Before the Hearing Commissioners
appointed by the Grey District Council and
West Coast Regional Council

Under	the Resource Management Act 1991
In the matter of	Resource consent applications by TiGa Minerals and Metals Ltd to establish and operate a mineral sands mine, and associated activities on State Highway 6, Barrytown (RC-2023-0046; LUN3154/23)

Statement of evidence of Gary Charles Teear

19th January 2024

Applicant's solicitors:
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Qualifications and experience

1 My full name is Gary Charles Teear.

2 I have the following qualifications: BE(Hons)(1st class) Civil Engineering, MCom(Hons) Economics, and the Coastal Studies paper at MSc level (Geography), University of Canterbury.

3 I am a Chartered Professional Engineer (CPEng) #34736 with a current practising certificate and a Chartered Member of Engineering NZ.

4 I am currently a director of OCEL (Offshore & Coastal Engineering Ltd.) and have held that position since 1992.

5 My previous work experience includes Port and Harbour engineering - breakwater, wharf and coastal protection structure design, dredging, wave action, sediment movement - and Offshore engineering - structures, fixed and floating, moorings, pipelines and subsea engineering. My academic qualifications have been complemented by my practical qualifications and experience as a commercial diver to saturation level and surfing experience both as a surf competitor and a surf boat operator.

6 I am fully familiar with the West Coast coastal environment having undertaken numerous coastal hazard assessments along the coast from Hokitika, north up to Mokihinui. OCEL has also had an involvement with the design of the Punakaiki Village seawall. I am currently undertaking port engineering work at the ports of Greymouth and Westport.

7 My role in relation to TiGa Minerals and Metals Limited's (**TiGa**) application to establish and operate a mineral sands mine at SH6 Barrytown (**Application and Application Site**) has been to provide advice in relation to coastal engineering and coastal processes.

8 My assessment is based upon the proposal description attached to the evidence of Ms Katherine McKenzie as Appendix 1.

9 In preparing this statement of evidence I have considered the following documents:

(a) the AEE accompanying the Application;

(b) submissions relevant to my area of expertise;

(c) the statements of evidence on Geotechnical Stability prepared by Cam Wylie and on Hydrogeology prepared by Jens Rekkers.

(d) planning provisions relevant to my area of expertise.

(e) section 42A report

(f) The NZ Coastal Policy Statement 2010.

10 I became involved with the project in December 2023 and visited the Application Site on the 19th of December 2023. OCEL undertook an aerial drone survey of the coast at the location on the 16th of January 2024.

Code of Conduct for Expert Witnesses

11 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

12 I have prepared evidence in relation to:

(a) the existing coastal environment of the Application Site.

(b) the key findings of my assessment of effects.

(c) matters raised by submitters to the Application.

(d) matters raised in the Grey District Council's (GDC) staff reports (report issued under s42A of the RMA). The West Coast Regional Council's (**WCRC**) report did not raise any issues on coastal matters.

(e) proposed conditions of consent.

Executive Summary

13 This evidence describes the coastal environment at the western boundary of the Application site and discusses the potential impact of the mining development on the Mixed Sand Gravel Beach (MSGB) system that provides natural protection for hinterland.

14 The coastal environment comprises a MSGB and its associated lagoon system behind a continuous gravel berm at the top of the beach which constitutes a natural barrier to wave action and inundation.

15 Barrier beaches in a natural state are resilient coastal forms able to gradually shift landward in response to rising sea-level and wave action while retaining their

integrity so the existing protection from wave action for the hinterland behind the MSGB will continue, even as climate induced Sea-Level Rise (SLR) accelerates.

16 The whole system would move inland with consequent changes in the extent and area of the lagoons determined by the height of the ground behind the natural barrier. The system is dynamic and driven by changes in the wave action on the beach, storm frequency, sediment supply to the beach, both from local streams and rivers, and in the prevailing littoral drift up from the south, and SLR.

17 Currently the beach is eroding back at an estimated rate of 1 m/year. The ongoing long-term coastal erosion and shoreline retreat is occurring because of a long-term region-wide deficit in new sediment reaching and resupplying the beach face and changes to the balance between waves and sediment supply along the coast. (Hicks NIWA)

18 SLR causes coastal recession in addition to the ongoing erosion. The conservatively estimated combined erosion rate due to the ongoing erosion and SLR is estimated at 2 m/year. It is conservative to the extent that it employs the Bruun Rule which is applicable for sand beaches, less so for MSGBs because the beach processes are quite different to those on a sand beach. A quantitative method predicting the rate of retreat for MSGBs is not currently available but the rate of retreat for MSGBs is known to be less than for sand beaches.

19 The land behind the beach and the lagoons has no effect on and is independent of the beach processes. The Application site is 250 m from the high water tide mark on the beach with a 20 m setback from the edge of the lagoon. At the estimated conservative rate of combined erosion it would take in excess of 100 years for the sea to reach the location.

20 The mining operation will have no potential effect on erosion of the coast being behind the natural barrier and well setback. The risk of inundation for the 2130 planning horizon applies for both the existing topography and the reinstated topography. The reinstated level would be an average of 0.8 m below the existing level across the site, but along the western end it would be reinstated to at or above the existing level as per the rehabilitation plan.

21 Filling the mining excavation with the original sand minus the HMC content does not increase the coastal erosion potential once the sea reaches the location because the sand is essentially the same as the sand extracted, and normally consolidated under self weight. The rate of erosion would be close to the same for the refilled area as for the original ground.

22 The mining operation will have no impact either in the short-term or the long-term on coastal processes. The proposed mine areas are well clear of the dynamic

coastal area being located landward of the lagoons and have no influence on the coastal processes.

The Existing Environment

15 The mine site is located on the Barrytown Flats 30 km north of Greymouth off SH6 on open farmland, 10 km south of Punakaiki township. The application area is located within the coastal environment identified by the Te Tai Poutini proposed District Plan (TTPP) and the West Coast Regional Coastal Plan but is outside of the Coastal Marine Area as defined by the RMA.

16 Barrytown Beach to the west of the Application area is a mixed sand/gravel beach (MSGB) the proportional composition of sand and gravel varies across the beach profile. MSGBs can be classified into different classes based on the relative abundance of sand and gravel (mean grain size under and over 2 mm respectively) and their spatial distribution within a beach: (1) pure gravel: (2) mixed sand and gravel beaches (MGSB) in which sand and gravel-sized sediment is fully mixed across the beach system: and (3) composite beaches where gravel is generally at the steeper upper beach and sand is located at a lower-gradient intertidal platform at the base of the beach.

23 MGSBs can be found in a wide range of tidal and wave environments many of them forming the only or primary defence against flooding or erosion of the hinterland, as in this case for the beach at Barrytown Flat.

24 The areas of the beach profile with the poorest sorted material, a mixture of sand and gravel, have mild slopes whereas as those with the best sorted material, gravel only, were steeper, the larger the mean grain diameter the steeper the slope.

25 The generally steep berms maintain the steep reflective character of MSGB at the top of the tide, which combined with coarser sediment is able to both absorb and reflect wave energy not dissipated during wave breaking. High infiltration rates during wave uprush result in less backwash.

26 The beach north of the application site, shown in photograph no.1 included in Appendix 1, classifies as a Composite MSGB, class 3. At low tide the beach is wide and flat and dominated by sand while at high tide the beach is a steep (27^{o}) gravel bund forming a barrier. The abrupt change in slope occurs around the high tide (MHWS) mark.

27 Barrier beaches are a common geomorphological feature worldwide. The gravel bund barrier is generally parallel to the shore and separated from it by a wetland or lagoon. For the beach north of the proposed mine location the gravel bund is backed by a narrow elongated shallow wetland area, known as a ribbon lagoon and shown in photograph no.2. The water in the wetland discharges/percolates

through the gravel bund to the sea emerging onto the beach at the toe of the bund as upwelling seepage in the sand at regularly spaced intervals along the beach.

28 Barrier beaches act as a natural means of coastal protection (Sandy Beach Morphodynamics, Jackson & Short 2020). The wetlands and lagoons formed behind barrier beaches provide shelter for many coastal habitats of environmental significance. One explanation of their formation is that they have been formed by landward migration of submerged sand/shingle banks with rising sea levels since the last ice age.

29 Barrier beaches are constantly evolving in response to short- and long-term processes. Short-term changes are principally related to the wave climate and the frequency and magnitude of storm events. The primary factors for change in the longer-term are SLR, longshore sediment transport and changes in sediment sources and sinks.

30 Close to the mine site location the narrow water feature behind the barrier expands to form a series of coastal lagoon features – Devery's lagoon and Rusty lagoon - and the height of the gravel bund decreases before increasing again in height and regaining its barrier form further south.

31 There is a discharge of water from the lagoons in a stream discharge out across the beach in a wide, shallow channel. The MSGB at this location classifies as a class 2 MSGB, sand and gravel-sized sediment is fully mixed across the width of the bund. This relatively low, wide area in front of the lagoons is clearly washed over by wave runup in storm events at high tide. The sediment exposed on the beach, a mixture of sand and gravel, as is evident in photograph no.3, not a uniform gravel bund as evident further north and south.

32 The washover area is wide and low compared to the gravel bund and grades into a vegetated area on the edge of the lagoon features as is evident in photograph no.4. The volume of wave runup washover water will increase the water level in the lagoons, but not by much, given the surface area of the lagoons, and will flow back out to sea through the existing stream discharge to the sea.

33 The whole beach system is dynamic and the location of the discharge point from the lagoons and Canoe Creek to the south of the site -reference photograph nos.5 and 6 - will vary over time with storm events. There is a form of dynamic stability at play, the coastal features will persist but change in shape. Barrier beaches in a natural state are able to gradually shift landward, along with the associated lagoon features in response to rising sea-level while retaining their integrity.

34 The landward movement can continue until arrested by a hard geological feature such as the base of the Paparoa range just east of SH6.

Wave Energy Environment

35 The West Coast wave environment is high energy being exposed to, and characterised by, persistent high energy, long period swell generated on the unlimited wave fetches to the southwest. The average significant wave height in deep water offshore is of the order of H_s = 1.6 – 1.7 m (NIWA). Waves reaching the West Coast can have originated from below South Africa.

36 These deep-water waves approach the coast at an angle that reduces after refraction in the shallowing water but still arrives at an angle – reference photograph no.7 - to the beach that drives a strong littoral drift to the north. Waves from the north also impact directly on the beach, again at an angle to the beach but these are less frequent and generally less energetic than waves from the SW and don't significantly affect the net littoral drift to the north. The net northward longshore transport potential has been estimated from hindcast wave data to be in the range from 1.7 million m^3/year to 2.6 million m^3/year (NIWA).

Erosion

37 The coastline to the north and south of the site, along virtually the entire length of the West Coast north of Fiordland is eroding. There have been a number of studies of the causes of the erosion, principally by NIWA. The main findings of these studies suggest that the shoreline "shows evidence of short-medium term (1-20 years' time-frame) cycles of accretion and erosion superimposed on a trend of long-term erosion.

38 The short-medium term shoreline movements are characterised by accretionary "lenses" and erosion "bites" as at Mokihinui from several to 10 m in width and spanning 500-1000 m segments of shore" (Hicks, NIWA 2007).

39 Historic erosion rates identified over the last 50 to 100 years vary along the length of the West Coast shoreline and along individual beaches. On the Barrytown Beach the erosion rates are noted (in the Review of West Coast Region Coastal Hazard Areas, Hicks, NIWA) as highest along the southern to middle parts of the beach with erosion rates reducing further north (Hicks NIWA).

40 Generally, long-term observed retreat rates along the West Coast vary in a range between 0.3 - 0.4 m/year at Ngakawau and Hector, 0.6 – 0.8 m/year at Granity (NIWA 2007) and up to 1 m/year at Charleston, 2m/year allowing for future SLR (OCEL 2015). The retreat will occur episodically, being primarily caused by storm events. This retreat rate will be specific to each location and modulated by vegetation, defences and sediment supply.

41 The historic rate of erosion retreat close to the proposed Barrytown mining site, as determined from vegetation lines on the available historic photography is quite

variable in the area of the coastal lagoons and the Canoe Creek mouth as is to be expected in such a dynamic environment but indicates rates of retreat of the order of 1 m/year either side of the lagoons. The historic vegetation lines are shown in drawing no. DR-231202-001 included in Appendix no.1

42 The ongoing long-term coastal erosion and shoreline retreat is occurring because of a long-term (decadal to century) region-wide deficit in new sediment reaching and resupplying the beach face and changes to the balance between waves and sediment supply along the coast. The sediment is being moved north by the littoral drift faster than it is being supplied to the beach.

43 The patterns of coastal erosion are not constant. Cycles of short to medium term accretion and erosion patterns occur depending on the particular complex interactions between wave climate variability, storm occurrence, storm tracks and how often storms and river flood events occur which are the dominant source of sand and gravel supply to the coastline. Landslides in river catchments due to historic earthquakes also have had a significant influence on sediment supplied to the coast on the West Coast.

44 An underlying ongoing rise in sea-level has also been a relatively minor factor in the historic erosion rate. This will change in a climate change future when the SLR contribution to shoreline recession will accelerate to become a significant if not dominant component of the combined erosion rate.

Future Shoreline Changes & SLR

45 The current national policy – NZ Coastal Policy statement 2010 - is to anticipate sea-level changes out to 2120, just less than 100 years from now. Four scenarios of NZ wide SLR projections recommended in the Ministry for the Environment's 2017 coastal guidance, based on the IPCC 5th Assessment Report are shown in figure no.1 in Appendix no.1.

46 SLR could range from 0.55m to 1.35 m or higher by 2120. Sea level height is relative to the average mean sea level over the period 1986-2005 which the IPCC use as a zero baseline for the projections. The 4 scenarios are based on four Representative Concentration Pathways (RCPs).

47 An RCP is a greenhouse gas concentration trajectory adopted by the IPCC. The pathways describe different climate futures all of which are possible ranging from RCP 2.6, a stringent pathway requiring that CO_2 emissions start declining by 2020 and go to zero by 2100, to RCP 8.5, CO_2 emissions continue to rise throughout the 21st century.

48 In terms of the Ministry's Coastal Hazards and Climate Change Guidance Category C applies for the proposed Barrytown Flat development - Existing Coastal

Development and Asset Planning. Councils should use a minimum transitional value for SLR of 1.2 m out to 2130. This is far beyond the anticipated life (15 years) of the mine.

49 The implications for the proposed development at Barrytown are that over the life of the mine the rise in sea-level will have minimal effect on the development. There is no risk of inundation from SLR, the height at the mine location, currently 4-6 m above Mean Sea Level (MSL) – reference Figure 40 of the Hydrological Impact Assessment, Attachment I to the AEE- is in excess of the SLR for the life of the mine and 250 m from the beach behind the gravel barrier bund. At current erosion rates it would take well in excess of 100 years for the beach to reach the mine location.

50 There is an inundation risk for the Application site and the surrounding taking into account the 2130 planning horizon but that applies irrespective of whether the mining goes ahead or not. The finished level of the land following reinstatement after the mining operation at an average of 0.8 m below the current level across the site, except along the western end where it would be reinstated to at or above the existing level as per the rehabilitation plan, does not perceptibly change that.

51 The addition of a new wetland area, constituting ponds 3 and 4, on completion of the mining operation will not create any new issues in regard to SLR and inundation issues.

52 Barrier beaches in a natural state can gradually shift landward in response to rising sea-level while retaining their integrity so the existing protection from wave action for the hinterland behind the MSGB will continue. A simple earth berm could be used to protect the reinstated land and adjoining properties from being inundated at some time in the distant future if required.

53 SLR is not just an increase in the depth of water at the location there is also an associated beach retreat/shoreline recession as the coast adjusts to the increased water depth. The current rate of erosion retreat extrapolated from the historical shoreline change already includes the SLR to date. The beach retreat consequent on future SLR needs to be added to the historic rate.

54 The beach retreat/shoreline recession resulting from SLR is typically approximated by the Bruun Rule, a simple geometric relationship between shoreline recession Δx which results from ΔS of SLR. The principle is that an initial equilibrium profile of length L (the horizontal distance to the closure depth from the beach crest) for a given depth of closure d_c will re-establish itself further landward and higher by a depth ΔS after SLR, as the d_c remains constant. This implies that the material eroded on the upper part of the profile is deposited on the lower part of the profile. $\Delta x = L \cdot \Delta S / (d_c + h)$ where h is the height of the beach crest above MSL (Mean Sea Level).

55 This method is widely used in international literature and is recommended by the MfE (2017) guidance. As the rule is governed by simple two dimensional conservation of mass principles it is limited in its application which is principally for sand beaches.

56 The beach processes for MSGBs differ from those for sand beaches in that runup from storm waves pushes the coarser gravel material higher on the beach profile, building the crest level, rather than moving sediment offshore as occurs for a sand beach. If runup overtops the gravel bund material can be overwashed causing a loss of material from the front face and building up the back of the barrier.

57 As sea-level rises increased material is overwashed resulting in recession. The width of the barrier bund may not remain constant, narrowing with lower rates of sea-level rise as crest building dominates and widening with increased rates as overwash dominates. A quantitative method for predicting these dynamic changes in morphology is not currently available.

58 It is generally accepted in the international literature that beaches containing gravel components will erode less than sand beaches under SLR as the coarser material is moved landward and upwards on the beach rather than large volumes of sediment being lost to offshore. While the process can be modelled using the generalised Bruun Rule applied to the MSG beach the result will be conservative i.e. a faster rate of recession than will actually occur. However, using that approach and approximating $L/(d_c + h)$ as the sand beach slope, 1:100 the beach recession calculated for 1 m SLR in 100 years would be 100 m, 1 m/year.

59 The combined recession rate would then be a conservative 2 m/year. At that rate it would take 125 years to reach the mine location.

60 The presence of different sediment fractions ranging from sand to cobbles enables MSGB to adapt to changing water levels and storm conditions more quickly than sand beaches and reducing the rate of erosion. MSGBs are characterised by higher rates of beach recovery after storms and are more resilient to changing conditions.

Assessment of effects

61 The mining operation will have no impact either in the short-term or the long-term on coastal processes. The proposed mine areas are well clear of the dynamic coastal area being located landward of the lagoons and have no influence on the coastal processes.

Matters raised by submitters

62 A number of submitters - Messrs Weston, Ellis and Freeman and Mses Lough and Langridge - expressed general concerns about the potential deleterious effects of the mining operation on ongoing coastal erosion and inundation and felt that this aspect had not been properly addressed in report form. In addition, concern was expressed that backfilling the mining void with the sand left after the HMC component (≈ 10%) had been extracted would create a potential weak area that could be rapidly exploited and eroded when the sea finally reached the area as a result of SLR.

63 The MSGB on the seaward edge of the application site and its associated gravel bund act as a natural barrier protecting the hinterland behind it. It is shaped by the forces of the sea and can adapt to changing water levels and storm conditions. In response to erosion the gravel bund can move landward while retaining its integrity.

64 The changes are driven primarily from the seaward side, not from behind the shelter afforded by the MSGB. Areas onshore of the lagoons have no effect on the beach processes.

65 With regard to the infilling of the mine excavation the infill material will be the same material that was extracted by the mining operation, non cohesive sand, less the HMC component. The sand will compact under its own weight, normal consolidation, similar to the surrounding material in what was previously swamp, so even if the sea reached the location, highly unlikely in the life of the mine, or the 100 year planning horizon, it won't erode the infill material any faster than the surrounding untouched ground would erode.

WCRC and GDC staff reports

GDC Report

66 Mr Geddes raises the question of setback from the coastal wetlands at paragraph 146 of his report. There is ongoing coastal erosion reflected in the landward movement of vegetation lines over time, as indicated by historic aerial photographs, combined with the additional coastal erosion generated by SLR results in a landward movement of the gravel bund at the top of the beach. The whole MSGB system moves inland driven by coastal processes from the seaward side.

67 This lateral translation will impinge on the coastal lagoons and force the seaward edge of the lagoon back. The impact on the landward edge will depend on the height of the land along that edge. If it is low, close to water level, then any increase in the water level in the lagoon consequent on increased washover volumes into the lagoon will move the landward edge of the lagoon landward as well.

68 If the landward edge has some freeboard, height above water level, either in its natural form or with a bund in place the landward edge will remain static, the setback will be unchanged, and the width of the lagoon will narrow at this point.

69 Ultimately as the gravel bund moves back it will roll over the current landward edge of the lagoon. That is well into the future. In the meantime the shape of the lagoon will change but the changes relate more to the topography inshore than the dynamic processes driving the recession of the MSGB. They don't act directly on the landward boundary of the lagoon until the gravel barrier gets there and swamps it.

70 Mr Geddes raises the question of coastal inundation at paragraph 180 of his report. The risk of coastal inundation during the mining operation is very low and would only result from storm surge or tsunami effects occurring at high tide. The Application site is protected by a barrier gravel bund at the top of the beach the height of which reduces where the discharge from the lagoons flows over the beach to the sea.

71 Once through this gap the water would spread out behind the barrier, raising the water levels in the lagoons and flow across the Barrytown Flats, the same as it would do for the land in its existing form. Because the mining activity is set back 20 m from the nearest lagoon edge it would not significantly change anything in either its effects or risk.

72 The tsunami risk for the West Coast of New Zealand is relatively low risk compared to the rest of New Zealand, in particular the East Coast which is exposed to tsunamis generated by major earthquakes in deep submarine trenches representing tectonic plate boundaries – Pacific/Australian – directly offshore. The maximum tsunami wave height (maximum amplitude) for the West Coast is still considerable at 4-6 m but the return period for an event of that size is 2500 years making the probability of an event during the life of the mine negligible. An event of that size would overwhelm the barrier beach other than at dead low tide.

73 In paragraphs 182 and 329 and Appendix 1, paragraph 6, Mr Geddes raises concerns about the potential for inundation of adjacent properties as a result of the changes to landform on the application site. Once the mining area has been reinstated the average change in the height of the mining area across the site is estimated to be 0.8 m lower than at present, except along the western end it would be reinstated to at or above the existing level as per the rehabilitation plan. This will not significantly change the inundation risk to adjoining properties.

74 If the ground level of the western part of the site is being raised the rising water in an inundation event would flow around the raised areas until the inundation height is such that they are submerged. These areas will not displace water onto adjoining properties, they either block the flow or have no influence.

75 The West Coast Regional Council's report did not raise any issues on coastal matters.

NZ Coastal Policy Statement

76 I have considered the New Zealand Coastal Policy Statement objectives and policies as they relate to my area of expertise, and observe that the proposal is consistent with these provisions in the following ways:

(a) Objective 1- Because the proposal has sufficient setback from the coastline, of the order of 250 m, it will safeguard the integrity, form and function of the coastal environment.

(b) Objective 5 - The proposal is consistent with objective 5 because the mining activity is not located in a coastal hazard risk area.

(c) Policy 3 – Precautionary Approach – By setting the proposal significantly back from the coastline the applicant has demonstrated a precautionary approach to their activities, such that it will not interfere with coastal processes, natural defences.

(d) Policy 24- I have identified the coastal hazard risk areas based on my projections of erosion taking into account the appropriate SLR scenario, and the mining area is outside of the area that will be affected within the next 100 years.

Conclusion

77 The application site has natural protection from wave action and the effects of SLR in the form of a MSGB (Mixed Sand Gravel Beach), composite beach form, a wide sandy beach apparent at low tide with a steep gravel bund, natural barrier at the top of the beach. Barrier beaches in a natural state are able to gradually shift landward in response to rising sea-level while retaining their integrity so the existing protection from wave action for the hinterland behind the MSGB will continue as climate induced SLR accelerates.

78 The West Coast coastline is eroding as a result of sediment being moved Northward by littoral drift faster than it is being supplied to the beach. The Barrytown beach coastline is eroding back at an estimated rate of 1 m/year as a result and the shoreline recession rate will be increased by future SLR effects. The MSGB is a resilient natural feature, more so than a sand beach, able to adapt to wave action and SLR, moving landward while retaining its protective function and the integrity of the natural barrier.

79 The proposed mining operation located back behind the lagoon system that is associated with the MSGB form will not affect the natural beach processes. Even

at an accelerated rate of erosion, the current rate of erosion, 1m/year, plus a conservative estimate of SLR induced recession of 1 m/year to give a combined rate of 2 m/year, it will take in excess of 100 years for the coastline to reach the site of the mining operation which will have recovered the HMC resource long before then.

80 The reinstated land and wetland will not be more prone to coastal natural hazards, nor will the change to ground levels exacerbate any potential inundation of adjacent properties.

Gary Charles Teear Dated this 14th day of January 2024

Appendix 1 – Photographs, Figures and Drawing

Photograph no.1

Photograph no.2

Photograph no.3

Photograph no.4

Photograph no.5

Photograph no.6

Photograph no.7

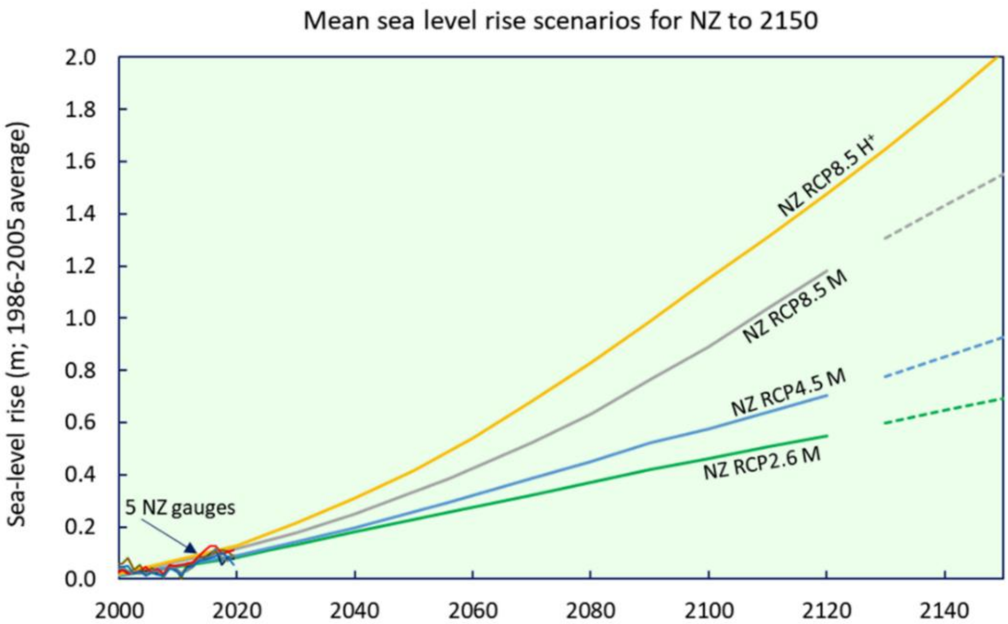
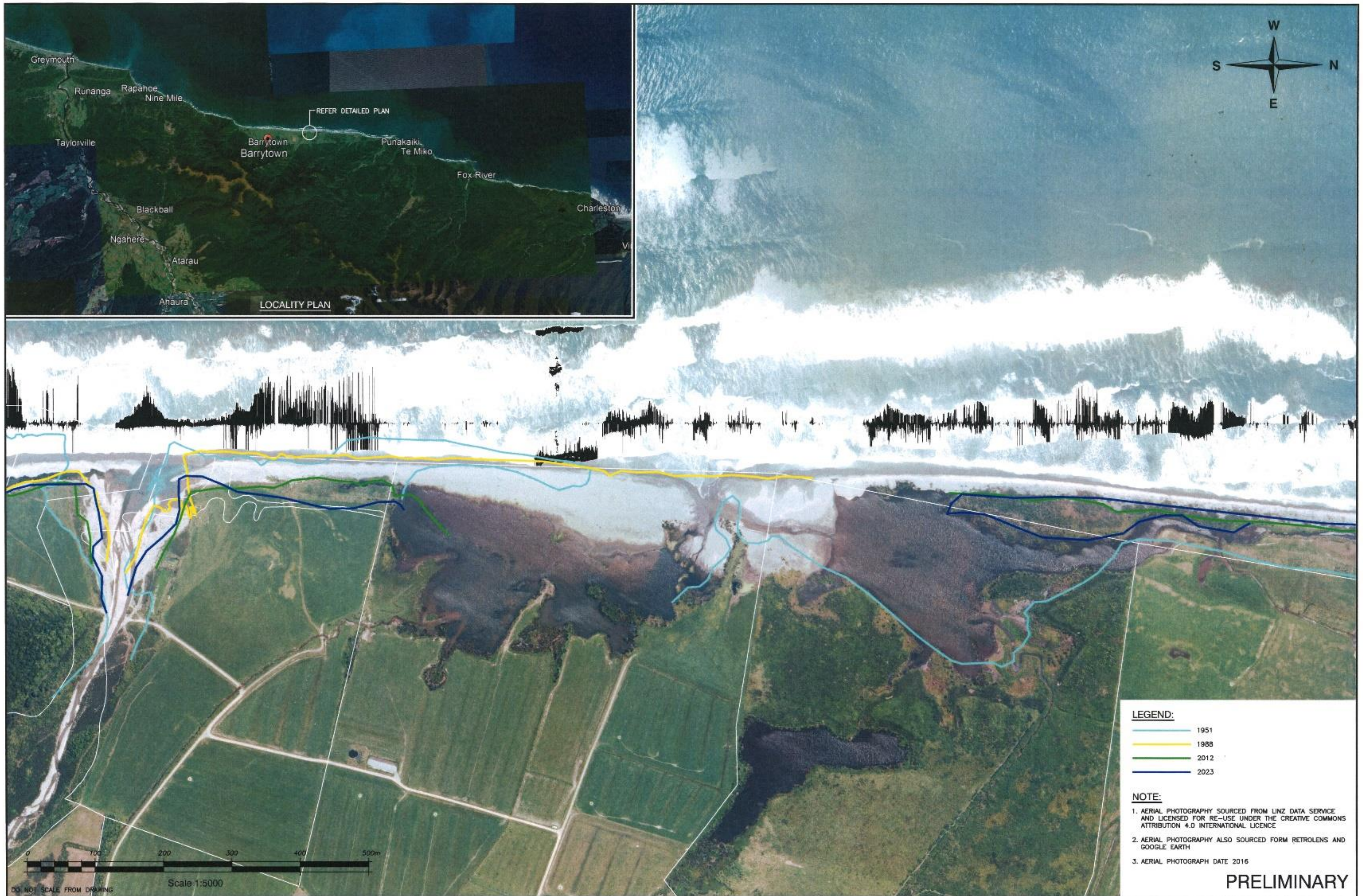


Figure no.1



LEGEND:

- 1951
- 1988
- 2012
- 2023

NOTE:

1. AERIAL PHOTOGRAPHY SOURCED FROM LINZ DATA SERVICE AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE
2. AERIAL PHOTOGRAPHY ALSO SOURCED FORM RETROLENS AND GOOGLE EARTH
3. AERIAL PHOTOGRAPH DATE 2016

PRELIMINARY

							Drawn	RVE
							Checked	
							Traced	
PRELIMINARY ISSUE FOR INFORMATION	1	22/12/2023	RVE	PRELIMINARY			Approved	
Amendments	Rev'n	Date	Drawn	Issued for	Checked	Approved	Date	12/2023

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TiGa METALS AND MINERALS

BARRYTOWN SAND MINING SITE

PLAN OF HISTORICAL EDGE OF VEGETATION LINES

Scale (A3)	ACAD Filename
1:5000	231202/DR-231202-001R1
Drawing No.	Rev.
DR-231202-001	1