Bioresearches
A Babbage Company

Southern Sea Defences Renewal Project

# Residual Effects Analysis Report: Kororā

for: Wellington International Airport Limited

on

Consulting Biologists – Established 1972
P.O. Box 2027, Auckland 1140. New Zealand
www.Bioresearches.co.nz

# DOCUMENT CONTROL AND REVISION RECORD

| | |
|---|---|
| Document title | Southern Sea Defences Renewal Project<br>Residual Effects Analysis Report: Kororā |
| Prepared for | Wellington International Airport Limited |

| | | |
|---|---|---|
| Author(s) | Michael Anderson, Senior Ecologist | |
| | Chris Wedding, Ecology Manager | |
| Reviewer(s) | Chris Wedding<br>Ecology Manager | Dr. John Cockrem,<br>Kororā Ornithology |

| Version | Date | Author(s) | Reviewer |
|---|---|---|---|
| Draft 1 | 3 September 2025 | MA & CW | CW |
| Draft 2 | 17 October 2025 | | CW, JC |

| | |
|---|---|
| Job number | 67466 |
| Filename | 67466_Wial_REAR-Penguins |

**Reference:** Bioresearches (2025). Residual Effects Analysis Report: Kororā. Report for Wellington International Airport Limited pp 26.

**Cover Illustration**: Moa Point Stage 1 Kororā Sanctuary location

# EXECUTIVE SUMMARY

Wellington International Airport Limited (WIAL) proposes to reconstruct approximately 400 m of the Southern Seawall at Moa Point to safeguard nationally significant airport infrastructure from coastal erosion, climate change, and storm surge. The works will require removal of the existing seawall, establishment of construction yards, and remediation of the eroding Eastern Bank. Construction will take 24–30 months within a wider 6–8 year programme.

**Ecological Context**

The existing seawall and adjacent rubble slopes provide nesting habitat for kororā (little penguin, *Eudyptula minor*). Kororā are classified as *At Risk – Declining* nationally and *Threatened – Endangered* at a Wellington mainland scale.

**Residual Effects**

Measures to avoid and minimise adverse effects (mitigation, effects management hierarchy, National Policy Statement for Indigenous Biodiversity, 2023 (NPSIB)) are discussed in a separate report (Kororā Ornithology 2025) and address careful deconstruction of the existing seawall, and capture-relocation to avoid significant harm and / or mortality to any individuals, chicks and eggs, if present at time of works. Following these management measures, the Project will result in loss of existing kororā roosting and / or nesting habitat within the current seawall, noting that the new seawall may present new opportunites. Residual adverse effects have been assessed as being an overall loss of up to 50 roosting and / or nesting locations (Kororā Ornithology 2025a).

**Compensation Package**

Given that there is some uncertainty of the number of roosting and / or nesting locations within the existing sea wall, and the difficulty in replicating a like-for-like outcome for these habitat features, a Biodiversity Compensation Model (BCM) was applied to quantify the adequacy of proposed compensation, bring provision of nest boxes within two-staged approach. Two new predator-controlled colonies will be created:

1. Stage 1 Moa Point Colony (prior to seawall works) – 100 nest boxes, penguin underpass, planting, and predator exclusion fencing.
2. Stage 2 Eastern Bank Colony (post-construction) – 70 nest boxes, rock features, planting, and fencing following demobilisation of the construction yard.

The BCM for Stage 1 and Stage 2 Kororā nestboxes (all data and predictions provided by Kororā Ornithology 2025) demonstrate that a net positive outcome will be achieved at 20 and 26 years respectively, assuming 50% occupancy of 160 nest boxes.

This assessment recognises that ecological models such as the BCM are decision-support tools rather than guarantees. Outcomes will depend on robust implementation, monitoring, and ongoing collaboration with tangata whenua, regulators, and the community.

***Inputs to the modelling for value scores prior to and after impact, value scores prior to and after compensation, finite end point, areal extent of impact, and areal extent of compensation, have been assigned by Dr John Cockrem, Kororā Ornithology.***

# TABLE OF CONTENTS



## List of Tables



## List of Figures

## List of Appendices

# 1 INTRODUCTION

Wellington International Airport Limited (WIAL) proposes to reconstruct the Southern Seawall at the southern end of the runway at Moa Point, Wellington. The Southern Seawall Renewal Project (the Project) is required because the existing seawall has reached the end of its functional life. Renewal will safeguard the airport's nationally significant infrastructure against natural hazards, increase resilience to climate change, and reduce the otherwise escalating demands of seawall maintenance.

The Project includes several key components (mapped in Figure 1):

- establishment and operation of three construction yards (Miramar Golf Course Yard, George Bolt Street Yard, and Moa Point Yard);
- reconstruction of approximately 400 m of the Southern Seawall with rock and cubipod armour;
- remediation of the eroding Eastern Bank; and
- creation of two new kororā (little penguin, *Eudyptula minor*) colonies to provide safe, long-term breeding habitat.

Construction will take approximately 24–30 months, within a broader 6–8 year project timeframe. Works will be sequenced to maintain airport operations and scheduled around aviation safety constraints associated with the airport's obstacle limitation surfaces (OLS). Some activities, including parts of the seawall reconstruction, must be undertaken during night-time curfew hours when aircraft movements are minimal.

## 1.1 Ecological context

Kororā are classified as *At Risk – Declining* under the New Zealand Threat Classification System (Robertson *et al.*, 2021) and *Threatened – Endangered* at a Wellington mainland scale (Crisp *et al.*, 2023). They face ongoing threats on land and at sea, from predation, habitat loss, disturbance, and climate change.

The Project area includes the existing Southern Seawall and adjacent rubble slopes and associated vegetation, that have been identified as providing roosting or nesting habitat for kororā. Surveys and assessments confirm that kororā are present within the existing seawall structure and associated informal rock rubble areas. Consequently, there is significant risk of adverse effects on kororā during project works, including injury and mortality during deconstruction of the existing seawall, and loss of this habitat following works.

## 1.2 Purpose of Report

Construction activities will result in the loss of existing kororā habitat within the seawall and Eastern Bank and this residual adverse effect has been assessed as more than minor (Kororā Ornithology 2025a). The Effects Management Hierarchy (EMH) requires that biodiversity offsetting is provided where possible, and where not possible, then biodiversity compensation is provided. Where biodiversity compensation is not appropriate, then the activity itself is avoided (NPS-IB, refer Section 1.3).

This report provides analyses of the 'offsettability' (Pilgrim et al. 2013) of the residual effects of the project on kororā, and the actions proposed to achieve an overall net gain outcome, as required by the principles for biodiversity offset and compensation.

This Residual Effects Analysis Report (REAR) provides a transparent, quantitative assessment of the Project's effects on kororā and the adequacy of proposed compensation measures. It has been prepared in accordance with the National Policy Statement for Indigenous Biodiversity (NPSIB; Ministry for the Environment, 2023), Department of Conservation guidance on biodiversity offsetting and compensation, and the Biodiversity Compensation Model (BCM).

Specifically, this report:

- tests whether offsetting or compensation is feasible within ecological and practical limits; and
- applies calculations of modelled values before and after impacts to demonstrate that proposed measures will deliver a net gain outcome for kororā habitat.

By applying these frameworks, the report ensures that the Project appropriately manages residual ecological effects on kororā, consistent with national policy, statutory requirements, and good ecological practice.

***Inputs to the modelling for value scores prior to and after impact, value scores prior to and after compensation, finite end point, areal extent of impact, and areal extent of compensation, have been assigned by Dr John Cockrem, Kororā Ornithology.***

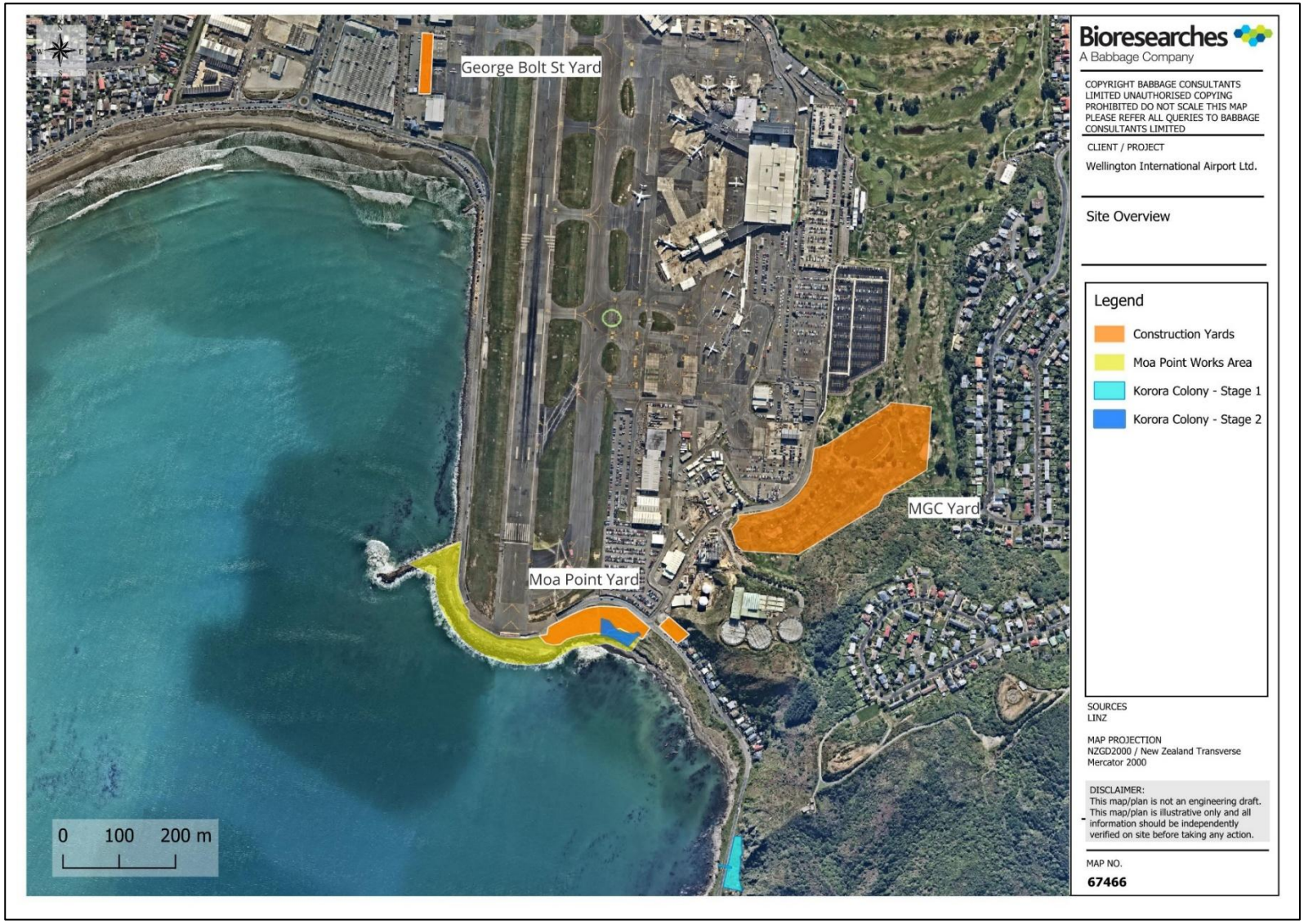


***Figure 1. Overview of the proposed project, showing the proposed works site for seawall renewal at Moa Point, including proposed stage 1 and 2 Kororā colony, and three proposed laydown yards.***

## 1.3 Statutory Context and Application of the Effects Management Hierarchy

### 1.3.1 Legislative and Policy Framework

The management of adverse effects on indigenous biodiversity in Aotearoa New Zealand is guided by the Resource Management Act 1991 (RMA), the National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB), and regional and district planning instruments.

#### 1.3.1.1 Resource Management Act 1991 (RMA)

Under Part 2 of the RMA, particular regard must be given to the protection of significant indigenous vegetation and habitats of indigenous fauna (s6(c)), the intrinsic values of ecosystems (s7(d)), and the maintenance and enhancement of the quality of the environment (s7(f)). Councils are empowered to require biodiversity offsetting and/or compensation where residual effects cannot be avoided, remedied, or mitigated.

#### 1.3.1.2 National Policy Statement for Indigenous Biodiversity (NPS-IB 2023)

The NPS-IB establishes a national objective to maintain indigenous biodiversity, with policies requiring application of the EMH when managing adverse effects on Significant Natural Areas (SNAs) and other areas of indigenous biodiversity. The EMH requires that:

1. Adverse effects are **avoided** where practicable;
2. Where not avoided, they are **minimised**;
3. Where not minimised, they are **remedied**;
4. More than minor residual adverse effects are then addressed through **biodiversity offsetting**, where feasible and consistent with the principles in Appendix 3 of the NPS-IB; and
5. Where offsetting is not possible, **biodiversity compensation** is provided, consistent with Appendix 4.

The NPS-IB also specifies principles for offsetting and compensation, including additionality, long-term outcomes, landscape context, and recognition of mātauranga Māori.

#### 1.3.1.3 Proposed Wellington District Plan (PWDP)

The PWDP reinforces the EMH in relation to managing effects on indigenous biodiversity. Relevant provisions include:

- **Rule 23.1.1 (EMH):** requires that all adverse effects on indigenous biodiversity be managed in accordance with the EMH.
- **Biodiversity Offsetting Policy:** offsets must be demonstrably measurable, additional, and preferably deliver a net gain. They must be like-for-like unless ecological circumstances justify limited trading up.
- **Biodiversity Compensation Policy:** compensation is only available where offsetting cannot be achieved and must clearly demonstrate that benefits outweigh residual losses.

Together, these provisions establish a clear statutory basis for requiring offsetting and compensation of residual effects on kororā.

### 1.3.2 Application of EMH to the Project

The Ecological Impact Assessment (EcIA) for the Southern Seawall Renewal identified that the primary ecological receptors affected are kororā (little penguin, *Eudyptula minor*), with nesting sites confirmed within the existing seawall and Eastern Bank rubble slopes.

The Project has applied the EMH as follows:

- **Avoidance:**
    - Direct works have been designed to remain within the existing seawall footprint where practicable.
    - Critical penguin breeding areas have been identified, and construction staging avoids peak breeding periods where feasible.
- **Minimisation:**
    - Construction methods include night-time surveys and penguin detection protocols to reduce disturbance.
    - Works will be managed under a Kororā Management Plan, including pre-construction clearance of nests and translocation of birds if necessary.
- **Remedy:**
    - The new seawall which will replace the existing structure, may present new roosting and nesting opportunities.
- **Offsetting and Compensation:**
    - Offsetting of residual effects on kororā is not considered feasible, because the loss of existing habitat within the seawall cannot be quantified or replaced on a like-for-like basis (i.e. like-for-like retreats within the renewed Seawall cannot be accurately quantified or guaranteed).
    - Accordingly, **a compensation package is proposed**, centred on the creation of two purpose-built kororā colonies that will deliver a net increase in secure nesting opportunities compared to the current seawall habitat, consistent with the NPS-IB compensation principles.
    - A brief explanation of the compensation approach is provided below.

#### 1.3.2.1 Suitability of BOAM

The Biodiversity Offsets Accounting Model (BOAM) is a decision-support tool designed to quantify losses and gains for like-for-like offset scenarios, using net present biodiversity value (NPBV) to test whether no net loss (or preferably a net gain) can be achieved. It is appropriate where:

- Impacts and proposed offsets can be quantified using standard biodiversity attributes;
- Like-for-like trades are possible within the same biodiversity type; and
- Outcomes can be predicted with reasonable certainty.

For this Project, BOAM is not suitable because:

- The affected habitat (kororā habitat cavities within an engineered seawall) cannot be accurately quantified or replicated in kind.
- Engineering and safety constraints preclude reconstruction of rock void habitat in the seawall.
- Proposed management measures instead involve establishing entirely new colonies with enhanced ecological security, which fall outside BOAM's equivalence framework.

Accordingly, BOAM is not applied to this Project.

#### 1.3.2.2 Suitability of BCM

The Biodiversity Compensation Model (BCM) is designed for cases where offsetting cannot be achieved with confidence, but where compensation can deliver conservation outcomes that outweigh residual losses. The BCM allows for:

- Consideration of ecological values where offsetting principles cannot be fully met;
- Integration of compensation actions that differ from the impacted habitat type (e.g., trading seawall habitat for enhanced, secure habitat);
- Application of explicit contingencies for delivery risk, uncertainty, and confidence;
- Transparent, quantitative assessment of whether proposed measures are likely to achieve no net loss or a net gain.

For the Southern Seawall Renewal Project, BCM is the appropriate tool because:

- The residual effects cannot be offset like-for-like;
- Compensation opportunities exist that can enhance kororā outcomes (secure colonies with higher quality (nest-boxes) and greater security than existing habitat);
- The BCM framework ensures transparency in assumptions, risk adjustment, and monitoring commitments, consistent with best practice and the NPS-IB principles for biodiversity compensation.

# 2 THE BIODIVERSITY COMPENSATION MODEL (BCM)

## 2.1 Purpose of the BCM

The Biodiversity Compensation Model (BCM) is a decision-support tool developed to help practitioners and decision-makers design and evaluate biodiversity compensation packages where residual adverse effects cannot be offset with confidence. Unlike offsets, which require a like-for-like exchange of biodiversity values, compensation acknowledges that equivalence may not be possible but seeks to deliver ecological benefits that are likely to outweigh the residual losses (Baber et al., 2021a; Baber et al., 2021b).

The BCM provides a structured framework to:

- Identify and quantify the scale of ecological losses remaining after avoidance, minimisation, and remediation.
- Assess the ecological gains expected from proposed compensation actions.
- Incorporate risk, uncertainty, and time-lags through explicit multipliers and discounting.
- Test whether proposed measures are likely to achieve no net loss (NNL) or, preferably, a net gain (NG) in biodiversity values, consistent with the National Policy Statement for Indigenous Biodiversity (NPS-IB) principles (MfE, 2023).

## 2.2 How the BCM Works

The BCM applies a value-based scoring system to both impact and compensation sites, which reflects:

- the ecological importance of the site (including threat status of the biodiversity affected),
- current and potential condition, and
- long-term security of management actions.

Residual losses are calculated as a net present biodiversity value (NPBV), incorporating discounting (commonly at 3% per annum) to account for delays in ecological recovery. Proposed gains are similarly quantified, but further adjusted by:

- Delivery risk multipliers – recognising the chance that actions may not be implemented fully.
- Confidence multipliers – accounting for the likelihood of ecological success.

This explicit treatment of risk and uncertainty represents an improvement over earlier “gut-feel” or ratio-based compensation approaches (Baber et al., 2025).

### 2.2.1 Recent Debate on the BCM

Recent debate within the ecological community has queried the robustness of compensation modelling. Baber et al. (2025) argue that the BCM, when used transparently and conservatively, supports better biodiversity outcomes than unstructured compensation packages based solely on judgement or unsubstantiated ratios. In contrast, Maseyk et al. (2025) caution that models such as the BCM risk creating a false sense of certainty, noting that poor calibration, over-optimistic assumptions, or failure to adequately reflect ecological uncertainty can undermine outcomes.

Both papers agree that the BCM must only be applied within the EMH, and only once avoidance, minimisation, and remediation have been exhausted. Moreover, they stress that the model should not be seen as a guarantee of ecological success, but as a decision-support tool whose outputs require careful interpretation, transparent communication of assumptions, and rigorous monitoring to ensure predicted gains are delivered.

### 2.2.2 Role in Decision-Making

The BCM provides several key benefits as a decision support-tool:

- It standardises compensation assessment, increasing transparency and comparability across projects.
- It explicitly accounts for risk, uncertainty, and time-lags, avoiding overly optimistic assumptions.
- It allows for clear demonstration of ecological trade-offs, including whether proposed measures achieve no net loss or a net gain.

For the Wellington Airport Southern Seawall Renewal Project, the BCM ensures that the proposed kororā compensation package is robust, science-based, and consistent with the NPS-IB (MfE, 2023). However, following Maseyk et al. (2025), the outputs are presented here as decision support rather than definitive predictions. Success will depend on the quality of on-ground implementation, adaptive management, and long-term security of the proposed colonies.

Biodiversity compensation is acknowledged as a valid tool under the EMH (NPS-IB).

# 3 COMPENSATION PACKAGE

## 3.1 Overview

***Inputs to the modelling for value scores prior to and after impact, value scores prior to and after compensation, finite end point, areal extent of impact, and areal extent of compensation, have been assigned by Dr John Cockrem, Kororā Ornithology.***

To address residual effects, the Project will establish two purpose-built kororā colonies designed to provide secure, long-term nesting opportunities:

- **Stage 1: Moa Point Road Colony**
    - Constructed prior to seawall works, ensuring continuity of nesting habitat during construction.
    - Provides 100 artificial nest boxes, designed to mimic natural burrows but provide enhanced shelter, thermal stability, and drainage.
    - A penguin underpass will be built beneath Moa Point Road, connecting the colony safely to the marine environment (avoids a road crossing).
    - Fencing and native planting will provide additional protection, shade, and cover.
- **Stage 2: Eastern Bank Colony**
    - Established post-construction, once the Eastern Bank construction yard is decommissioned.
    - Will comprise approximately 70 nest boxes, supplemented with rock features and planting to mimic natural habitats.
    - Fully fenced, elevated and secure ground to reduce inundation risk from storm surge and sea-level rise.
    - Designed to expand regional nesting capacity and create a second focal point for colony establishment at the project site.

Both colonies are being designed with reference to best practice for artificial seabird colonies in New Zealand, including evidence that penguins readily occupy and successfully breed in artificial nest boxes when predation risk is controlled (Perriman & Steen, 2000; Sutherland et al., 2014; Ratz, 2019). The dual-site approach ensures that kororā displaced from the seawall will have immediate alternative nesting opportunities (Stage 1), as well as long-term secure options (Stage 2) once construction is complete.

The BCM outputs assume that the Stage 1 and 2 nest colonies will achieve 50% occupancy by 20 years following their establishment. After applying risk adjustments, discounting, and confidence multipliers, the model predicts that these compensations will achieve a net positive biodiversity outcome above the 10% buffer target recommended for ecological prudence.

The colonies will be secured for at least 30–35 years with funding commitments for predator control, vegetation management, and long-term monitoring. Adaptive management provisions will ensure that if nest box uptake, breeding success, or predator control fall below thresholds, corrective measures (e.g., acoustic lures, modified box designs, intensified predator management) will be implemented.

## 3.2 Adherence to Principles for Biodiversity Compensation

***Table 1. Principles of biodiversity compensation (NPSIB, Appendix 4) and how these are achieved for the Southern Seawall Renewal Project.***

| | Principles / Criteria of biodiversity offsetting | How these principles are achieved |
|---|---|---|
| 1 | **Adherence to effects management hierarchy:** A biodiversity offset is a commitment to redress more than minor residual adverse effects and should be contemplated only after steps to avoid, minimise, and remedy adverse effects are demonstrated to have been sequentially exhausted. | Details about the adherence to the effects management hierarchy are provided in section 1.3 |
| 2 | **When biodiversity compensation is not appropriate:** Biodiversity compensation is not appropriate where indigenous biodiversity values are not able to be compensated for. Examples of biodiversity compensation not being appropriate include where:<br>(a) the indigenous biodiversity affected is irreplaceable or vulnerable;<br>(b) effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse or irreversible;<br>(c) there are no technically feasible options by which to secure a proposed net gain within acceptable timeframes. | Kororā are Nationally 'At Risk'. While losses at the seawall are locally significant, they are not irreplaceable. Without compensation, however, cumulative effects of habitat loss, predation, and disturbance could contribute to ongoing regional decline.<br>The existing seawall (and the habitat it supports) is degrading.<br>Like-for-like offset not feasible due to engineering and safety constraints; alternative compensation measures available. |
| 3 | **Scale of biodiversity compensation:** The indigenous biodiversity values lost through the activity to which the biodiversity compensation applies are addressed by positive effects to indigenous biodiversity (including when indigenous species depend on introduced species for their persistence), that outweigh the adverse effects. | The overall positive effects of specific biodiversity components (Stage 1 and Stage 2 nest-box colonies) provide sufficient biodiversity gains as demonstrated by the BCM (Figure 2). |
| 4 | **Additionality**: Biodiversity compensation achieves gains in indigenous biodiversity above and beyond gains that would have occurred in the absence of the compensation, such as gains that are additional to any minimisation and remediation or offsetting undertaken in relation to the adverse effects of the activity. | There are no current or future plans to undertake any of the proposed enhancement actions. The proposed enhancement would be undertaken in addition to other remediation and rehabilitation proposed. Note also that the restored Seawall (using cubipods) has not been considered as part of any of the compensation actions. |
| 5 | **Leakage:** Biodiversity compensation design and implementation avoids displacing harm to other indigenous biodiversity in the same or any other location. | Stage 1 colony occurs within a coastal area that supports Not Threatened flora and fauna (e.g. common grass skink and Raukawa gecko). The proposal would not adversely affect these species (refer Bioresearches 2025a). |
| 6 | **Long-term outcomes:** Biodiversity compensation is managed to secure outcomes of the activity that last as least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management, and monitoring. | All compensation actions, including construction and additional pest control, and nest box monitoring, will be funded by WIAL for at least 20 years at each created colony. |

| | | |
|---|---|---|
| 7 | **Landscape context:** Biodiversity compensation is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the Project area and the compensation site, taking into account interactions between species, habitats and ecosystems, spatial connections, and ecosystem function. | The compensations actions will be undertaken within the immediate landscape where they are expected to benefit the same Kororā community (all at Moa Point, southern Wellington coast). |
| 8 | **Time lags:** The delay between loss of, or effects on, indigenous biodiversity values at the impact site and the gain or maturity of indigenous biodiversity at the compensation site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years). | The BCM model accounts for time lags between loss of biodiversity values at the impact site and gains at the offset Project areas. Specifically, Stage 1 net positive outcomes are predicted to be achieved at 20 years post establishment, and Stage 2 at six years later. |
| 9 | **Trading up**: When trading up forms part of biodiversity compensation, the proposal demonstrates that the indigenous biodiversity gains are demonstrably greater or higher than those lost. The proposal also shows the values lost are not to Threatened or At Risk (declining) species or to species considered vulnerable or irreplaceable. | No trade ups are considered, however Kororā nest boxes and the locations identified for the two colonies are assessed as being of higher value than the existing seawall (protection from storm surges, wind etc.). |
| 10 | **Financial contributions:** A financial contribution is only considered if:<br>(a) there is no effective option available for delivering biodiversity gains on the ground; and<br>(b) it directly funds an intended biodiversity gain or benefit that complies with the rest of these principles. | The proposed compensation actions and associated monitoring are fully funded by Wellington International Airport. |
| 11 | **Science and mātauranga Māori:** The design and implementation of a biodiversity offset is a documented process informed by science and mātauranga Māori. | The design of the biodiversity compensation (nest box provision) is based on established and best practice methods for Kororā supplementary habitat provision. Published scientific data and studies of Kororā nest box occupancy have informed predicted outcomes. |
| 12 | **Tangata whenua and stakeholder participation:** Opportunity for the effective and early participation of tangata whenua and stakeholders is demonstrated when planning for biodiversity compensation, including its evaluation, selection, design, implementation, and monitoring. | Tangata Whenua engagement and consultation continues to form part of this compensation package, which will evolve with new considerations. Tangata Whenua will be provided opportunities for participation in all aspects of ecological management and monitoring. |
| 13 | **Transparency:** The design and implementation of a biodiversity compensation, and communication of its results to the public, is undertaken in a transparent and timely manner. | Wellington International Airport has engaged with Wellington Regional Council and held public engagement events (26-27 August 2025) to communicate it's proposal, including the Kororā compensation design. The BCM is used as a decision support tool, which presents a transparent breakdown of values prior to and after impacts and compensation actions. The model also accounts for risk, uncertainty, and time-lags. |

## 3.3 BCM Model Results

Figure 2. shows the output of a BCM for the provision of a 100 nest-box kororā colony at Stage 1, and a 70 nest-box colony at Stage 2 of the Project. The BCM predicts that a 10% net positive outcome would be exceeded at 20 years following colony construction (i.e. the compensation score is 19.6% higher than the impact score). Table 2 provides an explanation of the values (as advised by Dr. John Cockrem, Kororā Ornithology), entered into the BCM.

| Model Inputs | | |
|---|---|---|
| **Input descriptors** | **Input data** | |
| Project/reference name | korora Seawall habitat | |
| Biodiversity type | roost and nest sites | |
| Technical expert(s) input | John Cockrem | |
| Benchmark | 5 | |
| How many habitat types OR sites are impacted | 1 | |
| Number of proposed compensation actions | 2 | |
| Net gain target | 10% | |
| **Habitat/Site Impact(s)** | **Seawall nest sites** | |
| Impact risk contingency: | 3 | |
| Impact uncertainty contingency: | 3 | |
| Areal extent of impact (ha): | 50 | |
| Value score prior to impact: | 2 | |
| Value score after impact: | 0.5 | |
| **Compensation Action(s)** | **Stage 1 nest boxes** | **Stage 2 nest boxes** |
| Discount rate: | 3.0% | 3.0% |
| Finite end point (years): | 20 | 26 |
| Compensation confidence contingency: | 3 | 3 |
| Areal extent (ha) of compensation type: | 50 | 35 |
| Value score prior to compensation: | 0.001 | 0.5 |
| Value score after compensation: | 4.5 | 4.5 |

| Model outputs | | | |
|---|---|---|---|
| | **Total impact score** | **Seawall nest sites** | |
| **Impact score** | **-19.80000** | -19.80000 | |
| | **Total compensation score** | **Stage 1 nest boxes** | **Stage 2 nest boxes** |
| **Compensation score** | **23.68333** | 15.56867 | 8.11466 |
| **Net gain outcome** | **19.6%** | | |

***Figure 2. BCM Model for the loss of 50 nest boxes and gain of 80 (160 nest boxes with 50% occupancy).***

***Table 2. BCM Model inputs and justification for Wellington International Airport southern seawall construction and penguin colony restoration.***

| Model inputs | Explanation |
|---|---|
| Biodiversity type | **Kororā habitat within rock seawall** |
| Technical expert inputs(s) | **Prof. John Cockrem** |
| Benchmark | **Benchmark- always 5**<br>A benchmark of 5 would be a pest free island with natural burrows that provide protection from weather, predators etc. |
| How many habitat types OR sites are impacted | **1**<br>Constructed seawall, currently used by kororā (little penguin; *Eudyptula minor*) for nesting and roosting. |
| Number of proposed compensation measures | **2**<br>Creation of two penguin colonies: Stage 1(established at time of impact) and Stage 2 (established after seawall construction). |
| Net Gain target | **10%** |
| **Impact model inputs and descriptions** | |
| Habitat/site impacted | A constructed rock seawall. Crevices and gaps are used as roosting and breeding habitat for kororā |
| Impact contingency risk (uncertainty) | **3: High risk/high value** (calculated impact score is multiplied by 1.1 (+10%))<br>Kororā have a conservation status of 'At Risk – Declining' (Robertson et al., 2021), making it a high-value species. |
| Areal extent of impact (ha) | **50**<br>The estimated maximum number of nesting pairs of kororā within the seawall. This number is used rather than Areal extent, as extent does not reflect the impact, as the density of nesting pairs is highly variable amongst sites. |
| Value score prior to impact | **Seawall nest sites: 2 low value**<br>Low value nesting habitat (compared to naturally occurring native coastal vegetation). The site is highly exposed to wave action and nest sites are vulnerable to inundation. No pest control is currently undertaken. Breeding success is not known, as it is not possible to directly access and monitor nests, but is expected to be low. Note the value '2 ' is conservative in that it is only slightly below an average of 2.5 |
| Value score after impact | **0.5**<br>The seawall habitat will be remediated with a new cubipod rock wall, which may also support similar cavities that kororā could use, however is expected to be lower value. |
| **Compensation model inputs** | |
| Compensation Action 1 | **Stage 1 nest boxes** |
| Discount rate | **+3 %** (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a).<br>The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). |

| | |
|---|---|
| Finite end-point | **20 years**.<br>Stage 1 colony construction will be completed before the seawall removal. It is anticipated that it will take 20 years for 50% occupancy to be achieved. This allows time for initial colony discovery and use by penguins, as well as for penguins to establish breeding philopatry following successful breeding seasons, to increase colony population size. |
| Compensation contingency (confidence) | **3 (Moderate confidence)**<br>Nestboxes for kororā have been placed at many locations around the New Zealand coastline.. Some uncertainty remains around final occupancy rate. |
| Areal extent (ha) of compensation type | **50**<br>100 nest boxes in total will be installed within the colony. It is assumed that a final occupancy rate of 50% of nest boxes will be achieved after 20 years, resulting in 50 breeding pairs of penguins in the colony. The occupancy rate is based on knowledge of kororā biology and recruitment rates at nestbox colonies, and on experience of the uptake of nestboxes gained from the installation of kororā nestboxes at other locations in the Wellington region and other regions in the North and South Islands. |
| Value score prior to compensation measure (relative to benchmark) | **0.001**<br>As per the value score before impact (negligible). Kororā do not currently use this area for nesting or roosting. |
| Value score after compensation measure (relative to benchmark) | **4.5**<br>The new colony will have high quality habitat with nest sites that are safe from inundation during storms, predation by dogs, interference by people, and risks of injury or death when crossing a road. In the medium term, the significance of the new colony will increase as natural nest sites along the adjacent coast are lost due to sea level rise and increased incidence and intensity of storm events.<br><br>Kororā breeding success was higher in nestboxes than in natural nest sites in studies in Otago (Perriman and Steen, 2000) and in South Australia (Sutherland, Dann, and Jessop, 2014). A study of kororā at an Otago nestbox colony showed that kororā prefer to use sites on flat rather than sloping ground, and prefer sites that are underneath shrubs that have a low canopy to provide shelter and have open ground to sites that do not have open ground underneath a canopy (Ratz, 2019). Nestboxes in the new colony will be on flat ground underneath shrubs and will be higher quality nest sites than seawall sites in crevices amongst rocks and concrete blocks.<br>Perriman, L. and Steen, H. (2000). Blue penguin (*Eudyptula minor*) nest distribution and breeding success on Otago Peninsula, 1992 to 1998. New Zealand Journal of Zoology 27: 269-275.<br><br>Ratz, H. (2019). Parameters influencing selection of nest boxes by little penguins (*Eudyptula minor*). Notornis 66: 129-138. |

| | |
|---|---|
| | Sutherland, D. R., Dann, P. and Jessop, R. E. (2014). Evaluation of artificial nest sites for long-term conservation of a burrow-nesting seabird. Journal of Wildlife Management 78: 1415-1424. |
| **Compensation model inputs** | |
| Compensation Action 2 | **Stage 2 nest boxes** |
| Discount rate | +3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a).<br>The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). |
| Finite end-point | **26 years**. Colony establishment is anticipated to be initiated 6 years after the completion of the Stage 1 colony. It is anticipated that it will take 20 years for 50% occupancy of the nest boxes. This allows time for initial colony discovery and use by penguins, as well as for penguins to establish breeding philopatry following successful breeding seasons, to increase colony population size. |
| Compensation contingency (confidence) | **3 (Moderate confidence)**<br>Nest box supplementation is a well-established method used at multiple penguin breeding sites throughout the country. Some uncertainty remains around final occupancy rate. |
| Areal extent (ha) of compensation type | **35**<br>70 nest boxes in total will be installed within the colony. It is assumed that a final occupancy rate of 50% of nest boxes will be achieved after 20 years, resulting in 35 breeding pairs of penguins in the colony. |
| Value score prior to compensation measure (relative to benchmark) | **0.5**<br>There is currently 1 kororā site in this area. However, access is becoming increasingly difficult due to erosion of the nearby earth bank. |
| Value score after compensation measure (relative to benchmark) | **4.5**<br>The new colony will have high quality habitat with nest sites that are safe from inundation during storms, predation by dogs, interference by people, and risks of injury or death when crossing a road. In the medium term, the significance of the new colony will increase as natural nest sites along the adjacent coast are lost due to sea level rise and increased incidence and intensity of storm events.<br><br>Kororā breeding success was higher in nestboxes than in natural nest sites in studies in Otago (Perriman and Steen, 2000) and in South Australia (Sutherland, Dann, and Jessop, 2014). A study of kororā at an Otago nestbox colony showed that kororā prefer to use sites on flat rather than sloping ground, and prefer sites that are underneath shrubs that have a low canopy to provide shelter and have open ground to sites that do not have open ground underneath a canopy (Ratz, 2019). Nestboxes in the new colony will be on flat ground underneath shrubs and will be higher quality nest sites than seawall sites in crevices amongst rocks and concrete blocks. |

# REFERENCES

**Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021a).** *Biodiversity Compensation Model for New Zealand – A User Guide (Version 1).* Tonkin & Taylor Ltd.

**Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021b).** *Biodiversity Compensation Model for New Zealand – Excel Calculator Tool (Version 1).* Tonkin & Taylor Ltd.

**Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2025).** Evaluating biodiversity compensation in Aotearoa New Zealand: Improving transparency and consistency through the Biodiversity Compensation Model. *New Zealand Journal of Ecology, 49*(1), Article 3591. https://doi.org/10.20417/nzjecol.49.3591

**Boffa Miskell Limited 2025.** *Wellington International Airport Limited Southern Seawall Renewal Project: Landscape, Natural Character and Visual Effects Assessment*. Report prepared by Boffa Miskell Limited for Wellington International Airport Limited.

**Bioresearches. (2025a).** *Wellington International Airport: Southern Seawall Renewal Project – Ecological Impact Assessment.* Report prepared for Wellington International Airport Ltd.

**Bioresearches. (2025b).** *Wellington International Airport: Southern Seawall Renewal Project – Avifauna Management Plan.* Report prepared for Wellington International Airport Ltd.

**Cockrem, J. F. (2025).** *Assessment of potential effects of Wellington Airport seawall renewal on kororā (little penguin, Eudyptula minor).* Independent ecological report prepared for Wellington International Airport Ltd.

**Crisp P, Robertson H, McArthur N and Cotter S. 2023. Conservation status of birds in the Wellington Region,2023.** Greater Wellington Regional Council, Publication No. GW/KI-G-23/21, Wellington.

**Department of Conservation (2010).** *NZ Coastal Policy Statement.*

**Maseyk, F. J. F., Maron, M., Seaton, R., & Dutson, G. (2015).** *A Biodiversity Offsets Accounting Model for New Zealand: User Manual.* Contract Report No. 2014-008, prepared for the Department of Conservation.

**Maseyk, F. J. F., Barea, L. P., Mealey, C., Corkery, I., & Giejsztowt, J. (2025).** Facilitating better ecological outcomes from high-stakes decision-making requires evaluation of biodiversity models to address risk and transparency. *New Zealand Journal of Ecology, 49*(1), Article 3592. https://doi.org/10.20417/nzjecol.49.3592

**Ministry for the Environment. (2023).** *National Policy Statement for Indigenous Biodiversity 2023.* Wellington, New Zealand.

**New Zealand Government. (2014a).** *Guidance on Good Practice Biodiversity Offsetting in New Zealand.* Wellington, New Zealand.

**New Zealand Government. (2014b).** *Limits to Offsetting in New Zealand* (supplement to the Good Practice Guidance). Wellington, New Zealand.

**Perriman, L., & Steen, H. (2000).** Blue penguin (*Eudyptula minor*) nest distribution and breeding success on Otago Peninsula, 1992–1998. *New Zealand Journal of Zoology, 27*(4), 269–275.

**Pilgrim, J. D., Brownlie, S., Ekstrom, J. M. M., Gardner, T. A., von Hase, A., ten Kate, K., Savy, C. E., Stephens, R. T. T., Temple, H. J., Treweek, J., Ussher, G. T., & Ward, G. (2013).** A process for assessing the offsetability of biodiversity impacts. *Conservation Letters, 6*(5), 376–384.

**Ratz, H. (2019).** Parameters influencing selection of nest boxes by little penguins (*Eudyptula minor*). *Notornis, 66*(3), 129–138.

**Robertson, H. A., Baird, K., Dowding, J. E., Elliott, G. P., Hitchmough, R. A., Miskelly, C. M., McArthur, N., O'Donnell, C. F. J., Sagar, P. M., Scofield, R. P., & Taylor, G. A. (2021).** *Conservation status of New Zealand birds, 2021*. New Zealand Threat Classification Series 36. Department of Conservation.

**Sutherland, D. R., Dann, P., & Jessop, R. E. (2014).** Evaluation of artificial nest sites for long-term conservation of a burrow-nesting seabird. *Journal of Wildlife Management, 78*(8), 1415–1424.

**Wellington City Council. (2022).** *Section 32 Report – Ecosystems and Indigenous Biodiversity* (Proposed District Plan). Wellington, New Zealand. Wellington City Council

**Wellington City Council. (2024).** *2024 District Plan (Proposed District Plan decisions incorporated): Online ePlan*. Wellington, New Zealand. Wellington City Council

**Wellington City Council. (2022).** *Appendix 3: Biodiversity Compensation* (Proposed District Plan – submissions summary extract). Wellington, New Zealand. Wellington City Council

# APPLICABILITY AND LIMITATIONS

## Restrictions of Intended Purpose

This report has been prepared solely for the benefit of Wellington International Airport Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

## Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

## Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Bioresearches.

# *Appendix A Kororā Colony Designs*

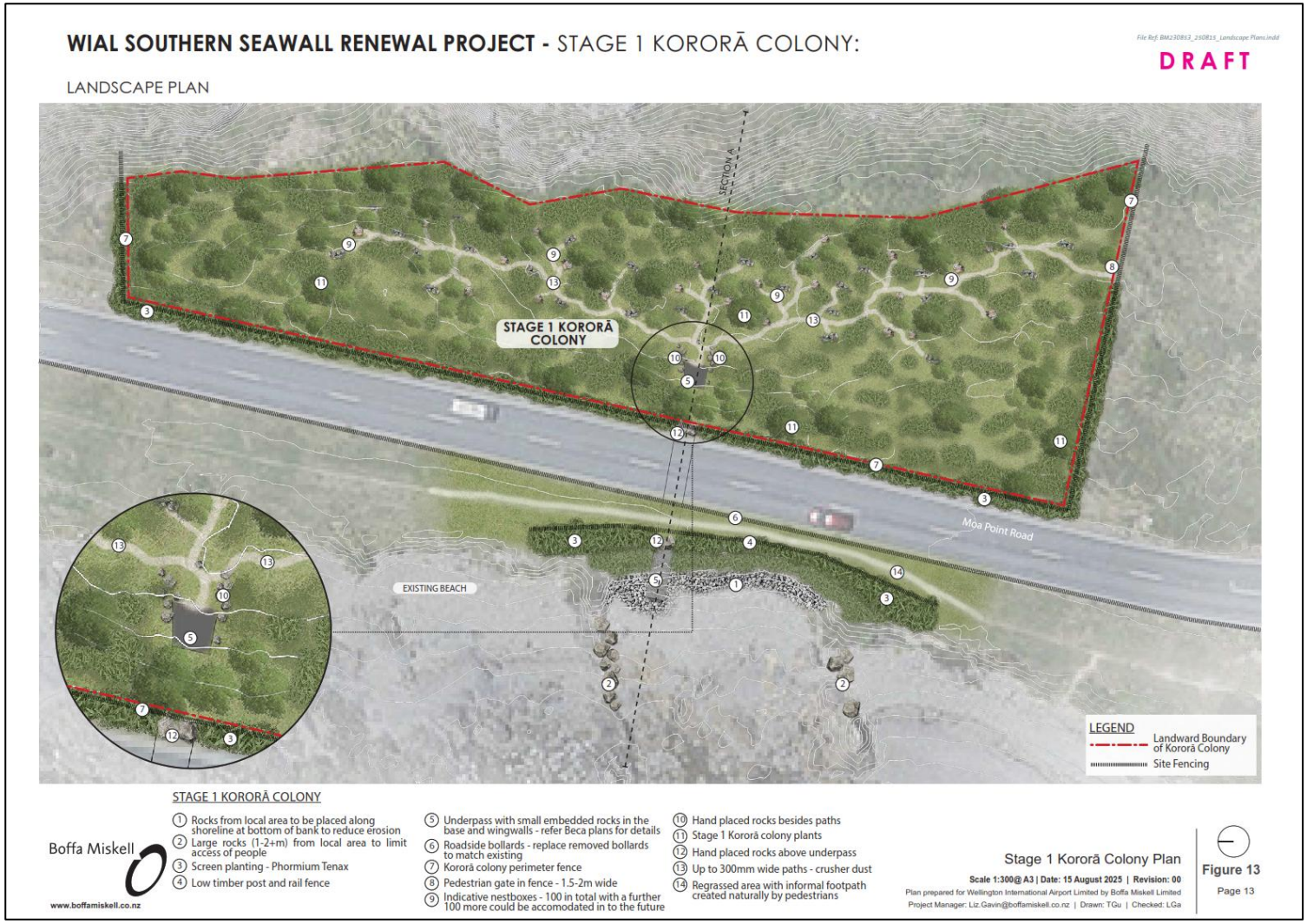


***Figure 3. Stage 1 Kororā colony design. Design plans supplied by Boffa Miskell. See full design plans for additional detail regarding colony design, plant species and nest boxes.***

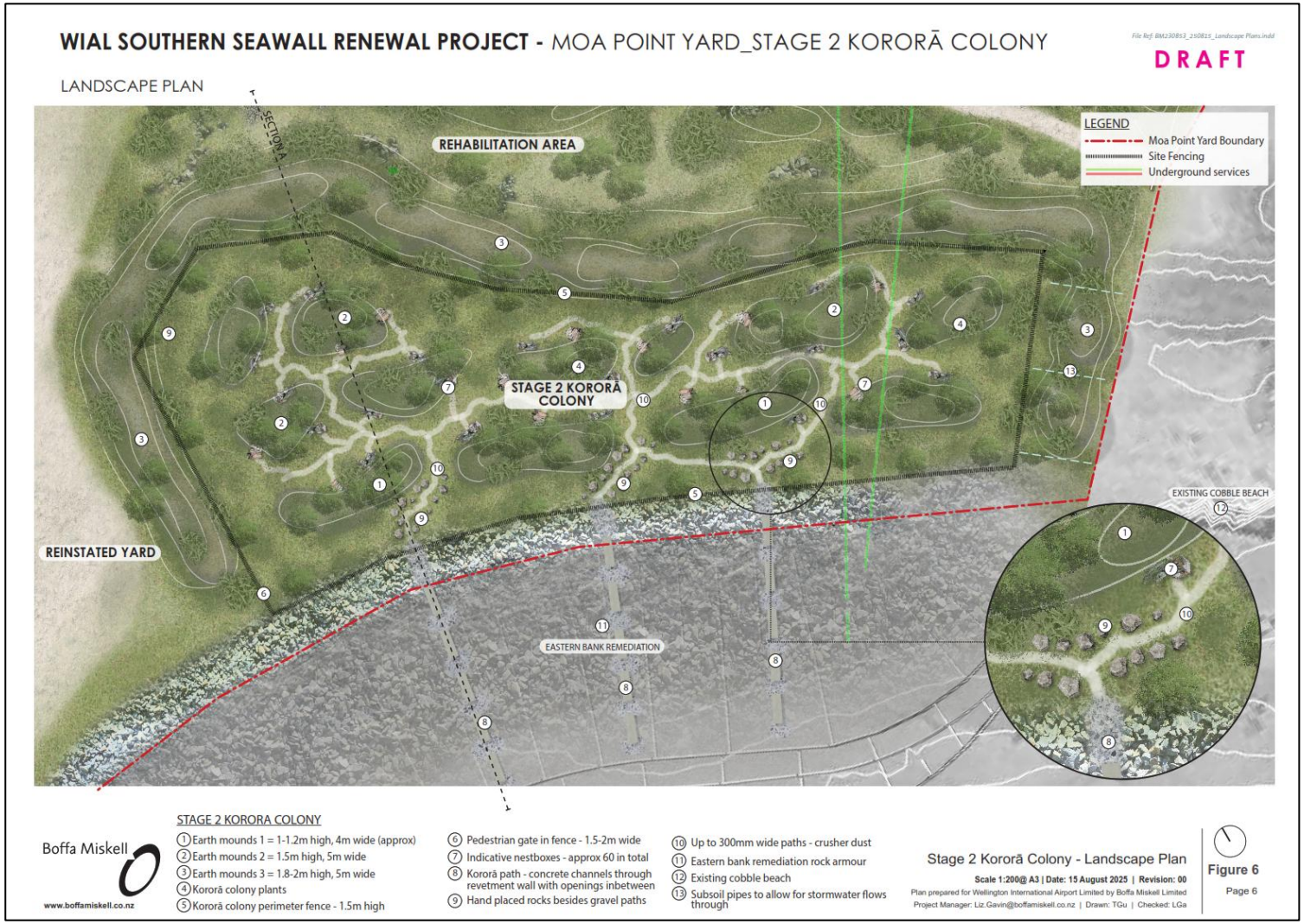


***Figure 4. Stage 1 Kororā colony design. Design plans supplied by Boffa Miskell. See full design plans for additional detail regarding colony design, plant species and nest boxes.***

## Auckland

**Address |** Level 4, 68 Beach Road, Auckland 1010

**Post |** PO Box 2027, Shortland Street, Auckland 1140, New Zealand

**Ph |** 64 9 379 9980

**Fax |** +64 9 377 1170

**Email |** contact-us@babbage.co.nz

## Hamilton

**Address |** Unit 1, 85 Church Road, Pukete, Hamilton 3200

**Post |** PO Box 20068, Te Rapa, Hamilton 3241, New Zealand

**Ph |** +64 7 850 7010

**Fax |** +64 9 377 1170

**Email |** contact-us@babbage.co.nz

## Christchurch

**Address |** 128 Montreal Street, Sydenham, Christchurch 8023

**Post |** PO Box 2373, Christchurch 8140, New Zealand

**Ph |** +64 3 379 2734

**Fax |** +64 3 379 1642

**Email |** solutions@babbage.co.nz

## Babbage Consultants Australia Pty Ltd – Australia

**Address |** Suite 4, Level 2, 1 Yarra Street, Geelong,

Victoria 3220, Australia

**Ph |** +61 3 8539 4805

**Email |** contact-us@babbage.co.nz

**www.bioresearches.co.nz**

**www.babbage.co.nz**

**www.babbageconsultants.com.au**