IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications by Waka Kotahi NZ Transport Agency (Waka Kotahi) to Manawatū-Whanganui Regional Council and Greater Wellington Regional Council for resource consents to enable the construction, operation and maintenance of new state highway, shared use path and associated infrastructure, between Taylors Road (to the north of Ōtaki) and Stage Highway 1 north of Levin.

SECTION 87F REPORT OF LOGAN ARTHUR BROWN – WATER QUALITY AND AQUATIC ECOLOGY

MANAWATŪ-WHANGANUI REGIONAL COUNCIL AND GREATER WELLINGTON REGIONAL COUNCIL

28 April 2023

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A. OUTLINE OF REPORT

1. This report, required by section 87F of the Resource Management Act 1991 ("**RMA**"), addresses the issues set out in sections 104 to 112 of the RMA, to the extent that they are relevant to the applications lodged with the Manawatū-Whanganui Regional Council ("**Horizons**") and Greater Wellington Regional Council ("**GWRC**") for the Ōtaki to North of Levin Highway Project (the "**Ō2NL Project**").

2. The resource consents applied for, by Waka Kotahi NZ Transport Agency ("**Waka Kotahi**"), are required to authorise the construction, operation and maintenance of new state highway, shared use path and associated infrastructure, between Taylors Road (to the north of Ōtaki) and State Highway 1 north of Levin.

3. In addition, Waka Kotahi separately lodged Notices of Requirement ("**NoRs**") relating to the Ō2NL Project with Horowhenua District Council and Kāpiti Coast District Council (the "**District Councils**"), respectively. Matters relating to the NoRs are outside the scope of this report, and are being addressed by the technical advisors for the District Councils.

4. In preparing this report, I have relied on the expert advice from the following technical advisors within the Horizons and GWRC reporting teams:

   (a) James Lambie, Terrestrial Ecology;

   (b) Michael Thompson, Surface Water Take and Allocation;

   (c) Michaela Stout, Surface Water Take and Allocation; and

   (d) Kerry Pearce, Erosion and Sediment Control.

5. I have also liaised with Justine Bennett, who is reporting on water quality for the District Councils, in the preparation of this report. Where I rely on Ms Bennett's reporting, I have identified it in my report.

6. While this report is pursuant to section 87F of the RMA, I have in accordance with section 42A(1A) and (1B) attempted to minimise the

repetition of information included in the application and where I have considered it appropriate, adopt that information.

B. QUALIFICATIONS / EXPERIENCE

7. My name is Logan Arthur Brown. I am the Freshwater and Partnerships Manager at Horizons. I have been in that position since July 2016. Prior to this I was a Senior Scientist – Water Quality. I have been employed by Horizons since June 2010. Previously I was employed by the Department of Conservation as a Freshwater Technical Support Officer.

8. As a senior scientist with Horizons, I oversaw the delivery of the coastal and estuary monitoring programmes, State of the Environment monitoring programmes for biological parameters which include periphyton, macroinvertebrates and fish, our contact recreation programme and the LakeSPI monitoring programme. I was also involved in a number of research programmes specifically around periphyton, including *Microcoleus autumnalis*. I remain involved in a number of research programmes focused on freshwater systems within Horizons.

9. My current role involves overseeing a team involved in the implementation of works that are aimed towards water quality and freshwater aquatic habitat improvements. These range from stream fencing, riparian planting, fish barrier identification and removal/remediation, the construction of wetland treatment systems, lake weed harvesting operations and the exploration of new methods that will result in water quality enhancement. These projects are being jointly undertaken with our Treaty partners, other Councils, and numerous landowners within the Horizons region.

10. I hold the qualifications of Master of Science – Ecology, Bachelor of Business Studies majoring in Economics, and Bachelor of Science majoring in Ecology, each from Massey University.

11. I am a member of the New Zealand Freshwater Sciences Society. I have been certified as an Independent Hearing Commissioner under the Ministry for the Environment "Making Good Decisions" programme.

12. I am familiar with the proposed works corridor and surrounding area. I visited the site and a number of stream locations along the proposed road corridor on 8 September 2022, along with Mr Alex James on behalf of Waka Kotahi. I also participated in some of the ecological workshops that were held during the preparation of the application.

C. CODE OF CONDUCT

13. I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. I confirm that I have stated the reasons for my opinions I express in this report and considered all the material facts that I am aware of that might alter or detract from those opinions.

14. This report addresses water quality and aquatic ecology effects relating to the construction and operation of the Ō2NL Project. Statements expressed in this report are made within the scope of my expertise, except where I rely on the technical advice, I have referred to above.

15. I have all the information necessary to assess the application within the scope of my expertise and am not aware of any gaps in the information or my knowledge.

D. EXECUTIVE SUMMARY

16. The key conclusions of my report include:

    (a) The Ō2NL Project will have adverse effects on the values of the waterways within the catchments affected by the works. The majority of these effects can be avoided, remedied or mitigated by the measures contained in the application. The exception is the loss of stream habitat which cannot be fully avoided, remedied or mitigated within the footprint of the Ō2NL Project area and therefore an offsetting management regime is proposed for stream loss.

    (b) There are reaches of streams that will be lost as a result of the Ō2NL Project. This involves stream loss as a result of the stream diversions for the road, and the installation of culverts. The

streams affected by the Ō2NL Project have had SEV scores calculated for them pre and post (with mitigation) construction of the works. As it is not possible to fully avoid, remedy, or mitigate the effects of this loss, the likely quantum of stream habitat restoration to offset the residual effects has been established, with the potential for offset sites scoped through the technical assessment process.

(c) The use of the SEV and ECR to calculate the volumes/area that are required to be offset due to the loss of stream habitat as the result of the proposal demonstrate a transparent methodology that can be replicated and understood. However, when undertaking the actual offsetting itself the method proceeds on the basis that ideal conditions are provided for aquatic fauna and that they will return from other surrounding reaches or through migration from the sea for migratory fish species. This is an assumption as there are number of factors that will control if or when these species will return. Many of these factors are outside of the control of Waka Kotahi and therefore while the offsetting model works on the basis that if we create a suitable habitat for them the species will return, this may not necessarily be the case. However, this is current accepted practice for stream loss offsetting at this present time.

(d) I am in general agreement with the offsetting proposal for the Ō2NL Project, subject to imposition of conditions which address residual uncertainty over the perpetuity of the offsets.

(e) The management of sediment prior to being discharged to waterways will be critical to managing instream effects from sediment. Subject to imposition of appropriate standards, and the erosion and sediment control ("**ESC**") recommendations of Mr Pearce for Horizons and GWRC, I am of the opinion that the ESC measures can effectively limit the instream effects as a result of sediment discharges into freshwater environments. However, as the application notes, even with these measures in place the Ō2NL Project will result in more sediment entering the

catchments in which earthworks are undertaken compared to the status quo.

(f) I recommend that proposed standards for discharges from sediment treatment devices reflect the sensitivity of the receiving environment. Using the information in the application for catchment sensitivity to sediment, I have proposed three different clarity standards based on the receiving environment, rather than relying on the one standard proposed project wide by Waka Kotahi.

(g) For operational stormwater, Waka Kotahi has proposed a range of treatment devices that will treat stormwater on an ongoing basis, prior to it being discharged to the receiving environment. This is based on a treatment train approach across the proposed road corridor. Overall, this will see an improvement in the quality of stormwater when compared to the current situation. These improvements rely heavily on the on-going monitoring and maintenance of the stormwater treatment devices so that they operate as designed and to ensure the removal of contaminants from the discharges prior to them entering the receiving environment. For this reason, I have recommended the monitoring of at least two treatment wetland complexes in catchments that are likely to be more sensitive to the inputs of stormwater.

(h) The Ō2NL Project proposes a number of water takes from catchments across the alignment. There are two types of water takes proposed. Those that fit within the core allocation and minimum flow framework of Horizons and GWRC and supplementary takes (Horizons) or those that occur at flows above median (GWRC). The overall intent of these takes is to minimise effects on the receiving environments. However, slight modifications are required to be made to the proposed conditions to reflect the intent of the takes within the Assessment of the Effects on the Environment ("**AEE**") and Technical Assessment K: Freshwater Ecology. This is to ensure that the proposed takes reflect the actual volume of water within the

waterways that is able to be abstracted and to manage the effects of values of the waterways.

(i) Waka Kotahi have identified light pollution for aquatic life at two locations and proposed mitigation measures based on stream shading to reduce the effect on the stream. I have recommended that conditions addressing these matters should sit within the freshwater section of the proposed conditions and ecological management plan to ensure that they are not lost within conditions proposed to deal with other matters of the proposal such as landscape etc.

(j) The methodology in relation to water quality and freshwater ecology parameters for the natural character assessment provides a robust and transparent methodology for the assessment of natural character under the One Plan and what the expected changes will be after construction of the new State Highway. I agree with the conclusions reached by Ms Williams.

E. SCOPE OF REPORT

17. My technical assessment considers the effects of the Ō2NL Proposal on water quality, freshwater ecology, and where relevant to my areas of expertise, natural character. It covers the following topics:

(a) Sensitivity of the receiving environments;

(b) Light pollution;

(c) Effects of sedimentation and standards;

(d) Sediment standards and monitoring;

(e) Discharge to O-Te-Pua Lagoon;

(f) Fish recovery;

(g) Water contamination from construction activities (excluding sediment);

(h) Water takes;

(i) Operational stormwater discharge;

(j) Fish passage;

(k) Offsetting; and

(l) Natural Character.

18. I have reviewed and relied on the following information provided by Waka Kotahi:

(a) Technical Assessment K: Freshwater Ecology;

(b) Technical Assessment H: Water Quality;

(c) Technical Assessment D: Landscape, visual and natural character;

(d) Technical Assessment G: Hydrogeology and Groundwater;

(e) Assessment of Effects on the Environment;

(f) AEE Appendix 4.2: Stormwater management design;

(g) AEE Appendix 4.3: Erosion and Sediment Control; and

(h) Waka Kotahi's response to the request for further information under section 92 of the RMA, by the Regional and District Councils, dated 22 December 2022 (the "**Section 92 Response**").

F. BACKGROUND

19. The application contains detailed information on the Ō2NL Project and the potential effects of the proposal across the catchments that are anticipated during construction and implementation. For brevity purposes, I do not repeat this information in detail.

20. For water quality and aquatic ecology habitat, there are two main routes for effects on freshwater values:

(a) The discharge of contaminants to the freshwater system through the construction and on-going operational phases of the Ō2NL Project, which influence both water quality and the streambed; and

(b) The loss of aquatic habitat through culverting, stream diversions, installation of stormwater discharge structures.

21. The technical information shows that the various waterways have differing sensitivities as receiving environments. This is important when considering the activities in each of the catchments, as standards/ triggers which might apply for a catchment with lower values (therefore being a less sensitive receiving environment) are unlikely to protect the values within a waterway that has higher values. As I discuss in more detail below, it is therefore appropriate to have different standards/ triggers for discharges applying to different catchments, as well as differing levels of effort being made with respect to recovery of the various species from waterways prior to works being undertaken.

G. EFEFCTS OF PROPOSAL

Sensitivity of receiving environments

22. A range of water quality, ecological and stream habitat information has been collected and analysed to inform the design of the Ō2NL Project. This analysis includes information collected by external parties to the Ō2NL Project such as Horizons' State of the Environment monitoring programme. This information and the accompanying analysis is set out in the technical reports accompanying the AEE.

23. The application identified that the proposed road alignment crosses a number of catchments that differ in their sensitivity as receiving environments. These are described in Technical Assessment K: Freshwater Ecology and Technical Assessment H: Water Quality. At paragraph 5 in Technical Assessment K: Freshwater Ecology an overall assessment is made of the ecological values within the waterways across the road corridor. The overall values being described as:

(a) "High" – two sites (Ōhau River and Waikawa River).

(b) "Moderate" – ten sites (Stream 39, Stream 39.1, Kuku Stream, Stream 29, Stream 27.1, Stream 19, Stream 17, Stream 18, Manakau Stream, and Waiauti Stream).

(c) "Low" – all other permanently flowing streams.

(d) "Negligible" – ephemeral waterways.

24. Based on the information provided within the application, I would agree with these overall values, although, as I noted below, the sensitivity of each of the waterways varies depending on the contaminant and activity under consideration.

25. I note that throughout Technical Assessment K: Freshwater Ecology and Technical Assessment H: Water Quality the rankings for the waterways change depending on the parameter that is being analysed at the time. For example, if we take the discharge of sediment to waterways, Table K14 in Technical Assessment K: Freshwater Ecology considers the sensitivity of each of the receiving environments to sediment inputs, and Technical Assessment H: Water Quality has for example looked at the sensitivity of the receiving to the discharge of stormwater. Considering the sensitivity of the receiving environment to a particular contaminant and/or activity means that each of the receiving environments, of which there are a number in the Ō2NL Project, can be independently and adequately addressed. The receiving environments sensitivity and the effects of the proposed Ō2NL Project are considered throughout this report.

26. The One Plan identifies a number of values relating to the Horizons region's waterways.[1] These values include the social, economic, cultural and environmental values of the region's waterways. The region has also been split up into 43 water management zones, and then into a further 124 water management sub-zones.[2] These values can be at a water management zone level (i.e. apply to the whole sub-zone) such as the contact recreation value, or they can be at a reach scale (e.g. trout spawning).

[1] Horizons Regional Council One Plan – Schedule B.
[2] Horizons Regional Council One Plan – Schedule A.

27. The proposed works for the Ō2NL Project fall within the Waikawa (West_9), Ōhau (Ōhau), Hōkio (Hoki), and Manawatū (Mana) water management zones. Within those, the Project falls into the Manakau (West_9b), Waikawa (West_9a), Lower Ōhau (Ōhau_1b), Lake Horowhenua (Hoki_1a), and Koputaroa (Mana_13e) water management sub-zones.

28. The following zone-wide values apply to all of the streams affected by the proposal:

    (a) Aesthetics;

    (b) Contact recreation;

    (c) Mauri;

    (d) Industrial abstraction;

    (e) Irrigation;

    (f) Stock water;

    (g) Existing infrastructure;

    (h) Capacity to assimilate pollution; and

    (i) Life supporting capacity – hill country mixed (Manakau, Ōhau), lowland mixed (Lake Horowhenua, Koputaroa).

29. In addition, the Natural Resources Plan (Appeal version 2022) contains reach and catchment specific values for Waitohu Stream and its tributaries. Schedule F values for the Waitohu catchment are:

    (a) Category 2 Surface waterbody;

    (b) Significant indigenous ecosystems - Habitat for indigenous fish species of conservation interest; and

    (c) Significant indigenous ecosystems - Habitat for 6 or more migratory indigenous fish species (longfin eel, giant kōkopu, shortjaw kōkopu, inanga, koaro, redfin bully, torrentfish and lamprey); Category 2 Surface waterbody.

30. I have identified the reach specific values in the affected catchments at **Appendix A**.

31. Technical Assessment H: Water Quality has considered the water quality targets contained within the One Plan and the Proposed Natural Resources Plan ("**PNRP**"). The report also notes that the that the One Plan targets/standards are broadly similar to the GWRC ones.[3] However, for transparency, the technical assessment has undertaken a comparison between the two.[4]

32. Waka Kotahi has used the Ecological Impact Assessment guidelines (EIANZ, 2018) to undertake the assessment of the effects of the Ō2NL Project. This process:

    (a) Establishes the level of ecological value of the environment;

    (b) Establishes the magnitude of ecological effect from the proposed activity on the environment;

    (c) Determines the overall level of effect to determine if mitigation is required; and

    (d) Establishes the magnitude and overall level of effects following implementation of measures to avoid, remedy or mitigate the effects.

33. The EIANZ methodology provides a transparent method to assess the effects of an activity on the receiving environment. However, one weakness of the methodology is the selection of the starting baseline. Many of the region's waterways have been degraded through anthropogenic factors, which has resulted in many of the values identified for those waterways not being provided for. Therefore, a starting basis for an assessment which factors in the current state (and the values provided for) may be very different to what the community wants the values of those waterways to be (e.g. as provided for in the One Plan) or what Central Government requires of Regional Councils in protecting or enhancing water quality and its associated values through

[3] Technical Assessment H: Water Quality para 50.
[4] Technical Assessment H: Water Quality, appendix H.3

instruments like the National Policy Statement for Freshwater Management 2020 ("**NPSFM**"). Therefore, it is my opinion that care is required when only looking at the current state especially if the current state does not align with targets/standards in the relevant regional planning framework or NPS documents (like the NPSFM).

34. Allowing further degradation of systems that are already degraded does not result in maintenance or enhancement of water quality. Instead, it moves water quality and freshwater ecology within the region further away from the targets/standards in those instruments/plans and the aspirations that communities have for their waterways. Many of the unnamed tributaries along the road corridor are unlikely to meet the water clarity standards in the respective regional plans. An example of this is visual clarity within the Waitohu catchment. Monitoring in the Waitohu Stream at Norfolk Crescent has a 5 year median distance for visual clarity as 1.01 metres,[5] whereas the PNRP has a target clarity of above 1.6 metres at above the 50th percentile flow. As I discuss below, the fact that values (for water quality) are already compromised is not a sufficient or good reason to allow for further degradation. In my view, it reinforces the need for standards on the discharge of some parameters (particularly sediment) into the waterways across the road corridor.

35. Waka Kotahi has assessed overall ecological values (based on flow permanence, SEV scores, habitat characteristics, macroinvertebrate community assemblages, and fish species present) for the catchments that are to be traversed as a result of the Ō2NL Project. Based on this, information catchments have been grouped into the following values based on their current state:[6]

    (a) High – Ōhau and Waikawa Rivers;

    (b) Moderate – Kuku Stream, Manakau Stream, Waiauti Stream, Streams 39, 39.1, 29, 27.1, 19, 17, and 18); and

    (c) Low – all other permanently flowing streams.

[5] https://www.lawa.org.nz/explore-data/wellington-region/river-quality/waitohu-stream/waitohu-stream-at-norfolk-crescent/.
[6] Technical Assessment K: Freshwater Ecology, paragraph 5.

36. When considering overall ecological values for the reaches of the catchments to be affected by the Ō2NL Project, I do not disagree with this overall assessment. However, I note that more detailed assessments for individual parameters/contaminants/works may mean that the levels of sensitivity change as the various parameters are considered. This aligns with the assessment undertaken in Technical Assessments K and H when considering individual activities across the range of works that the Ō2NL Project proposes. I discuss this further below.

H. LIGHT POLLUTION

37. The potential effects on macroinvertebrate communities as a result of light pollution on night flying insects is covered in detail in the Technical Assessment K: Freshwater Ecology.[7] There are two locations within the Ō2NL Project that have potential effects on freshwater values as a result of this lighting:

    (a) Roundabout linking Ō2NL to SH57 (chainage 13100) in close proximity to streams 39 and 39.1; and

    (b) Interchange near the southern end linking to the existing SH1 (chainage 34100) in close proximity to Stream 1 and 3.

38. Waka Kotahi proposes to undertake riparian planting along the stream margins to manage the effects from the lighting.

39. The Section 92 Response noted that this mitigation is via conditions DLV1 (Landscape planting) and RWB3 (Natural Character planting) as contained in the relevant planting plans. Although Waka Kotahi has provided this clarification through the Section 92 Response, it does not appear to be reflected in the conditions it has proposed for the application. Although the planting may well be identified as part of the landscape and natural character plantings, it is provided to mitigate effects of the lighting. Therefore, it should sit by itself as a requirement to mitigate an effect of the Ō2NL Project.

[7] Paragraphs 222–230.

40. Working on the basis that the planting that is to occur is at chainage 34100 (for Stream 1 and 3), I am not certain that the proposed planting will achieve shading of the stream (both upstream and downstream of the road crossing). The shading provided by the riparian vegetation is important as it is what is proposed to manage the effects of the light pollution. In my opinion a standalone condition should be included in the condition set, requiring the riparian vegetation to develop a closed canopy over the stream to be planted. This planting should occur upstream and downstream of the road corridor (culverts) at Streams 39, 39.1, 1 and 3. This is to ensure that the potential effects from light pollution are managed in an appropriate manner and so the response is aligned with the recommendations in Technical Assessment K (Freshwater Ecology).[8]

41. I note that no length upstream or downstream of the culvert inlet and outlets has been provided or recommended within the application. In my opinion, a distance of 100 metres upstream and downstream of the culvert inlet and outlet would be appropriate.

I. EFFECTS OF SEDIMENTATION AND STANDARDS

42. As with any large scale construction project, there is a risk of discharges of sediment into waterways, and even with best practice sediment management there will still be some construction sediment effects. It is a question of the magnitude of those effects.

43. As noted in Technical Assessment H:[9]

> The catchments with the highest percent increase in sediment load were those with the largest earthwork footprint relative to catchment size. These were Waitohu tributaries (catchment B, C, D), Manukau tributary (catchment G) and Mangahuia Stream (catchment I).

44. Waka Kotahi has assessed the modelled extra sediment at both the proposed works area scale and at a wider catchment scale. I have

[8] Technical Assessment K, at para 228(a).
[9] Technical Assessment H: Water Quality para 108.

repeated this information in Table 1 below, alongside the increase in sediment as a percentage.

45. Assessments need to be undertaken at both the catchment and proposed works area scale to consider the full effects of the Ō2NL Project within the context of the catchment. However, I would usually expect the immediate receiving environment (i.e., at the affected reach, sub-catchment) to be considered before the wider receiving environment. Although the wider catchment is important, this is context that Waka Kotahi has no control over in terms of managing in-river effects from the proposed activity – i.e., they are a constraint that must be worked within.

Table 1: Sediment load from earthwork sites after ESC measures as estimated using the USLE. Base information taken from Table H.15 in Technical Assessment H: Water Quality.

	Earthwork footprint from USLE calculation							
ID	**Name**	**Earthwork area (ha)**	**Sediment load with earthworks (t/yr)**	**Sediment load from project footprint before earthworks**	**Increase in sediment load from project (t/yr)**	**% increase earthworks area**	**% increase catchment sediment load**	**Earthworks area as % of catchment**
A	Greenwood	7.38	0.35	0.07	0.28	400	13	3.95
B	Waitohu	20.30	18.27	2.64	15.63	592	46	14.10
C	Waitohu 1	22.70	20.43	2.95	17.48	592	51	17.87
D	Waitohu trib 3	8.57	7.71	1.11	6.6	597	65	31.74
E	Waiauti	11.75	10.58	1.53	9.05	591	8	1.48
F	Manakau	2.73	2.46	0.35	2.11	603	2	0.36
G	Manakau trib	9.59	8.63	1.25	7.38	590	40	11.28
H	Manakau trib	3.85	0.18	0.04	0.14	350	14	4.53
I	Mangahuia	28.87	4.91	0.87	4.04	464	40	14.29
J	Waikawa	7.35	0.35	0.07	0.28	400	1	0.23
K	Waikokopu	9.59	0.45	0.10	0.35	350	15	4.84
L	Kuku	29.14	1.37	0.29	1.08	372	10	3.04
M	Ōhau	27.94	1.31	0.28	1.03	368	1	0.20
O	Koputaroa	43.75	7.44	1.31	6.13	468	12	2.94
P	Koputaroa trib	27.19	4.62	0.82	3.8	463	18	4.57

46. As covered in Technical Assessment K (Freshwater Ecology) and Technical Assessment H (Water Quality), the effects of sediment, both suspended and deposited, on the freshwater values within waterways is well established through years of research and the development of New Zealand specific guidelines for waterways.

47. To assist in explaining the impact of fine sediment in our waterways, I have included a diagram below that was prepared to support the development of a sediment attribute (Franklin, P., Stoffels, R., Clapcott, J., Booker, D., Wagenhoff, A., Hickey, C, 2019) within the NPSFM (Proposed 2019). The diagram shows the complex linkages that increased fine sediment can have on waterways. It depicts how sediment that does not remain as suspended sediment drops out of suspension and becomes deposited sediment. This is especially true for heavier sediment particles in areas where the velocity of the water is lower (as the velocity is lower sediment particles drop out of suspension and become deposited sediment more readily).

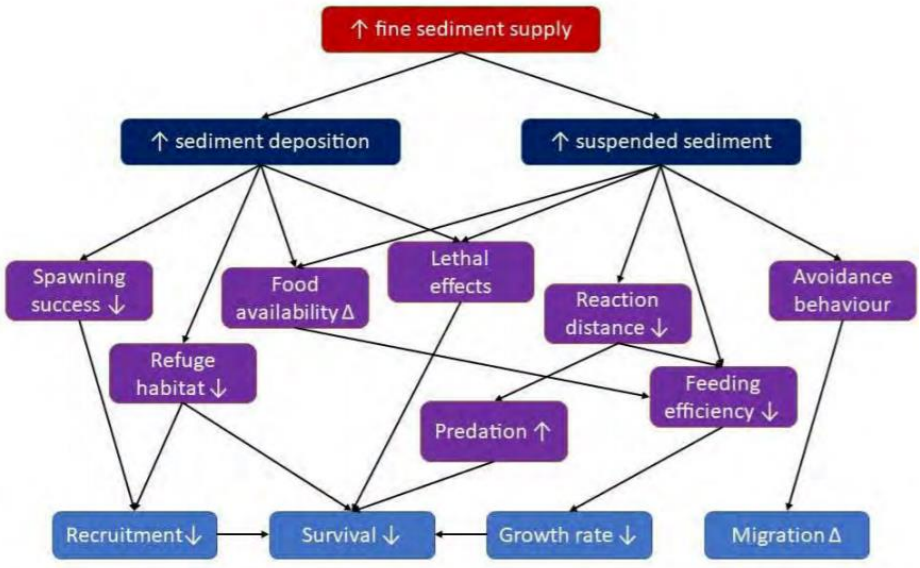

Figure 2-1: Conceptualisation of key effects pathways showing the negative impacts of increased fine sediments on aquatic organisms. ↑ = increases; ↓= decreases; Δ = changes (may be up or down).

Figure 1: Figure showing the pathway for effects from increased fine sediment supply into waterways (Franklin, P., Stoffels, R., Clapcott, J., Booker, D., Wagenhoff, A., Hickey, C, 2019).

48. Documentation on the effects of suspended and deposited sediment shows the following instream effects:[10]

(a) Sediment deposition can lead to periphyton loss. This is a result of fine sediment covering larger substrate on which periphyton is normally able to grow on. In addition, the suspension of sediment in the water column reduces the amount of sunlight that reaches the streambed and reduces the ability for periphyton growth. Periphyton at low levels forms the base of the food chain as a food source for macroinvertebrates and its reduction impacts on food supply.

(b) Deposited sediment results in degradation of macroinvertebrate communities that are present at a site/s and downstream reaches affected by the deposited sediment. This degradation in the macroinvertebrate communities occurs for a range of reasons including:

(i) Deposited sediment reducing the interstitial space (the empty area between rocks that macroinvertebrates use as refugia from predators or unsuitable instream conditions i.e., floods) that is available for macroinvertebrates to inhabit; and

(ii) Change in periphyton communities changing the food supply that is available for macroinvertebrates to consume.

(c) Sediment leads to changes in the fish communities that are seen at a site for the following reasons:

(i) Suspended sediment reduces the ability of sight feeding fish to be able to detect their prey due to decreased water clarity;

[10] Davies-Colley, R., Hicks, M., Hughes, A., Clapcott, J., Kelly, D., & Wagenhoff, A., 2015.

(ii) Suspended sediment has been shown to cause damage to the gills of fish through physical abrasion of the gills with the sediment particles;

(iii) Many native nocturnal fish species use the interstitial spaces within rivers as cover during the day. The deposition of sediment effectively fills in these interstitial spaces which means they are unavailable for fish to use;

(iv) Deposited sediment has the ability to prevent the development of macroinvertebrate and fish eggs as the sediment smothers the eggs preventing the transfer of dissolved oxygen to the developing organism;

(v) There is a change in food supply due to the change in macroinvertebrate communities.

49. The technical assessments accompanying the application confirm that the bulk earthworks during construction will increase sediment loss into waterways. This will be particularly apparent during rainfall events and in particular high intensity rainfall events and in smaller sub-catchments. The technical assessments also work on the basis that the effects from sedimentation will only be short-term and that once works are completed sedimentation levels within the streams will return to pre-construction levels. The return to pre-construction conditions is proposed by Waka Kotahi to be shown through monitoring that will occur prior, during and post construction.

50. The effects of sedimentation can be reversed if the source of sediment is stopped. This effectively means that sediment that has been deposited onto the stream bed in previous events is flushed from the system. However, looking at the sediment on the stream bed surface is only part of the story when considering the effects of sedimentation. Streams can effectively be considered high rise buildings (except the building is upside down and the penthouse is the visible part of the stream bed – i.e. the best habitat is at the stream bed). Deposited sediment makes its way into the lower layers (storeys) of the building and overtime the deposition of sediment fills these storeys and

effectively reduces the amount of habitat that is available for aquatic life to be able to use as refugia from unsuitable climatic events and predators. Once the source of sediment is stopped, the top layers of sediment are flushed from the system by freshes (small floods) and larger events. However, in order to remove the sediment that has been deposited into those lower layers, larger events are required to move some of the larger substrate and enable sediment to be removed.

51. In addition, consideration should be given to the estuarine environments that are at the base of each of these catchments. Given that the project crosses a number of catchments and will have surface water discharges into these the Ō2NL Project has the potential to move sediment through into 4 estuaries (Ōhau, Waikawa, Manawatū, Waitohu). Recent monitoring and reporting on the health of the Waikawa and Ōhau Estuaries has recommended that limits are established for sediment and inputs that will protect the estuary from further degradation.[11] I also note that the Waikawa Estuary is one of only two estuaries within the Horizons region that has seagrass present, although it was found restricted to a very small area within the estuary.

52. The lower reaches of the Waitohu Stream (Estuarine area) are recognised within Schedule F1b of the PNRP as a 'known river and parts of the coastal marine area with inanga spawning habitat'. Inanga spawning is also recognised as a value in the One Plan for the lower Ōhau and Manawatū Rivers. Although the lower Waikawa is not recognised in the current One Plan as having this value, work since the One Plan development has identified this value in those reaches.

53. As noted above, sediment discharges into the upper reaches of these catchments will make their way downstream. Inanga spawning occurs during spring tides on riparian vegetation that is normally out of the water other than during the spring tide high tide state. This area is susceptible to deposition of sediment during fresh events for two main reasons:

[11] Roberts K.L., Stevens, L.M., Forrest B.M. (2021) Synoptic Subtidal Monitoring of Waikawa Estuary, Manawatū. Salt Ecology Report 063, prepared for Horizons Regional Council, March 2021. 39p. and Roberts K.L., Stevens, L.M., Forrest B.M. (2021) Synoptic Subtidal Monitoring of Ōhau Estuary, Manawatū. Salt Ecology Report 063, prepared for Horizons Regional Council, April 2021. 37p.

(a) These areas frequently have grass species as the dominant riparian vegetation, which usually is taller and rough-looking vegetation (perfect for inanga spawning). However, it is also highly susceptible to capturing sediment as the water flows through it.

(b) Flows at this point of the catchment can tend to spread over a large area due to the low gradient and sediment comes out of suspension easier into these areas (the lower velocity allows sediment to come out of suspension). This has the potential to effect inanga spawning in two ways:

(i) Deposition of sediment onto developing eggs, which effectively prevents the transfer of oxygen between the atmosphere across into the egg and the embryo within the egg dies or the egg never starts to develop.

(ii) Sediment deposition also fills in the spaces at the bottom of the vegetation that the inanga spawn in, meaning that the habitat is no longer available for use. The loss of this habitat cannot be offset elsewhere as these spawning requirements and areas are very specific and localised to each of the tidal zones of the catchments that the road corridor crosses. The avoidance of the effect is the best mechanism to protect the value.

54. Therefore, in my opinion, effects of sedimentation within the receiving environment need to be considered wider than at the reach scale.

55. Further, given the number of variables outside of Waka Kotahi's control around removing sediment from the streams/waterways, I do not consider it to be as simple as stating that sedimentation is a short term effect of the Ō2NL Project.

56. Even if it is assumed that the effects from sedimentation are short term, this does not mean that sedimentation effects on the values that those streams hold cannot be significant. Where kakahi/koura/fish are present within a waterway the deposition of sediment and disappearance of those species is not a short-term effect. Kakahi/koura/fish would need

to recolonise the reach from upstream. Alternatively, the kakahi/koura/fish would need to recolonise from other catchments. This would involve, in the case of kakahi, 'catching a ride' during their juvenile phase attached to a fish species; in the case of koura, crawling back into the reach from another catchment; and for fish, it would involve coming back into the catchment during their migratory phase if chemical and habitat cues are still present within the catchment (upstream of the affected area). These events do not happen on a short term scale and may never happen – i.e., there might not be any kakahi populations in close proximity to migrate back into those reaches.

J. SEDIMENT STANDARDS AND MONITORING

57. Given the significant effects that can arise from the deposition of sediment within waterways, it is important to ensure that the volumes/concentrations of sediment that enter waterways/catchments is limited. To provide certainty that these volumes/concentrations of sediment are met without unanticipated effects on the receiving environment, I am of the opinion that enforceable standards for end of pipe concentrations should be included in conditions. In addition, these end of pipe standards should be tailored to the receiving environment into which they enter.

58. Paragraph 109 and Table H.17 of Technical Assessment H: Water Quality show the modelled change in total suspended solids (TSS) and clarity (change in metres) as a result of the Ō2NL Project. These modelled results are based on the average TSS concentrations currently seen in-stream and are then forecast using predicted TSS concentrations due to the proposed earthworks.

59. This later information being based on the estimated percent increase in catchment sediment loads as a result of the works. The modelled values need to be treated with caution as they are based on a number of assumptions (such as the data collected to date is representative of the catchment) and a limited number of data points. They do, however, indicatively show that the Ō2NL Project will result in increases in sediment entering the waterways across the project corridor. The

various catchments will have different sensitivities to these additions of sediment.

60. Waka Kotahi has identified that there are catchments that are at a high risk of sediment release from earthworks and have high ecological values.[12] These catchments are catchment B (Waitohu), catchment C (Waitohu, also downstream is the Forest lakes), and Catchment I (Mangahuia).

61. Sediment from the proposed works will enter waterways and either become suspended or deposited sediment and deposited sediment can become suspended sediment over time.

62. Excessive deposited sediment can fundamentally change how waterways function and therefore the values that it is able to support. However, suspended and deposited sediment are not completely distinct things. The amount of suspended sediment in a waterway can be used as an indicator as to the amount of deposited sediment in a waterway. As I note above, deposited sediment starts as suspended sediment (unless via a landslide) as it makes its way into waterways, and it turns into deposited sediment when the water no longer has the capacity to be able to carry the sediment any further (heavy particles normally dropping out of suspension first and fine clay particles carrying on down the catchment). This dropping out of suspension is the result of changes in velocity (slowing) reducing the energy the water has to carry the sediment or simply because the sediment concentration is too great and the water velocity cannot carry it. The amount of sediment coming out of suspension is greatest during the receding limb of elevated flows.[13]

63. In considering the effects of sedimentation the focus is usually on the stream values that suspended and deposited sediment can change within a waterway. However, another issue that is frequently overlooked is that sediment particles frequently have phosphorus bound to them. In-river processes, particularly during low flow conditions, can result in this phosphorus being used by algae to enable growth (effectively

[12] Technical Assessment H: Water Quality, paragraph 118.
[13] Hicks, 2019.

mining the nutrients from the sediment particle).[14] Therefore, the effects of sedimentation can be (and will be) felt well beyond the catchment from which it is derived and will add to nutrient enrichment within a waterway.

64. As an overall summary in relation to sediment from the Ō2NL Project:

(a) The effects of sediment, both suspended and deposited on the freshwater values within waterways is well established through years of research and the development of New Zealand specific guidelines for waterways.

(b) The Ō2NL Project involves the movement of significant volumes of sediment which has the ability to have significant adverse effects on the sub-catchment if not managed in an appropriate manner.

(c) Waka Kotahi proposes a number of triggers/standards for the deposited sediment within the impacted catchments. These triggers/standards should be tailored to the receiving environment and its sensitivity.

(d) The management of sediment prior to being discharged to waterways will be critical to managing instream effects from sediment. The concentrations that are discharged to various sub-catchments should be managed according to the values and the sensitivity of them to additional sediment inputs. Where targets/standards are currently not meet in the relevant catchments, discharges must still be managed in a manner which recognises that the increased volume of sediment discharged to the catchment is likely to be inconsistent with maintaining or enhancing water quality.

65. As a consequence I have recommended triggers/standards that vary depending on the receiving environment. As I explain below, these triggers/standards align with information provided in the Technical Assessments accompanying the application.

[14] Wood et al, 2007.

66. Waka Kotahi has proposed conditions that relate to clarity for discharges to water associated with:

(a) dewatering (RGW1 (d)); and

(b) erosion and control standards (RES1 (d)).

67. Both of these conditions propose a standard/target of 100mm clarity prior to the discharge entering a waterway. While I support the intent of a clarity standard, in my view, the standard must be related to the sensitivity of the receiving environment for sediment.

68. The application has undertaken an analysis of the sensitivity for each of the receiving environments (catchment and sub-catchments). Based on current information within the application I would agree that the correct sensitivity has been applied to each of the reaches/catchments that will have sediment discharges to them. Based on this information I would recommend the following standards for the various catchments across the proposed road corridor.

Catchment	Stream name/code[15]	Sensitivity[16]	Proposed trigger/standard
Koputaroa	39, 39.1	Moderate	150 mm
	42.3, 42.2, 42, 43, 41, 40,	Low	100 mm
	39.1	Nil	100 mm
Punaha	37	Nil	100mm
Ōhau	33 (Ōhau River)	Very high	200 mm
	32 (Kuku)	High	200 mm
	29	Moderate	150 mm
	34.5, 31, 30	Low	100 mm
	35.4, 35.1, 34, 28	Nil	100 mm

[15] Aligns with the stream name/code from Technical Assessment K.
[16] Taken from Table K14, Technical Assessment K.

Catchment	Stream name/code[15]	Sensitivity[16]	Proposed trigger/standard
Waikawa	Waikawa Stream (27).	Very high	200 mm
	27.1, Manakau Stream (15), Waiauti Stream (14),	High	200 mm
	25, 23,	Moderate	150 mm
	22, 19, 18, 17,	Low	100 mm
	26, 20, 18.5, 13, 12.	Nil	100 mm
Waitohu	0	Moderate	150 mm
	11, 10, 3, 2, 1	Low	100 mm
	9, 8, 7, 6.1, 6, 5, 4.	Nil	100 mm

69. I note that 100mm has been used as the minimum standard/trigger. In doing so, I have assumed that Waka Kotahi has proposed a trigger that would provide a level of protection to the lowest value waterway within the waterways affected by the proposal.

70. The completion of monitoring will be important both at the 'end of pipe' and within the waterway. This will ensure treatment devices comply with the above proposed standards.

71. While a discharge standard will provide some certainty, it is possible that meeting the discharge standard will not always result in the protection of the stream values in the high value waterways (or any waterway). With many of these types of projects (this one included) an assumption is made that the management of sediment through a range of tools and the imposition of a discharge standard will provide an adequate level of protection to the stream values. However, to test this assumption and provide further certainty for effects management, additional in-stream monitoring is proposed by Waka Kotahi to assess potential effects. I

support this in-stream monitoring. It is possible that the monitoring may show that additional measures need to be undertaken to manage the discharge to a higher standard. This instream monitoring is important in relation to actual instream effects. However, the monitoring is only as effective as the ability for Waka Kotahi to respond to the effects. In my view, the conditions of consent need to provide for/direct this response.

72. As noted above,[17] the catchments with the highest percent increase in sediment load were the Waitohu tributaries (catchment B, C, D), Manukau tributary catchment G and Mangahuia Stream (catchment I). Despite this, the Section 92 Response noted that Catchments B, C, and I will not be monitored for deposited sediment or macroinvertebrates due to the low risk of detecting an effect given current deposited sediment levels and degraded macroinvertebrate communities.

73. These catchments are identified as high risk for sediment discharges due to having the largest earthwork footprint relative to catchment size. In these circumstances, it is important to also consider the downstream receiving environments. Although instream monitoring may not be required at the location of the proposed discharge, it does put even further reliance on ensuring that there are appropriate end of pipe standards and monitoring that goes with those standards to ensure that effects are managed.

74. Proposed condition RFE4 sets out the required monitoring for the Ō2NL Project. I consider the proposed instream monitoring regime to be mostly comprehensive and reflective of the scale of the proposed works and the sensitivity of the receiving environments across a number of catchments. However, there are elements within RFE4 that could be expanded on to provide further clarity and certainty for all parties. These are outlined below:

    (a) RFE4(a) The monitoring is proposed to be carried out at existing water quality monitoring sites, where the sites are suitable for deposited sediment and macroinvertebrate monitoring. However, it is unclear what is meant by existing monitoring. For

[17] At paragraph [40]. Also see Technical Assessment H: Water Quality at para 108.

example, Technical Assessment K contains Table K8 that shows macroinvertebrate monitoring that was able to be undertaken at a number of locations across the catchments affected by the Ō2NL Project. If it is the intention that all of these sites are monitored upstream and downstream of the proposed alignment, then I would be supportive of such an approach. Although would note that it would be resource hungry to monitor this many location on a frequent basis. The establishment of these monitoring locations will provide certainty to parties as to the proposed scale monitoring within the road corridor.

(b) RFE4(b) – baseline monitoring requirements. The Section 92 Response records that baseline monitoring is to commence in July 2023. I support baseline monitoring commencing well in advance of any works to allow for a good understanding of the true state of the waterway. Monitoring well in advance of works also allows for natural variability to be established and built into any effects assessments that may need to be completed in the future. An understanding of this natural variability is especially important in high value waterways that are more sensitive receiving environments. In my opinion this monitoring should commence at least 24 months prior to works commencing in the affected catchment to ensure a robust baseline of data is established.

(c) RFE4(b. iii) – is tied to sediment and erosion control monitoring and the condition should also refer to this particular monitoring requirement in RES9.

(d) Additional clause for monitoring for incidents. RFE4(b. iii) specifically refers to event based monitoring which is defined. However, previous experience has shown that monitoring also needs to allow for the monitoring of incidents that may occur during the work. Event based monitoring is monitoring that is highly likely to need to occur as it based rainfall triggers. Incident based monitoring is unforeseen however, expectations on what this monitoring should involve to enable an assessment of

effects of the incident to be undertaken. This is currently missing from the conditions.

(e) RFE4(c) – only refers to routine monitoring. Baseline and routine monitoring should collect the same information to enable analysis and comparison of them to be undertaken.

(f) RFE4 (d) and (g) reference a comparison to baseline information. Given that Waka Kotahi has proposed upstream and downstream monitoring, as well as the collection of baseline information this should refer to baseline and upstream monitoring data.

75. Wellington Fish and Game (Submitter 59) have requested that a Sports Fish and Game Fish Management Plan be developed for the project to protect fishery values, habitat of sports fish and game birds. This management plan would identify a number of monitoring requirements across the waterways and wetland potentially affected by the Ō2NL Project.

76. In terms of a method of protecting values within a waterway I support the intent of the management plan. However, the monitoring needs to be linked to values that are recognised in the waterway that is affected by a proposal. In that regard, I have the following comments specific to the trout fishery values of the waterways crossed by the road corridor:

(a) I agree that there is an effect of sediment on the development of trout redds, and this would be of particular concern if the proposed works were to occur within or upstream of an area known for trout spawning. Based on the current values of the One Plan and GWRC there are no known spawning sites affected by the proposal (either directly at the site or downstream of works area). However, the One Plan layers map the identified values prior to 2007, and while the PNRP is more recent it is possible that information gathered since mapping shows that this value does occur in the vicinity or downstream of the proposed works area. If this is the case the provision of this information would be useful to further inform my opinion on this matter.

(b) Wellington Fish and Game have also requested *"avoidance of works in stream bed, bank, riparian, and avoidance of discharge of sediment to water during trout spawning period 31 April to 31 August inclusive."* As I note above, unless evidence is provided to the contrary, none of the waterways affected by the Ō2NL Project (or downstream of the road corridor) hold the value of trout spawning under the regional plans, and the exclusion period is not required.

(c) For the monitoring of trout populations Wellington Fish and Game has proposed a range of survey methods that could be used to develop a robust monitoring programme, including methods such as eDNA surveys, electrofishing surveys and drift dive surveys. They have also recommended a standard of *"a 30% reduction in abundance of large trout compared to pre works survey numbers, and a 30% reduction in recruitment of juvenile are to act as a trigger for possible effect and active management response"*. I am supportive of monitoring and associated triggers/standards/thresholds. However, I consider that further information is required from Wellington Fish and Game as to what streams/rivers this monitoring would apply to, and the frequency of any proposed monitoring required.

(d) There would also need to be certainty that an effect on the trout population at a river reach identified through this monitoring is able to be directly linked back to the effects of the Ō2NL Project. This is to ensure a link between the activity, threshold breach, and any required management response. Based on the values identified in the One Plan and Natural Resources Plan this monitoring could be directed to either the Ōhau or Waitohu Rivers. Direct discussion with Wellington Fish and Game's freshwater ecologist and other experts involved in the process would refine the need for the proposed monitoring, what the scope of the monitoring should be, and the scale of catchment over which it would need to occur.

K. DISCHARGES TO O-TE-PUA WETLAND/LAGOON

77. At the southern end of the proposed alignment is the O-te-pua wetland, which contains a lagoon system at the start of the wetland. This wetland is identified in the GWRC Natural Resources Plan (Appeals version, 2022) within Schedule C – Site with significant mana whenua values for Ngā Hapu o Otaki,[18] a Category 1 Surface Waterbody, and the wetland surrounding the lagoon within Schedule F3: Identified significant wetland. Stormwater pond 17 will discharge into the lagoon system. In addition, the catchment is modelled to have an increase in sediment that enters the lagoon system as a result of the proposed works and the ESC measures.

78. Given the presence of a lagoon system I consider that the discharge of contaminants into the system must be treated in a different way. In theory, rivers are able to export nutrients and sediment overtime (noting that this does not mean that these do not cause effects in the process of being exported). Within lagoon systems, sediment/nutrients effectively become trapped and accumulate. This means that degradation of systems occurs over time, and the only way to reverse this is to either export the sediment/nutrients from the system or undertake in-lagoon interventions (to bind the nutrients and effectively make them unavailable for use). Therefore, even though the Ō2NL Project is proposed to improve the quality of the stormwater that is discharged to the lagoon through the stormwater treatment train process compared to the current stormwater quality, this does mean that there will be an improvement in the water quality within the lagoon itself. As noted above, due to the nature of lagoons and lakes in accumulating contaminants, the proposal will result in a slowing of the rate of degradation of the lagoon rather than an improvement in it. This is on the basis that no in-lake interventions are proposed to improve the health of the lagoon.

18 https://mapping.gw.govt.nz/GW/GWpublicMap_Mobile/?webmap=85393478ca2847f4a37079037e1d79ea

79. Although we have no water quality monitoring information for the lagoon it would be safe to assume that they are in a degraded state. This assumption is based on:

(a) The land use in the upstream catchment of the lagoon, including rural land use and roading;

(b) Similar lagoons in the Horizons and GWRC area also showing degraded water quality; and

(c) The following statement "The lagoons were open and shallow, with a soft, fine mud bottom, and very few macrophytes present." from a 2017 report.[19]

80. There is insufficient information within the application to enable an assessment under the NPS-FM attributes for lakes (into which the lagoon falls). The number of data points required to undertake such an assessment (at least 36 monthly samples) are not within the timescales of this project. On this basis Waka Kotahi may wish to model what the predicted current water quality of lagoon may be to inform this discussion further.

L. FISH RECOVERY

81. Waka Kotahi has proposed to undertake fish removal and/or recovery where required to enable instream works. This is intended to minimise the effect on larger aquatic life (i.e. excluding the macroinvertebrates other than kakahi and koura) that would otherwise be harmed as a result of the works. As I understand it, proposed condition RFE1 is intended to reflect the proposal for fish removal and/or recovery. However, in my view, the condition could be improved so as to ensure fish removal and/or recovery is delivered on. Some of the issues are covered in more detail below:

(a) RFE1 (a) – although this condition would avoid effects on migratory fish (where practicable), in my view, it is unlikely to be implemented. I note, in particular, the proposed wording - 'at

[19] McEwan, A. (2017). Wetland fish surveying. Riverscapes Freshwater Ecology Limited Report No. 17-25.

times when migratory fish are present'. The information provided in the application shows that a number of the catchments have high fishery values, including migratory fish species. Migratory fish are therefore likely to be present in a number of the waterways at all times. I understand the intention is to avoid works when migratory species are migrating through these reaches. As such, I recommend that the condition is directly linked to the predicted migration period for each species of migratory fish in the catchment. These peak migration periods and the catchments they would apply to, should then be identified in the Freshwater Ecology Management Plan.

(b) RFE1 (b. ii) – the use of techniques to encourage fish, koura or kakahi species to move out of the impacted reach. For species such as kakahi (freshwater mussel) this approach is not possible given their life cycle. It is also unlikely to be effective for koura. For fish species, I note that some species such as tuna (eels) are likely to burrow into the substrate and therefore not move out of a reach. In my opinion, best practice would have both i and ii being undertaken.

(c) Proposed condition RFE1 (e) – has a proposed threshold of 50% recovery of individuals between the first round of recovery and final round of recovery at which point it can cease. This threshold was previously used in the Te Ahu Turanga project and in my view, it remains valid for that project as it was based on the predicted species found within the relevant waterways. However, the waterways and receiving environments within the Ō2NL Project are different than those encountered on the Te Ahu Turanga alignment. Notably, the waterways along the Ō2NL Project also have a wider range of species and greater number of individuals. Given these differences it is my opinion that the effort put into fish, koura, and kakahi recovery should be greater for the Ō2NL Project. I consider that an appropriate threshold would be 20%.

(d) RFE1 currently does not require the capturing of information on the species and number of individuals that are recovered and

moved under this condition. It would be normal (and good) practice for this information to be captured and provided to Horizons/GWRC as part of compliance reporting. In addition, this information should also be entered into the New Zealand Freshwater Fish Database. The New Zealand Freshwater Fish Database plays an important role in ensuring that organisations/entities that monitor and/or interact with freshwater species are feeding this information into a national database. It is reliant on third parties to provide information. The information then informs the management of New Zealand's freshwater fauna, including further resource management decisions, such as, for example, resource consent applications.

M. WATER CONTAMINATION FROM CONSTRUCTION ACTIVITES (EXCLUDING SEDIMENT)

82. Technical Assessments K and H deal with potential effects associated with hazardous chemicals, setting concrete in waterways, and vegetation removal that may result in small debris entering a waterway.[20] These technical assessments cover off the potential effects from these activities. I agree with these assessments and therefore do not repeat the material here.

83. However, I note that the authors recommend that the development of management plans will be important to manage these effects. In my opinion, these recommendations need to be implemented. I have set out the relevant sections from these reports and the requirements for the management plans:[21]

> To avoid and minimise the risk of vegetation clearance affecting water quality, it is recommended that the EMP includes measures to avoid and minimise leaching of wood chip residue to waterways. Procedures for avoiding and minimising adverse effects of mulch on water quality include:

[20] Paragraphs 174–178, and 119–134, respectively.
[21] Technical Assessment H: Water Quality paragraphs 133 and 134.

(a) minimising the area and duration of soil exposure from vegetation clearance;

(b) minimising the volume of vegetation to be mulched;

(c) locating wood residue piles with an appropriate separation distance from any waterways (i.e. 10 - 20m); and

(d) managing potential leachate from these piles.

The Ō2NL Project should set aside large woody debris for later use in rehabilitating the site and streams.

A Hazardous Substances Procedure ("HSP") should be developed as part of the Construction Environmental Management Plan ("CEMP") to describe the processes to be implemented to minimise potential risks of hazardous chemicals (including cement) to aquatic life. These are standard practices to avoid and minimise adverse effects and, provided appropriate management practices are implemented, the risk of cement and concrete causing adverse water quality effects on streams will be low. Technical Assessment K (Freshwater Ecology) further discusses this risk in the context of ecological sensitivity of the receiving waters.

The HSP should also cover procedures to avoid and minimise the risk from other hazardous chemicals such as oil, diesel, lubricants entering the water. This should include storing those materials in bunded containment facilities, minimising the volumes kept on site, staff training and emergency procedures in case of a spill.

N. WATER TAKES

84. The evidence of Mr Thompson (for GWRC) and Ms Stout (for Horizons) cover in detail the proposed takes from a number of waterways along the proposed road corridor. This also includes an assessment against the core allocation limits, and the associated minimum flows within each of the catchments.

85. The water takes have been broken in two different classes:

(a) takes that fall into core allocations and associated minimum flows within each of the catchments; and

(b) supplementary takes, which are takes from the waterway when flows are above median flow within the waterway from which the take is occurring.

86. A number of catchments such as the Ōhau, Waikawa, and Waitohu Stream have reaches of the river where there is significant flow loss and then regain in the reaches between the foothills and the coastal margin, particularly during severe summer dry spells. This means that at times the upper reaches of the rivers will have water present that then disappears (to ground) and then re-surfaces prior to the river reaching the coast. For many of the rivers this is frequently seen as dry riverbed in the vicinity of the current State Highway One Bridges. This may mean that at times the rivers are still above their minimum flows (as recorded at the flow site tied to the allocation framework) however, the take may cause the waterway to cease flowing for a reach of the waterway. The loss of water from a reach will have significant adverse effects of the aquatic life present within the waterway. Depending on the flow conditions leading into such an event it may be that the proposed take results in these ceased flows occurring earlier than they naturally would or it could also result in the cessation of flows when they would not have naturally occurred.

87. Waka Kotahi proposes to manage these effects by limiting the rate of take from the waterway. I consider this to be an important part of the management approach. The limit applies to both the takes within the core allocation framework and the supplementary takes. Regardless of the take type, in the AEE (51.4.2.5) Waka Kotahi has proposed that *"at any time no more than 10% of the flow will be abstracted and abstraction rates will be scales depending on the actual flow at the time".*

88. The mechanism for managing effects within the streams and rivers from which abstraction is to occur is through limiting the percentage of flow that can be abstracted from any river at a point in time. As set out above, Waka Kotahi have committed to this being no more than 10% of the flow at the time. This applies equally to the proposed takes within the core

allocation and minimum flow framework and the proposed takes at flows above minimum flow. I consider these in further detail below.

Core allocation and minimum flow take

89. The main rule governing the taking of surface water in the Horizons region under the core allocation is Rule 16-5. Where the takes fit within the core allocation limits and will comply with the minimum flows identified in the One Plan (Schedule C), it will be a controlled activity. Rule 16-5 reserves control over several matters, outlined below:

    (a) the volume and rate of water^ taken, and the timing of the take

    (b) the location of take

    (c) intake velocity and screening requirements

    (d) measures to avoid, remedy or mitigate any adverse effects^ on the Values of the water body^ at and below the point of take

    (e) effects^ on the natural flow regime, the magnitude of the median flow and the frequency of flushing flows

    (f) the efficiency of water^ use

    (g) effects^ on other water^ takes

    (h) effects^ on rare habitats*, threatened habitats*, at-risk habitats* and Sites of Significance - Aquatic

    (i) compliance with minimum flow requirements

    (j) duration of consent

    (k) review of consent conditions^

    (l) compliance monitoring

90. Relevantly, for the purpose of my reporting is Rule 16-5(d) and (h) which refers to measures to avoid, remedy or mitigate any adverse effects from the water take on the values of the water body at and below the

point of take and effects on rare habitats, threatened habitats, at-risk habitats and Sites of Significance - Aquatic.

91. The proposed take point on the Waikawa River is identified in the One Plan as having the site/reach specific value of Site of Significance – Aquatic (for short jaw kokopu and redfin bully). For the Waikawa catchment additional consideration therefore needs to be given to the SOS-A value that this reach of the catchment holds.

92. Waka Kotahi has proposed that the take on any particular day will be based on the flow that has been experienced on the preceding day. Although I understand the operational reasons for such as approach, this does not align with method by which the freshwater ecology assessment has evaluated the Project's overall effects. Technical Assessment K:[22]

> … the proposed instantaneous rates of abstraction are set low as to provide trickle replenishment of storage ponds (see Table 4.4 of the DCR (Appendix Four to Volume II)). At any time no more than 10% of the flow will be abstracted and abstractions rates will be scaled depending on the actual flow at the time. Therefore proposed abstraction rates are a relatively small proportion of the flow at any time, even as water courses approach their minimum flow level.

93. As discussed in the evidence of Ms Stout, the Waikawa Stream has reaches of the river that lose water to ground and therefore has reaches that are known to dry out during low flows. At the time the One Plan was being developed, the flows required to maintain connectivity as a result of water takes were not considered. To be clear, there will be situations when the reach of the river will cease flowing (water may remain in pools and other suitable locations) without the presence of takes. However, takes upstream of the loss zone have the potential to result in the reach losing flow faster than it would naturally or for a longer duration. To minimise the likelihood of the take resulting in the flow in the Waikawa Stream ceasing in the loss zone it would be preferable to have minimum flow + the proposed take flow at that flow to ensure that the take keeps

[22] At paragraph 182.

the river above the minimum flow in the One Plan. This is the result of the flow site being stationed upstream of the proposed take location. In this case the minimum flow at which the take would need to cease would 0.220 m^3/s + 0.022m^3/s, effectively the minimum flow as recorded at the North Manuka site becoming 0.242 m^3/s. This minimum flow requirement is not an issue for the Ōhau catchment, as Waka Kotahi only proposes to take water when above the median flow in this catchment.

94. There remains a number of uncertainties as to the location of the proposed take point and the influence that this may have on the loss zone of the Waikawa Stream.

95. Horizons undertook an intensive investigation in the Ōhau and Waikawa catchments over a number of years to better understand nutrient, periphyton, macroinvertebrate, groundwater levels and flow directions and in-river flow relationships. This involved a number of gaugings being undertaken across the catchment on the same day at a range of sites. For illustrative purposes I have reproduced the results of some of the flow recordings from the North Manakau (flow recording site) and flow gaugings taken on the Waikawa Stream at upstream of the confluence with the Manakau (lowest catchment site prior to the confluence with the Manakau). This information shows that between these two reaches there is a clear loss of water from the reach even through the Waikawa Stream is above the minimum flow. .

Table 2: Flows in the Waikawa Stream at North Manakau (upstream of the proposed take location) and gauging flows in the Waikawa upstream of the Manakau Stream confluence. Showing the loss of flows between the two points even when the flows upstream are above the minimum flow.

Date	Flows at Waikawa at North Manakau (l/s)	Flows at Waikawa at u/s Manakau confluence (l/s)
9th February 2016	355	33
1st March 2016	340	37
3rd May 2016	407	90

96. Based on the above, it is difficult to conclude that ceasing take water at the minimum flow will protect the values in this reach of the Waikawa River. To fully understand this would require further work on the flows at the North Manakau flow location and when the cessation of flow within the lose zone of the Waikawa Reach begins to occur. Therefore, at this stage, the actual flow at which takes should cease to protect these downstream flows is currently not known and would require further work to establish. This is a matter that sits outside this resource consent process and requires further work to be undertaken as part of the Horizons freshwater planning process.

97. However, to ensure that effects are managed as best they can be with the knowledge currently available, I am of the opinion that Waka Kotahi should be limited to taking at a maximum rate of 10% of the flow at the time the abstraction is occurring. I also support an approach where the minimum flow is raised to reflect that the flow recording site is upstream of the proposed take point. This way Waka Kotahi cannot be responsible for the Waikawa Stream dropping below the minimum flow as specified in the One Plan and any associated effects on the relevant values.

98. In order to manage instream effects, there must be a robust relationship between the proposed take location and the monitoring site used to inform the need to stop taking water. I note for the Koputaroa Stream that the proposed take location and flow recording location are a reasonable distance apart (refer to *Figure 1*, taken from Ms Stout's report). However, the Tavistock flow recording site is proposed to be the monitoring location to dictate the cessation of abstraction. There is limited information available to understand whether such a relationship exists between the take location and the Tavistock flow recording site. In my time at Horizons I have been involved in fish monitoring (night spotting),and undertaken fish barrier remediation when the upper sections of the Koputaroa Stream have ceased to have surface flow (pools were still present but no flow between them) however, I have never encountered this lack of flow at the Tavistock flow recording location.

99. Further, I note that the approach proposed by Waka Kotahi does not align with the AEE in which it is proposed that *"at any time no more than*

10% of the flow will be abstracted and abstraction rates will be scales depending on the actual flow at the time". To have confidence that this will be met, Waka Kotahi will either need to:

(a) Install a flow recording site at the proposed take location to which abstraction could be related to; or

(b) Undertake paired gaugings at the proposed take point and at the proposed monitoring location to establish a robust and accepted flow relationship. If this option were to be pursued it would need to be a matter contained with the proposed Ecological Management Plan. The additional requirement for this plan would be for Waka Kotahi to establish the flow relationship between the proposed abstraction point and the Tavistock Road flow monitoring location. This should involve the collection of at least 24 paired flow gaugings at flows below median flow as measured at the Koputaroa Stream Tavistock Road monitoring site, with at least 12 of these occurring at flows below half median flows as measured at the Koputaroa Stream Tavistock Road monitoring site.

100. There does not appear to be any disagreement with Technical Assessment K: Freshwater Ecology on the potential effects of continuing to take water at flows that are below the minimum flows set in both the One Plan and the Natural Resources Plan. This means it comes down to putting in place the correct measurement and cut-off thresholds to ensure that the effects do not eventuate on the values the waterways hold. The proposed regime by Waka Kotahi means that flow information as close to the take point as possible is required to ensure the management of effects. If this is not possible there must be certainty in any relationship that exists between the take point and the monitoring site. It is not apparent from Ms Stout's report that this confidence exists at this point in time, at least for, the Koputaroa Stream.

101. For the other catchments the management regime to manage effects will require slight modifications to the minimum flows to reflect the placement of the take versus the current monitoring location. Such

measures would reflect the proposal contained in the AEE and also covered in Technical Assessment K: Freshwater Ecology.

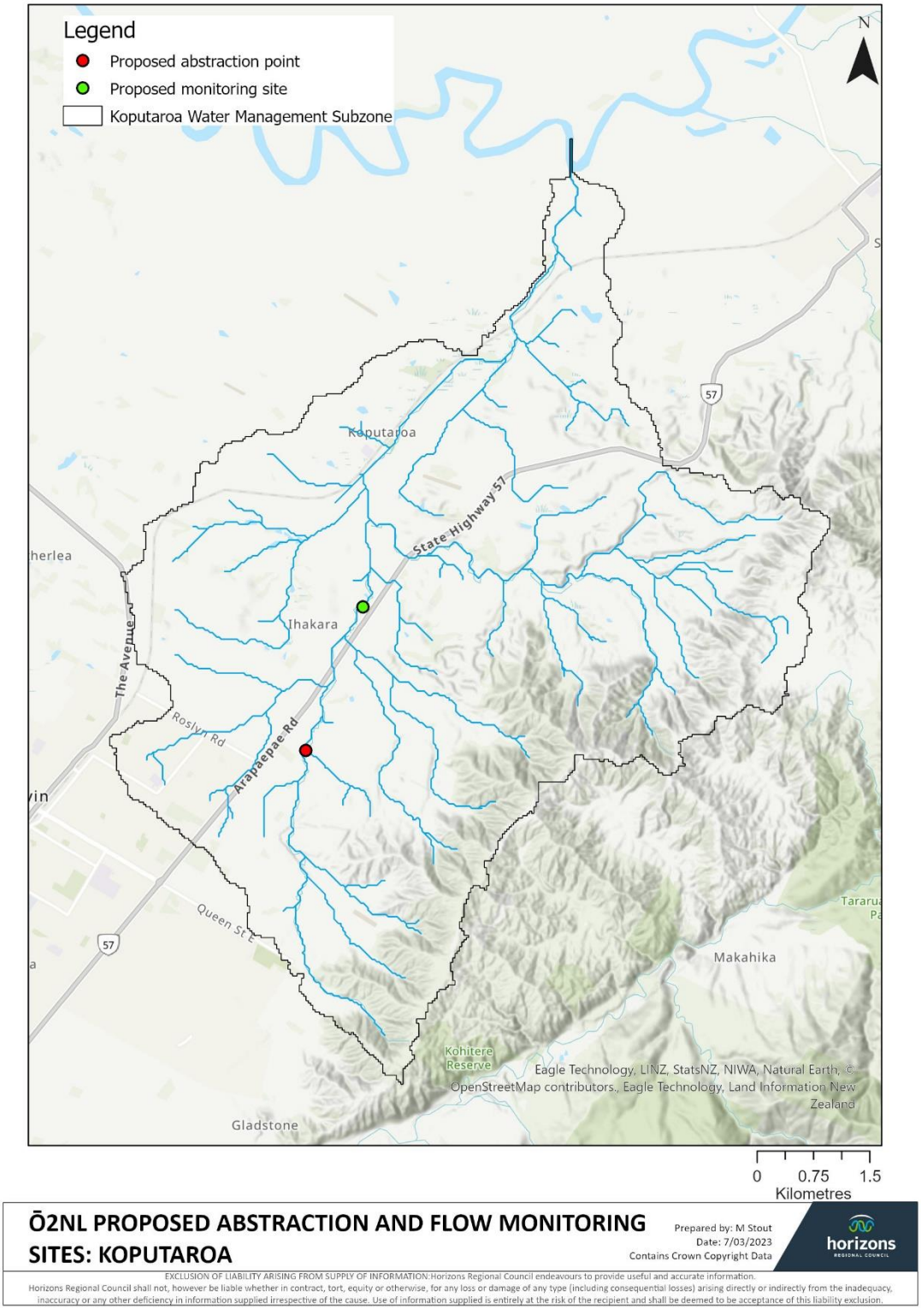

Figure 2 Map showing the location of the proposed abstraction point (inferred from Volume III - Drawing Set – 07 Accommodation Works) and Tavistock Road flow recorder (proposed monitoring site) on the Koputaroa Stream. Taken from Ms Stout's evidence.

102. In summary, in order to manage the effects on the relevant values, I recommend that:

(a) As proposed by Waka Kotahi, the flows abstracted are no more than 10% of the flow at the time of the abstraction across all takes and catchments;

(b) The flows being experienced in-river and the abstracted volumes are being monitored as close as to possible in real time and that the abstraction rate is reflective of the flow at the time as per the closest flow recording site for all takes and catchments;

(c) As the abstraction location on the Waikawa Stream is downstream of the flow recorder, both the 'turn on' and 'turn off' trigger flow for this site should be the minimum flow plus the abstraction rate (10%), as the effects of the abstractions will not be measured at the respective flow recorders. This is to ensure that the take does not result in the river dropping below the minimum flow; and

(d) For the Koputaroa Stream, Waka Kotahi either installs a flow recording site at the proposed take location or establishes a robust flow relationship between the take location and the existing flow recoding site at Tavistock Road.

Supplementary take

103. Waka Kotahi has applied for supplementary takes (in the Horizons region) or takes above median flow (in GWRC). In general, the basis for these takes is that the river is experiencing higher flows, the take is a lower proportion of the total flow, and the in-river flows still allow for flushing and channel forming flows. These larger river flows are important ecological components of freshwater systems as they effectively reset some of the biological processes occurring within streams/river (e.g., periphyton growth) and the larger they become they function in maintaining channel shape, form, and function for both aquatic and terrestrial organisms that rely on riparian margins (e.g., dotterels).

104. Supplementary takes are generally set as a percentage of the flow at the time that the river is above median. This occurs on the basis that the potential effects that are normally associated with water takes will not be seen in the river from which the take is occurring. The premise of this being that the take at the time is reflective of the flow in the river that is being experienced at the time – that is, as the flow in the river increases the volume abstracted increases and as the river recedes the volume of water abstracted decreases (and the percentage of flow remains the same in both instances). The approach relies on the abstraction and a flow site in the catchment being linked and having a flow relationship to allow comparison to occur in real time.

105. Proposed condition RWT1 states that *"The abstraction of surface water must occur at a rate of not more than ten (10) percent of the mean daily flow in the water body on the preceding day measured at the flow gauge required by clause (e)."*

106. As reported by Mr Thompson and Ms Stout, these catchments are very reactive (flashy systems) and therefore a fresh event (i.e., an elevated flow event allowing for a take as move above median) one day does not mean that flows would be above median the preceding day to take water under the supplementary regime. Therefore, the take would need to be based on the actual flow in the river at the time of the take (or as close as possible). There will be some limitations on how instant the two can be reflective of each other however, given the current availability of telemetry between systems such an approach should be able to be matched to hours rather than days.

107. Mr Thompson and Ms Stout note the location of the flow monitoring locations compared to the take locations. With the Waikawa, Ōhau, and Waitohu the monitoring locations are upstream of the proposed take points, and for the Koputaroa and Waiauti and Manakau the flowing monitoring sites are downstream of the proposed take point. Ms Stout notes:

> The abstraction sites on the Koputaroa, Manakau, and Waiauti Streams are upstream of the relevant flow recorder. On these streams, the initial (i.e. 'turn on') trigger flow should be the

> median flow plus the abstraction rate (10%) to avoid reducing the flow recorded at the flow site to below median, and having to switch off soon after commencing abstraction. However, the 'turn off' trigger flow could be left as the median flow, as the effect of the abstraction is measured at the flow recorder. In contrast, the abstraction sites on the Ōhau River and Waikawa Stream are downstream of the relevant flow recorder. Both the 'turn on' and 'turn off' trigger flow for these should be the median flow plus the abstraction rate (10%), as the effects of the abstractions will not be measured at the respective flow recorders.

108. I agree with this recommendation in order to reduce any potential effects from the proposed abstractions. In addition, I am of the view the take from the Waitohu Stream should also be treated in the same way as the Ōhau and Waikawa takes.

O. OPERATIONAL STORMWATER DISCHARGES

109. Technical Assessment H: Water Quality has undertaken an assessment of the potential effects of the operational stormwater resulting from the Ō2NL Project. This assessment undertakes an analysis of the current state of the treatment of the State Highway network and how this will change as a result of the proposed treatment process for stormwater for the Ō2NL Project.

110. Regarding water quality inputs and outputs for stormwater, Technical Assessment 4.2 notes that the concept design for the Ō2NL Project highway stormwater management system is designed to:[23]

(a) Provide stormwater runoff treatment over more than 90% of road surface area in the Ō2NL Project;

(b) Provide a treatment train approach that can capture and treat 75-90% of total suspended solids, oils, and soluble metals (copper and zinc) from road runoff for 90% of storms. The treatment train includes vegetated batter slopes, treatment

[23] Technical Assessment 4.2: Stormwater Management Design paragraph 5(a and b).

swales and constructed wetlands before discharge into the receiving environment.

111. Monitoring of the efficiency of stormwater treatment devices in relation to the removal of contaminants is very rarely undertaken. However, there is a strong reliance on the treatment to manage instream effects and for the Ō2NL Project to result in overall improvement in water quality within the catchments. Accordingly, in my opinion, representative monitoring of the efficiency of contaminate removal is warranted.

112. Technical Assessment Appendix 4.2 notes:[24]

> …practically, the containment of accumulated contaminates in swales, constructed wetlands and basins within the footprint of the Ō2NL project means that monitoring and maintenance efforts can be realistically specified for defined areas. Future renewal of treatment components will then be programmed on the basis of the information gained from monitoring and identifying performance trends over time.

113. Monitoring does not need to occur over all devices; however, the monitoring that is undertaken should be in those catchments that are identified as potentially at higher risk of stormwater either from a thermal, hydrological, or water quality perspective.

114. Based on the information within Technical Assessment H: Water Quality the following catchment and associated treatment devices should be considered for this monitoring:

(a) Catchment P, Koputuroa tributary and stormwater pond/wetlands 1 and/or 2, Catchment M, Ōhau, and stormwater pond/wetland 10, and Catchment I, Manga-huia Stream and stormwater pond/wetland 14). These catchments are included on the basis of the increased impervious area and the potential for effects on hydrology and temperature of the receiving environments.

[24] At Appendix 4 - Page 20.

(b) Catchment B, Waitohu tributary, and stormwater pond/wetlands 18 and/or 19, Catchment L, Kuku Stream, and stormwater pond/wetland 12 and Catchment P, Koputuroa tributary and stormwater pond/wetlands 1 and/or 2. These are included due to these streams potentially having an increase in contaminant load of TPH, in part due to the small length of SH1 draining to the catchment relative to a larger length of the new road.

115. Given the potential effects of the stormwater discharges on O-Te-Pua Lagoon, the monitoring of any of the operational stormwater discharges that will into this lagoon will be essential to ensure that effects are minimised as far as possible through the Project and depending on the modelled water quality of the lagoon other measures that may be required to improve the ecological health of the system.

116. I understand that monitoring of such treatment devices is not a straightforward exercise. However, I do not consider this sufficient reason for not undertaking monitoring where the nature of the effects and receiving environment necessitates it. In this case, the effects will be managed through a treatment regime and monitoring of this system will inform its implementation. For these reasons, I am of the view that the efficiency of the stormwater system should be monitored.

117. Monitoring will need to be comprehensive to show the efficiency overtime (a least 12 months of data) and is likely to require:

(a) Monitoring continuously of flows entering the device;

(b) Monitoring continuously of flows leaving the device;

(c) A range of contaminant concentrations entering the device over a event/s;

(d) A range of contaminant concentrations exiting the device over a event/s.

118. Submission 45 by Te Pae Hauora o Ruahine o Tararua (MidCentral, Te Whatu Ora) suggests that the stormwater ponds should be populated with native fish that feed on insect larvae. I agree that some native fish

species will feed on the free floating larvae of mosquitoes; however, the environments provided with the stormwater treatment devices do not necessarily provide the right type of environment for these species.

119. The stormwater treatment devices will at times have no standing water for fish to survive in. Further, the majority of native fish species are migratory in nature – the treatment devices would therefore need to be constructed in a way that enables fish passage both into and out of these devices. Without fish passage into such devices, they would require restocking on a regular basis. Mosquitos' life cycle means they can return quickly once water is available for egg and larvae development and this is likely to be faster than 1) fish will migrate back into a treatment device after water returns or 2) the time that it would take to restock the treatment systems from wild stock.

120. In my view, the approach suggested by the submitter is likely to be resource hungry and unlikely to have the desired effect of controlling mosquitos.

P. FISH PASSAGE

121. Waka Kotahi has undertaken a detailed assessment of the aquatic life within the waterways affected by the Ō2NL Project.

122. The technical information shows that a number of the native fish species within the catchments affected by the proposal are migratory in nature. That is, they require access to the sea at some stage of their life cycle, although the freshwater-saltwater-freshwater is a vital consideration for fish passage. Fish passage also needs to be considered for species that move through our waterways without necessarily going to sea (i.e. non-migratory species) or for those species that once they come in from the sea from their juvenile life stage move up and down rivers for spawning (e.g., torrentfish). On this basis, free unimpeded access both upstream and downstream of instream structures is vital to ensure on the on-going survival of our fish species.

123. Waka Kotahi states that it will design all culverts in permanent streams to provide fish passage using the "stream simulation" designs as

standard.[25] Ephemeral streams with permanent habitat upstream (that is farm dams and ponds) may use a flexible baffled design to facilitate fish passage at time when there is surface water flow. This equates to:

(a) A "no effect" situation for bridge sites (Ōhau River, Waikawa Stream, Manakau Stream, Waiauti Stream).

(b) A "Net Gain" for Stream 2 (new culvert under existing SH1 near chainage 34,050), Stream 20 (approximate chainage 28,575), and Stream 23 (approximate chainage 28,050), where a new culvert will increase connectivity due to existing barriers being removed, and for Kuku Stream where an existing farm culvert is being removed. This equates to a "positive effects" situation.

(c) A "Very Low" level of effect for all other waterways."[26]

124. The stream simulation approach represents international best practice for the design of culverts to allow passage of aquatic organisms and is the recommended best practice approach for New Zealand.[27] I am supportive of this approach.

125. The proposed conditions for fish passage through culverts are RFE2 and RFE3. Although requiring provision for fish passage the conditions do not refer to the fact that it is to be provided through the stream simulation approach. To ensure that best practice is carried through into design and implementation this reference should be included within the proposed consent conditions to provide certainty to all parties.

126. A critical requirement to ensure fish passage through and past structures is to ensure the design is able to be (and has been) effectively implemented on the ground. I have experienced situations where the design enables fish passage and implementation has not achieved the requirements for fish passage. It is therefore important that the detailed designs for the culverts are independently peer reviewed by an freshwater ecologist who specialises in fish passage. Then, once construction is complete, an experienced freshwater ecologist should

[25] Technical Assessment K; Freshwater Ecology paragraph 16.
[26] Technical Assessment K: Freshwater Ecology paragraph 16.
[27] New Zealand Fish Passage Guidelines: For Structures up to 4 metres.

also undertake an ‘as built’ inspection of the culvert, and report back on any concerns with implementation.

127. Waka Kotahi has proposed at condition RFE3 that certain information is provided after the installation of the culvert and each time after a significant natural hazard. The information being collected is required by Regulations 62, 63, and 68 of the Resource Management (National Environmental Standards for Freshwater) Regulations 2020. This requirement is different to an ‘as built’ as the as built requires an assessment against the original design and further, on the ability of the design to enable fish passage. Therefore, these requirements are complementary (but in addition) to each other and provide slightly different information for different purposes.

128. Waka Kotahi has proposed that temporary diversions and culverts with fish passage will only be provided where the structure is to remain in place for at least seven days. This issue was explored further in the Section 92 Response, with the main reason being a desire to allow the contractors some flexibility for very short term temporary crossings. Waka Kotahi consider this time period is short enough to provide for certainty of planning and weather forecasting. The Section 92 Response states further that it will not have a measurable impact on fish populations especially given proposed condition RFE1 which limits activities during migration periods.

129. I note that the Section 92 Response on these matters did not align with Technical Assessment K: Freshwater Ecology[28] and the overall conclusion it reaches on fish passage during the construction phase of the Ō2NL Project.

130. In regard to the seven day period having no measurable ecological effect, I note that the passage and timing of migratory fish species is not well understood – for example, the triggers for migration to occur. Ecologists have developed windows in which peak migration is understood to occur, however, it is also understood that migration occurs outside of this window. Although I understand what Waka Kotahi

[28] Paragraphs 154 to 158.

are trying to achieve, I see no evidential basis for this seven day exclusion period for fish passage. Unless further information is provided to support the seven day period from an ecological perspective I am of the opinion that the period should be no greater than 48 hours.

131. As it is proposed RFE1 would also prevent work at any time when migratory fish are present. This is likely to be all year in some reaches in which works are to occur. I understand that the intent was for works not to occur when migratory species are predicted/expected to pass through this reach of the river during their peak migratory phase. As presently worded however, there would be some reaches of rivers in which works could not occur as migratory species would be present all year.

Q. OFFSETTING

132. As I have identified above, Technical Assessment K - Freshwater Ecology has identified the area of stream that needs to be offset due to residual effects that cannot be avoided, remedied, or mitigated. This has been achieved through the use of the SEV and ECR methodology to establish the required level of offsetting. Use of the SEV is a transparent method to consider how the assessment has been undertaken.

133. Technical Assessment K comments on the application meeting the eleven biodiversity offsetting principles of the "Biodiversity offsetting under the RMA" guidance document.[29] Based on the information contained within Technical Assessment K, I agree that the offsetting principles are complied with.[30]

134. Schedules G1 and G2 of the PNRP outline the principles that will be used to guide the development of biodiversity mitigation (G1) and biodiversity offsets (G2). Although Waka Kotahi have not undertaken a direct assessment against each of the items covered under G1, in my view, the assessment can be undertaken with information contained throughout Technical Assessment K: Freshwater Ecology. The one exception is the proposed permanency of the mitigation measures that

[29] At paragraph 219.
[30] Paragraph 219 (a) through to (k).

are put in place, which is a requirement of Schedule G1 but is not detailed. As outlined and covered further below, perpetuity is one of the measures considered to ensure that offsetting fulfils its intended function. This applies equally to mitigation measures, to ensure that the proposed desirable effect continues well after completion of the project.

135. The requirements of Schedule G2 closely align with those required under the best practice offsetting guidance.[31] The only complicating factor with Ō2NL Project corridor is the boundary between Horizons and GWRC, meaning the offsetting as proposed is not necessarily being contained within the catchment where the effects will be experienced. For the Ō2NL Project, Waka Kotahi has taken the stream offsetting approach of attempting to gain the largest ecological benefit that it can. Therefore, offsetting works are focused to particular catchments where the length of stream can be maximised, providing the maximum ecological benefit to the stream. This approach has far greater ecological benefits than undertaking small, disjointed restoration works within a number of catchments. In my view, this is not contrary to Schedule G2. Although technically the offsetting will occur outside of the GWRC region there is an appropriate ecological rationale for this, and it will have the overall ecological benefit that Schedule G2 requires.

136. Proposed condition REM11 sets out the area of stream channel that is to be constructed and planted and the area of existing streambed area to be planted. Within the proposed parameters there is a slight variation in what is considered the minimum width for planting. New channels will require a minimum of 5 metres and existing channels a minimum of 3 metres. In my view, a proposed 3 metre riparian strip (including planting) is extremely thin and would not be expected to deliver additional ecological benefit compared to simple fencing of the waterway. This is due to the practicalities of implementing such a strip – with a three metre strip, the fence will be placed on the 3 metre margin. There then needs to be at least a metre of distance from the fence before planting can begin (the typical reach of livestock, to reach a new establishing plant).

[31] Biodiversity Offsetting Under the Resource Management Act – A Guidance Document, 2018. Prepared by Fleur Maseyk, Graham Ussher, Gerry Kessels, Mark Christensen and Marie Brown

Vegetation planted to close to fences is undesirable for other reasons as well, as it creates on-going maintenance issues (shorting of electric fences, and debris falling onto fences). This then leaves 2 metres to be planted, with the planting likely to be at least 1 metre back from the stream edge (to allow for some streambed widening once stock etc are removed from having access). In reality, this effectively results in one row of vegetation that can be planted. This provides minimal room for the establishment of vegetation that will shade the stream channel.

137. As the shading of the stream channel is what drives the SEV habitat characteristics and results in the improvement of the ecological health with the stream, I am concerned that some of the planting widths within condition REM11 are insufficient. I recommend that the riparian width needs to be a minimum of 5 metres to be effective at providing the desired outcomes for the offsetting (although they will still be less than the outcomes with a wider riparian buffer).

138. Forest and Bird (Submitter 62) have submitted that pest plants need to be absent or suppressed for the duration of consent and that pest animals requiring control are specified within the consent. I agree that pest plants need to be controlled to ensure success of the offsetting – one of the principles of offsetting is permanence. The weed control therefore needs to occur for longer than the actual term of the consent and is effectively required in perpetuity. My understanding is that this achieved with an agreement between landowners and Waka Kotahi (Waka Kotahi effectively get the planting established (including weed and pest animal control during this time) and then the responsibility flips to the landowner through covenants on their properties). Given the importance of pest control to the offsetting measures, I consider that the conditions should require legal arrangements are in place for the pest control to occur over time. It is not immediately apparent that condition REM13 requires this.

139. Proposed Condition REM18 requires confirmation of the actual stream area lost following completion of construction activities, with any changes to the area impacted necessitating a change in the offset area. If the recalculation results in a value different to the value in proposed condition REM11 the Ecology Management Plan will need to be

modified to reflect the required changes. Given the nature of the SEV, ECR and the proposed offsetting there are a number of assumptions made (i.e., that if x is to occur (riparian planting, for example)) then y will happen (shading of the stream will provide debris to the stream for habitat complexity and improved aquatic habitat)). This is on the basis that even through works may improve habitat, Waka Kotahi has no control on when or if aquatic species will return to the location.

140. As a consequence, there needs to be certainty that delivery of the necessary parameters is achieved to ensure these outcomes. This includes ensuring that what has been predicted to occur at the offset site is what will happen and that the proposed improvement is an actual improvement. I cover this in two separate sections below.

Constructed channels

(a) The design of the constructed channels refers to the:

> stream creation and enhancement measures must be generally consistent with the design for stream diversions shown on the Stormwater: Typical Details Swales and Open Channels included in the 'Notices of Requirement for a Designation and Application for Resource Consents' dated 1 November 2022 'Volume III Drawings and Plans', and implemented within three (3) years of the completion of construction.

Although this diagram provides the general shape of the channels to be created it does not provide detail on the other stream characteristics that are important to maintain and/or enhance stream function.

(b) In Technical Assessment K,[32] there is reference to diversion channels and the additions of meanders within them to provide a more 'natural' stream. However, the conditions presently provide no certainty that these meanders will be created. Additionally, instream debris and stream morphology such as pool, run, riffle sequences play an important role in provide

[32] At paragraph 142(d).

habitat complexity for a number of freshwater organisms. Therefore, it will be important that these constructed channels are created to be wider than the referenced diagram.

(c) These issues were discussed in the Section 92 Response which noted that the design of the stream diversions will form part of the Ecology Management Plant (that is subject to certification). However, on review of Schedule 7 which outlines the requirements for the Ecology Management Plan the expected requirements for the stream creation is limited to approaches to stream creation and enhancement.[33] In my view this should be expanded to include those matters normally considered in stream creation/enhancement, including:

(i) Meander patterns consistent with the stream type and that are present upstream and downstream of the proposed works area;

(ii) The pool, riffle, run sequence present in the existing stream channel,

(iii) Designs being consistent or sympathetic to the existing environment;

(iv) The inclusion of instream debris to provide instream habitat complexity;

(v) The opportunity to include undercut banks to provide further habitat complexity.

141. The above is consistent with the recommendations in Technical Assessment K: Freshwater Ecology.[34]

142. Ideally, the SEV scores at the offset sites would be recalculated at the end of the relevant time period. This work would allow the calculation of the current SEV (future and current) scores at the sites (at the time the measurements are undertaken), which can then be compared back to

[33] Schedule 7: Freshwater Ecology Management Plan requirement f.
[34] At paragraph 214.

what was predicted to occur. There is a possibility that the predicted scores will not be met. However, as mentioned above, with biological systems there are likely to be a range of reasons that predicted scores might not match actual scores, despite the adoption and implementation of best practice. This does, however, place a reliance on best practice being adopted, consented and implemented to ensure that overall there is a net gain through the offsetting proposal.

143. Waka Kotahi has undertaken work with a number of landowners to identify reaches of streams/rivers at which offsetting could occur. These sites are contained in Appendix K.6.[35] This information contains the current SEV score of the site and proposed score as a result of the offsetting works. Although this work has progressed I am unsure as to whether or how many of the locations have been confirmed through legal mechanisms to ensure that they achieve the required outcomes of the offsetting process. This is likely to be a similar issue with the terrestrial offsetting package.

144. As noted above, one of the key requirements of offsetting is permanence – the outcomes of the proposed offset needs to be secured for the length of time the effect exists for and into perpetuity. Put simply, it is necessary to ensure that what was predicted to occur actually occurs, and that there is a feedback loop to monitor performance. There are two elements here that Waka Kotahi needs to ensure occur to meet this requirement:

(a) That the area (m^2) required for the offsetting is kept in perpetuity for this purpose. For land that is outside of the ownership of Waka Kotahi this will need to be through appropriate covenants or other legal mechanisms on the land on which the works occur; and

(b) That the works that are undertaken are maintained in a state that ensures the on-going benefit to the waterway in which the works are undertaken. This mostly being through animal and plant pest control and ensuring the on-going survival of the vegetation that

[35] Pages 159 – 160.

is to provide the benefit to the stream. Any agreements entered into with landowners need to be clear on who is responsible for the on-going success of this work.

145. Given the uncertainty as to where exactly offsetting measures will be undertaken as a result of the Ō2NL Project, I recommended that an Offsetting Plan for the site/s is developed and submitted to the Regional Councils, to ensure that the proposed offsetting measures will fulfil their intended purposes. Compliance with condition REM14 will likely produce the plans required.

R. SUBMISSIONS

146. I have read all of the submissions relating to the resource consent applications. The majority of submissions deal with matters that are outside of my area of expertise and will be dealt with by other experts. The majority of issues raised by submitters I have responded to in the sections above where I address the particular topic in question. Submissions not already addressed above are included below:

(a) Submission 20 makes specific reference to the Manga-huia Stream and the high values that it holds for native fish species with previous surveys having found Banded Kokopu, Giant Kokopu, inanga and Longfin eels. On this basis the submitter notes that the stream should be considered a high value waterway because of the presence of these fish species The submitter is correct that the presence of these species does show a high value stream for native fish populations. However, when undertaken the assessment of overall ecological values the presence of fish fauna is only one of the factors that is considered. Others include by way of example macroinvertebrate communities, and the amount of sediment. Waka Kotahi has shown regard to the range of factors through Technical Assessment K: Freshwater Ecology, and the fisheries values associated with site should be represented in the final classification. Therefore, while the submitter is correct, and the stream has high fish values, the values should have been reflected in the overall assessment of the stream.

(b) Submission 60 notes a watercourse that runs through their property. This property falls within the Lake Horowhenua catchment. The submission questions potential earthworks effects on the waterway. I note from a water quality perspective that the road alignment is proposed to have water discharges (both sediment and operational stormwater) discharged to ground at this location. Based on this I would expect that water quality effects would be minimal. However, in my view, the effects of the actual earthworks themselves at this location would be better responded to by Waka Kotahi.

(c) Submission 73 (KiwiRail) raises freshwater related issues through reference to sediment and erosion control, and appropriate culvert sizing. The matters are more related to infrastructure management rather than water quality or aquatic habitat. Based on these matters I comment no further on them.

(d) Submission 74 (Muaūpoko Tribal Authority). The submission covered a number of matters related to the proposal. Specifically related to freshwater habitat and water quality it records the need to ensure the connection of wai, fish passage, the protection of water quality both during construction and ongoing effects from stormwater contamination. These matters as they relate to freshwater habitat and water quality have been covered above.

S. NATURAL CHARACTER

147. I have read and considered the natural character materials that relate to freshwater ecology and water quality matters. The freshwater ecology and water quality considerations within the Natural Character assessment are informed by Technical Assessment K: Freshwater Ecology and Technical Assessment H: Water Quality. The matters related to these two topics are, in my opinion, adequately reflected within Ms Williams' Natural Character report.

148. One matter that I have noted within the proposed mitigation for natural character is an overlap of offsetting for stream loss and proposed mitigation for natural character. I particularly note paragraph 239 of

Technical Assessment D: Landscape, visual and natural character, relating to the riparian management (planting and fencing) along the Kuku Stream. Technical Assessment D notes that:

> The purpose of this riparian restoration is to increase the perceived naturalness of the stream to balance the presence of the Project on such perceived natural. It would also have benefits in downstream water quality and ecological health and would complement downstream revegetation that has been carried out.

149. However, drawing Planting Concept Plan: RMA purpose Type Sheet 11 (drawing No. 310203848-01-700-C2010) has this proposed area as offsetting for riparian/freshwater sites. I agree that this proposed planting assists the mitigation of natural character effects at this location, and that it will have linked benefits for water quality. However, they are not additional to the measures required to mitigate natural character – that is, the benefits eventuate with the natural character mitigation and are not separate additional water quality benefits.

150. Following the offsetting principles strictly, there needs to be an additional element, which the proposed work at this location does not provide. Further information/clarification is required as to how this offset is to be delivered. It would be helpful if Waka Kotahi confirmed that this has not been proposed at any other locations along the road corridor.

T. CONDITIONS

151. I have made a number of recommendations regarding conditions already in my report. I note below the item to be managed and the specific reference within this report.

(a) Light pollution and certainty of mitigation at paragraphs 40 and 41;

(b) Standards for the discharge from sediment treatment devices targeted to the sensitivity of the receiving environment at paragraphs 68;

(c) Monitoring of sediment and associated in-stream effects at paragraphs 74 and 75;

(d) Fish Recovery at paragraph 81;

(e) Inclusion of additional parameters into the management plans for the discharge of contaminants from construction activities at paragraph 83;

(f) Water takes at paragraph 102;

(g) Supplementary water takes at paragraphs 107 and 108;

(h) Operational stormwater discharges at paragraphs 116 and 117;

(i) Fish passage and temporary structures at paragraph 130;

(j) Offsetting and minimum buffer distance for riparian management at paragraph 137;

(k) Perpetuity of offsetting at paragraph 138 and 144;

(l) Constructed channel requirements at paragraph 140; and

(m) Offsetting management plans at paragraph 145.

Logan Brown

28 April 2023

APPENDIX A

REACH SPECIFIC VALUES

Manakau (West_9b)

(a) Domestic food supply; and

(b) Flood control and drainage.

Waikawa (West_9a)

(a) Domestic food supply;

(b) Site of Significance – Riparian;

(c) Site of Significance – Aquatic (shortjaw kokopu and redfin bully); and

(d) Flood control and drainage.

Lower Ōhau (Ōhau_1b)

(a) Domestic food supply;

(b) Trout fishery (Ōhau mainstem);

(c) Site of Significance – riparian (just downstream on the mainstem of the Ōhau);

(d) Site of Significance – aquatic (mainstem of the Ōhau for redfin bully); and

(e) Flood control and drainage.

Lake Horowhenua (Hoki_1b)

(a) Domestic food supply; and

(b) Flood control and drainage.

Koputaroa (Mana_13e)

(a) Flood control and drainage.

Waitohu

(a) Trout fishery value (mainstem only); and

(b) Whitebait migration zone