Grey District Plan
LU3154-23

TiGa Minerals and Metals

Review – Terrestrial Ecology

12 December 2023

Evidence of

Mike Harding

Environmental Consultant

Contents

List of Abbreviations

DOC	Department of Conservation
EEA	Barrytown Mineral Sand Mine Ecological Effects Assessment (Bramley et al, 2023)
EIANZ	Ecological Institute of Australia and New Zealand
GDC	Grey District Council
NPSFM	National Policy Statement for Freshwater Management 2020
NPS-IB	National Policy Statement for Indigenous Biodiversity, 2023
NZCPS	New Zealand Coastal Policy Statement 2010
RMA	Resource Management Act 1991
SNA	Significant Natural Area

List of Submitters Referred to in this Evidence

Submitter Number	Full Submitter Name
60	Michael Frederick Spruce
61	West Coast Penguin Trust
80	Suzanne Hills
84	Conservation Volunteers New Zealand (Gemma Thomson)
87	Sophia Josephine Allan
101	Dr Susan Waugh
141	Anne Inwood
179	Chanelle van Rooyen
208	NZ Penguin Initiative
223	Dr Roseanna Gamlen-Greene
241	Director General of Conservation
309	Fiona McDonald
317	Graham Wood

Introduction

1. My full name is Michael Arthur Coupland Harding. I am an independent Environmental Consultant based at Nelson. I hold a Diploma in Parks and Recreation Management (with Distinction) from Lincoln University (1986) and papers in Botany and Geology from Otago University (1980). I have seven years' experience in national park management and conservation advocacy, and a subsequent thirty years' experience as an independent ecologist.

2. My work as an independent ecologist has included field surveys of indigenous vegetation and habitat, assessments of ecological significance, assessments of priorities for protection of indigenous ecosystems, and advice on management of indigenous ecosystems, throughout New Zealand. Consultancy work relevant to this application is:

    a. Preparation of a West Coast Plant Pest Control Strategy (DOC contract, 1994);

    b. Provision of advice on priorities for protection of indigenous forest on the West Coast (Forest Heritage Fund contract, 1994);

    c. Assessment of conservation values of Timberlands West Coast Ltd Indigenous Forests (Ministerial Contract, 2000);

    d. Peer review of West Coast SNA project (Ministry for the Environment contract, 2002);

    e. Assessment of terrestrial ecology for upgrades of State Highway 73 (Arthur's Pass) and State Highway 6 (Haast Pass) (Opus contracts, 1994; 1998; 2000; 2009; 2011, and 2015);

    f. Review of Mt Davy SNA BLA-P002 (Grey District Council contract, 2017);

    g. Ecological Assessment of GDC lands at Mt Buckley, Taylorville, and Cashmere Bay (DOC contract, 2017);

    h. Survey and assessment of SNAs at more than 1000 sites in Nelson, Tasman, Ashburton, Timaru, Mackenzie, and Waitaki districts (2000 to 2023);

    i. Provision of ecological advice to the Biodiversity Collaborative Group for development of the National Policy Statement for Indigenous Biodiversity (2020); and,

    j. Review of recommendations of the National Panel on Stewardship Land on the West Coast (EDS contract, 2022).

3. I have been engaged by Perspective Consulting, on behalf of Grey District Council (GDC), to review terrestrial ecological matters related to the application (LU3154-23) by TiGa Minerals and Metals for mining at Barrytown Flats.

4. I confirm that I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note 2023. I have complied with it in preparing this evidence. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise, except where I state that I am relying on the evidence of another person.

5. In preparing this evidence I have been aware of and viewed the following material:

    - Barrytown Mineral Sand Mine Ecological Effects Assessment (Bramley et al, 2023).
    - Attachment E - Ecological Response Memorandum (Bramley, 2023).
    - Wetland Construction and Riparian Planting Plan (Bramley & Bodley, 2023a)
    - Barrytown Mineral Sand Mine Avian Management Plan (Bramley & Bodley, 2023b)

6. This evidence benefitted from a four-hour site visit in May 2023 in the company of the applicant's ecologist (Gary Bramley).

7. The first part of this evidence (review of terrestrial ecology matters) was prepared in September 2023; the second part (analysis of submissions) was prepared in November 2023.

Scope of Evidence

8. This evidence is prepared in accordance with s42A of the Resource Management Act 1991 (RMA). It provides a review of terrestrial ecology matters relevant to the application.

9. The following matters are reviewed in this evidence:

    - Terrestrial ecology values at the location of the proposed activity[1].
    - Assessment of ecological values.
    - Terrestrial ecology values of adjacent areas.
    - Potential adverse effects of the activity.
    - Adequacy of Information.

Terrestrial Ecological Values at the Location

10. A description of terrestrial ecological values is presented in the applicant's Ecological Effects Assessment (hereafter called the **EEA**).[2] That report describes terrestrial vegetation and habitat at the site as farmland that has been modified and maintained as grassland (pasture) for dairy farming. The proposed mine location is at the lower-altitude part of the site close to the coastal lagoon.

11. The EEA describes indigenous vegetation at the location as: three isolated kahikatea (*Dacrycarpus dacrydioides*) trees, with epiphytes; and sedges and rushes along drains. Otherwise, the area affected by the proposed mine (the "location") is described in the EEA as

[1] In this evidence the "location" is the area directly affected by the proposed activity (the mine footprint), and the "site" is the land parcel within which the proposed activity is located.
[2] Bramley et al, 2023.

supporting exotic pasture. That description is consistent with my observations at the location during my site visit.

12. Indigenous vegetation elsewhere at the site (outside the mine footprint) is described in the EEA as: riparian vegetation along Collins Creek; and, flaxland-sedgeland around the margins of Canoe Creek Lagoon. I did not survey that vegetation closely during my site visit. However, the EEA description of that vegetation is consistent with my observations.

13. Other indigenous vegetation at the site – and not described in the EEA – is a small area of indigenous forest alongside the Coast Road (State Highway 6), near the proposed entrance/access to the mine. I checked this vegetation briefly during my site visit. Dominant canopy species are tarata/lemonwood (*Pittosporum eugenioides*), mahoe (*Melicytus ramiflorus*), pigeonwood (*Hedycarya arborea*), mapou (*Myrsine australis*), and pohuehue (*Muehlenbeckia australis*). A single northern rata (*Metrosideros robusta*) tree is present at the southern end of the forest patch.

14. The method employed by the applicant for survey of avifauna was four seasonal surveys over a one-year period (April 2022 to January 2023). The EEA lists 27 native bird species recorded within or near the site during seasonal surveys,[3] seven of which are listed as 'threatened' or 'at risk.'[4] Survey data are complemented by a list of 26 birds of conservation interest[5] recorded within 10km of the site, from the on-line eBird database.

15. I did not undertake a bird survey during my brief site visit. Robust assessments of avifauna require repeated surveys at different seasons, and during the full range of climate/weather conditions. Specialised methods are sometimes required to detect cryptic or discreet bird species.

16. The EEA avifauna survey data are constrained by the duration of the survey (one year), and the lack of surveys of adjacent habitats. Recorded observations – such as those on eBird – cannot be assumed to be comprehensive; the absence of observations of species does not necessarily mean those species are absent. Further, some species – such as matuku/Australasian bittern or crake – can be difficult to detect.

17. Examples of the difficulty of comprehensive bird surveys are: the observation of an additional 'threatened' bird species – Pacific reef heron (*Egretta sacra*) – by the applicant's ecologist during a separate site visit; and, observation of a kotuku/white heron (*Ardea modesta*) at the site on the day of my visit.[6]

18. The EEA proposes that none of the eight bird species of conservation interest that were recorded at the site are likely to "rely on the pasture habitat within the site."[7] The EEA provides insufficient data to support that assumption. It is possible that the open-pasture habitat provides an important seasonal or occasional resource for mobile (migratory) bird species, such as South Island pied oystercatcher (*Haematopus ostralegus*).

[3] Bramley et al, 2023, Table 8, p26.
[4] Robertson et al, 2021.
[5] 'Threatened' and 'at risk' species, as determined by Robertson et al (2021).
[6] Mark Geddes, pers.comm.
[7] Bramley et al, 2023, p26.

19. Nevertheless, I concur with the contention in the EEA that higher quality – and more natural – habitats for birds are present at the wetland, lagoon, and forest habitats on adjacent land. The adequacy of the avifauna data for those habitats is discussed below.

20. The applicant's survey of herpetofauna appears to have been limited to a search of the Department of Conservation's Bioweb database. The EEA concludes that the grazed pasture at the location does not provide suitable habitat for indigenous herpetofauna (lizards). I do not have specialist expertise in herpetofauna. However, as an ecologist, that assumption appears reasonable, considering the very modified condition of the habitat.

21. The applicant does not appear to have undertaken any survey – or investigation – of terrestrial invertebrate fauna. The very modified nature of the habitat at the location suggests that sedentary invertebrate fauna will be substantially depleted: naturally-occurring vegetation has been lost; and, the land has been modified to facilitate drainage for pasture development. However, mobile invertebrates – such as Lepidoptera (moths and butterflies) – will be present in the vicinity, and may utilise habitats at the location.

22. The EEA states that "any original wetlands within the site have been reclaimed by 'humping and hollowing' for agricultural purposes" and that "these modifications have resulted in a near complete loss of wetland ecosystem types from the area" and that "ecosystem services provided by wetland systems including flow attenuation and water quality improvement have also been lost."[8] I concur that any original wetlands at the site have been modified. However, it may be that hydrological processes across the site are still sufficiently intact to contribute to the integrity of wetland ecosystems. The application provides insufficient data to support the statement that wetland ecosystem services have been lost.

Assessment of Ecological Values

23. Ecological values of indigenous biodiversity at the site are assessed in the EEA by the method proposed in the Environmental Institute of Australia and New Zealand (EIANZ) Guidelines.[9] The EIANZ Guidelines are non-statutory, and are not endorsed by the Ministry for the Environment, Department of Conservation, nor Ecological Society of New Zealand.

24. The EIANZ Guidelines have two important limitations for the assessment of ecological value: the baseline for assessing representativeness; and, the separating and averaging of component values to provide an "overall" ecological value. The guidelines state that combining values should be done in a way that avoids suppressing project impacts on individual features or components.[10] However, the method – as applied in the EEA – has that effect.

25. Recent hearing decisions expressed concern that use of the EIANZ Guidelines can result in wide differences in assessed ecological value and magnitude of effect, and noted that use of the

[8] Bramley et al, 2023, p27.
[9] Roper-Lindsay et al, 2018.
[10] ibid, p69.

guidelines is problematic.[11] I believe that use of the EIANZ Guidelines to assess ecological value at this site is inappropriate. Notable points of disagreement are summarised below.

26. The EEA assesses the representativeness value of the shrubland along Collins Creek as 'low' because "it is not representative of any former forest or other vegetation type." This assessment arises from the use of an 1840 baseline in the EIANZ Guidelines for assessment of representativeness. This baseline has its origins in the Reserves Act 1977; one of the purposes of which is to protect vegetation that gave New Zealand its original character. It is an inappropriate baseline for assessment of an application under the Resource Management Act 1991 (RMA).

27. The RMA requires the protection of indigenous vegetation and habitat, and the maintenance of indigenous biodiversity; not the protection of "former" vegetation. If there was any doubt, this has been dispelled by the National Policy Statement for Indigenous Biodiversity (NPS-IB). The NPSIB states – as a key assessment principle – that assessments of representativeness are of "the indigenous vegetation of the ecological district in the present-day environment."[12]

28. Therefore, the representativeness value of the shrubland along Collins Creek is at least 'moderate;' not 'low.' And, the representativeness value of the rushland and flaxland surrounding Rusty Pond and Canoe Creek Lagoon are – in my assessment – 'high;' not 'moderate.' I concur that the representativeness value of the areas of open pasture that will be directly affected by the proposed activity (the mine footprint) is 'low.'

29. The EEA assesses the ecological context values of the shrubland along Collins Creek, and the rushland and flaxland surrounding Rusty Pond and Canoe Creek Lagoon, as 'low' and 'moderate' respectively. The ecological context criterion includes values such as buffering, linkages, and networks of habitat. These shrubland, rushland, and flaxland communities clearly buffer Collins Creek, Rusty Pond, and Canoe Creek Lagoon. And, these communities are very likely to link areas of habitat, or contribute the network of fauna habitat in the wider area.

30. Therefore, the ecological context values of the shrubland along Collins Creek, and the rushland and flaxland surrounding Rusty Pond and Canoe Creek Lagoon, are – in my assessment – 'moderate' and 'high' respectively. The ecological context values of the area of open pasture that will be directly affected by the proposed activity are more difficult to assess, due to the absence of complete data on fauna habitat.

31. An ecological context value of the proposed mine location – and the wider site – is its position as an enclave of developed land within a landscape of largely undeveloped land: indigenous vegetation and wetlands to the north; extensive forest on the Paparoa Range to the east; Canoe Creek and the Langridge Scenic Reserve to the south; and, Canoe Creek Lagoon and the beach/sea to the west.

[11] Report and Decision of the Hearing Commissioners, Bathurst Coal Limited v Canterbury Regional Council and Selwyn District Council, 17 June 2022; Joint Report and Decision of the Hearing Commissioners, Simpson v Mackenzie District Council and Canterbury Regional Council, 8 November 2023.
[12] NPS-IB, Appendix 1, A (2).

Terrestrial Ecological Values of Adjacent Areas

32. The EEA descriptions of adjacent areas of indigenous vegetation and habitat appear to be derived from existing documents, records, and observations. There is no indication that the ecological values of adjacent areas – or the wider Barrytown Flats coastal-plain ecosystem – were surveyed during the preparation of the EEA. Adjacent areas of indigenous vegetation and habitat are summarised below.

33. The coastal plain (Barrytown Flats) within which the proposed activity is located supports numerous – ecologically interconnected – areas of lagoon, wetland, flaxland, shrubland and forest. It is bordered by beach, foredune, and lagoon systems, all of which are part of a dynamic and fast-changing coastal environment. And, there is extensive forest-bird habitat nearby in the foothills of the Paparoa Range.

34. An extensive wetland-lagoon complex – Barrytown Flats-Canoe Creek Lagoon – is present to the north and west of the site. The northern part of this complex is scheduled as a Significant Natural Area (SNA) (Site PUN-W034) in the Proposed Te Tai o Poutini Plan. The southern part (Canoe Creek Lagoon) was originally included in this SNA, but has since been omitted from the presently-proposed SNA.

35. Vegetation at Canoe Creek Lagoon is described in the EEA, and illustrated in Figure 16 of the EEA[13]. I viewed the vegetation adjacent to the lagoon at two locations during my site visit. Canoe Creek Lagoon, and its surrounding riparian vegetation and habitat, is ecologically significant; it should be regarded as an SNA.[14]

36. Other areas of indigenous vegetation and habitat – including natural wetlands – are present on the property on the northern side of the site, adjacent to the PUN-W034 SNA. Further north, a wetland/forest sequence is protected as three areas of public conservation land (Lawson Creek Scenic Reserve; Coast Road Barrytown Scenic Reserve; and, Barrytown Flat Conservation Area).

37. An area of indigenous forest on the adjacent property to the south of the site – across Canoe Creek – is protected as public conservation land (Langridge Scenic Reserve). A narrow strip of land along Canoe Creek is also protected as public conservation land (Canoe Creek Conservation Area), linking Langridge Scenic Reserve with an extensive area of public conservation land on the Paparoa Range (Paparoa Range South Conservation Area).

38. The proposed mine location lies between areas of protected land to the north and south; and between the coast to the west, and forested slopes of the Paparoa Range to the east. Ecologically, it is an enclave within areas of indigenous vegetation and habitat, substantial portions of which are protected as public conservation land.

39. The site lies only a few kilometres south of the only known breeding habitat for tāiko /Westland petrel (*Procellaria westlandica*). The EEA notes that tāiko have a threat status of 'at risk; naturally uncommon,' with the qualifiers OL (one location) and St (population stable). The threat status of this species has two other qualifiers: CD (conservation dependent) and CR

[13] Bramley et al, 2023, p28.
[14] The Canoe Creek Lagoon vegetation/habitat meets the NPS-IB Appendix 1 SNA criteria.

(conservation research needed).[15] The CD qualifier means that the species is likely to move to a higher threat category if current management ceases.[16] The CR qualifier means that the causes of decline and/or solutions for recovery are poorly understood, and research is required.[17]

40. The EEA states that access to the property north of the site was not available, but assumes that natural wetlands are present on that property and within 100m of the site.[18] There are areas of indigenous vegetation/habitat on that property, including areas outside the SNA. I concur that there are very likely to be natural wetlands present.

41. The year-long avifauna survey at the site would have detected the presence of some bird species at habitats immediately adjacent to the site, and some mobile species that are present in the wider area. However, this survey method and duration may not detect all cryptic or secretive bird species that utilise adjacent habitats, especially those species which make only seasonal or occasional use of those habitats.

42. Bird species that are difficult to detect and may be present in the area – if only briefly – include: South Island fernbird (*Bowdleria punctata punctata*); Australasian bittern (*Botaurus poiciloptilus*); reef heron (*Egretta sacra sacra*); southern blue penguin (*Eudyptula minor minor*); marsh crake (*Porzana pusilla affinis*); and, spotless crake (*Porzana tabuensis tabuensis*).

Potential Adverse Effects of the Activity

43. Assessment of the potential adverse effects of the activity on terrestrial ecology is constrained by the lack of information in the EEA on indigenous biodiversity values on adjacent properties. It is further constrained by our limited understanding of ecological processes in the wider Barrytown Flats coastal-plain ecosystem.

44. Three types of potential adverse effects on terrestrial ecology are reviewed below: effects at the location; effects adjacent to the location; and, effects on the wider ecosystem.

Potential Adverse Effects at the Location

45. The EEA assessment of potential adverse effects of the activity uses the method proposed in the EIANZ Guidelines. The limitations of these guidelines are discussed above. Additional limitations – for the assessment of effects – are the separating and averaging of component effects to provide an "overall" ecological effect; and, ambiguity in criteria for assessing the magnitude of effects.

46. The EEA summarises the magnitude and level of each effect with and without mitigation.[19] The level of effect is derived from the ecological value of the affected vegetation/habitat and a 'magnitude of effect' ranking. The ecological values ascribed to some vegetation/habitats are – in my assessment – too low (see earlier discussion). Therefore, some of the level of effect rankings in the EEA are also too low.

[15] Robertson et al, 2021.
[16] Townsend et al, 2008.
[17] Rolfe et al, 2019.
[18] Bramley et al, 2023, p15.
[19] Bramley et al, 2023, Table 22, p67-68.

47. The level of effects on terrestrial ecology at the mine location proposed in the EEA may be realistic, if the ecological values of the location are accurately documented. Areas of uncertainty are the importance of habitats at the location for mobile/migratory bird species, and for mobile invertebrate fauna (e.g., Lepidoptera).

48. The Avian Management Plan proposes how the location will be managed to avoid adverse effects on mobile avifauna at the location of mining activity, in particular banded dotterel (*Charadrius bicinctus*), little blue penguin (*Eudyptula minor*), and South Island pied oystercatcher (*Haematopus ostralegus finschi*).[20] The proposed management will likely mitigate – but will not necessarily avoid – adverse effects on nesting avifauna at the mine location.

49. The applicant's response to the request for further information on the local populations (and habitat use) of cryptic/secretive bird species was provided in Attachment E[21]. It concludes that all six bird species – if present – are likely to have been detected during the avifauna survey at the site, and that none of these species would be expected to utilise the exotic pasture within the mine footprint. The duration of the avifauna survey was one year, so cannot be relied upon to conclude that these species will not be present during the 12-year period of mining activity.

50. I understand that the proposed access to the mine from State Highway 6 has been revised so that it will no longer affect a strip of indigenous forest alongside the Coast Road (State Highway 6).[22] The composition or significance of this forest does not appear to have been assessed in the application. In the absence of advice to the contrary, it should be assumed that the forest is significant, or at least contributes to indigenous biodiversity values in the area.

Potential Adverse Effects adjacent to the Location

51. Potential adverse effects of the activity on terrestrial ecological values at adjacent areas are:

- Disturbance of birds (and possibly invertebrates) by noise and artificial light.
- Modification or loss of vegetation/habitat by altering hydrology (ground-water levels and recharge rates).
- Modification or loss of vegetation/habitat through erosion and/or inundation caused by catastrophic land movement (earthquake) or storm events.

Disturbance of Fauna

52. The possible effects of the activity on avifauna at habitats directly adjacent to the mine location are described as "noise, human activities and vehicle movements near their habitats, particularly during the breeding season."[23] Management actions proposed to address these effects include: maintaining buffers; planting; and, avoiding mining adjacent to high-quality habitat during the breeding season.

[20] Bramley & Bodley, 2023 (b), p7-10.
[21] Bramley, 2023.
[22] Att F Revise Site Plan 20.06.23.
[23] ibid, p19.

53. The proposed buffer of 20m is narrow, especially as at the Canoe Creek Lagoon margin – and probably elsewhere – the adjacent vegetation/habitat is ecologically significant (an SNA).[24] It is likely that a 20m separation between mining activities and fauna habitat will be insufficient to avoid adverse effects on sensitive species using that habitat.[25] A wider buffer should be provided to reduce this risk. The earlier hearing decision noted that there was evidence that a buffer of 100m would be required to mitigate effects on avifauna.[26]

54. One species that is sensitive to disturbance, and is known to utilise habitats in the area, is matuku/Australasian bittern. The earlier hearing decision noted that there was evidence that the mining activity may cause the displacement of matuku from what is regarded as the best habitat in the ecological district, and that the loss of one individual would affect the matuku population.[27]

55. The applicant's response to the request for further information notes that matuku have been observed previously in "the lagoon area" and that suitable habitat is present. It cannot be assumed – from the data presented – that the vegetation may not be sufficiently dense to provide breeding habitat, as stated by the applicant.[28]

56. The other proposed management actions appear appropriate to mitigate adverse effects on avifauna at habitats adjacent to the site. However, the limited period of data collection (one year) and the possibility that other – discreet or cryptic species – may be occasionally present, mean that it is not possible to be certain that all adverse effects on avifauna utilising habitats directly adjacent to the site will be avoided.[29]

57. The applicant's response to the request for further information on the local populations (and habitat use) of cryptic/secretive bird species provides further information on the distribution, records, and habitat use of the six listed bird species. It indicates that the risk of adverse effects on these species is low. It cannot be assumed that adverse effects will be completely avoided.

58. An important potential adverse effect is that of disturbance (notably light) on tāiko/Westland petrel, of which the only known breeding colony is located near (3.6km from) the site. Management actions are proposed to avoid the risk of tāiko being disoriented by artificial light, including: specifying the type of lighting at the mine location; restricting operating hours; and, restricting truck movements past the breeding colony to daylight hours.[30]

59. It is difficult to determine whether those actions would avoid – or only mitigate – the adverse effects of the proposed activity on tāiko. In the absence of certainty, it would be prudent to at

[24] These areas are not scheduled as SNAs, but meet the NPS-IB Appendix 1 criteria.
[25] NPSIB Clause 3.10 (2)(e) a new activity to avoid a "reduction in the size or occupancy of Threatened or At Risk (declining) species that use an SNA for any part of their lifecycle' (NPSIB Clause 3.11 lists exceptions, including "mineral extraction that provides significant national public benefit').
[26] Joint Report and Decision of the Hearing Commissioners Applications WCRC RC-2020-0159 and GDC LUN 29226/20, para 105.
[27] Joint Report and Decision of the Hearing Commissioners Applications WCRC RC-2020-0159 and GDC LUN 29226/20, para 197.
[28] Bramley, 2023, p4.
[29] For example: Att E (Bramley & Bodley 2023 (b)) states (on page 4) that "a pair of reef heron was seen on the beach near the coastal lagoon in 2020 during field work for this project." This species is not listed in the EEA.
[30] ibid, p10-17.

least restrict mine operations (including truck traffic) to daylight hours, during November to January (inclusive), to reduce the risk of artificial light disorienting young tāiko.[31]

60. The avoidance of adverse effects on tāiko is especially important considering the species has a threat status of 'at risk; naturally uncommon,' with the qualifiers OL (one location), CD (conservation dependent) and CR (conservation research needed). The NZ Coastal Policy Statement requires that adverse effects on "indigenous taxa that are listed as threatened or at risk" are avoided.[32] Tāiko (and South Island pied oystercatcher) are listed as 'at risk' species.[33]

61. The NZ Coastal Policy Statement 2010 (NZCPS) also requires that activities avoid significant adverse effects on vulnerable coastal ecosystems, including "lagoons" and "coastal wetlands;" and "habitats, including areas and routes, important to migratory species."[34] Information provided by the applicant is insufficient to determine whether those any significant effects will be avoided.

Modification of Vegetation/Habitats by Altered Hydrology

62. The application proposes that ground and surface water levels will "be managed to avoid effects on wetland values"[35] adjacent to the site. Adequate assessment of potential adverse effects on ecological values at adjacent areas requires robust data on the indigenous biodiversity values of those areas. Any assessment of effects should consider the sensitivity of vegetation, habitats, and species in the receiving environment.

63. The applicant's response to the request for further information repeats the descriptions of vegetation at the Canoe Creek Lagoon, and provides further analysis of the vulnerability of the plant communities on a scale of low-medium-high. It states that the magnitude of effects is "at the lower end of the scale" but effects will vary between species and locations.[36]

64. The response discusses those varying effects in theoretical terms, noting that small wetland herb and turf species may be threatened by competition from exotic plants if changing water levels result in more prolonged exposure.[37] It concludes that species' populations are not considered vulnerable because there are no species of conservation concern in the Canoe Creek Lagoon, and that the proposed water management plan will avoid effects by maintaining water levels.[38]

65. It is not clear that the Canoe Creek Lagoon and its margins have been surveyed comprehensively for species of 'conservation concern.' And, the obligation to avoid adverse effects is not confined to such species; there is a wider obligation to protect and maintain indigenous biodiversity.[39]

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[31] Note that vehicle movements on the Coast Road may need to be restricted for a longer period to reduce the risk of mortality to kororā/little penguin (see paragraphs 112 and 117).
[32] NZ Coastal Policy Statement 2010, Policy 11 (a)(i).
[33] Robertson et al, 2021.
[34] NZ Coastal Policy Statement, Policy 11 (b).
[35] Bramley, 2023, p2.
[36] Bramley, 2023.
[37] Bramley, 2023, p2.
[38] ibid, p7.
[39] NPS-IB, Policy 7 and Policy 8.

66. The EEA states closer survey of vegetation on the property adjacent to the northern boundary of the site is not necessary because the proposed activity will not affect biodiversity beyond the location of the activity and its buffer area. That is an optimistic assumption. It is also inconsistent with the obligations that "A precautionary approach is adopted when considering adverse effects on indigenous biodiversity,"[40] and to "Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse."[41]

67. A precautionary approach is appropriate for this application because: the incomplete information about indigenous biodiversity at adjacent habitats means the effects on indigenous biodiversity are "uncertain;"[42] and, those effects could cause "significant or irreversible damage" to indigenous biodiversity.[43]

68. I cannot analyse the possible effects of altered hydrology on adjacent wetlands without better information on the character and composition of the plant communities at those wetlands. If there is any mining-induced alteration to hydrology (especially water levels) at adjacent wetlands, there remains a risk that there will be adverse effects on indigenous biodiversity.

Modification of Vegetation/Habitats by Land Movement

69. A possible adverse effect on adjacent vegetation and habitats is collapse of the wall of the excavated pit, if the proposed mitigation (injection wells) fails. Pit-wall stability is beyond my area of expertise. However, the expert hydrological review notes that "the question remains as to what injection pressures can be sustained without leading to pit wall instability."[44]

70. If a pit wall close to the site boundary did collapse, there could be significant adverse effects on adjacent vegetation/habitat through erosion and dewatering of the Canoe Creek Lagoon and other wetlands. The EEA provides insufficient information to assess the magnitude of that potential effect; vegetation and habitat on the property north of the site have not been surveyed as part of this application.

71. To address the risk of pit-wall collapse, and to protect nearby waterbodies, a 100 metres wide buffer was proposed at the earlier application hearing.[45]

72. Another potential effect is modification or loss of adjacent vegetation/habitat in the event of catastrophic land movement (earthquake) or a storm event. The applicant's response to the risk of the excavated mine pit causing or exacerbating erosion/dewatering of the coastal lagoon and other adjacent lagoons/wetlands following a catastrophic earthquake or coastal-inundation event is summarised in a letter from Tai Poutini Resources.[46] This letter quotes from the geotechnical assessment.

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[40] NPS-IB, Policy 3.
[41] NZ Coastal Policy Statement 2010, Policy 3 (1).
[42] NPS-IB, Clause 3.7 (1)(a).
[43] NPS-IB, Clause 3.7 (1)(b).
[44] WGA211239-MM-HG-0002_A Consent application review, p7.
[45] Joint Report and Decision of the Hearing Commissioners Applications WCRC RC-2020-0159 and GDC LUN 29226/20, paras 55 & 143.
[46] Letter from Tai Poutini Resources to Grey District Council, 29 July 2023, p8.

73. The first quote is "The open pit is expected to be stable for the proposed configuration with no substantial ground displacement due to instability expected > 5m from the pit crest based on this study. The coastal lagoon, Collins Creek, Northern Drain and property boundaries are at low to very low risk of being adversely affected due to mining during operations and for the finished landform."[47]

74. The second quote is "The pit will be only open at the mining front and gets backfilled as the mining voids advances. The void (that facilitates lateral spread) is exposed for a very short duration. Combined with the very low likelihood of a "catastrophic" event, the potential for extensive damage away from the pit is intuitively Very Low."[48]

75. I do not have specialist expertise on likelihood of catastrophic land movement or erosion, but the likelihood of their occurrence does not appear to have been adequately addressed by the applicant. The information provided by the applicant, in response to my request, appears to only repeat statements made in the application.

76. The West Coast is a geologically dynamic environment; its contemporary landforms result from recent (in geological terms) land movement, erosion, and deposition. An important influence has been earthquake-induced movement. Rupture events on the Alpine Fault – the South Island's major seismic hazard – have a recurrence interval of around 300 years. The last event was in approximately 1717, which implies that the Alpine Fault is late in its current seismic cycle.[49]

77. The risk of an Alpine Fault rupture occurring during the proposed 12-year consent period for mining may be low.[50] However, if it did occur, the effects on the mine location – and adjacent areas – could be dramatic. The occurrence risk, and possible effects, do not appear to have been adequately addressed in the application.

78. Another important influence is storm events, notably intense rainfall and – at the Barrytown coastal plain – high seas (storm surges). This risk was discussed in the Commissioners' decision on an earlier application: "Barrytown Beach is located to the west of the site and is identified in the operative West Coast Regional Coastal Plan (RCP) as a coastal hazard area having farmland and natural values of wetlands and coastal vegetation threatened by beach erosion and wave inundation and vulnerable to sea level rise effects."[51]

79. Climate change is predicted to alter rainfall patterns, increase the frequency and severity of storm events, increase mean temperatures, and raise the sea level.[52] The risk of storm events leading to inundation of the mine, and consequent erosion and/or dewatering of adjacent areas does not appear to have been adequately addressed in the application.

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[47] Wylie, 2023.
[48] I cannot locate the source of this quote.
[49] Orchiston et al, 2018.
[50] It could be as high as 12%. See discussion under Analysis of Submissions.
[51] Joint Report and Decision of the Hearing Commissioners Applications WCRC RC-2020-0159 and GDC LUN 29226/20, para 33.
[52] Keegan et al, 2021.

Potential Adverse Effects on the Ecosystem

80. The proposed mine location is part of a coastal-plain ecosystem. The location is connected to other components of the ecosystem by hydrological and ecological processes, such water flows, movement of species, and habitat use. Examples are the hydrological connections with adjacent wetlands, and the flight paths of birds such as tāiko.

81. The application contains detailed information about the hydrology and ecological values of the mine location. Ecological values of adjacent areas – and the wider coastal-plain ecosystem – are less well documented. The risk of activities at the mine site having unexpected adverse effects on the coastal-plain ecosystem may be low. However, the application contains insufficient information on the values and functioning of that ecosystem to conclude that there will be no adverse effects and, if there were any adverse effects, that those effects would be minor.

Adequacy of Information

82. Three matters requiring further information were identified in May 2023:

    i. Information on the vegetation at the coastal lagoon, PUN-W034 SNA, and any other adjacent indigenous vegetation/habitat, including an assessment of the vulnerability of plant communities (or individual species' populations) to hydrological changes.

    ii. Information on the local populations (and habitat use) of cryptic/secretive bird species that are hard to detect and therefore may have been missed by on-site surveys, in particular: fernbird; bittern; reef heron; little blue penguin; marsh crake; and spotless crake.

    iii. An assessment of the risk of the excavated mine pit causing or exacerbating erosion/dewatering of the coastal lagoon and other adjacent lagoons/wetlands following a catastrophic earthquake or coastal-inundation event.

83. The applicant's responses to these requests are discussed in the preceding paragraphs under the heading 'Potential Adverse Effects of the Activity' (above), and in the analysis of submissions (below).

84. Additional data that would assist in the assessment of potential adverse effects of the proposed activity are:

    i. Descriptions of plant communities, including a comprehensive list of indigenous species in each plant community/vegetation type, at locations adjacent to the site (the property) that may be affected by hydrological changes.

    ii. Avifauna surveys at habitats adjacent to the site, with a particular focus on cryptic or secretive species, such as matuku and fernbird. Subsequent, ongoing monitoring of avifauna at locations adjacent to the site – in addition to those at the site - may provide useful information for the future assessment of effects.

    iii. Inventory of mobile invertebrate fauna at and in the vicinity of the site.

Analysis of Ecological Issues Raised by Submitters

85. Following the preparation of this evidence (above), submissions to the application were read. Information and views on terrestrial ecological values potentially affected by the proposed activity, and that are not already addressed in this evidence, are analysed below. In this analysis, the information/views are referenced to submission numbers; referenced submissions are listed in the table on page 3 of this evidence.

Tāiko/Westland petrel

86. A considerable number of submitters outline the potential adverse effects of the activity on the tāiko/Westland petrel population, principally the effects of artificial light. One submitter (101: Dr Susan Waugh) has undertaken extensive research on tāiko, and should be considered an expert on this species.

87. Tāiko are endemic to New Zealand, breed only in the Paparoa Range between the Fox and Grey rivers, and the largest and best-studied colony is behind the Barrytown Flats (101). Individuals are long-lived (up to 37 years), typically breed at 10 years of age, form long-term monogamous pairs, and are mostly nocturnal on land. The tāiko breeding season is from March to November, with adults typically returning to the colony at dusk. Fledglings leave the colony from November.[53]

88. The main tāiko flyway is between the breeding colony and the sea (101), though birds have been recorded along the coast between Mokihinui and Hokitika,[54] and tāiko do not always fly straight to the sea; they are known to follow the coastline (317).

89. The population of tāiko is estimated to comprise 2800 (101) or 4000[55] breeding pairs. There is evidence the tāiko population has slowly increased since the 1970s,[56] but a range of threats have the potential to reduce population growth.[57]

90. The main threats to the tāiko population are: landslips/extreme climate events that degrade nesting habitat; bycatch mortality in fisheries; attraction of fledglings to light; and potential encroachment of feral pigs into breeding areas. Storm events in 2014 severely reduced habitat quality, destroyed large parts of some colonies, and increased the likelihood of further landslips and erosion for 75% of the breeding population.[58] Vehicle movements and light disturbance are among the most important threats (101).

91. Less well understood are the threats posed by rapid increases in sea surface temperatures. The consistent use by tāiko of one marine area for foraging across varying times and conditions increases the risk of adverse effects on the population from climate or human-induced changes to sea temperatures and food supplies.[59]

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[53] NZ Birds Online
[54] Ibid.
[55] Ibid.
[56] Waugh et al, 2017.
[57] Waugh & Wilson, 2017.
[58] Ibid.
[59] Waugh et al, 2018.

92. These threats result in the present listing of the species as 'at risk; naturally uncommon.' [60] Importantly, this listing has qualifiers that acknowledge that the threat status of tāiko would be higher if conservation management ceased and/or further species' data were available. One submitter (101) notes that tāiko are now listed as 'endangered' by the International Union for Conservation of Nature and Natural Resources (IUCN). An NZCPS policy is to avoid adverse effects of activities on taxa that are listed by the IUCN as threatened.[61] (In addition to avoiding adverse effects of activities on indigenous taxa listed as at-risk or threatened in the NZ Threat Classification System lists).

93. The principal threat posed to tāiko by the proposed activity is distraction/disorientation of birds (especially fledglings) by artificial light associated with activities at the mine location and by trucks transporting the mined material along the Coast Road. Birds grounded by light disturbance cannot easily fly away (due to their wing structure), so become vulnerable to mortality from traffic, predation, starvation, and dehydration (101). Grounded tāiko have been retrieved from locations between Hokitika and Westport (61). Groundings are most likely to occur between November and January.[62]

94. The loss of additional individual tāiko through light disturbance or vehicle collision would make the population more vulnerable to decline and eventual extinction, especially if such losses coincided with other disturbances such as storm events. This risk is exacerbated by the increased frequency and severity of storm events that are predicted to result from human-induced climate change. The magnitude of the effect on the tāiko population from additional mortality will also be influenced by the resources available for protection and management of the breeding colony.

95. There appears to be no dispute between the applicant and submitters that increased light disturbance from mining and vehicle movements will increase the risk of tāiko mortality. The applicant's response to this risk is to minimise lights and light-intensity at the mine location, restrict the hours of mining operations, and restrict the number and period of truck movements on the Coast Road, as set out the Avian Management Plan.

96. The proposed actions are expected to reduce – but not eliminate – the risk of tāiko mortality. The Avian Management Plan proposes that encounters with tāiko will be monitored and reported. If tāiko collision with a mine-related vehicle occurs, the plan will be reviewed "with a view to avoiding any further mortality."[63] The Plan also proposes that TiGa staff will be trained to implement an "accidental discovery protocol."

97. I proposed in my Review (para 59, above) that the risk to tāiko could be reduced by restricting mining operations and vehicle movements to daylight hours during November to January (inclusive). Further research in response to the information presented by submitters, leads me to conclude that it would be prudent to further reduce the risk of light disturbance to tāiko by ensuring all activities associated with the mine operation (including vehicle movements) are restricted to the hours and weather conditions during which no lights of any form are required.

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[60] Robertson et al, 2021.
[61] NZ Coastal Policy Statement 2010, Policy 11 (a)(ii).
[62] Bramley & Bodley, 2023 (b). p11.
[63] Bramley & Bodley, 2023 (b). p13; p14

98. If a restriction such as that outlined above does not eliminate the risk of tāiko mortality, there is no certainty that the activity will avoid adverse effects on tāiko. The precarious state of the tāiko population means that the loss of any individual from the population should be considered an adverse effect. Avoidance of such an adverse effect is required by the NZCPS.

99. A further issue raised by submitters (e.g., 60; 241) is the effectiveness and reliability of the mine operator reporting tāiko mortality. If conditions of a consent for the activity require the modification or cessation of mine operations in the event of grounded tāiko, there will be little incentive for staff at the mine location or truck drivers to report such incidents. A more reliable method of tāiko monitoring should be considered.

Matuku/Australasian bittern

100. One submitter (87) states that they have observed matuku at Canoe Creek Lagoon. The submission of the Director General of Conservation (241) notes that vegetation at Canoe Creek Lagoon (particularly raupo) is a key feature of the habitat of shy wetland species, including matuku.

101. Matuku are extremely cryptic and rarely seen: their secretive behaviour, inconspicuous plumage, and inaccessible habitats mean they are frequently overlooked. Matuku are found throughout the country, and in Australia. Favoured habitats in New Zealand are raupo-fringed lakes, spring-fed creeks with vegetative cover, and rank grass along paddock/drain edges. Birds typically utilise a network of habitats, seasonally.[64]

102. Matuku can travel long distances; the longest recorded flight in New Zealand is 140km. The estimated population size in New Zealand in the 1980s was 900 individuals, though there has been a steep decline in the population since that time. There is a similarly low population, and steep decline, in Australia.[65] Matuku are listed as threatened/nationally critical, with the qualifiers: CR (conservation research needed); DPT (data poor trend); RF (recruitment failure); Sp (sparse); and, TO (threatened overseas).[66] Matuku are extremely sensitive to disturbance.[67]

103. The applicant notes that matuku were "identified as being present within 10 km of the site, but not confirmed as present during the surveys of the site," and that efforts will be made to detect and monitor matuku "prior to the commencement of mining and continue until mining is completed." [68] The applicant provides further information on matuku observations on the West Coast, noting there are five records within 10km of the site, and that "the rāupo, flaxland and other foraging habitat on the fringes of the lagoon is very suitable for bittern, but may not be sufficiently dense for breeding." [69]

104. There appears to be no dispute that matuku are present – probably only occasionally – and that vegetation at Canoe Creek Lagoon provides favourable matuku habitat. It is also evident that matuku are difficult to detect, and sensitive to disturbance. I proposed in my Review (para 53, above) that the risk to matuku could be mitigated by providing a buffer of 100m (instead of

[64] NZ Birds Online.
[65] Ibid.
[66] Robertson et al, 2021; Townsend et al, 2008.
[67] NZ Birds Online.
[68] Bramley & Bodley 2023 (b). p4 & p17.
[69] Bramley, 2023. p4.

20m) between the lagoon margin and mining operations. The analysis in the preceding paragraphs affirms the need for an adequate buffer.

105. If a restriction such as that outlined above does not eliminate disturbance of matuku, there is no certainty that the risk of adverse effects on this threatened species will be avoided. The population size and threat status of matuku means that displacement of any individual by disturbance should be considered an adverse effect. Avoidance of such an adverse effect is required by the NZCPS.

Royal spoonbill and kotuku/white heron

106. Three submitters (45, 87, 103) note that royal spoonbill (*Platalea regia*) and kotuku/white heron (*Ardea modesta*) use the Canoe Creek Lagoon habitat. A kotuku was observed at the site on the day of my visit. Kotuku are listed as threatened/nationally critical, with the qualifiers: CR (conservation research needed); OL (one location); SO (secure overseas); and, St (stable).[70] Royal spoonbill is listed as at risk, naturally uncommon, with the qualifiers: Inc (increasing); RR (range restricted); SO (secure overseas); and, Sp (sparse).[71]

107. These two species appear to be occasional users of the lagoon habitat. They are not known to breed at the lagoon: the only recorded breeding location of kotuku in New Zealand is near Okarito Lagoon; royal spoonbill breed at several coastal locations throughout the country.[72] Disturbance of these species by mining activities would be an effect; it is less clear whether the magnitude of any adverse effects on the species (instead of on individuals) would be more than minor.

108. The NZCPS also requires that activities must avoid significant adverse effects on vulnerable coastal ecosystems and habitats, including lagoons. There are insufficient data to confidently determine whether any adverse effects on royal spoonbill and kotuku habitat at the lagoon would be significant.

Kororā/little penguin

109. Submitters express concern at the potential effects on kororā/little penguin (*Eudyptula minor*). Annual surveys (2011-2015) recorded kororā tracks on the Barrytown Beach (between Razorback Point and 17 Mile Bluff), and kororā are present in the vicinity of the proposed mine (61). Kororā nest along the Barrytown Flats north and south of the proposed mining area (84), and there are recent records of kororā at buildings and rock stacks inland from the beach within 2km of the mine location (208).

110. Kororā mortality from collisions with vehicles on the Coast Road have been recorded north and south of the location of the proposed mine (223). Observations over a ten-year period (2000 to 2010) recorded "around about 100 kororā over this ten year period deceased on the highway after vehicle collisions" (309). Several submitters note the lack of consideration of kororā in the application documents.

[70] Robertson et al, 2021; Townsend et al, 2008.
[71] Robertson et al, 2021; Townsend et al, 2008.
[72] NZ Birds Online.

111. Kororā are locally common along the New Zealand coast. They are primarily nocturnal on land, returning to nesting areas on dusk. Nests comprise burrows or cavities, including under or within artificial structures such as buildings and rock-stacks. Many adult kororā are hit and killed by cars where coastal roads run between nesting areas and the sea, such as in north Westland.[73]

112. Kororā nest between July and December, with peaks in August and November. Both sexes incubate, with short shifts of 1-2 days, until the eggs hatch after 33-43 days.[74] Kororā adults are therefore at risk of mortality from vehicles from mid-winter (July) to early summer (December).

113. Kororā are listed as at risk/declining, with the qualifiers: CI (climate impact); CR (conservation research needed); DPS (data poor size); and, DPT (data poor trend).[75] The main threats to kororā are predation, risk of entanglement in nets, collision with vehicles, and encroachment on or displacement from breeding habitat.[76] Other threats are changes to the abundance and distribution of food supply by climate change/marine heatwaves (61).

114. Consideration of kororā in the Avian Management Plan are: listing the species as present within 10km of the mine site; inclusion as a species to managed at the mine site; and, discussion of kororā distribution and habitat use.[77] Additional data on kororā are provided in response to the request for further information, including records of kororā in the vicinity of the mine location. The only reference to road mortality is a dead kororā "observed at the end of Burke Road during the field work for this project in 2020." [78]

115. A significant potential adverse effect of the mine operation is mortality of kororā caused by mine traffic on the Coast Road. There are insufficient data in the application documents to determine the potential magnitude of this effect. Information provided by submitters indicates that the magnitude of this effect may be high. Kororā are an at-risk species, so avoidance of such an adverse effect is required by the NZCPS.

116. Annual average daily traffic on State Highway 6 at Canoe Creek is 786 vehicles, 11% (88) of which are heavy vehicles.[79] The proposed mining activity will generate 50 heavy vehicle movements (30 tonnes per truck) per day.[80] The activity will generate other – light vehicle – traffic. The heavy vehicles alone will increase traffic on the Coast Road by 6.3%, and will increase heavy vehicle traffic by 57%.

117. To help avoid adverse effects on kororā, it would be prudent to restrict mine traffic on the Coast Road to hours of daylight, outside the dawn and dusk periods, for the July to December period.

[73] Ibid.
[74] Heather & Robertson, 1996.
[75] Robertson et al, 2021; Rolfe et al, 2021.
[76] NZ Birds Online.
[77] Bramley & Bodley, 2023 (b).
[78] Bramley, 2023. p5.
[79] Annual Average Daily Traffic (AADT) data, Waka Kotahi/NZ Transport Agency.
[80] Bramley et al, 2023. p5.

Buffering to avoid effects of the activity on avifauna

118. One component of the avoidance of adverse effects on avifauna discussed in the preceding paragraphs is provision of a buffer between the activity and avifauna habitat on adjacent properties, notably Canoe Creek Lagoon. Determining the distance required for an adequate buffer is difficult; there are no published standards of which I am aware. The distance required to avoid disturbance of avifauna will depend on factors including the sensitivity of the affected species, the ambient disturbance levels, the type and frequency of the activity, and timing.

119. The Avian Management Plan proposes an initial buffer of 100m,[81] though provides no data to justify that distance. The Commissioners' decision on an earlier application for this activity also proposed a 100m buffer, based on the evidence presented at that hearing.[82]

120. The main potential adverse effects of the activity on adjacent avifauna habitats appear to be noise, artificial light, and movement/activity. With respect to noise, the Assessment of Noise Effects[83] prepared for the applicant is of limited use for assessing effects on avifauna. The sampling sites used for that assessment were all east of the proposed mine (near the Coast Road), and were selected for the purpose of assessing effects of noise on residents at nearby dwellings.[84]

121. I am unaware of any assessment of ambient noise, or the effects of noise, at adjacent areas of wildlife habitat, such as Canoe Creek Lagoon. The Assessment of Noise Effects indicates that ambient noise levels near residences are between 50 and 60 dB. The assessment does not appear to provide comparable noise levels from machinery and equipment near the wildlife habitat.[85]

122. The Avian Management Plan proposes parking "earthworks machinery" and "starting the engine from time to time" as a method for discouraging bird-nesting at the mine location. [86] The effectiveness of this method is unclear. However, it indicates an expectation that machinery noise will disturb avifauna.

123. An example of noise effects on avifauna was provided on the day of my site visit. A kotuku/white heron that had landed at the site took flight in response to a loud bang nearby.[87] The type of noise, and perhaps the frequency at which the noise levels change, may be important determinants of adverse effects on avifauna.

124. The potential adverse effects of the noise of mine machinery and vehicles on avifauna at adjacent habitats, and the buffering required to avoid those effects, do not appear to be adequately addressed in the application.

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[81] Bramley & Bodley 2023 (b). p7.
[82] Joint Report and Decision of the Hearing Commissioners Applications WCRC RC-2020-0159 and GDC LUN 29226/20, paras 55 & 143.
[83] Marshall Day, 2023.
[84] Ibid, Fig.2, p7.
[85] I understand that the noise levels cited for machinery and vehicles (Marshall Day, 2023, Table 5, p14) are sound power levels, so cannot be directly compared with the cited ambient noise levels (measured sound pressure level data) (Darran Humpheson, pers.comm.).
[86] Bramley & Bodley 2023 (b). p10.
[87] Mark Geddes, pers.comm.

Avian Management Plan

125. Components of the Avian Management Plan are discussed in the preceding paragraphs. Additional components relevant to issues raised by submitters are the management of avifauna at the mine location, and monitoring of avifauna at adjacent habitats.

126. The Avian Management Plan notes that "site works and other activity is likely to deter birds (except dotterel) from establishing nests near that activity, forcing them nest elsewhere." [88] If the mining activity does not discourage birds from nesting at the mine location, three methods are proposed for species management to "reduce the need to disrupt mining activities." These methods are: "completing a disruptive site walkover;" "installing streamers/tapes that flutter in breeding habitats to deter birds from nesting;" and, "parking earthworks machinery in future stage locations, starting the engine from time to time, but not moving equipment."[89]

127. The methods proposed to discourage nesting do not avoid effects. Instead, the purpose of the actions is to have an effect: displacement of birds from potential nest sites. It is unclear from the data provided in the application – and from our limited knowledge of avifauna habitat use in the area – whether these actions would have adverse effects on 'at risk' or 'threatened' taxa (instead of effects only on individual birds) and whether the magnitude of any adverse effects would be more than minor.

128. A more appropriate response to the presence of 'at risk' or 'threatened' avifauna at the mine location would be to cease mining activity, and not recommence the activity until that habitat use ceases.

129. The Avian Management Plan proposes monitoring of avifauna at the mine location, and at locations adjacent to the site (the property), and annual reporting of the results of that monitoring.[90] This monitoring will provide information about birds present at the site, and at areas immediately adjacent to the site. Over time (many years) it will provide valuable data on the avifauna of the area.

130. The monitoring proposed in the Avian Management Plan may provide adequate data on the effects of the activity on avifauna at the mine location. However, it will not provide adequate data on the effects of the activity on avifauna at habitats adjacent to the site. The provision of data sufficient for robust (scientific) analysis would require: better baseline data; monitoring of other variables (e.g., natural climate fluctuation and disturbance); and, monitoring at a control site (undisturbed by the mining activity).

131. The difficulty of monitoring the effects on avifauna is compounded by the fact that adjacent areas (notably Canoe Creek Lagoon) may provide critical habitat for species that are present only occasionally or sporadically. The open-freshwater, wetland, and beach habitats of the Barrytown Flats represent the only extensive habitats of these types along a long – and otherwise steep and rocky – coastline. The significance of these habitats – even if used only occasionally – may be greater than suggested by their size and condition.

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[88] Bramley & Bodley 2023 (b). p9.
[89] Ibid. p10.
[90] Bramley & Bodley 2023 (b). p17-18.

Hydrology and wetlands

132. The potential effects of the activity on wetlands and lagoons in the vicinity of the mine location are also raised by some submitters. The submission of the Director General of Conservation (241) notes that the "coastal lagoon immediately west and north of the application area is dominated by native plant species and has high ecological values." And, "both the excavations and water extraction have the potential to change the hydrology of the lagoon and therefore potentially change the lagoon vegetation" (241).

133. The submission of the Director General of Conservation further notes that "records dating back to 1881 clearly show the area as coastal lagoon, north and south of Canoe Creek" and that the area is therefore subject to the provisions of the National Policy Statement Freshwater Management Regulations 2020, contrary to the applicant's statement that the coastal lagoon is manmade.

134. These submissions affirm the importance (discussed above, in the review of terrestrial ecology matters) of providing certainty that mine operations will not affect the hydrology of adjacent areas.

Ecosystem effects

135. Several submitters note that the area supports remnants of a formerly-extensive sandplain forest ecosystem, and that it represents the best remaining coastal lowland habitat on the Barrytown Flats. Submitters state that the mine site provides critical habitat connectivity to other remnant habitats and the forested Paparoa Range (80), and note the importance of protection of the mountains to sea forest corridor and restoration of the sandplain forest ecosystem (84).

136. As discussed above (para 80-81) the application contains insufficient information on the values and functioning of that ecosystem. It is therefore difficult to conclude that there will be no ecosystem-wide adverse effects arising from the activity and, if there were any adverse effects, whether those effects would be minor.

137. The NZCPS requires that activities avoid adverse effects on "indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare." [91] Remnants of the sandplain ecosystem (forest and wetlands/lagoons) are depleted to an extent that they should be considered "rare."

Coastal erosion

138. Several submissions contain observations of regular coastal erosion. For example: observation of "significant coastal erosion" at the Conservation Volunteers NZ restoration site (84); "As a frequent beach user around Barrytown, I have seen the coastal erosion taking place and the effects of storms and high tides on the shoreline" (141); and, "The erosion of the land along the beach is clearly visible with clumps of dirt/land being washed away with every high or big tide" (179). These statements are consistent with my own observation of recently-deposited driftwood on a paddock at the mine site.

[91] NZ Coastal Policy Statement 2010, Policy 11 (a)(iii).

139. The West Coast Proposed Coastal Plan describes the coastal hazard for the area between Burke Road and 17 Mile Bluff as "Loss of farmland, residential sections at risk due to long term erosion from longshore drift of beach material from south to north, and wave washover flooding. Erosion, flooding risk around creek mouths from mouth migration or blockage." The risk priority ranking is 'medium.' [92] Lower (coastal) parts of the proposed mine location lie within a 'coastal inundation' zone in the Te Tai o Poutini Plan.[93]

140. As discussed above (para 79), there is a risk of storm events leading to inundation of the mine, and consequent erosion and/or dewatering of adjacent areas. This risk does not appear to have been adequately addressed in the application.

Earthquake risk

141. Several submissions articulate the likelihood of a major earthquake, and the risk of catastrophic land disturbance at the mine. Submitters note that there is a 75% chance of a major rupture of the Alpine Fault occurring within the next 50 years, and an 82% likelihood of that event being magnitude 8 (or greater). One submitter (80) calculates that over the 12-year term of the mine consent, the probability of such an event occurring is approximately 12%.

142. The risk of catastrophic failure of the mine – and the consequent risk of coastal erosion and sea-water incursion – are discussed above (para 74-77). The likelihood of catastrophic land movement or erosion has not been adequately addressed in the application. The applicant's assessment is that "Combined with the very low likelihood of a "catastrophic" event, the potential for extensive damage away from the pit is intuitively Very Low."[94] This assessment appears optimistic; prediction of risk should be based on data, not intuition.

Summary

143. The applicant's description of vegetation at the location (the proposed mine footprint) is consistent with my observations during a site visit. The description of avifauna is limited by the duration of surveys (one year). Additional notable bird species observed at the location since the surveys are pacific reef heron and kotuku/white heron. No data are provided on invertebrate fauna.

144. The applicant's assessments of indigenous biodiversity values at the site, and of the potential effects of the activity, are constrained – and the values and effects inappropriately reduced – by use of the non-statutory (EIANZ) Guidelines.

145. Assessment of the wider ecological effects of the proposed activity is constrained by the lack of vegetation and avifauna surveys of adjacent sites, and further constrained by our limited understanding of ecological processes in the wider Barrytown Flats coastal-plain ecosystem.

146. Potential adverse effects of the activity on terrestrial ecology at the mine location are displacement of mobile fauna (such as South Island pied oystercatcher) from feeding – and possibly breeding – habitat, and grounding (and subsequent mortality) of birds (such as tāiko)

[92] West Coast Proposed Coastal Plan 2016. p110.
[93] Te Tai o Poutini (TTPP) Draft Coastal Hazard Mapping Variation for Consultation, November 2023.
[94] Letter from Tai Poutini Resources to Grey District Council, 29 July 2023, p8.

distracted by artificial light or other mining activities. Potential adverse effects on invertebrate fauna are unknown.

147. Potential direct adverse effects of the activity on terrestrial ecology at adjacent sites are disturbance of avifauna through mine operations, notably artificial light, movement, and noise. Adjacent areas are known – despite lack of formal survey – to provide habitat for threatened and at-risk bird species.

148. The applicant's proposals to address these potential adverse effects on terrestrial ecology may minimise the risk – and mitigate the effects – but will not provide certainty that adverse effects on threatened and at-risk taxa will be avoided (as required by the NZ Coastal Policy Statement).

149. A potential indirect effect is loss of indigenous vegetation and habitat – notably at wetlands and lagoons – through a reduction in ground-water levels following collapse of the pit wall and/or inadequate recharge of the water table. Similar – and more catastrophic – adverse effects on terrestrial ecology at adjacent sites may occur in the event of sea-water incursions/storm surges.

150. Predicted effects of climate change are increased intensity and frequency of storm events, and consequent coastal erosion, which increase the risk of catastrophic landform failure at the mine location. Storm events, and changes in sea-surface temperatures, make the species potentially affected by the activity (notably tāiko) more vulnerable to population declines and extinction.

151. Historic data suggest that significant land displacement along the Alpine Fault, and a consequent high-magnitude earthquake, are overdue. There is insufficient information in the application to assess the risk – and consequences for terrestrial ecology – of catastrophic land movement resulting from a high-magnitude earthquake.

152. An important potential adverse effect of the activity on terrestrial ecology away from the mine location is grounding and subsequent mortality of tāiko/Westland petrel following distraction by vehicle lights and/or collision with mine-traffic on the Coast Road. A further potential adverse effect away from the mine location is mortality of kororā/little penguin on the Coast Road, when birds moving between nest sites and the sea are struck by vehicles. The potential adverse effects on kororā have not been adequately addressed in the application.

Mike Harding

12 December 2023

References Cited

Bramley, G.; Carter, N.; Fitzpatrick, M. 2023. Barrytown Mineral Sand Mine Ecological Effects Assessment. Ecological Solutions report to TiGa Minerals and Metals Limited. 82p.

Bramley, G. 2023. Att E – Ecological Response Memorandum, 8p.

Bramley, G.; Bodley, R. 2023 (a). Wetland Construction and Riparian Planting Plan. Ecological Solutions Report. 25p.

Bramley, G.; Bodley, R. 2023 (b). Barrytown Mineral Sand Mine Avian Management Plan. Ecological Solutions Report. 27p.

Bramley, G.; Carter, N.; Fitzpatrick, M. 2023. Barrytown Mineral Sand Mine Ecological Effects Assessment. Ecological Solutions Report. 82p.

Marshall Day, 2023. Barrytown Mineral Sand Mine Assessment of Noise Effects. Marshall Day Acoustics Report No. Rp 002 R03 20191310. 32p.

Heather, B.D.; Robertson, H.A. 1996. *Field Guide to the Birds of New Zealand*. Viking.

Orchiston, C.; Mitchell, J.; Wilson, T.; Rob Langridge, Davies, T.; Bradley, B.; Johnston, D.; Davies, A.; Becker, J.; McKay, A. (2018) Project AF8: developing a coordinated, multi-agency response plan for a future great Alpine Fault earthquake, *New Zealand Journal of Geology and Geophysics*, 61:3, 389-402, DOI: 10.1080/00288306.2018.1455716

Robertson, H.A.; Baird, K.; Elliot, G.P.; Hitchmough, R.A.; McArthur, N.J.; Makan, T.D.; Miskelly, C.M.; O'Donnell, C.F.J; Sagar, P.M.; Scofield, R.P.; Taylor, G.A.; Michel, P. 2021. Conservation status of birds in Aotearoa New Zealand, 2021. *New Zealand Threat Classification Series 36.* Department of Conservation, Wellington.

Rolfe, J.; Makan, T; Tait, A. 2019. Supplement to the New Zealand Threat Classification System manual; New qualifiers and amendments to qualifier definitions 2021.

Rolfe, J.; Makan, T; Tait, A. 2021. Supplement to the New Zealand Threat Classification System manual 2008; New qualifiers and amendments to qualifier definitions.

Roper-Lindsay, J.; Fuller, S.A.; Hoosen, S.; Sanders, M.D.; Ussher, G.T. 2018. Ecological Impact Assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Townsend, A.J.; de Lange P.J.; Duffy, C.A.J.; Miskelly, C.M.; Molloy, J.; Norton, D.A. 2008. *New Zealand Threat Classification System Manual*. Department of Conservation, Wellington.

Waugh, S.M.; Barbraud, C.; Adams, L.; Freeman, A.N.D.; Wilson, K-J.; Wood, G.; Landers, T.J.; Baker, G. B. 2015. Modelling the demography and population dynamics of a subtropical seabird, and the influence of environmental factors. *The Condor 117*: 147-164.

Waugh, S.M.; Wilson, K-J. 2017. Threats and threat status of the Westland petrel (*Procellaria westlandica*). *Marine Ornithology 45*: 195-203.

Waugh, S.M.; Griffiths, J.W.; Poupart, T.A.; Filippi, D.P.; Rogers, K.; Arnould, J.Y.P. 2018. Environmental factors and fisheries influence the foraging patterns of a subtropical seabird, the Westland Petrel (*Procellaria westlandica*), in the Tasman Sea. *The Condor 120*: 371-387.

Wylie, C.A. 2023. Geotechnical Assessment Tailings Operations and Storage. Barrytown Mineral Sands Tailings. TiGa Mineral and Metals Ltd. 29p + appendices.

Attachment 1: Schedule 97 Taonga Species

Taonga species[95] recorded at or in the vicinity of the site:

Bird species recorded at or adjacent to the site by the applicant:[96]

kāhu	Australasian harrier	*Circus approximans*
kōau	black shag	*Phalacrocorax carbo*
matuku moana	reef heron	*Egretta sacra*
pākura/pūkeko	swamp hen	*Porphyrio porphyrio*
pārera	grey duck	*Anas superciliosa*
pīpīwharauroa	shining cuckoo	*Chrysococcyx lucidus*
pīwakawaka	South Island fantail	*Rhipidura fuliginosa*
poaka	pied stilt	*Himantopus himantopus*
riroriro	grey warbler	*Gerygone igata*
ruru koukou	morepork	*Ninox novaeseelandiae*
pūtakitaki	paradise shelduck	*Tadorna variegata*
tara	white-fronted tern	*Sterna striata*
tūī	tūī	*Prosthemadera novaeseelandiae*
weka	western weka	*Gallirallus australis australis*

Additional taonga bird species recorded at or adjacent to the site by other observers:

karoro	black-backed gull	*Larus dominicanus*
kotuku	white heron	*Ardea modesta/Egretta alba*

Additional taonga bird species of conservation interest recorded (on eBird) within 10km of the site:[97]

kakariki	yellow-crowned parakeet	*Cyanoramphus auriceps*
karearea	New Zealand falcon	*Falco novaeseelandiae*
kororā	little/blue penguin	*Eudyptula minor*
kōau	little shag	*Phalacrocorax melanoleucos brevirostris*
kōau	pied shag	*Phalacrocorax varius varius*
pihoihoi	New Zealand pipit	*Anthus novaeseelandiae*
tītī	sooty shearwater	*Puffinus griseus*
tītī	tāiko/Westland petrel	*Procellaria westlandica*
mātā	South Island fernbird	*Bowdleria punctata punctata*
roroa	great spotted kiwi	*Apteryx haastii*
tara	black-fronted tern	*Chlidonias albostriatus*

Other taonga bird species likely to utilise habitats in the vicinity of the site:

korimako	bellbird	*Anthornis melanura*
kōtare	kingfisher	*Halcyon sancta*
kūkupa/kererū	New Zealand pigeon	*Hemiphaga novaeseelandiae*

[95] Ngai Tahu Claims Settlement Act 1998.
[96] Bramley et al, 2023, Table 8; Bramley, 2023.
[97] Bramley et al, 2023. Table 7.

Plant species recorded at or immediately adjacent to the site by the applicant:

harakeke	flax	*Phormium tenax*
kahikatea	white pine	*Dacrycarpus dacrydioides*
kāpuka	broadleaf	*Griselinia littoralis*
raupo	raupo	*Typha orientalis*
tī kōuka	cabbage tree	*Cordyline australis*

Additional taonga plant species recorded at or immediately adjacent to the site by other observers:

akatorotoro	white rata	*Metrosideros perforata*
aruhe	fernroot/bracken	*Pteridium esculentum*
koromiko	koromiko	*Veronica salicifolia*
tarata	lemonwood	*Pittosporum eugenioides*