Te Kaunihera o Te Hiku o te Ika
Far North District Council

HE ARA TĀMATA
CREATING GREAT PLACES
Supporting our people

Private Bag 752, Kaikohe 0440, New Zealand
ask.us@fndc.govt.nz
0800 920 029
fndc.govt.nz

Whatuwhiwhi WWTP Discharges
Resource Consent Application APP.007203.02.03
FNDC response to NRC s.92 request for further information

To:	Ben Tait, Consultant Planner	Department:	Northland Regional Council (NRC)
CC:	Stuart Saville, Consents Manager	Department:	NRC
From:	Louise Wilson Senior Infrastructure Planner	Department:	Infrastructure Services Far North District Council (FNDC)
Date:	14 November 2025		
Sub:	FNDC response to NRC s.92 request for further information		

Tēnā koe Ben,

Thank you for the s.92 further information request dated 11 September 2025. This memo provides a response to questions 8 to 11 of the s.92 request. This memo should be read in conjunction with the attached report from WSP Consultants which addresses questions 1-7.

Assessment of Discharge Alternatives (8) Please detail whether alternative methods for discharging treated wastewater to land have been considered as part of the application process. If such alternatives were evaluated, summarise their environmental, economic, and practical viability. *Reason: This information is required to address the requirements of Policy D.4.3 of the Proposed Regional Plan for Northland (PRPN), and to demonstrate that all reasonable discharge options have been properly assessed. It is noted that the current application seeks consent to discharge to water.* *For reference, Policy D.4.3 of the PRPN states:* *An application for resource consent to discharge municipal, domestic, horticultural or farm wastewater to water will generally not be granted unless:* *1) the storage, treatment and discharge of the wastewater is done in accordance with recognised industry good management practices, and* *2) a discharge to land has been considered and found not to be environmentally, economically or practicably viable.*	

FNDC offers the following consent condition relating to discharge to land.

> *The Consent Holder must, within **three years of the commencement of this consent**, complete an investigation into the feasibility of the discharge of treated wastewater from the Whatuwhiwhi Wastewater Treatment Plant to land.*
> *The investigation must:*
>
> > *(a) Assess the practicability of land-based discharge, including technical, environmental, cultural, and economic considerations;*
> > *(b) Identify potential sites and evaluate their suitability of receiving treated wastewater and*
> > *(c) Be undertaken by a suitably qualified and experienced person(s).*
>
> *The results of the investigation, including a recommendation as to whether a land-based discharge is a feasible long-term option, must be provided to the **Northland Regional***

Council's Compliance Manager *(or assigned monitoring officer) and to* ***Te Whānau Moana and Te Rorohuri*** *within the three-year timeframe.*

The discharge to land investigation will consider the new Wastewater Environmental Performance standards which became effective in December 2025.

(9) Please confirm the timeframe by which FNDC will decide on upgrading the WWTP to address the existing plant capacity issue.

(10) Please clarify whether FNDC has considered potential future wastewater flows from all local development provided for under the operative and proposed versions of the Far North District Plan such as the proposed Carrington Estate subdivision in its planning for WWTP capacity and discharge management, and if so, how these have been accounted for in assessing potential effects.

Timeframes - There is budget in the 2025/26 annual plan capital programme for capacity improvements. See https://www.fndc.govt.nz/__data/assets/pdf_file/0026/38933/Proposed-capital-works-programme-2025-26.pdf. FNDC would prefer to obtain resource consent prior to commencing upgrades to ensure upgrades align with any new consent conditions. However, upgrades that comply with District and Regional Plan requirements could proceed prior to a determination of this application.

Scope and Capacity - The scope of the lodged application is for the existing consented flow volumes only. The existing consented volume is sufficient for the permitted level of growth within the Whatuwhiwhi scheme area of benefit. The technical reports provided in this application were based on flow and load assumptions that did not include any provision for the proposed Carrington Estate development.

The proposed Carrington Estate development is not a permitted or controlled activity. The Carrington Estate land use and subdivision application (RC2220163) was processed as a non-complying activity. At time of writing, the application had been publicly notified but a hearing had not been held. The consent has not been approved let alone given effect to. Consequently, the potential effects of implementing RC2220163 do not need to be addressed in the current W-WWTP renewal application as they are not within the scope of what has been applied for and are not part of the receiving environment

National Environmental Standards for Freshwater 2020

(11) Please provide an assessment of the proposed discharge against the relevant regulation and conditions of the National Environmental Standards for Freshwater 2020, specifically Regulation 46 and 47.

Reason: The AEE provides an assessment of the proposed activity against Regulation 54(d), whereas Regulations 46 and 47 apply to the maintenance and operation of specified infrastructure and other infrastructure.

The proposed discharge has been assessed against the National Environmental Standards for Freshwater 2020, specifically Regulation 46. Regulation 46 states the permitted activity standards for the maintenance and operation of specified infrastructure and other infrastructure within, or within 100m of a natural inland wetland. The Flood Hazard Risk Assessment and the Water Quality Assessment conducted by WSP Consultants did not find any evidence that the discharge will change, or is likely to change, the water level range or hydrological function of the wetland. Consequently, the proposed activity is a permitted activity pursuant to Regulation 46(3)(c). Regulation 47 need not be assessed as permitted activity status pursuant to Regulation 46 has already been established.

Confidential

Far North District Council
Whatuwhiwhi WWTP Consent S92

December 2025

1-14657.01

WSP
Whangarei
Mansfield Terrace Service Lane
125A Bank Street
PO Box 553
Whangarei 0140, New Zealand
+64 9 430 1700
wsp.com/nz

REV	DATE	DETAILS
1	17/12/2025	Draft for Client Review
2	18/12/2025	Final

	NAME	DATE
Prepared by:	Tom Porter	17/12/2025
Reviewed by:	Iryna Khoruzhenko	17/12/2025
Approved by:	Phillip Shoebridge	17/12/2025

S92(1) REQUEST FOR FURTHER INFORMATION

RESOURCE CONSENT APPLICATION APP.007203.02.03 – FAR NORTH DISTRICT COUNCIL – DISCHARGE WATER AND CONTAMINANTS FROM WHATUWHIWHI WASTEWATER TREATMENT PLANT

In reference to your requests for further information dated 11 September 2025, please find below our response to these requests.

Current Ecological Assessment

(1) Provide a current quantitative ecological assessment of the near field wetland receiving environment, including the following, using a methodology that is consistent with, or builds upon, previous Wildlands Consultants protocols (2016 & 2019):

- An evaluation of vegetation composition, nutrient content (nitrogen and phosphorus), water depth, and other relevant ecological indicators within both control and impact zones.
- Interpretation of any observable shifts in eutrophic indicator species (e.g. raupō) or other relevant ecological indicators.

Reason: A current quantitative ecological assessment is requested to ensure that consideration of effects from the proposed discharge reflects the existing environmental conditions.

To be supplied separately

(2) Provide an evaluation of any observed shifts in plant communities since establishment of the WWTP, using ecological survey data, other literature and/or aerial imagery, especially replacement of low nutrient assemblages by species adapted to elevated nutrient conditions (e.g. flax, raupō, rushes).

Reason: This information is requested to provide an up-to-date understanding of the wetland's current condition and to detect any changes that may have occurred since the WWTP was established.

To be supplied separately

Open Water Quality Assessment

(3) Please provide a summary of any existing data or knowledge on open water quality in the Waimango Wetland (beyond the immediate vegetated discharge zone), with respect to total nitrogen, total phosphorus, and chlorophyll-a. Where recent data are lacking, please outline your proposed approach for characterising water quality. This may include a plan and timeframe and for sampling and analysis, or expert judgement based on comparable environments.

Reason: This information is requested to assess nutrient status and potential eutrophication risks within the wider Waimango Swamp environment.

i) Summary of existing data or knowledge

We undertook a thorough search of water quality data in the Waimango Wetland and the nearby Waihuahua Swamp, including monitoring data from Northland Regional Council and Land Air Water Aotearoa (LAWA). We found no publicly available information beyond the data previously reported. We have carried out a detailed search for any investigations into the health of the wetland and nearby wetlands, but did not find any published research.

Lake Waiporohita, which LAWA classify as a small dune lake (LAWA, 2025). It is located just to the immediate south of the catchment and is monitored by the Northland Regional Council. It is mentioned as it indicates nutrient input from similar land uses to the Waimanga catchment. Results from LAWA (LAWA, 2025) state that the lake is in a poor state with respect to nutrients (LAWA, 2025). The lake *is located in a pastoral-dominated catchment that is completely fenced. The lake has no inflows or outflows (LAWA, 2025).*

ii) Development of a sampling plan

We recommend that monitoring of vegetation in the wetland is used as the method for assessing whether the wastewater discharge is having a negative impact upon the trophic states and health of the wetland, as nutrient status and eutrophic state will manifest in the types of vegetation present and quantity. This is discussed fully in the ecologist's response to questions 1 and 2 of this S92.

There are several reasons why we do not recommend undertaking water quality sampling of the wider wetland as part of this consent.

- Health and safety - due to concerns about being able to safely take a water quality sample from the wetland away from the site. We recommended in our water quality assessment, which accompanied the resource consent application (WSP, 2025a), that water quality sampling be undertaken at an agreed-upon location with safe access, located as close as possible to the edge of reasonable mixing. This sampling location would require a safe access route to be created.
- LiDAR and GIS Mapping analysis has shown that the wetland is part of a wide flat area, with no discernible flow pathways through the wetland route from the WWTP. This prevents the option of undertaking upstream and downstream monitoring to directly identify the impact of WWTP discharge on the wetland's contaminant levels.
- The catchment analysis (described in response to Question 4) has identified land uses within the wetland's catchment that could be significant contributors of contaminants. There is also a population of waterfowl that visit and live in the wetland. Therefore, taking samples in the wetland won't enable the source of the contaminants to be identified, as there are multiple potential sources of nutrients and contaminants within the wetland.

iii) Recommended approach

Ecological sampling has previously been undertaken (as discussed in WSP, 2025a) to monitor the health of the wetland and identify any changes in its health resulting from contaminant loads. Our ecologist has proposed an updated methodology for monitoring the ecology of the wetland, centred on drone-based vegetation surveys. We recommend using this monitoring method to measure the impact of any changes in water quality on the wetland. As our ecologist describes in the responses to questions 1 and 2 of this S92, [ecological monitoring can be used to] d*etect changes in Waimango Swamp plant composition, communities' health, and structure through the consenting period that suggest eutrophication of the receiving environment due to W-WWTP treated discharges*.

We also propose that sampling at the point of reasonable mixing should be used as the means to measure the water quality contaminant input of the Wastewater treatment works (WWTP). Our water quality assessment (WSP, 2025a) for the WWTP, provided with the consent application, describes the proposed location for reasonable mixing.

Cumulative Nutrient Load Assessment

(4) Provide an assessment of cumulative nutrient loads (nitrogen and phosphorus) to Waimango Swamp including:

- Identification of all key catchment sources contributing nutrients to the wetland.

- Estimates or discussion on the relative contributions from each source, where possible.

Reason: This information is important to contextualise nutrient loads from the proposed discharge relative to other sources and understand the sensitivity of the receiving environment. It is noted that FNDC's application states cumulative effects could not be considered due to insufficient information (see WSP. May 2025. Whatuwhiwhi Wastewater Treatment Plant Water Quality Assessment).

Catchment sources

Mapping of the catchment has calculated that Waimango Wetland has a catchment of 2435 hectares (Appendix A). This mapping has identified several drains/channels that can direct flow from the surrounding land uses into the wetland.

Analysis of land use information from the New Zealand Land Cover Database Version 6.0 (LCDB v6) (Manaaki Whenua – Landcare Research, 2025) has identified the proportion of different land uses in the catchment (Table 1). The dominant land use in the catchment is highly productive exotic grassland, making up 56.5% of the catchment. Other human-influenced land uses include Orchards, Vineyards, or Other Perennial Crops (3.3%), exotic forests (2.8%), and low-producing grasslands (0.6%). Appendix B contains a map illustrating the various land uses within the catchment.

Highly productive grassland is expected to contribute nitrogen and phosphorus loads through stock grazing and fertiliser use on this land. While it is not possible to estimate the exact nitrogen and phosphorus loads from these land uses without modelling, an approximate estimate has been calculated for the land use to be compared with the loads estimated to be generated from the WWTP.

Nationwide contaminant load modelling undertaken by the National Institute of Water and Atmospheric Research (NIWA) estimated nitrogen loads to be 18.2 kg/ha/yr and phosphorus loads 4.36 kg/ha/yr from (non-dairy) pastureland (Elliot et al., 2005).

Based on the NIWA analysis (Elliot et al., 2005), the 1374 hectares of high-producing exotic grassland within the catchment have the potential to contribute 25,007 kg /yr of total nitrogen and 5,991 kg/yr of total phosphorus to the wetland.

For additional context, LAWA results from Lake Waiporohita, which is immediately south of the Waimango catchment, are scored as *Very Poor* for water quality (which is measured through chlorophyll *a*, total nitrogen, total phosphorus and water clarity) (LAWA, 2025). LAWA states that the lake's catchment is dominated by pastoral land use (LAWA, 2025) with determinable inflows or outflows. This indicates the potential for high nutrient loads from the surrounding land use to the Waimanga wetland.

It is also worth noting that there are local observations of waterfowl living and visiting the wetland. These have the potential to provide a localised source of contaminants.

Table 1. Proportion of different land uses within the catchment in summer 2023/24 (Manaaki Whenua – Landcare Research, 2025)

Land use	Land use area (Hectares)	Area as a percentage of the catchment
High Producing Exotic Grassland	1374.4	56.5
Lake or Pond	242.0	9.9
Manuka and/or Kanuka	231.3	9.5
Herbaceous Freshwater Vegetation	219.6	9.0

Gorse and/or Broom	132.0	5.4
Orchard, Vineyard or Other Perennial Crop	80.9	3.3
Exotic Forest	68.5	2.8
Sand and gravel	60.2	2.5
Low Producing Grassland	14.4	0.6
Built-up Area (settlement)	8.1	0.3
Forest - Harvested	3.5	0.1
Total area	**2434.63**	**100.0**

Potential loads from WWTP

Total nitrogen and total phosphorus concentrations are not currently monitored at the plant. However, typical values for these parameters in waste stabilisation pond systems in New Zealand are outlined in Appendix A of the Water New Zealand Waste Stabilisation Good Practice Guide 2017 (Water New Zealand, 2017). For a two-pond system, the typical effluent concentration is 8 mg/L for total phosphorus and 35 mg/L for total nitrogen. The Whatuwhiwhi system incorporates aeration and aquamats, which have been shown in New Zealand to enhance total nitrogen removal by approximately 50% (Ratsey, 2016). Therefore, it is anticipated that under the current plant configuration, the median effluent concentration of total nitrogen will be 18 mg/L.

While the aeration and aquamat system at Whatuwhiwhi is expected to enhance total nitrogen removal, it is not anticipated to significantly affect phosphorus removal beyond levels typically achieved through sedimentation in a two-stage pond system. Thus, the total phosphorus effluent concentration is assumed to be 8 mg/L for the plant as currently configured.

Based on the average dry weather flows for 2024 of 154 m3/day, the current loading of TN and TP at the discharge point is ~2.8 kg/day and 1.2 kg/day, respectively.
These TN and TP effluent loads represent the plant's performance under its current condition, with no additional upgrades. Implementation of the future recommended plant upgrades will result in further reductions in both total nitrogen and total phosphorus loads at the point of discharge.

Based on this analysis, the WWTP is estimated to contribute 1,022 kg/yr of total nitrogen and 438 kg/yr of total phosphorus.

Comparison of loads from WWTP and the surrounding catchment

The catchment contaminant load analysis and analysis of the estimated annual loads (Table 2) from the WWTP have demonstrated that the highly productive grassland has the potential to contribute significantly higher loads of total nitrogen and total phosphorus to the wetland than from the WWTP. It should be noted that this analysis is solely to demonstrate the potential loading, and that processes within the catchment will significantly reduce the loads generated from the highly productive grassland within the catchment from reaching the wetland.

Table 2. Comparison of contaminant loads from Whatuwhiwhi WWTP and the contributing catchment's highly productive land

	Annual total nitrogen load (kg/yr)	Annual total phosphorus load (kg/yr)
Whatuwhiwhi WWTP	1022	438

Highly productive grassland	25,007	5,991

Risk-Based Effects Assessment

(5) Please undertake a risk-based assessment of potential effects arising from WWTP nitrogen and phosphorus loads on the Waimango Swamp, using a recognised likelihood–consequence framework. The response should include:

- An evaluation of the current water quality status and trophic classification of the swamp. If direct monitoring data are insufficient, base your assessment on expert judgement or comparable waterbodies.
- An assessment of whether proposed ongoing nitrogen and phosphorus loads from the WWTP may shift the swamp's trophic classification, with discussion of associated ecological implications. This should include consideration of risks such as cyanobacterial blooms or other adverse ecological outcomes within the Waimango Swamp.

Reason: This information is requested to inform understanding of the potential risks to wetland health arising from nutrient inputs associated with the WWTP discharge, particularly whether these could cause measurable changes in ecosystem function or trigger harmful events such as algal blooms.

WSP recommends that the likelihood–consequence framework be developed following the proposed ecological monitoring (as discussed in response to questions 1 and 2). This will provide a more accurate picture of the trophic state of the wetland. The results of the monitoring can then be used to develop a robust framework to assess the risks of a shift in trophic state and subsequently the ecological implications. A likelihood–consequence framework for this consent is outlined in Table 3.

Table 3. Example of a potential likelihood–consequence framework.

Risk	Likelihood	Impact	Monitor	Mitigation
Increased nutrients lead to changes in plant composition, the health of plant communities, and their structure.	Possible	Deterioration in the health of plant species within the wetland	Periodic habitat mapping. Analysis of changes in species abundance and diversity.	Reduction in contaminants discharged from WWTP. Engagement with landowners within the catchment to reduce nutrient loads from surrounding land use
Increased nutrients lead to the loss/decline of plant species	Possible	Reduction in vegetation that is sensitive to eutrophic conditions.	Periodic habitat mapping. Analysis of changes in species abundance and diversity.	Reduction in contaminants discharged from WWTP. Engagement with landowners within the catchment to reduce nutrient loads from surrounding land use

Change in phytoplankton composition, e.g., from diatoms to Cyanobacteria	Possible	Increase in nuisance algae and associated issues.	Periodic habitat mapping and aerial analysis. Analysis of changes in species abundance and diversity.	Reduction in contaminants from WWTP discharge and surrounding land uses.
Excess loading of nutrients (particularly nitrogen and phosphorus)	Possible	Eutrophication and associated impacts (e.g. oxygen sags)	Nutrient monitoring at the point of reasonable mixing.	Reduction in contaminants discharged from WWTP Engagement with landowners within the catchment to reduce nutrient loads from surrounding land use
Increased competitive advantage of aggressive/invasive species	Need further investigation	Dominance by invasive species	Periodic habitat mapping. Analysis of changes in species composition.	Investigation into reasons for change and identification of appropriate actions.

Proposed Discharge Quality Standards

(6) Please describe the rationale for the proposed discharge quality standards for Biochemical Oxygen Demand, Total Suspended Solids, E. coli, and Total Ammoniacal Nitrogen. In your response, please explain how these standards have been determined in relation to water quality-dependent values within the receiving environment.

The proposed discharge quality standards for **Biochemical Oxygen Demand** and **Total Suspended Solids** were set in line with the proposed standards put out for consultation of *Water Services (Wastewater Environmental Performance Standards) Regulations 2025 for wetlands and lakes (*Taumata Arowai*, 2025). Prior to the final publication of the standards, this was to align the plant with future anticipated changes. After the consent submission, the standards were published, and wetlands and lakes as a receiving environment were changed to "Lakes only" in the final publication of the document; however, the new regulations based on the limits for lakes still provide a useful guide*. The total suspended solids standard of 10 mg/l (as an annual median) is lower than in the proposed wastewater standards (15 mg/l as an annual median). With the proposed upgrades to the WWTP, it was determined that the 10 mg/l would be a practicable limit and would help keep the discharge in a direction of improvement.

The limits **for E.coli** at the point of discharge were set to meet the National Policy Statement for Freshwater Management (NPS-FM) (MFE, 2020) standard for human contact (Band C) for lakes and rivers.

Total Ammoniacal Nitrogen limits were set to meet the National bottom line requirements of the NPS-FM (MFE, 2020) at the point of reasonable mixing.

(7) Considering your response to Question 5 above, please comment on whether it would be appropriate to propose specific discharge quality standards for total nitrogen and/or total phosphorus.

Reason: This information is requested to better understand how the proposed standards will avoid or mitigate adverse effects on the environment.

We do not consider phosphorus or total nitrogen limits to be the most appropriate method to protect the health of the wetland. We recommend that ecological monitoring as discussed in response to questions 1 and 2 is used to monitor the health of the wetland. The discussion in response to question 3 outlines why ecological monitoring is more robust for this receiving environment than specific nutrient monitoring for phosphorus and nitrogen.
Also, we consider the WWTP to be classified as a *small plant* under the National Wastewater Standards (Taumata Arowai 2025b), as the current annual average BOD loads to the treatment plant are less than 85kg of cBOD5 a day and the average annual population is currently under 1000 people to the WWTP (WSP, 2025b). The small plant standards do not require concentration limits for total nitrogen nor total phosphorus (Taumata Arowai, 2025b). It is acknowledged that the National Wastewater Standards do not apply specifically to discharge to a natural wetland, however the standards do apply to very low dilution scenarios and lakes and recognise the limited impact that small catchments have on the receiving environment in terms of total nitrogen and phosphorus.

Assessment of Discharge Alternatives

(8) Please detail whether alternative methods for discharging treated wastewater to land have been considered as part of the application process. If such alternatives were evaluated, summarise their environmental, economic, and practical viability.

Reason: This information is required to address the requirements of Policy D.4.3 of the Proposed Regional Plan for Northland (PRPN), and to demonstrate that all reasonable discharge options have been properly assessed. It is noted that the current application seeks consent to discharge to water.

For reference, Policy D.4.3 of the PRPN states:

An application for resource consent to discharge municipal, domestic, horticultural or farm wastewater to water will generally not be granted unless:

> *1) the storage, treatment and discharge of the wastewater is done in accordance with recognised industry good management practices, and*
>
> *2) a discharge to land has been considered and found not to be environmentally, economically or practicably viable.*

Answer to be provided by FNDC

WWTP Capacity and Performance

Section 4.3 of the Options Assessment 1 (Appendix J of the Consent Application and Assessment of Environmental Effects) states:

> The current estimated loads exceed the W-WWTP's 2008 design capacity and given that the plant is still in its 2008 configuration it means that the current loads exceed the current available capacity. The W-WWTP was designed for phased addition of Aquamats and a third blower which would have catered for an ultimate 2026 capacity, but this has never materialised.
>
> The forecast 2059 loads are well within the WWTP's 2016 design capacity, therefore with the addition of the extra Aquamats as well as the third blower envisaged with the original 2016 upgrade the plant would

have capacity for treating the loads out to 2059 based on the current consented required effluent quality standards. [My emphasis]

Answer to be provided by FNDC

(9) Please confirm the timeframe by which FNDC will decide on upgrading the WWTP to address the existing plant capacity issue.

Answer to be provided by FNDC

(10) Please clarify whether FNDC has considered potential future wastewater flows from all local development provided for under the operative and proposed versions of the Far North District Plan such as the proposed Carrington Estate subdivision in its planning for WWTP capacity and discharge management, and if so, how these have been accounted for in assessing potential effects.

Reason: Understanding the timing of capacity upgrades is requested to better consider the effects of the proposed discharge and assess whether the current proposal could be compromised by additional loads or might require further upgrades within the duration of the sought consent.

Answer to be provided by FNDC

National Environmental Standards for Freshwater 2020

(11) Please provide an assessment of the proposed discharge against the relevant regulation and conditions of the National Environmental Standards for Freshwater 2020, specifically Regulation 46 and 47.

Reason: The AEE provides an assessment of the proposed activity against Regulation 54(d), whereas Regulations 46 and 47 apply to the maintenance and operation of specified infrastructure and other infrastructure.

Answer to be provided by FNDC

LIMITATIONS

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for Far North District Council ('Client') in relation to Whatuwhiwhi WWTP Consent Support S92 ('Purpose') and in accordance with the Short Form Agreement with the Client dated 12 November 2025 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report and Offer of Services dated 10 November 2025. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

BIBLIOGRAPHY

Elliott, AH., Alexander, R.B, Schwarz, Shankar, U, Sukias, J.P.S and McBride, GB (2005) *Estimation of nutrient sources and transport for New Zealand using the hybrid mechanistic-statistical model SPARROW*. Journal of Hydrology (NZ) 44 (1): 1-27

Land, Air, Water Aotearoa (LAWA) (2005) Lake Waiporohita. https://www.lawa.org.nz/explore-data/northland-region/lakes/lake-waiporohita/lake-waiporohita-at-centre

Manaaki Whenua – Landcare Research. (2025). *LCDB v6.0 – Land Cover Database version 6.0, Mainland New Zealand* [Data set] https://lris.scinfo.org.nz/layer/123148-lcdb-v60-land-cover-database-version-60-mainland-new-zealand/

Ministry for the Environment (MFE) (2024) National Policy Statement for Freshwater Management 2020.

Ratsey, H. (2016). Upgrading Waste Stabilisation Ponds Reviewing the Options.

Taumata Arowai (2025) Proposed national wastewater environmental performance standard Discharge to water. .https://www.taumataarowai.govt.nz/assets/Uploads/Wastewater-consultation/Information-Sheet-Proposed-discharge-to-water-wastewater-standard.pdf?vid=3

Water New Zealand. (2017). Water New Zealand Good Practice Guide: Waste Stabilisation Ponds: Design and Operation.

WSP (2025a) *Whatuwhiwhi Wastewater Treatment Plant Water Quality Assessment*

WSP (2025b) *Whatuwhiwhi WWTP Best Practical Options - Options Assessment*

APPENDIX A

N

0 1 2 km

Legend

- Waimango Swamp Catchment
- Wastewater Treatment Plant
- Drains/Rivers

CLIENT

FAR NORTH DISTRICT COUNCIL

wsp
Christchurch Water
+64 3 363 5400
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
J. Simpson	T. Porter
SHEET NUMBER	SCALE
1 of 1	1:35,760

PROJECT

Far North District Council
Whatuwhiwhi, Karikari Peninsula
Whatuwhiwhi WWTP Consent S9

SHEET

Whatuawhiwhi WWTP Consent
Waimango Swamp Catchment Overview

PROJECT NUMBER	REVISION DATE	REVISION
1-14657.01	12/12/2025	R0

APPENDIX B

N

0 1 2 km

Legend

- Waimango Swamp Catchment
- Wastewater Treatment Plant
- Drains/Rivers

Land Use

- Built-up Area (settlement)
- Exotic Forest
- Forest - Harvested
- Gorse and/or Broom
- Herbaceous Freshwater Vegetation
- High Producing Exotic Grassland
- Lake or Pond
- Low Producing Grassland
- Manuka and/or Kanuka
- Orchard, Vineyard or Other Perennial Crop
- Sand and Gravel

CLIENT

FAR NORTH DISTRICT COUNCIL

Christchurch Water
+64 3 363 5400
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
J. Simpson	T. Porter

SHEET NUMBER	SCALE
1 of 1	1:35,760

PROJECT

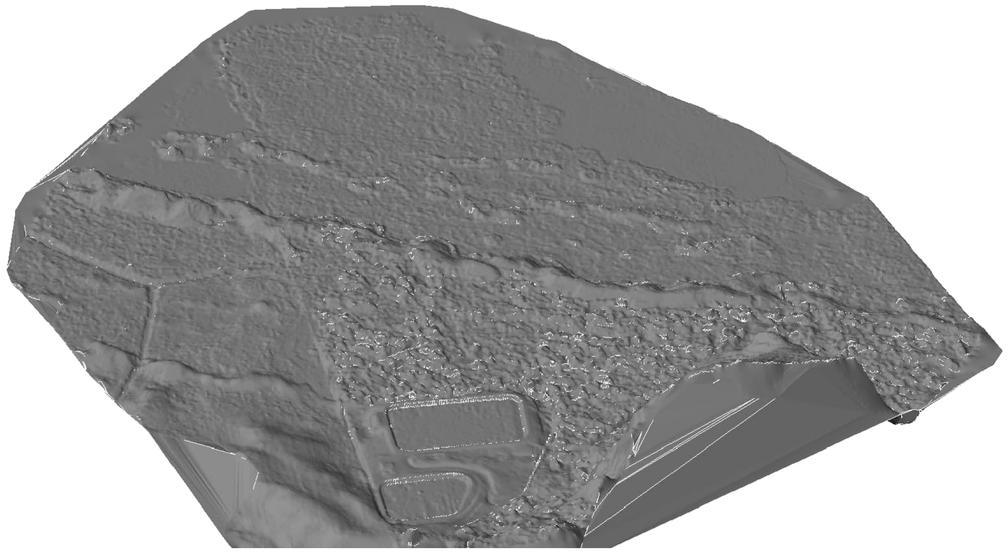
Far North District Council
Whatuwhiwhi, Karikari Peninsula
Whatuwhiwhi WWTP Consent S9

SHEET

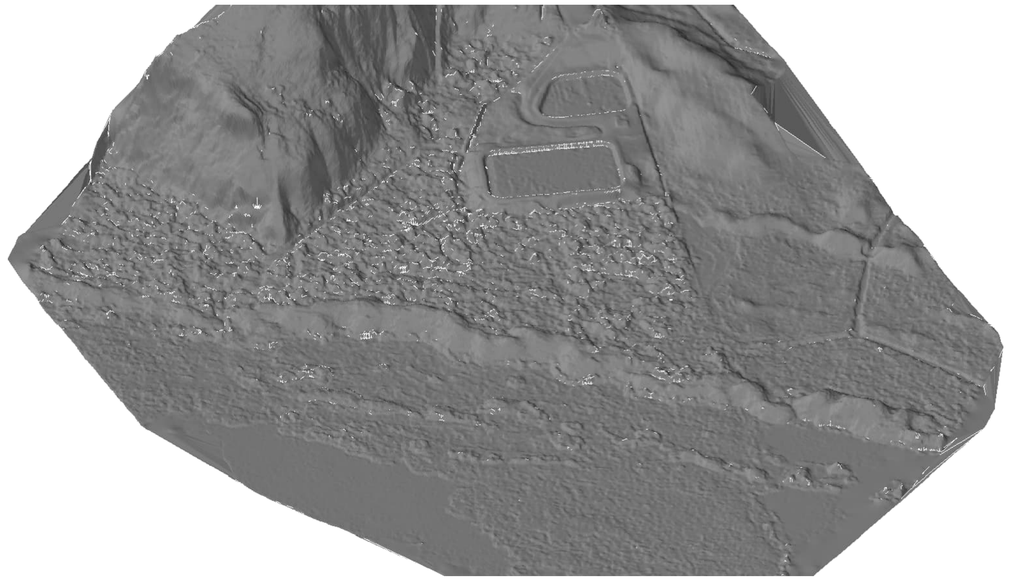
Whatuawhiwhi WWTP Consent
Waimango Swamp Catchment Land Use

PROJECT NUMBER	REVISION DATE	REVISION
1-14657.01	12/12/2025	R0

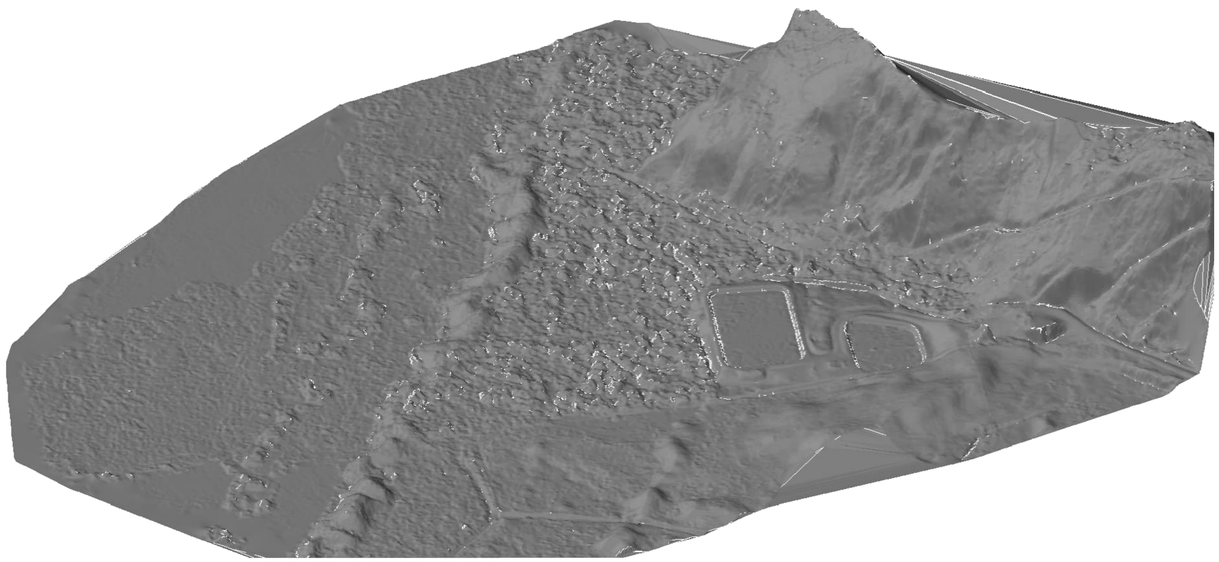
APPENDIX C



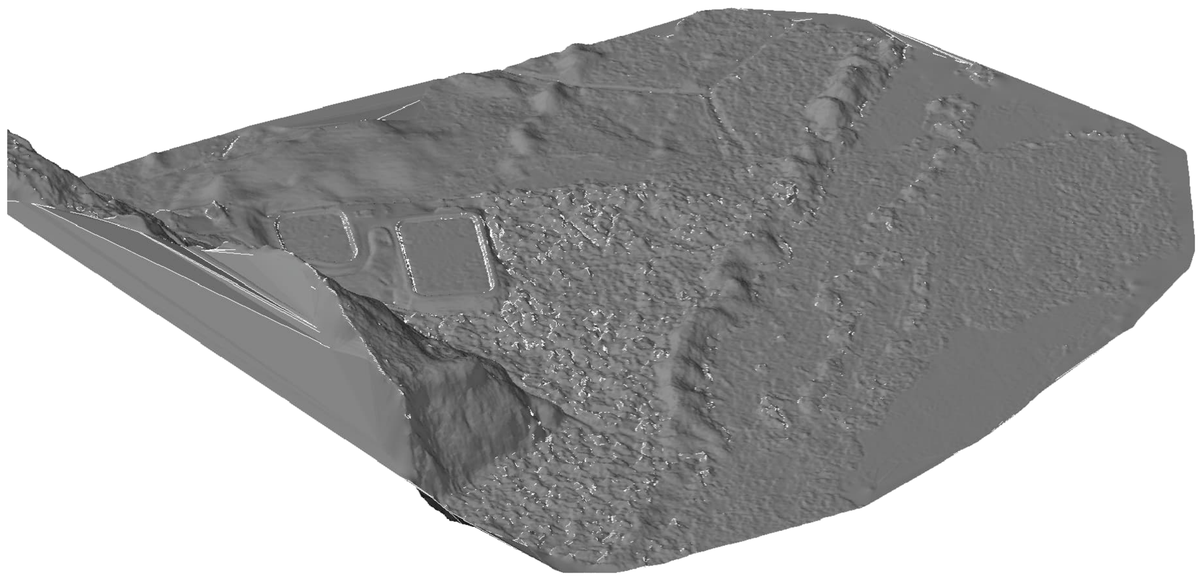
NORTHWEST ISOMETRIC



SOUTHEAST ISOMETRIC



SOUTHWEST ISOMETRIC



NORTHEAST ISOMETRIC

This sketch is provided for information purposes only and does not constitute a fully completed design or a final construction document. WSP does not assume any responsibility for the accuracy or completeness of this sketch or adherence to any applicable Standards, Codes or Regulations.

PROJECT: FAR NORTH DISTRICT COUNCIL WHATUWHIWHI WWTP CONSENT S92	MADE BY: MAT CHIARONI	JOB No.: 1-14657.01	DATE: 2025/12/17
TITLE: LIDAR ISOMETRIC VIEWS 5 X VERTICAL EXAGGERATION	CHECKED BY: PHILLIP SHOEBRIDGE	REVISION: 1	PAGE No.: 1
		SKETCH No.	

1. SECTION 92 REQUEST AND RESPONSES

Question number	Question	Specific questions	Proposed approach / response
1	Provide a current quantitative ecological assessment of the near field wetland receiving environment, including the following, using a methodology that is consistent with, or builds upon, previous Wildlands Consultants protocols (2016 & 2019)	An evaluation of vegetation composition, nutrient content (nitrogen and phosphorus), water depth, and other relevant ecological indicators within both control and impact zones. Interpretation of any observable shifts in eutrophic indicator species (e.g. raupō) or other relevant ecological indicators.	*A new physical survey cannot be completed due to practically time /safety concerns (no safe access). The site is a brackish lagoon of localised unknown depths, with heavy floating vegetation mats making it unsafe for repeated personnel access.* *Concerns exist with the previous vegetation plots/nutrient sampling in terms of location, monitoring frequency, findings, and analysis.* *To provide a baseline we recommend a drone survey to provide more accurate LiDAR/imagery data to determine the water flow paths and to identify the best location for vegetation monitoring and/or sampling, as well as providing high resolution images for an overview of wetland plant species sensitive to trophic state changes and to provide a robust baseline for future vegetation surveys*
2	Provide an evaluation of any observed shifts in plant communities		Gap analysis + high-level memo *Following on from the above recommendations this is not currently possible with historically available imagery, data, and information. Further high-resolution imagery is required to better understand temporal*

	since establishment of the WWTP, using ecological survey data, other literature, and/or aerial imagery, especially replacement of low nutrient assemblages by species adapted to elevated nutrient conditions (e.g. flax, raupō, rushes).		*changes from continued discharge of treated wastewater. Recommendation that following the 2025 acquisition of high resolution 4k imagery be utilised as a baseline for further assessments, with repeated flights using the same methodologies and specifications to detect any changes in vegetation, and communities which could suggest a shift in trophic state and eutrophication of the Waimango Lagoon.*

1.1 QUESTION 1

Provide a current quantitative ecological assessment of the near field wetland receiving environment, including the following, using a methodology that is consistent with, or builds upon, previous Wildlands Consultants protocols (2016 & 2019).

The following request is not achievable due to practicality considerations, time and access concerns regarding health and safety, coupled with the original survey design, placement, and findings of supplied past monitoring reports. There are more accurate and repeatable monitoring options now available that need to be considered for inclusion when determining the discharge effects from the Whatuwhiwhi WWTP.

Since the approval of the current consent in 2011, Wildlands has conducted vegetation surveys in 2013, 2016, and 2019 to determine any vegetation changes as a result of discharges from the WWTP. It is noted that both survey locations and methodologies were revised between 2013 and 2016 (Wildlands, 2016), with the implementation of a new baseline monitoring approach designed to enable accurate annual analysis of wetland vegetation changes. This methodology involved establishing vegetation plots at both control and impact sites, as well as calculating nutrient concentrations within collected plant tissue samples.

Upon review of these earlier monitoring surveys, no indications of eutrophication or vegetation changes were noted from the reports. It is not clear that there is an actual measurable effect in the receiving environment from the provided monitoring to date. WSP considers that this could be attributed to the original survey design and sampling site/s placement, with survey sites at the site boundary and controls sites on the neighbouring Carrington Estate. These sites are some distance from the discharge location, well beyond an estimated zone of reasonable mixing (50m beyond the outfall) with no sampling sites in place in the near field of the outfall, which you would expect some potential for change would be in this location initially, if at all.

WSP does not consider the vegetation monitoring undertaken to date provides adequate coverage of the near field or wider Waimango Lagoon. A revision and reestablishment of the baseline monitoring requirements is recommended, taking advantage of recent developments in remote sensing techniques and technologies with high-resolution imagery capture that is now more cost effective and widely available. This has the potential to eliminate in field wetland monitoring requirements, site risks to personnel with analysis being able to be completed remotely, aside from the UAV pilot operating from the WWTP site.

1.1.1 WILDLANDS WETLAND MONITRORING REPORTS

In 2019 the last round of vegetation surveys was completed with no further surveys or analyses undertaken since. The 2019 report by Wildlands by way of a roundup of current and past survey's findings noted the following.

- The vegetation surveys observed no changes that can reliably be attributed to an increase in eutrophication. Of particular note, in both 2016 and 2019 the nutrient content of the plant material indicated nitrogen limitation, but not phosphorus limitation at both the control and impact sites. There was deemed to be no statistically significant difference between these sites and between the years. It is anticipated that the degree of dilution afforded to the wastewater as it permeates through the wetland is such that any impact of these additional nutrients is sufficiently limited that it is unable to be measured, and is indistinguishable from background loads of nutrients already entering the wetland as well, it is also likely that the large amount of vegetation present rapidly assimilates large amounts of the nutrients.
- Water level depth fluctuations could be interpreted as having more of an impact on vegetation species presence, composition, abundance from the results. A review of low-resolution

publicly available imagery shows water levels increasing or remaining constantly high from 2016 onwards. The surveys also noted the dieback of more terrestrial canopy (Manuka) favouring species, likely due to increase water levels. These trees were not noted to have been naturally replaced via recruitment.

- As such, though the site is discharging elevated concentrations of nutrients, it is not clear that there is an actual measurable effect in the receiving environment from the provided monitoring to date, and the activity may be characterised as having a less than minor effect based on this assessment. It is also noted that this assessment has been unable to consider cumulative effects, given a lack of consistent continuous and comprehensive monitoring information in the Waimango Swamp.

1.2 QUESTION 2

Provide an evaluation of any observed shifts in plant communities since establishment of the WWTP, using ecological survey data, other literature, and/or aerial imagery, especially replacement of low nutrient assemblages by species adapted to elevated nutrient conditions (e.g. flax, raupō, rushes).

Following on for the first response, due to the past survey findings and analysis, quality, or availability of historic high-resolution imagery, it is exceedingly difficult to observe any shift in plant communities since the establishment of the WWTP. By following the recommendations promoted in this chapter, there is now a genuine opportunity to accurately identify wetland plant species and observe community changes using high-resolution imagery captured by UAVs.

A current review of vegetation found out the immediate discharge outfall and surrounds suggests that dominant species observed are highly tolerant of elevated nutrients and include giant rush (*Juncus palladis),* pūrei *Carex secta, Cabbage tree (Cordyline australis), Raupō (Typha orientalis).* There has been some dieback of manuka, but this is difficult to attribute to elevated nutrients rather than increased water levels and or natural senescence.

Figure 1 Whatuwhiwhi WWTP outlet diffuser, with nutrient tolerate wetland vegetation.

1.3 WHATUWHIWHI WWTP RECONSENTING INVESTIGATIONS 2024/2025

As part of reconsenting for the W-WWTP, WSP conducted comprehensive reviews of water quality data in both the Waimango Wetland and the nearby Waihuahua Swamp, including an additional assessment in 2025. No additional publicly available information was identified beyond the data previously reported.

In November 2024, both walkover inspections and eDNA sampling were conducted to review previous monitoring activities and their outcomes. A single, detailed eDNA sample revealed a variety of indicator species typical of nutrient-rich palustrine habitats, showing signs of both impacted and high-quality environments. Among the summary findings, *Acanthocyclops robustus* suggested nutrient enrichment, while *Typha orientalis* was also present, favouring high-nutrient areas. Since only one sample was taken, gathering

additional samples nearby could provide deeper insights into the local species composition and emerging trends.

During the walkover, attempts were made to locate the Wildlands vegetation plots and photo points at impact sites, but no 2024 vegetation survey was conducted. The sites showed signs of disturbance/interference (missing, dislodged plot markers, flattened impacted vegetation and access trails)—possibly from livestock / wild pigs/horses/stock—and, after five years since the 2019 survey, could not be fully identified.

The Impact and Control plots are located at the northeastern edge and for the Control, just beyond the site boundary (Carington Estate Farms, Jade LP), with no vegetation monitoring near the outlet discharge. Notably, vegetation changes would be expected to start at the discharge point and diminish with distance from the source.

A revision of the monitoring survey and methodology requirements needs to be considered by FNDC to better understand the trophic status at Waimango Lagoon and any potential effects from WWTP discharges.

1.4 2025 UAV WSP IMAGERY LIDAR AQUISTION

WSP has recently flown the WWTP site and surrounds in 2025 in response to the Section 92 request for further information to support the application from the Northland Regional Council. Below are two examples of the high-resolution imagery obtained which shows the quality of remote sensing capabilities now available.

These shots provide an excellent baseline starting point for analysis, but with earlier obtained available imagery from satellites simply not evenly remotely close in resolution and detail further flights following the recent capture resolution, quality and standards are required to demonstrate any changes in response to the discharges.

Figure 2 WSP UAV acquired imagery 2025, showing the discharge outlet and immediate receiving environment. Plant species can easily be characterised by human eye, or with the aid of AI and Machine learning.

Figure 3 WSP UAV acquired imagery 2025, closeup showing the definition obtained allowing for species and vegetation community identification.

Figure 4 Satellite Imagery available from 2024, the image resolution is not usable for fine vegetation assessments beyond this scale which is simply too course for assessment.

Figure 5 Satellite Imagery available from 2015, the image resolution is not usable for fine vegetation assessments beyond this scale which is simply too course for assessment, note the difference from the 2024 date image above.

WAY FORWARD / RECOMMENDATIONS

Freshwater wetland systems deliver a wide array of ecosystem services and serve as vital habitats for sensitive and threatened biodiversity. Effective management of these environments necessitates a thorough resource inventory and the implementation of cost-efficient monitoring tools. The intricate and extensive boundaries of natural water bodies present challenges to comprehensive sampling efforts, the Waimango Lagoon at Whatuwhiwhi exemplifies this challenge.

Consequently, extrapolating data from point-specific samples may not accurately reflect the true diversity and changes to vegetation across large freshwater ecosystems. Employing remote sensing for mapping freshwater vegetation can address issues related to accessibility, scale, and distribution; however, this approach depends on high-resolution imagery with suitable spectral characteristics (Ashraf, et. al., 2010).

To gain a more comprehensive understanding of the trophic status of Waimango Lagoon and the impacts of WWTP discharges, it is recommended that FNDC reevaluate whether the past vegetation monitoring programme has been fit for purpose. Due to the difficulty in accessing and working within the receiving environment Council should consider incorporating advancements in remote sensing technologies with machine learning techniques; UAV high-resolution photography, terrain analysis, combined with UAV water sampling could further improve the assessment of potential effects associated with WWTP discharge.

Key considerations from here are:

- Commit to an annualised mandatory fixed seasonal period (summer) monitoring programme for the consent term with the agreed methods. Review at Year 3 on the ongoing frequency required and if changes are discernible.
- Consider reinstatement/or abandonment of the established monitoring plots, which have not provided clearly attributable data or correlations to indicate increased eutrophication. Or does council move away from these physical surveys and consider primarily remote sensing options only if acceptable?
- An evaluation of the immediate outfall discharge location for vegetation and then the zone of reasonable mixing (50m) beyond the initial outfall discharge.
- Consider the current control plots locations (land tenure and accessibility considerations) for the control sites or seek to better formalise access arrangements with the landowner. Can these be reliably repeated.
- Recommend the use of remote sensing with the use of a UAV – capturing depth, deriving high resolution 4k imagery to identify and map vegetation communities – especially those species sensitive to changes in nutrient status.

1.5 UAV – REMOTE SENSING FOR MONITORING

Unmanned aerial vehicles (UAVs), or commonly known as drones, are remotely piloted aircraft increasingly used for surveys, photographic documentation, and terrain analysis, particularly in areas where access or safety is a concern. Traditionally, remote sensing has relied on satellite imagery and sophisticated, costly analytical software. UAVs now offer a more efficient, cost-effective, and immediate alternative for these applications. This coupled with the advances in the use of AI and machine learning analysis to detect and identify subject patterns in the landscape can help better interpret effects.

- **Primary Objective:** Detect changes in Waimango Swamp plant composition, communities' health, and structure through the consenting period that suggest eutrophication of the receiving environment due to W-WWTP treated discharges. Traditional baseline assessment methods used to date have not demonstrated clear correlations attributed to increases to nutrients and their availability. High

Resolution Imagery will enable better understanding and quantifiable measurement of vegetation changes and community composition than the current methods used to understand changes.

Key Indicators:

- Species composition and coverage.
- Vegetation health (NDVI or other spectral indices).
- Canopy height and density (LiDAR-derived).
- Hydrological changes (surface water extent).

1.5.1.1 AVAILABLE AERIAL IMAGERY

Use of satellite imagery can be problematic in New Zealand and especially Northland as often cloud cover, and their associated shadows obstruct the view of the Earth's surface, absorb or scatter light in the visible and near-infrared spectra crucial for vegetation analysis (e.g., NDVI calculation), leading to incomplete data, misclassification, and an inability to monitor rapid changes in vegetation. A search of historic aerial imagery available for the site and the wider Karikari peninsula is not to a standard or resolution capable for assessing vegetation changes or being interpreted consistently. For this assessment. it is difficult to discern vegetation changes that are not simply down to senescence or fluctuating water levels. It is recommended that a new baseline be established with the WSP imagery captured in 2025 with repeated flights undertaken.

1.5.1.2 NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

The normalised difference vegetation index (NDVI) is a popular tool for measuring how healthy and dense vegetation is by analysing sensor data and suggested for use in this application. NDVI is calculated using spectrometric readings from two types of light: red and near-infrared, which are typically collected by remote sensors like satellites.
NDVI is widely used because it is reliable; its readings closely match the actual condition of vegetation. The scale is straightforward: NDVI values range from -1 to 1. Areas with no plants have an NDVI of zero, and this number increases as plant growth improves. Regions filled with lush, thriving plants will show an NDVI of one. Negative values (below zero) indicate environments without dry land, such as oceans, which return an NDVI of -1.

1.6 UAV WAIMANGO LAGOON SURVEY DESIGN RECCOMENDED REQUIREMENTS

1.6.1 FLIGHT PLANNING:

- Use high-resolution RGB and multispectral sensors (e.g., Red, Green, Blue, NIR).
- Overlap: 70–80% forward and side overlap for photogrammetry.
- Altitude: 50–120 m depending on desired resolution. Needs to be fixed altitude in order to be close enough but cover the required investigation extent.
- Schedule survey flights that over similar periods (summer) for consistency.

1.6.2 LIDAR CAPTURE DATA AQUISTION:

- RGB for species identification and visual mapping.
- Multispectral for vegetation health indices (NDVI, SAVI).
- Integrate LiDAR for 3D structure and elevation mapping.

- Point density: ≥10 points/m² for vegetation structure analysis.
- Generate Digital Terrain Model (DTM) and Digital Surface Model (DSM).
- Calculate canopy height and biomass proxies.

1.6.3 DATA PROCESSING

Photogrammetry:

- Use software like Pix4D for Ortho mosaic generation.

Spectral Analysis:

- Compute NDVI, NDWI, and other indices to assess plant health and water stress.

LiDAR Analysis:

- Extract elevation profiles, canopy height models, and vegetation density metrics.

1.6.4 CLASSIFICATION AND CHANGE DETECTION

Machine Learning / AI:

- Train supervised classifiers for species or vegetation type mapping.

Baseline vs Monitoring:

- Compare current data to baseline to detect spatial and temporal changes.

Integration:

- Combine spectral and structural data for robust analysis.

1.6.5 GROUND TRUTHING

- Utilise existing monitoring sites to validate UAV and LiDAR-derived classifications.
- Or revise and utilises GPS-tagged quadrats for species composition and health checks.

1.6.6 REPORTING AND VISUALIZATION

Use GIS platforms (ArcGIS, QGIS) for spatial analysis and reporting generate maps showing:

- Vegetation health gradients.
- Species distribution.
- Structural changes (height, density).

2 REFERENCES

Ashraf, S., Brabyn, L., Hicks, B. J., & Collier, K. J. (2010). *Satellite remote sensing for mapping vegetation in New Zealand freshwater environments: A review*. New Zealand Geographer, 66(1), 33–43.