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Resource Consent Application review

Waikaka Gold Mine
River Engineering Report

Report prepared for:
Environment Southland

Report prepared by:
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1 Introduction

This report presents the results of an independent technical peer review carried out by GeoSolve Limited (GeoSolve) for Environment Southland (ES), according to ES Consultancy Service Order A1182021 dated 24 October 2024 and countersigned by GeoSolve on 30 October 2024.

The Service Order provides for GeoSolve to undertake the following Scope and Nature of Services:

1. *Review and comment on the assessment of effects and technical report in the application for resource consents by Waikaka Gold Mines Limited (APP-20242608), specifically:*
 - *the technical reports provided with the application: river engineering and flood hazard management, Attachment N at pages 523-572;*
2. *Review and confirm the proposed conditions of consent relating to river engineering and flood hazard management;*
 - *Proposed conditions - Attachment I at pages 341-353; and to*
3. *Provide the outcome of the review in a written report on whether the material reviewed is technically robust and comprehensive, and whether any additional information is required.*

Our review has comprised:

- Desktop review of the provided documents,
- Site inspection in the company of the Applicant Mr. N. Becker (25 November 2024),
- Informal telephone discussion with river engineering consultant Mr RJ Hall to clarify minor technical points (26 November 2024).



2 Review of Technical Reports and Effects Assessment

The technical documents to be reviewed have been presented as a series of reports, each referencing the earlier reports while developing updated proposals. This review addresses the technical reports as a suite of documents, as relevant to the final proposal.

2.1 Hydrology

The Waikaka Stream and Shepherds Creek diversions and flood protection bunding have essentially been designed for the peak flow of the 20-year ARI (5% AEP) flood event. Given that the proposed duration of each diversion is about 2 years, the exceedance probability of this event is estimated at approximately 10% so there is 90% probability that the design flow will not be exceeded during each diversion period. This is considered to be an appropriate risk level, given that any diversion overflows are likely to be contained within the mining permit area and hence would affect only the applicant's business operation.

The Technical Reports identify the 20-year ARI design flows as 116 m³/s and 19.1 m³/s for Waikaka Stream and Shepherds Creek respectively. Derivation of these flows is not formally presented but Mr RJ Hall has advised that standard hydrological methodologies were applied based on data supplied by ES. We note the effects of future climate change are not considered. Checking against the NIWA tool "New Zealand River Flood Statistics" indicates close agreement with the adopted design flow figures, and we concur that future climate change effects are not relevant given the short-term nature of the diversions. Therefore we consider the adopted figures to be appropriate.

2.2 Channel Design

The diversion channel and flood protection designs have been developed and tested using industry standard 2D hydraulic modelling software, based on conveying the estimated 20-year ARI flows as per the hydrological analysis. Detailed checking of the hydraulic modelling is beyond the scope of this review; however the described inputs are considered appropriate and the results are within the expected range, therefore we are comfortable with this analysis.

The diversion designs will incorporate a sinuous armoured low flow channel within a wider floodway. We consider that this design feature will generally replicate the current stability of the existing channel during low to normal flow periods while providing more natural fish habitat than a straight channel.

However, during higher flows, some of the wider diversion channel alignments will be somewhat shorter, and therefore steeper overall, than the existing channel. Therefore the diversion channels will incorporate armoured pool/riffle features that will act as drop structures to provide gradient control in those steeper diversion reaches, while also providing enhanced fish habitat. Due consideration has been given to superelevation effects. Berms and embankments will be grassed. With these provisions we are satisfied



that the diversion channel design is generally capable of resisting erosion, noting that regular monitoring is desirable and some maintenance may be required.

Likewise, the proposed reinstated channel design is expected to provide a regime with stability at least equal to that existing pre-mining, again subject to monitoring and remedial maintenance as required.

Some design details of the diversion and reinstated channels and associated features have yet to be developed. We understand these details will be provided via Temporary Diversion Management Plans (TDMPs), to be submitted to ES for certification.

Subject to satisfactory TDMPs being developed and adopted, we consider that any flood or erosion risk associated with the diversion channels will be minimal, and can be regarded as an acceptable business risk to the mining operation.

2.3 Flood Protection

The diversions and the wider reach through the permit area are to be partially and temporarily bunded to the extent desirable to protect the mine operation against potential moderate (20-year ARI) flooding. This bunding, by design, will cut off floodplain areas that currently provide storage for out-of-channel floodwaters.

We are satisfied that any residual flood risk within the mining permit area during the activity will be minor, and can be regarded as an acceptable business risk to the mining operation.

The design plan indicates that bunding will generally be emplaced on one side of the channel only at each location, which will allow channel overflows to spill onto berms on the opposite side. However it is unclear to what extent the opposite bank berms will provide sufficient additional storage to compensate for the overbank areas cut off by the bunding, and it is possible that increased flood flows would be passed downstream due to the confining effect of the bunding. In this regard the AEE asserts: "Downstream effects are expected to be accommodated within the existing capacity of the Waikaka Stream channel, given that existing capacity is estimated to be at the same level, i.e., 1:20 year AEP". However no supporting information is provided in support of this statement. Accordingly we recommend that the Applicant be requested to provide technical information to confirm that the proposed flood protection bunding will not significantly exacerbate downstream flooding or erosion effects beyond the mining permit area.



3 Review of Proposed Conditions of Consent

Comments and existing Conditions text are shown below in plain text. Suggested changes are noted in underlined italics:

The proposal as presented is subject to further detailed design, to be developed as the project progresses. It is understood that these details will be provided via Temporary Diversion Management Plans (TDMPs) to be certified by ES. Therefore it is recommended that Condition 1 in the Master Condition Set be worded so as to allow for further details in the TDMPs, e.g.:

1. The activity must be carried out in general accordance with the plans and all information submitted with the application dated 26 August 2024 and subsequent Temporary Diversion Management Plans as certified by Environment Southland. This will then be consistent with Conditions 14 & 17 as drafted.

Minor suggested edit:

- 12.b. Placement and use of dams ... (More than one dam will probably be required.)

The Conditions of Consent should address concerns of ES Catchment Operations staff, along with those of other interested parties.

14. The TDMP will give ES Catchment Operations appropriate information and control over final designs, revegetation, and other relevant matters. We recommend an additional information requirement:

14.a.ix. Detailed procedures for managing any bridging/culverting/fords and farm drain connections on the existing channel and the diversions and the reinstated channel, with particular attention to avoiding flow restriction and erosion.

20. Southland Regional Pest Management Plan

We note that crack willows are a listed pest plant and therefore under this Condition are not to be planted in or near waterways. Therefore this Condition adequately addresses ES Catchment Operations concern on this issue. We concur with the view that crack willows are generally undesirable from a river engineering perspective, as they are well known to spread vigorously and create serious obstruction to natural river flows thus affecting river morphology and exacerbating flood hazard.

24. **Planning question:** should the implementation of these habitat features be "in consultation with" or "to the satisfaction of" the relevant interested parties e.g. ES, Fish & Game, and/or DoC?

- 25.a.ii. We note that ES Catchment Operations staff have recommended that pH be added to the parameters to be monitored and remediated if necessary.

There is a strong preference by ES Catchment Operations staff for clearance of existing willows and other channel obstructions within the mining permit area to take place as early as possible, noting this work was programmed for the 2024/2025 season. We concur that it



seems logical and desirable for the Applicant to maintain consistency with this program as far as practicable, and we recommend the inclusion of an appropriate Condition such as:

Clearance of obstructive vegetation on the existing main stream channel within the mining permit area shall be undertaken consistent with current Environment Southland river management objectives. Consequently this work shall be commenced in the first year of the mining operation and shall continue progressively as early as practicable.

We also recommend a stream monitoring/maintenance Condition such as:

The diversions shall be inspected annually and following any flood events where the channel has flowed bank-full or higher. Any erosion, channel obstruction or other damage shall be promptly remediated as appropriate. A photographic record of each such inspection and any remedial works shall be supplied to Environment Southland. Similar monitoring and maintenance of the reconstructed stream reaches shall be undertaken for a period of five years following reinstatement.

Planning question: We note that in the Proposed Conditions of Consent there is no mention of the proposed temporary flood protection embankments (flood bunding). Does this activity require specific consenting? The AEE mentions a 'flood management plan' - should this be specified in the Conditions of Consent like the TDMPs?



4 Conclusions and Recommendations

We consider that:

- The river engineering technical reports demonstrate that the proposed activity can be undertaken without significant adverse effects on river stability and flood conveyance within the mining permit area.
- We note that further information will be required to provide some final design details for the diversion channels; we understand this detail will be forthcoming by way of Temporary Diversion Management Plans which will be subject to certification by Environment Southland.
- We recommend that the applicant be requested:
Please provide technical information to confirm that the proposed flood protection bunding will not significantly exacerbate downstream flooding or erosion effects beyond the mining permit area.

To assist the consenting process, in Section 3 above we have provided comments and suggested amendments to the draft Conditions of Consent as relevant to river engineering.



5 Applicability

This report has been prepared for the sole use of our client, Environment Southland, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our prior review and written agreement.

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