruku Valley of Russell Forest is not clearly associated with the Waipoua Nursery, but certainly Waipoua Nursery seedlings were planted at Punaruku, as were trees from the FRI nursery in Rotorua. The disease is there, the Waipoua-sourced plantings are there, but the Punaruku plantations inspected so far are not symptomatic of kauri dieback.

The above infected plantations are mostly associated with nursery seedlings dispatched from Waipoua Nursery between 1953 and 1959, with the strongest association being in the 1955–1957 plantings. It is

the intention of this section of the report to examine the Waipoua Nursery systems, which may have played a part in infecting the seedlings used at the above and other plantations.

Context: NZFS Nurseries

In the early years of the NZFS, nursery work was seen as a routine aspect of forest management on moderate to large forest stations. It was seen as more efficient to grow trees near the sites being established in exotic plantations. A local nursery also had benefits of allowing an integrated work programme on forest stations and staff training opportunities. In Northland in the 1940s, there were nurseries at Puhipuhi, Waitangi and Glenbervie as well as the facility at Waipoua.

There was a nursery at Tairua Forest on Coromandel, which also produced some kauri. When Whangapoua Forest was established in the late 1940s, there was considerable investigation in terms of seeking a suitable site to establish a nursery. Even on GBI, a small nursery was established to produce exotic conifers for the very modest exotic forest establishment agenda on the island. The nurseries were small in scale, and most work was done by hand. Horses were often used for initial cultivation and harrowing.

Waipoua Nursery Production

The 1951 annual report for Waipoua describes the production of 331000 seedlings, mostly exotic conifers, 243000 of which were planted at Waipoua. In that year, seedlings from the nursery were dispatched as far afield as Tairua and Riverhead. Production had reduced to 141000 seedlings by 1952, and to less than 10000 seedlings by 1953 as the Northern District Nursery in Kaikohe took over production of exotic plantation species. The 10000 trees produced that year were mostly indigenous or niche exotics. In the same year, the nursery recorded tree stock on hand of approximately 47000 trees, including 43000 kauri ranging in age from 2–7 years, indicating the specialised direction the nursery had taken.

Nursery Practices

In terms of broad information for this section, the late Jim Cox, who was based at Waipoua from the late 1940s through to about 1960, must be acknowledged because he supplied most of the material. In 1949, he attended a leading hand training course at the Forest Training Centre in Rotorua and took very detailed notes. His notes on nursery practices have been useful in compiling this section of the report. Jim Cox was interviewed by Will Ngakuru for the KDP in 2012.

Cox's comments re Frank Morrison's involvement in the nursery were to the effect that "we had good systems; then Frank Morrison came along and changed everything". There is no doubt that Morrison was an inveterate tinkerer and was propelled by "science", and the authority his role as Forester gave him, as well as new knowledge he acquired from his experiences, for example, his tour of Queensland in 1955 to look at the Australian systems of growing *A. robusta*, meant his opinion carried weight. Joe Levy also influenced nursery practices at Waipoua through his trials with the Dunemann frame.

Sowing

In 1953, seed beds were reduced from 1.8 m wide to 1.2 m wide, with approximately 0.6 m between beds. They were built up via intense cultivation; digging, forking and raking to a depth of at least 150 mm, with the soil from the walkway between the beds thrown onto the bed to achieve the desired

height. Seed was sown in bands. The bands were imprinted onto the beds by running a roller with three raised bands of the desired width (150 mm wide and 150 mm apart) along the beds. Seed was sown by hand into the imprinted bands and covered with a fine tilth. Figure 24 is an old photo from 1956 of band sowing and shows the scale at which it was generally practiced.

Figure 86. Band sowing at Waipoua Forest Nursery. Note height of bed and demarcation wires.
Note. Photo extracted from the 1956 Waipoua Forest Annual Report.

The beds were covered, usually with hessian to reduce drying and to deter birds from eating the seeds/seedlings. In later developments/innovations, the bands were reduced in width to 50 mm, and by 1956, seed was line sown into the beds (Figure 25).

Figure 87. Line sowing at Waipoua Forest Nursery.
Note. Photo extracted from the 1956 Waipoua Forest Annual Report.

PA Risks from Sowing

In terms of kauri dieback risks from this phase of nursery activity, these can be summarised as follows.

1. *Seed bed preparation*. This was a low to moderate risk activity where PA could be circulated via material adhering to tools and to the footwear and clothing of nursery workers. However, starting in about 1957, the Waipoua Nursery brought organic material (taraire leaf litter and pukahu from kauri stands) in from the adjacent forest and forked it into the beds to improve soil texture. This material, from potentially infected natural forest, raises the risk status considerably.
2. *Seed sowing*. Most likely a very low risk activity. Indeed, PA does not circulate via seed. Again, it would be the possibility of workers' boots/clothing causing a transfer. The fine material used to cover the seeds could have come from the bed itself, but was often sieved at a central location and brought to the beds, thereby opening up wider risk areas of possibly questionable sieved material and a further range of potentially infected tools.

Cultivating and Weeding

Waipoua Nursery used hand weeding to control competing weeds. After about a year in the seed beds, seedlings were "wrenched" to sever tap roots and to encourage fibrous root development. Wrenching

involves angled slicing under the seedling with a sharp spade to trim the tap root. Weeding activity can be seen in Figure 26.

Figure 88. Weeding line-sown kauri at 11 months, Waipoua Forest Nursery. Note slatted frames to reduce seedling exposure. Previously, tea tree was used for this purpose.
Note. Photo extracted from the 1956 Waipoua Forest Annual Report.

PA Risks from Cultivating and Weeding

Weeding constitutes a low risk of transfer via workers; boots and clothing. Wrenching poses several risks, raising the overall risk from these activities to a moderate level. Risk of transfer via a dirty spade bringing infected material in is also possible. Risk of transfer of material already in the bed being picked up and circulated adds an element of uncertainty. Risk of transfer via workers' boots and clothing adds to the overall risk.

Lining Out

After 1–2 years in the seedling beds, trees were lifted and "lined out" 100 mm apart in rows approximately 225 mm apart. They were placed upright against the vertical face of a prepared trench, and the soil was filled back over the roots. Sometimes, lining-out boards were used to hold the plants in place as they were lined out. The Waipoua bush house, constructed in 1948, held up to 20,000 lined-out kauri seedlings (Figure 27). If there were more trees than the bush house could hold, they were lined out in the open nursery and screened from the sun with tea tree. By 1954, the bush house had become dilapidated, and it was dismantled in 1955. Trees were lined out in the beds, and slats across the frames provided shade/shelter.

Figure 89. Kauri seedlings lined out in the Waipoua bush house.
Note. Photo extracted from the 1954 Waipoua Forest Annual Report.

PA Risks Associated with Lining Out

This work involved lifting the seedlings from the seedling bed and moving them to the lining-out site in another part of the nursery. Risks are modest and relate to the use of tools and the movement of personnel. The bush house was used for many years for this purpose, and there would have been a compounding risk coming from repeated use of the same site. Some of the losses in the nursery associated with seedlings lined out in the second Dunemann trial could be interpreted as some parts of the nursery being infected with a root rotting pathogen. This is alluded to in some of the annual reports, with various remedies employed, possibly with some success, to sterilise soil in parts of the nursery where losses had occurred.

Lifting, Preparation and Dispatch of Seedlings

Approximately 6 weeks before lifting, seedlings were given a final wrenching. A variety of methods were used at Waipoua to prepare seedlings for transfer to the planting site. The various methods are described below. It is hard to judge from Frank Morrison's paper which of the seedling preparation methods was the standard one used in those times.

- *Trees bundled in fives and wrapped in hessian*

This method saw workers pack trees into damp nursery soil, which was then bound in hessian and tied. The theory was that some nursery soil would be planted with each seedling, thereby easing the transition from nursery to plantation. This theory was, perhaps, naively optimistic about the degree of care exercised by forest workers at the planting site.

- *Trees bundled in soil and wrapped singly in hessian and tied*

The intention with these trees was that they would be planted “as is”, and the hessian would rot away, allowing an easy transition to the planting site.

- *Trees puddled in groups of five or ten and tied*

“Puddling” involved making sticky soil slurry into which the bundled trees were dipped repeatedly until enough soil adhered to the roots to bind the bundle. Bundles were packed into boxes for dispatch. A weakness of this system was the damage inflicted on the plants when workers broke the bundle up prior to planting, often by tapping it on their boot or on a nearby stump.

- *Soil blocks*

This was a growing system used at Waipoua in quite extensive trials commencing in 1955. It employed an English “Gorodam” soil block machine to compress and indent the soil blocks. The soil blocks were then packed into boxes. Two or three seeds were sown in each indentation and later thinned to one, or a cotyledinous seedling was transplanted into the soil block. The seedling(s) remained in the soil block until planted out. The system offered several advantages over nursery bed techniques; i.e., no lining out, very little weeding, no lifting, bundling, puddling, etc.

Figure 90. A Gorodam soil block-making machine as used at Waipoua Nursery.

- *Seedlings rolled in veneers*

Lifted seedlings were wrapped in soil and rolled in veneers (1.5 mm thick) and either lined out for a year or planted immediately.

- *Seedlings in tubes*

Steel tubes, possibly galvanised, were used based on a technique used in Queensland on *A. robusta*. Trees were placed in the tubes some months before planting out.

PA Risks Associated with Tree Dispatch Methods

All of the methods described above, except the soil blocks, required packing of the tree roots in soil prior to dispatch. The source of the soil requires consideration from a PA perspective. The soil used

could have been nursery soil or may have been brought in to fulfil a particular requirement. For example, puddling required a tacky solution with reasonably high proportions of clay. Soil blocks had a need to hold together for the 3 (or more) years the tree was kept in the nursery, and required a particular mix, one ingredient of which was river sand. Every site used for sourcing soil posed the risk of uplifting PA material with the soil. Re-use of material such as the steel tubes or the boxes trees were dispatched in offered a further risk of having brought PA back to the nursery.

Dunemann Frame Use at Waipoua Forest Nursery

In April 1953, Assistant Forester Joe Levy commenced trials of the Dunemann frame system for raising kauri seedlings.

The Dunemann System

Described by Levy and as used in West Germany, where 14-in (35 cm)-deep boxed beds of spruce needles were laid. The needles were thoroughly soaked, and then a 3 mm layer of beech (leaf) mould was laid on top. The seeds were sown and were then covered with another 3-mm layer of beech mould.

First Dunemann Frame Trial at Waipoua

1953 Planting: Seed Lot AK 53/661

Levy substituted compacted pine needles for the spruce needles and used taraire leaf mould for the top two layers. Levy was keen to try the system, as it appeared to offer many advantages over the current practice (standard frames and Kelly frames). Perceived advantages were that:

- Dunemann frames could grow double the number of seedlings in equivalent space;
- very little weeding was required;
- the frames were rat proof;
- their use led to an improved fibrous root system;
- they allowed for more rapid germination of kauri seed.

Levy built beds 1.8 m long x 0.9 m wide x 0.3 deep (he did not say how many) and sowed them with 1 oz (28 g) of seed each from seed trees 847 and 852. He sowed the same quantity of seed from the same two seed trees in Kelly frames as a control.

Figure 91. Kauri seedlings in Dunemann frame 11 months after sowing, Waipoua Forest Nursery.
Note. Photo from 1954 Waipoua Annual Report.

1954

All 206 Dunemann frame seedlings from seed tree 847 were lined out in the bush house, along with 206 seedlings from seed tree 847, which were uplifted from the Kelly (control) frame.

1955

All seed tree 847, bush house (Dunemann frame trial and Kelly control) seedlings were lined out in the open. All the 2-year-old seedlings from seed tree 852, from both the Dunemann (136 seedlings) and Kelly control frames (148 seedlings) were lined out in the open.

1956

Survival of Dunemann-raised seedlings from time of lining out was 77%. Survival of Kelly frame-raised seedlings from the time of lining out was 66%. Mortality was "due to the wet conditions". The Dunemann-raised seedlings were seen at time of lining out to have superior fibrous root systems and better overall shoot development.

Kauri Dieback Risks from First Dunemann Trial

There is concern within the KDP that the 1950s kauri seedlings coming out of Waipoua Forest Nursery may have conveyed kauri dieback to other state forests. The Dunemann frame system of using recovered taraire leaf litter from Waipoua Forest could have been the means of introducing PA to the nursery and thence to the other forests via contaminated seedlings. Kauri/taraire is a common forest association at Waipoua. If the source stand of the taraire leaf litter was already infected with PA, then the collection of the leaf litter for the Dunemann trial could have been the means of introducing kauri dieback to the Waipoua Forest Nursery. However, looking at the report on the above trial, there is nothing to indicate the presence of PA in the Dunemann management of kauri seedlings within the period described by Levy (1953–1956). For example:

- mortality of kauri seedlings raised in the Dunemann frames was lower;
- root systems were rated as "superior".

So, in terms of this first trial, there is nothing to indicate the (active) presence of PA in this cohort of seedlings within the 1953–1956 trial period. However; where did they go? There were 503 3-year-old trees alive during this trial when Levy's report for the Fifth Kauri Conference was compiled in April 1956. The location of these trees' final planting destination is important. Joe Levy reported to the Sixth Kauri Conference in 1957 that all of the first Dunemann-raised trees and the controls were planted at Raetea Forest at 6 ft. x 6 ft. spacing in 1955. This 1955 date is incorrect, because in his 1956 report to the Fifth Kauri Conference, Levy reported that the whole cohort of Dunemann (and Kelly-raised control) seedlings were intact at the Waipoua Nursery in April 1956.

The 1955 plantation at Raetea was planted at 10 ft. x 10 ft. spacing using Waipoua Nursery-raised seedlings from seed lot number AK 52/654.They were planted in sections keyed to their seed tree origins. This seed lot is recorded on the cover sheet of SP A228. The spacing was described in the *Working Plan for Raetea State Forest* (1962–1972). Furthermore, in one of his Forester's 4-weekly reports, Levy describes in detail the 1956 Raetea plantings carried out by the Omahuta Forest workmen "under my direct supervision". To quote this report:

"Several variants were adopted as follows: 2700 trees were planted at 10 ft. x 10 ft. on approximately 6.5 acres, partly clear and partly in mānuka. [A total of] 300 trees were planted at 15 ft. x 15 ft. on 1.5 acres in the open. [A total of] 300 kauri and 325 *E. saligna* were planted in line-by-line mixture at 6 ft. x 6 ft. over half an acre in the open. [And] 466 stock from 1953 Dunemann frames and controls were planted in the open at 6 ft. x 6 ft. In addition, I release cut and blanked with stock of numbered seed trees the half acre of 1955 kauri trial planting."

The above information on the 1956 planting is further corroborated in the *Raetea Forest Working Plan* (1963–1972). So the destination of the 1953–1956 first Dunemann trial is unequivocal. The trees were planted at Raetea. Their location within the 3.4 ha 1956 plantation can probably be deduced by the 6 ft. x 6 ft. spacing if enough trees have survived to pick up this pattern on the ground. The 1956 plantation at Raetea appears to be a primary site for PA. It was unthrifty from the start, requiring numerous blanks. Also, it was subject to repeated cattle incursions, meaning that if there was any PA there initially, active vectoring was on-going. The 1955 plantation at Raetea, in contrast, is very healthy, and neither symptoms nor soil testing indicates the presence of PA. Whatever stock was used by Levy to blank it in 1956 does not seem to have conveyed PA there.

Risk Footnote: Omahuta HQ Plantation

Behind the old Omahuta Forest HQ is a highly infected stand of approximately 50 plantation kauri. The KDP has been unable to identify the nursery origin of this plantation or the date of its establishment. Given that Omahuta workmen did the plantation establishment work at Raetea, it is quite possible that some trees intended for planting at Raetea were diverted to Omahuta. The discrepancy between the number of 1953 Dunemann trial trees inventoried by Levy at the Waipoua Nursery in April 1956 (503 trees) and the number planted at Raetea (466 trees) might indicate where most of these trees came from. Joe Levy's presence supervising the Omahuta gang may have led to such a diversion, if he approved it, a kind of formal authorisation. There is no mention of the Omahuta plantation in any NZFS record located by the author to date.

Second Dunemann Frame Trial at Waipoua

1954 Planting: Seed Lot AK 54/681

In this second trial, a new Dunemann frame 36 ft. x 4 ft. (10.8 m x 1.2 m) was constructed. The same methods were used (compacted pine needles for the seed bed covered with 3 mm of taraire leaf mould, seeds sown and then covered with 3 mm of taraire leaf mould). Three ounces (approximately 84 g) of seed from each of four seed trees (seed lots 843, 849, 847 and 857) was sown in the Dunemann frame. The control beds (alongside) were sown with 1.5 oz (approximately 42 g) of seed from each of the same seed trees. Note, kauri seed sowing at Waipoua was usually carried out from March–April.

1955

In winter 1955, two of the seed tree lots, from seed tree 843 (1086 trees) and seed tree 849 (976 trees) were lined out in the open from the Dunemann frame. Half were mulched with Dunemann frame material. Trees from the control, seed tree 843 (263 trees) and seed tree 849 (153 trees) were lined out in the open as well. The other two seed tree cohorts (847 and 857) were left in the frames (Dunemann and control).

1956

By April 1956, the situation for this Dunemann frame trial was as per Table 10

Table 10 Second Dunemann frame (1954) kauri plantings, Waipoua Forest Nursery

Frame or control (F/C)	Seed tree #	Year lined out	# of trees lined out	# of trees alive by 1956	Survival rate (%)
F	843	1955	1068	886	83
F	849	1955	976	732	75
F	847			Some alive in frame	Nearly all dead
F	857	1955	No data/notes	Some alive in frame	Some dead
C	843	1955	263	204	78
C	849	1955	153	31	20
C	847	1955	No exact figure available	Seedlings healthy	100%
C	857	1955	No exact figure available	Seedlings healthy	100%

Note. Control (C) seedlings were planted in a Kelly frame.
Abbreviation. #, number.

In endeavouring to explain the losses, Levy comments that the weather at Waipoua had been unremittingly wet, and this wetness perhaps explains why the mulched, lined-out stock had higher mortality and poorer growth than the un-mulched seedlings. He also comments on a late 1954 flood sweeping through the nursery which, among other things, shifted the Dunemann frame several feet.

Kauri Dieback Risks from Second Dunemann Trial

Some features of the trial arouse interest from a kauri dieback perspective.

1. The very high mortality (80%) in the lined-out seed tree 857 seedlings in comparison to the control seedling mortality
2. The almost total loss of the seed tree 847 seedlings, which were left in the Dunemann frame
3. The relatively high survival rates (75% and 83%) of the Dunemann-raised and lined-out seedlings
4. The flood in late 1954

Possibly, something above the ordinary was at work in points number 1 and 2 listed above. It needs to be borne in mind that mortality of seedlings is a constant issue for nursery managers. However, these heavy losses in both the frames and the lining out beds are beyond normal expectations. Possibly, PA was at work. This raises the issue of how the beds might have become infected. The previous trial (the first trial) with the Dunemann frame had encountered none of these mortality issues. This possibly mitigates against the transfer of PA material via the taraire leaf litter. Some of the seedlings in that trial (the first one) were held in the frames for 2 years with no observed mortality.

The mulching of lined-out stock with Dunemann organic material is another possible cause. Levy suggests that the mulching exacerbated the sodden nature of the nursery beds, which he saw "possibly

explains why mulched, lined-out stock have showed lower survival and poorer growth". His report is not clear as to whether Dunemann organic material was used as mulch on the control, lined-out seedlings that suffered higher mortality than the Dunemann-raised seedlings. It is possible the flood was the more likely explanation. This does not mean that the author believes the taraire leaf litter explanation is invalid, just that the flood seemed to trigger something quite widespread.

The 1953 Dunemann frame was functional in the nursery at the time of the flood (late 1954). Trees from this trial were lined out in 1954 into the bush house (before the flood) and in 1955, into the beds (after the flood). We do not know their relative locations in the nursery. The flood gets no mention in describing the 1953 trial. There is no irrational pattern of mortality of seedlings in this trial. Nevertheless, that cohort of trees may have carried kauri dieback to Raetea Forest, so something may have introduced the pathogen to the Waipoua Nursery. Was it the taraire leaf litter, or was it the flood? Both explanations presuppose that the forest surrounding the nursery was infected with PA. In terms of the 1954 trial, the fact of the mortality in the Dunemann frame remains, the fact of the mortality in the control, lined-out stock remains, the fact of the flood and its impact on the Dunemann frame remains and the fact that exactly the same methodology was used in raising the seedlings as in the previous trial remains.

A further piece of information re the possible role of taraire leaf litter as a vector of introduction of PA to the Waipoua Nursery is that, commencing in either 1957 or 1958, a process of forking collected taraire leaf litter into the upper layer of kauri nursery beds became almost a standard practice, with no apparent adverse effects. In fact, in his report to the Tenth Kauri Conference in 1962, Morrison endorses the practice as preferable to, and at least as beneficial as soil sterilisation using chloropicrin or formalin. Certainly, there is no indication of *Phytophthora*-type activity accompanying the practice. So, the prospect of the transfer of PA into the Waipoua Nursery via the taraire leaf litter as the key agent may not be as likely, based on the above information.

Risk Footnote: PA Risks Further Afield

In terms of tracing where the trees from the second Dunemann trial were planted, 2000 1/3-size trees from this seed lot (AK 54/681) were planted at Raetea in 1958, both as blanks (most likely in the 1956 established area) and to make up the 1.0 ha 1958 plantation. This 1958 plantation is currently symptomatic for PA. Seedlings from the second Dunemann frame trial were lined out in 1955, and this would match the 1/3-size description above, so some or all of them may have gone to Raetea. However, no certainty exists as to the plantation destination of the second Dunemann trial seedlings.

Third Dunemann Trial at Waipoua

1955 Planting: Seed Lot AK 55/698

Joe Levy was concerned at the cost of gathering taraire leaf litter and wished to trial using sawdust as a substitute. He proposed to do this trial in 1955 but was unwell on sick leave at the critical sowing time. He installed a late-sown trial using 2 oz (56 g) of kauri seed each under sawdust and taraire leaf litter, but germination under both media was poor, and the trial was abandoned.

Kauri Dieback Risks from Third Dunemann Trial

There is nothing in this trial that provides any insights on possible connection of the Dunemann frame use to PA. The low germination can most likely be assigned to the well-established pattern of germination success fading as the time from seed collection to seed sowing stretches out.

Fourth Dunemann Trial at Waipoua

1956 Planting: Seed Lot AK 56/716

In this trial, 8 oz of seed was sown in Dunemann frames, half under sawdust and half under taraire leaf litter in April 1956. At the time of reporting (July 1956), germination was "good" in both media.

Kauri Dieback Risks from Fourth Dunemann Trial

Nothing in this trial's short reporting period (4 months) suggests any connection of the trial to PA presence. Seedlings from this seed lot were planted at Waipoua Forest in compartments 58 and 59, but at the time of the writing of this report, no information had come to light to say that any of these seedlings came from the Dunemann-raised stock. A total of 300 seedlings from this seed lot were used for grafting at Waipoua, and some of these grafted trees were planted out in compartment 58.

Dunemann Frames Used Elsewhere

In his report to the 1956 Kauri Conference, Levy expressed concern that he was unable to isolate the cost of the Dunemann operation at Waipoua and proposed to set up a Dunemann trial "where there is no nursery so that costs may be accurately kept for comparison with standard practice at Waipoua". Levy proposed to "continue the experiments in autumn 1957 at Omahuta, the resultant stock to be planted at Raetea State Forest No. 2".

A Dunemann frame was set up at Omahuta in 1957. The Omahuta period report for March 1957 provides a brief mention of "9-nursery production. Preparing frames and bed and sowing kauri seed 6 ft. (man hours)." The May period report records "the kauri seed, sown in a frame enclosing decaying pine needles and humus last period shows a favourable strike". There is no further mention of the Omahuta Forest Dunemann trial in the Omahuta Forest period reports. Levy also recorded the setting up of the Omahuta Dunemann frame in his report to the Sixth Kauri Conference in July 1957. In his section of the *Kaikohe District Annual Report for 1957*, Levy commented as follows.

"*Dunemann Frame*. On April 26th, 1 lb of kauri seed was sown in a Dunemann frame at Omahuta HQ, using *P. patula* needles and a covering of sawdust. Unfortunately, heavy weed infestation from adjacent grass area has more or less ruined the experiment, while during the hot dry summer weather, watering was not maintained. There seems to be no point in continuing with this type of frame unless it can be given the close attention which I was able to give the first two at Waipoua."

This appears to be the end of the matter. The Dunemann trials were abandoned. The close attention that an intelligent and motivated young Junior Forester (Levy), who was, at that time, in permanent residence at Waipoua, was able to bring to the trials was lost as Levy's career progressed and he was moved into other locations and roles and was required to delegate his work to station staff, who were probably also distracted by their other responsibilities. Meanwhile, Frank Morrison had been to

Queensland to look at *A. robusta* management and was adding some of the Queensland methods to the kauri-raising nursery techniques at Waipoua.

Summary Comments on Dunemann Frame Trials

The following points can be made on the Dunemann trials and their possible association with the movement of kauri dieback.

- A plantation where 1953 trial Dunemann-raised trees were planted is infected with PA (a 1956 plantation at Raetea).
- Massive die-off occurred in 1954 trial kauri seedlings held in the Dunemann frame into their second year.
- Taraire leaf litter was brought from the forest into the nursey for use in the Dunemann frames.
- The infected kauri plantation at Omahuta HQ may have been at least partly planted with Waipoua Dunemann-raised seedlings.

Clarity on the possible Dunemann frame–kauri dieback association is obscured by the following facts:

- Waipoua-raised seedlings from sources other than the Dunemann frames were also planted in the 1956 Raetea kauri plantation area. This plantation performed badly right from the start, with yellowing and mortality, requiring considerable blanking in subsequent years. Several cattle incursions also occurred.
- Waipoua-raised seedlings were planted at Raetea in 1955, 1956, 1957 (as blanks), 1958 and 1959. All except the (isolated) 1955 stand are infected with kauri dieback.
- All the 1950s plantations at Raetea except the 1955 area suffered repeated cattle incursions.
- The highly abnormal scale of the die-off of lined-out seedlings from the control Kelly frame in 1955 adds uncertainty to the analysis.
- The possible effects of the late 1954 flood that “swept through the nursery” adds a new variable to the analysis.
- The possible roles that other management practices used at Waipoua Nursery may have played in introducing and spreading kauri dieback, e.g. soil block manufacture, puddling of seedlings for dispatch, recycling of equipment, mulching and other practices add numerous variables (see the “Waipoua Forest Nursery” section of this report for more detail).

Nevertheless, at least some of the trees coming out of Waipoua Nursery in 1956 conveyed kauri dieback to Raetea Forest. Was it the Dunemann-raised trees infected through the taraire leaf litter? Or did the 1954 flood introduce and disperse kauri dieback through the flooded parts of the nursery? These questions are difficult to answer with the facts at hand.

Figure 92. Waipoua Nursery site in 1930, still a bare paddock.
Notes. The nursery was set against the bush edge, with a dead mature kauri visible in the catchment. Nursery beds are in the foreground.

Figure 30 is a photo of the Waipoua Nursery site, which is implicated in the kauri dieback scenario. Its layout is therefore of interest. In Figure 30, a swing bridge to the later nursery site across the Waipoua River is on the extreme right. The forest immediately behind the nursery site is described by Burns and Leathwick in their 1992 *FRI Bulletin 143, Vegetation Map of the Waipoua Forest Sanctuary* as "F4 taraire kohekohe forest", and the kauri stand to the rear as "F10 kauri/taraire forest". Workers from the nursery would most likely have gathered leaf litter for the Dunemann frames from these taraire stands.

The view in Figure 30 also looks into the catchment of the Waikohatu Stream. This is a very big catchment, draining a substantial area of mature kauri forest, with some stands very badly afflicted with kauri dieback and including those where kauri dieback was first observed in 1971 and ascribed to *P. cinnamomi*. It was the Waikohatu Stream that flooded across the nursery in 1954, not the Waipoua River.

The Northern Arboretum, Waipoua Forest

Introduction

The Northern Arboretum, which was developed at Waipoua Forest in the 1940s and 1950s, is of interest to the KDP because it brought a range of foreign *Agathis* and *Araucaria* species to NZ at a time when biosecurity mechanisms may not have been adequate to prevent pathogens being brought in along with these imported plant species. The purpose of this section of the Historic Pathways report is to examine the development of the arboreta at Waipoua, to review the current field situation, to highlight any risk areas the developments may have allowed, and to assess if the current arboretum remnants pose any ongoing risks re kauri dieback.

Origin of the Arboretum

The concept of an arboretum comprising species of the genera *Agathis*, *Araucaria* and *Phyllocladus* appears to have been the brain child of the then Director of the NZFS, Alex R. Entrican. Entrican communicated the concept to R. D. Campbell, the Auckland Conservator of Forests, at a meeting held in Auckland on 25th November 25th, 1941. Earlier, most likely in May 1941, Entrican had arranged for some shipments of foreign *Agathis* seed to the Waipoua Nursery as recorded in an undated, hand-written note as follows. The handwriting is Entrican's:

"Seed supplies to Waipoua Nursery for the establishment of an arboretum of *Agathis* and *Araucaria*."

The species brought into the arboretum are listed in Table 11 below.

Table 11 Seed supplied for the Northern Arboretum, Waipoua in 1941

Species	Lot #	Supplier
Agathis robusta	HO 40/318	Forestry Dept., Queensland
A. palmerstonii	HO 40/317	Forestry Dept., Queensland
A. dammara	HO 41/326 AK 472	Forestry Dept., Dutch East Indies West Java
A. philippinensis	HO 41/327 AK 473	Forestry Dept., Dutch East Indies Celebes
A. celebica	HO 41/338 AK 477	Forest Offices, Manado, Celebes
Araucaria brasiliana	HO 41/337	Exp. Ins. of Agr., Santa Fe, Argentine
Phyllocladus rhomoidalis	HO 41/328 AK 474	Forestry Dept., Tasmania

Abbreviations. #, number; Dept. department; HO, Head Office

Survey and Design

Forest Assistant A. D. McKinnon visited Waipoua, probably in late 1941, and submitted a report in January 1942 in which he evaluated two options for a site for the arboretum, one option near the forest HQ and the other in shrublands near the southern entrance to the forest. On the basis of the lower scrub height, easier topography and greater land area available, McKinnon recommended proceeding with the site near the southern forest boundary. Figure 31 shows the site as it was according to its layout plan (c. 1946).

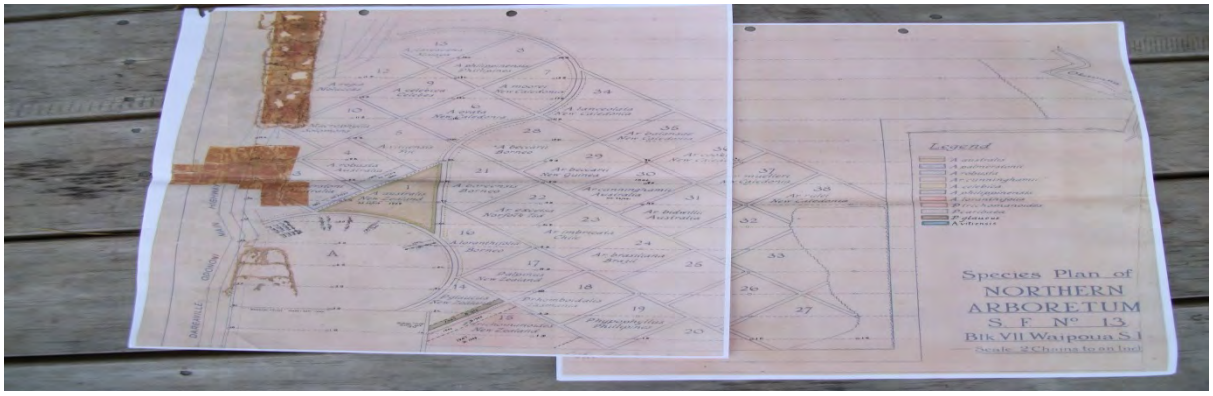


Figure 93. Layout plan for the Northern Arboretum, Waipoua Forest, c. 1946.

On March 6th, 1942, Entrican sent the Auckland Conservator a memorandum with instructions for the development of the arboretum. There were five main instructions:

1. "The area at the southern entrance to Waipoua by the state highway will be used for this purpose.
2. Provision will be made for one caretaker's residence at this point.
3. The whole of the area is to be laid off in such a way as to facilitate the planting of closely planted groups.
4. One avenue is to be formally laid out. This may either be in the area itself or form a portion of the main road. Great care is to be taken in the selection of trees for this particular avenue.
5. Nurse species should be employed wherever practicable, and some interplanting in the adjacent forest itself should be undertaken. It is desirable that the trees be grown in such a way as to develop a proper forest form."

Entrican further required a topographic and soil survey as a basis for planning and laying out the arboretum. There was some debate between the Director General and Conservator re details, with the survey finally being undertaken in late 1945 and a detailed layout plan being compiled in August 1946, in time to record the first arboretum plantings, which had been carried out in the winter of 1946. A copy of the layout plan at a scale of two chains to the inch has been lodged in Archives NZ Mangere. The author has not sighted the topographic survey map (produced at a scale of one chain to the inch, as required by Entrican). Given Entrican's close interest in the project, such a plan may be held in Archives NZ in Wellington. This plan grids up the area into 39 sub-compartments of 0.5 to 1 acre each, with the intention to plant 15 species of *Agathis*, 10 species of *Araucaria*, five species of *Phyllocladus* and one area carrying representatives of all the species. As proposed, each sub-compartment required approximately 1000 trees (Figure 31).

Development History

The area was surveyed, gridded up and the main "avenue" formed in 1945–1946. The patterns of roads, tracks and grids stand out quite strongly in 1950 aerial photography. These grid lines are visible on the 1950 aerial photograph to the west of the highway as well as in the area of the arboretum, which lies to the east of the highway. Planting commenced in 1946, when the avenue edges were planted with NZ kauri at 12 ft. intervals, 12 ft. back from each side of the road. A start was made on planting the blocks with *A. robusta* (327 trees in sub-compartment 4) and *A. palmerstonii* (59 trees in sub-compartment 3), and the planting of the *Araucaria cunninghamii* block (1119 trees in sub-compartment 30) was completed. Groups of trees were planted radially in the circular area A, as follows, starting on the western edge:

- *A. australis*, 5 trees
- *A. palmerstonii*, 5 trees
- *A. robusta*, 5 trees
- *A. celebica*, 4 trees
- *A. philippinensis*, 5 trees
- *A. loranthifolia* Salisb., 5 trees
- *Araucaria cunninghamii*, 5 trees

- *Phyllocladus trichomanoides*, 5 trees

Four specimens of *A. loranthifolia* Salisb. were planted in sub-compartment 16 in 1946. They show up as a line of four dots on the site map opposite the southern corner of the 1948 *A. australis* plantings in sub-compartment 1. The *A. loranthifolia* Salisb. may have been brought to Waipoua as ready-to-plant seedlings, because no record of this seed being available exists in archives. The remainder were raised in the Waipoua Nursery and dispatched to the planting site, each balled separately with nursery soil and scrim-wrapped.

A total of 832 *P. trichomanoides* were planted in sub-compartment 15, and 95 *P. glaucus* were planted in sub-compartment 14. Survival was initially excellent. A survival survey of the 1946 planting done in March 1947 recorded 100% survival for all species except *A. australis* (87%) and *P. trichomanoides* (NZ tānekaha) at 91%. There was no planting at the arboretum in 1947 except for some blanking (87 trees) of the circular "avenue" NZ kauri (Figure 32).

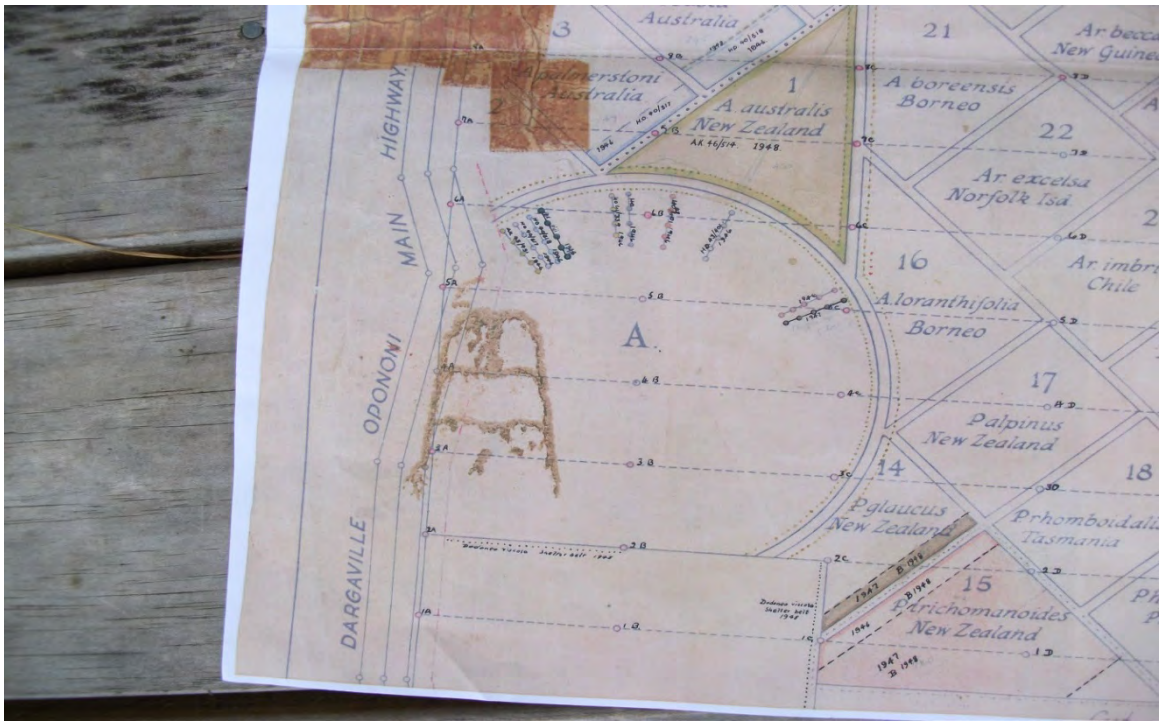


Figure 94. The plan for circular avenue kauri plantings at the Northern Arboretum, Waipoua Forest.

The 1948 Plantings

The 1948 plantings were conducted as follows:

1. The planting up of sub-compartment 1 with 1100 *A. australis* trees from seed lot AK 46/514
2. The planting of five *A. vitiensis* imported to Waipoua as seedlings from Fiji. These were planted in the usual radial pattern in area A, adjacent and to the east of the five *A. robusta* (seed lot HO 40/318) planted in 1946
3. Thirty-two *A. robusta* seedlings (seed lot HO 40/318) were added to the sub-compartment 4 plantings of that species

4. Twelve *A. palmerstonii* seedlings of seed lot AK 47/532 were added to the sub-compartment 3 plantings of that species
5. A total of 264 blanks of *A. australis* were used to fill survival gaps in the "avenue" plantings of that species
6. Three blanks of *A. australis* (seed lot AK 43/491[?]) were used to replace gaps in the radially planted group of five trees in area A
7. A total of 175 wilding blanks of *P. trichomanoides* were used to fill survival gaps in sub-compartment 15
8. Exactly 70 wilding blanks were used to fill survival gaps in *P. glaucus* plantings in sub-compartment 14

The 1949 Plantings

The 1949 plantings were less extensive.

1. A further 33 *A. palmerstonii* seedlings of seed lot HO 47/376 were added to the sub-compartment 3 plantings
2. A larger group of 192 *A. robusta* seedlings of seed lot HO 46/366 were added to the sub-compartment 4 plantings of that species
3. A total of 104 wilding blanks of *P. trichomanoides* were used to fill mortality gaps in sub-compartment 15
4. Exactly 80 wilding blanks of *P. glaucus* were used to fill mortality gaps in sub-compartment 14

The 1950 Plantings

Efforts in 1950 comprised only three tasks.

1. Adding 190 *A. palmerstonii* seedlings of seed lot HO 47/376 to sub-compartment 3 plantings
2. Adding 314 *A. robusta* seedlings of HO 46/366 to sub-compartment 4 plantings
3. Using 90 more wilding blanks to fill mortality gaps in sub-compartment 15

Review of Site

The above planting activities, which decreased over the years, indicate a waning of impetus in the development of the arboretum. This was partly due to the inability of the Waipoua Forest Nursery to produce foreign *Agathis* seedlings in the kinds of numbers that would meet the requirements of the development plan. The waning of impetus may have also related to the difficulties of developing a sophisticated, cutting-edge facility at a remote site where soils and climate may not have been suitable for the realisation of Entrican's vision.

The Auckland Conservator F. J. Perham sent a memo to Director General Entrican in May 1948 in which he summarised the achievements to date and requested sufficient seed (13 species of foreign *Agathis*, nine species of foreign *Araucaria* and two species of foreign *Phyllocladus*) to complete the planting plan. No access to seed import information re the *Phyllocladus* and *Araucaria* was available at the time of the writing of this report, but the *Agathis* records held by Scion do not show any importations

from Perham's list, apart from some seed of *A. vitiensis* (Fijian kauri). No record of a response to this memo from Entrican exists today.

Frank Morrison produced an undated, 5-page report on the arboretum in about 1950.The report has nine pages of appendices, and these are probably its main value today. The scope of the report is quite narrow, as he was not required to comment on the general viability of the arboretum. However, concern about the viability of the arboretum shows up in correspondence in May 1951, principally from Assistant Director General A. L. Poole. Poole did not believe that the plan, as conceived, could be implemented, and requested that the Conservator develop proposals for a simpler facility at alternative sites. In other correspondence, he proposed that FRI acted as the coordinating body for arboretum development.

Conservator Perham complied, and in a September 13th, 1951 memo to the Director General, he described Frank Morrison's proposal to use the soon-to-be-abandoned Waikohatu Nursery as the centre of a simplified design for an arboretum based on FRI's control plan number 10. This control plan could not be located at the time of the writing of this report. Perham asked for the Director General's go-ahead to use the proposed site. The site was endorsed by FRI in a November 1951 memo. However, the gazettal of the forest sanctuary included most of the land intended for this proposal, and the site was dropped.

Poole endorsed a site at the HQ proposed by Joe Levy instead, and this was settled on. Planting commenced in the winter of 1953. This is the site between the Waipoua HQ and the camp commonly referred to as "the arboretum". It was planted with a range of species, including some exotic kauri and kauri cohorts. For example, in 1960, 18 *A. alba* (now *A. dammara*) from seed lot FRI 55/569, 22 *A. cunninghamii* from seed lot FRI 56/354 and seven *A. robusta* from seed lot FRI 57/746 were planted. Much of this arboretum has been felled in the last few years, although at least two *A. robusta* (species identification unsure) are visible today.

Later Intervention

In 2001, Stephen King, who then ran the Waipoua Forest Trust, led the felling of all the surviving *A. cunninghamii, A. robusta, A. palmerstonii* and the *P. elliottii* shelter belts on the basis that their presence in a forest sanctuary was inappropriate. He did not liaise with DOC about this action.

The Situation Today

Will Ngakuru and the author inspected part of the Northern Arboretum in January 2013. Some of the *A. robusta* and *A. palmerstonii* felled by Waipoua Forest Trust had coppiced and were growing quite vigorously. The 1948 *A. australis* plantation was well stocked with small trees growing quite well on this rather poor site. Inspectors were unable to spot any of the radially planted, exotic *Agathis* in area A. The author revisited the Northern Arboretum site on October 11th, 2016, used compiled GPS points (from the NZTopo database) to help relocate key sites and concentrated on inspecting the circularly laid-out sub-compartment A, as this was where the widest range of foreign *Agathis* were planted.

The author located a white-painted squared batten. This was located at E1651972 / N6051440. No tags or other information were attached to the batten. From this batten, a line of four A*. australis* planted at 6 m intervals was visible. These trees were from seed lot AK 43/491. However, some of the original trees died, and the line was blanked in 1948. The seed lot of the blanks was not described, but they are likely

to be of the same lineage as the adjacent 1948 plantation in sub-compartment 1 (seed lot AK 46/574). The four trees were small for their age (8 cm DBH and approximately 3 m tall) but were occupying a low-fertility, densely vegetated site.

Parallel to this line, and in close proximity, lines of five each of *A. palmerstonii*, *A. robusta* and *A. vitiensis* were planted, the first two in 1946 and the Fijian kauri (*A. vitiensis*) in 1948. No trace of the *A. robusta–A. palmerstonii* remains (these are distinctive, large-leafed plants and therefore easy to identify). At the time the area was inspected, it was carrying quite a good stocking of naturally regenerated *A. australis*. The author was not familiar with the foliage of Fijian kauri, but saw nothing in a search of sub-compartment A remotely resembling a foreign plant. Nor could the author discern a planting pattern.

Further east, around the circular sub-compartment A, groups of five specimens of *A. celebica*, *A. philippinensis*, *A. loranthifolia*, *A. cunninghamii*, NZ tānekaha and *P. toatoa* had been planted. Again, even with careful use of GPS, the author was unable to locate any of these trees. These other *Agathis* are all tropical species and tend to have much larger leaves than NZ kauri. A line of four *A. loranthifolia* has been recorded as planted within and near the western edge of sub-compartment 16. Again, upon inspection, no trace of these trees could be found. The "avenues" of kauri were also difficult to discern, primarily because the whole area was regenerating quite well to *A. australis*. Sub-compartment 1, planted with seed lot number AK 46/574 in 1948, was well-stocked with small but healthy trees. There was also quite prolific natural regeneration within the stand.

A. robusta and A. palmerstonii

These two species were planted in sub-compartments 4 and 3, respectively. A total of 865 *A. robusta* from various seed lots were planted in sub-compartment 4 from 1946–1950. A total of 294 *A. palmerstonii* were planted across the same span of years. They were cut down by Stephen King and others in about 2001. Some were coppicing at the time of inspection. The coppiced regrowth was generally not very vigorous; some of the plants did not look healthy. Note that these two species have now been amalgamated as *A. robusta*.

Taxonomy

Classification of *Agathis* is a dynamic area of taxonomy. When the arboretum plan was produced in 1946, it proposed the planting of 15 species of *Agathis*. In his kauri management review booklet of 1983, John Halkett listed 15 species and sub-species of *Agathis*. However, the species and sub-species listed in 1983 were very different from the 1946 list. The gymnosperm database (http://www.conifers.org/ar/Agathis.php) lists 19 species and no sub-species. Again, this list is very different from the 1946 and 1983 lists (Table 12. The main effects of modern classification on information about the Northern Arboretum are as follows.

- *A. palmerstonii* no longer exists as a species. It is now subsumed into *A. robusta*.
- *A. loranthifolia*, *A. celebica* and *A. philippinensis* no longer exist as separate species. They are all now classified as *A. dammara*.
- *A. vitiensis* no longer exists. It is classified as *A. macrophylla*.

However, the situation is dynamic, and the most up-to-date information can be found on the Systematics of *Agathis* website (http://www.agathis.info/index.php), which currently lists 21 *Agathis* species.

Table 12 Current Agathis taxonomy (from the Gymnosperm database)

Name	Common name	Location
A. atropurpurea	Blue (or black) kauri	Australia
A. australis	NZ kauri	New Zealand
A. borneensis	Borneo kauri, Dammar minyak	Sumatra, Borneo and the Malay peninsula
A. corbassonii	Corbasson (or red) kauri	New Caledonia
A. dammara	Borneo kauri	Philippines, Indonesia
A. endertii	Endert kauri	Borneo
A. flavescens	Malesian kauri	Malaysia
A. kinabaluensis	Kinabalu kauri	Malaysia
A. labillardieri	Western New Guinea kauri	Indonesia and Papua New Guinea
A. lanceolata	Koghis kauri	New Caledonia
A. lenticula	Tanggilan kauri	Borneo
A. macrophylla	Melanesian kauri	Solomon Islands, New Hebrides, Fiji
A. microstachya	Atherton kauri	Australia
A. montana	Panie kauri	New Caledonia
A. moorei	Moore kauri	New Caledonia
A. orbicula	Sarawak kauri	Borneo
A. ovata	Scrub kauri	New Caledonia
A. robusta	Kauri pine, Eastern New Guinea kauri	Australia, Papua New Guinea
A. silbae	Santo kauri	Vanuatu

Kauri Dieback Considerations

There are areas of possible concern re the establishment of the Northern Arboretum. Seeds and seedlings were imported from *Agathis* sites from around the Pacific and South-east Asia. The documentation on seed imports is quite good in that the central seed store database is still intact and available at the Scion Archive and importations of seed generally show in the database. Seedling import is another matter.

1. On August 23rd, 1948, six *A. vitiensis* seedlings were dispatched by seaplane from Fiji to the NZFS in Auckland, along with six *Albizia falcata* and six *Calophyllum burmannii*. They had been inspected in Fiji, were certified free from diseases and had been treated with Bordeaux mixture (fungicide) and white oil (insecticide). On August 26th, 1948, they were dispatched to Waipoua by the New Zealand Railways Road Services (NZRRS) with instructions for Ranger Moore at Waipoua Forest to remove and destroy any attached soil, to plant the *A. vitiensis* in the Northern Arboretum and to line out the other species in the nursery for planting in the HQ arboretum in 1949. Plant pathologist Nick Waipara of MPI and Auckland Council commented that these treatments, if carried out properly, would have been effective in dealing with any plant diseases in the soil, but would have been ineffective against pathogens in the roots or seedlings.
2. A September 1944 memo from Alex R. Entrican, Director of Forestry for the NZFS, dispatched the following seedlings for the Northern Arboretum to the Officer-in-Charge, Waipoua Forest. No seed lot numbers were quoted in the dispatch (Table 13).

Table 13 Species contained in Entrican dispatch to the Northern Arboretum, Waipoua

Species	# of seedlings dispatched
A. robusta	13
A. philippinensis	9
A. celebica	2
A. palmerstonii	9
A. dammara	18

Abbreviation. #, number.

The consignment also included 11 seedlings from four different species of *Widdringtonia* (southern African conifers). Entrican did not state how the seedlings were produced or where they were grown. The memo stated that they were for the Northern Arboretum, but no plantings occurred on that site until 1946. They were most likely held in the Waipoua Forest Nursery prior to planting out. Four *A. philippinensis* without a seed lot number were planted in the arboretum in 1946, and these may have been from this group. On the other hand, seed of this species was sent to Waipoua for arboretum purposes in 1941.

The *A. celebica* planted in 1946 were identified as seed lot 41/338 (or 339 as per Figure 32), so most likely, these were nursery stock grown in the Waipoua Forest Nursery and not part of the shipment sent by Entrican. No record of any *A. dammara* being planted in the arboretum exists, nor was it proposed in the plan. Note, this lack of records could be due to a taxonomical mix -up. All of the *A. robusta* and *A. palmerstonii* trees planted in the arboretum are traceable back to a seed lot number, so is not likely to be part of the Entrican shipment.

No *Widdringtonia* were recorded as being planted anywhere at Waipoua. What happened to these trees? The *A. philippinensis* may have been planted in the arboretum; this record is not clear as to source. If the trees went to the nursery and died there, then that might suggest a pathological explanation and a possibly exotic pathogen in the nursery. However, no clear facts supporting this theory exist. Other questions that cannot be answered also compound historic analysis. Were the seedlings imported? Were the seedlings grown in NZ at a nursery other than Waipoua? Were the seedlings planted in the arboretum? No one knows and no historic records point to answers, but most likely the answer for all of these questions is “no”, except for the *A. philippinensis*. Were the seedlings on-grown in the Waipoua Forest Nursery? Again, this is not certain, but probably they were.

In terms of this shipment, a large or possibly enormous biosecurity risk seems to have been taken. Further archival research might indicate if and how these trees were held in the Waipoua Nursery and if and where they were planted. It appears that the Northern Arboretum has remained uninfected from any disease that might have a foreign origin. Given the history of root infection problems in the Waipoua Forest Nursery, possible contamination from imported plant material associated with the development of the Northern Arboretum cannot be ruled out.

Current Risks from the Northern Arboretum Site

Having inspected the site with the benefit of good archival information, the author judged that the Northern Arboretum site did not hold any active threats to the welfare of kauri at the time of inspection.

Although some potentially serious risks were taken in the 1940s when the arboretum was being established, these risks have not manifested themselves in any way on the site. All kauri seen on the site were healthy, and growth was consistent with what would be expected on a fairly infertile Waipoua site (Figure 33). Natural regeneration leading towards a well-stocked kauri forest was well underway. The risks taken in the development of the arboretum were more likely to have manifested themselves in the Waipoua Forest Nursery, where most probably, some foreign-origin seedlings were held for up to 2 years.

Figure 95. Kauri (A. australis) planted in 1948 in sub-compartment 1, Northern Arboretum, Waipoua Forest.

Figure 96. Planted kauri (A. robusta) in sub-compartment 4, the Northern Arboretum were subsequently cut down c. 2001 and have coppiced from their stumps. Note P. elliottii stumps and logs from shelter belt that was also cut.

FRI Planting of Australian *Agathis* Species at Waipoua Forest

The attached plan (Figure 35) maps the planting of two areas of *A. robusta* at the Waipoua Forest HQ in 1954. The plan is an FRI 1980 re-drawing of a 1955 plan. The areas are away from the formal HQ arboretum, which lies between the visitor centre and the camp. The area planted probably relates to the

modified arboretum site worked out between Poole, Levy and Morrison following the withdrawal from the site near the southern boundary and the dropping of the proposed Waikohatu site due to that area being gazetted into the forest sanctuary.

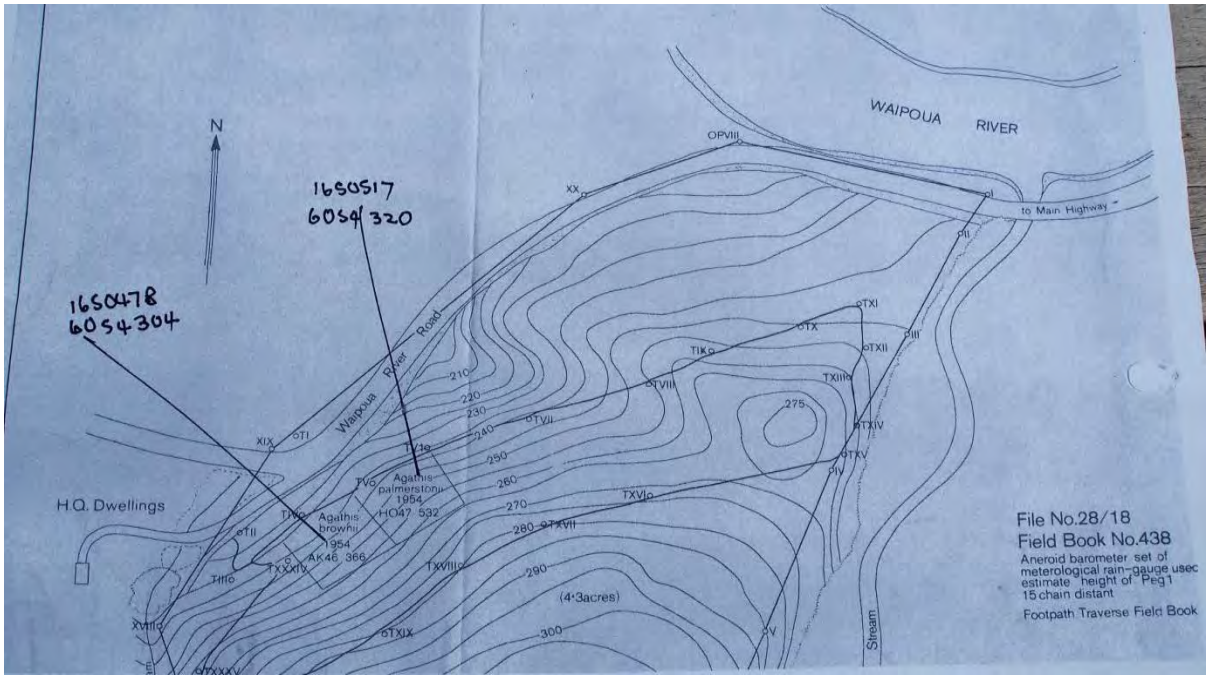


Figure 97. Map of Forest Research Institute (FRI) plan for planting Australian kauri at Waipoua Forest Headquarters (HQ). Note. This figure shows only the northern half of the FRI plantings.

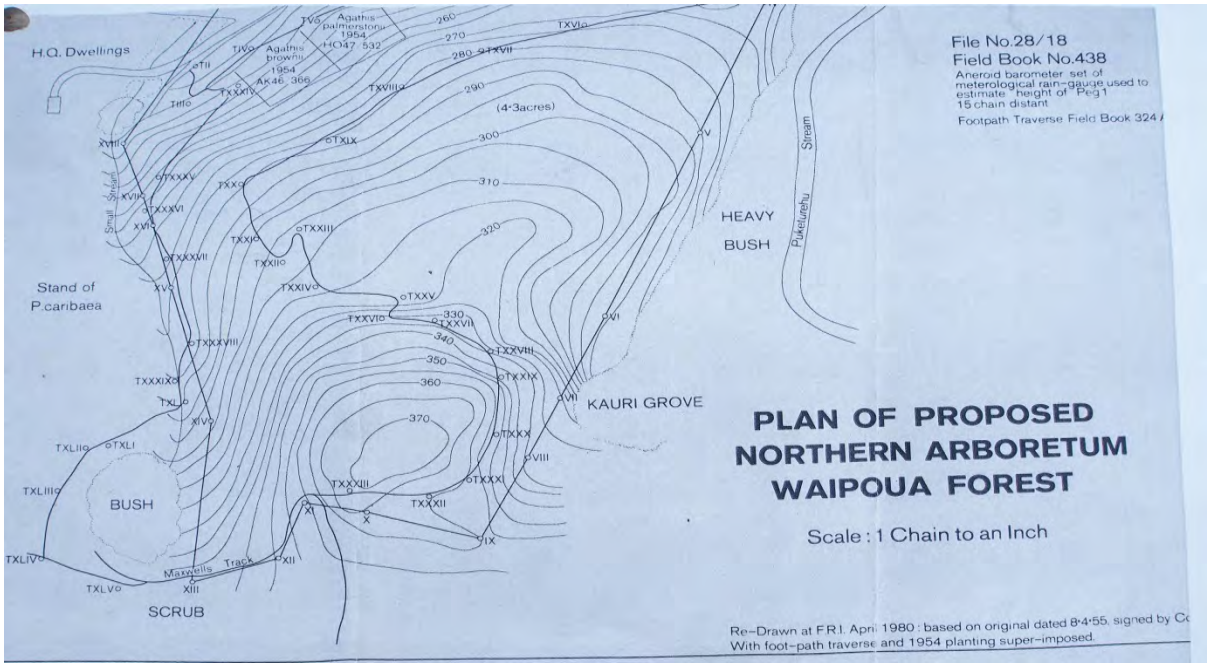


Figure 98. Southern half of Forest Research Institute (FRI) plan for planting exotic kauri at Waipoua Forest HQ.

The plan refers to file 28/18 field book 438 (bottom right, Figure 35). The plantings are described on the plan as *A. brownii,* planted in 1954 from seed lot AK 46/366 and *A. palmerstonii*, planted in 1954 from seed lot HO 47/532. (Both these species are now classified as *A. robusta*). The plan is a bit difficult to interpret, as the Waipoua River Road was realigned since completion of the survey that the plan was

based on. However, once this is understood, the location is relatively easy to pin down, as the old road formation is still intact and the HQ dwellings are easily located.

Field Check on FRI Plantings

On October 11th, 2016, the author visited what were judged to be the sites of these plantings. From what was observed, it appears that these plantings have perished. In fact, it was difficult to even visualise the plantings, as there was absolutely no trace of them (Figure 37). The vegetation at the time of the visit comprised a well-stocked, regenerating kauri–podocarp forest of good health and moderate vigour. There were signs of previous marijuana-growing activities within the stand, but nothing current. There was no indication of any kauri dieback. The Maxwell's Track traverse on the plan no doubt relates to a walking track around Puketurehu constructed by the original Waipoua Forest Guard, James Maxwell. An old track was perceptible on the ground, and this may be the Maxwell's Track indicated at the southern edge 0f Figure 36 above.

Figure 99. Interior of the Waipoua Forest HQ area showing only NZ native vegetation, with absolutely no trace of plantation flora (E1650526 / N6054324).

Exotic Shelterbelts, Waipoua Forest

Starting in 1952, Frank Morrison prescribed a series of shelter belts in the heathland areas of western Waipoua. The 1952 plantings, somewhat west of Pawakatutu, were two bands of trees laid out in a northwest/southeast alignment. Trees planted here were *P. radiata* and *P. elliottii*. The *P. radiata* mostly failed on this site. The main plantings occurred in 1957 at Huaki, when several belts were laid out in a generally north–south alignment. These 1957 belts were widened and extended in 1958. All trees used on these later shelterbelts were *P. elliottii* grown in the Waipoua Forest Nursery.

Other shelterbelt plantings occurred at a smaller scale, such as the one to the west of Pawakatutu Road, a bit north of the junction between Pawakatutu Road and Radio Road. The shelterbelts around the old lookout site at Pawakatutu were also added. Today these belts stand out strongly as peculiarly

runic landscape features, particularly when viewed on Google Earth/Google Maps. The Huaki shelterbelts were assigned SP number 431/9 by Ron Lloyd when he was reviewing Morrison's work after Morrison's death in about 1970. The author deems that the shelterbelts have no close association with kauri dieback risk, as far as relevant information available can be relied upon.

Purpose of the Shelter Belts

The purpose of the shelterbelts was described by Morrison in both his 1956 and 1957 annual reports. He wrote in the 1957 report:

"The object of these was the provision of protection for kauri natural regeneration against the prevailing westerly wind. It had been noticed that the kauris were often growing at a faster rate than the heathland mānuka and that these (kauri) were being damaged by whipping in the wind. Those kauri which had emerged through the mānuka canopy without damage invariably became flat-topped and virtually stopped growing.

"It was considered that an exotic shelterbelt would protect against the wind but would also encourage continuous kauri growth and would prevent kauri malformation. If the belt increased the rate of growth of mānuka, then earlier opening of the canopy would follow, which in turn would reduce competition with kauri and would not cause so much physical interference."

Current Situation

On October 21st, 2016, Te Roroa Ranger Laurie Joseph and the author looked at one of the Huaki shelterbelts, and the belt north of the junction between Radio Road and Pawakatutu Road. In both cases, good kauri regeneration around, and especially under, the pines, was evident. It was also noticeable that some species such as tōwai and rimu were prospering adjacent to and under the pines. These species were generally absent from the wider landscape, and their presence is probably associated with the microclimate, i.e., the ameliorating effect of the pines. The heavy litter of pine needles and the now massive root systems of the pines has probably also improved the structure and fertility of the podzolised gumland soils.

In the Huaki belt, some of the pines had been blown down (in a north-easterly gale), and again, the large pine root balls and fallen trunks have probably added to the opportunity for a wider range of native plants to colonise the site. This is not to say that the same succession processes would not have occurred if the pines had never been planted. What the pines have done is speed regeneration locally. It is probable that the same improvements to microclimate and diversity are occurring nearby in the compartment 30 kauri plantations established in the late 1970s and early 1980s, albeit at a slower pace.

The underlying purpose of the 1950s shelterbelt planting was to produce a taller, straighter kauri tree (which contained more and better wood). From the inspection, it seemed this purpose had some modest success. The historic goal is not consistent with current conservation thinking, but may be of interest to Te Roroa.

Summary Comment on Exotic Shelter Belts

The planting of the 1950s shelterbelts has inscribed some odd patterns on a unique landscape and in some ways added to its intrigue. At the time of inspection, there was no indication that the *P. elliottii* shelterbelts were spreading via seedlings colonising into the wider landscape. They were not weedy in that sense. There were wilding pines in the landscape, but these appeared to be *P. radiata* and *P. pinaster*.

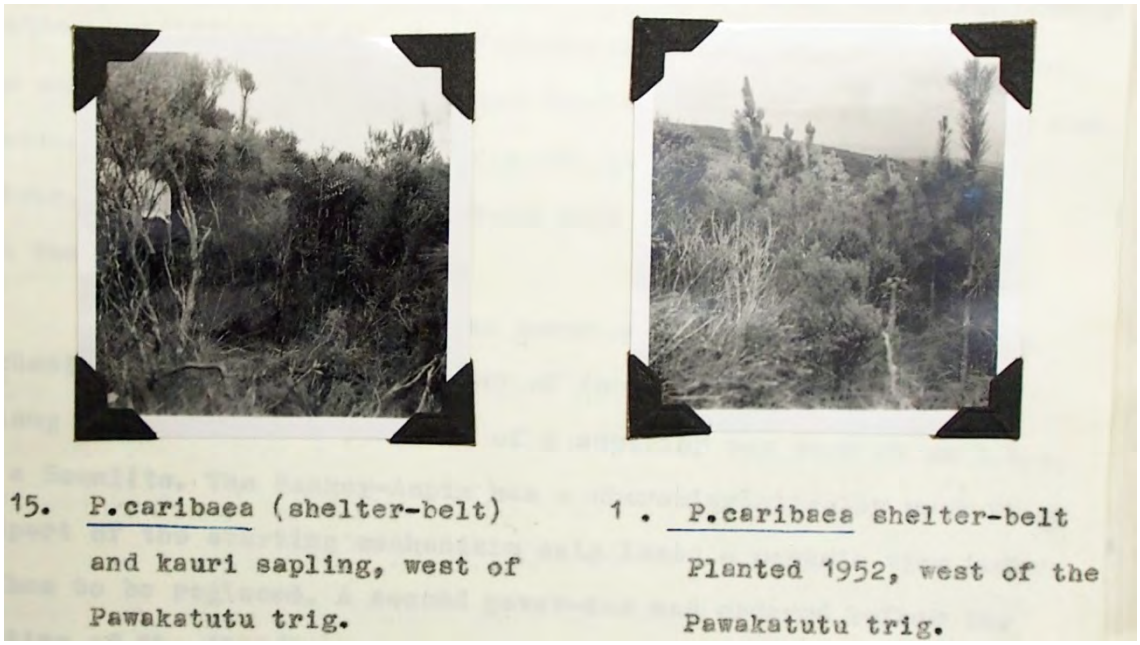


Figure 100. Two historic photos of the exotic shelterbelts at Waipoua.
Note. Photos extracted from the Annual Report Waipoua Forest, 1957.

It appeared that the pines will fade out naturally through windfall, natural mortality and native forest succession. The Pawakatutu West belts are already far less dense than the more recent Huaki belts. When they do disappear, they will leave a different pattern of native forest structure on the site they occupied. The author would advocate leaving these belts to natural succession processes. These shelterbelts are physical indicators of an interesting period of Waipoua's forest management history.

Plantations and Kauri Management in Other State Forests

NZFS Practices at Russell Forest

Short History of Russell Forest

Russell Forest is an aggregation of former state forests (Kaurinui, Ruapekapeka, Hukerenui, Opuawhanga Forests, etc.) and acquired adjacent lands, mostly former Māori land. Virtually all of the forested lands have been logged for their indigenous timber resources, often prior to acquisition as state forest. Russell Forest now comprises a contiguous forest tract of over 10000 ha.

The NZFS had a presence at Russell Forest since 1950, but up to 1958, management effort had been focussed on establishing exotic trees in the lower Punaruku Valley, surveying the indigenous forest resources, setting up a management framework of a rudimentary forest HQ, developing roads and access tracks and establishing a compartment framework. This development work was overseen by Forester Ron C. Lloyd who, in 1955, had moved to the NZFS District Office in Kaikohe from GBI, where he had been the NZFS Officer-in-Charge.

Over the next three decades, a small crew based at Punaruku implemented forest management activities under a local Forest Ranger Officer-in-Charge, overseen by Ron Lloyd and his successors. These management activities comprised:

- Indigenous silviculture (TSI) across most of Russell Forest
- Seasonal exotic forest work at other larger forests such as Glenbervie and Puhipuhi
- Valuation of adjacent indigenous forested land as a component of NZFS policy of acquisition of kauri forest
- Planting kauri and other indigenous species
- Kauri seed collection
- Establishing various trials and SPs including production thinning of kauri
- Road and track construction
- Protecting the forest from trespass and poaching
- Harvesting kauri via helicopter extraction (1980–1982)

In 1987, with the corporatisation of the NZFS, Russell Forest staff were mostly made redundant or took new jobs away from the forest with DOC. The Punaruku Forest HQ complex closed.

Compartment Numbering at Russell

The compartment numbers for Russell Forest are as the author has found them in various archived documents. It is fairly obvious that the compartment numbering system changed. A 1978 map (Figure 38) exists, but it is out of sync with the compartment register, which mostly holds pre-1967 information. The geographic descriptions of compartments written into the compartment register tend to suggest that the old numbering of compartments in the lower Punaruku Valley was reasonably close to what was depicted on the 1978 map. However, outside this corner of Russell Forest, the compartment register appears wildly inaccurate.

Figure 101. Russell Forest areas treated under the TSI presecription from the 1950s–1980s.
Note. The Opuawhanga block in the north-east corner of the map marked "no TSI" was TSI treated in 1967.

Unfortunately for archivists, maps enclosed with old working plans held in Archives NZ often were placed in a sleeve at the back of the plan, and many of them are now absent. A lack of old and new compartment maps of Russell Forest means these historic documents can no longer be compared, making it difficult to identify site locations and historic NZFS activities that might have a bearing on PA risks.

Forest Management Activities at Russell Forest

TSI

General Description of TSI

For a description of the TSI prescription, see "NZFS Practices on Great Barrier Island: TSI". For a 1961 description of the Russell Forest TSI prescription, see the annual report extract Figure 40 below.

Implementation of TSI at Russell

According to the Russell Forest compartment register, TSI commenced in Russell Forest in 1958, when 230 acres in the Punaruku Valley was given silvicultural treatment: "ring-barking of kānuka and other unwanted broadleaves over kauri, etc." was performed. The crew moved quite rapidly through the forest, completing the Punaruku number 1 block in 1963–1964 and the Papakauri block in 1964.

The records about dates of treatment after 1964 were difficult to interpret. Discussion with Wally Pita, a former NZFS Leading Hand at the forest, indicated that most of the main body of Russell Forest was treated via TSI, i.e., Waikare block, Punaruku number 2 block after it was purchased in about 1970, and the areas towards Waikino on the Waikare–Kawakawa public road. The Opuawhanga block of 418 acres was treated in 1967. Pita was uncertain as to whether the Karetu block had been treated. The author was fairly sure it had been, but records could not be located to prove this one way or the other. Pita was fairly certain that outlying blocks at Waikino (Kaurinui), Hukerenui, Tapuhi and Ruapekapeka were not treated via TSI.

The kauri dieback pathogen has been picked up in soil samples at quite a wide range of sites across the lower Punaruku basin. How the infection was conveyed to and within the Punaruku Valley is uncertain. Because TSI was implemented via gangs of forest workers traversing whole landscape suites as they found and released kauri and other preferred species from competition, often in wet/muddy conditions, KDP leaders have expressed concern that this activity may have spread PA via muddy footwear, dirty tools, etc.

Could workmen/forest managers involved in TSI have introduced PA to Punaruku from another infected site? This possibility is remote, but it cannot be ruled out. There was some worker movement between GBI and Russell Forest, and Ron Lloyd moved back and forth between the two forests from 1955 until his retirement in the early 1980s. There were no biosecurity measures back then. However, the author's field work on GBI revealed no evidence of spread of PA via TSI on the island, so it is unlikely that it could have been accidentally moved between the two forests via TSI implementation.

Have TSI activities spread PA around the Punaruku Valley via forest workmen implementing the prescription? This is possible, but not very likely. As discussed, there is no evidence of spread of PA via TSI work on GBI, where very similar forests on similar topography were treated. In addition, in Figure 39, the most indications of forest management activities are nearly all contained in the lower Punaruku Valley, i.e., track construction, SPs of various kinds, planting trials for FRI, kauri planting, helicopter logging, etc. The lower Punaruku Valley was the centre of forest management activities at Russell Forest for many years, and some of these activities were more likely to spread PA than TSI.

To date, no sampling for PA has been done in Russell Forest outside the lower Punaruku basin (Punaruku number 1 block). It would seem prudent to widen this sampling to other TSI-treated parts of the forest, as many of these other sites would not have had their PA status compromised by non-TSI forest management activities, thus eliminating variables that confuse the issue in blocks already tested.

Kauri Planting

Table 14 shows the kauri plantings undertaken in Russell Forest. They are all in the Punaruku Valley.

Forest block #	Year planted	Area (ha or m^2)	# of trees	Seed lot #/comment
Russell SF 123	1950	3.2 12 m x 6 m	c. 5000	AK 48/571 (SP 207)
Russell SF 123	1963	0.4	320	AK 58/769 (line planted)
Russell SF 123	1977	*62.0	2100	Questionable early map (map 2) Not on later map
Russell SF 123	1978	6.0	3300	Early map (map 2) untrustworthy
Russell SF 123	1979	10.0	3400	Early map (map 2) untrustworthy
Russell SF 123	1980	4.3	3500	Not clearly defined on map
Russell SF 123	1981	4.8	5760	Not clearly defined on map
Russell SF 123	1982	12.0	6580	
Russell SF 123	1983	7.0	6049	
Russell SF 123	1984	7.3	4248	
Russell SF 123	1985	Blanks	5040	
Totals		*55.0	45297	

Notes. *1977 figure excluded from total.

Abbreviation. #, number.

Comments on Russell Forest Kauri Plantations

1950 Plantation: Seed Lot AK 48/571

The 5000-tree estimate for these 3.2 ha is based on the area covered today and tree spacing. Trees were ex Waipoua Forest Nursery. Interestingly, the seed lot register describes the distribution of seedlings grown from this seed lot in detail, but does not mention the dispatch of these seedlings to Russell Forest. The trees performed poorly from the start. A fertiliser SP (SP 207, control plan A 12/2) was installed in the middle of this plantation in 1956. There was no response to the fertiliser, and the plot was abandoned in 1971. Note that trees from this same seed lot were planted at Omahuta Forest and have performed reasonably well on what look like poorer sites.

Upon inspection, plantation trees were remarkably small for a plantation in its seventh decade. Some underplanting may have been done in 1984, and this has further confused the picture. Also, although the rationale for planting these Punaruku Valley plantations was that they were out of reach of natural kauri seedlings, a fair amount of natural kauri regeneration is now occurring in this and the later plantations, further confusing analysis of the historic situation. No kauri dieback symptoms were seen in this plantation.

1962 Plantation: Seed Lot AK 58/769

Interestingly, seed register records describes 4996 trees of this seed lot being sent to Russell Forest in 1962. The author has found no record of these trees being planted in this forest. The figure inscribed in the register for 1963 was 300 trees planted in 0.4 ha, ex Waipoua Nursery. No inspection of this plantation occurred.

PA Risk from these two plantations

The 1950 plantation is contemporary with and has the same seed lot number as a Glenbervie PA-positive plantation of the same age. However, this Glenbervie plantation is alongside plantations of 1949 and 1955 vintage, so there is no clear indication of the source of the PA infection there. Also, the same cohort has been planted at a wide variety of sites, especially Omahuta, without PA manifesting itself. The 1962 seed lot has not displayed PA where it has been planted elsewhere, e.g. at Trounson Park in 1962 and 1963.

1970s and 1980s Plantations

These Sweetwater Nursery trees were all planted in the Punaruku Valley, mostly on the lower slopes. A map of the 1980s plantations does exist, but other maps (e.g. map number 2) of the area do not allow one to identify with clarity the 1970s plantations, because they were drafted primarily to identify helicopter logging sites. The later map shows these plantations in different locations from map number, making analysis complicated.

Equipped with the later (and poor quality) map, it may be possible to located most of the 1970s and 1980s plantations. There may be merit in doing this, although it is unlikely that PA is present in any of them, unless it has been transferred from elsewhere in the Punaruku Valley. Also, it is probable that the plantation situation is obscured in many places by natural regeneration of kauri.

Other Plantings in the Punaruku Valley

The compartment register for Russell Forest records a considerable amount of other native forest plantation work. A detailed breakdown of this work can be seen in Table 15.

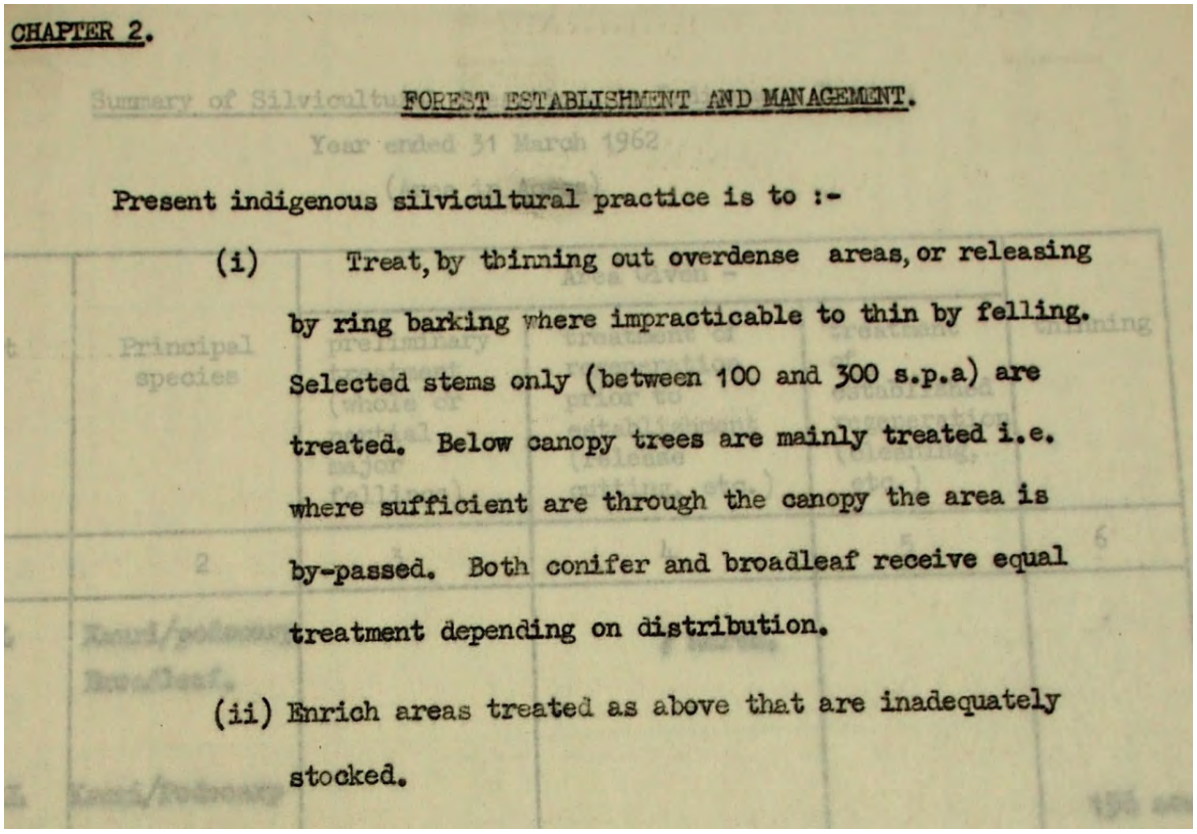
Table 15 Other indigenous plantation records for the Punaruku Valley in Russell Forest

Compartment	Year planted	# of trees	Species
4	1962–1963	9685	Tōtara, rimu, kahikatea, pūriri, kawaka, rewarewa
5	1963	5450	Tōtara, rimu, kahikatea, kauri
12	1962	320	*Kauri
14	?	200	Kauri, kawakawa
	1961	?	Silver beech ex FRI
	1960	?	Mountain beech ex FRI
15	1958–1962	10065	Tōtara, rimu, kahikatea, pūriri
	1960	?	Red beech (seed sown)
	1960	100	*Podocarpus elatus* ex FRI
16	1961	300	Kahikatea in groups
		100	Kauri in a group
	1962	?	90% kauri dead

Notes. *Most likely the 1963 plantation of 0.6 ha, but the anomaly is interesting. Seed lot information from Scion for non-*Agathis* species was not sourced to compile data shown in this table.

Abbreviation. #, number. ? = Not known

Table 15 shows an unusual mix of species for a kauri forest, but is indicative of the willingness to experiment. Much of this planting material was sourced from the Forest Research Institute (FRI). The big die-off of kauri in compartment 16 raises kauri dieback interest. Of additional interest to the KDP is the fact that the TSI prescription in the 1958–1962 period included the instructions to "enrich areas that are treated if they are inadequately stocked". These instructions are recorded in a 1961 annual report (Figure 40).



CHAPTER 2.

FOREST ESTABLISHMENT AND MANAGEMENT.

Present indigenous silvicultural practice is to :-

(i) Treat, by thinning out overdense areas, or releasing by ring barking where impracticable to thin by felling. Selected stems only (between 100 and 300 s.p.a) are treated. Below canopy trees are mainly treated i.e. where sufficient are through the canopy the area is by-passed. Both conifer and broadleaf receive equal treatment depending on distribution.

(ii) Enrich areas treated as above that are inadequately stocked.

Figure 102. The entry in the Russell Forest annual report, 1960, detailing the timber stand improvement (TSI) prescription.

Ron Lloyd had sourced rimu, kahikatea and tōtara from FRI, and kauri from Waipoua, and these trees were underplanted in the "inadequately stocked" areas. A total of 100 acres of this planting was done in 1961. This acreage and the figures above indicate the scale of the activity. It is possible that the full extent of trees brought in from the Waipoua Nursery for enrichment planting is under-reported for this activity. For example, an anomalous 1962 annotation in the seed lot register of 4996 trees from seed lot AK 58/769 going to Russell Forest supports the possibility of under-reporting. The only Waipoua-sourced kauri were the ones used in the 1950 and 1963 plantations.

Ron Lloyd compiled the compartment register for Russell Forest. He was usually meticulous in recording accurate numbers. It is not likely that he missed almost 5000 kauri seedlings from the books. Nevertheless, the enrichment planting seems to have continued until at least 1963, offering considerable soil disturbance and the chance of introducing something pathological along with the seedlings. Note, this enrichment planting parallels the use of wilding kauri at GBI. There is no record of the use of wildings in Russell Forest, however. Additionally, a post-number-2 map records 4.5 ha of kahikatea–rimu mix planted in 1983, and 0.7 ha of kahikatea–kawaka mix planted in 1984. This later map also records a 1982 planting of the gaps created by the helicopter logging. This part of Russel Forest has seen a large range of other forest management activities, which all could have been PA vectors.

Other Forest Management Activities in the Punaruku Valley

Timber Cruising

Starting c. 1962, the NZFS "timber cruised" (scouted) the Māori land in the headwaters of the Punaruku Valley, with a view to valuing it for purchase as state forest. This was the Punaruku number 2 block. The block had been logged previously, probably in the 1930s. Timber cruising involved traversing the whole landscape and measuring every merchantable tree, usually in two-man teams. This work had similar impacts to TSI in that all country was covered, often with wet conditions in attendance. Cruising's potential to pick up and spread PA was similar to that of TSI. This cruise was completed in 1966, and the block was purchased about 1970. To date, the Punaruku number 2 block has not been sampled for PA.

Logging by Helicopter

Logging by helicopter to extract the kauri logs was carried out in 1980–1982. Ridge-top pole stands of kauri were thinned with chainsaws, and logs of appropriate weight for the machine's lifting capacity were prepared in the bush. Strops around the logs were attached to the helicopter's lifting gear, and the logs were lifted out of the bush and flown to a landing area in the Punaruku Valley, where they were loaded and trucked away. In terms of PA-type impacts, this form of logging offered little soil disturbance, but there were occasional injuries to residual trees, and there was also the impact of the passage of the crews doing the logging to consider. The sites were all mapped and could be easily relocated if there was a desire to check them for PA presence. The sites inspected by the author appeared fine and free from infection, although it needs to be noted the Punaruku kauri are famously symptom free.

Thinning Trial: SP 314

A logging trial was conducted in the Papakauri block in 1964, when 9.6 acres were production thinned for kauri and tānekaha. The figures in the plantation register indicated that the trial produced about 6600 ft^3 of logs (186 m^3). This logging would not have been done without considerable impact and soil movement. This site could not be accessed, but due to past considerable soil movement, it is a very high priority for inspection and possible soil sampling by the KDP.

Other SPs and Trials

There were a number of other trials performed in Russell Forest, especially in the Punaruku Valley. Most were designed to assess the effectiveness of TSI.

- *SP 213*. A small trial near the old HQ to assess kauri seed germination on a raked and unraked area on the forest floor, this trial is of no interest to the KDP
- *SP 312*. Thinning of a stand of taraire, this project is of little interest to the KDP
- *SP 313*. Thinning of tānekaha, which may be of interest, as tānekaha are usually associated with kauri in the Russell Forest. Some felling of tānekaha was involved, as well as ring-barking
- *SP 315/1*. A thinning prescription trial (TSI), the actual prescription was signalled but not described on the SP cover sheet and would be worth researching to check the likely level of impact/disturbance
- *SP 315/2*. This thinning prescription trial occurred in compartment 11. The prescription was described in a Russell Forest working plan report, and was probably similar to that shown in Figure 40 — it would be worth reviewing if the opportunity arose

- *SP 315/3*. This was another thinning prescription trial plot. It is located in the Papakauri block

Road and Track Construction
Most of Russell Forest was logged before the NZFS became involved, and the NZFS inherited a framework of derelict logging roads when it acquired land in the area. Often, the logging crews had removed the bridges when they finished logging an area. Roads were very necessary for the implementation of work such as TSI, and considerable effort was put into reopening roads. Sometimes local contractors did the work, but more often, a light bulldozer was borrowed from a larger station such as Glenbervie, and the roads were opened via this approach, often incrementally, with the bulldozer work being undertaken in the summer. This approach was used to reopen the upper Punaruku Valley Road and the Papakauri Road.

In later years, the NZFS employed its own engineering staff, and improved road standards were imposed. A specialist crew operating out of Glenbervie Forest carried out road construction and road upgrades right through Northland. This included road metalling and the operation of quarries. Use of this approach is of interest to the KDP because of the potential of this activity to spread PA. However, there is no evidence at Russell Forest that this activity has spread kauri dieback. The Punaruku Valley Road has had heavy use and a lot of maintenance over the years, both by crown agencies and the public. It is probably fortunate that the road is in the bottom of the valley and generally away from the kauri ridges. The Papakauri Road, on the other hand, traverses a range of topography including kauri ridges. It is currently suitable for pedestrians and quads only. If PA were to be found to be associated with road development in Russell Forest, then this road would be a likely candidate. Visual monitoring and sampling along the Papakauri Road should be considered by the Programme.

Tracks in Russell Forest tend to follow ridge lines, and are often on old pack routes, kauri gum and logging accesses. A whole network of tracks for TSI access were developed or reopened by the NZFS, especially in the Punaruku Valley. Later, with the implementation of the NZFS recreation policies, many of these tracks were signposted and made available for the public, including listings as NZ Walkway routes and later, the Te Araroa Trail.

The issue of PA associated with the Te Araroa Trail has been well traversed by DOC in recent years. However, finding an alternative route to the Pukemoremore section of the track because of a PA site beside that track may not be a sensible choice, because the alternate alignment is within the area of most intense historic management by NZFS. The likelihood of encountering PA along the alternative route is therefore high. In the author's opinion, it would be more prudent to harden the Pukemoremore Track. The whole NZFS track network should be considered as a PA-vulnerable area.

Seed Collection from Seed Trees
Revisited seed trees may be vulnerable to infection due to damage from climbing spikes, etc. Discussion with Wally Pita, who did the tree climbing for the NZFS at Russell Forest, indicated that climbers seldom climbed the same tree more than once. However, he did describe some "practice" trees in the Punaruku Valley, which were climbed repeatedly, and one of which he understood to have died from PA. The 1978 map shows 11 seed trees in the Punaruku Valley and eight trees beside the

Papakauri Road. These seed trees could probably be relocated if there was a concern re vectoring of PA.

Seed orchards are of interest in this discussion. There is an annotation in the compartment register for compartment 1 describing a 1965 seed orchard (Figure 41).

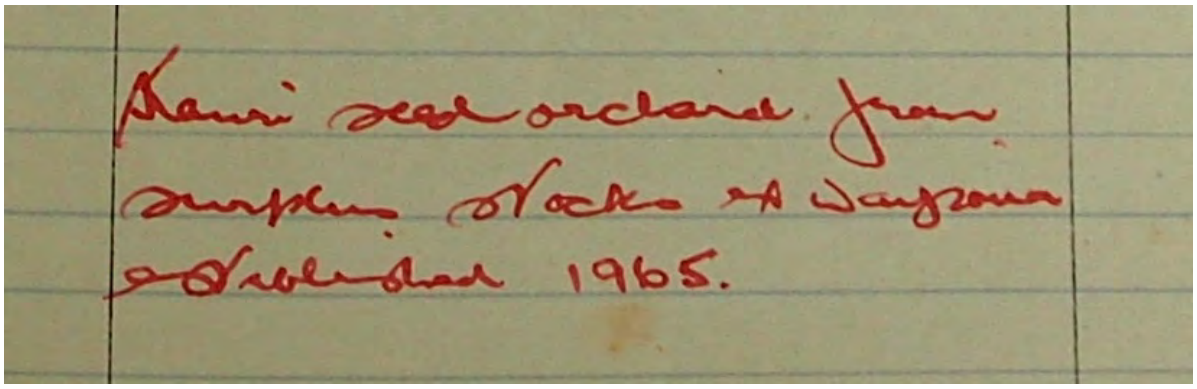


Figure 103. Annotation written about Russell Forest seed orchard.

There are also notes in Scion records about the Waipoua seed orchards. The notes describe "seed orchard A, [which held] 281 grafts [from] 1956–1964 and seed orchard B [by the] swing bridge, [which yielded] 74 grafts, [where staff] tested various means of producing planting stock [in] 1966 [and from where] surplus grafted stock [was] sent to Russell Forest for blanking of the third orchard".

The above quotation is the only reference found to date about this seed orchard. Both of the Waipoua seed orchards are heavily infected with PA. It will be important to locate the Russell Forest orchard, or the site of the orchard if the trees have died out. The author asked Wally Pita if he knew the location of these trees. He was unaware of them. They were described in the compartment 1 records, however. Compartment 1 was mostly in exotic pines, so it should be possible to scope the rest of the compartment, as the pines occupied most of it before they were removed.

Omahuta Forest Establishment Trials and Plantations

Scale of Omahuta Plantations

Omahuta Forest was the site of the NZFS' largest kauri plantation area. Omahuta is one of NZ's premier kauri forests and had a history of logging similar to many other such areas. Many areas previously reserved from exploitation were released for logging in WWII for "essential war purposes". This logging history left the NZFS with a post-war devastated and partly burned over landscape which, because of its low fertility and often difficult topography, was not very suitable for further development into farmland, a development direction that was often seen as the next step for many areas of worked-over native forest.

Because of its logging history, most of which was carried out under close supervision by the NZFS, Omahuta inherited a framework of forest infrastructure such as roads, tracks, firebreaks, an office, stables and paddocks, and a management framework of rangers and forest workers able to carry out

ongoing forest management activities. Rehabilitation of the logged-over landscapes was one of these management agendas, and a variety of species were used for this purpose.

Omahuta now carries some extensive areas of Japanese cedar (*Cryptomeria japonica*) and pockets of other conifers such as Lawson's cypress and Western red cedar, as well as plantations of mainstream exotic species *P. radiata* and Sydney blue gum, now held under Crown Forest licence by Summit Forests NZ Ltd., a subsidiary of Sumitomo Corporation of Japan. Omahuta is, however, a predominately native forest, and starting in 1944, there were considerable efforts to re-establish kauri and podocarps in the logged-over and sometimes burnt-over landscapes. There is little doubt that forest managers allocated areas of higher fertility for the exotic plantations and assigned some very infertile sites for kauri planting.

Table 16 lists Omahuta kauri plantations. Most were inspected by the author. The two-paired SPs 67I and 67II, and 205A and 205B, were much simpler in terms of NZFS objectives than most of the trials established at Waipoua Forest under Frank Morrison's leadership.

Table 16 Omahuta Forest kauri establishment trials and kauri plantations

Compartment #	Year planted	Areas (ha)	Source of trees	# of trees	Seed lot #
Lost records	1932–1948	1.2	Three areas part wild	?	?
Trials					
109 SP 205A	1944 and 1945	0.8	Waipoua Nursery	210 trees 2106 trees 220 trees	AK 40/453 3/1 (1944) AK 40/453 4/0 AK 41/465 2/2 (1945)
109 SP 205B	1946	0.4	Omahuta wildings	Not known	Wildings
104 SP 67/1	1952	0.8	Waipoua t Nursery Omahuta wildings	Planted 20 ft. x 10 ft. in 8 blocks of 50	200 wildings 200 ex Waipoua Nursery
109 SP 67/2	1952	0.8	Waipoua Nursery Omahuta wildings	Planted 20 ft. x 10 ft. in 8 blocks of 50	200 wildings 200 ex Waipoua Nursery
Plantations					
104	1950	8.5 18.2	Waipoua Nursery	20000 4000 Both blocks planted 12 ft. x 8 ft.	AK 48/571 AK 47/533
103	1951	12.9	Waipoua Nursery	14000	AK 48/571
104	1952	14.8	Waipoua Nursery	5663 planted 20 ft. x 10 ft.	AK 48/571
104	1954	4.0	Waipoua Nursery	2200	AK 51/640
109	1980	2.0	Sweetwater	1000	
109	1981	9.6	Sweetwater	3670	
109	1982	5.0	Sweetwater	4070	
109	1983	8.5	Sweetwater	4000	
109	1984	2.2	Sweetwater	8960	
108	1984	10.0	Sweetwater	8960 total for 1984	
104	1985	8.0	Sweetwater	8122	
Total		106.5			

Abbreviations. #, number; compt, compartment; SP, sample plot. ? = not known.

Omahuta SPs and Establishment Trials

Control Plan 13/2: SP 205

This SP was subdivided into two areas.

Area A

Area A (established 1944–1945) lies on Black Bridge (Number 3) Road and is a 0.8 ha plantation of nursery-raised seedlings. It looks to have been planted into an area of low scrub and rushes. Trees were planted closely (6 ft. x 6 ft., or 1.8 m x 1.8 m). An Omahuta period report recorded 1400 AK 48/571 trees being used in 1950 to blank an area planted at 6 ft. x 6 ft. It is most likely that these trees were used in SP 205/A as no other pre-1950 plantations were recorded, which would fit this descriptor.

Area B

Area B (0.4 ha) was established in 1946 in cutover forest near the forest sanctuary and at the back of a 1.6-ha area of 1946 planted hoop pine (*A. cunninghamii*). The intention of the SP was "to compare the growth rates and survivals of kauri wildings and nursery transplants". Area A was partially thinned of its mānuka cover in 1956. Area A was regularly release cut from competing vegetation.

Situation Today

The author inspected area A on September 19th, 2016. It appeared to be one of the best-stocked kauri plantations among those inspected. It lies on a very infertile site, with many of the native species present being indicators of acidic, infertile soils. The kauri trees were small but growing well for such a site, and in most places provided a closed canopy of kauri. In terms of kauri dieback, no symptoms were evident.

Figure 104. Interior shot of sample plot (SP) 205A. Note absence of understorey and very light ground cover.

Area B was inspected on January 11th, 2016, when the author was in Omahuta Forest. A few surviving hoop pine were visible. They were very much in decline, and will likely fade out in the next few years. The author was unable to identify any kauri trees that looked like they had been planted in 1946. The area was a classic old kauri logging cutover with extremely dense *Gahnia setifolia* and fern regrowth choking out most other vegetation. There were numerous mature and semi-mature kauri in the area, and kauri regeneration anywhere the *Gahnia* density was lower. Understanding what was regeneration and what was of planted origin was not possible. In saying that, all kauri trees encountered were healthy, with no sign of kauri dieback. A potentially well-stocked kauri forest was developing on the site, albeit very slowly. Generally speaking, *Gahnia* sites are very slow to regenerate to forest.

Summary Comment

Area A of this SP was one of the most successful efforts the author has seen in terms of establishing a kauri plantation. It is interesting that this very early plantation was not used as a template for the development of later plantations. Subsequent trials in various places, especially Waipoua, seemed to endeavour to answer questions that had already been answered by the planters of area A, SP 205, Omahuta.

Control Plan A7: SP 67

This was a paired trial with the objective of testing "nursery-raised wilding kauri established in indigenous cutover and under *Leptospermum scoparium* and *ericoides*' [mānuka and kānuka]". A total of 400 trees were planted in each plot; half of these (200 trees) were nursery-raised stock from Waipoua, and 200 were Omahuta Forest wildings lifted from compartment 6 (now known as compartment 103). The pattern of planting (eight groups of 50 trees in each plot) is shown on the key map, and for SP 67/1 would be easily identified if needed. Unfortunately, no seed lot number was found for the Waipoua seedlings. The *Leptospermum* area (SP 67/1) is on Kauri Pa Road (No. 2 Road) in compartment 104, while the cutover forest area (SP 67/2) is in compartment 9 on the Sanctuary Road (No. 9 Road). There are numbering errors and ambiguities on the plot sheet and key map. The numbers quoted above are the corrected ones.

Situation Today

The author inspected both areas on October 19th, 2016. In SP 67/1, trees were easily spotted from Kauri Pa Road. The area was quite well stocked, and the trees were growing well. The lines of kauri were easily visible. There was also a reasonable amount of natural regeneration on the site. The trees were healthy and exhibited no signs of kauri dieback.

The SP67/2 site is adjacent to Sanctuary Road in an area where there are nearby mature kauri giants. The cutover site has regenerated to *Gahnia*, *Astelia* and tree ferns with hardwood species such as *Quintinia serrata*, tōwai and hīnau. A reasonable stocking of kauri of various ages and sizes was developing on the site. The author could not see any lines of trees to suggest plantation origin. Instead, the area looked to have developed naturally since the logging of the 1940s. All the kauri seen were healthy and were not displaying any dieback symptoms.

Omahuta Kauri Plantations

1950s Plantations

Kauri plantings at Omahuta are described in the following sections in chronological order. Seedlings for all plantations described were sourced from Waipoua Forest Nursery.

Compartment 104: 1950 Plantation

This initial planting (8.5 ha) is located near Kauri Pa Road, but it does not intersect the road. Instead, it lies to the north of the road, and is bounded on the east by an old track and to the northwest by the Maere Stream. The author found access to the southern end of this plantation from Kauri Pa Road through extremely dense *Gahnia*. The mānuka canopy was collapsing, and the fallen trunks added to the site's difficulty. A group of kauri, potentially of plantation origin, were growing on an easy ridge on the edge of an old road or track. Their sizes, at 25–40 cm DBH, were consistent with their age and the site quality. The trees were healthy and displayed no signs of kauri dieback. The author observed only a small part of the stand and could not pick up a vantage point where a wider view could be gained. However, Google Earth shows a good stocking of kauri further back in the block.

Figure 105. Interior view of the 1950 8.5 ha Omauta Forest kauri plantation. Left and right kauri are most likely plantation origin. Centre tree is resting on an old stump, and is most likely natural regeneration.

Compartment 104: 1950 Plantation

This plantation (18.2 ha) lies within compartment 104 on Kauri Pa Road. Planters used the same Waipoua Forest Nursery-grown seedling batches as they used for the 1950, 8.5-ha stand described in the previous section (i.e., AK 47/533 and AK 48/571), all planted at 12 ft. x 8 ft. spacing (3.6 m x 2.4 m). This stand is visible on very easy topography for a long stretch of Kauri Pa Road. A total of 24000 trees were planted in both stands.

This plantation looked well-stocked from the road, and closer inspection confirmed this assumption. Trees were small but healthy. Interestingly, there was quite copious natural regeneration of kauri within the block, and when within the block, the planting lines were quite difficult to pick out. The lines of trees were quite discernible on Google Maps, however. There was no sign of any kauri dieback on the trees inspected.

1951 Plantation: Compartment 104

This plantation of 12.9 ha was sited in compartment 104 on Kauri Pa Road. Planters used 13000 seedlings of seed lot AK 48/571. From Kauri Pa Road, the stand looked to be quite erratically stocked. Growth was very good in some places. The topography was flat to gently rolling. Closer viewing confirmed the somewhat erratic stocking. The site appeared to be often wet; kahikatea had colonised the wet sites and were competing with kauri in places. In saying that, however, kauri growth in this plantation was better than in many other plantations at Omahuta. Trees were all healthy at the time of inspection, and there was no sign of any kauri dieback.

1952 Plantation: Compartment 104

This 1952 planting (15.0 ha) was laid out in compartment 104 along Kauri Pa Road. Planters placed 5663 trees from seed lot AK 48/571 planted at 20 ft. x 10 ft. intervals (6 m x 3 m). This plantation was situated opposite the above-mentioned 1951 plantation. It looked to be a generally infertile site, and was quite erratically stocked. Lines of trees were visible and were quite small compared with those across the road in the 1951 stand. Trees viewed in several locations were all healthy and displayed no sign of kauri dieback.

1954 Plantation: Compartment 104

Comprised of only 4 ha in compartment 104 on Kauri Pa Road, this plantation contained 2200 trees sourced from seed lot AK 51/640, ex Waipoua Forest Nursery. The author was particularly interested in this plantation because it was listed as “failed” in documents produced after 1954. It is possible that the failure may have had a pathological explanation, rather than being based on site or management conditions.

Seed lot number AK 51/640 is also associated with a PA-infected stand in compartment 4, Waipoua Forest. In addition, it was used in a failed plantation at Kiwiriki, GBI. Thus, it was pertinent to find any residual plantation kauri to check their condition. Given that the original plantings may have died out, it is quite possible that if their deaths were from kauri dieback, then this disease may have persisted and may have manifested itself in any naturally grown forest kauri on the site.

The site was inspected on October 19th, 2016, and the author went to three predetermined GPS points. The site was very mixed in quality, with very wet flats traversed by dry ridges. The forest cover was as expected on such a site. The ridges carried a light stocking of kauri, some of which would be 80–120 years old. These trees were shedding plenty of seed, and kauri were regenerating on suitable sites. On the flat areas, some good patches of kahikatea were developing. Within these, a few kauri were growing on suitable, drier areas.

The author identified no trees that could confidently be identified as of plantation origin. Some probably persisted on the site, but were not clearly identifiable with the backdrop of natural origin trees. No plantation lines were discernible. No sign of kauri dieback was visible in this plantation site.

Figure 106. Inside the 1954 plantation of 4.0 ha on Kauri Pa Road, Omahuta Forest. Located on one of the dry ridges, no planting patterns were apparent (E1658431 / N6103907).

Summary Comment on 1950s Plantations

Omahuta Forest contains 61.2 ha of kauri planted from 1944–1954. These kauri plantations, with the exception of the 1954 area of 4.0 ha, were growing quite well on generally low-fertility sites at the time of inspection (2016). Their relatively good stocking rates are testimony to consistent attention from past mangers in terms of release cutting and blanking. Stocking of the plantation-origin trees is augmented in many places by natural regeneration of kauri.

1980s Plantations

Seedlings were sourced from Sweetwater Nursery for these plantations, rather than from Waipoua Nursery. From 1980–1985, a further 45.3 ha of kauri was planted at Omahuta. The 26-year gap in planting between 1954 and 1980 indicates an interesting hiatus in commitment to kauri planting. Because there is no history of association between kauri dieback and Sweetwater-raised seedlings, the author did not examine these later plantations as closely as those from the 1940s and 1950s. Most of the following comments are therefore based on roadside viewing of the 1980s plantations.

1980 Plantation: Black Bridge Road

This plantation is 2.0 ha and lies alongside Black Bridge Road (No. 3 Road). At the time of inspection, it appeared to have been planted into a tōwai-dominated area, and seedlings have been suppressed where this species forms the canopy. Kauri trees seen were small, and many will be completely suppressed over time. Within the 2.0 ha, there were areas of mānuka-canopied shrublands, and the plantation trees should survive in these. The area was within range of natural seedfall of kauri, and natural regeneration on suitable microsites may therefore be expected.

1981 Plantation: Black Bridge Road

This planted area (9.6 ha) lies to the west of Black Bridge Road (No. 3 Road), between the 1980 stand described above and the SP 205A stand planted in 1944–1945. It also covers part of the eastern side of the road. As with the 1980 (2.0 ha) plantation described above, this stand was planted into a tōwai-dominated matrix, with similar suppression of the plantation trees evident. Again, at the time of inspection, there were areas of mānuka where reasonable survival of plantation kauri can be expected. The whole area was within range of natural kauri seedfall, predicating natural kauri colonisation of suitable sites within the plantation.

1982 Plantation: Kauri Pa Road

This Omahuta kauri plantation (8.5 ha) is located to the south of Kauri Pa Road (No. 2 Road). It was planted under a quite well-advanced canopy of hardwood species, especially tōwai, and consequently, strong suppression of the kauri plantation trees has occurred. In the western part of the plantation, more mānuka was evident at the time of inspection, and presumably better future survival of kauri will be the result. Emergent, semi-mature kauri rickers in this part were supplying plenty of natural kauri seedfall, and subsequent regeneration was visible on suitable microsites.

1983 Plantation: Crossroads

The only 1983 kauri plantation (8.5 ha) is situated between Kauri Pa Road (No. 2 Road) and Sanctuary Road (No. 4 Road). This is a mixed area of hardwood forest and mānuka-dominated shrublands. The area is bisected by the upper reaches of the Borneo Stream, and heavy forest along the stream valley has suppressed kauri regeneration. The mānuka-dominated areas to the west can be expected to hold plantation kauri and naturally regenerated kauri.

1984 Plantation: Eastern Kauri Pa Road

A smaller, 2.2-ha planting is evident on the eastern side of the first part of Kauri Pa Road (No. 2 Road). Again, poor survival of plantation kauri in this tōwai-dominated site was evident upon inspection.

1984 Plantation: No. 4 Road

A larger, 10.0-ha kauri plantation lies adjacent to the airstrip on No. 4 Road. The author viewed the upper end of this plantation (the southern end) in January 2016. Very few kauri were evident, indicating very poor survival in this part of the plantation. The northern end of the plantation (not inspected), appeared to have trespassed onto adjacent private land.

1985 Plantation: Northern Kauri Pa Road

The final planting of 8.0 ha occurred to the north of Kauri Pa Road (No. 2 Road). This plantation commenced immediately east of the start of Borneo Road (No. 9 Road). It was set up on a very harsh gumland site dominated by low mānuka. Growth was extremely slow, but many of the plantation trees survived to this day, and some natural regeneration was evident at the time of inspection.

Summary Comments on Omahuta Kauri Plantations

- The Omahuta kauri plantations described above appear to be PA free. The 1954 plantation of 4.0 ha on Kauri Pa Road was the most likely candidate for PA symptoms, given the provenance of its source seedlings and the early death of most of these when they were planted out, but quite close inspection of this site revealed no trace of kauri dieback.

- The 1940s and 1950s plantations were generally quite well stocked. This is largely a testament to consistent policies of follow-up management, i.e., blanking and release cutting, possibly for up to 10 years after the trees were planted.
- The 1944–1945 plantation (seed lot SP 205A) was one of the best stocked and successful plantations in the Omahuta kaurilands. It appeared that this plantation's developers problem-solved most of the issues that caused widespread plantation failures elsewhere in subsequent years.
- Where Omahuta Forest was cutover and sites were cleared by burnoff, a cover of *Leptospermum* (mānuka) and Weinmannia (tōwai) shrubland has replaced original vegetation. There is also a wide scattering of surviving kauri, mostly in the ricker stage of development. These are seeding into the shrubland habitats, with the result that natural kauri regeneration is now occurring in the most suitable microsites. Kauri are also seeding into the plantation areas, where regeneration of kauri is often prolific.
- It therefore appears that Omahuta would have regenerated back to a kauri forest without the need for any kauri plantation establishment.
- Kauri planted into a native vegetation cover dominated by tōwai will most likely fail.
- The generally poor performance of the 1980s plantations is largely a consequence of the withdrawal of follow-up management such as release cutting after the corporatisation of the NZFS in 1987.

PA-infected Plantation at Omahuta HQ

The situation of this plantation is well known in the conservation community. To reiterate, it is a heavily infected amenity plantation of less than 50 trees, and it lies behind the site of the NZFS office and workshop. The source of the trees is not known. They do not appear on any found stock maps or other plantation records. They are not mentioned in the Omahuta period reports of the 1950s. Their most likely origin is as an amenity planting to enhance the HQ site, and, being few in number, they may have fallen below the level of reporting requirements. It is possible that in 1956, infected trees from the Waipoua Forest Nursery Dunemann frame trial were diverted from Raetea Forest for planting on this HQ amenity site. The Dunemann trees were seed lot AK53/661.

As stated in the "Dunemann Frame Use at Waipoua Forest Nursery" section of this report:

"Given that Omahuta workmen did the plantation establishment work at Raetea, it is quite likely that some trees intended for planting at Raetea were diverted to Omahuta. The discrepancy between the number of 1953 Dunemann trial trees inventoried by Levy at the Waipoua Nursery in April 1956 (503 trees) and the number planted at Raetea (466 trees) might indicate where most of these trees came from. Joe Levy's presence supervising the Omahuta gang may have led to such a diversion; if he approved it, his approval would have acted as a kind of formal authorisation."

This is the best possible explanation of the source of the infected trees at Omahuta HQ, but it is not conclusive. Regardless of how the area became infected, and having inspected all the other plantation kauri in Omahuta without finding any PA symptoms, the author believes it is possible to be cautiously categorical that this is the only PA-infected site in all of Omahuta. It is most likely the only infected site

in all of the contiguous Omahuta and Puketi Forests. Its long-term management continues to be of the utmost importance for the welfare of these two kauri forests.

Raetea Forest Kauri Plantations

Policy Background

In 1955, the Director General of the NZFS, A. R. Entrican, announced a new policy whereby up to 2000 acres of kauri were to be "established on a plantation basis in open country". The Director General set some land characteristic criteria for the plantations:

1. Steepness to reduce percolation
2. Heavy soil for the same reason
3. Volcanic (basic) soil to retard soil change

Joe Levy reported to the Fourth Kauri Conference held at Auckland in June 1955 that land being planted at Glenbervie Forest met criteria 1 and 2, and that "400 acres of fairly clear country in State Forest No. 2 [Raetea]" met the third criterion. He further stated that "one acre of hardened stock will be planted this winter at 10 ft. x 10 ft. spacing and more extensive plantings made in 1956". Planting was carried out at Raetea from 1955–1959, when the policy waned, possibly with Entrican's retirement. A revised kauri policy in 1973 led to further kauri planting at Raetea from 1975–1985.

Source of Seedlings

The 1955–1959 planting efforts used seedlings supplied from Waipoua Forest Nursery. The 1975–1985 plantings used seedlings raised at Sweetwater Nursery.

Scale of Planting

The scale of planting, especially for the 1950s, was quite modest. An area of 6.2 ha was planted in the 1955–1959 period, and a further 70.2 ha was planted from 1975–1985 (Table 17).

Table 17 Raetea kauri plantations

Forest	Year planted	Area (ha)	# of trees planted	Seed lot #	PA status
Raetea SF 2	1955	0.8	c. 1000	AK 52/654	Clear
Raetea SF 2	1956	3.4	3766 Including 466 Dunemann	? AK 53/661	Positive
Raetea SF 2	1958	1.0	2000 1/3	AK 54/681	Positive
Raetea SF 2	1959	1.0	4000 (some of these likely used as blanks)	AK 55/698/848, AK 55/698/849, AK 55/698/850	Positive
Raetea SF 2	1975	4.7	3000	AK 72/1013	Positive
Raetea SF 2	1976	5.1	3300	AK 74/1040	*Clear
Raetea SF 2	1977	2.7	3500	AK/c/75/8	*Clear
Raetea SF 2	1978	5.9	5600	AK/c/75/8	*Clear

Forest	Year planted	Area (ha)	# of trees planted	Seed lot #	PA status
Raetea SF2	1979	Replanting	2900	AK/c/77/1	*Clear
Raetea SF 2	1980	7.8	3500	AK/c/77/1	*Clear
Raetea SF 2	1981	4.3	3000		*Clear
Raetea SF 2	1982	4.7	4030		*Clear
Raetea SF 2	1983	6.6	4000		*Clear
Raetea SF 2	1984	8.6	4000		*Clear
Raetea SF 2	1985	20.0?	18952		*Clear
Totals		76.6	63548		

Notes. *Not soil tested.

Abbreviations. #, number; c., approximately; SF, state forest. .Clear = No PA symptoms

Kauri Dieback and the Raetea Kauri Plantations

The 1950s Raetea plantations were identified as PA positive very early in the KDP's assessments of possible infections. Even in available NZFS records, there are indications of concern that "something was wrong" with some of these trees. A soil sample sent by Dave Bartram to FRI in 1975 identified *Phytophthora cinnamomi* and *P. pythium* as present. When the author was leading the further planting of kauri at Raetea in 1975, the planting crew noted and discussed the condition of the 1950s trees on the lower slopes and concluded that their poor condition was due to damage from cattle, which had intruded into the block.

Raetea is of interest in part because no natural kauri grow nearby. In a sense, it is a kind of field laboratory due to its isolation. Any disease there must have been brought in from afar by human activity, and the most obvious human activity is the work associated with the planting of the kauri. Looking back from Raetea to sources of trees and labour might offer some insights on the spread of the disease, and might also signal some biosecurity measures to protect Raetea and other kauri sites.

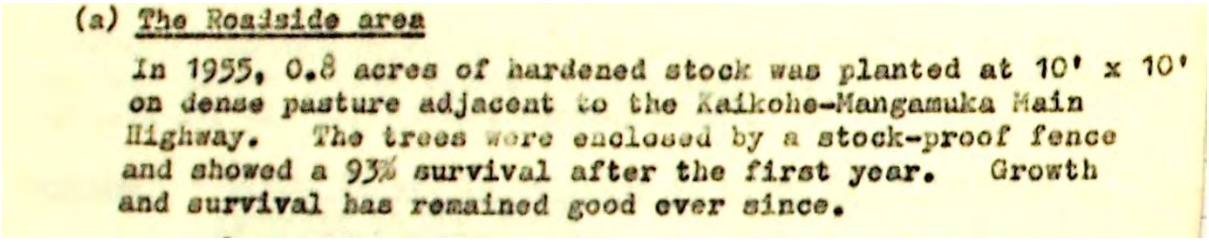
There is some indication that the Waipoua Forest Nursery became infected with PA in the 1950s and that the disease was transferred to various planting sites along with the seedlings. It was hoped that examination of the forest management records might pin down exactly which seedling cohort was infected, and Raetea was judged to be a good place to start the analysis based on its isolation and lack of natural kauri. Indeed, some of the records point to puzzling die-off of kauri seedlings raised at Waipoua Nursery via a system known as Dunemann frames. It is known that most of the trees from the first Dunemann frame trial at Waipoua were planted at Raetea in 1956, as mentioned in the "Dunemann Frame Use at Waipoua Forest Nursery" section of this report.

The 1950s Plantations

1955 Plantation: Seed Lot AK 52/654

This first kauri plantation established at Raetea was only 0.8 hectares, and trees were sourced from seed lot AK 52/654. This plantation is immediately adjacent to SH 1 at the northern end of the winding road over the Mangamuka mountain range. The trees have grown well, and at the time of inspection, were healthy and free from PA. A 1955 plantation of 4.7 ha at Glenbervie Forest from the same seed lot is PA positive, however. The initial Raetea kauri were planted into "open farmland". In 1958, Joe Levy established a fertiliser trial in this plantation, listed as SP A228, control plan 12/2. Being adjacent to SH

1, the area was well documented and photographed by the NZFS. Figure 45 is a description extracted from the NZFS *Working Plan for Raetea State Forest 2 (*1963–1973) (p. 2).



(a) The Roadside area

In 1955, 0.8 acres of hardened stock was planted at 10' x 10' on dense pasture adjacent to the Kaikohe-Mangamuka Main Highway. The trees were enclosed by a stock-proof fence and showed a 93% survival after the first year. Growth and survival has remained good ever since.

Figure 107. A description of the first kauri plantation at Raetea Forest.
Note. Excerpt extracted from the Working Plan for Raetea State Forest 2 (1963–1973).

1956 Plantation

The second effort at Raetea was somewhat larger (3.4 ha). In one of his Forester's 4-weekly reports, Joe Levy described the 1956 Raetea plantings carried out by the Omahuta Forest workmen "under my direct supervision". Levy stated,

"Several variants were adopted as follows: 2700 trees were planted at 10 ft. x 10 ft. on approximately 6.5 acres, partly clear and partly in mānuka, 300 trees were planted at 15 ft. x 15 ft. on 1.5 acres in the open. [Unfortunately, seed lot number for these two blocks of trees totalling 3000 seedlings has been lost to history]. [A total of] 300 kauri and 325 *Eucalyptus saligna* were planted in line-by-line mixture at 6 ft. x 6 ft. over half an acre in the open. [Again, no seed lot number is available for these trees]. [A total of] 466 stock from 1953 Dunemann frames and controls were planted in the open at 6 ft. x 6 ft. [These were seed lot number AK53/661]. In addition, I release cut and blanked with stock of numbered seed trees the half acre of 1955 kauri trial planting."

On November 3rd, 2016, the author traversed the western and eastern edges of this plantation. The adjacent 1958 and 1959 plantations were also inspected on the same day. An area of 6 ft. x 6 ft. spacing, which would match Levy's description of the Dunemann plantings, was discernible.

Figure 108. Part of the 1956 Raetea Forest kauri plantation. The Eucalyptus saligna–kauri mix is an obvious feature. The Dunemann frame seedlings may be the yellowing kauri immediately iin front of the gums, judging by their 6 ft x 6 ft spacing.

At the time of inspection, it appeared the kauri dieback disease had worked its way right through the 1956 plantation, except for some steep areas towards the south-eastern corner, where trees were healthy and vigorous. The very worst hit areas were in the mānuka "apron" of easy country sloping down to the river flats. Here, the trees have been dead for so long that most stumps had rotted away completely. In other places, the pattern of infection was quite variable. If the Dunemann trees were the source of the infection, PA should have been most advanced in the 6 ft. x 6 ft. Dunemann plantation. There was no doubt that PA is well established in that area, but no more so than many other sites within the 1956 plantings (and the 1958 and 1959 areas too, for that matter).

It does not appear that the disease has spread "naturally" through the plantations. It appears that the PA infection has had some "helpers" (vectors). Cattle have been through much of the 1950s plantations, and it is possible to judge that the current distribution of kauri dieback mirrors the area's use by cattle. The only areas the author noted that were not showing PA symptoms were the very steep south-eastern fringes of the 1956 plantation, where cattle would not have been able to access.

Figure 109. Non-symptomatic kauri on steep south-eastern edge of the 1956 kauri plantation, Raetea Forest.

The grazing lease for this part of Raetea Forest was closed in 1975. Up to that time, large numbers of cattle were wintered in the area. The author's understanding was that the lease was for 700 acres. The 1950s kauri plantations were a small parcel within this lease, and the ring fence around them was breached from time to time. New fences to protect kauri from trespassing stock were built in the 1970s. There is also some indication of past cannabis cultivation in the areas around the *E. saligna*/kauri plantings. This kind of cultivation would have very likely spread the disease. Pigs were and still are present from time to time, potentially exacerbating spread of PA.

From the evidence available at Raetea, it may not be possible to judge with certainty that the 466 Dunemann frame-sourced trees were solely responsible for bringing PA to the site. The inference is certainly there, but clarity of evidence has been obscured. The Raetea "field laboratory" has unfortunately been hugely disrupted by cattle and further disturbed by cannabis growers and wild pigs.

1958 Plantation: Seed Lot AK 54/681

The third plantation at Raetea (1.0 ha) was derived from seed lot AK 54/681, and 2000 1/3-size trees were planted. This plantation lies to the north of the 1956 plantation. Some of the 1956 *E. saligna* in the adjacent plantation have seeded into this stand, and these naturally established gums were already large trees at the time of inspection. The 1958 kauri were heavily infected with PA. Like the 1956 trees, the most infected areas were the easy, damp lower slopes.

1959 Plantation: Seed Lot AK 55/698

This plantation was also 1.0 ha, and 4000 trees of seed lot AK 55/698 were planted at 10 ft. x 10 ft. spacing. This plantation was mapped as two areas: a smaller southern piece forming a wedge between the 1956 and 1958 plantations, and a larger piece to the north of the 1958 plantation and adjacent to the old (1975) four-wheel-drive (4WD) track entrance. The southern piece is part of the apron of heavy PA infestation contiguous with similarly distressed 1956 and 1958 trees, which were planted into the same environment. The northern portion of the plantation is infected with PA. At the time of inspection, it appeared that the PA in this part of the plantation had been making gains more recently, as there were still pockets of not yet symptomatic trees in this stand.

1957 Planting

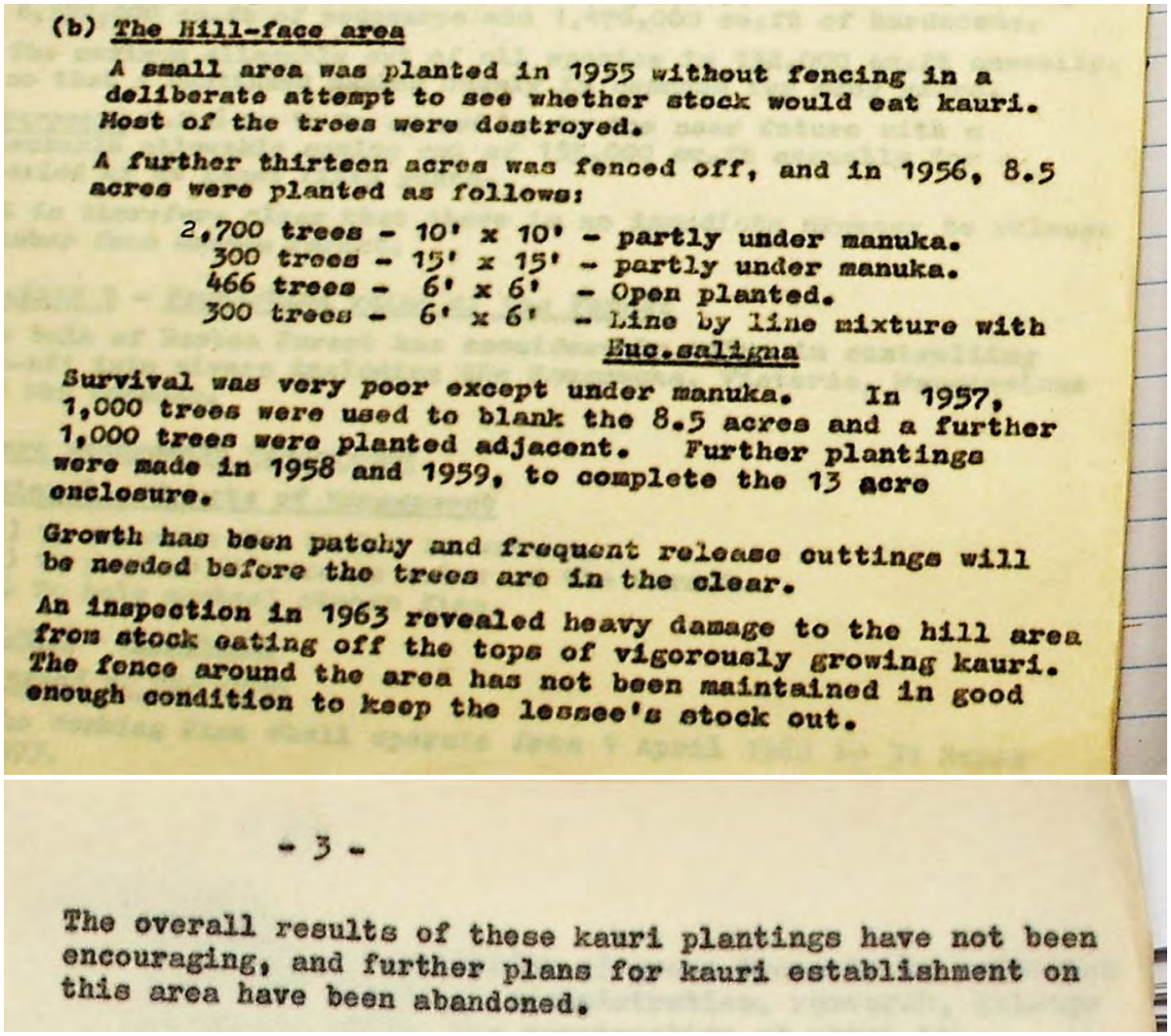
This plantation was probably done with seed lot AK 54/648 seedlings. A Raetea forest working plan extract (Figure 48) describes using 1000 seedlings to blank the 1956 planting failures, and a further 1000 trees "planted adjacent". Seed lot records from Scion's archives indicate 1676 seed lot AK 54/648 seedlings were sent from Waipoua to Kaikohe. Kaikohe was the NZFS District Office and would have directly managed the planting work at Raetea, so it is likely that these 1676 AK 54/648 trees were planted at Raetea. The same records show 2000 trees of the same seed lot going to Kaikohe (read Raetea) in 1958.

The wording of the working plan record (Figure 48) also suggests that 1000 trees were planted into an additional space in 1957, even though the map records do not show planting that year. The map of the Raetea plantations was compiled in the late 1970s. An earlier stock map of the 1950s plantations may exist, but archival searches have thus far have yielded no written map. The Figure 48 description states "a further 1000 trees were planted adjacent", indicating that the plantation was extended by a further 1000 trees in 1957. This makes sense in terms of the map, if 1957 planting is assigned to the map's southern portion of the 1959 planting. It would have been an odd management decision to leap-frog an area like this when carrying out the 1958 planting. This then would have this "1957" area being planted with seed lot AK 54/648, rather than the AK 54/681 used for planting in 1959. The records also show 4000 trees being planted at Raetea in 1959. In the author's opinion, it is safe to assume that some of these seed lot AK 55/698/845/849/850 trees were distributed throughout the 1956–1958 plantations as blanks.

Site Disruption by Cattle

It appears likely PA was introduced to the Raetea site via the 1950s plantings. The 1955 planting is in a discrete area, which has always been protected from stock. It is clear of PA symptoms. However, there are factors that make it difficult to draw precise conclusions about the origin and spread of PA at Raetea. These are:

1. Cattle, as recorded in the working plan document below (Figure 48), broke in and grazed most of the 13-acre fenced enclosure. Cattle are strongly implicated in the spread of PA in Kaipara, Puketotara and Northern Coromandel as well. Therefore, the boundaries between the different planting years and suites of plants were blurred by cattle grazing, and cattle clearly moved soil between sites.
2. There were other vector activities in the area. Cannabis cultivation was evident within the 1956–1959 fenced enclosure. Wild pigs are still present in low numbers. People use the area today. There is an adjacent picnic and camping area.



(b) The Hill-face area

A small area was planted in 1955 without fencing in a deliberate attempt to see whether stock would eat kauri. Most of the trees were destroyed.

A further thirteen acres was fenced off, and in 1956, 8.5 acres were planted as follows:

2,700 trees - 10' x 10' - partly under manuka.
300 trees - 15' x 15' - partly under manuka.
466 trees - 6' x 6' - Open planted.
300 trees - 6' x 6' - Line by line mixture with Euc.saligna

Survival was very poor except under manuka. In 1957, 1,000 trees were used to blank the 8.5 acres and a further 1,000 trees were planted adjacent. Further plantings were made in 1958 and 1959, to complete the 13 acre enclosure.

Growth has been patchy and frequent release cuttings will be needed before the trees are in the clear.

An inspection in 1963 revealed heavy damage to the hill area from stock eating off the tops of vigorously growing kauri. The fence around the area has not been maintained in good enough condition to keep the lessee's stock out.

- 3 -

The overall results of these kauri plantings have not been encouraging, and further plans for kauri establishment on this area have been abandoned.

Figure 110. Working Plan for Raetea State Forest 2, 1963–1973, pp. 2–3.

Precise Source of Infection

The PA infection of the Raetea kauri plantations came from the 1956–1959 plants, and from what the records and the site itself reveal, it is most likely that PA came in the 1956 plants. If required to state from where within this suite of plants the infection came, the author is of the opinion that the 466 Dunemann-raised seedlings were the primary vectors, given their known nursery history. Note though that the Dunemann history has been quite well documented compared with most of the Waipoua Forest Nursery seedling production activities.

The 1970s–1980s Plantations

All the trees in these plantations came from Sweetwater Nursery, not implicated in the spread of PA.

1975 Plantation

This kauri lot was planted as a 4.7-ha stand comprising 3000 trees. The 1975 plantation marked recommencement of planting of kauri at Raetea Forest. An area of 4.7 ha of mānuka and tōwai scrub was crushed and burned, and kauri were planted into this open environment. Today, these trees are reasonably well stocked and many are showing good growth, with trees up to 46 cm DBH. Their form is often quite odd compared with what you would find in a natural stand. Branch abscission is often absent, with persistent branch stubs apparent. There is often quite copious bleeding from branch stubs and from the lower crown. Double leaders are more common than in natural areas. Crowns are generally heavy and dark green. PA has been identified in this stand. At the time of inspection, the author did not see any symptomatic trees on his visit there (November 3rd, 2016). The site seemed stable, with some minor pig sign here and there. The spread of the PA infection from the 1950s plantations was most likely via humans or wild animals. Note that PA has spread uphill and has "leapfrogged" into the 1975 area. It has not "crept" in from the boundary.

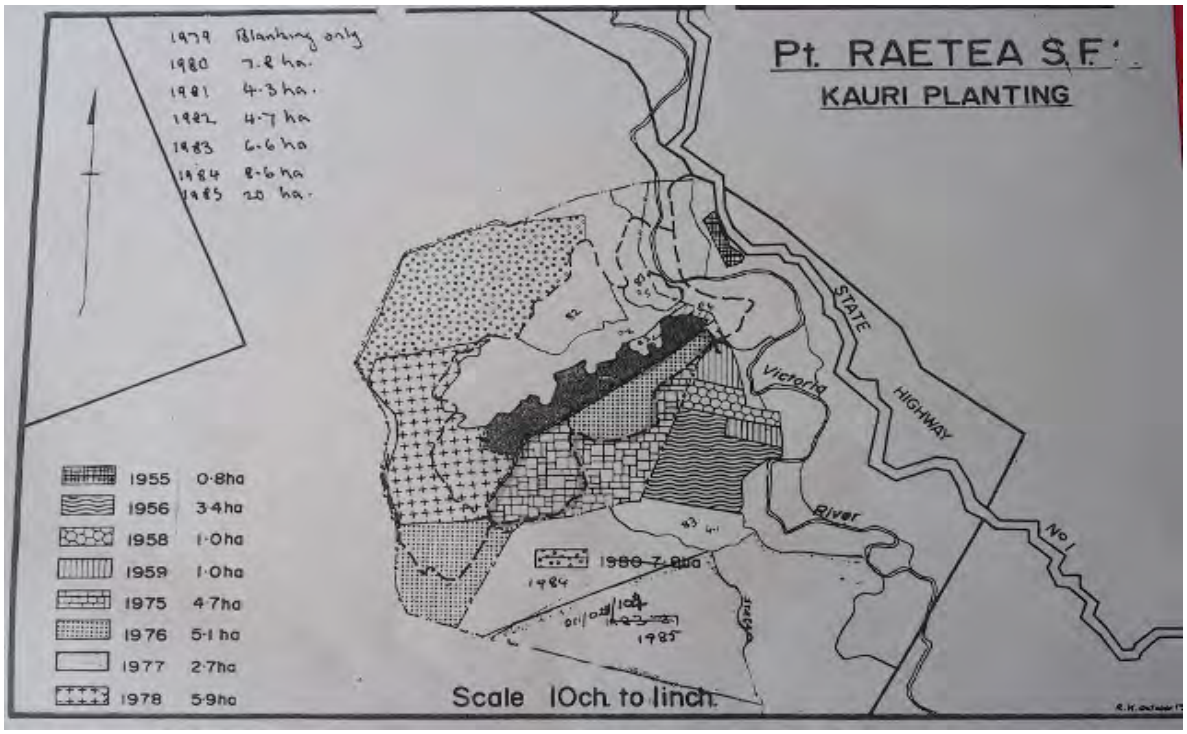


Figure 111. Map of Raetea kauri plantations.

1976 Plantation

This area of 5.1 ha was planted with 3300 trees. As with other sites, this area was crushed and burned. The fire got away on the top boundary, and due to the risk of further such fires, this was the last area at Raetea to be cleared in this way. The plantation is in two components, divided by the 1975 planting. Stocking is lighter than the 1975 plantings, with some of the trees being outgrown by competing mānuka and associated ferns (*Cyathea medullaris*). Nevertheless, there are some very large, tall kauri in this stand. They display many of the same growth characteristics as those described for the 1975 plantings.

1977 Plantation

This smaller site of 2.7 ha contains 3500 trees. The plantation was planted into an area that had been cleared by a light bulldozer. The dozer had scraped off the vegetation, unfortunately removing much of the topsoil along with the vegetation. Trees were slow to get going on this harsher site. Today, it is less well stocked than the 1975–1976 plantations, and the trees are smaller. They show in the landscape as emergent trees above mānuka canopy.

Northern Block of Plantations

These plantations were grouped because they are contiguous with each other, and all seem to be performing similarly. They were planted into line-cut areas in mānuka and tōwai scrub. They show up now in the landscape as scattered, emergent individuals and clumps of trees. In some places, the competing vegetation, especially tōwai and mamaku fern, has assumed control of the sites, and it is unlikely that kauri will emerge in such places without release cutting. However, there are enough surviving kauri to provide assurance that kauri will be the dominant tree element as the landscape evolves. There is no kauri dieback evident in these landscapes, and it is likely that the scattered nature of the kauri stocking will provide some buffering from the progress of PA through the area. Table 18 below provides a synopsis of the northern block of plantations.

Table 18 Northern block of kauri plantations, Raetea Forest 1978-1983

Year planted	Area planted (ha)	# of trees	Comment
1978	5.9	5600	
1979	Replants only	2900	Blanks
1980	7.9	3500	
1981	4.3	3000	
1982	4.7	4030	
1983	6.6	4000	Two blocks (northern area, 2.5 ha)

Abbreviation. #, number.

Southern Block of Plantations

These plantations fill the large valley to the south of the northern block. Casual viewing of the area showed very few kauri, but closer inspection revealed emergent individuals and clumps right across the landscape. No kauri dieback was apparent at the time of inspection. When the author was traversing the southern edge of the 1956 plantation, quite a few of the 1983 plantings were visible. They were emerging in places and were being suppressed in others. These trees would not have had much maintenance in the way of release cutting, so their survival to this point is interesting, and their persistence probably indicates that they will gradually become dominant elements in this landscape. Again, their scattered distribution most likely provides buffering from potential spread of PA infection. A short list of the southern block plantations appears in Table 19.

Table 19 Southern block of kauri plantations, Raetea Forest

Year planted	Area planted (ha)	# of trees	Comment
1983	4.1	4000	Adjacent to 1956 plantation
1984	8.6	4000	
1985	20.0*	18952	

Abbreviation. #, number.

Infected kauri can be seen in Figure 50, a panoramic view of the southern block plantations.

Figure 112. General view of southern block of Raetea Forest kauri plantations. Infected area to right front is the 1956 plantation. Darker green area in right middle distance is the 1975 plantation. Emergent kauri in shadow in left centre skyline are part of the 1976 plantation. Emergent trees to the right of these are part of the 1978 plantation. Shrubland in sunlight in centre right is the 1983 plantation. Shrubland in shadow behind this is the 1984 plantation.

Conclusions About Raetea Kauri Plantations

A number of conclusions can be made about Raetea kauri plantations.

1. The 1955 plantation adjacent to SH 1 is free of PA.
2. All of the other 1950s plantations are PA positive.
3. Opportunities to pin down exactly how PA was introduced to Raetea are compromised by gaps in historic records and site disruptions, mostly by cattle. However, there is a strong implication that Dunemann frame-raised Waipoua Forest Nursery seedlings are the source of the Raetea PA.
4. Opportunity to pin down how PA spread through the 1950s Raetea kauri plantations has been compromised by site disruptions, especially cattle incursions.
5. Kauri dieback has spread into the 1975 Sweetwater Nursery-sourced plantation.
6. All of the Raetea kauri plantations are contiguous (except the 1955 area beside the highway), i.e., there are no natural barriers to the spread of PA.
7. The plantations are currently free of major vectoring activities. Cattle are excluded; wild pig numbers are low and visitors infrequent.
8. There are some long-term challenges for the management of the Raetea kauri plantations.

Long-term Management of the Raetea Plantations

The Raetea plantations present some issues for DOC and the KDP to consider. The plantations are strong landscape features in a scenic part of inland Northland. They are very visible public issues. The plantations have always been a problem for DOC in that they are an unnatural area of native forest trees being managed by an agency with a mandate for managing natural areas. They are not a clear policy fit.

DOC has further developed the adjacent picnic and camping area in recent years, probably without fully factoring in the possible biosecurity risk the users of these facilities may pose to the wider kaurilands. Some of the kauri dieback risks visitors may pose have been intelligently reconciled by DOC. The 4WD track up the hill has been closed off for vehicles by the placement of huge rocks, and there are signs advising visitors not to enter the infected area on foot. The fences are functional. The picnic/camping area has been closed off for the winter, again by the placement of big rocks across the public access. However, there is no explanation to the visitor as to what is going on at the site, and this probably reflects the fact that DOC and the KDP do not have a plan for the site.

Below, the author recommends some options for managing kauri dieback on this site, with a preference for a combination of the second and third options.

Option 1: Eliminate the Problem

The Raetea kauri plantation is 76 ha of kauri within a block of no more than 100 hectares. It could be felled, crushed and burnt and allowed to revert, or possibly, it could be planted in exotic pines or developed for farmland. This extreme measure has the merit of eliminating entirely the long-term transfer risks offered by kauri dieback on this site. It is a large undertaking, but well within the capabilities of contractors. Biosecurity measures could deal with any PA transfer risks generated by the land-clearing operations. Note that there are no natural kauri stands within close–medium range of the plantations. There would be public awareness issues around the felling and burning of 100 ha of public conservation land, but an informed public could readily grasp what was at stake if informed/engaged adequately.

Option 2: Isolate the Problem

The current management of the site is a somewhat passive version of this option. Its weakness is that it is not part of a visible plan for the site. The public has not been engaged. But all the steps are in place, at least in part, except the public engagement.

- Cattle do not have access to the site.
- 4WD access is permanently blocked.
- The public is discouraged from visiting plantations.
- Wild animal numbers are very low.

If these measures were reinforced through implementation of a plan understood by the public, then the Raetea plantations could be “quarantined” with widespread public support.

Option 3: Monitor the Spread of PA within the Plantations

There may not be close interest in this site from DOC, the NRC or MPI. It would be a relatively simple matter if option 2 above was adopted to formally inspect, from time to time, the agreed defensive measures such as fences, signage, wild animal numbers, etc. The spread of PA symptoms could be assessed periodically, most likely by remote sensing, with possible ground-truthing via soil testing, either to inform management directly or as a research topic. Indeed, the dynamics of PA on this site have the potential to provide insight on the progress of the disease on other infected or vulnerable sites.

Puketi Kauri Plantations

1950s Kauri Plantations

The author visited Puketi on March 10th, 2016, with the purpose of locating and assessing any surviving trees from the kauri plantings of the 1950s. The secondary purpose was viewing the kauri plantations installed in the 1970s and 1980s. Plantations at Puketi are detailed in Table 20

Table 20 Kauri plantations, Puketi

Forest name	Compartment #	Year planted	Area (ha)	# of trees	Seed lot #	Nursery source	PA status
Puketi SF 4	19	1954*	1.6	530 @ 10 ft. x 20 ft.	AK 48/571	Waipoua	OK. No trees found
Puketi SF 4	19	1954	6.0	2270 @ 10 ft. x 20 ft.	AK 51/640	Waipoua	OK. No trees found
Puketi SF 4	19	1955	11.2	2200 @ 20 ft. x 20 ft.	AK 51/640	Waipoua	OK. No trees found
Puketi SF 4	Pirau	1977	22.0	3000		Sweetwater	OK
Puketi SF 4	Pirau	1978	10.7	3700		Sweetwater	OK
Puketi SF 4	Pirau	1979	11.8	2900		Sweetwater	OK
Puketi SF 4	Pirau	1980	12.1	2200		Sweetwater	OK
Puketi SF 4	Pirau	1981	10.3	4000		Sweetwater	OK
Puketi SF 4	Pirau	1982	3.0	4920?		Sweetwater	OK
Puketi SF 4	Pirau	1983	12.5	4000		Sweetwater	OK
Puketi SF 4	Mokau?	1984	7.3	4234		Sweetwater	OK
Puketi SF 4	Mokau?	1985	33.9	6274		Sweetwater	OK

Abbreviations. #, number; SF, state forest. * Date not shown on stock map. ? = Precise location uncertain OK = not known to have PA

Figure 51 shows the kauri plantings established in the 1950s. They were located in cutover podocarp forest, somewhat west of Onekura on the Mokau Ridge. The author judged that the 1954 plantation of 19 acres was encountered by the current Mokau Ridge Road, with the plantation being to the west and south of the road. Figure 51 shows two seed lots providing the trees that made up the 1954 plantation, i.e., 530 trees of seed lot number AK 48/571 planted at 20 ft. x 10 ft. make up 4 of the 19 acres. A further 2270 trees of seed lot number AK 51/640 were planted at 20 ft. x 10 ft. to make up 15 of the 19 acres. Seed lot AK 48/571 would have been 6 years old at the time of planting.

Figure 113. Map of kauri plantations established in Puketi in the 1950s.

Kauri Dieback in the 1950s Plantations

The author inspected some of the forested area where the 1954 plantation was most likely to have been sited. The area comprises a very dense scrub hardwood forest, with some mānuka on the easy ridge. The mānuka area would probably have been bare ground in the 1950s. At the time of inspection, it carried a scattered cover of mānuka over a very dense understory of *Gahnia*. Off the low ridge, the mānuka gave way to a canopy of tōwai and associated species, with a very dense understory of *Gahnia,* kiekie, supplejack, bush lawyer and other understorey species. A very few emergent natural kauri were visible, scattered within the stand. There was virtually no kauri regeneration. The five kauri trees that were of possible plantation origin were located on the ridge shoulder where a few kānuka and other kauri host-type vegetation provided a cover under which kauri might survive. The author saw no kauri regeneration on these sites. Above and below this narrow band, the canopy appeared too dense to allow the survival of kauri, plantation or natural in origin.

The five kauri trees, which could be of plantation origin, were scattered and too few in number to allow any discernment of a planting pattern. They varied between approximately 15 and 32 cm DBH. They all had healthy crowns. One had a split in the base and some gum bleed from that (Figure 52). This bleed did not appear to be symptomatic of PA.

Figure 114. Kauri tree at E1665718 / N6105722, DBH approximately 32 cm, Puketi Forest. Note gum bleed at base, probably not a result of PA infection.

Department of Conservation Ranger Dan O'Halloran has looked for plantation kauri in the area described as 1955 kauri of 28 acres to the south. He found virtually no kauri in this area. Again, it was a very dense *Gahnia* site under a hardwood canopy and was planted into a recently logged-over site. To the west of these kauri plantings (which were recorded as being planted at 20 ft. x 20 ft.), a large cutover area was planted with Japanese cedar (*C. japonica*). Ranger O'Halloran reported that none of these (cedar) trees were visible at the time of his inspection, and possibly, none have survived.

Comments on the Mokau Situation

It would be possible to surmise that the general failure of kauri in this area of Puketi was due to the trees being killed by a pathogen, possibly PA. Leaping to this conclusion may not be a clearly logical path, however, for the following reasons.

1. The site is not kauri friendly. The dense ground cover would have required regular and heavy releasing of the planted trees. It is impossible to say how well the trees were maintained. But it appears they were neglected.
2. The area has had a significant wild animal history, especially wild pigs and wild cattle; large numbers of the latter were rounded up or culled in the 1970s.
3. The parallel failure of the *C. japonica* would suggest a non-pathological cause.

Nevertheless, the failure is of interest, and the possible PA connection should not be dismissed out of hand. Note that a 1955 plantation of 406 seedlings from seed lot AK 51/640 planted at Kiwiriki GBI was also a complete failure. Consideration should be given to sampling the possible PA-positive1954 plantation trees.

These potentially infected trees are located at GPS points as follows.

- E1665718 / N6105722 (Figure 52)
- E1665681 / N6105721
- E1665687 / N6105721

Note also that seed lot AK 51/640 kauri were used in a 4.0-ha, 1954 plantation on Kauri Pa Road, Omahuta, and that this plantation also failed. Subsequent inspections of the GBI Kiwiriki cohort plantation (seed lot AK 51/640) were performed by the author in August 2016. No kauri dieback symptoms were seen on the site, and a few kauri were present on the site, which were probably of plantation origin. Also, careful subsequent inspection of the 1954 plantation at Omahuta revealed no sign of PA.

Kauri Dieback in the 1970s and 1980s Plantations

These plantings are mostly along the Pirau Road to the south of the forest. There were also plantings done towards the eastern end of the Mokau Road. Maps of the 1970s and 1980s Puketi kauri are non-existent in the case of the Mokau trees, or of very poor quality and dubious accuracy in terms of the Pirau Road trees.

Plantations on Pirau Road

The author inspected some of these, in particular the 1978 area of 10.7 ha. There were very few surviving kauri under this dense hardwood canopy at the time of inspection. In general, the plantations installed under a tōwai canopy had mostly failed, mainly because of suppression. These trees were release cut early in their history, but following the change to DOC management in 1987, this maintenance ceased, and without this management, large numbers of trees were lost. This loss reflects the 1950s Mokau situation and also serves as a reminder of kauri planting failures in compartment 58 at Waipoua Forest, where again, kauri failed under a dense hardwood canopy.

Better survival was evident at Pirau Road, where trees were planted into tea tree, even in heavily podzolised gumlands. There looked to be good survival and reasonable growth in the plantations opposite private landowner Magon's gate, near the Puketi Forest HQ.

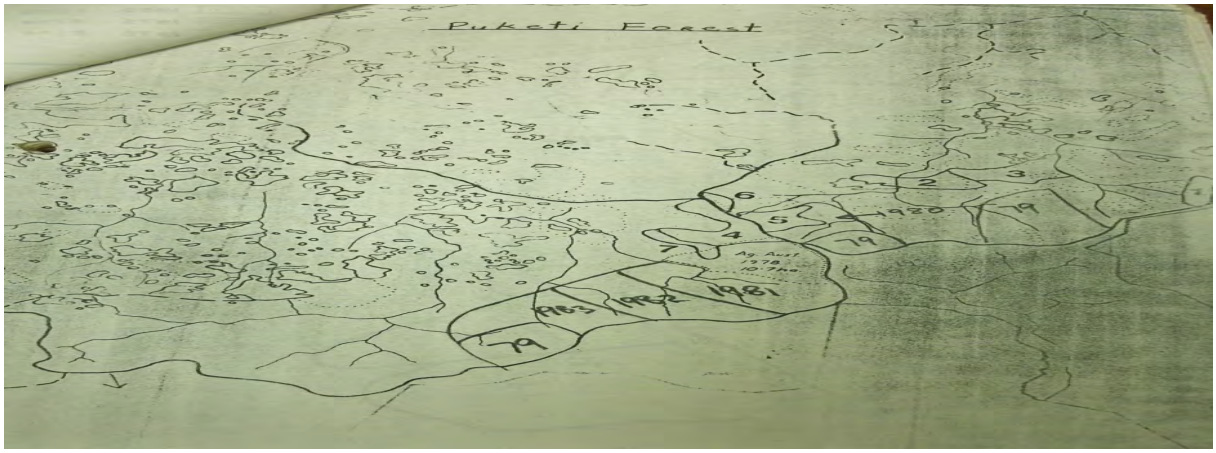


Figure 115. Sketch Map of kauri plantations on Pirau Road, Puketi Forest.

The Pirau situation is often difficult to analyse, because virtually all areas are within range of kauri seedfall, and the subsequent natural regeneration can make on-the-ground interpretation difficult. The situation is not helped by the lack of accurate maps. If a good quality map of the later Puketi kauri plantations does come to light, then a more detailed field review should be undertaken. There was no sign of any PA symptoms in any of the Pirau kauri viewed by the author (Figure 54).

Figure 116. Apparently healthy Pirau kauri, Puketi Forest.

Glenbervie Forest Kauri Plantations

Table 21 shows the extent of the Glenbervie kauri plantations. The 1949–1955 plantations are all close to each other, with a road dividing the 1955 stand from the 1949 and 1950 stands. All are PA positive but showing no PA symptoms. All seedlings in these stands came from Waipoua forest Nursery.

The 1974 stand, although some distance away, has become infected with PA, with some trees showing symptoms. It is only the second Sweetwater Nursery-sourced plantation to test positive for PA. The 1985 stand has been identified from the tables, but no map has been found of it. There are some features of kauri dieback in these plantations that should be examined.

Table 21 Glenbervie Forest kauri plantations

Forest name	Compartment #	Year planted	Area (ha)	# of trees planted	Seed lot #	PA status
Glenbervie SF 21	1	1949	2.4	*500	AK 46/514	PA-infected
Glenbervie SF 21	1	1950	2.4	6000	AK 48/571	PA-infected
Glenbervie SF 21	1	1955	5.2	5000 @ 10 ft. x 10 ft.	AK 52/654	PA-infected

Forest name	Compartment #	Year planted	Area (ha)	# of trees planted	Seed lot #	PA status
Glenbervie SF 21	1	1974	1.77	1600	AK 71/999	PA-infected
Glenbervie SF 21	Unknown (no map)	1978	6.7	1000		Unknown
Glenbervie SF 21	302?	1979	6.6	1000		Unknown
Glenbervie SF 21	302?	1980	1.0	1000		Unknown
Glenbervie SF 21	Unknown (no map)	1985	6.0	2880		Unknown
Total area			17.8			

Notes. *This figure is not enough trees to plant this block. There must be others, but no records show their existence.
Abbreviations. #, number; SF, state forest. ? = indicated on map but no polygon

1949–1955 Plantations

It is difficult to interpret how this stand became infected. The broad nature of the distribution of PA in the stands suggests that either there was wide infection in the suites of seedlings that were planted at Glenbervie, or that some very active vector spread the disease evenly through the stand from one or more points of infection. Going through the seed lots looking for parallel infections provides some illumination, but nothing definitive.

The 1949 stand of 2.4 ha was planted using seed lot AK 46/514. This seed lot was also used to plant the 1948, 0.8 ha stand at the Waipoua Northern Arboretum. This stand is healthy, with no PA symptoms. It is most likely that some of the SPs at Waipoua were planted with the 1949 stand's seed lot AK 46/514 (63/1 and 63/2 are the most likely candidates), but unfortunately, seed lots are not noted on the material unearthed by the author thus far. Kauri dieback is not known to be in these SPs.

Very large numbers of trees were planted at Omahuta using seedlings from seed lot AK 48/571, as was the above 1950 plantation. There are no PA symptoms on the Omahuta trees of that seed lot. These parallel uninfected stands at Waipoua and Omahuta tend to rule out the 1949 and 1950 Glenbervie plantations as being the forest's source of PA.

The 1955 stand was planted with 5000 trees from seed lot 52/654 at 10 ft. x 10 ft. spacing. This seed lot was used to plant the 1955 stand of kauri beside SH 1 in Raetea Forest. This stand yielded no PA in soil tests. It is also free of obvious symptoms. The seed lot register carries very little information on the distribution of this cohort. The small, very infected 1956 plantation in compartment 4 at Waipoua used 300 of this AK 52/654 cohort. Unfortunately, three other seed lots were also used in this planting, which somewhat muddies the picture as to how the Waipoua compartment 4 plantation became infected. The connection is there, but it is not strong and clear. Raetea refutes it. Compartment 4 Waipoua may endorse it.

Other Explanations for the Infection

Very few kauri plantations are successfully established without the need for "blanking". Blanking is replanting where the originally planted trees have died. It is likely that blanking was required in these

stands, although the 1955 stand had a survival rate the following year of 93%, which would be above the trigger level for blanking. It is possible that the disease was introduced via a cohort of infected blanks, which would have been distributed widely across the stand. Subsequent vectoring such as grazing would have moved it to the other kauri plantations.

The 1974 Plantation

This later planting is positive for PA. It is thought that this stand was not infected through PA-carrying seedlings but via local vectoring, most likely grazing animals.

The 1978–1980 and 1985 Plantations

These plantations are not necessarily in existence, as their presence is based on tables of annual plantings. An historic map shows 1979 and 1980 kauri plantings in compartment 302, but the plantations are indicated, not outlined. No map of the 1978 or 1985 plantations could be located at the time of the writing this report. Better information about these plantations may be found via liaison with Rayonier NZ.

Trounson Park Kauri Plantations

Trounson Kauri Park is a scenic reserve, and until the formation of DOC in 1987, it was administered by the Lands and Survey Department. Up to the late 1970s, when Lands and Survey Department set up a framework of Reserves Rangers in Northland, much of the management of the forested part of the reserve was delegated through local arrangement to the NZFS. As per Table 22 below, the NZFS established a series of kauri plantations in indigenous scrubland to the north of Trounson Park Road, a public road.

Table 22 Trounson Park kauri plantations

Year planted	Area (ha)	# of trees	Seed lot #	PA status
1955	0.1	?	?	No symptoms
1959	0.8	525 315	AK 55/698 AK 56/716	No symptoms
1960	0.8			No symptoms
1961	0.8			No symptoms
1962	0.4	734	AK 58/769	No symptoms
1963	1.0	1120	AK 58/769	No symptoms
1964	0.8	625	AK 60/842	No symptoms
1965	2.8	78 56 650 600 693	AK 60/845 AK 60/846 AK 61/846 AK 61/860 AK 61/878	No symptoms
1966	5.6 (3 blocks)			No symptoms
1967		*650	*AK 62/895	
Total area	13.1			No symptoms

Notes. ? = not known *Seed lot register assigned these trees to 1967 plantings. Note that there was no plantation added in 1967; these trees could have been used as blanks. Or the year assigned was wrong, as this cohort would have been 5 years old in 1967.

Abbreviation. #, number.

Condition of the Plantations

The plantations at Trounson are mostly growing well, and some stands of plantation trees are quite dominant in the landscape. Two of the three 1966 plantations are some distance to the west. The author did not inspect these. Heavy indigenous tōwai growth dominates the kauri towards Mangatu Road and will most likely suppress most of them in time.

Kauri Dieback in Trounson Plantations

The main body of old growth kauri forest at Trounson Park is quite heavily infected with kauri dieback. The fact that none of the plantation trees are displaying symptoms and that soil tests have not found kauri dieback is of interest to the KDP because:

- the disease has not been conveyed the short distance between the infected natural forest and the plantations. There has been plenty of traffic for management purposes between the two areas over the years;
- all of the seedlings planted at Trounson came from Waipoua Forest Nursery. The absence of PA in any of these plantations provides us with an ability to infer the PA status of several batches of seedlings produced from that nursery between 1955 and 1967;
- unfortunately, the seedling/seed lot information re the trees planted at Trounson is incomplete.

Aupouri Forest Kauri Plantation

Inspection of a 1969 kauri plantation in Aupouri Forest occurred on May 31st, 2016. The map below (Figure 55) shows this plantation near the eastern edge of Aupouri Forest. It is accessed via the dotted vehicle track.

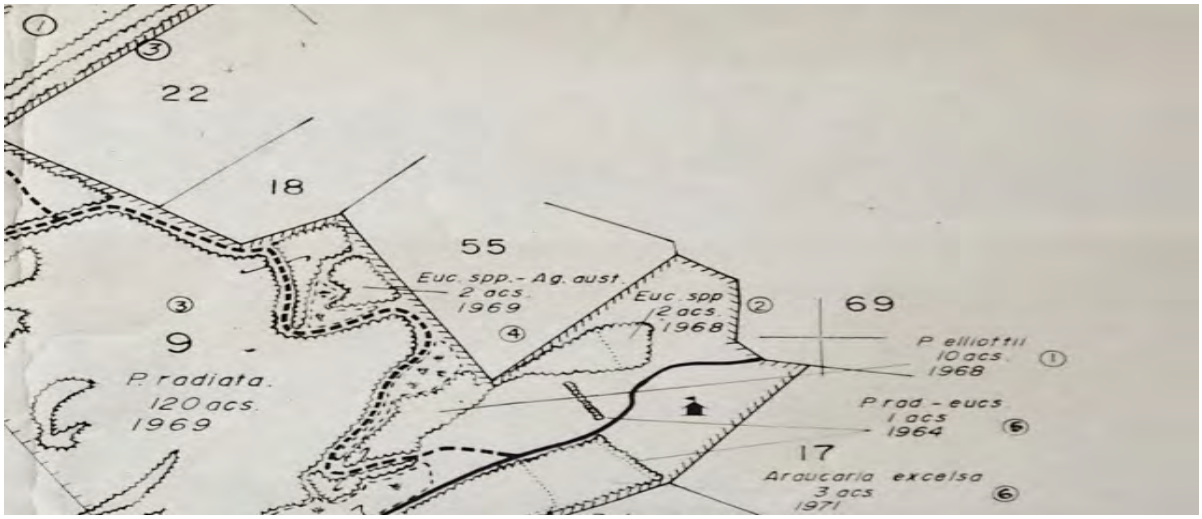


Figure 117. Map of part of Aupouri Forest showing 1969 Eucalyptus spp./Agathis australis plantation.

The plantation is on a small island surrounded by a *Juncus* (rushes) and tea tree wetland (Figure 56). The soil on the island is consolidated sand. At the time of inspection, it appeared the *Eucalyptus*

species (mostly *E. saligna*), planted concurrently, had largely died off, leaving the kauri with partial protection and very good light. Growth appeared very good, with many trees over 25 cm DBH and a few edge trees well over 30 cm DBH. There were a few small kauri in the 5–10 cm DBH range, but these too were healthy. Trees were a very good colour (dark green on the whole), and the stocking was quite full, with very few gaps in the kauri stocking. Undergrowth was sparse. There was no sign of PA.

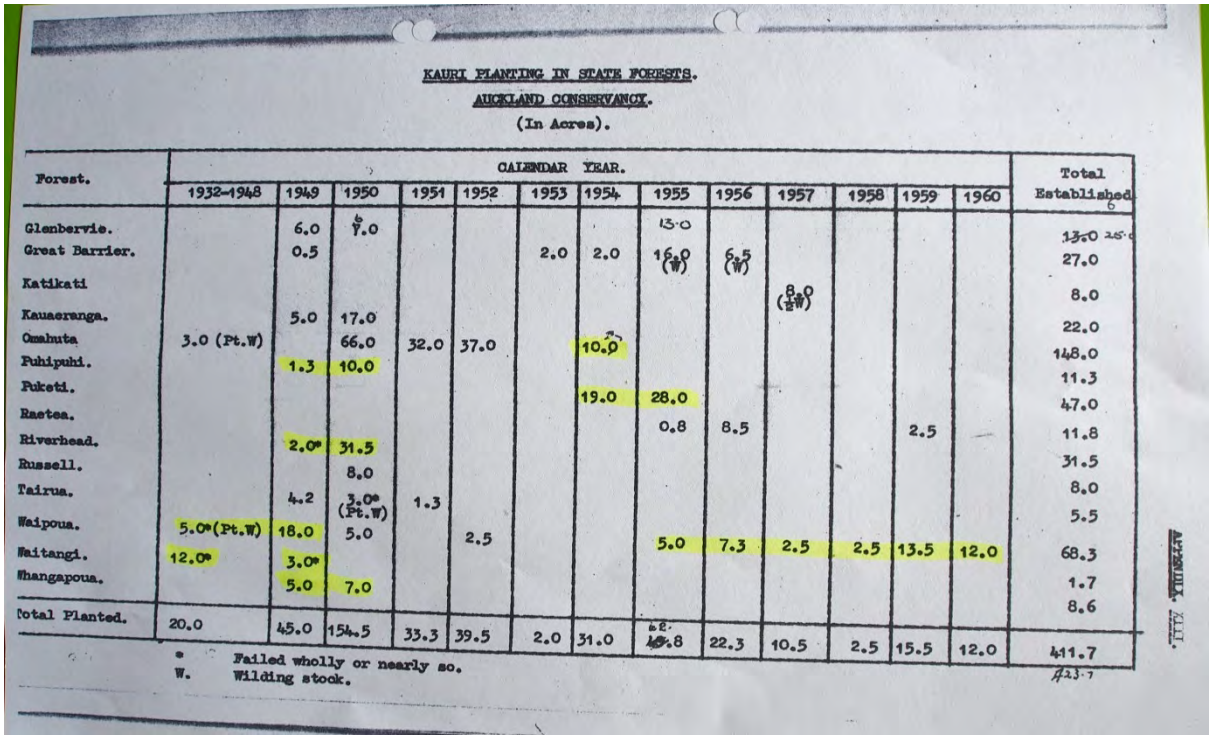
The stand was wonderfully buffered from possible PA vectors, it being situated on a swamp-surrounded island. It is likely that the swamp keeps water available through dry periods, and this may partly explain the trees' apparent vigour. It is possible too that the kauri have benefitted from aerial topdressing of adjacent pines. In terms of management, the current regime appeared to be working. The stand certainly illustrated that good kauri can be grown on sand (Figure 57).

Figure 118. View of kauri plantation across the Aupouri wetland. Note the die-off of the Eucalyptus canopy.

Figure 119. Interior shot of Aupouri kauri plantation. Large stems are eucalyptus.

Failed Kauri Plantations

There is a very high proportion of failure in NZFS efforts to establish kauri plantations, as the table from a kauri working plan from c. 1960 indicates (Figure 58). Plantation sites that the author judged to have failed are highlighted in yellow. Note that there are no agreed criteria for failure. The author's judgement is that nearly half of these plantations failed. On some of these sites, kauri of plantation origin are present, but no actual plantation of kauri appears to exist.



KAURI PLANTING IN STATE FORESTS.
AUCKLAND CONSERVANCY.
(In Acres).

Forest.	CALENDAR YEAR.												Total Established
	1932–1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	
Glenbervie.		6.0	7.0					13.0						13.0
Great Barrier.		0.5				2.0	2.0	16.0 (W)	6.5 (W)					27.0
Katikati										8.0 (½W)				8.0
Kauaeranga.		5.0	17.0											22.0
Omahuta	3.0 (Pt.W)		66.0	32.0	37.0		10.0							148.0
Puhipuhi.		1.3	10.0											11.3
Puketi.							19.0	28.0						47.0
Raetea.								0.8	8.5			2.5		11.8
Riverhead.		2.0*	31.5											31.5
Russell.			8.0											8.0
Tairua.		4.2	3.0* (Pt.W)	1.3										5.5
Waipoua.	5.0* (Pt.W)	18.0	5.0		2.5			5.0	7.3	2.5	2.5	13.5	12.0	68.3
Waitangi.	12.0*	3.0*												1.7
Whangapoua.		5.0	7.0											8.6
Total Planted.	20.0	45.0	154.5	33.3	39.5	2.0	31.0	62.8	22.3	10.5	2.5	15.5	12.0	411.7

* Failed wholly or nearly so.
W. Wilding stock.

Figure 120. Working plan table of kauri plantations (c. 1961). Failed plantations are highlighted in yellow. "Success" is around 56%.

On many of the sites of failed plantations, kauri are present, but it is likely that most of these are derived from natural regeneration. Analysing the 1960s, 1970s and 1980s plantings, a high proportion of failure is also evident. A full analysis of this later period of planting has not been conducted, but some examples are:

- Very little evidence of success in Opua Forest, where from 1977–1982, 251.9 ha were planted in kauri, mostly as enrichment group plantings.
- Indications that in Puketi Forest, much of the 1977–1985 planting has been suppressed by tōwai regrowth.
- The plantation situation in Russell Forest is difficult to discern, because of poor mapping and incursion of naturally regenerated kauri, but there is no strong evidence of success in the 1970s and 1980s plantations.
- The compartment 58 trials (1955–1963) in Waipoua Forest show a sparse presence of kauri here and there, but these trees are hardly describable as plantations.

Explanation of the Failures: Management Lapses

Plantation failure is of interest to the KDP, because catastrophic loss of seedlings can point to a pathological explanation. However, before considering this model, it is useful to traverse other, often more prosaic explanations.

Follow-up Management

Omahuta Forest Management Example

Figure 58 illustrates clearly how the level of success at Omahuta Forest stands out. A total of 148 acres was planted: Of those, 138 acres were established successfully. Omahuta Forest was an isolated area that had achieved some importance during WWII as a supplier of kauri timber for "war purposes", including the construction of wooden minesweepers. After the war, the Omahuta Forest station was left with a small complement of staff, a good road network and a generally degraded landscape of cutover and often burntover native vegetation. Not very much of the forest was deemed suitable for exotic afforestation via the normal *Pinus* establishment model. There was also the issue of rehabilitating the cutover areas.

Forest development work at Omahuta over the post-war years comprised:

- Developing exotic pine forest on "suitable" sites
- Underplanting cutover areas with suitable exotic species, especially Japanese cedar (*C. japonica*)
- Developing kauri plantations

The scale of all these operations was modest, and staff at Omahuta were able to stay on top of their work programmes and assign sufficient effort to all of the above tasks, including the kauri programme. At other forest stations, the main pressures were towards large-scale exotic forest planting programmes, and kauri work sometimes fell lower in the list of priorities. Not so at Omahuta.

Release Cutting and Blanking

The plantations at Omahuta are on generally harsh gumland sites, where kauri grow slowly and where native forest regrowth is relentless. Most of the Omahuta kauri plantations have probably had at least 5 years of release cutting, and possibly many more years of similar care at some sites such as SP 205A on Black Bridge Road. The same level of commitment is not apparent at other forests. In his 1971 report on the Waipoua Forest compartment 58 establishment trials, Sandy Rae comments that the failures he had identified there could be assigned in large part to lack of follow-up management, especially release cutting.

1954 Plantations at GBI and Omahuta

These two plantations both failed, and both carried the same seed lot number, AK 51/640. These two plantations are therefore of some interest. The GBI plantation of 2 acres is at Kiwiriki, and the Omahuta plantation of 10 acres is on Kauri Pa Road. They were inspected closely by the author, who found no indication of kauri dieback. At Kiwiriki, recognisable plantation trees were occasional; at Omahuta, natural versus plantation trees were indistinguishable. All kauri at both sites were clear of PA symptoms at the time of the writing of this report.

1970s and 1980s Plantations

Later planting efforts of the 1970s and 1980s are now failing, and again, much of the lack of success can be assigned to lack of follow up "nurturing", especially release cutting, but also lack of blanking. In the round of inspections of kauri plantations that led to this report, the author has observed that kauri will survive, often for many years, in forests where competing vegetation has overtopped the plantings. But if the overtopping vegetation comprises long-lived indigenous hardwoods such as tōwai, the kauri will eventually be suppressed. In these tōwai situations, kauri trees have already died out in the 1950s plantations in Puketi, and they are well on their way to succumbing where the 1970s and 1980s plantations are dominated by tōwai at Puketi.

Toi kiwi (*G. setifolia*) will also outcompete plantation kauri if allowed. In parts of Omahuta, toi kiwi is the dominant vegetation on some sites 70 (or more) years since the sites were logged and burned. In Puketi, it still dominates areas where kauri forest was flattened in the 1959 hurricane. Where the overhead cover is *Leptospermum* (mānuka and kānuka), even though the plantation trees are suppressed, they will usually survive and may eventually become canopy trees.

Comparison with Natural Areas

It needs to be borne in mind that in naturally seeded areas, vast numbers of kauri seedlings germinate and are suppressed. Very few survive. A tiny few reach the canopy. Plantation kauri are very few in number, and without intervention, will be overwhelmed by competing native vegetation.

Conclusion

It appears that the cause of most of the failures listed in Figure 58 has been the lack of follow-up blanking and release cutting. If a plantation is to succeed, the manager must be prepared to invest very heavily in maintenance after the trees are planted.

Explanation for Kauri Plantation Failures: Pathology

The obvious question remains: did some plantations fail because seedlings were carrying disease? It is very likely. It is noticeable in Sweetwater Nursery Manager Jim Nicholson's annual reports that he has routinely assigned nursery die-off of kauri and other seedlings to *P. cinnamomi*. It is almost certain that this disease affected kauri seedlings from Sweetwater from time to time, and that it will have had an effect on survival of seedlings in the field. Where seedling die-off did occur, it was usually remedied the following year by blanking the gaps where seedlings had died. If there was no follow-up, then larger scale failure of the plantation might follow.

PA progress in a Plantation

Where PA is present in a kauri plantation, for example at Raetea Forest in the 1956 plantation, it appears that the disease has moved through the plantation rather ponderously. Probably half the 1956 plantation trees are still alive, raising doubt that PA will cause catastrophic loss in a plantation. Rather, it appears that it will cause a slow and inevitable loss.

Plantation Sites Warranting Further Investigation

Based on the author's research, the KDP may wish to consider inspection/sampling of the following "failed" plantations.

Puhipuhi Forest

This forest is now run by Rayonier out of Glenbervie. Maps of failed plantation areas in Glenbervie are in the author's possession. The author inspected the site based on a written description before the map was located. There is a PA-symptomatic tree across the road in the farmland. There are kauri (healthy looking) in Puhipuhi, but not one was evident on the plantation site. But the inspection was cursory. This area is worth closer scrutiny.

Puketi Forest

See the "Puketi Kauri Plantations" section of this report for details.

Riverhead Forest

This was a large-scale failure. The author possesses maps of the site. It has never been inspected. Sources say Watercare Services (http://www.watercare.co.nz/Pages/default.aspx) has a role in managing it. Nick Waipara advises that Auckland Council staff have inspected these stands and have not found any PA symptoms.

Kauri logging in Northern State Forests

A brief review of kauri logging in Northland state forests, based on the author's personal knowledge, is presented in the following sections. The focus is on the period from c. 1950 onwards. It is probable that the era before 1950 warrants some serious attention in relation to kauri dieback, and the reasoning behind this deduction is also explored in the following sections.

Types of Log Sales

Permit Sales

Small-scale sales were administered by the NZFS under a permit system. These were often transactions with adjacent landowners, who approached the NZFS to purchase a tree or trees near a boundary, often with the intention of splitting posts (usually tōtara) or battens (kauri or tōtara) for local use. Often the tree targeted was dead.

Sawmill Areas

These were the most frequent methods of selling NZFS state forest timber. A certain geographical area was demarcated, all the merchantable trees within it were measured (cruised) for their merchantable volume and the timber was valued. Once the wood volume was known, the sawmill areas were publicly notified and sawmillers tendered for the cutting rights. The decision process was often fraught with political lobbying by intending purchasers.

The successful tenderer had a fixed period of time to log the area out. Sometimes, payment was on the basis of the cruise value; sometimes, it was based on measurement of the logs extracted by the miller. Log measurement (called log scaling) was done by a Forest Officer. That way, the purchaser paid for what he actually produced, rather than for an estimate of what he might produce. The miller was usually responsible for all aspects of log production, including road development, tree felling, extraction, skid (landing) construction, etc. The NZFS imposed standards (as required) in the contract documents, and regular sawmill area inspections by Forest Rangers were a requirement of management.

Indigenous Logging: General Overview

It needs to be borne in mind that most indigenous logging of state forests in Northland was targeted at species other than kauri. In the era of concern to the KDP, native timber was initially the key building material for most NZ houses. Later in that period (1950–1980s), exotic pine timber assumed dominance. The native timber "bread-and-butter" species were rimu matai, miro, tōtara, kahikatea and taraire. An example of production figures can be found in a typical Auckland Conservancy annual report for 1953, which records production from state forests of approximately 18 million board-feet of native timber, only 159000 of which is kauri.

Kauri was picked up as a by-product of native forest harvesting. It was often not included in general sawmill area quantities, but was marked in the bush, often during logging, by specialist officers such as Ron Lloyd, who marked on the basis of the tree's age and condition. The more derelict it was, the more likely it was to get marked. "Good" trees were not felled, but remained to grow and spread their seed.

There were variations to this model. In later years under the 1973 kauri policy, a "sustainable" cut of kauri was set (at 870 m^3/year), and trees of good health were targeted, along with what were called "decadent" stems, often via thinning of dense, mature kauri. Warawara Forest was opened up on the basis of the amount of dead and dying kauri there, but big quantities of green kauri were felled by the sawmill company under the direct supervision of the NZFS.

Herekino Forest

This forest was cut primarily by the Kaitaia Timber Company. The NZFS had an easement up a steep access from Pukepoto. The roads were clay and could only be used in dry conditions. Summer logging was the rule. Most of Herekino is podocarp hardwood forest, and kauri were not always encountered. When kauri was harvested, it was via the inspection/marking model described above.

Kaitaia Timber Company completed its last sawmill area in Herekino Forest in the mid-1970s. In 1980, the NZFS allowed the harvesting of approximately 500 m^3 of kauri from Herekino Forest. Kauri logging had been shut down in Puketi Forest to protect a kokako population, and the NZFS was caught with a contractual obligation to produce the kauri. An area near the western end of the forest was selected, and the kauri were marked for extraction. The area was quite limited, and to make up the quantity, some very large trees were included. They were harvested in wet conditions. Relatively soon after the harvesting, some of the residual trees died. Subsequent to this in the late 1980s, kaumātua Hec Busby was allowed waka logs by DOC for the NZ 150th celebrations. These came from the area logged in 1980. He was also later granted further logs from Herekino Forest for another waka.

Kauri Dieback Considerations

It is recommended that these 1980 and later waka extraction sites be investigated for kauri dieback.

SP 211: Herekino Forest

This was a thinning trial established by C. T. Sando in 1937 and reported on in considerable detail by Ron Lloyd in 1957. The Programme may judge it to be worth examining this trial from a kauri dieback perspective.

Omahuta Forest

Most of the logging in Omahuta was completed in the 1940s. There were salvage logging operations at a relatively small scale in the 1970s to recover timber from remaining heads and stumps from the earlier era. The 1970s logging of a state forest block (Carter's blocks) purchased from Carter Holt, where the purveyor had retained cutting rights, was done by Whitecliffs. This was subsequent to Whitecliffs being pulled out of Warawara Forest in 1973 after public controversy there.

If sampling of the Warawara cutover areas reveal PA presence, then sampling should be extended to this part of Omahuta, as the same equipment and personnel operated in both locations. No kauri dieback has been noted in Omahuta except in the small plantation near the old HQ, but this may not be conclusive due to the Warawara connection. There are probably no other issues in Omahuta to consider re kauri dieback.

Puketi Forest

Like its neighbour Omahuta Forest, Puketi has had a very long kauri logging history. It is within easy reach of the Hokianga Harbour, and from about the 1850s, kauri were felled into the Waipapa River bed and flushed down to the Hokianga during floods. In the early 20th Century, a rail link was built to Waipapa in the Bay of Islands by the Kauri Timber Company, and logs from the northeast of the forest were extracted, railed to salt water and then towed to the company's mill in Auckland.

The NZFS began the process of logging Puketi, primarily for podocarps, in 1952 when Lane and Sons of Totara North took up sawmill area 271. Prior to this, that part of Puketi had been education reserve, and it was only gazetted as state forest in 1952. These sawmill areas were set up at the western end of the north side of the forest (Mokau Ridge). Some of these initial areas, once cutover, were the sites of the 1954 kauri plantation establishment efforts.

The Puketi sawmill areas (Figure 59) were gradually extended eastward until, by 1962, the timber resources in the northern parts of the forest were exhausted, when the emphasis of Puketi logging shifted to the southern side of the Waipapa River and sawmill areas, beginning with SA 406 in 1965, moved westward along the Pirau Ridge until logging ceased in 1979.

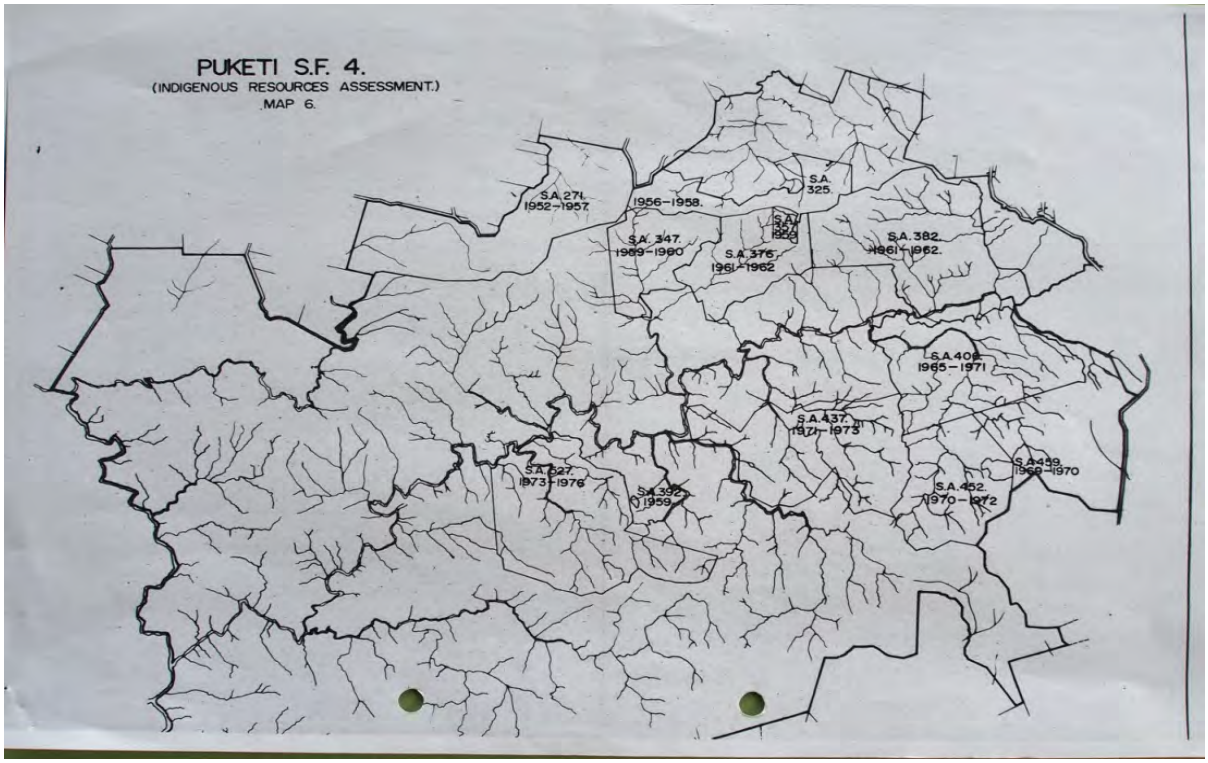


Figure 121. Map showing Puketi Forest sawmill areas (1952–1976).

In 1959, hurricane-force winds brought down large numbers of mature kauri trees right across the forest, but especially at Onekura on the north side of the forest, and in the Merumeru area to the south. The Onekura trees were salvage logged via a spur road from the Mokau Road. To extract the southern trees, a road was pushed in from Puketi Road (a public road) to connect with the Pirau ridge, and then it was pushed in further to recover the downed trees. This southern timber was worked by Winger's Sawmill in Kaikohe. The Onekura trees were logged by Lane & Sons. Some fallen trees were also recovered from the Manginangina Scenic Reserve at the eastern end of Puketi.

With the introduction of the 1973 kauri policy, an assessment was made of the mature kauri in Puketi, and a "sustainable" annual cut of 870 m^3/year was set. This completely changed the emphasis of harvest in Puketi. Prior to this, kauri was a by-product of logging that targeted rimu, miro, tōtara, etc. Now the emphasis was on kauri production. The kauri resource was cruised, and trees were marked for extraction. Trees showing signs of senescence such as dying branch tips, dead sides (called "dry"), rotten scars from kauri gum bleeding, etc., were prioritised for extraction, but it needs to be emphasised that Puketi was and still is, in general, a very healthy kauri forest, and it does not often display the "senescence" of the western forests Warawara and Waipoua. For 2 years, the forest was logged to produce this figure before conservation pressure and solid data on the use of Puketi by kokako closed Puketi down for logging.

Kauri Dieback in Puketi in Relation to Kauri Logging

Given that kauri was extracted in the last few years at Puketi via bulldozer extraction of trees felled in closed-canopy stands, and given that the contractor operated in forests all around the North, and given further that spread of kauri dieback can be associated with the spread of soil via heavy machinery, it is possible (in the author's opinion) that the thinned stands of mature Puketi kauri may have become established with PA. However, inspection of these cutover stands reveals only heathy residual kauri

trees. This health may be temporary, and PA may manifest itself at a later time, but at present there is cause for cautious optimism. The Programme should give thought to soil sampling these thinned, mature kauri stands.

Warawara Forest

This remote forest upland in the north Hokianga was opened up by the NZFS for logging by Whitecliffs Sawmilling Company in 1967. The logging was very destructive of the kauri forest, and harvesting was closed in 1974 after strong public controversy. Whitecliffs had logged the area, often in winter, and the mud and destruction and forest degradation had become a public issue. Some of the justification for opening up Warawara in the first place was the perception that the forest was "over-mature/senescent" and needed management. The perception of senescence was reinforced by the quite large areas of dead, old-growth kauri on the Warawara plateau. The cause of the dead groups of trees has never been explained except to reinforce the judgement of over-maturity.

Kauri Dieback Dimension

These old-growth, dead trees in Warawara were proposed for soil sampling in the KDP's Surveillance 2 Programme. Due to confusion over GPS locations of sampling points by the contractor, these areas were not sampled. It would be prudent for the KDP to ensure that the old-growth, dead trees are sampled, alongside portions of the Warawara cutover. If any PA shows up in these samples, then sampling should be extended to the Carter blocks of Omahuta Forest (see "Omahuta Forest" section above). There may be further opportunity in summer to take a detailed look at the old-growth kauri stands when Landcare Research, Te Rarawa and the Northland Regional Council (NRC) carry out a planned ecological assessment of the forest.

Waipoua Forest

Most archival searches for this project have been focussed on the period from c. 1950 onwards, as this was seen as the possible time when kauri dieback established and began to spread. The actual source of kauri dieback's arrival in New Zealand was not a focus of this project, but the question of its initial introduction does tend to lie behind the questions about its spread. In terms of kauri logging, the 1940s logging of Waipoua was substantial, and possibly covered a greater area of the forest than just the cutover areas north of Tāne Mahuta, so it may be of interest to the KDP.

Table 23 shows some figures for kauri production at Waipoua in the 1940s.

Table 23 Kauri wood production in Waipoua Forest in the 1940s

Year harvested	Timber volume (m^3 dead)	Timber volume (m^3 green)	Total wood (m^3)
1942	2		2
1943	736	48	784
1944	1535	402	1937
1945	1037	12	1049
Total	3310	462	3772

The total wood harvested was quite a significant amount and would involve considerable impacts. A search of records for the actual sites may shine some light on the spread of PA in Waipoua Forest.

Later Harvest

After the public controversy of the Waipoua Forest Sanctuary anti-logging campaign, there was little appetite in NZFS management staff for further forays into wood harvesting. However, by 1960, the NZFS was "selling 'dead and dying'" kauri from compartment 55 to the west of the sanctuary, where a 3-acre area yielded nearly 600 m^3 of wood. A further area of 8 acres containing 540 m^3 was contracted for the following year. These small-scale logging endeavours to the west faded out in the 1960s. From then onwards, the only kauri production from Waipoua was the occasional windfall tree along the highway or along the access road to the HQ.

The author believes these compartment 55 harvest areas are worth searching out from a kauri dieback perspective. These areas of logging match very closely the two compartment 55 kauri plantation sites installed in 1962 (3 ac) and 1963 (7 ac). These two plantations were probably put in to rehabilitate the logged-over site. The logging sites themselves were probably carrying trees killed/harmed by causes such as gum bleeding, fire damage, etc., but the plantation sites were possibly exacerbated by PA. The plantation sites are certainly worth finding and evaluating.

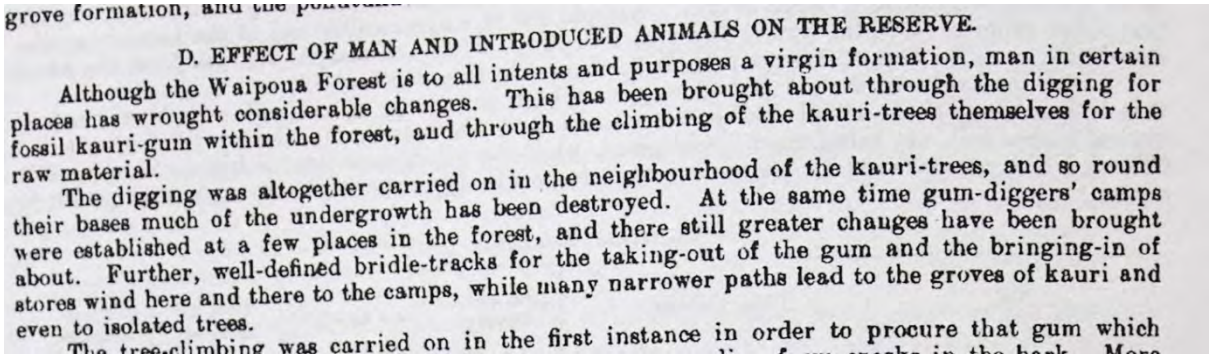
Russell Forest

For more information about Russell Forest, especially the Papakauri thinning trial (SP 314) and the 1980–1982 helicopter logging, refer to the "NZFS Practices at Russel Forest" section of this report.

Earlier Forest History and Kauri Dieback

1908 Report: Dr Leonard Cockayne

Figure 60 shows an extract from Dr. Leonard Cockayne's 1908 *Report on a Botanical Survey of the Waipoua Kauri Forest*. In the section pictured, he describes with some alarm the practices of the gum bleeders in particular. But it was his comment on digging around the roots of live kauri trees that raises the potential involvement of gum diggers in the introduction/spread of kauri dieback.



grove formation, and the

D. EFFECT OF MAN AND INTRODUCED ANIMALS ON THE RESERVE.

Although the Waipoua Forest is to all intents and purposes a virgin formation, man in certain places has wrought considerable changes. This has been brought about through the digging for fossil kauri-gum within the forest, and through the climbing of the kauri-trees themselves for the raw material.

The digging was altogether carried on in the neighbourhood of the kauri-trees, and so round their bases much of the undergrowth has been destroyed. At the same time gum-diggers' camps were established at a few places in the forest, and there still greater changes have been brought about. Further, well-defined bridle-tracks for the taking-out of the gum and the bringing-in of stores wind here and there to the camps, while many narrower paths lead to the groves of kauri and even to isolated trees.

The tree-climbing was carried on in the first instance in order to procure that gum which

Figure 122. Extract from Dr. Leonard Cockayne's 1908 Report on a Botanical Survey of the Waipoua Kauri Forest (p. 4).

In noting that gum digging and gum bleeding were now illegal in the forest, Dr. Cockayne describes kauri trees killed or dying through the damage done by gum bleeders. Interestingly, nowhere else in his report does he mention dead kauri. In general, apart from these comments on human and cattle damage, he reports on a healthy forest.

1918 Report: D. E. Hutchins

In 1918, D. E. Hutchins, a well-known forester with colonial Indian and South African experience, produced a report for the NZ Government titled *Waipoua Kauri Forest: Its Demarcation and Management*. In this report, Hutchins proposed his means for the setting aside and long-term management of Waipoua as a "scientific working" production forest. Hutchins notes that concerns over dead kauri in Waipoua were exaggerated. He believed only about 5% of Waipoua kauri were dead. This is still a lot of dead trees, and triggers an interest as to how they died. Dr. Cockayne's noting of deaths caused by gum bleeding could explain most of them, and the edges of the forest were affected by wildfires during those years, which would have killed more still.

1920s–1940s Reports: Professor W. R. McGregor

Professor McGregor led the very successful 1940s and early 1950s campaign to preserve Waipoua from logging. He also led the successful campaign to stop logging in Warawara Forest in the 1970s. He had been associated with Waipoua since the 1920s, and wrote extensively on the forest. His prose style was quite florid, and was more the voice of a romantic than an academic, but he was an extremely effective advocate. He was a very good photographer who took an enormous number of photographs of Waipoua. Some of these were reproduced in his 1948, 80-page booklet titled *The Waipoua Forest: The last Virgin Kauri Forest of New Zealand*. In many of the photos, dead kauri in the background vistas are clearly visible. His photographic collection is held at the Alexander Turnbull Library in Wellington. Figure 61 is a reproduction of one of the professor's photos from his booklet.

Professor McGregor's photographic collection of pictures of Waipoua would be an excellent source of information about historic logging activities, which may shed light on kauri dieback. These photographs are therefore worth examination by the KDP. Archives related to the collection are of interest as well.

Figure 123. The Waipoua kauri, photographed by Professor W. R. McGregor. Note the number of dead kauri trees in this photo looking over the Waipoua HQ site.

NZFS Logging of Kauri

Where did all the dead kauri that are visible in Figure 61 go? The author believes the NZFS harvested most of them. Waipoua is a much photographed forest, and there are many shots from the 1920s–

1940s taken along the highway through the forest, for example. In a surprising number of these photos, saw logs, many of them kauri, are clearly evident. The photograph below (Figure 62) is a Tudor Collins shot taken in 1946, probably of a vehicle passing the Joseph Ward tree on the highway through the forest. The photo also shows a skid with logs ready for loading. These logs are kauri.

Figure 124. Small details from a much larger Tudor Collins photo taken of the Waioua Forest highway, showing kauri logging activity (1946).

It is therefore possible that the wave of deaths currently affecting the forest have also occurred previously in relatively recent history, but the dead trees were mostly tidied up by the NZFS. Some of those deaths will be natural, some were no doubt caused by damage to trees from gum bleeders, but some may have been caused by kauri dieback. In harvesting these trees, the NZFS may have further spread the disease and helped trigger the current losses of old-growth trees. Some historic enquiry as to exactly where the NZFS harvested dead and dying kauri in Waipoua may shed some light on current losses of old-growth trees.

Appendix 1 Understanding Historic NZFS Materials

This project's purpose was to identify PA vectors into and from NZFS facilities and forests. The main lines of enquiry for the project were archival research, interview/discussion with former NZFS personnel and field investigations to identify current status of areas of interest.

To understand and support the outcomes of the project and to equip possible future enquiry, it is necessary to have some understanding of the way NZFS was structured, what reporting was required of staff and how records were stored and maintained. Note, this appendix is not a complete or authoritative analysis of NZFS structures and recording systems. Rather, it is a guide based on archival work and the author's personal memories as a former NZFS employee.

Structure, Record Keeping and Reporting Processes

Staff and Office Structure

NZFS was structured as follows.

Position	Location	Explanation
Director Generals/Directors of Forestry	Head Office, Wellington	
Directors	Regional locations	Directors included one role for administration and one for research. The Director of Research was based at the Forest Research Institute (FRI) in Rotorua
Conservators of Forests	Conservancies	Located regionally, e.g. Auckland covered virtually all public conservation land populated by kauri
Assistant Conservators/Senior Foresters	Conservancies	Usually promoted from District Forester applicant pool. Senior Foresters were based in conservancy offices
District Rangers	District offices	Kaikohe covered all of Northland
Officers-in-Charge	Forest stations	Local NZFS administration centres were usually based in large state forests, e.g. Waipoua, Omahuta, Great Barrier Island (GBI), Riverhead, etc. Larger forest stations often included nurseries in the early days, e.g. Waipoua, Riverhead, Tairua. In later times, large regional nurseries such as those at Cambridge and Sweetwater were established, and the person in charge had the status of Officer-in-Charge and reported to the District Ranger
District Foresters/Senior Foresters	District offices	Technical support/advice staff were university graduates, often trained at overseas forestry universities such as Canberra and Edinburgh, because there was no Chair of Forestry at any NZ university in the era before c. 1965. District Foresters were based in district offices. Foresters involved in kauri management and of interest to this project were sometimes based in forest stations
Assistant Foresters	Forest stations	Entry-level-grade staff were placed throughout the organisation in the 1940s–1950s, including forest stations such as Waipoua

Staff Relevant to this Project

Frank Morrison

Frank Morrison was based at Waipoua from c. 1949–1960, when he moved to Kaikohe District Office. Morrison's work was primarily associated with artificial establishment of kauri.

Ron Lloyd

Ron Lloyd was based at GBI from about 1949–1955. He too moved to Kaikohe District Office. Lloyd was mainly involved with developing systems for the silvicultural management of naturally regenerating kauri forests and the acquisition of natural stands of kauri, particularly at Russell Forest and Great Barrier Forest.

Other Foresters of Note

The Kauri Management Unit was established c. 1974 and was led by Ron Lloyd, with strong assistance from John Halkett. Other foresters involved with kauri management included Joe Levy (relocation and analysis of Foster's SPs at Waipoua; developing nursery systems including Dunemann frames in the Waipoua Nursery; artificial establishment of kauri at Raetea Forest, etc.). Keith Prior was known for his artificial establishment of kauri plots at Omahuta Forest. Malcolm Conway was based in Auckland as an Assistant Forester, Forester, Senior Forester and later, Assistant Conservator. He eventually became Director General of the NZFS. In the 1930s, Forester A. N. Sexton conducted surveys of Puketi and Omahuta, and C. T. Sando conducted thinning trials, etc. in Herekino Forest.

Scientific Support

Science advice and enquiry came from FRI.

Delivery Staff

Delivery staff were called Rangers and were usually internally trained as Technical Trainees, Ranger Trainees or at Woodsman schools. All Foresters did a field year as a Technical Trainee before going on to university. Woodsman school was a 2-year course. Technical and Ranger Trainees did a 4-year course with up to 2 years' residential training at Ranger schools at Rotorua and Reefton. Rangers were usually based at stations or district offices.

Forest workers were employed under Regulation 130 of an unspecified act, presumably the State Services Act or equivalent. They were classed as follows.

- Leading Hand
- Forest Hand One
- Forest Hand Two
- Labourer
- Junior Labourer (many senior officers of NZFS started their careers as Junior Labourers)

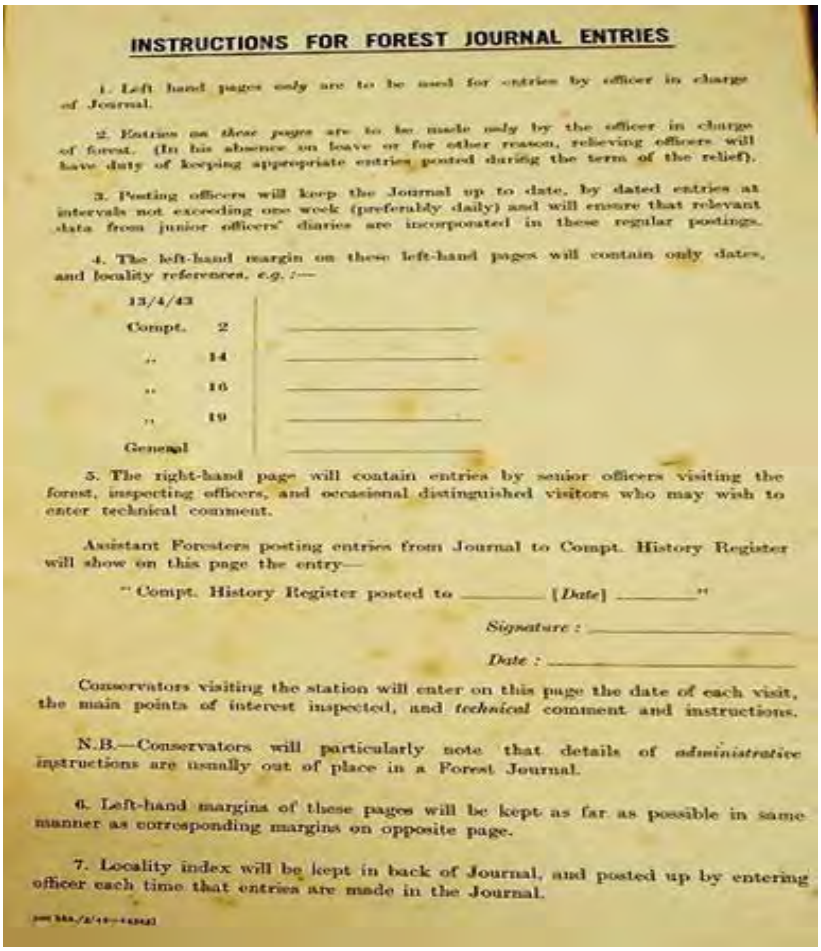
NZFS Training

The NZFS ran courses across all aspects of forest management, and these were often led by training staff based at the Forest Training Centre at Whakarewarewa.

Record Keeping

Forest Journals

These were hand-written records of daily events at forest stations. Entries in the forest journal were strictly prescribed (Figure 63). Entries could only be made by the person in charge of the forest. Locations of management activities were required to be clearly defined. The author wrote on the left-hand page of the journal. The right-hand side was reserved for comments and diary notes of more senior visiting forest officers.



INSTRUCTIONS FOR FOREST JOURNAL ENTRIES

1. Left hand pages *only* are to be used for entries by officer in charge of Journal.

2. Entries on *these pages* are to be made *only* by the officer in charge of forest. (In his absence on leave or for other reason, relieving officers will have duty of keeping appropriate entries posted during the term of the relief).

3. Posting officers will keep the Journal up to date, by dated entries at intervals not exceeding one week (preferably daily) and will ensure that relevant data from junior officers' diaries are incorporated in these regular postings.

4. The left-hand margin on these left-hand pages will contain only dates, and locality references, *e.g.* :—

13/4/43
Compt. 2 _____
" 14 _____
" 16 _____
" 19 _____
General _____

5. The right-hand page will contain entries by senior officers visiting the forest, inspecting officers, and occasional distinguished visitors who may wish to enter technical comment.

Assistant Foresters posting entries from Journal to Compt. History Register will show on this page the entry—

"Compt. History Register posted to _____ [*Date*] _____"

Signature : _____

Date : _____

Conservators visiting the station will enter on this page the date of each visit, the main points of interest inspected, and *technical* comment and instructions.

N.B.—Conservators will particularly note that details of *administrative* instructions are usually out of place in a Forest Journal.

6. Left-hand margins of these pages will be kept as far as possible in same manner as corresponding margins on opposite page.

7. Locality index will be kept in back of Journal, and posted up by entering officer each time that entries are made in the Journal.

Figure 125. Instructions within a forest journal explaining the standards required for journal entries.

Forest journals have not been well conserved into archives. For example, the Great Barrier State Forest Number 165 journal, held in the Archives NZ Mangere facility, is volume three and covers the years 1953–1959. Earlier and later volumes are not held by Archives NZ. So far, the author has been unable to locate have found no Waipoua Forest journals.

From a historic enquiry viewpoint, the forest journal can be a very valuable source of information. The Great Barrier volume cited above carries very detailed information on forest management activities, particularly when Ron Lloyd or Rod Lyttle were the authors. This kind of detail is also often absent from material recorded in the formal filing system. Indeed, the entries tend to be as good as the person making them. The only other journal located so far (the Omahuta journal) lacks the precision of the Great Barrier document.

Daily Diaries

Daily diaries were compiled at forest stations and district offices. These were often filled in by administrative staff and mostly record staff movements. No diaries can be located in Archives NZ.

Filing Systems

The filing system framework was the same from Head Office through to forest station level. All formal correspondence generated a file copy, which was placed in the file. However, almost invariably, the contents of the file tended to be more detailed at the station or district level than at a conservancy or head office. The more senior administration levels reserved their attention for more strategic issues, while forest station personnel recorded day-to-day activities.

Therefore, it can be useful to know at which level of the NZFS the document was compiled, as the file contents will vary even though the file reference number is the same. The following is a full NZFS file framework depiction copied from Archway, the Archives NZ repository.

1/ Administration	VIEW »
2/ Staff	VIEW »
3/ Employment	VIEW »
4/ Accounts, expenditure, buildings, costing	VIEW »
5/ Estimates, engineering, cost returns	VIEW »
6/ State forests	VIEW »
7/ and 8/ Provisional state forests	VIEW »
9/ Land deals	VIEW »
10/ Reports and supervision	VIEW »
11/ Draughting and photography	VIEW »
12/ Fire prevention, communications	VIEW »
13/ Publicity	VIEW »
14/ Stores, equipment, plant, vehicles and accommodation	VIEW »
15/ Timber utilisation, inspection, fifths to local bodies	VIEW »
16/ Applications and permits	VIEW »
18/ Maori Leases — general	VIEW »
19/ Timber appraisals, Crown land and timber on Maori land	VIEW »
20/ Mining privileges and miscellaneous licences	VIEW »
20/ Mining privileges and miscellaneous licences	VIEW »
21/ Trespass and seizures	VIEW »
23/ Sales and valuations	VIEW »
24/ Contracts	VIEW »
25/ Forest mensuration	VIEW »
26/ Sawmill statistics and registrations	VIEW »
27/ Sand dune reclamation	VIEW »
28/ Planting and by-products	VIEW »
29/ Private afforestation	VIEW »
30/ Plantation and nurseries	VIEW »
32/ Scenic Forests and State Forest Parks	VIEW »
34/ Working, Management, Seed and Planting Plans	VIEW »
35/ Logging General and Log Sales	VIEW »
36/, 37/ and 38/ Grazing	VIEW »
39/ Permits	VIEW »
42/ Recreation, Game	VIEW »
43/ Exports	VIEW »
45/ Miscellaneous	VIEW »
50/ Insects	VIEW »
57/ Marketing of Forest Products	VIEW »
58/ Stock on Hand	VIEW »

Different files were used depending on the level of detail being recorded and the significance of the particular state forest. For example, a relatively minor state forest such as Mataraua State Forest 9 might for many years have had all its administrative details recorded on the *6/9 Mataraua State Forest General* file. Then again, if something significant happened, such as a timber trespass (i.e., illegal logging within the forest), a file would have been opened in the *Trespass and Seizures* series (21/9), and that file would have recorded all the matter relating to that event until the issue was resolved. Therefore, if a searcher is tracking a particular line of enquiry, they will often need to direct their attention to the "activity file" series if they want to uncover the record. For example, the file 30/1/165, *Plantations and Nurseries Great Barrier*, appears to be an Auckland Conservancy file and records in considerable detail issues of plantation establishment and management of the small forest nurseries used on GBI.

Reporting

Because the NZFS was a government department reporting to a Minister, the NZFS used a reporting system to feed information about its management responsibilities upwards to the Minister:

- Monthly reports
- Period reports
- Bimonthly reports, etc.

The rigour, contents, and structure of these reports varied over time. In the early 1950s, junior foresters were required to produce monthly reports, and some of these have served this project very usefully. The period of these reports seems to stretch to 2 months, and then the reports cease.

Forest stations produced period reports, and these again varied from 1–2 months for the reporting period. The Omahuta period reports have been useful in bringing clarity to management activities based in that forest in the 1950s.

Annual Reports

Information in NZFS annual reports tends to be rigorous and consistent from year to year. These reports provide both a narrative and a statistical report on each year's achievements and major issues. Most NZFS files held in the Archives NZ Mangere facility appear to be from the Auckland Conservancy Office. In the older Auckland Conservancy annual report files, e.g. prior to 1954, the station (forest) annual reports are layered in the conservancy file underneath the conservancy annual reports. So far, this is the only place the author has found detailed reporting on significant issues at Waipoua Forest, for example. Because later conservancy annual report files do not contain these individual forest annual reports, it may be prudent for future Project staff to look elsewhere for them. Likely locations are the district annual report files and the files containing each year's statistics. However, there are gaps in the indexed records.

Other Reports

Another possible location for reports on the kauri management issues encountered at Waipoua, GBI and other places is in a file that contains the Foresters' and Assistant Foresters' 4-weekly reports and the Foresters' reports for circulation files. These reports cover the years 1953–1961, so they may be

useful accounts. The monthly reports for Waipoua Forest are in Archives NZ and cover the years 1944–1959 (three files). However, some of the period-type reporting is mostly statistical and conveys little sense of the issues being managed.

There may be a dearth of reporting documents on key topics. Frank Morrison's report on the Waipoua's Northern Arboretum is in-depth, detailed and useful today, but is unusual in its breadth and thoroughness. Bob Collins' account in the 1953–1954 annual report on the functioning of the Waipoua Nursery is also atypically very full.

Land Information

The NZFS managed forests primarily to supply NZ's wood needs (production) and for "conservation" purposes such as catchment protection (environmental). Whatever the purpose, given the long lifecycle of timber trees, the practice of forestry requires stable, long-term systems of record keeping.

State Forests

State forests were the fundamental land unit of the NZFS. A state forest was usually a contiguous area of forest; less commonly, it might have been an aggregation of discrete areas of forest in a particular geographic location. Each had a unique name, e.g. Warawara State Forest, and a unique number, e.g. Warawara State Forest Number 6. State forests were numbered from north to south, e.g. Herekino State Forest Number 1, Raetea State Forest Number 2, and so on.

The numbering system commenced early in NZFS history; if a new forest was acquired, it was assigned the next number available, e.g. Aupouri Forest was established on Far North dunelands acquired by the NZFS in the 1960s and was assigned the name and number Aupouri State Forest number 187. Note, there were categories of state forests within the Forest Act 1949. In the latter days of the NZFS, most state forests were categorised as permanent state forest. Many of these forests had been held previously as provisional state forests. Provisional state forests carried a different forest number than permanent state forests. This can cause confusion when searching old records of, for example, harvest operations within the same forested area. There is nothing apart from the legal description of the property to indicate the location of the affected piece of land, unless the researcher knows both the provisional forest number and the permanent forest number.

Provisional state forest categorisation gave administrators flexibility when making decisions about potential land uses. Many areas of provisional state forest passed into non-forested land uses, such as agriculture, and thence into private ownership through simple administrative actions. Reclassifying permanent state forest was a more complex matter.

There were also ways of offering additional legal protection to state forests through additional land classification. For example, large parts of Waipoua State Forest 13 were classified as forest sanctuary, which meant largely that these forested areas were protected from harvesting and other manipulations. Kauri forests where the forest sanctuary classification was used included the Omahuta and Manaia Forest Sanctuaries.

Forest Register

All of these reclassifications were recorded in the forest register. Any change to the land area or legal status of the land within a state forest was recorded there. Only draughting staff were permitted to put entries in the register. Copies were held in conservancy and district offices.

Compartments

If the management activities in a forest were of sufficient magnitude, the forest was subdivided into compartments. These compartments were usually configured around a simply defined geographic unit, such as a catchment or sub-catchment. Because of the intensity of management, all exotic forests were divided into compartments. Indigenous forests were not always so divided; it depended on what was happening within them. Many state forests of interest to the KDP were subdivided into compartments, e.g. Puketi, Omahuta, Waipoua, Russell, Great Barrier, Waipoua, Whangapoua and others. Other forests such as Raetea, Warawara and Opua were not subdivided into compartments.

Compartment Maps

Maps showing the compartment layout of whole forests were produced at 20 chains to the inch, at a scale of 1:15840 in the pre-decimal era, and at 1:20,000 post-decimalisation. Some of these maps included plantation information.

Compartment Numbers

Each compartment was assigned a number, unique within that state forest. The sub-compartment category was sometimes used as an identifier of plantations. In these cases, the sub-compartment matched the configuration of the plantation.

Sometimes, due to management necessities, compartment numbers were changed and compartments reconfigured. This happened in Great Barrier and Whangapoua Forests. It is likely to have occurred in other state forests. These changes to compartment numbering can create real difficulties for researchers dealing with incomplete record systems.

Compartment Records

The compartment record system chronicles all management activities within a compartment. These activities include plantation and silvicultural information, such as thinning and TSI activities.

Compartment History Form

Archives NZ holds a large ledger-type document titled *General Forest Histories* (1955–1968). It has obviously been used at GBI to record forest activities. It has an archives reference number, AFIU A1683 1124 Box 44.

Compartment Register

The GBI compartment register has also been used for recording silvicultural work within Great Barrier Forest. It too is held in Archives NZ. This type of register probably was compiled for all other forest stations where the forest was sectioned into compartments. Ron Lloyd compiled a compartment register for Russell Forest in the 1960s, for example, but there is no evidence that the document was sustained by Russell Forest staff. It is uncertain if the preponderance of large ledgers at GBI is typical of what was to be found at forest stations, or whether GBI was atypical because it was so isolated and was not part of any district office structure.

Card Systems

Compartment management information was originally recorded on *Card FS-B.64 Establishment/Management Unit Record Card* back when imperial measures were used (yards/feet/inches/acres), e.g. prior to 1967. Accompanying A4-size maps made at this time were at a scale of 10 chains to the inch, i.e., 1:7920. Post-1967 decimalisation, when the system changed to metric, card FS-B.65 was reformatted as a compartment summary card, and accompanying A4 maps were at a scale of 1:10,000. The only complete set of compartment records found in Archives NZ to date is that for Great Barrier Forest 165.

Stock Maps

In the 1940s–1960s period of interest to the KDP, all map information relating to exotic and indigenous plantings and changes to their age and configuration were represented on stock maps at a scale of 10 chains to 1 inch (1:7920). These maps were maintained and updated from time to time by conservancy office draughting staff. Original stock maps were often tinted with water colours, with different colours representing different plantation tree species. Copies of stock maps were created at various scales, i.e., 20 chains to the inch, 40 chains to the inch, etc. for use by district and station field personnel.

Often, stock maps carried a table summarising all of the plantation species displayed on that map. Some earlier stock maps also recorded the seed lot numbers of the species planted. Unfortunately, stock maps have not been well conserved. More often than not, only fragments folded into files are available. Full stock maps can occasionally be found in old map cabinets at former NZFS offices.

People associated with such places should be alerted to their possible presence and should avoid any pressure to dump such material. Archives NZ Mangere has stated their willingness to receive and conserve old maps. In addition, Scion has a large resource of as yet uncatalogued maps including stock maps, detailed layout maps for SPs and other potentially useful historic material.

Composite Species Maps

Composite species maps were introduced in the 1970s. They were usually produced at the 1:20,000 scale and carried plantation (including kauri) information. The various forest companies currently managing exotic forests do not use these maps on a daily basis but have often retained copies for their own reference. A few are still held in Archives NZ, having been used as base maps by survey archaeologists and harvest planners.

Other Maps

The NZFS was a well-resourced organisation with a very capable draughting division. Maps were produced to serve particular needs. For example, the kauri management review of 1983 produced maps of kauri distribution, which are still valuable. Particular projects such as the Puketi Forest inventory of 1975 left a legacy of kauri distribution maps, kauri harvest history, compartment configuration and other items of interest to the Project.

Most NZFS staff possessed survey and mapping capability and could produce maps as required. The fundamental survey tool was the compass and chain. Simple theodolites such as the Wilde T12 were also employed where greater precision was required. These survey tools were used to identify forest boundaries, plantation configurations and layout of sawmill areas. Sometimes this approach was used

to produce topographic and forest-type maps of whole forests. The best examples are the maps of Omahuta and Puketi Forests, compiled by A. N. Sexton in the 1935–1937 era. Such survey information was recorded in numbered field (note) books, and these were held in a register. Many of these can be found in Archives NZ.

Aerial Photography

Aerial photography compiled by the NZ Aerial Mapping Company was available at most district and conservancy offices. Mosaics available go back to the 1940s and can offer a very useful window into past management activities. However, NZ Aerial Mapping went into receivership some years ago. It was purchased by Opus.

The following information was obtained from the NZ Archaeological Associations website (https://nzarchaeology.org/) and describes the current situation. New Zealand Aerial Mapping currently hold archival Lands and Survey photogrammetry aerial photographs from the commencement of aerial photography onwards, obtainable as stereo pairs. One cannot view maps before buying them, but the company will respond with information on coverage. The contact is Chris Parkyn, freephone 0800 680 690. Offices are located at the corner of Warren and Avenue Roads, Hastings 4122.

Ad hoc aerial photography shot by NZFS draughting staff was commissioned in later years to record land clearing, road development and other activities to enable contract payments to be made and to bring precision to the mapping of plantations, harvesting, roading, water points and other operations. These later aerial photography records can sometimes be found in NZ Archives but are often difficult to interpret. Again, these records have been rather randomly conserved but it is still possible to find valuable records in DOC and forest company offices. Kauri Dieback Project staff need to be alert to these potential repositories and be aware of Archives NZ's willingness to conserve them.

Seed Records

Seed records were centrally managed from Rotorua, where staff at the central seed store based at Whakarewarewa managed the classification and sale (and import) of the seed needed by the NZFS. Each batch of seed for a given year was allocated a seed lot number. For example, kauri seed harvested from Waipoua Forest in 1968 was assigned the letters AK (for Auckland conservancy) and the numbers 68 (for the year 1968) and 959, a unique identifier for that batch of kauri seed. This batch identifier would be expressed as seed lot AK68/959, and this unique seed lot number would be used in sales or to track the use of this seed or its progeny from nursery to plantation. The seed lot numbering system was used rigorously in the 1940s–1960s in recording the development of plantations. Its wider use faded in the 1970s, although forest nurseries such as Sweetwater were rigorous in applying the system. However, the numbering system completely faded out with the disbanding of the NZFS in 1987.

Scion holds old seed lot records now. The author copied all of Scion-held kauri records from 1935–1986. These include imports of foreign *Agathis* from abroad.

Nursery Records

In the course of the Project, most information about NZFS nurseries was obtained from lateral sources such as period reports, annual reports and file notes. Formal records about the nurseries of interest to the Project are unobtainable.

Appendix 2 Glenbervie Forest: Jim Norris Interview 2015

Background

The author John Beachman met with Jim and Mary Norris at their home at 601 Kamo Road. Jim is 92 and Mary is 90. For further information, Norris can be contacted on 09 435 0118. Jim was in charge of Glenbervie Forest from 1968–1987. He was a very capable manager who ran forestry operations based from Glenbervie but covering Puhipuhi Forest and other exotic plantations in the general orbit of Whangarei, including Maungatapere, Russell Forest, Mokau and Tutukaka. Jim also managed a roading gang, which carried out road construction and maintenance activities across all the state forests south of the Mangamuka Mountains. His road gang trucked trees, both native and exotic, from Sweetwater Nursery to state forest operations all over the northern North Island.

Interview Notes

Key questions were as follows.

Q1. What forests did the roading gang cover?
A1. All of the Northland state forests except Aupouri, i.e., Waipoua, Otangaroa, Waitangi, Puketi/Omahuta, Russell.

Author's note. The gang did not function outside of Northland except for tree distribution; road maintenance was not carried out in other PA-positive areas, such as Whangapoua, as suspected.

Q2 re staff operations: Did NZFS staff circulate to and from other state forests?
A2. Yes, they did. When work was short, Russell Forest staff worked on silviculture in exotic forests at Puhipuhi and at Glenbervie itself. Specialist staff from Glenbervie helped out at Russell Forest.

Q3 re kauri distribution: Where were kauri trees distributed from Sweetwater Nursery?
A3. Staff and trucks from Glenbervie distributed indigenous and exotic seedlings from Sweetwater around Northland state forests and beyond. Kevin Redfern of Whangarei (09 437 1459) recalls carting 2000 kauri trees to Ruatoria, for example.

Q4 re other vectors: What other activities did you carry out?
A4. Mike Johnson of Northland pioneered the steerable gravity roller for clearing vegetation off steep country. He carried out many operations in and around Glenbervie and in other parts of Northland. He also operated the gravity roller in Whangapoua in the 1970s. Mike carried out roading works in northern Puketi for mineral exploration around Maungahorehore in the early 1970s.

Q5 re plantation locations: Where were Puhipuhi kauri plantations?
A5. These 1949 and 1950 plantations, which do not appear to have survived, cannot be recalled by Norris and cannot be located.

Appendix 3 GBI: Don Woodcock Interview

Management History on GBI

Don Woodcock was interviewed by John Beachman on May 31st, 2016. He served as an NZFS Officer-in-Charge on GBI for some time.

Under NZFS management, GBI's Officer-in-Charge had a considerable degree of autonomy. Because GBI was remote, it departed from the usual NZFS "station" structure in that it was not placed under a district office with reporting lines for the Officer-in-Charge to a District Ranger. Rather, the Officer-in-Charge reported to a Senior Ranger, Auckland Conservancy Office. Other senior officers, including Ron Lloyd who led the Kauri Management Unit based in Kaikohe, provided advice/oversight of kauri silvicultural programmes.

An important responsibility of the NZFS on GBI was to maintain the machinery for the Island's public roading network via an arrangement with the Ministry of Works. The NZFS personnel employed on GBI were to maintain road machinery and the NZFS fleets.

Great Barrier Island has been the subject of many management reconfigurations under DOC's management. It was a district office, subsequently a field centre, and then an area office with considerable autonomy for management decisions. In the late 2000s, it became a field base and was placed under Warkworth Area Office, with programme management removed from GBI and based at Warkworth. Great Barrier Island staff were allocated work from Warkworth programme managers. In the most recent reconfiguration, the senior DOC officer on GBI is called the Operations Manager. The reporting line and full responsibilities of this position have been finally clarified and GBI is now a District within the Auckland DOC Region, something of a return to its previous degree of administrative autonomy.

The constant DOC reconfigurations contrast with the NZFS management structure on the island, which was essentially the same from 1950–1987. New Zealand Forest Service policies underwent change over those years with, for example, public recreation (multiple use policy) assuming greater importance as the island's state forest recreational potential was opened up. The NZFS was the largest employer on an island where steady work was difficult to find. Consequently, NZFS personnel on GBI had long employment histories and carried large personal knowledge of the Island's resources.

Don Woodcock's Employment History on GBI

Don Woodcock moved to GBI in April 1971 as an NZFS ranger to take up the position of Second-in-Command (2IC) for Great Barrier Forest. Except for a short stint at Te Kuiti District Office, he worked for NZFS on GBI until NZFS was disestablished in 1987. He was appointed Officer-in-Charge, Great Barrier Forest for NZFS in 1986 and served until NZFS was disestablished in March 1987.

When DOC was first established in April 1987, Woodcock was appointed District Conservator on the island, reporting to the manager of the Auckland region. After the 1989 restructuring, Woodcock

became Field Centre Manager and reported to the Operations Manager in Auckland Conservancy Office. When the area office structure was set up in 1997, Woodcock did not apply for the in-charge position, and Steve McGill was appointed Area Manager. Don Woodcock took a Programme Manager Visitor and Historic position instead. When McGill moved to Kaitaia, Dale Tawa became Area Manager. When Dale stepped down, Jacqui Dyer was appointed Area Manager. Don Woodcock carried on as Programme Manager Visitor and Historic until he retired in 2009.

NZFS Records

There is a relative paucity of NZFS GBI records in Archives NZ (in saying this, however, the GBI record in Archives NZ Mangere is much more complete than for some forest stations such as Waipoua or Whangapoua). For example, the *Forest Journal 1953–1959* held in Archives NZ Mangere (ref. AFIU A1683 1124 box 42) is volume 3. Presumably, volumes 1 and 2 were compiled dating from the establishment of NZFS in the 1940s through to 1953, and presumably, there are later volumes post-1959.

Don Woodcock deposited a considerable lot of GBI NZFS records, including the above journal, volume 3, for archiving with a DOC records clerk. Presumably, that person lodged these with Archives NZ. Woodcock is unaware of the fate of the other journals. He commented that in the DOC era, some managers did not value old records and that some records were dumped. Some staff were alarmed at this potential destruction of historic material with which they had personal and family association, and some took steps to salvage records before they were dumped.

A number of station diaries were given by Don Woodcock to Eileen Walker as she had a very long association with NZFS on GBI. Her husband, Jim Walker, was one of the earliest NZFs employees on GBI. (Please note, station diaries were usually compiled by clerical staff and serve to record staff movements, weather conditions, visitors and other routine matters. Journals record management activities from the perspective of the Officer-in-Charge.) Eileen Walker is the mother of Brownie Walker, who manages the DOC workshop and mechanical infrastructure on GBI. Don Woodcock put a lot of other material, such as a large roll of maps, in the DOC workshop ceiling for safe keeping and to prevent them being dumped.

Other material ended up in different locations. Karen Wi, who is a former NZFS employee and John Wi's daughter, and who has worked for DOC from time to time, took some material home for safe keeping. Allen Gray of Awana GBI (A. H. Gray), who runs a small museum, also holds some former NZFS material, but this is more likely to be artefacts than paper records.

During the interview, John Beachman (the author) commented to Woodcock that not many files could be found in Archives NZ that Beachman judged were from GBI. Beachman's impression was that the files on GBI were mostly from Auckland Conservancy Office of NZFS. Woodcock was certain that the files had gone to DOC in Auckland for archiving, so they may not have all been lodged with Archives NZ. Note that when John Beachman was on GBI in August 2016, Brownie Walker gave him access to several boxes of GBI diaries and journals, which he had salvaged from the rubbish bins when Steve McGill was presiding over the clean-up.

Figure 126. Four boxes of GBI journals and diaries conserved by Brownie Walker.

This collection (Figure 64) comprises:

- The two missing forest journals, volume 1 covering 1946–1947 and volume 2, covering 1949–1950.
- Station diaries for 1945, 1948, 1951–1960 (1961 is missing), 1962–1967 (1968 is missing), 1969–2001 (2002 is missing) and 2003.
- A private professional series of diaries by Ron Lloyd covering 1950–1953.

The author (John Beachman) cannot understate the value of these documents as a record of a large chapter in GBI's history.

Forest Nurseries on GBI

Between 1949 and 1955, kauri plantations on GBI used seedlings raised in the Waipoua Forest Nursery and freighted them to the island. It was judged that this approach was too cumbersome, and a decision was made to use GBI-sourced wilding stock. Direct transfer of the wildings risked high seedling mortality, so to minimise this risk, small forest nurseries were set up to hold and to on-grow and harden the wildings.

Woodcock recollects a nursery for such purposes in the Kaiaraara Valley. There was another nursery at Whangaparapara. Trees were on-grown in steel tubes in these nurseries. Paddy McGeedy and Jim Walker ran the one at Whangaparapara. They stayed at the Green campground then. Don Woodcock recollects some very large kauri seedlings trees in the Kaiaraara Nursery, which he was told were Waipoua plants that had not been planted out. He planted some of these at Hātepe (Taupō district), but most were left at the nursery site because of their large size and deep roots. They should still be there and should be checked for PA symptoms.

Generally, the wilding plantings have not been entered into the stock maps, i.e., they have not been mapped. The compartments they were planted into prior to 1966 are recorded in the *1965–1975 Great Barrier Working Plan*. Woodcock said that the wildings were planted into areas where the natural kauri stocking was very low or kauri were absent. The chances of relocating these wilding plantations for PA assessment would seem low. Note, there are some rough site descriptions in file notes John Beachman has if an assessment is deemed necessary. The possible presence of Waipoua seedlings being held over for some years in the Kaiaraara Nursery suggests a risk of the transfer of PA to the nursery soils and thence to the wildings being held there and planted out across GBI.

PA sites on GBI

Currently, there a three known kauri dieback sites on GBI: Kaiaraara, Whangaparapara (the Gadgil site) and Okiwi. There is a management connection between the first two infected sites, i.e., possibly PA-infected Waipoua Forest Nursery seedlings at Kaiaraara and the FRI thinning trial plot (173/3) inland from Whangaparapara. The thinning work was done by the same NZFS personnel who planted the Kaiaraara seedlings, possibly using some of the same tools, thereby presenting the opportunity for transfer of PA. There is no obvious connection from either of these sites to the very entrenched infection at Okiwi, or any other obvious vector for that matter. Note that the Okiwi site was never state forest land.

Don Woodcock, with his long personal knowledge of kauri management on GBI, could not come up with any explanation or even a theory as to how the Okiwi site became infected with PA. He did note that Okiwi Station passed through many owners' hands before being acquired by DOC.

Kiwiriki Planting Site 1955

A total of 416 kauri seedlings ex Waipoua, seed lot AK 51/640 2/2, were planted at Kiwiriki in 1955. The plantation was never placed on the stock maps. It was recorded as an almost complete failure within 2 years. A failure of this scale could indicate PA infection of the seedlings as a possible cause. It is worth revisiting the planting site to see if any trees have survived and if there is any sign of kauri dieback on the site or in the vicinity. Don Woodcock has no knowledge of the plantation itself, but during the interview, he said that the boulder and stone wall shown on the forest journal map drawn by Ron Lloyd were features he remembered noticing. He thought they were remnants of a farmhouse or similar and that the site could be fairly readily relocated. The Kiwiriki site requires a field check due to its history of failure.

TSI

Tree stand improvement is the silvicultural prescription applied to natural stands of regenerating forest, whereby competing vegetation is removed to allow unimpeded canopy access to the favoured species of tree. In the GBI case, the favoured species was kauri. Where kauri were absent, other coniferous timber species such as rimu, tōtara, kahikatea, etc. were elevated as favoured species. The prescription allowed for releasing of good-form kauri from other competing conifers, although Woodcock said this was not the practice. The prescription also allowed for thinning out of "dense thickets of kauri saplings of similar height". Implementation of this prescription placed NZFS gangs in most of the kauri stands on GBI. From a kauri dieback viewpoint, this could have offered multiple opportunities for the spread of PA via infected tools, muddy boots, muddy vehicles on clay bush roads and so on.

Woodcock confirms that most of the former state forest regenerating kauri on GBI was treated using this prescription. Many of these treated areas are recorded on compartment maps copied from Archives NZ. They are also recorded on page 19 of the *GBI Working Plan for 1965–1975* (gross area of 6619 acres covered [net area, 2991 acres] by 1955–1965). Note, it may be worth checking with Woodcock as to whether areas were treated more than once. During the interview, he advised that most of the state forest areas were covered except for some of the more mature upland central areas and some areas to the east. Tools used were somewhat specialised. Woodcock showed me two examples. The axe-handled model to the left of Figure 65 was used for heavier cutting. The slasher-handled tool to the

right was the most favoured tool for general work, especially for ring-barking overhead vegetation such as kānuka.

Figure 127. Tools used for TSI on GBI. Don Woodcock in photo.

The fact that there are only three kauri dieback sites on GBI would tend to suggest that the risk of transfer via TSI is low. The sampling carried out by Auckland Council in 2014 would have covered some of the TSI sites, but no PA was identified during that surveillance.

NZFS Machinery Used on GBI

Don Woodcock commented that the forest road between Kaiaraara and Whangaparapara was constructed prior to his arrival in 1971 using a bulldozer on loan from Coromandel and operated by two people. One operator was named Leef and the other, possibly Ngatai. Woodcock thinks the work may have been done during two visits. Given the potential for spread of PA via dirty machinery, the background of this work is important. It appears Max Johnston in Thames surveyed the road line and supervised construction of the road in about 1960. He said the bulldozer was driven by Jim Walker. He also stated that roading machinery on Coromandel carried out work in many of the state forests on the peninsula. He was uncertain if the machinery was based at either Whangapoua or Tairua Forest, but Johnston was sure that it operated across Coromandel. This account should be corroborated with Brownie Walker. It is more likely that the dozer came from Riverhead Forest. A detailed perusal of the station diaries described above may clarify the origin of the machinery and enable a better assessment of PA transfer risks.

SPs on GBI

There are a range of SPs throughout the former state forests on GBI. Of particular interest to the Kauri Dieback Programme is SP 173/3, located in the upper Kaitoke Stream catchment. This SP is co-located with NZ's first observed PA site, the Gadgil site, originally sampled in 1972 by FRI Scientist Peter Gadgil and identified by Kew Gardens plant pathologists as *Phytophthora heveae* and then later re-assessed by Dr. Ross Beever as PA. The general judgement about the origin of this site's infection has been contamination by NZFS personnel who carried out SP thinning, possibly using the same tools as they had used in planting PA-contaminated Waipoua Forest Nursery-sourced seedlings in the Kaiaraara Valley. There are some pros and cons re this judgement.

Pros

- There is a management connection between work carried out in the Kaiaraara in establishing plantations with seedlings from Waipoua Forest Nursery and the work carried out thinning the kauri stands within SP 173/3. The same personnel, possibly using the same tools, carried out both works.

- Plot 173/3 is in a very remote part of GBI. It is difficult to postulate other means than NZFS worker activity carrying the infection to this site.

Cons

- NZFS workers carried out work in virtually all kauri areas of GBI, yet there are only three known infected sites on the Island. If NZFS worker activity was such a significant vector, surely more sites would be PA positive.
- FRI personnel Roger Cameron and Frank Bekhuis established SP 173/3 in 1958. They could have brought the infection.
- The planting of the Kaiaraara trees and the establishment of the plot were not simultaneous. Records show that thinning of 173/3 most likely occurred in 1958–1959. The last Waipoua Forest Nursery-sourced plantings occurred in the Kaiaraara in 1955. The obviously PA-stricken plantation was established in 1953.
- The distance between the two sites is approximately 5 km in a straight line across quite rough country. The forest road from Kaiaraara to Whangaparapara was not opened up for vehicles until the 1960s. The SP site was most likely accessed from Whangaparapara, not Kaiaraara.
- GBI has a colossal history of disturbance, including kauri logging and gold mining. The marks of these activities are all over the island, including at the infected site in the upper Kaitoke. The PA at this site could have had a much earlier origin.
- The site has extremely impoverished soils and very slow growth of all forest species including kauri. PA can take several decades to manifest in symptoms such as trunk lesions and crown dieback. The infection was widespread — "12 chains by 4 chains wide" — when it was first noted. It could have been infected considerably earlier than the late 1950s.

Other Related Information re SPs

Plot 173/1 is in the Kaiaraara. It was thinned in February 1957. Plot 173/2 is adjacent to the forest road near the access track to SP 173/3. Sample plot 173/2 was thinned in 1957. If SPs 173/1 and 173/2 are infected with PA, this infected state would add credibility to the postulation that worker activity brought the infection to the Gadgil site. Therefore, it would be sensible from both the historic enquiry and the biosecurity viewpoints to assess the conditions of SPs 173/1 and 173/2, respectively.

At the time of the interview, Don Woodcock was aware of having accompanied FRI personnel to SPs 173/2 and 173/3 but was not familiar with SP 173/1. He judged from the small location map that SP 173/1 was adjacent to the cleared phone line, which ran from Kaiaraara to Whangaparapara. Woodcock did recollect an SP on the South Fork Track, which was a thinning trial. It was re-measured regularly by GBI staff. This may be SP 332, which is a 1972 plot. No copy of this plot's cover sheet is currently available. Woodcock also mentioned a thinning trial on a ridge to the north of the Kaiaraara Stream. This is likely to be SP 336/6, a 1963 plot. Again, a copy of this SP's cover sheet has not been located.

Woodcock discussed SP 424. This plot is in the 1953 plantation established using Waipoua seedlings, seed lot AK 50/616. This plot was established by Officer-in-Charge Wulf Young in 1969 with the purpose of monitoring the growth of the trees. Numbered tags were placed on all the trees in the stand, and their height and diameter growth measured every 3 years. If, as is likely, this stand has become infected with PA, John Beachman and Don Woodcock concur that the plot would offer the opportunity to monitor how the disease has tracked through a stand.

Peter Gadgil's Additional Sampling

When FRI Scientist Peter Gadgil sampled the PA-infected stand in the upper Kaitoke in 1972, he also sampled some other sites, one of which was described in Gadgil's file note as "Mt. Young over Coppins Creek". Note that there is no Coppins Creek on GBI. Coffins Creek is west of Mt. Young and matches the description in the Gadgil/Basset file note. This sample was also positive for *P. heveae*. If the site is also PA positive, this is a fourth positive site on GBI.

Mt. Young is a difficult piece of territory. It is likely that Peter Gadgil sampled something much nearer the road. At the time of the interview, Don Woodcock said that the old telephone line and associated track cut across the Mt. Young ridge and upper Kiwiriki stream and that these could have been the likely sampling entry point choices. Note that the forest road between Whangaparapara and Kaiaraara was in existence when Gadgil did his sampling in February 1972, and that there are stands of good quality kauri regrowth adjacent to the road in the Coffins Creek area.

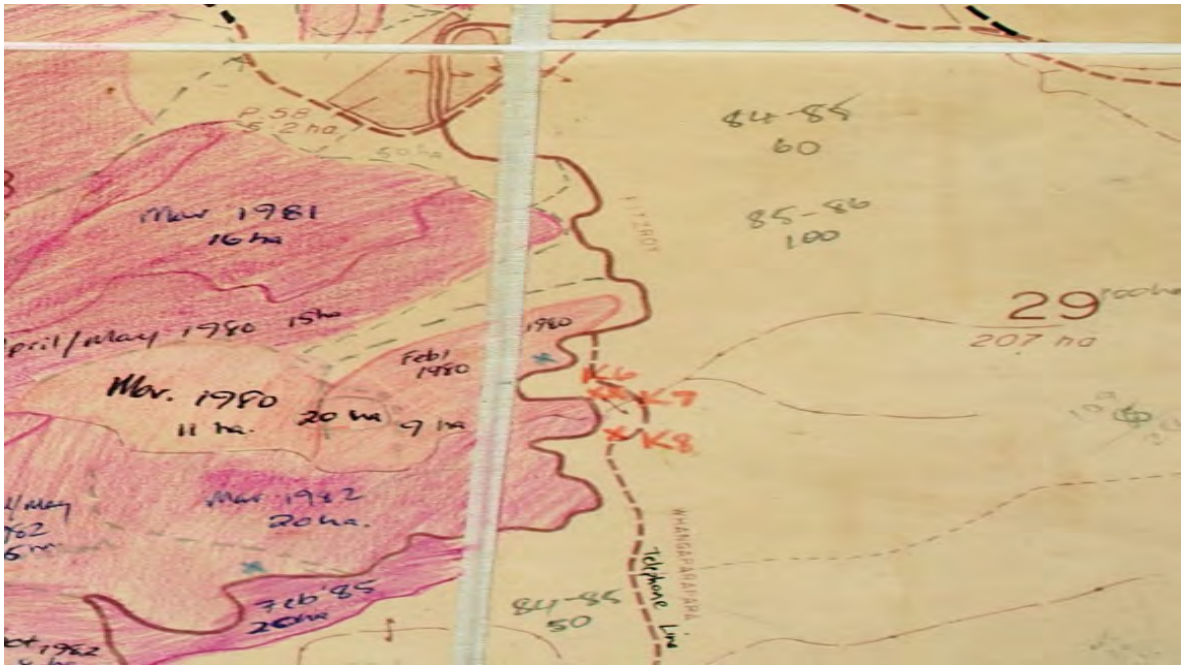


Figure 128. Map of Peter Gadgil's possible Mt. Young sampling site, as identified by Don Woodcock.
Notes. Coffins Creek intersects Forest Road in the lower centre of picture. The numbers K6, K7, etc. represent sample trees. Mt. Young's location is somewhat east of compartment number 29. Pink, shaded areas have been TSI treated.

John Beachman
May 31st, 2016

Appendix 4 Russell Forest: Wally Pita Interview

Background

Author John Beachman met with Wally Pita at his home in Punaruku on April 13th, 2016. Wally is a former NZFS employee who worked in Russell Forest in the 1970s and 1980s.During his employment he was involved with, and often played a leading part in, NZFS management work in Russell Forest. As tangata whenua and with the above history of working in the forest, he maintains a keen interest in it. Wally provided his comments on the following areas of work.

TSI

Tree stand improvement was the application of silvicultural treatment in regenerating kauri forests. The system was developed by Ron Lloyd on GBI in the early 1950s and is derived from British colonial silvicultural models as practiced in the tropical forest of Malaya and elsewhere.

Ron Lloyd's model involved traversing a forest and releasing from competition and potential suppression the (timber) species of trees favoured by the prescription. In the case of GBI and Russell Forests, the most favoured species was kauri, with a descending hierarchy of other indigenous conifers becoming the favoured species if the kauri were absent. In the valleys and other parts of the forest where kauri was absent, the prescription required the cutting of rata vines from favoured conifers and hardwood species such as taraire and tawa.

In practical terms, TSI involved ring-barking or otherwise eliminating unfavoured canopy species such as mānuka, kānuka and tōwai. It also involved felling ponga, which were shading regenerating kauri. Where a less favoured species such as tānekaha was judged to be stifling a kauri pole or sapling, the tānekaha would be ring-barked or felled. This was an elegantly simple prescription, and staff at GBI and Russell became very efficient at its implementation. Because it required every acre of forest to be treated, staff became very knowledgeable of the areas they were managing.

Tree stand improvement is of interest to the KDP because in its implementation, the forest worker inevitably moves soil around the forest on clothing and tools, and this soil movement could act as a PA vector. Therefore, it is in the interests of the Programme to know where TSI was and was not practiced, respectively.

Where TSI was Practiced

Tree stand improvement was carried out in all of the forested areas of the main body of Russell Forest, i.e., the whole of the Punaruku Valley (Punaruku compartment numbers 1 and 2), all of Papakauri and all of the Waikare block. It was applied to the forested areas along either side of the road between Waikare and Karetu (Waikare Road).

Wally Pita is uncertain if the Karetu block was TSI treated. It may have been.

He is sure that the Western outlying blocks (Ruapekapeka block and Hukerenui block) were not treated. Similarly, no treatment occurred in the Tapuhi block to the south, the Kaikanui blocks to the east and the Kaurinui and Waikino blocks to the north-west.

See map below for TSI distribution (Figure 67). The map records the discussion with Wally Pita re TSI.

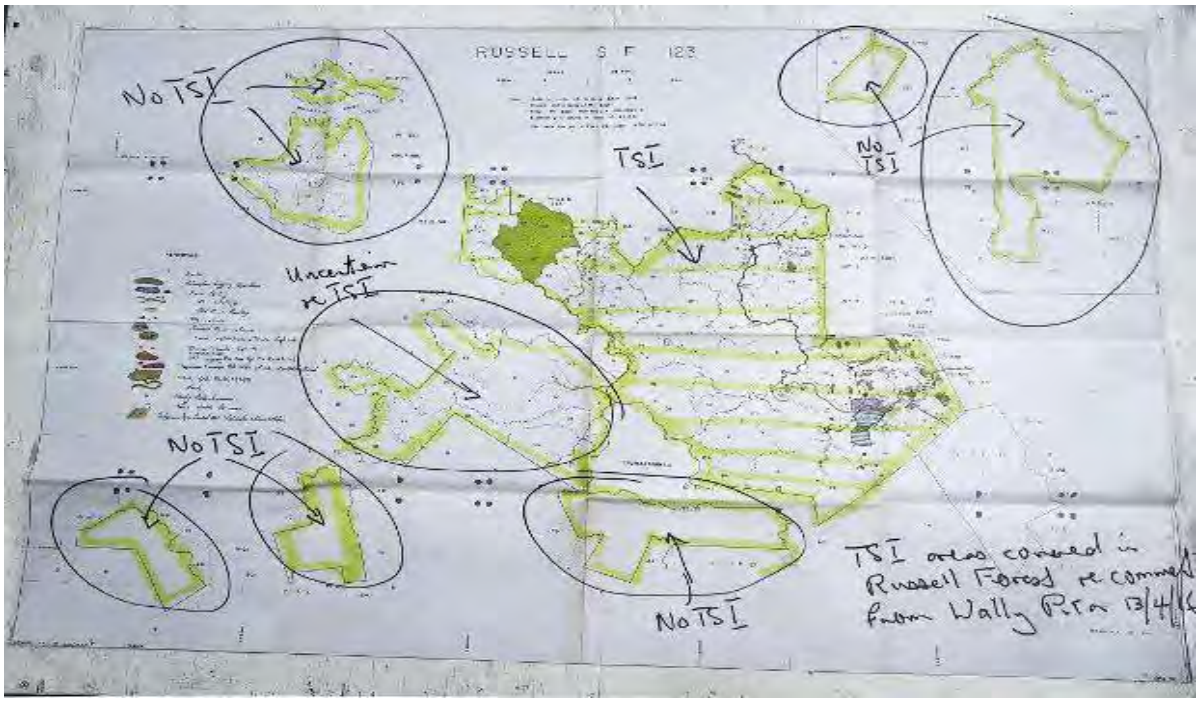


Figure 129. Outline of Russell Forest areas treated under TSI prescription, 1950s–1980s.

Kauri Seed Collection

Asked about collecting kauri seed and the location of seed trees, Pita said he and another member of the Russell Forest crew went to Waipoua to learn climbing from staff there. He said they did not collect from designated seed trees. Rather, they selected trees of good form and vigour and climbed these, harvesting cones from the upper crown.

To climb the trees, they coiled up their rope at the base of the tree. They wore boots with steel chisel points, which were driven into the tree to provide purchase. They used their arms around the trunk to hang on and lift and kicked in the toe spikes as they worked their way up the tree, trailing their rope. When they got to the crown branches, they removed their boots and climbed up to near the top. Here, they passed the rope around the tree to provide purchase, deployed their boson's chair and leaned out to pick the cones off the ends of the branches, filling up the planting bag around their waist. They worked their way down the tree, picking as they went and lowering themselves via control of the free end of the rope. They could only pick one side of the tree as they descended. Sometimes, if it was a particularly good tree, two of them would climb and thus pick the whole tree.

Cones were dried in the shed at the NZFS HQ. The seed was extracted and sent to Sweetwater Nursery. Pita remembers that most seed collection was from within the Punaruku and Papakauri Blocks of Russell Forest, but that NZFS workers had, on occasion, collected from the Ngaiotonga Scenic

Reserve. He said the tree in the Punaruku Valley (noted by Tony Beauchamp and John Beachman) with numerous toe-spike scars up its trunk was a "practice tree", and seed collection trees were generally not revisited from year to year.

Wild Animals

There have always been wild pigs and goats in Russell Forest. The author's recollection of working in the Punaruku number 2 block in 1964–1965 was that goats were quite common, but in months of field work there, he never encountered wild pigs or pig sign. Pigs were mostly absent from that part of the forest at that time. Currently, pigs are present throughout the forest, usually in low numbers.

A small population of sika deer established in the forest from a release in the early 1990s. On-going DOC- and NRC-sponsored efforts to eradicate them have not yet reached the point where these animals can be deemed eradicated. Eradication of wild deer is the only formal wild animal control activity current in Russell Forest.

In the 1960s, possums had yet to arrive, but when they did, the population built up rapidly, and there were mass deaths of rata in the late 1970s and 1980s. This forest die-off trend has continued with the more recent and ongoing die-off of Hall's tōtara and tōwai, the latest manifestation of Russell Forest degradation.

In terms of trespassing cattle, Wally Pita recalled an ongoing issue with cattle straying between Waikare and Papakauri in the 1970s and 1980s. It took some time and effort to resolve this trespass. It is worth noting (from a kauri dieback perspective) that cattle trespass was common in Northland in the 1950s, 1960s and 1970s, with some farmers routinely pushing their stock into the bush for free winter grazing.

Kauri Planting

Wally Pita was very familiar with the kauri planting done in Russell Forest in the 1970s and 1980s. Most of these plantings are recorded on the stock and species maps in the author's possession. Pita was less familiar with the older 1950s and 1960s plantings, which are of particular interest to the KDP. He thought that in the 1970s, the NZFS may have overplanted part of the 1950 8-acre (3.2 ha) Punaruku Valley plantation. The map does not indicate the overplanting.

At the time of the interview, Pita was aware of the many SPs and trial plantings that are mostly situated in the Punaruku Valley. He was a key organiser in the helicopter extraction of kauri carried out from 1980–1982. He reminded the author during the interview that kauri were planted in some of the light gaps created by that logging. These plantings were not recorded on any maps. Trees used were from Sweetwater Nursery.

Kauri Seed Orchard

In the compartment description for compartment 1 of Russell Forest, there is an entry in Ron Lloyd's handwriting as follows: "Kauri seed orchard from surplus stock ex Waipoua established 1965". This orchard is worth trying to find, as it most likely comprised grafted trees, and such trees in the Waipoua seed orchards are heavily infested with PA. Pita did not know of this area directly, but commented that

there were several small areas fenced off in the lower Punaruku Valley. This area is probably one of these. At some later date, Pita is willing to visit the valley with the author to check the location.

Russell Forest Records

Pita was unaware of what had happened to the files and other records held at the NZFS HQ at Punaruku. He commented that the last Officer-in-Charge was Martin Brown. Brown has yet to be located or contacted.

Ongoing Dialogue

Pita is a valuable contact for the KDP re kauri management in general, with an emphasis on Russell Forest. Most of the people who worked in the forest in the 1950s and 1960s have passed away. It would be a valuable exercise to return to Wally Pita with the question of TSI treatment of the Karetu block and some of the trial sites within the Punaruku Valley. He is very interested in the current dialogue centred on Waikare re the dire condition of Russell Forest.

John Beachman
Aril 15th, 2016

Appendix 5 Kauri Seed Lots Sown at Waipoua Forest Nursery

Seed lot #	Quantity sown (kg)	Year sown	Year planted	Area (ac)	# sown	Destination	Blanked	Current condition
AK 40/453	6.90	August 1940	1944		2316	Omahuta compt 9	1945	Good
			?		154	Omahuta compt 8		Not known
AK 41/465		1941	1945		220	Omahuta compt 9	Blanks	Good
AK 44/497	6.60	April 1944	1947		84	N. Arboretum	Blanks	Not mapped
					86	Wairangahau		Not mapped
AK 45/506	11.30	April 1945	1947		3114	Wairangahau		Not mapped
AK 46/514	9.40	May 1946	1948		500	Glenbervie		Not mapped
					1100	N. Arboretum		
					264	N. Arboretum	Blanks	Good
			1949	6.0	5428	Waipoua		Compt 15 southern end
			1950	1.0		Waipoua		Below compt 58 plantings
AK 47/533	11.50	April–May 1947	1949	0.2	500	GBI		OK
			1950	9.0	4000	Omahuta compt 6		OK
			1950	10.0	5100	Waipoua compt 15		Below compt 58 plantings
			1950	0.2	400	Waipoua SP		
AK 48/571	12.30	March 1948	1950	57.0	27500	Omahuta compt 6		
			1950	10.0	5000	Puhipuhi compt 5		
				3.0	4500	Waipoua SP		
					340	N. Arboretum	Blanks	
				9.0	6000	Glenbervie compt 2		PA
				32.0	12600	Riverhead compt 16		
				1.0	800	Riverhead compt 12		
				1.0	600	Riverhead compt 17		
					6000	Kauaeranga compt 2		

Seed lot #	Quantity sown (kg)	Year sown	Year planted	Area (ac)	# sown	Destination	Blanked	Current condition
AK 48/571			1951		2332	Waipoua Huaki, etc.		
						*Omahuta compt 3		
					*7000	Puketi		OK
			1954	4.0	530			Failed
AK 48/571			1952	0.5	247	Waipoua Huaki etc		
						*Omahuta compt 6		
					*5663			
AK 50/616	4.73		1952	1.0	1200	Waipoua SPs		
			1953	1.5	535	*GBI compt 5		
			1956	0.7	139	Waipoua compt 4		PA
AK 51/640	7.00		1954	10.0	2200	*Omahuta compt 6		"Failed"
			1954	19.0	2270	*Puketi		Failed
			1954	2.0		*GBI compt 5		
			1955	28.0	2200	*Puketi		Failed
			1955	5.0		Waipoua compt 58		
			1955		406	*GBI Kiwiriki		Not mapped/"failed"
								PA
			1956	0.7	80?	Waipoua compt 4		
			1956	4.8		Waipoua compt 58		
AK 52/654	8.30		1955	2.0		*Raetea		Good
			1956	0.7	?228	Waipoua compt 4		PA
			1956	4.8		Waipoua compt 58		
			1957		441	Waipoua L/4		?
AK 53/661	2.50 (includes first Dunemann trial)		1956		466 (Dunemann) and 3300 other Waipoua Nursery stock 1441	Raetea		PA
			1957		1000	Waipoua		
			1957		570	Waipoua compt 58		
			1957			Waipoua compt 58	Blanks 1956	
AK 54/681			1958		2000	*Raetea	Some for Blanks	PA

Seed lot #	Quantity sown (kg)	Year sown	Year planted	Area (ac)	# sown	Destination	Blanked	Current condition
AK 55/698	Not known		1958		1190	Waipoua		?
			1959		1937	Trounson		?
				2.0	525	Raetea		
					4000	Waipoua compt 58		PA
			1960		500	Waipoua compt 58		Burn/strip
			1960		1524			Lines
AK 56/716	2.80		1959		325	Trounson		
					850	Waipoua compt 58		
			1960		123	Waipoua compt 58		Lines
AK 57/731	2.80		1960		870	Waipoua compt 58		Lines
			1961		600	Waipoua compt 58		Burn/strip
					1037	Waipoua compt 58		Group
AK 58/769	1.50		1962		527	Waipoua compt 59?		
					4996	Russell		
					734	Trounson		
			1963		1120	Trounson		
					600	Waipoua compt 55?		
AK 59/810			1962		214	Waipoua compt 55?		
			1963		1275	Waipoua compt 55?		
			1964		271	Waipoua compt 55?	Blanks?	
AK 59/811	0.17 (seed tree 18)		1962		240	Waipoua?		
AK 59/812	224.00 g Seed tree 20		1962		267	Waipoua compt 58		
AK 59/813	170.00 g Seed tree 31 (in compt 59)					?		
AK 59/814	470.00 g Seed tree 843		1962		756	Waipoua compt 58		
AK 59/815	100.00 g Seed tree 674	1959				?		

Seed lot #	Quantity sown (kg)	Year sown	Year planted	Area (ac)	# sown	Destination	Blanked	Current condition
AK 60/841	800.00 g Single tree	1960	1963 1964		1166 1360	Waipoua Waipoua		
AK 60/842	1300.00 g Seed tree 31 Compt 59	1960	1964		625	Trounson		
AK 60/844	476.00 g Seed tree 50	1960	1963 1964 1965		174 294 138	Waipoua compt 58 Waipoua compt 58 Riverhead		
AK 60/845	196.00 g Seed tree 693	1960	1965		78	Trounson		
AK 60/846	245.00 g Seed tree 18	1960	1965		56	Trounson		
AK 60/848	322.00 g Seed tree 20	1960	1964 1965		229 25	Waipoua compt 58 Trounson		
AK 61/856	468.00 g Seed tree 18	1961	1965		650	Trounson		
AK 61/860	600.00 g Seed tree 843	1961	1965		600	Trounson		
AK 61/874	120.00 g	1961				No record		
AK 61/877	170 g Seed tree 82	1961				No record		
AK 61/878	812.00 g Seed tree 854	1961	1964 1965 1967		145 693 254	Waipoua compt 58 Trounson S'water		
AK 61/879	378.00 g Seed tree 847					No record		

Seed lot #	Quantity sown (kg)	Year sown	Year planted	Area (ac)	# sown	Destination	Blanked	Current condition
AK 62/895	4.00	1962	1964		200	Trounson		
			*1967		650	Trounson		Blanks?
			1969	2.0	1175	Aupouri compt 9		Good
			1971		400	Kauaeranga		?
AK 62/875	680.00 g	1962	1964		3700	?		
AK 63/898	3.75	1963	1967		500	Kumeu		?
					325	S'water		?
AK 64/908	?	1964				Sales		
AK 64/945	90.00 g	1964				?		

Notes: Most information in this table came from the *Seed Register*. There are many gaps, discrepancies, puzzles and even contradictions in this information, hence the gaps, enigmatic abbreviations, and question marks in the above table. Seed lot AK 62/895 may have been germinated at Kaikohe and lined out at S'water. *Also, no 1967 area exists at Trounson of this seed lot. Blanks refer to trees planted later in the "blank" spots where original seedlings perished. Quantity sown is measured in kilogrammes except where noted.

Abbreviations: compt, compartment; D'mann, Dunemann; GBI, Great Barrier Island; N. Arboretum, Northern Arboretum; SP, sample plot; S'water, Sweetwater Nursery.

Appendix 6 Other NZFS Nurseries Where Kauri Seed Was Sown

Seed lot #	Quantity sown (g)	Year of sowing	Year planted	Area (ac)	Quantity planted	Destination	Blanked (Y/N)	Current condition
AK 48/571	Tairua 900 g	Mar 1948	1950 1950	5 3	2250 1000	Whangapoua Tairua	N	Cleared 1971?
AK 59/813	Beaumont 50 g	May 1959	Not known				N	
AK 60/847	Kaikohe 225 g	Mar 1960	Not known				N	
AK 61/858	Kaikohe 680 g	1961	Not known				N	
AK 67/955	Kumeu 448 g	Oct 1970	1973		425	Kauaeranga	N	Not known*
AK 68/959	S'water 680 g	Mar 1968	1971		300	Private sales, etc.	N	Not known
AK 69/979	S'water 224 g	Sep 1969	Not known			Unknown	N	
AK 71/999 (tree 843)	S'water 840 g	Not recorded	1974		1497	Glenbervie	N	PA
AK 72/1013	S'water 900g	Feb 1972	1974–1975		500 2912	Coro F Park KMU Raetea	N	 PA
AK 73/1030	S'water 670 g	Feb 1973	1975 1976		566 1794	KMU KMU	N	
AK 73/1031 seed orchard	S'water 50 g	Mar 1973	1975		230	KMU	N	
AK 74/1040	S'water 2.3 kg	Mar 1974	1975 1977 1977		1100 1/0 883 388 56	KMU Raetea Raetea Puketi Russell	N	
AK /c/75/8	S'water 25.6 kg	1975	1977 1978		c. 16000 c. 30000	State forests See list	N	
AK C/76/1	S'water 26 kg	Mar/Apr 1976	1978 1979		c. 10500 c. 6000	State forests See list	N	
AK C/77/1	S'water 23.4 kg	1977	1979		c. 26000 c. 32000	State forests See list	N	

Note. Most information contained in this table came from the *Seed Register*. Months are described in widely accepted abbreviated format. * this plantation has not been inspected.
Abbreviations. c., approximate date or approximate number; Coro F Park,Coromandel Forest Park ; KMU,Kauri Management Unit ; S'water, Sweetwater Nursery.

Appendix 7 Kauri Plantation Record

Abbreviations for all tables below: c., approximately; NA, not applicable; PA, *Phytophthora agathidicida*; SF, state forest.

Kauri plantation record — Herekino 1979	
Forest name	Herekino
Location detail	Unreliable map. Site not known
Year/s of planting	1979
Area (hectares)	5.2
Number planted	2900. 400 blanks in 1980
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown. No map
Anthropogenic influences	Wild pigs
Confidence in data	High
Comments	Inspect if map found. Known information is reliable

Kauri plantation record — Raetea SF 2 1955	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1955
Area (hectares)	0.8
Number planted	c. 1000
Seed lot number	AK 52/654
Source of plants	Waipoua Nursery
% of original plantation remaining	Dominant >75%
Anthropogenic influences	Picnic area. Good fences
Confidence in data	High
Comments	Healthy stand of trees. No PA detected in this plantation via soil test

Kauri plantation record — Raetea SF 2 1956	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1956
Area (hectares)	3.4
Number planted	3766
Seed lot number	Including AK 53/661 Dunemann
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Cattle incursions, wild pigs. Marijuana growing, forest management, visitors
Confidence in data	High
Comments	PA via soil tests. This stand may be source infection for all Raetea PA

Kauri plantation record — Raetea SF 2 1958	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1958
Area (hectares)	1.0
Number planted	2000 1/3*
Seed lot number	AK54/681
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Cattle incursions, wild pigs, visitors
Confidence in data	High
Comments	PA active. *1/3 is a nursery term. 1=1 year in seed bed. 3= 3 years lined out in nursery. Tree therefore 4 years old when planted out.

Kauri plantation record — Raetea SF 2 1959	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1959
Area (hectares)	1.0
Number planted	4000
Seed lot number	AK 55/698
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Cattle incursions, wild pigs, visitors
Confidence in data	NA
Comments	PA positive. Very large number of trees in a small area. Some were likely used to blank previous planting failures

Kauri plantation record — Raetea SF 2 1975	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1975
Area (hectares)	4.7
Number planted	3000
Seed lot number	AK 72/1013
Source of plants	Sweetwater Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	PA positive. Most likely cross-infected from adjacent 1950s plantations. Some very large trees

Kauri plantation record — Raetea SF 2 1976	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1976
Area (hectares)	5.1
Number planted	3300
Seed lot number	AK74/1040
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Growing quite well

Kauri plantation record — Raetea SF 2 1977	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1977
Area (hectares)	2.7
Number planted	3500
Seed lot number	AK/c/75/8
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Less vigorous stand than 1975–1976 due to site preparation issues

Kauri plantation record — Raetea SF 2 1978	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1978
Area (hectares)	5.9
Number planted	5600
Seed lot number	AK/c/75/8
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	Moderate
Comments	No PA symptoms. Difficult to accurately discern plantation boundaries

Kauri plantation record — Raetea SF 2 1979	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1979
Area (hectares)	0.0
Number planted	3500 as blanks in previous
Seed lot number	AK/c/77/1
Source of plants	Sweetwater Nursery
% of original plantation remaining	NA
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	All blanking. No net area increase

Kauri plantation record — Raetea SF 2 1980	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1980
Area (hectares)	7.8
Number planted	3500
Seed lot number	AK/c/77/1
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Variable stocking

Kauri plantation record — Raetea SF 2 1981	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1981
Area (hectares)	4.3
Number planted	3000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Variable stocking

Kauri plantation record — Raetea SF 2 1982	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1982
Area (hectares)	4.7
Number planted	4030
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Variable stocking

Kauri plantation record — Raetea SF 2 1983	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1983
Area (hectares)	6.6
Number planted	4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. Variable stocking

Kauri plantation record — Raetea SF 2 1984	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1984
Area (hectares)	8.6
Number planted	4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. More field checks needed to accurately determine stocking

Kauri plantation record — Raetea SF 2 1985	
Forest name	Raetea SF 2
Location detail	Victoria Valley
Year/s of planting	1985
Area (hectares)	20(estimated)
Number planted	18952
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs, visitors, forest management
Confidence in data	High
Comments	No PA symptoms. More field checks needed to accurately determine stocking

Kauri plantation record— Omahuta SF 5 trial (1944–1945)	
Forest name	Omahuta SF 5 trial
Location detail	Compartment 109 SP 205A
Year/s of planting	1944–1945
Area (hectares)	0.8
Number planted	2306 (1944) and 220 (1945)
Seed lot number	AK 40/453 (1944) and AK 41/465 (1945)
Source of plants	Waipoua Nursery
% of original plantation remaining	Dominant >75%
Anthropogenic influences	Adjacent to a forest road. Wild pigs, hunters
Confidence in data	High
Comments	No PA symptoms. Remarkably well stocked stand on a low fertility site

Kauri plantation record — Omahuta SF 5 trial (1946)	
Forest name	Omahuta SF 5 trial
Location detail	Compartment 109 SP 205A
Year/s of planting	1946
Area (hectares)	0.4
Number planted	Unknown
Seed lot number	wildings
Source of plants	Omahuta wildings
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, hunters
Confidence in data	Moderate
Comments	Unable to identify natural regeneration versus plantation trees on ground. No PA symptoms. Natural regeneration processes dominate the site

Kauri plantation record — Omahuta SF 5 trial (1952)	
Forest name	Omahuta SF 5 trial
Location detail	Compartment 104 SP 67/1
Year/s of planting	1952
Area (hectares)	0.8
Number planted	400
Seed lot number	Unknown
Source of plants	200 Omahuta wildings. 200 ex Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Planting pattern easily discernible. No PA symptoms. Quite well stocked, vigour reasonable

Kauri plantation record — Omahuta SF 5 trial (1952)	
Forest name	Omahuta SF 5 trial
Location detail	Compartment 109 SP 67/2
Year/s of planting	1952
Area (hectares)	0.8
Number planted	400
Seed lot number	Unknown
Source of plants	200 wildings 200 ex Waipoua Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	Unknown
Comments	Uncertain of source of trees when on site. Natural or plantation? Can't judge. This is a planting trial within a mature kauri forest

Kauri plantation record — Omahuta SF 5 (1950)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1950
Area (hectares)	8.5
Number planted	24000 shared with 1950 18.2 ha area
Seed lot number	AK 47/533 and AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High–moderate
Comments	Author viewed a very limited part of this plantation. Scattered trees growing quite well. Tough site. Main area not observed

Kauri plantation record — Omahuta SF 5 (1950)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1950
Area (hectares)	18.2
Number planted	24000 shared with 8.5 ha 1950 area
Seed lot number	AK 47/533 and AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Looks to be quite well stocked; plenty of natural kauri regeneration on site. No PA symptoms. Tough site. Trees small but healthy

Kauri plantation record — Omahuta SF 5 (1951)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1951
Area (hectares)	12.8
Number planted	14000
Seed lot number	AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Variable stocking. Flat site swampy in places. Some very good growth in places. No PA symptoms. Natural kahikatea competing in some areas

Kauri plantation record — Omahuta SF 5 (1952)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1952
Area (hectares)	14.8
Number planted	5663
Seed lot number	AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Erratic stocking. Low fertility site. No PA symptoms. Poorly stocked

Kauri plantation record — Omahuta SF 5 (1954)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1954
Area (hectares)	4.0
Number planted	2200
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Could not confidently identify any plantation-origin kauri. Plenty of natural kauri regeneration. No PA symptoms despite careful search. Listed as a failed plantation

Kauri plantation record — Omahuta SF 5 (1980)	
Forest name	Omahuta SF 5
Location detail	Compartment 109
Year/s of planting	1980
Area (hectares)	2.0
Number planted	1000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Kauri being suppressed by tōwai canopy. No PA symptoms.

Kauri plantation record — Omahuta SF 5 (1981)	
Forest name	Omahuta SF 5
Location detail	Compartment 109
Year/s of planting	1981
Area (hectares)	9.6
Number planted	3670
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Kauri being supressed under tōwai canopy. No PA symptoms.

Kauri plantation record — Omahuta SF 5 (1982)	
Forest name	Omahuta SF 5
Location detail	Compartment 109
Year/s of planting	1982
Area (hectares)	5.0
Number planted	4070
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Kauri being suppressed No PA symptoms. Suppression of kauri

Kauri plantation record — Omahuta SF 5 (1983)	
Forest name	Omahuta SF 5
Location detail	Compartment 109
Year/s of planting	1983
Area (hectares)	8.5
Number planted	4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High
Comments	Kauri surviving in manuka-dominated areas. No PA symptoms. Suppression of kauri in tōwai areas

Kauri plantation record — Omahuta SF 5 (1984)	
Forest name	Omahuta SF 5
Location detail	Compartment 109
Year/s of planting	1984
Area (hectares)	2.2
Number planted	8960 (includes plantation compartment 108)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	Moderate
Comments	No PA symptoms. Suppressed under tōwai

Kauri plantation record — Omahuta SF 5 (1984)	
Forest name	Omahuta SF 5
Location detail	Compartment 108
Year/s of planting	1984
Area (hectares)	10.0
Number planted	8960 (shared with 1984 area)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Rare (<1%)–occasional (1–19%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	Moderate
Comments	Some parts have no kauri present. No PA symptoms. Northern end of plantation not inspected

Kauri plantation record — Omahuta SF 5 (1985)	
Forest name	Omahuta SF 5
Location detail	Compartment 104
Year/s of planting	1985
Area (hectares)	8.0
Number planted	8122
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	High–moderate
Comments	Brutally infertile site but many kauri surviving. No PA symptoms. OK survival, very slow growth

Kauri plantation record — Puketi SF 4 (1954)	
Forest name	Puketi SF4
Location detail	Compartment 19 Mokau
Year/s of planting	1954
Area (hectares)	1.6
Number planted	530
Seed lot number	AK48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare <1%
Anthropogenic influences	Wild pigs, wild cattle, hunters. Planted shortly after logging.
Confidence in data	High–moderate
Comments	Listed as “failed” in early documents. Author saw nothing to refute this. Most likely suppressed/smothered by competing native regrowth. No PA symptoms seen. Few kauri present

Kauri plantation record — Puketi SF4 (1954)	
Forest name	Puketi SF4
Location detail	Compartment 19 Mokau
Year/s of planting	1954
Area (hectares)	6.0
Number planted	2270
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare <1%
Anthropogenic influences	Wild pigs, wild cattle, hunters, planted shortly after logging.
Confidence in data	High–moderate
Comments	Listed as “failed” in early records. I saw nothing to refute this. Most likely suppressed/smothered by competing native regrowth. No PA symptoms seen. Few kauri present

Kauri plantation record — Puketi SF4 (1955)	
Forest name	Puketi SF4
Location detail	Compartment 19 Mokau
Year/s of planting	1955
Area (hectares)	11.2
Number planted	2200
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining.	Rare <1%
Anthropogenic influences	Wild pigs, wild cattle, hunters, planted after logging.
Confidence in data	High–moderate
Comments	Listed as “failed” in early records. Inspection by DOC confirms lack of kauri No PA symptoms reported

Kauri plantation record — Puketi (1977)	
Forest name	Puketi
Location detail	Pirau
Year/s of planting	1977
Area (hectares)	22. This figure appears unreliable
Number planted	3000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Moderate–low
Comments	Poor survival due to suppression. No reliable maps in records. No PA symptoms observed. No key map. Strong suppression via tōwai canopy

Kauri plantation record — Puketi (1978)	
Forest name	Puketi
Location detail	Pirau
Year/s of planting	1978
Area (hectares)	10.7
Number planted	3700
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Moderate
Comments	Low survival where tōwai is canopy. Only 1970s area with reliable map. No PA symptoms. OK survival in mānuka areas. Tōwai dominant elsewhere

Kauri plantation record — Puketi SF 4 (1979)	
Forest name	Puketi SF 4
Location detail	Pirau
Year/s of planting	1979
Area (hectares)	11.8
Number planted	2900
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, pig hunters, predator trapping
Confidence in data	Moderate–low
Comments	Map is unreliable. No PA symptoms. Figures are accurate but no key map makes field checks meaningless

Kauri plantation record — Puketi (1980)	
Forest name	Puketi
Location detail	Pirau
Year/s of planting	1980
Area (hectares)	12.1
Number planted	2200
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Low
Comments	No PA symptoms. Figures are accurate but no key map prevents validation

Kauri plantation record — Puketi (1981)	
Forest name	Puketi
Location detail	Pirau
Year/s of planting	1981
Area (hectares)	10.3
Number planted	4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Low
Comments	No PA symptoms. Figures are accurate but no key map prevents validation

Kauri plantation record — Puketi (1982)	
Forest name	Puketi
Location detail	Pirau
Year/s of planting	1982
Area (hectares)	3.0
Number planted	4920
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	Low
Comments	Low confidence in all data. Tree numbers/planted area does not make sense. No PA symptoms. Planting area/tree number figures are unreliable. No key map

Kauri plantation record — Puketi SF 4 (1983)	
Forest name	Puketi SF 4
Location detail	Pirau
Year/s of planting	1983
Area (hectares)	12.5
Number planted	4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Low
Comments	No PA symptoms. No key map. Area/seedling figures reliable

Kauri plantation record — Puketi SF4 (1984)	
Forest name	Puketi SF4
Location detail	Mokau?
Year/s of planting	1984
Area (hectares)	7.3
Number planted	4234
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and pig hunters
Confidence in data	Low
Comments	No key map. No kauri dieback symptoms observed. % plantation a guess. Accurate planting figures. No key map prevents validation

Kauri plantation record — Puketi SF 4 (1985)	
Forest name	Puketi SF 4
Location detail	Mokau
Year/s of planting	1985
Area (hectares)	33.9
Number planted	6274
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs, pig hunters
Confidence in data	Low
Comments	Figures suggest this was group planted. No kauri dieback symptoms. No key map makes field checking impossible

Kauri plantation record — Warawara SF 6 (1978)	
Forest name	Warawara SF 6
Location detail	No maps
Year/s of planting	1978
Area (hectares)	2.4
Number planted	1000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, wild cattle
Confidence in data	High
Comments	Cannot assess until map found. Planting data accurate. No maps means no inspection was made

Kauri plantation record — Warawara SF 6 (1979)	
Forest name	Warawara SF 6
Location detail	No maps
Year/s of planting	1979
Area (hectares)	7.7
Number planted	2900
Seed lot number	Unknown
Source of plants	Unknown
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, wild cattle
Confidence in data	High
Comments	Cannot assess until map found. Planting data is accurate. No maps mean no field checks can be done

Kauri plantation record — Warawara SF 6 (1980)	
Forest name	Warawara SF 6
Location detail	No maps
Year/s of planting	1980
Area (hectares)	5.6
Number planted	2000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, wild cattle
Confidence in data	NA
Comments	Cannot assess until map found. Planting data is accurate. No maps and no field checks

Kauri plantation record — Warawara SF 6 (1981)	
Forest name	Warawara SF 6
Location detail	No maps
Year/s of planting	1981
Area (hectares)	5.0
Number planted	3030
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, wild cattle
Confidence in data	High
Comments	Planting data are accurate. Cannot assess until map found. No maps and therefore no inspection

Kauri Plantation Record — Warawara SF 6 (1982)	
Forest name	Warawara SF 6
Location detail	No maps
Year/s of planting	1982
Area (hectares)	1.8
Number planted	2120
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs, wild cattle
Confidence in data	High
Comments	Cannot assess until map found. Planting data are accurate

Kauri plantation record — Waitangi Endowment Forest (1936)	
Forest name	Waitangi Endowment Forest
Location detail	Compartment 1 Mt. Bledisloe
Year/s of planting	1936 (may have been planted in 1937). 1936 may refer to seed planting in nursery
Area (hectares)	0.6
Number planted	21310 plus 5600 blanks in 1938
Seed lot number	AK 36/354
Source of plants	Waipoua Forest Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Near busy tourist area (Mt. Bledisloe)
Confidence in data	Moderate
Comments	This is apparently a small fragment of a much larger plantation, most of which failed. Only glitch in data is planting date. Most likely 1937. No PA symptoms. Vigorous, well-stocked stand

Kauri plantation record — Russell Forest (1950)	
Forest name	Russell Forest
Location detail	Punaruku
Year/s of planting	1950
Area (hectares)	3.2
Number planted	c. 5000
Seed lot number	AK 48/571
Source of plants	Waipoua Forest Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Visitor area. Pigs and hunters too
Confidence in data	Moderate
Comments	Low vigour plants. Made hard to read by presence of natural regenerating kauri. May have been partly overplanted in 1980s. No PA symptoms

Kauri plantation record — Russell SF 123 (1963)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1963
Area (hectares)	0.4
Number planted	320
Seed lot number	AK 58/769
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Visitors, pigs and hunters
Confidence in data	Moderate
Comments	Poor map. No PA symptoms. Small stand amid heavy regrowth

Kauri plantation record — Russell SF123 (1977)	
Forest name	Russell SF123
Location detail	Punaruku
Year/s of planting	1977
Area (hectares)	62.0 (figure unreliable)
Number planted	2100
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors. wild pigs and hunters
Confidence in data	Low
Comments	No map. Cannot identify this plantation. Plenty of natural regeneration. Could have been group planted. Number of trees (2100) will be accurate. Unreliable data re area planted

Kauri plantation record — Russell SF 123 (1978)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1978
Area (hectares)	6.0
Number planted	3300
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors, wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1979)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1979
Area (hectares)	10.0
Number planted	3400
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors. Wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1980)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1980
Area (hectares)	4.3
Number planted	3500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors. Wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1981)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1981
Area (hectares)	4.8
Number planted	5700
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors. Wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1982)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1982
Area (hectares)	12.0
Number planted	6580
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors, wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1983)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1983
Area (hectares)	7.0
Number planted	6049
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors, wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Russell SF 123 (1984)	
Forest name	Russell SF 123
Location detail	Punaruku
Year/s of planting	1984
Area (hectares)	7.3
Number planted	4248
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Visitors, wild pigs and hunters
Confidence in data	Low
Comments	Not inspected. Map unreliable. Area planted and tree numbers reliable. PA unlikely. Lack of map means no detailed inspection possible

Kauri plantation record — Puhipuhi SF 16 (1949)	
Forest name	Puhipuhi SF 16
Location detail	Compartment 5
Year/s of planting	1949
Area (hectares)	0.5
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Exotic production forest activity
Confidence in data	Moderate
Comments	Listed as "failed" (poor drainage, weed suppression) in old kauri planting summary. Under-planted in *Eucalyptus* plantation originally planted in 1908. Site needs careful review now that a map is available. Contiguous with 1950 area below. Site check needed

Kauri Plantation Record — Puhipuhi SF 16 (1950)	
Forest name	Puhipuhi SF 16
Location detail	Compartment 5
Year/s of planting	1950
Area (hectares)	4.0
Number planted	5000
Seed lot number	AK 48/571
Source of plants	Waipoua Forest Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Exotic production forest activity
Confidence in data	Moderate
Comments	Listed as "failed" (poor drainage, weed suppression) in old kauri planting summary. Site needs careful review now that a map is available. Contiguous with 1949 area above. Site check needed

Kauri plantation record — Glenbervie SF 21 (1949)	
Forest name	Glenbervie SF 21
Location detail	Compartment 2/4
Year/s of planting	1949
Area (hectares)	2.4
Number planted	500
Seed lot number	AK 46/514
Source of plants	Waipoua Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Exotic production forestry activity
Confidence in data	High
Comments	PA positive. Contiguous with other kauri plantations

Kauri plantation record — Glenbervie (1950)	
Forest name	Glenbervie
Location detail	Compartment 2
Year/s of planting	1950
Area (hectares)	2.4
Number planted	6000
Seed lot number	AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Exotic production forestry activity
Confidence in data	High
Comments	PA positive. Contiguous with other kauri plantations

Kauri plantation record — Glenbervie SF 21 (1955)	
Forest name	Glenbervie SF 21
Location detail	Compartment 2
Year/s of planting	1955
Area (hectares)	5.2
Number planted	
Seed lot number	AK 52/654
Source of plants	Waipoua Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Exotic production forestry activity.
Confidence in data	High
Comments	PA positive. Contiguous with other kauri plantations

Kauri plantation record — Glenbervie SF 21 (1974)	
Forest name	Glenbervie Forest
Location detail	Compartment 1
Year/s of planting	1974
Area (hectares)	1.77 two sub-stands).
Number planted	1600
Seed lot number	AK71/999
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Exotic forest management activity Rayonier.
Confidence in data	High
Comments	A somewhat unthrifty stand. PA positive. Presumably cross-infected from older (not contiguous) kauri plantations

Kauri plantation record — Glenbervie SF 21 (1985)	
Forest name	Glenbervie SF 21
Location detail	Unknown
Year/s of planting	1985
Area (hectares)	6.0
Number planted	2880
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Exotic forest management activity
Confidence in data	NA
Comments	No map available. Information from seedling distribution records is reliable. Map needed to locate this plantation

Kauri plantation record — Trounson Kauri Park (1955)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1955
Area (hectares)	0.1
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1959)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1959
Area (hectares)	0.8
Number planted	840
Seed lot numbers	AK 55/698 (525) and AK 56/716 (315)
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1960)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1960
Area (hectares)	0.8
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1961)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1961
Area (hectares)	0.8
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	Moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1962)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1962
Area (hectares)	0.4
Number planted	734
Seed lot number	AK 58/769
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1963)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1963
Area (hectares)	1.0
Number planted	1120
Seed lot number	AK 58/769
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1964)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1964
Area (hectares)	0.8
Number planted	625
Seed lot number	AK 60/842
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1965)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1965
Area (hectares)	2.8
Number planted	2077
Seed lot number	AK 60/845 (78), AK60/846 (56), AK 61/846 (650), AK 61/860 (600) and AK 61/878 (693)
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Trounson Kauri Park (1966)	
Forest name	Trounson Kauri Park
Location detail	North block
Year/s of planting	1966
Area (hectares)	5.6 (3 blocks)
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Protected reserve
Confidence in data	High–moderate
Comments	No PA symptoms. Close inspection needed

Kauri plantation record — Waipoua SF 13 (1948)	
Forest name	Waipoua SF 13
Location detail	Northern Arboretum
Year/s of planting	1948
Area (hectares)	0.4
Number planted	1100
Seed lot number	AK 46/514
Source of plants	Waipoua Nursery
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Few wild pigs. Waipoua Forest Trust interest
Confidence in data	High
Comments	Significant natural regeneration of kauri in plantation area. No sign of PA symptoms. Healthy stand on infertile site

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Compartment 14 (old numbering system)
Year/s of planting	1949
Area (hectares)	0.4
Number planted	Unknown
Seed lot number	AK 47/537
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest management. Wild pigs
Confidence in data	High
Comments	Kauri present but stand looks natural. No PA symptoms. Without old map author would have judged this to be a natural area

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Compartment 14 (old numbering system)
Year/s of planting	1949
Area (hectares)	2.0
Number planted	Unknown
Seed lot number	AK 46/514
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest. Wild pigs
Confidence in data	High
Comments	No PA symptoms. Without old map author would have judged this to be a natural area

Kauri plantation record — Waipoua DF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15, now 58/1
Year/s of planting	1949
Area (hectares)	2.4
Number planted	Unknown
Seed lot number	AK 48/573
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	May have been planted more than once. No PA symptoms. Listed as 1950 planting on later maps

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15, now 58/1
Year/s of planting	1949
Area (hectares)	0.8
Number planted	Unknown
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	May have been planted more than once. No PA symptoms. Listed as 1950 planting on later maps

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15, now 58/1
Year/s of planting	1949
Area (hectares)	0.4
Number planted	Unknown
Seed lot number	AK 46/514
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu Wild pigs
Confidence in data	High
Comments	May have been planted more than once. No PA symptoms. Listed as 1950 planting on later maps

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15, now 58/1
Year/s of planting	1949
Area (hectares)	1.2
Number planted	Unknown
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	May have been planted more than once. No PA symptoms. Listed as 1950 planting on later maps

Kauri plantation record — Waipoua SF 13 (1949)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15/7, now 58/1
Year/s of planting	1949
Area (hectares)	0.4
Number planted	Unknown
Seed lot number	AK 46/514
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	May have been planted more than once. No PA symptoms. Listed as 1950 planting on later maps

Kauri Plantation Record — Waipoua SF 13 (1950)	
Forest name	Waipoua SF 13
Location detail	Old compartment 15/8, now 58/1
Year/s of planting	1950
Area (hectares)	2.0
Number planted	Unknown
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	No PA symptoms

Kauri plantation record —Waipoua SF 13 (1950)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/1
Year/s of planting	1950
Area (hectares)	4.4
Number planted	Unknown
Seed lot number	See preceding 7 entries
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	No PA symptoms. Stand is a composite of 1949 and 1950 planting

Kauri Plantation Record — Waipoua SF 13 (1955)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/2 (area O)
Year/s of planting	1955
Area (hectares)	2.0
Number planted	Unknown
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High–moderate
Comments	Surviving trees growing well. No PA symptoms

Kauri plantation record — Waipoua SF 13 (1956)	
Forest name	Waipoua SF 13
Location detail	Compartment 4
Year/s of planting	1956
Area (hectares)	0.3
Number planted	607
Seed lot number	AK50/616 (139), AK 52/654(148), AK51/640(160), AK 52/654 (80) and AK53/661 (80)
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent to busy road. Within exotic forest
Confidence in data	High
Comments	Complex little area containing two fertiliser SPs. Difficult to discern plantings. Active PA area. Many PA deaths. Diagnosis based on soil test

Kauri plantation record — Waipoua SF 13 (1956)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/3 (area Q)
Year/s of planting	1956
Area (hectares)	2.0
Number planted	1050 and 570 blanks in 1957
Seed lot number	AK 51/640 and AK 52/654. Blanks AK53/661
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	Low stocking. Good growth. No PA symptoms seen

Kauri plantation record — Waipoua SF 13 (1957–1958)	
Forest name	Waipoua SF 13
Location detail	Compartments 58/4 and 58/5 (area N)
Year/s of planting	1957 and 1958
Area (hectares)	2.0
Number planted	1000. There are most likely other trees and other seed lots
Seed lot number	AK 53/661
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	Whole area line planted at approximately 6.0 m x 6.0 m in 1957 and then again in 1958 to give a final spacing of 3.0 m x 3.0 m. No PA symptoms seen. Surviving trees vigorous

Kauri plantation record — Waipoua SF 13 (1959)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/6 (area P)
Year/s of planting	1959
Area (hectares)	2.4
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	No PA symptoms. Surviving trees vigorous

Kauri plantation record — Waipoua SF 13 (1959)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/7 (area M)
Year/s of planting	1959
Area (hectares)	2.0
Number planted	850? (may be compartment 58/8)
Seed lot number	AK 56/716? (may be compartment 58/8)
Source of plants	Unknown
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High–moderate
Comments	Some doubt over seedling numbers and seed lots. No PA Symptoms. Surviving trees vigorous

Kauri Plantation Record — Waipoua SF 13 (1959)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/8 (area I)
Year/s of planting	1959
Area (hectares)	0.4
Number planted	850? Possibly planted in compartment 58/7
Seed lot number	AK 56/716? Possibly planted in compartment 58/7
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare (<1%)–occasional (1–19%)
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High–moderate
Comments	Not inspected. Distant viewing shows no kauri. No known PA symptoms. Strip-planted area. Not inspected on ground

Kauri plantation record — Waipoua SF 13 (1960)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/9 (area C)
Year/s of planting	1960
Area (hectares)	3.6
Number planted	2517
Seed lot number	AK 55/698 (1524), AK 57/731 (870) and AK 56/716 (123)
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	Scattered surviving trees growing vigorously. No PA symptoms seen

Kauri plantation record — aipoua SF 13 (1960)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/10 (area G)
Year/s of planting	1960
Area (hectares)	0.4
Number planted	500
Seed lot number	AK 55/698
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare (<1%)–occasional (1–19%)
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High–moderate
Comments	Strip-planted area. Not inspected. Distant view shows no kauri. No known PA

Kauri plantation record — Waipoua SF 13 (1961)	
Forest name	Waipoua SF 13
Location detail	Compt 58/11 (area B)
Year/s of planting	1961
Area (hectares)	5.6
Number planted	1037. Likely to be more
Seed lot number	AK 57/731
Source of plants	Waipoua Nursery.
% of original plantation remaining	Rare (<1%)–occasional (1–19%)
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	Moderate
Comments	No site inspection. Distant view reveals very few kauri. Presence/condition of kauri not known

Kauri plantation record — Waipoua SF 13 (1961)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/12 (area J)
Year/s of planting	1961
Area (hectares)	0.4
Number planted	600
Seed lot number	AK 57/731
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare (<1%)–occasional (1–19%)
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Not inspected. Strip-planted area. Distant view shows no kauri

Kauri plantation record — Waipoua SF 13 (1961)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/13 (area F)
Year/s of planting	1961
Area (hectares)	0.4 (Mora tree feed fertiliser trial)
Number planted	Not known
Seed lot number	Not known
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High–moderate
Comments	Looks to be an overplanted 1949–1950 planting. No PA symptoms seen. Part of this general area inspected. Reasonable survival of plantation trees. Author may not have encountered this particular site

Kauri plantation record — Waipoua SF 13 (1962)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/14 (area K)
Year/s of planting	1962
Area (hectares)	4.4
Number planted	1494 plus 121 grafts
Seed lot number	AK 57/810
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	Partial inspection. Low numbers of surviving plantation trees growing well. No PA symptoms seen

Kauri plantation record — Waipoua SF 13 (1963)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/15
Year/s of planting	1963
Area (hectares)	4.0
Number planted	1509
Seed lot number	AK 60/841 (1108), AK 60/844 (174) and AK59/810 (227)
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wāhi tapu. Wild pigs
Confidence in data	High
Comments	Information from data only. Not inspected. Condition not known

Kauri plantation record — Waipoua SF 13 (1962)	
Forest name	Waipoua SF 13
Location detail	Compartment 55/1
Year/s of planting	1962
Area (hectares)	0.8
Number planted	741
Seed lot number	AK 58/769 (527) and AK 59/810 (214)
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Very remote. Wild pigs and pig hunters
Confidence in data	Moderate
Comments	Remote area. Seedling and seed lot information is based on seed lot records. May be planting of a 1961 logging site. Not inspected. Much natural regeneration in general vicinity. Inspect if opportunity arises

Kauri plantation record — Waipoua SF 13 (1963)	
Forest name	Waipoua SF 13
Location detail	Compartment 55/2
Year/s of planting	1963
Area (hectares)	2.8
Number planted	1875 plus 271 blanks
Seed lot number	AK 58/769 (600), AK 59/810 (1275 plus blanks) and AK59/810 (271)
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Very remote. Wild pigs and hunters
Confidence in data	Moderate
Comments	Remote area. May be planting of a 1962 kauri logging site. Not inspected. Much natural regeneration in vicinity. Near sanctuary boundary. Inspect if opportunity arises

Kauri plantation record — Waipoua SF 13 (1964)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/16
Year/s of planting	1964
Area (hectares)	2.0
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate–low
Comments	Not inspected. Looks to be a more suitable kauri site (manuka overstory) than much of compartment 58

Kauri plantation record — Waipoua SF 13 (1964)	
Forest name	Waipoua SF 13
Location detail	Compartment 58/17
Year/s of planting	1964
Area (hectares)	1.0
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate–low
Comments	Not inspected. Looks to be a more suitable kauri site(Manuka overstory) than much of compartment 58

Kauri plantation record — Waipoua SF 13 (1958–1959)	
Forest name	Waipoua SF 13
Location detail	Compartment 30/1
Year/s of planting	1958–1959
Area (hectares)	0.2
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	In large regenerating shrubland area
Confidence in data	Moderate
Comments	Not inspected. Was an unofficial ripping trial by Frank Morrison in a gumland site. Inspect if opportunity arises

Kauri plantation record — Waipoua SF 13 (1977)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1977
Area (hectares)	7.3
Number planted	1600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs and hunters
Confidence in data	High
Comments	Plenty of natural regeneration. Healthy looking stand showing no PA symptoms

Kauri plantation record — Waipoua SF 13 (1978)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1978
Area (hectares)	10.5
Number planted	3200
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Wild pigs and hunters
Confidence in data	High
Comments	Plenty of natural regeneration. Healthy looking trees. No PA symptoms observed

Kauri plantation record — Waipoua SF 13 (1970)	
Forest name	Waipoua SF 13
Location detail	Compt 30
Year/s of planting	1970
Area (hectares)	5.4
Number planted	1900
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Unknown
Confidence in data	High
Comments	Plenty of natural regeneration. Healthy looking trees. No PA symptoms observed

Kauri plantation record — Waipoua SF 13 (1980)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1980
Area (hectares)	12.3
Number planted	2760. Possibly some podocarps
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	Moderate
Comments	Not inspected. Inspect if opportunity arises to define PA status and stand health

Kauri plantation record — Waipoua SF 13 (1981)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1981
Area (hectares)	8.0
Number planted	4030
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	High–moderate
Comments	Not inspected. No map at that time. Newly found map confirms location. Inspect if possible to define condition and PA status

Kauri plantation record — Waipoua SF 13 (1982)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1982
Area (hectares)	15.3
Number planted	5000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	High
Comments	Inspection needed to identify condition and PA status. No map until recently. Site confirmed in compartment 30. Map appears to show kauri/podocarp planting

Kauri plantation record — Waipoua Forest (1983)	
Forest name	Waipoua Forest
Location detail	Compartment 30
Year/s of planting	1983
Area (hectares)	15.5
Number planted	4728
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	Moderate
Comments	Stand area impossible to read on composite species map. It is possible some 1983 kauri plantings went into Lookout area. Map of that area is also very hard to read. Compartment 30 map adequate for inspection of plantation area

Kauri plantation record — Waipoua SF 13 (1984)	
Forest name	Waipoua SF 13
Location detail	Compartment 30
Year/s of planting	1984
Area (hectares)	4.3 from KMU- (Kauri Management Unit) table
Number planted	4400 (includes compartment 60 area below)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Mapped on composite species map

Kauri plantation record — Waipoua SF 13 (1984)	
Forest name	Waipoua SF 13
Location detail	Compartment 60, Lookout area
Year/s of planting	1984
Area (hectares)	6.0 (from KMU table)
Number planted	4400 (includes compartment 30 area)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Low
Comments	No reliable map of plantation. Therefore no inspection possible.

Kauri plantation record — Opua SF 113 (1977)	
Forest name	Opua SF 113
Location detail	Ridges south of Oromahoe Road
Year/s of planting	1977
Area (hectares)	36.2
Number planted	1000 (group planting)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	Low
Comments	Considerable mortality on these bony ridges. Would expect natural regeneration of kauri on these sites. Site check needed Figures suggest widely dispersed group planting.

Kauri plantation record — Opua SF 113 (1978)	
Forest name	Opua SF 113
Location detail	Ridges south of Oromahoe Road
Year/s of planting	1978
Area (hectares)	61.2
Number planted	3100 (group planting)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	Low
Comments	Considerable mortality on these bony ridges. Would expect natural regeneration of kauri on these sites. Site check needed Figures suggest widely dispersed group planting.

Kauri plantation record — Opua SF 113 (1979)	
Forest name	Opua SF 113
Location detail	Not known. Maps lost
Year/s of planting	1979
Area (hectares)	25.5
Number planted	3200
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Pigs, goats, marijuana growing
Confidence in data	Low
Comments	If map found check site. Data entered here is guesswork Figures suggest widely dispersed group planting.

Kauri Plantation Record — Opua SF 113 (1980)	
Forest name	Opua SF 113
Location detail	Not known. Maps lost
Year/s of planting	1980
Area (hectares)	20.0
Number planted	2000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	NA
Comments	Data entered here is an educated guess. If map found, check site. Figures suggest widely dispersed group planting.

Kauri plantation record — Opua SF 113 (1981)	
Forest name	Opua SF 113
Location detail	Not known. Map lost
Year/s of planting	1981
Area (hectares)	38
Number planted	3000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	NA
Comments	Data entered here is an educated guess. If map found, check site. Figures suggest widely dispersed group planting.

Kauri Plantation Record — Opua SF 113 (1982)	
Forest name	Opua SF 113
Location detail	Not known. Map lost
Year/s of planting	1982
Area (hectares)	7.0 Presumably line planted.
Number planted	3810
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	NA
Comments	Data entered here is an educated guess. If map found, check site

Kauri plantation record — Opua SF 113 (1984)	
Forest name	Opua SF 113
Location detail	Not known. Map lost
Year/s of planting	1984
Area (hectares)	28.6 (3 blocks)
Number planted	2284
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and goats. Marijuana plantations
Confidence in data	NA
Comments	Check site if map found. Figures suggest widely dispersed group planting.

Kauri plantation record — Aupouri SF 187 (1969)	
Forest name	Aupouri SF 187
Location detail	Compartment 9
Year/s of planting	1969
Area (hectares)	0.8 Planted under eucalyptus canopy. Eucs. Have subsequently died.
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Unsure. Possibly Sweetwater
% of original plantation remaining	Abundant 50–74%
Anthropogenic influences	Well protected within active exotic forest
Confidence in data	High
Comments	Very healthy plantation

Kauri plantation record — Riverhead SF 131 (1949)	
Forest name	Riverhead SF 131
Location detail	Compartment 16
Year/s of planting	1949
Area (hectares)	1.2
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Rare <1%
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Failed from beginning. Site Checked by Auckland Council KDP personnel. No dieback symptoms

Kauri plantation record — Riverhead SF 131 (1950)	
Forest name	Riverhead SF 131
Location detail	Compartment 12
Year/s of planting	1950
Area (hectares)	0.8
Number planted	800
Seed lot number	AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Site checked by Auckland Council KDP personnel. No dieback symptoms

Kauri plantation record — Riverhead SF 131 (1950)	
Forest name	Riverhead SF 131
Location detail	Compartment 16
Year/s of planting	1950
Area (hectares)	12.6
Number planted	12600
Seed lot number	AK 48/571
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Unknown
Confidence in data	High–moderate
Comments	Failed rapidly. Site checked by Auckland Council KDP personnel. No dieback symptoms

Kauri plantation record — Great Barrier SF 165 (1949)	
Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1949
Area (hectares)	0.1
Number planted	500
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Straddles local pedestrian pathway
Confidence in data	High
Comments	Small trees growing slowly. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1953)	
Forest name	Great Barrier SF 165
Location detail	Kaiaraara
Year/s of planting	1953
Area (hectares)	0.7
Number planted	Unknown
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Road. Walkway. Flooding. Hub area for visitors
Confidence in data	High
Comments	PA presence determined via soil test

Kauri plantation record — Great Barrier SF 165 (1954)	
Forest name	Great Barrier SF 165
Location detail	Compartment 5
Year/s of planting	1954
Area (hectares)	0.8
Number planted	Unknown
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Visitors. Flooding
Confidence in data	High
Comments	No PA symptoms seen

Kauri plantation record — Great Barrier SF 165 (1954)	
Forest name	Great Barrier SF 165
Location detail	Compartment 5
Year/s of planting	1954
Area (hectares)	0.3
Number planted	Unknown
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Visitors. Flooding.
Confidence in data	Moderate
Comments	Trial which was deliberately not mapped. Location questionable, but most likely down-stream and across river from 1953 plantation listed above. Presence inferred from large plantation-age trees by river. No PA symptoms seen

Kauri plantation record — Great Barrier SF 165 (1955)	
Forest name	Great Barrier SF 165
Location detail	Compartment 44 (Kiwiriki)
Year/s of planting	1955
Area (hectares)	0.8
Number planted	406
Seed lot number	AK 51/640
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs. Adjacent walkway
Confidence in data	High
Comments	"Failed" plantation. A few remaining trees. Kauri regeneration. Map in *Forest Journal* (volume 3). No PA symptoms seen. A few remaining plantation trees. All healthy

Kauri plantation record — Great Barrier SF 165 (1955)	
Forest name	Great Barrier SF 165
Location detail	Compartment 22 (old numbering system, 11)
Year/s of planting	1955
Area (hectares)	2.4
Number planted	Unknown
Seed lot number	Wildings
Source of plants	Island wildings
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Wild pigs. Flooding.
Confidence in data	Moderate
Comments	Not properly assessed. Most likely group planted. No apparent PA symptoms. Would benefit from close inspection

Kauri plantation record — Great Barrier SF 165 (1956–1964)	
Forest name	Great Barrier SF 165
Location detail	Various
Year/s of planting	1956–1964
Area (hectares)	12.2
Number planted	Unknown
Seed lot number	Wildings
Source of plants	GBI wildings
% of original plantation remaining	Unknown
Anthropogenic influences	TSI
Confidence in data	Moderate–low
Comments	Most wilding areas were not mapped and were erratically recorded. Planting appears to have been an extension of TSI work. Much more planting done up to 1975 than these figures indicate. Not mapped. Poorly recorded. Can't inspect.

Kauri plantation record — Great Barrier SF 165 (1976)	
Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1976
Area (hectares)	3.6 (3 areas)
Number planted	Unknown
Seed lot number	Wildings
Source of plants	GBI wildings
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few.
Confidence in data	High
Comments	No PA symptoms. Kauri being suppressed. Good map

Kauri plantation record — Great Barrier SF 165 (1977)	
Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1977
Area (hectares)	14.3 (2 areas)
Number planted	3100
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%–common (20–49%)
Anthropogenic influences	Few.
Confidence in data	High
Comments	No PA symptoms. First of Sweetwater Nursery trees. Natural suppression occurring. Good map

Kauri plantation record — Great Barrier SF 165 (1978)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1978
Area (hectares)	4.6
Number planted	Part of 5700 (others to compts 3 & 4).
Seed lot number	NA
Source of plants	Sweetwater Nursery
% of original plantation remaining	Not known. Not inspected
Anthropogenic influences	Few. Adjacent to predator fenced sanctuary
Confidence in data	Data good
Comments	Good map.

Kauri plantation record — Great Barrier SF 165 (1978)

Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1978
Area (hectares)	4.3 (2 areas 3.6 ha and 0.7 ha)
Number planted	Part of 5700 (other to compts 2 & 4)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression occurring. Good map. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1978)	
Forest name	Great Barrier SF 165
Location detail	Compartment 4
Year/s of planting	1978
Area (hectares)	2.2
Number planted	Pt 5700 (others to compts 2 & 3).
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	medium
Comments	Good map. Suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1979)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1979
Area (hectares)	5.3 (2 areas)
Number planted	Pt 4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	NA
Comments	Good map. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1979)	
Forest name	Great Barrier SF 165
Location detail	Compartment 24
Year/s of planting	1979
Area (hectares)	2.7
Number planted	Pt 4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Pigs
Confidence in data	High
Comments	Underplanted in *P. pinaster*. No PA. Some good kauri growth

Kauri plantation record — Great Barrier SF 165 (1979)	
Forest name	Great Barrier SF 165
Location detail	Compartment 66
Year/s of planting	1979
Area (hectares)	7.0
Number planted	Pt 4000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	No PA symptoms. Natural suppression of kauri

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 1
Year/s of planting	1980
Area (hectares)	0.8
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1980
Area (hectares)	2.3
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1980
Area (hectares)	2.0
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 5
Year/s of planting	1980
Area (hectares)	7.5
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Flooding
Confidence in data	High
Comments	Small trees being suppressed. Many toppled in big flood. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 24
Year/s of planting	1980
Area (hectares)	0.1
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Wild pigs
Confidence in data	high
Comments	Under-planted in *P. pinaster*. No PA symptoms. Some good kauri growth

Kauri plantation record — Great Barrier SF 165 (1980)	
Forest name	Great Barrier SF 165
Location detail	Compartment 66
Year/s of planting	1980
Area (hectares)	5.4
Number planted	Pt 4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20-49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1981)	
Forest name	Great Barrier SF 165
Location detail	Compartment 1
Year/s of planting	1981
Area (hectares)	1.5
Number planted	Pt 4400
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1981)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1981
Area (hectares)	6.0
Number planted	Pt 4400 Other plantings in Compts. 1, 3, 52 & 66.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression. No PA symptoms
Kauri plantation record — Great Barrier SF 165 (1981)	
Forest name	Great Barrier Forest 165
Location detail	Compartment 3
Year/s of planting	1981
Area (hectares)	0.7
Number planted	Pt 4400 Other plantings in Compts 1,2,52 & 66
Seed lot number	
Source of plants	Sweetwater nursery
% of original plantation remaining	Not inspected not known
Anthropogenic influences	Wild pigs
Confidence in data	moderate

Comments	Mapped. Not inspected.

Kauri plantation record — Great Barrier SF 165 (1981)	
Forest name	Great Barrier SF 165
Location detail	Compartment 52
Year/s of planting	1981
Area (hectares)	0.3
Number planted	Pt 4400 Other plantings in compts. 1,2,3,& 66.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Under-planted in *P. pinaster*. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1981)	
Forest name	Great Barrier SF 165
Location detail	Compartment 66
Year/s of planting	1981
Area (hectares)	5.4
Number planted	Pt 4400 Other plantings in Compts 1,2,3, & 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1982)	
Forest name	Great Barrier SF 165
Location detail	Compartment 1
Year/s of planting	1982
Area (hectares)	1.0
Number planted	Pt 8000 Other plantings in compts 2, 3, & 52.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural Suppression. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1982)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1982
Area (hectares)	1.6
Number planted	Pt 8000 Other plantings in compts 1, 3, & 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural Suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1982)	
Forest name	Great Barrier SF 165
Location detail	Compartment 3
Year/s of planting	1982
Area (hectares)	7.3
Number planted	Pt 8000 Other plantings in compts 1, 2, & 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1982)	
Forest name	Great Barrier SF 165
Location detail	Compartment 52
Year/s of planting	1982
Area (hectares)	0.9
Number planted	Pt 8000 Other plantings in Compts 1, 2, & 3.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Underplanted in *P. pinaster*. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1983)	
Forest name	Great Barrier SF 165
Location detail	Compartment 1
Year/s of planting	1983
Area (hectares)	5.1
Number planted	Pt 8516 Other plantings in compts 52 & 66.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression of kauri occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1983)	
Forest name	Great Barrier SF 165
Location detail	Compartment 52
Year/s of planting	1983
Area (hectares)	1.5
Number planted	Pt 8516 Other plantings in compts 1 & 66.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1983)	
Forest name	Great Barrier SF 165
Location detail	Compartment 66
Year/s of planting	1983
Area (hectares)	0.5
Number planted	Pt 8516 Other plantings in compts 1 & 52.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression of kauri occurring. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1984)	
Forest name	Great Barrier SF 165
Location detail	Compartment 1
Year/s of planting	1984
Area (hectares)	5.1
Number planted	Pt 8728 Other plantings in compts 2 & 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1984)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1984
Area (hectares)	6.0
Number planted	Pt 8728 Other plantings in compts 1 & 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1984)	
Forest name	Great Barrier SF 165
Location detail	Compartment 52
Year/s of planting	1984
Area (hectares)	0.8
Number planted	Pt 8728 Other plantings in compts 1 & 2.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri. No PA symptoms

Kauri plantation record — Great Barrier SF 165 (1985)	
Forest name	Great Barrier SF 165
Location detail	Compartment 2
Year/s of planting	1985
Area (hectares)	5.7
Number planted	Pt 7816 Other plantings in compt 52
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Suppression of kauri occurring. No PA symptoms

Kauri plantation record — Great Barrier SF165 (1985)	
Forest name	Great Barrier SF165
Location detail	Compartment 52
Year/s of planting	1985
Area (hectares)	1.1
Number planted	Pt 7816 Other plantings in compt 1.
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Few
Confidence in data	High
Comments	Natural suppression of kauri occurring. No PA symptoms

Kauri plantation record — Coromandel SF 149 (1949)	
Forest name	Coromandel SF 149
Location detail	Compartment 1 Mangarehu
Year/s of planting	1949
Area (hectares)	0.8
Number planted	3500
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Exotic Forest adjacent. Visitors
Confidence in data	Moderate
Comments	No dieback reported. Inspection needed

Kauri plantation record — Coromandel SF 149 (1950)	
Forest name	Coromandel SF 149
Location detail	Compartment 11 Mangarehu
Year/s of planting	1950
Area (hectares)	7.3
Number planted	6000 +1300 blanks in 1951
Seed lot number	AK 48/571
Source of plants	(All) grown at Tairua Forest Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent exotic forest. Visitor area
Confidence in data	High
Comments	Small trees; quite well stocked. No sign of kauri dieback. Tairua Nursery source is interesting. Waipoua seed. Inspection needed

Kauri plantation record — Coromandel SF 149 (1971)	
Forest name	Coromandel SF 149
Location detail	Compartment 19 near Whangaiterenga campsite
Year/s of planting	1971
Area (hectares)	1.2
Number planted	Most likely 425
Seed lot number	Most likely AK 67/955
Source of plants	Kumeu Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Near popular camp site
Confidence in data	Moderate
Comments	Site inspection needed

Kauri plantation record — Coromandel SF 149 (1974)	
Forest name	Coromandel SF 149
Location detail	Compartment 11
Year/s of planting	1974
Area (hectares)	1.6
Number planted	500
Seed lot number	AK 72/1013
Source of plants	Sweetwater
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs
Confidence in data	Low
Comments	Map is poor quality. Inspection needed

Kauri plantation record — Coromandel SF 149 (1975)	
Forest name	Coromandel SF 149
Location detail	Compartment 11
Year/s of planting	1975
Area (hectares)	0.5
Number planted	500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate–low
Comments	Inspection needed

Kauri plantation record — Coromandel SF 149 (1975)	
Forest name	Coromandel SF 149
Location detail	Compt 401 Whenuakite
Year/s of planting	1975
Area (hectares)	1.3
Number planted	1100
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	Moderate
Comments	Map is accurate. Site inspection needed

Kauri plantation record — Coromandel SF 149 (1976)	
Forest name	Coromandel SF 149
Location detail	Hikuai Block
Year/s of planting	1976
Area (hectares)	1.0 Indigenous on map
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Sweetwater
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	NA
Comments	This is recorded as indigenous planting and may not have had any kauri planted in it. KMU kauri distribution figures do not describe Coromandel kauri planting in 1976

Kauri plantation record — Coromandel SF 149 (1977)	
Forest name	Coromandel SF 149
Location detail	Compartment 1 Mangarehu
Year/s of planting	1977
Area (hectares)	1.6
Number planted	900
Seed lot number	Unknown
Source of plants	Sweetwater
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Accurate map and seedling information. No current site information. Field inspection needed

Kauri plantation record — Coromandel SF 149 (1978)	
Forest name	Coromandel SF 149
Location detail	Compartment 1 Mangarehu
Year/s of planting	1978
Area (hectares)	2.2
Number planted	1000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Wild pigs and hunters
Confidence in data	Moderate
Comments	Map and data accurate. No current site information. Inspection needed

Kauri plantation record — Coromandel SF 149 (1978)	
Forest name	Coromandel SF 149
Location detail	Compartment 401 Whenuakite
Year/s of planting	1978
Area (hectares)	5.5
Number planted	3500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Adjacent highway
Confidence in data	High
Comments	No PA symptoms. Tree deaths in c. 2014 not PA.

Kauri plantation record — Coromandel SF 149 (1979)	
Forest name	Coromandel SF 149
Location detail	Compartment 19 Whangaiterenga
Year/s of planting	1979
Area (hectares)	6.8
Number planted	2700
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Info accurate but have no current site information Site inspection needed

Kauri plantation record — Coromandel SF 149 (1979)	
Forest name	Coromandel SF 149
Location detail	Compartment 401 Whenuakite
Year/s of planting	1979
Area (hectares)	3.9
Number planted	2600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Adjacent highway
Confidence in data	High
Comments	No PA symptoms. Tree deaths c. 2014 not PA

Kauri plantation record — Coromandel SF 149 (1980)	
Forest name	Coromandel SF 149
Location detail	Compartment 401(Whenuakite)
Year/s of planting	1980
Area (hectares)	6.7
Number planted	1900
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Adjacent highway
Confidence in data	High
Comments	Note adjacent 1980 kauri underplanting (*P. elliottii*), SP 448/3. Inspection and review of SP data may reveal source of trees used in underplanting (possibly Forest Research Institute). No PA symptoms. Tree deaths c. 2014 not PA

Kauri plantation record — Coromandel SF 149 (1980)	
Forest name	Coromandel SF 149
Location detail	Compartment 320 (Tairua dump)
Year/s of planting	1980
Area (hectares)	2.9
Number planted	2000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Local industrial area
Confidence in data	Moderate
Comments	Map and data accurate. Inspection needed to assess current condition

Kauri plantation record — Coromandel SF 149 (1981)	
Forest name	Coromandel SF 149
Location detail	Compartment 320 (Tairua dump)
Year/s of planting	1981
Area (hectares)	2.1
Number planted	Pt 11500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Nearby industrial area
Confidence in data	High
Comments	Map and data accurate. Inspection needed to assess current condition

Kauri Plantation Record — Coromandel SF 149 (1981)	
Forest name	Coromandel SF 149
Location detail	Compartment 401 (Whenuakite)
Year/s of planting	1981
Area (hectares)	2.5
Number planted	Pt 11500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional (1–19%)–common (20–49%)
Anthropogenic influences	Adjacent highway
Confidence in data	High
Comments	No PA symptoms. Tree deaths c. 2014 are not PA-related

Kauri plantation record — Coromandel SF 149 (1982)	
Forest name	Coromandel SF 149
Location detail	Compartment 365 (Wentworth Valley)
Year/s of planting	1982
Area (hectares)	5.5
Number planted	5000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	Moderate
Comments	Data accurate. Inspect to assess condition

Kauri plantation record — Coromandel SF 149 (1983)	
Forest name	Coromandel SF 149
Location detail	Compartment 320 (Tairua)
Year/s of planting	1983
Area (hectares)	1.2
Number planted	1500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Adjacent industrial area
Confidence in data	High
Comments	Data accurate. Inspect to assess current condition

Kauri plantation record — Coromandel SF 149 (1983)	
Forest name	Coromandel SF 149
Location detail	Compartment 30 (Broken Hills)
Year/s of planting	1983
Area (hectares)	38.2
Number planted	14000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	High
Comments	Not familiar with site. No current information. Data accurate. Very big area.Recommend inspect and assess

Kauri plantation record — Kaimai Mamaku Forest Park (1957)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Near HQ
Year/s of planting	1957
Area (hectares)	1.2
Number planted	200 Nursery stock on 0.4 ha and wildings on 0.8 ha
Seed lot number	AK 54/681
Source of plants	Waipoua Nursery (half wildings)
% of original plantation remaining	Unknown
Anthropogenic influence	Unknown
Confidence in data	NA
Comments	Cannot locate this plantation. Worth checking if a map found

Kauri plantation record — Kaimai Mamaku Forest Park (1958)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Near HQ
Year/s of planting	1958
Area (hectares)	3.2
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Not known. Likely Waipoua
% of original plantation remaining	Unknown
Anthropogenic influences	Unknown
Confidence in data	NA
Comments	Worth checking if map found

Kauri plantation record — Kaimai Mamaku Forest Park (1978)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Compartment 1 (stand 2)
Year/s of planting	1978
Area (hectares)	1.7
Number planted	Pt 5000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High–moderate
Comments	Very light stocking of very small trees. No PA seen

Kauri plantation record — Kaimai Mamaku Forest Park (1979)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Compartment 1 (stand 3)
Year/s of planting	1979
Area (hectares)	4.4
Number planted	8000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Unknown
Confidence in data	High–moderate
Comments	Very light stocking of very small trees. No PA seen

Kauri plantation record — Kaimai Mamaku Forest Park (1980)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Compartment 1 (stand 4)
Year/s of planting	1980
Area (hectares)	4.8
Number planted	5500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High–moderate
Comments	Light stocking of small trees. Much suppression. No PA seen

Kauri plantation record — Kaimai Mamaku Forest Park (1981)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Compartment 1 (stand 5)
Year/s of planting	1981
Area (hectares)	4.8
Number planted	Part of 11500
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High–moderate
Comments	Light stocking of small trees Much suppression. No PA seen

Kauri plantation record — Kaimai Mamaku Forest Park (1982)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Compartment 1 (stand 6)
Year/s of planting	1982
Area (hectares)	3.0
Number planted	Part of 8140
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	NA
Comments	Light stocking. Small trees. Much suppression. No PA seen

Kauri plantation record — Kaimai Mamaku Forest Park (1983)	
Forest name	Kaimai Mamaku Forest Park (Athenree)
Location detail	Unknown
Year/s of planting	1983
Area (hectares)	6.5
Number planted	4600
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Occasional 1–19%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High–moderate
Comments	Light stocking, small trees. Much suppression. No PA symptoms seen

Kauri plantation record — Tairua SF 150 (1949)	
Forest name	Tairua SF 150
Location detail	Compartment 126 (SP 440)
Year/s of planting	1949
Area (hectares)	1.7
Number planted	Unknown
Seed lot number	AK 47/533
Source of plants	Unknown
% of original plantation remaining	Unknown
Anthropogenic influences	Within exotic forest
Confidence in data	Moderate
Comments	Not mapped. Not located. Possibly no residual trees. Possibly overplanted in 1990. Plantation not found. Scion SP records may hold more info.

Kauri plantation record — Tairua SF 150 (1950).	
Forest name	Tairua SF 150
Location detail	Compt 16 (Compt 62 in seed register).
Year/s of planting	1950
Area (hectares)	1.4
Number planted	1000
Seed lot number	AK 48/571
Source of plants	Tairu nursery
% of original plantation remaining	Plantation not found
Anthropogenic influences	Not known
Confidence in data	Medium. Nursery information reliable. No map of plantation
Comments	Worth finding to assess condition and PA status

Kauri plantation record — Tairua SF 150 (1951)	
Forest name	Tairua SF 150
Location detail	Compartment 136
Year/s of planting	1951
Area (hectares)	0.9
Number planted	Unknown
Seed lot number	Unknown
Source of plants	Waipoua Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Unknown
Confidence in data	High
Comments	Somewhat unthrifty stand. Some basal lesions. Assessed for PA. Symptoms not PA

Kauri plantation record — Tairua SF 150 (1982)	
Forest name	Tairua SF 150
Location detail	Compartment 133
Year/s of planting	1982
Area (hectares)	2.0
Number planted	2000
Seed lot number	Unknown
Source of plants	Unknown
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High
Comments	Trees growing quite well

Kauri plantation record — Tairua SF 150 (1983)	
Forest name	Tairua SF 150
Location detail	Compt 133
Year/s of planting	1983
Area (hectares)	1.4
Number planted	1000

Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High
Comments	No PA symptoms. Trees growing quite well

Kauri plantation record — Tairua SF 150 (1984)	
Forest name	Tairua SF 150
Location detail	Compartment 133
Year/s of planting	1984
Area (hectares)	7.7
Number planted	Part of 24308
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent exotic forest
Confidence in data	High
Comments	Trees growing quite well. No PA symptoms

Kauri plantation record — Tairua SF 150 (1984)	
Forest name	Tairua SF 150
Location detail	Compartment 101
Year/s of planting	1984
Area (hectares)	5.0
Number planted	Part of 24308
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Valley situation
Confidence in data	High
Comments	No PA symptoms. Trees growing quite well

Kauri plantation record — Waihou SF 201 (1982)	
Forest name	Waihou SF 201
Location detail	Compartment 1 (stand 5)
Year/s of planting	1982
Area (hectares)	1.0
Number planted	2120 shared with stand 2 (listed below)
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Adjacent exotic forest
Confidence in data	Moderate
Comments	Stand not seen. Inspect for condition of kauri

Kauri plantation record — Waihou SF 201 (1982)	
Forest name	Waihou SF 201
Location detail	Compartment 1 (stand 2)
Year/s of planting	1982
Area (hectares)	2.0
Number planted	2120 shared with stand 5 above
Seed lot number	
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Adjacent exotic forest
Confidence in data	Moderate
Comments	Stand not visited. Inspect if opportunity arises

Kauri plantation record — Whangapoua SF 169 (1949)	
Forest name	Whangapoua SF 169
Location detail	Compartment 45 (old compartment 10)
Year/s of planting	1949
Area (hectares)	2.0
Number planted	6000
Seed lot number	AK 47/533
Source of plants	Waipoua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Now a production exotic forest block
Confidence in data	High
Comments	Plantation failed and was planted in *P. radiata* in 1972. A 2015 inspection revealed no surviving kauri Area replanted in pines. No residual issues

Kauri plantation record — Whangapoua SF 169 (1950)	
Forest name	Whangapoua SF 169
Location detail	Compartment 45 (was compartment 10)
Year/s of planting	1950
Area (hectares)	2.8
Number planted	2250
Seed lot number	AK 48/571
Source of plants	Tairua Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	Now a production exotic forest block
Confidence in data	High
Comments	Plantation failed and was planted in *P. radiata* in 1972. 2015 inspection revealed no surviving kauri. Area replanted in pines. No residual issues

Kauri plantation record — Whangapoua SF 169 (1983)	
Forest name	Whangapoua SF 169
Location detail	Compartment 51
Year/s of planting	1983
Area (hectares)	0.7
Number planted	750
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Adjacent highway
Confidence in data	High
Comments	No PA symptoms. Residual trees growing quite well in places. Natural suppression

Kauri plantation record — Whangapoua SF 169 (1983)	
Forest name	Whangapoua SF 169
Location detail	Compartment 67
Year/s of planting	1983
Area (hectares)	2.2
Number planted	680
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common (20–49%)–abundant (50–74%)
Anthropogenic influences	Planted into area of natural regeneration
Confidence in data	High
Comments	Much natural regeneration. No PA symptoms. Vigorous stand of trees

Kauri plantation record — Whangapoua SF 169 (1983)	
Forest name	Whangapoua SF 169
Location detail	Compartment 90
Year/s of planting	1983
Area (hectares)	0.8
Number planted	430
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Unknown
Anthropogenic influences	In exotic forest
Confidence in data	Moderate
Comments	Not inspected. Remote site well buffered by exotic forest. Inspect for condition of kauri

Kauri plantation record — Whangapoua SF 169 (1984)	
Forest name	Whangapoua SF 169
Location detail	Compartment 83
Year/s of planting	1984
Area (hectares)	12.0
Number planted	6000?
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Unknown
Confidence in data	High
Comments	Steep site suitable to kauri. No PA symptoms. Kauri growth looks promising

Kauri plantation record — Flay's Road (1984)	
Forest name	Flays Road District Council Reserve near Whangapoua SF 169
Location detail	Flay's Road
Year/s of planting	1984
Area (hectares)	Unknown
Number planted	Possibly 6000
Seed lot number	Unknown
Source of plants	Sweetwater Nursery
% of original plantation remaining	Common 20–49%
Anthropogenic influences	Community forest?
Confidence in data	High–moderate
Comments	Site was prepared by NZFS staff and planted by community. No PA. Trees erratically stocked but growing quite well

Note. Seed lot numbers in plantations derived from Sweetwater Nursery planting stock not supplied in most source information. Generally speaking seed lot information was not used as a definer of plantations in the later (post 1975) planting era. Recorded in tables above as 'unknown'.

Appendix 8 Vector Profiles and Risk Assessments

Overview

Seven likely/possible primary kauri dieback vectors associated with the work of the NZFS exist. These possible vectors are listed below.

1. Nurseries growing kauri seedlings
2. Kauri plantations
3. Kauri establishment trials
4. Silvicultural manipulations within natural kauri forests
5. Kauri logging
6. Forestry engineering works: roading, quarrying, land clearing
7. Circulation of NZFS personnel

Vector Profiles and Risk Assessments

Nurseries Growing Kauri Seedlings

A total of eight NZFS nursery groups produced kauri seedlings.

1. Waipoua Forest Nursery
2. Sweetwater Nursery
3. GBI Bush Nurseries (two known island nursery sites)
4. Tairua Nursery
5. Kaikohe Nursery
6. Cambridge Nursery
7. Kumeu Nursery
8. FRI Nursery

Waipoua Forest Nursery

This nursery is located on the north side of the Waipoua River near the forest HQ. Some kauri plantations developed using seedlings from this nursery are PA positive. The nursery ceased production in 1968. The nursery site has had no active use since its closure. It is currently in rough pasture and regenerating native forest. The adjacent Waipoua Forest Sanctuary is heavily infected with PA.

Waipoua Forest Nursery Risk Assessment

Risk is low, as adjacent lands are already infected with kauri dieback. The nursery site is very infrequently visited. Consider and incorporate site into a wider kauri dieback management plan for Waipoua Forest.

Sweetwater Nursery

Sweetwater Nursery is a large, industrial scale nursery north of Kaitaia, which produced millions of pine seedlings for the NZFS afforestation programme from approximately 1965–c. 1990. Sweetwater Nursery also produced all of the kauri seedlings for the NZFS kauri planting programme (c. 1975–1986). There is no evidence that this nursery produced any kauri seedlings carrying kauri dieback to any plantation site. The nursery closed c. 1990 and has been in pasture ever since.

Sweetwater Nursery Risk Assessment

No risk is posed by Sweetwater Nursery. No action by the KDP is therefore required.

GBI Bush Nurseries

The GBI nursery operation was comprised of two small nurseries on the island used to hold/harden lifted wilding kauri seedlings, which were later planted out. These sites are possible vectors for kauri dieback, although no PA has been found in any wilding-sourced kauri plantation on GBI. Sites have not been used as nurseries since the mid-1970s. One site (Kaiaraara) is adjacent to a kauri dieback-infected 1953 plantation. There are wilding-sourced, planted kauri on this old site. None is known to have kauri dieback.

GBI Bush Nurseries Risk Assessment

There are no ongoing risks associated with nursery activity on these sites. The infected 1953 plantation is the risk site. The kauri on the old nursery site are vulnerable to infection from the nearby 1953 kauri plantation trees. It is therefore advisable to develop a plan to manage/mitigate the risks of wider contamination from the infected 1953 plantation. The old bush nursery site requires particular consideration when this plan is being devised.

Tairua Nursery

This Nursery closed c. 1960. It produced one batch of kauri seedlings in 1950, which were planted in the Whangapoua and Tairua Forests. The Whangapoua plantation failed. The Tairua plantation has not been located and may have failed, too. It is not judged that there is anything sinister in the failure. The nursery site has been in pasture for 30+ years.

Tairua Nursery Risk Assessment

No risk is associated with Tairua Nursery. If a map can be found identifying the site of the 1950 Tairua kauri plantation, this plantation site should be assessed for presence of kauri and any dieback symptoms.

Kaikohe Nursery

This nursery closed in the late 1960s. Kauri were grown there but on a modest scale. It is not known where they were planted. The nursery site was developed for housing in the late 1960s and is now a suburban environment.

Kaikohe Nursery Risk Assessment

No risk is associated with Kaikohe Nursery, and therefore, no action is required.

Cambridge and Kumeu Nurseries

These two nurseries were large NZFS establishments principally tasked with growing *P. radiata* seedlings. Both grew some kauri, e.g. Kumeu Nursery staff sowed a pound of seed in 1970, and the seed lot records shows that 425 trees from this batch went to Kauaeranga (Coromandel Forest Park) in 1973 or 1974. The seed lot records do not show the growing or distribution of any other kauri seedlings from these two nurseries.

Cambridge and Kumeu Risk Assessment

No risk is associated with either nursery. If additional records are found showing production and distribution to plantation sites of significant numbers of kauri seedlings from these two nurseries, these plantation sites should be checked and the nurseries' risk profiles reassessed.

FRI Nursery

The FRI Nursery is now Scion. Staff there propagated kauri and other indigenous trees for field plantings in Russell Forest and other sites. The other plantation sites are not known. The Russell Forest area (Punaruku) is PA positive via several soil tests at different locations. The source of the Russell Forest infection is not known.

FRI Nursery Risk Assessment

The FRI Nursery is still in production. The author has not examined FRI Nursery records to check kauri seedling production and distribution. Seed lot records show significant amounts of seed going to FRI, particularly in the early 1960s, but clarity is absent on whether this seed was for the co-located Central Seed Store or the FRI Nursery. Therefore, the author was not able to assess risks posed by this nursery.

As far as individual memory allows, the author recalls Russell Forest was the only Northland destination of kauri and other indigenous seedlings from the FRI Nursery. Records show that most of the kauri planted at Whenuakite on Coromandel were sourced from Sweetwater Nursery. However, FRI SP 448/3, a 1980 underplanting trial, does not attribute its seedlings to Sweetwater Nursery. These trees may have come from the FRI Nursery, in fact. There are also unverified reports of other FRI plantings of kauri on the Mamaku Plateau and in the Kaimai–Mamaku Forest Park.

Examination of Scion SP registers and other records will bring some clarity to the scale and locations of FRI Nursery's production and distribution of kauri seedlings. Scion Nursery records should be examined in future, and field checks of any significant planting sites should be undertaken by the Programme.

Kauri Plantations

Most of the historic kauri plantations have been dealt with in the main body of this report. This section of Appendix 8 is a summary of the overall risks posed by the various plantations. The aim in presenting this additional information is to assess the level of menace each plantation may offer to adjacent and wider kauri lands.

At the lower end of the risk matrix, mangers may see the need to protect a plantation from external/adjacent PA vectors. The risk assessment process is pictured below in template table format. This format was used for each plantation to compress, to quantify and to make visual the issues around

each forest containing kauri plantations. The subsequent tables define threat scores for the plantations. The final table summarises plantation risks.

Undefined abbreviations for all tables below: NZ, New Zealand; NZFS, New Zealand Forest Service; PA, *Phytophthora agathidicida*;

Template plantation risk assessment

Criteria	Score
Plantation score (*PS*)	
PA present	5
No PA symptoms/vulnerable nursery source	3
No PA symptoms/unlikely nursery source	2
Threat score (*TS*)	
Adjacent PA-free kauri forest	5
Adjacent PA-positive kauri forest	3
Adjacent non-kauri habitat or farmland	2
Threat posed by the kauri plantation Multiply plantation score *(PS)* x threat score *(TS)* to yield total score for the threat *(X)* posed by the kauri plantation *PS x TS = X*	
Comments	

Aupouri Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery score)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (exotic forest score)
Threat posed by the kauri plantations *(PS x TS = X)*	Threat posed by Aupouri Forest kauri plantations (*X*): 2 x 2 = 4
This is a very low score and indicates that this plantation most likely does not carry PA and that the disease has nowhere local to spread	

Raetea Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
PA present	5 (PA present in 1956–1959 plantations)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (no kauri in adjacent habitat for 2 km)
Threat posed by the kauri plantations *(PS x TS = X)*	Threat posed by Raetea Forest kauri plantations (*X*): 5 x 2 = 10
Comments This is a moderate score and deals with the threat posed by Raetea to the wider forest of which it is a part. There are plantations in Raetea from more than one nursery source. PA has most likely spread from an original infection in the 1956 cohort through all the contiguous Waipoua-sourced plantations and into the adjacent Sweetwater-sourced 1975 plantation. It is likely that PA is continuing to spread through the mostly contiguous kauri plantations. The above assessment does not deal with each of these situations separately	

Omahuta Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
PA present	5 (proven soil test)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5 (Puketi/Omahuta, 20000 ha kauri)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Omahuta kauri plantations: 5 x 5 = 25
Comments This Omahuta score is extremely high and indicates urgent action is needed to prevent a widespread and devastating kauri dieback contagion in NZ's second highest raked kauri forest. The score indicates the most urgent plantation situation in Omahuta. There are many other plantations there sourced from Waipoua Nursery, but none is showing PA symptoms, and their risk profile is moderate	

Notes: Omahuta Forest has an infected plantation near the old HQ site. The adjacent kauri forest habitat is PA free and includes Puketi Forest.

Puketi Forest (Mokau or Northern Sector) kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (Waipoua-sourced seedlings)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Puketi northern sector kauri plantations: 3 x 5 = 15
Comments This is a high score and indicates the need to monitor Waipoua sourced plantations in the northern parts of Puketi	

Note: Forest split because plantation sites in Puketi are clustered but widely separated.

Puketi Forest (Pirau or Southern Sector) kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced seedlings)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Puketi (southern sector) kauri plantations: 2 x 5 = 10
Comments Moderate–high score driven by the PA free status of Puketi Forest	

Warawara Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced seedlings)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Warawara kauri plantations: 2 x 5 = 10
Comments Moderate–high score driven by PA-free status of Warawara Forest	

Russell Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (some Waipoua-sourced seedlings planted)
Threat score (*TS*)	
Adjacent PA-positive kauri forest	3 (PA widespread in Punaruku)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Russell kauri plantations: 3 x 3 = 9
Comments Moderate score driven by the known widespread infection within Punaruku Valley. The plantations themselves do not appear to be infected and are probably not the original infection source	

Puhipuhi Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 ("failed" plantation, ex Waipoua Nursery)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (within exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Puhipuhi kauri plantations: 3 x 2 = 5
Comments Any residual trees from the 1949–1950 "failed" plantations need to be found and assessed for PA symptoms	

Glenbervie Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
PA present	5 (in stands planted 1949–1974)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (managed exotic forests)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Glenbervie kauri plantations: 5 x 2 = 10
Comments PA has spread from the Waipoua-sourced 1949–1955 stands to the Sweetwater-sourced 1974 stand. Currently this situation is tightly managed by the exotic forest owner, Rayonier. But that could change. Programme needs regular Rayonier dialogue and needs to monitor this site	

Trounson Kauri Park kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (all plantation sites ex Waipoua Nursery)
Threat score (*TS*)	
Adjacent PA-positive kauri forest	3 (Trounson badly afflicted with PA)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Trounson kauri plantations: 3 x 3 = 9
Comments No PA symptoms in plantations. Main body of reserve infected with PA. Plantations are actually vulnerable to infection from the main body of the reserve	

Waipoua Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
PA present	5 (PA in plantation, compartment 4)
Threat score (*TS*)	
Adjacent PA-positive kauri forest	3 (Waipoua widely affected with PA)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Waipoua kauri plantations: 5 x 3 = 15
Comments Score is moderate/high and is indicative of only one of the many complexities within Waipoua. Waipoua needs a wider kauri dieback management plan which captures and manages all of its vulnerabilities. Waipoua, at many levels, including in the public mind, is NZ's premier kauri forest. It is, along with Waitakere forest, the most PA afflicted kauri forest	

Opua Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (all plantation sites ex Sweetwater Nursery)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5 (no known PA in Opua Forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Opua kauri plantations: 2 x 5 = 10
Comments Opua Forest, approximately 2000 ha, most likely has no vulnerability to kauri dieback infection from its Sweetwater Nursery-sourced kauri plantings of the 1970s and 1980s	

Riverhead Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (Waipoua-sourced "failed" plantations)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (within exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Riverhead kauri plantations: 3 x 2 = 6
Comments Low score reflects absence of PA and plantations' locations within a manged exotic forest	

Great Barrier Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
PA present	5 (PA in 1953 Kaiaraara plantings)
Threat score (*TS*)	
Adjacent PA-positive kauri forest	3 (2 other widely separated PA infections)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Great Barrier kauri plantations: 5 x 3 = 15
Comments Moderate–high score. Like Waipoua, this score does not reflect the complexity of GBI's kauri forests. There are three widely separated, known PA infection points on GBI. The balance of the forest appears PA free. Close monitoring is needed to establish the extent and management requirements of the Kaiaraara plantation PA infection. At Waipoua, PA situation is unrecoverable; at GBI, it may still be recoverable	

Coromandel State Forest Park kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (1949–1950 Mangarehu ex Waipoua Nursery)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5 (no PA in the park)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Coromandel kauri plantations: 3 x 5 = 15
Comments Score reflects the PA-free status of Coromandel State Forest Park. It is a very big kauri forest area with many internal complexities and possible vulnerabilities. It has many Sweetwater-sourced 1970s and 1980s plantations. Also, a Kumeu Nursery-sourced 1973–1974 plantation exists. As the Mangarehu plantation is the only Waipoua-sourced plantation in the whole park, there is merit in closer inspection/soil sampling. (Visual inspection of 1950 plantation in 2011 showed no PA symptoms).	

Athenree Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 ("lost" 1957 plantation near HQ)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (within exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Athenree kauri plantations: 3 x 2 = 6
Comments This plantation used 200 Waipoua-sourced seedlings as well as local wildings in a 1957, 1.2 ha plantation. That seed lot (AK 54/681) is PA positive at Raetea, although the Raetea site may have been cross-infected from neighbouring plantations. If this plantation has survived and can be located, its PA status needs to be established as a matter of urgency.	

Kaimai–Mamaku State Forest Park kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced plantation)
Threat score (*TS*)	
Adjacent PA-free kauri forest	5 (no PA in Kaimai–Mamaku park)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Kaimai–Mamaku kauri plantations: 2 x 5 = 10
Comments Score reflects the PA free status of Kaimai—Mamaku	

Tairua Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/vulnerable nursery source	3 (Tangatara area)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Tairua kauri plantations: 3 x 2 = 6
Comments Score reflected plantation's location within a large, managed exotic forest. The 0.9 ha 1951 plantation has been soil sampled and PA was not found in that sampling. The Sweetwater-sourced plantations within Tairua Forest are similarly enfolded/isolated within the exotic forest	

Waihou Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced seedlings)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Waihou kauri plantations: 2 x 2 = 4
Comments Low score reflects location in exotic forest and Sweetwater Nursery source of plantations. These plantations have not been inspected as part of this project and should be site checked	

Whangapoua Forest kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced seedlings)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (within exotic forest)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Whangapoua kauri plantations: 2 x 2 = 4
Comments Low score reflects Sweetwater source of seedlings and plantations' locations within exotic forest. Waipoua-sourced plantation from 1949 and Tairua Nursery-sourced plantation from 1950 were overplanted with *P. radiata* in 1972, and no kauris survive today. Therefore, the author has judged that these seedling cohorts have been eliminated	

Flay's Road kauri plantations

Criteria	Score
Plantation score (*PS*)	
No PA symptoms/unlikely nursery source	2 (Sweetwater Nursery-sourced plantation)
Threat score (*TS*)	
Adjacent non-kauri habitat or farmland	2 (adjacent indigenous scrub looks kauri free)
Threat posed by the kauri plantations *PS x TS = X*	Threat posed by Flay's Road kauri plantations: 2 x 2 = 4
Comments Low score reflects seedling source and absence of kauri in surrounding landscape. Flay's Road plantation is on a Council reserve and was planted in 1984 by local volunteers, led and supported by staff from Whangapoua State Forest	

Summary of plantation scores

Forest name	Score	Comment
Omahuta	25	Infected plantation; huge threat to major kauri ecosystem
Waipoua	15	Already heavily infected
Great Barrier	15	One infected plantation. Much of forest appears PA free
Coromandel	15	No PA. Some vulnerabilities
Puketi North	15	No PA. Some vulnerabilities
Puketi South	10	PA-free forest. All Sweetwater Nursery-sourced seedlings
Raetea	10	Relatively contained. Infection may be spreading across/within Raetea plantations
Warawara	10	PA-free forest. All Sweetwater Nursery-sourced seedlings
Glenbervie	10	Infected plantations. Within exotic forest
Opua	10	PA-free forest. All Sweetwater Nursery-sourced seedlings
Kaimai–Mamaku	10	PA-free forest. All Sweetwater Nursery-sourced seedlings
Russell	9	Infected forest. No known plantation infection
Trounson	9	No PA in plantations. All trees sourced from Waipoua Nursery seedlings. Main body of reserve is PA infected
Riverhead	6	Exotic forest. No PA. Waipoua Nursery-sourced seedlings
Athenree	6	Exotic forest. "Lost" 1957 plantation used 200 Waipoua Nursery-sourced seedlings.
Tairua	6	Exotic forest. Some vulnerabilities
Aupouri	4	Exotic forest. Single plantation well contained
Waihou	4	Exotic forest. Isolated plantations ex Sweetwater Nursery.
Whangapoua	4	Exotic forest. 1949–1950 vulnerable plantations over-planted with *P. radiata* in 1972. Other plantations all Sweetwater Nursery-sourced seedlings
Flay's Road	4	TCDC Thames Coromandel District Council reserve planted in 1984 with Sweetwater Nursery-sourced seedlings

Kauri Establishment Trials

These trials are centred in Waipoua Forest, and to a much lesser extent, Omahuta Forest. The trials are dominated by Forester Frank Morrison's work at Waipoua Forest, from 1950–1964. Trials have been described in detail elsewhere in this report. Most of the work in compartment 58 is categorised as establishment trials because that was how it was described when such work was initiated. However, there are SPs within the compartment 58 trials, adding further complexity to what were often already complex trials. This layered complexity in compartment 58 adds further difficulty to arriving at an accurate assessment of the field situation when projects in compartment 58 were active.

The balance of Morrison's trials were spread across Waipoua Forest. Some have been obliterated and planted over with pines. One has been grassed over as a picnic area. Many of the trials are of little significance and were written off many years ago. Their interest to the Programme is in the trials' potential to be sources of kauri dieback contamination. Most of them were small to very small in size, too small to depict as a polygon on a map, but a few were substantial (e.g. 0.9 ha).

In terms of the macro-issues associated with establishment trials, these are broadly captured in the "Kauri Plantations" section of this appendix.

There were kauri dieback symptoms in one of the Waipoua trials inspected by the author (SP 62/2). No PA symptoms were observed in a relatively cursory inspection of compartment 58, however. This is remarkable in that virtually all 1948–1961 seedling cohorts used there were from Waipoua Forest Nursery, the site was subjected to a wide range of manipulations and cattle disrupted much of the site. Compartment 58 needs to be managed as having an extremely high probability of carrying PA, and this high likelihood needs to be captured in a broader kauri dieback management plan for Waipoua.

TSI as a Vector

Vector Profile of TSI

Tree stand improvement involved removing (usually by rink-barking) canopy vegetation above regenerating kauri saplings and small trees. It was a widespread practice at GBI and Russell Forests. The TSI programme is described in detail in the Appendix 4 "TSI" section. Some TSI work was also carried out in the western shrublands at Waipoua Forest. On GBI, kauri dieback is confined to three relatively discrete sites (where the full range of PA symptoms is displayed). On the basis of a noticeable absence of any PA symptoms in the extensive areas on GBI where TSI was practiced, the author has concluded that kauri dieback infection is not associated with TSI practices there.

At Russell Forest, only the Punaruku Valley has been sampled for PA, and the disease there has been found to be widespread. There are virtually no PA symptoms being displayed in infected stands at Russell Forest, making it difficult to draw any conclusions re the wider forest's overall PA status without much wider soil sampling. Wider soil sampling might point to the infection source being historic TSI practices, but based on the evidence at GBI, this seems unlikely.

Risk Assessment of TSI

Risk from TSI as a PA vector is low, based on the evidence on GBI. However, a cautionary note should be introduced to this assessment of risk, which is: absence of evidence is not evidence of absence. On GBI and at Russell, TSI was a very widespread practice. If it did convey PA and the symptoms have yet to show, then NZ's two largest areas of regenerating kauri forest could carry widespread contamination. The KDP could consider implementing wider soil sampling across Russell and/or GBI to clarify this issue.

Kauri Logging

This report contains a section, "Kauri Logging in Northern State Forests", which describes in detail the logging activity in kauri forests since c. 1950.

Vector Profile of Kauri Logging

Logging caused major impacts on the kauri forests through forest removal/destruction. From a kauri dieback perspective, logging offers a wealth of vectors for PA transfer.

- Soil disturbance/transfer through road building and machine extraction of logs.
- Logger and tool movements within the bush.
- Machine removal of mounded organic matter from the base of trees to allow longer trunks to be cut.
- Muddy logs stored on bush skid sites.
- Truck logging on clay roads.

- Contractor machinery moving from forest to forest.

These vectors occur in clusters.

Risk Assessment of Kauri Logging

The table below indicates the exposure via logging to PA contamination risk. Logging occurred in all of the forests of the North. To the best of the author's knowledge, only Waipoua and Russell Forests currently harbour PA. The Omahuta HQ site is considered a spot infection at this time. The risk assessment for logging in all areas is displayed below.

Forest name	Level of risk (L/M/H)	Recommended actions
Herekino	H	Assess "waka" sites and 1980 logging site in Waitotoki area
Puketi	M	Monitor 1970s kauri logging sites
Warawara	L	Soil test dead, old-growth kauri on plateau. If positive, develop a new plan
Omahuta	L	If Warawara PA positive, test Carter blocks
Waipoua	H	Assess 1960s logging sites in compartment 55. Consider investigating all post-1940 logging sites. The fact that Waipoua is already widely infected with PA reduces the potential impact of possible PA-infected former logging sites
Russell	L	Assess 1962 thinning trial in Papakauri (SP 314). The 1979–1981 helicopter logging sites are too entwined with the Punaruku PA-positive sites to allow simple analysis

Abbreviations. H, high risk; L, low risk; M, medium risk.

Forestry Engineering Works

Engineering works involved heavy machinery to open up and develop forests, generally for exotic forest management purposes. The topic does not have a discrete section in this report where it is described in detail, but some of the issues are captured in the "Forestry Practices at Russell Forest" section of this report, and specific information can be found in Appendix 2, "Glenbervie Forest: Jim Norris Interview". Forestry engineering works are also dealt with at some length in a 2015 KDP document, *Whangapoua Historic Vectoring Report*.

Vector Profiles for Engineering Works

Sharing of Equipment

The NZFS often based equipment, such as light bulldozers, at its larger forest stations. Forest officers responsible for development of kauri plantation sites often "borrowed" these machines and their operators to break in roads and tracks to provide access to plantation sites for the workers who were cutting the lines and planting the seedlings or carrying out other silviculture such as TSI.

The bulldozer and operator based at Waitangi Forest developed such accessways into Puketi, Raetea, Opua and Omahuta Forests in the 1970s and 1980s. This tractor and operator also opened up lines to allow the Raetea plantations to be ring-fenced. The access road to the 1975–1977 Raetea kauri

plantations, the crushing of scrub on those sites, and their fire-breaking, was carried out by a local contractor, Bob Curreen, using a TD 9 tractor.

The bulldozer based at Glenbervie Forest was borrowed by Russell Forest staff and used to re-open access to and through the Papakauri block and onwards along the ridge behind Pukemoremore, with the intention (never fulfilled) of opening a road access right across the forest to Tapuhi. The bulldozer based at Riverhead Forest was shipped to GBI c. 1960–1961, where it was used by local staff to open the Forest Road from Kaiaraara through to Whangaparapara. As yet unverified reports suggest that a bulldozer from Coromandel was also used on the construction of Forest Road.

Glenbervie Roading Gang

From c. 1980, the NZFS centred its road maintenance gang at Glenbervie Forest, and this gang moved around Northland to all forests except Aupouri (e.g. Waipoua, Otangaroa, Russell, Waitangi, Omahuta, Puketi) maintaining a very significant infrastructure of roads. Most of these roads serviced the exotic forest estate, but some, such as the Pirau and Mokau Roads in Puketi and the Sanctuary Road in Omahuta, are within kauri forests. This gang never operated outside of Northland.

Land Clearing for Exotic Plantation Development

Native vegetation was cleared to allow areas to be planted in pines. This became a highly mechanised and specialised activity and was almost always carried out by contractors. The vegetation being cleared was often advanced regenerating native forest including former kauri-forested areas. Some of the contractors operated in both Northland and Coromandel.

Land clearing methods included chainsaw felling, rotary slashing with wheel tractors, crushing with bulldozers, crushing with towed rollers and crushing with steerable gravity rollers. All land clearing activities required the development of access roads, tracks and firebreaks. Any of the machine-based methods involved enormous movement of soil.

Quarries

Quarries were developed to supply road metal. Sometimes the quarry sites were in native forested locations including kauri sites. Road metal was moved from the quarry sites to forest roads, sometimes to other state forests, offering the opportunity for widespread distribution of any PA fragment lodged in the quarry metal.

Risk Assessment of Forest Engineering

The risk of forest engineering works spreading PA is summarised below in table format.

Activity	Nature of risk	Risk score L/M/H	Evaluation/follow-up action needed
Equipment sharing	Risk of PA transfer within and between forests	M Some large risks taken	• No evidence of PA transfer • Re-evaluate if PA shows • Likely that 1975–1977 works at Raetea moved PA within those sites • Inspect Papakauri Road in Russell forest and Forest Road, GBI
Glenbervie road maintenance gang	Risk of PA transfer within and between forests	L Secondary activity	• No evidence of PA transfer • Re-evaluate if PA shows
Land clearing	Risk of PA transfer within and between forests. Large scale often multiple activities	H However no evidence of operations within PA infected environments	• No evidence of PA transfer • Re-evaluate if PA shows • Inspect/monitor kauri enclaves within exotic forests for signs of PA
Quarrying	Risk of PA transfer within and between forests	M Quarry locations within kauri forests a potential concern	• No evidence of PA transfer • Re-evaluate if PA shows • Inspect/monitor quarry and shale pit sites at Puketi (Mokau and Pirau), Omahuta and Russell Forests

Abbreviations. H, high; L, low; M, medium.

Circulation of NZFS Personnel

Vector Profile for NZFS Personnel

Many NZFS staff moved around a great deal. The NZFS was very field-oriented, and staff were expected to be familiar with and capable of reporting on a wide range of field situations. Staff also moved from site to site to deal with the seasonal demands of field work. There is a concern that this circulation may have transferred PA material at a time when biosecurity measures were infrequent. In the author's opinion, if PA was spread this easily, then the circulation and daily work of NZFS staff would have led to a much wider distribution of PA than that which confronts us today. Indeed, staff movements occurred en masse between the infected Waitakere and the uninfected Hunua Forests, yet Hunua remains PA free.

Risk Assessment for NZFS Personnel

The current modest distribution of PA in former state forests reveals that PA is actually very hard to transfer. Project investigators have examined many gross biosecurity risks being taken by unknowing NZFS staff, and yet, today it is acknowledged that NZFS staff had a very limited "success" rate at moving the disease. Risk of PA transfer via the circulation of NZFS personnel is deemed low.

Appendix 9 NZFS Kauri Plantations

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Herekino SF 1		1979	5.2		400 blanks in 1980	2900		Map KMU table	Sweetwater	Map does not clearly show location	
Raetea SF 2	Victoria Valley	1955	0.8	0.8	OK	c. 1000	AK 52/654	Map + WP and SP A228	Waipoua		
Raetea SF 2	Victoria Valley	1956	3.4	8.5	PA infected	3766	Including AK 53/661	Map + WP and SP A228	Waipoua		Yes
Raetea SF 2	Victoria Valley	1958	1.0		PA infected	2000 1/3**	AK 54/681	Map +WP and SP A228	Waipoua		Yes
Raetea SF 2	Victoria Valley	1959	1.0	2.5	PA infected	4000	AK 55/698/848 AK 55/698/849 AK 55/698/850	Map + WP and SP A228	Waipoua		Yes
Raetea SF 2	Victoria Valley	1975	4.7		PA infected	3000	AK 72/1013	Map KMU table	Sweetwater		Yes
Raetea SF 2	Victoria Valley	1976	5.1		OK	3300	AK 74/1040	Map KMU table	Sweetwater		
Raetea SF 2	Victoria Valley	1977	2.7		OK	3500	AK/c/75/8	Map KMU table	Sweetwater		
Raetea SF 2	Victoria Valley	1978	5.9		OK	5600	AK/c/75/8	Map KMU table	Sweetwater		
Raetea SF2	Victoria Valley	1979	Replanting			2900	AK/c/77/1	KMU table	Sweetwater		
Raetea SF 2	Victoria Valley	1980	7.8		?	3500	AK/c/77/1	Map	Sweetwater		
Raetea SF 2	Victoria Valley	1981	4.3			3000		KMU table	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Raetea SF 2	Victoria Valley	1982	4.7			4030		Map KMU table	Sweetwater		
Raetea SF 2	Victoria Valley	1983	6.6			4000		Map KMU table	Sweetwater		
Raetea SF 2	Victoria Valley	1984	8.6			4000		Map	Sweetwater		
Raetea SF 2	Victoria Valley	1985	20.0?			18952		Map	Sweetwater		
Omahuta SF 5		1932–1948	1.2	3.0 (part wildings)				From table in working plan. No map	Part wildings		
Omahuta SF 5	Old compt 9, now 109	1944–1945		2.0	Good — 1/3 lost in a thinning trial in 1956. Otherwise well stocked		1944 AK 40/453 3/1, 210 trees. AK 40/453 4/0, 2106 trees. AK 40/453 (1944). 1945 AK 41/465 2/2, 220 trees	CS map. SP 205A record	Waipoua		
Omahuta SF 5	Compt 109	1945	0.4	3.0			AK 41/465 2/2 220 trees	CSmap. SP 205B	Waipoua		
Omahuta SF 5	Compt 109 (compt 8 recorded in SP record)	1952	0.8	Nursery raised wilding kauri	Not checked	200 wildings. 200 ex Waipoua Forest Nursery		CS map. SP 67(2) Scion records			
Omahuta SF 5	Compt 104	1952	0.8	Nursery raised wilding kauri	Shows on Google	200 wildings. 200 ex Waipoua Forest Nursery		CSmap. SP 67(1) Scion records			

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Omahuta SF 5	Compt 104	1950	26.4	66.0		20000 4000	AK 48/571 AK 47/533	WP table + CSmap	Waipoua		
Omahuta SF 5	Compt 103	1951	12.8	32.0		14000	AK 48/571	WP table + CS map	Waipoua		
Omahuta SF 5	Compt 104	1952	14.8	37.0		5663	AK 48/571	WP table + CS map	Waipoua		
Omahuta SF 5	Compt 104	1954	4.0	10.0		2200	AK 51/640	WP table + CS map	Waipoua		
Omahuta SF 5	Compt 109	1980	2.0			1000		CS map. KMU table	Sweetwater		
Omahuta SF 5	Compt 109	1981	9.6			3670		CS map. KMU table	Sweetwater		
Omahuta SF 5	Compt 109	1982	5.0			4070		CS map. KMU table	Sweetwater		
Omahuta SF 5	Compt 109	1983	8.5			4000		Compt map. KMU table	Sweetwater		
Omahuta SF 5	Compt 109	1984	2.2			8960		CS map. KMU table	Sweetwater		
Omahuta SF 5	Compt 108	1984	10.0			8960		CS map. KMU table	Sweetwater		
Omahuta SF 5	Compt 104	1985	8.0			8122		CS map. KMU table	Sweetwater		
Puketi SF 4	Compt 19	1954?	1.6	4.0	No trees found	530	AK 48/571	CS map	Waipoua		
Puketi SF 4	Compt 19	1954	6.0	15.0	No trees found	2270	AK 51/640	WP table CS map	Waipoua		
Puketi SF 4		1955	11.2	28.0	No trees found		Possibly wildings. See WP notes	WP table CS map	?		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Puketi SF 4	Pirau	1977	22.0			3000		KMU Kauri disposals summary. Unreliable map	Sweetwater		
Puketi SF 4	Pirau	1978	10.7			3700		KMU Kauri disposals summary	Sweetwater		
Puketi SF 4	Pirau	1979	11.8			2900		KMU Kauri disposals summary	Sweetwater		
Puketi SF 4		1980	12.1			2200		Kauri disposals summary	Sweetwater		
Puketi SF 4		1981	10.3			4000		KMU Annual summary	Sweetwater		
Puketi SF 4		1982	3.0			4920?		KMU Annual summary	Sweetwater		
Puketi SF 4		1983	12.5			4000		KMU Annual summary	Sweetwater		
Puketi SF 4		1984	7.3			4234		KMU Annual summary	Sweetwater		
Puketi SF 4		1985	33.9			6274		KMU Annual summary	Sweetwater		
Warawara SF 6		1978	2.4			1000		KMU Kauri disposals summary	Sweetwater	No map	
Warawara SF 6		1979	7.7			2900		KMU Kauri disposals summary	Sweetwater	No map	
Warawara SF 6		1980	5.6			2000		KMU Kauri disposals summary	Sweetwater	No map	
Warawara SF 6		1981	5.0			3030		KMU table	Sweetwater	No map	

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Warawara SF 6		1982	1.8			2120		KMU table	Sweetwater	No map	
Waitangi Endowment Forest		1949		3.0	Reported failed in 1955			Conway 1955 annual meeting		No map	
Waitangi Endowment Forest	Mount Bledisloe, compt 1	1936	0.6	12.0	OK. Well stocked			Map + WP table		Residual stand. A much larger area was planted	
Russell SF 123	Punaruku Valley	1950	3.2	8.0			AK 48/571. Info from SP 207	Data from helicopter logging map	Waipoua		
Russell SF 123	Punaruku Valley	1963	0.4				AK 58/769	Map			
Russell SF 123	Punaruku Valley	1977	62.0?		No maps. Map 2 unreliable	2100		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1978	6.0		No maps. Map 2 unreliable	3300		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1979	10.0		No maps. Map 2 unreliable	3400		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1980	4.3		No maps	3500		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1981	4.8			5760		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1982	12.0			6580		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1983	7.0			6049		KMU Kauri disposals summary	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Russell SF 123	Punaruku Valley	1984	7.3			4248		KMU Kauri disposals summary	Sweetwater		
Russell SF 123	Punaruku Valley	1985	Blanked into previous plantings			5040		KMU Kauri disposals summary	Sweetwater		
Puhipuhi SF 16		1949	0.5	1.3	Failed			WP table stock map	Waipoua		
Puhipuhi SF 16		1950	4.0	10.0	Failed	5000	AK 48/571	WP table stock map	Waipoua		
Glenbervie SF 21		1949	2.4	6.0		500	AK 46/514	Map + WP	Waipoua		Yes
Glenbervie SF 21	Compt 2?	1950	2.4	6.0		6000	AK 48/571	Map + WP	Waipoua		Yes
Glenbervie SF 21		1955	5.2	13.0			AK 52/654	Map + WP	Waipoua		Yes
Glenbervie SF 21		1974	1.77			1600	AK 71/999	KMU table. Rayonier map and patch report	Sweetwater	Rayonier data	Yes
Glenbervie SF 21		1985	6.0			2880		KMU table	Sweetwater	No maps. Location not known	
Trounson		1955	0.1	0.3				Stock map	Waipoua		
Trounson		1959	0.8	2.0		525 trees 315 trees	AK 55/698 AK 56/716	Stock map	Waipoua		
Trounson		1960	0.8	2.0				Stock map	Waipoua		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Trounson		1961	0.8	2.0				Stock map	Waipoua		
Trounson		1962	0.4	1.3		734	AK 58/769	Stock map	Waipoua		
Trounson		1963	1.0	2.4		1120	AK 58/769	Stock map	Waipoua		
Trounson		1964	0.8	1.9		625	AK 60/842	Stock map	Waipoua		
Trounson		1965	2.8	7.0		2077	AK 60/845 AK 60/846 AK 61/846 AK 61/860 AK 61/878	Stock map	Waipoua		
Trounson		1966	1.0	14.0		650	AK 62/895	Stock map	Waipoua		
Waipoua SF 13		1938		2.3	Failed and replanted in 1948			Conway 1955 annual meeting	Waipoua		
Waipoua SF 13		1940		0.2	Failed and replanted in 1949			Conway 1955 annual meeting	Waipoua		
Waipoua SF 13	Arboretum area 3	1946			Culled in year 2000. Some coppicing		HO 40/517	Arboretum map	Waipoua		
Waipoua SF 13	Arboretum area 4	1946			Culled in year 2000. Some coppicing		HO 40/518	Arboretum map	Waipoua		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Waipoua SF 13	Arboretum area 1	1948	0.4	Approximately 1.0	Good survival	1100	AK 46/514	Arboretum map	Waipoua		
Waipoua SF 13	Comprises next 7 records below	1949	7.2	18.0				WP table	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 14	1949	0.4	1.0	Natural forest		AK 47/537	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 14	1949	2.0	5.0	Natural forest		AK 46/514	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 15, now compt 58/1	1949	2.4	6.0	Part 58/1		AK 48/573	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 15, now compt 58/1	1949	0.8	2.0	Part 58/1		AK 47/533	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 15, now compt 58/1	1949	0.4	1.0	Part 58/1		AK 46/514	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 15, now compt 58/1	1949	1.2	3.0	Part 58/1		AK 47/533	Old map	Waipoua	No corresponding records	
Waipoua SF 13	Old compt 15 now Compt 58/1	1949	0.4	1.0	Part 58/1		AK 48/571	Old map	Waipoua		
Waipoua SF 13	Old compt 15, now compt 58/1	1950	2.0	5.0			AK 47/533	WP table	Waipoua		
Waipoua SF 13	Compt 58	1952	1.0	2.5				WP table	Waipoua		
Waipoua SF 13	Compt 58/1	1950	4.4	11.0				Map	Waipoua		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Waipoua SF 13	Compt 4	1956	0.3	0.7	PA infected	139 14880801 60	AK 50/616 AK 52/654 AK 51/640 AK 52/654 AK 53/661	Stock map. SP info: SP 209/3 and 209/4.1956 annual report	Waipoua	Complex area, impossible to separate seedling batches on ground	Yes
Waipoua SF 13	Compt 58/2	1955	2.0	5.0				Map + WP	Waipoua		
Waipoua SF 13	Compt 58/3	1956	2.0	5.0				Map + WP	Waipoua		
Waipoua SF 13	Compt 58/4	1957	1.0	2.5		1000	AK 53/661	Map + WP	Waipoua		
Waipoua SF 13	Compt 58/5	1958	1.0	2.5				Map + WP	Waipoua		
Waipoua SF 13	Compt 58/6	1959	2.4	6.0				Map + WP	Waipoua		
Waipoua SF 13	Compt 58/7	1959	2.0	5.0				Map	Waipoua		
Waipoua SF 13	Compt 58/8	1959	0.4	1.0				Map	Waipoua		
Waipoua SF 13	Compt 58/9	1960	3.6	9.0		2517	AK 55/698. AK 57/731. AK 56/716	Map	Waipoua		
Waipoua SF 13	Compt 58/10	1960	0.4	1.0		500	AK 55/698	Map	Waipoua		
Waipoua SF 13	Compt 58/11	1961	5.6	14.0		1037	AK 57/731	Map	Waipoua		
Waipoua SF 13	Compt 58/12	1961	0.4	1.0		600	AK 57/731	Map	Waipoua		
Waipoua SF 13	Compt 58/13	1961	0.4	1.0				Map	Waipoua		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Waipoua SF 13	Compt 58/14	1962	4.4	11.0		1494	AK 57/810	Map	Waipoua		
Waipoua SF 13	Compt 58/15	1963	4.0	10.0		1509	AK 60/841. AK 60/844. AK 59/810	Map	Waipoua		
Waipoua SF 13	Compt 55/1	1962	0.8	3.0		527 214	AK 58/769 AK 59/810	Map	Waipoua		
Waipoua SF 13	Compt 55/2	1963	2.8	7.0		600 1275	AK 58/769 AK 59/810	Map	Waipoua		
Waipoua SF 13	Compt 58/16	1964	2.0	5.0				Map	Waipoua		
Waipoua SF 13	Compt 58/17	1964	1.0	2.5				Map	Waipoua		
Waipoua SF 13	Compt 30/1	1958	0.1					Map	Waipoua	Strip planting?	
Waipoua SF 13	Compt 30/1	1959	0.1					Map	Waipoua	Strip planting?	
Waipoua SF 13	Compt 30	1977	7.3 (11.8 on KMU table)			1600		Composite species map + KMU table	Sweetwater		
Waipoua SF 13	Compt 30	1978	10.5 (12.6 on KMU table)			3200		CS map + KMU table	Sweetwater		
Waipoua SF 13	Compt 30	1979	5.4			1900		CS map and KMU table	Sweetwater		
Waipoua SF 13	Compt 30	1980	12.3 (6.0 on KMU table)			2760, possibly kauri/podocarp mix		CS nap and KMU table	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Waipoua SF 13	Compt 30	1981	8.0			4030		CS map and KMU tables	Sweetwater		
Waipoua SF 13	Compt 30	1982	15.3			5000		KMU table	Sweetwater		
Waipoua SF 13	Compt 30	1983	15.5			4728		Map KMU table	Sweetwater		
Waipoua SF 13	Compt 30	1984	4.3			Part of 4400 below		KMU table CS map	Sweetwater		
Waipoua SF 13	Compt 60, lookout	1984	6.0			4400		KMU table	Sweetwater		
Opua SF 113		1977	36.2		Group planting?	1000		KMU table + map	Sweetwater		
Opua SF 113		1978	61.2		Group planting?	3100		KMU table + map	Sweetwater		
Opua SF 113		1979	25.5		Group planting?	3200		KMU table	Sweetwater		
Opua SF 113		1980	20.0		Group planting?	2000		KMU table	Sweetwater		
Opua SF 113		1981	38.0		Group planting?	3000		KMU table	Sweetwater		
Opua SF 113		1982	7.0		Group planting?	3810		KMU table	Sweetwater		
Opua SF 113		1984	28.6		Group planting?	2284		KMU table	Sweetwater		
Aupouri SF 187	Compt 9	1969	0.8		Mixed with *Eucalyptus* spp.		No record	Summit records including map	Uncertain.Possibly Kaikohe and Sweetwater	Inspected 31/5/16. Very healthy trees growing well	

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Riverhead SF 131	Compt 16	1949	1.2	3.0	Almost complete failure by 1954			WP table stock map	Waipoua		
Riverhead SF 131	Compt 12	1950	0.8	2.0		800	AK 48/571	Stock map. SP 192 Scion archive	Waipoua		
Riverhead SF 131	Compt 16	1950	12.6	31.5	Failed. Poor condition in 1952	12600	AK 48/571	WP table stock map	Waipoua		
Great Barrier SF 165	Compt 3	1949	0.1	0.5		500	AK 47/533		Waipoua		
Great Barrier SF 165	Compt 5 and compt 24. Road is compt boundary	1953	0.7	1.8	PA infected		AK 50/616	WP table, stock and compt map	Waipoua		Yes
Great Barrier SF 165	Cpt 5	1954	0.8	2.0			AK 51/640	WP table	Waipoua	Mapped	
Great Barrier SF 165	Compt 5	1954	0.3	0.8			AK 51/640	WP table	Waipoua	Not mapped	
Great Barrier SF 165	Compt 44, old compt 24	1955	0.8	2.0	Failed	406	AK 51/640	WP table. Journal map	Waipoua		
Great Barrier SF 165	Compt 22, old compt 11	1955	2.4	7.0			wildings	WP table stock map			
Great Barrier SF 165	Old compt 11/2	1956	2.6	6.5			wildings stock	WP table			
Great Barrier SF 165	Compt 5, old 8/4	1957	0.1	0.8			wildings	Stock map WP table			
Great Barrier SF 165	Compt 11	1961	1.6	4.0				WP table. No map			
Great Barrier SF 165	Compt 13	1963	0.8	2.0				WP table. No map			

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Great Barrier SF 165	Compt 18	1963	0.8	2.0				WP table			
Great Barrier SF 165	Compt 24	1963	0.4	1.0			Wildings	WP table			
Great Barrier SF 165	Compt 45	1963	1.2	3.0				WP table			
Great Barrier SF 165	Compt 24	1964	4.8	12.0				WP table			
Great Barrier SF 165	Compt 3	1976	0.8				probably wildings	Compt 3 map			
Great Barrier SF 165	Compt 3	1976	2.0				probably wildings	Compt 3 map			
Great Barrier SF 165	Compt 3	1977	5.3 and 9.0			3100		KMU table. Compt 3 map	Sweetwater		
Great Barrier SF 165	Compt 3	1978	0.7			5700		KMU table. Compt 3 map	Sweetwater		
Great Barrier SF 165	Compt 3	1978	3.6					Compt 3 map	Sweetwater		
Great Barrier SF 165	Compt 2	1978	4.6					Compt 2 map	Sweetwater		
Great Barrier SF 165	Compt 4	1978	2.2					Compt 4 map	Sweetwater		
Great Barrier SF 165	Compt 2	1979	5.3			4000		KMU table. Compt map	Sweetwater		
Great Barrier SF 165	Compt 24	1979	2.7				Underplanted in *P. pinaster*	Compt map	Sweetwater		
Great Barrier SF 165	Compt 66	1979	7.0					Compt map	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Great Barrier SF 165	Compt 1	1980	0.8					Compt map	Sweetwater		
Great Barrier SF 165	Compt 2	1980	2.3					Compt map	Sweetwater		
Great Barrier SF165	Compt 3	1980	2.0			4600		KMU table. Compt map	Sweetwater		
Great Barrier SF 165	Compt 5	1980	7.5					Compt map	Sweetwater		
Great Barrier SF 165	Compt 24	1980	0.1				Underplanted in *P. pinaster*	Compt map	Sweetwater		
Great Barrier SF 165	Compt 66	1980	5.4					Compt map	Sweetwater		
Great Barrier SF 165	Compt 1	1981	2.1			4400		KMU table. Compt map	Sweetwater		
Great Barrier SF 165	Compt 2	1981	6.0					Compt map	Sweetwater		
Great Barrier SF 165	Compt 3	1981	0.7					Compt map	Sweetwater		
Great Barrier SF 165	Compt 52	1981	0.3				Underplanted in *P. pinaster*	Compt map	Sweetwater		
Great Barrier SF 165	Compt 66	1981	5.4					Compt map	Sweetwater		
Great Barrier SF 165	Compt 1	1982	1.0			8000		KMU table Compt map	Sweetwater		
Great Barrier SF 165	Compt 2	1982	1.6					Compt map	Sweetwater		
Great Barrier SF 165	Compt 3	1982	8.0					Compt map	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Great Barrier SF 165	Compt 52	1982	0.9				Underplanted in *P. pinaster*	Compt map	Sweetwater		
Great Barrier SF1 65	Compt 66	1982	1.3					Compt map	Sweetwater		
Great Barrier SF 165	Compt 1	1983	5.1			8516		KMU table KMU table Compt map	Sweetwater		
Great Barrier SF 165	Compt 52	1983	1.5	2.0				Compt map	Sweetwater		
Great Barrier SF 165	Compt 66	1983	0.5					Compt map	Sweetwater		
Great Barrier SF 165	Compt 1	1984	5.1			8728		KMU table Compt map	Sweetwater		
Great Barrier SF 165	Compt 2	1984	6.0					Compt map	Sweetwater		
Great Barrier SF 165	Compt 52	1984	0.8					Compt map	Sweetwater		
Great Barrier SF165	Compt 2	1985	5.7			7816		KMU table Compt map	Sweetwater		
Great Barrier SF 165	Compt 52	1985	1.1					Compt map	Sweetwater		
Coromandel Forest Park SF 149	Mangarehu, compt 1	1949	0.8	3.0		3500	AK 47/533	Compt map. Historic summary	Waipoua		
Coromandel Forest Park SF 149	Mangarehu, compt 1	1950	7.3		OK	6000 + 1300 blanked (1951)	All AK 48/571	Compt map. Historic summary	Waipoua		
Coromandel Forest Park SF 149	Whangaitereng a, compt 19	1971	1.2					Compt map	?		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Coromandel Forest Park SF 149	Mangarehu, compt 11	1973 or 1974	1.6			425?	AK 67/955?	Compt map	Kumeu		
Coromandel Forest Park SF 149	Mangarehu. compt 11	1975	0.5			500		Compt map	Sweetwater		
Coromandel Forest Park SF149	Whenuakite. compt 401	1975	1.3			1100		Compt map	Sweetwater		
Coromandel Forest Park SF 149	Hikuai, compt 301	1976	1.0					Compt map	Sweetwater	Kauri present?	
Coromandel Forest Park SF 149	Mangarehu, compt 1	1977	1.6			900		Compt map	Sweetwater		
Coromandel Forest Park SF 149	Mangarehu, compt 1	1978	2.2			1000		Compt map	Sweetwater		
Coromandel Forest Park SF 149	Whenuakite, compt 401	1978	5.5			3500			Sweetwater		
Coromandel Forest Park SF149	Whenuakite, compt 401	1979	3.9			2600			Sweetwater		
Coromandel Forest Park SF 149	Whangaitereng a, compt 19	1979	6.8			2700		Compt map	Sweetwater		
Coromandel Forest Park SF 149	Tairua dump, compt 320	1980	2.9			2000		Compt map	Sweetwater		
Coromandel Forest Park SF 149	Whenuakite, compt 401	1978	5.5					Compt map	Sweetwater		
Coromandel Forest Park SF 149	Whenuakite, compt 401	1979	3.9					Compt map	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Coromandel Forest Park SF 149	Whenuakite, compt 401	1980	6.7					Compt map	Sweetwater		
Coromandel Forest Park SF 149	Whenuakite, Cpt 401	1980						Compt map	Source not known	FRI trial A448/3	
Coromandel Forest Park SF 149	Whenuakite, Compt 401	1981	2.5					Compt map	Sweetwater		
Coromandel Forest Park SF 149	Tairua dump, compt 320	1981	2.1					Compt map	Sweetwater		
Coromandel Forest Park SF 149	Wentworth Valley, compt 365	1982	5.5			5000		KMU table Compt map	Sweetwater		
Coromandel Forest Park SF 149	Broken Hills compt 30	1983	38.2			14000		KMU table Compt map	Sweetwater		
Coromandel Forest Park SF 149	Tairua dump, compt 320	1983	1.2					Compt map	Sweetwater		
Athenree (Katikati)	Near HQ	1957	1.2		Not found		AK 54/681	WP table. Art est review table	Waipoua & half wildings		
Athenree (Katikati)	Near HQ	1958	3.2		Not found		AK 54/581?	Art est review table	Part wildings		
Athenree (Katikati) K-M SF Park	Compt 5	1978	5.0			Part of 5500		Compt map. KMU schedule	Sweetwater		
Athenree (Katikati) K-M SF Park	Compt 1, stand 2	1978	1.7			Part of 5500		Compt map. KMU schedule	Sweetwater		
Athenree (Katikati) K-M SF Park	Compt 1, stand 3	1979	4.4			8000		Compt map. KMU schedule	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Athenree (Katikati) K-M SF Park	Compt 1, stand 4	1980	4.8			5500		Compt map. KMU schedule	Sweetwater		
Athenree (Katikati) K-M SF Park	Compt 1, stand 5	1981	4.8					Compt map. KMU schedule	Sweetwater, presumably		
Athenree (Katikati) K-M SF Park	Compt 1, stand 6	1982	3.0			8140		Compt map. KMU schedule	Sweetwater		
Athenree (Katikati) K-M SF Park	Compt 1, stand 7	1983	6.5			4600		Compt map. KMU schedule	Sweetwater		
Tairua SF 150	Compt 126	1949	1.7	4.2 recorded in M Johnston's 1971 survey			AK 47/533 recorded on SP 440 cover sheet	WP table. Not on compt 126 map	Waipoua?	Not found. Most likely overplanted in 1990	
Tairua SF 150	Compt 16 (Compt 62 in seed register)	1950		3.5		1000	AK 48/571	Summary sheet	Tairua	Could not be located	
Tairua SF 150	Compt 136	1951	0.9	1.3				Map + WP table	Waipoua?		
Tairua SF 150	Compt 133	1982	2.5			2000		Compt map. KMU schedule	Sweetwater		
Tairua SF 150	Compt 133	1983	1.4			1600		Compt map. KMU schedule	Sweetwater		
Tairua SF 150	Compt 133	1984	7.7					Compt map	Sweetwater		
Tairua SF 150	Compt 101	1984	5.0					Compt map	Sweetwater		

Forest	Location detail	Age	Area (ha)	Area (*ac)	Current condition	# of seedlings	Seed lot #	Information source	Nursery	Comments	PA (Yes)
Waihou SF 201	Compt 1, stand 5	1982	1.0			2120 total		Compt map KMU schedule	Sweetwater		
Waihou SF 201	Compt 8, stand 2	1982	2.0			2120 total		Compt map KMU schedule	Sweetwater		
Whangapoua SF 169	Compt 45, was compt 10	1949	2.0	5.0	No surviving kauri (inspected by JB 6/2015)	6000 3/0	AK 47/533	WP table stock map	Waipoua		
Whangapoua SF 169	Compt 45, was compt 10	1950	2.8	7.0	No surviving kauri (inspected by JB 6/2015)	2250 3/0	AK 48/371	WP table	Waipoua. Scion records show Tairua Nursery		
Whangapoua SF 169	Compt 51	1983	0.7			750		Map and aerial KMU schedule	Sweetwater		
Whangapoua SF 169	Compt 67	1983	2.2			680		Map and aerial KMU schedule	Sweetwater		
Whangapoua SF 169	Compt 83	1984	12.0			6000		Aerial	Sweetwater		
Whangapoua SF 169	Compt 90	1983	0.8			430		Map and aerial	Sweetwater		
Flay's Road plantation	TCDC Res	1984				Possibly 6000		No map found	Sweetwater		

Notes. New Zealand Forest Service (NZFS) kauri plantations are now primarily administered by the Department of Conservation (DOC). *Acreage is as per summary sheet/old maps.

** Nursery management term. 2000 1/3 in # of seedlings column. Refers to recording how seedlings were grown in nursery. In this case 2000 seedlings were held in the seedbed for one year (1) and then held in the lining out beds for three years (3) before being dispatched to the planting site. Hence 1/3 to describe nursery management. 4/0 would mean trees held in the seed bed for four years and not lined out before dispatch. Often recorded with seed lot information on old maps and schedules.

Abbreviations. #, number; Art Est review. A management review of Artificial establishment of kauri.; AK, Auckland Conservancy; compt, compartment; CS, composite species (as in a type of map); FRI, Forest Research Institute; HO, head office; JB, John Beachman (the author of this report); K-M SF Park, Kaimai-Mamaku State Forest Park; KMU,Kauri Management Unit ; Res, reserve; SF, state forest; SP, sample plot; TCDC,Thames Coromandel District Council ; WP, Working Plan ;

Appendix 10 Frank Morrison's Kauri Establishment Trials at Waipoua Forest 1950–1961

Year	Control plan #	Trial #	Location/ compartment #	GPS	Size (ac/ha)	Purpose(s)/seed lot #	Current/abandoned?	Current condition	PA status
1950	A3	A63/1	West of Huaki compt 56	E1644914 / N6058984 est	Large	Multiple	Abandoned	Not known	Not known
1950	A3	A63/2	Compt 30	E1644356 / N6057898 est	Large	Multiple	Abandoned	Visible from space	Not known
	A4	A64	Compt 14/5	E1645666 / N6055926 actual	0.4 ac/0.16 ha	Multiple	Abandoned	Not known	Not known
1950	A2	A62/1	Compt 2 site not known	?	2.2 ac/0.9 ha	Planting method	Abandoned	Not known	Not known
1950	A2	A62/2	Compt 14	E1644857 / N6055409 actual	2.2 ac/0.9 ha	Planting method	Abandoned	Quite well stocked	PA symptoms
1950–1952	A5	A65	Compt 1 adjacent SP 61	E1650228 / N6054157 est	0.5 ac/0.2 ha	Planting method	Abandoned	Well stocked	Not known
1950–1952	A6	A66	Compt 1	"Destroyed"	0.225 ac/0.1 ha	Planting method	Abandoned	Not known	Not known
1951	A1	SP 61	Compt 1 uphill of old NZFS HQ	E1650228 / N6054157 est	432 trees	Fertiliser/growth	Abandoned	Well stocked	Not known
1951	A8/1	A68/1 and 68/2	Compt 2/2 adjacent 62/1	"Destroyed"	0.21 ac/0.1 ha	Weedicide on mānuka trial	Abandoned	Not known	Not known
1951		A181	Compt 56	E1644789 / N6058809 est	?	Growth survival red/green seedlings		Not known	
1952	A10	A182	Compt 56	As above	0.2 ac/0.1 ha	Growth/survival puddled/hessian seedlings		Not known	
1956–1957	A12/2/1	A209/1	Compt 1	No site info	0.07 ac	Fertiliser trial using AK 53/661 seedlings.	Abandoned 1968		
1956–1957	A12/2/1	A209/2	Compt 1	No site info	0.07 ac	Fertiliser trial using AK 53/661 seedlings.	Abandoned 1968	Not known	
1956–1957	A12/2/1	A209/3	Compt 4 roadside stand	E1647919 / N6054540 est	0.07 ac	Fertiliser trial using AK 53/661 ssedlings	Abandoned 1968	Pt compt 4 stand PA infected	PA positive
1956–1957	A12/2/1	A209/4	Compt 4 roadside stand	E1647919 / N6054540 est	0.07 ac	Fertiliser trial using AK 53/661 seedlings.	Abandoned 1968	Pt compt 4 stand PA infected	PA positive
1956–1957	A12/2/1	A209/5	Compt 58 area Q or 58/3	Generic location	0.07 ac	Fertiliser trial using AK 53/661 ssedlings.	Abandoned 1968	Not known	Not known

Year	Control plan #	Trial #	Location/ compartment #	GPS	Size (ac/ha)	Purpose(s)/seed lot #	Current/abandoned?	Current condition	PA status
1956	A12/2/1	A209/6	Compt 58 area Q? or 58/3	Generic location	0.07 ac	Fertiliser trial using AK 51/640 + AK 52/654 seedlings.	Abandoned 1968	Not known	Not known
1957	A12/2/1	A209/7	Compt 58, area N? 58/4 or 58/5	Generic location	0.07 ac	Fertiliser trial using AK 53/661 ssedlings	Abandoned 1968	Not known	Not known
1958	A18	214/1	Compt 23 gone		5 trees	Coastal survival AK 55/698	Abandoned 1973	Not known	Not known
1958	A18	214/2	Compt 26	E1641304 / N6056372 est	5 trees	Coastal survival AK 55/698	Abandoned 1973	Not known	Not known
1958	A18	214/3	Compt 27 gone		8 trees	Coastal survival AK 55/698	Abandoned 1973	Not known	Not known
1958	A19	215	Compt 1/46 by river near HQ	E1649911 / N6054637 est # trees	0.1 ac?	Planting trials with AK 55/698 stock	Abandoned 1976	Not known	Not known
1958	A20	A216	Compt 59 Puketurehu	Puketurehu	20 trees	Planting trials with AK 54/681 stock	Abandoned 1976	Not known	Not known
1958	A21	A217/1	Compt 41 west of Pawakatutu		40 trees	Planting trial AK 55/698	Abandoned 1976	Not known	Not known
1958	A21	A217/2	State highway road edge	E1690957 / N6054727 est	40 trees	Planting trial AK56/716	Abandoned 1976	Not known	Not known
1958	A22	218	Compt 7/6 pines	E1647382 / N6053982 est	40 trees	Planting trial AK 57/716	Abandoned 1976	Not known	Not known
1958	A23	219	Compt 1 just uphill of NZFS HQ	E1650285 / N6054393 actual	0.2 ac	Planting trial AK 55/648	abandoned 1972	Not known	Not known
1958	A24	220	Compt 1 adjacent 219	E1650249 / N6054383 est	6 ssedlings in pre dug pits	Cotyledinous* planting trial	Abandoned 1976	Not known	Not known
1956–1961		SP 431/9	Compt 58			20 plus kauri establishment trials	Abandoned 1972		Not known

*Notes. * cotyledinous. Cotyledinous seedlings are very young seedlings which have yet to produce more leaves. i.e. only their colyledons (first two 'leaves') are showing.*

Abbreviations. #, number; compt, compartment; est, estimated; GPS, global positioning system; HQ, headquarters;. NZFS, New Zealand Forest Service; PA, *Phytophthora agathidicida*; SP, sample plot.