



27 September 2016

Otago Regional Council
Private Bag 1954
DUNEDIN

For: Charles Horrell & Elyse Neville

Dear Charles & Elyse

RE: CORONATION NORTH WATER QUALITY EFFECTS, MANAGEMENT AND MITIGATION

Following earlier without prejudice conversations with the ORC we write to provide further information in support of OceanaGold's Coronation North resource consent application in relation to water quality. In particular, this information relates to management and mitigation of effects from the Coronation North Waste Rock Stack (WRS) seepage.

In this letter, unless otherwise stated, all proposed monitoring conditions are for the life of the consent.

COAL CREEK FRESHWATER DAM

OceanaGold agrees with the ORC that the Coal Creek Freshwater Dam should be regarded as a final resort mitigation measure to address water quality effects from the WRS. As it is not necessary to immediately construct the dam OceanaGold has time to explore and implement appropriate contingency mitigation. We are committed to investigating alternative mitigation methods that may reduce the size of, or eliminate the need for, the dam. We discuss this topic later in our letter. First we address some dam related topics raised by the ORC as being of interest.

Stratification, deoxygenation and anoxic conditions

It is recognised that there is a risk that "the water in the lower end of the reservoir could vertically stratify at times of the year and in doing so potentially create a layer of low oxygen water in the deeper part of the reservoir"¹.

To address this risk the dam will be engineered to ensure that the proposed offtake from the reservoir is a surface siphon, i.e. to utilise a floating decant structure with a discharge point on the downstream toe of the embankment. We propose a consent condition to secure this:

The dam shall be fitted with a floating outlet system with a discharge pipe installed through the base of the embankment to ensure that the water discharged is from the upper surface of the reservoir.

Further, the dam will be engineered to ensure the released water gets as much aeration as possible in the area close to the toe of the dam. On the advice of Golder Associates, OceanaGold proposes the following consent condition which will ensure discharged water will be fully oxygenated:

For the purposes of water quality improvements and oxygenation, the water discharged from the base of the embankment shall flow over a short section of rip rap material before flowing into a small silt

¹ Section 4.2, *Aquatic Ecology Assessment*, Ryder Consulting – Appendix 8 of AEE

pond (this may be the same silt pond as used for silt control during construction of the embankment) from where it will overflow into the creek bed.

A condition requiring monitoring of dissolved oxygen is also proposed:

The consent holder shall conduct continuous dissolved oxygen monitoring at monitoring point CCMP01 (Coal Creek just prior to its confluence with the Mare Burn at approximately NZTM2000 1392985 4980236) for a one month period following filling of the reservoir to its final height and then annual 7-day continuous dissolved oxygen during the period 1 February to 31 May for the term of the consent. Information on flow and meteorological conditions shall be collected for the period of the monitoring.

ORC has expressed concern that under stratification conditions seasonal release of hydrogen sulphide, iron and manganese from the underlying sediments and WRS leachate entering the dam would occur. This would then be entrained in the surface-water offtake during winter turnover and release of these solutes into the water column would pose a risk to the biota in the dam and also the downstream receiving environment. Golder Associates has considered this concern in the attached report *Coronation North Project Water Quality Effects, Management and Mitigation* ("the Golder Report") at section 3. The advice received is that appropriate mitigation can be achieved through an engineered design for the discharge system. Therefore the conditions proposed above should adequately address this matter. If necessary, we could include a visual assessment for iron into the quarterly aquatic monitoring survey undertaken by Ryder Consulting. Further, since reducing the size of the reservoir would reduce the scale of any water quality issues the work that OceanaGold will undertake to manage and minimise seepage and thereby reduce the size of the dam will be beneficial.

ORC has asked whether it is possible for leachate from the WRS to be diverted downstream through a water race or other means, so as to avoid the need for a reservoir. Section 2.2.2 of the Golder Report considers a dam bypass. It is considered unlikely to be feasible on a scale that is practical but would not be ruled out in any future review of options.

Taieri Flathead Galaxias

ORC experts are concerned by the loss of spawning and refuge habitat for this species in Camp Creek, under and upstream of the dam footprint. It is acknowledged that there are sections of Maori Hen Creek and Trimbells Gully that will not benefit from the diluting effects of the dam. Any galaxiid habitat upstream of the project area is not on OceanaGold owned land and controls in respect of that habitat cannot be introduced in the consenting process. However, should the Coal Creek Freshwater Dam consents be given effect to OceanaGold proposes mitigation in the form of protection and/or enhancement of native fish habitat, likely within other areas of the Mare Burn catchment. This would take the form of trout barrier construction to the value of NZ\$30,000 which we are advised should provide for 3 or 4 barriers. An indicative condition of consent, which would be included in the relevant Coal Creek freshwater dam consent(s), follows²:

- (a) Prior to exercise of this consent, the consent holder shall establish a fund of NZ\$30,000 for the provision of trout exclusion devices to protect native fish habitat, particularly Taieri flathead galaxias (*Galaxias depressiceps*). Within 6 months the consent holder shall commence consultation with the Department of Conservation to determine suitable locations for the trout exclusion devices, with some preference to be given to locations within the Mare Burn catchment.
- (b) The consent holder shall provide the Consent Authority with details of the determined locations of the trout exclusion devices.
- (c) The trout exclusion devices shall be designed or supplied by a suitably qualified person.
- (d) The trout exclusion devices shall be installed within 24 months of the locations being determined.
- (e) The trout exclusion devices shall be maintained in good working order for the duration of this consent. Records shall be kept of all inspections and maintenance and those records shall be provided to the Consent Authority upon request.

² Please note we are consulting with the Department of Conservation regarding the final detail of this condition. Accordingly, while the general intent of the condition is settled the detail remains subject to change.

Introduction of predatory species

ORC experts are concerned that the introduction of predatory species to the dam reservoir would pose a risk to downstream galaxias populations, both during mining operations and long-term once consents expire. OceanaGold notes that any liberation of fish into the dam other than by the land owners or authorised visitors would be illegal as it would involve a trespass onto privately owned land, and would also be difficult due to the inaccessibility of the dam site. In our experience other much more accessible ponds/dams at the MGP site (for instance Deepdell Pit and Golden Bar Pit) have not had predatory species liberated into them, which suggests the prospects of it occurring at Coal Creek dam are remote. Nevertheless, there are steps OceanaGold could take to address the issue and we do not consider it is necessary to propose a consent condition for that purpose.

To reduce the risk of predatory fish being released into the waterway we could install a fish screen on the discharge outlet as part of our mine closure plan. Alternatively, please advise whether other examples of typical conditions imposed for irrigation dams or suchlike exist that we could consider.

ALTERNATIVE MITIGATION MEASURES / MANAGEMENT OF WRS SEEPAGE

OceanaGold is committed to investigating alternative measures to mitigate water quality effects from the WRS seepage, so that those mitigation measures can be used together with, or instead of, the dam. The goal is to either reduce the scale of the dam to be constructed or eliminate the need for it to be constructed. We already know that there are management methods that we can trial and implement. We have taken preliminary advice from O'Kane Consultants who have identified measures for us to investigate further, including:

- Separation of higher sulphide wastes from wastes with lower sulphide concentrations and encapsulation of the higher sulphide wastes within layers of low permeability compacted weathered rock within the WRS. This would reduce oxygen access to the higher sulphide waste and reduce seepage flows through the higher sulphide wastes. OceanaGold has successfully utilised this type of management method at its Reefton mine site where mineralised rock is encapsulated in a cell within the WRS.
- Reduction of oxygen ingress to the WRS, thereby reducing the rate of metal sulphide conversion from the waste rock to sulfates.
- Reducing water ingress to the WRS, thereby reducing the opportunity to transport sulfates from the WRS.
- Addition of limestone or lime to the stored wastes. Increasing the concentration of Calcium in the leachate water would encourage the precipitation of gypsum and thereby reduce the concentration of sulfate in the discharge water.
- Treatment of the WRS discharge water through dosing the water with lime to encourage the precipitation of gypsum and reduce the concentration of sulfate in the discharge water.

None of these potential options have yet been reviewed to a pre-feasibility level for application at the site. We intend to investigate options and commission a formal best practice options (BPO) report, to be shared with the ORC, which will inform and guide our final management and mitigation response. We would be pleased to discuss with you an appropriate condition of consent that would address this.

We acknowledge Policy 6.5.54(d) of the Otago RPS is to promote discharges to land where practical, rather than to water bodies. We have previously responded on this topic and the Golder Report revisits the point in section 2.2.1. The Golder Report identifies that there are options for irrigation to land, but OceanaGold is constrained as there are no downstream areas currently owned by us that are sufficiently large enough to serve the purpose of significant land based disposal. Pumping to upstream areas could be considered during operations but management post-closure raises challenges, which is why passive mitigation is preferred. We have not excluded the possibility that land based disposal could be included in the suite of management and mitigation options, particularly during the drier summer period.

TOXICITY STRATEGY

As Dr Ryder explained in a meeting with the ORC in August he has surveyed aquatic ecology at the Macraes site since the 1990s. He has not seen a downward trend in species abundance. Although there has been no specific toxicity assessment carried out, field based observations are that mining has had no clearly discernible long-term impact on species abundance. While there appear to be time-bound declines on survey graphs of Deepdell Creek, which have not been directly matched against water chemistry, Dr Ryder considers they are most likely attributed to drought years where the creek dries up.

The Golder Report provides an initial indication of contaminant toxicity at section 4. A review of water quality data from OceanaGold's environmental database that was considered most relevant to the Coronation North Project has been undertaken. As the Golder Report identifies (section 4.3 and Tables 8 & 9) mining influenced water is likely to meet the ecological guideline values referenced by the ORC reviewer for most of the parameters for which data is available and we are not aware of circumstances suggesting that remaining parameters for which data is not available would not meet the applicable values. There is no available data for manganese, silver or nickel because these elements have not been identified in previous test work at levels requiring monitoring or management. Downstream turbidity/suspended solids and dissolved oxygen have not previously been monitored but can be and will be in proposed conditions. Cyanide is not an applicable parameter as no cyanide or cyanide bearing wastes are being used or stored in the Mare Burn catchment. Dissolved copper and zinc would meet the suggested guideline values. The parameter that does not meet the British Columbia ("BC") guideline levels and requires management is sulfate.

As you know sulfate toxicity is water hardness dependent. Based on modelling the WRS discharges will have a high hardness. Comparing the Deepdell Creek downstream sulfate concentrations with the BC guidelines indicates the in-stream sulfate at lower concentrations is comfortably below the toxicity trend line (refer Figure 2 from Golder Report).

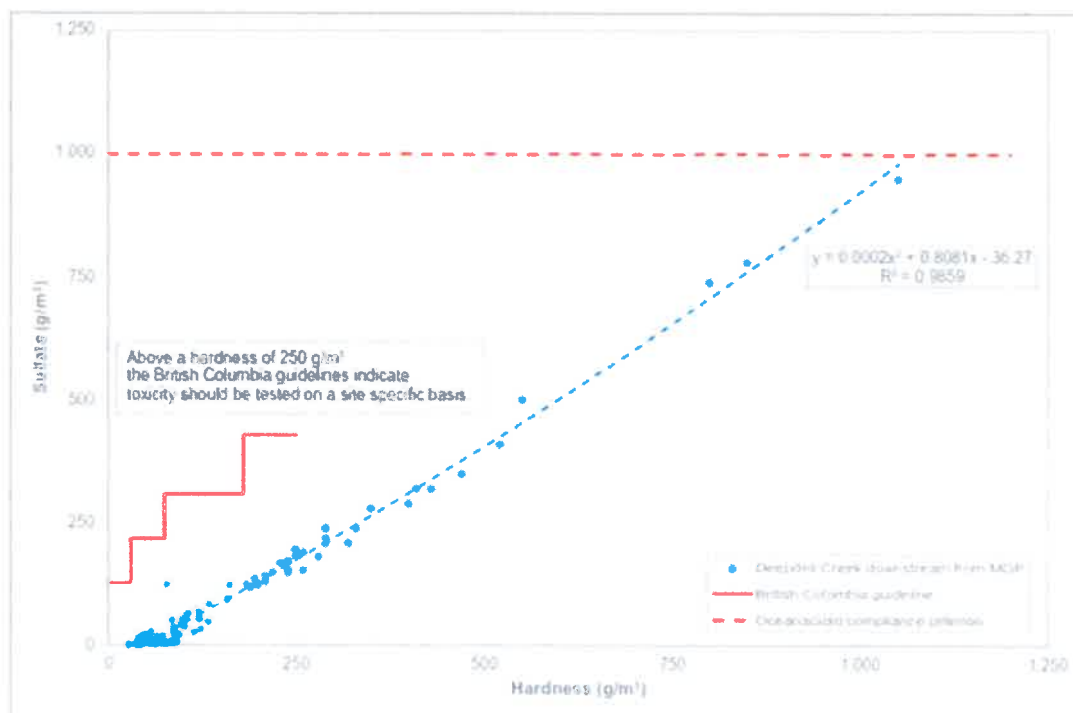


Figure 2 Sulfate to hardness relationship in Deepdell Creek at downstream compliance point, 1990 to 2015

However it is noted that above a hardness of 250 g/m³ the BC guidelines recommend that site-specific guidelines be applied. Accordingly rather than adopting the BC guidelines for the Coronation Project we

consider a site-specific guideline should be developed for the Mare Burn catchment. While that is being developed we consider it is appropriate to utilise existing parameter limits from the Coronation consents as relevant limits within the Coronation North consent conditions.

To the best of our (and Dr Ryder's) knowledge there is no existing toxicity data for Taieri Flathead galaxias or any of its close relatives (i.e. other Otago non-migratory galaxiids). Dr Ryder has noted that "this particular species appears to be pretty hardy given how the population has survived in the Macraes area under extreme summer and winter conditions, and the population in Mare Burn appears quite good despite intensive localised disturbance associated with stock and stock waste."³ Given the breeding cycle of flatheads (spawn in October to November laying eggs on the underside of rocks in riffle sections) it is not feasible to consider any specific testing prior to the consent hearing. OceanaGold will commit to plan for and undertake appropriate toxicity trials after the consent hearing to identify locally appropriate sulphate toxicity thresholds for Taieri Flathead galaxias. This will assist us to better understand the tolerance of this species, which may then enable a targeted management plan to be drawn up if necessary.

The detail of the trial programme would be proposed by a suitably qualified expert, like Dr Ryder, in consultation with the ORC. We have the following comment on the trial:

- The nature of the trials, whether field or laboratory, remains to be settled although presently our preference is for field trials.
- The parameter(s) being tested for is also open to discussion, although it appears sulfate is the only real concern.
- We suggest that testing on larvae would be sufficient to cover juvenile and adults too, since larvae are normally more susceptible.
- Should the results of trials indicate that water quality thresholds ought to be reviewed there is existing provision in the consent conditions for this.

We would be pleased to discuss a proposed consent condition that would provide for the toxicity trials.

Turbidity, suspended solids and water clarity

OceanaGold does not presently monitor for sedimentation, for instance by using the black disc clarity method, because there is not much sediment load. Dr Ryder has stated that over two decades informal visual monitoring indicates that background water clarity is usually good, with no evidence of water clarity declining as a result of mining and no evidence of sediment accumulation. Occasional turbidity can be caused by high rainfall events. Apart from two releases from silt ponds in the early 1990s, which have been addressed by installing a floating decant, the silt ponds at the MGP have not overflowed. Silt ponds do not have scouring and do not carry much in terms of sediment loads.

During the construction period of the project water clarity, turbidity and suspended solids are important parameters to consider. We put temporary sediment control measures in place until sediment ponds are built and our experience is that more sediment arises from fines off roads rather than from WRS construction. Dust suppression measures are employed to manage road dust and progressive WRS rehabilitation restricts dust during WRS construction. In the same way as we have successfully managed these parameters for other projects at the Macraes site (for instance MPIII and Coronation) an Erosion and Sediment Control Plan will be put in place for each aspect of the project – construction and operation of the open pit, WRS and Coal Creek Reservoir. In the case of the reservoir the risk period is only during the initial construction phase.

Sediment control is detailed in the Engineering Geology Ltd report appended to the Coronation North consent application⁴. An example Erosion and Sediment Control Plan consent condition is as follows:

³ Note that the Ryder Consulting aquatic ecology assessment at Appendix 8 of the AEE, section 2, details the following stock damage: to the channels of Maori Hen Creek particularly in the lower reaches; significant stock pugging of the bed and channel margins of Trimbells Gully tributary; heavy grazing by cattle/sheep and the margins and channel well tramped in Trimbells Gully Creek, and evidence of stock disturbance throughout the fish and invertebrate monitoring site TC01; the Coal Creek catchment suffers from heavily degraded physical habitat due largely to cattle and to a lesser extent sheep trampling and pugging. The assessment also observes that in Coal Creek water quality was likely to be characterised by elevated sediment loads and nutrient concentrations, green algae is common and indicative of high nutrient levels.

⁴ *Coronation North Project Erosion and Sediment Control* - Appendix 14 of AEE

(a) Prior to exercise of this consent, the consent holder shall submit to the Consent Authority, an Erosion and Sediment Control Plan for the Coal Creek Reservoir⁵. The Erosion and Sediment Control Plan shall follow the Environment Canterbury, *Erosion and Sediment Control Guidelines* (2007), but may be adapted to suit local conditions and experience. The Erosion and Sediment Control Plan shall include, but not be limited to:

- i) Details of the design and location of erosion and sediment control devices;
- ii) Key responsibilities of site staff in terms of implementation of the plan;
- iii) Construction details and specifications;
- iv) A construction timetable;
- v) Maintenance, monitoring and reporting procedures; and
- vi) Emergency response procedures, including response procedures for flood events and silt pond dam failure scenarios.

(b) The Erosion and Sediment Control Plan for this consent may be combined with any Erosion and Sediment Control Plan required by any other consent held by the consent holder for mining operations at Macraes Flat.

(c) The consent holder shall exercise this consent in accordance with the Erosion and Sediment Control Plan.

(d) The consent holder shall review the Erosion and Sediment Control Plan annually and if necessary, update it. Confirmation of the review shall be included in the Project Overview and Annual Work and Rehabilitation Plan required by resource consents RM16.138.xx and RM16.138.xx. The Consent Authority shall be provided with any updates of the plan within 1 month of any update occurring.

OceanaGold is prepared to incorporate visual clarity into the quarterly aquatic biological monitoring programme undertaken at the site by Ryder Consulting. Whilst we are not persuaded that continuous turbidity monitoring would provide useful data, we are willing to consider this at MB02 during dam construction if it is considered necessary by the ORC.

We will also include in our draft proposed consent conditions that the aquatic biological monitoring include quarterly qualitative visual assessments of the surface area of the stream bed covered by sediment. For instance a provision might require that monitoring include:

A visual estimation from the stream bank of the habitat length (in metres) and the percentage of stream bed within the wetted width covered by sediment <2mm in size, for each riffle, run and pool present and take a representative photograph.

If ORC consider it is necessary, OceanaGold is open to a suitable control site being established upstream of MB01 to provide confidence that sediment is not arising from the mine site. Conceptually this is a sound practice, but we are concerned to ensure that the chosen site is stable and suitable for the purpose and not already adversely influenced, for instance by land management practices or existing stock pugging. There is further work required to identify a control site, although preliminary thought is that a potential site could be as marked 'Mare Burn background' on the map below.

⁵ This condition is proposed for the Coronation North Pit, WRS and Coal Creek Reservoir consents



Plan Change 6A Monitoring including Nitrates, Ammoniacal N, nutrients

OceanaGold has recently implemented site wide monitoring for parameters associated with ORC Water Plan Change 6A. Monitoring will include turbidity, NNN, DRP and Total Ammoniacal Nitrogen at all our key compliance sites (site MB02 is included in this list).

Plan Change 6A allows for land owners to adopt their own monitoring regime and as such OceanaGold has undertaken to do this. As the parameters are not all directly relevant to waste rock stack discharge, we do not believe that these parameters should be included in the Compliance and Monitoring Schedules for the Coronation North Project except where the potential impacts of mining warrant it following an appropriate period of voluntary monitoring in accordance with the overall scheme of Plan Change 6A. Should our monitoring indicate that we cannot meet those parameters at MB02 this will be a trigger for us to undertake further investigations and to assess ecological effects and mitigation and management options.

Periphyton growth

Dr Ryder has indicated that streams in this location naturally get dry and even upstream tributaries, outside the influence of the mine, can show some periphyton growth. While there is potential for the Coal Creek Freshwater dam to grow periphyton our site-wide experience is that silt ponds and pit lakes do not tend to have such growth.

As part of the existing aquatic biology monitoring (undertaken by Ryder Consulting), quarterly visual assessments are made for periphyton and this will continue for Coronation North project.

Correction

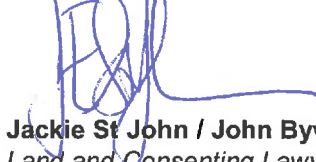
There was an error in the electrical conductivity units in the data that was supplied to the ORC previously. The correct units of measurement are uS/cm.

Conclusion

Should any of the information provided above require clarification please advise. We would welcome the opportunity to discuss proposed consent conditions with the ORC before the consent hearing.

Yours Sincerely

OCEANA GOLD (NEW ZEALAND) LIMITED

A handwritten signature in blue ink, appearing to read 'J St John', with a long horizontal flourish extending to the right.

Jackie St John / John Bywater

Land and Consenting Lawyer / Consenting Project Advisor