IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications by Meridian Energy Limited to Manawatū-Whanganui Regional Council, Greater Wellington Regional Council, Tararua District Council and Masterton District Council for resource consents to enable the construction, operation, and maintenance of a new wind farm on Mount Munro, located approximately 5km south of Eketāhuna

SECTION 87F REPORT OF SUSAN IRA – OPERATIONAL WATER QUALITY

MANAWATŪ-WHANGANUI REGIONAL COUNCIL, GREATER WELLINGTON REGIONAL COUNCIL, TARARUA DISTRICT COUNCIL AND MASTERTON DISTRICT COUNCIL

15 March 2024

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A. OUTLINE OF REPORT

1 This report, required by section 87F of the Resource Management Act 1991 (**RMA**), addresses the issues set out in sections 104 to 112 of the RMA, to the extent that they are relevant to the applications lodged with the Manawatū-Whanganui Regional Council (**Horizons**), Greater Wellington Regional Council (**GWRC**), Tararua District Council (**TDC**) and Masterton District Council (**MDC**).

2 The resource consents applied for, by Meridian Energy Limited (**Meridian or the Applicant**), are required to authorise the construction, operation and maintenance and improvement of a new wind farm on Mount Munro, located approximately 5km south of Eketāhuna. The project is known as the Mt Munro windfarm project (the **Mt Munro Project or Project**).

3 In this report I address potential effects relating to operational water quality from the turbines and associated infrastructure with regard to the resource consent applications (the **Application**) lodged with Horizons and GWRC (the **Regional Councils**) and TDC and MDC (the **District Councils**).

4 While this report is pursuant to section 87F of the RMA, I have in accordance with section 42A(1A) and (1B) attempted to minimise the repetition of information included in the application and where I have considered it appropriate, adopt that information.

B. QUALIFICATIONS / EXPERIENCE

5 My name is Susan Ira. I am the founding director at Koru Environmental Consultants Ltd. I have been in that position since January 2007. I have a Master of Science in Environmental and Geographical Science from the University of Cape Town in South Africa.

6 I have over 20 years' experience working in urban stormwater management, stormwater treatment, catchment management, water quality policy development, water quality consent review, life cycle costing of stormwater management, water sensitive urban design and green infrastructure.

7 I have specialist expertise in water quality treatment approaches, catchment management planning, water sensitive design, and green infrastructure. I came to New Zealand in 2003 and worked as a stormwater consent processing officer for the former Auckland Regional Council before becoming the manager of their stormwater consents and compliance team. In 2007 I founded Koru Environmental Consultants Ltd. During this time, I have undertaken numerous stormwater and water quality technical consent and plan change reviews for Auckland Council, Bay of Plenty Regional Council, GWRC and Environment Canterbury.

8 I have provided training on Auckland Council and Waka Kotahi's stormwater management guidelines nationally, and have also developed and provided national training for Water New Zealand on advanced stormwater management and water sensitive design. I am one of three New Zealand based trainers to have provided training to the stormwater community for the International Certification Programme for Green Infrastructure.

9 Other recent projects I have been involved in include:

(a) Technical Science Lead for water quality planning for the Lake Waikare and Whangamarino Wetland on behalf of Waikato Regional Council;

(b) One of four lead researchers on "Activating Water Sensitive Urban Design" in New Zealand jointly with NIWA, Manaaki Whenua Landcare Research and Batstone Associates for the National Science Challenge for Building Better Homes Towns and Cities;

(c) Development of a life cycle cost model for urban stormwater quality mitigation interventions for Auckland Council's Freshwater Management Tool and providing ongoing expert advice on scenario modelling, optimisation and implementation;

(d) Undertaking an independent review of rain garden implementation across the Auckland region on behalf of Auckland Council;

(e) Providing water quality advice, technical consent application and compliance reviews to Greater Wellington Regional Council on the stormwater management approach and stream diversions for Transmission Gully since 2014; and

(f) Providing water quality advice, technical consent application and compliance reviews to Bay of Plenty Regional Council for various structure plan changes and network discharge consent applications since 2021.

10 I am familiar with the site and surrounding area. I visited the site along with other experts of the Regional Councils and District Councils on 21 June 2023.

C. CODE OF CONDUCT

11 I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. This technical report has been prepared in accordance with that Code. In particular, unless I state otherwise, the opinions I express are within my area of expertise, and I have not omitted to consider material facts that might alter or detract from the opinions that I express.

12 My report should be considered together with the reports of:

(a) Mr Andrés Roa – Operational Water Quantity;

(b) Dr Adam Forbes – Freshwater Ecology; and

(c) Mr Kerry Pearce – Erosion and Sediment Control.

13 Where I have not expressly stated in this report the reasons why I disagree with other experts or submitters in relation to more minor matters, that should not be interpreted as agreement.

14 I identify below where I consider there to be gaps in the information provided by the Applicant, and in particular with respect to design detail. I otherwise have all the information necessary to assess the application within the scope of my expertise.

D. EXECUTIVE SUMMARY

15 The key conclusions of my report include:

(a) The proposed wind turbines and associated infrastructure will create new impervious surfaces that could lead to the discharge of contaminants (sediments, metals and hydrocarbons) into the local freshwater streams and the ground, and result in more than minor effects if not adequately mitigated;

(b) While the Applicant has proposed the use of stormwater treatment devices to mitigate the effects of the discharge of contaminants, no design calculations, drawings or details of the treatment devices have been provided;

(c) I do not have sufficient information to determine whether the operational stormwater discharges will be permitted activities;

(d) Submitters have raised a number of concerns relating to contamination of run-off from the wind farm leading to a deterioration in the water quality of streams and drinking water sources; and

(e) I have recommended that the stormwater treatment system be designed to achieve a minimum of 75% total suspended solids removal on a long term average basis, with measures to ensure that it is adequately maintained and operated in the long term.

E. SCOPE OF REPORT

16 My report focuses only on issues related to long term operational phase water quality effects. It covers the following topics:

(a) The effect of the discharge of contaminants from impervious areas associated with the operational phase of the wind farm on the receiving environment;

(b) The suitability of the proposed stormwater treatment approach to address the identified water quality effects;

(c) The long term operation and maintenance of the proposed stormwater treatment devices;

(d) The suitability of the proposed consent conditions in relation to operational phase water quality; and

(e) Relevant points raised by submitters.

17 I have reviewed and relied on the information provided by Meridian for the Mt Munro Wind Farm Resource Consent Application (dated 22 May 2023 – Assessment of Effects and the Tonkin and Taylor Engineering report in Appendix D) and the associated Section 92 responses received on 7 September 2023 (**RFI#1 Response 1**) (specifically, the Planning Assessment and Appendix 13 – Stormwater) and 25 October 2023 (**RFI#1 Clarification Response**).

F. BACKGROUND

18 Development of nationally significant infrastructure within rural areas creates impervious surfaces which reduce infiltration of water into the ground, reduce evapotranspiration of water by plants into the atmosphere and increase the volume of run-off which is discharged to the receiving environment (see Figure 1). In addition, impervious surfaces have contaminants (or pollutants) on them which become entrained in stormwater when it rains and, without treatment, these contaminants can be directly discharged to the receiving environment.

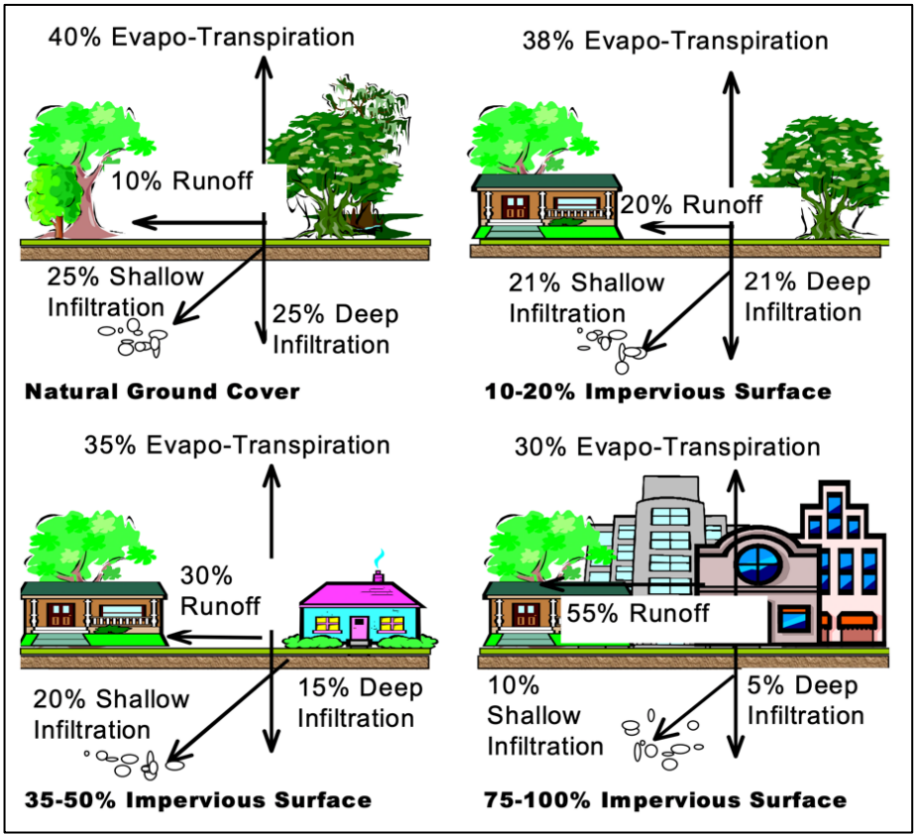

Figure 1 Changes to the natural water cycle as a result of impervious cover (image source:

https://www.waterboards.ca.gov/rwqcb2/water_issues/programs/stormwater/ISDC/Nemo_Fact_Sheet.pdf)

19 This leads to three key effects from stormwater discharges, namely: increased flooding, a decline in water quality, and effects on aquatic habitats both from an increase in the volume of water discharged and the poor water quality.

20 Key contaminants of concern from impervious surfaces depend on the type of surface as well as its use. Generally, contaminants of concern from the operational phase of major infrastructure projects include sediments, metals (such as zinc, copper and lead), hydrocarbons and temperature.

21 The main source of sediment from the operational wind farm would likely be the gravel surface roads as well as from accelerated stream channel erosion (see paragraph 27).

22 Sources of metals: A key source of zinc is the use of building and roofing materials such as galvanised steel or zinc alloy type roofs.[1] Every time it rains, dissolved zinc will leach from these building materials and become entrained in the stormwater. Unpainted galvanised roofs can lead to total zinc loads of ~2.24g/m2/year versus an inert roofing material (such as colour steel or concrete tiles) which lead to total zinc loads of ~0.02g/m2/year. Copper is widely used in the manufacture of alloys with zinc. Lead is less of a concern nowadays given that most paints are now lead free and lead is no longer contained within petrol. Other sources of zinc and copper are from vehicles (in tyres and brake pads) on roads and in parking areas.[2] Trafficked areas where vehicles are slowing down, turning, parking and speeding up represent high contaminant generating areas due to tyre and brake-pad wear and tear.

23 Water temperature is a fundamental variable which affects the distribution, growth, metabolism, behaviour and survival of aquatic organisms.[3] Stream temperatures are affected not only by the clearance of riparian vegetation (which shades and cools streams) but also possibly by the discharge of warm water from detention ponds and by warm-water runoff from impervious surfaces such as roads, roofs and paving.

24 With respect to the operation of the wind turbines themselves (as opposed to the associated roading and ancillary infrastructure), there is scant information available on the effect of the wind turbines on water quality. The Northern Ireland Environment Agency has investigated this topic and prepared a practice guide for the groundwater impacts of wind farms. They identified that pollution from spills or leaks of fuel or oil during the operational phase could lead to potential impacts on groundwater quality.[4]

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1 Ira S. 2021. Freshwater management tool: report 10. A total economic valuation approach to understanding costs and benefits of intervention scenarios – Part 2 Urban Source Control Costs. Prepared by Koru Environmental for Auckland Council.

2 Auckland Regional Council. 2010. Development of the Contaminant Load Model. Auckland Regional Council Technical Report 2010/004.

3 Kelly, S 2010. Effects of stormwater on aquatic ecology in the Auckland region. Prepared by Coast and Catchment for Auckland Regional Council. Auckland Regional Council Document Type 2010/021.

4 Northern Ireland Environment Agency. 2016. Wind farms and groundwater impacts: A guide to EIA and Planning considerations.

25 Researchers in Norway have also investigated the issue of water quality effects from wind turbines, and Lu et al.[5] tested 3 water samples from the wind turbines and one sample downstream of their subject site for various metals, bacterial contamination and pH. While faecal pollution levels were high at the downstream sample (likely from animal and human activity in the catchment), all metal concentrations were lower than their drinking level guideline values. Samples taken at the wind turbines had higher metal concentrations which were lowered to acceptable levels, with the exception of Aluminium (Al) and Manganese (Mn), following filtering. The study concludes that increasing the filter size would be recommended.

26 Based on the research presented in paragraphs 24 and 25, and as I would expect, it is considered that potential contaminants which could be entrained in stormwater from the completed wind farm operations are consistent with those which would be discharged from impervious surfaces in a semi-urban environment, as identified in paragraph 22 and Figure 2 below.

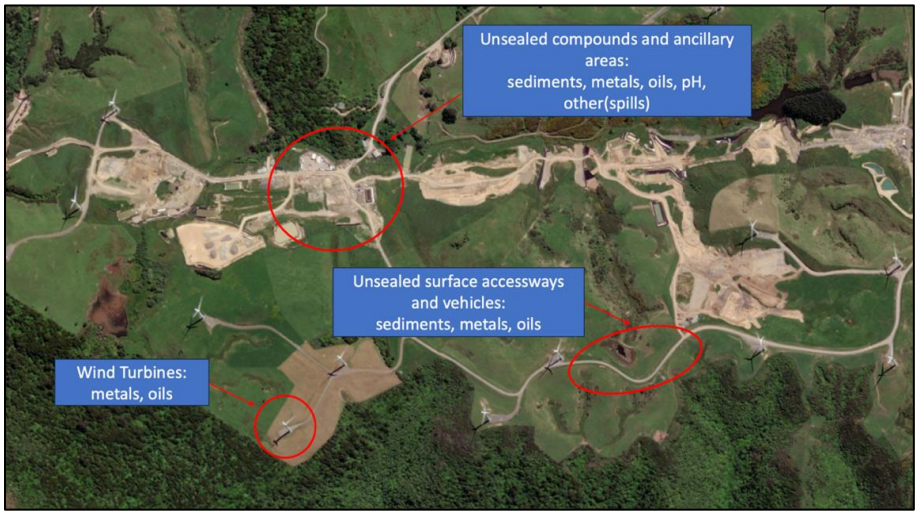

Figure 2 Operational water quality contaminants and sources (Ashurst, Tararua District - aerial taken from Apple Maps, 19 January 2024)

27 Increases in the volume and rate of stormwater runoff from impervious surfaces and point source discharges have the ability to destabilise stream channels and cause accelerated stream channel erosion (and associated downstream sedimentation). Detaining water and releasing it slowly assists

[5] J Lu et al 2019 IOP Conf. Ser.: Earth Environ. Sci. 344 012022.

in reducing accelerated stream channel erosion downstream, but it will not reduce the volume of water which is discharged. Disconnecting the impervious surfaces from the receiving environment via green infrastructure approaches such as rain gardens, filter strips or swales, together with providing for extended detention more readily mitigates stream channel erosion effects. The erosive effect of development on freshwater streams is dealt with in more detail by Mr Roa and Dr Forbes in their reports.

28 In summary, I consider that development of the Mt Munro Project will create new impervious surfaces that could lead to a discharge of contaminants if unmitigated. Key contaminants of concern include sediments, metals amongst others: zinc, copper, lead, aluminium, manganese), pH and oils/ hydrocarbons.

G. ASSESSMENT OF APPLICATION

29 The original application documents received in May 2023 did not adequately assess the effects of the discharge of contaminants from impervious areas resulting from the operational phase of the wind farm. Much of the infrastructure (i.e. the roads, substation and some of the laydown areas) will remain on site after the construction phase has been completed. Ongoing maintenance activities, vehicles on the roads, and the roads and associated hardstand areas all have the ability to discharge contaminants and negatively affect the quality of run-off and the receiving environment in the long term. Since the road pavement will be an unsealed granular pavement, ongoing discharge of sediments could also occur. Additionally, the creation of table drains in cut areas could concentrate flows and the application does not specify if any of these table drains would discharge directly to streams within the site.

30 Further information was requested from the Applicant via section 92 of the RMA. The Applicant's RFI#1 Response 1[6] acknowledged the water quality

[6] Tonkin+Taylor Memo from Pushpaka Rabel to Gene Sames, Nick Bowmar, Lynley Fletcher dated 7 September 2023 and entitled "Mt Munro Wind Farm Stormwater S92 responses", Appendix 13 to the RFI#1 Response 1.

effects of the new unsealed roads and surfaces needed for the wind farm. The Applicant confirmed that:[7]

> It is expected that construction areas typically comprising access roads and laydown areas will comprise of unsealed gravels and are likely to generate suspended sediment from run-off. While this has the potential to discharge into existing watercourses, it will be managed through the design by incorporating measures such as table drains to collect the run-off, scour protection within the drains, and treatment devices to treat sediment prior to discharge. The sediment from these unpaved areas can be further minimised through maintenance of these surfaces and drainage systems during construction and over their design life.

31 To date no detail has been provided on the location or design of any of these devices and the Applicant has stated that decisions regarding stormwater treatment design and location, as well as developing a plan for the long term operation and maintenance of the stormwater treatment system, will be made at the detailed design stage. The Applicant has not provided an assessment of the effect of stormwater contaminants other than sediment, nor of potential contamination from the wind turbines themselves.

32 The Applicant confirmed that the GWRC standard, supplemented by Waka Kotahi[8] and Auckland Council[9] stormwater standards will be used as the basis for the design of these devices. I am supportive of the use of the Waka Kotahi and Auckland Council documents as minimum standards for the design of stormwater treatment devices to enable them to achieve a 75% total suspended solids reduction on a long term average basis. The GWRC document[10] referenced in the application relates to erosion and sediment control standards during construction activities and is not appropriate for the mitigation of stormwater contaminants from the long term/ operational phase of the wind farm.

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7 Appendix 13, p.1 and 2.

8 Waka Kotahi. 2010. Stormwater Treatment Standard for State Highway Infrastructure.

9 Auckland Council. 2017. Stormwater Management Devices in the Auckland Region.

10 Greater Wellington Regional Council. 2021. Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region.

33 I agree that the use of swales and filter strips would mitigate the effect of the identified key contaminants of concern from the unsealed roads, however, their efficacy is fully dependent on their location, design, construction and long term operation. As mentioned previously, this information has not been provided within the application documents. Filter strips and/ or buffer areas would also need to be designed around the wind turbines themselves and stormwater treatment provided for any yard, compound, refuelling areas or other ancillary impervious surfaces.

34 I am not supportive of using stormwater ponds for the treatment of run-off from the operational phase impervious areas. Stormwater ponds are not considered to be best practice stormwater management devices for providing treatment for metals and reducing temperature effects. Auckland Council's contaminant load model (CLM – v2, 2010)[11] estimates that a wet pond only removes approximately 30% and 40% of total zinc from roads and other paved surfaces respectively. Additionally, ponds only remove around 5% of zinc from roofing materials. This is because the majority of zinc from roofs is dissolved.

35 Ponds remove stormwater contaminants via the process of sedimentation (i.e. the zinc would need to be in particulate form to be removed in the pond) and therefore they are very inefficient at removing dissolved contaminants. In comparison, constructed stormwater wetlands remove 70% of zinc from roads and other paved surfaces. The vegetative processes operating within the constructed wetlands are responsible for this higher level of contaminant removal and their ability to remove dissolved contaminants.

36 Constructed stormwater wetlands have many other added benefits over ponds:

(a) Designed correctly, wetlands will not result in temperature spikes on the receiving freshwater streams, as opposed to ponds which can cause temperature effects, as I described earlier.

[11] Auckland Regional Council. 2010. Development of the Contaminant Load Model. Auckland Regional Council Technical Report 2010/004.

(b) The dense vegetative planting surrounding the wetland is an added safety feature and acts as a deterrent for any children or adults wanting to swim in the ponds.

(c) The dense vegetation surrounding the wetlands helps to reduce the resuspension of contaminants during higher flow events.

(d) Wetlands are shallower systems than stormwater ponds, with the majority of the wetland depth being 0.1 – 1m depth, making them safer than deeper ponds.

37 As a result, I would recommend that the Applicant consider using constructed stormwater wetlands rather than ponds as a stormwater treatment mitigation measure.

38 Overall, and based on the currently level of detailed provided (no conceptual design plan nor detailed design have been provided), I cannot confirm whether or not the effects of the proposed activity from the diversion and discharge of stormwater will have no more than minor effects on the receiving environment.

39 Based on my experience, the proposed system of swales and filters, along with the use of constructed stormwater wetlands, would adequately mitigate the effects of the discharge of contaminants from impervious areas during the operational phase of the windfarm. However, the efficacy of these treatment devices is fully dependent on their location, design, construction and long term operation, and the Applicant has not provided this information as part of the application documents. In order to adequately assess the effects of the discharge of contaminants on the receiving environment in the long term, I am of the view that detailed design of the stormwater system should be required as a condition of consent, and provided to the Councils for approval prior to construction commencing.

H. SUBMISSIONS

40 Submissions 3, 6, 7, 8, 13, 30, 34, 44, 47, 49, 61 and 68 raise concerns about a range of topics relating to a deterioration in water quality as a result of the wind farm, including:

(a) the undesirable wider impact and pollution of the waterways from a deterioration in water quality;

(b) deterioration in water quality from the wind turbines which may affect drinking water supplies (from streams or groundwater sources); and

(c) deterioration in water quality from the wind farm which may affect drinking water for stock.

41 Relief sought by the submitters ranges from recommendations for water filtration systems, undertaking water quality monitoring and the development of an operational environmental management plan (EMP) to ensure good site management practices.

42 If unmitigated, contaminants discharged from the wind turbines, unsealed roads and ancillary yard areas and structures has the potential to cause a decline in water quality. While the Applicant has undertaken to provide stormwater treatment from the operational phase of the wind farm, no conceptual or design details have been provided.

43 I agree with the relief sought by the submitters in that the Applicant should prepare an EMP for the operational phase of the wind farm, and that this EMP should include a water quality monitoring plan to assess the efficacy of the stormwater treatment system for the first few years of operation. Dr Forbes has addressed this aspect in more detail in his evidence.[12] I have also recommended changes to conditions to ensure that the Regional Councils have the ability to be satisfied that the design of the stormwater

[12] Section 87F Report – Freshwater Ecology (15 March 2024) at paragraph 69.

management system delivers on the outcomes anticipated by the application.

I. CONDITIONS

44 The Applicant has offered a condition requiring final design drawings and an accompanying detailed design report to be provided prior to the commencement of construction (condition 8 in the District Council consents and condition 3 in the Regional Council consents). The condition also requires as-builts to be provided upon completion.

45 While I am supportive of these conditions, the lack of information provided by the Applicant means that the conditions need to be more specific and incorporate the relevant standards to which the stormwater management system should be designed. In this regard, it is my view that the two relevant standards which should be set in the consent include:

(a) A condition requiring that all stormwater treatment devices are designed to achieve a minimum standard of 75% total suspended solids removal on a long term average basis. The condition should also require the stormwater treatment devices to be designed in accordance with the Auckland Council or Wellington Water stormwater standards;[9] and

(b) A condition requiring that inert roof materials be used on any building structures.

46 Additionally, the stormwater treatment management system must be integrated with the overall stormwater management approach with respect to the stormwater quantity matters discussed by Mr Roa in his evidence.

47 I also recommend conditions requiring approval of the detailed design plans and drawings by the Regional and District Councils in advance of construction and as-builts/ certification of the works to be submitted.

48 I recommend that the following additional conditions be included on the consent to address the concerns raised in my report:

(a) A condition requiring the applicant to prepare and submit, for approval by the Regional and District Councils, an operation and maintenance plan for the stormwater management system prior to practical completion of the earthworks operations; and

(b) A condition requiring the applicant to prepare and submit, for approval by the Regional and District Councils, an environmental management plan for the operational phase of the wind farm, including a water quality monitoring plan, as detailed by Dr Forbes.

49 **Appendix A** to this report provides recommendations for matters which need to be included in the operation and maintenance plan, and detailed design report.

Susan Ira

15 March 2024

J. FIGURES

Figure 1 Changes to the natural water cycle as a result of impervious cover (image source:

https://www.waterboards.ca.gov/rwqcb2/water_issues/programs/stormwater/ISDC/Nemo_Fact_Sheet.pdf)

Figure 2 Operational water quality contaminants and sources (Ashurst, Tararua District - aerial taken from Apple Maps, 19 January 2024)

K. REFERENCES

Auckland Regional Council. 2010. Development of the Contaminant Load Model. Auckland Regional Council Technical Report 2010/004

Auckland Council. 2017. Stormwater Management Devices in the Auckland Region

Greater Wellington Regional Council. 2021. Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region

Ira S. 2021. Freshwater management tool: report 10. A total economic valuation approach to understanding costs and benefits of intervention scenarios – Part 2 Urban Source Control Costs. Prepared by Koru Environmental for Auckland Council

Kelly, S. 2010. Effects of stormwater on aquatic ecology in the Auckland region. Prepared by Coast and Catchment for Auckland Regional Council. Auckland Regional Council Document Type 2010/021

J Lu et al 2019 IOP Conf. Ser.: Earth Environ. Sci. 344 012022

Northern Ireland Environment Agency. 2016. Wind farms and groundwater impacts: A guide to EIA and Planning considerations

Waka Kotahi. 2010. Stormwater Treatment Standard for State Highway Infrastructure

L. APPENDIX A

Detailed Design Report:

The applicant should prepare a design report, detailed design drawings and associated calculations for the stormwater management system to include information such as:

i) Details of the mitigation measures: the design, size, location of the stormwater management system, including configuration of the outlet structures, discharge locations, and hydraulic performance of management devices for the wind farm in accordance with Wellington Water's stormwater guideline design standards;

ii) The size of channels and the related erosion protection measures for primary, secondary and overland flow paths (on-site and off-site) including for the receiving waterways immediately downstream;

iii) Integration of the design with the overall stormwater quantity design and mitigation measure needed for the project (as discussed by Mr Roa in his evidence).

The Operation and Maintenance Plan should include, but not be limited to:

i) A programme for regular maintenance and inspection of Works authorised under the consent;

ii) A programme for the collection and disposal of debris and sediment collected by the stormwater management devices or practices;

iii) A programme for inspection and maintenance of outfall erosion;

iv) A programme for post storm maintenance; and

v) General inspection checklists for all aspects of the stormwater management system.