IN THE ENVIRONMENT COURT OF NEW ZEALAND
WELLINGTON REGISTRY

I MUA I TE KŌTI TAIAO O AOTEAROA
TE WHANGANUI-Ā-TARA ROHE

ENV-2020-WLG-00014

UNDER	the Resource Management Act 1991
IN THE MATTER OF	a notice of motion under section 87G of the Act seeking the grant of resource consents to Waka Kotahi NZ Transport Agency for Te Ahu a Turanga: Manawatū-Tararua Highway

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STATEMENT OF EVIDENCE OF CAMPBELL ROSS STEWART ON BEHALF OF WAKA KOTAHI NZ TRANSPORT AGENCY

EROSION AND SEDIMENT CONTROL

12 June 2020

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INTRODUCTION

1. My full name is **Campbell Ross Stewart**.

2. I am a Director of Southern Skies Environmental Limited, an environmental consultancy company specialising in erosion and sediment control ("**ESC**"), environmental management and planning.

3. I prepared Technical Assessment A: Erosion and Sediment Control ("**Technical Assessment A**") as part of Volume IV of the Assessment of Environmental Effects ("**AEE**"), which accompanied the application for resource consents lodged with Manawatū-Whanganui Regional Council ("**Horizons**") on 11 March 2020 in respect of Te Ahu a Turanga: Manawatū Tararua Highway Project (the "**Project**").

4. My qualifications and experience are set out in paragraph 4 of Technical Assessment A.

5. In preparing Technical Assessment A and my evidence I have:

   (a) visited the area in which the Project is proposed to be built on several occasions throughout 2019;

   (b) walked large sections of the proposed alignment of the Project with members of the Project's construction team[1] and discussed and planned construction techniques and methodologies;

   (c) walked the Site-Specific Erosion and Sediment Control example areas with Horizons technical staff and discussed the proposed construction techniques and methodologies; and

   (d) had numerous meetings and telephone conservations with Horizons technical staff and representatives regarding various options for assessing sediment yield and monitoring erosion and sediment control measures.

Code of conduct

6. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this assessment is within my area of expertise and I have not

[1] Tony Adams, Construction Manager, Hardus Pieters, Enabling and Civil Construction Manager, Clare Miller, Earthworks Manager.

omitted to consider material facts known to me that might alter or detract from the opinions I express.

Purpose and scope of the evidence

7. Technical Assessment A assesses the likely erosion and sediment-related effects associated with the Project's construction, and recommends ESC methods, practices and standards to avoid, remedy or minimise those potential effects.

8. My evidence does not repeat in detail the technical matters set out in Technical Assessment A. Rather, in this evidence I:

   (a) present the key findings of Technical Assessment A, updated to take into account information received more recently in an executive summary;

   (b) comment on issues raised in submissions received in respect of the Project; and

   (c) comment on the section 87F report prepared by Horizons.

SUMMARY

9. The Project consists of approximately 11.5km of state highway connecting Ashhurst and Woodville via a route over the southern end of the Ruahine Ranges. It is located within catchments of the Pohangina River and the Manawatū River and directly affects nine smaller catchments which all drain to the Manawatū River.

10. Water quality across the catchments is varied;[2] baseline monitoring found that most sites have relatively low visual clarity and moderately high turbidity, with the exception of Catchment 7, which had a relatively high proportion of fine sediment on the stream bed. Macroinvertebrate indices varied across the alignment, ranging from 'poor' to 'fair' water and habitat quality, but with areas in parts of upper catchments 2C and 5 having macroinvertebrate communities typical of good water and habitat quality despite the surrounding agricultural land use.[3]

11. In Technical Assessment A I have described the proposed design of the ESC measures and management approach to be implemented during the construction phase of the Project, and assessed the effectiveness of those

[2] As discussed in the evidence of Keith Hamill and Technical Assessment C.
[3] As discussed in the evidence of Justine Quinn and at paragraph 21 of Technical Assessment H.

measures. My role has included the preparation of related management plans and documents, including the Technical Assessment and:

(a) an overarching ESC Plan ("**ESCP**"), provided in Volume VII of the application documents, which includes:

(i) an ESC Monitoring Plan ("**ESCMP**"); and

(ii) a Chemical Treatment Management Plan ("**CTMP**");

(b) Concept ESC Drawings ("**Concept ESC Drawings**", provided in the Drawing Set, Volume III); and

(c) three example Site-Specific ESC Plans ("**SSESCPs**", provided in the Drawing Set, Volume III and, in full, in response to the request for further information made by Horizons under section 92 of the Resource Management Act 1991).

12. The objectives of the ESC management of the Project are:

(a) to minimise the potential for sediment generation and sediment yield[4] by maximising the effectiveness of ESC measures associated with earthworks; and

(b) to take all reasonable steps to avoid or minimise potential adverse effects on freshwater environments within or beyond the Project area that may arise from the discharge of sediment during the construction of the Project.

13. After site walkovers, extensive liaison with the Project design team and specialists, and discussions with Horizons, I have prepared an ESC design approach based on GD05,[5] which represents industry best-practice and will minimise the discharge of sediment during the construction phase to an acceptable extent, and ensure that any potential adverse off-site effects are temporary.

14. As described in Technical Assessment A, the assessment of potential effects from the discharge of treated sediment laden runoff to the freshwater receiving environments has been based on estimates of sediment yield for various parts of the Project area, using the Universal Soil Loss Equation ("**USLE**"). Having considered USLE estimates undertaken for other Transport Agency infrastructure and land development projects with which I am familiar,

[4] Sediment yield is the volume of sediment that leaves an earthworks site. The purpose of erosion and sediment control is to minimise sediment yield to the greatest extent practicable and to a level that is acceptable for a particular receiving environment.
[5] Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region*.

and comparing those Project USLE estimates with recorded sediment retention pond ("**SRP**") performance within other sites, I consider that the sediment yield estimates undertaken for the Project are realistic and likely to be conservatively high, when compared to likely actual sediment yields that will occur during construction.

15. The sediment yield estimates have been further validated by an analysis of the responsiveness of various soils along the Project alignment to chemical treatment, which will maximise treatment device efficiency by enhancing settlement rates.

16. The ESC management of the Project will be guided by the ESCP which describes the overall principles and methodology to be adopted. The ESCP is supported by management plans and procedures, including the Concept ESC Drawings, the CTMP and the ESCMP, which detail the extensive and ongoing monitoring and maintenance of ESC measures that will be implemented throughout the construction period. This will include additional monitoring of the performance of SRPs and decanting earth bunds ("**DEBs**") during or immediately after specific rainfall trigger events.

17. The detail of the ESC measures to be implemented within a given area of the Project will be provided in the SSESCPs. Those plans will provide the design detail of individual ESC measures to be implemented in the relevant area and will be prepared and submitted to Horizons for certification against GD05 and relevant consent conditions, prior to works commencing in that area.

18. The maintenance of best-practice ESC will be driven by a dedicated Environmental Management Team, led by the Environmental Manager, and supported by an Environmental Technical Specialist, Environmental Coordinator and Environmental Supervisor. Day-to-day operation and maintenance of ESC measures will be undertaken by ESC Foremen and ESC Labourers.

19. The Project Environmental Management Team and Construction Management Team will be required to work closely with Horizons' compliance monitoring inspectors for the duration of the construction period of the Project, to ensure a high standard of compliance and a no-surprises approach to design changes and site management.

20. All ESC measures must be maintained in full compliance with GD05 for the duration of works within each area of the Project, until that area is stabilised. This will be achieved through ongoing day-to-day inspection and

maintenance of all ESC measures, including the monitoring and maintenance of all chemical treatment systems as detailed in the CTMP.

21. To supplement the day-to-day monitoring and maintenance programme, additional monitoring of ESC performance (as detailed in the ESCMP) will comprise:

    (a) continuous automated and telemetered recording of inflow and outflow turbidity of two SRPs, as proxies for overall performance of the SRPs across the Project;

    (b) additional site inspections and on-ground manual sampling of turbidity, clarity and pH of inflows and outflows of all SRPs and DEBs in response to higher intensity and volume rainfall trigger events (15mm/hr and 25mm/24hrs). The rainfall triggers will be recorded by an on-site telemetered rain gauge with alerts transmitted to the mobile phones of site staff;

    (c) additional inspections when the average sediment retention efficiency of the automated monitored SRPs (based on turbidity of inflows and outflows) falls below 90%;[6] and

    (d) reporting on all trigger events and annual reporting of ESC performance.

22. The ESC monitoring described above will be complemented by ecological monitoring described in the Ecology Management Plan ("**EMP**"). This will include trigger event (land slips or device failure) and routine monitoring of water quality, deposited sediment and macroinvertebrates. These processes are depicted in a Monitoring Flow Diagram that was Appendix 2 to the Transport Agency's response to Horizons' section 92 request for further information.[7] That Diagram has now been updated in response to Horizons' section 87F reports, as I discuss below; the updated Diagram is annexed to **Ms Justine Quinn's** evidence as **Attachment JQ.5**.

23. Notwithstanding that monitoring regime and the responses proposed if adverse ecological effects are observed, I anticipate that rigorous maintenance of GD05 controls will minimise the sediment yield to the acceptable level adopted in the assessment of effects. The additional monitoring will provide feedback on the performance of the controls and

[6] 90% efficiency has been nominated as a practical average value that is indicative of the efficiencies assumed in modelling but allows for some variability between storms.
[7] Section 92 Response Appendix 2.

downstream effects and, if necessary, trigger the consideration of changes to ESC management within a given works area or across the Project.

COMMENTS ON SUBMISSIONS

24. I comment below on a submission point regarding ESC raised by Queen Elizabeth the Second National Trust ("**QEII Trust**"). One other submission mentioning ESC is that of Transpower New Zealand Limited; that submission relates to dust effects and is addressed in the evidence of **Mr Richard Chilton**.

25. Paragraph 4 of attachment 1 to the submission made on behalf of the QEII Trust raises two matters of specific relevance to ESC; the submission asserts that:

    (a) *"Sedimentation effects will be high and have been underestimated because of the "overall" approach to effects assessment"*; and

    (b) *"Monitoring of erosion and sediment controls should include contingency measures for if proposed controls are inadequate".*

26. In respect of the first point, I am not aware of any information to support the contention that sedimentation effects have been underestimated. On the contrary, for the reasons explained in Technical Assessment A and summarised above, I consider that the estimate of sediment yield undertaken is likely to be an **overestimate** of the sediment that will be discharged to the receiving environment during the construction phase of the Project.

27. The assumptions upon which the estimate is based do not include progressive or temporary stabilisation, or the extent of rock that will be exposed during excavations. As discussed in Technical Assessment A, I also note that the reported actual sediment loads recorded on the Ara Tūhono – Puhoi to Warkworth motorway project ("**Ara Tūhono**") were significantly lower than the loads predicted by the USLE during the consenting phase of that project.

28. **Mr Keith Hamill** and **Ms Quinn** have based their assessments on my estimates, which have also been accepted by Mr Pearce[8] on behalf of Horizons. I note that **Ms Quinn** has concluded that for the Manawatū River and sub-catchments 1, 2, 8 and 9, overall ecological effects will be low while for sub-catchments 3, 4, 5, 6, and 7 they may be moderate to high, although acceptable (in ecological terms) and temporary.

[8] Section 87F Report of Kerry Stewart Pearce – Erosion and Sediment Control; [52] and [53].

29. Further, the proposed erosion and sediment control system will comprise industry best-practice and is supported by a comprehensive ESC and ecological monitoring programme. I cannot comment further on this submission point in the absence of technical evidence challenging my assumptions and conclusions.

30. In respect of QEII Trust's second point, as noted above and as described in the ESCMP, EMP and the Aquatic Ecological Monitoring and Responses Flowchart,[9] a suite of ESC and receiving environment monitoring is proposed, both routine and event-based. While compliance with the proposed best-practice ESC system has been assessed as likely to minimise downstream sediment effects to an acceptable level, the monitoring plans include a range of investigation procedures that will allow the identification of appropriate responses that would be taken in the circumstance that effects were more significant than anticipated. The potential responses provide flexibility in terms of specific detail, subject to particular circumstances should they arise.

31. I do not consider the proposed monitoring and *"contingency measures"* to be inadequate, or even simply adequate. They are best-practice, developed to reflect the specific characteristics of the site, its receiving environments, and the way in which GD05-compliant ESC measures function.

32. I consider that the adoption and maintenance of the proposed ESC controls should ensure that downstream effects are appropriately minimised, and that monitoring and contingencies have been proposed that will identify and respond to more significant effects, should they arise. I do not consider that the proposed ESC management system needs to be amended in that regard.

COMMENTS ON SECTION 87F REPORT

33. I have reviewed the section 87F reports, with a focus on Appendix 3 (water quality and ecology) prepared by Mr Brown and Appendix 5 (erosion and sediment control) prepared by Mr Pearce.

34. In general terms Mr Pearce comments in a positive way on the approach I have recommended that the Transport Agency and Alliance adopt for ESC management through use of the best-practice GD05 standard and the employment of *"a comprehensive management plan structure to manage the adverse effects associated with the proposed development"*.[10] This reflects

[9] Section 92 Response Appendix 2; now updated and annexed to **Ms Quinn's** evidence as **Attachment JQ.5**.
[10] At paragraph 14.

the various discussions I have had with Mr Pearce in developing that approach.

35. There are a number of matters of detail recommended in those reports, however, with which I do not agree. Largely these are manifest in the amendments to conditions proposed by Horizons (although various other changes to conditions recommended by Horizons I do consider to be acceptable). The set of conditions provided through the evidence of **Ms Ainsley McLeod** incorporates those changes sought by Horizons in respect of ESC that I consider to be acceptable.

36. I discuss these matters below, grouped into key issues.

TSS limits

Introduction

37. Mr Pearce[11] and Mr Brown[12] recommend that TSS limits be imposed through conditions, to be complied with at the discharge point of sediment retention devices. For the reasons provided below, I consider that TSS discharge limits cannot be complied with. Furthermore, in my view conditioned TSS limits are not necessary to ensure that the downstream effects remain within the envelope assessed to be acceptable by **Ms Quinn** and **Mr Hamill**.

The TSS limits proposed by Horizons

38. Mr Pearce and Mr Brown both refer to Technical Assessment A and Technical Assessment C and appear to accept my estimate of sediment yields, which **Mr Hamill**[13] interpreted from the USLE calculations I provided to be 2 to 3 times more from the exposed earthworks of the Project than the corresponding area in an undisturbed state[14]. Mr Pearce relies on Mr

[11] Section 87F Report of Kerry Stewart Pearce – Erosion and Sediment Control; [61] [106].
[12] Section 87F Report of Logan Arthur Brown – Water Quality; [105].
[13] Technical Assessment C, at [95].
[14] Section 87F Report of Kerry Stewart Pearce – Erosion and Sediment Control [54]; Section 87F Report of Logan Arthur Brown – Water Quality [68]

Brown's report in terms of the details of the limits and the condition he proposes, which read as follows:

> *Condition ES2(f)*
>
> *The median value of the discharge of sediment from the outlet of any sediment retention devices must not exceed a TSS concentration greater than the level set out in the table below:*

Catchment (as show on Drawing TAT 3 DG E 4100 A)	*TSS*
C1, C2, C3, and C8	*63mg/L*
C4	*32mg/L*
C5, C6, C7, and C9	*40mg/L*

> *Advice Note: This standard does not apply when the emergency spillway on a sediment retention device is operating.*

39. One issue with this proposed condition is that Mr Brown's recommended device outlet discharge limits do not reflect my estimate of sediment yields (which, as noted above, appears to be an estimate accepted by Mr Brown).

40. Rather, he has relied on the TSS values suggested by **Mr Hamill**[15] that may occur during the proposed works; as clarified by **Mr Hamill** in his evidence, those values correspond to TSS values measured in catchments C2, C4 and C7 assuming the addition of sediment from the Project sediment ponds after mixing with upstream catchment flows. That analysis was an example based on a data set from two rain events of 2.5mm and 14mm.

41. Because the instream values suggested by **Mr Hamill** equate to the discharge from devices once mixed with the greater volume of water arising from upstream catchment flows, in my view it is not valid to apply them to the outlet of an SRP or DEB.

42. There are other issues with using those values – or indeed any other TSS values – as limits for consent compliance purposes, as I explain below. **Mr Hamill** comments on additional issues with the approach proposed by Horizons, from his perspective as a water quality scientist.

The appropriateness of TSS and other limits more generally

43. As explained in Technical Assessment A and the Transport Agency's response to Horizons' section 92 request for further information, and in the following paragraphs, imposing a TSS limit is not consistent with the operation of GD05-compliant SRPs and DEBs. Nor is it consistent with the

[15] Technical Assessment C, at [98].

approach promoted in the ESCP and ESCMP and is not consistent with the activity for which consent is sought.

44. A TSS limit cannot be practically applied to a SRP or DEB even for a small earthworks site, given the variability of the sediment load in runoff that occurs throughout a storm or across various storms. That variability cannot be controlled by those constructing the Project. However, the standard of ESC implemented can be controlled (i.e. maintaining best-practice measures) which in my experience, provides confidence over the average performance of the devices and the likely downstream effects.

45. In terms of that performance, SRP efficiency is dependent on many factors. In simple terms, the sediment retention efficiency (i.e. the settlement rate) is limited by the residence time of water in the pond and the water velocity through the pond. The slower water moves through the pond, the longer it remains in the pond, and the more settlement of sediment will occur.

46. This 'residence time' is controlled by the inflow rate of water to the device, which itself is controlled by the rainfall intensity, duration and volume, the slope of the site (i.e. a steeper site means faster runoff), the soil type, the soil moisture condition of the site (in that a dry site will generally soak up more rainfall), the surface condition (a rougher surface retains more water), and ground cover (more runoff eventuates from exposed ground, and less from vegetation or stabilised ground).

47. As water enters the device, the sediment-laden water is denser than the water that is already in the pond (from which some of the sediment has settled out). The denser water flows to the lower part of the water column and displaces the cleaner water upwards. The cleaner top layer of water is skimmed off by the decants. The decants are designed to discharge at a rate of 3L/s/ha of contributing catchment. Depending on the catchment size, a SRP may have one, two or three decants. The height of the decants is offset so that small events only engage the lower decant, with larger events activating decant two and decant three consecutively as the water level in the pond rises (due to the inflow exceeding the decant rate).

48. The residence time of water in the pond reduces as each additional decant activates and the pond efficiency progressively decreases. If the inflow rate causes the water level to rise further and spill into the primary spillway (the upstand pipe / manhole riser), the efficiency further reduces. The function of the emergency spillway is to safely discharge flows from low frequency larger events that exceed the combined capacity of the decants and primary

spillway. Mr Pearce and Mr Brown have recommended that the TSS limit apply to all discharges up to and including the primary spillway.

49. The Project-specific assessments of effects are based on the average efficiencies of those SRPs which include a range of efficiencies that occur throughout various rainfall events. They are based on the average performance of the sediment retention devices proposed rather than a specific discharge limit. The typical function of SRPs, as I have described above, makes it very difficult to monitor TSS in discharges from the various outlets and account for the variability from each over time either as a maximum or an averaged basis.

50. Further, the design and function of SRPs and DEBs as recommended in GD05 have been developed for New Zealand conditions, which experience frequent and / or consecutive rainfall events, and sites that have steeper topography and spatial constraints. Australia, which has historically required sediment retention ponds to be sized to fully contain storms of up to a nominated return period event, is now adopting the GD05 type of device. In 2018 IECA Australasia updated its industry guideline (the equivalent to GD05) to incorporate those devices on the basis of higher actual efficiency, particularly when consecutive rainfall events occur.

51. Again, Mr Pearce has accepted the validity of the estimates of sediment yield upon which the water quality and ecological assessments are based. As explained in Technical Assessment A, those estimates are considered conservative (*"i.e. not underestimated"*[16]) as a result of the research and experience derived over recent years from various projects including Ara Tūhono.

52. I have again reviewed monitoring reports prepared during the construction phase of that project. None of the trigger rain events sampled complied with the limits proposed by Mr Brown for the full duration of each event.

53. In respect of this Project, I also note that the current turbidity monitoring presented in the section 92 response for Catchment 2 (Mangamanaia Stream) and Catchment 7 (Raukawa Stream) shows a high variability of turbidity in this 'natural' environment, without the Project, from very low values to greater than 1000NTU[17]. That corresponds with my experience of the function of SRPs and DEBs and the acceptable level of effects that are

[16] Section 87F Report of Kerry Stewart Pearce – Erosion and Sediment Control; [54].
[17] Based on the relationship derived by Mr Hamill in Technical Assessment C [28] 1000NTU equates to approximately 1639g/m3 TSS.

achieved by well-constructed and maintained GD05 devices. It is also important to note that:

(a) the highest SRP and DEB sediment discharge loads will correspond with the most intense rainfall and the higher turbidity in the streams derived from existing land use; and

(b) the lowest stream turbidity levels from existing land use will correspond with periods when the SRP and DEB loads will be low or nil i.e. no discharge occurring.

54. Further, and as highlighted by **Mr Hamill** in his evidence, more recent turbidity data from Catchment C7 suggests that the existing stream flows would have failed to comply with the recommended limits.

55. Finally, in relation to dewatering activities, Mr Pearce states that water should be required to achieve 100mm clarity before being discharged off site and has recommended a condition in that regard. I agree with this requirement, and it is reflected in the Dewatering Management Plan submitted with the ESCP. The 100mm clarity has also long been adopted as an easy on-site check of SRP water quality and is a target, but not a limit in that regard for SRPs and DEBs. For dewatering it can be a limit, as the Project team has full control over when pumped dewatering occurs.

56. However, for the reasons explained above, it cannot be adopted as a discharge limit for SRPs and DEBs due to the variability of sediment discharge concentration that will occur throughout a rainfall event. I note that, based on the Chemical Analysis and Reactivity Test ("**CART**") analysis of soils in the Project area, 100mm clarity over several soil types corresponds to a NTU of between 62 and 75. This approximately corresponds to a TSS range 103 to 123 mg/L.[18] Based on CART results, achieving the 100mm clarity target would fail to comply with the TSS limit proposed by Horizons.

57. In conclusion, in my view it is not possible for an earthworks site implementing best practice erosion and sediment control measures to comply with a TSS limit, or indeed other Project-wide discharge limits (e.g. turbidity) when applied as compliance limits, or to devise a maximum or averaged monitoring regime based on TSS limits.

[18] Refer Technical Assessment C [28] for turbidity / TSS correlation.

The need for discharge limits

58. Even leaving aside the difficulties with limits based on TSS, in my view it is unnecessary for any other discharge limits to be imposed. I explain this view below.

59. The design, construction and monitoring approach proposed is summarised in my evidence above and in detail in Technical Assessment A, the ESCP and the ESCMP. In my experience the day-to-day monitoring and maintenance of the ESC measures throughout the construction period of the Project will achieve the anticipated outcomes. Those activities will be complemented by additional event-based sediment retention device monitoring and ecological monitoring, and quarterly ecological monitoring. The automated and event-based sediment retention device monitoring will provide additional information to the Project team on the performance of the devices that can inform management across the Project. The ecological monitoring will provide actual data of the state of the streams during the construction phase.

60. I do not agree with Mr Brown's application of the One Plan requirement that where *"targets/standards are currently not met 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"*[19]. In my view it is not realistic for any large-scale earthworks project to capture all sediment from worked areas, such that water quality will be maintained or enhanced in an absolute sense during the construction phase. In my experience, it is not possible to achieve those outcomes. Rather, in this case consent is being sought for earthworks activities that will have effects that are temporary and acceptably minimised by the adoption of best practice ESC measures, supported by additional sediment retention device and ecological monitoring and responses.

61. Nor do I agree with Mr Pearce's suggestion[20] that a turbidity limit could be imposed in lieu of a TSS limit. While the Project will incorporate continuous and event-based turbidity monitoring on two SRPs to inform the ongoing review and refinement of the ESC management, a turbidity limit cannot be set that could be continuously complied with. Nor, in my opinion and for the same reasons as described above, is such a limit necessary.

[19] *Section 87F Report of Logan Brown* – Water Quality and Ecology [13(d)]
[20] *Section 87F Report of Kerry Stewart Pearce – Erosion and Sediment Control*; [62]

62. Mr Pearce also suggests that *"In the absence of a discharge standard, further conditions around staging of the proposed earthworks should be considered for the management of the scale of sedimentation effects"*.[21] I do not agree with this suggestion and it is an important point to clarify.

63. Firstly, staging and discharge limits are not related. In practice, the variability of sediment concentrations from an SRP or DEB occurs at all scales of earthworks, and on an individual device basis. Therefore, even if the Project was constrained to very tight staging limits, the discharges from devices would still not continuously comply with the proposed limits.

64. Secondly, at face value Mr Pearce's suggestion implies that there is an unacceptable sedimentation effect that needs to be addressed through additional controls. The technical assessments prepared and evidence presented by **Mr Hamill** and **Ms Quinn** do not support that conclusion.

65. Mr Pearce has accepted the estimates of sediment yield and the adoption of GD05. The earthworks programme is already staged across four earthworks seasons that align with the Project works programme. Mr Pearce has agreed that the estimates of sediment yield are conservative. Part of the conservatism is that when undertaking those calculations, I did not assume progressive stabilisation, which will occur in practice. Mr Pearce has effectively endorsed the consent conditions proposed by the Transport Agency that require progressive stabilisation (which I discuss further below), and I have recommended those conditions as they reflect best practice. Thus, the Project already incorporates a practical extent of staging. I do not consider the imposition of additional staging requirements through a resource consent condition to be justified or necessary. I discuss this further from paragraph 73 below.

66. When considering how sediment retention devices function, the variability of rainfall events and the manner in which well managed earthworks projects operate, I do not consider that compliance with a discharge limit imposed through a consent condition is necessary to manage effects. Indeed, if a limit was imposed that adequately reflected the variability of discharges from SRPs and DEBs it would have to be unreasonably high and could unintentionally create a maximum that significantly exceeds the actual sediment yield that the Project aims to achieve and on which has been anticipated through the ESC design and technical assessments.

[21] At [77].

67. In my experience, it is much more effective to focus on good site management and monitor in-stream effects on an ongoing basis to ensure the anticipated outcomes are being achieved.

Cost of monitoring the limits

68. Further to my views that a TSS limit cannot be complied with and is not necessary to ensure that sediment-related effects are appropriately minimised, the cost implications of such a requirement are relevant.

69. Because of the variability of sediment concentration within the discharge from a SRP and DEB during a rainfall event, manual grab sampling will not be representative of the range of TSS that will occur. Therefore, to monitor compliance with the TSS limit as proposed by Horizons, all SRPs and DEBs would require automated sediment samplers that are set at a practical minimum sampling interval (say 15 minutes) and to sample for the full period that the devices are discharging. In Season 2, which is the largest of the programmed construction seasons, that would require automated sampling of at least 100 devices.

70. The cost of setting up the samplers at each device would be approximately $16,000 per device.[22] Over a three-hour discharge period, that would create 1200 samples. Sample analysis takes 3 to 5 days to be reported, at a cost in the order of $16 / sample, so the sample analysis cost would be in the order of $19,200 for a rainfall event that resulted in a three-hour sampling period.

71. The time and staff cost required to collect the samples and service the samplers would also be significant. It is hard to estimate but given the topography of the site and number of devices, it might not be possible to service all samplers within a reasonable timeframe. Achieving that across consecutive rainy days would also be difficult.

Monitoring triggers / targets vs compliance limits

72. The Project will adopt monitoring triggers and targets such as 90% efficiency for the continuously monitored SRPs and the 100mm clarity for dewatering and as a simple check of SRPs and DEBs. These triggers and targets are useful tools that assist the management of the ESC measures. However, for the reasons explained above, they cannot be adopted as compliance limits for SRPs and DEBs as ongoing compliance cannot be achieved. Nor does the effects assessment that has been undertaken rely on such compliance.

[22] Price obtained from Envco (environmental monitoring equipment suppliers).

Staging and progressive stabilisation

73. In paragraph 76 of his report, Mr Pearce identifies additional key principles of GD05 being:

    (a) minimising disturbance;

    (b) staging construction;

    (c) protecting steep slopes; and

    (d) protecting watercourses.

74. In paragraph 77 he goes on to suggest that *"in the absence of a discharge standard, further conditions around staging of the proposed earthworks should be considered for the management of the scale of sedimentation effects"*.

75. These key principles are reflected in the ESCP, which addresses the scale of the Project earthworks and its potential sediment effects. Those principles will be given effect through preparation and implementation of the SSESCPs, and compliance with the conditions imposed by the Court. In particular, Condition LD4 proposed by the Transport Agency (which has been accepted by Horizons) includes a range of progressive stabilisation requirements. The steepest excavations will be into rock faces that will have low erodibility. The rock faces will be benched such that each bench provides runoff control. As required by the conditions, erodible cut and fill faces will be progressively stabilised every 10m, any exposed areas that are not programmed to be worked for 14 days or more will be temporarily stabilised, and the work areas will be progressively stabilised as they are completed.

76. All these actions will reduce the effective area of the Project that is open to erosion at any one time. None of this stabilisation was assumed in the estimates of sediment yield, which further increases the conservatism of those estimates. When combined with the programmed staging of earthworks over a four-year construction period, these management tools represent an effective staging of works to minimise erosion and consequently minimise sediment yield.

77. For completeness I also note that the ESC principles that will be adopted will protect watercourses through minimising sediment discharges and isolating stream works from stream flows. Those requirements are embedded in the various ESC conditions.

Other matters

78. Below I discuss the changes to conditions recommended in the section 87F reports.

79. There are a number of changes recommended by Horizons that I consider are appropriate, and they are reflected in the amended set of conditions presented by **Ms McLeod**.

References to GD05

80. Various changes to conditions proposed by Horizons (LD6(a), ES2(a), ES4(c), ES5(c), ES6(d) and ES7(a)) require compliance with GD05 *"and any subsequent revisions of that document"*. From a practical perspective, GD05 is unlikely to change significantly within the construction phase of the Project. However, it is difficult to support the inclusion of *"any subsequent revisions"* given that the technical requirements and / or outcomes that may be sought through such revisions are unknown. I am unable to comment on the appropriateness or implications of future changes to that guideline.

Construction Environmental Management Plan

81. In condition CM4(a) a 20-day lead in time was sought for submission of the Construction Environmental Management Plan ("**CEMP**"). Horizons recommends 40 working days. In my experience with similar projects, 20 working days is appropriate and sufficient and aligns with the pace with which such documents are updated in conjunction with the Project work programme and commencement dates. The draft CEMP and its various supporting documents have already been submitted and reviewed during this consenting phase.

82. Horizons' proposed changes to condition CM4(c)(iii) require that the Dust Control Procedure ("**DCP**") is submitted with the ESCP as part of the CEMP. It is unclear to me why the DCP has been specifically mentioned. It is already an appendix of the ESCP along with a number of other appendices such as the ESCMP, all of which have been submitted and reviewed through this consenting phase, for consideration by the Court.

Winter works

83. Horizons has recommended adding a further Condition LD6(a) which requires exposed ground to be stabilised by 30 April each year. I consider this additional clause to be unnecessary because it duplicates the requirement of Condition LD5. Condition LD6 as proposed by the Transport

Agency (and accepted by Horizons), provides exemptions where winter earthworks can be undertaken. Condition LD6(a) repeats the intent of Condition LD5 but fails to provide for the exemptions of LD6. I therefore do not support LD6(a) as recommended by Horizons, or alternatively would recommend that the words *"unless otherwise approved under (b)"* are added to the end of that condition.

Dewatering

84. Condition LD7(i)(b) should not include a requirement for chemical batch dosing when dewatering to a sediment retention device. That is just one means of achieving adequate water clarity before discharging to the environment. Sufficient settlement may be achieved without the addition of chemical. As proposed through the Dewatering Management Plan submitted with the consent application, I recommend that this condition simply impose performance standards of 100mm clarity and pH of 5.5 to 8.5 for any discharges.

Erosion and Sediment Control Standards

85. Horizons' proposed changes to condition ES2 seek to impose various requirements that I comment on as follows:

    (a) ES2(f) – I do not recommend that TSS limits be imposed, for the reasons provided above.

    (b) ES2(g) – I refer to the evidence of **Ms Quinn** and **Mr Hamill**.

    (c) ES2(i):

        (i) The changes sought to this condition conflate the 3000m^2 GD05 design threshold[23] between a DEB and SRP and would add complexity to the design requirements of DEBs that are to service steeper ground (>18 degrees) and I recommend that they are not imposed.

        (ii) Firstly, while of less concern in practice, the proposed condition requires DEBs that will service catchments ≥ 3000m^2 to incorporate SRP features. This is an unnecessary requirement because GD05 requires catchments ≥ 3000m^2 to be serviced by SRPs, rather than DEBs. The table below provides a comparison of the main GD05 design requirements for DEBs and SRPs. This

[23] GD05 specifies 3000m^2 as the maximum contributing catchment for a DEB. Greater than 3000m^2 should be serviced by a SRP which has additional features such as a forebay, level spreader bar, and 3% volume for steeper sites.

illustrates that for catchments greater than 3000m^2, the condition proposed by Horizons in effect requires all the features of an SRP and is redundant.

Component	DEB	SRP
Contributing catchment	≤ 3000m^2	≥ 3000m^2
Storage volume (ratio of contributing catchment)	2%	2% or 3% based on slope (18% gradient) and flow path length (200m)
T-bar decant	Yes	Yes
3:1 to 5:1 length to width ratio	Where possible	Yes
Forebay	No	Yes but no volume specified

(iii) Of greater concern is the requirement to increase the storage volume and add a forebay for catchments steeper than 18 degrees. GD05 provides for the use of DEBs to treat smaller areas (≤ 3000m^2) where runoff cannot be directed to a SRP. Those areas are often spatially constrained in terms of installing a device that complies with the full requirements of a SRP. Mr Pearce has not provided a technical basis for increasing the storage volume requirement from 2% to 3% for DEBs servicing steeper land and imposing that increase as well as a 10% forebay would increase the footprint required for the device by over 50%. This may mean that a DEB with those features cannot be accommodated in the constrained locations that cannot be serviced by a SRP.

(iv) It also prevents a degree of flexibility in device design for particularly difficult locations, which is sometimes agreed with regulators. That could force the Project to look for alternatives, such as silt fences, which have lower sediment treatment efficiency. In my opinion Horizons' proposed changes to

condition ES2(i) would unnecessarily complicate the requirement to achieve compliance with GD05 and do not add benefit to the outcomes sought.

Amending the Erosion and Sediment Control Plan and Appendices

86. In respect of condition ES3(a)(ii), the Transport Agency originally proposed a lead-in time of five working days for the submission of a revised ESCP, where the ESCP is not to be certified (for example because the changes are administrative in nature, such as to nominate different personnel). Horizons has recommended that the lead-in time be changed to 20 working days.

87. The ESCP has been submitted to the Court and can be reviewed through this consenting phase and will be resubmitted and further reviewed through the resubmission of the CEMP under Condition CM4. It is unlikely that further significant changes will be made to that document as the key management plans going forward will be the SSESCPs. Therefore, I consider that the 5 working day lead-in is appropriate.

88. Where certification of a revised ESCP is required, proposed condition ES3(d) effectively provides for deemed certification if no response is received from Horizons. A period of ten working days was originally proposed, and Horizons seeks to amend that to 20 working days. I note that the condition only applies when there is no response; in the event that Horizons responds that it is not satisfied with the revised ESCP, deemed certification does not occur. While changes during construction are unlikely, they can arise from dynamic changes to the Project's design, which can arise for environmental reasons. These can occur at relatively short notice and I consider 10 working days to be sufficient.

Site Specific Erosion and Sediment Control Plans

89. The changes proposed by Horizons to condition ES4(d)(iii)(H) would require that *"specific details on dust management"* be included in every SSESCP. In my view that is not necessary. The DCP that is an appendix to the ESCP and is proposed to be approved for the Project provides a Project-wide management system for dust. There will be no specific variation for each SSESCP area. The key function of the SSESCPs is to focus on the specific erosion and sediment control measures that are to be implemented within each work area. They can range from covering a large earthworks footprint or just a single culvert installation. It is essential that they are uncluttered and avoid unnecessary information for timeliness of preparation, clarity of

interpretation, speed of review and certification, and accurate implementation.

90. A further change proposed by Horizons is to condition ES4(d)(vii), which would require the specific design details and bench test results for each work area to be included in the corresponding SSESCP. That is not the intention of the management system described in the ESCP, and Horizons' recommendation does not work from a timing perspective.

91. The CART assessment describes the outcome of bench tests of representative soils within the Project footprint and the CTMP describes how the chemical treatment systems will be implemented. Bench testing for each works area will occur after the respective SSESCP has been certified and machinery has established on site that can sample the subsoil. Therefore, the bench testing results cannot be part of the SSESCP.

92. As explained in the ESCP and CTMP, the bench test results and specific chemical treatment system details will be provided with the as-built plans. As such, I do not support the inclusion of details of the bench test results and treatment system in Condition ES4 (d)(vii) as they are already included in the as-built requirements of Condition ES7 as proposed by the Transport Agency.

93. Condition ES5(c) effectively provides for deemed certification of a SSESCP if no response is received from Horizons. The original condition proposed by the Transport Agency allows a period of ten working days before deemed certification occurs, and Horizons has recommended 20 working days.

94. For the reasons I have discussed above, I considered 10 working days to be sufficient and also critical for the construction programme. During the Huntly Bypass project, Waikato Regional Council was generally reviewing and certifying SSESCPs within two to three days of submission. In my experience 10 days will be sufficient and workable for the Project as it is the intention of the Alliance's Environmental and Construction Teams to maintain a positive, proactive, and 'no surprises' relationship with Horizons. That approach will include forewarning Horizons of upcoming SSESCPs and works programmes.

Amending the certified Site Specific Erosion and Sediment Control Plans

95. Where an amended SSESCP need not be certified, proposed condition ES6(b)(vi) provides for the consent holder to submit it to Horizons five working days before it takes effect. Where an amended SSESCP is provided

to Horizons for certification, proposed condition ES6(e) provides for deemed certification if Horizons does not respond within five working days. Horizons recommends that both these periods instead be ten working days.

96. In my experience five working days is sufficient and in fact critical for the construction programme. These revisions will occur during construction with an area being managed under a certified SSESCP and cannot usually be delayed for an extended period awaiting certification. Any such revisions will have been flagged and discussed with Horizons prior to submission.

CONCLUSION

97. I have read the appendices to the section 87F report prepared by Mr Pearce and Mr Brown, and the amendments to conditions recommended by Horizons. I consider a number of those changes acceptable from an ESC management perspective.

98. My key area of concern is the imposition of discharge limits for sediment retention devices. Such limits are not consistent with the function of GD05 devices. The limits proposed by Mr Brown cannot be complied with and are exceeded by the existing flows measured in Streams C2 and C7 or the discharges estimated for the sediment retention devices.

99. I have also commented on other changes recommended by Horizons that I do not consider to be appropriate or that require further amendment to achieve the outcomes sought by the Transport Agency and Horizons.

100. In my opinion, the key to minimising downstream sediment-related effects is by implementing and vigilantly maintaining GD05 compliant ESC measures, combined with progressive stabilisation, and supported by event based and routine monitoring of the receiving environment. This approach has achieved successful outcomes in similar and larger roading projects for which I have provided ESC design and onsite support.

Campbell Ross Stewart

12 June 2020