LE ROY'S BUSH SCENIC RESERVE SLIP REMEDIATION PLAN

ENVIRONMENTAL IMPACT ASSESSMENTS LTD
SUSTAINABLE WATER SOLUTIONS

LE ROYS BUSH SLIP REMEDIATION PROJECT (DRAFT 1)

PREPARED FOR FRIENDS OF LE ROY'S BUSH

ENVIRONMENTAL IMPACT ASSESSMENTS CLIENT REPORT A2E
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Executive Summary

This report has been prepared for Friends of Le Roys Bush (FOLRB) to provide an ecological restoration plan for two slips located within Le Roys Bush Reserve (LRBR). This report outlines the necessary courses of action for the restoration of the site, to prevent further erosion and sediment loss entering the watercourse, and determining which authorities, groups and/or professions should be notified and/or tasked to aid restoration and prevent further environmental damage from occurring. This report has reviewed literature that is suitable for the site's unique environmental characteristics to enhance restoration success.

It is recognised that some areas of the slips pose health and safety risks, for which slip 1 = 98 m^2 and slip 2 = 165m^2. In our view these areas are best restored using an external contractor who is qualified and equipped to work in potentially hazardous areas.

A 225m^2 polygon has been identified as a safe zone for which volunteers of the FOLRB could restore provided there was a safety feature implemented at the south end of the track near a small slip. This feature (a ladder or a rope) would enable safe access to the restoration polygon. A series of waratahs connected with string could be used to define the area to work within.

This report outlines some detail on existing vegetation within the reserve as well as a before / after analysis that enables the reader to see what vegetation existed prior to the cyclone Gabrielle event. A list of plant species has been provided that incorporates a number of considerations including, previous vegetation pattern, existing recolonising of vegetation within the slip areas, historical Māori use of vegetation and general forest eco type.

A Kauri Dieback management plan is incorporated into this document as the risk of spread of this disease must be minimised to enable successful regeneration of the forest.

A pest plant management plan is also included in this document to provide guidance on necessary measures to reduce pest plan incursions within the restoration area. It is recommended that this report be shared with relevant authorities such as Auckland Council, the Kaipatiki Local Board and relevant contractors for which further guidance can be provided.

Introduction

Le Roys Bush Reserve (LRBR) is one of a number of forested gullies in Northcote and Birkenhead on Auckland's North Shore. It contains lowland forest with significant examples of kauri-tanekaha forest, broadleaved forest, pōhutukawa forest and wetland associations, including the largest area of raupō wetland remaining on the North Shore.

This important remnant bush area has been protected, treasured and restored, allowing native flora and fauna to flourish. Interpretive signage helps park users understand, value and treasure this special place.

Several community initiatives have been implemented at LRBR, including weed control programmes and revegetation planting days. A key player for coordinating the ecological restoration and maintenance of LRBR is the Friends of Le Roys Bush (FOLRB) community volunteer group, for which this report has been provided.

Purpose

This report has been prepared for FOLRB to provide an ecological restoration plan for two slips located within LRBR. This report outlines the necessary courses of action for the restoration of the site, to prevent further erosion and sediment loss entering the watercourse, and determining which authorities, groups and/or professions should be notified and/or tasked to aid restoration and prevent further environmental damage from occurring. This report has reviewed literature that is suitable for the site's unique environmental characteristics to enhance restoration success.

Unfortunately, most access areas including boardwalks have been severely damaged within the reserve which poses health and safety risks for undertaking ecological restoration within the reserve. Given the risks of ‘hanging infrastructure’ surrounding the major slips (there are smaller upstream slips not the focus of this report), it is likely that a health and safety management plan may be required for undertaking restoration within close proximity to the two larger slips downstream of the waterfall (slips 1 and 2). These less safe areas are best tackled by external contractors.

This report does not provide a health and safety management plan; rather it details what tasks are required to successfully remediate the slips contained within the reserve.

Description and Background of the Site Area.

Background

The northern valley of LRBR was known as Te Uruwao (or Te Uruao) by early Māori. LRBR’s tracks are located in the valley which early Māori settlers used to follow in order to access pipi and fish such as Tuna (eels), īnanga (whitebait), koura (freshwater crayfish) and banded kōkopu towards Little Shoal Bay (Auckland Council, n.d.). LRBR and the surrounding area was originally known to Māori as Wai Manawa, which means source of water (Auckland Council, 2024). The stream flowing through this valley forms a waterfall where the descent of the Wai Manawa Stream is steep.

Le Roys Bush Reserve was bought in 1918 by Edward Le Roy and named Urutapu. Edward Le Roy established three ponds in which he grew water lilies and kept goldfish (Janssen, 2021). He culverted streams to prevent flooding and piped the stream under the ponds, formed tracks through the bush and planted many native plants from Great Barrier and other parts of New Zealand.

After his death in 1947, the reserve was purchased by a public subscription organised by Mr Prickett and members of the North Shore Branch of the Forest and Bird Society. Over time, more parcels of bush were added to the reserve.

In the 1970s, Little Shoal Bay became a rubbish dump used by the Birkenhead Council. Local communities protested this, by sitting on bulldozers. Eventually, the council decided to extend the reserve to include Little Shoal Bay.

In 2015, the mana whenua were consulted on the establishment of a lookout at the head of the LRBR stream and advised the name of the stream was Te Wai Manawa.

Some significant slips have occurred within the reserve as a result of exceptionally adverse weather of cyclone Gabrielle. As seen in Figure 1 overleaf, the slips are located in the upper section of the reserve, which fall towards the Wai Manawa Stream down a moderately steep gully. LRBR contains a diverse range of ecotypes, with the upper section (containing the two significant slips) being a broadleaf coastal forest with pockets of kauri trees, and the lower section of the reserve containing a large raupō (bullrush) freshwater wetland (Auckland Council, n.d.). A series of tracks run through LRBR containing boardwalks and steps measuring 2 metres wide at the narrowest point towards the slips.

Native trees and plants present within the section of the slips are: the king fern (*Ptisana salicina*),Kiekie (*Freycinetia banksii*), Kauri (*Agathis australis*), New Zealand begonia (*Elatostema rugosum*), supplejack (*Ripogonum scandens*), nikau palms (*Rhopalostylis sapida*), cabbage tree (*Cordyline australis*) and fivefinger (*Pseudopanax arboreus*; Auckland Council, n.d.; Auckland Design Manual, n.d.; New Zealand Plant Conservation Network, n.d.).

Within the slip areas (see Figure 10), there are some sizeable exotic species present such as inkweed (*Phytolacca octandra*) and woolly nightshade (*Solanum mauritianum*). However, the management of the reserve has focused on keeping New Zealand native and endemic species present through the removal of pest plant and weed species by community volunteers, such as the Pest-Free Kaipātiki Restoration Society (PFK) and the volunteers of FOLRB group (New Zealand Plant Conservation Network, n.d.; Pest Free Kaipatiki Restoration Society, n.d.).

The two slips are almost immediately adjacent to each other (see Figure 10), where slip 2 is on the true right bank of the Wai Manawa Stream, and slip 1 is on the true left bank of Wai Manawa Stream.

FIGURE 1: LOCATION OF SLIPS

Figure 1 shows the approximate location of the two major slips within the reserve. Stream and overflow GIS data were obtained from Auckland Council GeoMaps.

Natural Hazards

Due to the location of LRBR lying in a gully, natural hazards such as wind are reduced (see Figure 2 below) with LRBR being classified as a low wind zone. However, one natural hazard for this area is flooding, shown in Figures 1 and 2, which show how this section is close to a flood plain, a flood-sensitive area and an overflow path (an overflow path is the route water takes when man-made drainage networks are overloaded).

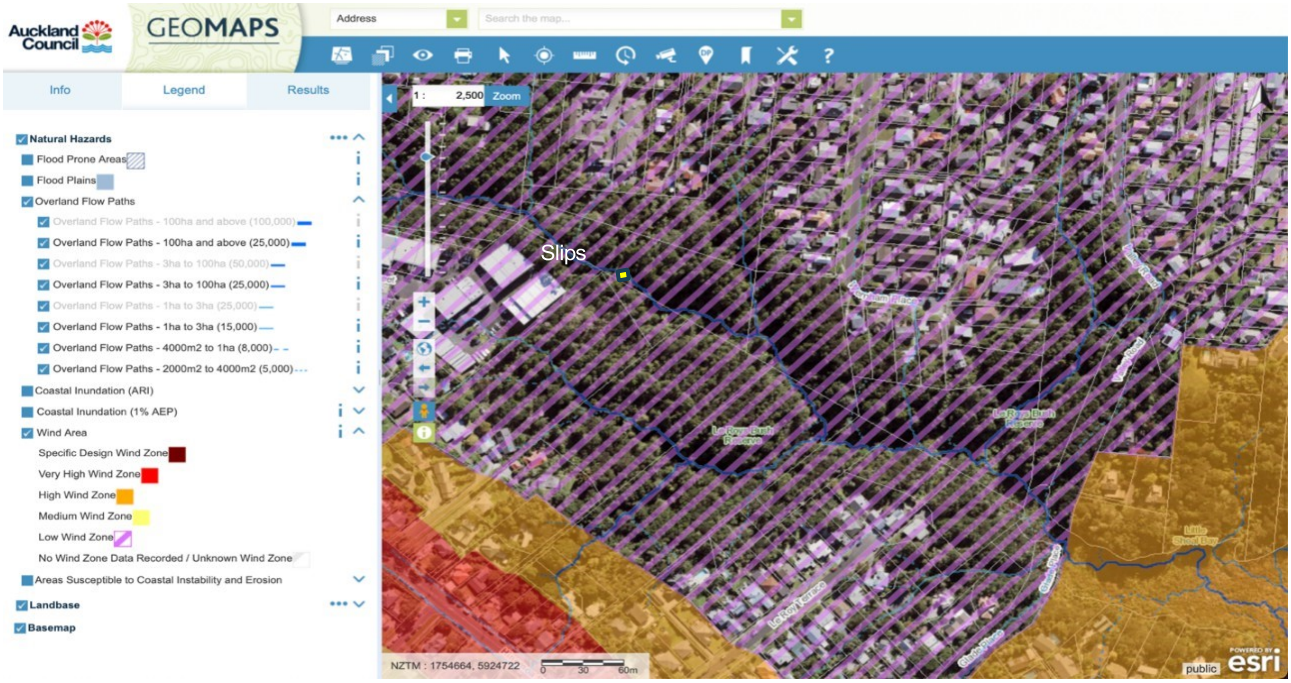

FIGURE 2: WIND HAZARD MAP

Slips Description

The slips occurred on the 27th of January 2023, during cyclone Gabrielle. Figure 3 shows post- slip photos taken by the community group FOLRB. A notable feature near the slips is the waterfall (seen in Figure 3), which is located approximately 17 metres NNW of the largest slip (slip 2) on the true right bank of the stream. It is likely that the weight of the water logged soil profile on the steep slopes resulted in the land slips at the two sites.

FIGURE 3: WATERFALL – A NOTABLE FEATURE

FIGURE 4: LOWER SLIP 1
Figure 4 shows the true left bank view of Slip 1 of which grass regeneration is occurring in the lower section. Prominent plants seen are Mānuka (*Leptospermum scoparium*), Nikau palms (*Rhopalostylis sapida*), New Zealand begonia (*Elatostema ru*gosum), and king ferns (*Ptisana salicina*).

Slip 1's horizontal distance from top to bottom was estimated from these coordinates to be approximately 20 metres at maximum, whereas slip 2 is estimated at 25 metres. Both slips are approximately 10 metres wide and approximately 17 metres in height (vertically); however, slip 2 has a much steeper angle (approximately a 45-degree angle from horizontal) and is therefore likely to be much more dangerous and difficult to restore. No large rocks or boulders are exposed as the soil horizon remaining at each slip is mostly clay-dominated subsoil (B horizon), with little organic matter present.

Before and After Analysis

Slip 1 is the smaller of the two slips and has a large amount of debris at the base. Grasses are growing and regenerating within this depositional zone which has good topography and water holding capacity for vegetation to colonise this area. Figures 5 – 6 overleaf show photos of regenerating vegetation. In some areas weed species such as inkweed (*Phytolacca octandra*) and woolly nightshade (*Solanum mauritianum*) have been outcompeting native species for space to regenerate. However, a few native species which are recolonising on the lower section of slip 1 are Mānuka (*Leptospermum scoparium*) and Coprosma (*Coprosma repens*), which are key primary and pioneer species. This highlights that the natural processes of succession and regeneration are still occurring for some native species (Department of Conservation, n.d.). Prior to the slip occurring (in 2018), a high percentage of king fern (*Ptisana salicina*) and kiekie (*Freycinetia banksii*) were present (Figure 7) and later recorded after the slip, buried within the debris (Figure 7).

FIGURE 5: SLIP 1 TAKEN IN MAY 2024

Figure 5 shows the true-left bank slip (slip 1) mid to top section, taken in May 2024.

FIGURE 6 PIONEER AND PRIMARY SUCCESSION PLANTS REGENERATING

Figure 6 shows the primary succession plants regenerating naturally at slip 1. The photo was taken in May 2024 approximately 1 year after the cyclone event. Colonising species include pōhuehue (*Muehlenbecia axillaris*), karamu (*Coprosma robusta*), Kānuka (*Kunzea ericoides*) and Rautahi (*Carex geminata*).

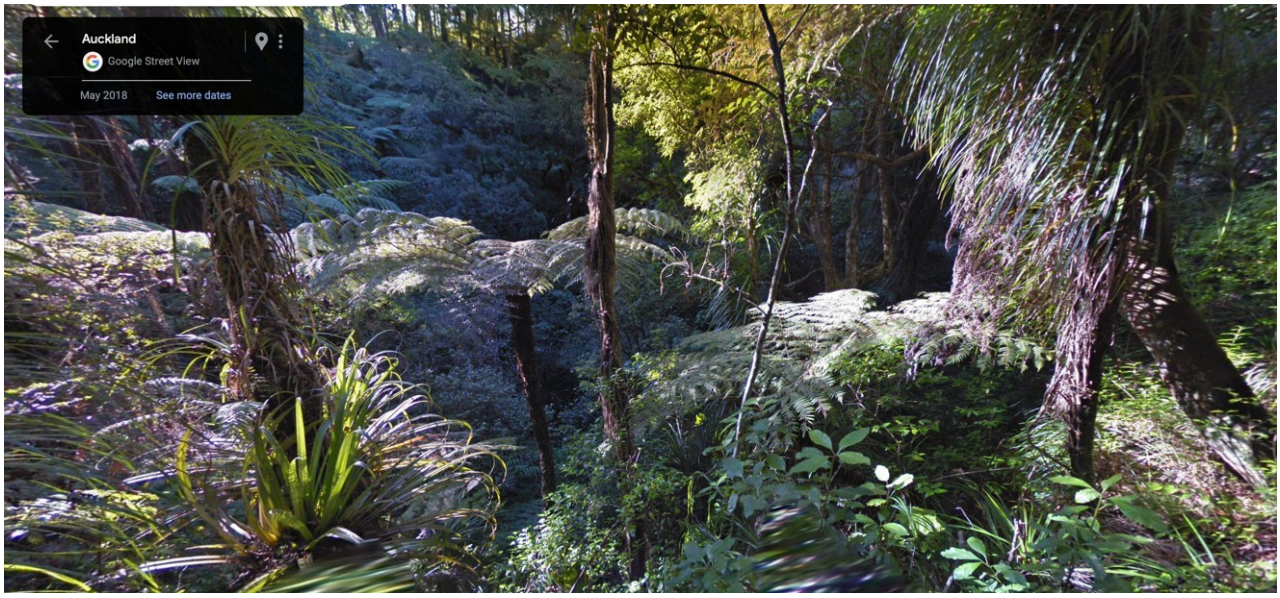

FIGURE 7: TRUE LEFT BANK VIEW OF SLIP 1 IN 2018

Figure 7 shows a true left-bank view of the slip location in 2018 (before the slips occurred), taken from Google Street View. This shows a large presence of king fern (*Ptisana salicina*) and kiekie (*Freycinetia banksii*) pre-slip. These photos provide a good reference to ensuring replanting selections and recommendations are appropriate for the reserve.

True Right-Bank Slip (Slip 2)

Slip 2 is the steepest of the two (although not as wide) and is characterised as a scar slip. Scar slips generally have a hard clay base with very little topsoil structure and steep topography that provides for poor regeneration of plants depending on moisture, soil fertility and further weathering of the surface (Environmental Topics, n.d.)

There is less evidence of regrowth at slip 2 when compared to slip 1, likely due to its steepness and lack of topsoil. Slip 2 is mainly comprised of soil horizons B and a minor amount of C, and therefore mostly clay; new plantings must be able to withstand a more moist environment with less fertile soil and less organic matter. Although these slips will eventually be repaired on their own by natural succession (Johnson, 2019), this may take a very long time, and may not reach previous productivity levels.

A study on scar slips after landslides in the Wairarapa found that areas, where soil was left to naturally generate over time, had reduced grass growth after several decades with no improvements, compared to those that did not have scar slips (Rosser & Ross, 2011). This indicates that slip remediation measures will likely be required for slip 2 to maximise ecological restoration potential.

FIGURE 8: TRUE RIGHT BANK SLIP

Figure 8 shows the true right bank scar slip taken from the board walk on May 2024. This feature has remained devoid of vegetation since the slip appeared after cyclone Gabrielle.

FIGURE 9: TRUE RIGHT BANK SLIP (SLIP 2) TOP (TOP) AND MID (BOTTOM) VIEW PRIOR TO THE CYCLONE

Figure 9 shows the top of the true right bank slip (slip 2) and mid areas prior to the cyclone (2018) taken from Google Street View. This shows that this area was previously vegetated with king ferns, coprosma, kiekie, and kahikatea.

Workable Areas

Figure 10 overleaf shows the relevant area around each slip, including walkways slip outlines, the waterfall, the stream, and other important areas of note such as likely hazardous zones and

potential walkways for enabling restoration efforts. This map was created in QGIS using GPS points taken during a site visit. The alternative track (orange dashes) marked on the map shows a potential route to access the southern side of slip 2 (along the walkway). However, this route's proximity to a nearby large kauri tree, the potential danger of spreading kauri dieback, along with a very slippery substrate during wet weather, makes this track potentially dangerous and is not recommended if alternatives are available. This track is not recommended for residents or community members, but only for site access for contractors and experts.

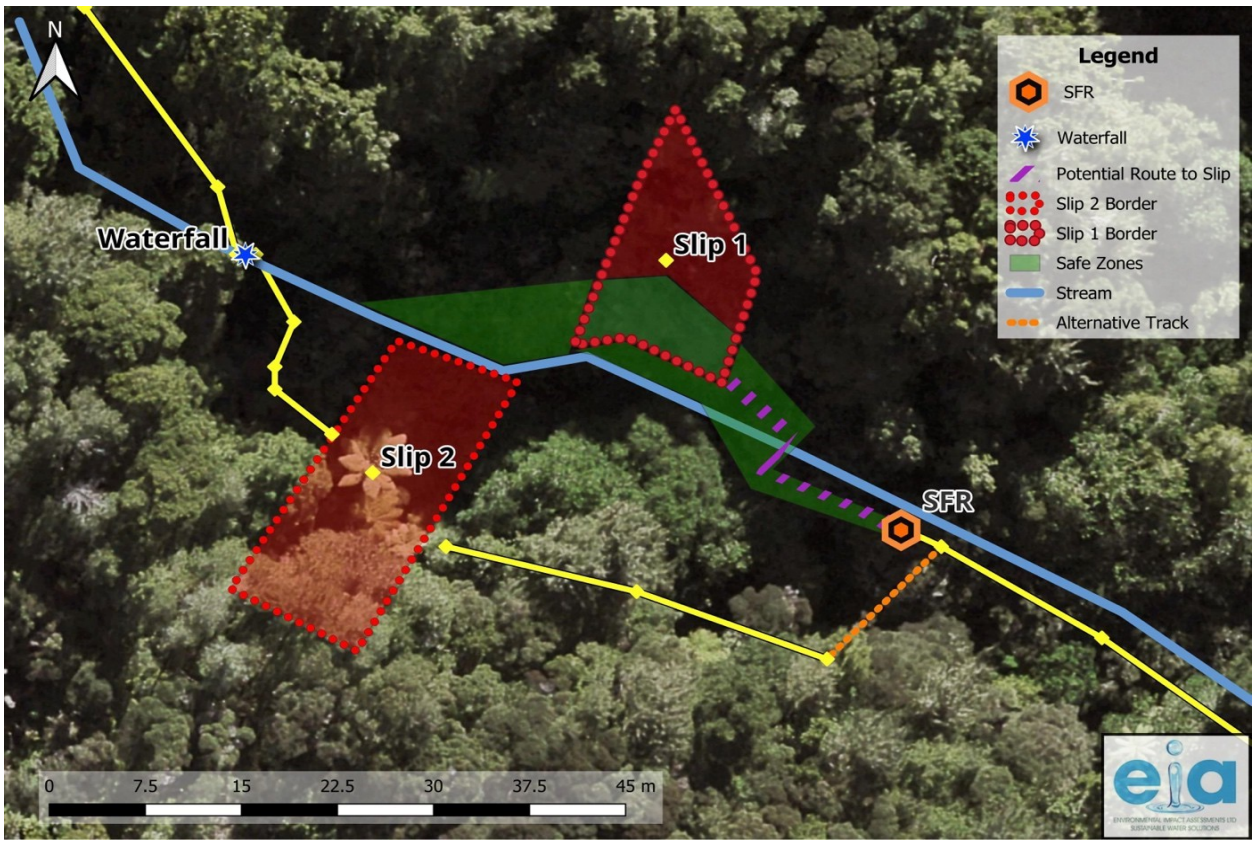

FIGURE 10: SLIP AREAS AND ZONES

Figure 10 shows the extent of the slip remediation project, with the orange marking labelled "SFR" for "Safety Feature Required" (SFR) indicating the location of a feature required to allow individuals working on the project to safely descend down from the path to access slip 1. The green polygon indicates a safe zone for which community plantings could be undertaken with minimal risk.

The safe zone (green polygon) should first be pegged out using waratahs and string to ensure community volunteers are working within a safe area. Polygons outside of the green safe zone are recommended for experienced contractors who have the expertise and equipment to work in potentially hazardous areas.

FIGURE 21: HANGING INFRASTRUCTURE IS HAZARDOUS

Figure 11 shows typical hanging walkway infrastructure that is unsafe for volunteers to be working near. This type of terrain and hazard risk is typical of areas outside the safe zone which is recommended to be worked on by experienced contractors.

Kauri Dieback Management Plan

Kauri dieback cleaning stations have been introduced to the reserve around entries and exits of tracks by the Auckland Council to combat the spread of this disease. Kauri dieback disease can easily be spread by water running through soil, soil on people's shoes, animals, tools and equipment or people walking off the tracks (Kaipatiki Community Facilities Trust, n.d.)

The Auckland Council are likely to require a kauri dieback management plan for any ecological restoration works occurring within scenic reserves. The plan needs to outline hygiene practices that will be employed to ensure that the risk of kauri dieback spread is minimised.

Ideally any hand tools should be sterilised with SteriGENE prior to and after any community works within the area. A temporary shoe scrub/wash station should be in place so that volunteers can clean their boots prior to entering the reserve. SteriGENE should be less than 6 months old, otherwise fresh solutions should be created to ensure maximum effectiveness of the sterilant.

No power tools or machinery are required for the planned restoration works therefore no vehicle or machinery wash stations are required.

Māori Significance

LRBR contains a diverse biodiversity, that local Māori people used for traditional medicine, food, water and plant fibres for weaving (Phillips & Daly, 2008). LRB's tracks are located in the valley which early Māori settlers used to follow in order to access pippi and fish such as Tuna (eels), īnanga (whitebait), koura (freshwater crayfish) and banded Kōkopu towards Little Shoal Bay (Auckland Council, n.d.). LRBR and the surrounding area was originally known to Māori as Wai Manawa, which means source of water (Auckland Council, 2024). LRBR contains diverse habitats for many significant plants that were used in everyday life for mana whenua such as Raupō (*Typha orientalis*), Kiekie (*Freycinetia banksii*) and cabbage trees (*Cordyline australis*; Auckland Council, n.d.).

This highlights the importance of including suitable plants when planting in an area which can hold significance to Māori. Consultation with mana whenua for this area would result in a more beneficial ecological and cultural outcome of the restoration project.

Track Management

The recent devastation of cyclone Gabrielle has resulted in a severe amount of damage to the reserve as a whole. Restoration of the reserve not only includes remediation of the slips but also includes replacement of damaged track infrastructure and potentially realigning of existing tracks to avoid future slip areas. This poses important implications for the ecological restoration plan to ensure any proposed work is not 'undone' for other reserve management reasons.

The Kaipatiki Local Board should be notified of any ecological restoration works undertaken by volunteers as the future management of this reserve is currently uncertain.

Current Erosion and Sediment Control Methods Used in New Zealand

Hydroseeding

Hydroseeding is the process of spraying a unique mixture of seeds, water, fertiliser, and mulch (called a slurry) onto the ground using a high-pressure pump unit. The units used are usually carried on a small trailer as they are made of steel and become heavy when filled. Hydroseeding protects against soil erosion by forming a hard sheet (erosion control blanket) which allows the seeds to grow and germinate within 5-7 days. The mixture stays moist from the properties of the mulch slurry, whilst protecting the seeds from natural elements like wind and (only moderate) rainfall (Evergreen Landcare, n.d.). Depending on the choice of mixture the hydroseed mix will naturally decompose (usually 12-18 months) allowing the seeds/new plants to root and take over to prevent erosion and sediment loss (A Good Turf Co Ltd, n.d.; Johnson, 2019). Hydroseeding is most beneficial for slopes that are prone to drying out, in high wind exposed areas, soil surface temperature fluctuating zones or low soil fertility areas as a slow-release fertiliser can be used (Evergreen Landcare, n.d.).

Hydroseeding has been used throughout New Zealand usually used by landscaping companies or construction companies for stabilising the sides on roads and highways. Some large-scale projects hydroseeding has been used for are Transmission Gully, Puhoi to Warkworth, Waikato

expressway, Christchurch southern motorway and Brynderwyn Hills (Evergreen Landcare, n.d.; NZ Transport Agency Waka Kotahi, n.d.).

Hydroseeding is not always successful as evidenced by the Brynderwyn Hills State Highway 1 works. With high rainfall the success rate in exposed areas is not always guaranteed.

FIGURE 3: BRYNDERWYN HILLS HYDROSEEDING FAILURE

A site visit was undertaken with Tony Littlewood from PGG Wrightson on May 2nd, 2024. Tony confirmed that hydroseeding would be particularly difficult to undertake for slips 1 and 2 because of the need for vehicular access to enable machinery access to the sites.

Hydroseeding is not recommended for slips 1 and 2 due to the inaccessibility of the site for a vehicle and trailer.

Seeds and Cuttings

A popular method currently used in New Zealand is the use of seeds and cuttings as these can be taken from a live developed planting but can offer less immediate effect as they are small in size, however once established this can offer an effective permanent control method (Phillips, 2005).

Mānuka seedlings do not tolerate shade and grow better on wet soils and low-fertility soils than kānuka. Stunted mānuka will even colonise sites with little or no topsoil, where only lichen and moss grows, and does better on stony soils compared to kānuka.

Mānuka seedlings are recommended to be planted within designated areas as there is already evidence that natural dispersal of Mānuka seedlings is occurring on the base of slip 1 (Boffa Mikell Limited, 2017).

Sediment and Erosion Control

Sediment and erosion control are important tools to minimise sediment inputs to streams when sites within a reserve are being restored. A silt fence on the stream side of the green safe zone is warranted to ensure minimal inputs to the Wai Manawa Stream occur (Evergreen Landcare, n.d.).

Geo textile control matting is often used in very steep areas to provide a stable substrate for

any plantings, while also preventing undercutting or further slips within an area. Control matting is not recommended within the safe green zone for volunteer planting as this area is unlikely to slip however this matting could have application in other areas by contractors.

MacMat® is a three-dimensional permanent erosion control mat composed of UV stabilized, non-degradable synthetic fibers with an additional structural skeleton of Maccaferri double-twisted steel wire mesh within the polymer matrix. MacMat® immediately increases the soil's resistance to erosion by providing an environment that enhances the growth of vegetation through the mat. Supplied in rolled form, MacMat® can be anchored to the slope surface using launched or drilled soil nails. Topsoil can be brushed into the voids within the matrix. Seed can be applied to the surface before or after MacMat® is installed as vegetation will develop unhindered by the matrix. MacMat is not needed within the volunteer safe zone however it could have application for steeper areas managed by contractors (GeoStabilization International, n.d.). Coir mat is a more natural alternative which has been used in Le Roys bush before. Native seeds can be embedded into the mat.

FIGURE 13: LEFT AREA COULD BE MATTED, RIGHT AREA PREVIOUSLY MATTED

Figure 13 shows an area that could be matted to prevent undercutting and movement. This is on the true right bank just after the waterfall. Figure 13 also shows an area that has previously been matted further north up the track.

In our view localised areas of matting could be undertaken in more gently sloping areas of the reserve, however for steep scars etc. it is strongly recommended to consult with a Geotech engineer first.

Pest Plant Management

As with all ecological restoration works, a pest plant management plan is required to ensure pest plants do not outcompete native plantings. For the 225m^2 polygon (the safe zone) the pest plant management is quite simple. Where you see a pest plant, dig it out and replace that spot with a native plant. If the pest plant is large you are better off to simply cut the pest tree to ground level and paint with an appropriate herbicide. Herbicide spraying should not be undertaken within the reserve area as you are working within a stream catchment that could be affected by herbicide sprays. Herbicide applications are most effective during spring and

summer as this is when the plant will most actively uptake the poison. Herbicide applications during winter are not warranted. Any application of herbicide through cut and paste must be a certified user of the product.

The two sizeable pest plants observed within the safe zone are tobacco weed and inkweed. The control methods recommended for these are tabled below.

TABLE 1: PEST PLANT CONTROL

Plant	Scientific Name		Control Method
Small tobacco weed	*Psolanum mauritianum*	Sustained control	Pull out seedlings and small plants
Large tobacco weed			Cut stump to within 2 cm of ground level. Teat stump with Tricholoram at 200 mls/L water or weed Actions Bly/Met mix.
Small Inkweed	*Phtolacca octandra*	Not a legally declared pest	Pull out seedlings and small plants. Leave on site to rot down to minimise disturbance.
Large inkweed			Cut stump to within 2 cm of ground level. Paint with a mix of 2g metasulfuron (MSF600) dissolved in 1 L of water.

Planting Plan

The planting area is a 225m^2 polygon contained within Le Roy's Bush in Birkenhead. The site has a NE to SW aspect for which the ground surface is moderately sloping towards the Wai Manawa Stream. The site is well shaded owing to the topography of the Wai Manawa Stream Catchment as well as the surrounding tall native podocarp trees. The site contains adequate topsoil to enable planting of native species and signs of ecological succession is evident. The ecological district for this area is the Tāmaki Ecological District.

An ecological district is a local part of New Zealand where the geology, topography, climate, plants and animals interrelate to produce a characteristic landscape and range of ecosystems.

The Tāmaki Ecological District includes the low-lying hills, pumice and other volcanic deposits of the North Shore, the Auckland isthmus as far south as Wiri on the edge of the Mānukau Harbour and across to Cockle Bay on the Waitematā Harbour.

Some of the reserves for which wetlands occur include:

- Waiatarua Reserve
- Onepoto Domain
- Chelsea Estate Heritage Park
- Anns Creek Reserve
- Coatesville Scenic Reserve
- Waikumete Cemetery.

The Auckland Protection Strategy, produced by the Department of Conservation in 2009, states that the original ecosystems found in the Tāmaki Ecological District included a network of freshwater wetlands and lakes formed by the blockage of drainage patterns by volcanic activity.

The report estimates that only one percent of the historic extent of freshwater wetlands remain in the Tāmaki Ecological District. The wetlands within this biodiversity focus area are therefore of high biodiversity value. This means the Le Roys Bush Reserve has a particularly important component of the Tamaki Ecological District owing to its extensive stand of raupo wetland for which the ecotype is classified as 'endangered' for this district.

In order for native plantings to have optimal survival it is recommended that any plants brought into the reserve come from within the Tamaki Ecological District. The nearest native plant nursery to this reserve is the Kaipatiki Project nursery located on Lauderdale Rd in Birkdale.

Pest plant management is outlined on page 19 of this report will be undertaken prior to planting. Digging out of pest plants is preferred as herbicide applications are less effective during the winter which is the season best suited for native plantings.

In my view mulching is not required within the safe zone for volunteer planting as the forest floor provides plenty of leaf and twigs to provide a damp layer and the reserve in general maintains a damp soil matrix given the low wind zone and high degree of shading due to the surrounding topography and tall trees close by.

The overall goal of this planting is to enhance with eco-sourced (from the Tamaki Ecological District) trees and plants that are typical of the area which will improve the biodiversity and ecological values of the site.

The total area proposed for supplementary planting is 225m^2 (see the green areas of Figure 10).

A list of plant species has been provided overleaf that incorporates a number of considerations including previous vegetation pattern, existing recolonising of vegetation within the slip areas, historical Māori use of vegetation and general forest ecotype. The density of planting and hence the number of plants proposed is low, because there is already vegetation establishing within the polygon.

If replacement planting is needed, suitable species should be assessed at the time of planting, as per the annual monitoring sheet included in the appendix of this report.

Planting quantity, density and grade

Most plants will be of 0.5 litre or ¾ grade. PB2s and PB5s would also be appropriate. In general, smaller plants will survive better over summer dry spells than larger grade plants. This is because of the larger root mass to leaf area volume than larger PB grade plants.

In the planting table overleaf a guide is provided as to how far apart each species needs to be planted in order to form an even cover over the area to be planted. Therefore if just one species is to be planted on one day, for example, planting at the spacings shown will result in an even cover of this species over the area. However, in practice some clustering may occur to give a more natural uneven appearance. Planting in lines or on a grid pattern should be avoided so a natural random look occurs.

Planting Calculator

Area 225 m^2 Project/Site Friends of Le Roys's Bush polygon

PLANTING

Species	Proportion	Spacing	No. of plants to use
King Fern	10 %	3 m	3
Kiekie	10 %	1 m	26
Kauri	5 %	5 m	1
NZ Begonia	20 %	0.5 m	206
Karamu	10 %	1 m	26
Five finger	5 %	2 m	3
Cabbage Tree	10 %	4 m	2
Manuka	10 %	1 m	26
Kanuka	10 %	1 m	26
Kahikatea	10 %	5 m	1
Totals	100 %		320

Tanekaha require well drained low fertile soils that are intolerant of poor drainage. Given the safe zone is close to a floodplain we have not included Tanekaha (Celery Pine) in the above table. Natural colonisation may occur however the above table is focused on colonising species suitable for the site.

Planting Methodology

One of the most important aspects of successful planting is to ensure that root disturbance is kept to a minimum and that air spaces are not left between the root system and the soil. To achieve this, the seedlings need to be well heeled in. This is helped by carrying out plantings when the ground is damp, ideally after rain in late autumn.

The seedlings should be planted into holes twice the size of the root ball. The roots should be loosened at the base of the root mass prior to planting to aid root growth away from the root ball. Extra care should be taken in doing this with Mānuka and Kānuka otherwise they may be easily damaged. If the soil has a low organic matter content, it may be helpful to mix some organic matter with the soil at this time.

Regarding fertilisation, a small amount of slow release fertiliser added to the hole at planting time can help get the plants off to a good start. This fertiliser should be well mixed with the soil and not in direct contact with the plant roots, as this may burn the plant. Alternatively, it is also suitable to place a fertiliser tablet in the hole on the upslope side of the plant.

Maintenance of planting

The table overleaf outlines when activities such as initial planting, fertilisation, weed control and replacement planting should be undertaken. Planting should begin in late autumn once the ground has become wet, or in winter. Ideally planting will be complete by July.

The most intensive management and maintenance will be required over a five-year period. Auckland Council may require a progress report on the success of plantings and any pest control. The report should comment on the progress and general health of the overall planting, identify any problem areas, and make recommendations to address any problems. The recommendations must then be implemented. The following year's report should then comment on the success, or otherwise, of the implemented recommendation. An example annual monitoring sheet is included at the end of this report.

Potential problems may include plants in certain areas not performing to expectations due to low soil fertility, excessive dryness or dampness, or the presence of insect pests or diseases. Remedies may be the provision of additional fertiliser or soil testing to identify any nutrients at levels too low to allow good plant growth. The identification of any pests or diseases may result in the need to apply pesticide or fungicide to control the problem. If excessive dryness is identified as a problem in areas then the use of mulch may need to be considered depending on the level of the problem. Any replacement plants should be of the most drought resistant varieties and have water retaining gels mixed with soils placed back into the hole. The early identification of problems will allow for the most expedient fix.

Annual maintenance cycle for establishing revegetation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1	*	* Ж		* •	# Ж	#	#	#Ж			*	
Year 2	*			∇ • *	∇	∇	∇	Ж			*	
Year 3	*			∇	∇	∇	∇	Ж			*	
Year 4	*			∇				Ж			*	
Year 5	*			∇				Ж			*	

= Initial planting • = Fertilisation if required
* = Weed control Ж = Pest control
∇ = Replacement planting of dead or poorly performing individuals.

DISCUSSION

This report has provided a comprehensive assessment of two slip areas located within Le Roys Bush Reserve and the necessary work required to remediate the areas in a safe and ecologically sustainable manner.

A safe zone polygon has been identified for which volunteers of the Friends of Le Roy's Bush could undertake pest plant control and native plantings. A safety feature (either a ladder or steps) is required for access to the safe zone polygon to ensure that members of the community can help with restoring this portion of the reserve.

Outside of the polygon is recommended for restoration by contractors who have the skills and necessary equipment to undertake this work in a safe manner. A geotechnical assessment may be required before any contractor undertakes work in these areas. There is hanging track infrastructure in these areas that should be avoided by the community as it poses health and safety risks.

A kauri dieback, pest plant and native planting plan is provided in this report that enables the community to get on with ecological restoration within the reserve. A progress report template is provided in Appendix 1 of this report which should be undertaken yearly and submitted to Auckland Council.

Long term management of the reserve has not been discussed in this report as this is something likely to be formulated by Auckland Council or the Kaipatiki Local Board. It has been stressed in this report that any restoration works undertaken by Friends of Le Roy's Bush should be communicated with relevant groups including local mana whenua, Auckland Council and Kaipatiki Local Board.

The Le Roy's Bush Reserve is a regional icon to the Tamaki Ecological District and should be given a high priority for this ecological restoration to proceed.

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Appendix 1: Annual Monitoring Field Sheet for Native

These sheets must be completed on an annual basis and submitted to Council for a five-year period follo completion of the planting. The release of the various stages of the bond will require the satisfactory completio sheets and work as outlined in the maintenance schedule.

Administration

Date (dd/mm/yyyy): _____

Resource consent number: _____

Address: _____

Property owner and contact details: _____

_____

Has property changed owners in the last year, yes or no? _____

If yes, who was previous owner? _____

Survival Rate

Percentage survival: _____

Growth estimate (cm/year): _____

Percent ground cover (native vegetation): _____

Fertilisation

Date applied (dd/mm/yyyy): _____

What was used: _____

Areas applied: _____

_____

Quantity used: _____

Weed control

Date undertaken: _____

Sprays used: _____

Weeds targeted: _____

Areas targeted: _____

_____

Replacement planting

Date undertaken: _____

Species being replaced: _____

Species planted: _____

Number of plants replaced: _____

Problems

(for example are certain weeds proving difficult to control and detrimental to the planting, are animal pests causing significant problems)

Nature of problem: _____

Possible solutions: _____

Analysis of plant losses

(are losses greater than expected, are there any obvious reasons, are losses in certain areas, are certain species showing high losses, what are possible solutions?)

Appendix 2: Native Plant Species Preferences

PLANTING	SUN/SHADE	SOIL WET/DRY	SOIL FERTILITY	NOTES
Karamu (Coprosma)	Shade	Well-Drained	Highly Fertile Soil	Sandy Soil Preferred
NZ Begonia	Shade	Wet	Low Fertility	Acidic Soil Preferred
Mānuka	Part Sun/Full Sun	Wet	Low Fertility	Can Have No Topsoil, High Erosion Control
Kānuka	Part Sun/Full Sun	Dry/Well-Drained	Moderate-Good	High Erosion Control
King Fern	Shady	Damp	Highly Fertile (Rich)	Endangered Species (At risk)
Cabbage Tree	Full Sun/Light Shade	Occasional Wetness/Well-Drained	Moderate-Good	Sandy/Clay Soil Preferred, High Erosion Control
Five Finger	Full Sun/Light Shade	Damp/Well-Drained	Fertile Soil	Good Colonizer of Clay Banks
Kahikatea	Light Loving/Part Shade	Poor Drainage/Moist	Fertile Soil	Likes River Flats/Swamps, Alluvium Soils (Loose Clay, Silt, Sand, Gravel Deposited by Running Water)
Kiekie	Shady/Full Sun	Wet/Moist Soil	Rich Soil	Clay, Silt and Sand Loving
Kauri	Full Sun	Moist/Well-Drained	Fertile Soil	Can Tolerate Low Soil