BEFORE THE OTAGO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER OF	Discharge Permit, Water Permit and Landuse Consent Application RM24.184 Oceana Gold Limited

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STATEMENT OF EVIDENCE OF DR MICHAEL JOHN CRAWSHAW GREER

ON BEHALF OF OTAGO REGIONAL COUNCIL

28/05/2025

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1. INTRODUCTION

QUALIFICATIONS AND EXPERIENCE

1.1 My name is Michael John Crashaw Greer. I am the Principal Freshwater Scientist at Torlesse Environmental Ltd.

1.2 I hold a PhD in Ecology and a Bachelor of Science in Zoology from the University of Otago.

1.3 I have over 14 years of work experience in freshwater quality and ecology, and have worked for local government, the Department of Conservation and NIWA. Since the 6th of June 2022 I have been the Principal Scientist at Torlesse Environmental Ltd. Prior to that I was employed by Aquanet Consulting Ltd as a Senior Freshwater Scientist, Greater Wellington Regional Council as a Senior Environmental Scientist and Environment Canterbury as an Ecology Scientist.

1.4 Since 2018 I have been engaged by 17 different regional, district or city councils; the Department of Conservation; and various industry bodies, private companies, and corporations to provide a variety of technical and scientific services in relation to water quality and aquatic ecology. My work routinely involves:

a) Providing assessments of effects on water quality and/or aquatic ecology, recommending or assessing compliance with resource consent conditions;
b) Designing or implementing water quality/aquatic ecology monitoring programmes at the scale of a specific activity and at a wider catchment or regional scale; and
c) Advising regional councils on regional plan development and National Policy Statement for Freshwater Management (NPS-FM) implementation.

1.5 I have worked as a technical advisor on behalf of both consenting authorities and applicants on well over 200 resource consent applications, compliance assessments and/or prosecution cases. These applications have been for a wide range of activities, including stream reclamation, water abstraction and discharges to land and water.

BACKGROUND AND ROLE

1.6 In June 2023 I was engaged by the Otago Regional Council (ORC) to provide a technical review of a suite of resource consent applications (**the application**) by Oceana Gold (NZ) Ltd (**the applicant**/**Oceana**) for their Macraes Phase Four (**MP4**) Project at the Macraes Gold Project (**Macraes**). MP4 includes:

a) Extension to the Innes Mills, Coronation and Golden Bar open pits at Macraes, and the extension of associated backfills and waste rock stacks (**WRSs**);
b) Tailings disposal in the Frasers Tailings Storage Facility (**FTSF**) to support the open pit extensions and current consented mines;
c) A minor realignment of the Golden Bar Road;
d) Rehandling of waste rock from Northern Gully WRS to Golden Point Pit; and
e) Ancillary features such as topsoil stockpiles, low-grade ore stockpiles, silt ponds, areas for pit infrastructure and access roading.

1.7 In June 2023, I reviewed a draft version of the application and provided a formal email to ORC that documented my opinion regarding what additional information would be required to make an informed surface water quality and ecology technical review of the application for ORC.

1.8 In April 2024, I reviewed the final application before it was accepted and provided a formal email to ORC that assessed whether the technical information provided with the application was sufficient in terms of Schedule 4 of the Resource Management Act (RMA) 1991, and identified the further information required to accept the application under under Section 88 of the RMA.

1.9 In June 2024, I undertook a site visit of Macraes, including the relevant open pits, WRSs, sediment ponds and potentially impacted surface water bodies.

1.10 In July 2024, I reviewed the accepted application and provided a formal email to ORC documenting the additional information needed to address my concerns with the effects assessment methodologies employed in the application. This was provided so that the identified information could be requested by ORC under Section 92 (S.92) (1) of the RMA.

1.11 In March 2025, I documented my final technical assessment of the application in a technical memorandum to ORC. That memorandum documents my assessment of the application throughout its various stages and included responses to specific questions raised by ORC in relation to:

a) The robustness of the technical information provided in support of the application, including the content of:
    i) The **Surface and Groundwater Assessments** produced by GHD Ltd (Appendices 11 to 14 of the application and Annexures 3 and 4 of the applicant's Section 92 response); and
    ii) The **Ecology Effects Assessments** by Dr Greg Ryder (Appendices 20 to 23 of the application and Annexures 5 and 15 of the applicant's Section 92 response).
b) The nature and magnitude of the adverse surface water quality and ecology effects likely to arise as a result from the application;
c) Whether the application and the appended technical reports are consistent in terms of:
    i) The technical information presented about the Coronation, Golden Bar, Frasers, Innes Mills the Top Tipperary Tailings Storage Facility (TTTSF) areas, and the wider site; and
    ii) The recommendations made and adopted to manage surface water effects from the Coronation, Golden Bar, Frasers, Innes Mills and TTTSF areas, and the wider site.
d) Whether the applicant has clearly described an appropriate surface water monitoring programme that is consistent with recommendations in the technical reports appended to the application; and
e) The appropriateness of the source control methods adopted by the applicant, and whether it is clear how and when these will be implemented.

1.12 This evidence documents the information previously provided to ORC in the technical memorandum produced in March 2025. It also includes previously undocumented assessments against S.107(1) of the RMA and the Water Services (Drinking Water Standards for New Zealand) Regulations 2022, and a review of the **proposed conditions** provided by the applicant.

1.13 I have not undertaken any additional monitoring or field investigations, and my review relies on the data and information provided by ORC, Oceana and their advisors.

2. CODE OF CONDUCT

2.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note and that I agree to comply with the code. My evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that might alter to detract from the opinions which I express.

3. SCOPE

3.1 My evidence addresses the following matters:

a) The effects of the proposed activity on water quality and ecology of the:
   i) Mare Burn;
   ii) Golden Bar Creek;
   iii) Clydesdale Creek;
   iv) An unnamed tributary of the Clydesdale Creek which would be subject to reclamation under the proposed activities;
   v) Murphys Creek;
   vi) Deepdell Creek;
   vii) Shag River; and
   viii) The North Branch of the Waikouaiti River.
b) An assessment of the application against S.107(1) of the RMA and the Water Services (Drinking Water Standards for New Zealand) Regulations 2022; and
c) A review of the proposed conditions.

3.2 My evidence considers information contained in:

a) The relevant sections of **the application** "*Macraes Phase 4 Project – 28 March 2024: Resource Consent Application and Assessment of Environmental Effects*;
b) The **applicant's S.92 Responses:**
   i) "*RE: Request for further information under section 92(1) of the Resource Management Act 1991 (the Act) – Consent Application Number RM24.184*" dated 15/10/2024; and
   ii) "*RE: Request for further information under section 92(1) of the Resource Management Act 1991 (the Act) – Consent Application Number RM24.184*" dated 07/02/2025.
c) The **Ecology Effects Assessments** included in Appendices 20 to 23 of the application and the updated information contained in Annexures 5 and 15 of the S.92 response dated 15/10/2024);
d) The **Surface and Groundwater Assessments** (Appendices 11 to 14 of the application and the updated information contained in Annexures 3 and 4 of the S.92 response dated 15/10/2024 and Annexure 2 of the S.92 response dated 07/02/2024).
e) The **Proposed Consent Conditions**;

These documents are referred to throughout this evidence using the bolded terms above.

3.3 In this evidence I assess the effects of the proposed activity as it is described in the documents listed above. Accordingly, I make no comment on how subsequent changes to the application, including those recommended by submitters, will alter the effects of the activities.

3.4 I understand that some of the mitigations are not certain due to the requirement to obtain separate resource consents. However, I have not factored this uncertainty into this assessment, as I have relied on the proposed and existing water quality compliance standards as the basis for my assessment, rather than specific actions taken on site.

3.5 While I have read the submissions by Mr Dean Parata and Mr Trevor Hay; Mr Richard Geels, Mr Neil Roy; Kāti Huirapa Rūnaka ki Puketeraki, Te Rūnaga o Moeraki and Te Rūnanka o Ōtākou; the Royal Forest and Bird Protection Society of New Zealand Incorporated; the Department of Conservation; the Otago Fish & Game Council; and Fire and Emergency New Zealand, they do not contain sufficient technical information for me to provide comment on their relevance at this time. If required, I will provide supplementary evidence prior to the hearing that considers any technical evidence lodged by submitters.

4. EFFECTS OF THE PROPOSED ACTIVITY ON WATER QUALITY AND ECOLOGY

EFFECTS ON WATER QUALITY AND ECOLOGY IN MARE BURN (MONITORING SITES MB01 AND MB02)

4.1 The modelling presented in the Surface and Groundwater Assessments for the Coronation Pit extension indicates that water quality within the Mare Burn catchment is generally expected to remain within existing compliance limits for:

a) pH;
b) Dissolved arsenic;
c) $Cyanide_{WAD}$;
d) Dissolved copper;
e) Dissolved iron;
f) Dissolved lead;
g) Dissolved zinc;
h) Sulphate;
i) Nitrate-nitrogen; and
j) Ammoniacal nitrogen.

4.2 While a low modelled risk of the sulphate and nitrate-nitrogen compliance limits being exceeded during prolonged low flow periods was identified, the Surface and Groundwater Assessment notes that if this were to eventuate water release from the as yet unconstructed Coal Creek Dilution Dam should be sufficient to mitigate any exceedance. In my initial review of the application, I also raised the potential for the modelling presented in the Surface and Groundwater Assessment to be underestimating dissolved copper concentrations given the large disparity between modelled and measured maximum current concentrations. In response, the applicant provided the raw copper data that fed into the Surface and Groundwater Assessment as part of their second S.92 response (dates 07/02/2025). Those data confirmed the identified disparity was due to an extreme outlier in the measured data record.

4.3 Based on all of the information provided by the applicant to date, I agree with the conclusion in the Surface and Groundwater Assessments that the risk of exceeding the existing compliance standards in the Mare Burn Creek is low during all phases of the proposed activity (mining, closure and post-closure of the extended Coronation pit). Accordingly, when the existing consents held by Oceana are considered part of the existing environment, it is my opinion that the proposed activity will not result in any further degradation of water quality in the Mare Burn. Consequently, I consider there to be limited potential for greater adverse ecological effects in this river than those anticipated under existing consents.

4.4 Importantly, however, the existing compliance criterion for zinc in the Mare Burn exceeds one of the commonly used thresholds for the onset of significant adverse effects: the 80% species protection Default Guideline Value (DGV) set out in the Australian and New Zealand Guidelines (**ANZG**) for Fresh and Marine Water Quality 2018[1]. Therefore, it is my opinion that the existing consents allow for significant adverse zinc toxicity effects when current state is treated as the baseline. Similarly, the existing nitrate-nitrogen standard allows for significant increases that could result in increased nitrate toxicity risk and an increased risk of periphyton growth[1]. This, in turn, could generate significant adverse effects on aquatic life.

4.5 Median nitrate-nitrogen concentrations (during and post-closure) and 95th percentile nitrate-nitrogen and dissolved zinc concentrations (during mining, during closure and post closure) are modelled to increase due to the proposed activity, with the largest increases

[1] Nitrate-nitrogen, ammoniacal-nitrogen and dissolved reactive phosphorus are the nutrients that drive periphyton (i.e., algal) growth in rivers. As their concentration increase, so to does the risk of nuisance blooms, with that risk being mediated or compounded by factors such as light availability, temperature and river flows.

being predicted during and after mine closure for zinc and nitrate respectively. Accordingly, considering theoretical consented baseline, no adverse ecological effects are expected. However, under 'real world' conditions, meaningful increases in contaminant concentrations are predicted which could result in a degradation of current ecological metrics.

4.6 In the Ecology Effects Assessments, Dr Greg Ryder considers the available fish, macroinvertebrate and periphyton monitoring data, and assesses the potential for the modelled changes in water quality, including increased dissolved zinc and nitrate-nitrogen concentrations, to adversely affect aquatic life. That assessment, when paired with the additional information provided with the S.92 responses suggests that:

a) The predicted increases in nitrate-nitrogen concentrations in the Mare Burn are not expected to result in a change in nitrate toxicity attribute state under the NPS-FM 2020, and that nitrate-nitrogen concentrations will remain below (i.e., meet) the level required to protect 95% of species from nitrate toxicity effects. This is relevant as the 95% species protection thresholds correspond to the ANZG[1] recommended level for the protection of slightly to moderately disturbed ecosystems like the Mare Burn;
b) The Mare Burn is currently already subjected to nuisance periphyton blooms (92nd% periphyton weighted composite cover >40%[2]). Thus, the modelled increase in nitrate-nitrogen concentrations does not represent an significant increase in the risk of adverse effects as:
    i) Those adverse effects are already occurring;
    ii) Dissolved reactive phosphorus concentrations[1] are sufficiently low that they are expected to constrain the risk of periphyton blooms despite an increase in nitrate-nitrogen concentrations.
c) The dissolved zinc concentrations will remain below the ANZG DGV[1] for the protection of 95% of species (the recommended threshold for protection of slightly to moderately disturbed ecosystems).

4.7 I also note that to date the applicant has not provided an assessment of the extent to which nitrate-nitrogen and dissolved zinc concentrations are expected to increase in the Mare Burn in the absence of the proposed MP4 activities. I suspect that at least some of the predicted increase in these contaminants is an unrealised effect of past and current consented mining activities, and this is supported by the additional modelling information for North Branch of the Waikouaiti River provided by the applicant in their second S.92 response (dates 07/02/2025).

4.8 Based on Dr Ryders assessment and my own review of the measured and modelled water quality data, I agree with Dr Ryder that:

a) "*There is no evidence to suggest that future mine induced water quality will significantly alter the composition of the benthic invertebrate community at Mare Burn monitoring sites*"; and
b) "*There is no evidence to suggest that fish populations will be adversely affected as a result of the proposed Coronation expansion*"

4.9 Accordingly, I find no evidential basis to disagree with the conclusions made in the application that "*the effects of the Project on the waters of the Mare Burn will be less than minor*". Nevertheless, I do note that the proposed conditions do not formalise the applicant's intent to remain within the existing compliance standards. This is covered in more detail below in paragraph 7.1(c). Nor do they formalise any intent to constrain contaminants to the levels predicted by the Surface and Groundwater Assessment.

Note: *All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the Mare Burn have been addressed through the information provided by the applicant with their S.92 responses*.

EFFECTS ON WATER QUALITY AND ECOLOGY IN GOLDEN BAR CREEK (MONITORING SITES GB02 and NB01)

4.10 The Surface and Groundwater Assessment for the Golden Bar pit extension suggests that water quality within the Golden Bar Creek catchment is expected to remain within existing compliance limits. Thus, for most water quality parameters the proposed activity will not result in any further degradation of water quality in Golden Bar Creek if the existing consents held by Oceana are considered part of the existing environment. Furthermore, Dr Ryder's assessment shows that while dissolved arsenic (during and post closure), dissolved zinc (during mining and post-closure) and sulphate concentrations (post-closure only) are expected to increase within the bounds of the existing compliance limits, they are not predicted to exceed thresholds at which more than minor toxicity effects are expected (i.e., the ANZG 95% species protections DGV or corresponding sulphate thresholds developed by whole of effluent toxicity on the flathead galaxias (*Galaxias depressiceps*)). Accordingly, for most contaminants discharged from MP4, there is no evidence that the proposed activity will generate changes in water quality with the potential to result in more than minor or significant adverse effects on aquatic life.

4.11 However, unlike the Mare Burn, existing consents do not set compliance standards for nitrate-nitrogen in the Golden Bar Creek. Thus, large increases in this contaminant are not part of the existing environment. The Surface and Groundwater Assessment suggests median concentrations of this contaminant could double during the mining stage of the proposed activity, as could 95th percentile concentrations during all phases (mining, closure and post-closure). While the increased concentrations remain well below the level at which nitrate toxicity effects occur, in my initial assessment I raised the possibility that they could increase the risk of periphyton growth to the extent that adverse effects on aquatic life could occur.

4.12 The potential for such effects were not considered in the initial Ecology Effects Assessment for the Golden Bar Pit extension. However, in response to my concerns, Dr Ryder reasoned in the first S.92 response that, as for the Mare Burn, the potential for increased nitrate concentrations to generate a meaningful increase in periphyton growth is constrained by the low dissolved reactive phosphorus concentrations in the Golden Bar Creek[1]. The lack of quantitative evidence to support that conclusion at that time was then remedied by Dr Ryder through the provision of the available raw phosphorus and periphyton monitoring data as part of the second S.92 response (dated 07/02/2025). Based on those data, I can now concur with Dr Ryder's assessment that, while the proposed activity will increase nitrate concentrations in Golden Bar Creek, and such increases sit outside the environment allowed for by existing consents, they are unlikely to result in more than minor adverse effects on aquatic life via an increase periphyton growth.

4.13 Based on all of the water quality and ecological data provided by the applicant, I find no evidential basis to disagree with the conclusions made in the application that "*there will be no more than minor adverse effects on aquatic ecology in Golden Bar Creek*". However, I note that the compliance standards lodged with the application do allow for unanticipated increases in contaminant concentrations and therefore greater adverse effects than what has been described in the Ecology Effects Assessments. More detail on this is provided in paragraphs 5.1(0 and 7.1(a) below.

Note: *All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the Golden Bar Creek have been addressed through the information provided by the applicant with their S.92 responses.*

EFFECTS ON WATER QUALITY AND ECOLOGY IN CLYDESDALE CREEK (MONITORING SITE GB01)

4.14 The modelling presented in the Surface and Groundwater Assessments and the updates provided with the S.92 responses indicate that the existing compliance limits for the Clydesdale Creek catchment will continue to be met under the proposed activities. Thus, for most water quality parameters, the proposed activity will not result in any further water quality degradation in an existing environment that includes the existing consents held by Oceana.

4.15 However, those consents do not set compliance standards for sulphate or nitrate-nitrogen in the Clydesdale Creek. Thus, increases in those contaminants cannot be considered to be part of the existing environment. Nevertheless, despite modelled post closure increases in median nitrate-nitrogen and sulphate concentrations of 50% and 71% respectively, the Ecology Effects Assessment confirms that relevant thresholds for the protection against toxicity effects are not expected to be exceeded. Accordingly, I concur with Dr Ryder's assessment that increased nitrate and sulphate concentrations are unlikely to adversely affect the local flathead galaxias population or the benthic invertebrate community.

Note: *The potential for increased periphyton growth due to elevated nitrate nitrogen concentrations in Clydesdale Creek remains unclear as I understand this attribute is not monitored there.*

4.16 Overall, it is my opinion that there is sufficient evidence to support the conclusion made in the application that the proposed activity is "*unlikely to alter the make-up of the benthic invertebrate and fish communities of Clydesdale Creek*". However, I note that the proposed conditions do not formalise the applicant's intent to remain within the existing compliance standards. This is covered in more detail below in paragraphs 5.1(0 and 7.1(a) below.

Notes:

In my final review of the application for ORC I noted that there was potential for more than minor effects to arise from an increase in copper toxicity risk in the Clydesdale Stream. This was an error, as I had not noted the updated copper modelling results for this stream contained in Table 2 of Annexure 4 to the applicant's first S.92 response. Those results suggest that dissolved copper concentrations will be reduced during the mining phase of the Golden Bar Pit extension, and will be maintained during and after the closure phase.

All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the Clydesdale Creek have been addressed through the information provided by the applicant with their S.92 responses. The only uncertainty that remains is the potential for increase periphyton growth as a result of the proposed activities.

EFFECTS ON WATER QUALITY AND ECOLOGY IN MURPHYS CREEK (MONITORING SITES MC01 AND MC02)

4.17 The Surface and Groundwater Assessment for the Golden Bar extension, paired with the updated modelling results for Murphys Creek in the S.92 responses indicates that:

a) Water quality in this system is expected to remain within existing compliance limits; and
b) For all relevant contaminants, any degradation in water quality within the existing compliance limits are likely to be sufficiently small that applicable thresholds for the onset of adverse effects on aquatic life are not expected to be exceeded.

4.18 Thus, I find no evidential basis to disagree with the conclusions made in the application that "*there will be no more than minor adverse effects on aquatic ecology in [..]Murphy Creek*".This is consistent with Dr Ryder's opinion, as expressed in the Ecology Effects Assessment, that there is no reason to "*expect to see any changes in the composition of the aquatic fauna*" of Murphys Creek, under the proposed activities.

4.19 Nevertheless, I note that the compliance standards in the proposed conditions allow for unanticipated increases in contaminant concentrations and therefore greater adverse effects than what has been described in the Ecology Effects Assessments and the application. More detail on this is provided in paragraphs 5.1(0 and 7.1(a) below.

Note: *All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in Murphy's Creek have been addressed through the information provided by the applicant with their S.92 responses.*

EFFECTS ON WATER QUALITY AND ECOLOGY IN THE NORTH BRANCH OF THE WAIKOUAITI RIVER (MONITORING SITES NBWRRF, NB02 AND NB03)

4.20 The Surface and Groundwater Assessment of the cumulative effects of the entire MP4, and the updated/expanded modelling results provided with the S.92 responses, indicates that water quality within the North Branch of the Waikouaiti River is expected to remain within existing compliance limits for all relevant contaminants, and that the proposed activity will not result in an increase in the concentrations of most water quality parameters

from what is anticipated by the already consented environment.

4.21 However, as for Clydesdale Creek, existing consents held by Oceana do not set compliance standards for nitrate-nitrogen in the North Branch of the Waikouaiti River. Thus, theoretically, increases in that contaminant should not be considered to be part of the existing environment. However, while the Surface and Groundwater Assessment suggests median nitrate-nitrogen concentrations could increase by more than two orders of magnitude during and after MP4, additional modelling provided with the second S92 response (dated 07/02/2025) suggests the vast majority (~97%-100%) of this increase is driven by past and current consented mining at Macraes rather than the proposed activity. Of note, the same pattern applies to most of the modelled water quality parameters, suggesting that while some degradation in water quality is expected in the North Branch of the Waikouaiti River from present day conditions (but not from the existing compliance standards), this mostly due to factors other than the proposed activity.

4.22 Accordingly, I concur with Dr Ryder's opinion in the Ecology Effects Assessment that there is no reason to "*expect to see any changes in the composition of the aquatic fauna*" in the North Branch of the Waikouaiti River. However, I note that the compliance standards lodged with the application do allow for unanticipated increases in contaminant concentrations and therefore greater adverse effects than what has been described in the Ecology Effects Assessments. More detail on this is provided in paragraphs 5.1(0 and 7.1(a) below.

Note: *All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the North Branch of the Waikouaiti River have been addressed through the information provided by the applicant with their S.92 responses.*

CUMULATIVE EFFECTS ON WATER QUALITY AND ECOLOGY IN DEEPDELL CREEK (MONITORING SITES DC07 AND DC08) AND SHAG RIVER (MONITORING SITES @ MCCORMICKS AND @ LOOP ROAD)

4.23 The cumulative Surface and Groundwater Assessment and the modelling provided with the S.92 responses, indicates that water quality within the Deepdell Creek and Shag River are generally expected to increase but remain within existing compliance limits. While a low risk of exceedance of the sulphate and dissolved arsenic limits was identified, model exceedances were not at the level or frequency that would be expected to generate toxicity effects (i.e., median concentrations greater than the ANZG 95% species protections DGV or corresponding sulphate thresholds developed by whole of effluent toxicity on the flathead galaxias). As such, it is my opinion that the proposed activity will not result in any further

degradation of water quality in these water ways when considered against an existing environment that includes the unrealised effects of currently consented activities.

4.24 Despite this, I note that the existing compliance criteria for nitrate-nitrogen allow for significant increases in nutrients that could result in increased toxicity risk and an increased risk of periphyton growth, which, in turn, could generate adverse effects on aquatic life. Median nitrate concentrations in all stages of the proposed activity are expected to increase by more than 60-fold in Deepdell Creek and by an order of magnitude in the Shag River. In my opinion, there is a risk of this increasing periphyton growth to the extent that macroinvertebrates and fish could be impacted. Dr Ryder has not considered this in the Ecology Effects Assessment, but comments made there do suggest that the risk of increased algal growth may be higher in Deepdell Creek than in the other impacted stream discussed in this evidence, as there is *"sufficient dissolved phosphorus in Deepdell Creek to promote algae and plant growths"*.

4.25 However, I acknowledge that the applicant has not provided an assessment of the extent to which nitrate-nitrogen concentrations in Deepdell Creek and the Shag River are expected to increase in the absence of activities planned through MP4. Thus, the actual contribution of MP4 to increases in nitrate-nitrogen concentrations, and, potentially, periphyton growth, in the Deepdell Creek and the Shag River is uncertain. Those increases may well be as-yet-unrealised effects of past mining, which is supported by the additional modelling information for the North Branch of the Waikouaiti River provided by the applicant in their second *s.92* response.

4.26 Overall, on the basis that the existing environment is assumed to include the compliance standards contained in existing consents, I agree with the conclusion in the application that "*the effects of the Project on the waters of the Deepdell Creek catchment* [and Shag River] *will be no more than minor*". However, I still consider that there is potential for significant degradation in water quality in these rivers from the current state, and that this may have adverse effects on the ecology that have not been considered in the Ecology Effects Assessments. Nevertheless, the extent to which this degradation is driven by the proposed activity versus past mining activity at Macraes is unclear.

Note: *All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the Deepdell Creek and Shag River have been addressed through the information provided by the applicant with their S.92 responses.*

EFFECTS OF THE PROPOSED RECLAMATION OF AN UNNAMED TRIBUTARY OF CLYDESDALE CREEK

4.27 The applicant proposes reclaiming 430 metres of a tributary to Clydesdale Creek as part of the Golden Bar WRS extension. In the Ecology Effects Assessment, Dr Ryder evaluates this reclamation and concludes that the tributary holds limited ecological value. However, he recommends offsetting its loss by identifying, enhancing and protecting the "*equivalent length of local (to the Macraes area) stream habitat* […]*, with similar or potentially better ecological values*".

4.28 Based on the description of the impacted waterways character, ecology, connectivity, and hydrology outlined in the Ecology Effects Assessment, I concur with Dr Ryder's findings. In my opinion, the proposed reclamation's impact on aquatic life will be no more than minor at the sub-catchment and catchment scales, provided the offsetting recommended by Dr Ryder is implemented. Moreover, the applicant's commitment to doubling the length of stream designated for riparian enhancement and protection—exceeding Dr Ryder's original suggestion—further strengthens the assurance of a no more than minor net outcome for ecosystem health.

5. SECTION 107 ASSESSMENT

5.1 My assessment of the proposed activities against the receiving environment standards in S.107(1) of the RMA is as follows:

a) I understand that MP4 is not expected to result in the production of oil or grease films, scums or foams, or floatable or suspended materials (Clause (c));
b) While there is potential for the Murphy's silt pond to result in a conspicuous green color in the Murphys Creek due to high sulfate concentration (Clause (d)), I understand these colour effects cannot be attributed to the proposed activities as discharges form the Murphys silt pond to Murphys Stream are:
    i) Rare, with the silt pond being pumped back to the Frasers open pit;
    ii) Are the result of historical and current consented mining activities at Macraes;
    iii) Are not expected to increase with the implementation of MP4, with Murphys Silt Pond being treated as a sump under MP4 to capture seepage from the WRSs that will then be pumped back to the Frasers Open Pit to ensure compliance with existing water quality compliance standards (see Appendix 13 of the application).
c) In my initial assessment, I raised concerns about the potential for sediment discharges from the Northern Gully silt pond to generate intermittent conspicuous

changes in visual clarity into an un-named tributary of the Deepdell Creek during the proposed excavation of Northern Gully Waste Rock Stack. These concerns were not allayed by the additional assessments provided in Annexure 4 and Annexure 15 of the first S.92 response (dated 15/10/2024). However, the planning responses in the second S92 response (dated 07/02/2025) provides some certainty that the potential for discharges from the Northern Gully silt pond to generate conspicuous changes in visual clarity is low due to the size of the pond and active water level control meaning that high sediment discharges should only occur at river flows when background sediment concentrations are already high.

d) The proposed compliance standards should not result in fresh water becoming unsuitable for consumption by farm animals as the existing and proposed compliance standards (noting that these have not been provided for all receiving environments) do not exceed the current ANZG stock water standards[3] (see Table 1 below). However, I do note that the arsenic and sulphate compliance standards and modelled future concentrations of these parameters in some rivers do exceed those in the draft revision to these guidelines[4] which do not apply until their final publication (see link below[2]).

Table 1: Comparisons of existing and proposed compliance standards for MP4 against thresholds for significant adverse effects on aquatic life (ANZG 80% species protection DGVs), stock water standards (ANZG) and the drinking water standards (Water Services (Drinking Water Standards for New Zealand) Regulations 2022). Red shading indicates where the compliance standards exceeds one of these thresholds.

Parameter	Compliance standard (mg/L)	Threshold for significant effects (mg/L)	Stock water standards (mg/L)	Drinking water standards (mg/L)
Dissolved arsenic	0.15	0.14	0.5	0.01
Dissolved copper	0.009	0.0025	0.4	2
$Cyanide_{WAD}$	0.1	0.018	N/A	0.6
Dissolved iron	1	N/A	N/A	N/A
Dissolved lead	0.0025	0.0094	0.1	0.01
Dissolved zinc	0.12	0.031	20	N/A
Sulphate	250-1000	N/A	1000	N/A
Nitrate (median and 95th %ile)	2.4	6.9	90.29	11.3
	3.5	9.8		

[2] https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/primary-industries/stock-water-guidance

e) As set out in paragraphs 4.1 to 4.26, I do not consider that the modelled effects of the proposed activity on water quality are sufficient to cause a significant adverse effect on aquatic life. However, if fully implemented the existing and proposed compliance standards for dissolved arsenic, copper and zinc, and cyanide$_{WAD}$ would likely result in significant adverse effects on aquatic life, as they far exceed the commonly used thresholds for the onset of such effects (i.e., the ANZG 80% species protection DGVs). This is demonstrated in Figure 1 below and Table 1.

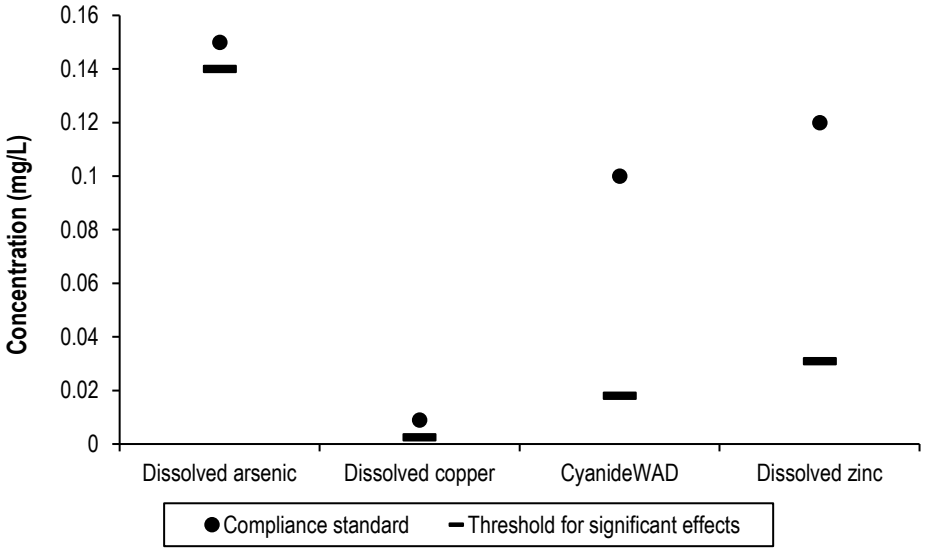

Figure 1: Comparison of existing and proposed compliance standards (dots) with the commonly used thresholds for the onset of significant adverse effects (red bars – ANZG 80% protection guideline)

6. DRINKING WATER ASSESSMENT

6.1 The existing and proposed compliance standards allow for dissolved arsenic concentrations to exceed the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 (see Table 1). Furthermore, the Surface and Groundwater Assessments do suggest that those standards will be exceeded on occasion (<5% of the time) at Deepdell Creek (currently, during mining and post-closure), and Golden Bar Creek (post-closure). However, it is not possible to determine the extent to which the unrealised effects of past and current consented mining activities contribute to those expected exceedances.

7. RECOMMENDATIONS ON CONSENT CONDITIONS

7.1 In my opinion, the proposed consent conditions:

a) Allow for significant increases in contaminant concentrations in all receiving environments, most of which are not expected with the current or proposed mining

activities and would generate significant adverse effects if realised (see paragraph 5.1(e)). While I acknowledge that most of these increases are technically allowed for under existing consents, this is generally not the case for nitrate-nitrogen or ammoniacal nitrogen. Accordingly, I consider the proposed compliance standards for those parameters to be entirely inappropriate in those rivers where they do not yet apply. If they were to be adopted, they would allow for massive increases in contaminant concentrations that modelling suggests are not required to facilitate current or future mining activities. They could also drive increased periphyton growth, which may result in significant adverse effects. I recommend that compliance standards set for nitrate and ammonia should not exceed modelled concentrations (with the provision of a small buffer to account for model uncertainty). I am happy to engage in expert conferencing with the applicant's and submitter's experts to develop appropriate nitrate-nitrogen and ammoniacal nitrogen limits that facilitate the proposed activity without allowing for unanticipated adverse effects.

b) Should include periphyton targets to reduce the risk of increases in nitrate-nitrogen causing nuisance blooms. However, I acknowledge that any trigger framework needs to account for natural variability and only drive management responses when exceedances are demonstrably due to an unanticipated impact of MP4;

c) Should explicitly confirm the water quality compliance standards for the Mare Burn, Clydesdale Creek, Deepdell Creek, and the Shag River; and

d) Should include standard Section 107(1)-type conditions to prevent conspicuous changes in colour and visual clarity, and significant adverse effects on aquatic life.

8. SUMMARY

8.1 MP4 in combination with separately authorised mining activities will result in an increase in contaminants in all surface water receiving environments compared with the present day situation. With the exception of the North Branch of the Waikouaiti River, the exact contribution of the MP4 activities to these future effects has not been explicitly modelled

8.2 Discharges from the MP4 activities are unlikely to cause toxicity effects on aquatic life in impacted receiving environments that are greater than those allowed by existing consents. However, I still consider that there is potential for significant degradation in water quality Deepdell Creek and the Shag River that may have adverse effects on the ecology, namely periphyton growth, that have not been considered in the Ecology Effects assessments.

8.3 My assessment of the proposed activities against the receiving environment standards in

S.107(1) of the RMA is:

a) MP4 is not expected to result in the production of oil or grease films, scums or foams, or floatable or suspended materials;
b) MP4 is not expected to cause a conspicuous change in the colour or clarity of impacted receiving environments;
c) MP4 should not cause the impacted receiving environments to become unsuitable for consumption by farm animals; and
d) While MP4 is not expected to cause significant adverse effects on aquatic life in the impacted receiving environments, the existing and proposed compliance standards do allow for significant adverse effects on aquatic life.

8.4 MP4 is expected to result in dissolved arsenic concentrations exceeding the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 in Deepdell Creek (currently, during mining and post-closure), and Golden Bar Creek (post-closure), and this exceedance is allowed for under the proposed compliance standards.

8.5 In my opinion, the proposed consent conditions:

a) Allow for significant increases in contaminant concentrations in all receiving environments, most of which are not expected with the current or proposed mining activities and would generate significant adverse effects if realised;
b) Should set compliance standards for nitrate-nitrogen and ammoniacal nitrogen at a level that does not exceed modelled concentrations in those rivers where compliance standards for these parameters do not exist;
c) Should include periphyton targets to reduce the risk of increases in nitrate-nitrogen causing nuisance blooms;
d) Should explicitly confirm the water quality compliance standards for the Mare Burn, Clydesdale Creek, Deepdell Creek, and the Shag River; and
e) Should include standard S.107(1)-type conditions to prevent conspicuous changes in colour and visual clarity, and significant adverse effects on aquatic life.

8.6 All points of disagreement between myself and Dr Ryder regarding the effects of the proposed activity on water quality and ecology in the impacted receiving environments have been addressed through the information provided by the applicant with their S.92 responses.

Dr Michael John Crawshaw Greer

28 May 2025

REFERENCES

[1] Australian and New Zealand Governments and Australian state and territory governments (ANZG). 2018. Australian and New Zealand guidelines for fresh and marine water quality. Governments and Australian state and territory governments, Canberra, Australia.

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[3] Australian and New Zealand Environment and Conservation Council (ANZECC). 2000. Australian and New Zealand guidelines for fresh and marine water quality. Australian and New Zealand Environment and Conservation Council, Canberra, Australia.

[4] Australian and New Zealand Governments and Australian state and territory governments (ANZG). 2023. Australian and New Zealand guidelines for fresh and marine water quality: Draft livestock drinking water guidelines. Governments and Australian state and territory governments, Canberra, Australia.