APPENDIX H

DPI FISHERIES RESPONSE

Our Ref: 59918111:DP_Rev0_Final
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Dear Paul,

SNOWY 2.0 - RESPONSE TO SUBMISSIONS
DPI FISHERIES

We have prepared the following responses to the Department of Primary Industries - Fisheries (DPIF) submission on the Snowy 2.0 Main Works EIS (correspondence: 5 December 2019) which relate to the Aquatic Ecology Assessment (AEA) prepared by Cardno and included as Appendix M.2 of the Snowy 2.0 Main Works EIS.

General Comments

1. **Does not include appropriate measures to mitigate the likelihood of the spread of aquatic pests and diseases and translocation of native species, which has potentially significant impacts on both threatened fish, the Snowy Mountains Trout Fishery, and the Upper Murrumbidgee recreational fishery.**

Fish barrier controls aimed at preventing transfer of undesirable fish to secondary catchments are described in Section 7.2.3.2 of the AEA. Following this submission, further information on the details and appropriateness of fish barrier controls aimed at preventing transfer to other catchments has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (we understand this is addressed in Appendix N of the Response to Submissions (RtS)).

Appropriate mitigation measures aimed at preventing transfer of pests via vectors other than the pumped hydro system are provided in Section 6.4.5 of the AEA.

2. **Is dismissive of and/or underestimates those impacts, especially with respect to the impact of Redfin Perch on Macquarie Perch, and at the same time uses suggestive and speculative comments that do not provide any value to the assessment other than to lessen the severity of potential impacts.**

Cardno disagrees with this statement and considers that the material presented in the AEA represents a complete and accurate assessment of the potential impacts to aquatic ecology associated with the Snowy 2.0 project based on the information available at the time of the assessment.

Additional detail is provided in responses to specific submissions 57, 58, 59, 60, 61, 65 and 68

3. **Does not recognise or investigate the potential need for a permit in accordance with section 216 of the Fisheries Management Act 1994, despite being discussed at meetings with Snowy Hydro during the development of the EIS.**

These discussions are outside the scope of the AEA and have been addressed separately by Snowy Hydro (See Appendix N of the RtS).

4. **Does not provide details to support claims of the reportedly high construction costs and environmental impacts associated with otherwise technically feasible measures to mitigate the spread of pests and**

diseases, mitigate direct impacts on species, and to mitigate indirect impacts on species and habitats.

Following this submission, further information on the options considered to prevent or minimise transfer of undesirable fish species has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

5. **Does not provide details of the few mitigative measures that are proposed, e.g. mesh size and composition of the screen at the dam wall of Tantangara.**

Following this submission, further information on the mitigation measures proposed to prevent transfer of undesirable fish species out of Tantangara Reservoir has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

6. **Significantly underestimates the potential impacts on threatened species of fish (notably Stocky Galaxias, Murray Crayfish, Macquarie Perch and Trout Cod) and recreational fishing.**

Cardno disagrees with this statement and considers that the material presented in the AEA represents a complete and accurate assessment of the potential aquatic impacts associated with the Snowy 2.0 project.

Additional detail is provided in our response to submissions 57, 58, 59, 60, 61, 65 and 68 and in addition responses to specific submissions 20, 22, 26, 33, 35, 40, 41 and 45.

Potential impacts to salmonids was assessed as part of the AEA, however the potential social and economic impacts associated with recreational fishing was undertaken within the Social Impact Assessment.

7. **Proposes some mitigation measures for the recreational trout fishery that lack detail, were not negotiated with DPIF, and the limited information provided suggests they would not be supported by DPIF and the majority of recreational fishing stakeholders.**

As noted in the Appendix M.3 of the Main Works EIS, Snowy Hydro has committed itself to supporting DPI Fisheries and the local community to develop measures to stock Tantangara Reservoir with large salmonids (above the typical fingerling size) which would be better able to avoid the impacts of competition or predation from any redfin perch in the reservoir, should they be transferred. Snowy Hydro anticipates working closely with DPI Fisheries and members of the local fishing community to implement this program in such a way that the positive impacts to the local community and recreational fishing in the region are maximised.

8. **Makes invalid assumptions or draws unreasonable conclusions (especially in the risk assessments and assessments of cumulative impacts) that DPIF rejects on the basis of the provided information, and requires further justification and evidence to enable a more accurate assessment of impacts at the individual and cumulative level.**

Cardno disagrees with this statement and considers that the material presented in the AEA represents a complete and accurate assessment of the potential impacts to aquatic ecology associated with the Snowy 2.0 project based on the information available at the time of the assessment.

See response to Submissions 2 and 6. Further, with regard to assessment of cumulative impacts the following is provided in Section 8 of the AEA:

"*All identified construction and operational related activities and associated impacts have potential to affect sensitive aquatic receptors in Talbingo Reservoir, Tantangara Reservoir and other catchments within the study area. Although the potential effects of the various project impacts have been considered separately, there are likely to be interactions among impacts associated with the project design that could reduce or magnify the intensity of a response or raise or lower the threshold of response. Moreover, there is also potential for cumulative effects between the project and external factors. Interactive effects of multiple impacts are poorly understood but given most of the impacts affect similar receptors within the study area and a worst case scenario has been assumed for each impact (i.e. mortality to biota), then cumulative impacts are considered unlikely to change the conclusions of this assessment. Cumulative impacts may lengthen the recovery time in some areas for some sensitive receptors but not to the extent that would change the stated conclusions.*"

It is reiterated that while cumulative impacts could occur, interactive effects are poorly understood to the extent that providing any more than a qualitative assessment (i.e. the severity of two impacts may be greater than the sum of their parts) is not possible. Given that worse case scenarios are considered where appropriate (e.g. loss of threatened species or populations of threatened species), then indeed cumulative impacts are considered unlikely to change the conclusions of this assessment.

Notwithstanding these issues, the mitigation measures included within the AEA include commitments to management plans and monitoring programs that will be applied within a framework of adaptive management to provide the best opportunity to respond in a timely manner to impacts of unpredicted magnitude.

Primary Containment

9. **Both the EIS and the THA Aquatic report state that "flat panel wedge wire screens, drum screens and submerged water intake, fish friendly screens were considered technically feasible", however associated high construction costs and environmental impacts rendered those options as unfeasible. No details have been supplied in the EIS or supporting documentation regarding the relative costs associated with these options nor the associated environmental impacts. The detail of the designs, financial implications and environmental impacts need to be provided to allow for a transparent and rigorous assessment of the options along with a comparative analysis of these impacts compared with the impacts of the transfer of alien fish species between the reservoirs.**

Following this submission, further information on the options considered to prevent or minimise transfer of undesirable fish species has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

Secondary Containment in Tantangara Dam

10. **There is no detail regarding the specification of the secondary containment measures to confine Redfin perch within Tantangara, therefore it is not possible to evaluate and assess the efficacy of the design. The secondary containment also does not adequately take into account the increased risk of transfer of Redfin perch downstream via secondary vectors (i.e. fishermen). If a population establishes within Tantangara Dam, this significantly increases the risk of potential transfer of the species downstream.**

Following this submission, further information on the mitigation measures proposed to prevent transfer of undesirable fish species out of Tantangara Reservoir has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

See also response to Submission 49 regarding other transfer vectors.

Climbing Galaxias Impacts on Stocky Galaxias

11. **DPIF does not agree with the assumption made regarding the overall likelihood of transfer of Climbing Galaxias from Talbingo to Tantangara. While it is agreed that the likelihood of transfer of adults is unlikely, DPIF considers it highly likely that the larvae and juveniles will be transferred given the life history and previous incursions of the species. By proposing the instream barrier to mitigate the upstream movement of Climbing Galaxias, the EIS has tacitly acknowledged that the transfer will occur despite its own risk assessment; that the larvae and juveniles will be viable; and that a translocated population will be established within Tantangara and its tributaries.**

The assessment of impacts of fish transfer took a precautionary approach regarding the probability that climbing galaxias transfer and establish into new catchments due to the project. The apparent low abundance of climbing galaxias in the Yarrangobilly River (and potentially in Talbingo Reservoir) would be expected to substantially limit the number of individuals that may be transferred. The reproductive ecology of landlocked populations in the MDB is unknown, but it is possible that reservoirs or lakes replace the marine larval stage (Lintermans, 2007). If the few climbing galaxias detected in the Yarrangobilly River catchment form part of a breeding population, it is possible that the fish may spend part of their larval life stage within Talbingo Reservoir where they may be at risk of entrainment into Snowy 2.0. Due to the very low observed abundance of this fish, the risk of entrainment through Snowy 2.0 was assessed as unlikely compared with other species of fish in the reservoir, with the overall likelihood expected to be unlikely given the reasons outlined above.

It is also unclear if the likely low abundance of individuals that would be transferred and the possible sporadic nature of transfer events would be sufficient to establish a self-sustaining population in Tantangara Reservoir / upper Murrumbidgee River catchments. It is noted also in EIS Section 7.2.3.3 how the habitat of the Tantangara Reservoir / upper Murrumbidgee River catchments appears sub-optimal for climbing galaxias, particularly the absence of substantial riparian vegetation, which would also limit the number of

individuals with opportunity to reach the habitat of stocky galaxias. Given these considerations, it is far from certain that climbing galaxias would reach or establish in the habitat of stocky galaxias.

Nevertheless, SHL has taken a precautionary approach and proposes the installation of a barrier in Tantangara Creek to protect the habitat of stocky galaxias if any climbing galaxias are transferred and are able to reach this far upstream in the Tantangara Catchment.

See additional detail provided in response to Submissions 20 and 50.

> **The proposed instream barrier on Tantangara Creek to protect Stocky Galaxias in that system may afford protection to that small known population, however it does not protect the species should it occur elsewhere in the catchment. Whilst there are currently no other known populations of the species within the catchment, surveys have not been exhaustive and it is possible that other populations exist within or outside the catchment. In addition, incursions of Redfin Perch and Climbing Galaxias into Tantangara will significantly jeopardise the longer term conservation of the species, as it is currently reliant on the establishment of additional populations potentially within and outside its known range.**

See response to Submission 41.

Spoil Disposal Impacts on Murray Crayfish within Talbingo Reservoir

12. **The assessment of impacts on Murray Crayfish is largely based on the small proportion of the impact area relative to the entire reservoir, i.e. only 1% of the reservoir will be directly impacted. However, this rationale works on the assumption that all areas of the reservoir have equal habitat value to the species, which is not the case. Murray Crayfish are restricted to a very small proportion of suitable habitat within the reservoir, which needs to be quantified, as does the percentage of this habitat directly impacted by spoil and indirectly by associated impacts on water quality. There is also an assumption that the relocation of Murray crayfish away from the direct impact zone will completely mitigate the impact with no net impact on the population. That assumption may hold if it can be proven that there is additional suitable and available habitat for these individuals to occupy and that it is also unaffected by other direct or indirect impacts.**

The estimated in-water footprint for the revised excavated material placement program in Ravine Bay is 3 ha. This represents 0.6% of the total potential Murray crayfish habitat in the reservoir.

See additional detail provided in response to Submission 29 and 39.

> **Zukowski and Whiterod (2019) reported that that the Murray Crayfish population within Talbingo Dam is in significant recent decline. While some speculation is made regarding the cause of this decline, there is no mention or assessment of how this current state of the population may be able to cope with additional and significant impacts on their habitat and water quality. Given that the population is already in serious decline, this significantly reduces the resilience of the population to withstand increased threats and stresses. The current population status and trend needs to be assessed further in the EIS in the context of the extent and magnitude of potential impacts.**

See response to Submission 27.

Qualitative Risk Assessments

13. **DPIF does not agree with many of the risk ratings and consequences assigned to various impacts and species, particularly threatened species (see details below). The risk assessments are critical in the evaluation of the level of impacts on threatened species, and determine whether or not further assessments are required in the form of Species Impact Statements. DPIF suggests that these risk assessments need to be reviewed and assigned by an independent expert panel to provide a more rigorous, transparent and balanced approach.**

Responses to specific submissions regarding the risk assessments are provided below.

The risk assessment process for the AEA was based on the Australian and New Zealand Standard guidelines for risk management (AS/NZS 4360:2004) and the Handbook for Environmental Risk Management – Principles and Process (HB 203:2006) (Standards Australia, 2006) which is considered an international benchmark in standard risk management. Cardno used this process for the Marine Fish Stocking EIS and the Artificial Reef Project undertaken in collaboration with DPIF. This included workshops

to identify the key issues, receptors, scales and timeframes that were attended by the same members of Cardno staff that were included in the development of the risk assessment for the Snowy 2.0 Aquatic Ecology Assessment. This included Dr Marcus Lincoln-Smith, who was also appointed as peer reviewer on the expert panel for the NSW Marine Estate threat and risk assessment. Oher Cardno staff who assisted in the development of the risk assessment all have tertiary qualifications each with over 12 years' experience of environmental impact assessment.

The risk assessment methodology and development of the various categories of likelihood, consequence and risk were developed with the assistance of experts in aquatic ecology and impact assessments and the definitions clearly identified in the risk assessment approach, including categories of likelihood and consequence, overall risk and components of the aquatic environment to be assessed (Section 4.5 of the AEA).

This approach provides a rigorous and transparent assessment approach that has been applied consistently throughout the assessment. Other industry experts (including experts in galaxiid, crayfish and fish disease) were also engaged throughout to ensure a robust and balanced approach to the aquatic ecology assessment. Throughout the development and implementation of the risk assessment Cardno kept at the forefront the objectivity and integrity of the process, with integrity in particular one of the four core values defined in Cardno's Code of Conduct.

In addition to the impact assessment provided in the main sections of the AEA, Assessments of Significance have also been undertaken for each threatened species with potential to be impacted by the project using prescribed methods in the NSW DPI Threatened Species Assessment Guidelines (NSW DPI 2008).

Cumulative Impacts

14. **The cumulative impacts section is under developed and lacks detail and accurate analysis of the potential impacts. DPIF questions the logic behind the assertion in the EIS that the cumulative impacts would not be likely to change the overall conclusions of the assessment. DPIF is of the opinion that some cumulative impacts should significantly change the level of risks and outcomes. For example, the cumulative impacts of EHNV and Redfin Perch entering the mid-Murrumbidgee downstream of Tantangara Dam would be significantly higher risk to the Macquarie Perch population than either threat in isolation. Similarly, the cumulative impact of direct habitat loss, changes in water quality and sedimentation is likely to have a much greater impact on the Murray Crayfish population in Talbingo than any of those impacts in isolation. These cumulative impacts and relationships need to be developed further and addressed in more detail within the assessment.**

See response to Submission 8.

Further, it is acknowledged that cumulative impacts of individual stressors (e.g. potential EHNV and redfin perch impacts on Macquarie perch) could, or would be expected to, result in additive or synergistic impacts resulting in elevated risks to species. However, the poorly understood interactions between stressors hinders assessment of the presence and magnitude of associated impacts. As noted, worst case scenarios (e.g. loss of threatened species or populations of threatened species) have been considered for each impact where appropriate. While cumulative impacts may result in greater extent or magnitude of impacts, it would not be to the extent that would change the stated conclusions.

EHNV Transfer Risk

15. **The EHNV status within Talbingo Reservoir is currently unknown, and the sampling undertaken to inform the EIS was 'not sufficient to have high confidence in the result'. In addition to the inadequacy of the sample size, there is also a question regarding the suitability of the analysis and the interpretation of that analysis (Hicks et al 2019). The associated conclusions regarding EHNV likelihood of occurrence and transfer, and impacts on threatened species have been made on a paucity of appropriate information and therefore cannot be relied upon. Further information is required regarding the present status of EHNV within Talbingo, as clearly the current study is inadequate and as identified in Hicks et al (2019) 'the stability of EHNV in the environment is sufficient to enable it to remain viable for the duration required to move from Talbingo to Tantangara and to the Macquarie perch population in the upper Murrumbidgee River if water is released from the reservoir during an active disease outbreak'. A more rigorous and appropriate assessment of the current and potential extent of EHNV is clearly required for a project and potential impacts of this magnitude.**

See response to Submission 66.

Specific Comments

16. **Executive Summary, Existing Environment, states that 'water clarity generally restricts the photic zone to within a few meters of the surface' however elsewhere in the document it states that plants grow to a depth of 10 meters (section 6.3.2.2) and that the photic zone extends to 7.7 meters (Table 6.3), clearly there is some discrepancy in these figures and this needs clarification within the document.**

The 10 m photic depth provided in EIS Section 6.3.2.2 is given as an 'approximate' depth to frame the impact assessment. The 7.7 m photic depth provided in EIS Table 6-3 is that calculated to occur with turbidity of 2 NTU and extinction coefficient (k) 0.60, alongside that calculated to occur with greater turbidity up to 20 NTU (1.0 m photic depth). Although turbidity in Talbingo Reservoir is generally around 2 NTU, it may be greater (e.g. 5 NTU would equate to a photic depth of 3.6 m). Water clarity and photic depth will vary spatially and temporally in the reservoir and with variables such as inflows, surface inflows and re-suspension of water particles.

17. **Tantangara Reservoir is classified in the EIS as type 2 (moderately sensitive). DPIF previously advised that it considers Tantangara Reservoir to be a type 1 (highly sensitive) Key Fish Habitat (KFH).**

Table 1 in Section 3.2.2 of *Policy and guidelines for fish habitat conservation and management* NSW DPI (Fisheries) (2013) indicates Tantangara Reservoir would provide Type 2 Moderately sensitive key fish habitat (i.e. Weir pools and dams up to full supply level where the weir or dam is across a natural waterway, not supporting threatened species). As no threatened species have been identified in Tantangara Reservoir, it is unclear on what basis it would be considered Type 1 Highly sensitive key fish habitat.

18. **Operational Phase: operational activities with potential to affect the aquatic ecology that have not been included in the EIS and should be considered are: re-suspension of fine sediments due to operation; changes in the storage levels and their impacts on primary production, particularly Tantangara which will have a significant change to the storage level and operation.**

As noted in Section 7.2.1 of the AEA, the design of the intake channels and the measures set out in the WMP and Commissioning Plan would ensure that the potential for sediment mobilisation in the reservoirs and downstream transport of harmful volumes of sediment out of the reservoirs during commissioning and operation is minimised to the greatest extent practicable. In the unlikely event that the release of potentially harmful amounts of sediment cannot be avoided, DPI Fisheries would be consulted to ensure that appropriate measures can be put into place to minimise impacts to sensitive aquatic receptors.

Following the commencement of the operation of Snowy 2.0, both Tantangara and Talbingo reservoirs will have increased operational functions as head and tail storages for pumping and generation at the Snowy 2.0 station. Due to these additional functions, the short and long term water levels in these reservoirs, as well as the rates of water level rise and fall, are expected to experience some degree of change compared with the historical operations. However, the water levels in both reservoirs will remain within the MOL (minimum operating level) and the FSL (full supply level), as required by the Snowy Water Licence for the existing Snowy Scheme. The variability in storage levels within the existing Snowy Scheme has existed since the scheme was implemented, and is approved under the EP&A Act. This will continue under Snowy 2.0. It is understood further information is provided in Section 4.2.4 of the RtS prepared by EMM.

19. **The statement 'Notwithstanding this, introduction of Redfin perch into Tantangara Reservoir could occur at some stage during the life of the project'. This statement is purely speculative, provides no value to the assessment or bearing on the risks associated with the project, and only serves to distract from the fact that Snowy 2.0 as currently proposed will translocate Redfin into the Reservoir.**

This statement in the executive summary has been taken out of context. It refers to the potential for transfer of redfin perch to occur due to the pumped hydro system, irrespective of the mortality that would occur during entrainment and transfer from Talbingo Reservoir to Tantangara Reservoir. It does not refer to non-project related vectors (such as via birds and via fishing activities).

20. **It is stated that 'If transferred to the Tantangara Reservoir, there is a small risk of them (climbing galaxias) interacting with stocky galaxias.' DPIF considers the likelihood of interaction to be almost certain prior to mitigation, and to be unlikely after mitigation, with the resulting residual risk level of high, not moderate as suggested in the EIS. The EIS also**

seems to consider their assessment of moderate residual risk as acceptable, however DPIF does not, and especially at the more realistic residual risk level of high.

The reference to 'small' risk rating is located in the executive summary and is associated with residual risk (i.e. following installation of the barrier control on Tantangara Creek).

In Section 7.2.3.4 of the AEA it is considered 'likely' that *if transferred* to Tantangara Reservoir that climbing galaxias would move upstream of the waterfall on Tantangara Creek (in the absence of the barrier control). If it does enter the habitat of stocky galaxias, the associated consequence was considered 'Catastrophic' (the most severe rating) with a risk rating of 'Extreme' (the most severe risk rating).

The 'Rare' likelihood of movement upstream of the waterfall following installation of the barrier is considered appropriate given the barrier would be designed and installed in consultation with experts in galaxiid ecology. Given the Consequence would remain 'Catastrophic', this provides a relative risk rating of 'Moderate'. Any change to this assessment would not change the control measures already proposed.

Further information on the justification of mitigation measures proposed to prevent transfer of climbing galaxias into the upper Tantangara Creek catchment has been provided to DPIE and DPIF by Snowy Hydro (See Appendix N of the RtS).

See additional details provided in response to Submission 11 and 13

21. **The statement regarding identified residual risks 'transfer of invasive species (fish and/or fish disease) between Talbingo and Tantangara reservoirs and into associated catchments during operation in the unlikely event of failure of all controls'. This statement is misleading as there are no controls identified for the transfer of fish and or fish disease from Talbingo to Tantangara, this statement only relates to the associated catchments beyond Tantangara where secondary controls have been identified.**

As noted, this statement refers to transfers and associated impacts to secondary catchments only, not any that may occur for water transfers from Talbingo Reservoir to Tantangara Reservoir. It is acknowledged that this statement is unclear in this circumstance.

22. **Section 6.2.2.2 Direct – hydraulic entrainment within dredge area, states that 'a longreach excavator may be used which would present minimal (if any) entrainment risk'. Whilst this may be the case for mobile fish, Murray Crayfish which are a burrowing species, who's main survival tactics are to seek refuge in burrows or under woody debris, rocks etc. and still likely to be entrained via this method of dredging.**

This section considers impacts associated with entrainment, not disturbance to habitats. In this case, a long reach excavator would not represent a risk of entrainment, compared with a suction dredge. Direct impacts to aquatic biota following disturbance of habitat during dredging and excavation are assessed in Section 6.2.2.1 of the AEA.

23. **Section 6.2.2.4 Indirect – changes to water quality, Suspended sediment and turbidity. This section identifies that some suspended sediment may 'escape under the silt curtain'. Why does the silt curtain not extend all the way to the bed of the reservoir to eliminate this risk? Further detail needs to be provided on the likelihood that suspended sediments will escape under the silt curtain, and the volume and frequency of those events. DPIF understands that modelling has shown that the likelihood of suspended sediments escaping under the sediment certain is almost certain.**

As noted in Mitigation measure AE07, All dredging works would be closely monitored and carried out in accordance with the Dredging and Excavated Materials Management Plan (DEMMP) and/or Aquatic Habitat Management Plan (AqHMP). Specific details regarding the nature of and placement locations of any silt curtains will be established within these documents which will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

24. **It also states in this section that 'Although there may be impacts to some biota, the affected areas are expected to be very small (i.e. <1% relative to the extent of these habitats in the reservoirs). How has this percentage been calculated? And what habitats and species is it referring to? What would be of more value is identifying the specific habitats referred to here, the proportion of the reservoir they represent and the percentage of this proportion that will be impacted.**

This section assesses impacts associated with construction of the intake, and the statement in question to impacts associated with mobilisation of any potential contaminants in the dredge / construction area. The

habitats within the disturbance footprint are typical of those throughout the reservoir (bare rock, soft sediment, wood debris), though historic aerial imagery suggests that the amount of wood debris in this area would be relatively small (due to apparent absence of trees in this area prior to creation of the reservoir). Murray crayfish were caught within the disturbance footprint and in adjacent areas during surveys by Zukowski and Whiterod (2019), and elsewhere in the reservoir.

During recent surveys, Murray crayfish were caught in water depths between 3 and 15 m (Zukowski & Whiterod 2019). Using a conservative maximum water depth of 20 m and assuming all shorelines of Talbingo Reservoir are equally suitable as Murray crayfish habitat, the total available habitat area between FSL and 20m water depth is 495 ha. Given that the footprint of the proposed intake area is approximately 1 ha, the potential loss of Murray crayfish habitat equates to 0.2% of the reservoir's total crayfish habitat. This level of impact is not considered to be significant and is unlikely to affect the population of Murray crayfish in Talbingo Reservoir.

25. **Section 6.2.2.6 Impacts on KFH, Threatened Species and EEC's. This section states that 'Consideration will be given to using wooded debris that may be cleared from the intake area to rehabilitate disturbed areas away from the intake locations following construction works.' This statement is very unclear and noncommittal and needs to be further refined, to provide a clear position on what is being undertaken and why.**

Areas disturbed during construction of the intake would not be rehabilitated using woody debris that would have been removed from these areas in order to ensure that this debris does not subsequently impede the flow of water into the intakes by becoming resuspended and blocking the trashracks. Given the abundance of woody debris throughout the reservoir, the small area of the disturbance footprint and the apparent relatively low abundance of woody debris in this area inferred from historic aerial imagery, the permanent removal of woody debris within this area would have minimal to negligible impacts on aquatic biota in the reservoir. This approach also has the additional benefit of rendering the intake area less favourable to fish which may in turn reduce the risk of fish entrainment into the intakes. Given the very large volume of woody material present within the rest of the reservoir, placing any wood removed during intake construction elsewhere within the reservoir would likely create unnecessary disturbance in these areas for minimal positive environmental benefit.

As noted in mitigation measure AE01 in Section 6.2.4, An AqHMP would be prepared and implemented to guide management of impacts to aquatic habitat. The plan would include a program to restore and enhance the aquatic habitat of the approved disturbance area with the exception of intakes and channel areas as soon as practicable following the completion of development in these areas. This plan will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

26. **6.2.2.6 - The Murray crayfish section states that 'the latest surveys found three individual Murray crayfish at depths of between 2.3-7 m in and around the vicinity of the proposed intake structures'. DPIF assumes this is referring to Site 8, however there are a number of other sites in this vicinity where Murray Crayfish were detected and would be directly impacted via the project.**

Site 11 in Zukowski and Whiterod (2019) relates to the intake disturbance location. One crayfish was caught at this location, with an additional one crayfish caught at each of the sites adjacent to the disturbance location (I.e. Sites 10 and 12) bringing the total to three crayfish caught in and around the proposed intake structure location. In total, 19 Murray crayfish were caught throughout the reservoir (albeit in apparent low abundance) at 11 of the 14 sites sampled.

As noted in mitigation measure AE01 in Section 6.2.4, An AqHMP would be prepared and implemented to guide management of impacts to aquatic habitat. Included in the plan, would be a program to relocate Murray crayfish from the shallower parts of the approved disturbance area in Talbingo Reservoir prior to disturbing these areas. This plan will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

27. **This section also mentions the decline in the population and indicates that it may be potentially caused by increases in Elodea in the reservoir, and was also suggested as a possible cause in Zukowski & Whiterod (2019), however there is no evidence in either document to support this theory, and is therefore of little value or relevance to the project. What is evident is that the population is in significant decline, which further reduces it capacity to cope with additional disturbances and further reduces the resilience of the population. This reduced capacity needs to be identified and included within the assessment.**

Page 20 of Zukowski & Whiterod (2019) includes the following:

"*Dense areas of Canadian Pondweed have been shown to directly hinder the movement of freshwater crayfish (Hessen et al. 2004). Further, it can cause large fluctuations in dissolved oxygen concentration and pH causing elevated stress levels to crayfish. Hessen et al. (2004) specifically demonstrated that, similar to the Talbingo Reservoir, in Lake Steinsfjorden (southeast Norway) as Canadian Pondweed spread over shallow areas it increasingly excluded the Noble Crayfish Astacus astacus to the point it was absent from dense vegetation areas. Canadian Pondweed is a threat to crayfish in other areas of southern Australia (Whiterod and Zukowski 2017).*"

Although Murray crayfish are not specifically noted in these studies, this species would be expected to respond in a similar way to other species of freshwater crayfish. Fewer crayfish were sampled in the most recent surveys, indicating a smaller abundance in 2019 compared with previous surveys by the authors, which were undertaken approximately 10 years ago.

As noted in the AEA (Cardno 2019), the area of direct disturbance relative to the total area of the reservoir is small with a number of mitigation measures listed in Section 6.2.4 designed to reduce the potential for direct and indirect impacts to Murray crayfish within Talbingo Reservoir.

See response to Submission 24. The potential loss of Murray crayfish habitat from intake construction equates to 0.2% of the reservoir's total crayfish habitat. This level of impact is not considered to be significant and is unlikely to affect the population of Murray crayfish in Talbingo Reservoir.

As noted in Mitigation measure AE01, An AqHMP would be prepared and implemented to guide management of impacts to aquatic habitat. The plan would include a Trigger Action and Response Plan (TARP) for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species. This plan will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

28. **Section 6.3.2.2 Direct – loss/modification of aquatic habitat due to smothering. It states that the 'replacement of soft sediment habitats within the region with excavated rock would most likely change the physical characterises of this environment. The area within the placement footprint would most likely be made up of material with larger particle sizes'. These impacts are not 'most likely' it is certain that the activity will change the physical characteristics of that environment and the area will be made up of material of larger particle sizes.**

In-water placement of excavated materials would change the physical characteristics of the habitat. It is expected that material placed within the reservoir would include larger rocks, which would add to habitat heterogeneity and may provide habitat for trout cod and or Murray crayfish. See also response to Submission 31.

SHL has undertaken further analysis of options for the management of excavated material. The currently preferred option for Talbingo Reservoir is placement of drill and blast (D&B) material only in Ravine Bay, with all of the finer grained tunnel boring machine (TBM) material to be placed in nominated areas on land, including one area directly upslope from the Ravine Bay placement area.

29. **It is identified that the 'placement footprint area between MOL and FSL represents less than 1.5% of the reservoir area.' Whilst this may indeed be correct, what percentage does this represent of certain habitats within the reservoir, specifically that of Murray crayfish?**

The estimated in-water footprint for the revised excavated material placement program in Ravine Bay is 3 ha. Assuming all shallow water areas within 20 m water depth of FSL are representative of potential Murray crayfish habitat in Talbingo Reservoir (a total area of 495 ha), the maximum loss of crayfish habitat due to the in-water placement area is equivalent to 0.6% of the total potential habitat in the reservoir. Together with the area that would be directly modified due to construction of the intake (0.2%), cumulatively, this represents <1% of potential Murray crayfish habitat that would be affected directly. This direct modification of habitat would be expected to have a very minor to negligible impact on Murray crayfish.

30. **This section also states that 'placement of larger sized particles such as boulders and cobble into this area (which is mostly void of this type of habitat) would contribute to some degree to the habitat complexity and heterogeneity with in the area.). Please provide supporting evidence, documentation or references to how this placement will contribute to habitat complexity and the heterogeneity of the area and which species and how they will benefit, particularly given that large proportions of the spoil material will now be produced via TBM and will be of much smaller particle size than boulder and cobble.**

The revised excavated material placement program would include the placement of larger rocks in the reservoir including those over 200 mm diameter derived from drill and blast excavation. The placement of such rocks in the reservoir is expected to contribute to habitat complexity (e.g. boulders, which appear sparse in the reservoir, are also considered a form of habitat complexity by NSW DPI (2006)). Boulders greater than 50 cm in diameter in two dimensions are also considered key fish habitat NSW DPI (2013). Rocks and the hard surfaces they provide would providing cover / reproductive habitat for trout cod (e.g. MDBC 2007; NSW DPI 2006) and would also provide structural habitat and cover for other native species such as Murray crayfish.

31. **Rocky Habitat - this section states that 'the extent of this habitat in the reservoir is small and represents a very minor component of the aquatic habitat present'. Snowy Hydro needs to identify what proportion of the reservoir this habitat represents? Similar to the above comments it is also stated that the 'placement of excavated rock, over time, potentially compensate for any loss of, and increase the existing rocky habitat in these areas, which have the potential to add habitat heterogeneity and potentially have a positive benefit to any organisms that utilise this habitat'. Please provide supporting evidence, documentation or references to how this placement will contribute to habitat complexity and the heterogeneity of the area and which species and how they will benefit.**

Qualitative assessment of the relative proportion of rocky habitat in the reservoir was undertaken in shallow sections from towed camera surveys of the reservoir. Large rocks were only viewed occasionally in the footage, with soft sediment and submerged timber appearing by far the most abundant substratum type (See also Section 5.1.1 of Annexure B of the AEA).

Hard surfaces such as rocks / boulders have been identified as providing cover / reproductive habitat for trout cod (e.g. MDBC 2007; NSW DPI 2006). NSW DPI (2006) also considers boulders as a form of habitat complexity. Based on this, it would be expected introduction of rock material would contribute to habitat complexity and benefit trout cod, particularly if the abundance of this habitat is currently limited.

The proposed placement of coarse D&B material in a 3 ha area of Ravine Bay would provide habitat complexity due to the addition of different sized bed material into the benthic environment.

32. **Aquatic Vegetation - it is stated that 'macrophytes would re-establish in the placement areas within a few years'. As above, DPIF needs to see the supporting evidence, documentation or references to back up this claim of how macrophytes will re-establish in such a short period of time in solid rock.**

It is not expected that macrophytes would re-establish on solid rock, nor is the material in the placement area expected to consist solely of solid rock but rather a mix of coarser D&B material including sand-sized particles that would be expected to provide suitable substratum for colonisation by aquatic macrophytes. The most abundant macrophyte identified in the reservoir is *Elodea*. In Australia, *Elodea* is known to spread by fragmentation and is therefore likely to spread into disturbed areas by vegetative growth. The suitability of substratum for colonisation would depend on its particle size distribution (PSD), and if suitable, *Elodea* fragments from adjacent undisturbed areas could establish. Several online resources, e.g. ISSG (2020), USFWS (2020), ALA (2020), refer to *Elodea's* ability for rapid growth.

33. **Section 6.3.2.4 This section clearly identifies and highlights there will be significant increases in turbidity levels, and in some areas much greater than those identified in Table 6.3. These will have impacts on biota, productivity and will settle out to a depth greater than 150mm in some of the most important Murray crayfish habitats with the reservoir, i.e. Raven Bay, Middle Creek, Middle Arm, the lower Yarrangobilly River arm and the Tumut River arm. The impact of this has not been adequately identified or assessed, particularly with respect to Murray crayfish, a species known to be sensitive to high suspended sediment levels.**

See response to Submission 13.

The revised excavated material placement methodology includes placement of material in Talbingo reservoir from drill and blast excavation only. Material from TBM excavation that would produce greater proportions of fine material would not be included. This would result in the material placed in the reservoir containing approximately 2% fines (<63 µm), compared with 10% fines if TBM material were included. Revised modelling indicates this would result in lower concentrations of suspended sediment throughout the reservoir compared to the modelling presented in the EIS and used for the impact assessment presented in the AEA (see 4.3.3 Excavated rock management). For example, maximum surface TSS at the dam wall would be 2.5 mg under the revised methodology, compared with approximately 18 mg/L presented in the EIS. At 1 km from the placement the maximum TSS would be 5 mg/L compared with approximately 30 mg/L in the EIS.

These revised values are comparable with background TSS in the reservoir. The duration of elevated TSS values would also be reduced at these locations to within 18 months, rather than over 36 months as predicted previously. These values are likely to result in levels of turbidity in these areas within ANZECC guidelines for turbidity, and, overall, suggest impacts to Murray crayfish and other aquatic biota at least 1 km north of the placement area would be minor. Levels of TSS would be expected to be greater than this within the placement area and upstream in the Yarrangobilly River arm Tumut River arm of the reservoir.

To help mitigate risks to aquatic biota to changes in water quality, during excavated material placement in the reservoir, A TARP will be in place with real time continuous physicochemical water monitoring at buoys immediately adjacent to the rock emplacement area and in locations further away. Trigger action responses will depend on the extent of water quality impacts and will be developed in consultation with relevant agencies. See Section 4.4.1 of the RtS for further information.

The assessment acknowledges that Murray crayfish would be vulnerable to elevated suspended sediment and sedimentation. Updated sedimentation rates are currently unavailable but with significantly reduced TSS concentrations predicted, the rates of sedimentation will also be significantly reduced. It is noted also that the greatest sedimentation rates (i.e. up to 150 mm) were predicted only adjacent to the placement area, with rates decreasing with distance from the placement area (Section 6.3.2.4 of the AEA). Sedimentation rates were predicted to be between 7 mm/year and 45 mm/year in the southern half of the reservoir and between 2 mm/year and 15 mm/year in the northern half of the reservoir. These rates are expected to be lower under the current methodology.

Crayfish sampling within Talbingo reservoir by Zukowski & Whiterod (2019) indicate that although in low apparent abundance, Murray crayfish are broadly distributed throughout the reservoir from the reservoir dam wall in the north and into the Yarrangobilly Arm of the reservoir in the south. As shown in Table 3 of Zukowski & Whiterod (2019), the higher numbers of crayfish caught in the Yarrangobilly Arm in the more recent study are more indicative of additional sampling effort in this area as opposed to higher actual abundance.

Following the implementation of mitigation measures described in Table 6.4, the AEA considered it likely that minor impacts to Murray crayfish would occur due to changes in water quality associated with placement, resulting in a moderate risk to this species.

34. **Similar to previous comments regarding why the silt 'curtains will not extend to the bed of the reservoir'.**

Specific details regarding the nature of and placement locations of any silt curtains will be established within the DEMMP and/or AqHMP. These documents will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

35. **This section mentions 'significant change to water quality throughout the reservoir and impact on aquatic ecology' and 'increases in concentration of aluminium and changes in pH' however the expected changes for pH have not been provided, given that species such as Murray crayfish are sensitive to changes in pH these values need to be provide to allow for assessment.**

Reference in the AEA to predicted changes in the pH of reservoir waters was associated with the fine materials proposed for in-water placement. With the revised plan for placement of only coarser D&B material in Ravine Bay, the associated change in pH is no longer expected.

As noted in the AEA the AqHMP will include a trigger action and response plan for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species.

36. **Sedimentation has been stated to be 'Greater in shallower parts of the reservoir (i.e. reservoir edges) than in deeper parts'. These are the more valuable habitats for many species, particularly Murray crayfish, yet there is an inadequate assessment of this impact.**

See response to Submission 28 and 33

37. **Table 6.3 clearly shows a significant reduction the photic depths with the impact of this to cause the aquatic plants to 'die and decompose and cause eutrophication with associated reductions in dissolved oxygen concentrations'. What are the predicted DO levels and over what area of the reservoir and for what period of time?**

Reference in the AEA to predicted changes in the DO of reservoir waters was associated with the suspension of fine materials (<63 µm) proposed for in-water placement and the reduction in photic depths. With the revised plan for placement of only coarser D&B material in Ravine Bay, the amount of fine material

available for resuspension will be much reduced and widespread changes in photic depths and DO are no longer expected.

As noted in the AEA the AqHMP will include a trigger action and response plan for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species.

38. **Table 6-4 Mitigation AE08 states that 'silt curtains will be deployed where practicable'. Does this mean that it is envisaged that there may be areas where it is not practicable to deploy silt curtains? If so what are these areas and conditions and how does this effect the impacts on water quality?**

See response to submission 34

39. **Table 6-4 Mitigation AE01 The relocation of Murray crayfish from shallower parts of the disturbance area prior to disturbance, is based on the assumption that there is suitable habitat and capacity to relocate these animals to other areas of the reservoir where they will survive, however there is no evidence provided to support this. Given the significant declines in the population and the apparent limited habitat, this may not necessarily be useful measure to maintaining the population and mitigating the impacts.**

As indicated by the survey by Zukowski & Whiterod (2019), it would be anticipated that relatively few individuals will be retrieved during capture and relocation programs. Based on our surveys of habitat for the EIS it is our opinion that there would be suitable habitat for translocation of Murray crayfish elsewhere in Talbingo Reservoir. Surveys by Zukowski & Whiterod (2019) indicate that Murray crayfish are located throughout the reservoir (albeit currently in apparent relatively low abundance). This suggests that suitable habitat exists throughout the reservoir. DPI Fisheries would be consulted during the preparation of the AqHMP including the prescribed process for capture and relocation of Murray crayfish. If preferred by DPI Fisheries, individuals could be provided to DPI Fisheries for use in captive breeding or relocation programs in other locations.

40. **Table 6-5 DPIF has reviewed this table and provides the following suggested changes:**

    Loss/modification of aquatic habitat due to smothering; and the Displacement/direct mortality of existing aquatic organisms; and the likelihood and consequences for Murray crayfish should be changed to high for both the before and after mitigation. Changes to water quality the after mitigation for consequences should be changed to Moderate.

See response to Submission 13 regarding the experience of the team developing and implementing the risk assessment, its transparency and clearly defined categories. On the basis of this assessment, Cardno does not anticipate sustained population level impacts on Murray Crayfish in Talbingo Reservoir as a result of the excavated material placement program following implementation of the mitigation measures described in Table 6.4.

The mitigation measures proposed in Table 6.4 represent a commitment by Snowy Hydro to minimise the potential impacts associated with the excavated material placement program within each of the reservoirs to the greatest extent practicable. As noted in the AEA the AqHMP will include a trigger action and response plan for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species. This plan will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

41. **Section 6.4.1.5 Installation of Fish Barriers. The proposed instream barrier on Tantangara Creek to protect Stocky Galaxias in that system, whilst it may afford the protection of that small known population it does not afford protection to the species elsewhere in the catchment and it still remains extremely vulnerable to other risks and threats. Whilst there are no other known populations of the species within the catchment, surveys are far from exhaustive and it is possible that other populations exist within or outside the catchment that would not be provided protection via the barrier. Also the longer term conservation of the species involves the establishment of additional population potentially within and outside the know range, however option will be all but removed if climbing galaxias establish within the catchment.**

Extensive surveys were undertaken by Cardno during preparation of the Main Works EIS and also presumably prior to the listing of this species as critically endangered under the Fisheries Management Act. Several tributaries in the Tantangara Creek catchment were sampled for galaxiids, including: Boggy Plain Creek, Gooandra Creek, Kiandra Creek and an unnamed creek on Bullocks Hill Trail. Salmonids were present at all sites and no galaxiids were caught. Galaxiids were detected further downstream in the

Tantangara Creek and Murrumbidgee River Catchment. However, none of the individuals caught were identified as stocky galaxias (Raadik, 2018). Based on understanding of its inability to co-occur alongside introduced salmonids, if the species does occur elsewhere, it would be restricted to sections of watercourses above natural barriers (e.g. waterfalls) that are comparable to that present on upper Tantangara Creek. As noted in Allan and Lintermans (2019), preliminary surveys of potential translocation locations indicate that existing options are limited.

As noted in Allan and Lintermans (2019), all known potential translocation sites already contain salmonids so would require construction of an artificial barrier and treatment of the waterway to remove all salmonids and other fish that could compete with the stocky galaxias as well as other potential catchment protection measures. These measures would not change in the event that climbing galaxias established within the catchment.

The proposed barrier would afford protection to all known individuals of this species.

42. **The screening system to be installed in Tantangara Reservoir is stated to 'prevent the passage of all life stages of Redfin perch, eastern gambusia and climbing galaxias, however not details are provided on the specifics of the screens or the evidence of their efficacy. Recent information obtained by DPIF suggest that Redfin perch larvae can pass through a 0.25mm screen in a passive environment, suggesting that the proposed screen will not be effective.**

Following this submission, further information on the mitigation measures proposed to prevent transfer of undesirable fish species out of Tantangara Reservoir has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

SHL has not been able to obtain full access to the study referenced by DPI but note that the study was conceptual only in its approach, utilised a different screen type to that proposed for Snowy 2.0 and did not replicate other key features of the proposed design. To our knowledge, the study is not peer-reviewed or complete. As such, SHL does not feel that this study provides any value with regards to predicting the likely efficacy of the screening system proposed at this location (See Appendix N of the RtS).

43. **Section 6.4.2.2 Direct – temporary obstruction of fish passage. It states that 'Reik's crayfish and common yabbies have migratory stages in their life history which could be temporarily affected by barriers to fish passage.' Both Reik's crayfish and the common yabby do not have a migratory stage in their life history and would not be affected by barriers to fish passage.**

Acknowledged.

44. **Table 6-6 Mitigation Code AE02, This measure should also include temporary crossings.**

Fairfull & Witheridge (2003) already includes details on considerations for the management of the construction phase of crossing works including temporary crossings.

45. **Table 6-7 Indirect spread of aquatic weeds and pest fish, Tantangara Reservoir, native aquatic species, the likelihood of occurrence changes from possible in before mitigation to unlikely after mitigation, however there are no mitigation measures outlined for the spread of aquatic weeds and pest fish to Tantangara so therefore this likelihood should remain the same under both scenarios. Similarly for the Upper Murrumbidgee River, native aquatic species, no mitigation measures are identified so the likelihood should remain unchanged. The Upper Tantangara Creek, threatened aquatic species stocky galaxias consequences should be increased to catastrophic for both the before and after mitigation scenarios.**

See response to Submission 13 regarding the experience of the team developing and implementing the risk assessment, its transparency and clearly defined categories.

This section is related to the spread of invasive species by vectors (e.g. via vehicles / plant equipment) during construction, not during operation of the proposed power station. Preventing the spread of aquatic weeds and pests via vehicle and plant equipment movements will be managed via measures outlined in the Weed, Pest and Pathogen Management Plan, thereby reducing the risk of transfer and associated impacts via these pathways.

46. **Section 6.5.1 with major draw downs, decreased flows and increased cease to flow periods, it is very likely that there will be stranding of fish in these systems, yet there does not appear to be any consideration or proposals to monitor and if needed rescue and relocate stranded or at risk fish.**

No native species of fish have been identified in the watercourses that may be affected by drawdown (Galaxiids have been identified downstream only in areas not anticipated to be affected). Therefore, the requirement for such activity is likely minimal. Impacts to salmonids, if they occur, would likely be more effectively offset by increased stocking.

Revised groundwater drawdown predictions incorporating measure to limit inflows into the tunnel indicate less severe reductions in water availability in nearby watercourses (RtS Section 4.5.1 Water) than described in the EIS. This are expected to reduce the increase in number of zero flow days and severity and extent of associated impacts to aquatic ecology. While there would be potential for zero flow days and stranding of salmonids to occur, these events are likely to be less frequent and less severe than previously predicted.

47. **Table 7-2 Given that there are no proposed mitigation measures being proposed, why is the after mitigation section being included in this table?**

Risk assessment tables throughout the AEA use an identical format to clearly show instances where mitigation measures are proposed that will be expected to reduce the risk of an impact. Additional mitigation measures are not always deemed appropriate or required, especially in cases where the inherent risk is small.

48. **Section 7.2.3.1 Description of Impacting Process it is stated that 'flat-panel wedge wire screens, drum screens and submerged water intake, fish friendly screens were considered technically feasible'. However associated high construction costs and environmental impacts render these options and not feasible. No information was provided on the relative costs associated with these options, nor the environmental impacts. Both the financial implications and environmental impacts need to be provided to allow for a transparent and rigorous assessment.**

Following this submission, further information on the options considered to prevent or minimise transfer of undesirable fish species has been discussed in meetings with DPIE and DPIF and provided by Snowy Hydro (See Appendix N of the RtS).

49. **Section 7.2.3.2, the risk of a spill event from Tantangara reservoir post the construction of Snowy 2.0 has been described as extremely rare, however it is still a possibility and therefore poses a substantial risk to the downstream fish communities should a population of redfin perch establish within Tantangara reservoir. There is also no assessment undertaken regarding the increased risk of accidental/deliberate transfer of redfin perch by other means if a population establishes within Tantangara reservoir. If a population was to establish with Tantangara this in itself poses a heightened risk of transfer by the simple fact that there is a population within the catchment and the proximity to the receptor. This risk needs to be included and assessed as has been done with the other potential transfer risks, this risk also needs to be included within the cumulative impacts**

A discussion on SHL's very high capacity to manage inflows and avoid spills from Tantangara Dam is described in Section 7.2.3.4 of the AEA. Following the construction of the Snowy 2.0 project, SHL has high confidence in being able to avoid spill from Tantangara Dam. Other potential vectors would include accidental or deliberate transfer via general public. This illegal activity is regulated by DPIF via provisions in the Fisheries Management Act and is outside of the control of Snowy Hydro.

See response to Submission 8 regarding cumulative impacts.

50. **Section 7.2.3.3 Primary Catchments, Likelihood of transfer, Area 1 - the assumptions made in this section relating to climbing galaxias are inaccurate, whilst it is not likely that there is a large resident population of climbing galaxias within Talbingo reservoir as suggested, the most likely life history scenario for climbing galaxias is that the resident populations are present within the tributary and headwater streams of Talbingo reservoir, where they live and spawn, the eggs are then washed and stimulated to hatch on high flows and the newly hatched larvae are washed into the reservoir. It is most likely that they then remain within the reservoir for 5-6 months before migrating back upstream in the tributaries. So whilst it is unlikely that there is a large resident population within the reservoir, and it is unlikely that spawning is occurring with the reservoir, by virtual of the fact that the larvae are most likely being washed into the lake at a very early life stage (i.e. just hatched) the likelihood of transfer is quite possible rather than unlikely as suggested.**

See response to Submission 11.

The likelihoods of transfer provided here are based on a relative assessment among different species of fish, using apparent relative abundance and habitat usage (e.g. deeper water versus shallower shoreline areas). Compared with the relatively abundant species such as redfin perch and salmonids known to occur in deeper waters, climbing galaxias would be less likely to be transferred.

During surveys for the project, two climbing galaxias individuals were detected in Yarrangobilly River, which forms part of the Talbingo Reservoir catchment.

The reproductive ecology of landlocked populations in the MDB is unknown, but it is possible that reservoirs or lakes replace the marine larval stage (Lintermans, 2007). If the few climbing galaxias detected in the Yarrangobilly River catchment form part of a breeding population, it is possible that the fish may spend part of their larval life stage within Talbingo Reservoir where they may be at risk of entrainment into Snowy 2.0. Due to the very low observed abundance of this fish, the risk of entrainment through Snowy 2.0 was assessed as relatively unlikely compared with other species present in the reservoir.

As noted in Submission 20, in Section 7.2.3.4 of the impact assessment it is considered 'likely' that *if transferred* to Tantangara Reservoir that climbing galaxias would move upstream of the waterfall on Tantangara Creek (in the absence of the barrier control).

51. **Area 2 It is stated that climbing galaxias are unlikely to be transferred, as mentioned above DPIF consider it quite possible and likely a transfer could occur, and if it does it is also highly likely that this species would move upstream into the tributaries of Tantangara reservoir including Tantangara Creek above the waterfall.**

See response to Submission 11, 20 and 50. It is acknowledged in the EIS, that should it be transferred to Tantangara (which is considered unlikely), over time these fish could colonise upper section of the Murrumbidgee River catchment including the upper section of Tantangara Creek, hence the reason why a barrier has been proposed in this location to prevent this.

52. **Area 2b - requires some supporting evidence or a reference to support the statement 'that the 3.7 km pipe would be unsuitable for the active passage of climbing galaxias'.**

See DPI Fisheries website: https://www.dpi.nsw.gov.au/fishing/habitat/threats/barriers

Types of barriers to fish barriers identified include "*behavioural obstructions (e.g. dark tunnels or unnatural substrates created by pipes).*"

53. **Tantangara Reservoir, Redfin Perch - this section states 'It is noted that also that introductions could occur irrespective of the Project'. This statement is irrelevant to the risks posed by the project and provides no benefit to the assessment.**

The statement is considered relevant in that it provides context to compare current risks with potential future risks.

54. **This section also classifies the habitat in Tantangara reservoir as marginal for redfin, and whilst it may not be ideal habitat, a more accurate description would be suboptimal rather than marginal.**

The term 'marginal' is derived from the description of these areas following MaxEnt modelling undertaken by Baumgartner *et al*. (2017).

Tantangara reservoir is also described as providing sub-optimal habitat for redfin perch in Section 7.2.3.2. These terms are interchangeable.

55. **It is stated that 'yabbies are not native to either reservoir', yet there is no evidence or a reference to support this statement.**

This was information provided by Tarmo Raadik (pers., comm), following identification of photographs of specimens, *Cherax* not found naturally in the area of the upper Murrumbidgee River.

56. **Upper Tantangara Creek Catchment - in this section the climbing ability of climbing galaxias is described as being 'purported', yet the climbing ability of the climbing galaxias is well reported and documented, and the species has been recorded from above waterfalls equal to and much greater than the one that exists on Tantangara Creek. Therefore the climbing ability of climbing galaxias is certainly not purported and there is no doubt that they would have the ability to climb the waterfall on Tantangara Creek.**

The potential ability of climbing galaxias to move over the waterfall in the upper section of Tantangara Creek, should they be transferred to Tantangara Reservoir, is not disputed hence the reason why a barrier has been proposed above this location to prevent movement into the catchment above this location.

57. **Redfin Perch - the habitat within the mid-Murrumbidgee River has been described in this section as being suboptimal for redfin perch. DPIF disagrees with the statement, and suggest that the habitat would be optimal for redfin perch within much of the mid-Murrumbidgee River. There are many large deep slow pools, weed beds, woody debris and structural habitat required by redfin perch. Therefore it is highly likely that if redfin perch were translocated into this section of the river they would establish a self-sustaining population, most likely with an initial population boom, as has been seen and reported in other similar river systems. This would have catastrophic consequences for the native fish community, particularly Macquarie perch.**

Reference to sub-optimal habitat is provided in the context of comparison with lotic environments:

"*Although the Mid Murrumbidgee River would probably provide sub-optimal habitat compared with lotic environments, it does support structural habitat including wood debris suitable for spawning, at least in slower flowing pool sections, and the establishment of a self-sustaining population of redfin perch here cannot be ruled out*"

In addition, modelling of habitat suitability by Baumgartner et al. (2017) which included co-authors from DPIF concluded that the mid-Murrumbidgee River from the Tantangara dam wall downstream to about Cooma constituted marginal habitat, defined as <0.2 probability of survival. Downstream of Cooma, habitat suitability increased to a probability of survival of 0.2-0.4.

As noted above, establishment of a self-sustaining population of redfin perch here in the event of a transfer has not been discounted and has been considered in the impact assessment for the AEA.

58. **Macquarie Perch - this sections states that 'There may be potential for some level of co-occurrence, for example while redfin perch and Macquarie perch may compete for resources, some degree of niche separation may be present.' DPIF consider the likelihood of co-occurrence to be extremely unlikely and without supporting evidence or justification should be deleted. DPIF requests copies of the supporting documentation or references to support this statement.**

The potential for co-occurrence is related to observed differences in spawning habitat and predator avoidance by Macquarie perch, at least in a laboratory setting (Brown and Morgan 2015). The assessment does not suggest that co-occurrence is a likely outcome, rather it attempts to provide a balanced assessment of potential outcomes, and acknowledges that a potential outcome of redfin introduction here is loss of the population of Macquarie perch from this section of the Murrumbidgee River.

59. **It is also stated in this section that based on some lab experiments and differential spawning requirements that 'this could suggest co-existence is possible, though no conclusive evidence of long-term redfin perch and Macquarie perch co-existence has been identified'. If no evidence has been identified then it should not be suggest or included as part of this assessment. What has been identified and well documented is the detrimental impact and loss of populations of Macquarie perch due to invasions by redfin perch.**

As noted above, co-occurrence is not being considered the likely outcome of any interaction.

60. **It is stated that the 'potential impact could range from a small reduction in population size up to the loss of the population'. The lower end of this range is based on speculative potential niche separation and co-occurrence for which there is no evidence. The likely scenario if redfin perch establish in the mid Murrumbidgee is rapid and significant decline of the population of Macquarie perch to the point of local extinction - this needs to be clearly identified and included in the document.**

See response to item 58 and 59.

The risk assessment in Table 7-4 assessed the likelihood of a 'Major' consequence to Macquarie Perch, being the potential loss of the population should redfin establish downstream of Tantangara Dam.

As noted in the AEA and the response to Submission 20, the impact assessment took a precautionary approach with regard to the potential for transfer of fish to and their establishment in new catchments. The likelihood of this occurring in the case of redfin perch was assessed as 'possible' in the absence of controls

and ‘rare’ following the implementation of the proposed barrier to prevent fish movement out of Tantangara Reservoir.

61. **It is stated that ‘given the many uncertainties, not least the very low likelihood of transfer of redfin to this location, the potential reduction in population size likely to occur cannot be predicted with certainty’. The objective of this assessment is not to predict outcomes with absolute certainty, it is to identify risks, look at the likely outcomes of these risks and identify mitigation options and measures for these risks. What can be predicted with a very high level of certainty is that if redfin establish within the mid-Murrumbidgee catchment, then the impacts on the resident Macquarie perch population will be catastrophic, with the most likely outcome the localised extinction of that population.**

As above, it is considered possible that if redfin perch are transferred to Tantangara Reservoir and subsequently establish in this section of the Murrumbidgee River then impacts to the Macquarie perch population could occur. Loss of a population (not species extinction) is defined as a Major consequence in Table 4-4 of the AEA. Regardless of the likelihood, consequence and risk rating identified here, the barrier control at Tantangara Reservoir dam wall is proposed. Coupled with Snowy Hydro’s high confidence in avoiding spills over the dam once Snowy 2.0 is operational (See Section 7.2.3.2 of the AEA), these measures would substantially reduce the risk of transfer of redfin perch to this section of the Murrumbidgee River.

62. **Table 7-3 AE18 - again further details are required regarding the size and effectiveness of the proposed screens to allow an evaluation of the level of efficacy.**

See response to submission 5.

63. **AE04 - the monitoring and surveillance programs included within the section need to be for the operational life of the project, this needs to be clearly stated.**

Any management plans prepared during construction of the project would only apply for the period of construction. Some elements of the plans such as monitoring programs may need to continue beyond the period of construction. The details of these monitoring programs, including their duration and the process for adaptive management, will be developed in consultation with DPIF and where appropriate will become operational procedures.

64. **Table 7-4 - why has an assessment not been included for other native species and salmonids in the upper Murrumbidgee Catchment?**

Assessments of impacts to salmonids and other native species (e.g. Reiks crayfish) due to transfer of redfin perch are provided in Section 7.2.3.3 under Upper Murrumbidgee Catchment. The outcome of the assessment was the same as that for Tantangara Reservoir (i.e. Likelihood: Possible, Consequence: Moderate and Risk Ratting: Moderate for native species). Risk ratings are not provided for non-native species. It is acknowledged a drafting error appears to explain the absence of this information from Table 7-4 of the AEA.

65. **Table 7-4 - the consequence to Macquarie perch from impact of potential fish transfer needs to be changed from major to catastrophic for both before and after mitigation.**

See response to submission 13.

Loss of a population, rather than an entire species, is defined as a major consequence in Table 4-4 of the AEA. Catastrophic consequences would occur in the case of extinction of an entire species. Regardless of the consequence and associated risk rating, as set out in Section 7.2.3.6, the barrier controls proposed for Tantangara Reservoir are expected to prevent the transfer of fish out of Tantangara Reservoir to other catchments to the greatest extent practicable and therefore represent the most appropriate and reasonably practicable measures to minimise any negative consequences to Macquarie perch as a result of the risk of redfin transfer from Talbingo Reservoir

66. **Section 7.2.5.2 Talbingo Reservoir, the sample size for EHNV sampling was ‘not sufficient to have high confidence in the result’. Further to the sample size not being adequate there is question regarding the suitability of the analysis and the interpretation of this analysis (Hicks et al 2019). Further adequately detailed and appropriate sampling, analysis and interpretation is required. Further information is required regarding the present status of EHNV within Talbingo as clearly the current study is inadequate and as identified in Hicks et al (2019) ‘the stability of EHNV in the environment is sufficient to enable it to remain viable for the duration required to move from Talbingo to Tantangara and to the Macquarie perch population in the upper Murrumbidgee River if water is released from the reservoir during an active disease**

outbreak'. Therefore the conclusion that 'a possible occurrence of EHNV within native species (threatened or non-threatened) during the life of the project is considered unlikely following installation of the fish barrier, which would be expected to reduce, but not eliminate the risk of EHNV being transferred in the event of an outbreak of EHNV in Tantangara reservoir' is unjustified. As highlighted by Hicks et al (2019) the risk of transfer is likely irrespective of the fish barrier, therefore the risk would be deemed as high until further information regarding the EHNV status within Talbingo is provided and the consequence for Macquarie perch is catastrophic and for other native species it would be major.

The description of the existing aquatic environment and environmental assessment is based substantially on the technical review of Hicks et al (2019). In the wild, the only species of fish in NSW known to be affected by an outbreak of EHNV is the introduced redfin perch. Rainbow trout have succumbed to EHNV in aquaculture facilities. Additionally, clinical studies have identified that gambusia are susceptible and that native species including Macquarie perch, Murray cod (but not trout cod), mountain galaxias and possibly climbing galaxias, among other species, are also susceptible. No outbreak of EHNV in the wild has been recorded for these species. Potential susceptibility of stocky galaxias is unknown. As a precautionary measure, for the purposes of the EIS it has been assumed that any of the above species could be susceptible to EHNV in the wild.

There has been no known outbreak of EHNV recorded in Talbingo Reservoir, which would be evident primarily in redfin perch and perhaps rainbow trout. In particular no outbreaks were evident at the time of the major outbreak in Blowering Reservoir in 1996 or 2009. There have been no outbreaks of EHNV recorded in Tantangara Reservoir. Based on existing information including the report by Hick et al. (2019) it is not possible to eliminate the likelihood that EHNV exists in Talbingo Reservoir. As a precautionary measure, for the purposes of the EIA, it is assumed that EHNV could be present in Talbingo Reservoir, despite a lack of evidence for this.

As such, mitigation measures for the project include a surveillance plan for EHNV in key locations within the project area.

The assessment of reduced risk of transfer of EHNV via the secondary controls was based on the understanding that the barrier would prevent movement of live redfin perch and whole dead fish, if present. This would leave only transfer of EHNV via the water, or attached onto small particles of biological matter. By reducing the transfer of live redfin, the likelihood of transfer is also reduced, but not eliminated, as is acknowledged by the residual risk ranking in the EIS.

67. **7.2.5.5 Mitigation Measures and Residual Risks - surveillance is included as a mitigation measure, however surveillance in itself is not a mitigation measures if there are not actions associated with it or implemented once detection occurs, which appears to be the case here. The only mitigation measures identified currently is the installation of the fish barrier, to which no details regarding its efficacy have been provided and as highlighted by Hicks et al (2019), there is still significant risk of transfer of disease, particularly if there is an outbreak within Tantangara reservoir.**

Actions associated with the surveillance program will be described in the associated management plan to be developed in consultation with DPIF. Actions include design and implementation of surveillance and response plans in the event of an outbreak of EHNV (see response to item 66, above).

68. **Table 7-8 Threatened aquatic species – Macquarie perch, consequence for both before and after mitigation should be catastrophic, and the likelihood for after mitigation should be changed to possible, this would change the risk for both after and before mitigation to high**

Assessment of consequences and risk to Macquarie perch considered the points raised in response to Submission 65. Also see response to Submission 13 regarding the experience of the team developing and implementing the risk assessment, its transparency and clearly defined categories.

As noted by Hick et al. (2019), Outbreaks of EHNV are not common in the study area and the frequency and virulence of outbreaks may be declining. The last known outbreak in NSW occurred in Blowering Reservoir in 2009. EHNV has never been detected in Talbingo reservoir, including in testing undertaken for this study. There have also been no reports of infection of wild Macquarie perch. If an outbreak were to occur in this section of the Murrumbidgee River, it is not unreasonable to expect that some individuals would survive.

The reduction in likelihood (i.e. from possible to unlikely) of this occurring represents the introduction of mitigation (i.e. surveillance program and response plans aimed at reducing the volume of infectious material that would be transferred, should an outbreak occur in either Talbingo or Tantangara reservoir at some point in the future, as well as the fish barrier at Tantangara Dam).

69. **Section 9.1 Summary of mitigation measures AE01 - the AqHMP is proposed to be prepared in consultation with DPIF - it is DPIF's position that any such plan will be approved by and/or part of the potential s.216 permit issued by DPIF, if appropriate. DPIF is currently having issues with the quality and appropriateness of the AqHMP that were developed for the Exploratory Works, so any future plans will be to the satisfaction and written agreement of DPIF as conditions of approval.**

Acknowledged. Snowy Hydro and the contractor will seek to comply with all conditions of project approval stipulated by DPIE (refer to RtS Section 4.3.1 Approvals process and compliance).

70. **AE08 - clarification is required regarding the application of silt curtains 'where practicable' - what does that mean exactly, are there areas already identified as not being practicable, if so how does this impact on the water quality? The phrase 'where practicable' does not sound consistent with world's best practice.**

Specific details regarding the nature of and placement locations of any silt curtains will be established within these documents which will be prepared in consultation with relevant agencies and will be subject to approval by DPIE.

71. **AE02 - similar to the above statement, bridges and culverts will be designed in accordance with DPIF fish passage requirements, not 'where practicable'. This measure should also include temporary crossings. As above, DPIF has prepared policies and guidelines for road crossings that are world's best practice and Snowy 2.0 will be expected to meet and/or exceed those guidelines.**

Acknowledged.

72. **Table 9.2 Direct noise and vibration from blasting - an accurate assessment is not possible here as no figures are given so the risks are not able to be determined. The residual risk to Murray crayfish from changes to water quality and the 'edge push placement' requires further assessment. The indirect spread of aquatic weeds and pest fish sections does not include the mid-Murrumbidgee section, which is one of the sections seemingly most at risk from this impact.**

See response to Submission 33 with regard to residual risks to Murray crayfish. As noted in the AEA the AqHMP will include a trigger action and response plan for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species.

Proposed blasting will be limited in extent and duration (i.e. will take place during construction and within the intake construction area only), and is not expected to result in significant reservoir-wide impacts to aquatic biota in Talbingo Reservoir. It is acknowledged, however, that localised impacts to biota could occur in and immediately adjacent to the intake construction area. Measures will be included in the AqHMP help mitigate impacts to aquatic species. As noted in the AEA, a translocation program for Murray crayfish would be undertaken with the work area prior to disturbance. Measures to discourage other biota from the area prior to blasting will also be considered during the preparation of the AqHMP. The absence of assessment of indirect spread of aquatic weeds and pest fish sections in the mid-Murrumbidgee section appears to be a drafting error. These assessments are provided in Table 7-8.

73. **Annexure B – Existing Aquatic Ecology, section 4.6 Pathogens and Other Aquatic Pests – this section identifies Lernaea spp as a risk and that is 'suspected to occur in the catchment' however no assessment or mention of this parasite has been included within the assessment. Were any investigations undertaken to determine is Lernaea is present within any of the catchments impacted by the project?**

No external parasites were noted on any of the fish caught from Talbingo Reservoir and Tantangara Reservoir.

Lernaea spp. is Suspected / anecdotal (rather than confirmed) from the Murrumbidgee River catchment (including Talbingo Reservoir) based on the NSW Aquatic Pest and Disease Distribution maps: https://www.dpi.nsw.gov.au/fishing/pests-diseases/pest-disease-distribution

This would suggest that if present in Talbingo Reservoir, Lernaea would be in very low abundance.

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