File Ref: BM200252_035_A4L_ECO_LIZ_Mitigation.mxd

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Data Sources:
Designation sourced from DCC 2GP online
Landfill design and road footprint sourced from GHD

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Smooth Hill Designation (2GP)
- Access Road
- Landfill Footprint
- Stockpile
- Operations Area
- Mitigation Planting

SMOOTH HILL LANDFILL

Potential buffer planting

Date: 26 May 2021 | Revision: 0

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: BMc | Checked: SKi

Figure 5

Native plants have been chosen based on plants that may have been in the area historically, which provide ideal lizard habitat including a variety of shrubs, trees and low growing ground cover plants (see Vegetation Restoration Management Plan, Boffa Miskell 2021b).

Areas to be cleared, which surround indigenous vegetation and potential lizard habitats, should be temporarily fenced with silt-fence material to prevent the dispersal of lizards out of these areas into the construction footprint.

An appropriate predator control programme is to be designed and implemented within the designation site to prevent large scale influx of rodents and mustelids prior to the construction on site, which includes focusing on areas which are likely to remain, such as West Gully 2 and 3. Lizards are acutely threatened by mice and rats, as well as mustelids such as weasels and stoats. We recommend that ongoing trapping is implemented in these areas (as detailed in the plant and animal pest control detailed in the draft Landfill Management Plan, Boffa Miskell 2021a).

3.3.5 Residual effects

Creation of predator corridors and increased edge effects: increased edge effects and predator corridors are likely to form around the edges of the landfill footprint. In turn, without buffered planting between the landfill and any remnant of native scrub, there will be increased edge effects, including but not limited to soil / sedimentation run off; dust suppression; predator influx.

Ongoing disturbance through increased traffic: there will be increased traffic and people as a result of the landfill and road upgrade. This will negatively affect lizards by disturbance, with potential for harm / injury or death.

Increased dust deposition through dust from landfill: traffic into the landfill and trucks dumping waste may expose the remaining indigenous vegetation and lizard habitat to increased dust deposition.

Inability to salvage all lizards within the footprint: we acknowledge that the methods of survey and capture of lizards are imperfect and, as a result, it may not be possible to salvage every lizard within the construction footprint. It is likely that some lizards may not be detected during salvage and will be injured or killed as a result.

4.0 Lizard salvage, transfer and release

All surveys and salvage must be undertaken no more than 2 weeks prior to commencement of road widening (including associated works such as vegetation clearance).

All lizard salvage and surveys must be carried out between October and March inclusive (weather dependent).

Surveys must be undertaken in mild, fine conditions with preferably little wind, with daytime temperatures ranging between 15 and 25 degrees (lizards are most detectable within this temperature range).

Any lizard habitat will be clearly demarcated. Any disturbance outside of this area must be avoided. The demarcation will be communicated during an osite meeting with the contractor two weeks prior to clearance.

4.1 Lizard salvage methods

4.1.1 Before habitat clearance

If the habitats are still present within the landfill footprint and road edges:

Methods for skinks and geckos

Tracking tunnels (as of May 2021) have not yet been accepted as an approved standard method for surveying lizards, however, they are currently used in a range of situations to determine lizard presence (M. Lettink pers. Comm. May 2021). Tracking tunnels do not determine species present but do indicate presence of lizards.

Tracking tunnels will be installed within the rank grassland vegetation within the landfill footprint, and any habitat identified by the project herpetologist. Tracking tunnels will be installed at a spacing of 10 m, and baited with pear. These can be set up and left in place for ideally 2-3 months prior to construction. Tracking tunnels will be checked and refreshed every 10 days to ensure ink does not dry out, and bait is fresh.

If lizards are found to be present:

A combination of pitfall trapping and funnel trapping of McLaren Gully and Big Stone roads will be carried out in stages in order to adequately salvage the area with enough time consideration given for each stage. Traps will be placed at 10 m spacings in habitat deemed suitable for lizards and baited with tinned pear and checked once daily.

All traps will be left for a minimum of four trap days (three nights). After the fourth night, if no lizards are caught then salvage will cease. If more than 20% of the traps are still catching lizards, then salvage will continue until less than 20% of traps capture lizards.

Each stage of the road will be treated as an individual salvage event. For example, the start of McLaren Gully Road at the intersection of State Highway 1 will be the first stage of salvage (Table 6, Figure 6).

Table 6. Summary of survey methods, stages and areas to be surveyed and/or salvaged. TT = tracking tunnel

Area	Stage / Section	Approx. No. of TTs and / or Traps required	Size / Length of habitat	Road Side
SH1 intersection – McLaren Gully Road	One	100	500m	Northern and Southern
McLaren Gully Road – First Forestry Road to Northern pine block	Two	80	400 m	Northern and Southern
McLaren Gully Road End of northern pines to Forestry Road	Three	120	600 m	Northern and Southern
McLaren Gully Road - Forestry Road sweeping bend	Four	25	250 m	South western side
McLaren Gully Road – Forestry road to end of toitoi beyond eucalyptus	Five	65	650 m	Mostly Northern side
Big Stone Road intersection to Landfill	Six	35	350 m	On Landfill side of the road

4.1.2 Road widening Stage One – Stage Six

It is impractical to consider salvage for all stages if skinks are not found. The following is an adaptive management approach to address this.

- If no lizards - move on to next stage.
- If only one or two skinks detected in tracking tunnels salvage may be avoided **ONLY IF** West Gully 3 is protected from residual effects (see Section 5.0).
- If one or two species of skink or gecko is recorded (i.e. prints differ enough to determine species difference) but less than 20% tracking tunnels within a stage have lizard presence, salvage must be carried out.
- If more than 20% of tracking tunnels within a stage have lizard presence, salvage must be carried out in this stage, and release site must be enhanced.

File Ref: BM200252_036_A4L_ECO_LIZ_Staging.mxd

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Data Sources:
Designation sourced from DCC 2GP online
Landfill design and road footprint sourced from GHD

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Smooth Hill Designation (2GP)
- Access Road
- Landfill Footprint

SMOOTH HILL LANDFILL

Lizard Survey and/or Salvage Staging

Date: 04 June 2021 | Revision: 1

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: BMc | Checked: SKi

Figure 6

4.1.3 Salvage Review Prior to construction of Road and landfill

This plan is written using best practice approved methods at the time of writing and methods may change or adapt based on new research and development of new tools. We consider that species composition may also change prior to the construction of the landfill and road widening.

Further, the effects, remediation, mitigation (including the choice of salvage as a mitigation tool) may change over time, and must be reviewed prior to the construction of the landfill and road widening.

4.1.4 Data collection

Lizard capture data will include species identity, sex, length, tail regeneration, notes on scale / lamellae / feet / mouth / pattern colouration (if there is any doubt about species identification), GPS coordinates and a habitat description for the capture location, date and time. Weather conditions will be recorded during and at the beginning and end of each salvage or survey event.

If possible – depending on the species caught – the weight, reproductive condition, photos suitable for individual identification, scale counts / macro photographs of feet / head scales for species identification and tail tips will be collected. Tail tips will be taken following the DOC standard operating procedure for sampling avian and reptile tissue. This is especially necessary in cases where skinks are caught but not able to be identified to species level.

4.1.5 Transportation

Lizards will be held individually in cloth bags in a secure, vented container out of the sun. Lizards will be transported to the release site within 12 hours of capture.

4.2 Risk associated with proposed management

Potential risks to lizards as a result of the proposed salvage include:

- Overheating: lizards will be placed in individual containers and kept in a cool place until released. Handling will be minimised to ensure they do not become stressed. All traps will be checked daily in the morning.
- Overcrowding: it is likely that any population of lizard within habitat within the proposed release area is under pressure from predation and is therefore not at carrying capacity, and as a result overcrowding is not likely to be a risk.
- Competition: it is likely that any population of lizard within habitat within the release site is already under extreme pressure from predation and is therefore not at carrying capacity, and as a result competition is not likely to be a risk. A lizard survey will be required to be carried out within the release area prior to release to determine species presence and abundance.
- Displacement: any lizards are likely to be released within habitat similar to where they were captured and within the same geographic range, however the effects of displacement can only be minimised and not eliminated.

- Injury / death: all lizards will be captured or supervised by an appropriately qualified herpetologist, following best practice and full hygiene protocols, minimising the risk of injury, death and disease transmission through inappropriate handling and capture.

5.0 Lizard release site assessment

5.1 Release site options

If salvage and release is deemed the best lizard management option, we propose two options for releasing lizards: Smooth Hill Reserve (West Gully 3 – within the designation) or Brighton Beach (Brighton / Taieri Mouth Marginal Strip) (Figure 7). Table 7 addresses the criteria for consideration of a site for lizard release.

West Gully 3 comprises tall kanuka treeland, surrounded by pine plantation. West Gully 3 is east facing and has some low growing vegetation, which is suitable for lizards (Figure 8, also see Boffa Miskell, 2021b). ACOs placed along the edge of the habitat may have had skink presence with scat recorded within these during surveys.

The Brighton / Taieri Mouth Marginal Strip comprises remnant coastal vegetation, including flax, cabbage tree, gorse, hebe, bracken, rank grass, marram, and mapou (Figure 7). The marginal strip has not been surveyed for lizards.

These two options have been considered based on the potential for lizards to be present within the designation site and in habitat adjacent to McLaren Gully and Big Stone roads. West Gully 3 is the preferred option but will require buffering from forestry and residual landfill effects. The rationale is provided below, considering the mitigation of the effects from landfill:

- West Gully 3 must be protected from adverse effects (including felling, removal of scrub, pest plant species encroachment, and sediment deposition).
- appropriate and long-term predator control including rodent and mustelids.
- fencing (at least mesh, ideally UV stable woven material) of the surrounding West Gully 3 with a 10 m buffer around the edge.
- removal of pine plantation and associated pest plant species from within the 10 m buffer.
- in addition, a lizard survey of the release site must be carried out prior to release to determine its suitability – this may include DOC approved methods and any new methods that have been approved since this plan draft.
- prior to construction of the landfill and road widening, if the project herpetologist does not deem this release site suitable, we propose Brighton / Taieri Mouth Marginal Strip the next suitable release site.

The release site has been selected based on its ability to accommodate lizards within habitats similar to those from which they were captured. Further considerations included Principles 6, 7 and 9 of the Lizard Salvage Guidelines (Department of Conservation, 2019).

Table 7: Assessment of lizard release site options based on Principle 6 of the Lizard Salvage Guidelines (DOC 2019). Both options are tabled and are in bold where management of the release site may differ.

Principle relating to salvage and release	Description	Detail/Activity
1. The site must be ecologically appropriate and have long-term security	**Resident lizard communities must be understood** *Will released lizards increase viability of population, or be released in high enough numbers to start new population?*	A lizard survey of the proposed release site to be undertaken prior to construction.
	The release site must be an appropriate distance from the impact site to prevent lizard homing, but close enough that it provides similar habitat	The release site has similar habitat – consisting of rank grassland, low scrub and *Muehlenbeckia* and would be an improvement on the habitat available in the impact site.
	The location must be within the species natural geographic range. *Ensure no mixing of potentially genetically structured populations.*	The location of the release site is within the geographic range of the southern grass skink, cryptic skink and korero gecko.
2. The habitat at the site must be suitable for the salvaged species	**Vegetation composition and size:** predominantly indigenous vegetation and sufficiently large and continuous for residents, release lizards and allowing for population growth.	The habitat in both proposed release sites is similar to the impact site, comprising rank grass, regenerating scrub, low *Muehlenbeckia* species. The habitat is continuous and provides habitat along a 2 km marginal strip.
	Must contain sufficient resources for potential population. e.g., food, cover, retreats. What enhancements are proposed for expanded population?	The habitat may contain low numbers of lizards so food cover and retreats are already sufficient, however planting of lizard friendly plants is proposed for the buffer of **West Gully 3**
	Habitat enhancement – must be ongoing in an ecologically relevant timeframe	**West Gully 3** Planted along edges with lizard friendly habitat and pine trees and gorse / broom will be removed
	Edge effects – The release site must be buffered from intermittent climatic extremes, such as drought.	**West Gully 3:** Must be buffered from edge effects by fencing at least a buffer of 10 m, planted with lizard friendly plants including *Muehlenbeckia, Gaultheria* and *Coprosma spp.* **Brighton Marginal Strip:** Not buffered from climatic extremes such as sea level rise / storm surge however this is not considered a high risk given the proximity of the Pacific Ocean. (Dunedin City Council, 2014)
3. The site must provide protection from predators	*Habitat must protect from predators, or effective pest control must be in place. Must include full suite of predators including trapping for mice*	See plant and animal pest control as detailed in the draft Landfill Management Plan (Boffa Miskell 2021a)
4. The site must be protected from future human disturbance	*Land tenure must ensure long term protection from disturbance*	**West Gully 3**: will be protected in the long term from disturbance following the conditions above (restoration planting, fencing and predator control) **Brighton Marginal Strip:** is a DOC reserve but under different rules than general DOC conservation areas.

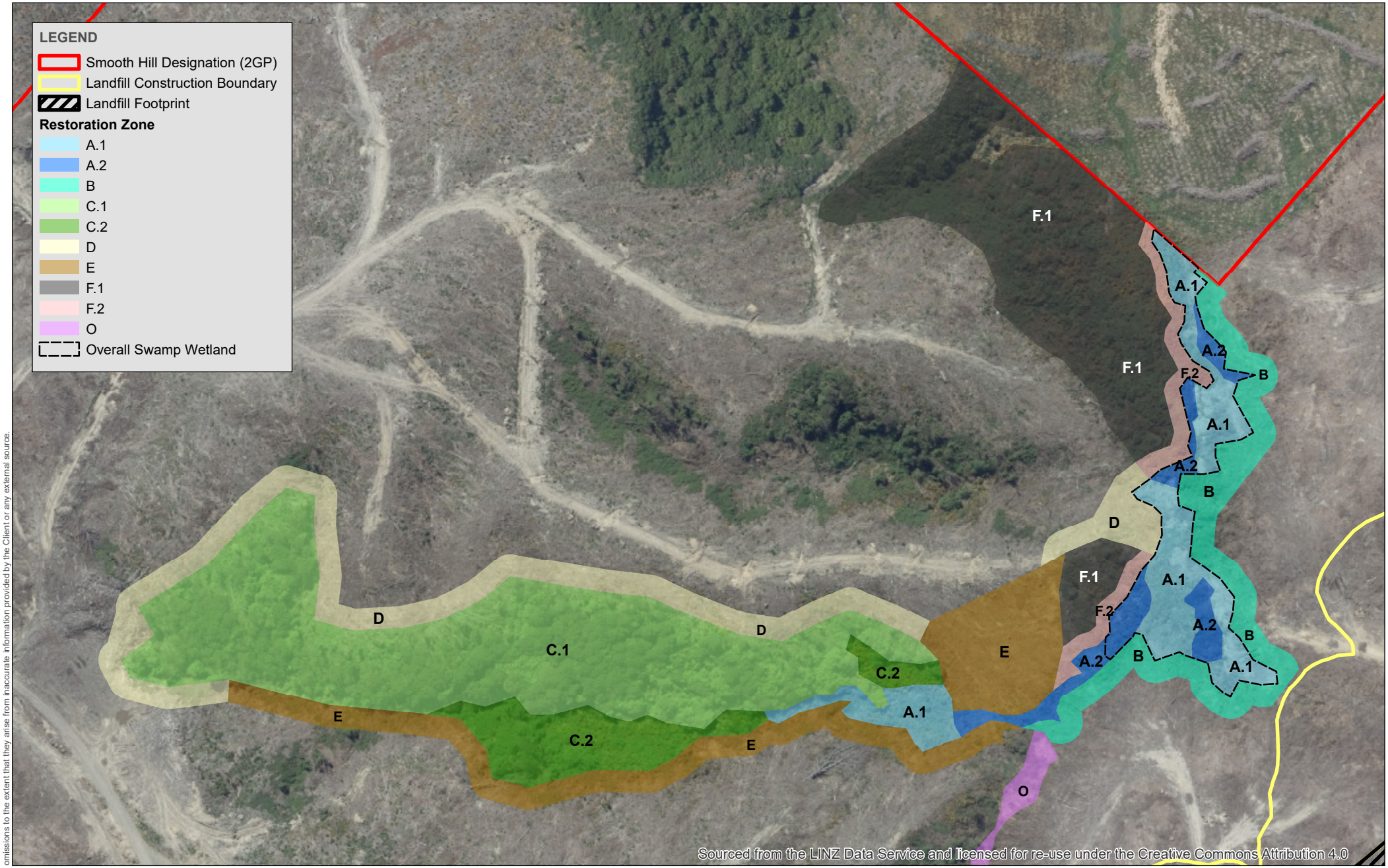
Figure 7. Habitat along the marginal strip at Brighton Beach.

5.1.1 Restoration of the buffer around West Gully 3

The Smooth Hill Vegetation Restoration Management Plan (Boffa Miskell, 2021) describes the vegetation restoration required for the restoration of West Gully 3 and surrounding area.

- Zone A.1 – existing wetland – weed removal
- Zone A.2 – existing wetland, degraded area – weed removal and planting
- Zone B – wetland buffer – weed removal and planting
- Zone C.1 – existing regenerating forest – weed removal, minor planting
- Zone C.2 - existing regenerating forest, degraded area – weed removal, planting
- Zone D – forest buffer – weeding and planting of lizard friendly species
- Zone E – additional plantings area – removal of pines, minor planting
- Zone F.1 – weedy regenerating scrub – leave to regenerate
- Zone F.2 – weedy regenerating scrub – weed spraying buffer
- Zone O – additional wetland offset area – weed removal and planting

File Ref: BM200252_030_A4L_Wetland_Plan_Fig3.mxd



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Data Sources:
Designation sourced from DCC 2GP online
Landfill design and road footprint sourced from GHD

Projection: NZGD 2000 New Zealand Transverse Mercator

SMOOTH HILL LANDFILL

Detailed restoration plan for West Gully 3 - proposed lizard release area (reproduced from Boffa Miskell 2021b)

Date: 04 June 2021 | Revision: 1

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: JMo | Checked: TBI

Figure 8

5.2 Predator control at the release site

The Landfill Management Plan (Boffa Miskell, 2021a) details predator control at the release site:

Initial Work

Subject to the preparation of a detailed Pest Control Programme prior to the construction of the landfill, it is anticipated that the following procedures will be employed at the Smooth Hill Landfill to manage plant and animal pests.

5. *Establish a rodent control network around the landfill site using bait station and/or traps which reflect industry best practice.*
6. *Reduce the possum population to 30% Waxtag Index to enable the ease of ongoing population maintenance.*
7. *Establish a predator (mustelids, possum and rat) trapping network across the wider site to protect native species.*
8. *Establish a network of devices to control mice in West Gully 3 to protect lizards*

Further, predator control will be set up in the release site with a pre-control monitor, including using tracking tunnels within a small area of the release site. Tracking tunnels are an appropriate method for monitoring predators within the release site as they monitor for both rats and mice.

We consider that mouse and rat control should be undertaken in the release site in the form of bait stations and traps for the life of the landfill (traps will be a mixture of A24 self-resetting and manual traps). Bait stations and traps will be set out across the chosen lizard release area in a grid at 20 x 20 m spacings, checked and refilled quarterly. The original post-release tracking tunnels will be monitored before and after a bait pulse to adapt bait levels accordingly to ensure that baiting is sufficient for the site. Suitably experienced contractors will administer the bait stations and monitoring at the site.

Predator control at the release site must be approved and reviewed by the project herpetologist and by DOC prior to implementation.

5.3 Release methods

Any lizards caught will be released into habitat within the lizard release site where there is appropriate ground cover. The baseline lizard survey will determine the distribution of lizards resident in the site. Any korero gecko will be released into rock piles in aggregations (if more than one is found at any time).

6.0 Contingency Actions

The purpose of contingency actions is to ensure that there is no net loss of lizards and lizard habitat post development, or in the event that lizard salvage and transfer fail or be only partly successful.

Proposed contingency measures are detailed in Table 8.

Table 8. Proposed lizard mitigation and compensation measures for the Landfill and road widening.

Measure	**Contingency Action(s)**	**Frequency / timing**
Salvage and transfer of lizards (mitigation)	Capture and relocate lizards from the affected area prior to the start of construction to reduce mortality. Skinks will be captured in funnel and/or pitfall traps using best-practice methods. Skinks will be released into a 1.9 Ha release site (West Gully 3).	Salvage dependent on timing of construction. Report lizard salvage results to DOC, including submission of ARDS (Amphibian & Reptile Distribution Scheme) records.
Cryptic skink discovery	If **cryptic skinks** are discovered during salvage, we recommend fencing the regenerating treeland and wetland offset area at West Gully 4 this area and incorporating it into the Smooth Hill Reserve Area (Figure 8; Boffa Miskell 2021b).	Dependent on the outcome of salvage
Release site	A contingency approach if more than 150 lizards are salvaged from the project, was recommended but has since been incorporated into Boffa Miskell (2021b) (enhancement to be carried out along the scrub face (see Figure 9, also Boffa Miskell 2021b), to allow for extra habitat.	Dependent on the outcome of salvage
Post-release monitoring	Post-release monitoring will be carried out.	Annually for three years in late spring / early summer. Report results to DOC on conclusion of the monitoring (see Section 7.0 below)
Predator control	If < 20 skinks are salvaged, mouse and rat control will be undertaken at the release site	Bait stations will be baited, traps checked and refilled

Measure	Contingency Action(s)	Frequency / timing
	in the form of bait stations set out across the lizard release site.	quarterly for the life of the landfill.
Restoration planting	If lizards are recorded during pre-clearance lizard surveys of the development site, contingency actions include: • Buffer revegetation around the edge of the West Gully 3 release site, if chosen.	To be determined if lizard salvage is required.

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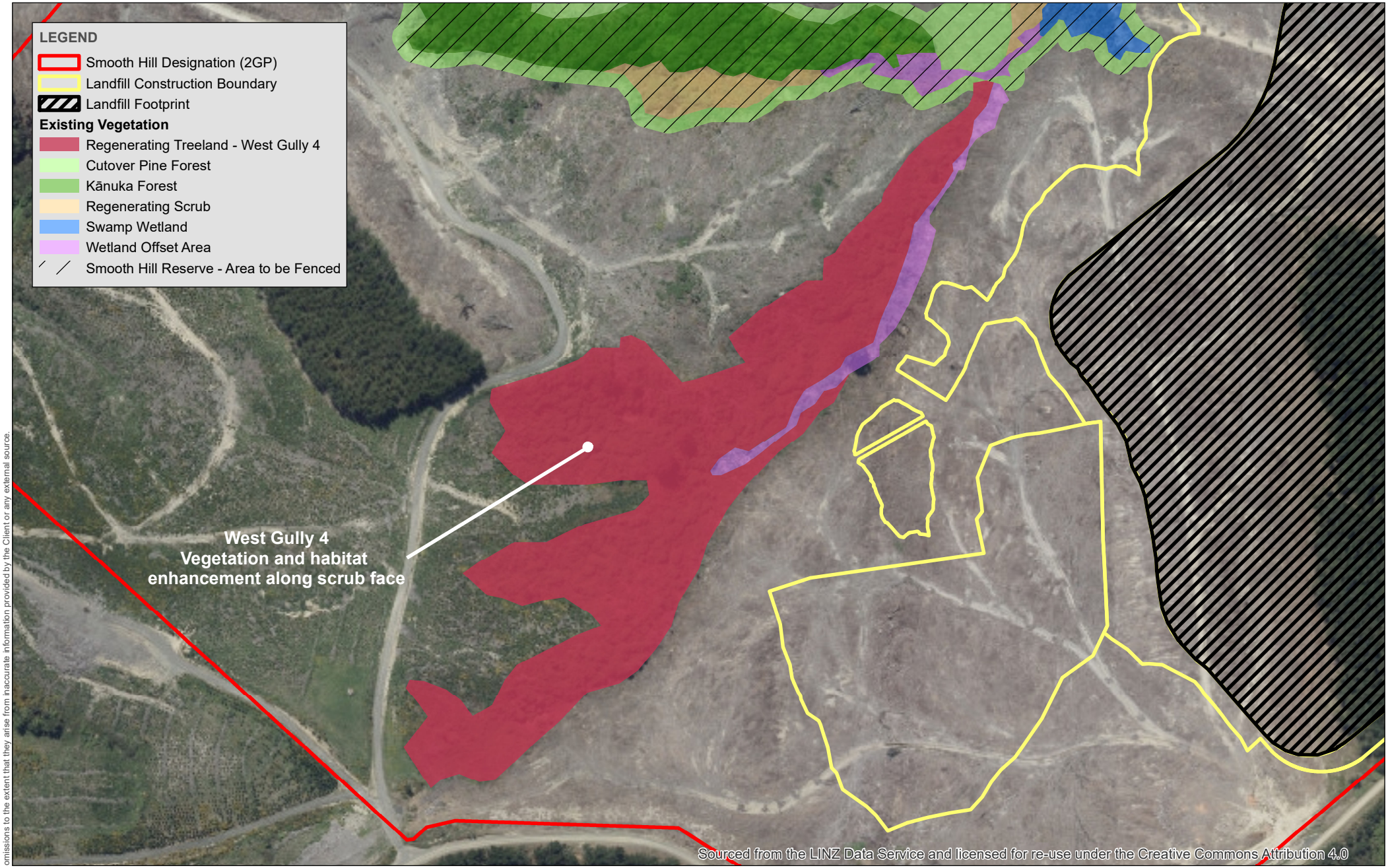

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Data Sources:
Designation sourced from DCC 2GP online
Landfill design and road footprint sourced from GHD

Projection: NZGD 2000 New Zealand Transverse Mercator

SMOOTH HILL LANDFILL

Further area to be enhanced based on accidental discovery of cryptic skink

Date: 04 June 2021 | Revision: 0

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: JMo | Checked: TBI

Figure 9

7.0 Post release monitoring and reporting

7.1 Post-release monitoring

The following post-release monitoring must be followed if:

- >20 individuals of the most abundant 'Not Threatened' species = 3-year monitoring programme.
- >20 individuals of the most abundant 'At Risk' species = 5-year monitoring programme.

If ≥20 individuals are salvaged, monitor lizards in the chosen release site for a period of 3 years following their release to determine population persistence. This will be assessed using footprint tracking tunnels. Post-release monitoring will be carried out annually for three years in late spring / early summer.

7.2 Reporting

Post-release monitoring will be reported to DCC and DOC at the conclusion of the monitoring, unless changes occur such as a population crash, the condition of the release site deteriorates, or high predator influx occurs. If any of these scenarios occur, consultation with DOC will be undertaken to determine the best solution.

8.0 References

Boffa Miskell (2021a.) *Smooth Hill Landfill: Draft Landfill Management Plan. June 2021.* Report prepared by Boffa Miskell Limited for Dunedin City Council.

Boffa Miskell (2021b). *Smooth Hill Landfill: Vegetation Restoration. Draft Management Plan. June 2021.* Report prepared by Boffa Miskell Limited for Dunedin City Council.

Dunedin City Council (2014). *Coastal hazards of the Dunedin City District. Review of Dunedin City District Plan – Natural Hazards.* Prepared by Otago Regional Council.

Hitchmough, R.; Barr, B.; Lettink,M.; Monks, J.; Reardon, J.; Tocher, M.; van Winkel, D.; Rolfe, J. (2016). *Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17*. Department of Conservation, Wellington. 14 p.

About Boffa Miskell

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.

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Appendix 5: Falcon Management Plan

Boffa Miskell

Smooth Hill Landfill

Draft Falcon / Kārearea Management Plan
Prepared for Dunedin City Council

4 June 2021

Document Quality Assurance

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Prepared by:	Karin Sievwright Ecologist / Professional Boffa Miskell Limited	
Reviewed by:	Dr Leigh Bull Senior Ecologist / Partner Boffa Miskell Limited	
Status: DRAFT	Revision / version: A	Issue date: 4 June 2021

Template revision: 20180621 0000

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Cover photograph: Proposed Smooth Hill landfill location, © BML, 2019

Contents

1.0 Introduction

This Falcon / Kārearea Management Plan has been prepared for the Dunedin City Council (DCC). It is one of a suite of ecological management plans and is to be read in conjunction with the draft Landfill Management Plan (Boffa Miskell 2021a), which has been prepared to support the construction, operation, closure and aftercare of the Smooth Hill Landfill

This document is a plan to manage potential effects on eastern falcon / kārearea (*Falco novaeseelandiae* "eastern") during construction of the landfill. This species was identified in the Ecological Impact Assessment for the project (Boffa Miskell Ltd, 2020) as an At Risk (Recovering) species (Robertson et al., 2017), which utilises habitat within the project footprint and that may require management during enabling and construction works to reduce potential adverse effects on them.

The resource consent application for this project has been lodged with the DCC and the Otago Regional Council (ORC) and draft consent conditions have been formed as part of the application package. These will be finalised through the consenting process.

This Falcon Management Plan follows the draft consent conditions[1] drafted at lodgement of consent, as below.

> A Falcon Management Plan shall be prepared by a suitably qualified ecologist prior to the commencement of construction, to ensure effects on any eastern falcons nesting at the site during construction of stages 1 – 4 of the landfill are avoided or minimised. The plan shall be developed in consultation with Te Rūnanga o Ōtākou. As a minimum the plan shall include:
>
> a. Background information on falcons.
>
> b. Responsibilities for falcon management.
>
> c. Mitigation measures.
>
> d. Monitoring.
>
> e. Review and updating of the plan.

The plan shall be provided to ORC for approval that it meets the requirements in this condition prior to construction commencing. The plan shall be implemented for the duration of any landfill construction works.

[1] Draft consent conditions to be finalised following issuing of consents

2.0 Background Information on Eastern Falcon / Kārearea

2.1 Ecology and Identification

The eastern falcon / kārearea (Photo 1, Photo 2, Photo 3) is one of three forms of the New Zealand falcon species. It is the largest and lightest form and is found from eastern and central South Island. Habitats utilised by eastern falcon / kārearea include pine plantation, pine slash, farmland, native scrub and forest, and coastal areas (Bell, 2017). They are highly mobile and have large home ranges; 9 km^2 has been reported at Kaingaroa Forest (Seaton, 2007; Seaton et al., 2013) and up to 75 km^2 has been reported in indigenous forest (Fox, 1977).

Falcon / kārearea are raptors that pre-dominantly feed on live prey such as small to medium-sized birds, rodents and lagomorphs (rabbits and hares). They have relatively short, deep rounded wings and a long tail, which makes them highly manoeuvrable when hunting (Photo 3). They often hunt from an elevated perch but may also hunt along habitat edges or surprise prey by contour-flying close to the ground.

Their breeding season is broadly between August and May[2], with peak egg laying occurring from August to January. They lay between one and four eggs in a simple scrape on the ground (Photo 5) with varying amounts of cover, on a ledge, or within an epiphyte in a tree. They are territorial birds, particularly during the breeding season, and often use their distinctive 'kek kek kek' alarm call when defending their territory / nest. They are also prone to dive bombing people if they come too close to their nest.

Falcon / kārearea look somewhat similar to harrier hawk / kahu (*Circus approximans*), which is a Not Threatened species found throughout New Zealand. Falcon and harrier hawk occur in similar habitats. Key identification features to distinguish between these two species are listed in Table 1 and shown in Photo 1, Photo 2, Photo 3 and Photo 4.

Key threats to falcon / kārearea include habitat loss, degradation and modification, electrocution from uninsulated powerlines, and predation.

Table 1. Key differences between New Zealand falcon / kārearea and harrier hawk / kahu.

Characteristic	**Species**	
	Falcon / Kārearea	**Harrier hawk / Kahu**
Size	Smaller (40-50 cm)	Larger (50-60 cm)
Foraging behaviour	Aerial hunter that feeds on live prey (rarely feeds on carrion[3])	Often scavenges and feeds on carrion (e.g. roadkill)
Flight behaviour	Active chasing flight and when gliding has flat wings	Lazy, looped flights in thermals and when gliding has its wings in a shallow V-shape
Rump colour	Brown	Cream / pale

[2] Seaton, R.; Hyde, N. 2013 [updated 2017]. New Zealand falcon. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[3] Carrion is the decaying flesh of dead animals.

Photo 1. Adult New Zealand falcon / kārearea (photo by Les Feasey).

Photo 2. Adult harrier hawk / kahu (photo by Marie-Louise Myburgh).

Photo 3. New Zealand falcon / kārearea gliding with flat wings (photo by Craig McKenzie).

Photo 4. Harrier hawk / kahu gliding with its wings in a shallow v-shape (photo by Imogen Warren).

Photo 5. Falcon / kārearea nest (shallow scrape) with eggs (photo by Andrew Thomas).

Photo 6. Falcon / kārearea chick (photo by Steve Attwood).

2.2 Habitat Surrounding and Within the Project Area

Exotic production pine forest is prevalent in the northwest and south of Dunedin. These plantations provide good habitat for eastern falcon / kārearea for approximately four years post-felling (Seaton, 2014). This is because the open areas created attract many small birds that provide prey for falcon / kārearea. The piles of pine slash also provide good nesting sites for falcon / kārearea, as do young re-planted pine adjacent to mature pine stands. As scrub regenerates and newly planted seedlings grow, these areas become less suitable for falcon / kārearea.

Surveys conducted in October 2015 in pine forest blocks northwest and south of Dunedin, identified falcon / kārearea at seven locations and included six single birds and one pair (Parker Conservation, 2015). A more recent survey (2016 / 2017 falcon / kārearea breeding season), conducted northwest to south of Dunedin in an approximately 150,000 ha area of plantation pine and native forests surrounding the Taieri Plain, detected a minimum of 16 breeding falcon pairs (Parker Conservation, 2017). Areas of production pine forestry around Dunedin and the Smooth Hill site are shown in Appendix 1.

Most of the Smooth Hill site provides potential falcon habitat. The key habitats include regenerating native scrub, treeland and forest (gully areas), macrocarpa forest and radiata pine treeland (including re-planted areas and piles of pine slash). These habitats are shown in Appendix 2.

During surveys conducted at the Smooth Hill site, two observations of an individual falcon / kārearea were made. One was recorded during the May 2019 survey, the other during the July 2019 survey. On both occasions the falcon / kārearea was heard calling. During the May observation the falcon / kārearea was observed interacting with a harrier hawk / kahu above a stand of exotic conifers to the west of the site. During the July observation the falcon / kārearea flew south-east over the site into an adjacent pine forest block. Two falcons / kārearea were also incidentally observed on the proposed landfill site in October 2019 outside of the formal survey period. They flew over the site, landed briefly on a pine stump on the proposed landfill site, then flew off together over an adjacent pine forest block to the south. The locations of these falcon observations are shown in Appendix 2.

Falcon / kārearea were also heard, but not seen, in the wider area (not within the project site) during other fauna surveys conducted on site in spring. No nesting falcon / kārearea were detected on site during the breeding season survey conducted. A falcon / kārearea pair, however, did nest on site the previous breeding season (Fulton Hogan, *pers. comm.* 2019) and four falcon / kārearea pairs have been recorded at, and / or in, the vicinity of the Smooth Hill area (Graham Parker, *pers. comm*. 2020). Falcon / kārearea were heard in native forest to the north of McLaren Gully Road in June 2020.

3.0 Management and Mitigation During Enabling & Construction Works

Outlined below are the management actions to reduce potential enabling and construction work impacts on falcon / kārearea using habitat within the project footprint.

3.1 Conduct Enabling and Construction Works Outside of the Breeding Season

If timing allows, in areas identified as potential falcon / kārearea habitat on site (see Appendix 2), enabling and construction works will be conducted outside of the falcon / kārearea breeding season (i.e. will take place between 1 June and 31 July). Enabling and construction works include tree felling / vegetation clearance, earthworks, and constructing roads and other infrastructure.

3.2 Enabling and Construction Works Within the Breeding Season

If enabling and construction works in areas identified as potential falcon / kārearea habitat on site (see Appendix 2) cannot take place outside of the falcon / kārearea breeding season (i.e. where the breeding season is broadly between 1 August and 31 May, inclusive), then the following management actions will be implemented to manage potential effects on falcon:

- Pre-construction falcon / kārearea surveys (Section 3.2.1);
- Establishing buffer / exclusion zones (Section 3.2.2); and
- Staff training and assignment of responsibilities for falcon / kārearea management (Section 3.2.3).

3.2.1 Pre-Construction Falcon / Kārearea Surveys

If enabling and construction works are to occur during the falcon / kārearea breeding season in areas identified as potential breeding habitat on site (shown in Appendix 2), a suitably qualified and experienced ecologist will check for the presence of breeding birds (including nests and chicks) within a week before the commencement of enabling and construction works.

This check will involve:

- surveying the area of proposed works with binoculars to look for any falcon in the area;
- walking through the area of proposed works and looking for nests; and
- conducting 60-second playback surveys of taped falcon calls using an appropriate device (e.g. an iPod, mobile phone or iPad with speakers) at 200 m intervals within the area of proposed works, each followed by a three-minute period of and listening and looking for falcon.

If no nesting birds are identified, works can commence.

If nesting birds are identified, an exclusion zone will be established immediately around the nest/s as described in Section 3.2.2 below.

3.2.2 Establishing Buffer/Exclusion Zones

If an active nest is detected during the pre-construction falcon / kārearea survey, or during construction works, works where the nest is located will stop immediately and will not re-commence until nesting activities are complete (i.e. nest is empty) as determined by a suitably qualified and experienced ecologist (refer to Section 3.2.2.1).

The construction manager will be informed and a 200 m area (radius) around the nest will be cordoned off with flagging or fencing with appropriate signage informing people that this is a "No Go Zone". The falcon / kārearea, or nest contents, will not be handled at any time. The establishment of the exclusion zone will be conducted under the guidance and supervision of a suitably qualified and experienced ecologist.

A hard hat and protective eye wear should be worn while establishing the exclusion zone/s as falcon are very territorial and may potentially be aggressive / protective of their nest when people approach (dive-bombing strike behaviour is common).

3.2.2.1 Monitoring

Active falcon / kārearea nests within exclusion zones will be monitored weekly by a suitably qualified and experienced ecologist. Observations of the nest will be made with binoculars outside of the exclusion zone. If an adverse effect is identified (i.e. the nest is abandoned, or frequent dive-bombing behaviour is observed, which is indicative of disturbance), mitigation measures will be implemented, as advised by the ecologist. This may include increasing the size of the buffer zone if frequent dive-bombing is observed (or if nest abandonment is observed, increasing the size of the buffer zone in future nests that are detected) and / or conducting pest control around the exclusion zone to reduce predation risk.

3.2.2.2 Reporting

Records of all pre-clearance falcon / kārearea pre-construction surveys will be kept as well as records of all falcon / kārearea nests detected on site. The following nest detection / monitoring information will be recorded:

- location / habitat type;
- detection date / date of exclusion zone establishment;
- if the bird/s are banded[4];
- nest contents upon detection (i.e. adult, eggs, chicks);
- nest contents during weekly observations;
- behaviour of the falcon / kārearea; and
- any other notes of interest (e.g. if the exclusion zone is increased as a result of birds being disturbed by construction activities)

[4] If banded, the coloured bands would be present on a leg. Note which leg and the colour of the band/s.

This information will be entered into an Excel spreadsheet and appended to this management plan during the annual update of the plan (as discussed in Section 4.0). These results will be provided to the Department of Conservation (DOC) on request.

If any banded birds are observed, this should be reported to Parker Conservation[5] (a local ecological consultancy) as they are monitoring falcon / kārearea in the wider area.

3.2.3 Staff Training and Responsibilities for Falcon / Kārearea Management

Construction workers will be trained annually to identify falcon / kārearea (including identifying their call as well as their characteristic falcon / kārearea dive-bombing behaviour during the breeding season), their nests and to distinguish between falcon / kārearea and harrier hawks / kahu. Observations will be reported to the construction manager so that appropriate records can be kept, and management actions implemented as required. It is the responsibility of all people working on site to report falcon / kārearea observations during the breeding season (broadly 1 August – 31 May) to the construction manager and to follow adhere and abide by the requirements of this management plan.

4.0 Review and Updating of the Plan

This falcon / kārearea management plan is a dynamic document that is to be updated annually during construction (at the end of the falcon / kārearea breeding season) by the construction manager, or other appointed person, on site. The plan is to be updated with the reporting information listed in Section 3.2.2.2. Following this, the plan will be reviewed by a suitably qualified and experienced ecologist to determine if the current management actions are sufficient and effective in managing falcon, and if necessary, additional adaptive management actions will be recommended and incorporated into the plan. Subsequently, the management plan will be provided to local iwi (Te Rūnanga o Ōtākou) and a Biodiversity Officer at Dunedin City Council for review and comment.

[5] parkerconservation@parkerconservation.co.nz

5.0 References

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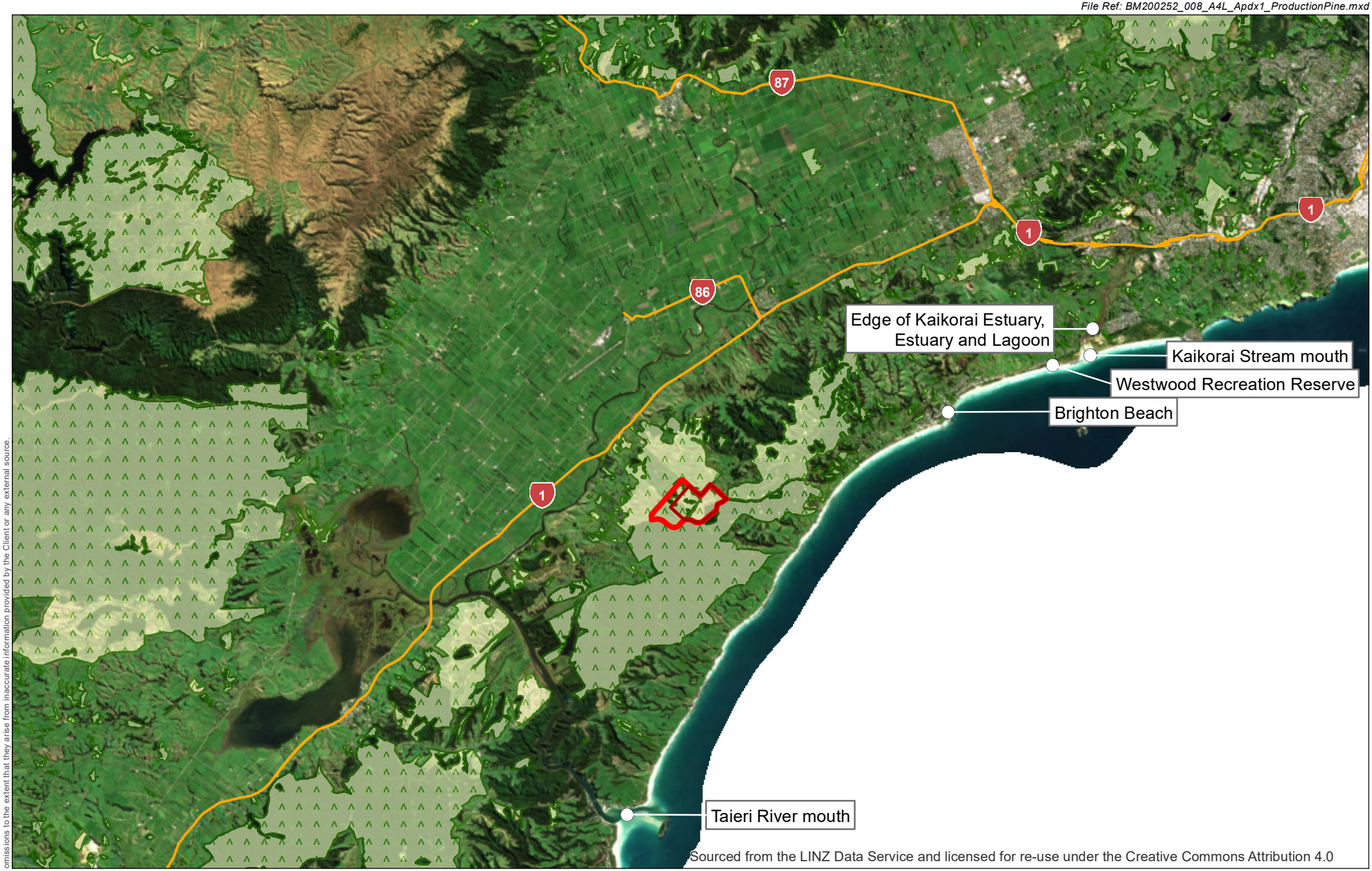

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0 4 km

1:150,000 @ A4

Data Sources:
Designation sourced from DCC data service
Forestry sourced from LCDB5

Projection: NZGD 2000 NZTM

LEGEND
- Production Pine Forestry
- Designation
- Application Site
- State Highway

SMOOTH HILL LANDFILL

Areas of production pine forest near Smooth Hill

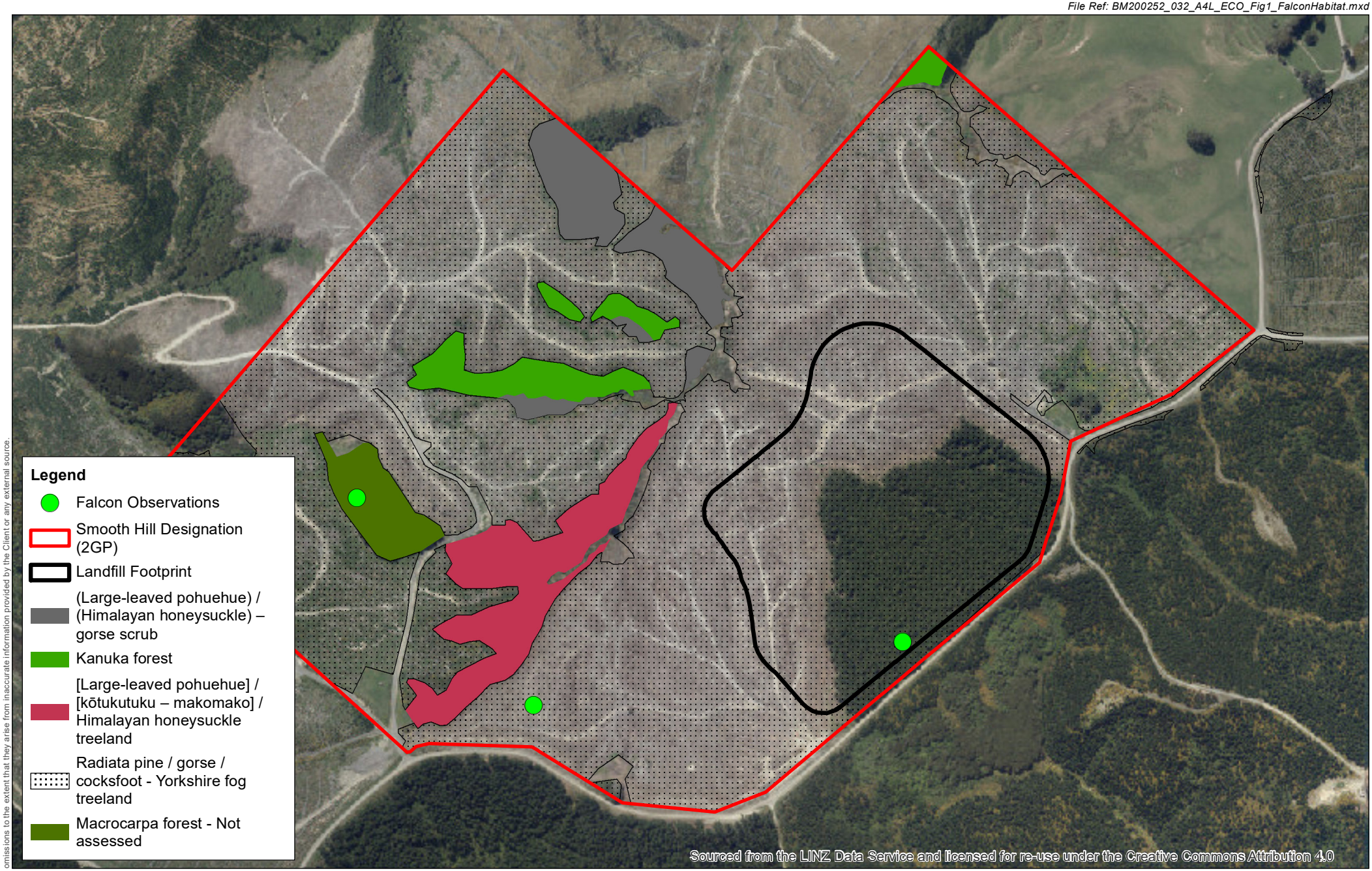
Date: 04 June 2021 | Revision: 0

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: BMc | Checked: KSi

Appendix 1

File Ref: BM200252_032_A4L_ECO_Fig1_FalconHabitat.mxd



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0 200 m

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Data Sources:
Designation sourced from DCC 2GP online
Landfill design and road footprint sourced from GHD

Projection: NZGD 2000 New Zealand Transverse Mercator

SMOOTH HILL LANDFILL

Falcon Habitat Overview

Date: 04 June 2021 | Revision: 0

Plan prepared for DCC by Boffa Miskell Limited

Project Manager: rachael.eaton@boffamiskell.co.nz | Drawn: BMc | Checked: KSi

Appendix 2

About Boffa Miskell

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.

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Appendix 6: Glossary of Terms

Appendix 7: Resource Consents