ASSESSMENT OF LIZARDS FOR A PROPOSED EXPANSION OF THE KIWI POINT QUARRY, NGAURANGA GORGE, WELLINGTON

*Barking gecko (*Naultinus punctatus*), one of the lizard species potentially present within the proposed quarry footprint.*

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1. INTRODUCTION

Kiwi Point Quarry has been operating on Wellington City Council (WCC)-owned land in the Ngauranga Gorge since the 1920s. The current pit is about 40 metres deep and will be deepened by another 15 metres to reach the highest value rock. Only four to five years of rock remains within the current pit and WCC and the quarry operator hope to extend the life of the centrally-located quarry by extending mining southward.

The proposed quarry expansion and associated development has the potential to adversely affect ecological features and values, including indigenous lizard populations and their habitats. This would trigger the need to produce a lizard management plan outlining appropriate mitigation measures, and to apply for a Wildlife Act Authority permit from the Department of Conservation; required where indigenous lizards and/or their habitats are potentially affected by development. A survey to assess the lizard species present, their distribution, abundance, and habitats is an essential requirement to inform any lizard management plan, Wildlife Act Authority, and consent applications. Measures to avoid or minimise potential adverse effects on lizards, and potential mitigation opportunities based on best practice biodiversity offsetting can then be evaluated. This report describes a lizard survey undertaken at the Kiwi Point quarry proposed expansion site in December 2017 and also addresses requirements for further work.

2. DESKTOP ASSESSMENT OF WELLINGTON LIZARD TAXA

The Wellington Region currently has 12 indigenous lizard (gecko and skink) taxa known to remain on the mainland. Based on an assessment of nearby records from the Department of Conservation's Herpetofauna database, seven species were identified as being potentially present at the subject site prior to the field survey. All seven have been recorded within two kilometers of the proposed quarry. Four of these species have a current threat status of 'At Risk-Declining' (Table 1). In the Wellington Region, lizards live in in a range of environments, from rocky coastal scree slopes to wetlands, forests, and even urban gardens, as such they often live close to people and can be vulnerable to disturbance. The lizard fauna of the Wellington Region is diverse relative to other urban centres in New Zealand and warrants a greater focus in consenting processes.

Table 1: Lizard records within two kilometres of the Kiwi Point Quarry site (Department of Conservation Herpetofauna database), their threat status (Hitchmough et al. 2016), and distributions.

Common Name (Bell 2014)	Scientific Name	NZ Threat Status	Nearest Report(s) and Dates
Ngahere gecko	*Mokopirirakau* sp. "Southern North Island"	At Risk, Declining	1.6 km Khandallah 2014
Barking gecko	*Naultinus punctatus*	At Risk, Declining	900 m Broadmeadows 1997 1.4 km Khandallah 1994
Ornate skink	*Oligosoma ornatum*	At Risk, Declining	540 m Khandallah 1951 1.3 km Khandallah 1956
Glossy brown skink	*Oligosoma zelandicum*	At Risk, Declining	750 m Khandallah 2005 Several older reports from Khandallah

Common Name (Bell 2014)	Scientific Name	NZ Threat Status	Nearest Report(s) and Dates
Raukawa gecko	*Woodworthia maculata*	Not Threatened	350 m Khandallah 2002 1 km Broadmeadows 2013
Copper skink	*Oligosoma aeneum*	Not Threatened	250 m Tyers Stream 1994 470 m Khandallah 2013 Several older reports from Khandallah
Northern grass skink	*Oligosoma polychroma*	Not Threatened	300 m Khandallah 2013 800 m Khandallah 1993

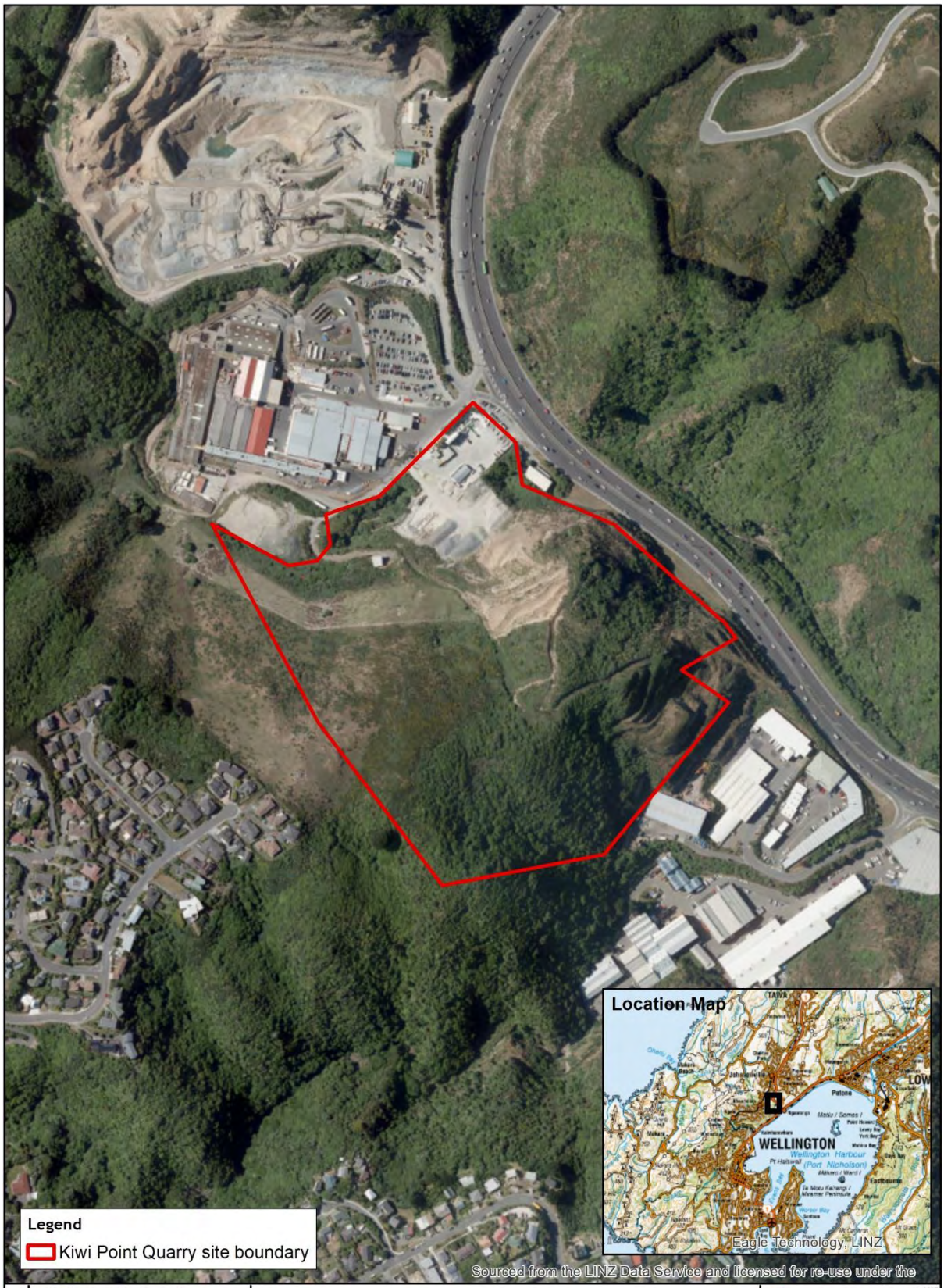
In the Wellington Region, lizards should be assumed to be present until proven otherwise. Lizards can live in a wide range of indigenous, exotic, natural, and artificial habitats. As such, lizard habitats can sometimes be surprising to lay people (for example long grass on road sides can provide important habitat for species such as the northern grass skink). A key requirement is that a thoroughly-experienced lizard expert is used to assess sites for lizards, as the Wellington Region has cryptic lizard species that can be difficult to detect, such as Ngahere gecko (*Mokopirirakau* sp. 'Southern North Island') and barking gecko (*Naultinus punctatus*).

The subject site (Figure 1) is covered with indigenous forest on the shady, southern side of the ridge, and mostly by exotic scrub (gorse (*Ulex europaeus*), broom (*Cytisus scoparius*), and blackberry (*Rubus fruticosus*)) and grassland on the northern, sunny side of the ridge (Wildland Consultants 2017). Forest on the southern side is dominated by ngaio (*Myoporum laetum*), māhoe (*Melicytus ramiflorus*), and māpou (*Myrsine australis*), often with overlying *Muehlenbeckia* vines. The canopy height is quite short throughout much of the site, being less than four metres. The site ranges from 60-180 metres elevation above sea level, and covers 13.3 hectares.

3. SURVEY METHODS

3.1 Overview

Best practice search techniques vary with lizard species and habitat, and thus, there is no one method that adequately covers all species. As such, a range of techniques must be utilised to ensure adequate coverage and sufficient detection probabilities. Best practice detection techniques used for each species are outlined in Table 2 below, along with the methods used during this survey. Although potentially useful for locating the four terrestrial skink species potentially present, pitfall trapping was not used during this survey, as the survey was limited to two days and pitfall trapping is best undertaken over three or more consecutive days (pitfall traps must be checked daily when open). More thorough descriptions of each search technique employed are given in the following section.



Data Acknowledgment

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Figure 1: Location of the Kiwi Point Quarry site

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Table 2: Survey or detection methods used for lizards during the Kiwi Point survey.

Common Name	Habitat	Best practice survey methods	Survey methods employed
Ngahere gecko	Forest, shrubland.	Tree covers, spotlighting.	Tree covers, spotlighting.
Barking gecko	Forest, shrubland.	Day searching, spotlighting.	Day searching, spotlighting.
Ornate skink	Forest, shrubland, leaf litter.	Pitfall trapping, Onduline, raking.	Raking, Onduline.
Glossy brown skink	Damp habitats with dense cover.	Day searching, pitfall trapping, Onduline, raking.	Day search, raking, Onduline.
Raukawa gecko	Rocky areas or clay banks.	Day search, spotlight, Onduline.	Day search, spotlight, Onduline.
Copper skink	Forest, shrubland, leaf litter.	Pitfall trapping, Onduline, raking.	Raking, Onduline.
Northern grass skink	Grassland, shrubland.	Day searching, pitfall trapping, Onduline, raking.	Day search, raking, Onduline.

3.2 Survey methods used

Each of the survey methods used to attempt to locate lizards at the Kiwi Point site is described in detail below.

Spotlighting

Spotlighting was undertaken within the Kiwi Point site over two warm nights, with night time temperatures well over 10°C. The survey was aligned with a period of warm weather in December 2017. The focus was on locating active or emergent Ngahere gecko and barking gecko as they undertake hunting or foraging at night, or as they rest on branches or amongst foliage. The biggest advantage of spotlighting is that it is usually more effective than day-searching for locating Ngahere gecko and barking gecko in tall vegetation, i.e. three metres or taller. It is very difficult to see geckos from underneath during the day because they appear as black silhouettes against the sky. When spotlighting, the full range of vegetation heights from ground level to near the tops of tall trees was searched. Head-mounted LED Lenser H7 spotlights or similar were used to look for the white undersides of geckos amongst the vegetation and/or eye shine produced by reflection of the torch beam on the geckos retinas. Barking geckos do not utilise artificial retreats and are best detected in forest habitats by spotlighting (they can also be spotted basking by day in foliage). Raukawa geckos can be detected by spotlighting, or by examination of rocky areas.

Day Searches and Raking

Day searches were undertaken at the Kiwi Point site over two days in fine, warm weather. These searches focused on bush edges, low canopy bush, shrubland, and grassland. Day searches focused on looking for both emergent or basking lizards, and lizards using refugia, e.g. under rocks, amongst dense ground cover, amongst dense foliage, tree holes, and under piles of leaf litter. Raking of leaf litter was used to target detection of ornate and copper skinks. This technique disturbs lizards sheltering in leaf litter, which can subsequently be caught and identified. Northern grass skink (*Oligosoma polychroma*) and glossy brown skink (*Oligosoma zelandicum*) can often be spotted basking in grassland or other sunny spots close to cover. In contrast, ornate skink (*Oligosoma ornatum*) and copper skink (*Oligosoma aeneum*) are not avid

baskers, preferring to shelter in leaf litter, so can be difficult to detect visually, but raking of leaf litter is an effective method for detection.

Tree Covers and Onduline Retreats

Easily the most effective detection technique for Ngahere geckos is via the use of artificial tree covers which mimic loose bark (made from closed-cell foam (Bell, 2009); Plate 1). Tree covers for detection of arboreal lizards are constructed from closed-cell foam (Bell, 2009). Forest-inhabiting lizards use loose bark and hollows on trees as refugia. The use of these tree covers (dimensions: 30 cm wide x 70 cm long) placed on tree trunks and branches presumably mimics these microhabitats. These tree covers have proven to be several times more effective than spotlighting for forest geckos (*Mokopirirakau* sp.) in the North Island and have detected these cryptic geckos often where spotlighting has failed to do so.

Onduline ACOs create a thermally stable retreat for lizards that mimics the conditions of a rock crevice, which form natural retreats for lizards (Lettink & Cree, 2007). Onduline ACOs generally consist of a stack of two or three 50 40 cm corrugated Onduline sheets with 1-2 cm spacing between each layer (Plate 2).

Forty Onduline retreats and forty tree covers (made from closed cell foam) were installed, but will not be checked until March 2018, as they require at least three months settling time before being checked, in order to give lizards sufficient time to find the retreats and begin habitually using them. The positions of all tree covers and Onduline retreats were recorded as GPS coordinates. As this survey was planned with insufficient time to allow for prior set up of Onduline retreats and tree covers, this report will be updated subsequent to March 2018 following checking of the artificial retreats. Without the use of tree covers and Onduline retreats only a partial assessment is possible and some species are likely to be overlooked. Therefore, it is likely that lizards will be detected in March 2018.

Survey Effort

Two days of field work, including night surveys were undertaken at the Kiwi Point site. Across the two days, 16-person hours (two personal for eight hours) were spent transporting the artificial retreats (tree covers and Onduline) onto site and installing them. Twelve-person hours were spent day-searching for basking lizards, including terrestrial skinks and terrestrial and arboreal geckos under rocks and amongst dense foliage, and raking leaf litter. During day-searches, basking terrestrial skinks were targetted in grassland, shrubland, and on bush edges in the morning whilst temperatures were not too hot. Barking geckos were searched for in dense foliage, particularly *Muehlenbeckia* and mapou. This involved both looking for geckos basking and physical parting of dense vegetation looking for geckos sheltering within, or movement that may indicate the presence of a gecko. Raking took place mostly during the hottest parts of the day under the forest canopy targeting potential copper skink and ornate skink habitat. Night time spotlighting was undertaken for 14-person hours in total across the two nights.

3.3 Information collected during the survey

The start time, finish time, personnel, and weather conditions (air temperature, wind (Beaufort scale), rain and cloud cover (eighths)) were recorded for all day searches and night spotlighting. The following information would be recorded for any lizard found: location, habitat notes, sex, life-history stage (adult, sub-adult or juvenile), snout-vent length (SVL), vent-to-tail length (VTL), and pregnancy status of mature females.

Plate 1: Tree covers (closed cell foam).

Plate 2: Onduline lizard retreat.

4. SURVEY RESULTS

No lizards were located during the two days and night of field work. The survey coincided with a period of very warm weather with both days being clear and sunny with light winds. The day time high was 24°C on the first day and 26°C on the second day. These high day-time temperatures may have restricted lizard emergence and activity somewhat during daylight hours, particularly in the afternoon, and may have decreased detection probability of some species (if present). Night time temperatures, however, were considered suitable for emergence of Ngahere gecko and barking gecko. Both nights were warm with the air temperature of 14°C and 17°C on the first and second nights respectively at the commencement of spotlighting.

The location of installed tree covers and Onduline retreats is shown in Figure 2. Onduline retreats were installed in a variety of habitats as follows: grassland and rocky areas around the access track on the northern side in an attempt to target northern grass skink and raukawa gecko (n = 11)[1], grassland and shrubland near the bush edge targeting all four terrestrial skink species (n = 14)[1], and under the forest canopy amongst dense leaf litter or in partial sunlit clearings targeting copper skink and ornate skink (n = 15)[1]. Tree covers targeting Ngahere gecko were installed primarily on the larger ngaio and mahoe trees spread from the top of the hill down the south side towards the southwest corner of the site.

[1] Number of Onduline retreats.

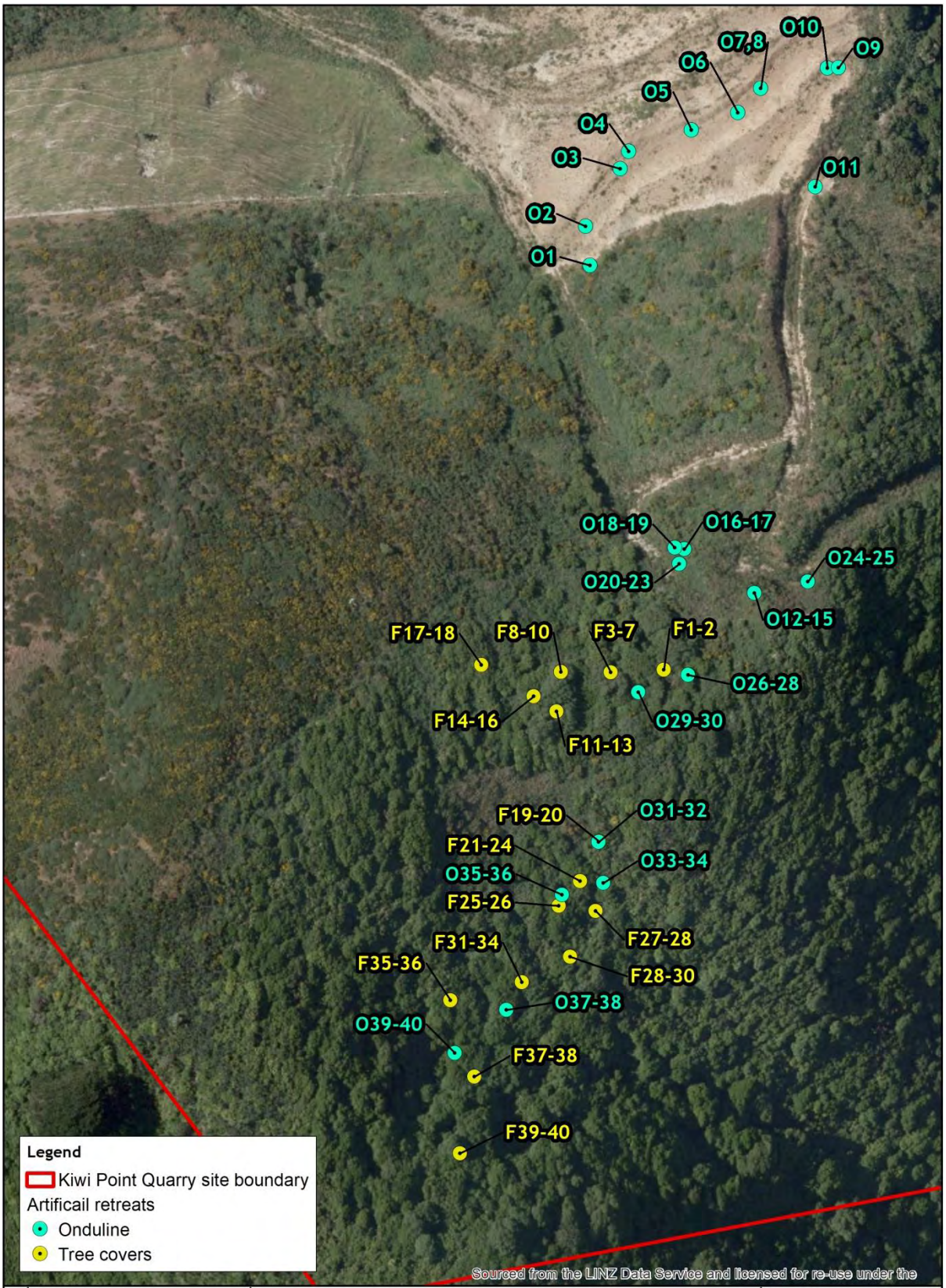
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Figure 2: Location of 40 tree covers (F1-F40) and 40 onduline retreats (O1-O40) installed in an attempt to detect lizards at the Kiwi Point site.
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Although no lizards were detected during this brief two-day survey, checking of the artificial retreats in March 2018 will allow for a second opportunity to detect lizards on site. The likelihood of each species being present on site, given current information, is discussed in the following section.

4.1 Likelihood of species presence

The likelihood of each of the seven potential lizard species (as outlined in Table 1) being present at the site is discussed below.

Ngahere gecko: At Risk-Declining

Ngahere gecko (Plate 3) are considered moderately likely to be present, based on their presence in several other indigenous forest remnants throughout the area, including in Belmont, Khandallah, Ngaio, Otari-Wiltons Bush, Korokoro, and Newlands. The closest record from the site is 1.6 kilometres away in Khandallah, and is recent (2014). Other recent surveys have located Ngahere geckos in similar indigenous forest remnants in Wellington, indicating that these inner-City regenerating bush areas are of local importance to this declining species. The best method (by far) of detecting these geckos is the use of tree covers. Detection by spotlighting is associated with more uncertainty. As such, it is likely that this species will be found in March 2018 under the tree covers. The largest trees were selected for installation of the foam covers. These larger trees are likely to be more attractive to Ngahere gecko than smaller trees, so we expect the geckos to locate the covers within the three-month timeframe. If Ngahere gecko are not detected in the tree covers, this will not necessarily mean that they are not present on site, but would suggest that if present, their population density is likely to be very low.

Plate 3: Ngahere gecko (*Mokopirirakau* sp. “Southern North Island”).

Barking gecko: At Risk-Declining

Barking gecko is a cryptic species that can be difficult to detect, in part due to its sparseness and apparent rarity. The species appears to be widespread in the Wellington Region, but nowhere particularly abundant, and is thought to be in decline. There are scattered records throughout Wellington City and surrounds, but many are decades old. Of most relevance to this survey, single barking geckos were recorded at Broadmeadows some 900 metres from the site in 1997 and Khandallah 1.4 kilometres from the site in 1994. More recently, but much further afield, barking geckos have been reported from Belmont Regional Park 5.5 kilometres to the

northeast of the site. The likelihood of barking gecko being present at the Kiwi Point site is considered low, due to the lack of recent records in the area, history of disturbance, and marginal habitat. Barking gecko are most frequently recorded from kānuka shrubland or forest, which is not present at the Kiwi Point site, aside from 1-2 small patches. The *Muehlenbeckia*-covered mapou and mahoe/ngaio low forest represents potential habitat for the species, but this was searched thoroughly by day and night without any geckos being located.

Ornate skink: At Risk-Declining

All records of ornate skinks from within two kilometres of the site are from the 1950s (Table 1), so it is unlikely that they are still present. There are also no recent reports from any of the surrounding suburbs. Nonetheless, some potential habitat is present on site, so their presence cannot be ruled out.

Glossy brown skink: At Risk-Declining

Glossy brown skinks have been recorded several times from Khandallah, and as close as 750 metres from the site boundary in 2005. However, the survey did not identify particularly suitable habitat for this species. Glossy brown skink are known to prefer densely vegetated ground cover and damp habitats, and much of the Kiwi Point site is not overly damp or dense at ground level. Glossy brown skink are therefore unlikely to be present.

Raukawa gecko: Not Threatened

There are few records of raukawa geckos from the surrounding area, however one was located only 300 metres from the site in 2002 in a roof cavity. In the Wellington Region this species typically lives in rocky areas where it shelters in rock crevices/under rocks by day, or under driftwood on beaches. These geckos are primarily active at night (except for possible basking by day) and can be located spotlighting. Accessible rocky parts of the site were examined and no geckos were found, or any evidence of their presence (sloughed skins or faeces). Raukawa geckos are therefore unlikely to be present at Kiwi Point, although small numbers could be present.

Copper skink: Not Threatened

Copper skink (Plate 4) are one of the most widespread indigenous lizards on the North Island mainland and are well known from the Wellington Region. There are several recent records from Khandallah with the closest being only 250 metres from the site boundary at Tyers stream. As such it is moderately likely that copper skinks are present, at least in small numbers, and they may be detected when the Onduline retreats are checked in March 2018.

Plate 4: Copper skink (*Oligosoma aeneum*).

Northern grass skink: Not Threatened

As with copper skink, northern grass skink could be present at the site in low numbers, as there are recent reports from surrounding areas (Table 1) and potential habitat is available on-site. The Onduline retreats should be attractive to this species, so once again, there will be a second opportunity to detect them in March 2018.

Overall Assessment

A tabulated summary of the relative likelihood of each of the seven taxa being present at the site is set out in Table 3. Threat status for each species is from Hitchmough *et al.* (2016).

Table 3: Likelihood of the presence of indigenous lizard species at Kiwi Point quarry.

Common Name	Threat Status	Likelihood	Reasoning
Ngahere gecko	At Risk-Declining	Moderate	Nearby records, suitable habitat, difficult to detect without tree covers.
Barking gecko	At Risk-Declining	Low	Lack of recent reports from surrounding areas. Marginal habitat.
Ornate skink	At Risk-Declining	Unlikely	Lack of recent reports from surrounding areas.
Glossy brown skink	At Risk-Declining	Unlikely	Largely unsuitable habitat for this species.
Raukawa gecko	Not threatened	Low	Not detected in suitable rocky habitat. Few records nearby.
Copper skink	Not threatened	Moderate	Nearby records, suitable habitat.
Northern grass skink	Not threatened	Moderate	Nearby records, suitable habitat.

5. SURVEY LIMITATIONS

At this stage, despite the lack of lizard detection in the current survey, it is assumed that indigenous lizards of one or more species are nevertheless present on-site and that they have simply avoided detection, possibly due to the survey coinciding with very warm weather. It is considered highly likely that at least one species will be present on site and that some mitigation effort will be required to address adverse effects on lizard habitat.

6. POTENTIAL ADVERSE EFFECTS

The main potential adverse effects of quarry development would be clearance of a relatively large area - approximately 3.5 hectares - of indigenous forest vegetation and habitat that may be locally important for indigenous lizards. Some lizards may also be present in adjacent areas of grassland or shrubland, even if dominated by exotic weeds, such as gorse, broom, and blackberry. Some lizards would probably be killed during quarry excavation. Other lizards may be displaced by habitat loss and subsequently be more likely to be extirpated by predators or be at an increased risk of other causes of mortality.

Twelve lizard species have been recorded on the mainland around Wellington, including seven within two kilometres of the Kiwi Point quarry, and the area is quite diverse in terms of its assemblage of lizards relative to other urban centres around New Zealand. For example, only one lizard species has been reported from both Dunedin City and Hamilton City. Although Wellington's assemblage of lizards is diverse, most (or all) species appear to be in decline and some species are slowly disappearing from the Region. Losses of habitat for these species could be potentially significant on a regional or national scale.

7. POSSIBLE MITIGATION FOR CLEARANCE OF LIZARD HABITAT

Options for mitigation to address the loss of lizards (if found, or assumed present, and based on a scenario of full quarry development) include pest control, habitat creation, and salvage and relocation. Pest control needs to be undertaken long-term and be done over a large scale to have a noticeable benefit to lizard populations. As such, mitigation that focuses on improving or creating habitats is considered more likely to address losses in lizard abundance (and therefore constitute appropriate mitigation), as opposed to small-scale or temporary pest control programmes where it is difficult to achieve or monitor effectiveness.

Lizard mitigation can work alongside proposed mitigation for vegetation losses (Wildlands Consultants, 2017). A lizard restoration site should be chosen which encompasses suitable lizard habitat and allows room for habitat expansion and improvement. A site for appropriate creation of such habitat would be somewhere within a protected area and should be selected by a herpetologist. Subject to species and number of lizards located during the March 2018 visit, an appropriate amount of rock could be utilised from the Kiwi Point quarry or from rocks excavated as part of the new quarry development. Rock piles could be created in areas dominated by

grassland or exotic vegetation (such as gorse and broom) but with suitable lizard habitats adjacent or nearby (indigenous shrubland, rank grassland, or indigenous bush edges) to allow for easy colonisation by lizards. These rock piles need to be constructed carefully, incorporating advice from a herpetologist on site. Some rocks will need to be strategically placed by hand, to ensure that they comprise suitable retreat sites.

A one-off brief salvage effort to remove as many lizards as possible from the development footprint and place them in the newly-created habitat could occur no earlier than three months following completion of the created habitat; to allow for the habitat to settle and some invertebrates to colonise. However, it is understood that not all lizards would be able to be salvaged from the site due to their cryptic nature and the difficulties in finding them or extracting them from their retreats. In addition, some lizards may recolonise or re-enter the development footprint between the time of the salvage and the time of actual development. As such, it won't be possible to completely avoid the loss of individual lizards.

At least 50 lizard-friendly indigenous plants encompassing equal proportions of kānuka, *Coprosma propinqua*, and *Melicytus crassifolius* should be planted around the rock piles within the proposed protected area. These shrubs create dense foliage and habitat that is favoured by both skinks and geckos. These plants also support abundant insects and/or fruit, providing lizards with reliable food sources. Plants should be monitoring over a period of five years, until well established, and any plants that die should be replaced. More details on what is required for lizard mitigation can be outlined in a Wildlife Act Authority application and Lizard Management Plan if lizards are detected in the March 2018 check of the artificial retreats.

Monitoring to show the effectiveness of the mitigation should be undertaken. This could be done by installing a small number of Onduline retreats around each rock pile and checking these at least three months later. If lizards colonise the rock piles then they will begin utilising the Onduline retreats, and when the retreats are lifted, either the lizards, their shed skins, or their droppings, will be evident. Evidence of lizards colonising each rock pile and evidence of breeding females and young could be used as indicators of effective mitigation. A report on the mitigation activities and subsequent monitoring (usually a condition of the permit) should be submitted to the Department of Conservation.

8. PERMIT REQUIREMENTS

A Wildlife Act Authority from the Department of Conservation will need to be applied for in order to gain a permit to destroy indigenous lizards and/or their habitats. A form is available from: http://www.doc.govt.nz/Documents/about-doc/concessions-and-permits/wildlife-research-permits/wildlife-act-authority-application-9.pdf.

A lizard management plan (could be a sub-section of a larger ecological management plan) should be produced outlining appropriate mitigation measures and these can be referred to in the Wildlife Act Authority application.

The Department of Conservation will assess the Wildlife Act Authority application and (usually) approval will be obtained to proceed with development with conditions in regards to lizard mitigation attached. The Department will either agree with the proposed mitigation option/s or suggest additional (or alternative) measures to mitigate for effects on lizards.

9. CONCLUSIONS

The proposed quarry site contains indigenous forest and exotic grassland and shrubland that represents potential habitat for up to seven lizard species, with three species most likely to be present: Ngahere gecko, copper skink, and northern grass skink.

Adverse effects of clearance of these habitats for quarry development on lizards may be significant, and require mitigation. If this is the case, then a Wildlife Act Authority and Lizard Management Plan will be required. Ideally, mitigation for any adverse effects on lizards should occur at a nearby site that has features similar to the areas to be affected and where habitat can be expanded and enhanced.

ACKNOWLEDGMENTS

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