IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications by Waka Kotahi NZ Transport Agency to Manawatu Whanganui Regional Council for resource consents associated with the construction and operation of Te Ahu a Turanga: Manawatū Tararua Highway.

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

A. QUALIFICATIONS / EXPERIENCE

1 My full name is Logan Arthur Brown. I am currently employed by the Manawatū-Whanganui Regional Council ("**Horizons**") as the Freshwater and Partnerships Manager. I have held this role since July 2016, and 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.

2 I have a Masters in Science – Ecology, a Bachelor of Business Studies majoring in Economics and a Bachelor of Science majoring in Ecology from Massey University.

3 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*. In my current role, I am still involved in a number of research programmes focused on freshwater systems.

4 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.

5 I have been engaged by Horizons to provide freshwater quality and ecology expertise on the resource consent applications by Waka Kotahi NZ Transport Agency (the "**Applicant**") for resource consents associated with the construction and operation of Te Ahu a Turanga: Manawatū Tararua Highway (the "**Proposal**").

6 I am familiar with the catchments and streams in the Manawatū catchment having been involved in stream monitoring in the Manawatū catchment for the last 10 years and having visited the site along with other Horizons experts on 10 September 2019.

B. CODE OF CONDUCT

7 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 2014. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this report is within my area of expertise.

SCOPE OF REPORT

8 My report focuses only on issues related to freshwater and the potential effects on freshwater values as a result of the Proposal and covers the following topics:

(a) Sensitivity of the receiving environments;

(b) Baseline information and monitoring;

(c) Culverts and fish passage;

(d) Dewatering and fish salvage during construction;

(e) Concrete;

(f) Vegetation clearance and onsite mulching;

(g) Loss of stream habitat length;

(h) Stream diversion restoration;

(i) Offsetting;

(j) Effects of sedimentation and standards;

(k) Sediment standards;

(l) Stormwater discharges;

(m) Instream triggers/standards; and

(n) Natural Character.

9 In considering the above topics I have reviewed the evidence provided by the Applicant in relation to freshwater quality and ecology and provided a summation of the effects of the Proposal. I have also provided comments on submissions where they relate to water quality as a result of sediment and stormwater discharges, loss of aquatic habitat, offsetting for freshwater and other potential freshwater adverse effects.

10 I have reviewed and relied on the information in the following reports:

(a) Technical assessment A: Erosion and Sediment Control by Mr Campbell Stewart;

(b) Technical assessment B: Stormwater Management by Mr David Hughes;

(c) Technical assessment C: Water quality by Mr Keith Hamill;

(d) Technical assessment H: Freshwater Ecology Report by Ms Justine Quinn;

(e) Technical assessment I: Natural Character by Mr Boyden Evans;

(f) Freshwater reports that were tabled as part of the Notice of Requirement ("**NoR**") application process specifically:

(i) Freshwater – Ecological Impact assessment (Boffa Miskell, 2018a);

(ii) Fish survey report (Boffa Miskell 2018b);

(iii) Natural Character Assessment (NoR Appendix 4.A).

11 I have also reviewed the Applicant's response to Horizons further information request under section 92 of the RMA, dated 29 April 2020 (the "**s92 RMA Response**").

EXECUTIVE SUMMARY

12 The key conclusions of my report are:

(a) The Proposal 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 Proposal area and therefore the Applicant has proposed an offsetting management regime for stream loss.

(b) The Applicant has undertaken an assessment of fish passage through the culverts that will be constructed across the length of the road. The majority of the culverts are to provide for fish passage as part of their design and construction. While there are a limited number of culverts where no fish passage will be provided, I accept that in those cases there is either very limited habitat (either length or intermittent flows) upstream of the culvert or the habitat available will be unsuitable i.e. constructed streams as a result of the Proposal.

(c) There are reaches of streams that will be lost as a result of the Proposal. This involves stream loss as a result of the creation of spoil sites, diversions for the road, and the installation of culverts. The streams affected by the Proposal have had SEV scores calculated for them pre and post (with mitigation) construction of the works and it has been established that 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. I am in general agreement with the offsetting proposal, subject to the imposition of conditions which address residual uncertainty over the location of the offsets.

(d) The Applicant has identified three catchments that will experience high effects of sedimentation (adverse) from the Proposal. These Catchments are 5, 6, and 7. The Applicant has concluded that the level of effect is acceptable given the nature of the work and duration of the Project, with specific offset or compensation measures unnecessary to address this effect. I am of the view that a greater level of oversight is required. Given the values within catchments 5, 6 and 7, the effects that sedimentation can have on these values, and the unknown timeframe within which those values will take to recover from sediment deposition, it would be prudent to have catchment specific discharge standards included within the conditions to provide sufficient protection for these areas.

(e) The Applicant has proposed a range of treatment devices that will treat stormwater on an ongoing basis, prior to it being discharged to the receiving environment. Overall, this will see an improvement in the quality of stormwater when compared to the current situation. The only current unknown in relation to stormwater discharges is the ability of the treatment devices to be able to remove *E. coli* and soluble nutrients. I have recommended a condition of consent to address this uncertainty going forward.

(f) Having considered the assessment undertaken for natural character, the analysis of the ranking of the attributes, and the further information that has been collected and considered by the Applicant as part of the application (since the NoR process), I am of the opinion that the methodology in relation to water quality and freshwater ecology parameters 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.

C. BACKGROUND

13 The Applicant has applied for resource consents to enable the construction, operation, use and maintenance of approximately 11.5km of new State Highway that will replace the closed Manawatū Gorge road. The road will connect Ashhurst and Woodville, via a route over the Ruahine Ranges, and in doing so will cross multiple catchments, all of which eventually drain into the Manawatū River.

14 To establish the new road alignment a number of activities are required to be undertaken. If these activities are not undertaken in an appropriate manner, they have the potential to result in significant adverse effects on water quality, aquatic habitat and aquatic species. The main activities include:

(a) The installation of 33 culverts along the newly constructed road;

(b) The creation of 8,014 metres of stream diversion;

(c) The loss of stream habitat;

(d) The removal of riparian vegetation;

(e) Works within the beds of waterways within the project envelope;

(f) Ongoing stormwater discharges from the roading network;

(g) Earthworks volumes comprised of:

(i) Bulk structural cut to structural fill of approximately 4,600,000m^3; and

(ii) Cut to waste, disposal of surplus material (undercut and unsuitable) of approximately 1,200,000 m^3.

(h) The creation of 16 spoil sites and the resultant infilling of gully systems as a result of the spoil sites.

15 The application excludes those activities that resource consents have been sought for (or will be sought for) enabling works. Therefore, the enabling resource consents and the requirements for avoidance, remediation, mitigation or offsetting and/or

compensation in relation to freshwater will be/have been dealt with in those applications.[1]

16 Full details of the works to be completed as part of the construction of the road alignment, the ongoing effects from stormwater discharges, and loss of aquatic habitat as a result of the Proposal are covered within the application (in particular the DCR, section 3 AEE and related construction methodologies). For brevity they are not repeated here. I acknowledge that the information around the Proposal design and alignment has far greater detail than what was available at the hearing for the NoR and also reflects changes which incorporates a more Northern Alignment.

17 A range of technical assessments accompany the application and have been relied on by the Applicant when considering the effects of the Proposal on the receiving environment. As covered in these technical assessments and further in my assessment below, each of the waterways have a different sensitivity to the proposed activities. In the affected catchments, this sensitivity mostly comes from the current land use within those areas. The Applicant has identified nine sub-catchments as being directly affected by the Proposal (refer Figure H.1, page 12, Technical Assessment H). Based on the information provided throughout the application I agree that these are the immediate receiving environments. However, the main stem of the Manawatū River, the Manawatū Estuary, and eventually the Tasman Sea are the final receiving environments for all activities that occur in the Manawatū catchment.

18 The differing sensitivity levels within the receiving environments is important when considering the activities because 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 made with respect to recovery of the various species from waterways prior to works being undertaken.

[1] Technical Assessment H – Freshwater Ecology paragraph 14.

D. EFFECTS OF PROPOSAL

19 My technical assessment considers the effects of the Proposal on water quality, freshwater ecology, and where relevant to my areas of expertise, natural character.

Sensitivity of Receiving Environments

20 A range of water quality, ecological and stream habitat information has been collected to inform the design of the Proposal, as set out in the technical reports accompanying the AEE. All of the information collated in support of the Proposal shows that as the road alignment crosses the Ruahine Ranges the catchments affected by this Proposal differ in sensitivity as receiving environments.

21 The One Plan identifies a number of values (as contained in Schedule B)[2] within the region's waterways. These values include the social, economic, cultural and environmental values of the region's waterways. The region has been split up into 43 water management zones and then into a further 124 water management sub-zones as identified in Schedule A of the One Plan.[3] 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 (i.e. trout spawning). The proposed works for the Project fall within the following water management zones, Upper Gorge (Mana_9) and Middle Manawatū (Mana_10) and the following water management sub-zones Middle Manawatū (Mana_10a), Lower Pohangina (Mana_10d), and Mangaatua (Mana_9c).

22 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;

[2] http://www.horizons.govt.nz/CMSPages/GetFile.aspx?guid=9dc34171-2a86-4050-ab71-3f4043f12a8a
[3] http://www.horizons.govt.nz/CMSPages/GetFile.aspx?guid=4c2a879a-8f05-44a1-952b-e8f34078f8c8

(f) Stock water;

(g) Existing infrastructure;

(h) Capacity to assimilate pollution;

(i) Life supporting capacity – hill country mixed.

23 The following reach specific values apply to the affected catchments:

(a) Sites of Significance – Cultural (Pohangina up to the rail bridge, and the Manawatū River into the Gorge);

(b) Sites of Significance – riparian (Manawatū and Pohangina River main stems);

(c) Trout fishery – other (Manawatū and Pohangina River main stems);

(d) Flood control and drainage (Pohangina River main stem and Mangamamana Stream up to the Saddle Road bridge).

24 The Applicant has used the Ecological Impact Assessment guidelines (EIANZ, 2018) to undertake the assessment of the effects of the Proposal. This has the following steps:

(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.

25 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 instruments like the National Policy Statement for Freshwater Management ("**NPSFM**"). Therefore, care is required when only looking at the current state especially if the current state does not align with targets/standards in Regional Plans or NPS documents (like the NPSFM).

26 Allowing further degradation of systems that are already degraded does not result in maintenance or enhancement of water quality. Instead, it takes water quality and freshwater ecology further away from the targets/standards in those instruments/plans and the aspirations that communities have for their waterways. As I discuss later in this report, the fact that values (for water quality) are already compromised is not a sufficient or good reason to allow for further degradation.

27 An example of this shortcoming in approach is the current deposited and suspended sediment levels in the waterways effected by the Proposal. As noted in the application, many of these levels are above the One Plan target for the waterways,[4] with the elevated deposited sediment levels being one of the factors that has resulted in many of the values in the waterways not being maintained or provided for.

Baseline information and monitoring

28 As I have identified, the Applicant has undertaken monitoring and information gathering through a number of stages of this Proposal.

29 During early development of the Proposal, the Applicant proposed a programme that would collect baseline information from some of the streams in the region that were intended to be affected by the works. I reviewed the proposed monitoring programme on behalf of Horizons to ensure that the monitoring captured appropriate information on the baseline conditions of the streams that were, at that stage, in the envelope of the NoR. This monitoring has been summarised in the Te Ahu a Turanga: Manawatū Tararua Highway – Baseline Freshwater Monitoring Results James, A. (2019) and used in the application. For example, it has informed Technical Assessment C – Water Quality (e.g. at paragraphs 30 to 32). (A copy of this report was provided to Horizons via the s92 RMA Response). Monitoring and further information was then collected to feed into the NoR process and was summarised in the supporting documentation for

[4] Technical Assessment H – Freshwater Ecology, paragraph 198.

the NoR application. Further information has since been collected to inform the assessment of effects for the Proposal as set out in the resource consent application.

30 In my view, the information collected through these various stages has allowed for a thorough understanding of the values that these streams/catchments currently hold and enabled an assessment of the effects on those values.

31 Combining the information contained in Technical Assessment H - Freshwater Ecology and Technical Assessment C - Water Quality reports, it is apparent which of the catchments are the most sensitive as receiving environments for the Proposal. Table 1 pulls together the various water quality and freshwater ecology parameters that have been monitored as a part of the Proposal showing whether they meet the One Plan targets for water quality parameters and the classifications for SEV, IBI, and MCI. This allows us to consider both water quality and freshwater ecology together and the current sensitivity of the receiving environment. As identified in these reports, catchments 5 and 7 are the most sensitive from a water quality and ecological perspective, with generally the highest water quality and ecological values of the catchments affected by the Project.

Table 1: Catchment C1 through to C8 and compliance with the One Plan targets for pH range, temperature, dissolved oxygen, particulate organic matter, dissolved reactive phosphorus, soluble inorganic nitrogen, ammonia, clarity, *E. coli*, deposited sediment, MCI, and Stream Ecological valuation (SEV) and IBI index (SEV and IBI not being One Plan targets but values that provide information on stream characteristics). This table is produced based on information in Technical Assessment C and H, Water Quality and Freshwater Ecology respectively.

Variable	C1	C2	C3	C4	C5	C6	C7	C8
Ph range	Y	Y	Y	Y	Y	Y	Y	Y
Temp. <	Y	Y	Y	Y	Y	Y	Y	Y
DO	Y	Y	Y	Y	Y	Y	Y	Y
POM	Y	Y	Y	Y	Y	Y	Y	Y
DRP	N	Y	Y	Y	N	N	N	N
SIN	N	N	Y	Y	Y	Y	N	N
NH4	Y	Y	Y	Y	Y	Y	Y	Y
Clarity >	N	N	N	N	N	N	N	N
E. coli	N	N	Y	N	N	Y	Y	N

Deposited sediment	N	N	N	N	N	N	Y	N
MCI (100)	63 (N)	60-78 (N)	67 (N)	78-88 (N)	101-120 (Y)		90-120 (Y)	
IBI	24 (very poor)	70 (2) - excellent 24(2c) - poor	52 (Moderate)	34 (very poor)	48 (moderate)		54 (moderate)	42 (poor)
SEV	0.32	0.29-0.79	0.38-0.66	0.40-0.56	0.52-0.76		0.44-0.78	

Culverts and Fish Passage

32 The Manawatu catchment is home to 23 species of native and introduced freshwater fish. This is a different number of species to the value used in Technical Assessment H – Freshwater Ecology (paragraph 126), with inanga, shortjaw kokopu, koaro, giant kokopu, banded kokopu, lamprey, Crans bully, and rainbow trout missing from Table H.5. During the surveys to inform the proposal five species were encountered. The identified species are reflective of land use and the limitations on habitat availability currently in the catchment i.e. a lack of riparian vegetation in many of the catchments. More favourable habitat would lead to a greater diversity of native fish species in the sub-catchments.

33 Many of the native freshwater fish are diadromous in nature, meaning that they require access to the sea at some stage in their life. The most commonly known diadromous species are the whitebait and eel species. Any impediments between their freshwater habitat and the sea can therefore influence the distribution of fish populations in the catchment. Of the five species that were encountered during surveys to inform the Proposal, four of the species are migratory (short fin eel, long fin eel, redfin bully and common bully).

34 The Proposal includes the construction of 33 culverts that have the potential to impede the passage of freshwater fish into the headwaters of the catchments affected by the Works. Technical Assessment H - Freshwater Ecology has undertaken an assessment of the culverts required to be constructed across the road length and depending on the availability of habitat upstream of the culverts, whether fish passage is required and the type of passage that is required. Specifically, the Applicant has

sought to identify areas of highest fish passage value and those areas *"…where the residual habitat following construction would not be sufficient to warrant passage*."[5]

35 Generally, good practice has fish passage being provided at all culverts. However, I accept that there may be situations where, for technical reasons, the provision of fish passage may not be required through certain culverts, for example, a lack of habitat upstream. Despite this, the Department of Conservation (via the Freshwater Fisheries Regulations) may still require fish passage to be provided in some circumstances.

36 The findings from the culvert assessment are shown in Table H.14 of Technical Assessment H - Freshwater Ecology.[6] This Table also shows the grouping of fish species (climbers or swimmers) that are used in the development of suitable gradients to enable fish passage through the culvert structures. Those culverts where the Applicant has sought not to enable fish passage either have no habitat upstream of the culvert (therefore the culvert would be the end point of the habitat) or there is very limited habitat upstream of the culvert. Where there is very little habitat (for example 20 metres at culvert CU-14) the streams are likely to be intermittent and therefore are likely to only provide a small amount of habitat for a limited amount of the year.

37 I am of the opinion that the conclusions drawn by the Applicant around the provision of fish passage across the Proposal are sound. That is, where upstream habitat is minimal, intermittent in nature, or was going to comprise only constructed habitat following construction, fish passage measures are not incorporated into the design.

38 However, in my view an additional requirement is for the design of the culvert to ensure that fish passage is maintained at these structures over the lifetime of the culvert. One of the work programmes undertaken by the Freshwater team at Horizons involves working with structure/asset owners to restore fish passage at structures that once would have provided for fish passage, but which now operate as barriers due to a lack of maintenance. Therefore, in my opinion it is vital that continuing maintenance of the structures involves an on-going assessment of whether the ability for fish to be able to migrate through them continues to be retained over the life of the asset.

39 I also recommend that final sign-off/certification of the culvert design is undertaken by an experienced fish passage ecologist prior to construction of each of the culverts commencing. Remediation of poorly installed and/or designed culverts is expensive

[5] See Technical Assessment H – Freshwater Ecology, at [167].
[6] Pages 73 – 74.

and frequently does not result in as positive outcomes if design and installation had occurred correctly in the first place. In addition, “as builds” should be required to be completed for installed culverts so as to certify that the installation allows/provides for fish passage for the target species. A recent example is in the Wharakakapu Stream where the Transport Agency installed a new culvert which has or is in the process of being retrofitted for fish passage. This work was required because the design and/or final construction did not provide for fish passage as required by the resource consent conditions. This is currently being worked through between the parties, however it takes time and is likely to result in less positive outcomes than originally proposed.

40 I have recommended to Mr St Clair, as the s42A reporting planner, that a condition of consent require that “as builds” are provided for all constructed culverts. That same condition should also require the provision of fish passage in all those culverts recommended in Technical Assessment H, Table H.14.

41 While undertaking fieldwork to inform the current application, the Applicant has found a culvert that runs underneath the Kiwirail rail tracks where Catchment 7 enters into the Manawatū River. It has a man-made barrier to fish passage (refer Figure 1 below). Within Technical Assessment H - Freshwater Ecology[7] and Technical Assessment I - Natural Character, the Applicant proposes that the culvert will be made fish passable as a part of the package of works associated with the Proposal.

42 I note that this undertaking has not been carried across into the consent conditions proposed in the application. In my view a condition should be included which requires the Applicant to make the culvert fish passable for those species that are anticipated to be within the catchment. The condition should also require that a plan (including design) of how this is to be done should be submitted to the Council prior to the works being undertaken.

[7] Page 79.

Figure 1: Culvert that runs under the Kiwirail rail line were catchment seven enters the Manawatū River. Photo on the left shows the raised culvert outlet creating a barrier to fish passage for the majority of native fish, Photo on the right is downstream of the culvert looking towards the Manawatū River.

Dewatering and Fish Salvage during Construction

43 The Proposal involves large areas of streambed (aquatic habitat) being lost from the stream network in the catchments affected by the Proposal and the associated road corridor. When undertaking works that result in the stream loss, there will be aquatic life that will be destroyed as a result of the works.

44 Technical Assessment H - Freshwater Ecology covers in detail the species that could be expected in the receiving environment within the Proposal area including fish, kakahi (freshwater mussels), and koura (freshwater crayfish). I agree that the species that are considered to be in the vicinity of the Proposal area are what could be expected, given the current land use and quality of habitat that is present.

45 Technical Assessment H - Freshwater Ecology and the Ecology Management Plan (EMP) include Fish Recovery Protocols for those species that will be affected by the removal of this habitat. The recovery protocols are based on the threat classification of the species that might be encountered, the number of individuals caught, and reducing capture rates. These are practical methods to inform when to cease the recovery of individuals from a habitat that is either permanently or temporarily being lost. The reality is that it is not possible to recover all individuals that will be in the affected reaches, however, numbers can be significantly reduced by following the Fish Recovery Protocols. Proposed condition EC13 deals with fish salvage, relocation and fish passage during construction and refers to the EMP for details of the protocols.

46 While the Fish Recovery Protocols cover in detail how the process will be undertaken, there are some general principles that apply to fish recovery that would be best captured as resource consent conditions. These include:

(a) Depending on the habitat type and its suitability for fish recovery, fish recovery shall be undertaken via electro-fishing and/or trapping, and/or dewatering and muck out;

(b) Koura and kakahi shall be searched for, recovered and transferred in those areas that contain suitable habitat for those species;

(c) If native fish with a conservation status of 'threatened' or 'at risk – declining' are captured, trapping and/or electro-fishing will continue until no further conservation status of 'threatened' or 'at risk – declining' individuals are captured;

(d) For those fish species that do not have the conservation status of 'threatened' or 'at risk – declining' a declining capture rate of 50% between the first and last recovery event should apply if the first recovery event encounters more than 10 individuals of each species over a 150 metre monitoring reach.

47 The Applicant has correctly identified those aspects of the Fish Recovery Protocols that are likely to require permits from other organisations such as the Department of Conservation, and/or the Ministry for Primary Industries to allow the transfer of these species from affected reaches. The need for these permits has not been considered as part of this assessment and will be a matter for the Applicant.

Concrete

48 Depending on the works that are being undertaken the Applicant has identified the risk that unset concrete could find its way into the waterways affected by the Proposal and therefore cause adverse effects to the aquatic life present within the waterways.

49 The Applicant has identified a number of measures to avoid adverse effects from concrete used through construction. These include undertaking the works in the dry, using pre-cast concrete slabs, or creating diversions around the works areas. These are all measures that can avoid the effects of such activities. The adoption of these measures will ensure that the effects from these activities are avoided.

Vegetation clearance and onsite mulching

50 Vegetation removal is required as part of the Proposal. As covered in Technical Assessment H - Freshwater Ecology and Technical Assessment C - Water Quality, there are two main ways that the removed vegetation can have effects on water quality and the associated instream ecology (this does not include the functions that riparian vegetation plays in stream health as this is captured under the loss of streams/habitat). The first way is where the storage of mulch and its breakdown results in leachate making its way into surrounding waterways, and the second is when there is direct deposition of mulch and small debris into the waterway. Both factors can cause significant depletion of dissolved oxygen from the water column, resulting in adverse effects for the aquatic life that is present within that waterway.

51 As covered in both Technical Assessment H - Freshwater Ecology[8] and Technical Assessment C - Water Quality[9] these effects are easily managed through appropriate management regimes such as capturing leachate if generated, not storing large mulch piles next to waterways, and not depositing large amounts of small debris into the streams, especially given the small nature of the majority of the streams affected by the Proposal. For clarity, the installation of large woody debris into streams has beneficial effects on habitat complexity and therefore habitat available for aquatic life and the references above are to small debris (e.g. vegetation that has been mulched).

Loss of Stream Habitat/Length

52 The Applicant has undertaken a significant amount of work in identifying those reaches of streams that will be lost or permanently changed through direct in-stream works as a result of the Proposal. These investigations are detailed in Technical Assessment H - Freshwater Ecology. In summary, this work has involved:

(a) Walking of the majority of stream length that is to be lost as a result of the Proposal;

(b) The use of the Stream Ecological Valuation ("**SEV**") to develop a SEV score for a number of sites in stream reaches that are to be affected by the Proposal;

[8] Technical Assessment H – Freshwater Ecology paragraph 176.
[9] Technical Assessment C – Water Quality paragraphs 109 and 110.

(c) Use of the SEV calculator to predict the value of those affected streams after the works have been completed and mitigation and remedying actions have been implemented; and

(d) Calculation of current SEV scores at one of the potential offsetting sites.

53 The use of the SEV for the Proposal is, in my opinion, an appropriate use of the tool. The methodology provides a transparent, robust approach that has been reviewed and refined since its original development (Neale et al, 2017). The method can be adjusted to local data where it is available to reflect local conditions, and in this Proposal the tool has been modified using a small amount of reference data that Horizons has collected (covered in more detail at paragraph 99 of Technical Assessment H). The use of both the SEV and the Environmental Compensation Ratio ("**ECR**") methodology also allows for the quantum of offsetting to be calculated if avoidance, remediation or mitigation are not possible as a result of any activity.

54 The Applicant has considered the length and area of streams that will be lost and/or modified as a result of the Proposal. Modification of waterways will result in a reduction in the ecological function of them and as shown in Table H.18 of Technical Assessment H – Freshwater Ecology, the effect from stream loss and modifications will be very high in some of the catchments. The Applicant has proposed an offsetting package to address these residual effects. The methodology to assess the loss of this stream habitat and/or its function is transparent and based on an accepted methodology for the calculation for the area required to offset the effects of the Proposal.

55 To show the potential applicability of offsetting in this case, the Applicant has identified two areas were the offsetting works may occur (subject to final landowner approval). One of these offsetting locations is in the Mangamanaia catchment (Ratahiwi Farm),[10] for which the most baseline information with respect to calculating SEV's has been completed to date. This site looks promising as it provides a "like for like" offset. This is important as it is headwater streams of catchments that are mostly being lost as a result of the Proposal. As such, it is my view that any offsetting work should enhance the same type of habitat type that is being lost. I discuss this site further below.

[10] Technical Assessment H – Freshwater Ecology paragraphs 290 to 296.

Stream Diversions Restoration

56 The application involves a number of stream diversions, which are proposed to provide ecological habitat to mitigate some of the effects of habitat modification, as set out in Technical assessment H - Freshwater Ecology.[11] This mitigation is proposed to be achieved through the enhancement of 9,520 m^2 of new stream channel. The concept design of these stream diversions is contained in drawing TAT-3-DG-H-1451-C,[12] with placement of these diversions shown in drawings TAT-3-DG-H-1401 to 142i. The actual design varies depending on the type of stream.

57 Although the stream diversions look to replicate natural watercourse they also serve another purpose for the roading network, which is the conveyance of water, especially during elevated flows. Therefore, the designs do not fully replicate what a 'natural' environment looks like, especially in relation to keeping taller vegetation (i.e. trees) from being close to the streams edge. This is shown by taller vegetation being planted above the 100 year flood event (represented by the wording "low planting that is not an impediment to flow") (refer to drawing TAT-3-DG-H-1451-C).

58 As correctly identified in Technical Assessment H - Freshwater Ecology[13] the constructed streams will provide some ecological function (although this will not be as great as a natural stream in which restoration might be undertaken). It is also vitally important that the stream diversions are checked after the restoration works are completed to ensure that the diversions are providing the additional habitat and the ecological benefits anticipated. This is to ensure that what was predicted to occur has occurred and that the diversions contribute (as the Proposal suggests) to offsetting the effects of streambed habitat modification. This 'check' would involve recalculating the SEV scores for the restored site, comparing them back to what was predicted, and then offsetting any difference to ensure no net loss of ecological function. I discuss this approach (or 'check') again in further detail at paragraph 67 of this report.

59 During construction of the new beds for the stream diversions care will need to be taken to ensure that the large substrate does not result in water that does not flow over the created channel (i.e. due to the water effectively flowing through the gaps). Although large boulders and logs provide the habitat complexity and stability to the streambed, a range of substrate size will be needed to fill in the gaps between the

[11] Technical Assessment H – Freshwater Ecology paragraphs 278 to 284.
[12] Application Volume II – Drawings – Stormwater.
[13] Technical Assessment H – Freshwater Ecology paragraphs 278 to 284.

rocks and provide complexity to the habitat type. Otherwise, the Applicant would have ended up creating a streambed with all the water flowing underneath it.

60 Proposed consent condition EC15 a) i for the stream diversions requires that 9,520 m^2 of new stream channel is constructed and planted to a "maximum width of twenty (20) metres". The wording of the condition and its requirement for a maximum width of 20 metres does not apply best practice to the restoration work. Although 20 metres of planting is considered best practice, the condition presently appears to allow for any distance above 5 metres to comply with the proposed consent condition.[14]

61 I understand there are limitations within the roading network as to the width that can be achieved. It is for this reason that the Applicant has confirmed (via the s92 RMA Response) that the minimum distance in which restoration will be completed is 5 metres. It would be useful if the Applicant could clarify whether this reduced distance is also factored into the SEV and ECR predicted values for those reaches that will have less than 20 metres of riparian margin planted. This may be relevant when determining whether there is no net loss. If the minimum width has not been factored into the calculations for those areas where there is less than 20 metres proposed for restoration the SEV will, in my opinion, need to be re-calculated by the Applicant.

Offsetting

62 As I have identified above, Technical Assessment H - 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. Appendix H.4[15] contains the outputs from the SEV assessments that have been undertaken and I have confirmed already that these provide a transparent method to consider how the assessment has been undertaken.

63 Appendix H.3[16] contains the Offset SEV scores if the Mangamanaia catchment (Ratahiwi Farm) is the area that is used for offsetting to occur. Five classes of stream are provided with the current SEV score and the predicted scores assume best practice for stream restoration is undertaken. This work identifies that restoration areas are available in close proximity to the affected area for offsetting to occur. If

[14] The addition of a minimum of 5 metres was added only as part of the s92 RMA Response.
[15] Pages 116 – 123.
[16] Pages 114 – 115.

Ratahiwi Farm is not to be the final offsetting site (it is yet to be confirmed), the Applicant will need to undertake the same analysis at any new location with the surveys being completed during the same time of the year that the affected reaches survey was undertaken to ensure that the comparison is equal.

64 Ratahiwi Farm provides a good example of how the offsetting methodology can be used in catchments that are in close proximity to the Proposal footprint and which share 'like for like' characteristics to the habitat that will be lost. However, if this particular (preferred) site does not eventuate, the same requirements to align with the offsetting principles[17] will need to be followed in further site selection.

65 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 preferably in 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.

66 The Applicant's proposed Condition EC15 c) requires that the actual stream area lost is confirmed and any changes to the area impacted will require a change in the offset area (EC15 d). However, there is also a need to ensure that what has been predicted to occur at the offset site is what will happen and that the proposed improvement is an actual improvement. Table 4.1 in the Ecology Management Plan contains Outcome performance measures for years 1, 3, 5, and 10 (the riparian component is reproduced in Table 2 below). These are important performance measures as they provide the predicted response for the offsetting regime, and therefore should be included in consent conditions as enforceable standards. The management plan(s) should only provide the mechanism by which the performance measures will be met by the Proposal (including monitoring). This will ensure that there is no net loss in ecological function across the Proposal. The Applicant proposes that these performance measures are included in the Planting Establishment Planting Plan[18] however, (as I note above) in my opinion they would sit better within the consent conditions. This is particularly important where the effects are permanent as is the case here.

67 In addition, the SEV scores at the offset sites should be recalculated at the end of the relevant time period (as proposed in Table 4.1 of the Ecology Management Plan at 10 years). This work will calculate current SEV scores at the sites (at the time the

[17] Biodiversity Offsetting under the Resource Management Act, 2018, pages 4 and 5.
[18] Technical Assessment H – Freshwater Ecology paragraph 276.

measurements are undertaken), which can then be compared back to what was predicted to occur. There is a possibility that the predicted scores will not be met and therefore confirming the actual score is important. The result may warrant revisiting the amount of area that offsetting needs to occur at if the SEV's are to be achieved. When dealing with biological systems there are many reasons that what is predicted to occur does not occur, such as weather conditions during the growing season, different soils and nutrient availability etc. The key is to ensure that the Proposal has the ability to adapt to these occurrences.

- **Table 2: Table 4.1 of the Ecology Management Plan with only the riparian components.**

Vegetation/ecosystem type	Restoration outcome	Outcome performance measures			
		End of Year 1	**End of year 3**	**End of Year 5**	**End of Year 10**
Streams Offset Planting	Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara	▪ 75% survival ▪ Invasive weeds absent or at low levels ▪ Animal browse has no significant impact	▪ 75% survival ▪ 80% of original diversity ▪ Canopy beginning to close ▪ Invasive weed absent or at low levels	▪ Starting crop FTG ▪ Weeds under control and not spreading ▪ Animal browse has no significant impact on planting ▪ Natural regeneration occurring ▪ Enrichment species 80% of original diversity ▪ Enrichment 75% survival	▪ Starting crop have 80% canopy ▪ Grass and weeds are now suppressed ▪ Enrichment species are well established in the understory and sub canopy ▪ A clear trajectory towards the outcome state described for this vegetation type
Potential SFL Stream Offset Planting	Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara	▪ 75% survival ▪ Invasive weeds absent or at low levels ▪ Animal browse has no significant impact	▪ 75% survival ▪ 80% of original diversity ▪ Canopy beginning to close	▪ Starting crop FTG ▪ Weeds under control and not spreading	▪ Starting crop have 80% canopy ▪ Grass and weeds are now suppressed ▪ Enrichment species are well established in the

			▪ Invasive weed absent or at low levels	▪ Animal browse has no significant impact on planting ▪ Natural regeneration occurring ▪ Enrichment species 80% of original diversity ▪ Enrichment 75% survival	understory and sub canopy ▪ A clear trajectory towards the outcome state described for this vegetation type
Potential HFL Stream Offset Planting	Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara	▪ 75% survival ▪ Invasive weeds absent or at low levels	▪ 75% survival ▪ 80% of original diversity ▪ Canopy beginning to close ▪ Invasive weed absent or at low levels	▪ Starting crop FTG ▪ Weeds under control and not spreading ▪ Animal browse has no significant impact on planting ▪ Natural regeneration occurring ▪ Enrichment species 80% of original diversity ▪ Enrichment 75% survival	▪ Starting crop have 80% canopy ▪ Grass and weeds are now suppressed ▪ Enrichment species are well established in the understory and sub canopy ▪ A clear trajectory towards the outcome state described for this vegetation type

Effects of Sedimentation and Standards

68 The Proposal will involve approximately 195 hectares of earthworks (paragraph 23, Technical Assessment A Erosion and Sediment Control). Net sediment yields from the earthworks (using the USLE method) are estimated to be about 2 to 3 times higher than sediment yields from the current land use. Most of this sediment load will be discharged over short durations during wet weather events. Therefore, the wet weather suspended sediment concentrations are likely to increase by a similar amount (paragraph 95, Technical Assessment C – Water Quality). 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. The question really becomes the magnitude of those effects.

69 The Applicant has assessed the effects of the extra sediment at both a sub-catchment scale (Tables C.13 and C.14 Technical Assessment C, Water Quality) and at a wider Manawatū catchment scale (paragraph 97, Technical Assessment C, Water Quality). Both assessments are necessary to consider the full effects of the Proposal. 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.

70 The effects of sedimentation on waterways within the Manawatū catchment is a recognised water quality issue. Horizons has one of the largest Sustainable Land Use Initiatives programmes in the country, with funding from ratepayers, central Government (via MPI), and landowners. The purpose of the Horizons programme is to keep sediment on land and in turn, reduce the sediment concentrations within the Manawatū catchment (as well as other catchments within the Horizons Region).

71 As covered in Technical Assessment H - Freshwater Ecology and Technical Assessment C - 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.

72 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 links 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).

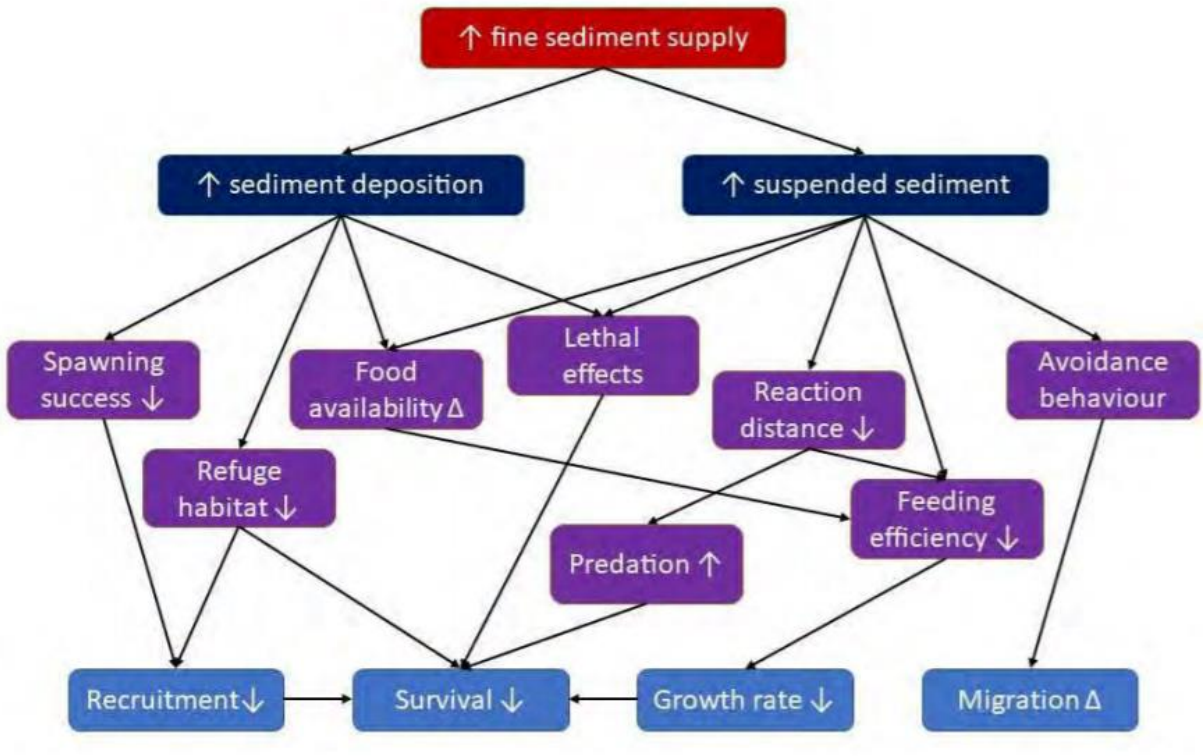

Figure 2-1: Conceptualisation of key effects pathways showing the negative impacts of increased fine sediments on aquatic organisms. ↑ = increases; ↓= decreases; Δ = changes (may be up or down).

Figure 2: 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).

73 Documentation on the effects of suspended and deposited sediment shows the following instream effects (Davies-Colley, R., Hicks, M., Hughes, A., Clapcott, J., Kelly, D., & Wagenhoff, A., 2015):

(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;

(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.

74 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 the Applicant to be shown through monitoring that will occur prior, during and post construction.

75 As part of its s92 RMA Response, the Applicant has proposed the following environmental bottom lines as a return to pre-construction levels:[19]

> A year of quarterly post-construction monitoring is proposed. Section 10.7.4.4 in the Ecology Management Plan will be updated to provide the following bottom lines:
>
> (a) 20% or greater decrease in mean QMCI relative to the lowest score from baseline monitoring that persists for 2 or more quarterly monitoring occasions; or
>
> (b) Decline in median percent (%) EPT taxa richness of 20% or more compared to baseline monitoring scores that persists for 2 or more quarterly monitoring occasions.

76 Although proposed as a bottom line, the additional analysis required if the 'bottom lines' are exceeded suggests that these requirements are more like triggers for further assessment of the cause and significance of the change. I have concerns with this approach and the absence of a threshold.

77 The s92 RMA Response provides the following information as to what will be considered;[20] *"Should these bottom lines be exceeded, an assessment of freshwater ecological effects should be undertaken to ascertain if there are adverse effects beyond what was anticipated by the Freshwater Ecology - Technical Assessment H. This will be undertaken with consideration of results obtained in paired-catchment control sites, natural variability and in relation to seasonal/rain related patterns. This is further described in the response to Q2.1 below*".

78 I am concerned that this additional step occurs after the 'bottom lines' have been exceeded. This approach is especially evident in the following statement *"Project ecologist to assess to determine if further mitigation or offset measures are warranted if the effects are additional to those already anticipated and are likely to persist."* (Section 2.1 of the s92 RMA Response). In my opinion, exceeding the "bottom lines"

[19] s92 RMA Response Letter Section 2.2.
[20] s92 RMA Response Letter Section 2.2.

is already stepping outside of the anticipated effects of the Proposal and further investigation as to whether action is required is insufficient. Action must also be taken to address the effect. It is also inappropriate to revisit "bottom lines" in circumstances where assumptions on the breadth and significance of effects of aspects of the Proposal have been based on those parameters. In my opinion if the "bottom lines" are exceeded additional monitoring is required to establish the further mitigation or offset measures required (not if required) to address the unanticipated effects.

79 From an ecological perspective, I would recommend the following amendments to Table 2 of the s92 RMA Response (section 2.1) to reflect this.

Table 3: Post construction monitoring, assessment against meeting pre-construction in-stream conditions, and further mitigation or offsetting requirements.

Monitoring results (summary)	Further action after a year of monitoring
Triggers and bottom lines are consistently achieved within the one-year post-construction monitoring	No additional action required ~~Monitoring may be stopped after half a year should results clearly indicate environment has returned to a pre-construction state.~~
Bottom lines not met within one-year post-construction monitoring period.	Monitoring to continue for at least another year. Project ecologist to ~~assess to determine whether additional monitoring (up to one year) and or~~ determine what action is required to mitigate or offset the effects based on the ~~anticipated~~ magnitude of effect and monitoring results. Assessment to include any possible cause of change and analysis beyond bottom line measures (may include for example, statistical cluster analysis to identify community change or other variables observed/monitored post-construction). Project ecologist to ~~assess to~~ determine the ~~if~~ further mitigation or offset measures required to address the unanticipated effects. ~~are warranted if the effects are additional to those already anticipated and are likely to persist~~.

80 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 looking at 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. In order to remove the sediment that has been deposited into those lower layers, larger events are however required to move some of the larger substrate and enable sediment to be removed. Given that there are so many variables outside of the Applicant's control around removing sediment from the streams/waterways, I do not consider it to be as simple as stating (as the Applicant has done) that sedimentation is a short term effect of the Proposal.

81 New Zealand has a standardised set of protocols for monitoring deposited sediment - Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values (Clapcott et al, 2011). Within this document there are a number of ways to monitor deposited sediment within waterways and the relevance of each of the monitoring methods depends on what information is being gathered (refer Table 4, NZ Sediment Protocols, page 14).

- **Table 4: Recommended sediment protocols based on protocol testing and validation.**

Type of assessment	**Sediment component**		
	Sediment cover	**Substrate composition**	**Interstitial space**
State of the Environment	Bankside visual estimate of % sediment	Wolman pebble count	Quorer SIS Or Quorer SBSV Or Shuffle
Assessment of effects	In-stream visual estimate of % sediment	Wolman pebble count	Quorer SIS Sediment depth (mm)

82 The depth of sediment is important when considering the potential effects on the receiving environments. I note that the Te Ahu a Turanga Manawatū Tararua Highway – Baseline Freshwater Monitoring Plan (James, 2018) proposed to monitor the level of deposited sediment within the streambed through the shuffle index (Clapcott, 2011). However, in the monitoring analysis report (James, 2019) it is noted that the small

size and shallower water depths of most of the streams did not allow this to be effective. This has resulted in gaps in sediment information for those streams.

83 It is important to differentiate between what deposited sediment assessed through the visual assessment method or the quorer or shuffle index method tells us about effects instream. The shuffle and/or quorer method provides information around the availability of interstitial spaces (the more sediment the less space) while the visual method simply provides information as to the level of sediment at the surface (refer Table 4 taken from Clapcott, 2011). In this case the Applicant has relied only on the visual assessment method. As a result, I am of the view that there is currently a lack of information on the level of sediment within streambeds impacted by the Proposal.

84 The distinction between assessment methods (visual assessment or quorer/shuffle index) is also important when later considering the monitoring of sedimentation, and setting deposited sediment triggers/targets and standards within the conditions.

85 I note that a number of the catchments are currently above the One Plan target for visual deposited sediment (Catchments 2, 3, 4, and 5). Some of the catchments have recorded deposited sediment levels up to 100 percent coverage of the streambed (catchments 2, and 4). The Applicant has proposed a number of triggers related to both visual deposited sediment and re-suspendable sediment (within the streambed). The event based deposited sediment trigger has been described as being, *"An increase in the median **visual** sediment coverage of 15% or more, relative to the highest baseline visual estimates for that site, for two or more consecutive quarterly monitoring occasions; or"* [my emphasis]. The use of a visual assessment as a trigger in Catchment 4 would mean that the Applicant can never be non-compliant as the highest baseline is already 100% (a similar position results with Catchment 2). This would be the case regardless of the potentially significant increases in the amount of deposited sediment within the stream bed and associated adverse effects. It is therefore important that the collection of quorer samples is undertaken to reflect the sediment that might be present in the interstitial spaces. I have recommended that the collection of quorer samples is included as condition of consent.

86 Even if it is assumed that the effects from sedimentation are short term, this does not mean that the effects from sedimentation on the values that those streams hold cannot be significant. I have prepared evidence to inform a number of compliance investigations and prosecutions in relation to sediment discharges to water and the effects on the waterways and the associated values. Some of these discharges have

completely changed the characteristics of the waterways and the values that they hold. At times there have been complete changes to the macroinvertebrate communities found within those streams and the fish communities they support.

87 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, which in this case will be difficult given many of the upstream reaches are intermittent and do not support these values year round. 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 in fact may never happen i.e. there might not be any kakahi populations in close proximity to migrate back into those reaches.

88 It is notable that a 'healthy population' of the non-migratory upland bully was found in Catchment 4 during the baseline surveys. Given that this species is non-migratory its removal from the catchment would be permanent unless reintroduced through human mechanisms. Recovery of macroinvertebrates is likely to be much more rapid given that macroinvertebrates have a flying stage once adults. This means that surrounding catchments can act as a reasonably quick source population (Ryan, 1991).

89 Even if the effects from sedimentation were only short term, this is likely to only apply to macroinvertebrate communities, and not other aquatic values in the waterways.

90 The Universal Soil Loss Equation ("**USLE**") produced in Technical Assessment A - Erosion and Sediment Control shows the increase in volumes of sediment that will be seen within the proposed works areas and within the catchment as a whole (refer Table A.4 Technical Assessment A - Erosion and Sediment Control).

- **Table 5: Table of estimated sediment yields and loads for the project – table based on information contained in Table A.4 in the Technical Assessment A - Erosion and Sediment Control)**

Catchment	Sediment load earthworks (t/yr)	Sediment load from existing land within project earthworks footprint (t/yr)	Catchment sediment load increase (t/yr)	% increase	% increase catchment load (dilution of effects)	Earthworks as a % of catchment
1	0.38	0.13	0.26	200	4%	2.2%
2	81.17	27.06	54.12	200	7%	3.4%
3	74	24.19	49.81	206	24%	12%
4	90.01	22.50	67.51	300	20%	11%
5	98.78	32.93	65.86	293	46%	23%
6	25.56	8.52	17.04	200	15%	7.5%
7	105.52	35.17	70.34		53%	27%
8	0.80	0.27	0.53		11%	5.3%
9	28.01	9.34	18.67		7%	3.5%

91 The Technical Assessment - Freshwater Ecology goes on to report at paragraph 207, *"The USLE modelling suggests that discharges from earthworks sites during rain events may result in sediment loads and suspended sediment concentrations two to three times higher than baseline conditions…"*

92 Mr Stewart, in Technical Assessment A - Erosion and Sediment Control, has also worked out how much the sub-catchment load (tonnes per year) would increase as a result of the earthworks. While it may be useful to put sediment loads into a catchment perspective, it does have a tendency to dilute the effects of an activity when you work on the rest of the catchment remaining constant (which is an assumption in itself) and spread the effects of the activity over a larger area.

93 A good example of this 'dilution' effect is in Catchments 5 and 7, with the earthworks occurring in 23% and 27% respectively of the land area within the catchments, yet at the catchment scale they increase sediment loads by 46% and 53% respectively. This applies roughly equally across the other catchments in that the percentage (%) area

of the catchment captured by earthworks results in twice the percentage (%) of sediment increasing. Although this may be useful to inform the discussion on the increase in sediment at a catchment scale, the effect of the discharges will be experienced downstream of the work areas. In this sense the size of the catchment area upstream of the work areas does not help in defining the effect from the activity.

94 Such an approach may be appropriate if the catchment had the capacity to assimilate further sediment inputs, however, as covered above, many of the catchments within the Proposal area already exceed the One Plan targets for deposited sediment and visual clarity. Therefore, the ability to assimilate further sediment is not available (refer to Table 1 for those catchments that exceed the One Plan targets). For example, Catchment 2 is 1,658 hectares in size, of which earthworks occur in 55.84 hectares (3.4% of the catchment) with the sediment load increasing by 54.12 tonnes per year (during construction). When worked out at the catchment scale it equates to a 7% increase in sediment loads at the catchment scale.[21] with the works area only taking up 3.4% of the catchment. At the earthworks site, however, there is a 200% increase in the sediment load. There will therefore be significant increases in sediment yields from the areas in which the works are undertaken. It shows the importance of managing sediment to ensure that the effects on waterways are also managed appropriately. The range of measures and their effectiveness in managing sediment discharges from the sites into waterways is addressed by Mr Pearce for Horizons.

95 Technical Assessment H - Freshwater Ecology states at paragraph 211: *"the baseline condition indicates that sediment deposition is an existing issue related to extensive agricultural land use in many of the catchments. The lower reaches of Catchment 5, 6 and the Upper reaches of sub-catchment 7A are exceptions to this, likely due to the presence of relatively intact riparian margins and steep nature of the streams."* In my opinion, this statement needs to be considered in the context of the cumulative impacts of sedimentation across the proposed activities as part of this application.

96 The effects assessment appears to adopt an "overall" approach. In my view, the assessments lack some of the specificity around effects as a consequence, especially in those catchments that have the potential to be significantly impacted by sedimentation. Table 6 taken from the s92 RMA Response shows the level of effects at the catchment scale. The assessment concludes *"These effects are assessed as temporary as they are short-term (consistent with the Ecological Impact Assessment*

[21] Technical Assessment A – Erosion and Sediment Control Table A.4.

Guidelines 2018)". The short term nature of effects has fed into the magnitude of effect assessments.[22] At paragraph 215 of Technical Assessment H – Freshwater Ecology the following conclusion is drawn "*I consider that this overall level of effect is acceptable given the nature of the work and duration of the Project, and that specific offset or compensation measures are not necessary to address this effect*." This is an overstatement, however. The short term nature is captured in the initial magnitude of effect assessment and therefore is already accounted for (and in my view should not be used again) when the final classification of effect takes place.

97 Even when looking at the effects of this activity in isolation in each of the sub-catchments, the overall effect in Catchments 5, 6 and 7 is still considered High and within Catchment 4 as Moderate (the remaining catchments being low). Given these assessments it is likely that the effects in these catchments will be significant and it is only the 'short' term nature of the effects being held out as justification. As I addressed above however, whether or not effects are temporary or short term is highly unknown and the argument is also likely to only apply to macroinvertebrate communities, not to other aquatic values in the waterways.

98 Overall the assessments supporting the application show that effects during construction for Catchments 5, 6, and 7 will be high (refer Table 6). When the Ecological Impact Assessment Guidelines (page 84) are considered, the following guidance is provided *"Options in the 'High and Moderate adverse' category represent a level of effect that requires careful assessment and analysis of the individual case. Such an effect could be managed through avoidance, design, or extensive offset or compensation actions. Wherever adverse effects cannot be avoided, no net loss of biodiversity values would be appropriate."* (Roper-Lindsay et al, 2018).

99 Technical Assessment H – Freshwater ecology comes to the conclusion "*the overall effect level of effect in Catchment 5 and 7 is anticipated to be High following implementation of mitigation measures and during construction*".[23] I assume that conclusion also includes Catchment 6 given the update to the Table provided in the s92 RMA Response. Having regard to the Ecological Impact Assessment Guidelines (above) it is my view that the effects that are likely to be experienced in these catchments are likely to be significant (adverse). This further supports my view that

[22] In considering the magnitude of effect, the timescale of potential effects must be considered, page 83, Ecological Impact Assessment Guidelines 2018.
[23] Technical Assessment H – Freshwater Ecology, paragraph 214.

robust and appropriate sediment control and discharge standards must be put in place.

100 The baseline monitoring (contained in Te Ahu a Turanga: Manawatū Tararua Highway – Baseline Freshwater Monitoring Results)[24] shows that the streams impacted by the Proposal do not currently meet the One Plan targets for deposited sediment and/or water clarity. These targets are designed to maintain and protect the One Plan values especially contact recreation and life supporting capacity. Further increases in the amount of sediment (suspended and deposited sediment) within these already compromised waterways will not be consistent with either maintaining or enhancing water quality as required by the One Plan and higher order instruments (the NPSFM, for example). I have concerns over a degraded (or non-performing) water quality environment being further impacted because it was not of perfect quality to begin with. This does not reflect the One Plan drivers of maintenance or enhancement. A possible increase in deposited sediment in the receiving environment will further move water quality away from the targets that are set in the One Plan to protect the contact recreation, life supporting capacity, and capacity to assimilate pollution values.

Sediment Standards

101 Given the significant effects that can arise from the deposition of sediment within waterways, it is important to ensure that the volumes/amounts/concentrations of sediment that enters the waterways is limited. To provide certainty that these volumes/amounts/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.

102 The Te Ahu a Turanga: Manawatū Tararua Highway – Baseline Freshwater Monitoring Results report referred to in Technical Assessment C[25] provides the results of TSS monitoring during wet weather from three of the catchments affected by the proposal (James, 2019). Given the different values and sensitivities that the catchments across the Proposal have, it would make sense that the thresholds/targets/triggers in each of the catchments also vary (to accommodate the catchment differences). This was also one of the conclusions in the Baseline Freshwater Report (James, 2019). At page 1 *"there were clear differences in baseline*

[24] A copy was provided with the s92 RMA Response.
[25] A copy was provided with the s92 RMA Response.

visual water clarity, TSS, turbidity, and deposited sediment among the catchments, indicating that it is worthwhile deriving catchment-specific limits or trigger values for the catchment affected by construction activities that take into account baseline information". Given the different values and baseline water quality in each of the sub-catchments, a sub-catchment approach to setting sediment thresholds/targets/triggers is, in my opinion, warranted for the Proposal.

103 The Applicant's experts have used end of pipe concentrations to assess the effects of the discharge on the receiving environment (refer Mr Hamill paragraph 95 to 99)[26]. These numbers provide an important context to the assessment of effects. From my reading of the application, these numbers are used to inform the conclusions reached around suspended sediment and water quality in Technical Assessment C – Water Quality and then used to inform the effects on Freshwater Ecology (refer paragraph 206 Technical Assessment H – Freshwater Ecology). As such, they should form the basis of resource consent conditions for discharge standards/thresholds/triggers.

104 In the assessment undertaken by Mr Hamill, at paragraph 98 *"Median TSS during wet weather events were measured as 58 mg/L in C2, 19mg/L in C4, and 25mg/L in C7. Assuming this is representative and given the predicted increase in sediment loads from earthwork sites, the median TSS discharge from sediment treatment devices would be approximately 63 mg/L in C2, 32 mg/L in C4, and 40 mg/L in C7. These increases in median values are all within the temporal range of wet weather TSS concentrations currently found at these sites (Table C.5)".* As I note above, the relevance of these sediment discharge concentrations to the assessment of effects makes it important to include these as discharge standards for the treatment devices.

105 Based on values provided by Mr Hamill in Technical Assessment C the following standards would apply (as a median) for TSS;

(a) Catchment 2 – 63 mg/L;

(b) Catchment 4 – 32 mg/L; and

(c) Catchment 7 – 40 mg/L.

[26] Volume IV - Technical Assessment C – Water Quality.

106 The remaining sub-catchments do not have values derived for them by Mr Hamill in his report, however, based on the values within the sub-catchments they could be clumped together into the following manner:

(a) Catchments C1, C2, C3, and C8;

(b) Catchments C5, C6, C7, and C9; and

(c) Catchment C4.

107 The Applicant has emphasised in the information provided in the s92 RMA Response that the focus should be on the deposited sediment within the waterways, as this has the greatest effect on the values that a waterway holds. I agree that deposited sediment has a significant effect on the values of a waterway however, it cannot be viewed in isolation of suspended sediment.

108 It is correct that 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 two different/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 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 (Hicks, 2019).

109 As covered in the technical report of Mr Hamill at paragraph 99, the percentage change in visual clarity has also been calculated for some of the streams affected by this Proposal. For example, in Catchment 7 the change in visual clarity may be up to 29% during rainfall events but higher in some catchments i.e. sub-catchments 3B, and 5B. This is against a One Plan target of less than 30% change.

110 Within the One Plan supporting documentation, the reasoning for the use of percentage change in water clarity was supported by: *"The translation of a "conspicuous change" in water clarity into numerical terms was studied by Davies-*

Colley and Smith (1990). The results indicate that most people are able to detect a change of 30% in visual clarity. Based on these results, Davies-Colley (1991) and the 2000 ANZECC guidelines recommend that visual clarity should not be reduced by more than 20% to avoid conspicuous change in water clarity. The recommended approach for the One Plan is to set a maximum clarity change of 20% where protection of water clarity is particularly important (e.g. naturally clear waters, presence of sensitive species, highly valued trout fisheries, etc.) and 30% elsewhere." (page 24) (Ausseil, & Clark, 2007). The target was therefore put in place to define the reference to conspicuous change as contained in the RMA and depending on the value of the waterway either 20 or 30% is defined as a conspicuous change in water clarity.

111 I note that the Applicant's s92 RMA Response proposes not to use the One Plan clarity target as a trigger or standard. It states, *"The One Plan target of less than 30% change in clarity is not proposed to be used because the standard is unlikely to be met on a 'without Project' basis and because the relationship of intermittent discharges to ecological effects is very uncertain."*[27] As covered above the visual clarity target in the One Plan was intended to provide the numerical measure of conspicuous change under the RMA. The Proposal is looking to exceed this 30% level of change.

112 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 mining the nutrients from the sediment particle) (Wood et al, 2007). 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.

113 As an overall summary in relation to sediment from the Proposal:

(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.

[27] S92 RMA Response Letter Section 6.1.

(b) The Proposal 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) The Applicant proposes a number of triggers/standards for the deposited sediment within the impacted catchments however, missing from the baseline information is interstitial sediment volumes. This information is fundamental to understanding and monitoring the effects in those catchments that already experience high visual deposited sediment, such as Catchment 4.

(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 that they currently hold. Where One Plan targets/standards are currently not meet in 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.

(e) Using information provided by the Applicant in the Technical Assessments accompanying the Application I recommend end of pipe standards for the various sub-catchments are included in conditions of consent.

Stormwater discharges

114 There are a number of contaminants in stormwater discharges from roads which can have an adverse impact on the freshwater environment. As part of the on-going operation of the road, there will be an increase in the stormwater loads discharged from hard surfaces (e.g. Catchments 2E, 3, 7 and 8). Some catchments will see a reduction in the load compared to current loads (e.g. Pohangina River and Catchments 1, 2, 4, and 9), while others will see no stormwater discharged to them (e.g. Catchment 5, and 6).[28] In all cases there will be an improvement (post treatment) in the quality of the stormwater that is discharged to the receiving environment.

115 The stormwater and treatment device proposal is described in Technical Assessment B – Stormwater Management as follows: *"The projects design provides treatment of stormwater runoff from all proposed State highway surface areas within the project.*

[28] Technical Assessment H – Freshwater Ecology paragraph 259.

Treatment of provided to a high standard of removal of 75% of TSS on a long-term average basis" A mixture of treatment methods are proposed including catch-pit devices and vegetated conveyance channels, swales for capture and conveyance of stormwater runoff (including wetland swales) and planted wetlands. It is intended by the Applicant that all stormwater runoff from the road will be treated.

116 The modelling of stormwater effects on the various receiving environments has been described in the Technical Assessment C - Water Quality. Overall, the analysis is reported to be a net reduction in the load of stormwater contaminants to the Manawatu River, although there will be a net increase in some catchments (catchments 2E, and catchments 3, 7, and 8). In those catchments where there is an increase, there is the potential for stormwater to cause a decline in water quality. Overall, Mr Hamill concludes that the effects will "*likely be small because of the intermittent nature of stormwater discharges, the quality of the stormwater is within relevant guidelines after adjusting for hardness, and for TSS, the stormwater has similar concentrations to that found in the streams during flood events."*[29] I generally agree with this analysis, with the exception of the *E.coli* and soluble nutrients as discussed below.

117 Technical Assessment C - Water Quality has considered the potential effects of other major contaminants derived from the road on the receiving environments. This assessment has usefully looked at the end of pipe concentrations and compared them to both acute and chronic toxicity thresholds. For acute toxicity for zinc, copper, and TPH (hardness adjusted) the discharge itself is able to meet the acute toxicity guidelines, except for in C8 which has been assessed as borderline, and with total copper also close to the ANZG guideline values in C1 and C8. However, it should be noted that the guidelines are for dissolved metals and the assessment has been undertaken with total metals. This means that the assessment is conservative as dissolved is only a fraction of the total. The assessment has also been undertaken for discharge itself (end of pipe) without allowance for dilution within the receiving environment. This is another conservative aspect of the assessment.

118 For the chronic assessment at paragraph 134 of Technical Assessment C – Water Quality the discharge would need to be diluted by the following:

(a) For zinc – between 1.4 times (C7) and 2.9 times (C1);

[29] Technical Assessment C – Water Quality paragraph 137.

(b) For copper – between 2 times (C7) and 4.2 times (C1); and

(c) For TPH – between 20 times (C3) and 38 times in C8 and 48 times in C7A d/s 7B.

119 As identified by Mr Hamill, it is likely that the required dilution for TPH will not be met in some of the catchments. As stormwater discharges are intermittent in nature, a comparison with the acute toxicity guidelines is more appropriate. The chronic toxicity guidelines are most appropriate for discharges that are mostly continuous in nature. The methodology used by Mr Hamill for the assessment of effects on water quality as a result of the stormwater discharges is transparent, and provides an indication of potential effects given the limited information held on stream flows for the receiving environments. For the metals and TPH analysis the effects of discharges should be minimal and overall the Manawatū catchment will see an improvement (unlikely to be measurable in the Manawatū River) in water quality due to the Proposal.

120 At paragraph 117, Mr Hamill notes *"Stormwater from rural road runoff typically has little microbiological contamination (e.g. E. coli bacteria) due to low loading and bacteria die-off between rain events"*, with a reference to a literature review on road runoff pollution in Europe. I have reviewed the reference document and have some concerns around its applicability to the New Zealand situation, especially for a road that has been designed with a steep gradient, and where there are already issues of stock effluent from stock trucks being spilt onto, and running off, the existing roads.

121 Stock truck effluent contains high *E. coli* and nutrient concentrations (in particular ammonia) and will need to either be treated through the stormwater treatment devices or other measures. The treatment devices design is silent on whether the devices are made to treat these types of contaminants, although the s92 RMA Response notes the expectation that they will remove a significant volume of the *E. coli*. Even if the proposed wetlands are effective at the removal of particulate nutrients, I remain concerned that over time they will release dissolved phosphorus into the receiving environment (due to wetland processes changing the phosphorus to a dissolved faction). This issue has emerged with other constructed wetlands.

122 The alternative to relying on the stormwater treatment devices is to avoid the potential effect in the first place. For example through the provision of effluent stations at either side of the ranges (such a site existed on the Woodville side of the Gorge prior to the Gorge Road being closed), modification to the treatment devices for the removal of

soluble nutrients, or as suggested by the Applicant in the s92 RMA Response, compliance with the Industry Code of Practice for the Minimisation of Stock Effluent Spillage from Trucks on Roads (April 2003). On review, I do note that compliance with the Code of Practice is entirely voluntary and at face value appears to not have any one entity responsible for overall compliance with the Code.

123 As covered in the Water Quality Technical Assessment the catchments affected by the Proposal (except catchment 3, 6, and 7) are unlikely to meet the One Plan targets for contact recreation (*E. coli*). Therefore, a possible increase in *E. coli* concentrations in the receiving environment will further move water quality away from the targets that are set in the One Plan in order to protect the contact recreation value.

124 The Applicant has stated through the s92 RMA Response that *E. coli* concentrations will not be an issue, especially given, *"The existing land use being replaced by the road is predominantly farmland that has an existing bacterial load to the streams that will reduce as a result of the road and exclusion of stock from catchments."* I do not consider this comparison to be the appropriate baseline for assessing whether effects are acceptable. Monitoring shows that the *E. coli* targets in the majority of the catchments do not met One Plan targets. Further, the Manawatū catchment (for rivers order 4 and above) is currently assessed as 34% swimmable[30] under the NPSFM against a target of 80% by 2030 and 90% by 2040. A significant amount of work must occur in order to reach the NPSFM swimmability requirements.

125 Given the uncertainty around the treatment efficiency of the stormwater treatment devices for the removal of soluble nutrients and *E. coli,* I recommend that monitoring be undertaken from at least one of the treatment wetlands (being one that receives stormwater from the ascending portion of the road). The monitoring must capture water entering and exiting the wetland, with a focus on dissolved reactive phosphorus, soluble inorganic nitrogen, TSS, and *E. coli*. If *E. coli* concentrations exceed 240 mpn/100 ml in the stormwater discharge from the wetland, I recommend that the condition require the Applicant to undertake analysis through faecal source tracking to determine the source of the contamination i.e. whether it is avian or rudimentary.

126 Overall at the catchment level, the Proposal will see an improvement in the quality of stormwater (especially metals and TPH) discharged to the Manawatū catchment from the road, and therefore an improvement in water quality in the Manawatū River

[30] http://www.horizons.govt.nz/HRC/media/Media/Water/Catchment-Summary-Manawatu.pdf

(although unlikely to be measurable) as a result of the Proposal. As concluded by Mr Hamill, most of the time and during baseflow conditions, stormwater quality can be expected to have a negligible or minor impact on stream water quality.[31] Notwithstanding the concerns raised above around *E. coli* and soluble nutrients from stock effluent, I generally agree with this statement. The proposed treatment will aid in the improvement of water quality.

Instream Triggers/Standards

127 Further information was requested by Horizons under section 92 of the RMA in relation to instream turbidity/SSC/NTU limits/targets and end of pipe standards for the sediment treatment devices. Specifically, Council Officers were interested in whether there was relationship between TSS and NTU that could be used for the creation of end of pipe standards for the treatment devices within the Proposal.

128 The s92 RMA Response stated, "*There is no direct relationship between TSS (or turbidity or clarity) and sedimentation, especially for intermittent discharges during rain events. This is because sedimentation is affected by a lot of instream morphology and hydraulic factors. It is sedimentation (the sediment the settles on the stream bed) that most strongly impacts on fish and invertebrates."*[32]

129 I agree that deposited sediment is one of the major drivers of changes in aquatic habitat and also effects on aquatic life. However, the statement that there is no direct relationship between TSS (or turbidity or clarity) and sedimentation is not accepted. Sediment experts have had issues developing models to establish sediment reductions required to meet deposited sediment thresholds, however, the difficulty has been in the development of the models not in the understanding of the mechanisms (Hicks *et al*, 2019 and Franklin et al, 2019). Taking an extreme example if a stream remains crystal clear during a flood (no sediment particles in suspension), then there are no sediment particles to come out of suspension and no deposited sediment issues within the stream. At the other end of the extreme is a stream that during flood flows experiences a high sediment load (high TSS/SSC and low clarity), in which case during receding flows or when the stream gradient flattens, sediment will drop out of suspension and become deposited sediment.

[31] Technical Assessment C – Water Quality paragraph 133.
[32] s92 RMA Response Letter Section 5.

130 I have already recommended at paragraphs 104 to 106 above that end of pipe concentrations relied on in the Applicant's technical assessments (to enable the effects assessment) should be used to inform triggers/thresholds/standards for the discharges from such treatment devices in resource consent conditions.

131 The Applicant has proposed the following as instream triggers for deposited sediment (cover and interstitial), and macroinvertebrate communities using QMCI and % EPT.[33]

Event-based monitoring of deposited sediment:

(a) An increase in the median visual sediment coverage of 15% or more, relative to the highest baseline visual estimates for that site, for two or more consecutive quarterly monitoring occasions; or

(b) An increase in the median re-suspendable sediment of 15% or more, relative to the highest baseline visual estimates for that site, for two or more consecutive quarterly monitoring occasions.

Routine quarterly monitoring:

(a) 15% or greater decrease in mean QMCI relative to the lowest score from baseline monitoring that persists for two or more quarterly monitoring occasions; or

(b) Decline in median percent (%) EPT taxa richness of 15% or more compared to baseline monitoring scores that persists for two or more quarterly monitoring occasions.

132 For all of the monitoring parameters and proposed triggers of the Applicant, I note that the comparison is to the lowest median (or mean) value that has been recorded during the baseline surveys and that the change needs to persist for two consecutive rounds of sampling. The reason for the double trigger in response is not clear from the information before us and the Applicant needs to clarify why the lowest median (or mean) value in monitoring **and** presented over two consecutive rounds of sampling has been proposed. With routine sampling three (3) monthly, this means that effects potentially can occur for at least a minimum of six months and potentially nine months

[33] S92 RMA response attachment 2: Aquatic ecological monitoring and responses.

or greater depending on the date the effect commences and the dates at which monitoring is undertaken.

133 As for event based monitoring, I note that the Proposal has "for two or more consecutive quarterly monitoring occasions". The reference to "consecutive quarterly monitoring occasions" at a minimum needs to be removed. My understanding of event monitoring is that it is triggered by an 'event' and therefore this monitoring could happen frequently or not at all depending on the weather conditions during the construction season. This creates problems with the requirement that there be an effect present in two consecutive rounds of sampling as there is no guarantee that a second level of monitoring will be triggered. In this case it is my view that the management responses should be required after the trigger is met in the first instance.

Natural Character

134 The Applicant assembled a team of experts to assess the effects on natural character as a result of the Proposal. The application has undertaken assessments at both the catchment scale (i.e. effects within a catchment) and also at the specific crossings of streams and wetlands that are affected by the Proposal. This assessment is presented in Technical Assessment I – Natural Character.

135 I was involved on behalf of the Territorial Authorities at the NoR stage for the assessment of Natural Character and in particular the components that relate to freshwater ecology. At the time I identified shortcomings with the approach that had been taken to complete the natural character assessment, particularly in relation to the inclusion of limited regional values, characteristics, and water quality parameters, the use of median values to decide on the final Natural Character score at a site and catchment, and the lack of documentation supporting why a certain score was derived. Since the NoR process, a large amount of further information has been collected by the Applicant, and the area impacted by the Proposal has been refined.

136 The Natural Character Assessment Matrix[34] for some of the defining features for each attribute have been refined since the NoR stage. This has led to the rankings for some of the catchments being changed since the NoR. This is not unexpected with a largely new set of experts advising on the application, more information having been collected on the receiving environments (especially around freshwater), changes in

[34] Technical Assessment I – Natural Character, Appendix I.2.

methodology following the feedback that was provided through expert conferencing for the NoR, and the revised alignment.

137 The majority of my concerns have been addressed through the application:

(a) Documentation has been provided which sets out the reasoning between the experts as to why a site/catchment ended up with a particular score for each of the attributes that were assessed.[35]

(b) Examples (photos) of stream/rivers within the region that range from having Outstanding Natural Character through to Very Low Natural Character[36] have been used for calibration against rivers/streams with differing levels of natural character.

(c) The median attribute score is no longer used to derive the final natural character rating for a site or catchment.[37]

(d) There has been use of regional context in relation to water quality and the One Plan values and targets have been factored into the assessment.[38]

138 Having considered the assessment undertaken, the ranking of the attribute (and supporting reasons), and the further information that has been collected and considered by the Applicant as part of the application, it is my opinion that the methodology in relation to water quality and freshwater ecology parameters provides a robust and transparent methodology for the assessment of existing natural character and what the expected changes to attributes and values will be post construction.

E. SUBMISSIONS

139 I have been provided with copies of the submissions that have been made on the application. A number of submissions specifically refer to effects on freshwater as a result of the Proposal. I respond (where I can) to each of the submissions below:

[35] Technical Assessment I – Natural Character, Appendix I.3 and I.4.
[36] Technical Assessment I – Natural Character, Figure I.3.
[37] Technical Assessment I - Natural Character, paragraph 58.
[38] See Technical Assessment C – Water Quality and H – Freshwater Ecology that have been used to inform the development of the Natural Character attribute rankings.

140 **Submission Number 18 by Mr J. Bent** – Mr Bent's submission is in relation to the discharge of stormwater as a result of the construction and operation of the new road. It is not clear as to whether Mr Bent has seen the following reports:

(a) Technical assessment B: Stormwater Management by Mr David Hughes;

(b) Technical assessment C: Water quality by Mr Keith Hamill;

(c) Technical assessment H: Freshwater Ecology Report by Ms Justine Quinn.

141 All of the above assessments consider the treatment of stormwater and the effects on the receiving environments and the improvements that will be made to stormwater discharges as a result of the Project compared to current discharges. Subject to confirmation from the Applicant around the efficiency of the stormwater treatment devices in the removal of soluble nutrients and *E. coli*, the effects of discharges should be minimal and overall the Manawatū catchment will see an improvement (although unlikely to be measurable within the Manawatū River) in water quality after the Proposal.

142 **Submission Number 15 from the Royal Forest and Bird Protection Society Inc (Forest & Bird)** includes a number of topics related to freshwater. I discuss each of the submission points in more details below:

(a) Forest and Bird request that the Applicant undertakes DNA water analysis and uses the FENZ predictions for fish that would be present in the catchment. I agree that these are possible methods that could be used to look at the presence (or possible presence) of fish species within the affected catchments. However, I do not believe that DNA sampling of water samples would add to the information provided by the Applicant. The information gathering method undertaken to inform the application has used standard monitoring methods, taken into consideration the natural obstacles to fish migration in some of the catchments, and has proposed aquatic salvage consent conditions to address the possibility of some species such as kakahi being present when, to date, they have not been encountered. In fact, the survey results and the output from the FENZ models overlap nicely and the species that the model predicted but were not encountered, would have been captured by the fishing methods used. The absence of trout from the streams is not surprising given the size of the streams and the inability of trout to be able to overcome some of the natural

obstacles (waterfalls) in some of the catchments. In my view therefore, the fish monitoring information and related conclusions drawn in the application regarding fish population are robust.

(b) The submission refers to, "*…"almost 33 percent of assessed native freshwater plants (182 of 559 species) were threatened or at risk in 2013. Of these, almost 20 percent were in the highest risk category: nationally critical",* and requests analysis of the native freshwater plants at the impact sites and whether they will be affected, and what their threat status is. I have looked further at the references provided with the submission and although the numbers are quoted correctly, it is used, in my opinion, a little out of context for this application. The species in the high level threat classification reference include wetland plant species and macrophytes found in lakes and wetlands and rivers. It would useful if Forest and Bird could provide further information on species that it might be particularly concerned with in (and are known to be in) the ecological district. There is otherwise a risk that the submission might raise issues with species that are not relevant to the site.

(c) The submission further covers macroinvertebrates and whether any rare or threatened species were found in the surveys. I do not have a copy of the list of macroinvertebrate species that were found during the surveys and which would have been used to calculate the macroinvertebrate indices. The Applicant's experts may wish to expand on this further. However, the methods used by the Applicant's team in conducting the surveys are nationally standardised methods[39] that are used throughout the country for state of the environment and effects monitoring. As such I consider the methodology and resultant information to be robust.

143 **Submission 16 from the Queen Elizabeth the Second National Trust (QEII)** raises a number of potential effects from the Proposal. QEII cover three main issues, underlined below for ease of reference with my response following on:

(a) <u>The adverse effects on stream values within the QEII covenants have not been adequately addressed.</u> The Catchments within the QEII covenants have been identified as having high ecological values and will experience high effects as

39 https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/macroinvertebrate-protocols-wadeable-streams-pdf-nov01.pdf

a result of the Proposal. The Applicant proposes no additional measures or offsetting to address the effects in these catchments other than the justification that the effects will be short-term and acceptable from a Proposal perspective.

(b) Sedimentation effects will be high and have been underestimated because of the "overall" approach to the effects assessment, and the monitoring of erosion and sediment controls should include contingency measures if proposed controls are shown to be inadequate. I agree that the effects assessment appears to adopt an "overall" approach, and in doing so has lost some of the specificity of effects, especially in those catchments that have the potential to be significantly impacted by sedimentation. I cover at paragraph 86 of my report the concerns I have around the reliance on "short-term" in this context. In addition, the short term nature is captured in the magnitude of effect and is already accounted for when you come to your final classifications for overall effects. The assessment also shows that overall effects during construction for Catchments 5, 6, and 7 will be High (refer updated Table below provided in the s92 RMA Response).[40] As I understand the Ecological Impact Assessment Guidelines (referred to earlier in my report) the effects that are therefore likely to be experienced in these catchments are likely to be significant (adverse). This further supports my view that robust and appropriate sediment control and discharge standards need to be in place.

- **Table 6: A summary version of this Table H.12 included in the s92 RMA response.[41]**

Catchment	Step 1: Ecological Value	Step 2: Magnitude of effect (after mitigation)	Step 4: Overall effect during construction
Manawatū River	High	Low	Low
Catchment 1	Low	Low	Low
Catchment 2	Moderate	Low	Low
Catchment 3	Moderate	Moderate	~~Low~~ Moderate
Catchment 4	Moderate	Moderate	Moderate
Catchment 5	High	Moderate	High

[40] s92 RMA Response Letter Section 1.
[41] s92 RMA Response Letter Section 1.

Catchment 6	High	Moderate	~~Low~~ High
Catchment 7	High	Moderate	High
Catchment 8	Low	Low	Low
Catchment 9	High	Low	Low

(c) The riparian planting offsetting is proposed in another catchment (Ratahiwi Farm) away from the effects (contrary to offset principles) and the location is still to be confirmed. My understanding is that the Applicant has yet to enter into a legally binding arrangement that would allow for the offsetting to occur. However, the Applicant has indicated that an area within Ratahiwi Farm, which is within the Mangamania catchment, is a possibility for offset works to be undertaken in. If Ratahiwi Farm is to be used, it is also likely that additional area will be required to fully meet the area required for offsetting.[42] The Applicant has undertaken some baseline SEV calculations within the Ratahiwi Farm streams which are indicative of the type of offsetting that could be undertaken. The Mangamania catchment is one of the catchments that is affected by the Proposal. In addition, the site is within the Ruahine Ranges and at a similar altitude to the streams that are being impacted by the Proposal. If the Ratahiwi sites were to proceed works would be completed at a whole sub-catchment scale rather than piecemeal works along reaches of streams that are connected. This, in my opinion, is like for like and aligns with the principles of offsetting. If additional sites are required, the Applicant will need to undertake further work in the form of SEV calculations and ensure that the additional areas or sites meet the offsetting principles.[43]

144 **Submission 19 on behalf of the Minister of Conservation (the Minister)** requests a number of actions in relation to freshwater. These are summarised and underlined below, with my response following on:

(a) Final fish passage designs within the culverts that are installed along the road. I agree that this would be prudent for the reasons set out above. The most effective, efficient and cost effective time to enable fish passage through culverts is during the design and construction phase. Having to refit or

[42] Volume V - Technical Assessment H – Freshwater Ecology paragraph 113.
[43] Biodiversity Offsetting under the Resource Management Act, 2018, pages 4 and 5.

undertake remediation works on culverts is expensive, can be difficult (and in some situations impossible) to complete, and it frequently does not result in the best outcomes for fish passage. Therefore, I have recommended a condition requiring approval of the final design by an ecologist that specialises in fish passage (this is in my view really important) prior to construction.

(b) Rat control be undertaken at release sites prior to kakahi being transferred. This request of the Minister assumes that kakahi are present within the works area. I agree (as covered in the submission) that rats do predate on kakahi. However, I am not confident that such an approach is practical in the current circumstances. Predator control has a number of unknowns in this case:

(i) It is not clear that kakahi are present (the current survey has not found them) so commencing rat control at an area may not be required;

(ii) The rat control would need to be on-going to ensure that the benefits of the initial control continued to be felt and question marks exist over the size of the area that the control need to be done in order for it to be effective for kakahi populations; and

(iii) If kakahi are present in the works area they will already be experiencing this predation by rats.

While I agree that predator controls would aid in preserving and enhancing kakahi populations, the above factors raise uncertainty around the reasonableness of any requirement for the Applicant to carry out this work both initially and then on an ongoing basis.

(c) DOC to have the ability to review the planting plans (in this case the riparian planting plans). From a technical perspective there is no barrier to this taking place. The appropriateness of this with regard to the setting of conditions will be addressed by Mr St Clair as the reporting planner for Horizons. As discussed at paragraph 61, I am unsure as to how a buffer distance of less than 20 metres has been factored into the predicted SEV calculations and ECR calculations. This is a matter the Applicant should clarify. Its response will inform whether further offsetting is required due to reduced buffer width in some catchments.

(d) Baseline standards / controls that are critical to achieving freshwater ecology outcomes should be included in consent conditions. The Applicant has proposed a number of measures within the EMP to manage the effects on water quality and freshwater ecology. The Applicant has also proposed a number of triggers in the s92 RMA Response for visual deposited sediment (15%), re-suspendable (interstitial space) sediment (15%), and QMCI (15% reduction), and % EPT (15% reduction) against a bottom line of a 20% change. Rather than sit within the EMP, it would be more appropriate (and certain) for these "bottom lines" to be in consent conditions, with the triggers for response in management plans. I have suggested conditions for deposited sediment (cover and interstitial), and macroinvertebrate communities using QMCI and % EPT[44] above. When combined with the end of pipe standards I have recommended, these conditions should ensure the instream values of the catchments are not significantly diminished as a result of sedimentation effects arising from the Proposal.

145 **Submission 13 from Meridian Energy Limited.** Mr James Lambie, on behalf of Horizons will respond to the majority of this submission as it relates to bird strike within the wind farm. I will respond in relation to water quality and aquatic habitat:

(a) The proposal from the Applicant mostly involves adoption of good management practices in the restoration of stream diversions. I say mostly, as there are limitations around the proposed habitat creation. This includes large vegetation being planted beyond the 100 year flood level and (at many of the sites) vegetation reaching a height of no greater than 1.5 metres in order to meet operational requirements/concerns from Meridian. Without sufficient planting the diversion streams/channels will effectively become drains that will convey water and will provide very little ecological function. In that case their ecological value would be lower than those streams which currently exist in the farmed environment.

(b) Additionally, the planting of stormwater devices is intended to provide water quality benefits such as the slowing of water flows, which allows particles to drop out of suspension and attach to biofilms that grow on the vegetation. The removal of these devices would result in stormwater being discharged to

[44] S92 RMA response attachment 2: Aquatic ecological monitoring and responses.

streams in an untreated manner and would be unlikely to result in the water quality improvements proposed (and relied on) by the Applicant.

(c) If too much of the restoration package is altered on Meridian land there is a risk of degradation of water quality and aquatic habitat within the proposed works area. This would not bring about the benefits relied on as part of the mitigation and offsetting regime proposed by the Applicant.

F. DISCUSSION AND CONCLUSION

146 The Applicant seeks resource consent to enable the construction, operation, use and maintenance of approximately 11.5km of new State Highway crossing the Ruahine Ranges, linking Woodville and Ashhurst as a replacement to the indefinitely closed Manawatū Gorge. The Proposal will have adverse effects on the values of the waterways within the catchments affected by the Proposal. The majority of these effects can be avoided, remedied or mitigated through measures as contained in the application. However, the loss of stream habitat cannot be fully avoided, remedied or mitigated within the footprint of the works area and therefore the Applicant has proposed an offsetting regime for stream loss.

147 The Applicant has undertaken an assessment of fish passage through the culverts that will be constructed across the length of the road. The majority of the culverts will have fish passage included within their design and construction and for a limited number of culverts no fish passage will be provided (there is either very limited habitat (either length or intermittent flows) upstream of the culvert or the habitat available will be unsuitable i.e. constructed streams as a result of the Proposal). I am satisfied with the methodology and conclusions reached in respect of fish passage, although, in my opinion, three additional measures are required:

(a) The final designs of the culverts to enable fish passage must be peer reviewed and certified by a freshwater ecologist that specialises in fish passage;

(b) When the culverts are constructed an “as build” is to be completed to certify that the construction has been completed in accordance with the design and fish passage has been allowed for; and

(c) That on-going maintenance of the culverts is undertaken to ensure that for the lifetime of the culverts they remain fish passable.

148 The Applicant has identified reaches of stream that will be lost as a result of the Proposal. Those losses include the stream loss as a result of the creation of spoil sites, diversions for the road, and the installation of culverts. The streams affected by the Proposal have had SEV scores calculated for them pre and post (with mitigation) construction of the works and it has been established that 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 offset sites scoped through the technical assessment process. As the Ratawihi Farm site is not yet confirmed as an offsetting site, care will need to be taken to ensure that any other site chosen (if necessary) has the same baseline information collected to inform the quantum of required offsetting. The offsetting requires an additional step to check that the expected outcomes at the offset sites are actually achieved. There are presently still unknowns as to how restoration activities will eventuate at any sites at which the works are undertaken. This might result in further offsetting works needing to be completed by the Applicant.

149 The Applicant has identified three catchments that will experience high effects of sedimentation (adverse) from the Proposal. These Catchments are 5, 6, and 7. Overall, the Applicant considers that this level of effect is acceptable given the nature of the work and the duration of the Project, and that specific offset or compensation measures are not necessary to address this effect.[45] Whether or not the effects are short term is unknown, and even then short term effects from sedimentation can have significant effects on streams. There is also a possibility of double counting in relation to short-term effects where these factors are already accounted for when considering the magnitude of effect (which in turn defines the expected level of effect). Given the values within catchments 5, 6 and 7, the effects that sedimentation can have on these values, and the unknown timeframe within which those values will take to recover from sediment deposition, I have recommended catchment specific discharge standards to provide a sufficient level of protection for these areas.

150 When considering ongoing stormwater discharges the Applicant has proposed a range of treatment devices that will treat stormwater prior to it being discharged to the receiving environment. Overall, this will see an improvement in the quality of stormwater compared to the current situation. The only current unknown in relation to stormwater discharges is the ability of the treatment devices to be able to remove *E.*

[45] Technical Assessment H – Freshwater Ecology, para 215.

coli and soluble nutrients. I have therefore recommended a condition of consent which requires the monitoring of at least one representative treatment device.

G. RECOMMENDATIONS/CONDITIONS

151 As addressed above (at paragraph 41) the Applicant proposes to undertake remediation of the Kiwirail culvert, which is currently a barrier passage for some of the region's native fish species. This proposal should be reflected in the consent conditions. This would require that the fish pass is designed by an appropriately qualified expert in fish passage requirements. As discussed at paragraph 147 I would recommend conditions which address three other matters relating to construction and design of fish passage, "as built" certification and ongoing monitoring of the structure.

152 Proposed condition EC13 deals with fish salvage, relocation and fish passage during construction and refers to the EMP for details. The Fish Recovery Protocols cover in detail how the process will be undertaken however, there are some general principles regarding fish recovery that would be best captured as resource consent conditions for enforceability. These conditions could include:

(a) Depending on the habitat type and its suitability for fish recovery, fish recovery shall be undertaken via electro-fishing and/or trapping, and/or dewatering and muck out;

(b) Koura and kakahi shall be searched for, recovered and transferred in those areas that contain suitable habitat for those species;

(c) If native fish with a conservation status of 'threatened' or 'at risk – declining' are captured, trapping and/or electro-fishing will continue until no further conservation status of 'threatened' or 'at risk – declining' individuals are captured;

(d) For those fish species that do not have the conservation status of 'threatened' or 'at risk – declining' a declining capture rate of 50% between the first and last recovery event should apply if the first recovery event encounters more than 10 individuals of each species over a 150 metre monitoring reach.

153 Once the timeframes within which restoration goals are to be satisfied passes, it will be important that the SEV scores are recalculated for the stream diversions. This is to ensure that what was predicted to occur as part of the overall mitigation,

remediation, offsetting package does occur. This would involve recalculating the SEV scores for the site as restored, comparing these scores back to what was predicted, and if required providing further offsetting for any difference in outcome. The proposed stream offsetting conditions presently require a "recheck" once the works are completed to ensure that the streams that require offsetting have been correctly identified, with the offsetting package able to be recalculated if needed. This does not provide any feedback loop via monitoring to detect those occasions that the predicted SEV scores might not be met. This may require that additional offsetting work is completed. I recommend the inclusion of additional requirements in EC15. This "recheck" would best be done at the same time that the 10 year monitoring is done for the riparian vegetation check, as discussed in paragraph 67, with analysis undertaken to ensure that the predicted SEV scores eventuate and the additional offsetting required to fully offset the works where the scores do not eventuate. This monitoring information should be provided to Horizons once further action is completed.

154 Table 4.1 within the EMP contains outcome performance measures for years 1, 3, 5, and 10 for riparian management as part of stream restoration. These are important measures as they provide the predicted response for the offsetting and in my opinion, they should be included in consent conditions as enforceable standards.

155 Given the role that interstitial sediment can play in influencing values within waterways I recommend the collection of quorer samples in the baseline information. This will allow assessment against the proposed deposited sediment values.

156 Given the adverse effects, that sedimentation can have on the waterways (both within the footprint of the Proposal and those further downstream) there is a need to limit the amount of sediment that is able to leave the site. This requirement is best dealt with in conditions. Based on the water quality data and analysis included in Technical Assessment C – Water Quality the following standards would apply (as a median) for TSS;

(a) Catchment 2 – 63 mg/L;

(b) Catchment 4 – 32 mg/L; and

(c) Catchment 7 – 40 mg/L.

157 As the remaining sub-catchments do not have values derived for them based on the values within the sub-catchments could be clumped together into the following:

(a) Catchments C1, C2, C3, and C8;

(b) Catchments C5, C6, C7, and C9; and

(c) Catchment C4.

158 Given the uncertainty around treatment efficiency of the stormwater treatment device for the removal of soluble nutrients and *E. coli,* I recommend that monitoring be undertaken from at least one of the treatment wetlands (one that receives stormwater from the ascending portion of the road). This monitoring is to capture water entering and exiting the wetland, with a focus on dissolved reactive phosphorus, soluble inorganic nitrogen, TSS, and *E. coli*. If E.coli concentrations exceed 240 mpn/100 ml in the discharge, the Applicant must undertake analysis through faecal source tracking to determine the source of the contamination i.e. whether it is avian or rudimentary.

LOGAN ARTHUR BROWN

25 May 2020

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