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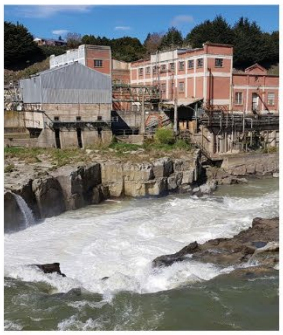

March 2024

Barrytown Mineral Sand Mine
Lighting Management Plan

Submitted to:
TiGA Minerals and Metals Limited

water fauna flora land

Quality Assurance

This report has been prepared and reviewed by the following:

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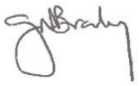

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1.0 Introduction

1.1 Overview

TiGa Minerals and Metals Limited ('TiGa') proposes a mineral sand mine located on farmland near Barrytown, approximately 36km north of Greymouth. The mining area is proximate to wetland areas, including coastal lagoons and other wetlands which provide habitat for a range of indigenous bird species, some of which are considered to be threatened or at risk (Robertson et al. 2021). Part of the adjoining wetland area is included within a Significant Natural Area (SNA) mapped in the draft proposed Te Tai o Poutini District Plan (Site PUN-W034). The proposed mine is also located approximately 3.6km south of the only known breeding colony of tāiko (Westland petrel, *Procellaria westlandica*).

Both fixed and mobile lighting can be disorienting for animals that are active at night. Animals perceive light differently from humans and artificial light can disrupt behaviour and cause physiological changes. Lighting can attract and disorient some species, including seabirds, migratory birds and other nocturnal species such as moths and frogs, whilst also repelling other species such as rodents and bats from the area thus forming a barrier which can lead to habitat loss. Lighting can also temporarily blind animals leading to an increase in mortality on roads. Artificial lighting can also change the predator/prey relationship by either aggregating or dispersing prey (depending on the species).

The Australian Government National Light Pollution Guidelines for Wildlife ('the guidelines') outline the process to be followed where there is the potential for artificial lighting to affect wildlife. The techniques set out in the guidelines can be applied to projects regardless of scale with the aims of not disrupting wildlife within, nor displacing wildlife from, important habitat[1] and ensuring wildlife can undertake critical behaviours such as foraging, reproduction and dispersal. The guidelines include a decision tree for whether to undertake an assessment of effects of lighting on wildlife as shown in Figure 1. Ecological Solutions (2023) assessed the effects of lighting on tāiko and concluded that lighting management was required to protect tāiko and this plan has been prepared to address the effects of lighting.

1.2 Background

TiGa proposes to construct and operate a mineral sand mine located north of Canoe Creek and west of State Highway 6 on the Barrytown flats approximately 36km north of Greymouth. The location and layout of the proposed mine is shown in Figure 2 and Figure 3.

The proposal is to undertake progressive strip mining across the site moving from west to east and south to north. Each open strip would be approximately 75m x 100m wide and no more than 8ha would be "open" at any one time[2]. The indicative mining approach is shown in Figure 3.

TiGa proposes mining and trucking only during daylight hours for their operations at Barrytown[3]. Processing will occur at night inside a purpose-built building. This building has been designed with minimal exterior fixed lighting and no windows. All doors can be closed to avoid light spill when not needed for entry or exit. Furthermore, the processing plant site will be bunded on the eastern and part of the northern sides with a 4.5 m bund, the top of

[1] Important habitats are defined in the guidelines as those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal.

[2] This includes rehabilitated areas and the Processing Plant area.

[3] The period outside daylight hours is defined as the period between 30 minutes after sunset and 30 minutes before sunrise. Sunrise and Sunset times will differ throughout the year, and are determined by sunrise and sunset times at Greymouth which can be found at the following website: https://www.timeanddate.com/sun/new-zealand/greymouth.

which will be planted with trees.

The restriction of mining and trucking to daylight hours, combined with the range of other management approaches above, are expected to substantially reduce potential effects due to artificial lighting, but there are still elements of both fixed and mobile lighting that will need to be managed to protect wildlife. This management plan has been prepared to address these potential effects of artificial lighting on wildlife (specifically tāiko) which may be using the mining area and immediate surrounds.

This plan provides for the requirements for all artificial lights on site for mining and processing activities and for the operation of mobile plant during the hours of darkness.

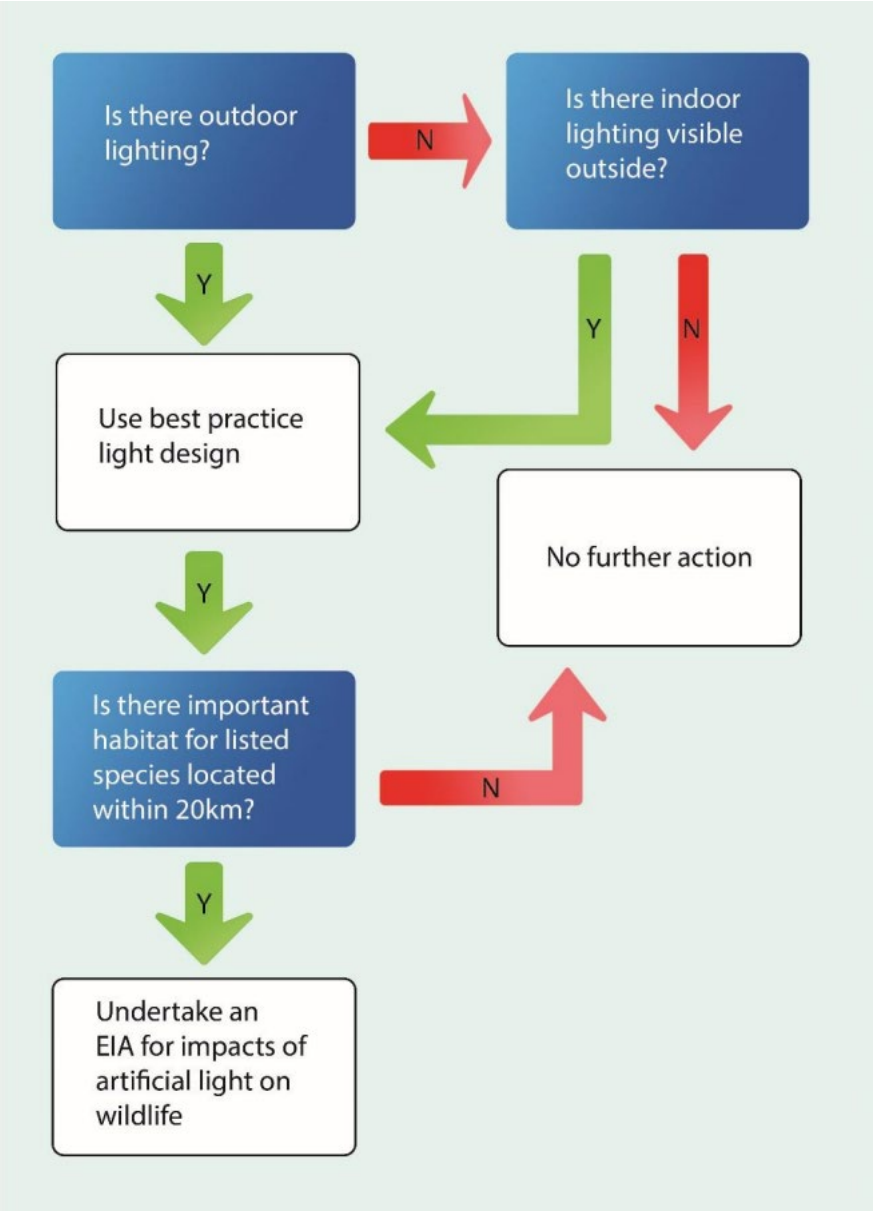

Figure 1: Decision tree for determining whether to undertake an assessment of effects for impacts of artificial light on wildlife (from National Light Pollution Guidelines for Wildlife, 2023).

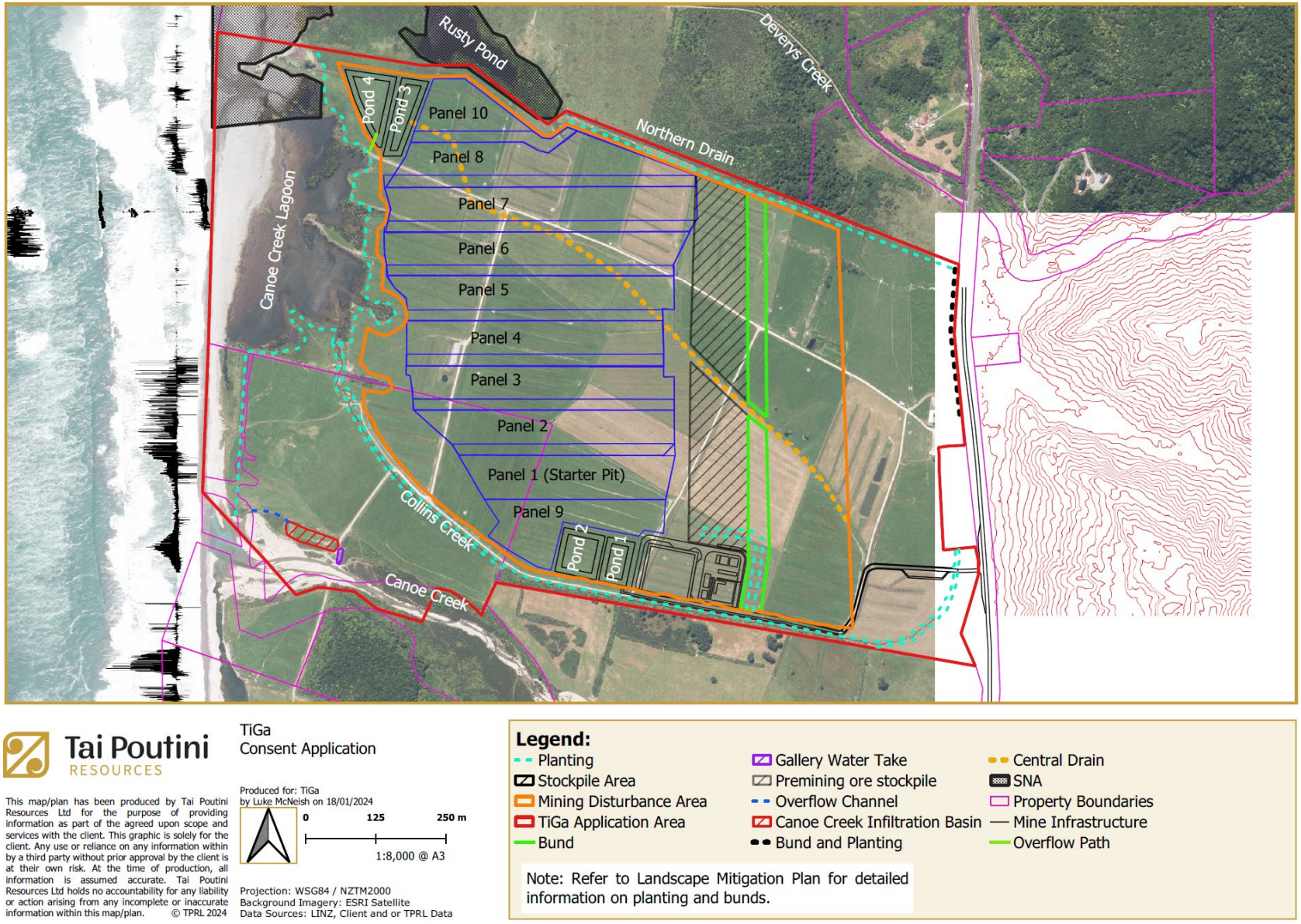

Figure 2: Location and features of the proposed mineral sand mine at Barrytown (from Tai Poutini Resources).

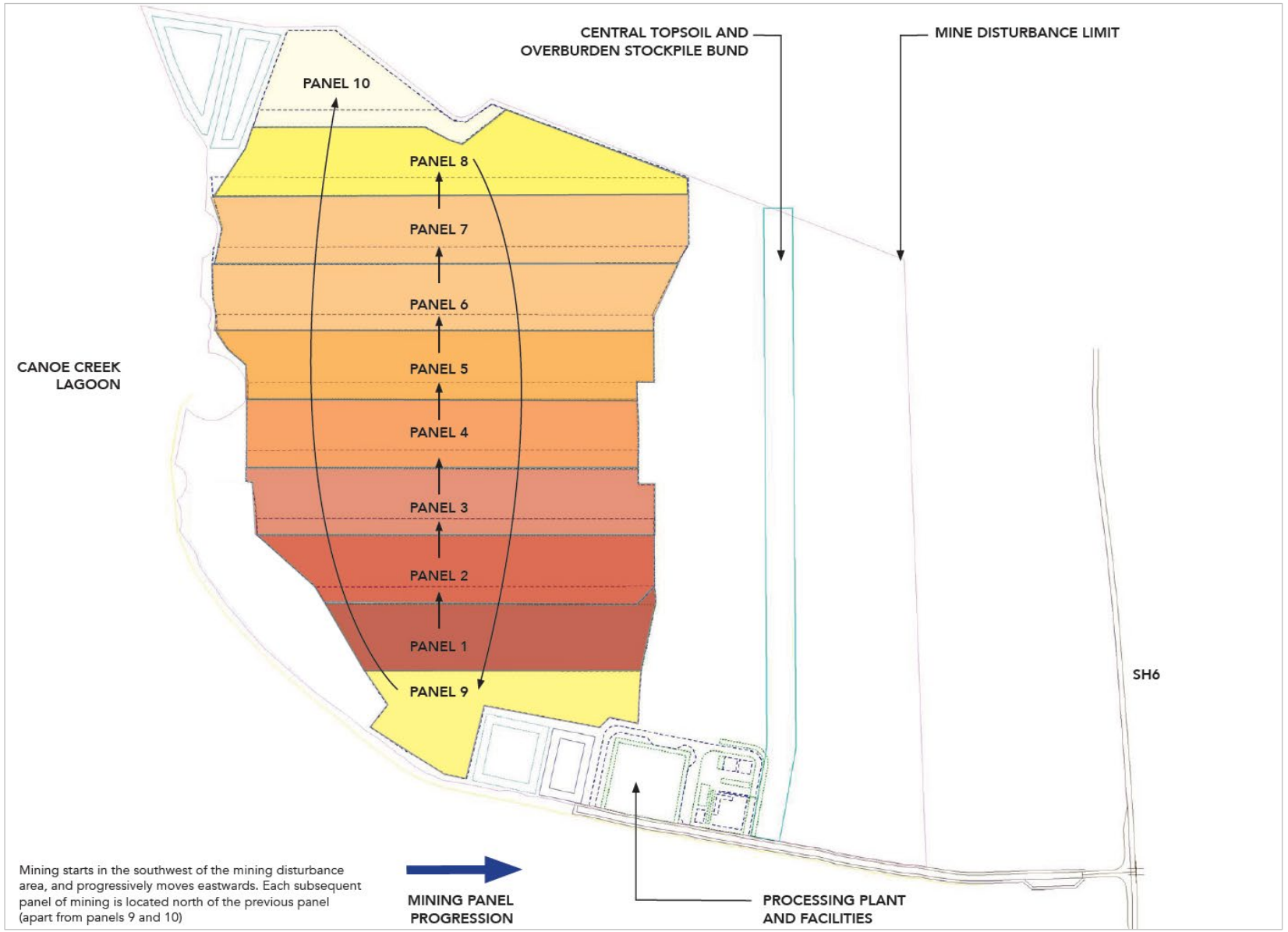

Figure 3: Indicative mining approach at TiGa mineral sand mine, Barrytown (From Glasson Huxtable Landscape Architects).

1.3 Mine Design

No mining or trucking would occur outside daylight hours. The Wet Concentrator Plant (WCP) would be located within a building at the site and would operate 24/7.

IHC Mining have considered the lighting approach and design detail for TiGa's proposal. There would be minimal light emissions from the WCP itself because the building has no windows, but does have personal access doors and roller doors for vehicle access to the building. The lighting design proposes 2000K rated light fittings.

The lights inside the building are active throughout the darkness hours, with lighting contained therein. The external lights would only be active when required.

1.4 Best Practice Lighting Design

Best practice lighting design incorporates the following design principles:

- Start with natural darkness and only add light for specific purposes.
- Use adaptive light controls to manage light timing, intensity and colour.
- Light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill.
- Use the lowest intensity lighting appropriate for the task.
- Use non-reflective, dark-coloured surfaces.
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

The application of these principles to this project are set out in Section 2 below.

1.5 Goals, Scope and Objectives

The goals of this Lighting Management Plan ('LMP') are:

i. To ensure adverse effects of artificial lighting on wildlife (specifically tāiko) are avoided.

ii. To ensure fixed and mobile artificial lighting at the proposed mine is managed in accordance with best-practice guidelines[4].

iii. To ensure ongoing use of the site and its environs by the birds which currently occur in the area.

This management plan also sets out the lighting management required at the site.

1.6 Relevant Conditions of Consent

Grey District Council and West Coast Regional Council have granted TiGa resource consents (NUMBER) to construct and operate the mine subject to conditions, which includes the following conditions associated with the land use consents from the Grey District Council:

12.1	Trucking, mining, overburden and topsoil stripping, bund development and any related activities must not operate during the hours of darkness. For the purpose of this condition, hours of darkness are considered to be between 30 minutes after sunset to 30

[4] National Light Pollution Guidelines for Wildlife (Australian Government, 2023).

	minutes before sunrise. *Advice Note:* sunrise and sunset times can be found here https://www.sunrise-and-sunset.com/en/sun/new-zealand/westport/2023/june *Advice Note: In addition to condition 12.1, further restrictions on transport operations are contained in Condition 15.0 Transport, and further noise restrictions are contained in Condition 16.0 Noise.*

13.2	The colours to be used for all buildings and structures must be recessive and non-reflective and have a light reflectance value (LRV) of less than 20%, including but not limited to Colorcote colours Mudstone (LRV 16%), Rivergum (18%), Permanent Green (LRV 10%) or Ironsand (9.5%).
13.4	The processing plant building must be constructed without windows, to avoid light spill from the building.

15.1	Truck movements to or from the site associated with removal of heavy mineral concentrate must only travel south of the site, and must be limited to 50 per day and 5 per hour and must only occur during the hours of daylight. For the purpose of this condition, hours of daylight are considered to be between 30 minutes before sunrise and 30 minutes after sunset. *Advice Note: For the purpose of the Transport conditions, a movement is defined as being a movement either to or from the site. A truck and trailer unit entering and leaving the site is therefore 2 movements.* *Advice Note: Refer to Condition 12.0 for further restrictions on hours/days of operation.*
15.2	Truck movements associated with the activity must be limited to no more than 3 per hour between 0500 and 0700 each day so long as those hours are during the hours of daylight. *Advice Note: For the purpose of the Transport conditions, a movement is defined as being a movement either to or from the site. A truck and trailer unit entering and leaving the site is therefore 2 movements.*

15.3	The Consent Holder must operate a transport service for mining and processing plant staff shift workers, and require all shift workers to use this transport service. The transport service must provide for staff living both north and south of the site, by running separate passenger vehicles in each direction. If there are less than 5 staff who arrive at site from either direction on any given shift, a passenger transport service is not required, provided that all staff arriving from that direction arrive and leave in the same vehicle.

	At least 10 working days prior to mining commencing, the Consent Holder must confirm to the Consent Authority how many staff are on each shift, their direction of travel, and what vehicles are proposed to cater for these staff movements. *Advice note: The purpose of this condition to is minimise the number of vehicles arriving at and leaving the site, especially during hours of darkness, to avoid transport associated effects on the Westland Petrel. Some flexibility in the configuration of these vehicles is required, because it is not possible to know where future staff will live, and how this may change. It is intended that the company will run 1-2 mini van vehicles in each direction per shift, as required to ensure no staff are arriving by private passenger vehicle for shift work.*
15.4	Notwithstanding Condition 15.3, light vehicle movements must be limited to 140 light vehicles per day. *Advice Note: For the purpose of the Transport conditions, a movement is defined as being a movement either to or from the site. A truck and trailer unit entering and leaving the site is therefore 2 movements.*

16.0 Lighting	
16.1	Lighting must not exceed 2.0 lux spill (horizontal and vertical) of light onto any adjoining property, measured at any point more than 2m inside the boundary of the adjoining property or the closest window on the adjoining property whichever is the closest.
16.2	Lighting must be designed, installed and operated in a manner which adheres to the Australian Government's National Light Pollution Guidelines for Wildlife January 2020 (or subsequent revision); including but not limited to: • Utilising the Seabird Light Mitigation Toolbox in Appendix G – Seabirds (Schedule 4); • All fixed lighting must be directed downward, shielded to avoid light spill, with a lighting temperature of no more than 2000K, and be filtered to reduce blue and violet wavelengths; • Lights must only illuminate the object or area intended; • Fixed lights must be mounted as close to the ground as practicable while still achieving site lighting requirements; • External lighting must be minimised on the seaward side of buildings to minimise light spill toward the coast; • External lighting must use the lowest intensity lighting possible, while ensuring compliance with workplace health and safety requirements

	• External lighting should be equipped with light minimising technology, including motion sensors and timers where practicable • Any windows must have blackout blinds fitted to avoid any light spill from internal lighting within buildings, • Where practicable, the consent holder should make efforts to ensure mobile lighting within the mine site adheres to the above principles, including dipping headlights of vehicles operating on site.
16.3	The consent holder must manage lighting on the site in accordance with a Lighting Management Plan (LMP), which has been prepared by a suitably qualified ecologist, and provided to the Department of Conservation for comment prior to certification. The objectives of the LMP are: i. To ensure adverse effects of artificial lighting on wildlife (specifically tāiko) are avoided. ii. To ensure fixed and mobile artificial lighting at the proposed mine is managed in accordance with best-practice guidelines[1]. iii. To ensure ongoing use of the site and its environs by the birds which currently occur in the area. *Advice Note: All Management Plans are required to adhere to the requirements of Condition 6.0.*
16.4	As a minimum, the LMP must include: a) A description of the wildlife that may be present on or around the site that may be sensitive to lighting b) A description of the potential lighting effects on identified wildlife c) Specific lighting management actions to protect identified wildlife d) Reporting requirements to enable consent authorities to confirm compliance with associated consent conditions, and keep wildlife stakeholders informed e) Best practice lighting design principles to avoid lighting effects on wildlife f) A description of the proposed exterior and mobile lighting associated with the activity (including vehicle movements to and from the site) g) Auditing requirements to ensure that lighting is installed and operated appropriately
16.5	The Consent Holder must provide a detailed lighting plan to Grey District Council and the Department of Conservation at least 20 working days prior to the commissioning of the processing plant, with an accompanying design statement, prepared by a suitably qualified lighting professional, confirming compliance with conditions 16.1 and 16.2. If the Department of Conservation considers that for any reason the detailed lighting plan does not comply with Condition 16.2, the Consent Holder must consider any reasons and recommendations provided by the Department of Conservation, amend the

[1] National Light Pollution Guidelines for Wildlife (Australian Government, 2023).

	management plan accordingly, and resubmit the management plan to the Grey District Council and the Department of Conservation.
16.6	Within 20 working days of the processing plant being commissioned, the Consent Holder must engage a suitably qualified lighting professional to carry out a lighting audit, to confirm that the lighting has been installed as per the detailed lighting plan required by Condition 16.3. The results and confirmation of compliance with conditions 16.1 and 16.2 must be submitted to the Consent Authority and the Department of Conservation within 10 working days of receipt of the audit.
16.5	If the lighting audit establishes compliance with conditions 16.1 and 16.2 is not achieved, the Consent Holder must investigate and implement additional mitigation required to achieve compliance. The Consent Holder must submit a report to Consent Authority within 10 working days of the audit detailing the mitigation measures that will be implemented and must undertake a further compliance monitoring report within 10 working days of any mitigation measure being implemented to demonstrate the effectiveness of that mitigation.

1.7 Updates

This plan will be updated as required following a lighting audit that requires additional improvements to this plan.

A lighting audit would be triggered by detection of a tāiko at the site as required by condition 18.7 as set out Sections 4.2 and 4.3 of the Avian Management Plan for the project (Ecological Solutions Limited 2024). Otherwise, the plan will be updated annually by a suitably qualified and experienced ecologist/ornithologist taking into account the mining proposed for the coming year, as well as the results of the previous year's avian monitoring and the outcome of any management actions undertaken to protect birds in the preceding year.

2.0 Best Practice Lighting Design

2.1 Natural Darkness

Natural darkness should be maintained wherever possible. Artificial lighting should only be used for specific and defined purposes. Additionally, it should only be present in the required location and for the specified duration of human use. The amount of artificial light installed at the site should be the minimum amount needed to achieve lighting objectives.

In order to avoid any effects of lighting at the mine during night time operations, no mining and no trucking will occur outside daylight hours[5].

With regard to fixed lighting, the WCP building is fully enclosed to prevent light emissions. Limited lighting will be required outside the WCP to allow safe work conditions. External

[5] Daylight hours are defined as the period between 30 minutes before sunrise and 30 minutes after sunset. Sunrise and Sunset times will differ throughout the year, and are determined by sunrise and sunset times at Greymouth which can be found at the following website: https://www.timeanddate.com/sun/new-zealand/greymouth

lighting will be reduced by:

- Light fittings will be fitted with motion sensors or push-button timers to illuminate only when approached in order to minimise time where any light is present.
- At the administration building and carpark, push button type timer switches will be used to give personnel adequate time to access their vehicle or the toilet facility. This method is considered superior to motion sensor lights which may be nuisance tripped by wildlife or other movements. The push button lights will provide necessary lighting for safe passage of personnel at the site while minimising the usage time of lighting in this area during hours of darkness.

With regard to mobile lighting, it is possible that occasional vehicle movements between the WPC and the pit and minor, temporary lighting may be required to be used in the pit at night to maintain equipment such as pumps. These lights will only be used as and when required (i.e,. when the maintenance is urgent and cannot wait until daylight hours). Management of these mobile light sources is set out in Section 3 below.

2.2 Adaptive Light Controls

The use of adaptive light controls is proposed as a way to reduce the effects of artificial lighting. Adaptive controls including motion sensors and push button lighting with timers will activate lights only when required. For example, when an operator is physically present and needs lighting at the site.

Adaptive light controls should maximise the use of the latest lighting technology to minimise unnecessary light output and energy consumption.

The pump outlet will be remotely monitored from the WCP control room using night-vision technology and lighting there would only be required to attend to maintenance requirements to keep the plant safe and operational.

2.3 Specific Lighting

Lighting should be located, directed and shielded to avoid lighting anything but the target object or area. Light that spills above the horizontal plane contributes directly to artificial skyglow, while light that spills into adjacent areas on the ground can be disruptive to wildlife in adjacent areas. Light fixtures should be located as close to the ground as possible and shielded to reduce skyglow. Additionally, artificial light can be prevented from shining above the horizontal plane by ensuring the luminaire is mounted horizontally relative to the ground and not at an angle, or mounted on a building so that the structure prevents the light shining above the horizontal plane.

The fixed light fittings currently specified are PL150 Type II mounted on 2.4m swing type poles with the following design enhancements:

- The light fitting has an included angle of 120 degrees (60 degrees either side of vertically down), so they predominantly shine down onto the equipment they are lighting up. The design will be optimised to ensure the light is directed downwards to minimise spillage.
- All lights will be fitted with backing shields where possible which are designed to limit leakage of light in the opposite direction to the equipment it is illuminating.

Mobile lighting units will be utilised for areas around the Mine Water Facility and the Pit area should a pump or other equipment need maintenance. Vehicles can carry or tow the mobile lighting sets to the desired location to provide lighting when needed for breakdown

situations. These lighting sets will also be configured as above to direct light and minimise leakage.

2.4 Low intensity Lighting

Lighting intensity should be appropriate for the activity. Only the minimum number and intensity of lights needed to provide safe and secure illumination for the area will be used. 2000K rating 50 – 100W lights are proposed which are at the yellow – orange end of the light spectrum.

Low-intensity lighting will be fixed to the tailings pump outlet and switched off when not required. The lighting will be shielded and directed as described above.

2.5 Non-reflective Surfaces

Light reflected from highly polished, shiny or light-coloured surfaces such as white painted infrastructure, polished marble or white sand can contribute to skyglow. The use of non-reflective, dark coloured surfaces should be used wherever possible.

Buildings and structures will be painted in recessive colours such as Colorcote Mudstone, Rivergum or Permanent Green (see Figure 4).

Figure 4: Recessive colours (Colorcote) to be used on buildings and structures at the site.

2.6 Type of Lighting

Most wildlife are sensitive to short-wavelength (blue/violet) light as this light is strongly detected under dark-adapted vision, particularly in nocturnal species. Only lights with little or no short wavelength (400nm to 500nm) violet or blue light should be used to avoid unintended effects.

Vehicles used on site will be fitted with amber lights or filters to reduce the effect of short-wavelength light on wildlife.

2.7 Number of fixed outdoor lights

2.7.1 Wet Concentrator Plant

Fixed lighting at the WCP will include up to eight external fixed lights as follows:

- Up to six Phoenix illuminator 50W LED bulkhead lights (spigot mount – type II optic – emergency function – mounted on a swing pole) located outside the WCP building to light the WCP stairs, thickener overflow tanks and electrical distribution board.
- One Phoenix illuminator 50W LED bulkhead light (spigot mount – type II optic – standard – mounted on a swing pole) to light the thickener.
- One Phoenix illuminator 50W LED bulkhead light (trunnion mount – type II optic – emergency function) to light the WCP stairs.

2.7.2 Mining Unit Plant

Fixed lighting at the Mining Unit Plant (MUP) will include up to 21 fixed lights as follows:

- Up to eight Phoenix plus 100W LED floodlight (trunnion mount);
- Two Phoenix illuminator 50W LED bulkhead lights (trunnion mount – type II optic – emergency function);
- One Phoenix illuminator 50W LED bulkhead light (trunnion mount – type II optic – standard),
- Five Phoenix illuminator 50W LED bulkhead lights (spigot mount – type II optic – standard – mounted on a swing pole);
- Five Phoenix illuminator 50W LED bulkhead lights (spigot mount – type II optic – emergency function – mounted on a swing pole).

This lighting will only be used during daylight hours in the event that it is required (e.g. due to dark/overcast conditions at the bottom of the pit. This lighting is not expected to affect nocturnal wildlife, but will still be managed as set out in this Lighting Management Plan (i.e., used only as required, targeted, 2000K and low intensity).

3.0 Mobile Lighting

Mobile lighting at the site would be associated with light vehicle movements necessary to maintain equipment in the event of a break down during darkness which cannot be deferred until daylightvehiclcc.

No trucking movements are proposed outside daylight hours. The number of vehicle movements associated with shift changes at either of two realistic scenarios are set out in Table 1.

Table 1: Time and number of staff minivan movements at the TiGa Barrytown site throughout the year with 7am to 7pm shifts.

Month	Average sunrise – 30 minutes	Total travelling outside daylight hours
January	0546	0
February	0625	0
March	0702	5

April	0640	3
May	0713	8
June	0737	8
July	0726	8
August	0650	7
September	0604	2
October	0607	0
November	0530	0
December	0533	0

Table 1 shows that no vehicle movements to or from the site would occur outside daylight hours in the during the months October to February.

These light vehicle and any other vehicle movements relating to shift changeovers or infrequent maintenance requirements on the site would be subject to the management requirements set out in the Avian Management Plan, this LMP, and the Traffic Management Plan for the site including speed limits as required by condition 27.2, a requirement to dip headlights (condition 16.2) and a requirement to report all near misses with wildlife (conditions 15.10 and 18.6).

4.0 Tāiko, Westland Petrel

4.1 Overview

Tāiko are the largest burrowing petrel still breeding on the New Zealand mainland (Waugh and Bartle 2013). The only known colony of tāiko is located between the Punakaiki River and Waiwhero Creek approximately 3.6km north of the site as shown in Figure 5. An estimated 6,000 pairs breed at this location under mostly coastal broadleaf forest.

Tāiko are mostly nocturnal on land, returning to their breeding colonies at dusk and leaving the colony before dawn. During the March to November breeding season, Westland petrels' range over shelf waters (<800 m water depth) of the South Island, Cook Strait, and on the Chatham Rise and south to seas around Stewart Island and Fiordland (Waugh and Bartle 2013). Most of the population migrates to western South America during the non-breeding season (summer), with a few remaining in New Zealand waters year-round (Waugh and Bartle 2013).

The tāiko population is considered to be approximately stable in numbers (Waugh and Bartle 2013), with the main threats being fisheries bycatch and predation by dogs, cats and weka whilst on land. Adult Westland petrels flying to and from the breeding colony occasionally collide with power lines, and grounding of adults and fledglings around exposed lights has been recorded.

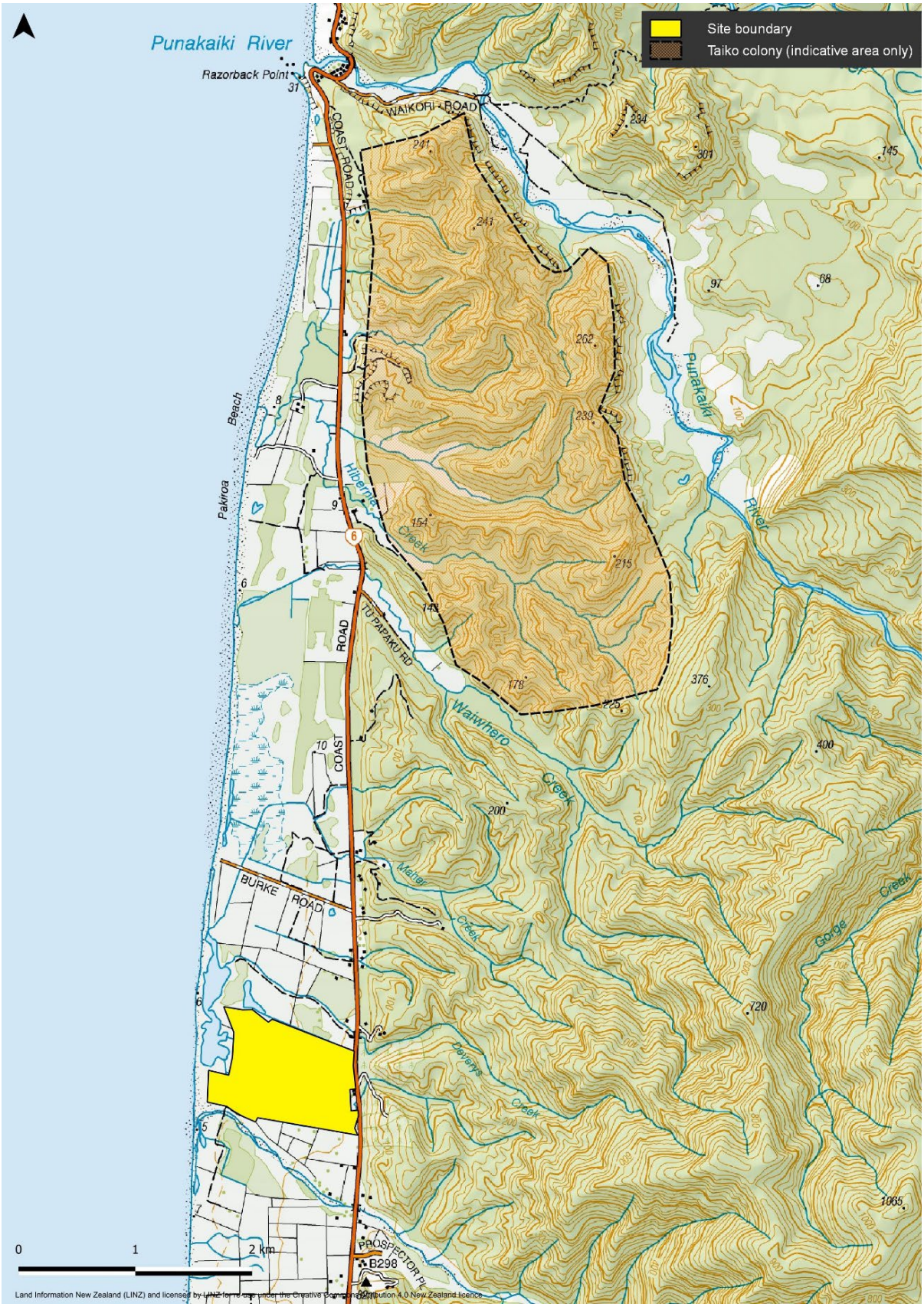

Figure 5: Location of the tāiko colony in relation to the TiGa mining site.

4.2 Potential Effects on Tāiko

4.2.1 Background

The area to be mined is located approximately 3.6km south of the only known colony of tāiko/Westland petrel. Tāiko breeding occurs between February and December. Adult birds entering and departing the colony, and at sea close to shore, may be disoriented and attracted by artificial lighting and can be grounded. The extent of such mortality associated with lighting is difficult to quantify, but the effects of lighting on the population historically has been assessed as low (Waugh and Wilson 2017). Young tāiko are thought to be disoriented by lights when leaving the breeding colony and this can also result in birds being grounded. Groundings are most likely to occur between November and January, with a peak in December as shown in Figure 6. Note that the specific cause of the groundings summarised in Figure 6 remains unknown.

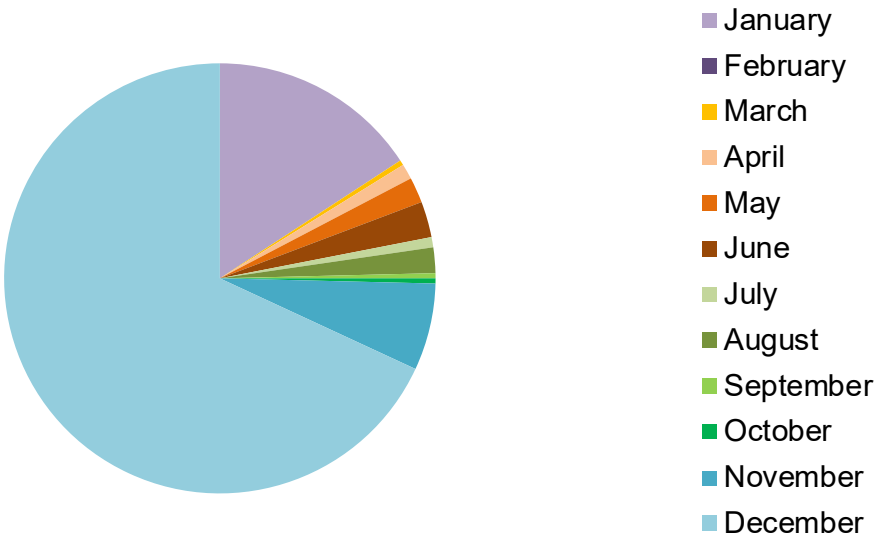

Figure 6: Records of grounded tāiko between 2007 and 2022 categorised by month of occurrence (Data from Department of Conservation).

4.2.2 Management Actions to protect tāiko

Mining and trucking will only occur during daylight hours and lighting on site will be managed so as to reduce the risk of tāiko being affected by it. The potential management options for seabirds provided in the guidelines and the approach taken for this project are set out in Table 2.

Table 2: Lighting management options for seabirds (from Appendix G (p 77 – 79) of the guidelines).

Management Action	Detail[6]	Specific Approach
Implement management actions during the breeding season	Most seabird species nest during the Austral spring and summer. Light management should be	Tāiko breeding occurs between March and November. Lighting management actions would be

[6] This is generic detail provided in the guidelines and needs to be adapted to each particular species and project.

	implemented during the nesting and fledging periods.	continuous at the site.
Maintain a dark zone between the rookery and the light sources	Avoid installing lights or manage all outdoor lighting within three kilometres of a seabird rookery. This is the median distance between nest locations and grounding locations. Avoiding the installation of lights in this zone would reduce the number of grounding birds by 50%	The tāiko colony is 3.6km north of the site. Outdoor lighting will be used only as required and managed to reduce the risk of groundings. The presence of tāiko at the site would result in a lighting audit as set out in condition 18.7 and Sections 4.3 and 4.4 of the Avian Management Plan.
Turn off lights during the fledging season	If not possible to extinguish lights, consider curfews, dimming options, or changes on light spectra (preferably towards lights with low blue emissions). Fledglings can be attracted back towards lights on land as they fly out to sea.	No trucking or mining will occur outside daylight hours. No shift changeovers will occur during the hours of darkness between October and February (inclusive). Dimming options and light spectra will be managed in accordance with this plan.
Use curfews to manage lighting	Extinguish lights around the rookery during the fledgling period by 7 pm as fledglings leave their nest early in the evening.	No trucking or mining will occur outside daylight hours. No shift changeovers will occur during the hours of darkness between October and February (inclusive).
Aim lights downwards and direct them away from nesting areas	Aim lights downwards and direct them away from nesting areas. Aim light onto only the surface area requiring illumination. Use shielding to prevent light spill into the atmosphere and outside the footprint of the target area. This action can reduce fallout by 40 per cent.	No trucking or mining will occur outside daylight hours. Lighting will be located, directed, shielded and limited in duration in accordance with this plan.
Use flashing/intermittent lights instead of a fixed beam	For example, small red flashing lights can be used to identify an entrance or delineate a pathway.	Use of flashing lights is not proposed. Lighting colour will be managed in accordance with this plan.
Use motion sensors to turn lights on only when needed.	Use motion sensors for pedestrian or street lighting within three kilometres of a seabird rookery.	Pedestrian or street lighting is not proposed. Motion sensors and push button lights with timers will be used to reduce lighting use.
Prevent indoor lighting reaching outdoor environment.	Use fixed window screens or window tinting on fixed windows and skylights to contain light inside buildings.	No windows or skylights are proposed on the WCP building. Doors will have seals to prevent light escaping. Light will be contained inside that building.
Manage artificial light on jetties, wharves, marinas, etc.	Fledglings and adults may be attracted to lights on marine facilities and become grounded or collide with infrastructure	N/A
Reduce unnecessary outdoor, deck lighting on all vessels and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Extinguishing outdoor/deck lights when not necessary for human safety and restrict lighting at night to navigation lights. Use block-out blinds on all portholes and windows.	N/A

Night fishing should only occur with minimum deck lighting. Avoid shining light directly onto fishing gear in the water. Ensure lighting enables recording of any incidental catch, including by electronic monitoring systems.	Night is between nautical dusk and nautical dawn (as defined in the Nautical Almanac tables for relevant latitude, local time and date). Light on the water at night can attract seabirds to deployed fishing gear increasing the risk of seabird bycatch (i.e. killing or injuring birds). Minimum deck lighting should not breach minimum standards for safety and navigation. Record bird strike or incidental catch and report these data to regulatory authorities.	N/A
Avoid shining light directly onto longlines and/or illuminating baits in the water.	Light on the water can attract birds and facilitate the detection and consumption of baits, increasing bycatch in fisheries (i.e. killing or injuring birds). Record bird strike or incidental catch and report these data to regulatory authorities.	N/A
Vessels working in seabird foraging areas during breeding season should implement a seabird management plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.	For example, see the International Association of Antarctica Tour Operators (IAATO) Seabirds Landing on Ships information page.	N/A
Use luminaires with spectral content appropriate for the species present.	Consideration should be given to avoid specific wavelengths that are problematic for the species of interest. In general this would include avoiding lights rich in blue light, however, some birds are sensitive to yellow light and other mitigation may be required.	The specific wavelengths problematic for tāiko remain unknown. Lights rich in blue would be avoided and ongoing monitoring and lighting audits will be used to update this Lighting Management Plan and the Avian Management Plan as required. It is proposed to use lights with a 2000k temperature as installed previously at Punakaiki.
Avoid high intensity light of any colour.	Keep light intensity as low as possible in the vicinity of seabird rookeries and known foraging areas.	Low intensity lighting is proposed in accordance with this plan.
Shield gas flares and locate inland and away from seabird rookeries.	Consider reinjecting excess gas instead of flaring, particularly on installations on migratory pathways.	N/A
Minimise flaring on offshore oil and gas production facilities.	Consider reinjecting excess gas instead of flaring, particularly on installations on migratory pathways.	N/A
In facilities requiring intermittent night-time inspections, turn on lights only during the time operators are moving around the facility.	Use appropriate wavelength explosion proof LEDs with smart lighting controls. LEDs have no warmup or cool down limitations so can remain off until needed and provide instant light when required for routine nightly inspections or in	Appropriate wavelength light at low intensity, directed and shielded is proposed to be used as required for night time maintenance and movements around the site. This lighting will not be used/be turned off when

	the event of an emergency.	not required.
Ensure industrial site/plant operators use head torches.	Consider providing plant operators with white head torches (explosion proof torches are available) for situations where white light is needed to detect colour correctly or in an emergency.	Head torches will be available for use.
Supplement facility perimeter security lighting with computer monitored infrared detection systems.	Perimeter lighting can be operated when night-time illumination is necessary but otherwise remain off.	No perimeter lighting is proposed.
Tourism operations around seabird colonies should manage torch usage so birds are not disturbed.	Consideration should be given to educational signage around seabird colonies where tourism visitation is generally unsupervised.	N/A
Design and implement a rescue program for grounded birds.	This will not prevent birds grounding, but it is an important management action in the absence of appropriate light design. Rescue programs have proven useful to reducing mortality of seabirds. The program should include documentation and reporting of data about the number and location of rescued birds to regulatory authorities.	A response programme for grounded birds is set out in the Avian Management Plan. All interactions with seabirds will be documented and reported to regulatory authorities.

To protect tāiko from accidental death due to vehicles within the site, the following is required:

- Requiring headlights to be dipped at all times within the site (condition 16.2). The effectiveness of this action in avoiding birds remains unknown, but it may assist. This practice will be trialled for at least three months. In the event that it proves unhelpful (e.g., if it becomes difficult to see wildlife at the site) this practice will be discontinued.
- Monitoring and reporting of all encounters with wildlife by all site vehicles throughout the year (conditions 15.10 and 18.6). In the event that a vehicle has a near miss or collides with a bird within the site this management plan will be reviewed (including consideration of banning night time vehicle movements) with a view to avoiding any further mortality (conditions 18.7 and 18.8).

In addition to avoiding night time mining at the site, other actions intended to protect tāiko and other species from accidental death due to collision with vehicles on the State Highway include:

- Monitoring and reporting by all mine related vehicle operators of all encounters with tāiko and other wildlife throughout the year. In the event that any mine related vehicle collides with native wildlife this management plan will be reviewed with a view to avoiding any further mortality as required by conditions 18.7 and 18.8. This monitoring includes self-reporting and monitoring using trail cameras as required by condition 18.5 and described in Section 4.2 of the Avian Management Plan.

4.2.3 Reporting

As required by conditions 18.6 and 18.15 and in accordance with the Avian Management Plan, between 1 November and 31 January each year a weekly report setting out the number and nature of any tāiko interactions at the site is to be prepared by the project ecologist and provided to the Grey District Council, Te Runanga o Ngāti Waewae, Paparoa Wildlife Trust, the Community Liaison Group for the project, West Coast Penguin Trust and the Buller/Kawatiri office of the Department of Conservation in Westport.

Between 1 February and 31 October this report shall be provided monthly. In the event that tāiko are detected by these methods this management plan will be reviewed and any changes necessary to protect tāiko included as required.

5.0 Artificial Light Auditing

Following completion of construction of buildings and structures within the site, an artificial light audit should be undertaken to confirm conformance with this Lighting Management Plan as required by condition 16.6.

The audit will involve the following:

- Reviewing best practice light management guidelines;
- Checking for compliance with the approved pre-construction lighting and conformance with the LMP;
- Recording, collating and reporting on the findings which will include any nonconformances;
- Make recommendations for any improvements or modifications to the lighting design that will decrease the impact on wildlife;
- Updating the LMP with any additional improvements or modifications required.

Artificial light audits making reference to the Australian Government Lighting Guidelines for Wildlife shall be undertaken when tāiko interactions are documented or at least annually.

6.0 Mitigation

Section 4.2.2 outlines the proposed mitigation measures to manage effects on tāiko in relation to the mine site. In summary, several actions have been proposed to mitigate any effects of artificial lighting on tāiko including following best practice lighting design outlined in the National Light Pollution Guidelines for Wildlife (Australian Government, 2023).

Lighting has been designed in a way to adhere to best practice lighting design, that is:

- Not operating during the hours of darkness.
- Using adaptive light controls (i.e., motion sensors and push buttons).
- Using lights angled downwards and backing shields to avoid light spill.
- Using low-intensity lights (2000K rating 50 – 100W lights are proposed).
- Painting buildings in recessive colours that are non-reflective.
- Vehicles will be fitted with amber lights or filters to reduce the amount of short-

wavelength light emitted.

7.0 Summary

TiGa proposes a mineral sand mine located on farmland near Barrytown, approximately 36km north of Greymouth. The mining area adjoins wetland areas which provide important habitat for a range of indigenous bird species, some of which are considered to be threatened or at risk. The proposed mine is also located near the only known breeding colony of tāiko (Westland petrel, *Procellaria westlandica*).

Best practice lighting guidelines include only adding light for specific purposes, using adaptive light controls where possible, lighting only the object or area intended, using low-intensity lighting along with non-reflective, dark surfaces, and using lights with reduced or filtered blue, violet and ultraviolet wavelengths. These management actions all form part of TiGa's proposal to manage any effects due to fixed lighting.

In order to avoid any effects of mobile lighting, no trucking will occur outside daylight hours. Any outdoor lighting will be temporary as may be required to be used in the pit at night to maintain equipment such as pumps. Any vehicles that may be required to service the pump will be fitted with amber lights or filters in accordance with this management plan.

The following actions will be deployed as appropriate at the site[7]:

- No mining or trucking outside daylight hours.
- The use of motion detectors, timing switches or similar methods to limit lighting to when it is required;
- Lighting will be used to light only the object or area intended;
- Lights will be deployed close to the ground, directed and shielded to avoid light spill as required;
- The lowest intensity lighting appropriate for the task will be used; and
- Non-reflective, dark-coloured surfaces will be used in preference to light or reflective surfaces.

8.0 References

Commonwealth of Australia. 2020. National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds version 1.0.

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.; Bartle J.A. 2013 [updated 2022]. Westland petrel | tāiko. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

[7] These are based on best practice lighting design, Appendix A of the Australian Government Light Pollution Guidelines available at http://www.environment.gov.au/system/files/resources/2eb379de-931b-4547-8bcc-f96c73065f54/files/nationallight-pollution-guidelines-wildlife.pdf