BEFORE THE FAST-TRACK EXPERT PANEL

IN THE MATTER of an application for approvals under section 42 of the Fast-track Approvals Act 2024 ("FTAA")

AND

IN THE MATTER of the application for approvals by Trans-Tasman Resources Limited for the Taranaki VTM Project, a project listed in Schedule 2 of the FTAA

JOINT STATEMENT OF EXPERT WITNESSES:

BENTHIC HABITATS AND SPECIES

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17 November 2025

INTRODUCTION

1. Expert conferencing on the topic of benthic habitats and species took place online via Microsoft Teams on 17 November 2025.

2. The conference was attended by the following experts:

   (a) Dr Alison MacDiarmid ("AM") (Applicant);
   (b) Dr Becky Shanahan ("BS") (Taranaki / Horizons Regional Councils);
   (c) Dr Tara Anderson ("TA") (KASM and Greenpeace); and
   (d) Dr Gregory Matthew Barbara ("GB") (Seafood NZ).

3. Steve Mutch (ChanceryGreen) acted as facilitator.

4. Caitlin Todd (ChanceryGreen) assisted the experts to draft the Joint Witness Statement ("JWS").

CODE OF CONDUCT

5. The experts confirm that they have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and agree to comply with it. The experts confirm that the issues addressed in this JWS are within their area of expertise, unless stated otherwise.

SCOPE OF STATEMENT

6. In Expert Panel Minute 19 (5 November 2025), the Panel directed experts in benthic habitats and species to conference regarding identified questions, recording matters that are agreed or disagreed and any unresolved matters or uncertainties.

7. The scope of this statement is limited to benthic habitats and species.

8. Appendix C of Panel Minute 19 formed the basis of an agenda for conferencing.

9. In this JWS, we report the outcome of our discussions in relation to each item (below), including by reference to points of agreement, disagreement, and unresolved matters or uncertainties. Where we are not agreed in relation to any issue, we have set out the nature and basis of that disagreement.

QUESTIONS FROM THE PANEL

1. Benthic Habitat Data

a. Is information on benthic habitats and species adequate in spatial and taxonomic resolution to support a robust effects assessment?

10. All experts agree that the initial surveys are sufficient for characterisation of the soft sediment habitats and the species present, including habitat formers.

11. All experts agree that the benthic surveys, both in and adjacent to the PPA and the near shore coast, identified the presence of some reefs. These were not well sampled but were verified by video. All experts agree that the surveys were inadequate to fully characterise the rocky reef habitat in the potentially affected areas, as shown in the Figures of the median plume model.

12. All experts agree that the mid-shelf area was not well surveyed as this was not a target in TTR's baseline surveys. The experts consider this was better surveyed by targeted multi-beam and video surveys in the Morrison et al. (2022) report; however, these were not used to assess mining effects.

b. Do experts agree on the identification and ecological significance of key benthic habitat types and sensitive sites (such as newly described reefs and species assemblages) potentially affected by the project?

13. All experts consider that the soft sediment habitats and associated species are well described, and the densities are well estimated. However, their ecological significance is not well understood.

14. All experts agree that there is insufficient information on rocky reef habitat distribution and associated species. There is evidence that reef size and height off the seabed may be an important co-variable with community types and their impact sensitivities. Their sensitivity to mining impacts is therefore unclear.

2. Mechanisms of Impact

a. What are the primary mechanisms by which the proposed mining and associated activities would affect benthic habitats and species?

<u>Desalination discharges</u>

15. All experts agree that the mechanism for discharge of the brine plume needs to be clarified. GB notes that the inclusion of the salination plant is new in the mining

process and has not been assessed but it has very important consequences as brine is denser than sea water and will sink to the bottom of the pit. GB notes that brine concentrations above 45 parts per thousand are known to be lethal to most larval stages of benthic organisms and brine discharges are often low in dissolved oxygen which can then lead to dead zones on the seafloor.

16. AM's understanding is that the brine will be mixed with the freshwater used to wash the ore resulting in a solution close to sea water salinity. This is based on Shawn Thompson's evidence (dated 13 October). All experts agree that more information is required to ensure that brine is adequately diluted.

17. GB raised that without understanding the fate of the brine, modelling of the salination would need to occur. To assist in understanding the extent of effects of desalination brine plume on benthic organisms needs to be undertaken. GB considers that a critical gap is the lack of the hypersaline plume modelling (30,000 m3/day desalination roughly 10.95 GL/year although TTR state around 5 GL/yr). GB considers that if paragraph 16 above is verified modelling may not be required. However, as part of the consent conditions, monitoring of the discharge to validate paragraph 16 should be required as part of the monitoring programme.

18. GB also raised that the effect of freshwater washing on the mobilisation of metals, as metals are more soluble in freshwater than sea water – Vopel et al. 2013 laboratory testing only used sea water (not from the site). Cu and Ni in particular become more bioavailable in freshwater. Vopel et al. 2013 discuss the complexity of interpreting the ratio of simultaneously extracted metals (SEM) to Acid Volatile Sulfide (AVS), noting that this ratio is a better predictor of toxicity than metal concentrations alone. In freshwater, factors like limited sulfate supply and oxygenation can significantly lower AVS levels, increasing the likelihood of metal bioavailability and potential toxicity. 2004 work by Morse and Rickard highlight that while freshwater environments are often perceived to have lower AVS concentrations than marine systems, AVS is crucial for controlling metal bioavailability. GB notes the practical implications for toxicity: a low AVS concentration in a freshwater sediment can increase metal bioavailability even if metal concentrations are not exceptionally high, leading to higher toxicity to organisms like benthic macroinvertebrates.

Mechanical removal within the PPA

19. All experts agree that sedentary biota sucked up during the mining operation will be killed.

Sediment deposition near-field

20. The experts agree that courser sediments are predicted to settle within 2-3kms of the active mining area within hours. These predictions will need to be validated during the mining operational monitoring surveys as part of the Operational Environmental Monitoring and Management Plan.

21. All experts agree that there will be burial from deposition by the IMV into the mining strips and mound formations on the adjacent seabed within the PPA.

22. All experts agree that the pits and mounds will be long-lived (decades to centuries) and will migrate across the seafloor down current through time.

Sediment deposition far-field

23. All experts agree that there will be movement of sediment to areas outside of the PPA.

24. All experts note that sediment deposition was modelled by Hadfield and MacDonald (2015). Figures 5-31 illustrate the extent of the deposition of suspended sediments in the far-field.

25. GB and BS note there are still uncertainties with the sediment plume model outputs.

26. BS considers that one mechanism is that the deposition of sediment on reef environments can prevent the settlement of some larval stages. All other experts agree with this.

Suspended sediment near-field and far-field

27. All experts agree that the sediment plume created from the mining will reduce available light due to increased turbidity down current from the activity in the near-field and far-field (see Pinkerton, 2017 – worst-case update). This has the potential to reduce photosynthesis of marine flora. The effects in the near-field will be more extreme than in the far-field.

28. All experts agree that increased suspended sediments, where concentrations are high enough, are known to cause clogging of gills and affect feeding mechanisms of invertebrates. However, different species respond in different ways with some being more susceptible than others (which may impact recovery rates of different species and community structure, including potential for opportunity of invasive species to colonise cleared substrate).

29. BS notes that some invertebrates incorporate suspended sediment into their tissues e.g. sponges, so can cope with some impact.

30. All experts agree that demersal fish (along with cephalopods and crustaceans) may also be susceptible to suspended sediments in both the near-field and far-field, particularly juveniles, with mechanisms including clogging of gills, feeding apparatus, and visual impairment in finding their prey.

31. All experts agree that mobile species may be displaced or avoid areas with increased suspended sediment concentrations from the plume.

Change in benthic geomorphology

32. All experts agree that, during mining, the existing habitat zones will be sequentially removed and replaced by the creation of up to 11m deep pits and up to 11m high mounds in some areas across the PPA. This sequence of pits, mounds and refilling pits will create extensive heterogeneity in seafloor geomorphology. TA has provided a concept diagram to visually illustrate the post-mining seafloor, noting that it is not to scale and is only a representation (see **Appendix 1**).

33. The experts note that the modelling undertaken and referenced in Iain MacDonald's evidence (dated 13 October 2025) suggests that pits at 35m water depth will take 104 years to infill to 90% recovery, while similar pits at 45m water depth will take 359 years to infill to 90% recovery.

34. AM notes that this heterogeneity could have positive and negative effects, i.e. beneficial to some species, not to others.

35. TA notes in relation to paragraph 33-34 above, that this may be particularly important for habitat-forming and habitat-engineering species within the PPA.

36. GB notes the creation of pits as described in paragraph 33-34 above also poses a risk of harbouring dead zones if brine is not adequately dispersed as brine is heavier than sea water. This is dependent on clarification of the evidence

presented by Shawn Thompson (dated 13 October) that brine would be diluted down to 1.1 times that of sea water or less.

Underwater noise

37. All experts agree that mining operations can mask individual mobile benthic organisms' calls in the near vicinity of the iron sand mining operations.

Other impacts

38. All experts agree that a combination of these mechanisms may lead to a change in community structure, particularly where habitat-forming or habitat-engineering species' distributions are affected.

    b. *Do experts agree on what effects are plausible or likely for each habitat and key species, given the predicted operational regime and model outputs?*

39. All experts agree that in addressing this question they are talking about the key effects as outlined in the paragraphs above.

40. All experts agree that within and close (<2-3 km) to the active mining area most, if not all, benthic invertebrate species would be either mechanically killed, buried, smothered or overcome by high levels of SSC.

41. All experts agree that the effects on other habitats and species will depend on exposure to elevated SSC. Most vulnerable will be rocky reefs, especially habitat-forming macro-algae, 3+ km of the mining area boundary particularly in an easterly direction from the point of mining.

42. GB considers that the effects of the brine on the benthic habitat within the pit are likely to have long lasting effects if dilution does not result in concentrations of less than 1.1 times that of sea water (at least 40:1 dilution).

43. TA considers the post-mining geomorphology of pits and mounds may have long lasting consequences on the recovery time for species that create habitat zones e.g. worm fields.

44. TA notes that there is considerable uncertainty regarding larval dispersal distances between different species in response to geomorphology changes, particularly those that form habitats appear from NZ data to have very low

distance dispersal. No information is known on *Euchone* species A dispersal capabilities.

45. All experts agree that there is potential for sensitive life stages, such as juvenile blue cod, to be impacted where their nursery habitats occur in areas with high suspended sediments from mining activities.

3. Magnitude and Spatial/Temporal Extent of Effects

a. Describe the expected magnitude, spatial extent, and duration of direct and indirect benthic effects (e.g., area of direct removal, area and depth of chronic or acute sedimentation, duration of effect)

46. All experts consider that this question is more closely related to the remit of the sediment plume modellers' discussion, rather than the benthic habitat experts without higher resolution information on the distribution of sensitive reef habitats.

b. How does model uncertainty affect confidence in these predictions, especially for high value or spatially restricted benthic habitats?

47. All experts agree that the sediment plume model has uncertainties, and that quantification of that uncertainty helps assess how reliable the model is in predicting biological/ecological impacts.

48. BS considers that the sediment plume model has uncertainties which are then carried forward into the optical effects modelling. GB and TA agree with this.

49. BS notes that the averaging across the SMD for primary productivity is not appropriate to determine the mining impact on primary productivity. This is especially true for benthic macroalgae. Areas of the SMD will be affected differently from the mining activity. GB agrees with this.

50. TA states that, based on Morrison et al. (2022), there are blue cod nursery habitats at four locations within the farfield, with one – at Reef Site D – located circa 6.3 km from the PPA boundary. There is no information available on SSC on the health of juvenile blue cod. However, other juvenile fishes (e.g., NZ snapper – Lowe 2013; Lowe et al., 2015) are known to be sensitive to SSC. No monitoring of demersal fish is currently required in the benthic monitoring conditions.

51. GB considers that inclusion of fish surveys be added to reef monitoring sites and nursery grounds. AM and TA agree with this.

4. Ecological Recovery and Resilience

a. What are the likely rates and completeness of ecological recovery for each benthic habitat type if affected by mining?

52. TA considers that within the PPA and nearfield should recover relatively quickly using biodiversity indicators. TA considers that an important caveat is the massive change in geomorphology of the seabed hasn't been captured in species recovery durations. TA considers some species will resettle in these substantially changed environments but may not represent the original community structure.

53. TA considers that the worm field zone is much more likely to require some important prerequisites which may include grain size (based on their narrow correlation with fine sediments) and the flatness of the seafloor (given the baseline data shows a strong correlation with very flat featureless sediment zones). TA considers that post-mining pits and mounds (+ or – 10m) may have an important consequence on their recovery. Given it may take up to 359 years for sediments in deep water where worm fields occur (45m) to recover, this may be an important factor. TA notes that there is a lot of uncertainty around this.

54. TA considers that in similar depths (45m) worm fields were not found in or on any of the strongly sloping habitats. This indicates that altered geomorphology may not be suitable for worm field zones, noting that *Euchone* species A may be present. It may not be able to form functional habitats.

55. GB and BS agree with TA's paragraphs 52-54 above.

56. GB considers there will be recolonisation of the mined sediments by species, but that different progression of species may become established due to the changes in the sediment structure and geomorphology. GB reiterates that should brine concentrations above 45ppt remain in the pits this could lead to decreases in dissolved oxygen and dead zones that would delay recovery by years if not decades until toxic brine dispersed.

57. BS notes that if longer lived reef habitat forming species (e.g., Ecklonia radiata that lives 7-10 years) are lost, recovery will be possibly challenged by colonisation of other, less structurally complex species (e.g., turfing algae). TA and GB agree with this.

58. TA, in her reading of Dr Iain MacDonald's evidence (dated 13 October 2025), notes that there appears to be a monitoring/consent (condition 26) limit of a 4m

mound height and an average less than 5m pit depth. However, it does not appear to TA how these heights are achieved given in the same evidence he presents that mounds and pits of up to 11m will be created and will take between 8 and 359 years to recover by 90%. TA considers it would be useful to have clarification on this point.

59. GB agrees it would be useful to have clarity on TTR's mining procedures in order to assess the expected level of impacts and recovery times of benthic organisms.

60. AM considers that, overall, seafloor communities in the PPA are likely to recover ("within 15% of total abundance, biomass, and species richness pre-mining") within 1 year for most species and within a few years for the larger, longer-lived starfish and gastropods. AM notes that recent evidence from the Kaikoura Canyon and the Chatham Rise indicate recovery in 1-12 years after disturbance in these colder deeper benthic habitats. AM notes that in the warmer, shallower sandy waters of the STB where disturbance by storm events and land derived sediments is common, recovery of the seafloor community, once mining in the immediate area has stopped, should occur more quickly.

61. All experts agree that there is no information regarding the recovery of benthic organisms in soft sediment habitats in the post-mining pits and mounds at this scale.

b. What uncertainties exist regarding the resilience of benthic habitats and species and their ability to recover?

62. TA notes that for some species found in flat or rippled sediments that recovery of the geomorphology may be required as a precursor to recovery. TA notes there is considerable uncertainty associated with this.

63. GB considers there are uncertainties in how TTR will manage its operations to achieve the <4m mounds and 5m pit, as well as the additional uncertainties outlined in GB's paragraphs above regarding the fate of brine and desalination discharge of permeate.

64. BS notes the impacts of suspended sediments on species is for disturbances shorter than 20 years, 258 days per year which means mining impacts should be considered as chronic rather than acute. Uncertainty of assessment of effects to date addresses the longevity of the operation.

c. *What are the ecological consequences if recovery times are substantially longer, or if recolonisation is incomplete, relative to the Applicant's assessment?*

65. All experts agree that, on a local scale (within the PPA) if recovery times are substantially longer, it will take longer for the benthic community to achieve original biomass and productivity. Recovery can occur only when mining permanently shifts to 3km or more away from any particular disturbed area.

66. BS clarifies and all experts agree that the farfield impacts of the plume may continue, regardless of where mining is occurring within the PPA. Noting that according to the sediment plume model outputs, some directional movement and intensity of the plume will occur.

67. TA considers that if the wormfields require a degree of geomorphological flatness and a narrow range of sediment grain-size, then the recovery consequence will be more directly linked to the recovery times of the geomorphic mounds and pits (i.e., 8-359 years for T90 – 90% recovery – based on Table 1 of Iain MacDonald's 13 Oct 2025 Evidence).

68. BS notes that longevity of the operation needs to be considered with regard to recovery. BS considers that storm events are acute with benthic systems able to recover between events. BS considers that mining will be for 258 days over 20 years which limits the ability to recover during periods of no mining. BS notes that all comparison studies are short-term. GB and TA agree with this.

5. Cumulative and impacts

a. *Describe the cumulative and long-term effects, including multiple mining events, sediment deposition, and other regional stressors (e.g. climate change, fishing), on benthic habitats and species in the STB.*

69. BS and GB consider that the impacts of mining with other stressors should be assessed as a chronic impact rather than an acute stressor given that mining will persist for 20 years.

70. All experts agree that impacts of climate change (including increased sea surface temperature, marine heatwaves, ocean acidification, and increasing storm events) will add to cumulative effects from mining in the affected areas.

71. TA notes that there is modelled information on background SSC plume and the Mining-driven SSC plume across the farfield, whereby mining-effects are factors

lower than the background. In addition, TA notes that organisms on the seabed are disturbed by natural events (e.g., storms). TA considers that the combination of these three factors is important in determining the total disturbance (cumulative effects) that the benthic community can co-exist with. TA notes that tipping points / thresholds are a natural consequence of natural and anthropogenic impacts. TA considers that it is the combination that is important, not the relative contributions. BS and GB agree with this.

6. Uncertainties and confidence

a. What are the major sources of uncertainty in predicting effects on benthic habitats and species in the STB?

72. All experts agree that fishing effort around the project area will continue but may change and it is unknown what level of intensity/effort will occur during the mining programme.

73. GB consider the uncertainties around the sediment plume modelling extents and extents of reef habitats within the affected area (many to still be quantified) make it difficult to assess the extent of impacts on habitats. BS agrees with GB.

74. All experts agree that the lack of inclusion of a localised assessment of effects on rocky reef systems limits the ability to determine the effects of the mining operation on these key habitats.

75. TA considers there is a high level on uncertainty regarding what the recovery communities will look like within the PPA, due to the significant change in seabed geomorphology (a change from less than a few mm up to a maximum of 22m). TA considers there is very high uncertainty – and thus equally strong probability that recovery communities will reflect one or more “alternate states”, communities characterised by different post-mining communities, than those of the pre-mining ones (as well described in the baseline surveys). TA considers that the recovery of an alternative state is not a like-for-like recovery. TA notes that mound communities would be expected to have a very different community structure than those of pits, and those of the original sediment flats (dominated by worm fields) or rippled sediments. GB and BS agree with TA.

76. TA considers that it is presently unknown what pre-requisite benthic conditions are required for the worm fields to recover. TA considers that pre-requisite conditions are not known except that worm fields were found in flat-sediment, finer-sands, and were absent from steeper slopes. Therefore, TA considers that

large mounds and pits (<+ or – 11 m) may not be suitable. At present, TA notes this is unknown. GB and BS agree with this.

b. How do these uncertainties affect your confidence in conclusions about the significance and manageability of predicted effects?

77. GB considers there are gaps in TTR's mining procedures for how pit depth and mound heights post-mining will be achieved along with management of brine. All other experts agree with this.

78. GB considers the outstanding issues of uncertainties in the Sediment Plume Modelling JWS (13 November 2025) reduce any confidence in predicting extents of impacts on sensitive receivers and habitat recovery. BS agree with this.

7. Consequences for Decision-Making and Conditions

a. Where information gaps, disagreement or significant uncertainty exist, what are the consequences for the application, effects assessment, and decision-making?

79. BS notes that it isn't possible to design appropriate mitigation conditions when the extent of impacts of the activity is uncertain. GB agrees with this.

80. AM disagrees with the above paragraph 79 and considers limits can be stated even when exact impact is not known.

81. BS notes that determinations of environmental impacts will have to be made on incomplete information, even though relevant information exists to assess effects. GB agrees with this.

8. Consequences for Decision-Making and Conditions

a. Are the proposed mitigation and management measures specified in conditions adequate and appropriate to manage effects on benthic habitats and species?

82. BS notes that while this is a different process to the previous Supreme Court decision (para 129), recognised that paucity in information about effects cannot be conditioned out due to the fact that given '*the uncertainty of the information, it was not possible to be confident that the conditions would remedy, mitigate or avoid the effects*', is still relevant. TA and GB agree with this.

83. AM disagrees with paragraph 82 above and considers that conditions can be imposed to effectively control/limit the impacts.

84. GB considers the TTR proposed consent conditions and mitigation, and management measures need to be revised in line with the uncertainties and points raised in this statement and as suggested in response to question 8.b.

> *b. If not, what further mitigation or alternative best practices are recommended, and how would these reduce impact or uncertainty?*

85. GB considers that benthic monitoring stations need to align with the sensitive reef habitats identified by Morrison et al. (2022) and including any other reef habitats closer to the PPA that may be identified during the pre-commencement multibeam swath survey. AM agrees. BS agrees in principle; however, this agreement does not negate concerns regarding the ability to adequately assess the project's potential effects prior to potential consenting.

86. GB notes that there are currently no monitoring programmes for fish abundances at reef locations. It is recommended baited remote underwater video or towed drop camera surveys for fish abundance and diversity be included in the monitoring programme. TA and AM agree.

87. GB considers that one transect per reef is insufficient to represent within reef diversity and 3-5 transects per reef should be considered for statistical analysis. TA agrees and considers one transect per reef would be insufficient to capture reef structure relative to distance from the PPA. AM and TA agree. BS agrees in principle; however, this agreement does not negate concerns regarding the ability to adequately assess the project's potential effects prior to potential consenting.

88. GB considers that inclusion of salinity monitoring and validation of brine dispersal from IMV discharge is needed.

89. AM considers that the ecosystem effects of fishing, mining and other existing human activities or threats vary in magnitude and frequency, spatially and temporally, and different habitats and species respond in different ways to different threats. Therefore, AM considers that the proposed monitoring programme needs to include a suitable representation of these different habitats at different distances from the mining operations to enable clear discernment of mining impacts from other effects.

90. TA notes, under consent condition 57, benthic monitoring requires total abundance, biomass, and species richness. However, TA notes these are all community indices. One issue TA considers is that a completely alternate state could occur with similar total abundance, biomass and spp richness, but be composed of a very different fauna (e.g. two communities can have 7 species with the same overall abundance and biomass of individuals, but different ecosystem function e.g., spp: a, b, c, d, e versus spp: v, w, x, y, z). GB and AM agree with this. BS agrees in principle; however, this agreement does not negate concerns regarding the ability to adequately assess the project's potential effects prior to potential consenting.

91. AM considers that a robust effects assessment will require pre- and post-commencement monitoring along the lines specified in section 6.4 and 6.5 of the application document.

92. GB, TA and AM consider that, while TTR propose not to mine within 3km of the CMA for the first five years and conduct quarterly monitoring during the first two years; it is important to continue the quarterly monitoring when mining operations enter within 3km of the CMA. For example, if TTR commence mining in the far west of the PPA and the reference reef monitoring indicates no impacts in the first two years but then mining moves to the eastern boundary of the PPA adjacent or within 3 km of the CMA, a reduced monitoring frequency may not detect impacts to sensitive habitats early. BS agrees in principle; however, this agreement does not negate concerns regarding the ability to adequately assess the project's potential effects prior to potential consenting.

93. GB, TA and AM consider that reef types (small vs large, low vs tall, etc.) and distance from activity need to be factors which are included in the monitoring design. BS agrees in principle; however, this agreement does not negate concerns regarding the ability to adequately assess the project's potential effects prior to potential consenting.

94. GB considers that without an assessment of the impacts of brine (including a brine fate plume model) on the benthos, it is recommended that brine discharge salinity within the pit and measured at 100m from the discharge point not exceed 1.3 ppt above ambient salinity averaged over 24 hours.

95. GB recommends that any condition or limit refer to the ANZG 2018 and methods rather than relying on the now revised ANZECC Guidelines from 2000.

SIGNATURES OF EXPERTS

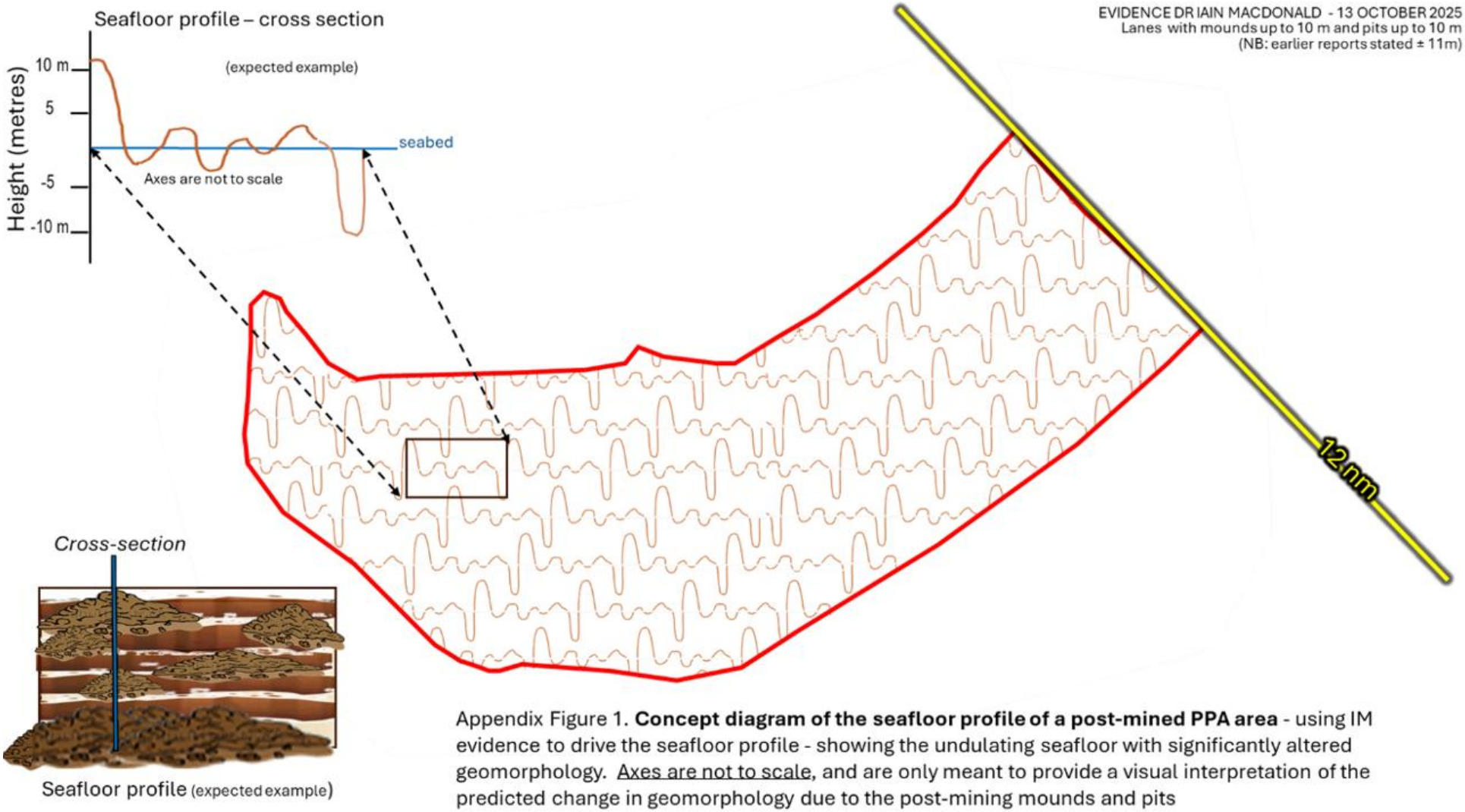
Dr Alison MacDiarmid

Dr Becky Shanahan

Dr Gregory Matthew Barbara

Dr Tara Anderson

APPENDIX 1



Appendix Figure 1. **Concept diagram of the seafloor profile of a post-mined PPA area** - using IM evidence to drive the seafloor profile - showing the undulating seafloor with significantly altered geomorphology. Axes are not to scale, and are only meant to provide a visual interpretation of the predicted change in geomorphology due to the post-mining mounds and pits