Kohukohu Wastewater Treatment Plan: Resource Consent Renewal

Cultural Impact Assessment

March 2023

Contents

EXECUTIVE SUMMARY

1. This Cultural Impact Assessment ("**CIA**") has been prepared to determine the values that Te Ihutai have in relation to their many taonga and to assess the actual and potential effects that the Far North District Council's ("**FNDC**") Kohukohu Wastewater Treatment Plant ("**WWTP**") resource consent renewal could have on those values and taonga.

2. Te Ihutai Hapū are the manawhenua of the area where the WWTP operates and generally discharges to within the Hokianga Harbour. The WWTP is located opposite Tauteihihi Marae

3. Te Ihutai require that in order to achieve long-term sustainable wastewater solutions for Kohukohu and surrounds, that they are an integral part of the solution.

4. Long term sustainability requires a commitment and resourcing from FNDC to do things differently, particularly with respect on-going and enduring relationships that consider the effects to tangata whenua as mana whenua and kaitiaki of the environment.

5. No treated wastewater from any sewage treatment plant should be discharged into the Hokainga Harbour and a land based disposal system should be appropriately investigated in collaboration with Te Ihutai.

6. As currently proposed, the resource consent results in effects that are more than minor to cultural values. As kaitaki of the Hokianga Harbour, Te Ihutai must ensure that it is available in a pristine state for future generations.

7. Based on the assessment, it is recommended that the resource consent application be **refused.** However, if not refused than recommended conditions of consent are proposed.

CULTURAL CONTEXT

8. Te Ihutai have mana whenua and mana moana of Kohukohu and particularly where the proposed activity has effects on its land and seaward extents. The three marae which affiliate to Te Ihutai are – Pateoro (1), Pikiparia (2), and Tauteihiihi (3) which are outlined in **Figure 1** below.

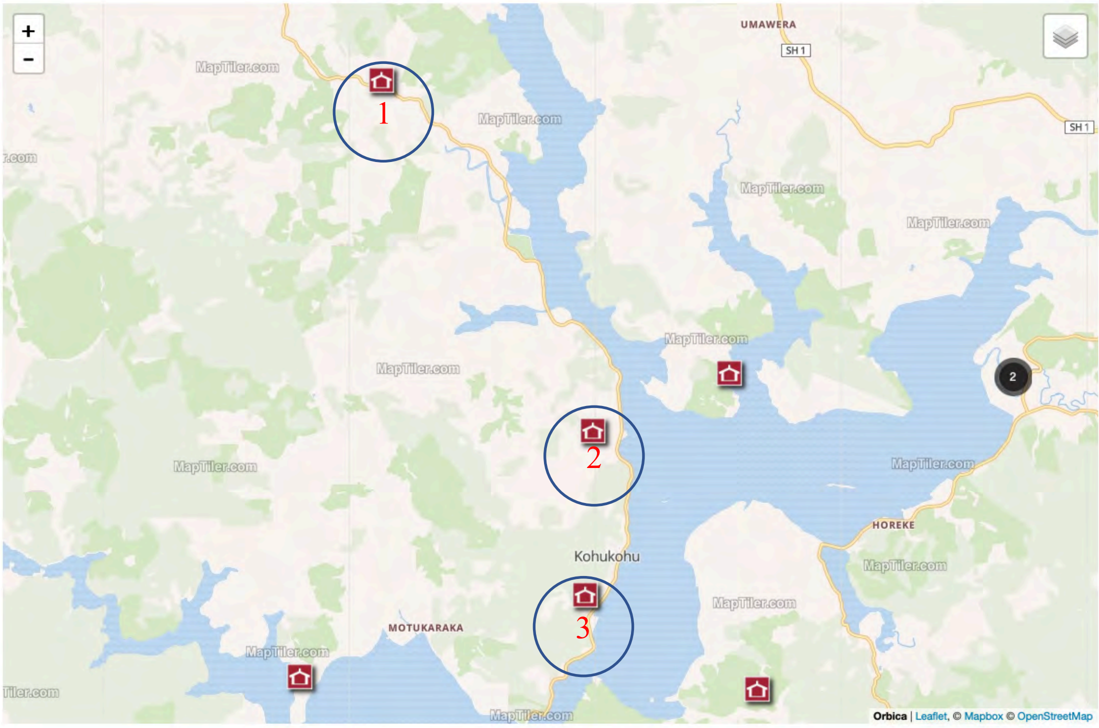


Figure 1 – Marae Locations (Source: Maori Maps))

Te Ihutai

9. The Kohukohu area and broader Hokianga Harbour has a long history of Te Ihutai use and occupancy. The harbour was, and to this day, is a major resource zone and travel route and played a significant role in Te Ihutai history.

10. The Te Ihutai rohe is not mapped, nor should it be as this includes various layers of history and whakapapa (genealogy) that weaves across the environment. There is no formal boundary as is typical of many western planning frameworks.

11. The ancestors of Te Ihutai used the area, including the Hokianga Harbour, as an ongoing food gathering site since the arrival of Kupe. The many associated tributaries and associated wetlands that flowed into the Hokianga ensured that mahinga kai resources such as tuna, manu, harakeke and raupō were readily available for use.

12. The many river tributaries provided kaimoana, with grasslands and forest areas of the vegetated backdrops throughout the Hokianga provided the land-based resources which were complementary to the seafood-based diet.

13. Te Ihutai ancestors used the common marine and coastal area for mahinga kai, including the collection of pipi (cockles), tio (oysters), karehu (periwinkle) and kuuharu (similar to toheroa), karati (baby snapper), flounder, kutai, kanae (mullet), eels, kahawai and tamure (adult snapper), including parore (black snapper). These resources were often located in the many mangrove and mudflat areas near the coastline.

14. Te Ihutai hold that they have always been part of the environment. They as kaitiaki sustain the environment, and the environment sustains them. Historically, this relationship has been emphasised by the location of their marae, around the Hokianga Harbour, as well as sites of significance, urupa, and papakainga.

15. Throughout history, Te Ihutai have sought to maintain their mana tiaki (inherited rights and responsibilities) over their environment. Many areas within the Hokianga were used for hunting and food gathering, the taking of timber and other resources, and the collection of Rongoa (medicines). Where resources diminished, rāhui (temporary restrictions) was promoted to enable resources to regenerate and be available for future generations.

16. Hapu also declared certain areas as torere and other burial sites where human remains were placed. These lands also included sites of historical,

environmental, political and cultural significance including maunga, awa, wahi tapu and pa.

17. The Crown, through legislation, assumed regulatory control over these resources and the environment. This has limited opportunities for Te Ihutai to develop and use those resources themselves and the responsibility over resource management decisions have been assimilated into Crown and local government agencies.

18. Land loss and the Crown’s regulatory regime undermined traditional practices over land, sea and resources. The health of kaimoana and other species of importance were also impaired by activities such as deforestation, land clearance, agriculture, and reclamations.

19. Current issues that directly relate to the proposal at hand, as well as broader matters considered by Te Ihutai are outlined below in **Figure 2.**

Figure 2 – Emerging Themes

20. The proposal related to the Kohukohu WWTP infringes on the mana tiaki of Te Ihutai and directly relates to many of the emerging themes presented. It is important to note that the starting position for Te Ihutai is that **no wastewater is discharged into the Hokianga Harbour.**

THE SIGNIFICANCE OF WAI

21. The significance of water to tangata whenua is a well traversed topic in resource management. Wai (water) is essential to life. In Maori traditions water is found in the beginning of origin stories and has a mauri (life force) of its own.

22. Every waterway, including large ones such as the Hokianga Harbour, has its own mauri, with a key principle that different waters should not be mixed.

23. The mauri of water used to carry waste, although technically ‘treated’, has been destroyed through that mixing and conveyance process. When wastewater of any form is therefore put directly into the Hokianga Harbour (in this context), its mauri is harmed.

24. This is compounded by the fact that the Hokianga has numerous discharge points and there are no overarching policy drivers that consider the Hokianga Harbour as its own landscape requiring environmental constraint.

25. The literature regarding current experiences and issues in relation to wastewater management is expansive and ranges from specific policy written by tangata whenua, Waitangi Tribunal claims reports, resource consent and court proceedings.

26. The common elements that emerge across the literature and exists today in this locality for Te Ihutai is that the **discharge of waste to water is culturally unacceptable.**

27. In 2010, the Report Tiaki Para: A Study of Ngai Tahu Values and Issues Regarding Waste[1] provided research on the contemporary views and issues of maori associated with wastewater.

28. In summary, the report clearly articulated the need for a fastidious separation between waste disposal and places dedicated to living and food harvest, preparation, and consumption. These set the baseline for wastewater management from a cultural perspective, and in fact is considered to be **normal human behaviour.**

29. Therefore, the critical separation between the human food chain and human waste streams is fundamental to a well-functioning and tikanga maori based approach to the environment. In context of the current application, this cultural and typical human way of living is not being adhered to and the proposed WWTP process enforces a way of living that is not consistent with tikanga maori.

[1] Craig Pauling and James Atarea. Tiaki Para A Study of Ngāi Tahu Values and Issues Regarding Waste (2010). Landcare Research.

TE HOKIANGA NUI A KUPE

30. According to tribal traditions, Kupe, was the first person to discover Te Ika A Maui “The Fish Of Maui”. The name Aotearoa itself is said to originate from the land’s first sighting by the great voyager’s wife. “He Ao, he Ao, he Aotea, he Aotearoa!” On his arrival, Kupe named this harbour, Te Puna i te Ao Marama, and it was from the ceremonial ritual in cementing his returning to Hawaiki, his homeland from Te Puna i te Ao Marama, that Te Hokianga Nui A Kupe receives its name.

31. During the end of the ritual, Kupe voiced his final words “Hei konei raa e Te Puna i te Ao Marama, ka hoki nei ahau, e kore ano ahau e hoki anga nui mai” “Farewell, The Spring of the World of Light, for I now return (home) from whence I will never return again”. The name Te Hokianga nui a Kupe was born from Kupe’s immortalised words and deeds. And today the name, Hokianga is respectfully used.

32. It is from this tradition that the prestige and mana of the Hokianga Harbour is so valued to Te Ihutai, tangata whenua and the community that has chosen to live beside it. To all people, especially Te Ihutai, there is perhaps no other taonga of the utmost cultural, spiritual and environmental significance than the Hokianga Harbour.

33. The kaitiaki hapū of the Harbour are inextricably linked by shared whakapapa and history. It is not suprising that all communities within the Harbour are determined to reduce environmental impacts resulting from activities such as effluent discharge, as well as other activities that are impacting the mauri of the Hokainga Harbour.

INTRODUCTION & PURPOSE

34. This Cultural Impact Assessment ("**CIA**") has been compiled by Sanson & Associates Ltd in response to a resource consent application from Far North District Council ("**FNDC**") to the Northland Regional Council ("**NRC**") in relation to the Kohukohu Wastewater Treatment Plant ("**WWTP**") resource consent renewal.

35. The purpose of this Assessment is to:

    a. Provide information about the cultural values associated with the development area;
    b. The effects on those cultural values and the relationship of tangata whenua to them as a result of the proposed activity; and
    c. Recommendations to avoid, remedy, or mitigate adverse effects.

36. In addition to the general approach above, this CIA has also been developed in accordance with D.1.2 of the Proposed Regional Plan for Northland July 2021 (Appeals)[2]. These requirements of the Policy are outlined below:

D.1.2 Requirements of an analysis of effects on tāngata whenua and their taonga

If an analysis of the effects of an activity on tāngata whenua and their taonga is required in a resource consent application, the analysis must:

1) include such detail as corresponds with the scale and significance of the effects that the activity may have on tāngata whenua and their taonga, and

2) have regard to (but not be limited to):

    a. any relevant planning document recognised by an iwi authority (lodged with the Council) to the extent that its content has a bearing on the resource management issues of the region, and

[2] See Policy D.1.2 https://www.nrc.govt.nz/media/tn1bdknp/proposed-regional-plan-july-2021.pdf

[85] The RMA definition of tāngata whenua is “in relation to a particular area, means the iwi, or hapū, that holds mana whenua over that area”. For an analysis of effects, the appropriate iwi or hapū will need to be identified. Council officers will be available to assist with this.

[86] An analysis of effects on tāngata whenua and their taonga may be necessary in circumstances not outlined in this policy – it will depend on the circumstances.

[87] Food and places for obtaining natural foods and resources. The work (mahi), methods and cultural activities involved in obtaining foods and resources.

[88] This includes, for instance, kai awa (river food) kai repo (swamp food) and kaimoana (sea food).

[89] This includes, for instance, impacts on the quality of water used for ceremonial purposes.

[90] This includes, for instance, use of rongoa (medicinal) plants, and uses for raranga (weaving).

[91] Māori non-commercial fisheries are defined in the Fisheries Act 1996.

[92] As defined by the Marine and Coastal Area (Takutai Moana) Act 2011.

b. the outcomes of any consultation with tāngata whenua with respect to the consent application, and

c. statutory acknowledgements in Treaty Settlement legislation, and follow best practice,[93] including requesting, in the first instance, that the relevant tāngata whenua undertake the assessment, and

3) specify the tāngata whenua that the assessment relates to, and

4) be evidence-based, and

5) incorporate, where appropriate, mātauranga Māori, and

6) identify and describe all the cultural resources and activities that may be affected by the activity,94 and

7) identify and describe the adverse effects of the activity on the cultural resources and cultural practices (including the effects on the mauri of the cultural resources, the cultural practices affected, how they are affected, and the extent of the effects), and

8) Identify, where possible, how to avoid, remedy or mitigate the adverse effects on cultural values of the activity that are more than minor, and

9) include any other relevant information.

[93] Best practice can be determined by relevant professional bodies.

[94] The full range of effects defined in Section 3 of the RMA need to be considered.

[95] For resource consent applications for restricted-discretionary, discretionary and non-complying activities.

THE PROPOSAL

37. FNDC seek to renew their existing consent as it relates to the Kohukohu WWTP.

38. Between the application being lodged (May 2016) and more recent correspondence to the Northland Regional Council from FNDC (August 2022), the following matters are noted:

    a. FNDC agree to adopt a Septage Management Plan if the consent is granted. In essence it has been found that FNDC are not achieving compliance with their own bylaws in terms of maintenance and management of the septic tanks within the Kohukohu Township.
    b. FNDC preferred option is to install curtain baffles and move the inlet pipe to the north-eastern corner of the oxidation pond in order to improve treatment processes and reduce faecal coliform concentrations that are currently impacting the ability to safely eat shellfish in the Hokianga Harbour.
    c. FNDC remain of the opinion that the current WWTP is the best option, having undertaken assessments associated with alternative land disposal options and sites.

39. The following documents have been reviewed in preparing this CIA:

    a. Resource Consent Application Kohukohu Wastewater Treatment Plant, May 2016, Prepared by Opus.
    b. Kohukohu WWTP Land Disposal Site Selection Analysis Report, February 2017, Prepared by Jacobs.
    c. Section 92 Request Letter. January 2020. Prepared Northland Regional Council.
    d. Hokianga Harbour Hydrodynamic Study. March 2020. Prepared by MetOcean Solutions

e. Cultural Impact Assessment of the Opononi Omapere Wastewater Discharge to the Hokianga Harbour. June 2020. Prepared by ART Consultancy.
f. Kohukohu Septage Management Review, July 2020, Prepared by Jacobs.
g. Semi-quantitative microbial human health risk assessment of the Kohukohu WWTP discharge in the Hokianga Harbour. August 2020. Prepared by Streamlined Environmental.
h. Kohukohu WWTP Upgrade Kohukohu WWTP Issues and Options. October 2020. Prepared by Jacobs.
i. S92 Response – Letter Aug 2022.

40. A copy of these documents is provided in **Appendix A.**

Regional Plan Rules Affected

41. The proposed activities are classified as follows under the Operative Water and Soil Plan for Northland (**RWSP**), Regional Air Quality Plan for Northland (**RAQP**) and the Regional Coastal Plan (**RCP**):

Plan & Rule	Description	Trigger
Soil & Water Plan	The discharge of treated sewage effluent directly into a water course from a sewage treatment and disposal system	15.03. 02 Discretionary Activity
	The discharge of sewage effluent into land in a manner outside the scope of or unable to meet the conditions pertaining to the permitted activity rules	15.03.01 Discretionary Activity

Air Quality Plan	Any activity not complying with permitted activity rules.	9.03(2) Discretionary Activity
Coastal Plan	The discharge of treated effluent to coastal water from land-based wastewater treatment plants	31.4.6(f) Discretionary Activity

42. It is also noted that the Proposed Regional Plan (PRP) is also relevant in the context of the application as such certain objectives and policies have been applied and must be considered.

43. No other consents are understood to be needed; however, it is unclear whether the activities associated with the preferred option within the ''Issues & Options Report' prepared by Jacobs require specific types of consent.

44. As currently presented, the proposal is a **Discretionary Activity**.

Site Description

45. The WWTP is located ~1km from the Kohukohu township and is located opposite Tauteihiihi Marae along Kohukohu Road. The location is outlined below in **Figure 3.** The effluent discharge process is outlined in **Figure 4.** The WWTP is directly adjacent to the Hokianga Harbour. A more defined image of the site is provided in **Figure 5**.

46. Various survey plans are provided as **Appendix B** as they relate to the site. The Waihoehoe River meanders through the site (parts of the sports fields).

Figure 3 - WWTP Location (Source: FNDC Resource Consent Application)

Figure 4 – Effluent Discharge Process (Source: FNDC Resource Consent Application)

Figure 5 – Application Site (Source: Prover)

47. The site of the treatment plant, pond, constructed wetland, and surrounding area, including watercourses, are described in some detail in the various application documents reviewed. This material is not repeated here, however the following key points are noted:

   a. The site has the legal description of Pt Section 86 Blk X Mangamuka Survey District and is 3.4961ha in size. The Gazette Notice pertaining to the site denotes that it is set aside as a Recreation Reserve and known as the Kohukohu Domain. There is no known Reserve Management Plan for the site.
   b. The Kohukohu WWTP has been operated by the Far North District Council on behalf of the Kohukohu community since the 1980's. The existing resource consent for the WWTP expired on the 31 August 2016.

c. The WWTP system collects discharge from 76 properties where primary sludge is removed[3], and some Biochemical Oxygen Demand ("BOD") treatment is carried out before wastewater is piped towards the WWTP. Sludge is removed at each property, and this is transferred to the Rawene WWTP. The next de-sludging of the 76 properties is due in 2024, having been carried out in 2019. Refer **Figure 6**).

d. The treatment plant is located adjacent to (across Kohukohu Road) the Tauteihiihi Marae (refer **Figure 7**).

e. At the WWTP, effluent undergoes secondary treatment via a single oxidation pond. Following oxidation, the effluent is further treated as it flows through a constructed surface flow wetland before eventually being discharged into the Hokianga Harbour via an extended channel 240m to the south of the WWTP (refer **Figure 8, 9, and 10** for images of the process, pond and wetland).

f. The WWTP discharges directly into an unnamed tributary before entering the culturally significant Hokianga Harbour.

g. Four other wastewater schemes eventually discharge into the Hokianga Harbour. This includes the Kaikohe scheme which discharges from the Wairoro, throught the Punakitere, and into the Waima River; Rawene via the Omanaia River, and Opononi Omapere via a direct outflow pipe.

[3] Every 3-5 years.

Figure 6 – Location of Wastewater Plants Discharging to Hokainga Harbour (Source: Google Earth)

Figure 7 – Application Site & Tauteihiihi Marae (Source: Prover)

Figure 8 – Aerial Overview & Treatment Process (Source: Jacobs)

Figure 9 – Existing Oxidation Pond (Source: Jacobs)

Figure 10 – Constructed Wetland (Source: Jacobs)

WWTP Characteristics

48. Details of the WWTP characteristics in terms of discharge volumes and wastewater quality are outlined in the various reports reviewed. In summary:

  a. Effluent flows ranged from 0.01 m3/day to 610 m3/day, with an overall median of 27 m3/day.
  b. For the majority (99%) of the time, when rainfall is below 50 mm, the effluent flow rate was below 154 m3/day.
  c. During conditions of significant rainfall exceeding 50mm, effluent flow rate increases by more than 5-fold above median flow rate. The cause of the increased flows is infiltration into the wastewater reticulation network, which is typical for most wastewater networks.
  d. The highest historical flow rates of 603 m3/day and 610 m3/day were recorded in summer 2011 when either daily rainfall or 24-hr antecedent rainfall exceeded 150 mm.
  e. Aside from the significant rainfall events in the summer of 2011, in other years the maximum effluent flow rate recorded was 228 m3/day.

f. Effluent flow was generally lower during summer than during other seasons. For instance, during summer, 50% of the time, effluent flow rate did not exceed 13 m3/day (compared to 27 m3/day compared with annual flow rates.
g. Analysis of long-term monitoring data (2010-2019) shows that the Kohukohu WWTP discharge water FC concentrations ranged from 27 to 1.14x105 CFU/100mL (Table 3), with a 95th percentile concentration of 2.44 x104 CFU/100mL (Table 3). At least 50% of the time, monthly FC concentrations were below 900 CFU/100mL.
h. In terms of faecal coliforms, seven samples collected during 2010-202 exceeded the existing resource consent conditions.

ASSESSMENT

49. In assessing the application, the documents provided have been considered as well as various information sources.

Statutory Considerations

50. Section 104(1) of the RMA states that, when considering an application for resource consent and any submissions received, the decision maker must have regard to:

(a) any actual and potential effects on the environment of allowing the activity; and

(ab) any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity; and

(b) any relevant provisions of—

(i) a national environmental standard:

(ii) other regulations:

(iii) a national policy statement:

(iv) a New Zealand coastal policy statement:

(v) a regional policy statement or proposed regional policy statement:

(vi) a plan or proposed plan; and

(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.

51. In terms of section 104(1)(b), it is understood that the relevant statutory planning documents for this application are:

a. The Regional Policy Statement for Northland (**RPS**);
b. The RWSP;

c. The RAQP;
d. The RCP;
e. The PRP;
f. The New Zealand Coastal Policy Statement (**NZCPS**)

52. Section 104(2) of the RMA states that, when forming an opinion for the purposes of section 104(1)(a), decision makers may disregard an adverse effect of an activity on the environment if a national environmental standard or plan permits an activity with that effect. This is often referred to as the ‘permitted baseline’.

53. The ‘Resource Consent Application’ does not address the question of whether any activities satisfy this test, as such it is assumed that all activities proposed require resource consent and shall be suitably assessed.

54. Section 104(2A) states that, when considering an application affected by section 124 of the RMA (which is the case under consideration), decision makers must have regard to the value of the investment of the existing consent holder.

55. The value of the investment as outlined in the Resource Consent Application. It is noted that the level of investment to date is ~$2,093,700, excluding labour[4].

56. Section 104(3)(a)(ii) states that decision makers must not have regard to the effect on any person who has given written approval to the application. No written approvals have been considered in drafting this CIA.

57. Section 104B of the RMA is also relevant in this case as the proposal has been prepared as a Discretionary Activity. The section states that decision makers may grant or refuse the application sought and, if granted, may impose conditions under section 108 of the Act.

[4] Refer Section 2.4 of the Resource Consent Application, prepared by WSP.

58. Section 105 of the RMA states that, when considering section 15 RMA matters (discharges), decision makers must, in addition to section 104(1), have regard to:

(a) The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
(b) The applicant's reason for the proposed choice; and
(c) Any possible alternative methods of discharge, including discharge to any other receiving environment.

59. Section 107(1) of the RMA states that decision makers are prevented from granting consent allowing any discharge into a receiving environment which would, after reasonable mixing, give rise to all or any of the following effects, unless exceptions specified in section 107(2) apply[5] -

(c) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
(d) Any conspicuous change in the colour or visual clarity;
(e) Any emission of objectionable colour;
(f) The rendering of fresh water unsuitable for consumption by farm animals;
(g) Any significant adverse effects on aquatic life.

60. The above matters have been considered through this CIA and addressed below.

[5] The exceptions being:
(a) That exceptional circumstances justify the granting of the permit; or
(b) That the discharge is of a temporary nature; or
(c) That the discharge is associated with necessary maintenance work – and that it is consistent with the purpose of this Act to do so.

SECTION 104(1)(a) – ACTUAL AND POTENTIAL EFFECTS ON THE ENVIRONMENT

61. The proposal will result in various actual and potential cultural effects on the environment. These effects are addressed under the headings below.

Septage Management

62. It is highlighted in many reports that very little maintenance, monitoring and oversight of the Kohukohu WWTP system is being undertaken, particularly the common effluent disposal system and the septic tanks on each property owned by FNDC in the Kohukohu Township.

63. These reports corroborate the feelings of many locals who believe the system is not being maintained to regulatory and safe standards.

64. The consequences of the current process being undertaken by FNDC are outlined as follows:

    a. As the septic tanks fill with sludge, there is expected to be increased carry-over of total solids and BOD. This will increase sludge volumes at the WWTP increasing the necessity for dredging of the pond and negatively impacting the treatment performance of the Kohukohu WWTP.
    b. As the septic tanks fill with sludge the high level of sludge can generate unpleasant odours and attract pests (AS/NZS, 2012).
    c. The high wet weather peaking factor suggests there is either groundwater infiltration, or stormwater connections to the septic tanks. If the flows are due to stormwater connections, these high flows will result in low retention times in the septic tank and potentially “flushing” of the system. This can result in sludge carryover from the septic tanks, increasing the load on the WWTP.

d. Desludging all of the septic tanks in the Kohukohu township over a 1-month period can shock load and destabilise the Rawene WWTP which receives the sludge for treatment.
e. A lack of maintenance records, including desludging procedures, makes it difficult to understand the effectiveness of desludging, the septic tanks condition and performance, and the impact of these on the performance of the WWTP.
f. Currently the FNDC Bylaw for the “Control of On-site Wastewater Disposal Systems” is not actively enforced, making it difficult to understand how well managed the septic tanks are by the property owners.
g. The Bylaw assumes the property owner is also the owner of the septic tanks, which is not the case for Kohukohu.

65. It is also noted within the ‘s92 Response August 2022’ that:

a. There is no influent sampling data and therefore the extent of treatment provided by the septic tanks is currently unknown. However, there were no reported significant issues of concern with the effluent quality as assessed by Jacobs.

66. In order to alleviate the problem, the proposal seeks to include the following recommended condition of consent (if granted):

Within six months of the commencement of consent the Consent Holder shall commission a suitably qualified and experienced person to prepare a Septage Management Plan (SMP) to demonstrate how the CEDS is to be operated and maintained to ensure compliance with the conditions of this consent. The SMP must, at minimum, contain the following information;

a. A suitable record of each individual tank connected to the CEDS that contains, at minimum, the following information;

i. Location details (i.e., GPS coordinates), and sketch plan of the septic tank on each property
ii. Basic property information (legal description, address)
iii. Contact information for the property owner
iv. Water supply type
v. The number of years the septic tank has been in service (the age of the septic tank).

b. A protocol for tank inspections which includes
   i. The frequency at which tanks will be inspected;
   ii. The methods of inspection that may be used.

Advice note: A consistent set of inspection methods are necessary to ensure that collected information is comparable for use in any improvement processes and for demonstrating compliance.

c. Details on how education and advice will be shared with properties connected to the CEDS for proper septic tank use and operation.

d. A template for recording tank inspection information which generally follows tank inspection requirements under AS/NZS 1547:2012.

e. A desludging programme for the septic tanks connected to the CEDS which recognises that older tanks may need to be desludged more frequently than newer tanks.

67. The proposed condition does little to alleviate concerns, and highlights the ongoing mismanagement of the Kohukohu WWTP and the ongoing effects it has in terms of discharge to the Hokianga Harbour. These basic maintenance requirements should already be undertaken, and the resulting effects currently on serve to exacerbate existing issues.

68. The core issue with the proposed condition is that whilst a Septage Management Plan is to be created and evidenced within 6 months, there is no requirement for FNDC to provide evidence of any maintenance or desludging works required. Evidence of implementation of the Septage Management Plan needs to form a requirement of the proposed condition if consent is granted.

69. From a cultural effects perspective, the proposed mitigation measure does not seek to change the method of disposal, rather it relies on maintenance and desludging works, which are said to make the WWTP operate more efficiently and effectively. However, the proposal does not reduce the key cultural effects of mixing waste water with water. Nor does it stop the WWTP from ultimately discharging into the Hokianga Harbour. As a result, cultural effects from the proposal are not considered to be sufficiently, avoided, remedied, or mitigated, with the proposal resulting in more than minor adverse effects.

Amenity Values

Odour Effects

70. It is not clear whether the Northland Regional Council has received any odour complaints in relation to the Kohukohu WWTP. The nearest sensitive receivers are those users of the Kohukohu Domain, the Tauteihiihi Marae, as well as users of the Hokianga Harbour.

71. The Tauteihiihi Marae complex is located 215m – 300m away from the Kohukohu WWTP. The odour effects from the plant can be exacerbated if oxygen content within the system is not maintained. When oxygen content drops, anaerobic bacteria can breakdown sewage and release odourous sulphide gases.

72. The current resource consent conditions require oxygen content within the system to always be maintained above 1g/m3 at all times and it is stated that the WWTP will continue to operate within these limits. Resource consent conditions state the monitoring requirements for the WWTP. At time of writing

of this report, it is not understood if any such air quality monitoring has been undertaken, and it seems that the process relies on a complaints system to effectively manage odour.

73. Whilst predominant wind is southwest (i.e away from the sensitive receivers) there are times Tauteihiihi Marae experience odour effects. Given that maintenance of the system has not been a priority, there is little confidence that odour will not be experienced at the marae.

74. The proposal impacts the ability for Tauteihiihi Marae to provide a quality marae environment, and sense of place for manuhiri (guests) who may visit the marae. The cultural and customary practices undertaken at the Marae should not be implicated by odour generated by the WWTP.

<u>Noise Effects</u>

75. In terms of noise effects generated from the Kohukohu WWTP, these are considered to cause no adverse cultural effects.

<u>Recreational Health Risk</u>

76. The Report prepared by Streamlined Environmental suggests that recreational health risk associated with the Kohukohu WWTP will not be negatively impacted by the proposal.

77. Notwithstanding the above, there remain concerns with the cumulative impacts of a series of discharges, including FNDC based wastewater discharges, and the underlying state of the Hokainga Harbour to recreational health.

Seepage and Water Quality

78. There is indirect seepage into the ground from the Kohukohu WWTP as outlined in the ‘Resource Consent Application’. This is said to come about through water from the unlined pond permeating into the ground. The rate of seepage has not been quantified in any reports considered.

79. While it is understood that there are no current users of groundwater (i.e no known bores for water supply), from a cultural perspective any seepage of wastewater through to groundwater remains culturally offensive to Te Ihutai.

80. This is from the basis that water conveying mixed water (wastewater) should not combine in any form with groundwater or coastal waters. This is a fundamental cultural value being dishonoured by the existing and proposed Kohukohu WWTP.

81. Section 4.2 of the 'Resource Consent Application' outlines the potential effects from discharge of contaminants to water. Of concern are the impacts to the abundance and diversity of kaimoana (seafood) as well as freshwater food sources. It is said that fish species are potentially affected as the discharge can clog gills and reduce feeding efficiency. Sediment deposition can also reduce egg and embryo survival rates.

82. The Kohukohu WWTP effects are contextualized against the upper catchment, particularly the Utakura River where faecal coliform is 3,000 times greater than the loading proposed from the Kohukohu WWTP. In effect, the Kohukohu WWTP is considered as appropriate in the context because the effects are far lower than in the upper catchment.

83. The impacts to water quality are observed across the Harbour, diminishing its mauri. The effects to kaimona and the ability to collect shellfish is impacted. The harbour must be considered as a whole and not piece by piece or else the Harbour will be subjected to a 'death by a thousand cuts'.

Cultural Values

Sites of Significance & Wahi Tapu

84. There are numerous Marae, wāhi tapu , taonga, and sites of significance within the surrounding environment. Whilst many of these have not been formally mapped in both Regional and District Planning schemes, they remain

significant. Similarly, there are numerous NZAA registered sites within and along the Kohukohu coastline and within the Hokianga Harbour and surrounds. Refer **Figure 11** below.

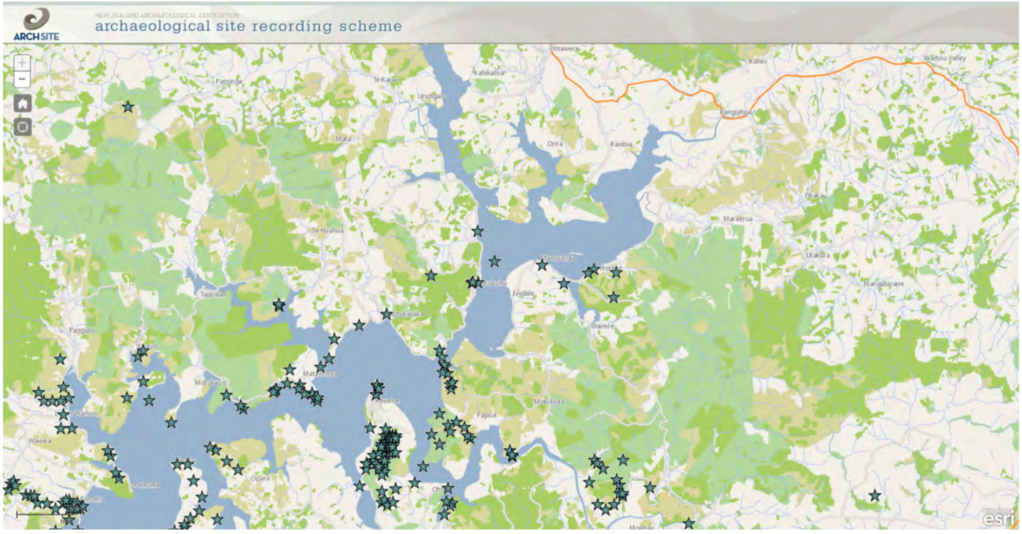


Figure 11 – Archaeological Sites (Source: NZAA)

85. The Proposed Far North District Plan has been recently notified for submissions, however no further mapping has been undertaken with respect of sites of significance to maori. Therefore, there has been minimal opportunity for tangata whenua to interact with this tool to formally protect such sites.

86. Whilst the Proposed Regional Plan recently provided opportunity for Sites and Areas of Significance to Tangata Whenua to be identified, in the locality and wider Hokianga Harbour environment, this has not been undertaken.

87. Notwithstanding this, the Proposed Regional Plan includes Policy D.1.5 Places of Significance to Tangata Whenua. This policy allows for consideration of sites not mapped, but those which meet the requirements of the policy. An assessment of the Hokianga Harbour has been undertaken below, with the conclusion reached that the Harbour can be considered as a Place of Significance.

D.1.5 Places of significance to tāngata whenua	
Policy Requirements	Assessment
For the purposes of this Plan, a place of significance to tāngata whenua: 1) is in the coastal marine area, or in a water body, where the values which may be impacted are related to any of the following: a) soil conservation, or b) quality and quantity of water, or c) aquatic ecosystems and indigenous biodiversity, and	The Hokainga Harbour is in the coastal marine area. Values being impacted are associated with water quality and aquatic ecosystems.
2) Is: a) a historic heritage resource, or b) ancestral land, water, site, wāhi tapu, or other taonga, and	The Hokianga Harbour is considered as a taonga.
3) is either: a) a Site or Area of Significance to tāngata whenua, which is a single resource or set of resources identified, described and contained in a mapped location, or b) a Landscape of Significance to tāngata whenua, which is a collection of related resources identified and described within a mapped area, with the relationship between those	The Hokianga Harbour as a landscape of significance has been appropriately described including its resources with the relationship between those component resource identified. This includes: • Effects of deforestation on water quality. Refer Crown Sponsorship of Mass Deforestation in Whangaroa and Hokianga 1840-1990 – WAI 1040 (2015). Waitangi Tribunal.

component resources identified, and	• Maori language, place names physical features and areas of the Hokianga. Refer Hokianga: From Te Korekore to 1840 WAI 1040 (2015. Waitangi Tribunal. • He Whenua Rangatira Northern Tribal Landscape Overview Hokainga, Whangaroa, Bay of Islands, Whangarei, Mahurangi and Gulf Islands WAI 1040 (2009). Waitangi Tribunal. • Tidal Mut Flat Reclamation in the Hokianga Harbour WAI 1040. (2016). Waitangi Tribunal. The Landscape is also supported by the many CIA's which have been undertaken in relation to the various wastewater schemes in the harbour. Note: there are numerous reports that can corroborate the requirements from the Waitangi Tribunal. Those listed are but some reviewed.
4) has one or more of the following attributes: a) Historic associations, which include but are not limited to: i. stories of initial migration, arrival and settlement, or ii. patterns of occupation, including permanent, temporary or seasonal occupation, or	The reports considered above, particularly Hokainga: From Te Korekore to 1840 describe the migration stories of various iwi and hapū, including the migration story of Kupe. The report He Whenua Rangatira Northern Tribal Landscape Overview details the patters of occupation within the Hokainga Harbour as well

iii. the sites of conflicts and the subsequent peace-making and rebuilding of iwi or hapū, or iv. kinship and alliances built between areas and iwi or hapū, often in terms of significant events, or v. alliances to defend against external threats, or vi. recognition of notable tupuna, and sites associated with them, or b) traditional associations, which include but are not limited to: i. resource use, including trading and trading routes between groups (for instance – with minerals such as matā/obsidian), or ii. traditional travel and communication linkages, both on land and sea, or iii. areas of mana moana for fisheries and other rights, or iv. use of landmarks for navigation and location of fisheries grounds, or v. implementation of traditional management measures, such as rāhui or tohatoha (distribution), or c) cultural associations, which include but are not limited to: i. the web of whanaungatanga connecting across locations and generations, or ii. the implementation of concepts such as kaitiakitanga and	history associated with various skirmishes between iwi / hapū. The landscape contains various elements of resource use, trading and travel, as well as landmark used to find resources. The web of whanungatanga, concepts of kaitiakitanga and Manaakitanga area also detailed in various WAI reports associated with the Hokainga Harbour. Spiritual associations to the harbour are also outlined in various reports reviewed in the Waitangi Tribunal.

manākitanga, with specific details for each whanau, hapū and iwi, or d) spiritual associations which pervade all environmental and social realities, and include but are not limited to: i. the role of the atua Ranginui and Papatūānuku, and their offspring such as Tangaroa and Tāne, or ii. the recognition of places with connection to the wairua of those with us and those who have passed away, or iii. the need to maintain the mauri of all living things and their environment, and	
5) Must: a) be based on traditions and tikanga, and b) be endorsed for evidential purposes by the relevant tāngata whenua community, and c) record the values of the place for which protection is required, and d) record the relationship between the individual sites or resources (landscapes only), and	The reports are clear in that the Hokianga Harbour is a spiritual taonga that must be protected, and that protection of it has coincided with colonisation and its practices. Each hapū and Iwi have their own relationship with the Hokianga Harbour and these are numerous to name. A few key principles / values are that: • Mixing of waters (e.g waste water to water) is not culturally acceptable; • The Hokainga Harbour has been a traditional food basket. • The Hokianga Harbour was treated with utmost respect, protection and preservation,

e) record the tāngata whenua groups determining and endorsing the assessment, and f) geographically define the areas where values can be adversely affected.	based on kaitiakitanga principles. The entire harbour is being subjected to a series of environmental issues. Whilst some of these may be unique and specific, in general this includes: • Impacts to water quality from discharges and various land use practices; • Impacts to fisheries and mahinga kai; • Impacts to tikanga maori approaches and kaitiakitanga through the continued discharge of human waste to water. • The lack of use of matauranga maori or tangata whenua involvement in the management and governance of the natural world.

88. Perhaps the most significant 'site' is the Hokianga Harbour itself, although not formally mapped in statutory plans, except for the Statutory Acknowledgement (refer below). In this context the Hokianga Harbour sits within a cultural context of its own landscape filled with an array of culture and traditions. This has been articulated in many of the CIA's prepared for the other WWTP applications.

89. From a statutory perspective, the Hokianga Harbour is considered as a Statutory Acknowledgement Area, under the Te Rarawa Claims Settlement Act 2015 (Refer **Appendix C**). As Ngapuhi has yet to settle, there are no such statutory acknowledgements available at present for this Iwi.

90. As outlined earlier in this Report, the Hokianga Harbour whilst culturally significant also provided sustenance to Te Ihutai through food and other cultural resources becoming abundant as a result of the confluence between land and sea.

91. The Hokianga Harbour is a taonga in its own right and holds significant cultural value. The proposed WWTP and its proposed discharge of water directly into the Harbour is considered to result in adverse effects that are more than minor from a cultural perspective to a site of significance to tangata whenua that cannot be appropriately avoided, remedied or mitigated through the current WWTP system.

Effects on Mahinga Kai

92. As outlined earlier in this report, the Hokianga Harbour and its surrounds, were essentially a pataka kai (food basket) for Te Ihutai.

93. According to the 'Natural Areas of Hokianga Ecological Area'[6], the Harbour is the fourth largest harbour in New Zealand. It was originally a large drowned valley, and is currently long, narrow and surrounded by dense mangrove forests, containing some of the largest salt marshes remaining in Northland. It also holds some of the last remnants of low-lying swamp forests / swam shrubland habitats, and native forest systems that water quality protection.

94. It is known that the middle and upper areas of the Harbour are under pressure from sedimentation runoff impacts and have become increasingly muddier each decade. Marine values are said to be compromised as a result[7]. There is also said to be abundance of Pacific Oyster spatfall[8].

[6] Natural Areas of Hokianga Ecological Area (2004), Department of Conservation, Conning Linda, Holland Wendy, Miller Nigel.
[7] Significant Ecological Marine Area Assessment Sheet (undated), Northland Regional Council.
[8] Coastal Resource Inventory, First Order Survey: Northland Conversancy (1990), Department of Conservation, T Shaw and J Maingay.

95. Contemporary gathering of shellfish and other seafood, Rongoa, and other cultural material within and surrounding the application site has not occurred since the 1980's and original commissioning of the Kohukohu WWTP by reason that this area would be polluted and have discharges to the environment that would make such activities impossible to fathom from a cultural perspective.

96. However, prior to this time and considering the location of the Tauteihiihi Marae, it is likely that food gathering and cultural resource harvesting occurred in this area, as well as other areas along the Hokianga Harbour.

97. **Figure 12** provides further spatial context of some of these important ecological features that are within and surrounding the site. The green represent mangrove riparian areas and the orange being saltmarshes. These environments permeate the Hokianga Harbour and contribute to the wildlife seen in the environment. The site contains such resources described. No mitigation measures are proposed on these areas.

98. Davidson and Kerr note that the 'species inhabiting the subtidal and intertidal areas support both resident and temporary species. Many species that visit the Harbour take advantage of the food and shelter at all or particular parts of their life history (e.g. snapper, eastern bar-tailed godwit, while many resident species form part of the food chain)'[9].

[9] R Davidsons and V. Kerr. (2001) Habitats and Ecological Values of the Hokainga Harbour. Davidson Environmental Ltd

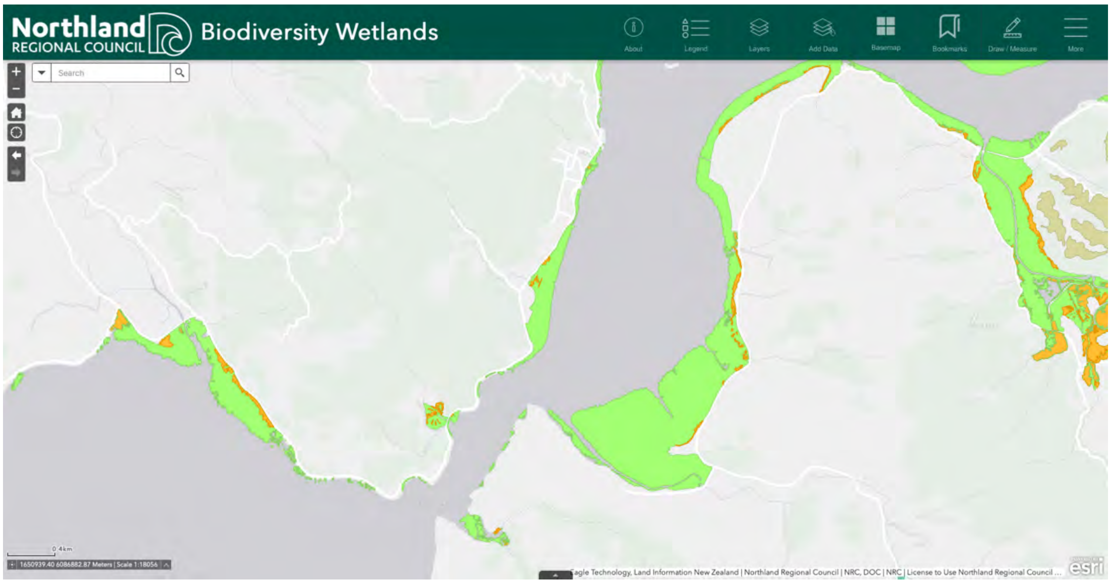


Figure 12 – Biodiversity Wetlands (Source: NRC Maps)

99. The Report prepared by Streamlined Environmental specifically addresses impacts to health from shellfish harvesting. At present, the quality of shellfish at the Hokianga sites do not currently meet the New Zealand Food Safety Authority 2006 guidelines.

100. Although it is contended thrpugh the various reports reviewed that the Kohukohu WWTP will result in negligible change to risk from shellfish harvesting, the cultural effects to the collection of shellfish, and perhaps other seafood, is diminished, and the proposal does little to mitigate this effect.

101. To add, the Report suggests that faecal source tracking be undertaken in the Harbour to 'resolve the uncertainty associated with elevated faecal indicator bacteria concentrations in shellfish tissues'. This is supported to fully understand where such contamination is coming from and to fully understand the cumulative impacts of all discharge into the Harbour.

102. From a marae perspective, the Hokianga Harbour is often used to provide food for manuhiri (guests) for numerous occasions. Providing food for guests on a marae is a traditional means to remove tapu (sacredness) from those visitors. Food stocks were often regulated by season and availability, and

resource use would only be undertaken at its peak. Where resources were under threat, a rāhui or temporary prohibition would be imposed to allow stocks to heal and regenerate.

103. In this instance, a prohibition on taking food is not proposed as in effect, the discharge disposal from the Kohukohu WWTP (and other discharges) already provides for this from a cultural perspective. Te Ihutai are being repressed by the current wastewater discharges to undertake their traditional activities in the coastal marine area. Notwithstanding this, for many whanau who rely on the Harbour to provide for their sustenance, they must contend with the potential health effects of eating food sources from the Harbour.

104. The constant pollution of the Harbour and the location of the wastewater treatment plant is detrimental to the ongoing ability of marae to provide for their manuhiri and carry out long standing traditions of manaakitanga. Many marae across the Hokianga are famous for their ability to provide seafood cuisine to guests. The ongoing damage to the Hokianga Harbour reduces the prestige of local marae and their ability to care for their guests.

105. Overall, the proposal results in more than minor cultural effects to Te Ihutai in terms of their ancestral association and relationship with the Hokianga Harbour.

Matauranga Maori

106. The data present and the terminology used throughout many supporting reports is difficult to understand and requires expert support and advice to understand.

107. Matauranga maori (indigenous knowledge) approaches can support scientific knowledge and technical reports and provide avenues for collaboration to equitably understand the effects and processes associated with wastewater.

108. These approaches have yet to be used to date to understand cultural concerns and effects more appropriately, including a far more encompassing and holistic view of the mauri of the Harbour.

109. Whilst a Hydrodynamic Report has been undertaken, this considers but one layer of effects (discharges from wastewater treatment plants) on the Hokianga Harbour. The issue with these types of reports is that it starts from a culturally flawed position – that is, it accepts the discharge of wastewater to water as being an acceptable human behaviour.

110. A key concern to Te Ihutai is the mauri of the Hokainga Harbour. The current regulatory regime associated with resource management and fisheries management allocates responsibility under various enactments and departments.

111. With this widespread allocation of responsibility, silo's are created and genuine care for the environment is lost (i.e that's 'their' responsibility). The Hokianga Harbour must be considered as a whole to truly gauge the impacts that activities, including the Kohukohu WWTP, is causing to the mauri of the Harbour. At present, the Kohukohu WWTP and the other discharges to the environment are causing more than minor effects to the health and wellbeing of the Harbour.

112. There are opportunities for FNDC to collaborate with Te Ihutai, users of the harbour, and other hapū who have a collective responsibility to look after the Harbour. These opportunities should be considered by decision makers to ensure that cultural wellbeing is reflected in the ongoing management and decisions that ultimately lead to effects on the Harbour.

<u>Rangatiratanga</u>

113. The establishment of the Kohukohu WWTP, next door to Tau Te Ihiihi Marae was the first breach of rangatiratanga undertaken by FNDC and its predecessors.

114. Following this, the WWTP’s operation and maintenance has continued to impact manawhenua with little to no understanding of the impacts this has to hapū values and Te Ihutai quality of life.

115. A key principle guaranteed under Te Tiriti of Waitangi is partnership. A partnership approach has not occurred with Council’s only interaction with manawhenua generally being on their terms and for projects they want / need to achieve.

116. Of importance to this discussion is the Treaty of Waitangi. Recent tribunal reports have confirmed that Ngāpuhi did not cede sovereignty. As a hapū of Ngapuhi, Te Ihutai are also of the view they remain a sovereign state of the Ngapuhi Confederation.

117. Hapū have been excluded from the design process of the WWTP and associated network infrastructure. This statement remains true for the proposed consent. Whilst we are dealing with legacy assets, the scope of the wastewater upgrades, and the costs and budget have largely been undertaken without any tangata whenua or cultural input. The relationship largely to date has been borne out of a consent process rather than a more strategic, collaborative, and enduring partnership.

118. Whilst it is understood that a key challenge for Council may be the time and resources required to support long term engagement, it is noted here that Te Ihutai hapū work entirely on a voluntary basis to respond to Council’s calls.

119. Recent decisions associated with the Taipa WWTP present the opportunity available for both parties to be able to work collaboratively on infrastructure issues such as the Kohukohu WWTP to ensure that mana whenua have a voice in making decisions from design through to operation. Such approaches are supported whole-heartedly.

120. However, it is noted that in the ‘s92 Response – August 2022’ that Council does not consider that any further investigation into land disposal or alternative disposal methods are required and that the status quo should remain.

121. Te Ihutai have not been involved in such assessments, although the reports have been considered. The ‘Issues and Options Report’ October 2020 notes that a collaborative workshop was undertaken on the 26 August 2020. The purpose of the workshop was to undertake a Multi Criteria Analysis (MCA) in order to consider the three options as follows:

   a. Option 1: Maintain Existing System, Clear Wetland Vegetation Overgrowth;
   b. Option 2: Option 1 Plus Curtain Baffles and Move Inlet Pipe, and Option 3: Option 2 Plus UV.

122. The key criteria of the MCA were as follows:

   a. Cultural acceptability: iwi/stakeholder concerns from consultation including effects on the mauri of the water, amenity and perception of a discharge to water.

   b. Environmental criteria: ensuring the harbour is safe for recreational activities including the gathering of kai moana, particularly close to the disposal site, and a reduction of nutrient load (N and P) going into the harbour from the WWTP, and that amenity impacts such as noise, visual aesthetics and odours are not significantly impacted.

   c. Practicability criteria: that the option can be consented in a timely manner, and considers the complexity of the construction process, distance from networks and services and the overall time taken to construct and commission the option.

d. Operational Criteria: technical factors including reliability, technical feasibility, robust & proven technology, operational resilience, staging/flexibility for future upgrading, Health and Safety in design and operational complexity.

e. Economic Criteria: Order of magnitude capital and operating cost estimates will inform the affordability of each option as well as the likely impact on rates.

123. In the Multi Criteria Analysis Process, the weighting provided to each criteria is outlined in **Figure 13** below.

Primary Criteria	Weighting	Secondary Criteria	Weighting
Economic Criteria	40.0%	Capital Cost	33%
		Operating and Maintenance Costs	33%
		Rating Impacts	33%
Environmental Criteria	20.0%	Land Use Effects (visual, noise and traffic impacts)	15%
		Odour (degree to which odour will be experienced beyond WWTP boundary)	15%
		Ecological Effects (does effluent quality exceed consent limits)	30%
		Carbon Footprint (level of energy and consumables required)	10%
		Public Health (protection of mahinga kai, impact on recreation, impact of spills or failure)	30%
Maori Cultural Values	20.0%	safeguards Māori cultural values and practices	100%
Practicability Criteria	10.0%	Constructability (complexity, distance from services, time to commission)	50%
		Regulations and Planning (complexity in obtaining consent)	50%
Operational Criteria	10.0%	Complexity of operation / required experience	25%
		Sludge management	25%
		Reliance on and complexity of plant consumables and replacement componentry	25%
		Health and Safety risks or plant process / access to site	25%

Figure 13 – MCA Primary & Sub-Criteria Weightings (Source: Jacobs)

124. It is unclear whether any tangata whenua representative where asked to attend the collaborative workshop, however in effect the MCA highlights that **none of the options** would safeguard maori cultural values and practices.

125. Therefore, a key issue in the entire exercise undertaken is how the options where promoted, and why there weren't options proposed that could / would

meet the cultural acceptability criteria? The entire exercise seems to give weight to the FNDC decision regarding which option to take, however from a cultural perspective, it continue to highlight the lack of respect and insight Council has with respect to cultural values.

Wastewater Disposal Options & Land Ownership

<u>Land Disposal Assessment</u>

126. The application includes an investigation into the potential for land disposal of treated wastewater. This assessment was desktop based and based on a number of constraints and considerations.

127. It is noted that Te Ihutai or local community member were not involved in this report nor its determinations. The report (as provided to the report writer) confirmed that there are valid sites possible within the constraints presented that would be suitable for land disposal. **Figure 14** below outlines these sites.

128. In conclusion, the Report suggests that Sites 4 and 5 could be investigated further to provide for appropriate land disposal of wastewater, however these are also subjected to particular constraints associated with slope and soil types and size. However, it is noted that in the final report prepared by Jacobs seems to differentiate from that provided to the report writer. The outcomes of the Report provided are found in **Figure 15** below. For clarity, the Issues and Options Report found on the NRC website is found in **Appendix D**.

129. This desktop study into the investigation into alternative disposal options has not been verified with ground truthing nor undertaken in collaboration with Te Ihutai and the local community. More time and resources are required to come up with a solution as the current operation remains culturally offensive and abhorrent due to the location of the WWTP and its continued discharge into waterways and the taonga being the Hokianga Harbour.

Figure 14 – Suitable Land Disposal Sites (Source: Jacobs)

3.4 Summary of GIS Analysis

Error! Reference source not found. summarizes all the key information on each of the proposed sites and the recommendations for further investigations. It has been concluded that none of the sites are considered feasible for land disposal.

Table 3-4Site Selection Analysis Summary

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5
Distance from WWTP	3071 m	~3409m	~3669m	1697m	578m
Area Suitable for Land Disposal (Ha)	4.3	11.0	6.3	2.4	2.3
Property Area (Ha)	5.0100	16.49	6.73	40.5	18.7
Land ownership	1	1	1	1	1
Soil type	Whakapara clay, Autea clay, Takahiwai clay	Autea clay, Takahiwai clay	Takahiwai clay, Te Tio clay	Autea clay	Autea clay
Soil Permeability	Well - moderate	Poor	Poor	Moderate	Moderate
Tsunami zone	Yellow,	Yellow,	Yellow	Green	Green
Flood risk	Yes	Yes	Yes	No	No
Recommended for further investigation	No	No	No	Yes	Yes

Document No. 17

Land Disposal Site Selection Analysis Report Jacobs

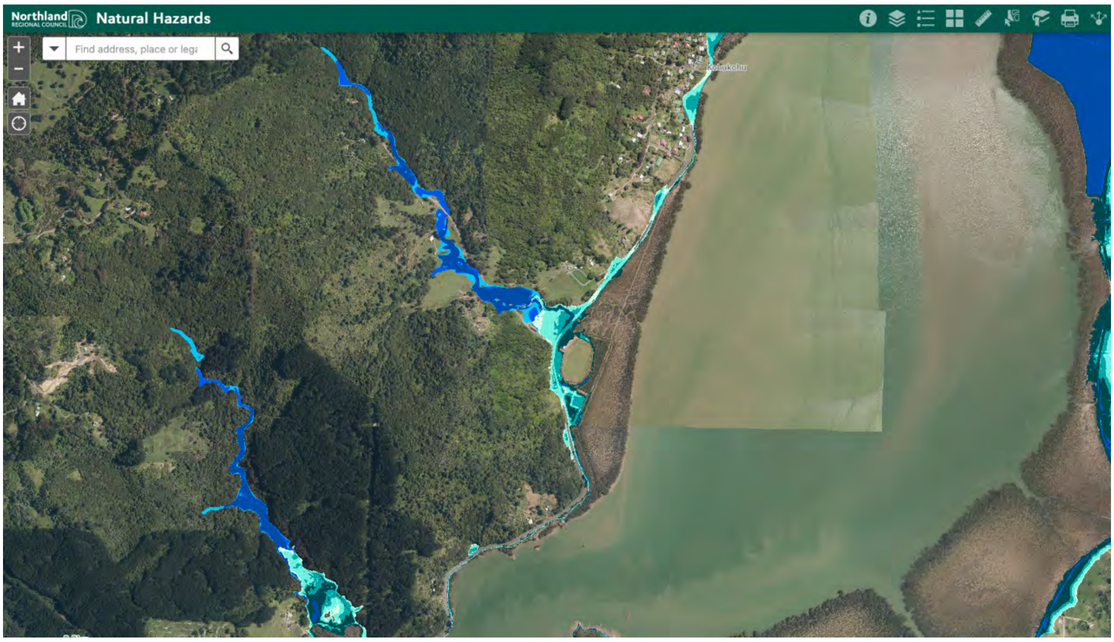
Figure 15 – Summary of GIS Analysis (Source: Jacobs)

130. It is apparent that the existing location and wastewater discharge remains culturally offensive to Te Ihutai and that the only credible solution is to find alternative land based methods to promote a culturally appropriate solution that addresses the effects on cultural values, mauri, and Te Ihutai relationship with the environment. This is compounded by the fact that none of the options presented would ever meet the cultural criteria proposed.

131. The approach to more formally and systematically consider alternative disposal options and methods should be partnership with Te Ihutai and the community to understand the level of impacts to all criteria considered appropriate. This approach has precedence in recent cases associated with the Taipa WWTP where a Working Group was established to consider in more detail such alternative disposal options.

Impacts of Flooding, Climate Change, and Urban Growth

132. Many of the reports considered to not identify the site as being flood prone or subject to coastal hazards. The Issues and Options Report uses flooding as a means to exclude potential options, however no assessment has been received on the effects of coastal flood hazards on the existing WWTP. The extent of coastal and river flooding across the various events (1:10 year; 1:50 year and 1:100 year).



133. It is currently unclear whether the flooding impacts to the WWTP affect the receiving environment and whether or not there is correlation to an effect to Tauteihiihi Marae in times of flooding or whether wastewater simply flows into the Hokianga Harbour.

134. Regardless, both outcomes remain culturally offensive and put the assessment of alternative options and investment in further renewal within environmental constraints that are considered difficult to avoid, remedy, or mitigate.

135. In terms of climate change, the operation of the Kohukohu WWTP is likely to be exacerbated by increases in rainfall intensity and severity. Impacts to existing infrastructure may result in increased stormwater infiltration resulting in further adverse cultural effects to the environment.

136. It is understood that Council is working on a climate change strategy that will link to their 30 year infrastructure strategy. It is becoming clear that likely responses for such assets, including the Kohukohu WWTP, is to relocate assets entirely, promote a managed retreat, or provide a reduction of services. Assessment of the natural hazard risk should be undertaken.

137. In terms of future urban growth, the Proposed District Plan and its supporting documentation is relatively silent on the Kohukohu township and surrounds. Modelling suggests[10] that Hokianga North areas will have stagnant growth (increase of 2 people between 2021-2034) otherwise reducing in growth between 2034-2073 (loss of 9 people).

138. However, household[11] are projected to increase with 26 households between 2021-2034 and 3 households between 2034-2073. In terms of dwellings[12] 36 are projected between 2021-2034 and 3 between 2034-2073. What this data estimates are that the households and dwellings created may not necessarily be used on a full time basis, but dwellings being constructed as holiday homes.

139. While it is difficult to determine whether this growth will utilize the Kohukohu WWTP, the Kohukohu Township is proposed to be in the General Residential Zone. The General Residential Zone allows for 600m2 sites as a Controlled Activity and 600m2 sites as a discretionary activity. Other activities within the General Residential Zone which are permitted subject to performance standards include:

   a. Visitor accommodation (up to six guests per night);
   b. Educational Facility (up to four students);
   c. Supported residential care (up to six occupants); and
   d. Multi unit development (up to three dwellings / townhouses).

140. Without any detailed assessment it is difficult to contribute further. However, there are concerns that the Proposed District Plan could result in additional growth in the township resulting in increased connections and effects to the WWTP that have not been appropriately considered. Impacts of increased

[10] Far North District Population Projections for Far North District Council (2022). Prepared by Infometrics.
[11] A household is a grouping of individuals and/or families living in the same dwelling and sharing facilities with each other.
[12] Dwellings include both occupied and unoccupied dwellings, and both are counted in the five-yearly national census.

urban growth are of concern to Te Ihutai and the cumulative effects this can bring to the Hokianga Harbour.

Land Ownership & Ancestral Connection

141. Whilst it is understood that land ownership is not an issue within the scope of a resource consent application, nonetheless it is an important cultural issue that has been raised. Enquiry into the process of how the WWTP site was obtained is considered to be required as Te Ihutai hapū actively participate in the Treaty of Waitangi settlement forums.

142. Whilst perhaps an oblique issue overall (in terms of the resource consent) there is a direct correlation to the ongoing management of the existing WWTP and the investment by Council should the land be found to be returned under any claims process.

143. In that sense, further investigation is required for an alternative disposal method and location(s) as the land under consideration may not forever be in the hands of the Far North District Council. By working proactively with Te Ihutai on this matter, including alternative locations and options, further ratepayer money may be minimised (in the long term) allowing for positive cultural outcomes supported by the community.

144. In terms of ancestral and traditional relationship to the Coastal Marine Area (CMA), the continued extension of the Kohukohu WWTP removes any such connection for Te Ihutai, particularly Tauteihiihi Marae given their proximity to the CMA and existing WWTP. This loss of access and relationship to the CMA results in a displacement of being able to gather food for manuhiri (guests).

Cultural Effects: Conclusion

145. Having considered the actual and potential cultural effects of the proposal, it is concluded that the proposal results in more than minor adverse effects to Te Ihutai.

146. The proposal is culturally repulsive, offensive and abhorrent to Te Ihutai on the basis that it mixes wastewater (despite being treated) with other forms of water and continues to impact the mauri of the Hokainga Harbour.

147. As currently presented, and when taking into consideration cumulative effects, the proposal does not provide for the relationship of maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga.

SECTION 104(1)(ab) – ENVIRONMENTAL OFFSETS AND COMPENSATION

148. Section 104(1)(ab) of the RMA requires decision makers to have regard to any measure proposed or agreed by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from the allowing the activity.

149. As currently presented, there are no offsetting or compensation proposed for any adverse effects.

SECTION 104(1)(b) – RELEVANT PLANNING PROVISIONS

150. Decision makers are required to have regard to the relevant objectives and policies of the RPS, RWSP, RCP, RAQP, PRP and NZCPS.

151. Section 6 of the Resource Consent Application provides an assessment of the relevant objectives and policies of the statutory plans listed, although does not provide consideration of the PRP or the RPS.

152. The only report which considered the relevant planning provisions is the Resource Consent Application. However, the assessment undertaken is not considered to assess the full suite of provisions relevant to the application.

153. The following tables provides an assessment of these matters from a cultural perspective.

New Zealand Coastal Policy Statement

Objective / Policy	Assessment
Recognition and Provision for Maori and their Cultural and Traditions	
To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land, by: • maintaining or enhancing natural biological and physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature; • protecting representative or significant natural ecosystems and sites of biological importance and maintaining the diversity of New Zealand's indigenous coastal flora and fauna; and • maintaining coastal water quality and enhancing it where it has deteriorated from what would otherwise be its natural condition, with significant adverse effects on ecology and habitat, because of discharges associated with human activity.	The proposal is not consistent with this policy as: • it does not maintain coastal water quality • Natural biological processing including impacts to shellfish. • Does not seek to enhance coastal water quality where it has been actively deteriorated by the WWTP and other uses within the overall catchment.
To preserve the natural character of the coastal environment and protect natural features and landscape values through: • recognising the characteristics and qualities that contribute to natural character, natural features and landscape values and their location and distribution; • identifying those areas where various forms of subdivision, use, and development would be inappropriate and protecting them from such activities; and • encouraging restoration of the coastal environment.	Parts of the Hokianga Harbour are considered as having high and outstanding natural character. These features are the known mangrove areas and saltmarshes that are located near the application site. No restoration of this area is proposed.

To take account of the principles of the Treaty of Waitangi, recognise the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment by: • recognising the ongoing and enduring relationship of tangata whenua over their lands, rohe and resources; • promoting meaningful relationships and interactions between tangata whenua and persons exercising functions and powers under the Act; • incorporating mātauranga Māori into sustainable management practices; and • recognising and protecting characteristics of the coastal environment that are of special value to tangata whenua.	The proposal is inconsistent with this objective. Tangata whenua have outlined the adverse effects to cultural values, the need for the use of matauranga maori and more meaningful interactions with decision makers associated with the WWTP. The proposal does not recognise nor protect the special cultural characteristics of the Hokianga Harbour that is of special value to tangata whenua as outlined various reports referred to.
To maintain and enhance the public open space qualities and recreation opportunities of the coastal environment by: • recognising that the coastal marine area is an extensive area of public space for the public to use and enjoy; • maintaining and enhancing public walking access to and along the coastal marine area without charge, and where there are exceptional reasons that mean this is not practicable providing alternative linking access close to the coastal marine area; and • recognising the potential for coastal processes, including those likely to be affected by climate change, to restrict access to the coastal environment and the	Access to the coastline is not a key issue of concern, but the location of the WWTP does restrict access directly opposite the Tauteihiihi Marae.

need to ensure that public access is maintained even when the coastal marine area advances inland.	
To ensure that coastal hazard risks taking account of climate change, are managed by: • locating new development away from areas prone to such risks; • considering responses, including managed retreat, for existing development in this situation; and • protecting or restoring natural defences to coastal hazards.	The proposal will result in an additional 15 years of the current location despite being mapped in a hazard zone with potential climate change implications. The proposal does not address hazards or climate change impacts on the operation of the activity over the next 15 years (if approved).
To enable people and communities to provide for their social, economic, and cultural wellbeing and their health and safety, through subdivision, use, and development, recognising that: • the protection of the values of the coastal environment does not preclude use and development in appropriate places and forms, and within appropriate limits; • some uses and developments which depend upon the use of natural and physical resources in the coastal environment are important to the social, economic and cultural wellbeing of people and communities; • functionally some uses and developments can only be located on the coast or in the coastal marine area; • the coastal environment contains renewable energy resources of significant value; • the protection of habitats of living marine resources contributes to the social, economic and cultural wellbeing of people and communities;	It is understood that the objective does not preclude uses such as the WWTP. However the following is noted: • The proposal does not depend upon the natural and physical resources of the costal environment nor does it have a functional need to be located where it is. For example, a land based system could provide

• the potential to protect, use, and develop natural and physical resources in the coastal marine area should not be compromised by activities on land; • the proportion of the coastal marine area under any formal protection is small and therefore management under the Act is an important means by which the natural resources of the coastal marine area can be protected; and • historic heritage in the coastal environment is extensive but not fully known, and vulnerable to loss or damage from inappropriate subdivision, use, and development.	a similar function outside of the coastal environment. • The proposal impacts the habitat of living marine resources that have cultural value and contribute to traditions and relationships Te Ihutai have with the Hokianga Harbour.
To ensure that management of the coastal environment recognises and provides for New Zealand's international obligations regarding the coastal environment, including the coastal marine area.	Noted.
1. Recognise that the extent and characteristics of the coastal environment vary from region to region and locality to locality; and the issues that arise may have different effects in different localities. 2. Recognise that the coastal environment includes: a. the coastal marine area; b. islands within the coastal marine area; c. areas where coastal processes, influences or qualities are significant, including coastal lakes, lagoons, tidal estuaries, saltmarshes, coastal wetlands, and the margins of these; d. areas at risk from coastal hazards; e. coastal vegetation and the habitat of indigenous coastal species including migratory birds; f. elements and features that contribute to the natural character, landscape, visual qualities or amenity values;	The Coastal Environment has been mapped by the NRC as required. The site is within the Coastal Environment as mapped by the NRC.

g. items of cultural and historic heritage in the coastal marine area or on the coast; h. inter-related coastal marine and terrestrial systems, including the intertidal zone; and i. physical resources and built facilities, including infrastructure, that have modified the coastal environment.	
In taking account of the principles of the Treaty of Waitangi (Te Tiriti o Waitangi), and kaitiakitanga, in relation to the coastal environment: a. recognise that tangata whenua have traditional and continuing cultural relationships with areas of the coastal environment, including places where they have lived and fished for generations; b. involve iwi authorities or hapū on behalf of tangata whenua in the preparation of regional policy statements, and plans, by undertaking effective consultation with tangata whenua; with such consultation to be early, meaningful, and as far as practicable in accordance with tikanga Māori; c. with the consent of tangata whenua and as far as practicable in accordance with tikanga Māori, incorporate mātauranga Māori1 in regional policy statements, in plans, and in the consideration of applications for resource consents, notices of requirement for designation and private plan changes; d. provide opportunities in appropriate circumstances for Māori involvement in decision making, for example when a consent application or notice of requirement is dealing with cultural localities or issues of cultural significance, and Māori experts, including pūkenga2, may have knowledge not otherwise available; e. take into account any relevant iwi resource management plan and any other relevant planning document recognised by the appropriate iwi authority or hapū	The proposal is inconsistent with this objective and is directly related to many of the issues articulated in this CIA. The proposal does not recognise the historic relationships of Te Ihutai with the coastal environment which included travel and fish / kaimoana gathering. Matauranga maori has not been incorporated into the proposal. No cultural monitoring is provided in the proposal.

and lodged with the council, to the extent that its content has a bearing on resource management issues in the region or district; and i. where appropriate incorporate references to, or material from, iwi resource management plans in regional policy statements and in plans; and ii. consider providing practical assistance to iwi or hapū who have indicated a wish to develop iwi resource management plans; f. provide for opportunities for tangata whenua to exercise kaitiakitanga over waters, forests, lands, and fisheries in the coastal environment through such measures as: i. bringing cultural understanding to monitoring of natural resources; ii. providing appropriate methods for the management, maintenance and protection of the taonga of tangata whenua; iii. having regard to regulations, rules or bylaws relating to ensuring sustainability of fisheries resources such as taiāpure, mahinga mātaitai or other non commercial Māori customary fishing; g. in consultation and collaboration with tangata whenua, working as far as practicable in accordance with tikanga Māori, and recognising that tangata whenua have the right to choose not to identify places or values of historic, cultural or spiritual significance or special value: i. recognise the importance of Māori cultural and heritage values through such methods as historic heritage, landscape and cultural impact assessments; and ii. provide for the identification, assessment, protection and management of areas or sites of significance or special value to Māori, including by historic analysis and archaeological survey and the development of methods such as alert layers and predictive methodologies for identifying areas of high	

potential for undiscovered Māori heritage, for example coastal pā or fishing villages.	
1. Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse. 2. In particular, adopt a precautionary approach to use and management of coastal resources potentially vulnerable to effects from climate change, so that: a. avoidable social and economic loss and harm to communities does not occur; b. natural adjustments for coastal processes, natural defences, ecosystems, habitat and species are allowed to occur; and c. the natural character, public access, amenity and other values of the coastal environment meet the needs of future generations.	The effects to future generations as it relates to the Hokianga Harbour is not known as there is no full understanding of the cumulative effects and various discharges which affect this taonga. The location of the WWTP affects amenity as it relates to Te Ihutai, particularly Tauteihiihi Marae.
Provide for the integrated management of natural and physical resources in the coastal environment, and activities that affect the coastal environment. This requires: a. co-ordinated management or control of activities within the coastal environment, and which could cross administrative boundaries, particularly: i. the local authority boundary between the coastal marine area and land; ii. local authority boundaries within the coastal environment, both within the coastal marine area and on land; and iii. where hapū or iwi boundaries or rohe cross local authority boundaries;	The effects of potential coastal inundation to the proposal has not been appropriately considered. Significant cumulative effects have not been addressed and there is no understanding of a 'tipping point' for the Hokianga Harbour.

b. working collaboratively with other bodies and agencies with responsibilities and functions relevant to resource management, such as where land or waters are held or managed for conservation purposes; and c. particular consideration of situations where: i. subdivision, use, or development and its effects above or below the line of mean high water springs will require, or is likely to result in, associated use or development that crosses the line of mean high water springs; or ii. public use and enjoyment of public space in the coastal environment is affected, or is likely to be affected; or iii. development or land management practices may be affected by physical changes to the coastal environment or potential inundation from coastal hazards, including as a result of climate change; or iv. land use activities affect, or are likely to affect, water quality in the coastal environment and marine ecosystems through increasing sedimentation; or v. significant adverse cumulative effects are occurring, or can be anticipated.	
1. Consider effects on land or waters in the coastal environment held or managed under: a. the Conservation Act 1987 and any Act listed in the 1st Schedule to that Act; or b. other Acts for conservation or protection purposes; and, having regard to the purposes for which the land or waters are held or managed: c. avoid adverse effects of activities that are significant in relation to those purposes; and d. otherwise avoid, remedy or mitigate adverse effects of activities in relation to those purposes.	Noted.

2. Have regard to publicly notified proposals for statutory protection of land or waters in the coastal environment and the adverse effects of activities on the purposes of that proposed statutory protection.	
1. In relation to the coastal environment: a. recognise that the provision of infrastructure, the supply and transport of energy including the generation and transmission of electricity, and the extraction of minerals are activities important to the social, economic and cultural well-being of people and communities; b. consider the rate at which built development and the associated public infrastructure should be enabled to provide for the reasonably foreseeable needs of population growth without compromising the other values of the coastal environment; c. encourage the consolidation of existing coastal settlements and urban areas where this will contribute to the avoidance or mitigation of sprawling or sporadic patterns of settlement and urban growth; d. recognise tangata whenua needs for papakāinga3, marae and associated developments and make appropriate provision for them; e. consider where and how built development on land should be controlled so that it does not compromise activities of national or regional importance that have a functional need to locate and operate in the coastal marine area; f. consider where development that maintains the character of the existing built environment should be encouraged, and where development resulting in a change in character would be acceptable; g. take into account the potential of renewable resources in the coastal environment, such as energy from wind, waves, currents and tides, to meet the reasonably foreseeable needs of future generations; h. consider how adverse visual impacts of development can be avoided in areas sensitive to such effects, such as headlands and prominent	The activity within the coastal environment is not considered appropriate from a cultural perspective. While there is a need for the asset, the location and method of disposal is a particular issue of concern to Te Ihutai. There is not a functional need for the WWTP to be located where it is. This is a legacy decision that exists today and causes adverse environmental effects.

ridgelines, and as far as practicable and reasonable apply controls or conditions to avoid those effects; i. set back development from the coastal marine area and other water bodies, where practicable and reasonable, to protect the natural character, open space, public access and amenity values of the coastal environment; and j. where appropriate, buffer areas and sites of significant indigenous biological diversity, or historic heritage value. 2. Additionally, in relation to the coastal marine area: a. recognise potential contributions to the social, economic and cultural wellbeing of people and communities from use and development of the coastal marine area, including the potential for renewable marine energy to contribute to meeting the energy needs of future generations; b. recognise the need to maintain and enhance the public open space and recreation qualities and values of the coastal marine area; c. recognise that there are activities that have a functional need to be located in the coastal marine area, and provide for those activities in appropriate places; d. recognise that activities that do not have a functional need for location in the coastal marine area generally should not be located there; and e. promote the efficient use of occupied space, including by: i. requiring that structures be made available for public or multiple use wherever reasonable and practicable; ii. requiring the removal of any abandoned or redundant structure that has no heritage, amenity or reuse value; and iii. considering whether consent conditions should be applied to ensure that space occupied for an activity is used for that purpose effectively and without unreasonable delay.	

1. In preparing regional policy statements, and plans:
    a. consider where, how and when to provide for future residential, rural residential, settlement, urban development and other activities in the coastal environment at a regional and district level; and
    b. identify areas of the coastal environment where particular activities and forms of subdivision, use, and development:
        i. are inappropriate; and
        ii. may be inappropriate without the consideration of effects through a resource consent application, notice of requirement for designation or Schedule 1 of the Resource Management Act process; and provide protection from inappropriate subdivision, use, and development in these areas through objectives, policies and rules.
2. Identify in regional policy statements, and plans, coastal processes, resources or values that are under threat or at significant risk from adverse cumulative effects. Include provisions in plans to manage these effects. Where practicable, in plans, set thresholds (including zones, standards or targets), or specify acceptable limits to change, to assist in determining when activities causing adverse cumulative effects are to be avoided.
	As the RPS is operative and the PRP (Appeals) moves through the statutory process, it is considered that this objective has been met by NRC.

Recognise the significant existing and potential contribution of aquaculture to the social, economic and cultural well-being of people and communities by:
 	
a. including in regional policy statements and regional coastal plans provision for aquaculture activities in appropriate places in the coastal environment, recognising that relevant considerations may include:
    i. the need for high water quality for aquaculture activities; and
    ii. the need for land-based facilities associated with marine farming;
b. taking account of the social and economic benefits of aquaculture, including any available assessments of national and regional economic benefits; and
	Aquaculture, if undertaken within the Hokianga Harbour would need to contend with the current environmental issues that are contributing to the poor heath (mauri) of the Hokainga Harbour.
	
	There have been many attempts to start mataitai and

c. ensuring that development in the coastal environment does not make water quality unfit for aquaculture activities in areas approved for that purpose.	taiapure within the Hokainga Harbour, however these have not eventuated. Future potential for such activities may be impacted by the cumulative effects impacting the Hokianga Harbour.
Recognise that a sustainable national transport system requires an efficient national network of safe ports, servicing national and international shipping, with efficient connections with other transport modes, including by: a. ensuring that development in the coastal environment does not adversely affect the efficient and safe operation of these ports, or their connections with other transport modes; and b. considering where, how and when to provide in regional policy statements and in plans for the efficient and safe operation of these ports, the development of their capacity for shipping, and their connections with other transport modes.	Not relevant
1. Avoid reclamation of land in the coastal marine area, unless: a. land outside the coastal marine area is not available for the proposed activity; b. the activity which requires reclamation can only occur in or adjacent to the coastal marine area; c. there are no practicable alternative methods of providing the activity; and d. the reclamation will provide significant regional or national benefit. 2. Where a reclamation is considered to be a suitable use of the coastal marine area, in considering its form and design have particular regard to: a. the potential effects on the site of climate change, including sea level rise, over no less than 100 years;	Not relevant.

b. the shape of the reclamation and, where appropriate, whether the materials used are visually and aesthetically compatible with the adjoining coast; c. the use of materials in the reclamation, including avoiding the use of contaminated materials that could significantly adversely affect water quality, aquatic ecosystems and indigenous biodiversity in the coastal marine area; d. providing public access, including providing access to and along the coastal marine area at high tide where practicable, unless a restriction on public access is appropriate as provided for in Policy 19; e. the ability to remedy or mitigate adverse effects on the coastal environment; f. whether the proposed activity will affect cultural landscapes and sites of significance to tangata whenua; and g. the ability to avoid consequential erosion and accretion, and other natural hazards. 3. In considering proposed reclamations, have particular regard to the extent to which the reclamation and intended purpose would provide for the efficient operation of infrastructure, including ports, airports, coastal roads, pipelines, electricity transmission, railways and ferry terminals, and of marinas and electricity generation. 4. De-reclamation of redundant reclaimed land is encouraged where it would: a. restore the natural character and resources of the coastal marine area; and b. provide for more public open space.	
To protect indigenous biological diversity in the coastal environment: a. avoid adverse effects of activities on: i. indigenous taxa4 that are listed as threatened5 or at risk in the New Zealand Threat Classification System lists;	The various reports note that effects are occurring to indigenous marine species from the WWTP.

ii. taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened; iii. indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare6; iv. habitats of indigenous species where the species are at the limit of their natural range, or are naturally rare; v. areas containing nationally significant examples of indigenous community types; and vi. areas set aside for full or partial protection of indigenous biological diversity under other legislation; and b. avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on: i. areas of predominantly indigenous vegetation in the coastal environment; ii. habitats in the coastal environment that are important during the vulnerable life stages of indigenous species; iii. indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh; iv. habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes; v. habitats, including areas and routes, important to migratory species; and vi. ecological corridors, and areas important for linking or maintaining biological values identified under this policy.	There is no assessment of the impacts of the proposal on the existing saltmarshes and mangrove areas. This impacts the ability of the Hokianga Harbour to operate as a mahinga kai.
1. Provide in regional policy statements and in plans, as far as practicable, for the control of activities in or near the coastal marine area that could have adverse effects on the coastal environment by causing harmful aquatic organisms7 to be released or otherwise spread, and include conditions in resource consents, where relevant, to assist with managing the risk of such effects occurring. 2. Recognise that activities relevant to (1) include:	There is no assessment within the proposal confirming that the proposal does not impact the potential spread of aquatic organisms.

a. the introduction of structures likely to be contaminated with harmful aquatic organisms; b. the discharge or disposal of organic material from dredging, or from vessels and structures, whether during maintenance, cleaning or otherwise; and whether in the coastal marine area or on land; c. the provision and ongoing maintenance of moorings, marina berths, jetties and wharves; and d. the establishment and relocation of equipment and stock required for or associated with aquaculture.	
1. To preserve the natural character of the coastal environment and to protect it from inappropriate subdivision, use, and development: a. avoid adverse effects of activities on natural character in areas of the coastal environment with outstanding natural character; and b. avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on natural character in all other areas of the coastal environment; including by: c. assessing the natural character of the coastal environment of the region or district, by mapping or otherwise identifying at least areas of high natural character; and d. ensuring that regional policy statements, and plans, identify areas where preserving natural character requires objectives, policies and rules, and include those provisions. 2. Recognise that natural character is not the same as natural features and landscapes or amenity values and may include matters such as: a. natural elements, processes and patterns; b. biophysical, ecological, geological and geomorphological aspects; c. natural landforms such as headlands, peninsulas, cliffs, dunes, wetlands, reefs, freshwater springs and surf breaks; d. the natural movement of water and sediment; e. the natural darkness of the night sky;	The proposal although within the Coastal Environment, is not mapped as being with high or outstanding natural character areas.

f. places or areas that are wild or scenic; g. a range of natural character from pristine to modified; and h. experiential attributes, including the sounds and smell of the sea; and their context or setting.	
Promote restoration or rehabilitation of the natural character of the coastal environment, including by: a. identifying areas and opportunities for restoration or rehabilitation; b. providing policies, rules and other methods directed at restoration or rehabilitation in regional policy statements, and plans; c. where practicable, imposing or reviewing restoration or rehabilitation conditions on resource consents and designations, including for the continuation of activities; and recognising that where degraded areas of the coastal environment require restoration or rehabilitation, possible approaches include: i. restoring indigenous habitats and ecosystems, using local genetic stock where practicable; or ii. encouraging natural regeneration of indigenous species, recognising the need for effective weed and animal pest management; or iii. creating or enhancing habitat for indigenous species; or iv. rehabilitating dunes and other natural coastal features or processes, including saline wetlands and intertidal saltmarsh; or v. restoring and protecting riparian and intertidal margins; or vi. reducing or eliminating discharges of contaminants; or vii. removing redundant structures and materials that have been assessed to have minimal heritage or amenity values and when the removal is authorised by required permits, including an archaeological authority under the Historic Places Act 1993; or viii. restoring cultural landscape features; or ix. redesign of structures that interfere with ecosystem processes; or	The proposal includes no mitigation measures to restore or rehabilitate natural character of the coastal environment.

x. decommissioning or restoring historic landfill and other contaminated sites which are, or have the potential to, leach material into the coastal marine area.	
To protect the natural features and natural landscapes (including seascapes) of the coastal environment from inappropriate subdivision, use, and development: a. avoid adverse effects of activities on outstanding natural features and outstanding natural landscapes in the coastal environment; and b. avoid significant adverse effects and avoid, remedy, or mitigate other adverse effects of activities on other natural features and natural landscapes in the coastal environment; including by: c. identifying and assessing the natural features and natural landscapes of the coastal environment of the region or district, at minimum by land typing, soil characterisation and landscape characterisation and having regard to: i. natural science factors, including geological, topographical, ecological and dynamic components; ii. the presence of water including in seas, lakes, rivers and streams; iii. legibility or expressiveness – how obviously the feature or landscape demonstrates its formative processes; iv. aesthetic values including memorability and naturalness; v. vegetation (native and exotic); vi. transient values, including presence of wildlife or other values at certain times of the day or year; vii. whether the values are shared and recognised; viii. cultural and spiritual values for tangata whenua, identified by working, as far as practicable, in accordance with tikanga Māori; including their expression as cultural landscapes and features; ix. historical and heritage associations; and x. wild or scenic values;	Not relevant as there are no nearby mapped outstanding natural features or landscapes.

d. ensuring that regional policy statements, and plans, map or otherwise identify areas where the protection of natural features and natural landscapes requires objectives, policies and rules; and e. including the objectives, policies and rules required by (d) in plans.	
Protect the surf breaks8 of national significance for surfing listed in Schedule 1, by: a. ensuring that activities in the coastal environment do not adversely affect the surf breaks; and b. avoiding adverse effects of other activities on access to, and use and enjoyment of the surf breaks.	Not relevant.
Protect historic heritage9 in the coastal environment from inappropriate subdivision, use, and development by: a. identification, assessment and recording of historic heritage, including archaeological sites; b. providing for the integrated management of such sites in collaboration with relevant councils, heritage agencies, iwi authorities and kaitiaki; c. initiating assessment and management of historic heritage in the context of historic landscapes; d. recognising that heritage to be protected may need conservation; e. facilitating and integrating management of historic heritage that spans the line of mean high water springs; f. including policies, rules and other methods relating to (a) to (e) above in regional policy statements, and plans; g. imposing or reviewing conditions on resource consents and designations, including for the continuation of activities; h. requiring, where practicable, conservation conditions; and	The Hokianga Harbour has not been identified and mapped as an area of cultural significance in statutory plans, however the RPS may well consider this as a Place of Significance despite being mapped as it meets many of the relevant criteria. As assessment of this has been undertaken and it is considered that the Harbour is a 'Place of Significance'.

i. considering provision for methods that would enhance owners' opportunities for conservation of listed heritage structures, such as relief grants or rates relief.	
Recognise the need for public open space within and adjacent to the coastal marine area, for public use and appreciation including active and passive recreation, and provide for such public open space, including by: a. ensuring that the location and treatment of public open space is compatible with the natural character, natural features and landscapes, and amenity values of the coastal environment; b. taking account of future need for public open space within and adjacent to the coastal marine area, including in and close to cities, towns and other settlements; c. maintaining and enhancing walking access linkages between public open space areas in the coastal environment; d. considering the likely impact of coastal processes and climate change so as not to compromise the ability of future generations to have access to public open space; and e. recognising the important role that esplanade reserves and strips can have in contributing to meeting public open space needs.	The proposal does not promote public open space.
1. Recognise the public expectation of and need for walking access to and along the coast that is practical, free of charge and safe for pedestrian use. 2. Maintain and enhance public walking access to, along and adjacent to the coastal marine area, including by: a. identifying how information on where the public have walking access will be made publicly available; b. avoiding, remedying or mitigating any loss of public walking access resulting from subdivision, use, or development; and c. identifying opportunities to enhance or restore public walking access, for example where: i. connections between existing public areas can be provided; or	The proposal does not promote walking access along the coast.

ii. improving access would promote outdoor recreation; or iii. physical access for people with disabilities is desirable; or iv. the long-term availability of public access is threatened by erosion or sea level rise; or v. access to areas or sites of historic or cultural significance is important; or vi. subdivision, use, or development of land adjacent to the coastal marine area has reduced public access, or has the potential to do so. 3. Only impose a restriction on public walking access to, along or adjacent to the coastal marine area where such a restriction is necessary: a. to protect threatened indigenous species; or b. to protect dunes, estuaries and other sensitive natural areas or habitats; or c. to protect sites and activities of cultural value to Māori; or d. to protect historic heritage; or e. to protect public health or safety; or f. to avoid or reduce conflict between public uses of the coastal marine area and its margins; or g. for temporary activities or special events; or h. for defence purposes in accordance with the Defence Act 1990; or i. to ensure a level of security consistent with the purpose of a resource consent; or j. in other exceptional circumstances sufficient to justify the restriction. 4. Before imposing any restriction under (3), consider and where practicable provide for alternative routes that are available to the public free of charge at all times.	
1. Control use of vehicles, apart from emergency vehicles, on beaches, foreshore, seabed and adjacent public land where: a. damage to dune or other geological systems and processes; or b. harm to ecological systems or to indigenous flora and fauna, for example marine mammal and bird habitats or breeding areas and shellfish beds; or	The proposal does not promote vehicle access.

c. danger to other beach users; or d. disturbance of the peaceful enjoyment of the beach environment; or e. damage to historic heritage; or f. damage to the habitats of fisheries resources of significance to customary, commercial or recreational users; or g. damage to sites of significance to tangata whenua; might result. 2. Identify the locations where vehicular access is required for boat launching, or as the only practicable means of access to private property or public facilities, or for the operation of existing commercial activities, and make appropriate provision for such access. 3. Identify any areas where and times when recreational vehicular use on beaches, foreshore and seabed may be permitted, with or without restriction as to type of vehicle, without a likelihood of any of (1)(a) to (g) occurring.	
Where the quality of water in the coastal environment has deteriorated so that it is having a significant adverse effect on ecosystems, natural habitats, or water-based recreational activities, or is restricting existing uses, such as aquaculture, shellfish gathering, and cultural activities, give priority to improving that quality by: a. identifying such areas of coastal water and water bodies and including them in plans; b. including provisions in plans to address improving water quality in the areas identified above; c. where practicable, restoring water quality to at least a state that can support such activities and ecosystems and natural habitats; d. requiring that stock are excluded from the coastal marine area, adjoining intertidal areas and other water bodies and riparian margins in the coastal environment, within a prescribed time frame; and e. engaging with tangata whenua to identify areas of coastal waters where they have particular interest, for example in cultural sites, wāhi tapu, other taonga, and	The Hokianga Harbour is being deteriorated to a point where significant adverse effects are occurring. This is resulting from the proposal, as well as other activities and discharges. Despite this the Hokianga Harbour is not formally identified or protected in statutory plans. Remediation and mitigation is not possible to the extent required by Te Ihutai as any discharge to the

values such as mauri, and remedying, or, where remediation is not practicable, mitigating adverse effects on these areas and values.	Harbour is considered culturally repugnant.
1. Assess and monitor sedimentation levels and impacts on the coastal environment. 2. Require that subdivision, use, or development will not result in a significant increase in sedimentation in the coastal marine area, or other coastal water. 3. Control the impacts of vegetation removal on sedimentation including the impacts of harvesting plantation forestry. 4. Reduce sediment loadings in runoff and in stormwater systems through controls on land use activities.	The effects of the wastewater discharge will have effects to shellfish as outlined in the Streamlined Environmental Report.
1. In managing discharges to water in the coastal environment, have particular regard to: a. the sensitivity of the receiving environment; b. the nature of the contaminants to be discharged, the particular concentration of contaminants needed to achieve the required water quality in the receiving environment, and the risks if that concentration of contaminants is exceeded; and c. the capacity of the receiving environment to assimilate the contaminants; and: d. avoid significant adverse effects on ecosystems and habitats after reasonable mixing; e. use the smallest mixing zone necessary to achieve the required water quality in the receiving environment; and f. minimise adverse effects on the life-supporting capacity of water within a mixing zone. 2. In managing discharge of human sewage, do not allow: a. discharge of human sewage directly to water in the coastal environment without treatment; and	The Hokianga Harbour is considered a sensitive cultural environment. The discharge proposed, as well as others in the environment, is resulting in adverse cultural effects. Whilst the capacity of the Harbour to assimilate the potential effects are noted (based on its scale), the effects nonetheless are culturally offensive. It is not believed that there has not been adequate

b. the discharge of treated human sewage to water in the coastal environment, unless: i. there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge; and ii. informed by an understanding of tangata whenua values and the effects on them. 3. Objectives, policies and rules in plans which provide for the discharge of treated human sewage into waters of the coastal environment must have been subject to early and meaningful consultation with tangata whenua. 4. In managing discharges of stormwater take steps to avoid adverse effects of stormwater discharge to water in the coastal environment, on a catchment by catchment basis, by: a. avoiding where practicable and otherwise remedying cross contamination of sewage and stormwater systems; b. reducing contaminant and sediment loadings in stormwater at source, through contaminant treatment and by controls on land use activities; c. promoting integrated management of catchments and stormwater networks; and d. promoting design options that reduce flows to stormwater reticulation systems at source. 5. In managing discharges from ports and other marine facilities: a. require operators of ports and other marine facilities to take all practicable steps to avoid contamination of coastal waters, substrate, ecosystems and habitats that is more than minor; b. require that the disturbance or relocation of contaminated seabed material, other than by the movement of vessels, and the dumping or storage of dredged material does not result in significant adverse effects on water quality or the seabed, substrate, ecosystems or habitats; c. require operators of ports, marinas and other relevant marine facilities to provide for the collection of sewage and waste from vessels, and for	consideration of alternative methods and sites for undertaking the required discharge. Whilst a desktop study has been made available, the need for further investigation is considered required. Therefore, discharge of human sewage is not possible under the NZCPS.

residues from vessel maintenance to be safely contained and disposed of; and d. consider the need for facilities for the collection of sewage and other wastes for recreational and commercial boating.	
1. Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to: a. physical drivers and processes that cause coastal change including sea level rise; b. short-term and long-term natural dynamic fluctuations of erosion and accretion; c. geomorphological character; d. the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent; e. cumulative effects of sea level rise, storm surge and wave height under storm conditions; f. influences that humans have had or are having on the coast; g. the extent and permanence of built development; and h. the effects of climate change on: i. matters (a) to (g) above; ii. storm frequency, intensity and surges; and iii. coastal sediment dynamics; taking into account national guidance and the best available information on the likely effects of climate change on the region or district.	The site is impacted by such coastal hazards, having been mapped by NRC. No assessment has been made on this matter.
In areas potentially affected by coastal hazards over at least the next 100 years: a. avoid increasing the risk10 of social, environmental and economic harm from coastal hazards;	Consideration of risk of the WWTP within an area of

b. avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards; c. encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocatability or recoverability from hazard events; d. encourage the location of infrastructure away from areas of hazard risk where practicable; e. discourage hard protection structures and promote the use of alternatives to them, including natural defences; and f. consider the potential effects of tsunami and how to avoid or mitigate them.	coastal hazards has not been undertaken. Managed retreat is not proposed. The NZCPS encourages the location of infrastructure such as the WWTP away from hazard risks where practicable. This aspect has not been substantiated.
1. Provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or sites of significant biodiversity, cultural or historic heritage or geological value, from coastal hazards. 2. Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands.	Not relevant.
1. In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes: a. promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk; b. identifying the consequences of potential strategic options relative to the option of “do-nothing”; c. recognising that hard protection structures may be the only practical means to protect existing infrastructure of national or regional importance,	In relation to the WWTP a desktop assessment has been undertaken, however this CIA considers that further investigation is required to minmise cultural effects.

to sustain the potential of built physical resources to meet the reasonably foreseeable needs of future generations; d. recognising and considering the environmental and social costs of permitting hard protection structures to protect private property; and e. identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches. 2. In evaluating options under (1): a. focus on approaches to risk management that reduce the need for hard protection structures and similar engineering interventions; b. take into account the nature of the coastal hazard risk and how it might change over at least a 100-year timeframe, including the expected effects of climate change; and c. evaluate the likely costs and benefits of any proposed coastal hazard risk reduction options. 3. Where hard protection structures are considered to be necessary, ensure that the form and location of any structures are designed to minimise adverse effects on the coastal environment. 4. Hard protection structures, where considered necessary to protect private assets, should not be located on public land if there is no significant public or environmental benefit in doing so.	
1. To monitor and review the effectiveness of the NZCPS in achieving the purpose of the Act, the Minister of Conservation should: a. in collaboration with local authorities collect data for, and, as far as practicable, incorporate district and regional monitoring information into a nationally consistent monitoring and reporting programme; b. undertake other information gathering or monitoring that assists in providing a national perspective on coastal resource management trends, emerging issues and outcomes;	Not relevant.

c. within six years of its gazettal, assess the effect of the NZCPS on regional policy statements, plans, and resource consents, and other decision-making; and d. publish a report and conclusions on matters (a) to (c) above.	

Regional Policy Statement for Northland

Objective / Policy	**Assessment**
Integrated Catchment Management	
Integrate the management of freshwater and the subdivision, use and development of land in catchments to enable catchment-specific objectives for fresh and associated coastal water to be met.	There are currently no catchment specific objectives for the Hokianga Harbour. Cumulative effects are therefore allowed to continue unabated as there is minimal understanding of the true effect of overall discharge and effects to the Hokianga Harbour.
Collaboratively: (a) Identify the values of water in catchments and receiving estuaries and harbours; (b) Provide for these values by establishing catchment-specific objectives and set water quality limits and environmental flows and / or levels, and where necessary targets; and (c) Establish methods to avoid, and where necessary phase out, over- allocation.	This has not occurred.
Region Wide Water Quality	
Improve the overall quality of Northland's fresh and coastal water with a particular focus on:	The proposal is unlikely to reduce sedimentation rates.

(a) Reducing the overall Trophic Level Index status of the region's lakes; (b) Increasing the overall Macroinvertebrate Community Index status of the region's rivers and streams; (c) Reducing sedimentation rates in the region's estuaries and harbours; (d) Improving microbiological water quality at popular contact recreation sites, recreational and cultural shellfish gathering sites, and commercial shellfish growing areas to minimise risk to human health; and (e) Protecting the quality of registered drinking water supplies and the potable quality of other drinking water sources.	Faecal matter has been found in shellfish, with potential impacts to human health. Risks to human health have been assessed, however further research is required (faecal tracking).
Improve the overall quality of Northland's water resources by: (a) Establishing freshwater objectives and setting region-wide water quality limits in regional plans that give effect to Objective 3.2 of this regional policy statement. (b) Reducing loads of sediment, nutrients, and faecal matter to water from the use and development of land and from poorly treated and untreated discharges of wastewater; and (c) Promoting and supporting the active management, enhancement and creation of vegetated riparian margins and wetlands.	Sediment and faecal matter from the proposal are not being reduced.
Indigenous Ecosystems and Biodiversity	
Safeguard Northland's ecological integrity by: a) Protecting areas of significant indigenous vegetation and significant habitats of indigenous fauna;	The ecological integrity of the Hokianga Harbour is not considered to be safeguarded with the proposal leading to effects to aquatic life.

b) Maintaining the extent and diversity of indigenous ecosystems and habitats in the region; and c) Where practicable, enhancing indigenous ecosystems and habitats, particularly where this contributes to the reduction in the overall threat status of regionally and nationally threatened species.	
(1) In the coastal environment, avoid adverse effects, and outside the coastal environment avoid, remedy or mitigate adverse effects of subdivision, use and development so they are no more than minor on: (a) Indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists; (b) Areas of indigenous vegetation and habitats of indigenous fauna, that are significant using the assessment criteria in Appendix 5; (c) Areas set aside for full or partial protection of indigenous biodiversity under other legislation. (2) In the coastal environment, avoid significant adverse effects and avoid, remedy, or mitigate other adverse effects of subdivision, use and development on: (a) Areas of predominantly indigenous vegetation; (b) Habitats of indigenous species that are important for recreational, commercial, traditional or cultural purposes; (c) Indigenous ecosystems and habitats that are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass, northern wet heathlands, coastal and	The effects of the proposal to the Hokianga Harbour which has a variety of cultural uses is not being appropriately avoided, remedied or mitigated. Cumulative effects are somewhat unknown because there are no overarching limits or objectives for the Hokainga Harbour as a whole.

headwater streams, floodplains, margins of the coastal marine area and freshwater bodies, spawning and nursery areas and saltmarsh. (3) Outside the coastal environment and where clause (1) does not apply, avoid, remedy or mitigate adverse effects of subdivision, use and development so they are not significant on any of the following: (a) Areas of predominantly indigenous vegetation; (b) Habitats of indigenous species that are important for recreational, commercial, traditional or cultural purposes; (c) Indigenous ecosystems and habitats that are particularly vulnerable to modification, including wetlands, dunelands, northern wet heathlands, headwater streams, floodplains and margins of freshwater bodies, spawning and nursery areas. (4) For the purposes of clause (1), (2) and (3), when considering whether there are any adverse effects and/or any significant adverse effects: (a) Recognise that a minor or transitory effect may not be an adverse effect; (b) Recognise that where the effects are or maybe irreversible, then they are likely to be more than minor; (c) Recognise that there may be more than minor cumulative effects from minor or transitory effects. (5) For the purpose of clause (3) if adverse effects cannot be reasonably avoided, remedied or mitigated then it maybe appropriate to consider the next steps in the	

mitigation hierarchy i.e. biodiversity offsetting followed by environmental biodiversity compensation, as methods to achieve Objective 3.4.	
Regionally Significant Infrastructure	
Recognise and promote the benefits of regionally significant infrastructure, (a physical resource), which through its use of natural and physical resources can significantly enhance Northland's economic, cultural, environmental and social wellbeing.	The existing infrastructure is causing adverse cultural effects, despite its utility in serving the Kohukohu Township.
(1) Allow adverse effects arising from the establishment and operation of new regionally significant infrastructure and the re-consenting of existing operations where: (a) The proposal is consistent with Policies 4.4.1(1), 4.4.1(2). 4.6.1(1)(a), 4.6.1(1)(b), 4.6.1(2) and 4.6.2 (1); (b) The proposal does not result in established water quality limits or environmental flows and / or levels being exceeded or otherwise could lead to the over-allocation of a catchment (refer to Policy 4.1.1); (c) Damage to and / or loss of the relationship of iwi with ancestral sites, sites of significance, wāhi tapu, customary activities and / or taonga is avoided or otherwise agreed to by the affected iwi or hapū; and (d) In addition to the matters outlined in 1) (a) – (c) above, other adverse effects are avoided, remedied or mitigated to the extent that they are no more than minor. (2) Allow adverse effects arising from the maintenance and upgrading of established regionally significant infrastructure wherever it is located, where:	The re-consenting of this application will promote continued adverse cultural effects. The relationship of Te Ihutai to the Hokianga Harbour is reduced by the WWTP. This has not been agreed to by Te Ihutai. Consideration of alternative disposal locations have occurred however, further investigation is required to confirm whether these are practicable, feasible and cause no greater adverse effects than the existing system.

(a) The adverse effects whilst the maintenance or upgrading is being undertaken are not significant; and (b) The adverse effects after the conclusion of the maintenance or upgrading are the same or similar to before the activity being undertaken. (3) When managing the adverse effects of regionally significant infrastructure decision makers will give weight to: (a) The benefits of the activity in terms of Policy 5.3.2; (b) Whether the activity must be recognised and provided for as directed by a national policy statement; (c) Any constraints that limit the design and location of the activity, including any alternatives that have been considered which have proven to be impractical, or have greater adverse effects; (d) Whether the proposal is for regionally significant infrastructure which is included in Schedule 1 of the Civil Defence Emergency Management Act as a lifeline utility and meets the reasonably foreseeable needs of Northland. (e) The extent to which the adverse effects of the activity can be practicably reduced. Such an assessment shall also take into account appropriate measures, when offered, to provide positive effects, either within the subject site or elsewhere provided that the positive effects accrue to the community of interest and / or resource affected; and (f) Whether a monitoring programme for any identified significant adverse effects with unknown or uncertain outcomes could be included as a condition of consent and an	

adaptive management regime (including modification to the consented activity) is used to respond to such effects. (g) Whether the infrastructure proposal helps to achieve consolidated development and efficient use of land.	
Efficient and Effective Infrastructure	
Manage resource use to: (a) Optimise the use of existing infrastructure; (b) Ensure new infrastructure is flexible, adaptable, and resilient, and meets the reasonably foreseeable needs of the community; and (c) Strategically enable infrastructure to lead or support regional economic development and community wellbeing.	Some optimisation of the existing system is proposed, however none of the options meet the cultural criteria provided in the MCA.
Enable people and communities to provide for their wellbeing through appropriate subdivision, use, and development that: (a) Consolidates urban development12 within or adjacent to existing coastal settlements and avoids sprawling or sporadic patterns of development; (b) Ensures sufficient development setbacks from the coastal marine area to; (i) maintain and enhance public access, open space, and amenity values; and (ii) allow for natural functioning of coastal processes and ecosystems; (c) Takes into account the values of adjoining or adjacent land and established activities (both within the coastal marine area and on land);	The proposal does not allow for the natural functioning of coastal processes and ecosystems. The discharge of treated wastewater is inconsistent with parts of the policy. The proposal has not adequately considered the effects to Tauteihiihi Marae,

(d) Ensures adequate infrastructure services will be provided for the development; and (e) Avoids adverse effects on access to, use and enjoyment of surf breaks of national significance for surfing. Note: in determining the appropriateness of subdivision, use and development, all policies and methods in the Regional Policy Statement must be considered, particularly policies relating to natural character, features and landscapes, heritage, natural hazards, indigenous ecosystems and fresh and coastal water quality.	which adjoins the site across Kohukohu Road.
Encourage development and activities to efficiently use resources, particularly network resources, water and energy, and promote the reduction and reuse of waste.	The proposal does not promote the reduction in wastewater.
Encourage the development of infrastructure that is flexible, resilient, and adaptable to the reasonably foreseeable needs of the community.	The existing infrastructure proposed to be renewed (from a consent perspective) is not considered to be flexible, resilient or meeting the needs of Te Ihutai.
Tangata whenua role in decision making	
Tangata whenua kaitiaki role is recognised and provided for in decision-making over natural and physical resources.	This CIA goes some way in meeting this objective, however it will depend on whether the decision makers accept the conclusions and recommendations of this report.
The regional and district councils shall provide opportunities for tangata whenua to participate in the review, development, implementation, and monitoring of plans and resource consent processes under the Resource Management Act 1991.	The CIA attends to this policy.

The regional and district councils shall when developing plans and processing resource consents under the Resource Management Act 1991 (RMA): (a) Recognise and provide for the relationship of tangata whenua and their culture and traditions with their ancestral land, water, sites wāhi tapu, and other taonga; (b) Have particular regard to kaitiakitanga; and (c)Take into account the principles of the Treaty of Waitangi including partnership.	The CIA attends to this policy.
The regional and district councils shall provide opportunities for the use and incorporation of Mātauranga Māori into decision-making, management, implementation, and monitoring of natural and physical resources under the Resource Management Act 1991.	The proposal does not include any such measures.
Natural Hazard Risk	
The risks and impacts of natural hazard events (including the influence of climate change) on people, communities, property, natural systems, infrastructure and our regional economy are minimised by: (a) Increasing our understanding of natural hazards, including the potential influence of climate change on natural hazard events; (b) Becoming better prepared for the consequences of natural hazard events; (c) Avoiding inappropriate new development in 10 and 100 year flood hazard areas and coastal hazard areas; (d) Not compromising the effectiveness of existing defences (natural and man-made);	The potential risks of natural hazards as they relate to the WWTP have not been considered. The proposal leaves the issue of climate change to a future strategy which is currently unknown. The effects are therefore unknown and does not meet this policy.

(e) Enabling appropriate hazard mitigation measures to be created to protect existing vulnerable development; and (f) Promoting long-term strategies that reduce the risk of natural hazards impacting on people and communities. (g) Recognising that in justified circumstances, critical infrastructure may have to be located in natural hazard-prone areas.	
Subdivision, use and development of land will be managed to minimise the risks from natural hazards by: (a) Seeking to use the best available information, including formal risk management techniques in areas potentially affected by natural hazards; (b) Minimising any increase in vulnerability due to residual risk; (c) Aligning with emergency management approaches (especially risk reduction); (d) Ensuring that natural hazard risk to vehicular access routes and building platforms for proposed new lots is considered when assessing subdivision proposals; and (e) Exercising a degree of caution that reflects the level of uncertainty as to the likelihood or consequences of a natural hazard event.	There is no recognition of the potential hazard risk within the proposal.
In 10-year and 100-year flood hazard areas and coastal hazard areas, mitigation measures to reduce natural hazard risk to existing development will be encouraged. These may include one or more of the following: (a) Designing for relocatable or recoverable structures (when changing existing buildings);	A change in approach is suggested throughout this CIA and that is to investigate further land disposal options (i.e managed retreat from the current location).

(b) Providing for low or no risk activities within hazard-prone areas; (c) Providing for setbacks (from rivers / streams or the coastal marine area); (d) Managed retreat by relocation, removal, or abandonment of structures; (e) Replacing or modifying existing development without resorting to hard protection structures (see Policy 7.2.2); or (f) Protecting, restoring or enhancing natural defences against natural hazards (see Policy 7.2.1).	
When managing subdivision, use and development in Northland, climate change effects will be included in all estimates of natural hazard risk, taking into account the scale and type of the proposed development and using the latest national guidance and best available information on the likely effects of climate change on the region or district.	The proposal somewhat considers the effects of climate change, although leaves this to another Council Strategy to determine.
Active Management	
Maintain and / or improve; (a) The natural character of the coastal environment and fresh water bodies and their margins; (b) Outstanding natural features and outstanding natural landscapes; (c) Historic heritage; (d) Areas of significant indigenous vegetation and significant habitats of indigenous fauna (including those within estuaries and harbours);	The proposal does not maintain or improve coastal water quality of the Hokianga Harbour or public access to the coast.

(e) Public access to the coast; and (f) Fresh and coastal water quality by supporting, enabling and positively recognising active management arising from the efforts of landowners, individuals, iwi, hapū and community groups.	
In plan provisions and the resource consent process, recognise and promote the positive effects of the following activities that contribute to active management: a) Pest control, particularly where it will complement an existing pest control project / programme; b) Soil conservation / erosion control; c) Measures to improve water quality in parts of the coastal marine area where it has deteriorated and is having significant adverse effects, or in freshwater bodies targeted for water quality enhancement; d) Measures to improve flows and / or levels in over allocated freshwater bodies; e) Re-vegetation with indigenous species, particularly in areas identified for natural character improvement; f) Maintenance of historic heritage resources (including sites, buildings and structures); g) Improvement of public access to and along the coastal marine area or the margins of rivers or lakes except where this would compromise the conservation of historic heritage or significant indigenous vegetation and / or significant habitats of indigenous fauna;	There are no additional measures proposed to improve water quality of the Hokianga Harbour.

h) Exclusion of stock from waterways and areas of significant indigenous vegetation and / or significant habitats of indigenous fauna; i) Protection of indigenous biodiversity values identified under Policy 4.4.1, outstanding natural character, outstanding natural landscapes or outstanding natural features either through legal means or physical works; j) Removal of redundant or unwanted structures and / or buildings except where these are of historic heritage value or where removal reduces public access to and along the coast or lakes and rivers; k) Restoration or creation of natural habitat and processes, including ecological corridors in association with indigenous biodiversity values identified under Policy 4.4.1, particularly wetlands and / or wetland sequences; l) Restoration of natural processes in marine and freshwater habitats.	
Support landowners, iwi, hapū, and community efforts to actively manage or improve key aspects of the environment especially where there is willing collaboration between participants and those efforts are directed at one or more of the activities in Policy 4.7.1.	There is no provision for the inclusion of Te Ihutai within the process associated with the operation and monitoring of the WWTP.

Proposed Regional Plan

Objective / Policy	Assessment
D.1 Tangata Whenua	
D.1.1 When an analysis of effects on tāngata whenua and their taonga is required A resource consent application must include in its assessment of environmental effects an analysis of the effects of an activity on tāngata whenua and their taonga86 if one or more of the following is likely: 1) adverse effects on mahinga kai87 or access to mahinga kai88, or 2) any damage, destruction or loss of access to wāhi tapu, sites of customary value and other ancestral sites and taonga with which Māori have a special relationship89, or 3) adverse effects on indigenous biodiversity in the beds of waterbodies or the coastal marine area where it impacts on the ability of tāngata whenua to carry out cultural and traditional activities90, or 4) the use of genetic engineering and the release of genetically modified organisms to the environment, or 5) adverse effects on tāiapure, mataitai or Māori non-commercial fisheries,91 or 6) adverse effects on protected customary rights,92 or	The CIA attends to this policy.

7) adverse effects on sites and areas of significance to tāngata whenua mapped in the Regional Plan (refer I Maps | Ngā mahere matawhenua).	
D.1.2 Requirements of an analysis of effects on tāngata whenua and their taonga If an analysis of the effects of an activity on tāngata whenua and their taonga is required in a resource consent application, the analysis must: 1) include such detail as corresponds with the scale and significance of the effects that the activity may have on tāngata whenua and their taonga, and 2) have regard to (but not be limited to): a) any relevant planning document recognised by an iwi authority (lodged with the Council) to the extent that its content has a bearing on the resource management issues of the region, and b) the outcomes of any consultation with tāngata whenua with respect to the consent application, and c) statutory acknowledgements in Treaty Settlement legislation, and 3) follow best practice,93 including requesting, in the first instance, that the relevant tāngata whenua undertake the assessment, and 4) specify the tāngata whenua that the assessment relates to, and 5) be evidence-based, and 6) incorporate, where appropriate, mātauranga Māori, and 7) identify and describe all the cultural resources and activities that may be affected by the activity,94 and 8) identify and describe the adverse effects of the activity on the cultural resources and cultural practices (including the effects on the mauri of the cultural resources, the cultural practices affected, how they are affected, and the extent of the effects), and 9) identify, where possible, how to avoid, remedy or mitigate the adverse effects on cultural values of the activity that are more than minor, and	The CIA attends to this policy.

10) include any other relevant information.	
D.1.3 Affected persons The following persons must be considered an affected person regarding notification95 where the adverse effects on the following resources and activities are minor or more than minor: ***Table 16: Circumstances where tāngata whenua are adversely affected for purposes of notification*** **Person** — **Resource or activity** The tāngata whenua identified in an analysis of the effects undertaken in accordance with policy D.1.2 'Requirements of an analysis of effects on tāngata whenua and their taonga'. — Cultural resources or activities identified in an analysis of effects undertaken in accordance with Policy D.1.2. The committee of management of a taiāpure. — Taiāpure The Māori committee, marae committee or the kaitiaki with responsibility for the mataitai. — Mataitai The tangāta kaitiaki / tiaki appointed by the provisions of the Fisheries (Kaimoana Customary Fishing) Regulations 1998 for the relevant rohe moana. — Non-commercial Māori fisheries.	Te Ihutai are considered to be directly affected by the proposal.
D.1.4 Managing effects on places of significance to tāngata whenua Resource consent for an activity may generally only be granted if the adverse effects from the activity on the values of Places of Significance to tāngata whenua in the coastal marine area and water bodies are avoided, remedied or mitigated so they are no more than minor.	The effects to cultural values are not appropriately avoided, remedied or mitigated to a no more than minor level. The Hokianga Harbour is considered to be a Place of Significance.

D.1.5 Places of significance to tāngata whenua96 For the purposes of this Plan, a place of significance to tāngata whenua: 1) is in the coastal marine area, or in a water body, where the values which may be impacted are related to any of the following: a) soil conservation, or b) quality and quantity of water, or c) aquatic ecosystems and indigenous biodiversity, and 2) Is: a) a historic heritage resource, or b) ancestral land, water, site, wāhi tapu, or other taonga, and 3) is either: a) a Site or Area of Significance to tāngata whenua, which is a single resource or set of resources identified, described and contained in a mapped location, or b) a Landscape of Significance to tāngata whenua, which is a collection of related resources identified and described within a mapped area, with the relationship between those component resources identified,97 and	The Hokianga Harbour is considered as a Place of Significance.

4) has one or more of the following attributes: a) Historic associations, which include but are not limited to: vii. stories of initial migration, arrival and settlement, or viii. patterns of occupation, including permanent, temporary or seasonal occupation, or ix. the sites of conflicts and the subsequent peace-making and rebuilding of iwi or hapū, or x. kinship and alliances built between areas and iwi or hapū, often in terms of significant events, or xi. alliances to defend against external threats, or xii. recognition of notable tupuna, and sites associated with them, or b) traditional associations, which include but are not limited to: vi. resource use, including trading and trading routes between groups (for instance – with minerals such as matā/obsidian), or vii. traditional travel and communication linkages, both on land and sea, or viii. areas of mana moana for fisheries and other rights, or ix. use of landmarks for navigation and location of fisheries grounds, or x. implementation of traditional management measures, such as rāhui or tohatoha (distribution), or c) cultural associations, which include but are not limited to: iii. the web of whanaungatanga[98] connecting across locations and generations, or	

iv. the implementation of concepts such as kaitiakitanga and manākitanga, with specific details for each whanau, hapū and iwi, or

d) spiritual associations which pervade all environmental and social realities, and include but are not limited to:

iv. the role of the atua Ranginui and Papatūānuku,[99] and their offspring such as Tangaroa and Tāne, or
v. the recognition of places with connection to the wairua of those with us and those who have passed away, or
vi. the need to maintain the mauri of all living things and their environment, and

5) Must:

a) be based on traditions and tikanga, and

b) be endorsed for evidential purposes by the relevant tāngata whenua community, and

c) record the values of the place for which protection is required, and

d) record the relationship between the individual sites or resources (landscapes only), and

e) record the tāngata whenua groups determining and endorsing the assessment, and

f) geographically define the areas where values can be adversely affected.

D.2 General	
D.2.2 Social, cultural and economic benefits of activities Regard must be had to the social, cultural and economic benefits of a proposed activity, recognising significant benefits to local communities, Māori and the region including local employment and enhancing Māori development, particularly in areas of Northland where alternative opportunities are limited.	The proposal provides some benefits to the Kohukohu Township but these are largely at the expense of cultural matters of importance to Te Ihutai.
D.2.3 Climate change and development Particular regard must be had to the potential effects of climate change on a proposed development requiring consent under this Plan, taking into account the scale, type and design-life of the development proposed and with reference to the latest national guidance and best available climate change projections	Climate change has been somewhat assessed but left to an unknown future Council strategy.
D.2.4 Adaptive management Regard should be had to the appropriateness of an adaptive management approach where: 1) there is an inadequate baseline of information on the receiving environment, and 2) the occurrence of potential adverse effects can be effectively monitored, and 3) thresholds can be set to require mitigation action if more than minor adverse effects arise, and 4) potential adverse effects can be remedied before they become irreversible.	On a catchment basis, it is clear that there is insufficient information in relation to the environmental impacts to the Hokainga Harbour. For this proposal specifically, further investigations into faecal tracking and land disposal options are proposed within relevant reports Given the large scale of the receiving environment, it is not

	certain that all effects can be effectively monitored.
D.2.5 Benefits of regionally significant infrastructure Particular regard must be had to the national, regional and locally significant social, economic, and cultural benefits of regionally significant infrastructure.	The WWTP may meet the threshold as being regionally significant however this has not been addressed in the proposal.
D.2.7 Minor adverse effects arising from the establishment and operation of regionally significant infrastructure. Enable the establishment and operation (including reconsenting) of regionally significant infrastructure by allowing any minor adverse effects providing: 1) The regionally significant infrastructure proposal is consistent with: a) all policies in Section D.1 Tāngata whenua, and b) Policy D.2.16 Managing adverse effects on historic heritage, and c) Policy D.2.17 Managing adverse effects on natural character, outstanding natural landscapes and outstanding natural features, and d) Policy D.2.18 Managing adverse effects on indigenous biodiversity, and 2) the regionally significant infrastructure proposal will not likely result in over-allocation having regard to the allocation limits in H.4.3 Allocation limits for rivers, and	If the WWTP meets the threshold as being regionally significant, than the proposal fails the first clause as it is not considered to be consistent with all policies within section D.1 Tangata whenua.

3) other adverse effects arising from the regionally significant infrastructure are avoided, remedied, mitigated or offset to the extent they are no more than minor.	
D.2.8 Maintenance, repair and upgrading of regionally significant infrastructure Enable the maintenance and upgrading of established regionally significant infrastructure wherever it is located by allowing adverse effects, where: 1) the adverse effects whilst the maintenance or upgrading is being undertaken are not significant or they are temporary or transitory, and 2) the adverse effects after the conclusion of the maintenance or upgrading are the same, or similar, to those arising from the regionally significant infrastructure before the activity was undertaken.	The WWTP may meet the threshold as being regionally significant however this has not been addressed in the proposal.
D.2.14 Resource consent duration102 When determining the expiry date for a resource consent, have particular regard to: 1) security of tenure for investment (the larger the investment, then generally the longer the consent duration), and 2) the administrative benefits of aligning the expiry date with other resource consents for the same activity in the surrounding area or catchment, and 3) certainty of effects (the less certain the effects, the shorter the consent duration), and 4) whether the activity is associated with regionally significant infrastructure (generally longer consent durations for regionally significant infrastructure), and	The proposed timeframe of 15 years is not considered appropriate in context. If consent is granted, a smaller term is proposed to ensure that decisions are made associated with the outcomes of alternative disposal options and locations (if recommendations and conclusions are agreed with).

5) the following additional matters where the resource consent application is to re-consent an activity: a) the applicant’s past compliance with the conditions of any previous resource consent or relevant industry guidelines or codes of practice (significant previous non-compliance should generally result in a shorter duration), and b) the applicant’s voluntary adoption of good management practice (the adoption of good management practices that minimise adverse environmental effects could result in a longer consent duration).	
D.2.18 Managing adverse effects on indigenous biodiversity Manage the adverse effects of activities on indigenous biodiversity by: 1) in the coastal environment: a) avoiding adverse effects on: i. indigenous taxa that are listed as Threatened or At Risk in the New Zealand Threat Classification System lists, and ii. the values and characteristics of areas of indigenous vegetation and habitats of indigenous fauna that are assessed as significant using the assessment criteria in Appendix 5 of the Regional Policy Statement, and iii. areas set aside for full or partial protection of indigenous biodiversity under other legislation, and	The effects to important cultural indigenous species are not avoided, remedied or mitigated appropriately through the proposal. The Hokianga Harbour has a known cultural purpose and the WWTP is inconsistent with this use as a food basket.

b) avoiding significant adverse effects and avoiding, remedying or mitigating other adverse effects on: i. areas of predominantly indigenous vegetation, and ii. habitats of indigenous species that are important for recreational, commercial, traditional or cultural purposes, and iii. indigenous ecosystems and habitats that are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, intertidal zones, rocky reef systems, eelgrass, northern wet heathlands, coastal and headwater streams, spawning and nursery areas and saltmarsh, and 2) outside the coastal environment: a) avoiding, remedying or mitigating adverse effects so they are no more than minor on: b) avoiding, remedying or mitigating adverse effects so they are not significant on: i. indigenous taxa that are listed as Threatened or At Risk in the New Zealand Threat Classification System lists, and ii. areas of indigenous vegetation and habitats of indigenous fauna, that are significant using the assessment criteria in Appendix 5 of the Regional Policy Statement, and iii. areas set aside for full or partial protection of indigenous biodiversity under other legislation, and i. areas of predominantly indigenous vegetation, and	

ii. habitats of indigenous species that are important for recreational, commercial, traditional or cultural purposes, and iii. indigenous ecosystems and habitats that are particularly vulnerable to modification, including wetlands, wet heathlands, headwater streams, spawning and nursery areas, and 3) recognising areas of significant indigenous vegetation and significant habitats of indigenous fauna include: a) Significant Ecological Areas, and b) Significant Bird Areas, and c) Significant Marine Mammal and Seabird Areas, and 4) recognising damage, disturbance or loss to the following as being potential adverse effects: a) connections between areas of indigenous biodiversity, and 2. b) the life-supporting capacity of the area of indigenous biodiversity, and 3. c) flora and fauna that are supported by the area of indigenous biodiversity, and 4. d) natural processes or systems that contribute to the area of indigenous biodiversity, and 5) assessing the potential adverse effects of the activity on identified values of indigenous biodiversity, including by: a) taking a system-wide approach to large areas of indigenous biodiversity such as whole estuaries or widespread bird and marine mammal habitats, recognising	

that the scale of the effect of an activity is proportional to the size and sensitivity of the area of indigenous biodiversity, and b) recognising that existing activities may be having existing acceptable effects, and c) recognising that minor or transitory effects may not be an adverse effect, and d) recognising that where effects may be irreversible, then they are likely to be more than minor, and e) recognising that there may be more than minor cumulative effects from minor or transitory effects, and 6) recognising that appropriate methods of avoiding, remedying or mitigating adverse effects may include: a) careful design, scale and location proposed in relation to areas of indigenous biodiversity, and b) maintaining and enhancing connections within and between areas of indigenous biodiversity, and c) considering the minimisation of effects during sensitive times such as indigenous freshwater fish spawning and migration periods, and	

d) providing adequate setbacks, screening or buffers where there is the likelihood of damage and disturbance to areas of indigenous biodiversity from adjacent use and development, and e) maintaining the continuity of natural processes and systems contributing to the integrity of ecological areas, and f) the development of ecological management and restoration plans, and 7) recognising that significant residual adverse effects on biodiversity values can be offset or compensated: a) in accordance with the Regional Policy Statement for Northland Policy 4.4.1, and104 b) after consideration of the methods in (6) above, and 8) recognising the benefits of activities on biodiversity values that: a) restore, protect or enhance ecosystems, habitats and processes, ecological corridors and indigenous biodiversity, and b) improve the public use, value or understanding of ecosystems, habitats and indigenous biodiversity.	
D.2.19 Managing adverse effects on land-based values and infrastructure	Tauteihiihi Marae is considered as a place of significance to tangata whenua. The proposal has direct amenity and cultural impacts to this Marae.

When considering an application for a resource consent for an activity in the coastal marine area or in, on or under the bed of a freshwater body, recognise that adverse effects may extend beyond the coastal marine area or the freshwater body to: 1) areas and values including: a) Areas of outstanding and high natural character, and b) Outstanding natural landscapes, and c) Outstanding natural features, and d) Historic heritage, and e) Areas of significant indigenous biodiversity, and f) Places of significance to tāngata whenua, and 2) land-based infrastructure including: a) toilets, and b) car parks, and c) refuse facilities, and d) boat ramps, and	

e) boat and dinghy storage, and 3) decision-makers should have regard to: a) the nature and scale of these effects when deciding whether or not to grant consent for activities in the coastal marine area or on the beds of freshwater bodies, and b) the need to impose conditions on resource consents for those activities in order to avoid, remedy or mitigate these adverse effects.	
D.2.20 Precautionary approach to managing effects on significant indigenous biodiversity and the coastal environment That decision makers adopt a precautionary approach where the adverse effects of proposed activities are uncertain, unknown or little understood, on: 1) indigenous biodiversity, including significant ecological areas, significant bird areas and other areas that are assessed as significant under the criteria in Appendix 5 of the Regional Policy Statement; and 2) the coastal environment where the adverse effects are potentially significantly adverse, particularly in relation to coastal resources vulnerable to the effects of climate change.	Although the Hokianga Harbour adjacent to the WWTP is not considered as a significant ecological area, the lower catchment (near the harbour mouth is). It is not assessed whether the proposal impacts this area of significance or the importance of aquatic species.
D.3 Air	
D.3.1 General approach to managing air quality When considering resource consent applications for discharges to air:	Odour discharges are a minor issue but these have cultural implications to Tauteihiihi Marae when carrying out customary practices and

1) ensure that discharges of contaminants to air do not occur in a manner that causes, or is likely to cause, a hazardous, noxious, dangerous or toxic effect on human or animal health or ecosystems, and 2) apply the best practicable option when managing the discharge of contaminants listed in the National Environmental Standards Air Quality, and 3) H.1 Stack height requirements when assessing height requirements for fuel burning devices of more than 40KW capacity, and 4) consider the use of air dispersion modelling where the effects of a discharge are likely to be significant on sensitive areas, and 5) take into account the Ambient Air Quality Guidelines (Ministry for the Environment, 2002) when assessing the effects of the discharge on ambient air quality, and 6) take into account the cumulative effects of air discharges and any constraints that may occur from the granting of the consent on the operation of existing activities, and 7) recognise that discharges to air may have adverse effects across the property boundary (including reverse sensitivity effects) and adverse effects on natural character, and 8) take into account the current environment and surrounding zoning in the relevant district plan including existing amenity values, and 9) consider the following factors when determining consent duration: a) scale of the discharge including effects, and	traditional activities at the marae.

b) regional and local benefits arising from the discharge, and c) location of the discharge including its proximity to sensitive areas, and d) alternatives available, and 10) use national guidance produced by the Ministry for the Environment, including: a) the Good Practice Guide for Assessing and Managing Odour (Ministry of the Environment, 2016), and b) the Good Practice Guide for Assessing and Managing Dust (Ministry of the Environment, 2016), and c) the Good Practice Guide for Assessing Discharges to Air from Industry (Ministry for the Environment, 2016), or d) any subsequent update or revision of these national guidance documents, and 11) generally enable discharges of contaminants to air from industrial and trade premises provided the best practicable option for preventing or minimising the adverse effects of the discharge is adopted and significant adverse effects on human health, amenity values and ecosystems are avoided.	
D.3.2 General approach to managing adverse effects of discharges to air Adverse effects from the discharge of contaminants to air are managed by:	The current mitigation measures proposed include air quality testing at three points of the oxidation pond.

1) avoiding, remedying, or mitigating cross-boundary effects on dust, odour, smoke and spray- sensitive areas from discharges of dust, smoke, agricultural spray drift and odour; and 2) protecting dust, odour, smoke and spray-sensitive areas from exposure to dangerous or noxious levels of gases or airborne contaminants; and 3) recognising that land use change can result in reverse sensitivity effects on existing discharges to air, but existing discharges should be allowed to continue where appropriate.	
D.3.4 Dust and odour generating activities When considering resource consent applications for discharges to air from dust or odour generating activities: 1) require a dust or odour management plan to be produced where there is a likelihood that there will be objectionable or offensive discharges of dust or odour at the boundary of the site where the activity is to take place, or where the activity is likely to cause a breach of the ambient air quality standard for PM10 in Schedule 1 of the National Environmental Standard for Air Quality. The dust or odour management plan must include: a) a description of dust or odour generating activities, and b) potentially affected dust sensitive areas or odour sensitive areas, and	An odour management plan is not provided.

c) details of good management practices that will be used to control dust or odour to the extent that adverse effects from dust or odour at the boundary of the site are avoided, remedied or mitigated, and 2) take into account any proposed use of low dust generating blasting mediums when assessing the effects of fixed or mobile outdoor dry abrasive blasting or wet abrasive blasting. Note: Policy D.3.4 does not apply to odour associated with the controlled discharge of gas containing an odorant (such as mercaptan) from pipelines and ancillary equipment.	
D.4 Land & Water	
D.4.1 Maintaining overall water quality When considering an application for a resource consent to discharge a contaminant into water or onto or into land where it may enter water or onto land where it may enter water: 1) ensure that the quality of fresh and coastal water is at least maintained, and 2) where a water quality standard in Appendix H.3 is currently met: a) ensure that the quality of water in a river, lake or the coastal marine area will continue to meet the standards in Appendix H.3; and b) consider whether any improvements to water quality are required in order to achieve Objective F.1.2	It is difficult to consider that coastal water quality is being maintained when further investigation is required (faecal tracking) to understand whether shellfish are being implicated by the WWTP or other discharges into the Harbour.

3) where a water quality standard in Appendix H.3 is currently exceeded, ensure that any resource consent for a new discharge will not, or is not likely to, cause or contribute to a further exceedance of a water quality standard in Appendix H.3; 4) where a water quality standard in Appendix H.3 is currently exceeded and the exceedance of the water quality standard is caused or contributed to by an existing activity for which a replacement resource consent is being considered, ensure any replacement resource consent granted for the existing discharge includes a condition(s) that: a) requires the quality of the discharge to be improved over the term of the consent to reduce the contribution of the discharge to the exceedance of the water quality standard in Appendix H.3; and b) sets out a series of time bound steps, demonstrating how the activity will be managed to achieve the water quality improvements required by (4) (a). 5) ensure that the discharge will not cause an acute toxic adverse effect within the zone of reasonable mixing 6) where a discharge will, or is likely to, cause or contribute to: a) an exceedance of the coastal sediment quality guidelines in Appendix H.3.4, or b) a transitory exceedance of the toxicants, metals and metalloids standard in Table 22, and the activity is associated with the establishment, operation, maintenance or upgrade of regionally significant infrastructure, determine whether higher levels of	

contaminants in the particular location affected by the discharge can be provided for while still achieving Objective F.1.2, and set appropriate levels of contaminants in accordance with best practice methodology to safeguard the ecosystem values present at the location affected by the discharge; and 7) where existing water quality is unknown, or the effect of a discharge on water quality is unknown, the activity must be managed using a precautionary approach, which may include adaptive management. Note: For the purpose of Policy D.4.1.(6)(b), best practice methodology can be determined by reference to ANZECC2000 Australian and New Zealand Guidelines for Fresh and Marine Water Quality Number 4, Volume 1 or any replacement guidelines.	
D.4.3 Municipal, domestic and production land wastewater discharges 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.	The desktop study on alternative discharge to land locations has been undertaken, but this considers that further investigation be undertaken for particular sites.
D.4.4 Zone of reasonable mixing When determining what constitutes the zone of reasonable mixing for a discharge of a contaminant into water, or onto or into land in circumstances which may result in that	The proposal states that the mixing zone is appropriate, however notes that the

contaminant (or any other contaminant emanating as a result of a natural process from that contaminant) entering water, have regard to: 1) using the smallest zone necessary to achieve the required water quality in the receiving waters as determined under Policy D.4.1, and 2) ensuring that within the mixing zone contaminant concentrations and levels of dissolved oxygen will not cause acute toxicity effects on aquatic ecosystems.	underlying condition of the Hokianga Harbour already exceeds the applicable standards. Therefore, the proposal represents additional and cumulative effects on top of the known water quality effects of the Harbour in the upper catchment.

Regional Coastal Plan

Objective / Policy	Assessment
Recognition and Provision for Maori and their Cultural and Traditions	
The management of the natural and physical resources within Northland's coastal marine area in a manner that recognises and respects the traditional and cultural relationships of tangata whenua with the coast.	The Kohukohu WWTP as evidenced above does not recognise and respect that wastewater discharge is culturally offensive. Cultural relationships of Te Ihutai with the coast and coastal marine area are impacted by the proposal.
To recognise and, as far as practicable, provide for the concerns and cultural perspective of tangata whenua with respect to the protection of natural and physical resources (especially seafood) in the coastal marine area.	The continued discharge of wastewater has effects to seafood and other cultural resources in the Hokianga Harbour by reason that the discharge directly implicates the food cycle, limiting tangata whenua use.
To recognise and, as far as practicable, provide for the concerns and cultural perspectives of tangata whenua in regard to the disposal of waste into water.	This CIA addresses this matter.
To directly involve tangata whenua in resource management decision- making in the following areas:	Matters (a) and (b) are not within scope, but may be in the

(a) Where Taiapure are established under the provisions of the Fisheries Act 1996; (b) Where maataitai reserves are established under the provisions of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992; (c) Waters classified for cultural purposes.	future should Te Ihutai wish to undertake these activities. The Hokianga Harbour and its waters are being directly implicated by the proposal and Te Ihutai have minimal decision making powers in this aspect.
To investigate options for involving tangata whenua in monitoring the effects of use, development and protection of resources within the coastal marine area.	To date, minimal involvement of tangata whenua in monitoring effects have been undertaken.
To provide technical advice, information and, where appropriate, financial resources to assist iwi authorities in the development of iwi management plans for natural and physical resources within the coastal marine area of their rohe.	There are no relevant iwi or hapū based environmental management plans at present for Te Ihutai.
Cultural Heritage Values	
The recognition and protection of sites, buildings and other structures, places or areas of cultural heritage value within Northland's coastal marine area.	The Hokianga Harbour has not been recognized (yet) as a site / area with enormous heritage values within the CMA.
The recognition and protection of sites, buildings and other structures, places or areas of cultural heritage value that exist adjacent to the coastal marine area and may be adversely affected by use and development of the coastal marine area.	The continued discharge of wastewater into the Hokianga Harbour as proposed is not being appropriately recognised.

To identify sites, buildings and other structures, places or areas of cultural heritage value within Northland's coastal marine area and, where practicable, assist in the protection of those at risk from the adverse effects of use and development.	The Hokianga Harbour is considered at risk from a cultural perspective and is not being suitably protected from ongoing discharges.
To encourage tangata whenua to identify waahi tapu and other sites of traditional, spiritual or cultural significance to Maori within or immediately adjacent to the coastal marine area within their rohe and to assess for themselves the most appropriate means of providing for the protection of these sites.	The uptake of opportunity is limited based on many factors. The lack of identified sites is considered to be based on the process provided, not the opportunity available.
In assessing the potential effects of a proposed activity to identify whether an activity will have an adverse effect on a known site, building, place or area of cultural heritage value within the coastal marine area or on adjoining land.	This CIA provides the context and detail with respect to adverse cultural effects resulting from the proposal.
To provide appropriate technical advice and information to assist iwi authorities in the development of hapu/iwi management plans for natural and physical resources within the area of their rohe.	There are no relevant iwi or hapū based environmental management plans at present for Te Ihutai.
Water Quality	
The maintenance, and where practicable, enhancement of water quality within Northland's coastal marine area.	The coastal marine area, particularly the Hokainga Harbour is not being enhanced or maintained as a result of the proposal. It is being continually degraded within limits that do

	little to recognise cultural values.
To classify the waters within Northland's coastal marine area as a means of clearly identifying the water quality management aims for individual areas of coastal water, and in a manner which recognises: (a) the high standard of existing water quality of the majority of Northland's coastal waters; (b) existing detailed information on the quality of the waters of the Whangarei Harbour and the Bay of Islands; (c) the importance of water quality to safe contact recreation and the quality of naturally occurring and commercially-grown edible shellfish resources; (d) the need to safeguard the life-supporting capacity of coastal waters and ecosystems, and to ensure that appropriate water quality standards are maintained.	The proposal results in effects to shellfish harvesting and gathering and the life-supporting capacity of coastal waters. This is articulated in the reports received and reviewed.
As far as practicable, to identify any parts of the coastal marine area which are, or which have the potential to be, significantly degraded by use and development and institute appropriate remedial action giving priority to areas of high use by the general public.	There seems to be no priority given to the Hokianga Harbour despite its importance to tangata whenua.
To increase public awareness of the importance of maintaining and enhancing coastal water quality.	This CIA increases the publics awareness of the cultural issues associated with the wastewater discharge.
Air Quality	

To maintain the high standard of air quality within Northland's coastal marine area.	Whilst odour is considered a smaller issue in relation to other effects, the proposal will result in odour effects to Te Ihutai.
To achieve the integrated management of coastal air quality across the administrative boundary of the line of Mean High Water Springs.	Not relevant.
An integrated management approach will be adopted between the Northland Regional Council and the territorial authorities in the Northland Region to effectively manage coastal air quality across the line of Mean High Water Springs.	Not relevant.
When considering any application for a plan change or resource consent for activities within or near to the coastal marine area that involve discharges of contaminants into air, consent authorities shall recognise that airborne contaminants can drift in either direction across the line of Mean High Water Springs.	Not relevant.
Unless a different approach is required in response to specific coastal issues, methods for the control of particular types of discharge to air within the coastal marine area shall be the same as those adopted on the landward side of Mean High Water Springs.	There are no known mitigation methods for the odour experienced as a result of the proposal.
Differences in the nature and sensitivity of the receiving environment (including existing ambient air quality) shall be recognised when determining an acceptable level of effect on the environment in relation to discharges of contaminants into air within the coastal marine area.	No such assessment as received has been reviewed confirming this matter.
Natural Hazards	
The avoidance, remediation, or mitigation of the adverse effects of natural hazards on coastal subdivision, use and development.	The proposed use remains within an area subject to flooding hazards. No mitigation, remedial, or avoidance measures are proposed in the

	event that a hazard implicates the existing WWTP.
The avoidance, remediation, or mitigation of the adverse effects of subdivision, use and development on the exacerbation of natural hazards in the coastal marine area.	As above.
To promote a consistent and co-ordinated approach toward managing coastal erosion and other natural hazards in Northland, including the identification and protection of natural systems which are a natural defence against erosion and inundation.	Coastal erosion is not identified for the site.
In consideration of coastal permit applications as far as practicable, to ensure that use and development, including coastal works, structures and reclamations within the coastal marine area: (a) are located and designed so as to avoid risk of damage by natural hazards; and, (b) cause minimal interference with natural sediment transport processes.	There is no assessment of the current WWTP in relation to natural hazard risk to assess this item fully.
In consideration of coastal permit applications to ensure that any natural hazard control measures undertaken in the coastal marine area are the best practicable option and the most effective in the long-term.	No known measures exist.
To provide for the maintenance of existing authorised shoreline protection works and structures.	Not relevant.
To maintain a state of preparedness for dealing with the effects of rising sea levels and rare events such as tsunamis.	Marae within Te Ihutai are largely within a green zone. The WWTP is located in an orange zone
Recreation	
Provision for recreational uses of the coastal marine area while avoiding, remedying, and mitigating the adverse effects of recreational activities on other users and the environment.	The proposal implicates water quality and recreational activities associated with swimming in the harbour, although these are noted as

	being minimal from an effects perspective.
To adopt a permissive approach toward recreational activities in Marine 1 and Marine 2 Management Areas, except where these: (a) require associated structures; or (b) cause adverse environmental effects, including those resulting from discharges of contaminants, excessive noise, and disturbance to significant indigenous vegetation and significant habitats of indigenous fauna; or (c) obstruct public access to and along the coastal marine area; or (d) endanger public health and safety; or (e) compromise authorised uses and developments of the coastal marine area; or (f) adversely affect the amenity values of the area.	The reports articulate that there are effects to shellfish and marine life through the discharge. The amenity of the Tauteihiihi Marae is reduced to an unacceptable level by being in close relation to the WWTP.
In consideration of coastal permit applications, subject to relevant protection policies within this Plan, to provide for new uses and developments within Marine 1, Marine 2, and Marine 4 Management Areas which maintain or enhance recreational opportunities within the coastal marine area.	The proposal is not for a new use.
In consideration of coastal permit applications within all Marine Management Areas, to ensure that uses and developments which occupy coastal space or utilise coastal resources, do not unnecessarily compromise existing recreational activities.	Recreational activities are only marginally compromised as a result of the pipe outfall.
Within Marine 1, Marine 2 and Marine 4 Management Areas, to help ensure that the use of recreational vessels and vehicles does not create a public nuisance within the coastal environment, or compromise the health and safety of other users, or result in adverse effects on the environment of the coastal marine area.	The proposal results in adverse effects to users wanting to

	gather and collect food within the Hokianga Harbour.
Structures	
The provision for appropriate structures within the coastal marine area while avoiding, remedying or mitigating the adverse effects of such structures.	The effects of the pipe outfall are not known to be causing adverse cultural effects.
To provide for the continued lawfully established use of existing authorised structures within Northland's coastal marine area.	The pipe is existing
Within all Marine Management Areas, to provide for: (a) the authorisation of appropriate existing unauthorised structures and to facilitate (b) the removal of all other unauthorised existing structures which do not meet those specified criteria.	Not relevant.
Within all Marine Management areas, to consider structures generally appropriate where: (a) there is an operational need to locate the structure within the coastal marine area; and (b) there is no practical alternative location outside the coastal marine area; and (c) multiple use is being made of structures to the extent practicable; and (d) any landward development necessary to the proposed purpose of the structure can be accommodated; and (e) any adverse effects are avoided as far as practicable, and where avoidance is not practicable, to mitigate adverse effects to the extent practicable.	Without understanding or carrying out more wholesome alternative disposal investigations, the policy cannot be assessed.

Notwithstanding Policy 3, within Marine 1 and Marine 2 Management Areas, to assess applications for new structures, with particular reference to the nature of and reasons for the proposed structures in the coastal marine area and to any potential effects on the natural character of the coastal marine area, on public access, and on sites or areas of cultural heritage value.	No new structures are proposed.
Notwithstanding Policy 3, within Marine 3, Marine 5 and Marine 6 Management Areas, to provide for the particular operational requirements of marine farms and ports in relation to new structures within the coastal marine area.	Not relevant.
Notwithstanding Policy 3, within Marine 4 Management Areas, to provide for the requirements of commercial and recreational vessels for permanent moorings and related structures and facilities.	Not relevant.
In assessment of coastal permit applications to promote the integrated management of structures and their associated activities where these traverse the landward coastal marine area boundary.	The pipe and WWTP are being assessed collectively.
In assessment of coastal permit applications to require that all structures within the coastal marine area are maintained in good order and repair and that appropriate construction materials are used.	The state of the pipe outfall is not known.
In Marine 1, 2, 3 and 4 Management Areas to restrict the presence of buildings and signs within the coastal marine area.	Not relevant.
Discharges to Water	
The avoidance of the effects of discharges of contaminants to Northland's coastal water and the remediation or mitigation of any adverse effects of those discharges of contaminants to coastal waters, which are unavoidable.	The cultural effects to the Hokianga Harbour from the proposal have not been avoided, or appropriately remedied or mitigated.
In the consideration of coastal permit applications to use the best practicable option approach to avoid, remedy, or mitigate the adverse effects of: (a) discharges from wastewater treatment plants	The term best practicable option contains many assumptions in how this is carried out. Land disposal is

(b) urban and industrial stormwater discharges (c) discharges from boat maintenance facilities (d) discharges from ports on the coastal marine area.	preferred as the best practicable option as the cultural effects from the existing method is considered to be culturally offensive and repugnant.
Subject to Policy 1, in the consideration of coastal permit applications, to progressively eliminate direct discharges of human sewage to the coastal marine area from land-based wastewater treatment facilities, including existing authorised discharges, except where: (a) the allowance of the discharge better meets the purpose of the Act than disposal on to land; and (b) there has been consultation with the tangata whenua in accordance with tikanga Maori and due weight has been given to Sections 6, 7 and 8 of the Act; and (c) there has been consultation with the community generally.	The preferred approach is for discharge to land options to be appropriately resourced and investigated.
To establish whether any existing authorised wastewater discharges, after reasonable mixing, give rise to all or any of the following effects: (a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; (b) any conspicuous change in the colour or visual clarity; (c) any emission of objectionable odour;	There are known effects to aquatic life permeating as a result of the operation of the WWTP but also other contributing discharges.

(d) any significant adverse effects on aquatic life; and, if so, to review its consent conditions, pursuant to Section 128(1)(b) of the Resource Management Act.	
To ensure that the individual and cumulative effects of authorised discharges to the coastal marine area do not compromise the maintenance and enhancement of coastal water quality.	This is not being adhered to and the ongoing discharge, over the cumulative area of the Hokainga Harbour is resulting in adverse cultural effects.
To progressively eliminate, as far as practicable, unauthorised discharges of contaminants to the coastal marine area, particularly those which contain: (a) untreated sewage (including those from ships and other vessels); or (b) toxic substances in concentrations or amounts which are likely to have significant adverse effects on aquatic life or other uses of the coastal marine area	There are no known unauthorized activities associated with the proposal.
To promote the effective management of rural runoff and its effect on the coastal marine area in order to improve coastal water quality	An all of catchment approach is required to understand the total effects on the Hokainga Harbour.
To ensure that the Regional Council, within its legal mandate, takes all reasonable steps to prevent and respond to oil spills should they occur.	Not relevant.
To identify sources of litter pollution in the coastal marine area and to develop appropriate means of dealing with each source.	Relevant insofar as litter pollution impacts the mauri of the Hokianga Harbour.

To promote the provision of facilities for the disposal of litter from ships and other vessels.	Relevant insofar as litter pollution impacts the mauri of the Hokianga Harbour.
To adopt a permissive approach to the discharge of cooling water to the coastal marine area, provided no contaminant other than heat is involved and any adverse effects on the coastal marine area are minor.	Relevant insofar as litter pollution impacts the mauri of the Hokianga Harbour.
To advocate for measure to minimise the risk of the introduction of exotic species via ballast water discharges.	It is unclear whether wastewater discharge gives rise to the introduction of more exotic species in the Hokianga Harbour.
Discharges to Air	
To provide for the discharge of contaminants to air while avoiding adverse environmental effects and, where avoidance is not practicable, remedying or mitigating those effects.	There are no known mitigation measures provided for odour / discharges to air from the WWTP and relies on the system working effectively with no upgrades currently proposed.
When considering any application for a plan change or resource consent for activities located within or near to the coastal marine area that involve discharges of contaminants to air, consent authorities shall recognise that ambient air quality is one of a number of attributes that collectively make up the natural character of the coastal environment.	Tauteihiihi Marae should be free of odour from the WWTP.
Discharges of contaminants into air from activities located within or near to the coastal marine area should not:	Odour effects are not considered to be significant, however further mitigation measures other than stating

(a) Result in significant degradation of existing ambient air quality in the coastal marine area; (b) Adversely affect areas of significant indigenous vegetation and significant habitats of indigenous fauna within the coastal marine area; (c) Have a significant adverse effect on water quality in the coastal marine area, as a result of airborne contaminants being deposited into water or deposited in a manner that results in them entering water; (d) Except in the Port Facilities and Marine Farming Management Areas, detract from people's use and enjoyment of the coastal marine area for recreation purposes (for example by causing odour or diminishing visibility as a result of smoke or haze); (e) Result in significant adverse cumulative effects on air quality in the coastal marine area, taking into account any existing discharges of contaminants into air in the locality. Activities involving discharges of contaminants into air should not be located within or near to the coastal marine area if these adverse effects cannot be avoided, remedied or mitigated.	that the existing system is ok are considered required.
The best practicable option may be employed to prevent or minimise any adverse effects from the discharge of contaminants into air from activities located within or near to the coastal marine area by having regard to: (a) The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and	The only current option promoted is that the system is operating correctly and the air / odour discharge is managed through the system controls. Further mitigation to Tauteihiihi Marae is required.

(b) The financial implications, and the effects on the environment, of that option when compared with other options; and (c) The current state of technical knowledge and the likelihood that the option can be successfully applied.	
Open burning of inorganic refuse should not be undertaken within the coastal marine area.	Not relevant.
In-situ cremation should not be used to dispose of the remains of dead animals (e.g. stranded marine mammals and stock) in the coastal marine area if practicable alternative methods of disposal are available that will have less significant adverse effects on the environment. Natural decomposition should be considered as an acceptable alternative in situations where it will not result in significant nuisance effects or cause a health hazard and where other disposal options will have more significant adverse effects.	Not relevant.
To recognise that many activities within the coastal marine area that discharge contaminants into air have a minor effect on air quality and, where appropriate, these activities should be provided for as permitted activities.	No permitted activities are outlined as part of the Resource Consent Application.
Network Utilities and Services	
Provision for network utilities and services within Northland's coastal marine area while avoiding, remedying or mitigating the adverse effects of such activity.	The adverse cultural effects have not been avoided, remedied or mitigated.
To identify within this Plan, the type and location of existing authorised network utilities and services currently within the coastal marine area and provide for their operation and maintenance subject to specified criteria.	It is assumed that this use was anticipated based on existing approvals.
To ensure that existing authorised network utilities and services in the coastal marine area are managed so as to, avoid, remedy or mitigate adverse environmental effects.	The adverse cultural effects have not been avoided, remedied or mitigated.
To ensure that any new network utilities and services within the coastal marine area are located, designed, and constructed so as to, as far as practicable, avoid adverse	No new facilities are proposed.

environmental effects, and where avoidance is not practicable, to mitigate adverse effects and provide for remedying those effects to the extent practicable.	
Subject to policy 3, to provide for the construction or emplacement of new network utilities and services within the coastal marine area provided that it can be shown that: (a) existing facilities are insufficient, inappropriate and/or have adverse environmental effects; and, (b) the new facility will have a demonstrable public benefit; and (c) there is no practicable alternative method, route, or site on land which better meets the purpose and principles of the Act.	No new facilities are proposed.

Regional Air Quality Plan

Objective / Policy	Assessment
Discharges of Contaminants to Air	
The sustainable management of Northland's air resource including its physical, amenity and aesthetic qualities by avoiding, remedying or mitigating adverse effects on the environment from the discharge of contaminants to air.	Amenity values are reduced to Tauteihiihi Marae because of odour emissions from the WWTP.
The maintenance and, where necessary, enhancement of the quality of the environment so that it is free from noxious, dangerous, offensive or objectionable adverse effects associated with discharges to air, such as odour, dust, smoke and poor visibility.	The quality of the Tauteihihi Marae environment is affected by the WWTP.
The reduction and minimisation of adverse effects from discharges of contaminants to air of global significance, such as greenhouse gases or ozone depleting substances, in agreement with government policy.	Not relevant.
To maintain the existing high standard of ambient air quality in the Northland region, and to enhance air quality in those instances where it is adversely affected, by avoiding, remedying or mitigating adverse effects of activities discharging contaminants to air.	Odour mitigation measures are limited in this instance, relying on the effective operation of the system components. There are no known warning systems or triggers and the approach relies on complaints to suggest adverse effects are acceptable.
To avoid, remedy or mitigate the adverse effects generated by discharges of contaminants to air including cumulative or synergistic/interactive effects.	As above.
To recognise that many activities which discharge contaminants to air have a minor effect on the quality of Northland's air environment.	This is noted and the WWTP has such an effect on the quality of the environment.

To manage the discharge of hazardous, noxious and dangerous contaminants to air in a manner that ensures any adverse environmental effects, including on human health, are avoided, remedied or mitigated.	Refer to effects to Tauteihiihi Marae from odour.
Where the effects of activities are unknown or not well understood, to adopt a precautionary approach to the granting of resource consent applications for the discharge of contaminants to air where it is considered that the effects of such discharges on the environment may be significant.	Odour effects are not considered significant, but require additional measures.
Where necessary, apply the best practicable option to discharges of contaminants to air, while complying with the other policies in this Plan.	It is questioned whether the best practicable options are being used.
To recognise that discharges of contaminants to air may adversely affect other receiving environments.	Refer to effects to Tauteihiihi Marae from odour.
To support and implement national policies that seek to avoid, remedy or mitigate the adverse effects on the global environment of motor vehicle and greenhouse gas emissions and ozone depleting substances.	Not relevant.
To promote a consistent regional approach to avoid the adverse health and environmental effects from abrasive blasting operations.	Not relevant.
To promote the integrated management of natural and physical resources in order to avoid, remedy or mitigate the adverse effects of discharges of contaminants to air.	Not relevant.
To ensure that the discharge of contaminants to air should not result in offensive or objectionable odours that could adversely affect people and communities.	Refer to effects to Tauteihiihi Marae from odour.

Regional Water & Soil Plan

Objective / Policy	Assessment
Recognition of and Provision for Maori and their Culture and Traditions	
The management of the natural and physical resources within the Northland region in a manner that recognises and provides for the traditional and cultural relationships of tangata whenua with the land and water.	Land disposal is preferred to the current WWTP arrangement. The current arrangement does not provide for the traditional and cultural relationships of tangata whenua with respect to wai.
To recognise and, as far as practicable provide for the relationship of Maori and their culture and traditions with respect to the use, development and protection of natural and physical resources in the Northland region.	The proposal is not considered to provide for this with respect to the proposal.
To gain an understanding, and as far as practicable, provide for the concerns and cultural perspectives of tangata whenua in regard to the disposal of waste into water.	This is provide in the CIA.
To have particular regard for kaitiakitanga and consider options for the involvement of tangata whenua in monitoring the use, development and protection of resources within the Northland region.	The proposal does not represent kaitiakitanga as it continues to exacerbate adverse effects to water.
To provide appropriate technical advice and information to assist iwi authorities in the development of hapu/iwi management plans for natural and physical resources within the area of their rohe.	Refer to similar policies.
Discharges	
The effective treatment and/or disposal of contaminants from new and existing discharges in ways which avoid, remedy or minimise adverse effects on the environment and on cultural values.	Adverse effects to cultural values will remain for an additional 15 years if consent is granted.

The reduction and minimisation of the quantities of contaminants entering water bodies, particularly those that are potentially toxic, persistent or bio-accumulative.	The proposal represents similar quantities of wastewater into water.
To require all new discharges of sewage or discharges with a high organic content to be: (a) By land disposal; or (b) To water, if after reasonable mixing: (i) it does not cause a discernible adverse change in the physio- chemical and/or microbiological water quality of the receiving water at the time of discharge; and (ii) it is the best practicable option (as defined by Section 2 of the Act).	This is not a new sewerage discharge, however land disposal is preferred in this instance.
To require by the year 2004 or according to an upgrading programme established as part of the conditions on a discharge permit all existing discharges of sewage or discharges with a high organic content to be: (a) By land disposal; or (b) To water, if after reasonable mixing: (i) it does not cause a discernible adverse change in the physico- chemical and/or microbiological water quality of the receiving water at the time of discharge; and (ii) it is the best practicable option (as defined by Section 2 of the Act)	This has not occurred.
To ensure there are adequate separation distances between water bodies and discharges to land to avoid or mitigate adverse effects on water quality.	The proposal includes a direct discharge to water.
To promote effective effluent treatment and disposal systems which are:	Land disposal is preferred.

(a) Low maintenance and low risk; (b) Land based, where the soil types, available disposal areas, back-up facilities and pumping systems are adequate;	
To avoid the cumulative adverse effects of sewage discharges, particularly in areas subject to concentrated development, a high water table, poorly draining soils, very free draining soils, or in areas which are ecologically and/or culturally sensitive.	Adverse effects to cultural values and culturally sensitive environments such as the Hokianga Harbour are not avoided.
To promote the installation of reticulated community sewerage schemes in urban and rural residential areas where on-site disposal systems contribute or are likely to contribute to the contamination of water, including coastal water and groundwater.	The system has been promoted by reason that renewals have been accepted in the past, however land disposal is preferred as coastal water is being implicated to a level which results in adverse cultural effects.
To promote alternative methods to reticulated sewage systems and septic tanks for sewage disposal.	Land disposal has only been assessed on a desktop basis in this instance.

Assessment of Relevant Planning Provisions

154. Having assessed the relevant planning provisions, from a cultural perspective, it is considered that the proposal is inconsistent with many of the relevant objectives and policies of the relevant plans.

PART 2 OF THE RMA

155. Section 104(1) of the RMA requires decision makers to consider Part 2 of the RMA. The Court of Appeal decision on RJ Davidson Family Trust V Marlborough District Council[13] provides the latest, and authoritative position on the matter.

156. The decision directs that where the NZCPS is relevant (in which it is in this case) and it is clear from the relevant NZCPS policies whether consent should be granted or refused, then there is no need for a decision maker to refer back to Part 2 of the RMA as the evaluative exercise would not add anything further to the clear policy intent of the NZCPS.

157. The decision also provides guidance on whether Part 2 of the RMA needs to be considered where the NZCPS provisions do not provide clear guidance on whether the consent should be granted or refused, and situations where the NZCPS is not relevant. Regardless, decision makers need to determine whether the relevant plan has been competently prepared under the RMA.

158. There is no evidence to suggest that the relevant plan(s) have not been competently prepared under the RMA. Therefore, recourse to Part 2 of the RMA is not required.

[13] CA97/2017 [2018] NZCA 316

CONCLUSIONS AND RECOMMENDED CONDITIONS OF CONSENT (IF GRANTED)

Conclusion

159. From a cultural effects perspective, this CIA outlines the reasons as to why the proposal will result in adverse cultural effects that are **more than minor** to the environment and to Te Ihutai specifically.

160. In addition, having assessed the relevant plan(s), it is also clear that the proposal is **inconsistent**, from a cultural perspective, with many of the relevant planning provisions' aims and intents. In some aspects, little to no assessment is provided on the relevant planning provisions.

161. The proposal fails to meet the NZCPS. Recourse to Part 2 of the RMA in this instance is not considered to be justified.

162. It is from this basis that it is believed that under section 104B(a) that the proposal should be **refused**.

163. Despite the above, it is understood that the proposal may have exceptional circumstances – that being that if resource consent were not granted, then the consent holder could not provide wastewater services to those connected to the Kohukohu WWTP.

164. Despite the adverse cultural effects of the WWTP on the Hokianga Harbour, cutting off the existing service to the Kohukohu township is not a desired outcome and would have negative social, cultural, and health related effects to all of those who live, work and recreate within and along the Hokainga Harbour.

165. Case law supports this position in many facets. On this basis, if decision makers do consider that exceptional circumstances exist, than Te Ihutai

respectfully request that the following conditions of consent are implemented subject to section 108 of the Act.

Recommended Conditions of Consent

Natural Hazards & Climate Change

The consent holder must, no later than (insert day, month, year) provide for the approval of the Northland Regional Council's Compliance Manager an assessment of the impacts of natural hazards and climate change and its potential impacts to the Kohukohu WWTP and any associated effects to Tauteihiihi Marae and adjoining parcels. Where mitigation measures are required, these are to be provided for the approval of all parties affected and to the satisfaction of the Northland Regional Council's Compliance Manager.

Odour Management

The consent holder must, no later than (insert day, month, year) provide for the approval of the Northland Regional Council's Compliance Manager an odour management plan that details the management measures to ensure that odour does not impact Tauteihihi Marae and the customary practices required for a functioning marae. The mitigation measures proposed must be agreed between the consent holder and the representatives of Tauteihiihi Marae. All mitigation measures shall be implemented within 6 months of the approval of odour management plan.

Establishment of Working Group to Consider Alternative Disposal Options & Alternative Renewal Options

The consent holder must, no later than (Insert day, month, year) establish a Working Group and invite X representative of Te Ihutai (appointed by mana whenua) and one representative of the Kohukohu community to be members of the of the Working Group.

The Working Group must also comprise two senior officers appointed by the Consent Holder, supported by an independent person qualified and specializing in wastewater engineering and land disposal systems (appointed by the Working Group and certified by the Northland Regional Council's Compliance Manager as being independent and having no conflict of interest).

The purpose of the Working Group is to provide for the involvement of Te Ihutai in:

(a) The assessment of disposal options for the treated wastewater required by Condition X.

(b) The assessment of options in relation to the existing WWTP (if land disposal is not possible) that considers feasible options where cultural criteria may be met.

(b) Providing a recommendation to the Consent Holder regarding the best practicable option for the disposal of treated wastewater required by Condition X.

The consent holder must, no later than (insert day, month, year) provide a report to the Northland Regional Council's Compliance Manager which assesses the options for disposing treated wastewater from the Kohukohu Wastewater Treatment Plant and the report must include recommendations as to which disposal option is considered to be the best practicable option (BPO). The assessment must include the option of disposing the treated wastewater to land and must identify the costs and benefits of all practicable disposal options. The assessment of the options must be undertaken by a suitably qualified and experienced person(s) and must involve the Working Group established in accordance with Condition X.

If the report required by Condition X determines that the BPO is to change to land disposal then the consent holder must, no later than (insert day, month, year), advise the Northland Regional Council's Compliance Manager, in writing whether or not it is committing to the land disposal option.

If the Consent Holder has advised the Northland Regional Council's Compliance Manager that it is committing to the land disposal option (refer Condition X) then the Consent Holder must establish and commission the land disposal system no later than (insert day, month, year). During the period that the land disposal system is being established, the Consent Holder must provide a written progress report to the Northland Regional Council's Compliance Manager every six months.

<u>Faecal Source Tracking</u>

The consent holder must, no later than (insert day, month, year) provide for the approval of the Northland Regional Council's Compliance Manager a faecal source tracking study to resolve the uncertainty associated with elevated faecal indicator bacteria concentrations in shellfish tissues collected at the Hokianga Harbour. The study must take into account and involve Te Ihutai and marae representatives to consider cultural effects. If required, the wastewater system shall be upgraded to include and implement measures which reduce effects to shellfish

<u>Septage Management Plan</u>

Within six months of the commencement of consent the Consent Holder shall commission a suitably qualified and experienced person to prepare a Septage Management Plan (SMP) to demonstrate how the common effluent disposal system (CEDS) is to be operated and maintained to ensure compliance with the conditions of this consent. The SMP must, at minimum, contain the following information;

a. A suitable record of each individual tank connected to the CEDS that contains, at minimum, the following information;

i. Location details (i.e., GPS coordinates), and sketch plan of the septic tank on each property
ii. Basic property information (legal description, address)
iii. Contact information for the property owner
iv. Water supply type
v. The number of years the septic tank has been in service (the age of the septic tank).

b. A protocol for tank inspections which includes
    i. The frequency at which tanks will be inspected;
    ii. The methods of inspection that may be used.

Advice note: A consistent set of inspection methods are necessary to ensure that collected information is comparable for use in any improvement processes and for demonstrating compliance.

c. Details on how education and advice will be shared with properties connected to the CEDS for proper septic tank use and operation.

d. A template for recording tank inspection information which generally follows tank inspection requirements under AS/NZS 1547:2012.

e. A desludging programme for the septic tanks connected to the CEDS which recognises that older tanks may need to be desludged more frequently than newer tanks.

Where the outcomes of the implementation of the Septage Management Plan requires upgrades / works to either the WWTP or the individual septic tanks, these works shall be provided to the Northland Regional Council's Compliance Manager with a works programme to ensure that the ugprades / works are undertaken.

<u>Cultural Inductions</u>

Prior to any works completed on the Kohukohu WWTP that are associated with a discharge to land (as provided for in Condition X), Te Ihutai hapū are to be present at the commencement of works, provide tikanga protocol and cultural inductions for all relevant staff members to be resourced by the Far North District Council.

Cultural Monitoring

At least 10 working days prior to the commencement of any works on the site associated with a discharge to land (as provided for in Condition X), the consent holder shall engage, at their expense, Te Ihutai assigned kaitiaki to:

a) Attend a pre-works meeting with the Contractors if/when required.
b) Undertake cultural monitoring of all site works at all stages associated with the proposal.

Wetland Off-Setting

The consent holder must, no later than (insert day, month, year) provide for the approval of the Northland Regional Council's Compliance Manager an Environmental Offset Strategy. The Strategy is to be developed in conjunction with Te Ihutai representatives and provide for appropriate off-set measures for the proposal.

Expiry Date

Resource consent (insert references) will expire 3 years from their dates of commencement.

APPENDIX A – APPLICATION DOCUMENTS

Resource Consent Application Kohukohu Waste Water Treatment Plant

Resource Consent Application

Kohukohu Waste Water Treatment Plant

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Reference: 1-13036.00
Status: Final

Contents

1 Introduction

The Kohukohu Wastewater Treatment Plant (WWTP) has been owned and operated by the Far North District Council (FNDC) since the 1980s. The WWTP collects the discharge from individual septic tanks on 76 properties in Kohukohu. The treatment consists of a single oxidation pond followed by a constructed wetland. After treatment the effluent is discharged into a catchment drain, which flows for a short distance before discharging into the Hokianga Harbour.

Since commissioning the Kohukohu WWTP resource consent from Northland Regional Council (NRC) has been renewed a number of times. The most recent resource consent was obtained from NRC in the early 2000's and is due to expire on 31 August 2016.

A new consent must be obtained, and this consent will again cover the same activities as no changes to the WWTP are envisaged. The requested term for this consent is 15 years.

The activities sought by this application meet the criteria under s124 (2) (d) (ii) of the *Resource Management Act 1991* (RMA) for lodgement within the period ending 3 months before the expiry of the existing consent (expiry date 31 August 2016). Accordingly, FNDC seeks that NRC allow the continued operation of the Kohukohu WWTP pursuant to s124 (2) (e) of the RMA, until a decision is made on this application and it is beyond challenge (s124 (3)).

The application also seeks to lodge with a request to extend timeframes under s37 of the RMA. This extension will allow for full consultation with affected marae's to occur.

1.1 Relevant Rules

The WWTP discharges treated wastewater into the environment both directly (discharge into the Hokianga Harbour) and indirectly (through seepage into the ground). In addition to this the WWTP also generates minor air emissions (odour and gases). As a result the operation of the WWTP triggers a number of rules under the NRC Water and Soil Plan (2004) and Air Quality Plan(2005). The relevant rules have been summarised below in **Table 1**.

Table 1: Relevant Regional Rules

Plan and Rule	Description	Trigger
Soil and Water Plan	The discharge of treated sewage effluent directly into a water course from a sewage treatment and disposal system	15.03. 02 Discretionary Activity
	The discharge of sewage effluent into land in a manner outside the scope of or unable to meet the conditions pertaining to the permitted activity rules	15.03.01 Discretionary Activity
Air Quality Plan	Any activity not complying with permitted activity rules	9.03(2) Discretionary Activity

Plan and Rule	Description	Trigger
Coastal Plan	The discharge of treated effluent to coastal water from land-based wastewater treatment plants	31.4.6(f) Discretionary Activity

1.2 Scope and Objectives

The scope of this report is limited to providing necessary information requirements under Section 88 and Schedule 4 of the *Resource Management Act 1991*. Accordingly the scope includes:

- A description of the proposed activity;
- An assessment of environmental effects – with particular focus on Section 35.1 of the Regional Water and Soil Plan – *Information Requirements for Discharge Permit Applications*;
- Assessment of the activity against Part 2 and section 104 (1)(b) of the RMA all relevant Regional Council Policies; and
- Consultation with relevant stakeholders including the local community and iwi/hapu.

The objective of this report is to present the above scope in sufficient detail to allow a thorough and efficient assessment by NRC.

2 Proposed Activity

2.1 Location

The Kohukohu WWTP is located approximately 1km south of Kohukohu, a township located on the northern/western side of the Hokianga Harbour (**Figure 1**). The site is located on reclaimed land that has been utilised for this activity since 1984. The WWTP oxidation pond has a surface area of 0.1 ha and the constructed surface flow wetland covers approximately 0.12 hectares.

Figure 1: Site Location

2.2 Activity Description

The effluent at Kohukohu township receives primary treatment by septic tanks that are located on individual residential properties. These septic tanks are maintained by FNDC. Solids are separated and deposited as sludge in these septic systems and the septic tanks are de-sludged every three to five years.

Once reaching Kohukohu WWTP the effluent undergoes secondary treatment. This involves oxidation followed by anoxic periods. This process encourages the eventual decline of biochemical oxygen demand, nitrogen and bacterial content in the effluent. The effluent receives further treatment as it flows through a constructed surface flow wetland. Here the wetland plants take up phosphorus, and what remains of the nitrogen content. Finally the effluent discharged into a catchment drain, where it flows into Hokianga Harbour.

Once the effluent reaches the Hokianga Harbour it mixes and disperses with this large body of water within a defined mixing zone. During a half tide and falling situation (when water in the harbour is moving out to sea), the end of this mixing zone is considered to be the Channel Beacon at coordinates 2559832 – 6647261. This process is illustrated in **Figure 2** and explained in further detail in **Section 3.1**.

Figure 2: Effluent Discharge Process

2.2.1 Effluent Quantity

Flow rates leaving the WWTP vary substantially throughout the year.

- In dry summer periods there are long periods where no outflow discharge occurs at all.
- During wet weather period's substantial increases in outflow discharge occur as a result of inflow and infiltration into the reticulation. Generally, based on a 50mm rainfall event, the system experiences around a 4 fold peaking factor.
  - The 99%ile outflow is 208 m^3/day,
  - The 95%ile outflow is 105 m^3/day and
  - The 90%ile outflow is 73 m^3/day.

» The median is only 15 m^3/day. During dry weather the quantity discharged is usually around this amount.

Water loss from the WWTP can be relatively significant and is obvious during dry periods with minimal rainfall. During dry periods it is common to record inflow volumes ~10 – 20 m^3/day with no outflow recorded. Water loss from the WWTP can be attributed to a combination of evaporation and loss from the unlined oxidation pond and constructed wetland.

As discussed, significant amount of this loss is likely to be attributed to evaporation. To demonstrate this, actual open water evaporation[1] from the NIWA electronic weather station at Kaitaia (Station number 18183) was obtained over a 10 year period (2004-2014) as a proxy for evaporation from the treatment ponds and wetland. Based on that data, and taking into account a total open water pond and wetland size of 2,300m^2, the average evaporation rate over a 10 year sample period is expected to be approximately 6.7m^3/day. In the summer months (December to February) average evaporation is expected to be around 10m^3/day.

2.2.2 Effluent Quality

The quality of the final effluent leaving the WWTP has been monitored and records of monitoring data is available from 2003 until the present. These measurements, in **Table 2** represent the effluent quality before any mixing or dilution has occurred within the Hokianga Harbour Mixing Zone (**Figure 2**).

Table 2: Summary of monitoring results from 2003-2016. Average values shown with confidence levels at 95%. Note pH and Dissolved oxygen monitoring data covers a period of 2010-2016.

Parameter	Average	Median	95%tile	Number of samples
pH	7±0.3	7.1	7.8	53
Dissolved oxygen (g/m3)	3.4±1	3.4	13	52
Ammonium (NH_4-N) (g/m3)	17±1.6	17	35	104
Total Suspended Solids	12±2.3	7	41	104
Biochemical Oxygen Demand (g/m3)	12.5±1.7	10.5	31	104
Faecal Coliforms (c/100mL)	4323±1615	900	27,700	102

[1] Details on the methodology can be found on the cloflo website: http://cliflo.niwa.co.nz/pls/niwp/wh.do_help?id=ls_evap1

2.3 Alternative Options

Schedule 4 (d) (ii) of the *Resource Management Act 1991* requires that the Assessment of Environmental Effects for the discharge of a contaminant includes 'a description of any possible alternative methods of discharge, including discharge into any other receiving environment.' The most common alternative which also aligns with kaitiakitanga principles, is the use of land based effluent disposal (i.e. irrigation). Irrigation is not considered an appropriate option in this case because of a number of reasons:

- There is a limited amount of area available to irrigate. The only nearby open grassed areas belong to a sporting facility and a Marae. These are not acceptable locations to irrigate.
- Kohukohu is low lying and directly adjacent to the Hokianga Harbour. As a result it receives surface runoff and groundwater flow from the surrounding catchment. This causes the groundwater table in Kohukohu to be quite high, particularly in winter when rainfall is frequent. Thus saturation and effluent runoff may occur.
- Northland Regional Council's fundamental soils data (**Figure 3)** identifies Kohukohu's main soil type as being clay loam. Clay loam has limited permeability, thus effluent runoff may occur.

2.4 Value of Investment by Consent Holder

As this application meets the criteria under s124 (2) (d) (ii) of the RMA, in accordance with Section 3b of Schedule 4 of the RMA, the investment made by the consent holder to date must be considered.

The reticulated sewage system in Kohukohu has cost the Far North District Council approximately $2,093,700 excluding labour. This includes:

- Land Purchase at the WWTP site: $5,500
- Cost of Treatment Plant: $992,600
- Town reticulation system and pump stations: $1,095,600

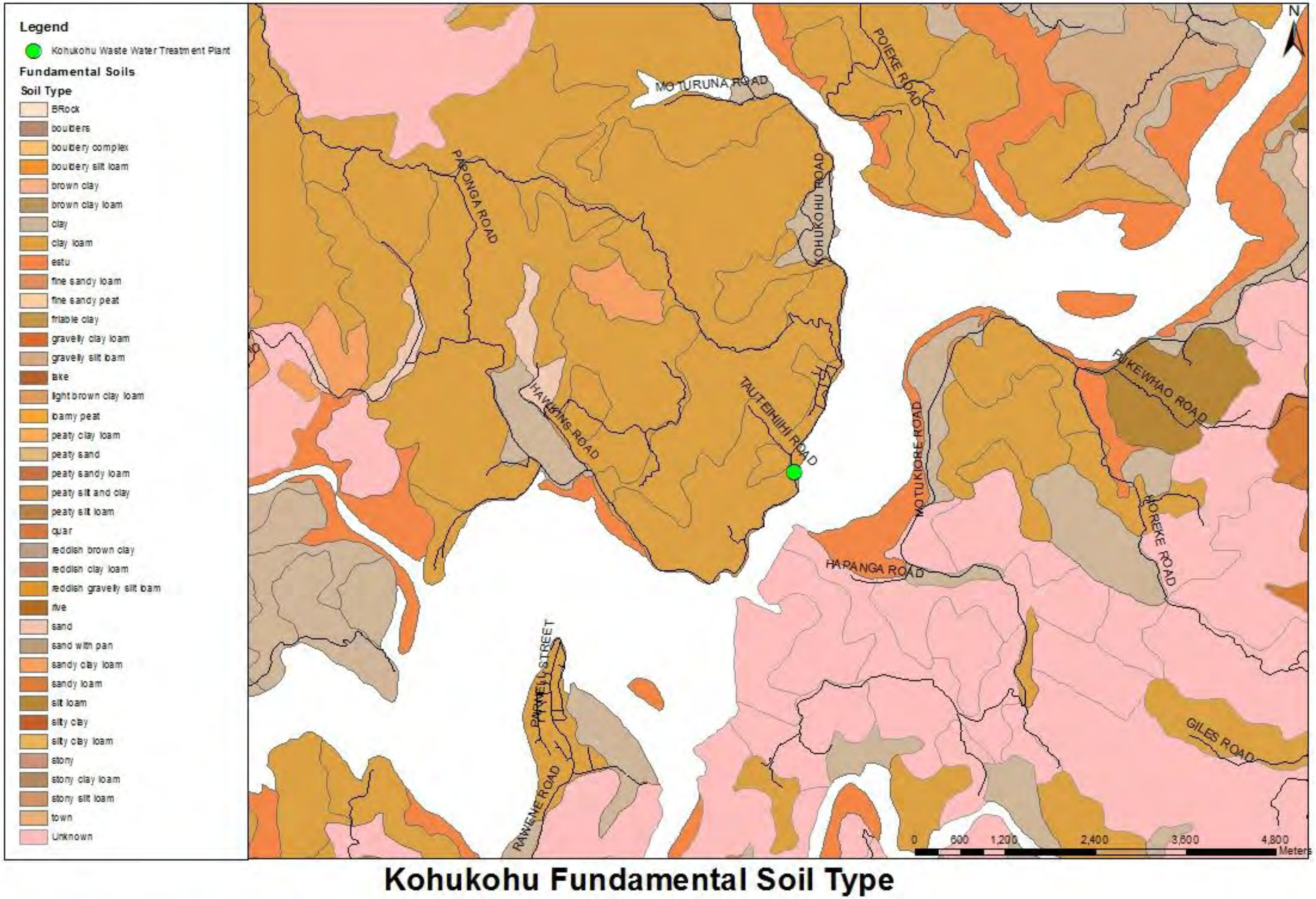

Figure 3: Northland Fundamental Soils

3 Existing Environment

The purpose of this section is to establish the existing baseline condition of the site and the surrounding environment of Hokianga Harbour. Understanding the baseline condition of an environment allows potential effects to this baseline condition to be assessed as set out in **Section 4**.

3.1 Water

3.1.1 Regional Water Objectives – Fresh Water Ecosystem Projection

Policy 3 of the *Northland Regional Council Regional Water and Soil Plan (2004)* lists guidelines for the management of waters for ecosystem purposes. The policy makes allowance for reasonable mixing. Thus it allows for effluent to be discharged and undergo a process of mixing and dilution in the receiving water body before it must reach the given water quality objectives in the plan. The area in which this mixing and dilution occurs is referred to as the mixing zone (**Figure 4**). Currently the end of this mixing zone is considered to be the Channel Beacon at coordinates 2559832 – 6647261.

Figure 4: WWTP release points and mixing process

For the purpose of ecosystem protection, the plan states after reasonable mixing the contaminant, is not likely to:

- Cause the natural pH of the water to fall outside the range of 6.5-9.0.
- Cause a change in the natural temperature of the water of greater than 3 degrees Celsius.
- Cause the concentration of dissolved oxygen (daily minimum) to be reduced below 6 g/m³.
- Cause levels of toxic metals to exceed the following, except where caused by natural events:

  » Total arsenic 50 mg/m^3
  » Total cadmium 0.2 – 2* mg/m^3
  » Total chromium 2 mg/m^3
  » Total copper 2 – 5 mg/m^3
  » Total lead 1 – 5 mg/m^3
  » Total zinc 5 – 50* mg/m^3
  » Total mercury 0.1 mg/m^3

- Cause the four- day average concentration of ammonium to exceed that detailed in **Table 3**.

Table 3: Four day average concentration of ammonium

Ammonium, NH4-N g/m^3					
pH	10°c	15°C	20°C	25°C	30°C
6.50	1.81	1.81	1.22	0.86	0.60
6.75	1.81	1.81	1.22	0.86	0.60
7.00	1.81	1.81	1.22	0.86	0.61
7.25	1.81	1.81	1.23	0.86	0.61
7.50	1.81	1.81	1.23	0.86	0.61
7.75	1.73	1.64	1.15	0.81	0.58
8.00	1.13	1.09	0.76	0.54	0.39
8.25	0.64	0.62	0.44	0.32	0.23
8.50	0.37	0.36	0.26	0.19	0.14

Note: pH and temperature, where practicable, should be measured in the midday-early afternoon period (noon to 2 p.m. NZ Standard Time).

- Cause the level of nutrients to fall outside the range of:

  » Dissolved Reactive Phosphorus 50 – 30 mg/m^3
  » Dissolved Inorganic Nitrogen (nitrate + ammonium) 40 – 100 mg/m^3

- Cause the visual clarity of the water, as measured by black disc, to be reduced by more than 20% in waters where visual clarity is an important characteristic of the water body and 40% in other waters, depending on site conditions.

Importantly, the above limits are ecological protection objectives for any receiving water body in the Northland Region and does not consider whether the receiving environment would actually meet these objectives prior to a discharge event.

In this case, the receiving water body is the upper Hokianga Harbour, a heavily disturbed ecosystem which is already unlikely to meet these objectives. Further details on the condition of the Hokianga Harbour are presented in the following section.

3.1.2 Hokianga Harbour Water Quality

The upper reaches of the Hokianga Harbour are characterised by a soft substratum of silt and clays and brackish estuarine water. Water circulation is dominated by tidal flows, there are strong tidal currents in some areas and relatively long water residence times. This area of the harbour contains large areas of high tidal flats, mangroves and salt marsh habitats (Davidson and Kerr, 2001). Threats to the quality of the harbour include the exotic grass (Spartina), stock grazing and trampling of salt marsh, sediment deposition and turbidity derived from erosion in the catchments (Davidson and Kerr, 2001).

Upstream Water Quality

NRC has been monitoring water quality of the Utakura River, which is located upstream of the WWTP, since 2007 (**Figure 5**). The results are available on the Land Air Water Aotearoa (LAWA) website. The monitoring results provide an approximate indication of baseline conditions before any influence from the Kohukohu WWTP. The statistical median values have been summarised in **Table 4**.

Table 4: Water Quality of the Utakura River 2007 - 2014

Measurement	Hokianga Harbour Water Quality Objectives	Median Value Utakura River
E.coli	126/100mL (recreational limit)	**309/100mL**
Black Disc	-	0.7 m
Turbidity	-	13.1 NTU
Total Oxidised Nitrogen	-	0.1225 g/m3
Ammoniacal Nitrogen (NH_3 + NH_4+)	-	0.0155 g/m3
Ammonium (NH4+)	1.81# g/m3	< 0.0155 g / m3
Dissolved Reactive Phosphorus (DRP)	0.03 – 0.05	0.01 g/m3
Total Phosphorus	-	0.0495 g/m3
pH	6.5 – 9.0	7.1

Overall the results indicate that the quality of water generally meet the NRC Harbour Water Quality Objectives, with the exception of the level of indicator bacteria (*E.coli*) which is elevated. Although objectives are not available for turbidity, the monitoring site at Utakura River is within the worst 25% of sites in New Zealand in accordance with the LAWA website.

Downstream Water Quality

Downstream of the site is classified as the Hokianga Harbour, which under NRC's monitoring programme, is classified as coastal. The coastal sites within Hokianga Harbour are only monitored for *Enterococci* which is a useful bathing quality indicator, however it is not directly comparable against *E.coli* which is the parameter measured at the WWTP and upstream in the Utakura River.

Figure 5: Utakura River Monitoring Site (LAWA 2016).

3.2 Ecosystem

Shaw and Maingay in the Department of Conservation Coastal Resource Inventory (1990) summarised the ecological values of Hokianga Harbour. They rated the harbour as internationally important on the grounds that the wetlands were important to a range of birds including migratory species. Other ecological values listed in the report included:

- extensive areas of salt marsh and mangrove vegetation around the Harbour;
- freshwater wetland are contiguous with salt marsh and mangrove; and
- the Harbour is important to a variety of bird species many of which are status species.

The Harbours feeding habitat is utilised by a variety of wading bird species including banded dotterel, pied stilt, godwit and ducks and less frequently lesser knots and wrybills. The mud and sand flat areas support invertebrates including shellfish (e.g. cockles), snails, crabs and worms that provide a staple food for many different wader bird species.

Limited data is available on freshwater and marine fish in the Hokianga Harbour, although a preliminary evaluation was undertaken by Davidson and Kerr (2001). This compared the values of Hokianga Harbour to other estuarine and Harbours in New Zealand. The study found that the Hokianga Harbour contains approximately 40 marine fish species.

Infilling, drainage and causeway construction have had a significant impact on the bird population of the harbour. Bird roosting areas and high tide feeding areas have been lost due to causeway construction. Causeways have also cut off and altered the upper tidal reaches of the harbour which has an effect on invertebrates and therefore bird species that feed in these areas. The proximity of roads to the estuary have also resulted in road kills of marsh birds (Davidson and Kerr, 2001).

From 2008-2012 NRC undertook a habitat assessment of the Utakura River (upstream of the WWTP) based on environmental factors, such as channel stability, periphyton abundance, riparian vegetation, the composition of organic and inorganic substrate in the stream and surrounding land use. Utakura scored in the lower third for habitat quality with a score of approximately 50/100. In particular Utakura River scored low for Riparian vegetation, hydrologic heterogeneity and bank stability.

3.3 Land

Much of the environment around the Harbour is dominated by pasture, forestry or early regeneration kanuka/pasture. There are, however, areas of mature forest or lowland swamp forest.

Substantial areas of Hokianga Harbour have been permanently lost through infilling, drainage and causeway construction. Modification to the Harbour has occurred through stock grazing, illegal rubbish dumping, and clearance of estuarine fringing vegetation. Davis and Bellingham (1984) reported that 246 ha of Harbour had been lost to drainage and infilling. Causeways have cut off and altered upper tidal reaches of the Harbour and caused loss or alteration of saline-freshwater zones and salt marsh to lowland forest vegetation (Davidson and Kerr, 2001).

As previously discussed, Kohukohu is low lying and directly adjacent to the Hokianga Harbour. As a result it receives surface runoff and groundwater flow from the surrounding catchment. This causes the groundwater table in Kohukohu to be quite high, particularly in winter when rainfall is frequent. Due to Kohukohu's position at the low point within its catchment, it generally contains alluvial soils that consist of silt and clays which have limited permeability.

3.4 Air

Kohukohu is approximately 30 km inland of the west coast of New Zealand. The WWTP is on the eastern side of an inlet and is surrounded by steep hills. The site is therefore sheltered and experiences low wind levels predominantly from the south west. The majority of land in Kohukohu is low density residential and agricultural (Statistics NZ, 2013). There are no major industries with air emissions near this area. The only activity (other than the WWTP) with some potential to generate air emissions is Kohukohu Road. This is an arterial road which connects West Coast Road to the Ferry crossing from Rawene. Some minor noise and vehicle emissions are expected from this road.

3.5 Community

The population of Kohukohu is 165 (Statistics NZ, 2013). The biggest industries in Kohukohu are agriculture, forestry and fishing with 75% of the population being employed in this sector. Kohukohu has a school, general store, café, art galleries, arts and crafts shop, hotel, voluntary fire and ambulance services, and a health clinic. There are also two churches and three Marae within the locality. Kohukohu School is a co-educational full primary (years 1-8) school with a decile rating of 2 (in 2011) and a roll of 54 (in 2015).

4 Potential Effects to the Environment

4.1 Positive Effects

The WWTP provides wastewater treatment for 76 properties in Kohukohu. The renewal of this consent is vital in order to continue to provide wastewater services for the community.

The Kohukohu WWTP will enable people and communities to continue to provide for their social, economic and cultural well-being and for their health and safety, consistent with the purpose of the RMA. The Kohukohu WWTP therefore has significant positive effects.

4.2 Water

4.2.1 Potential Effects from Discharge of Contaminants

Wastewater can contain a range of contaminants depending on its source. In this case the wastewater originates from domestic activities. Accordingly, unlike industrial/tradewaste it is unlikely to contain significant levels of toxicants (heavy metals, hydrocarbons or pesticides etc). Being domestic waste water it is most likely to contain inorganic and organic nutrients, suspended solids, and pathogens.

Potential impacts of high nutrients on water quality include:

- Direct increase to biochemical oxygen demand. Microorganisms quickly break down the nutrients in wastewater, particularly nitrogen and carbon based nutrients. In doing so they will consume the available oxygen in the water column. Thus oxygen breathers (i.e. aquatic animals) can be negatively impacted.
- Eutrophication - excess nutrients (particularly nitrogen and phosphorus) in lakes, estuaries, or slow-moving streams and rivers can stimulate excessive plant growth (phytoplankton, algae and nuisance plants and weeds). The problem with excessive plant growth (i.e. algae blooms) is it can cause:

  » A decrease in visibility - when aquatic plant growth increases in response to nutrients it can tend to spread across the surface of the water column, thus preventing penetration of light below the water surface. In addition to this, in high numbers, phytoplankton increase the turbidity of the water column. Thus organisms utilising the water column (submerged plants and animals) experience light restriction. This prevents growth of submerged plants, and restricts the ability of some aquatic animals to catch prey etc.

  » An altered oxygen cycle. Plants photosynthesise in the daytime causing the release of oxygen into the water column. However during the night they switch to respiration which consumes oxygen in the water column. This becomes highly pronounced when plant growth is intense (i.e. algae blooms). Also, when the intense plant growth dies off, the biochemical oxygen demand can rapidly increase as microorganisms break the algae down.

Suspended solids are mostly made up of inorganic materials such as sediment. However bacteria and algae can also contribute to the total solids concentration. Increased suspended solids in coastal waters can:

- Restrict light transmission causing a decrease in visibility as mentioned above.
- Have negative impacts on filter feeding animals (i.e. shellfish), by clogging feeding structures, interfering with particle selection and requiring the use of energy to clear away unwanted particles.
- Negatively impacting the abundance and diversity of fish assemblages by clogging gills and reducing feeding efficiency. Sediment deposition can also reduce egg and embryo survival by reducing oxygen supply and crusting over the egg, preventing the embryo from escaping.
- Discolour the water and reduce water quality making it less suitable/attractive for recreation, for example, swimming.

Pathogens are disease carrying organisms that generally occur in water that has been contaminated by human and/or animal waste. Water that contains high levels of pathogens can be harmful to human health. Swallowing water containing high levels of pathogens, or being exposed to pathogenic water through cuts in the skin or inhalation of spray, can lead to skin, eye and ear infections, and respiratory illness. Aquatic foods can also become contaminated with faecal pathogens from exposure to contaminated water. Such pathogens can stay in the flesh of shellfish long after the surrounding water quality has improved. Bacterial and viral contamination can affect both recreational and commercial shellfish gathering .

4.2.2 Potential Effects from Activity

As is described in **Section 2**, the quantity of effluent released by the Kohukohu WWTP is usually around 15m^3/day in the absence of rain. The quality of this effluent, based on the data available, suggests it still has biochemical oxygen demand, ammoniacal nitrogen concentration, and faecal coliform concentration that need to be mixed and diluted in order to meet NRC Water Quality Objectives. Mixing and dilution is dependent on the quantity and quality of water body that the discharge is released into.

In terms of quantity, this section of the Hokianga Harbour is 400m wide, it contains a substantial body of water which is continually refreshed by upstream to downstream flow and tidal flushing. In effect there is more than adequate quantity of water available for dilution.

In terms of quality, the concentration of ammonia within the Hokianga Harbour is well within water quality objectives, accordingly there is sufficient capacity for the harbour to absorb the ammonium from the released effluent.

Table 5: Comparison of Upstream Hokianga Harbour Quality to Effluent Quality.

Measurement	Hokianga Harbour Water Quality Objectives	Median Value Upstream (Utakura River)	Median Effluent Result
E.coli	126/100mL (recreational limit)	**309/100mL**	**400**
Black Disc	-	0.7 m	-
Turbidity	-	13.1 NTU	-
Total Oxidised Nitrogen	-	0.1225 g/m3	-
Ammoniacal		0.0155 g/m3	-

Measurement	Hokianga Harbour Water Quality Objectives	Median Value Upstream (Utakura River)	Median Effluent Result
Nitrogen (NH_3 + NH_4+)			
Ammonium (NH_4+)	1.81# g/m3	< 0.0155 g/m3	17
Dissolved Reactive Phosphorus (DRP)	0.03 – 0.05	0.01 g/m3	-
Total Phosphorus	-	0.0495 g/m3	-
pH	6.5 – 9.0	7.1	7.0

Parameter	Average	95%tile	Number of samples
pH	7±0.3	7.8	53
Dissolved oxygen (g/m3)	3.4±1	13	52
Ammonium (NH_4-N) (g/m3)	17±1.6	35	104
Total Suspended Solids	12±2.3	41	104
Biochemical Oxygen Demand (g/m3)	12.5±1.7	31	104
Faecal Coliforms (c/100mL)	4323±1615	27,700	102

In terms of indicator bacteria (i.e. *E.coli*), the overall loading of bacteria associated with the WWTP is significantly less compared to that which is occurring from rivers discharging into the harbour. For example, the median *E.coli* concentrations in the Utakura River are approximately 309 per 100mL and in reference to daily flow rates it is possible to extrapolate a total daily *E.coli* loading rate. For the purpose of this estimate the mean flow value of Utakura River has been taken to be 3.18 cubic meters per second[2]. Based on that flow rate, the total daily *E.coli* load from the Utakura River is estimated to be approximately 8.5×10^{11} E. coli per day.

For the Kohukohu WWTP, the average daily flow of 28m^3/day has been used against a median faecal coliform concentration of 900 faecal coliforms per 100ml, which equates to an approximate faecal coliform load of 2.5×10^8 per day. Based on this, it is estimated that on average the daily *E.coli* load from the Utakura River is about 3000 times greater than the faecal coliform loading from the Kohukohu WWTP.

These estimated loading rates demonstrate that outflow from upstream catchments have a significant effect on the existing environment of Hokianga Harbour, in particular the level of *E.coli* and its associated effects.

[2] Flow rate sourced from the Ministry for Environment (MFE) River Flows Database available at https://data.mfe.govt.nz/x/odt3cv

4.3 Ecosystem

Impacts to an ecosystem from a WWTP occur from either construction or operational activities.

In this case, there is no construction proposed and it is intended to continue the ongoing operation of the existing WWTP. Accordingly no new disturbance will be required (no clearing, dredging, de-watering etc).

Potential ecological impacts may come about from the continued discharge of the same quantity/quality of effluent into the Hokianga Harbour, in particular effects associated with the release of domestic waste water on downstream water quality.

As discussed in **Section 4.2**, the level of treatment in combination with dilution mixing is likely to be sufficient to reduce the concentration of nutrients (i.e. ammonium) to the level accepted under the regional plan.

As discussed above, the nutrients within the effluent will be dispersed and diluted in the Hokianga Harbour. As the pathogen content of the released effluent will neither worsen nor improve the pathogen content of Harbour (as it already contains approximately the same concentration of pathogens), effects associated with the continued operation of the WWTP is considered to have no more than a minor impact on the existing ecological condition of Hokianga Harbour.

4.4 Land

The proposal is for the continuation of an existing activity with no changes proposed, therefore there are no plans for earth disturbance works to be undertaken with this consent. As established in **Section 2.3** discharging to land is not a viable option for the WWTP, therefore continued discharge to water will occur.

As discussed in **Section 2.2**, the WWTP loses a volume of water before it is released into the environment. This comes about from a combination of evaporation and seepage of water from unlined ponds associated with the WWTP.

With regard to water lost through the ponds, the effluent slowly flows vertically and laterally with groundwater and is filtered through the minute pore spaces in the soil profile. This filtration causes many contaminants to be filtered out and absorbed by the soil profile (the principle behind a septic land disposal system). Groundwater underlying the WWTP flows to Hokianga Harbour. In between the WWTP and Hokianga Harbour there are no users of groundwater (no bores for water supply etc). Once the groundwater reaches the Hokianga Harbour, it would seep into the harbour in a slow diffuse manner that could be readily diluted (similar manner to mixing zone).

It is considered that due to the volumes of effluent seepage, the availability of fine soil to filter contaminants, lack of groundwater users, and availability of dilution in the receiving water body, there would be no more than minor impact on the land.

4.5 Noise and Odour

Wastewater systems have the potential to create a nuisance to those living and working in the surrounding area due to noise and odour.

Blowers and pumps associated with the WWTP may result in some minor noise impacts. Odour effects from sewage can result if oxygen content is not maintained within the system. If oxygen content drops, anaerobic bacteria can begin to breakdown the sewage releasing odorous sulphide gases. The current resource consent requires oxygen content within the system to always be maintained above 1g/m^3 at all times and the WWTP will continue to comply with this resource consent condition.

The nearest habitable building to the WWTP is a Marae which is located between 250 m and 350 m to the northwest. There is also a sporting field located immediately to the north of the WWTP. The predominant wind direction is south west, therefore wind will generally carry noise and odour away from the Marae and sporting field. Noise is likely to be much lower than that generated by cars utilising the Kohukohu Road.

4.6 Community

Statistics New Zealand data from 1996-2013 for Kohukohu indicates the population has fluctuated slightly, but has overall faced a small decline since 1996 (**Table 6**). Based on these trends it is unlikely that the population will increase in the future, if anything a slight decline might be expected. Accordingly it is unlikely that there will be any significant additional pressure on the WWTP from additional population. Larger flows or extensions are not proposed in this application.

However the WWTP and its reticulation system are ageing, and as previously discussed the reticulation system is subject to wet weather flow infiltration. There will be times that maintenance and upgrades will be required. It is known that the costs of running and maintaining the system are of significant concern to the community.

Table 6: Population of Kohukohu (Statistics New Zealand)

Year	Population
1996	220
2001	165
2006	186
2013	165

4.6.1 Tangata Whenua

Maori culture is centred on Mauri, an energy which binds and animates all things in the physical world. Without mauri, mana (power) cannot flow into a person or object (Te Ahukaramu Charles Royal, 2012). Mauri is within all life forms including water and this is harmed through contamination. For instance, the spiritual harm that is considered to result from consuming shellfish collected from water that may have been subject to effluent and other pollution, is unacceptable to many Maori (Ministry for the Environment).

From a traditional Maori perspective polluted water needs to pass through the earth to be purified and to have its mauri, or essence, restored. This is considered necessary, irrespective of whether treatment to remove or dilute pathogens, chemicals and metals has already occurred. Even human waste found in treated wastewater must first pass through the earth before re-entering any water.

The passing of the wastewater through the wetland, while not considered to be equal to passing through earth to be purified, does provide some cleansing from a traditional Maori perspective.

Formal consultation with affected marae is yet to be undertaken. FNDC staff will be engaging with affected marae over the coming months and it is expected that the resource application process will be placed on hold to enable this consultation to occur.

5 Notification

5.1 Section 95A- Public Notification Assessment

Section 95A of the Act states that a consent authority may, at its discretion, decide whether to publicly notify an application for resource consent for an activity. Section 95A states:

1) *A consent authority may, in its discretion, decide whether to publicly notify an application for a resource consent for an activity.*

2) *Despite subsection (1), a consent authority must publicly notify the application if-*

   a) *It decides (under section 95D) that the activity will have or is likely to have adverse effects on the environment that are more than minor; or*

   b) *The applicant requests public notification of the application; or*

   c) *A rule or national environmental standard requires public notification of the application.*

3) *Despite subsection (1) and (2)(a), a consent authority must not publicly notify the application if-*

   a) *A rule or national environmental standard precludes public notification of the application; and*

   b) *Subsection (2) (b) does not apply.*

4) *Despite subsection (3), a consent authority may publicly notify an application if it decides that special circumstances exist in relation to the application.*

Comment

Effects associated with the continued operation of the WWTP remain consistent with that which has occurred since the commissioning of the plant which was given consent and commissioned in the 1980s.

In addition, given the significant contribution that upstream catchments have on the *E.coli* loading of Hokianga Harbour, compared to the *E.coli* loading of the WWTP, it is expected that the continued operation of the facility will have a less than minor impact on the existing water quality of the harbour.

In reference to Section 95A, it is considered that adverse effects associated with the continued operation of WWTP are less than minor and therefore public notification of the activity is not warranted.

5.2 Section 95B and 95E- Limited Notification Assessment

If a consent authority does not publicly notify an application for a resource consent, it must decide (under sections 95E and 95F of the Act) if there are any affected persons in relation to the activity.

The consent authority must give limited notification of the application to any affected person unless a rule or national environmental standard precludes limited notification of the application.

Section 95B allows for such notification. Section 95B states:

1) *If a consent authority does not publicly notify an application for a resource consent for an activity, it must decide (under sections 95E and 95F) if there are any affected persons or affected order holders in relation to the activity.*

2) *The consent authority must give limited notification of the application to any affected person unless a rule or national environmental standard precludes limited notification of the application.*

3) *The consent authority must give limited notification of the application to any affected order holder even if a rule or national environmental standard precludes public or limited notification of the application.*

Section 95E of the Act provides for how a consent authority determines if a person is affected:

1) *A consent authority must decide that a person is an affected person, in relation to an activity, if the activity's adverse effects on the person are minor or more than minor (but are not less than minor).*

2) *The consent authority, in making its decision,-*

   a) *May disregard an adverse effect of the activity on the person if a rule or national environmental standard permits an activity with that effect; and*

   b) *In the case of a controlled or restricted discretionary activity, must disregard an adverse effect of the activity on the person that does not relate to a matter for which a rule or national environmental standard reserves control or restricts discretion; and*

   c) *Must have regard to every relevant statutory acknowledgement made in accordance with an Act specified in Schedule 11.*

3) *Despite anything else on this section, the consent authority must decide that a person is not an affected person of-*

   a) *The person has given written approval to the activity and has not withdrawn the approval in a written notice received by the authority before the authority has decided whether there are any affected persons; or*

   b) *It is unreasonable in the circumstances to seek the person's written approval.*

Comment

As discussed in **Section 2.3** and **Section 4.6**, the existing WWTP is located in proximity to a sportsfield and a marae. At least two additional marae occur within the Kohukohu locality.

Given the close proximity of the marae and the sportsfields there is potential for these localities to be effected by minor noise or odour impacts associated with the continued operation of the facility.

Thus consultation with these parties may be necessary, to notify these stakeholders of the renewal of this application.

In addition, discharge to contaminants to the local waterbody is likely to be of interest to Maori. As part of the resource consent process, local marae will be consulted and notified of the consent renewal. It is expected that upon submission of the application, the application will be placed on hold in order to allow this consultation to take place.

It is therefore considered that persons that administer the local sportsfields, and the local marae, have the potential to be affected by continued operation of the WWTP and limited notification to these parties should be considered. Notwithstanding as to whether limited notification is triggered, FNDC intends to consult with these parties regardless.

6 Statutory Assessment

6.1 Resource Management Act 1991

The sections of the RMA that are particularly relevant to this application are detailed below.

6.1.1 Section 5- Purpose

Section 5 of Part II identifies the purpose of the RMA as being the sustainable management of natural and physical resources. This means managing the use of natural and physical resources in a way that enables people and their communities to provide for their social, cultural, and economic wellbeing, while avoiding, remedying or mitigating adverse effects on the environment.

The WWTP provides wastewater treatment for 76 properties in Kohukohu. The renewal of this consent provides continued wastewater services for the community and enables people and communities to continue to provide for their social, economic and cultural well-being and for their health and safety.

The oxidation pond and constructed wetland is designed to harness processes that occur in natural wetlands for the treatment of wastewater. By using a constructed wetland it avoids the contamination and degradation of large areas of land and natural wetlands, therefore protecting natural resources.

6.1.2 Section 6- Matters of National Importance

Section 6 of the RMA sets out the matters of national importance that are to be recognised when managing the use, development, and protection of natural and physical resources.

The relevant matter to this application is:

> *(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.*

This application is a renewal of an existing discharge where the waste water is treated through an oxidation pond and surface flow wetland. The WWTP is land based with only the discharge affecting the coastal environment. The discharge is into a catchment drain and then the Hokianga Harbour where it receives adequate dilution. More information on this is in the Assessment of Environmental Effects **(Section 4)**.

6.1.3 Section 7- Other Matters

Section 7 of the RMA lists certain matters to which particular regard is to be had in making resource management decisions. The following 'other matters' are considered relevant to the proposal:

(a) Kaitiakitanga
(b) the efficient use and development of natural and physical resources
(f) maintenance and enhancement of the quality of the environment

The WWTP is designed to harness processes that occur in natural wetlands for the treatment of wastewater. Constructed wetlands are efficiently using natural resources to enable treatment performance per unit area of land to be optimised and ensures less variable discharge quality.

By providing a system where the waste water discharges through wetland plants the treatment process is having a level of regard to kaitiakitanga. From a traditional Maori perspective polluted water needs to pass through the earth to be purified and to have its mauri, or essence, restored. While ideally a land based system is the preferred option in respect of kaitiakitanga, this offers some feasible substitution. As discussed in Section 2.3, alternative land based irrigation methods were not considered feasible due to lack of available irrigation land and the potential for surface runoff from local impermeable soils.

FNDC staff acknowledge the continued operation of the WWTP will affect Maori cultural values. FNDC staff will engage with affected marae in the coming months. This consent application will be placed on hold upon lodgement of the application in order to enable sufficient time for marae to be consulted in a meaningful manner.

6.1.4 Section 8- Treaty of Waitangi

Section 8 of the RMA requires that the principles of the Treaty of Waitangi (Te Tiriti o Waitangi) must be taken into account in relation to managing the use, development, and protection of natural and physical resources.

6.1.5 Section 104 Assessment

Subject to Part 2 of the RMA and in accordance with section 104(1), when considering an application for resource consent and any submissions received, the Council must have regard to:

(a) any actual and potential effects on the environment of allowing the activity; and
(b) any relevant provisions of—
(i) a national environmental standard:
(ii) other regulations:
(iii) a national policy statement:
(iv) a New Zealand coastal policy statement:
(v) a regional policy statement or proposed regional policy statement:
(vi) a plan or proposed plan; and
(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application

The actual and potential effects on the environment of allowing the activity are set out earlier in **Section 4** of this report.

The relevant provisions of the policy statements and plans are set out in the following sections.

6.1.6 Section 105 Matters Relevant to Certain Applications

In accordance with Section 105 (1) if an application is for a discharge permit, the consent authority must, in addition to matters in section 104(1) have regard to *a. The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*

b. The applications reasons for the proposed choice; and

c. Any possible alternative methods of discharge, including discharge into any other receiving environment.

The condition of the receiving environment is described in detail in **Section 3** and resilience in **Section 4**. **Section 2** provides reasons for discharge and alternative options.

6.1.7 Section 107 – Restriction on Grant of Certain Discharge Permits

In accordance with Section 107 (1) a consent authority shall not grant a discharge permit to do something that would otherwise contravene section 15 or section 15A allowing:

a. The discharge of a contaminant or water into water; or
b. A discharge of a contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or
ba. The dumping in the coastal marine area from any ship, aircraft, or offshore installation of any waste or other matter that is a contaminant.

If, after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to all or any of the following effects in the receiving waters:

c. The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials.
d. Any conspicuous change in the colour or visual clarity.
e. Any emission of objectionable odour.
f. The rendering of fresh water unsuitable for consumption by farm animals.
g. Any significant adverse effects in aquatic life.

As identified in **Section 4**, overall the continued discharge associated with the WWTP will result in no more than minor impact to the existing ecological condition of Hokianga Harbour.

6.1.8 Section 124 Exercise of Resource Consent While Applying for New Consent

The activities sought by this application meet the criteria under s124 (2) (d) (ii) of the RMA for lodgement within the period ending 3 months before the expiry of the existing consent (expiry date 31 August 2016). Accordingly, FNDC seeks that NRC allow the continued operation of the Kohukohu WWTP pursuant to s124 (2) (e) of the RMA, until a decision is made on this application and it is beyond challenge (s124 (3)).

6.2 New Zealand Coastal Policy Statement

The New Zealand Coastal Policy Statement 2010 (NZCPS) is a national policy statement under the RMA. Its purpose is to state objectives and policies to achieve the purpose of the Act relative to the management of the coastal environment of New Zealand.

The NZCPS sits below and implements Part II of the RMA. It gives some guidance to Section 5 and 6 of the RMA. **Table 7** provides an assessment of the WWTP discharge against the objectives in the NZCPS.

Table 7: NZCPS Objectives

Objective	Response
To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land.	The WWTP is discharging a minor volume of waste water that has undergone primary and secondary treatment. This level of treatment in combination with dilution is considered sufficient to reduce these risks to match that in the baseline water upstream. Accordingly relative to baseline conditions the WWTP release has no more than minor impact on the current condition of the coastal environment and its ecosystem.
To preserve the natural character of the coastal environment and protect natural features and landscape values.	The WWTP discharges a small amount of waste water into the Hokianga Harbour. Overall this discharge will have a less than minor impact on the overall natural character, natural features and landscape values of the coastal environment.
To take account of the principles of the Treaty of Waitangi, recognise the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment.	FNDC staff acknowledge the proposed activity will affect Maori cultural values. FNDC staff will be engaging with the affected marae in the coming months. This consent application will be placed on hold on lodgement in order to enable sufficient time for marae to be consulted in a meaningful manner.
To maintain and enhance the public open space qualities and recreation opportunities of the coastal environment.	As per the first objective.
To ensure that coastal hazard risks taking account of climate change, are managed.	N/A
To ensure that management of the coastal environment recognises and provides for New Zealand's international obligations regarding the coastal environment, including the coastal marine area.	N/A

6.2.1 NZCPS Policy 23

The WWTP fits within Policy 23 for the discharge of contaminants. Policy 23 looks at managing discharges to the environment to ensure effects are no more than minor. **Table 8** provides an assessment of the activity against the relevant sections of Policy 23.

Table 8: NZCPS Policy 23

Policy	Response
In managing discharges to water in the coastal environment, have particular regard to: (a) the sensitivity of the receiving environment;	Please refer to **Section 3** for an overview of the receiving environment which has been taken into account for the assessment of environmental effects.
(b) the nature of the contaminants to be discharged, the particular concentration of contaminants needed to achieve the required water quality in the receiving environment, and the risks if that concentration of contaminants is exceeded;	Please refer to **Section 2** for details of the nature of the contaminants that are being discharged and **Section 3** for information on the water quality of the receiving environment. If the concentration of contaminants is exceeded then the risks are explained in **Section 4**.
(c) the capacity of the receiving environment to assimilate the contaminants;	**Section 4** covers capacity of the receiving environment to assimilate the contaminants.
(d) avoid significant adverse effects on ecosystems and habitats after reasonable mixing;	Please refer to **Section 4** for the assessment of effects on ecosystems and habitats after reasonable mixing.
(e) use the smallest mixing zone necessary to achieve the required water quality in the receiving environment; and	As described in **Section 4** the section of the Hokianga Harbour that the effluent is discharged into is a 400m wide with large flow volumes. This is considered sufficient to achieve the required regional water quality objectives.
(f) minimise adverse effects on the life-supporting capacity of water within a mixing zone.	Please refer to **Section 4.**
(2) In managing discharge of human sewage, do not allow: (a) discharge of human sewage directly to water in the coastal environment without treatment; and	The WWTP process provides primary and secondary treatment of the sewage before discharging it into the coastal environment.
(b) the discharge of treated human sewage to water in the coastal environment, unless: (i) there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge; and (ii) informed by an understanding of tangata whenua values and the effects on them.	Please see **Section 2** for an assessment of alternative options and **Section 4** for the assessment of effects on Tangata Whenua**.**

(3) Objectives, policies and rules in plans which provide for the discharge of treated human sewage into waters of the coastal environment must have been subject to early and meaningful consultation with tangata whenua.	FNDC staff acknowledge the proposed activity will affect Maori cultural values. FNDC staff will engage with affected marae in the coming months. This consent application will be placed on hold upon lodgement in order to enable sufficient time for mare to be consulted in a meaningful manner.

6.3 Regional Coastal Plan

The purpose of the Regional Coastal Plan is to promote the sustainable management of the natural and physical resources, thus giving effect to the purpose of the RMA. The Plan covers the area around Northlands coast from Mean High Water Springs to the 12 nautical mile (22.3 km) limit of New Zealand's territorial sea. **Table 9** provides an assessment of the activity against the Regional Coastal Plan.

Table 9: Regional Coastal Plan

Activity	Response
(a) Noise generated as a result of activity within the coastal marine area shall comply with the following standards: (i) the activity shall not cause excessive noise as defined in section 326 of the Resource Management Act; and (ii) any construction or maintenance activity near coastal subdivisions or other urban areas shall comply with the noise standards of the district council which is responsible for the use of the adjoining land.	(i) It is considered that the activity will not cause excessive noise as defined in section 326 of the RMA (ii) Not applicable
(b) All lighting associated with activities in the coastal marine area shall not by reason of its direction, colour or intensity, create: (i) a hazard to navigation and safety; or (ii) a hazard to traffic safety on wharves, ramps, and adjacent roads; or (iii) a nuisance to other users of the surrounding coastal marine area or adjacent land.	Not applicable
(c) Discharges to water shall, after reasonable mixing, comply with the relevant receiving water quality standards and shall not contain any contaminants which could cause: (i) the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials. (ii) any conspicuous change in the colour or visual clarity of the receiving waters. (iii) any emission of objectionable odour.	**Section 4** sets out expected quality of the discharge after dilution and mixing in Hokianga Harbour.

(iv) accumulation of debris on the foreshore or seabed underlying or adjacent to the discharge point (v) any significant adverse effects on aquatic life or public health	
(d) Any modification of the contour of the foreshore caused during any authorised construction or maintenance activity other than dredging shall be restored as soon as practicable after the completion of the construction or maintenance activity.	Not applicable.
(e) Unless expressly authorised to do so by a coastal permit, structures within the coastal marine area shall not unduly impede safe navigation within natural drainage channels or unduly restrict the flow of flood waters within such channels.	Not applicable.
(f) Discharges of contaminants into air shall not: (ii) Result in the discharge of black smoke apart from coal, oil or diesel burning equipment for a period of up to 15 minutes from startup from cold, or for soot blowing. (iii) Result in any offensive or objectionable odour, or any noxious or dangerous level of gases. (iv) Result in a discharge to air of offensive or objectionable dust. (iv) Result in concentrations of air pollutants that exceed as a minimum the National Ambient quality guidelines, May 2002.	The only relevant air emission is that of odour assessed in **Section 4**.

6.4 Regional Water and Soil Plan

The purpose of the Regional Water and Soil Plan is to promote the sustainable management of the water and soil resources in Northland, thus giving effect to the purpose of the RMA. **Table 10** and **Table 11** assess the WWTP against the relevant objectives and policies in the Regional Water and Soil Plan.

Table 10: Regional Water and Soil Plan: Water Quality Management

Objective	Response
The maintenance or enhancement of the water quality of natural water bodies in the Northland region to be suitable, in the long-term, and after reasonable mixing of any contaminant with the receiving water and disregarding the effect of any natural events, for such of the purposes listed below as may be	Please refer to **Section 4** for potential effects on aquatic ecosystems, recreation and aesthetic, and cultural purposes.

appropriate: Lakes, rivers, streams - aquatic ecosystems, contact recreation, water supplies, aesthetic and cultural purposes.	
Policies	**Response**
Until such time as the classification system referred to in Policy 7.05.02 is introduced, when processing applications for discharge permits, the Council will have regard to: (a) 2. 3. Existing water quality and uses of the subject water body; (b) Community aspirations for future use of the water body (as expressed in submissions on consent applications); (c) Opportunities for enhancement of water quality; (d) Relevant water quality guidelines (refer also Methods 7.06.07 to 7.06.10)	The relevant water quality objectives as stated in the regional soil and water plan have been considered and assessed in **Section 4**.
The Council will not grant a discharge permit which, either on its own or in combination with other lawful discharges, will result in any of the following effects in the receiving water, after reasonable mixing: (a) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; (b) Any conspicuous change in the colour or visual clarity; (c) Any emission of objectionable odour; (d) The rendering of freshwater unsuitable for consumption by farm animals.	An assessment of receiving water quality post treatment and mixing has been undertaken in **Section 4**.
When determining what constitutes a reasonable mixing zone, the Council will take into account: (a) The characteristics of the discharge and the sensitivity of the receiving water; (b) The assimilative capacity of the receiving water body; (c) The proximity and effects of other discharges; (d) The proximity of, and likely effects on, downstream uses; (e) The desirability of keeping the mixing zone as small as practicable; (f) The availability and cost-effectiveness of current treatment technology.	An assessment of receiving water quality post treatment and mixing has been undertaken in **Section 4**.

Table 11: Regional Water and Soil Plan: Discharges

Objectives	Response
1. The effective treatment and/or disposal of contaminants from new and existing discharges in ways which avoid, remedy or minimise adverse effects on the environment and on cultural values.	Please refer to **Section 4** for an assessment of how adverse effects are avoided, remedied or mitigated and an assessment of the effects on Tangata Whenua.
2. The reduction and minimisation of the quantities of contaminants entering water bodies, particularly those that are potentially toxic, persistent or bio-accumulative.	The waste water has undergone primary and secondary treatment with mixing, reducing the quantities of contaminants entering the water. This is assessed in further detail in **Section 4**.
Policies	**Response**
To promote effective effluent treatment and disposal systems which are: (a) Low maintenance and low risk; (b) Land based, where the soil types, available disposal areas, back-up facilities and pumping systems are adequate; (c) Operated in accordance with approved maintenance and contingency plans; and (d) Designed and maintained so as to prevent the collection of catchment runoff	The WWTP system is a simple low risk and maintenance system. A land based disposal system is not feasible at this location. Therefore the WWTP has continued to operate by discharge through constructed wetland before entering water for a number of decades.
To avoid the cumulative adverse effects of sewage discharges, particularly in areas subject to concentrated development, a high water table, poorly draining soils, very free draining soils, or in areas which are ecologically and/or culturally sensitive.	The WWTP is not located in an area of concentrated development. There is a high water table and poorly draining soils, which is why a water discharge was been selected over a land based system. **Section 4** provides an assessment of the WWTP against ecological and cultural values.
To promote the installation of reticulated community sewerage schemes in urban and rural residential areas where on-site disposal systems contribute or are likely to contribute to the contamination of water, including coastal water and groundwater.	The WWTP services a reticulated network in the Kohukohu community. Thus it avoids individual on site disposal in soils that not suitable for individual onsite disposal.
To promote alternative methods to reticulated sewage systems and septic tanks for sewage disposal.	Please refer to **Section 2.3** for a discussion related to alternative options.

6.5 Regional Air Quality Plan

The purpose of the Regional Air Quality Plan is to promote the sustainable management of Northlands air resources, thus giving effect to the purpose of the RMA. The plan covers all discharges of contaminants to air for the Northland region but does not include discharges to air from the coastal marine area. **Table 12** provides an assessment of the WWTP against the relevant Objectives and Policies of the Regional Air Quality Plan.

Table 12: Regional Air Quality Plan

Objectives	Response
The sustainable management of Northland's air resource including its physical, amenity and aesthetic qualities by avoiding, remedying or mitigating adverse effects on the environment from the discharge of contaminants to air.	Please refer to **Section 4** for an assessment of how adverse effects on the environment from the discharge of contaminants to air are avoided, remedied and mitigated.
The maintenance and, where necessary, enhancement of the quality of the environment so that it is free from noxious, dangerous, offensive or objectionable adverse effects associated with discharges to air, such as odour, dust, smoke and poor visibility.	Please refer to **Section 4** for an assessment of the quality of the environment in relation to discharges to air. There are no recent odour complaints registered against the site.
Policies	**Response**
To maintain the existing high standard of ambient air quality in the Northland region, and to enhance air quality in those instances where it is adversely affected, by avoiding, remedying or mitigating adverse effects of activities discharging contaminants to air.	Please refer to **Section 4** for an assessment of how adverse effects on the environment from the discharge of contaminants to air are avoided, remedied and mitigated.
To avoid, remedy or mitigate the adverse effects generated by discharges of contaminants to air including cumulative or synergistic/interactive effects.	Please refer to **Section 4**for an assessment of how adverse effects on the environment from the discharge of contaminants to air are avoided, remedied and mitigated.
To recognise that many activities which discharge contaminants to air have a minor effect on the quality of Northland's air environment.	It is considered that this is the case with the Kohukohu WWTP, the discharge of contaminants will have a less than minor effect on the quality of Northland's air environment.
To recognise that discharges of contaminants to air may adversely affect other receiving environments.	This is recognised and it is considered that no other receiving environments will be effected from the odorous compounds.
To ensure that the discharge of contaminants to air should not result in offensive or objectionable odours that could adversely affect people and communities.	There are no recent odour complaints registered against the site.

7 Conclusion

This application and AEE relates to the renewal of the current resource consent for the Kohukohu WWTP which was commissioned in the 1980s. As there is no intention to change the scale of activities currently undertaken at the WWTP, the activities that relate to the current consent continue to apply to the new consent. It is requested that a 15 year term is applied to this new consent.

The WWTP discharges treated wastewater into the environment directly via an outfall into Hokianga Harbour and indirectly through unintentional seepage into the ground. The WWTP also generates minor air emissions (odour and gases). As a result the operation of the WWTP triggers a number of rules under the NRC Water and Soil Plan and Air Quality Plan. In consideration of the rules triggered, this application relates to a 'Discretionary Activity'.

Policy 3 of the *Northland Regional Council Regional Water and Soil Plan* lists guidelines for the management of waters for ecosystem purposes. The policy makes allowance for reasonable mixing. Thus it allows for effluent to be discharged and undergo a process of mixing and dilution in the receiving water body before it must reach the given water quality objectives in the plan. The WWTP discharges effluent into a receiving water body that has the quality (relatively low in nutrients) and quantity (large body of water continually flushed) that is able to dilute and disperse the contaminants within a reasonable zone of mixing.

Some minor air and noise effects may continue to occur from the activity. In consideration of the activity, and that there has been no recent complaints from local persons, it is considered that air and noise effects are less than minor.

FNDC recognises that the continued use of the facility may effect Maori cultural values and FNDC will consult with local marae on submission of the resource consent application. It is expected that the application will be placed on hold to enable sufficient time for consultation to occur.

The WWTP provides the community with a reticulation sewage system thus avoiding individual onsite disposal systems in local soils that have limited loading capacity (e.g. alluvial soils with limited permeability). It is therefore likely that the operation of the centralised treatment facility has less effect on local soils and groundwater when compared to a scenario where sewerage is disposed at individual properties. The facility therefore serves an important public function and has significant positive effects on the local community. The discontinued use of this facility, and the need to treat water in an alternative manner, has the potential to impose a significant financial burden on the small community of Kohukohu.

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Kohukohu WWTP

Land Disposal Site Selection Analysis Report

Document No. | A

February 17, 2020

Far North District Council

Client Reference

Kohukohu WWTP

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A	17/2/2020	Draft Report	JD	TB	BM	KS

Contents

Executive Summary

This report presents the results of a desktop GIS analysis to identify potentially suitable sites for land disposal of treated wastewater from the Kohukohu wastewater treatment plant (WWTP).

This report assumes an annual average flow of $30m^3$/day and an average hydraulic loading rate of 2.0 mm/day. A total area of 3.0 hectares is required, including an allowance for 100% disposal buffer area and a storage pond.

A number of constraints were applied to the area of interest, which is sites located within a 7 km radius of the WWTP including:

Table 0-1 Screening Criteria for Land Disposal Sites

Parameter	Constraint	Unit
Proximity to WWTP	7 km	Km
Slope	<10	%
Proximity to waterways	≥20	m
Proximity to residential dwellings	>20	m
Proximity to cultural dwellings	500	m
Groundwater	>1.2	m
Elevation	>2m	m
Tsunami zone	Yellow – Safe	Zone
Flood risk	Preferably outside flood risk zone.	
Irrigation rate	3	mm/day

GIS spatial mapping using data sets from FNDC and Northland Regional Council (NRC) were used. Sites 1, 2 and 3 are located within an area marked as flood susceptible in FNDC flooding maps and were therefore excluded from further consideration. Sites 4 and 5 are less than the required 3.0 hectares based on the preliminary flow estimates and have also been excluded from consideration. Therefore, at this stage, land disposal is not considered viable due to a lack of suitable land area within 7km of the site, and is therefore excluded as an option for further consideration.

1. Introduction

Land disposal of municipal wastewater is a reasonably common method of wastewater disposal in New Zealand and is the preferred method from a Maori cultural perspective

The Kohukohu wastewater treatment plant (WWTP) discharges treated wastewater into the Hokianga Harbour. The Far North District Council (FNDC) are currently renewing the WWTP's resource consent which expired in 2016. As part of the consent renewal process, FNDC wish to investigate the feasibility of a land disposal option which would remove the discharge from the harbour. If potentially feasible, a land disposal option would be presented to the community along with continuing the harbour discharge and a decision made on an agreed strategy for the WWTP.

There are several factors which must be considered in the selection of a land disposal site, including:

- The volume and quality of wastewater to be applied
- Land use
- Soil types and quality
- Flooding and tsunami classifications
- Site elevation and topography

This report presents the site selection analysis completed for land disposal of effluent produced by the Kohukohu WWTP. Analysis has been completed using GIS spatial software and the datasets in the table below. Analysis and data processing were completed using Feature Manipulation Engine (FME) and the edited maps have been created in ArcGIS.

GIS Dataset	Source
Property Parcels	Land Information New Zealand
District Plan Zones	Far North District Council
Elevation (from 15m Digital Elevation Model)	University of Otago - National School of Surveying
Slope (from 15m Digital Elevation Model)	University of Otago - National School of Surveying
Watercourses	Land Information New Zealand
100-year flood plain extents	Northland Regional Council
Tsunami evacuation zones	Northland Regional Council
Marae locations	Maori Maps

2. GIS Screening for Potential Sites

2.1 Flow Summary

The flow data for the Kohukohu WWTP has been provided by FNDC for the period between 1st January 2010 and 8th December 2019. Figure 2-1 Kohukohu WWTP Flow Data shows the data over the past five years. The orange line depicts the average dry weather flow (ADWF) of 19m^3/day.

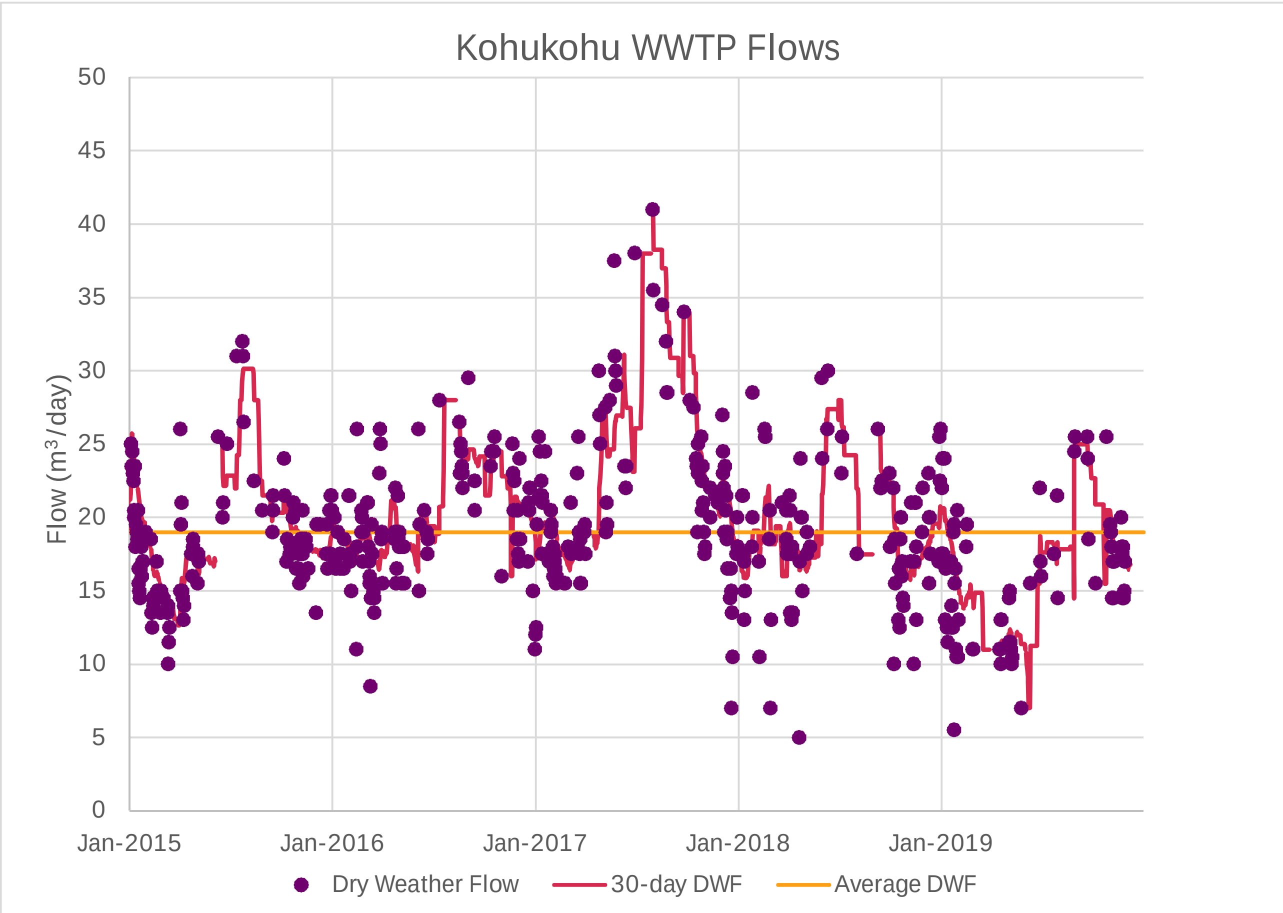

Figure 2-1 Kohukohu WWTP Flow Data

2.2 Required Land Area

For the purposes of this study, the land area requirement has been calculated based on an estimated annual average flow of 30m^3/day. A hydraulic loading rate of 2.0mm/day has been used, based on the poorly draining clay soils in the vicinity of the WWTP, and a water balance which considers evaporation, percolation and rainfall (USEPA Process Design Manual for Land Treatment of Municipal Wastewater Effluents (USEPA, 2006). At the aforementioned hydraulic loading rate and annual average flow, 0.9 hectares is required for land-based disposal as a minimum. In addition, a 50% buffer is required for spacing between the disposal trenches. A total land requirement of 3.0 Ha is recommended which would include a 100% redundancy buffer (typically required in Northland for land based disposal from septic tanks),water storage and a safety factor. This value would need to be confirmed following site-specific testing as part of the design of the land disposal system.

2.3 Site Selection Basis

2.3.1 Site Selection Criteria

The parameters outlined in Error! Reference source not found. contain the constraints applied on sites to assess their suitability for land disposal. The succeeding sections will discuss the application of the screening criteria in Error! Reference source not found. to identify suitable sites for land disposal.

Table 2-1 Site Selection Criteria

Constraint No.	Criteria	Criteria requirement	Basis
1	Proximity to WWTP	5 -7 kilometers	Ease of transport of effluent and manageable costs of installing infrastructure and operations within this distance (1)
2	Proximity to residential dwellings	>20m	Distance was selected based on previous work completed by CH2M Beca for Rawene WWTP (2)
3	Proximity to cultural dwellings	500m	Distance was selected based on previous work completed by AECOM for the Taipa WWTP completed with additional buffer (1)
4	Proximity to waterways	≥20m	Distance was selected based on previous work for Rawene WWTP (2)
6	Slope	<10%	Acceptable land slope for distribution as the risk of erosion and runoff is reduced (3)
7	Groundwater	>1.2m	At least 1m to groundwater is preferred with seasonal fluctuations of +/- 0.5m (3)
8	Elevation	>2m	Elevation was selected based on previous work completed by AECOM for the Taipa WWTP (1)
9	Tsunami zone	Yellow – Safe	Ideal zone.

2.4 Land Use

Figure 2-2 shows the location of the Kohukohu WWTP and the land use of the surrounding area within five and seven-kilometer radii from the Kohukohu WWTP and the Mangamuku River.

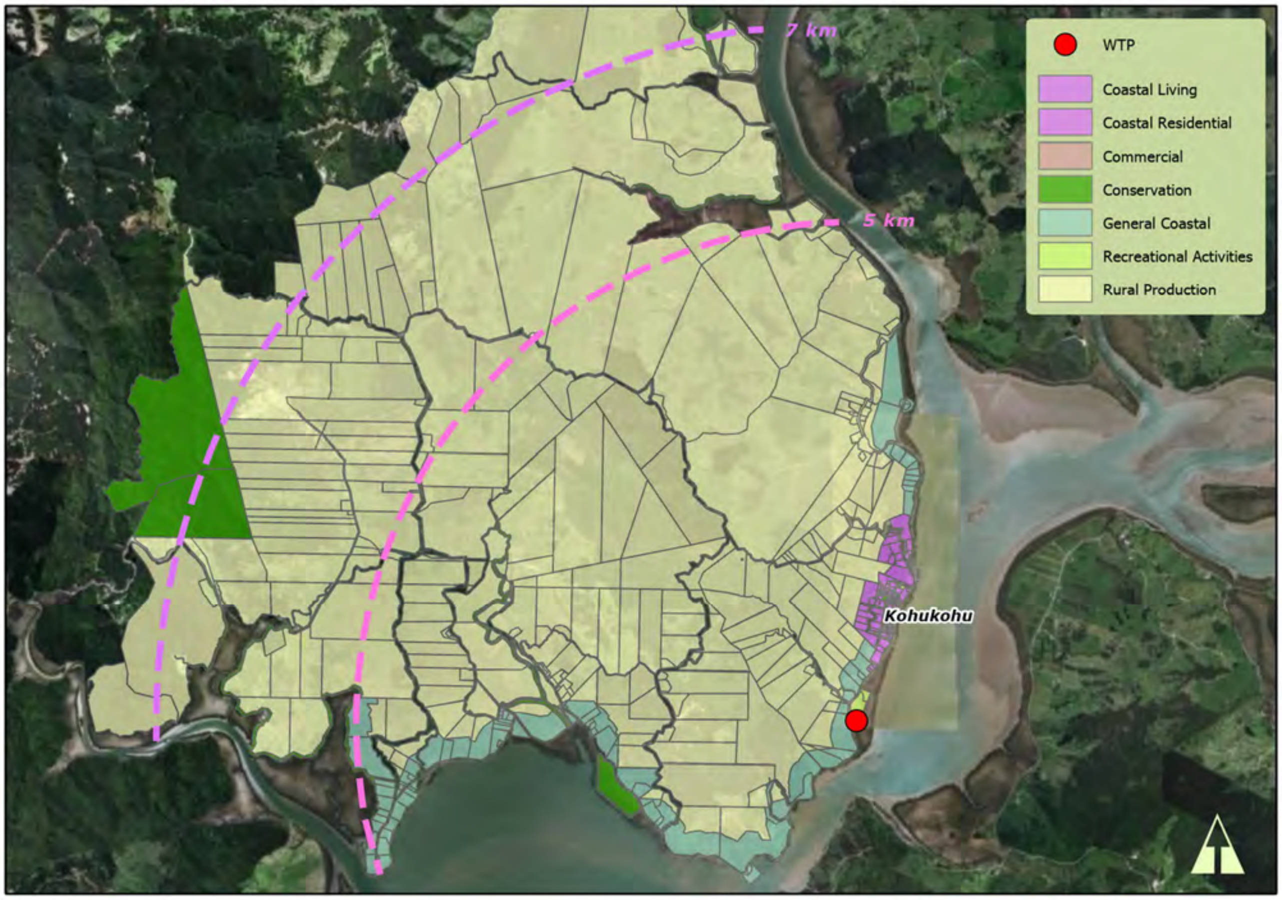

Figure 2-2 Kohukohu WWTP land uses within radius of interest

2.5 Proximity to Residential Dwellings and Conservation Land

A 20 meter minimum buffer distance between a land disposal site and residential dwellings has been applied. The likelihood for travel of effluent aerosols and runoff, which could adversely impact residents should they come into direct contact is diminished using this buffer distance. The same constraint has been applied to conservation land. Figure 2-3 Excluded residential and conservation land within 7 km radius from Kohukohu

WWTPshows the exclusion of residential and conservation land areas with the application of the buffer.

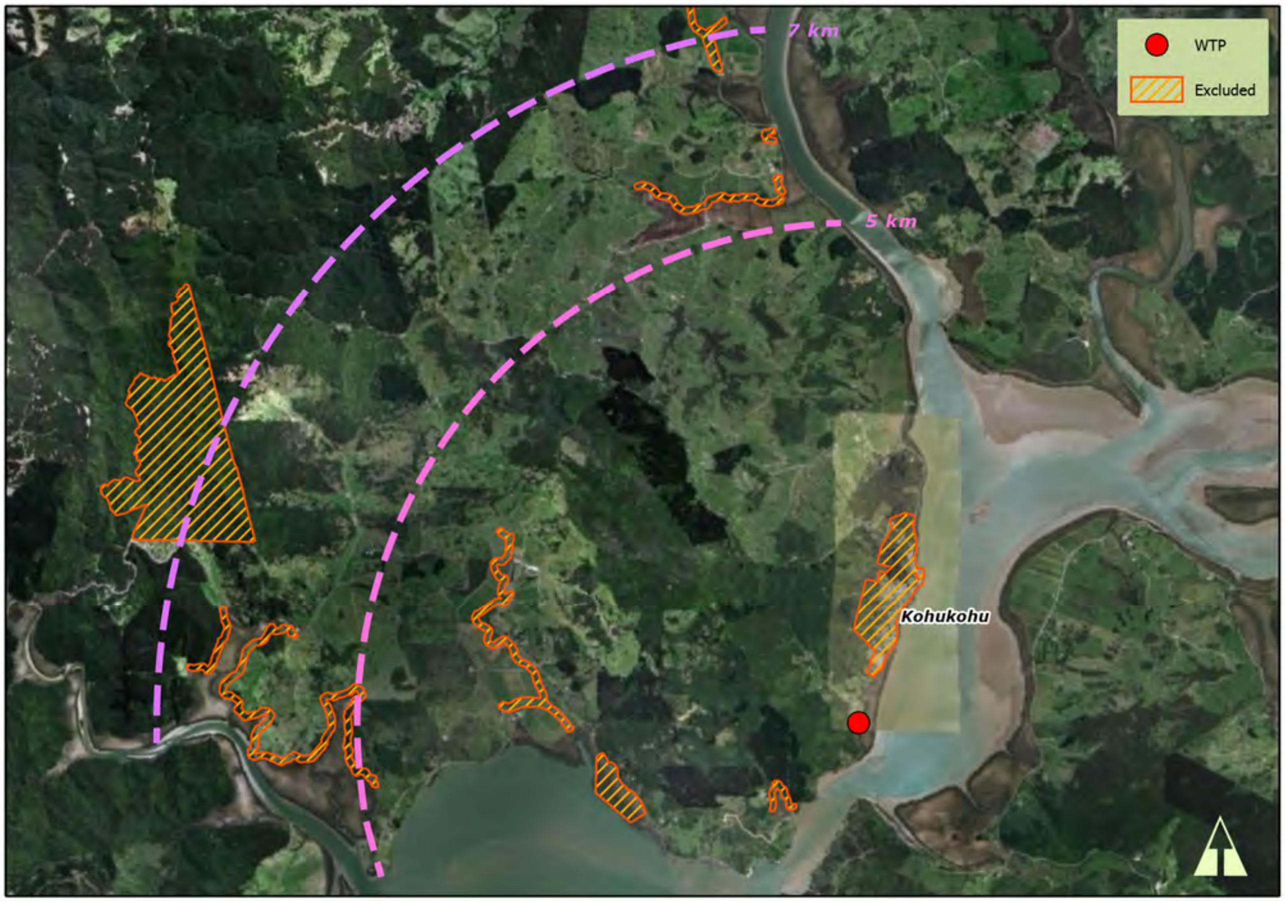

Figure 2-3 Excluded residential and conservation land within 7 km radius from Kohukohu WWTP

2.6 Proximity to Cultural Landmarks

The Ngai Taupoto, Tauteihiihi and Pikiparia maraes are located within 5km of the WWTP as seen in Figure 2-4 Maraes within the 7km boundary from the Kohukohu WWTP. The Ngai Taupoto Marae lies on Motukaraka Point Road at a distance of 7.4 km, Tauteihiihi Marae lies on Kohukohu Road at a distance of 230m and Pikiparia marae lies on Smith Deviation Road at a distance of 3.6 km from the Kohukohu WWTP. The maraes are culturally significant sites for the Kohukohu Maori tangata whenua and the local community, areas within the 500m buffer may also be heritage land and have archaeological significance. Figure 2-5 Excluded residential, conservation and culturally signifcant areas within a 7km boundary identifies maraes and other culturally significant areas and adds to the previously excluded area for residential and conservation land.

Figure 2-4 Maraes within the 7km boundary from the Kohukohu WWTP

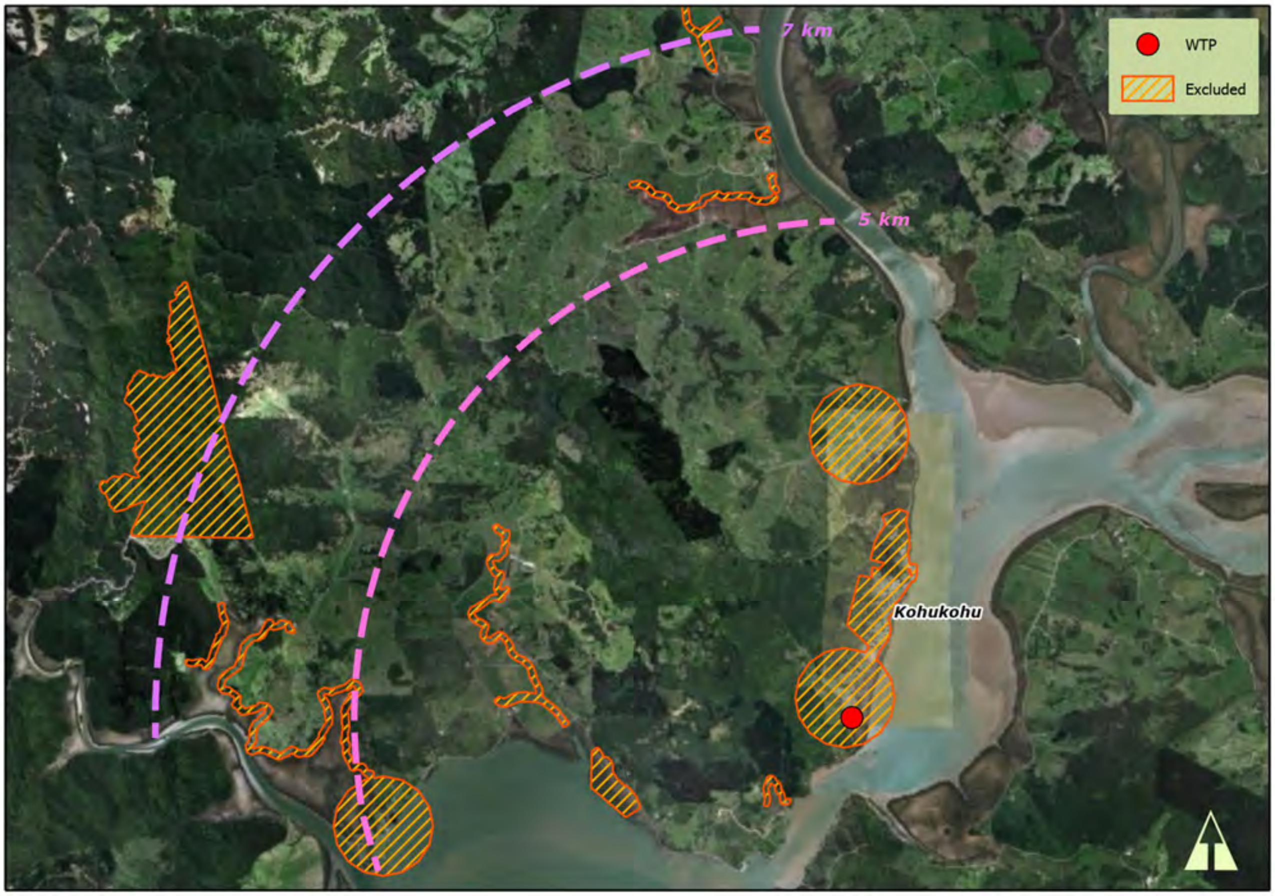

Figure 2-5 Excluded residential, conservation and culturally signifcant areas within a 7km boundary

2.7 Proximity to Watercourses

Watercourses flowing within the 7-kilometer radius from the Kohukohu WWTP have been highlighted and excluded from potential areas of use in Figure 2-6 Excluded residential dwellings, conservation land, cultural landmarks and water courses within a 7km boundary. A minimum buffer distance of 20m has been selected from each side of the waterway to avoid direct contamination of the Hokianga Harbour or the Mangamuka River by runoff of the treated effluent. Watercourses identified include all branches from the Mangamuka river and land drains located within the 7km radius from the Kohukohu WWTP.

Figure 2-6 Excluded residential dwellings, conservation land, cultural landmarks and water courses within a 7km boundary

2.8 Land Slope

The recommended maximum slope for disposal to pasture is below 10% (3). Metcalf and Eddy specifies that slopes below 12% are generally acceptable for land-based disposal with slopes greater than 6% performing better with direct injection measures e.g. Subsoil/ drip-feed irrigation refer to Error! Reference source not found. for detail. Slopes higher than this are unacceptable due to the lack of deep infiltration occurring into the soil, generation of runoff and erosion. Higher slope levels will contribute to the generation of runoff and he logistics of installation will prove to be a challenge.

Table 2-2 Land Disposal Slope Criteria

Slope Percentage	Land Disposal Performance
0 – 3%	Ideal slope range (3)
3 – 6%	Acceptable with minor erosion risks (3)
6 – 12%	Acceptable with direct injection methods, runoff development issues
12 – 15%	Greater runoff development and erosion issues.
15% ++	May be suitable for areas with excellent soil permeability

Using the slope and elevation level datasets from the University of Otago the FME tool was used to identify land with a slope level less than 10°. Figure 2-7 Slope levels within a 5 - 7 km radius from the Kohukohu WWTPidentifies all the slope percentages of land within a five to seven-kilometer radius from the Kohukohu WWTP. The lighter areas indicate sites that have a slope percentage between 1.5 – 10% which lie within the preferable area for irrigation as specified in Table 2-2.

Figure 2-7 Slope levels within a 5 - 7 km radius from the Kohukohu WWTP

2.9 Soil Permeability

The Northland Regional Council Soil factsheet viewer tool was used to estimate the types of soils that are within the 7km radius of interest surrounding the Kohukohu WWTP. Table 2-3 Soil types within 7km of the Kohukohu WWTP identifies the soil types and the drainage properties of each soil below:

Table 2-3 Soil types within 7km of the Kohukohu WWTP

Soil type	Description	Drainage Class	Soil permeability (m/s) (4)
AEH	Young Sandstone Soils - Autea clay loam/silty clay loam	3 – moderately drained (5)	$10^{-8} – 10^{-11}$
TC	Recent Estuarine Soils – Takahiwai clay	1 – Poorly drained (6)	$10^{-11} – 10^{-12}$
TFH	Young mudstone soils - Te Tio clay loam	2 – Imperfectly to poorly drained (7)	$10^{-11} – 10^{-12}$

WF	Whakapara silt loam and clay loam	4-3 Moderately to well drained (8)	10^{-8} – 10^{-11}

The soil surrounding the WWTP are generally clay type soils which are moderate to poorly drained. Loamy soils with slow to moderate permeabilities and moderate drainage are preferable for land-based disposal methods (3).

3. Second Stage Analysis of Potential Sites

Applying the criteria outlined in Error! Reference source not found., the areas outlined in Figure 3-1 Available Sites within a 7km radius from the Kohukohu WWTPare valid sites which meet the screening criteria and the total land requirement area of 2 hectares.

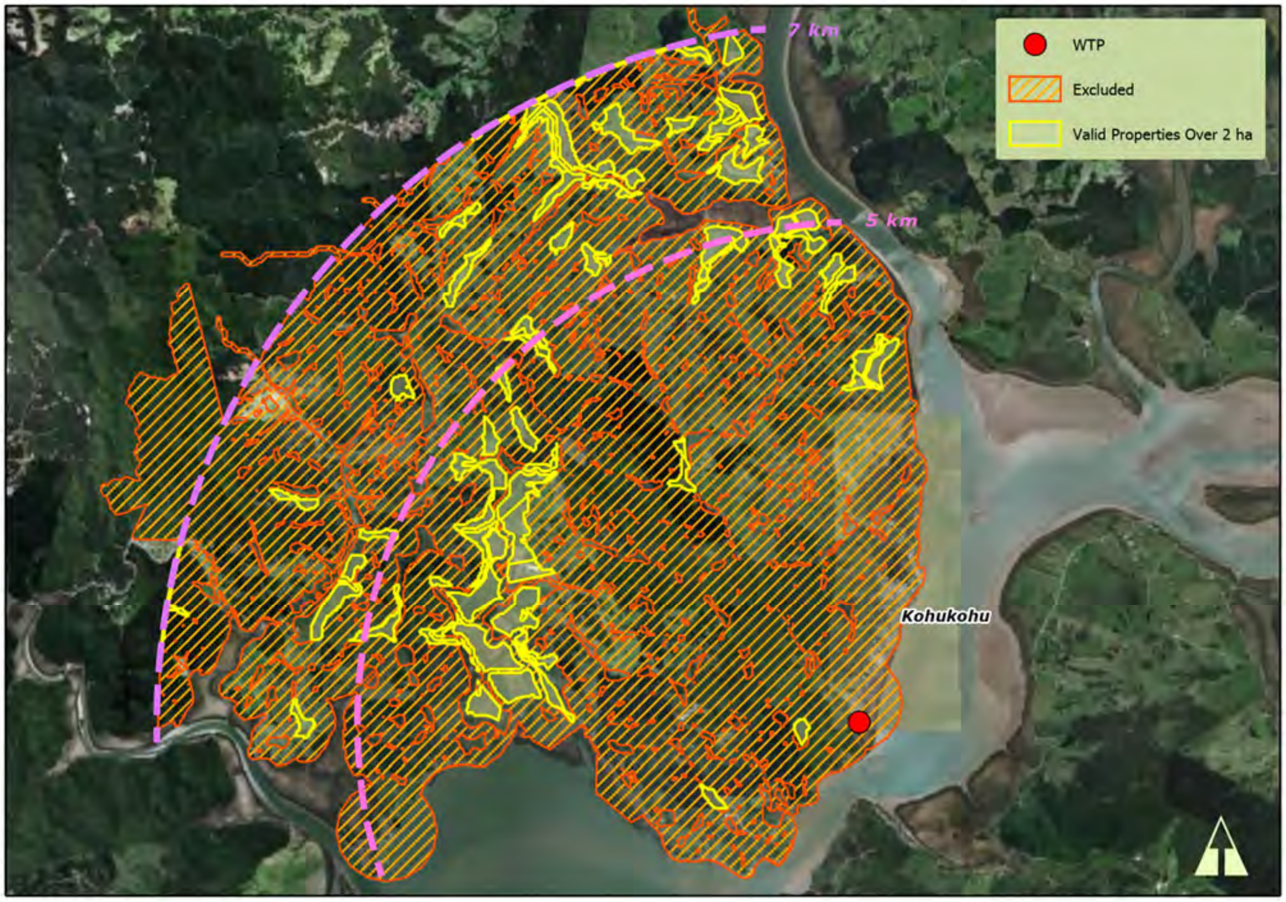

Figure 3-1 Available Sites within a 7km radius from the Kohukohu WWTP

Due to the large number of valid sites which are within a 5km radius, the sites outside this radius will not be discussed any further. The remaining sites were screened further in terms of existing land cover, number of lots affected, ownership of lots and distance from the WWTP. Five sites were chosen for further investigation, these can be seen in Figure 3-2 Selected Sites for Land Disposal, the sites have been investigated further to determine the optimum site.

Figure 3-2 Selected Sites for Land Disposal

3.1 Site 1, 2 and 3

Sites 1, 2 and 3 were assessed in conjunction due to similarities in topography and location. Site 1 lies at a distance of 3071 m from the Kohukohu WWTP. Pipe access for all sites will be along established roadways, access for all sites will be along Kohukohu Road and West Coast Road. Piping for Site 3 would need to travel further along Hawkins Road to reach the site. Site 1 has all four soil types stated in Table 2-3 Soil types within 7km of the Kohukohu WWTP, a majority of the site is the well-drained Whakapara clay (61%), a sizeable portion is the Takahiwai clay (27%) and a smaller portion is the Autea clay (12%). The Whakapara and Autea clays have moderate to well soil permeability however the presence of Takahiwai clay would reduce soil permeability and irrigation levels of the site.

Site 2 lies at a distance of ~3409m from the Kohukohu WWTP. The site contains the Takahiwai clay 96% and the Whakapara clay (4%) soil types. The Takahiwai clay type has poor permeability, is prone to pugging and is have poor soil structure and don't support subsoil drainage systems. This would decrease the levels of infiltration into the soil greatly, though the Whakapara soil type has generally good soil characteristics. Similarly, site 3 is located at a distance of ~3669m from the Kohukohu WWTP. The site soil type is comprised of 91% Takahiwai clay and 9% Te Tio clay loam. Like Site 2, a large percentage of the Takahiwai clay type with poor drainage characteristics would reflect in poor drainage of the soil and poor permeability of treated effluent for irrigation.

Table 3-1 Sites 1, 2 and 3 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (Ha)	Total Property Area (Ha)	No. of Landowners
1	Section 121 Blk X Mangamuka SD	26 Hawkins Road Kohukohu 0491	4.3	5.0100	1
2	Section 98 Blk X Mangamuka SD	190 Hawkins Road Kohukohu 0491	11.0	16.4909	1
3	Lot 2 DP 175963	26 Hawkins Road Kohukohu 0491	6.3	6.7262	1

Sites 1-3 are relatively flat, pasture land with slope levels ranging between 1.5 – 5% (1° - 3°), which is positive for irrigation purposes with respect to infiltration to the desired area and minimize runoff.

Sites 1 – 3 lie within the tsunami yellow zone Figure 3-3 Tsunami Zones surrounding the Kohukohu WWTP. The tsunami yellow is indicative of areas which may need to be evacuated should an earth quake of magnitude higher than 9 take place. Remaining areas of sites 1 – 3 lie within the green zones which would be unaffected in a tsunami scenario. Site 3 primarily lies within the yellow and green zones.

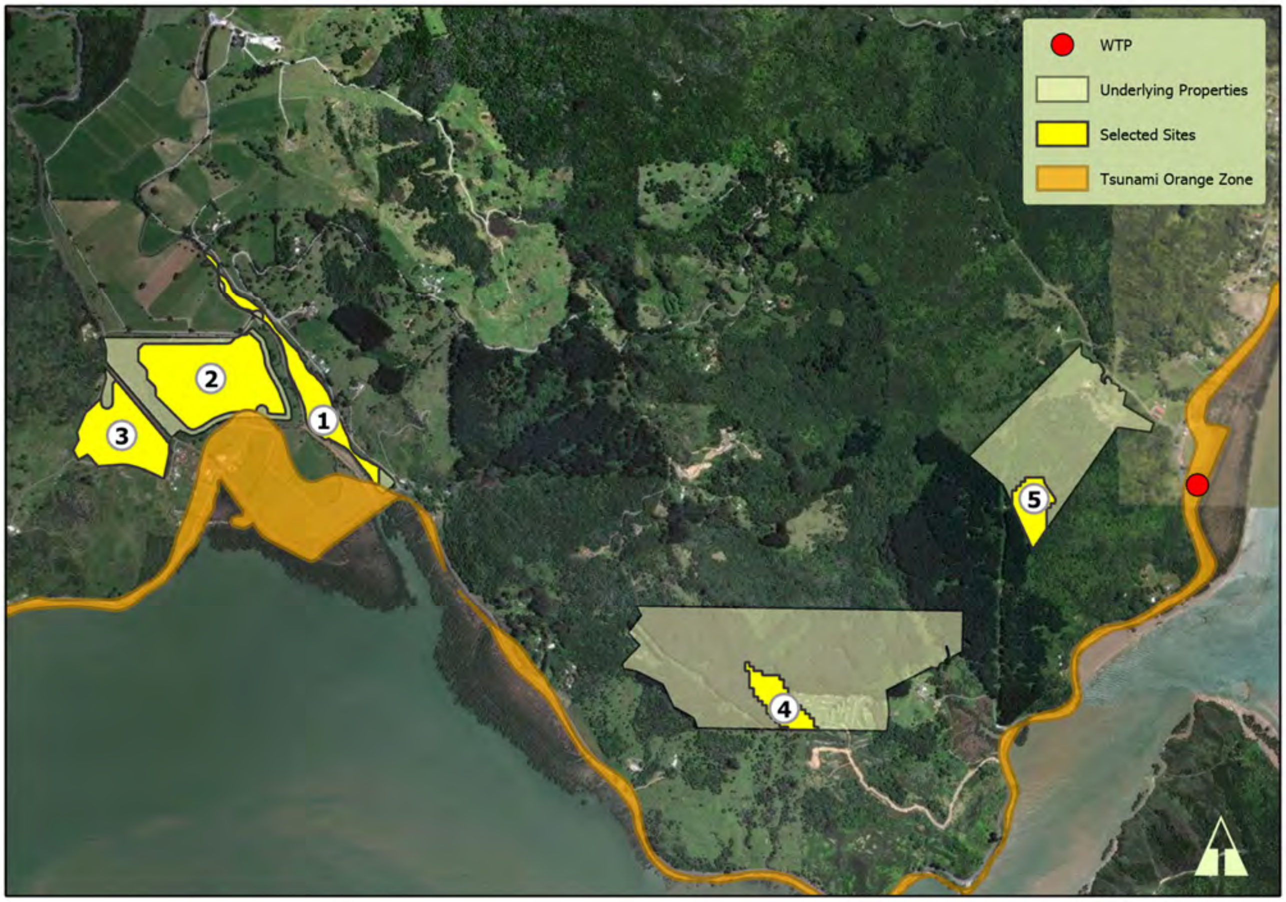

Figure 3-3 Tsunami Zones surrounding the Kohukohu WWTP

The flood risk of the sites was assessed using the Far North District Plan Potential Flooding Maps. (Figure 3-4 Sites 1-3 Flood Risk Map). Sites 1 to 3 were found to be susceptible to flooding and are therefore excluded from consideration due to flood risk.

Figure 3-4 Sites 1-3 Flood Risk Map

3.2 Site 4

Site 4 is located at a distance of 1,7km from the Kohukohu WWTP. Pipe access for the site will be along Kohukohu Road followed by private road RD SO 4196. Consultation with the landowner will need to be sought in order to obtain approvals to install pipe instruction. The Autea clay type soil dominates this site which has moderate drainage properties, the soil is also retains wetness during winter and is prone to pugging which would cause difficulties in terms of irrigation during winter and provision for storage would be required.

The property details for Site 4 have seen summarized in Table 3-2 Site 4 Property Informationbelow.

Table 3-2 Site 4 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (Ha)	Total Area (hectares)	Capital Value	Land Value	No. of Landowners
4	Pt Sec 22 Blk X Mangamuka SD	Kohukohu Road Kohukohu 0491	2.4	40.50	$155,000	$145,000	1

Site 4 slope varies between 3% – 10%, Site 4 lies in the green zone and likely to be unaffected by a tsunami event. The site also has not been found to be situated in a flood risk zone. However, Site 4 does not provide sufficient land area for disposal of the full flow, therefore excluded from consideration on this basis.

3.3 Site 5

Site 5 is located at a distance of 578m from the Kohukohu WWTP. The site is located at the top of a hill opposite the WWTP. There is no road access to the site, and a new access road would need to be constructed. The property details of Site 5 can be seen in Table 3-3 Site 5 Property Information below. The irrigation pipe access route will be along Tauteihiihi Road and across the site to reach the disposal area of in Figure 3-2 Selected Sites for Land Disposal located at the south-eastern corner of the property.

Table 3-3 Site 5 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (ha)	Total Area (hectares)	Capital Value	Land Value	No. of Landowners
5	Tauteihiihi 2B 3B ML 422722	33 Tauteihiihi Road Kohukohu 0491	2.3	186,653	$123,500.00	$114,000.00	1

Similar to the features of Site 4, the site is covered by forestation and vegetation. The property is also primarily of the Autea clay soil type and the slope level is within 3% - 10%. Site 5 does not provide sufficient land area for disposal of the full flow, therefore excluded from consideration on this basis.

3.4 Summary of GIS Analysis

Error! Reference source not found. summarizes all the key information on each of the proposed sites and the recommendations for further investigations. It has been concluded that none of the sites are considered feasible for land disposal.

Table 3-4Site Selection Analysis Summary

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5
Distance from WWTP	3071 m	~3409m	~3669m	1697m	578m

Area Suitable for Land Disposal (Ha)	4.3	11.0	6.3	2.4	2.3
Property Area (Ha)	5.0100	16.49	6.73	40.5	18.7
Land ownership	1	1	1	1	1
Soil type	Whakapara clay, Autea clay, Takahiwai clay	Autea clay, Takahiwai clay	Takahiwai clay, Te Tio clay	Autea clay	Autea clay
Soil Permeability	Well - moderate	Poor	Poor	Moderate	Moderate
Tsunami zone	Yellow,	Yellow,	Yellow	Green	Green
Flood risk	Yes	Yes	Yes	No	No
Recommended for further investigation	No	No	No	Yes	Yes

4. Conclusions

Spatial analysis has been performed to find an appropriate land-based disposal of effluent produced at the Kohukohu WWTP. No sites have been identified that meet the required criteria for land disposal, therefore, at this stage land disposal is not considered feasible for the Kohukohu WWTP.

5. References

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Please Quote: 3839

10 January 2020

Far North District Council
Attention: Jessica Crawford
Senior Infrastructure Consents Planner

Jessica.Crawford@fndc.govt.nz

Dear Madam

S92(1) REQUEST FOR FURTHER INFORMATION

RESOURCE CONSENT APPLICATION APP.003839.01.03 – FAR NORTH DISTRICT COUNCIL – DISCHARGES ASSOCIATED WITH KOHUKOHU WASTEWATER TREATEMENT PLANT (WWTP)

This resource consent application was lodged on 20 May 2016. A Section 37 extension to processing timeframes was requested by the applicant to 'allow for full consultation with affected marae to occur'. This consultation has not yet taken place.

Given the elapsed time since the application was made and the recent application for renewal of the consents associated with the Omapere/Opononi WWTP, the council considers it is necessary to proceed with the processing of this application. The council has therefore undertaken an initial assessment of the application and considers that the following further information is required, including an assessment of adverse effects on tangata whenua, their values and resources:

1 An assessment of the effectiveness of the septic tank maintenance schedule and treatment plant desludging schedule. There are ongoing issues with excessive sludge accumulation in the treatment ponds and wetland of the WWTP. As the purpose of the septic tanks should be to retain the majority of sludge so it does not enter the ponds it is considered that the current five yearly frequency of cleaning and inspection of the septic tanks is not sufficient.

Reason: To assess the current effectiveness of the WWTP.

2 A report on land disposal options for the wastewater which provides details of the cost and viability for each option. This report should provide a decision on whether land disposal is to be undertaken for this discharge and the reasons for that decision.

Reason: This is to meet Policy D.4.3(b) of the Proposed Regional Plan which states a discharge to water will generally not be granted unless "a discharge to land has been considered and found not to be economically or practicably viable". Policy 23(2)(b)(i) of the New Zealand Coastal Policy Statement also requires that "there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge".

3 A report on the outcome of quantitative microbiological risk assessment which assesses the level of risk the discharge poses to the health of people contacting the waters of, and consuming shellfish gathered within, the Hokianga Harbour. This report shall identify all recreational swimming and food gathering areas that were included in the assessment. If there is identified to be an unacceptable level of risk to public health, then the assessment shall recommend mitigation measures to reduce this risk to an acceptable level.

Reason: To allow council to properly assess the risk to human health from the discharge.

4 The application acknowledges the continued operation of the WWTP will affect Maori cultural values, however the application does not present a sufficient assessment of adverse effects on tangata whenua, their values and resources. The application also does not include an assessment of the effects on the Te Rarawa statutory acknowledgment area of the Hokianga Harbour. It is therefore requested that an assessment be undertaken on the effects on tangata whenua values and resources by the discharge. As minimum, this assessment should be undertaken in accordance with the criteria of Policy D.1.2 of the Proposed Regional Plan.

Reason: This is to allow the council to determine which tangata whenua are adversely affected by the application in accordance with Policy D.1.3 of the Proposed Regional Plan and to provide potential means of mitigation of any adverse cultural effects. It will also allow council when making a decision on this application to meet the requirements of Policy 23(2)(b)(ii) of the New Zealand Coastal Policy Statement which only allows a discharge of treated sewage to coastal water if it is "informed by an understanding of tangata whenua values and the effects on them".

5 Where the outcome of questions 3 or 4 above identify either an unacceptable level of risk to public health or a minor, or more than minor, adverse effect on Tangata Whenua, then a report on an assessment of the potential upgrade options for the WWTP that would mitigate these effects shall be provided. The report should provide details of the estimated cost of each option and incorporate the outcomes of the assessments required by questions 1 to 4 above.

Reason: To allow council to assess what methods are available to the applicant to mitigate any adverse effects. This information is also a requirement of Policy 23(2)(b)(i) of the New Zealand Coastal Policy Statement which requires that "there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge".

The assessments and subsequent reports required by 1 to 5 shall be undertaken by suitably qualified persons in the field of the requested information.

You have agreed to supply this further information by **Tuesday, 30 June 2020**. The processing of your application will be placed on hold from the date of this letter until this agreed date, or the date of receipt of the further information, whichever occurs first.

Once the council has received the further information, it will then make a decision on whether your application requires notification or whether it will be processed on a non-notified basis. If the council determines that your application is to be processed on a notified basis, an additional minimum initial fee will be required before the council proceeds any further with your application.

Please note that the council has the ability to decline your application on the grounds that it has insufficient information to determine the application.

The requirements outlined above are binding on you being the applicant, as well as on the council. Your opportunity to clarify or question the reasonableness of this further information request occurs within the next 15 working days, not at some later date.

Please contact me should you have any questions.

Yours faithfully

Katie McGuire
Consents Officer - Generalist

E-mail address: katiemcguire@nrc.govt.nz

Hokianga Harbour Hydrodynamic Study

Hydrodynamic Study of WasteWater Discharges

Report prepared for Far North District Council

March 2020

MetOcean SOLUTIONS

Document History

Versions

Version	Revision Date	Summary	Reviewed by
0.1	04/12/19	Initial document created	Berthot
0.2	16/12/19	Draft for internal review	Zyngfogel/Cussioli
0.3	18/12/19	Draft for client review	Berthot
0.4	10/01/20	Draft for internal review	Berthot
0.5	23/01/20	Draft for internal review	Zyngfogel/Goward-Brown
0.6	23/01/20	Draft for Client review	Berthot
0.7	11/03/20	Draft for Client review	Berthot

Distribution

Version	Date	Distribution
1.0	16/09/2020	Far North District Council

Document ID:

MetOcean Solutions is a Division of Meteorological Services of New Zealand Ltd, MetraWeather (Australia) Pty Ltd [ACN 126 850 904], MetraWeather (UK) Ltd [No. 04833498] and MetraWeather (Thailand) Ltd [No. 0105558115059] are wholly owned subsidiaries of Meteorological Service of New Zealand Ltd (MetService).

Executive Summary

Far North District Council (FNDC) currently discharges wastewater from four municipal WasteWater Treatment Plants (WWTP) into the Hokianga Harbour and its tributaries (Figure 1). FNDC are in the process of renewing these resource consents. In the community, there is growing concern over the health of the harbour and FNDC requires information about the effects of these discharges in the receiving environment, and/or identify simple ways to minimise the effects.

FNDC has commissioned MetOcean Solutions (MOS) to undertake a hydrodynamic modelling study of the wastewater discharges. The release of pollutants in the oceanic environment through an outfall is a process that is generally continuous over time, but often subject to significant fluctuations in released quantities. The fate of these pollutants can be assessed based on hydrodynamic modelling of historical conditions, thereby allowing estimations of the expected general spatial dispersion.

For this work MOS has partnered with the Cawthron Institute to undertake a data collection campaign; Water level and currents within Hokianga Harbour were measured in order to calibrate and validate the hydrodynamic model. This study will be used to support the required Quantitative microbial Risk Assessment (QMRA).

In addition, the council has a mandate to accelerate the development of a long-term plan for the existing Hokianga ferry and therefore require the acquisition of sub-bottom geophysical survey data in order to ascertain the viability of alternative route options and northern landing locations. For the survey work MetOcean Solutions has partnered with Scantec Ltd; Survey results are presented in a separate report (Appendix A:).

Figure 1:Hokianga Harbour Location (top) - Municipal Wastewater Treatment Plant Discharges in the Catchment of the Hokianga Harbour (bottom).

Field data collection:

A field measurement campaign was undertaken by Cawthron Institute to assist with the characterisation of the hydrodynamic regime within Hokianga Harbour and provide the necessary field data for calibration and validation of the hydrodynamic model. The campaign focused on four locations between the harbour entrance and the Narrows (Figure 2). The measurement period extended from July 2019 to August 2019 and included measurements of water elevation and current velocities.

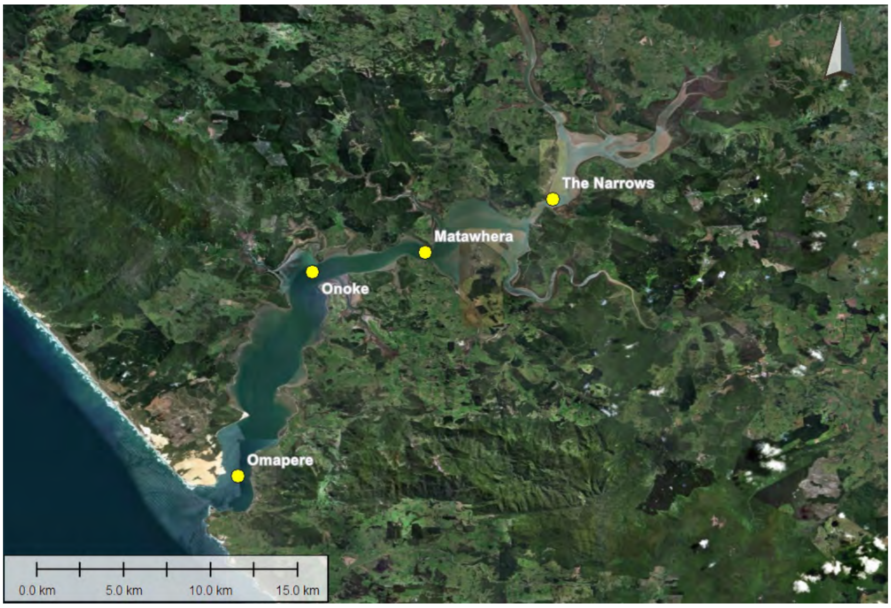

Figure 2:Instruments locations within Hokianga Harbour.

Hydrodynamic Modelling :

A SCHISM hydrodynamic model of Hokianga Harbour was setup for this study. The model resolution was optimised to ensure replication of the salient hydrodynamic processes. The resolution ranged from 90 m at the offshore boundary to 15 m within Hokianga Harbour and near the discharge locations. The model bathymetry was prepared based on the best available datasets for the region. The model was forced by tidal conditions (extracted from MOS greater NZ SCHISM model) and temperature/salinity (HYCOM model) at the offshore boundary, atmospheric data (wind and heat exchange extracted from MOS existing atmospheric models) and river discharges (Discharge report from NIWA for the Waima river (Wairoro-Penakitere-Taheke-Waima River), Waihou River, Orira River and Mangamuka River) forced at the boundary.

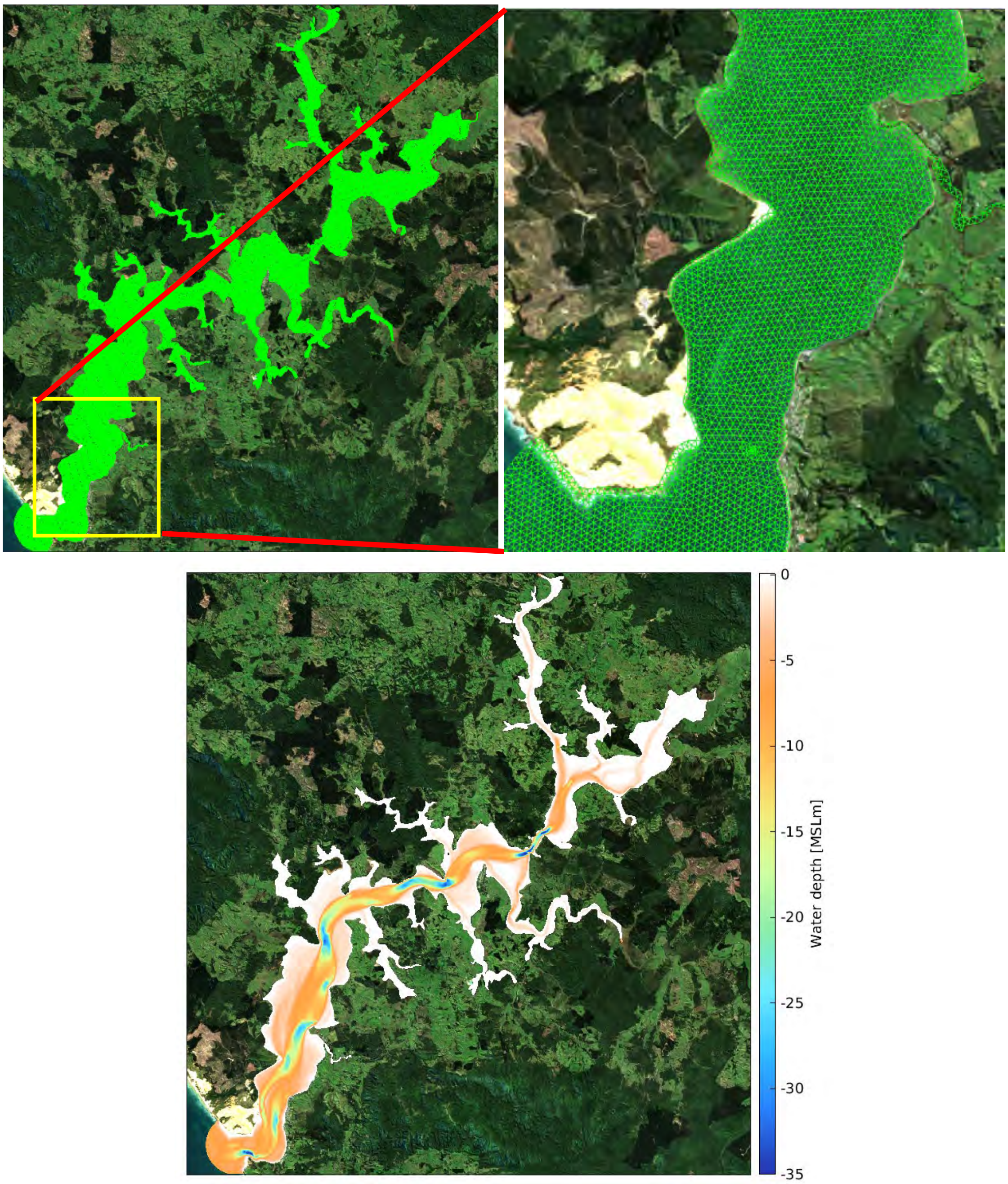

Figure 3:Hydrodynamic model: Bathymetry of model domain showing water depth (left) and triangular model (Center is the whole domain and right show the grid refinement around the Opononi discharge location).

The model was calibrated and validated using the water level and current collected by Cawthron within Hokianga Harbour. Comparisons between the measured and modelled data show that the model successfully reproduces the propagation of the tidal wave inside the harbour, with good agreement in terms of water level, current and temperature patterns.

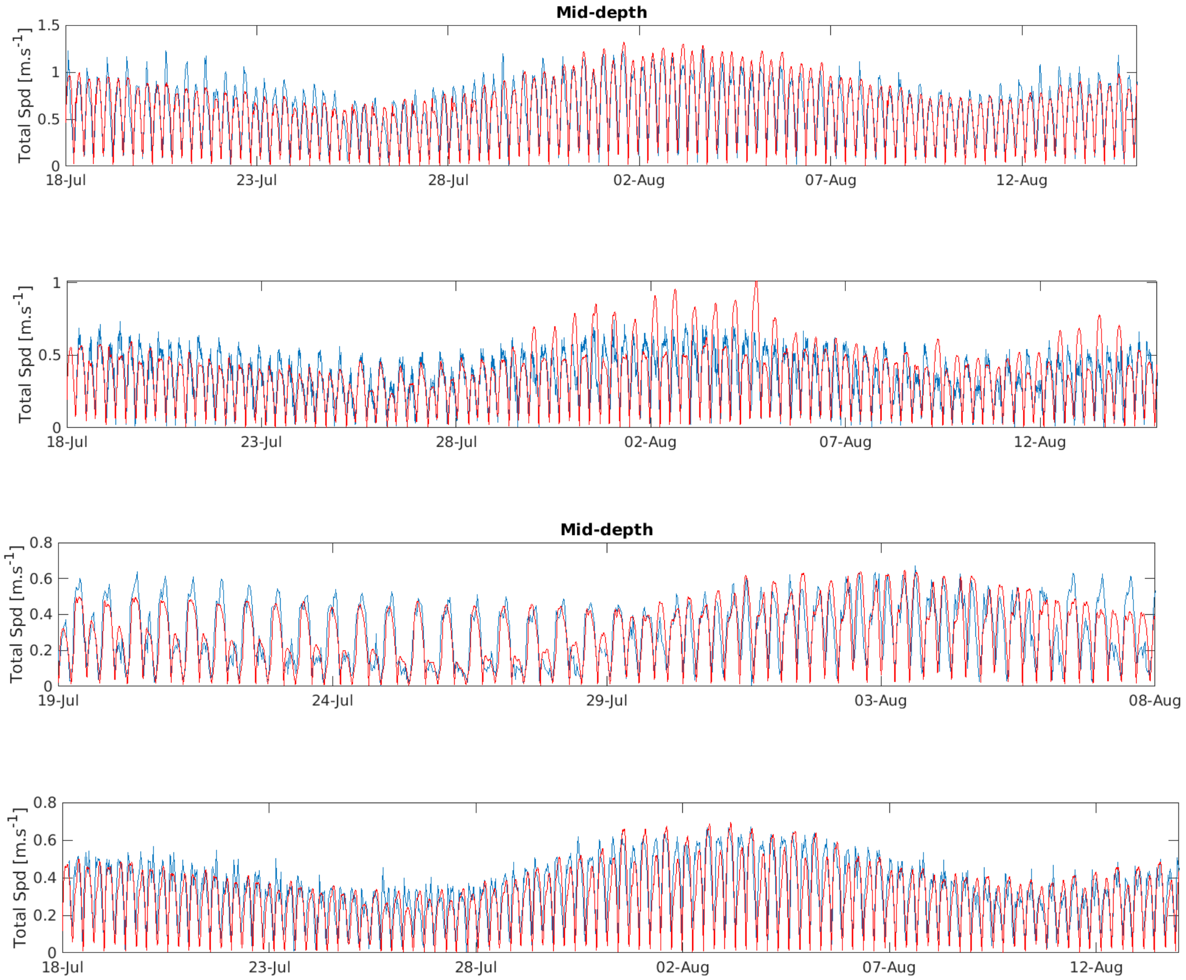

Figure 4:Measured (blue) and modelled (red) current speeds at Omapere ADCP Onoke FSI , Matawhera ADCP The Narrows FSI sites, from July 2019 to August 2019

WWTP Discharge Simulations

In order to model the four WWTP discharges a review of the discharge rate timeseries data was undertaken and a year representative of the variability in the discharge rate as well as a maximum at the proposed resource consent was adopted for each of these four discharges.

Different passive tracers (i.e. a neutrally buoyant pollutant with no decay) were used for each WWTP discharge. A nominated concentration value of 1 mg/L was used so that dilution can be calculated at various distance from the source. Specific contaminant concentration levels can then be determined using concentration ratios and the expected or measured discharge value.

In the present study, the approach consisted of running year-long simulations within two contrasting historical contexts (El Nino / La Niña/El Niño episodes). This allows robust probabilistic estimates of the plume dispersion and dilution patterns to be determined and thus provide some guidance on expected concentration levels associated with the Hokianga Harbour WWTP discharges.

The year-long simulations were extended by two days, and the discharge rate increased to the highest discharge recorded, in order to assess the impact of an extreme isolated event. The model simulations results were processed in term of dilution factors which were determined by dividing the tracer concentration at any grid point to the discharged concentration. A dilution factor of 1:1000 indicates a contaminant concentration at that location 1000 time smaller than discharged. Specific contaminant concentration levels at environmental receptors will be determined by consultants doing the QMRA, using concentration ratios and the expected or measured discharged value.

Results are presented in terms of 50th and 95th percentiles dilution factor maps and timeseries of dilutions factors at selected locations.

The 50th percentile maps present the dilutions factors expected to be exceeded 50% of the time.

The 95th percentile maps present the dilution factors expected to be exceeded 5% of the time (or not exceeded 95% of the time).

Timeseries of tracer concentration were also extracted at selected locations within Hokianga Harbour and dilution factors were calculated and provided to the consultants undertaking the QMRA.

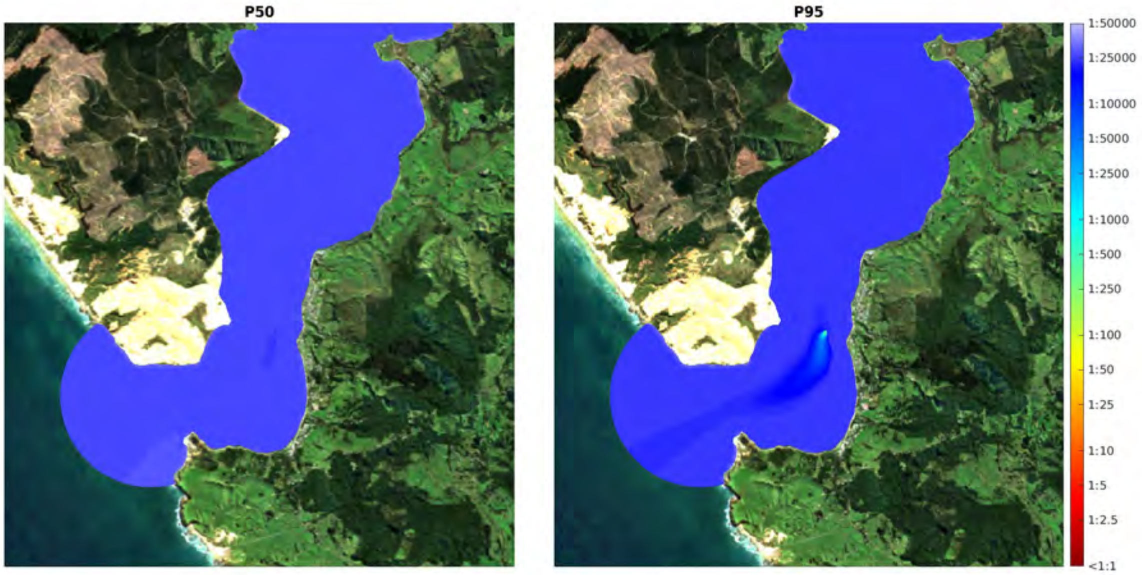

Figure 5:50th Percentile and 95th Percentile Dilution factor for Opononi WWTP during El Nino year (note P50 is less than

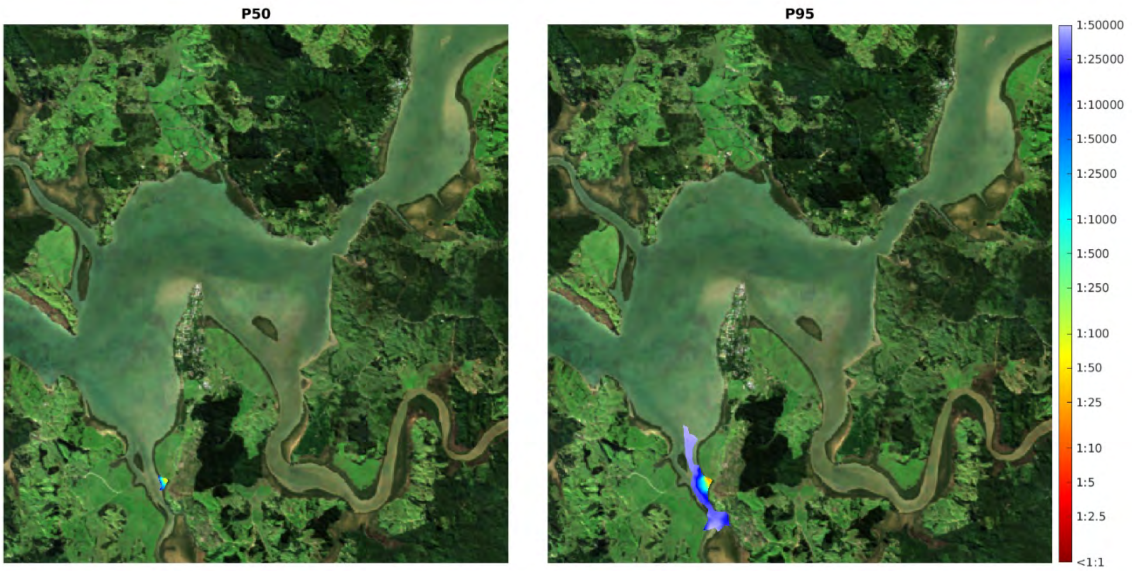

Figure 6:50th Percentile and 95th Percentile Dilution factor for Rawene WWTP during El Nino year.

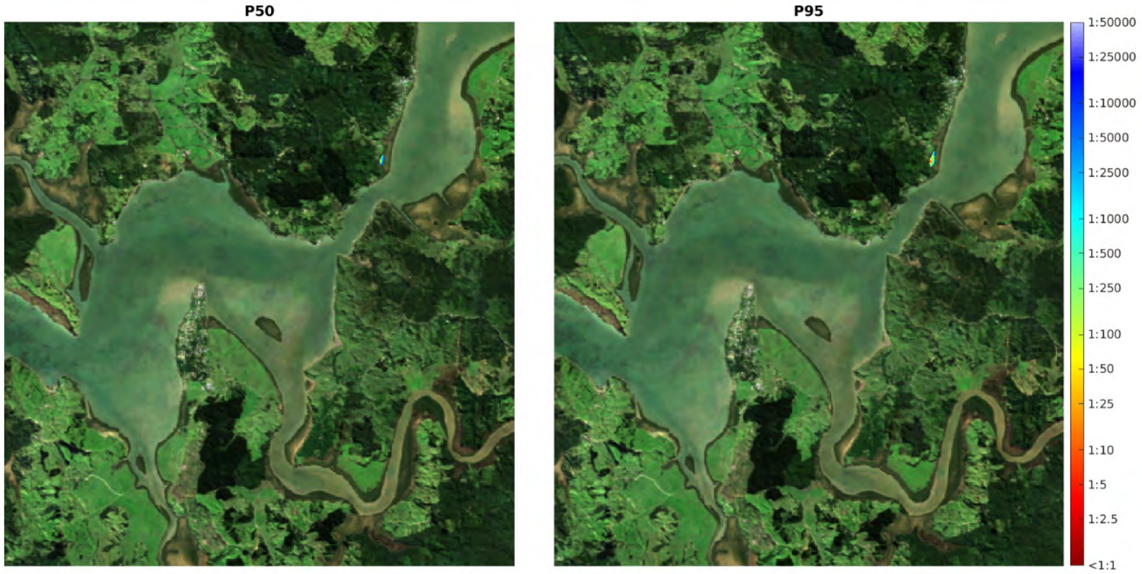

Figure 7:50th Percentile and 95th Percentile Dilution factor for Kohukohu WWTP during El Nino year.

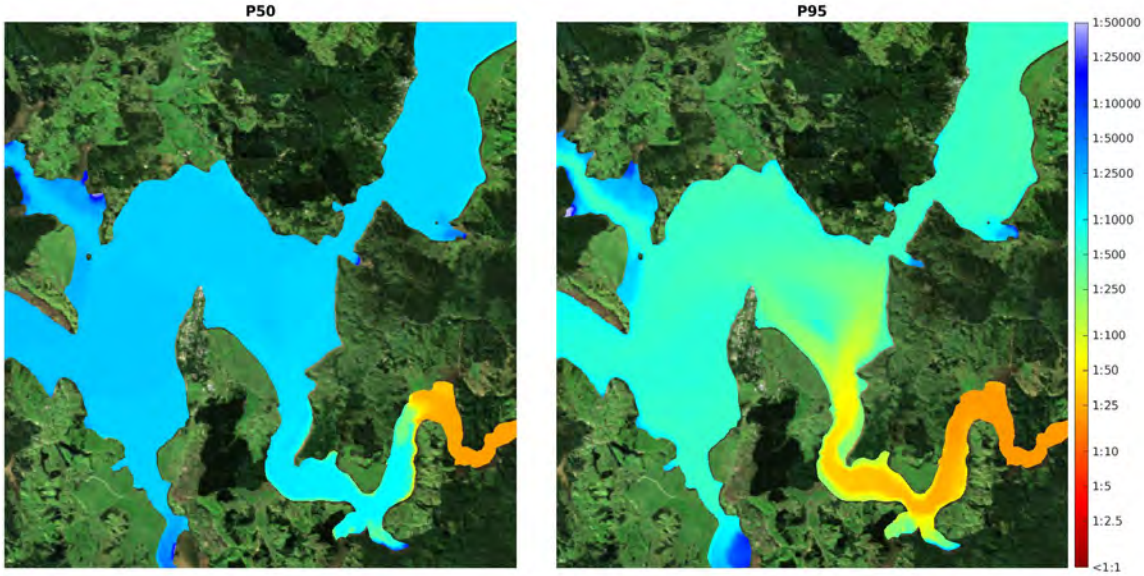

Figure 8:50th Percentile and 95th Percentile Dilution factor for Kaikohe WWTP during El Nino year.

Results shows that each WWTP discharges present very different plume extents due to their location within the harbour and the actual discharge volumes. Some of the key features for each discharge are:

- The Opononi WWTP discharge present an elongated plume stretching toward the entrance of Hokianga harbour. Dilution factors for the 50th percentile are as high as 1 in 5000 within 100 m of the discharge.

- The Rawene WWTP discharge plume is mostly contained within the Omanaia River and dilution factors for the 50^{th} percentile are about 1 in 5000 at 100 m from the discharge location
- The Kohukohu WWTP discharge plume is mostly confined to the vicinity of the discharge location with a dilution factor of 1 in 50,000 at approx. 50 m for the 50^{th} percentile.
- The Kaikohe WWTP discharge plume present dilution factors of 1 in 25 within the Waima River as far as downstream as the last bend before Motukiore Road. Dilution is about 1 in 1000 to 1 in 2500 within the harbour.

Contents

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List of Tables

1.Introduction

Far North District Council (FNDC) currently discharges wastewater from four municipal wastewater treatment plants (WWTP) into the Hokianga Harbour or its tributaries (Figure 1.1). FNDC are in the process of renewing two of these resource consents. In the community, there is growing concern over the health of the harbour and FNDC requires information about the effects of these discharges in the receiving environment, and/or identify simple ways to minimise the effects.

FNDC has commissioned MetOcean Solutions (MOS) to undertake a hydrodynamic modelling study of the wastewater discharge. In order to support the modelling, MOS has partnered with Cawthron Institute to undertake a data collection campaign which includes the measurement of water level and currents within Hokianga Harbour.

In addition, the Council has a mandate to accelerate the development of a long-term plan for the existing Hokianga ferry for which they require the acquisition of sub-bottom geophysical surveys to ascertain the viability of alternative route options and northern landing locations. For the survey work, MetOcean Solutions has partnered with Scantec Ltd; Results from the survey will be presented in a separate report in Appendix A:.

This report is structured as follows: an introduction to the study background and rational is provided in Section 1, while a summary of the available measured data are provided in Section 2. Methods applied, including numerical model definitions are presented in Section 3. Model validation and Results are given in Section 4 and Section 5 respectively. Conclusions are presented in Section 6 and References cited within the text are provided in Section 7.

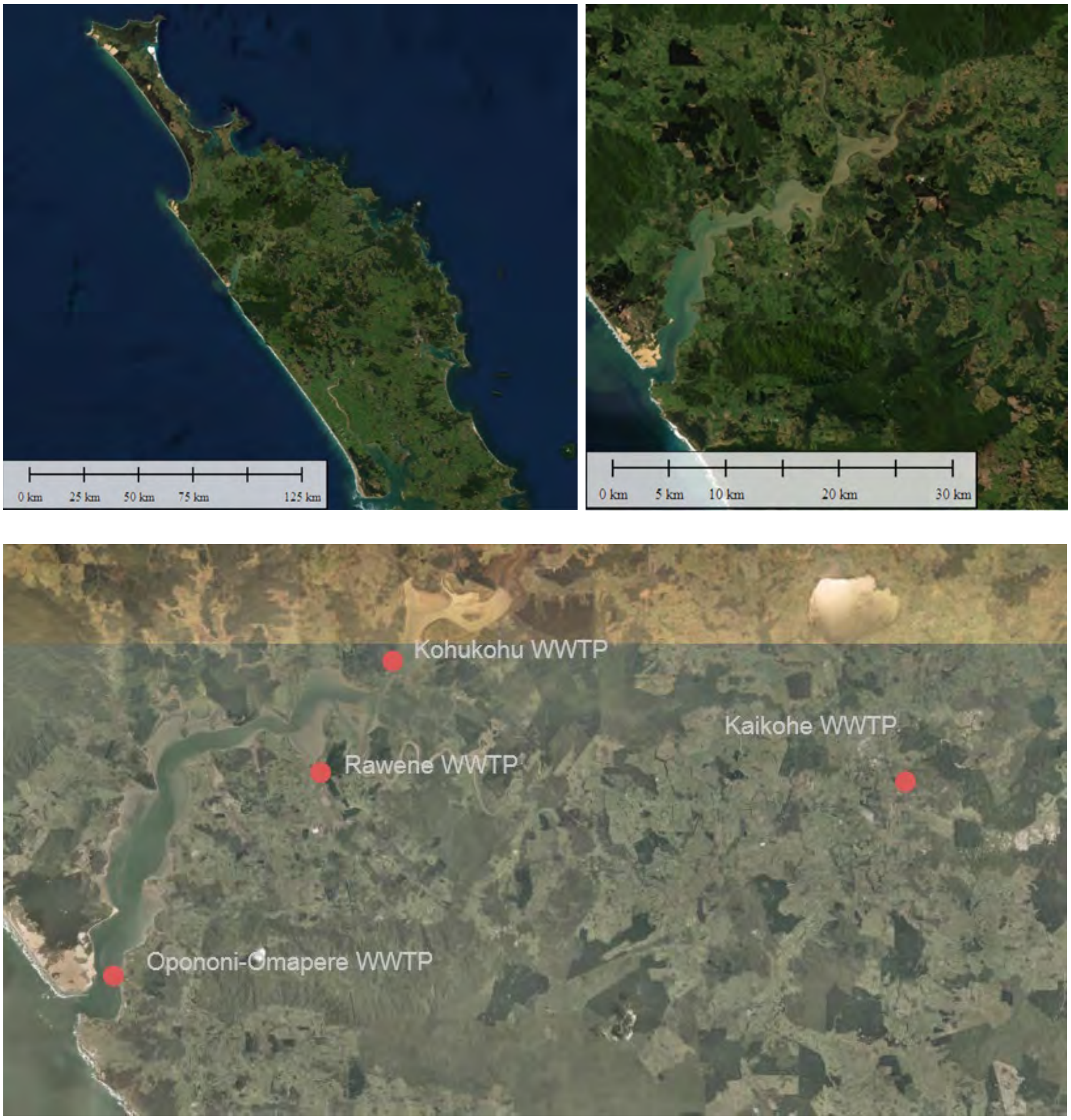

Figure 1.1: Hokianga Harbour Location (top) - Municipal Wastewater Treatment Plant Discharges in the Catchment of the Hokianga Harbour (bottom).

2. Field Measurement Campaign

A field measurement campaign was undertaken by the Cawthron Institute to assist with the characterisation of the hydrodynamic regime within Hokianga Harbour and provide the necessary field data for calibration and validation of the hydrodynamic model. The campaign focused on four locations between the harbour entrance and the Narrows (Figure 2.1).

2.1.1 Instrumentation and Deployment

The measurement period extended from July 2019 to August 2019 and included measurements of water elevation and current velocities. Measurements were undertaken using a range of instruments spread between the Hokianga Harbour entrance and the Narrows (Figure 2.1); coordinates of the deployment sites are provided in Table 2.1. Further details on instrument deployment and measured data are provided in the following sections.

The data collection campaign consisted of the collection of water level and ocean current information via four separate moorings in ~5 to 26m (CD) water depths throughout the Hokianga Harbour for 30 days. Two of the moorings included bottom mounted ADCPs with the other two featuring mid-water mounted FSI current meters. All moorings included pressure sensors. Detailed equipment description follows:

- Two sea-bed mounted ADCP instruments to record water level and current velocity profiles.
- Two FSI current meters deployed at mid-water on individual moorings, recording current velocities at a single point.
- Four RBR Solo pressure sensors (supplied by MetOcean Solutions) deployed on individual moorings, recording water levels.

Figure 2.1 shows the locations of the instruments deployed

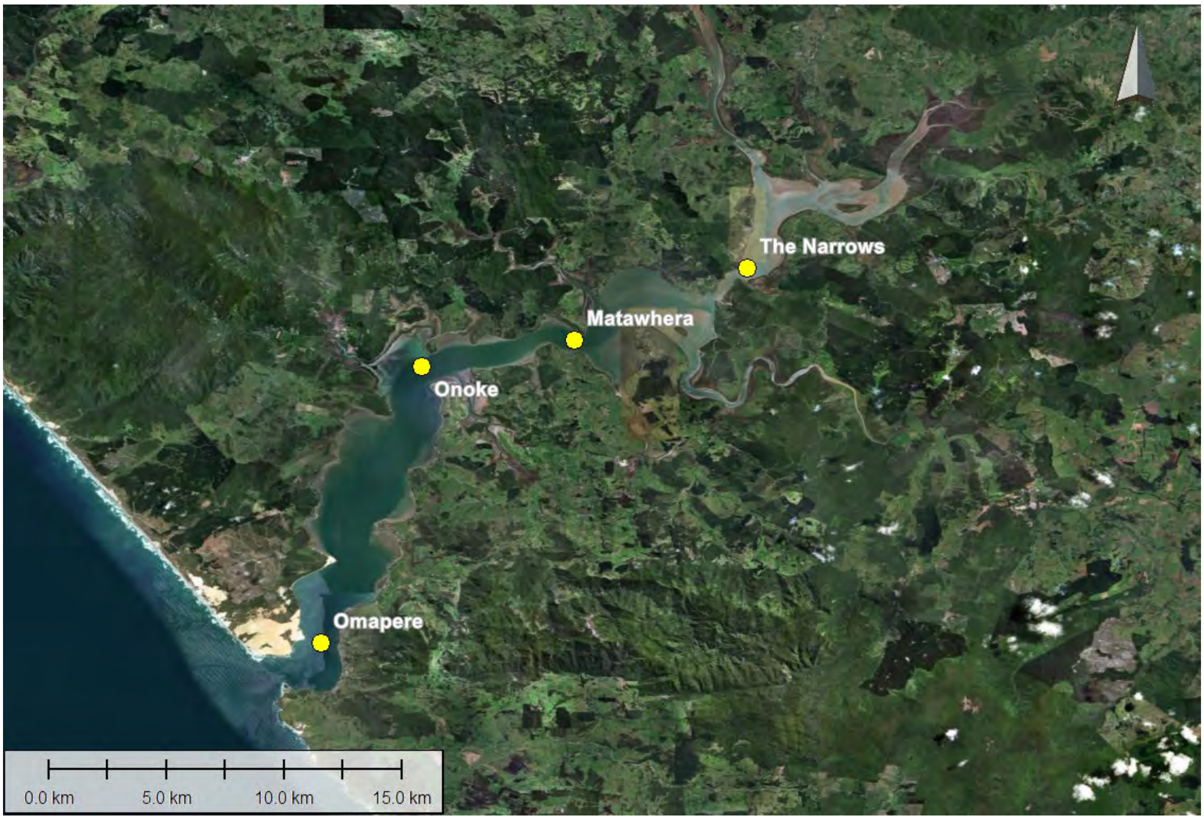

Figure 2.1 Instruments locations within Hokianga Harbour.

Table 2.1 Latitude, longitude, depth and instruments deployed at each mooring location.

Location	**Instrument**	**Latitude/ Longitude**	**Depth Deployment**
Omapere	ADCP	35°31.080'S	16.5 m
	RBR Solo	173°22.850'E	
Onoke	FSI	35°24.739'S	9 m
	RBR Solo	173°25.152'E	
Matawhera	ADCP	-35°24.152'S	25.6 m
	RBR Solo	173°28.652'E	
The Narrows	FSI	-35°22.473'S	5.5 m
	RBR Solo	173°32.673'E	

2.1.2 Data Processing

Data recorded by the pressure sensors were processed in Matlab. The data was checked and any unusable data, such as that collected during the deployment and retrieval of the instrument were removed; Pressure data was converted to water level and saved at 1-minute intervals. Similarly, any data recorded during the deployment and retrieval of the FSI current meters were removed from the dataset. Current magnitude and direction were calculated from U and V velocities and saved at 1-minute intervals.

Native files from the ADCPs were first processed using WinADCP (v 1.14) and various variables (e.g. velocities, depth, pitch, roll, amp, echo) were exported to be processed in Matlab. The instrument was configured with 29 bins (Omapere) and 35 bins (Matawhera), for both ADCPs the bin size was 1.0 m . The blanking depth was 0.50 m for the ADCP deployed at Matawhera and 0.88 m for the Omapere ADCP. In Matlab, bad data was flagged and removed based on threshold values. Bins above the maximum height of the surface layer were removed and the depth was corrected to account for the instrument height of 0.5m.

2.1.3 Water Level Measurements

The pressure sensors recorded during the entire time of deployment and captured well the tidal elevation, including spring and neap cycles (Figure 2.2 to Figure 2.5). Semi-diurnal tides are predominant in this area, with tidal amplitudes displaying variation in elevation between subsequent spring and neap cycles, resulting in some differences in the tidal current magnitudes both within, and between, spring-neap cycles (see next section – Current Measurements).

The deployments at Onoke and The Narrows presented a shift in the pressure data at around the 1st and the 4th of August, respectively. The shift resulted in an increase of 0.5 m in level, from 9 m to 9.5 m at Onoke (Figure 2.3) and from 5.5 to 6 m at The Narrows (Figure 2.5). The dates coincide with the start and the middle of the spring tide. According to data from the field campaign, the instruments did not alter position significantly between deployment and retrieval, therefore, the shift could be a result of the instrument frame sliding slightly along the bed sand/or the anchor weights sinking into the soft sediment.

Tidal amplitude variations (around the mean) for the period of the field campaign were: 3.4 m for Omapere, 4.9 for Onoke, and 3.6 m for Matawhera and The Narrows. Higher amplitudes at Onoke and The Narrows are results of the shift in data described above.

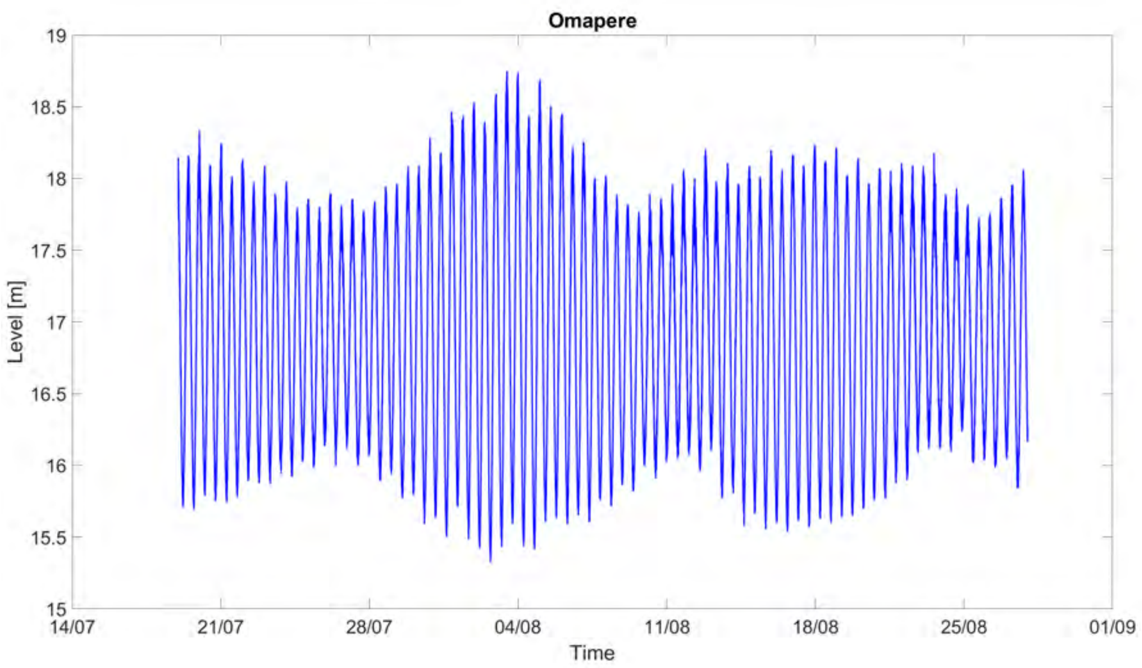

Figure 2.2 Water level at Omapere, calculated from measured pressure using an RBR Solo pressure sensor.

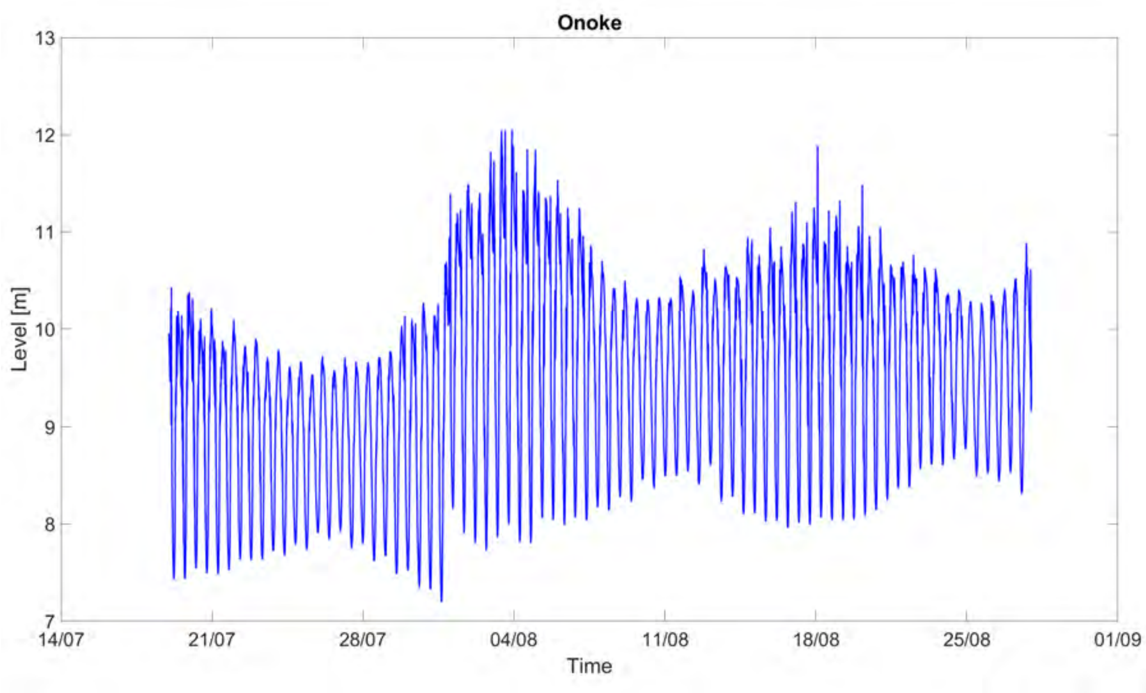

Figure 2.3 Water level at Onoke, calculated from measured pressure using an RBR Solo pressure sensor.

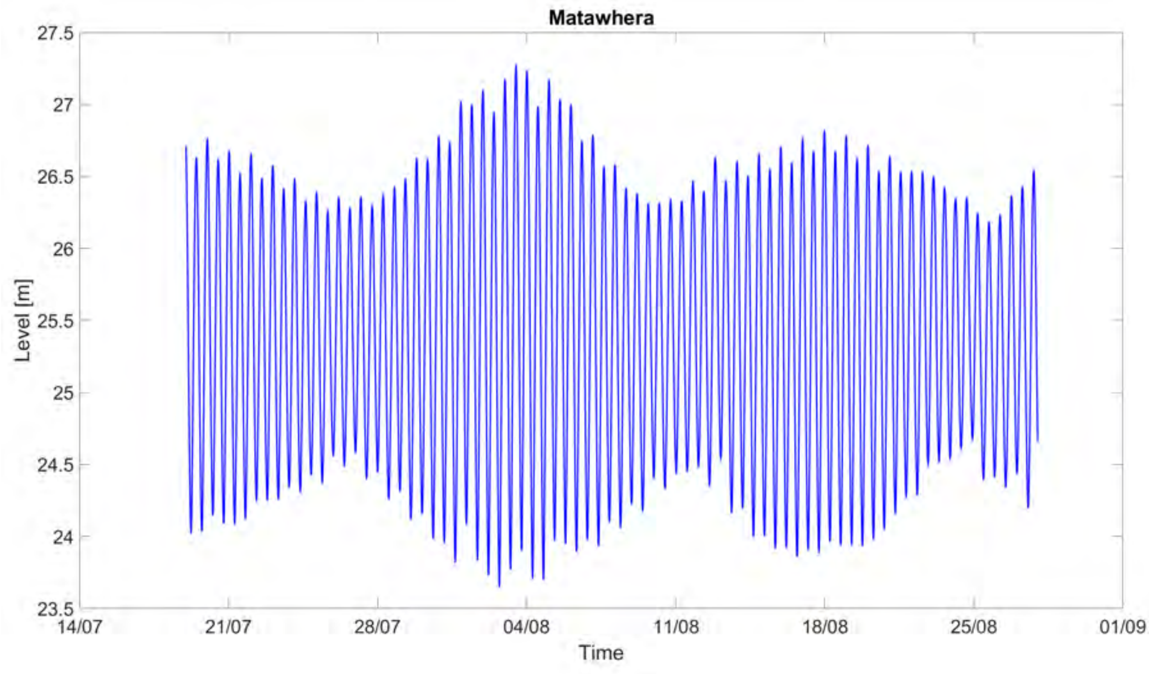

Figure 2.4 Water level at Matawhera, calculated from measured pressure using an RBR Solo pressure sensor.

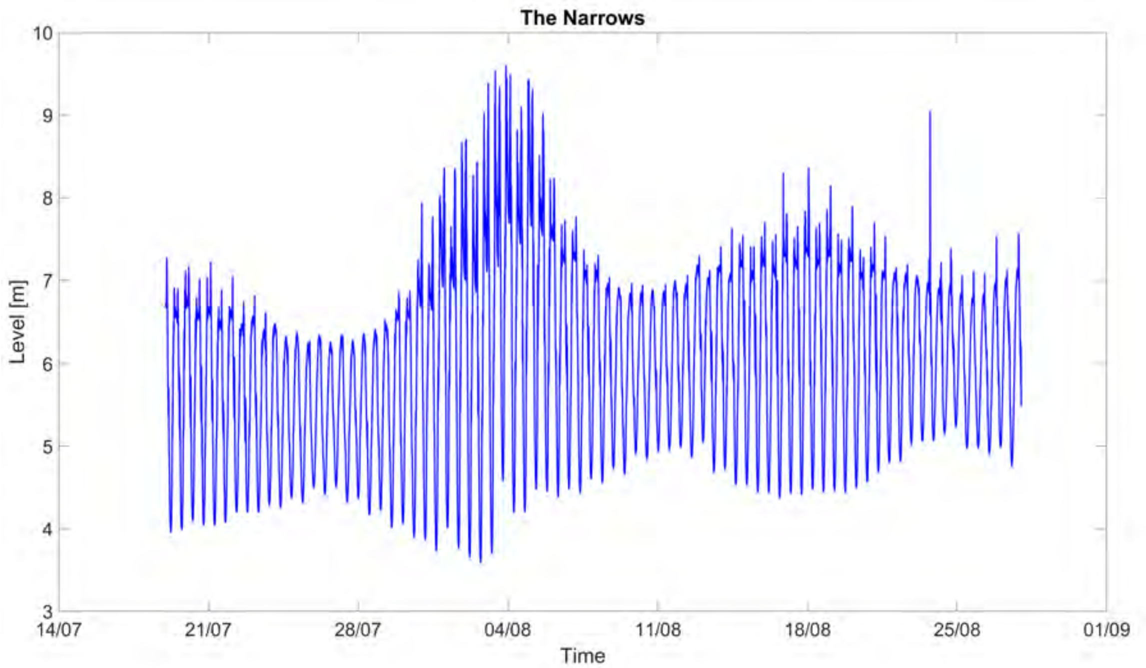

Figure 2.5 Water level at The Narrows, calculated from measured pressure using an RBR Solo pressure sensor.

2.1.4 Current Measurements

Current measurements were carried out using an ADCP at Omapere and Matawhera while an FSI was deployed at Onoke and The Narrows.

The ADCP and FSI current magnitude and direction are presented in Figure 2.6 to Figure 2.9.

For clearer visualisation, a one-week subset of current speed and direction at Omapere is shown in Figure 2.6. Directions of current flow measured at the entrance of the Harbour remained mostly aligned with the N-S axis of the channel throughout the period. Current reversals and magnitudes show a close correlation with tidal elevations, with faster currents at the beginning of the period shown in the subset, which correspond to the end of a spring tide, and slower currents in the following days leading to a neap tide. This indicates the dominant effect of the tide in this area. Mean current speeds over the campaign were 0.5 m s^{-1} and peak speed was 1.4 m s^{-1}.

At Onoke, current direction showed a N-NNE and SW pattern (Figure 2.7) indicating that currents flowing along the west margin of the channel are affected by the significant change in orientation of the main channel from N-S to almost E-W. Mean speed at this location during the field campaign was 0.3 m s^{-1} and the highest speed recorded was 0.7 m s^{-1}.

In contrast, currents at Matawhera typically flowed along the main channel axis, to the east-southeast during flood and to the west-northwest during ebb (Figure 2.8). Mean and maximum speed were 0.3 m s^{-1} and 0.8 m s^{-1}, respectively. The data shows a significant variability in current speed through the water column, with ebb current (WNW) stronger near the surface and flood current (ESE) stronger below mid depth level. This indicates the influence of the freshwater river flowing out to the ocean which tended to reduce the surface current. This pattern mainly occurs in July when the river discharges were much stronger than in August and stratification was likely significant. This is also shown in the validation plots later in this report (Section 5.1.2) with a stronger ebb and weaker flood during the first part of the data collection period.

This pattern is not as pronounced near the entrance where the water is expected to be mixed.

The Narrows was the most upstream, and shallowest, mooring deployment. Flow is predominantly affected by the orientation of the main channel, which can be seen in Figure 2.9 by the predominance of N and WSW current direction. Average and peak current speeds at this location were 0.3 m s^{-1} and 0.8 m s^{-1} respectively, very similar to the values recorded at Onoke and Matawhera.

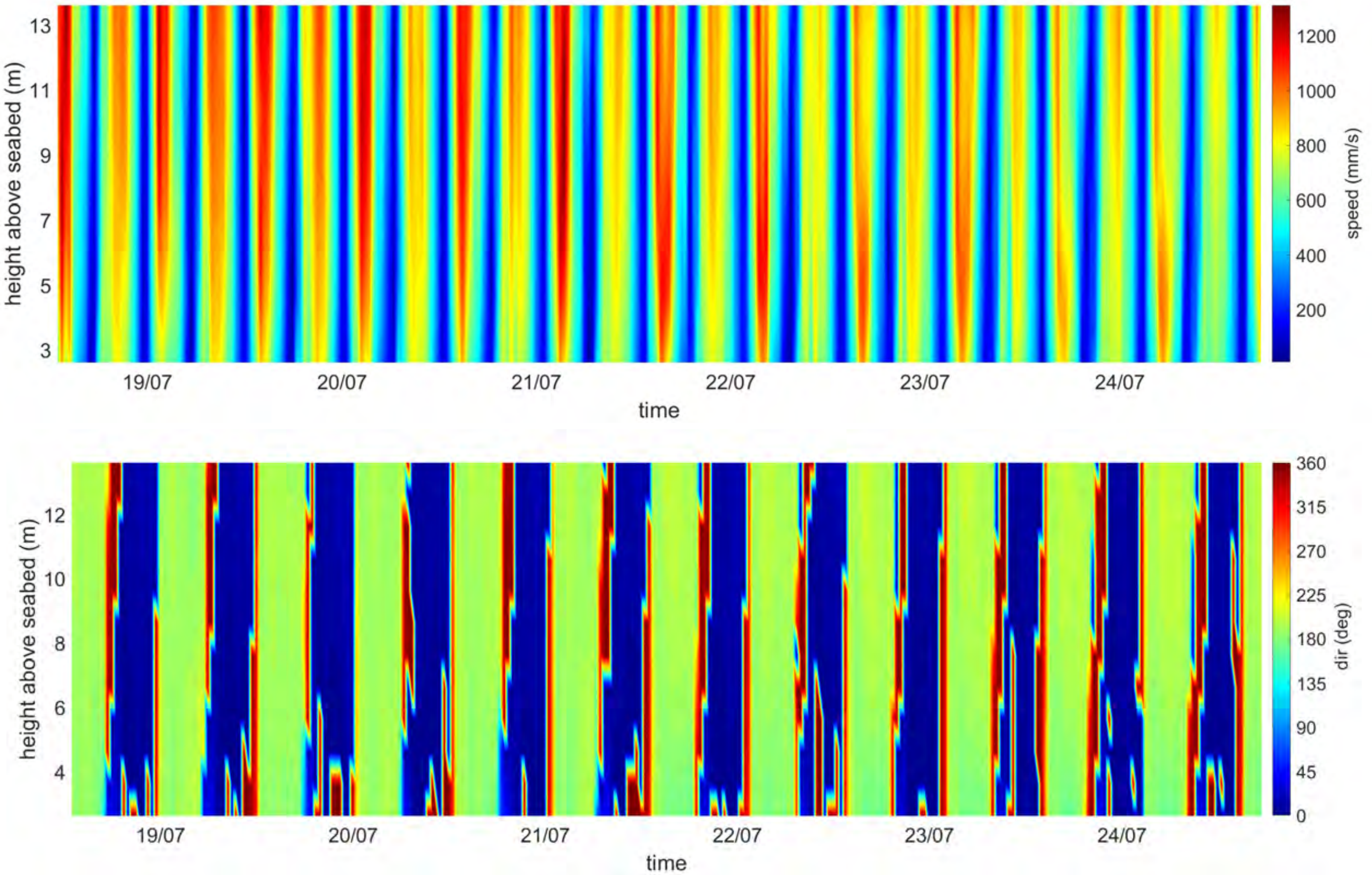

Figure 2.6 Current speed and direction at Omapere, recorded by seabed mounted ADCP. Figure shows a subset of the period recorded for clearer visualization.

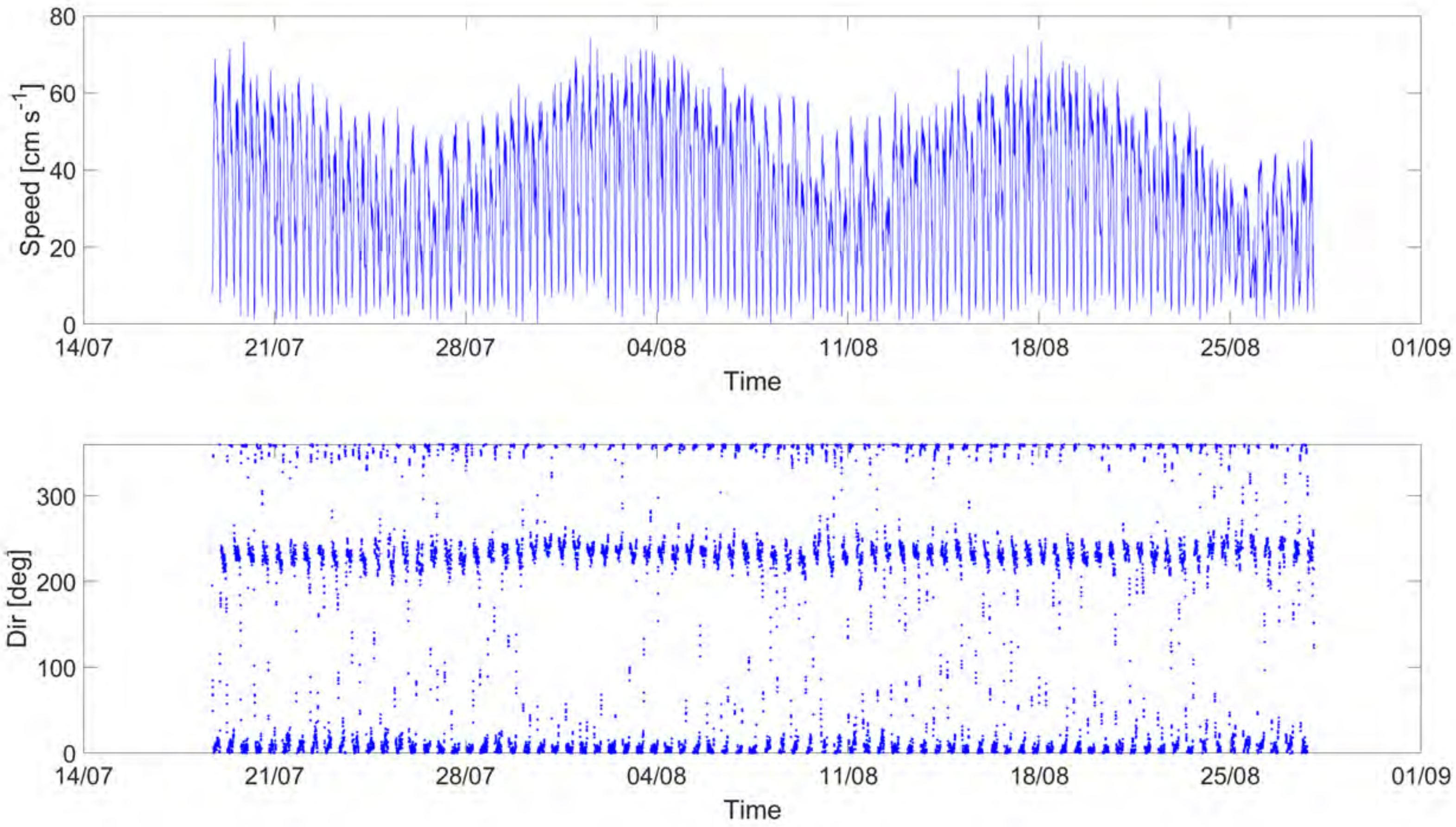

Figure 2.7 Current speed and direction at Onoke, recorded by an FSI current meter.

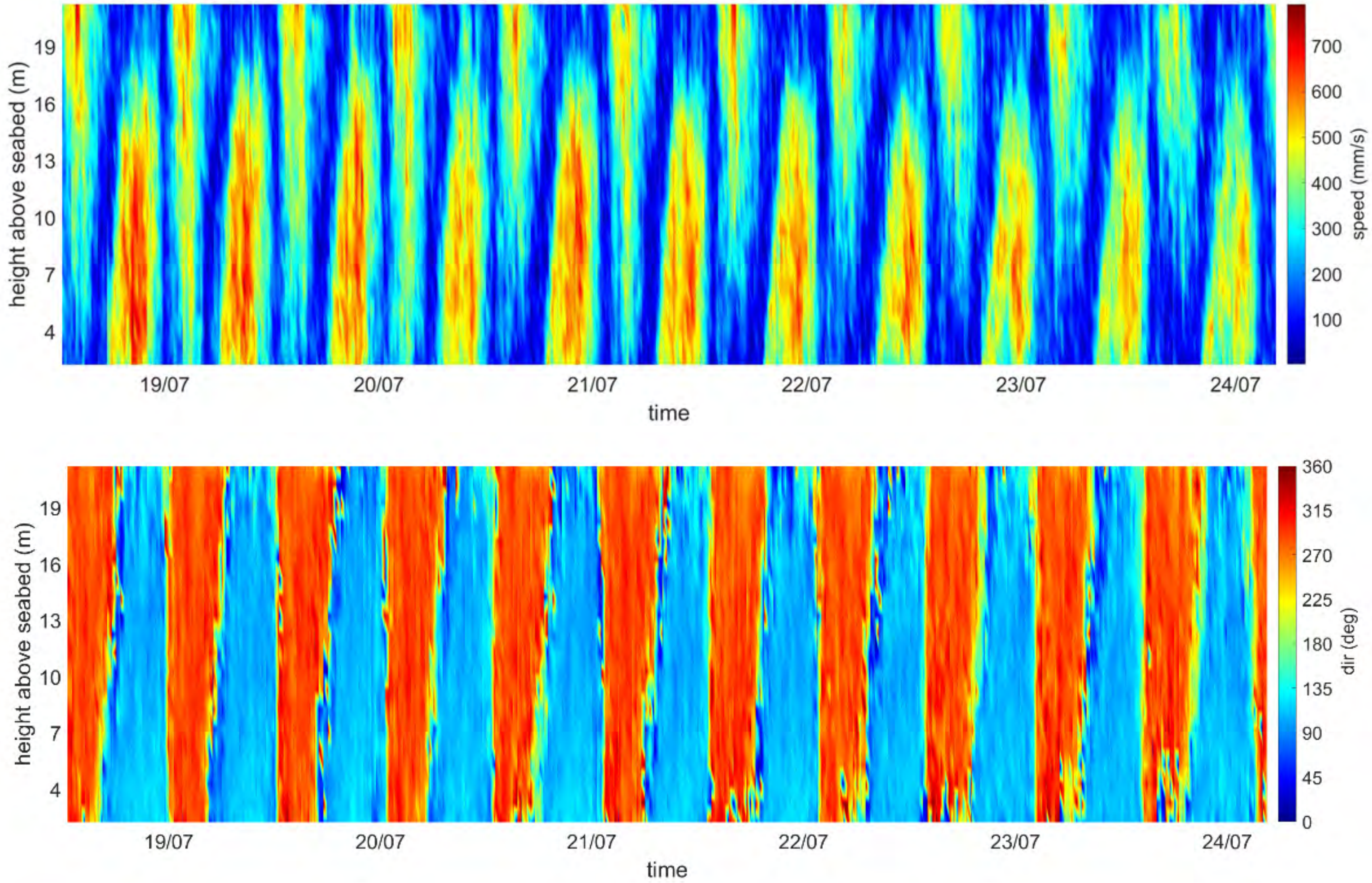

Figure 2.8 Current speed and direction at Matawhera, recorded by seabed mounted ADCP. Figure shows a subset of the period recorded for clearer visualization.

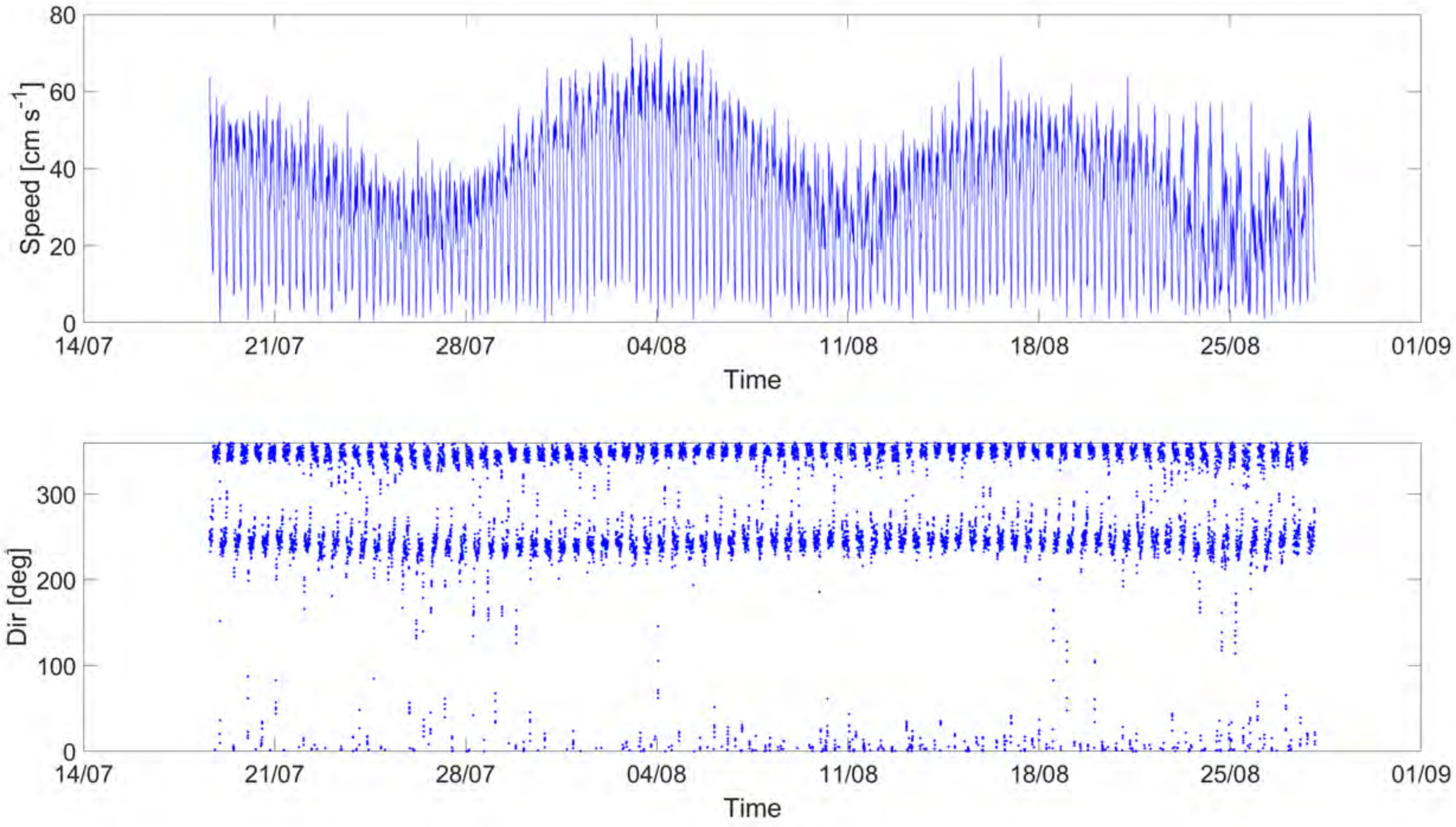

Figure 2.9 Current speed and direction at The Narrows, recorded by an FSI current meter.

3.Sub-Bottom Surveys – Scantec Ltd

The survey scope included measuring general stratigraphy and sediment thickness over bedrock in a triangular area of approx. 1.7 square kilometres. Equipment was mounted on a 5.5m vessel which was launched from the boat ramp at Rawene. A high powered 3.5kHz to 7kHz SBP system was used to penetrate the seabed and obtain reflections from bedrock. A Knudsen 320M 200kHz single beam echosounder was used to collect bathymetric data which needs to be collected as part of the SBP dataset to assist in data processing. The data was processed using seismic processing packages.

The Scantec report is included in Appendix A .

4. Numerical Modelling

4.1 Methodology

The release of pollutants in the oceanic environment through an outfall is a process that is generally continuous over time, but often subject to significant fluctuations in released quantities. The outcome of such releases is inherently non-deterministic and is governed, in part, by random variables such as currents, turbulence, wastewater network use and precipitation, it is therefore difficult to accurately predict.

However, the probability of future oceanic conditions can be assessed from the historical conditions, thereby allowing estimations of the general geographical dispersion expected. In the present study, the approach consisted of running year-long simulations within two contrasting historical contexts (La Niña /El Niño episodes, June 2010-June 2011, and June 2015-June 2016, respectively). This allows robust probabilistic estimates of the plume dispersion and dilution patterns to be determined and thus provide some guidance on expected concentration levels associated with the proposed outfall.

During El Niño conditions, New Zealand typically experiences stronger or more frequent westerly winds during summer. This leads to a greater risk of drier-than-normal conditions in east coast areas and more rain than normal in the west. In winter, colder southerly winds tend to prevail, while in spring and autumn, south-westerlies tend to be stronger or more frequent, bringing a mix of the summer and winter effects.

During La Niña conditions more north–easterly winds are characteristic, which tend to bring moist, rainy conditions to the north–east of the North Island, and reduced rainfall to the south and south–west of the South Island.

By considering both La Niña and El Niño episodes a robust probabilistic estimate of the plume dispersion and dilution patterns is able to be determined and thus provide guidance on expected concentration levels associated with the Hokianga Harbour WWTP discharges.

The discharge of waste-water into Hokianga Harbour has been modelled using a high-resolution local domain hydrodynamic model to characterise the salient hydrodynamics of the environment, while an Eulerian tracer technique has been applied in order to quantify the likely dilution of the discharged waste water.

The following sections detail the hydrodynamic models, including calibration and validation, and Eulerian tracer technique implemented for this specific study; assumptions around the discharge rates are also presented.

4.2 Hydrodynamic Model

4.2.1 Model description

The 2D and 3D baroclinic hydrodynamics of the Hokianga Harbour were modelled using the open-sourced hydrodynamic model SCHISM[1 2]. The benefit of using open-source science models is the full transparency of the code and numerical schemes, and the ability for other researchers to replicate and enhance any previous modelling efforts for a given environment.

SCHISM is a prognostic finite-element unstructured-grid model designed to simulate 3D baroclinic, 3D barotropic or 2D barotropic circulation. The barotropic mode equations employ a semi-implicit finite-element Eulerian-Lagrangian algorithm to solve the shallow-water equations, forced by relevant physical processes (atmospheric, oceanic and fluvial forcing). A detailed description of the SCHISM model formulation, governing equations and numerics, can be found in Zhang and Baptista (2008).

The SCHISM model is physically realistic, in that well-understood laws of motion and mass conservation are implemented. Therefore, water mass is generally conserved within the model, although it can be added or removed at open boundaries (e.g. through tidal motion at the ocean boundaries) and water is redistributed by incorporating aspects of the real-world systems (e.g. bathymetric information, forcing by tides and wind). The model transports water and other constituents (e.g. salt, temperature, turbulence) through the use of triangular volumes (connected 3-D polyhedrons).

The finite-element triangular grid structure used by SCHISM has resolution and scale benefits over other regular or curvilinear based hydrodynamic models. SCHISM is computationally efficient in the way it resolves the shape and complex bathymetry associated with estuaries, and the governing equations are similar to other open-source models such as Delft3D and ROMS. SCHISM has been used extensively within the scientific community[3 4], where it forms the backbone of operational systems used to nowcast and forecast estuarine water levels, storm surges, velocities, water temperature and salinity[5].

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[1] http://ccrm.vims.edu/schism/

[2] http://www.ccrm.vims.edu/w/index.php/Main_Page#SCHISM_WIKI

[3] http://www.stccmop.org/knowledge_transfer/software/selfe/publications

[4] http://ccrm.vims.edu/schism/schism_pubs.html

[5] https://tidesandcurrents.noaa.gov/ofs/creofs/creofs_info.html

4.2.2 Model domain and bathymetry

The model resolution was optimised to ensure replication of the salient hydrodynamic processes. The resolution ranged from 90 m at the boundary to 15 m within Hokianga Harbour and near the discharge locations.

Bathymetry is an essential requirement for coastal and estuaries numerical modelling. MetOcean Solutions has compiled an extensive national and regional bathymetric dataset derived from Electronic Navigation Charts (ENC). GEBCO data (Becker et al. 2009) was also used to characterise the deepest offshore areas. These datasets were updated with available hydrographic surveys for the region.

This included:

- LIDAR data available for parts of the harbour (Opononi-Omapere, Rawene and Kohukohu).
- Hydrographic surveys of the Hokianga Harbour completed by LINZ in 2015 (from the mouth to the upper reaches, see Figure 3).
- Hydrographic surveys of the Hokianga Harbour completed by NRC in 2006 (Motuti, Omapere and lower harbour).

Specialist data manipulation tools have been developed in-house to allow merging, interpolation and QA of raw bathymetric data to establish the numerical model domain (Figure 4.1and Figure 4.2).

The triangular elements of the model domain mesh is shown in Figure 4.3 and associated bathymetry is presented in Figure 4.4.

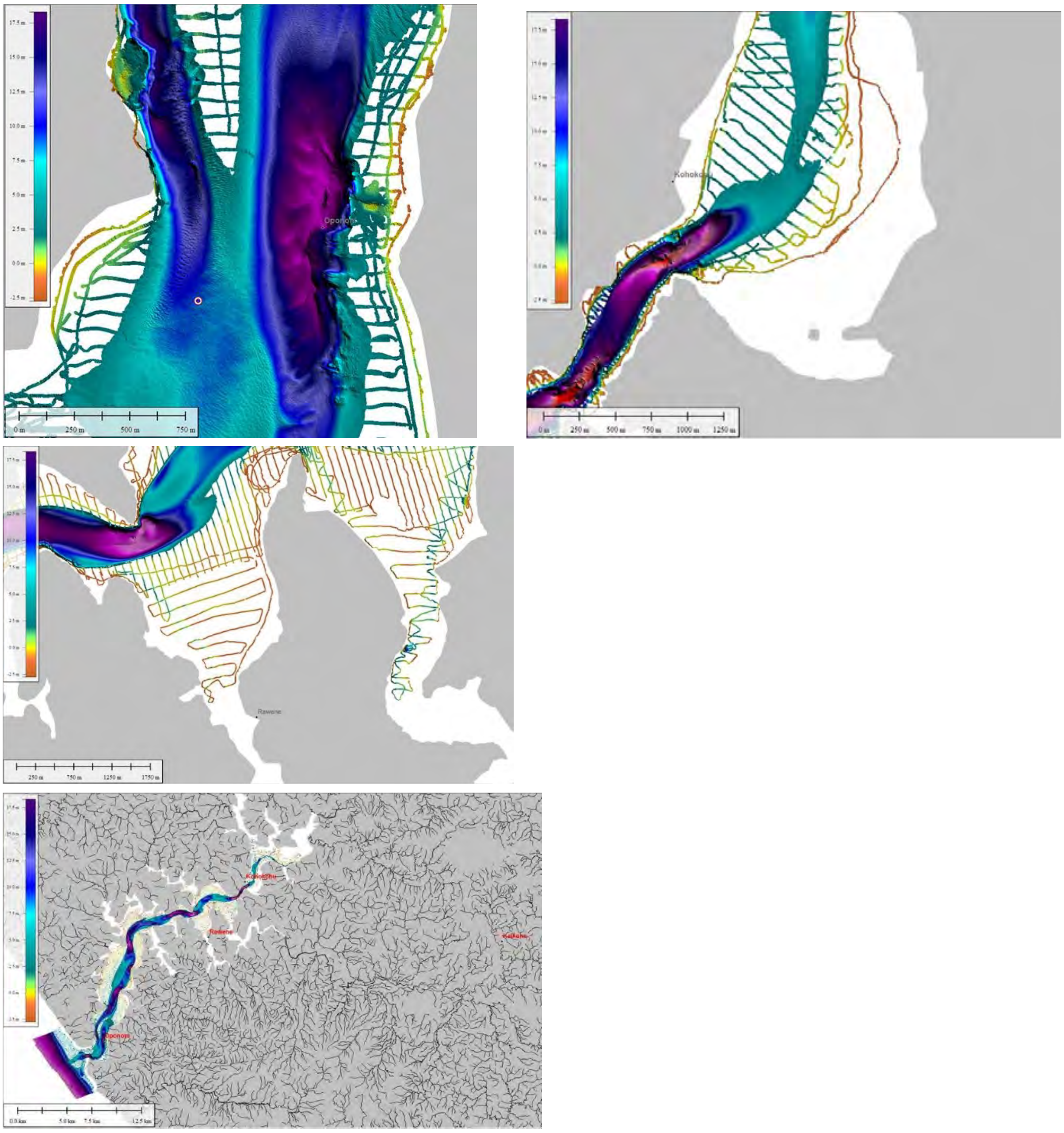


Figure 4.1: Hydrographic Survey for Hokianga Harbour completed by LINZ in 2015 near the WWTP (Top left: Opononi, Top right: Kohokohu, Bottom left: Rawene, Bottom right: Kaikohe)

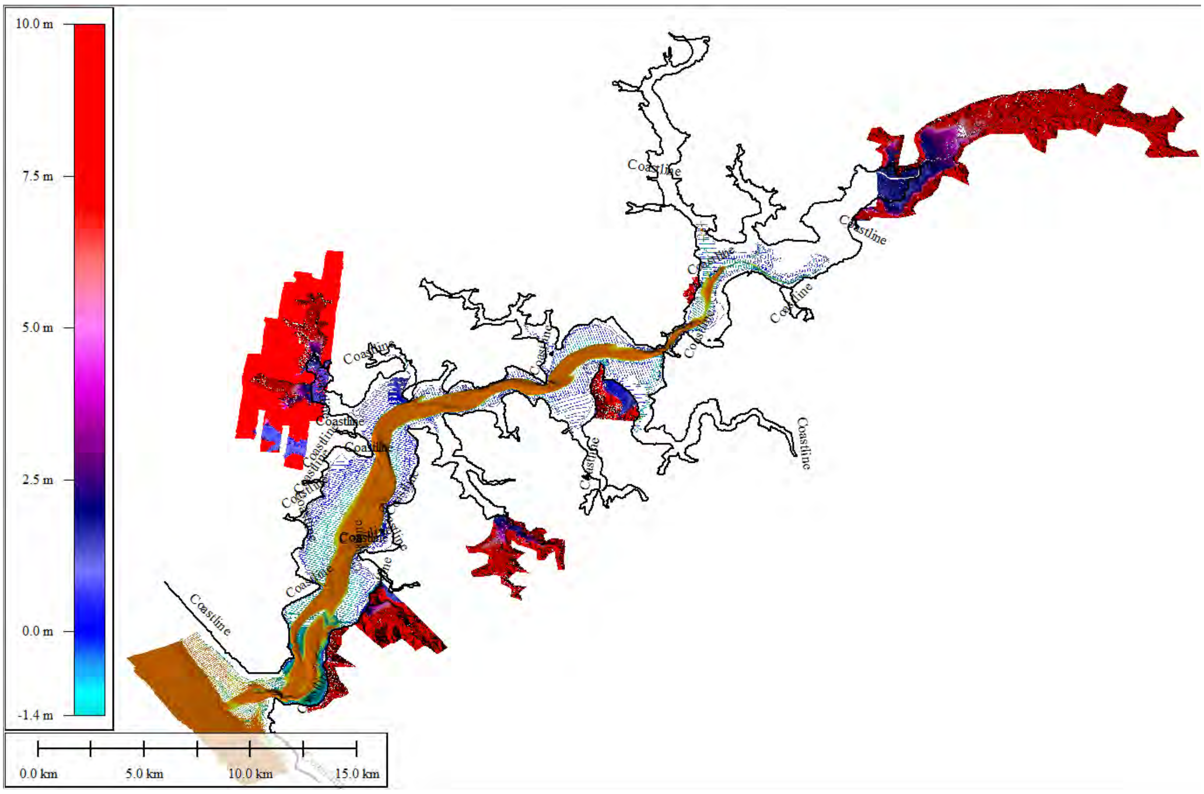


Figure 4.2: Compilation of all bathymetric data used to prepare the hydrodynamic model bathymetry of Hokianga Harbour.

Figure 4.3 Triangular model mesh defined for the Hokianga Harbour. Left is the whole domain and right show the grid refinement around the Opononi discharge location.

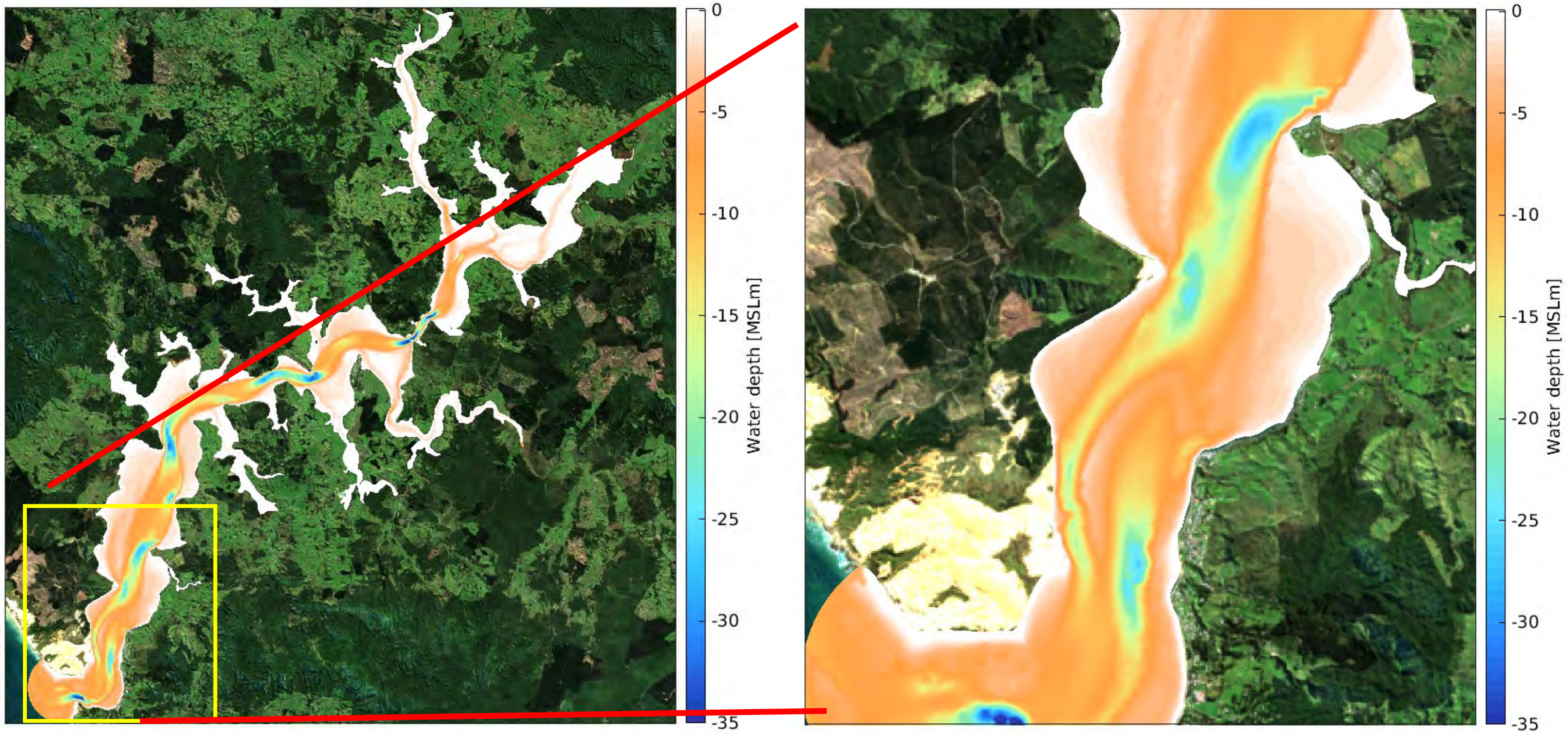


Figure 4.4 Bathymetry of model domain showing the water depth in m below mean sea level. Left is the whole domain and right is a zoom over the Opononi discharge location.

4.2.3 Vertical discretisation

For this model simulations, the vertical discretisation of the water column consisted of a Localized Sigma Coordinate system with Shaved Cell (LSC^2), a type of terrain-following layers as described in Zhang et al. (2014).

The use of this type of vertical grid was dictated by the stratification of the water column as well as the shallows area in the Northern end of the Harbour. The vertical grid is constituted of quadratic terrain-following coordinate with 4 layers near in the shallow area (less than 2m) and 24 layers near the offshore boundary A vertical section showing both the sigma layers and the water depths along a transect is presented in Figure 4.5.

For this study, the model was configured with increased vertical resolution at the surface. The vertical discretisation used in this study is appropriate for investigating the stratified flow regime that is expected within the harbour due to the mixing of the river fresh water and denser marine waters which leads to a concentration of fresh water in the upper levels of the water column.

In order to add more accuracy in the shallow region, the model was setup so that the minimum water depth calculated by the model is 0.001m. In other words, depth less than 1mm is considered dry.

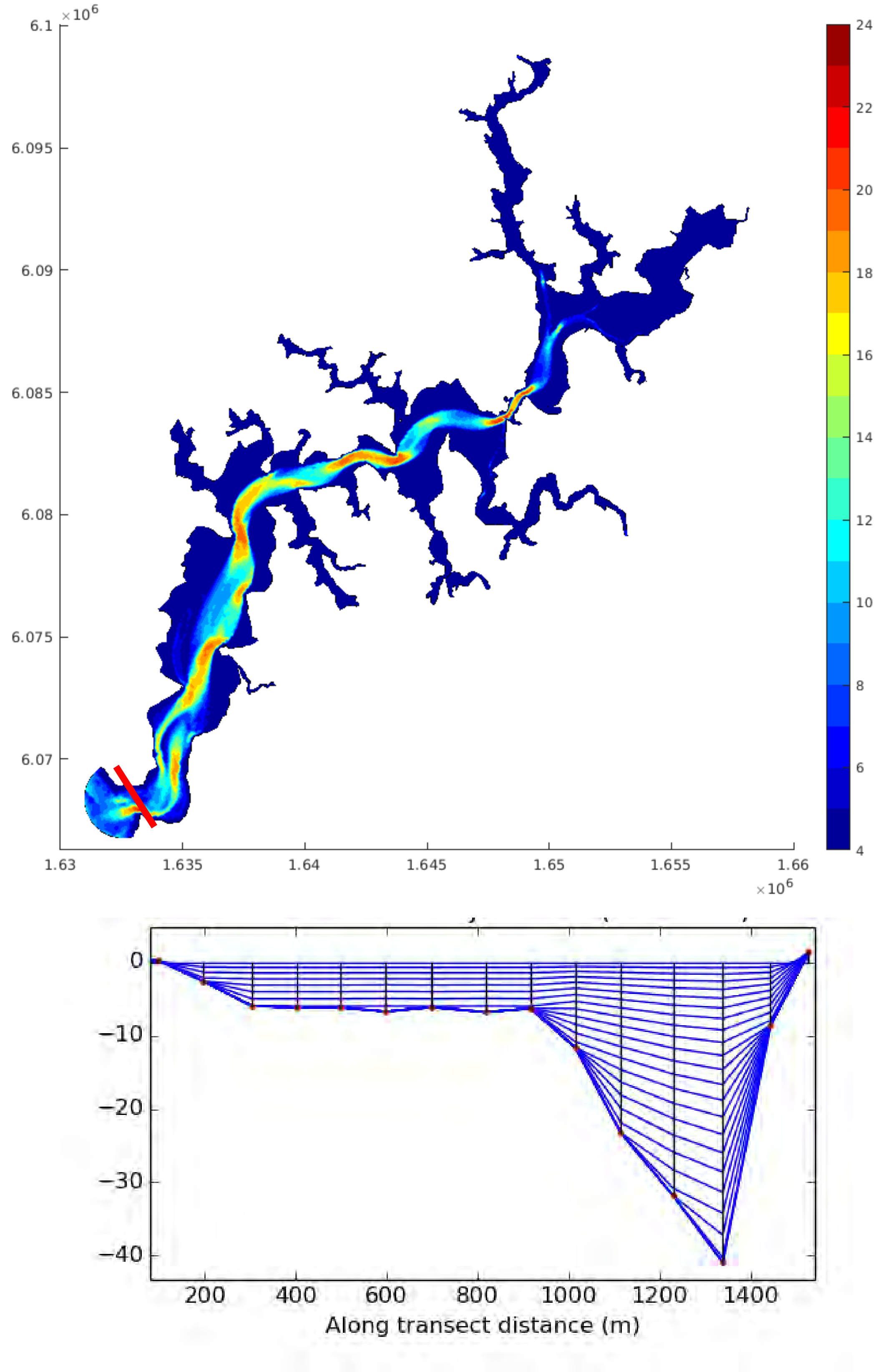


Figure 4.5 Map of Hokianga harbour showing the number of vertical level used in the model (left) and the cross section represented by the black line is shown on the right picture. Note the vertical resolution is increased near the surface to resolve the fresh water forcing.

4.2.4 Vertical mixing / turbulence closure

Vertical mixing was modelled using a *GLS* model with a (Kantha and Clayson 1994) stability function with minimum and maximum diffusivities set to 1×10^{-4} and 1×10^{-2}, respectively, following model validation and calibration. These values were adjusted as part of the model validation and calibration process.

The constant surface mixing length was held to the recommended default of 0.1 (i.e. 10% of the uppermost sigma layer); however, variations of the mixing length were examined during the validating and calibration process.

Frictional stress at the seabed was approximated with a quadratic drag law, with the drag coefficient (*CD*) determined using a manning coefficient of 0.01. Detailed explanations of the determination of the drag coefficient are given in (Zhang Y.L. and Baptista 2008).

4.2.5 Submerged Aquatic Vegetation

In order to include the mangroves ecosystem in the model, the Submerged Aquatic Vegetation (SAV) module was used. By using the SAV module the drag coefficient is increased (a coefficient of 1.13) and therefore affect the flow velocity.

Figure 4.6 Aerial photography of Hokianga Harbour showing in red the mangrove habitat used in the SCHISM model

4.3 Boundary Conditions and Forcing

4.3.1 Atmospherics Forcing

MetOcean Solutions maintains an up-to-date 12 km resolution New Zealand atmospheric hindcast reanalysis from 1979 to 2019 using the Weather and Research Forecasting (WRF) model and deriving boundary conditions from the global CFSR product. The improvement in resolution from the 35 km of CFSR adds accuracy and variability to the atmospheric fields that force the hydrodynamic models, especially over coastal margins where topography is known to substantially change the large-scale wind patterns and local responses. WRF reanalysis prognostic variables such as winds, atmospheric pressure, relative humidity, surface temperature, long and short wave radiation, and precipitation rate were used at hourly intervals to provide air-sea fluxes to force SCHISM in all domains, using a *bulk flux* parameterization (Fairall et al., 2003).

4.3.2 Open Boundary and Tidal Forcing

Tidal constituents were calculated from a greater New Zealand SCHISM domain (Figure 4.7). This New Zealand domain was run in hindcast baroclinic mode for a 10-year period spanning 2000-2009. Depth averaged velocity, elevations, tidal phases and amplitudes for the salient primary and secondary tidal constituents were derived near the Hokianga harbour entrance using harmonic analysis.

Residual surface elevation at the offshore boundary is a combined from multiple factors (Atmospheric pressure, tide and wave). In this study, the inverse barometric effect (IB) was calculated from the WRF mean sea level pressure. The impact of the wave on the offshore boundary was calculated using a basic wave set-up equation from Goda (1985), Where H_o is the wave height and L_o is the wavelength.

Wave setup (Goda 1985): $$\frac{0.01H_o}{\sqrt{\frac{H_o}{L_o}\left(1+\frac{h}{H_o}\right)}} \qquad \text{(Eq. 4.1)}$$

The final residual surface elevation is the sum of the IB and the wave setup (Figure 4.8)

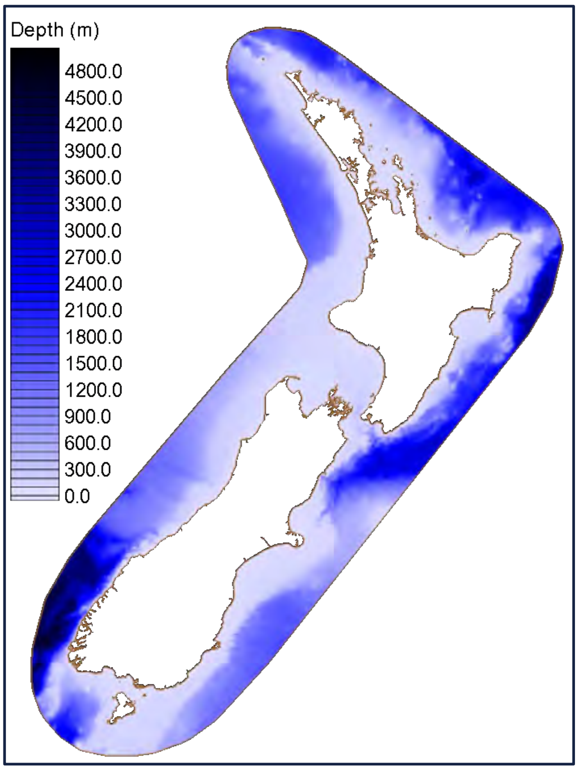


Figure 4.7 Extent of the NZ scale finite element domain used to derive tidal constituents at the Hokianga harbour entrance.

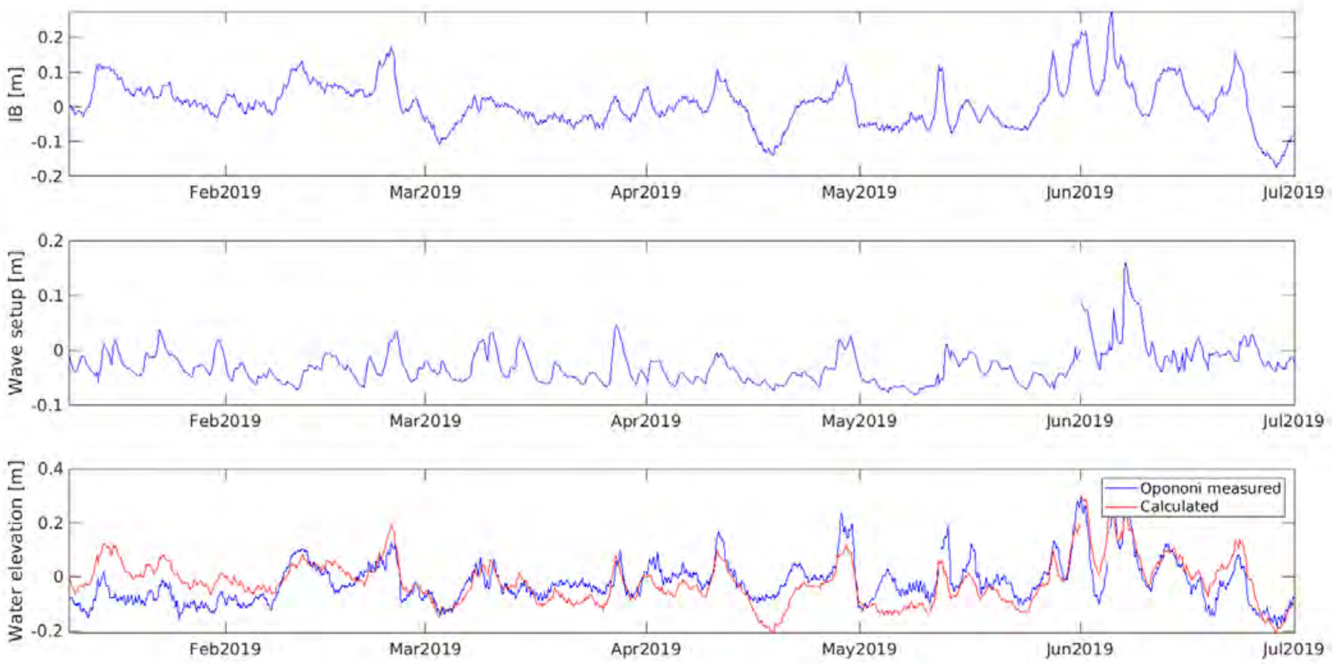


Figure 4.8 Time series of the IB calculated from the mean sea level pressure from WRF model (top).Timeseries of the wave setup calculated from the wave height at the offshore boundary using the equation from Goda 1985.(middle). Comparison of the residual elevation from IB and wave setup with the residual elevation measured at Opononi.

4.3.3 River Discharges

Only four major rivers were included in the model: Waima river, Waihou River, Orira River and the Mangamuka River (Figure 4.10).

Discharge records of Waihou and Waima rivers measured between 1989 and 2019 by NIWA and Northland Regional Council were processed to force the SCHISM domains. Due to the limited available data for Mangamuka River, a time series discharge rates for this river was estimated based on a ratio between the mean discharge rate from the Mangamuka and Waihou Rivers. The discharge from the Orira River was made constant and the mean discharge was used (0.4 m^3/s)

In order to include the runoff from the surrounding streams, the rivers discharge were increased by a percentage calculated during the calibration of the model (Table 4.1).

Table 4.1 Factor used for each of the river in order to account for the run off in Hokianga harbour.

River	Factor
Waihou	1.16
Mangamuka	1.25
Waima	1.10

The time series of the Waima river and Waihou river discharges are presented in Figure 4.9

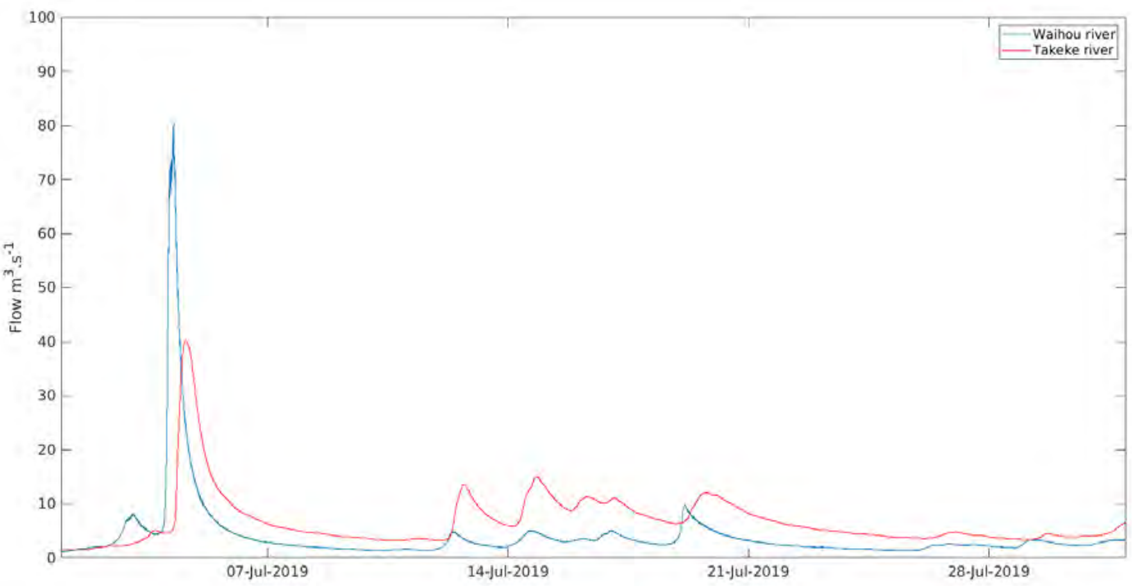


Figure 4.9 Timeseries of the Waihou and Waima river flow used during the validation period of the model.

Figure 4.10 Aerial photography showing in red the four rivers included in the model

4.3.4 Temperature and Salinity

A vertically and horizontally uniform salinity and temperature fields were applied to the open ocean model boundary from the HYCOM model.

River salinity was defined as fresh water (0 PSU), and river temperature was only measured at the Waiapa river (upstream from Waihou river).

The same temperature was used in all rivers. A time series of river temperature is presented in Figure 4.11.

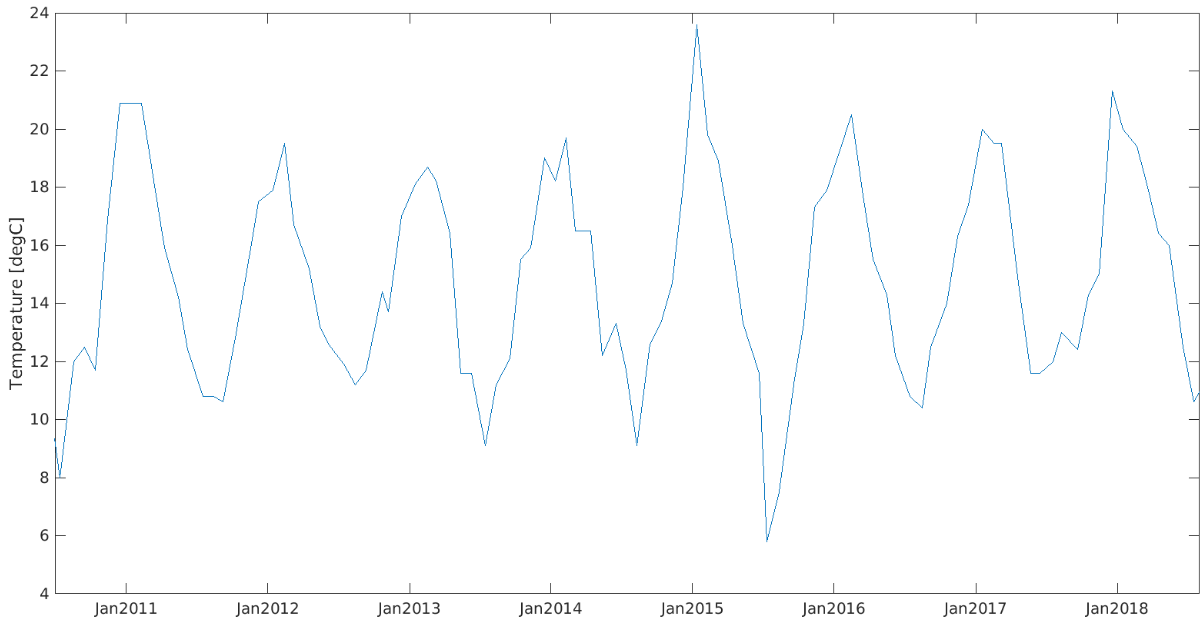


Figure 4.11 Timeseries of river temperature, measured at Waiapa river, used for all the rivers in the Hokianga Harbour model between 2010 and 2018

4.3.5 WWTP Discharges

As presented in the FNDC documents details of the WWTP discharges into Hokianga Harbour are as follows:

Opononi WWTP **-** 1634768E 6069462N (NZTM 2000)

- Discharged directly into the harbour via outfall pipe.
- Pumped from a holding pond and discharged into the harbour for maximum of 4 hours on an outgoing tide.
- Treated wastewater shall only be discharged to the Harbour for a max. of 3 hours each tidal cycle between one and four hours after high tide.
- Discharge Limit 450m3/day (revised from 685m3 previously)

Kohukohu WWTP – 1648973E 6085591N (NZTM 2000)

- Discharged into unnamed tributary of the Hokianga Harbour (tidal mud flat)
- Continuous gravity discharge. Known to have zero discharge in dry periods.
- Discharge limit 40m3/day (30 days average)

Rawene WWTP - 1645309E 6079915N (NZTM 2000)

- Discharged into Omanaia River (tidal mud flat)
- Continuous gravity discharge from the WWTP but once the discharge enters the drain it is controlled by a flood gate discharging to the Omanaia River. There are other contributors to the drain and therefore the discharge from the floodgate.
- Discharge limit 254m3/day (30 days average)

Kaikohe WWTP (1674845E 6079488N.)

- Discharged into unnamed tributary of the Wairoro Stream
- Continuous gravity discharge into freshwater that runs into the Hokianga Harbour.
- Discharge limit 1710m^3/day (30 days average)

Nearfield:

Each of the four WWTP discharge are occurring either via an outfall pipe or via continuous gravity discharge which therefore did not have any structural design which would lead to complex dilution patterns (diffuser, multiple pipe arrangement..). The nearfield dilution is expected to simply occur as the discharge water mixes with the stream water or the Hokianga Harbour water. The SCHISM model represent the release of the contaminant as a discharge flow (with a tracer concentration [C]) in a model cell similarly to that a pipe on the seabed (or with gravity discharge on dry land). The near field dilution is then occurring within that model cell .The representation in the numerical model as a discharge source is therefore suitable for assessing the fate and dispersion of the WWTP waters in the harbour.

Discharge Timeseries:

In order to model the four discharges a review of the discharge rate timeseries data was undertaken (see Figure 4.12) and an annual representation of the variability in the discharge rate, as well as a maximum, close to the proposed resource consent was chosen for each of the four discharge locations (Figure 4.13 and Figure 4.14). If needed, the discharge was increased to reach the resource consent limit.

Opononi was set up to only discharge up to four hours following high tide.

The probability of future estuarine conditions can be assessed from the historical conditions, thereby allowing estimations of the general geographical dispersion expected. In the present study, the approach consists in running year-long simulations within two contrasting historical contexts (La Niña /El Niño episodes, June 2010 - June 2011, and June 2015 - June 2016, respectively).

The yearlong run simulation was extended by two days with a discharge rate increased to the highest discharge recorded in order to assess the impact of an extreme isolated event (Figure 4.14).

Different passive Eulerian tracers (i.e. neutrally buoyant , no decay) were used for each WWTP discharge. A nominated concentration value of 1 mg/L was used so that dilution can be calculated at various distance from the source. Specific contaminant concentration levels can then be determined using concentration ratios and the expected, or measured, discharged value.

For the Kaikohe WWTP the discharge occurs more than 30 km upstream of the Waima River connection to Hokianga Harbour. The WWTP contaminant concentration gets diluted as it flows from Kaikohe to the harbour due to the little tributaries joining along the stream. Timeseries of river discharge data are only available further downstream of the discharge and closer to the harbour (i.e. 'Punakitere at Taheke' data from NRC).

A modelled discharge point closer to the harbour was therefore implemented. A dilution factor of 1/18.4 between the Kaikohe discharge location and the point where the modelled Waima river discharges into the harbour was adopted. Comparing the volume of water from the NIWA river maps service (https://shiny.niwa.co.nz/nzrivermaps/) data, at these two locations allow us to consider all the fresh water input from all the small tributaries between the WWTP discharge point and the modelled discharge point in the harbour. The mean flow value extracted from the NIWA site where 0.768m3/s near the Kaikohe discharge location and 14.1m3/s near the modelled Waima river point, this leas to a ratio of 18.4.It is noted that based on the available data (mean flow, mean annual low flow, 1 in 5-year low flow) this dilution ratio can vary between approximately 1/16 to 1/23.

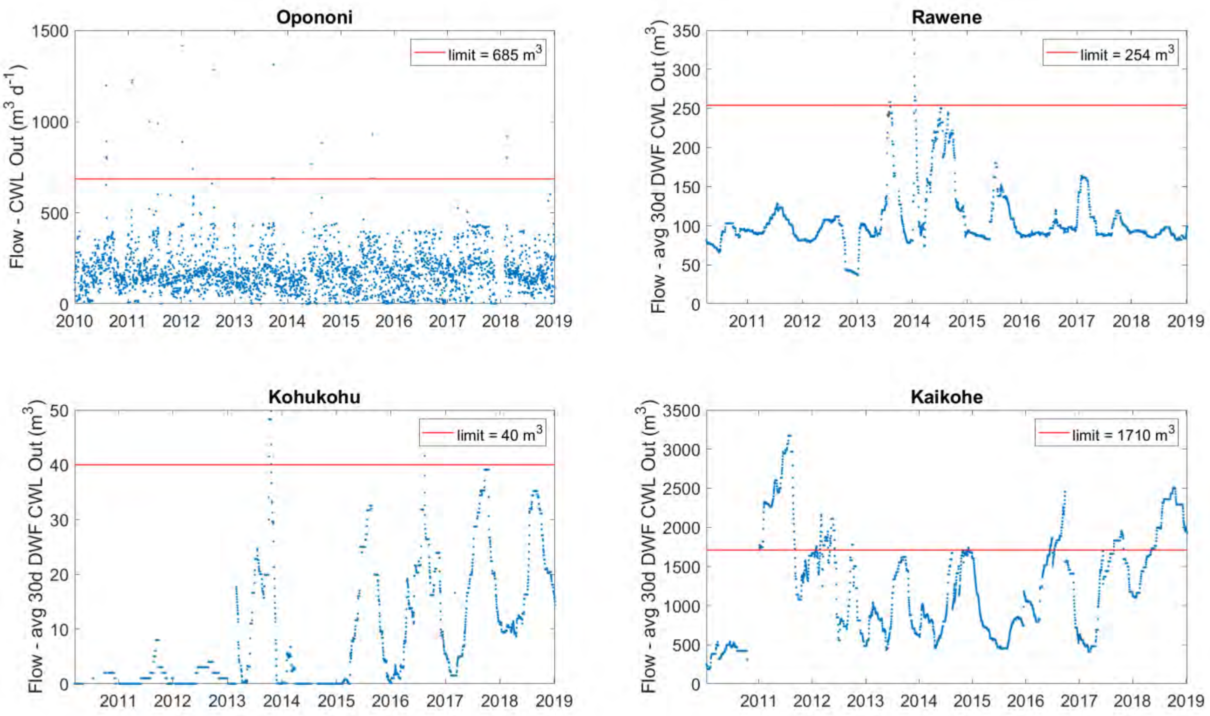


Figure 4.12 Discharge timeseries (blue) and council limits (red) from the four locations

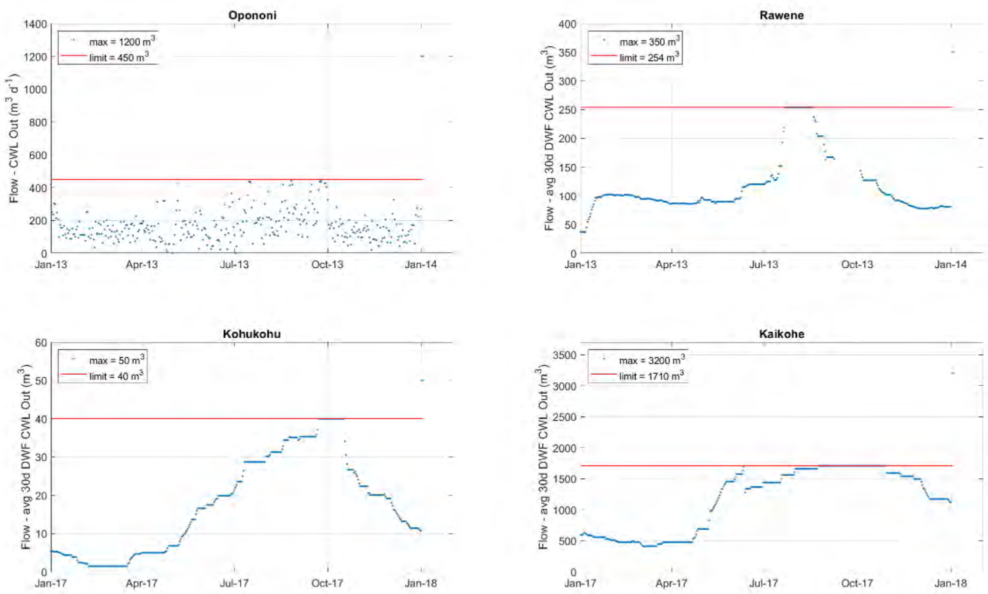


Figure 4.13 Discharge timeseries (blue) and council limits (red) from the four locations selected for use in the modelling

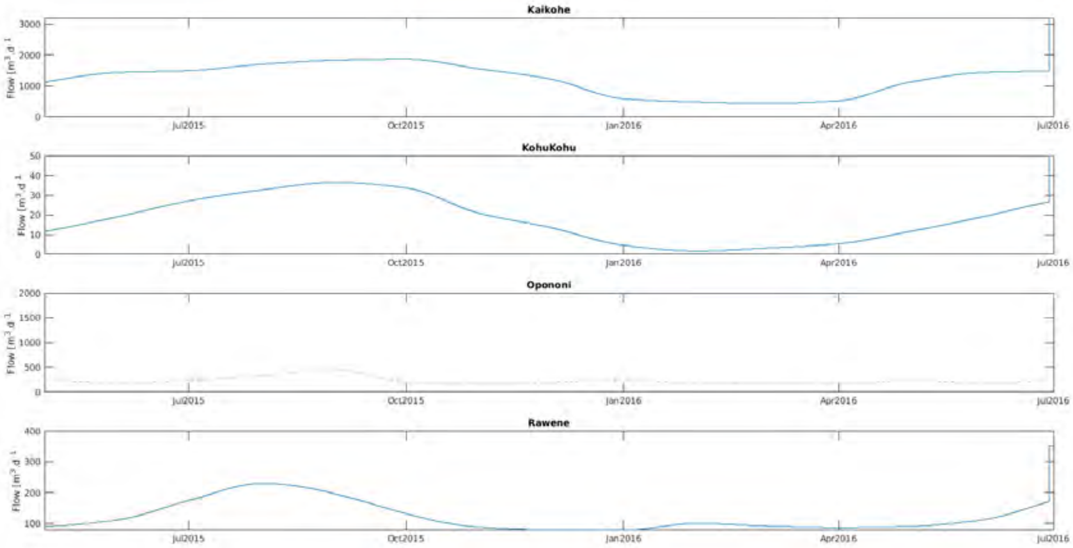


Figure 4.14 Modelled timeseries of discharge rate (in m3/day) from the four discharge locations. Note Opononi was only released during the first four hour of the ebb tide.

Contaminants:

Can you please proceed with doing concentration maps for the 50th and 95th percentile , then colorbar legend should be concentration in mg/L (based on a 1mg/L discharge concentration).

And then change Axis labels for time series

5. Results

5.1 Model validation

5.1.1 Elevation

Time series of measured water elevations have been processed and the residual elevations are separated from the tidal elevations.

The amplitudes and phases from M2, S2, N2, K2, K1 and L2 tidal constituents extracted from all data collection sites are shown from Table 5.1 to Table 5.6. Time series of total elevations are shown in Figure 5.1. Residual time series are presented in Figure 5.2.

Comparisons show that the model successfully reproduces the propagation of the tidal wave inside the harbour, with good agreement between both amplitudes and phases of the principal tidal constituents. The misalignment in the time series of the measured and modelled water level at Onoke and The Narrows are due to the movement of the instrument which occurred during the deployment as discussed in Section 2.1.3, nevertheless the water level variations are in good agreement.

Table 5.1 Comparison of measured and modelled amplitude and phase for the M2 constituent at all sites.

M2 constituent	Amplitude [m]		Phase [deg]	
Site name	**Measured**	**Modelled**	**Measured**	**Modelled**
Omapere	0.98	1.01	291.28	289.23
Onoke	1.11	1.08	293.48	296.86
Matawhera	1.14	1.10	302.13	301.65
The Narrows	1.24	1.10	307.76	311.17

Table 5.2 Comparison of measured and modelled amplitude and phase for the S2 constituent at all sites

S2 constituent	**Amplitude [m]**		**Phase [deg]**	
Site name	**Measured**	**Modelled**	**Measured**	**Modelled**
Omapere	0.25	0.25	322.28	316.62
Onoke	0.30	0.29	326.00	322.83
Matawhera	0.28	0.31	336.87	326.98
The Narrows	0.30	0.32	339.20	335.93

Table 5.3 Comparison of measured and modelled amplitude and phase for the N2 constituent at all sites

N2 constituent	**Amplitude [m]**		**Phase [deg]**	
Site name	**Measured**	**Modelled**	**Measured**	**Modelled**
Omapere	0.21	0.19	286.87	276.65
Onoke	0.24	0.20	292.74	286.25
Matawhera	0.24	0.20	299.92	291.98
The Narrows	0.26	0.20	306.89	301.51

Table 5.4 Comparison of measured and modelled amplitude and phase for the K2 constituent at all sites

K2 constituent	**Amplitude [m]**		**Phase [deg]**	
Site name	**Measured**	**Modelled**	**Measured**	**Modelled**
Omapere	0.08	0.08	320.89	322.66
Onoke	0.12	0.12	321.54	338.78
Matawhera	0.09	0.14	327.36	344.99
The Narrows	0.12	0.16	308.89	356.66

Table 5.5 Comparison of measured and modelled amplitude and phase for the K1 constituent at all sites

K1 constituent	Amplitude [m]		Phase [deg]	
Site name	Measured	Modelled	Measured	Modelled
Omapere	0.06	0.07	34.14	33.88
Onoke	0.08	0.07	41.38	38.59
Matawhera	0.07	0.07	41.31	41.17
The Narrows	0.09	0.07	32.81	46.16

Table 5.6 Comparison of measured and modelled amplitude and phase for the L2 constituent at all sites

L2 constituent	Amplitude [m]		Phase [deg]	
Site name	Measured	Modelled	Measured	Modelled
Omapere	0.05	0.01	283.54	232.30
Onoke	0.06	0.03	250.81	253.33
Matawhera	0.08	0.04	284.07	259.66
The Narrows	0.04	0.04	271.83	270.39

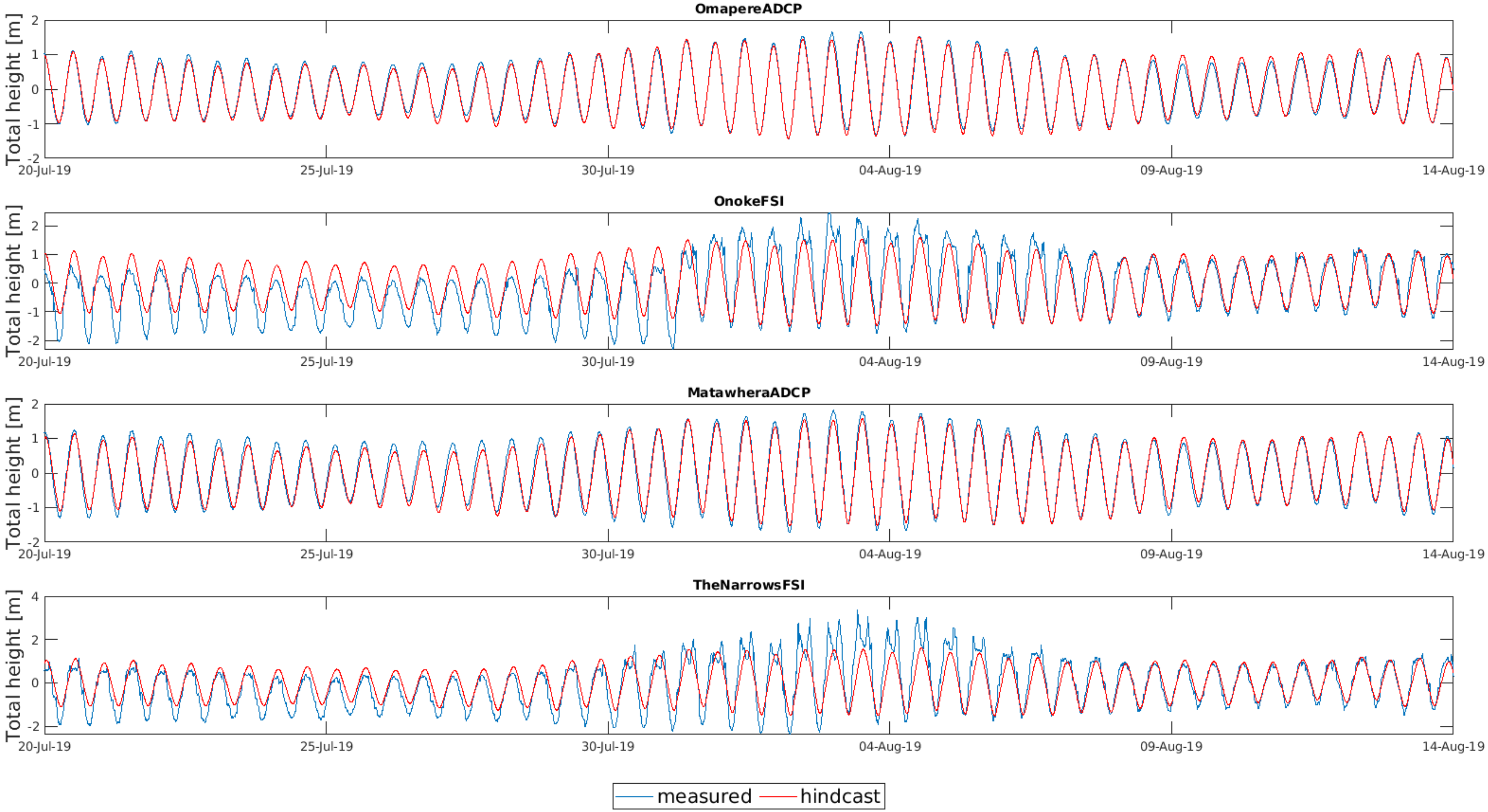


Figure 5.1 Timeseries of water elevation measured at the four sites (blue) and modelled (red) between July 2019 and August 2019. Note: the two FSIs have moved positioned during the measurement period.

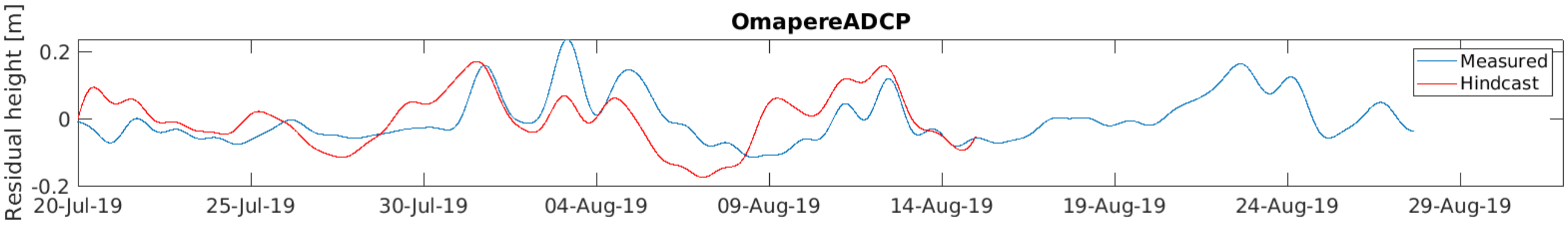


Figure 5.2 Timeseries of residual water elevation measured at Opononi sites (blue) and modelled (red) between July 2019 and August 2019

5.1.2 Velocities

The comparison of the total current speeds and directions at three levels in the water column at the Omapere ADCP site are presented in Figure 5.3 and Figure 5.4 respectively. Tidal signal was removed from the velocities, and currents were rotated in the channel axes. The resultant velocities are presented in Figure 5.5.

Comparison of current speeds and direction at Onoke and The Narrows are presented in Figure 5.6 and Figure 5.10 respectively. For both FSI sites, the extraction of the tidal signal was not possible due to the shift of the instrument during the deployment.

The comparison of the total current speeds and directions at three levels in the water column at the Matawhera ADCP site are presented in Figure 5.7 and Figure 5.8 respectively. Tidal signal was removed from the velocities, and currents were rotated in the channel axes. The resultant velocities are presented in Figure 5.9.

At all sites, the model reproduces well the tidal signal in the entire water column. More precisely, the amplitude difference between the ebb and flood current is modelled correctly especially at the Matawhera site (Figure 5.7).

The model tends to reproduce the current more accurately toward the end of the deployment (in August). This could be due to the freshwater influence on the environment. Higher precipitation rate and higher discharge from the river were observed between the 14th and 20th of July 2019 (Figure 4.9).

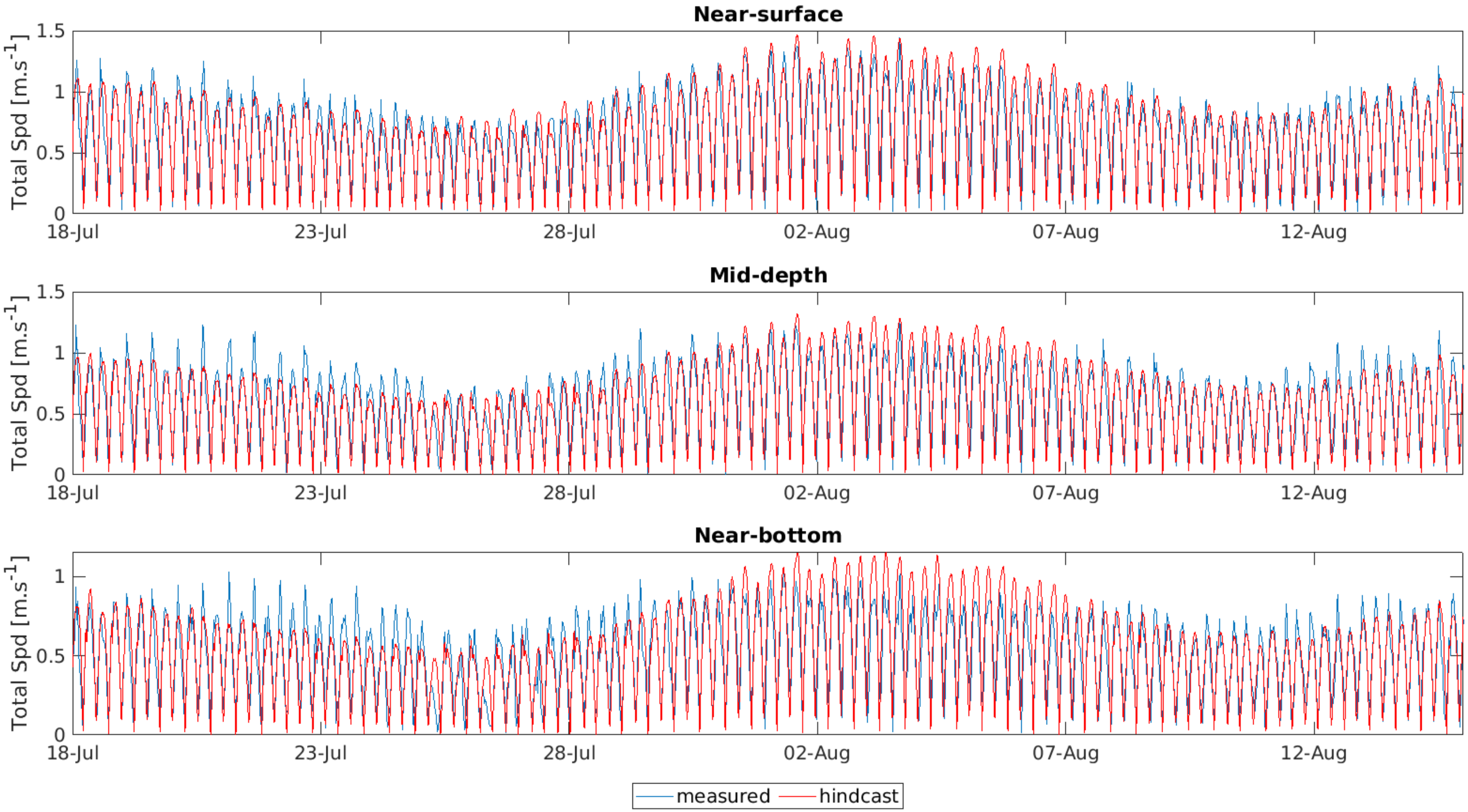


Figure 5.3 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),current speeds at Omapere ADCP site from July 2019 to August 2019.

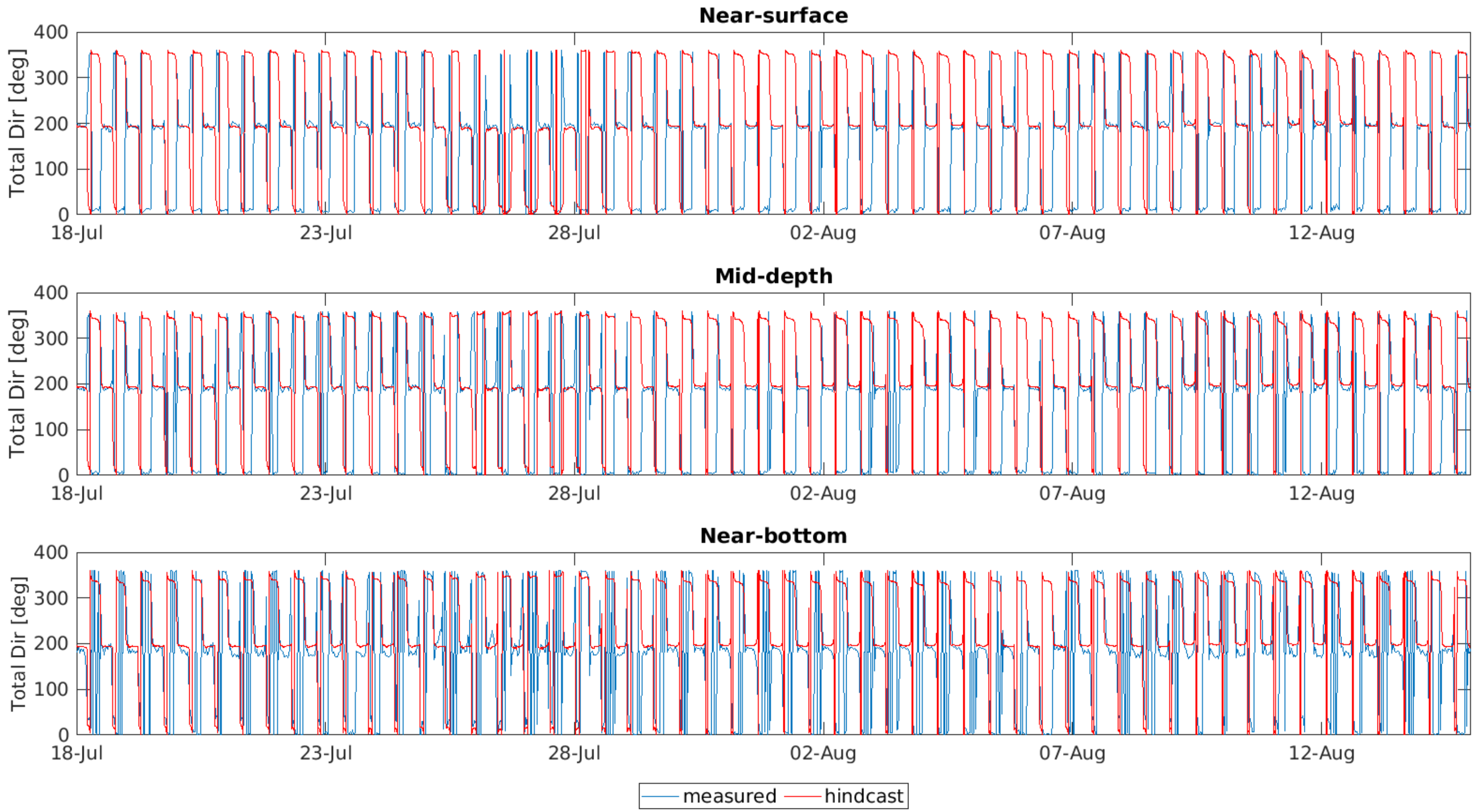


Figure 5.4 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),current direction at Omapere ADCP site from July 2019 to August 2019

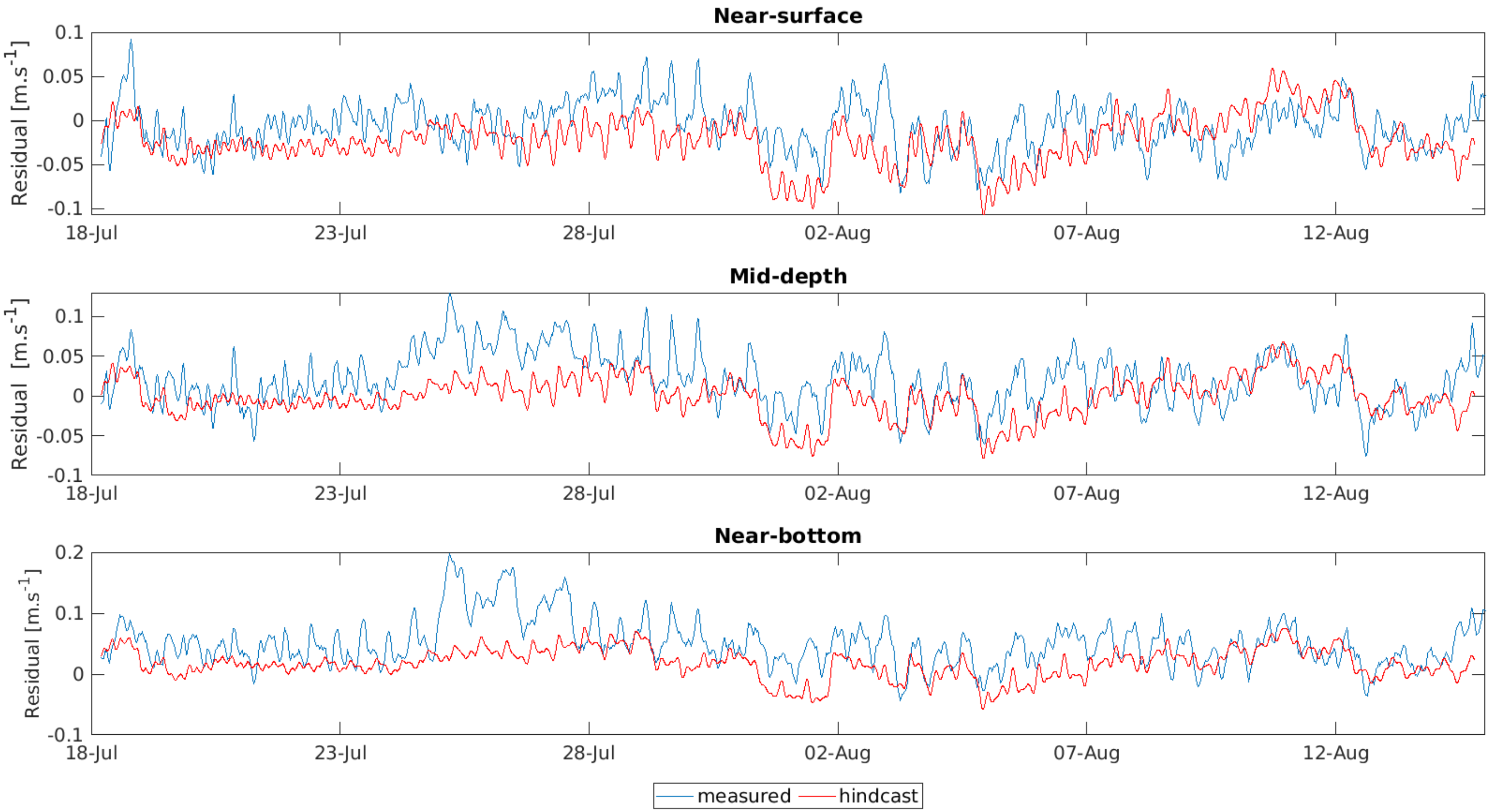


Figure 5.5 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),Residual velocities at Omapere ADCP site from July 2019 to August 2019. Note the current were rotated to be aligned with the main channel.

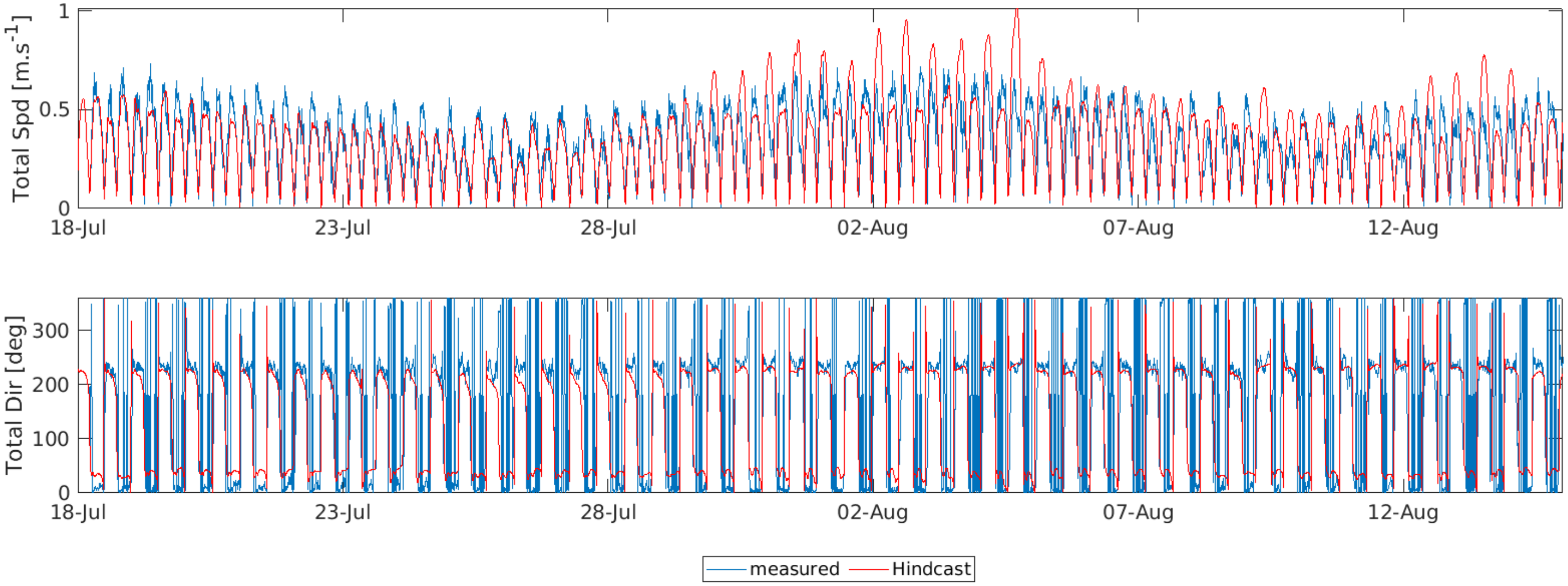


Figure 5.6 Measured (blue) and modelled (red) total mid-depth current speeds (top) and direction (bottom) at Onoke FSI site from July 2019 to August 2019

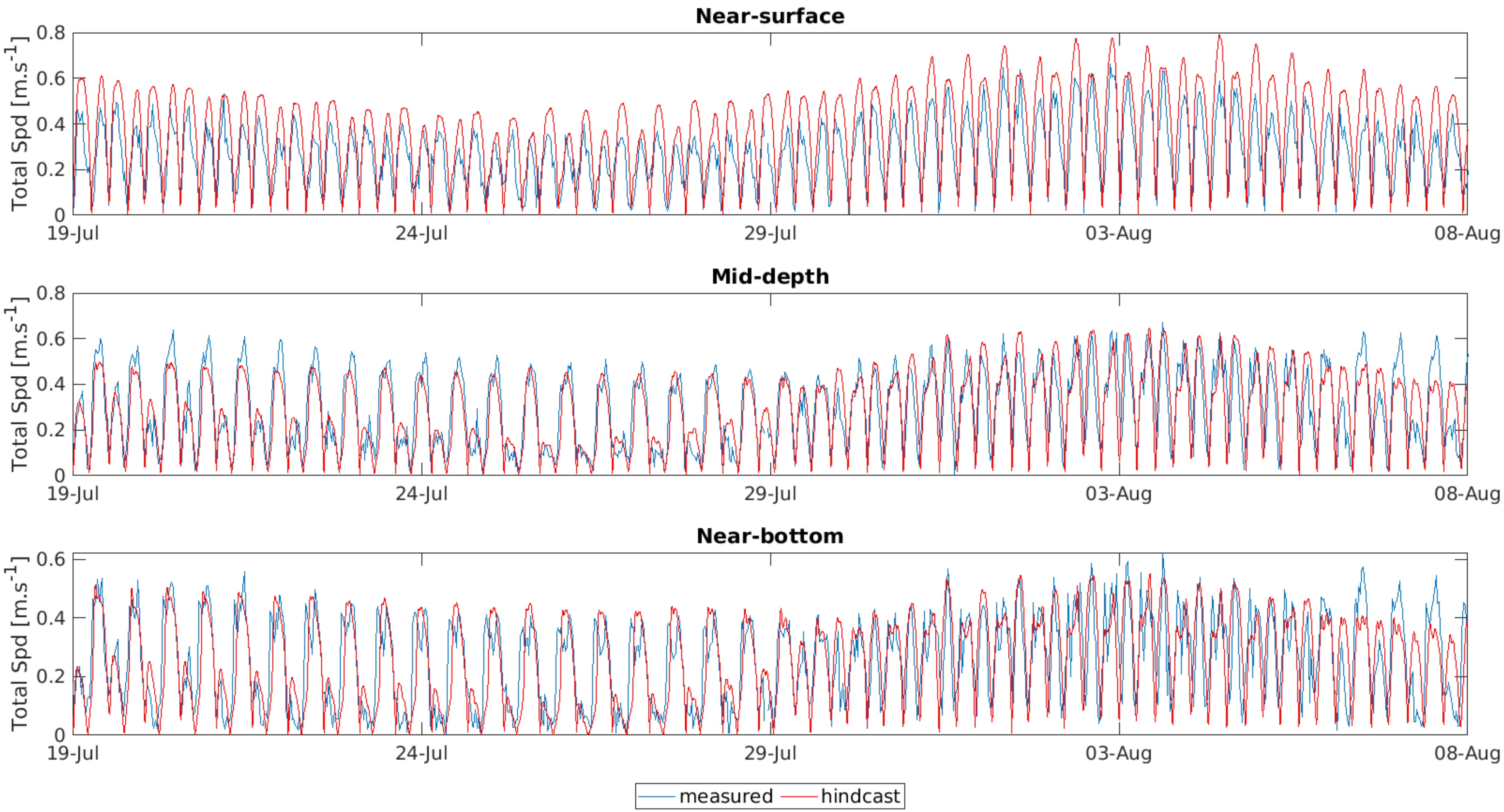


Figure 5.7 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),current speed at Matawhera ADCP site from July 2019 to August 2019

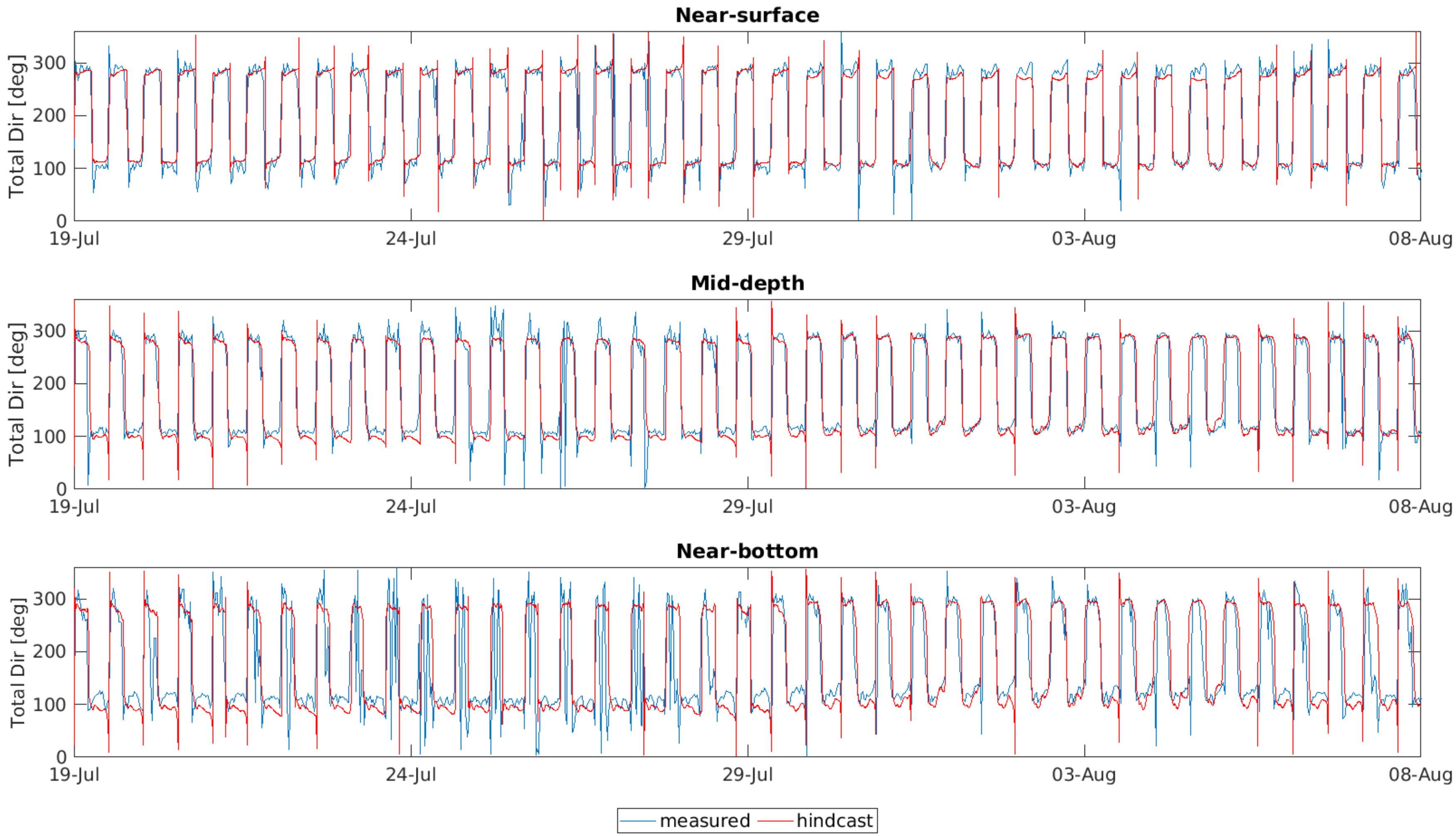


Figure 5.8 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),current direction at Matawhera ADCP site from July 2019 to August 2019

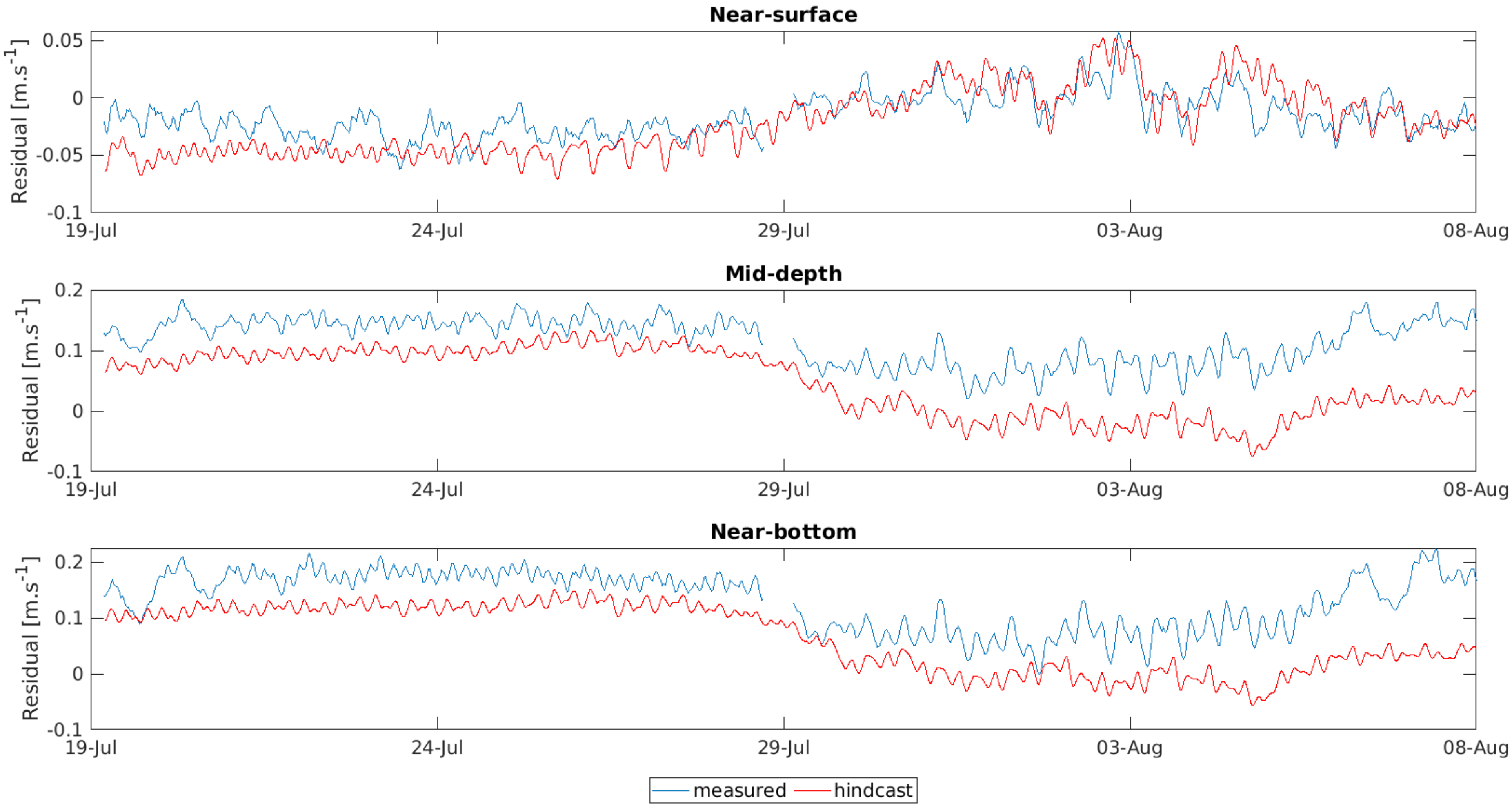


Figure 5.9 Measured (blue) and modelled (red) total near-surface (top), mid-depth (middle), and near-bottom (bottom),Residual velocities at Matawhera ADCP site from July 2019 to August 2019. Note the current were rotated to be aligned with the main channel

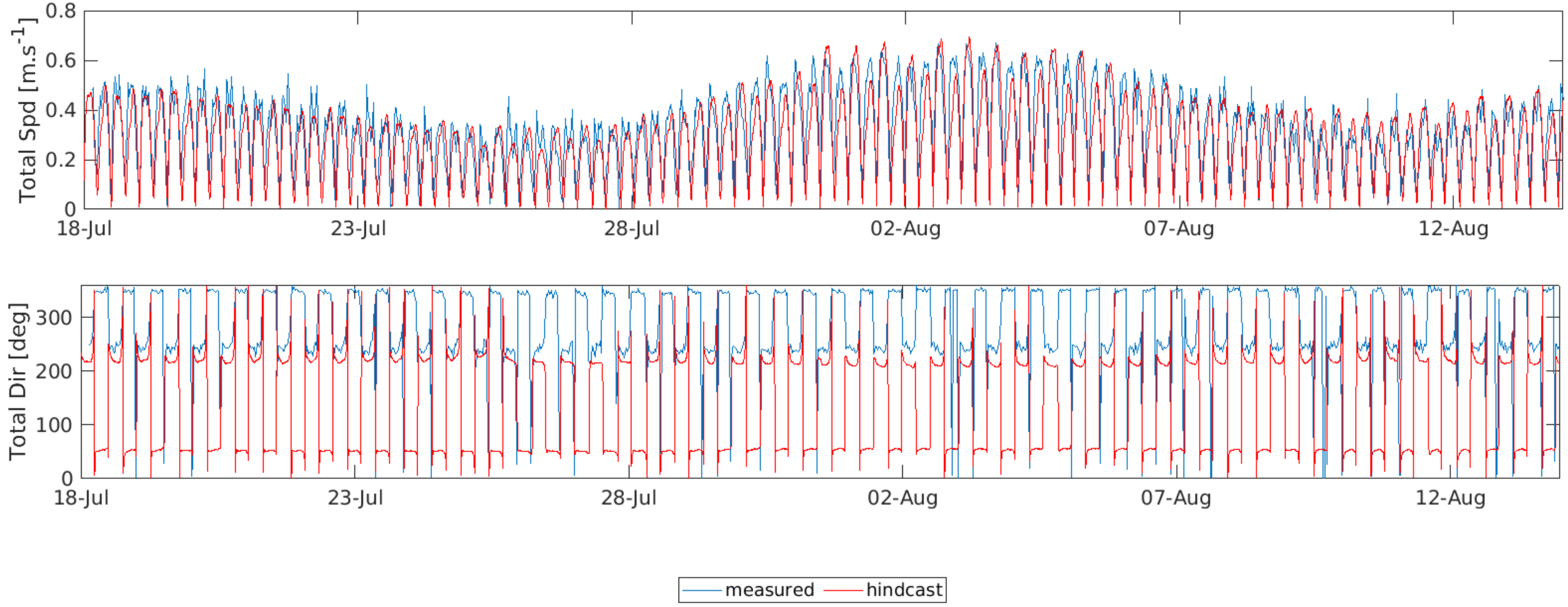


Figure 5.10 Measured (blue) and modelled (red) total mid-depth current speeds (top) and direction (bottom) at The Narrows FSI site from July 2019 to August 2019

5.1.3 Temperature and salinity

Timeseries of near-bottom temperature at all sites are presented in Figure 5.11. The temperature at the entrance of the harbour is modelled more accurately than the northern part of Hokianga Harbour.

Comparisons of mid-depth salinities are presented in Figure 5.12.

The variation and trend in temperature and salinity over the measurement period is well described by the model. Difference in the absolute temperature and salinity values are observed, however these are mostly related to the minimal information available to setup the initial conditions in the model .

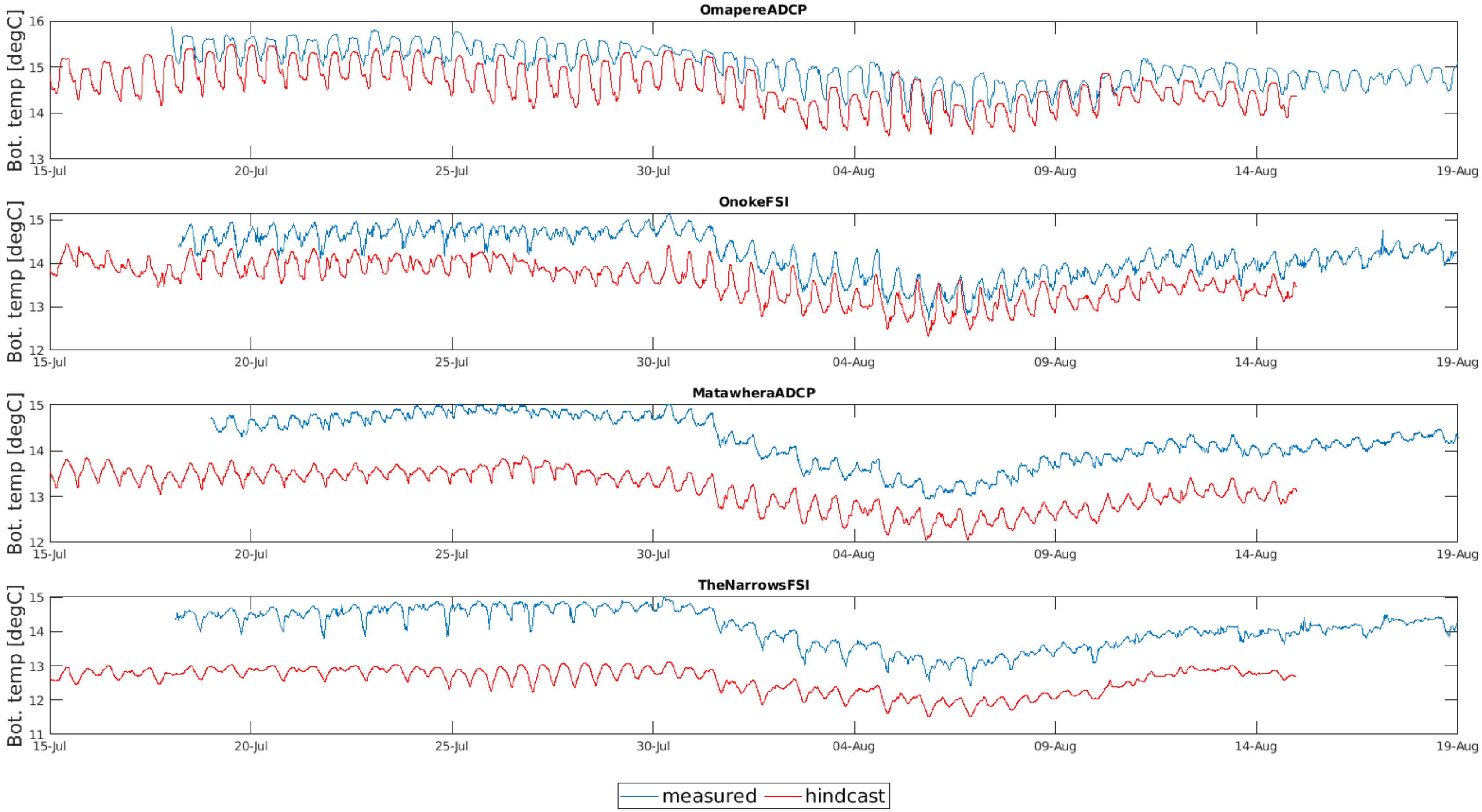


Figure 5.11 Comparison of bottom temperature measured (blue) and modelled (red) at all sites by the FSI and ADCP sensors during July 2019 to August 2019.

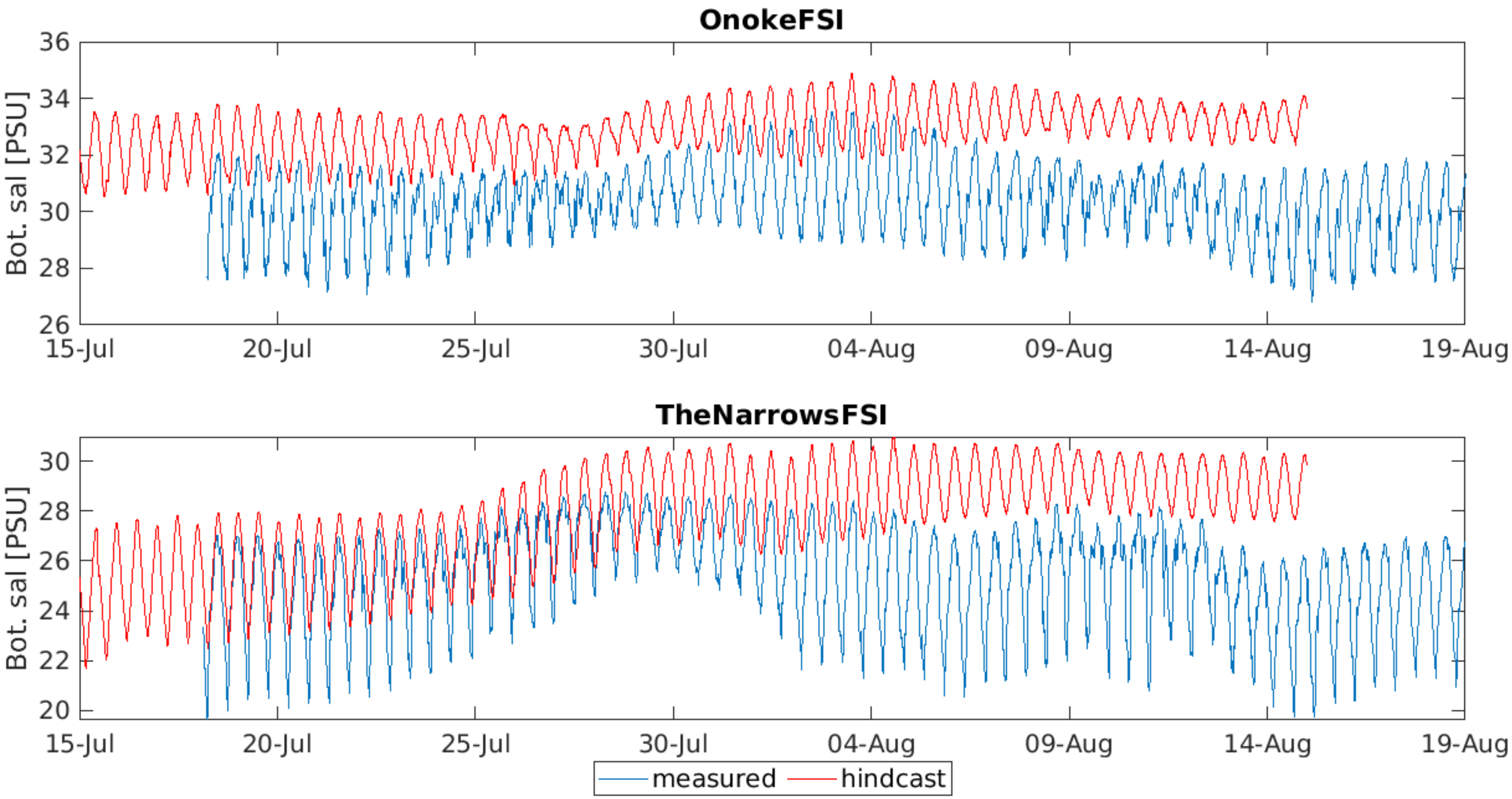


Figure 5.12 Comparison of bottom temperature measured (blue) and modelled (red) at Onoke and The Narrows sites by the FSI sensors during July 2019 to August 2019

5.2 Model results

Surface and bottom velocities in Hokianga harbour are represented in Figure 5.13 and Figure 5.14 during ebb and flood tide. The strong difference of flow between the two tides can be seen at the surface and the bottom of the Harbour.

The horizontal temperature and salinity are shown in Figure 5.15.

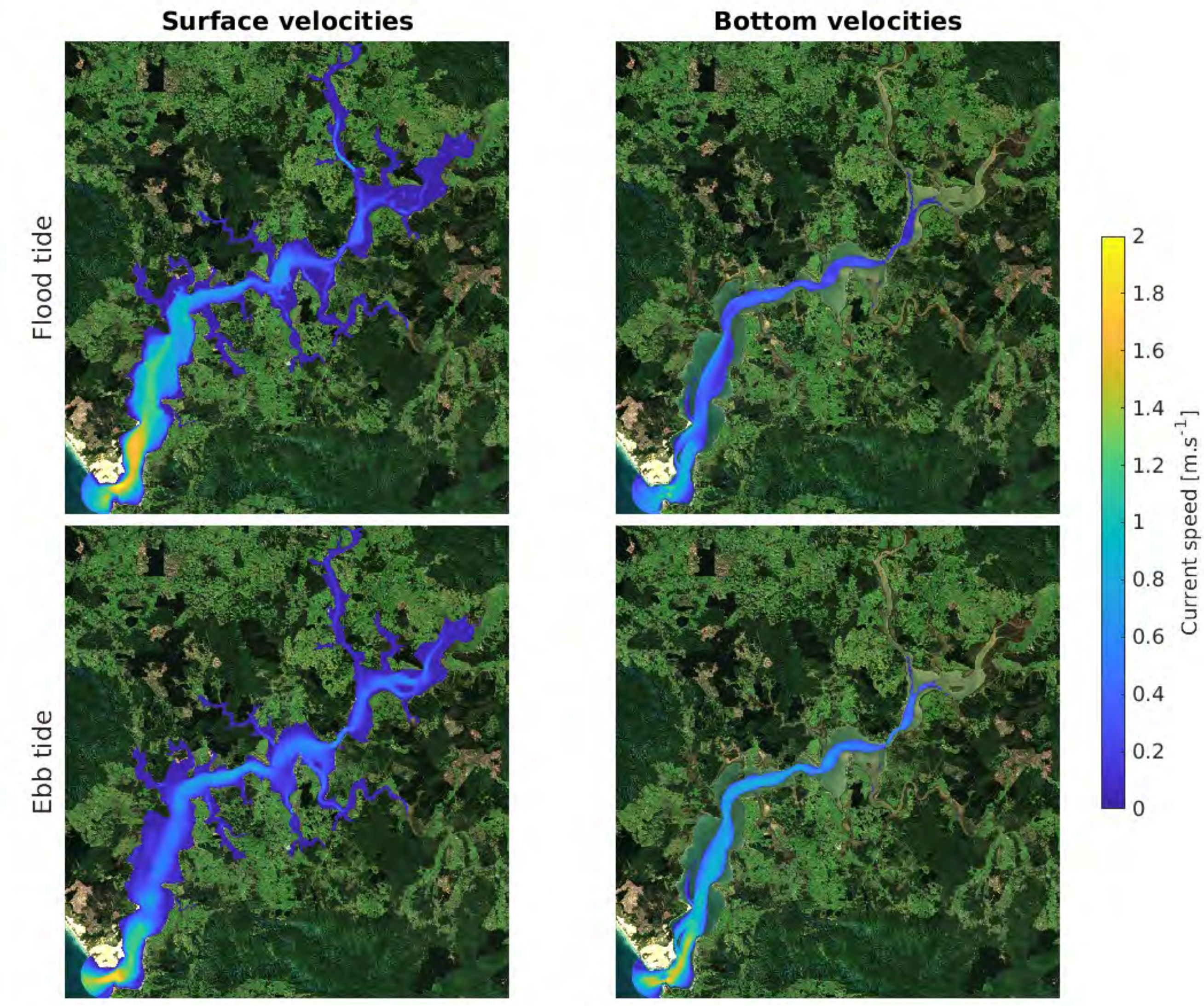


Figure 5.13 Aerial image from Hokianga harbour showing the peak surface (left) and bottom (right) velocities during the flood tide (top) and ebb tide (bottom).

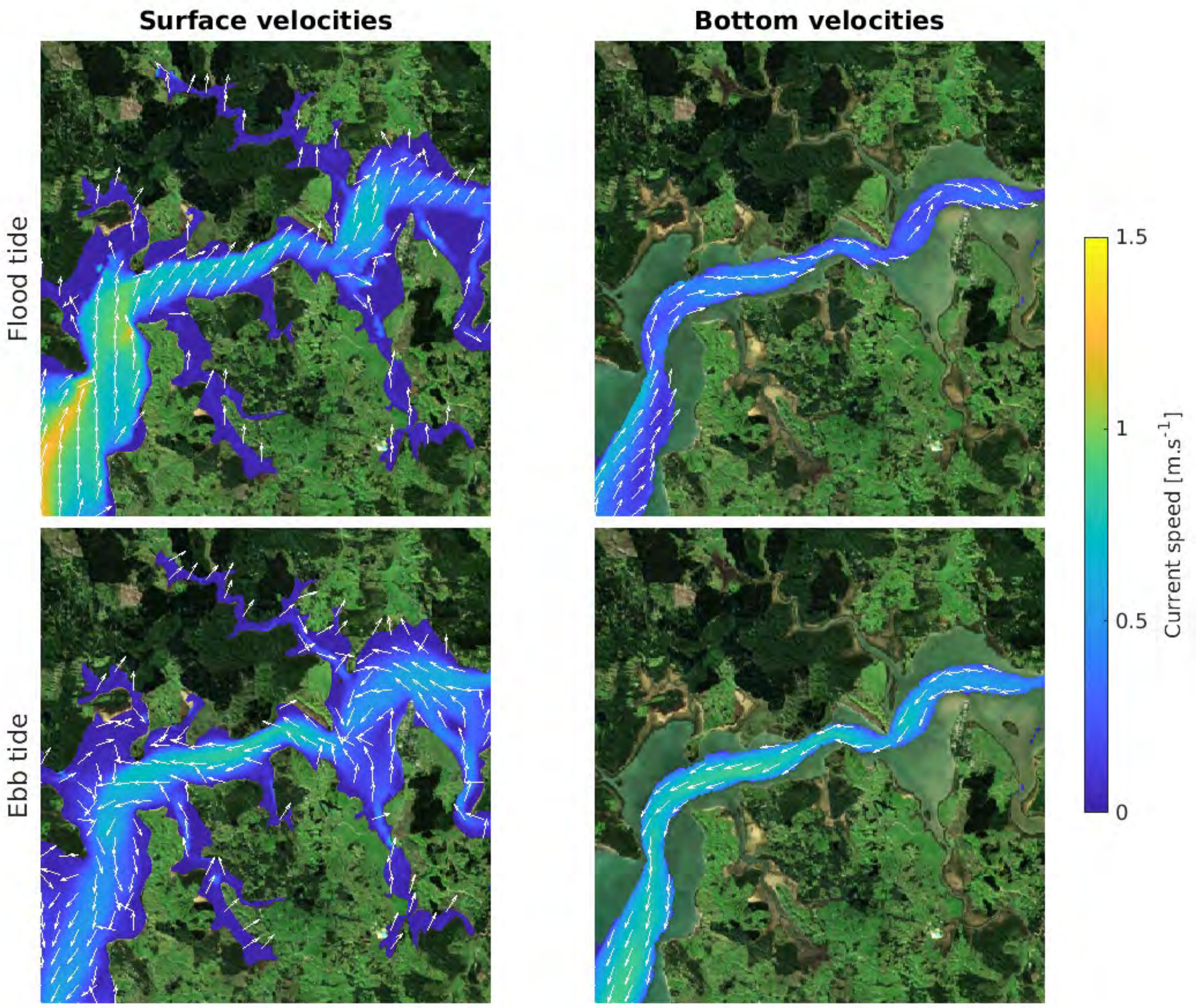


Figure 5.14 Aerial image zoom over Matawhera showing the peak surface (left) and bottom (right) velocities during the flood tide (top) and ebb tide (bottom).

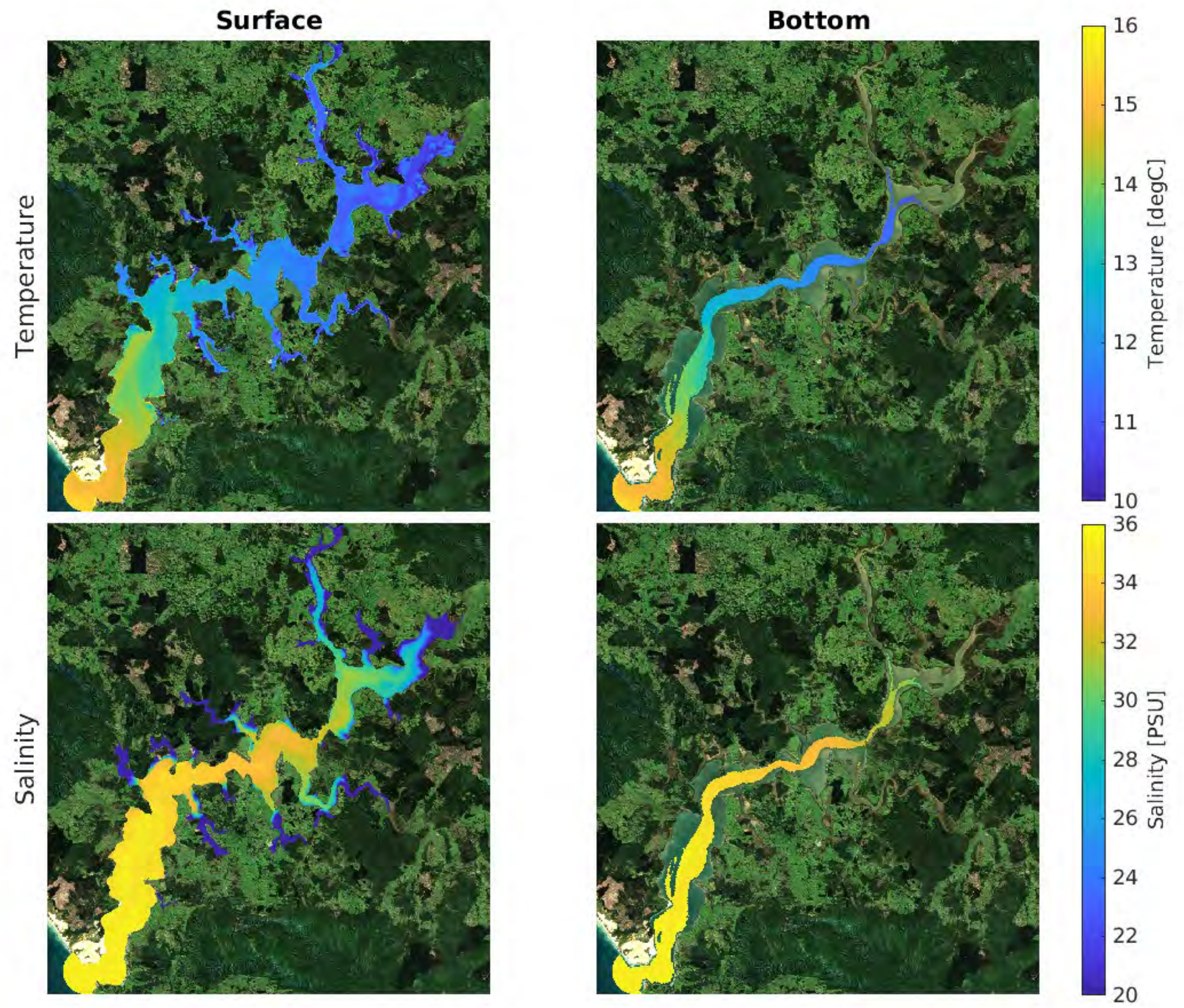


Figure 5.15 Aerial image from Hokianga harbour showing the surface (left) and bottom (right) temperature (top) and salinity (bottom) in July 2015.

5.3 WWTP Discharge Simulations

Simulations were undertaken for a full El Nino (July 2015-June 2016) and La Nina (July 2010 to June 2011) years. The WWTP discharges timeseries presented in Figure 4.14 were used together with a nominated tracer concentration of 1mg/L for each WWTP discharge. The model simulations results were processed in term of dilution factors which were determined by dividing the tracer concentration at any grid point to the discharged concentration. A dilution factor of 1:1000 therefore indicates the contaminant concentration (e.g. Ammoniacal Nitrogen, Total Suspended Solids, Biological Oxygen Demand.) at that location is 1000 times smaller than discharged at the WWTP. Specific contaminant concentration levels at environmental receptors will be determined by consultants doing the QMRA, using concentration ratios and the expected or measured discharged value.

5.3.1 50th Percentile and 95th Percentile Maps

Results are presented in Figure 5.16 to Figure 5.23, in terms of 50th and 95th percentile maps of dilution factor and tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) . The percentiles were calculated using the hourly output from the model over the full year.

The 50th percentile maps present the dilutions factors and concentration (in mg/L) expected to be exceed 50% of the time.

The 95th percentile maps present the dilution factors and concentration (in mg/L) expected to be exceeded 5% of the time (or not exceeded for 95% of the time).

The 50th and 90th percentile dispersion for each contaminant (e.g. E.coli / Faecal coliforms, Total Suspended Solids, Biological Oxygen Demand, Total Ammoniacal Nitrogen) can be visually estimated by multiplying the concentration seen on the maps by the expected concentration to be discharged or the Consent limit. However, it should be noted that the contaminants estimate may be conservative as no decay was considered for the passive tracer used in the simulations.

The results show dilution factors for the combination of all the four discharges together, which illustrate the potential cumulative effects of all discharges (Note: They assume that the same tracer concentration is being released simultaneously at each WWTP). The 50th and 95th percentile maps of dilution factor and tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) for the four WWTP combined are presented in Figure 5.24 and Figure 5.25.

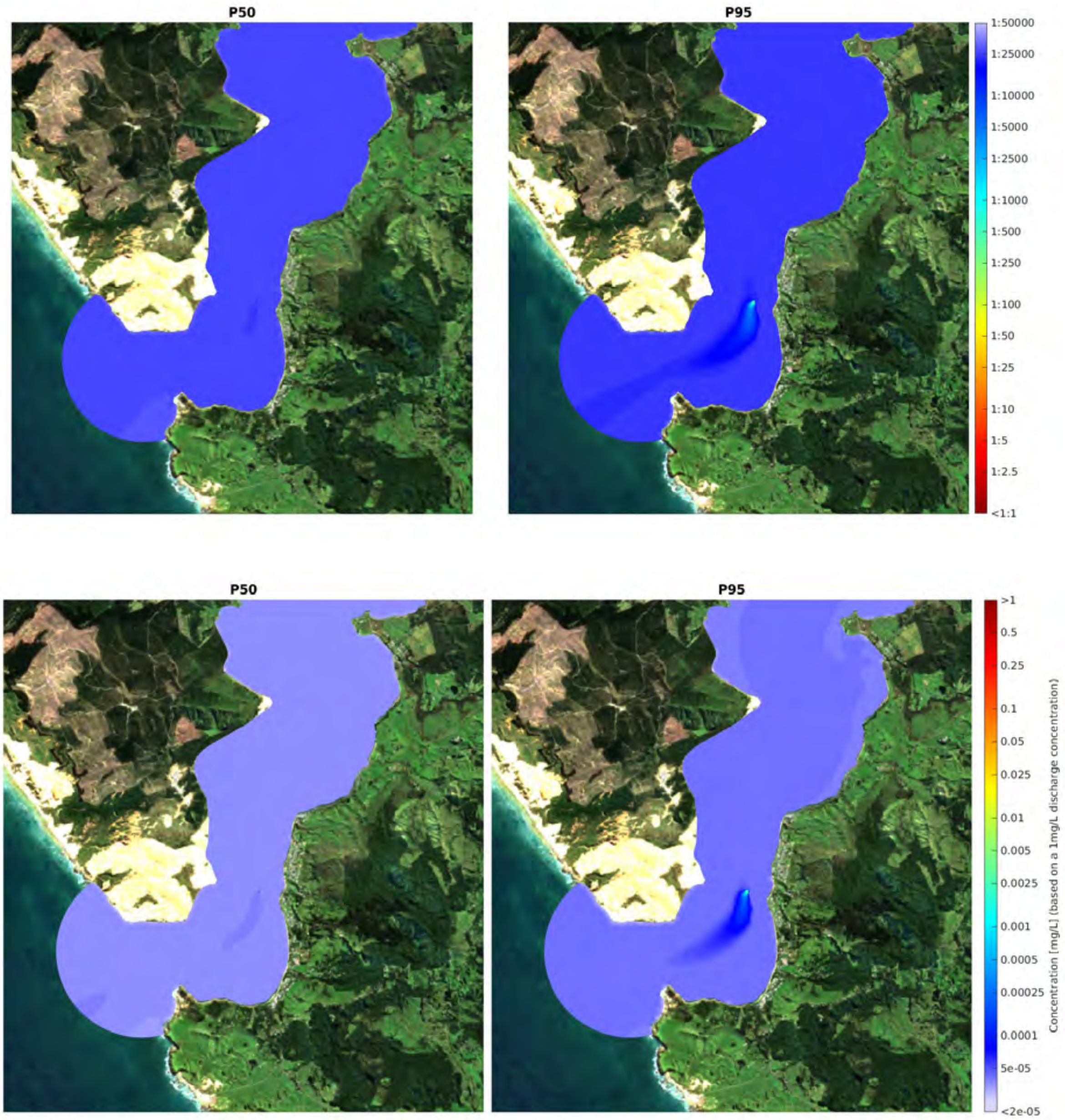


Figure 5.16 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Opononi WWTP during El Nino year

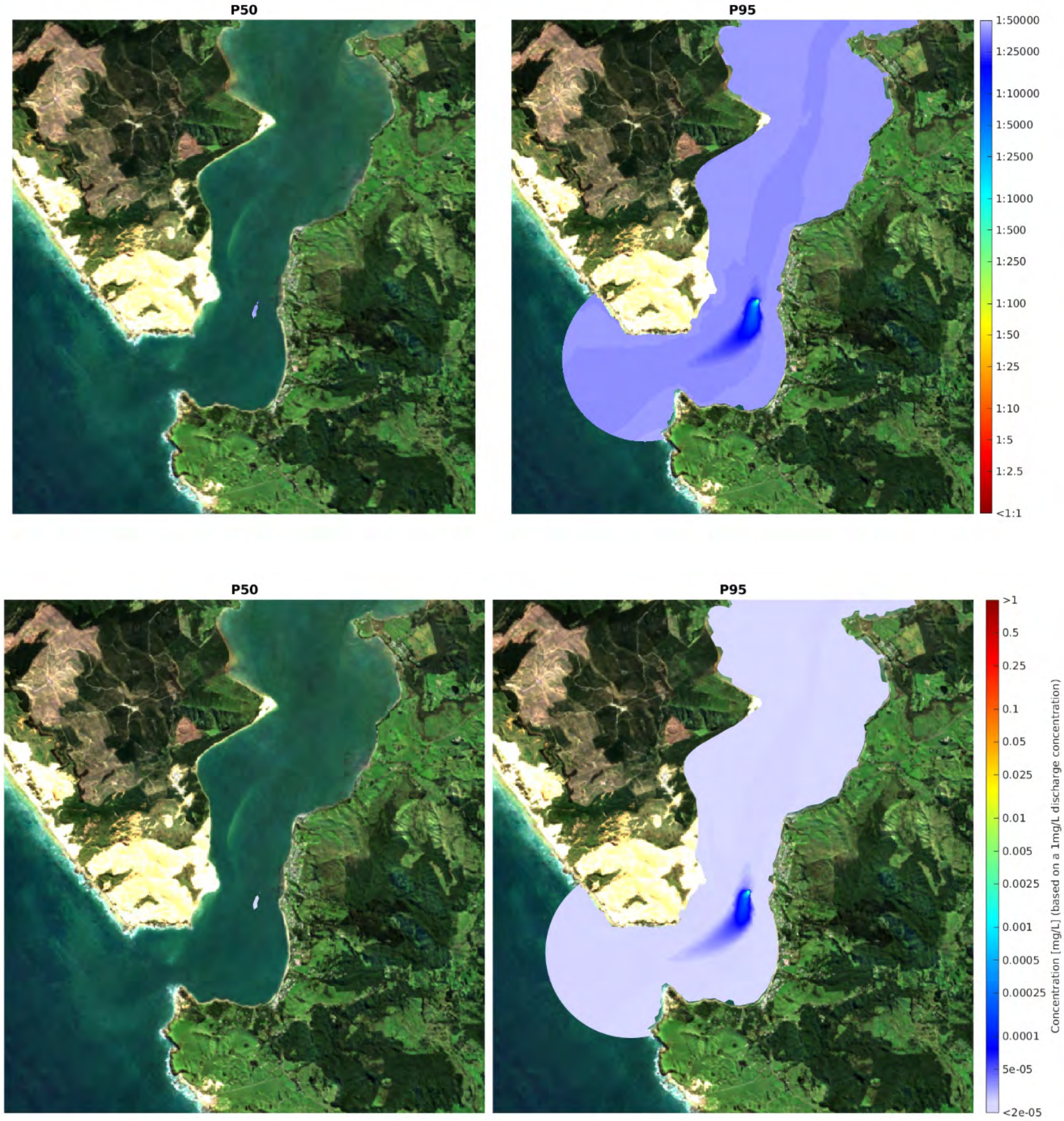


Figure 5.17 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Opononi WWTP during La Nina year.

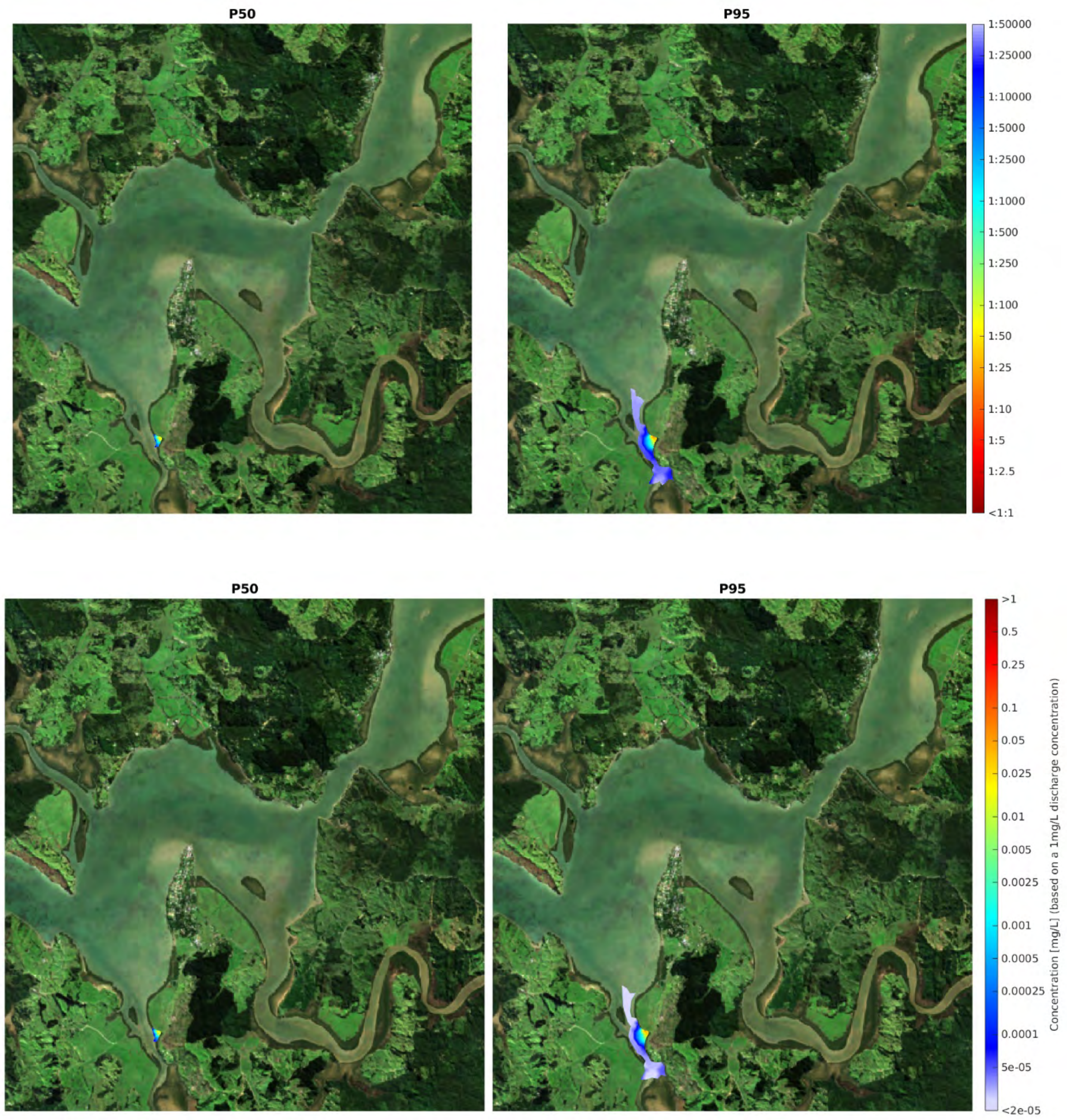


Figure 5.18 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Rawene WWTP during El Nino year.

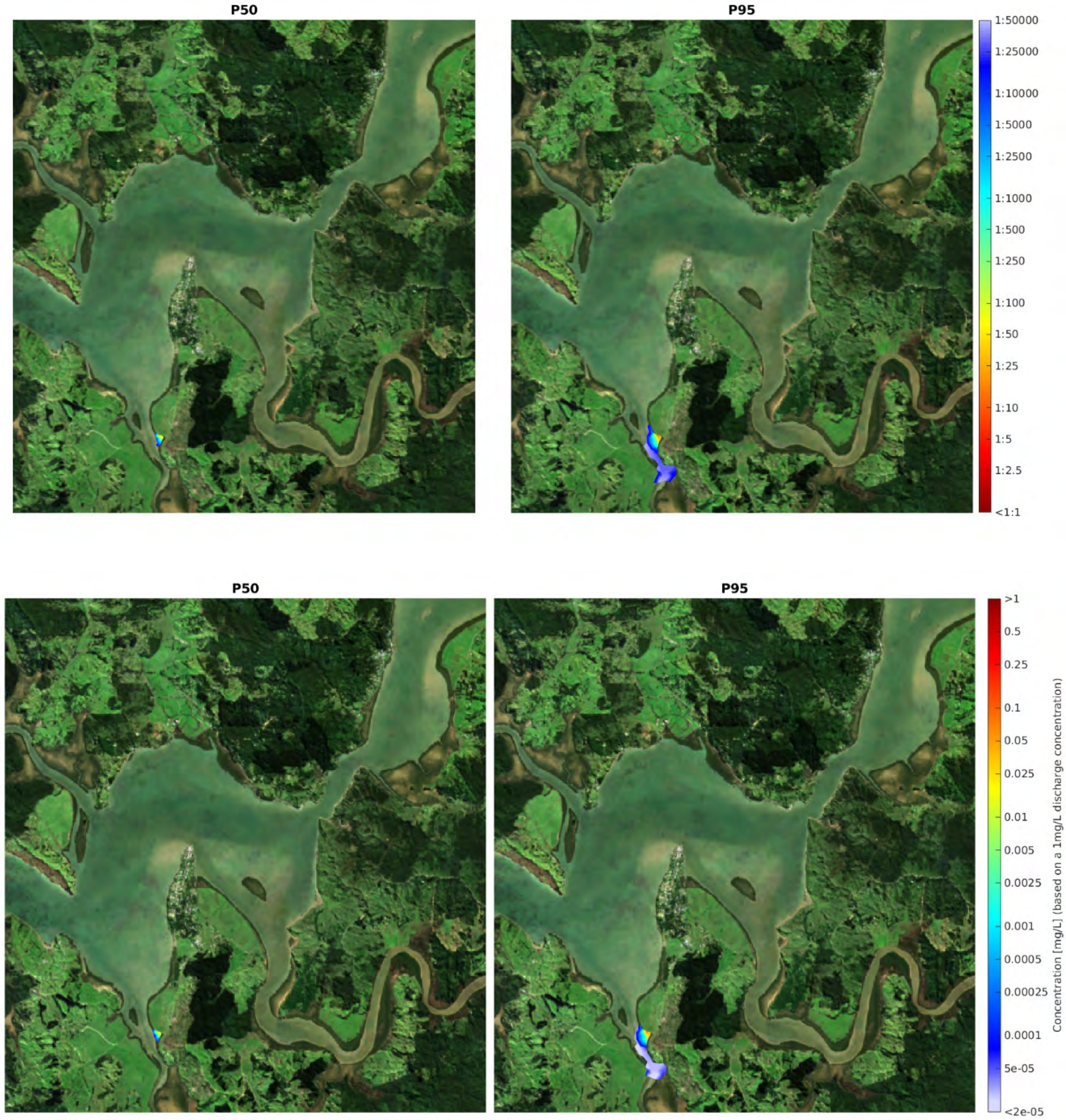


Figure 5.19 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Rawene WWTP during La Nina year.

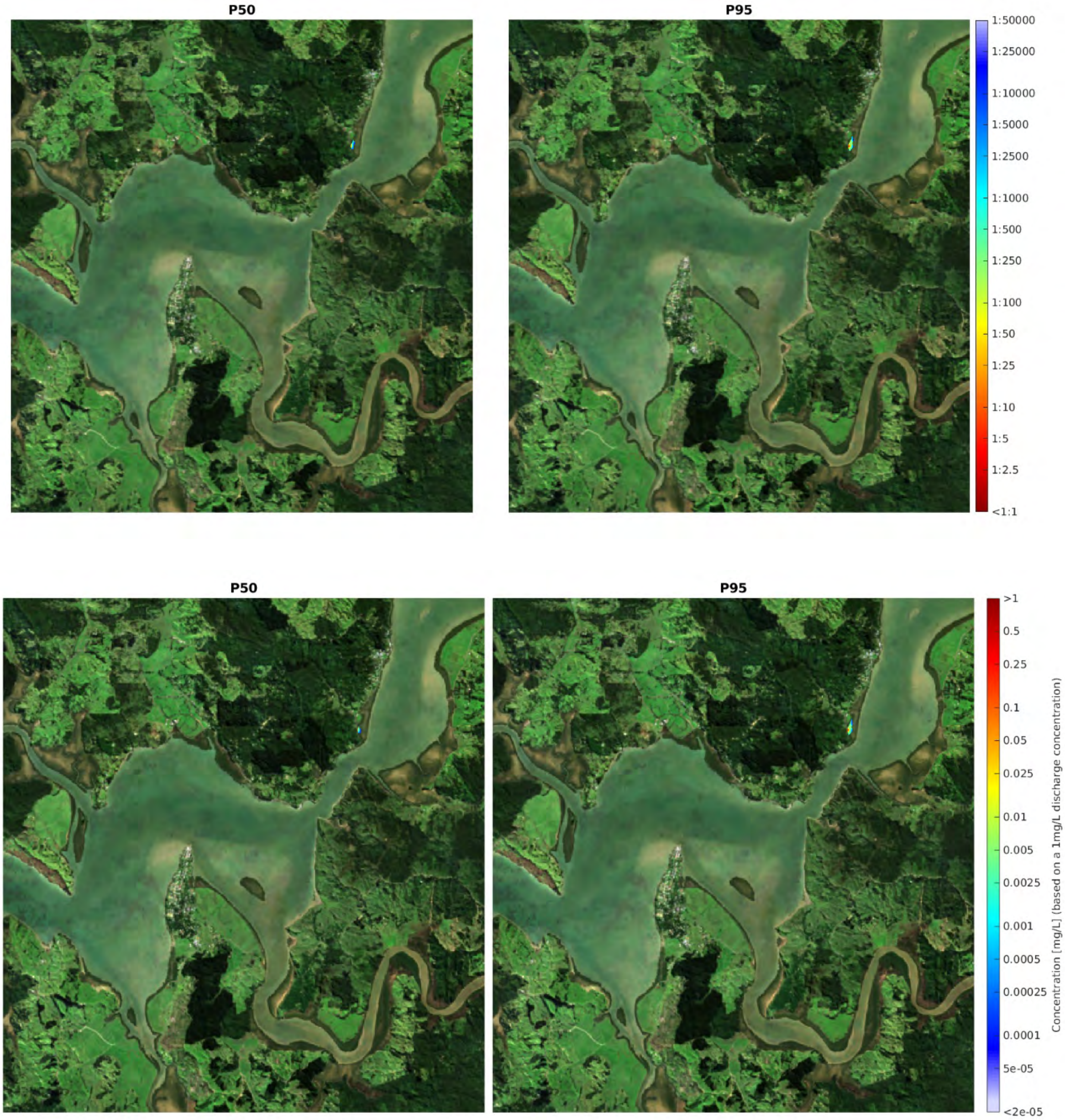
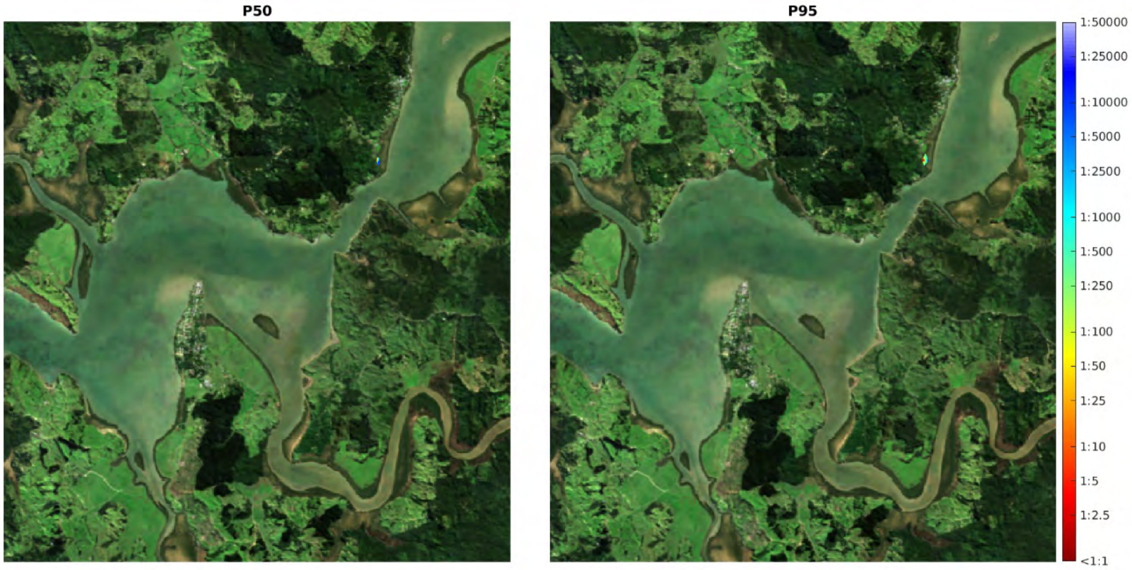


Figure 5.20 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Kohukohu WWTP during El Nino year.



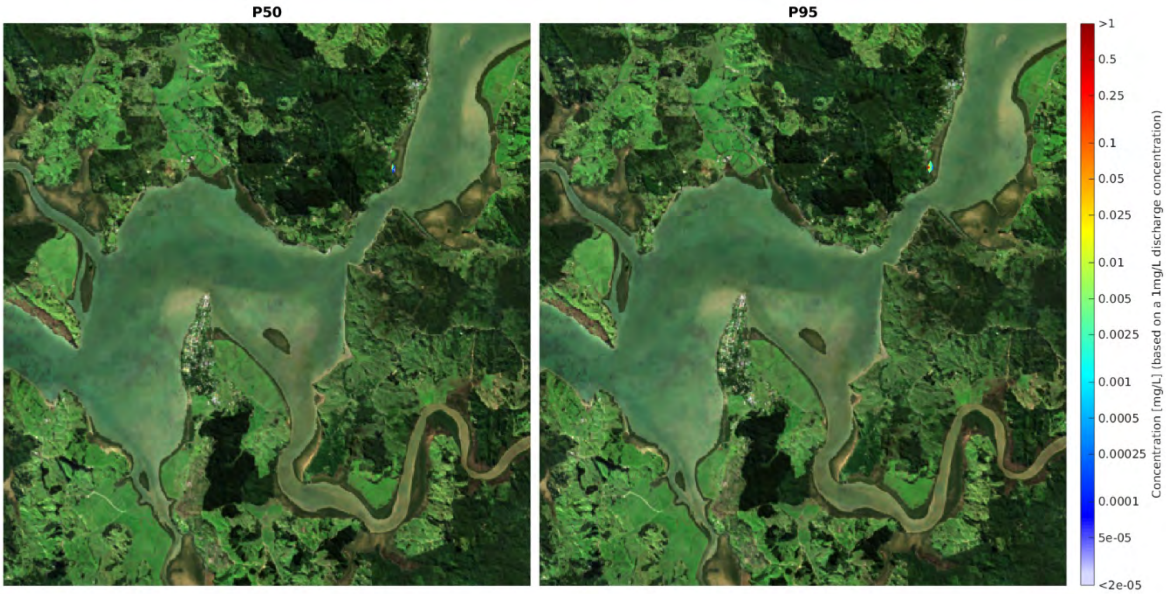


Figure 5.21 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Kohukohu WWTP during La Nina year.

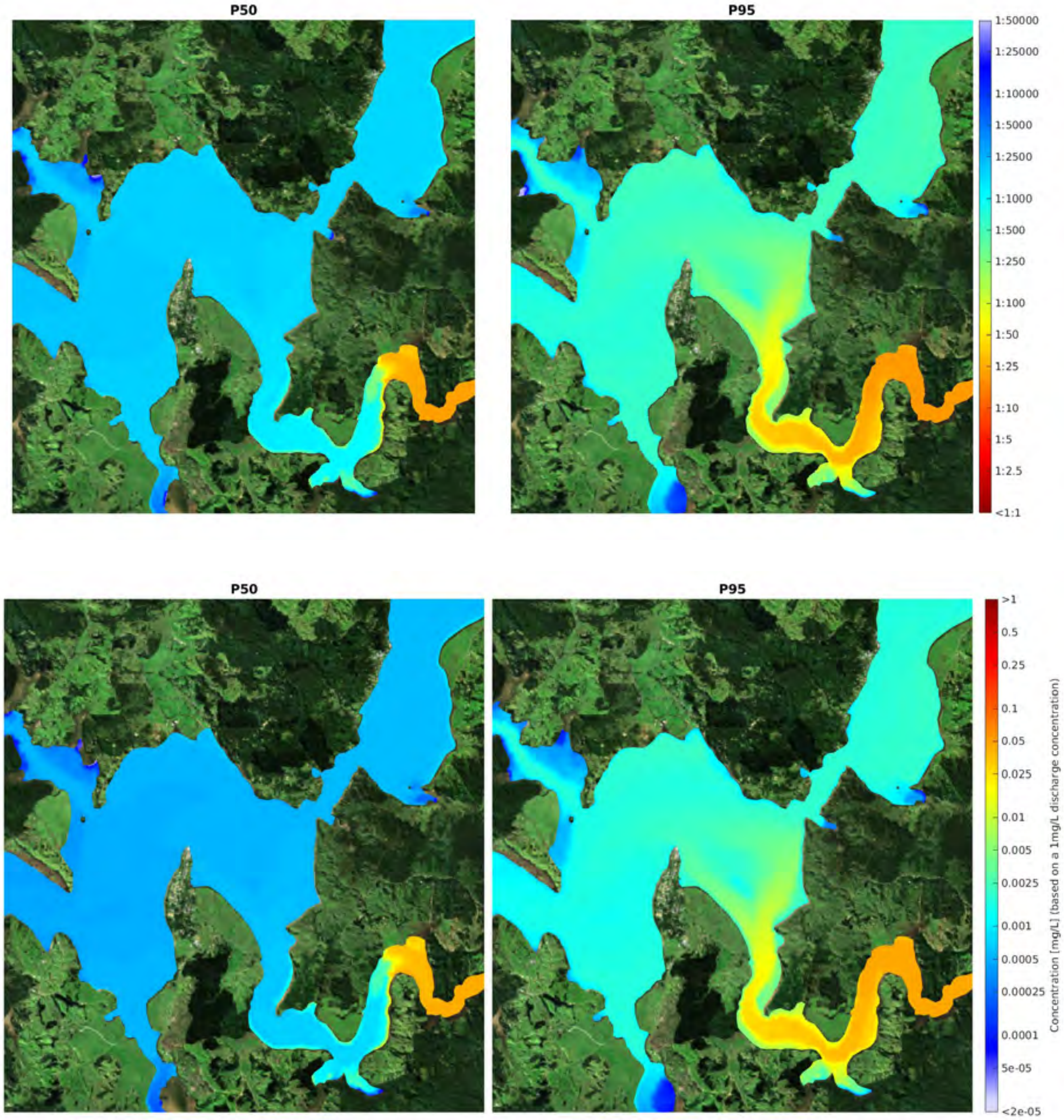


Figure 5.22 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Kaikohe WWTP during El Nino year.

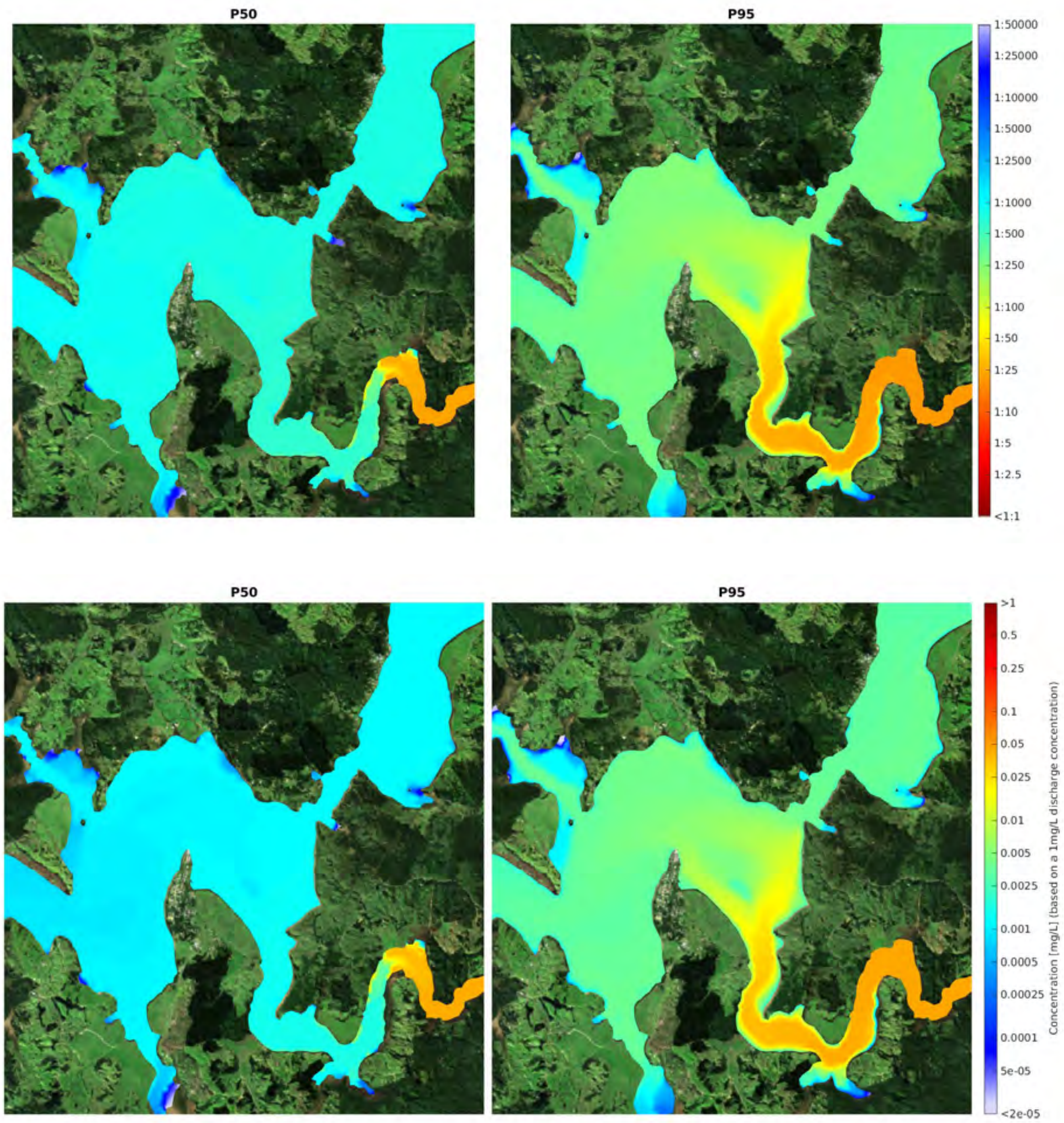


Figure 5.23 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for Kaikohe WWTP during La Nina year.

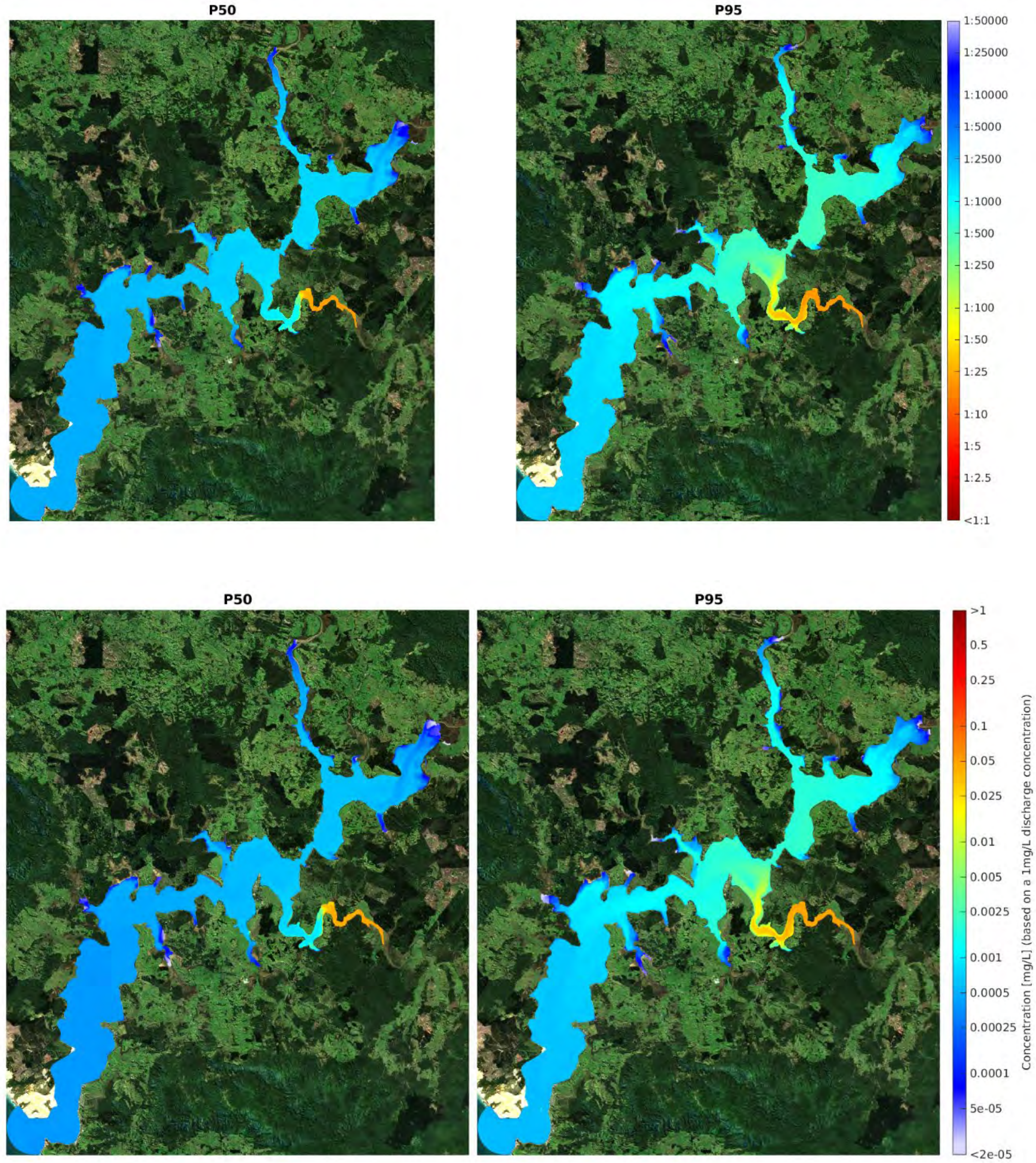


Figure 5.24 50th Percentile and 95th Percentile Dilution factor (top) and tracer concentration in mg/L (bottom) for the four WWTPs combined during El Nino year.

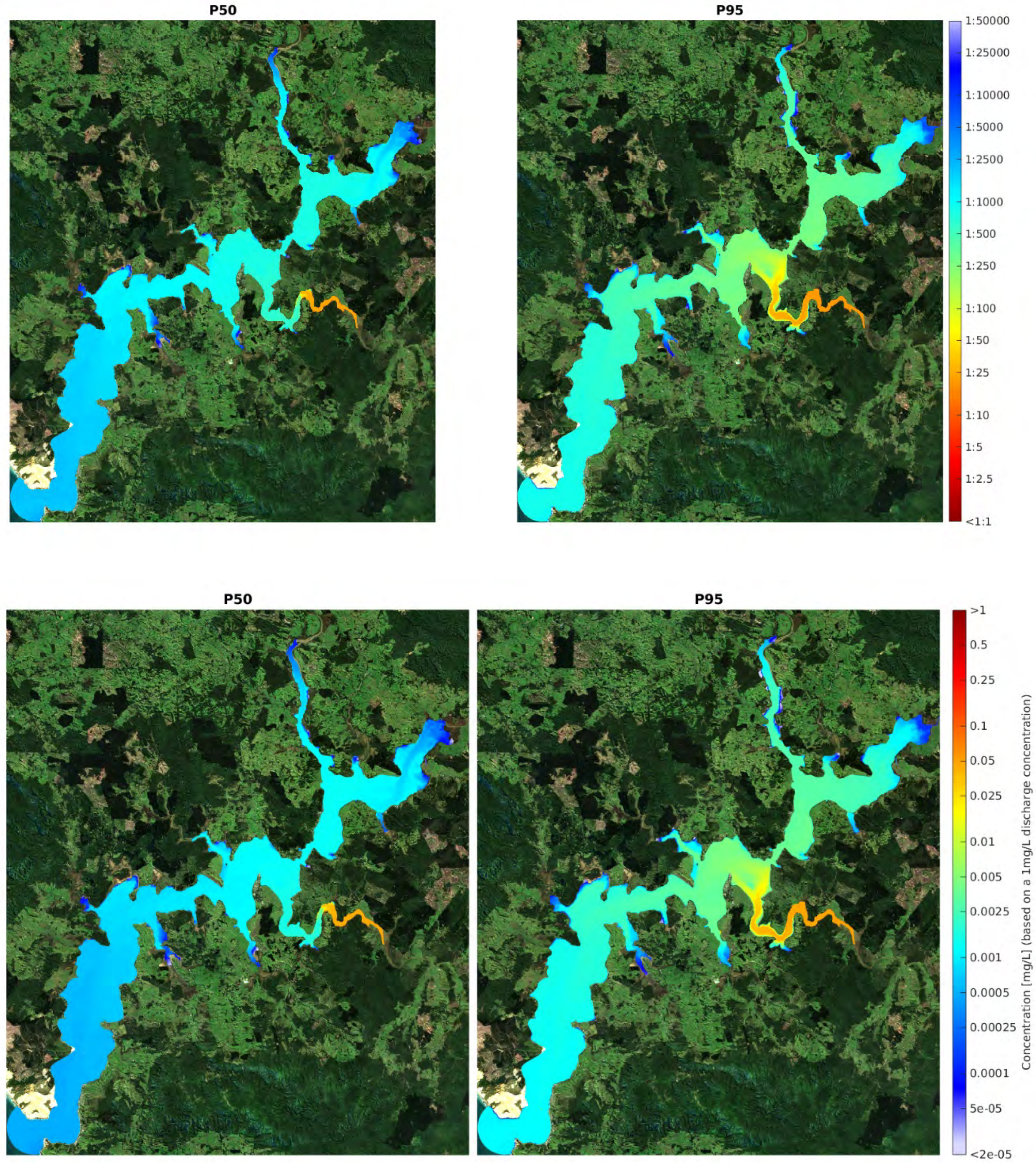


Figure 5.25 50th Percentile and 95th Percentile Dilution factor (top and tracer concentration in mg/L (bottom) for the four WWTPs combined during La Nina year.

5.3.2 Time Series of dilution

Time-series of tracer concentrations were extracted at selected locations (see Figure 5.26) within Hokianga Harbour. Figure 5.27 to Figure 5.31 presents the time-series tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location P1, P2, P3, CR1 and CR4. Locations near Opononi have been selected following communications with Streamlined Ltd (who is currently undertaking the QMRA for Opononi WWTP) and the timeseries data was provided to them for the assessment.

The concentration for each contaminant (e.g. E.coli / Faecal coliforms, Total Suspended Solids, Biological Oxygen Demand, Total Ammoniacal Nitrogen) can be estimated by multiplying the timeseries concentration by the expected concentration to be discharged or the Consent limit. However, it should be noted that the contaminants estimate may be conservative as no decay was considered for the passive tracer used in the simulations.

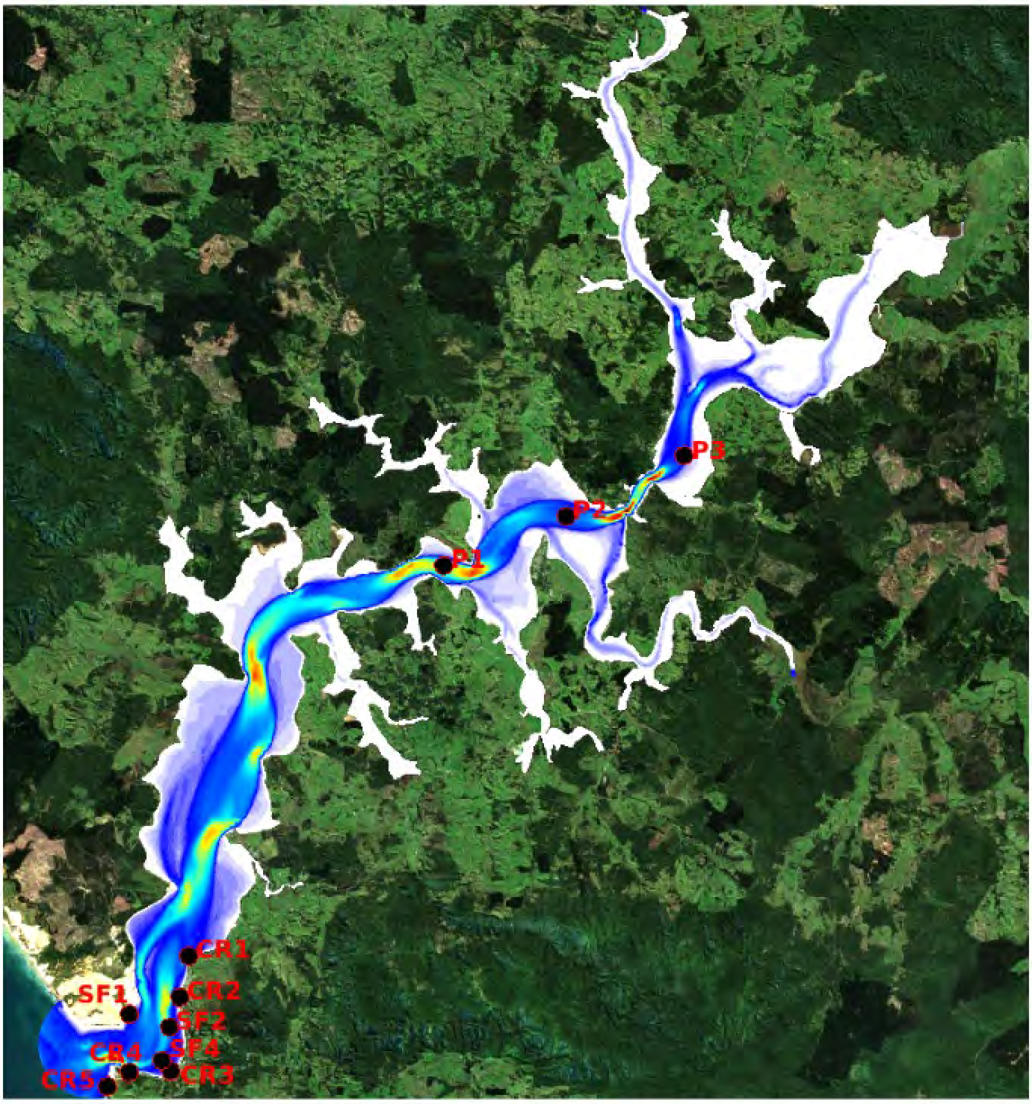


Figure 5.26 Location for tracer concentration timeseries extraction and analysis

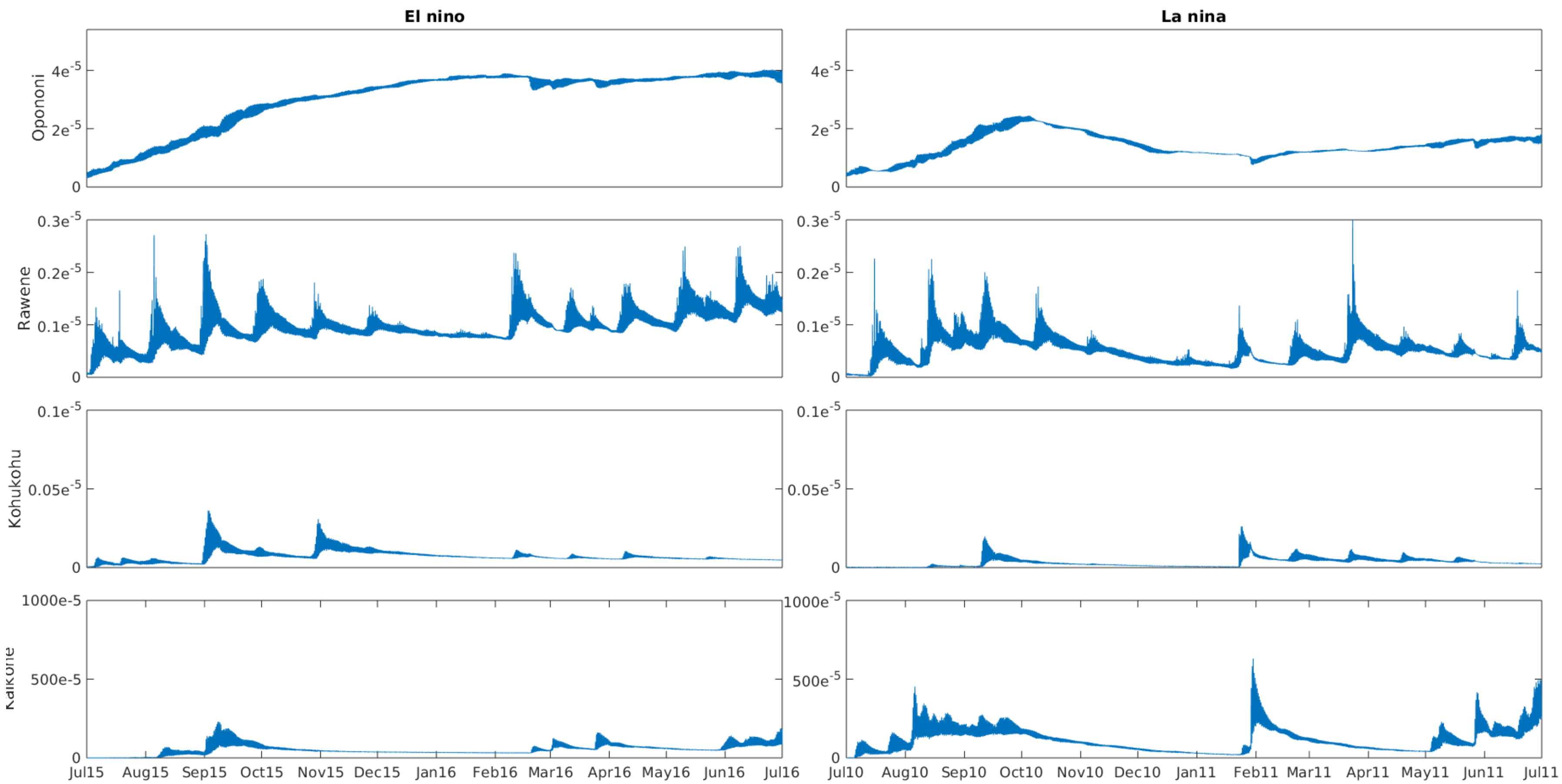


Figure 5.27 Timeseries of tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location P1 for each WWTP discharge for the El Nino and La Nina year simulations.

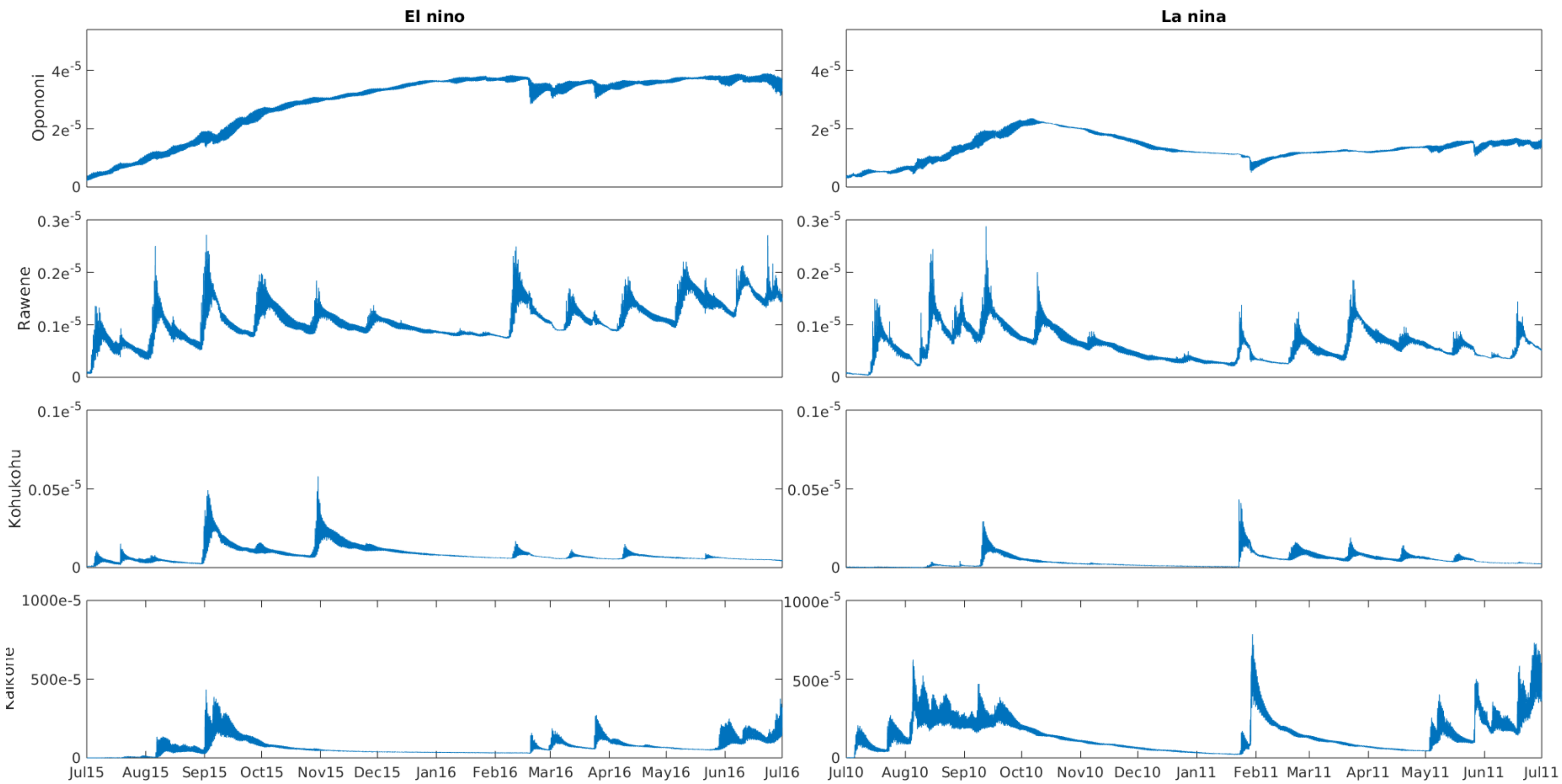


Figure 5.28 Timeseries of tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location P2 for each WWTP discharge for the El Nino and La Nina year simulations.

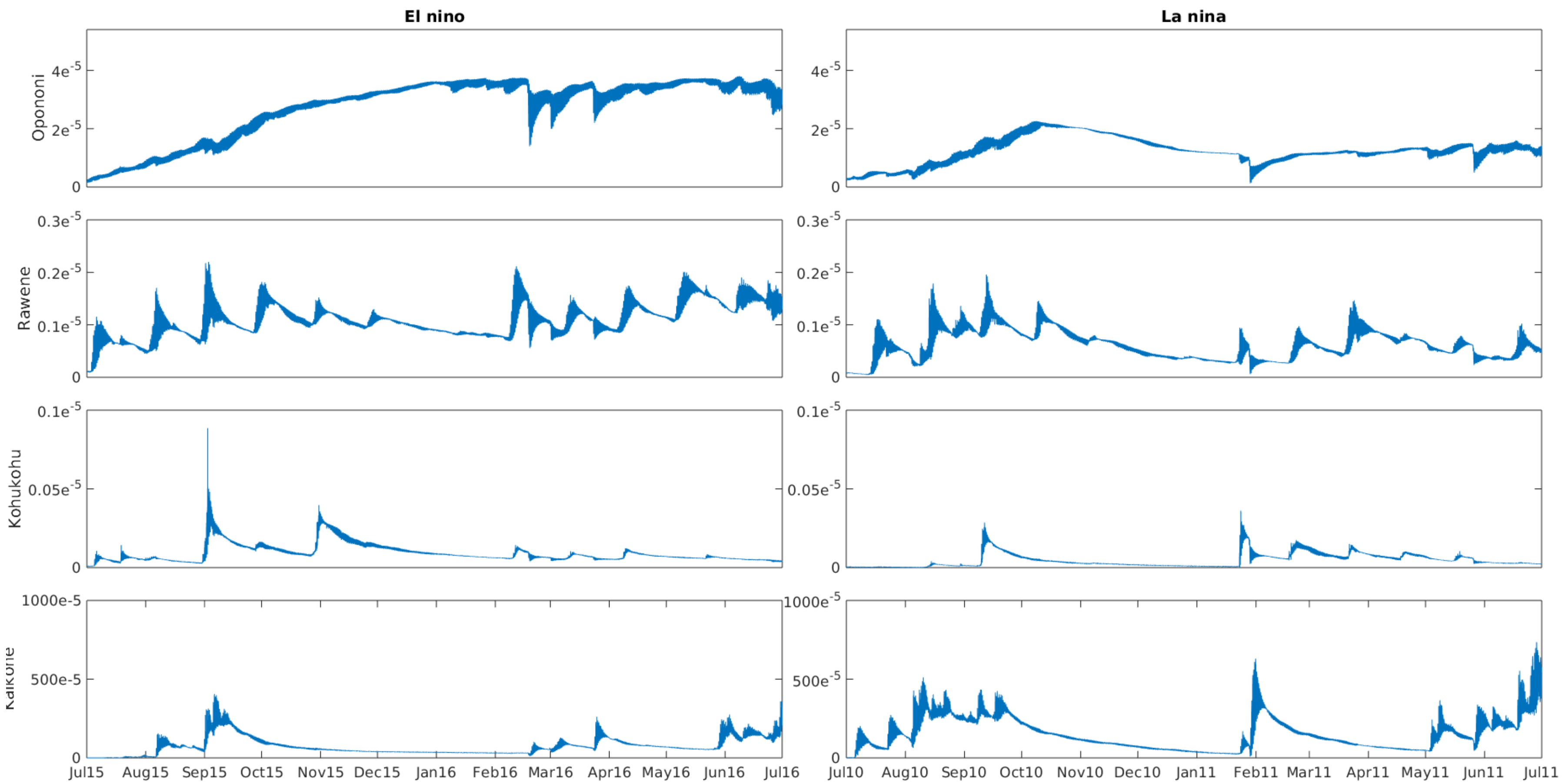


Figure 5.29 Timeseries of tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location P3 for each WWTP discharge for the El Nino and La Nina year simulations.

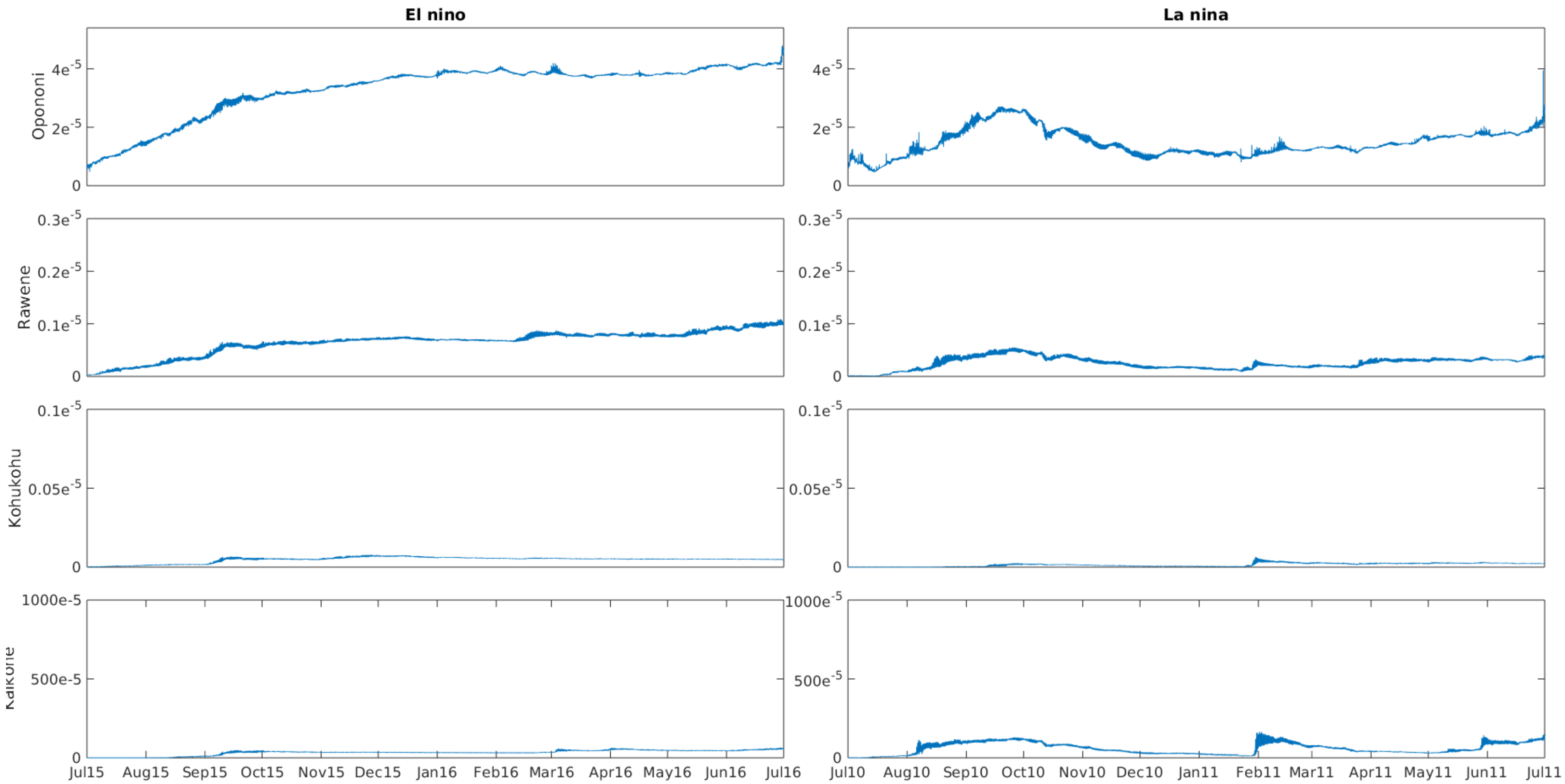


Figure 5.30 Timeseries of tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location CR1 for each WWTP discharge for the El Nino and La Nina year simulations.

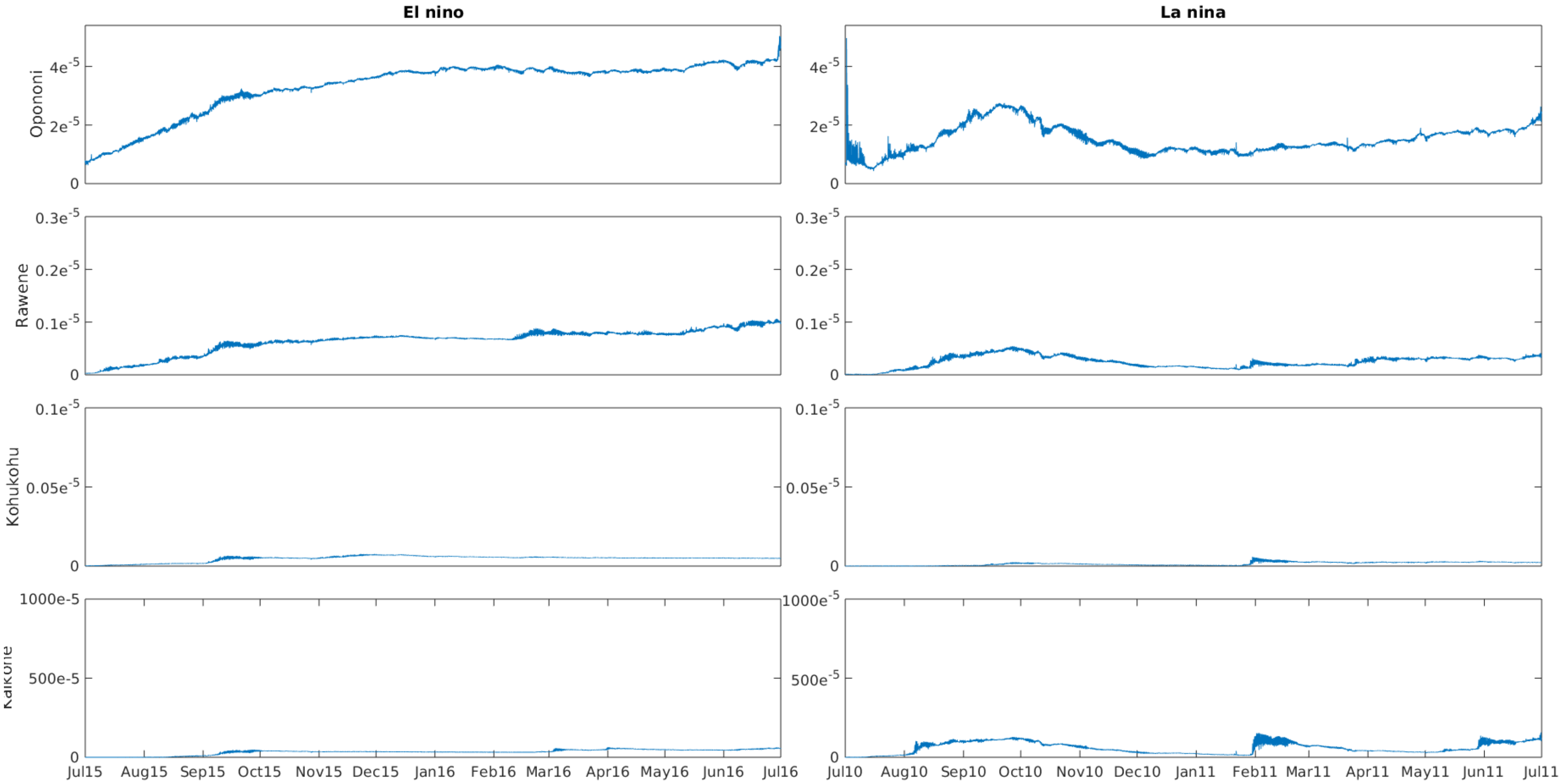


Figure 5.31 Timeseries of tracer concentration in mg/L (based on a 1mg/L concentration at the discharge point) at location CR4 for each WWTP discharge for the El Nino and La Nina year simulations.

5.3.3 Discussion

Opononi WWTP :

The modelled discharge at the Opononi WWTP typically varied from approximately 100 m^3/day to the proposed limit of 450 m^3/day . Results show that the dilution factor is about 1 in 25,000 near the discharge for the 50th percentile and about 1 in 1000 for the 95th percentile for both El Nino and La Nina. The plume followed the tidal currents and mostly extended toward the entrance of the harbour with a dilution of 1 in 5,000 at about 750m for El Nino and 500m for La Nina. Near the shoreline the dilution is about 1 in 25,000 or more.

Rawene WWTP :

The modelled discharge at the Opononi WWTP typically varied from approximately 50 m^3/day to the proposed limit of 254 m^3/day. Results show that the plume is mostly contained within the Omanaia River and dilution factor at about 100 m from the discharge is about 1 in 5,000 near for the 50th percentile (El Nino and La Nina) and about 1 in 500 for the 95th percentile and 1 in 1000 for the 95th percentile. The plume mostly extended north and south, with a 95th percentile dilution of 1 in 50,000 at about 1000 m (El Nino) and 300 m (La Nina) towards the north and about 700 m towards the south for both El Nino and La Nina.

Kohukohu WWTP :

The modelled discharge at the Kohukohu WWTP typically varied from approximately 2 m^3/day to the proposed limit of 40 m^3/day . Results show that the plume is mostly confined to the vicinity of the discharge location with a dilution factor of 1 in 50,000 at approx. 50 m and 100 m for the 50th percentile and 95th percentile respectively.

Kaikohe WWTP :

The modelled discharge at the Kaikohe WWTP typically varied from approximately 500 m^3/day to the proposed limit of 1710 m^3/day. As discussed previously more than 30 km upstream of the Waima River connection to Hokianga Harbour. The WWTP contaminant concentration gets diluted as it flows from Kaikohe to the harbour due to the little tributaries joining along the stream.

Results show that the 50th percentile dilution factor is about 1 in 25 up to 1000 m upstream of the Motukiore Road within the Waima River. Dilution then increase to about 1 in 2500 as it reaches the harbour near Rawene.

Dilution factor for the 95th percentile is about1 in 25 as far as the ‘Y’ junction where the Waima River connect to the harbour. Near Rawene the dilution is about 1 in 100.

Results are similar for both El Nino and La Nina with a slight increase in dilution during El Nino.

6. Conclusions

A hydrodynamic modelling study was undertaken to investigate dispersion of four WWTP discharge waters into Hokianga Harbour.

A field measurement campaign was first undertaken by Cawthron Institute and provided the necessary field data for calibration and validation of the hydrodynamic model. Water level and current were measured at four locations within Hokianga Harbour, Omapere, Matawhera, Onoke and The Narrows.

The open-source SCHISM system was setup and used to run high-resolution hydrodynamics and tracer dispersion simulations of the Opononi, Rawene, Kohukohu and Kaikohe WWTP discharge.

Comparisons between the model and measured water elevations show that the model captures the propagation of the tidal wave within the model domain well, including the phasing and amplitudes at various points. Principal model and measured tidal constituents show good agreement.

The shift of the FSI during the deployment period restricted the suitable methods that could be used to separate the total measured velocity into tidal and residual components.

Comparison of the total velocity indicates that the model generally reproduces well the phase and amplitude of tidal flows within the harbour. The stronger ebb tide compared to the flood tide can be seen in the model results.

Comparing the residual component of the velocity shows deviations between the model and in-situ measurements; most of the episodes are correctly reproduced. Interestingly, the model tends to reproduce the direction of change (i.e. velocity increase or decrease) but not always the velocity magnitude.

Overall, the comparisons indicate that the model reproduces the measured velocities, water elevations and salinity to a reasonable degree. In particular, the model appears to robustly reproduce the tidal dynamics in the study region, which makes it fit for the present purpose of producing waste-water studies inside the harbour.

Tracer dispersion simulations were undertaken for a full El Nino and La Nina year. The model simulation results were processed in terms of dilution factors which were determined by dividing the tracer concentration at any grid point to the discharged concentration. Results were presented in terms of the 50th and 95th percentile concentration and dilution factors which consists of a statistical representation of the plume extent.

Timeseries of concentration levels were extracted at selected location within the harbour and provided to consultants undertaking the QMRA.

Results shows that each WWTP discharges present very different plume extents due to their location within the harbour and the actual discharge volumes. Some of the key features for each discharge are:

- The Opononi WWTP discharge presents an elongated plume stretching toward the entrance of Hokianga harbour. Dilution factors for the 50th percentile are as high as 1 in 5000 within 100 m of the discharge.
- The Rawene WWTP discharge plume is mostly contained within the Omanaia River and dilution factors for the 50th percentile are about 1 in 5000 at 100 m from the discharge location
- The Kohukohu WWTP discharge plume is mostly confined to the vicinity of the discharge location with a dilution factor of 1 in 50,000 at approx. 50 m for the 50th percentile.
- The Kaikohe WWTP discharge plume present dilution factors of 1 in 25 within the Waima River as far as downstream as the last bend before Motukiore Road. Dilution is about 1 in 1000 to 1 in 2500 within the harbour.

7.References

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Appendix A: Sub-bottom Profile Survey, Rawene, Hokianga Harbour (Scantec Ltd)

Technical Report

Sub-bottom Profile Survey, Rawene, Hokianga Harbour

Project:	**MS971**
Client:	**MetOcean Solutions / Far North District Council**
Location:	**Rawene, Hokianga Harbour**
Date:	**Aug-Dec 2019**
Technical Staff:	**Matt Watson Don Molloy Kirsty Hamlin**
Release Date:	**20-12-19**

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1.0 Introduction

ScanTec Ltd was requested by MetOcean Solutions to carry out a sub-bottom profile (SBP) survey covering a predefined area of the Hokianga Harbour near Rawene.

The work was carried out on the vessel Sidescan1, and included 3.5kHz, 7kHz SBP measurements and also 200kHz bathymetric sonar.

The coverage area for the survey is shown as Figure 1 (see attached A3 figure sheets).

Site work was carried out during 3 shifts in August and November 2019. Weather conditions were fine, with low wind strength.

2.0 Survey methodology

2.1 Bathymetric Survey

A Knudsen 320M 200kHz single beam echosounder was used to collect bathymetric data, which needs to be collected as part of the SBP dataset to assist in data processing. Sonar equipment was linked to a RTK GPS positional system and TSS DMS-05 dynamic motion sensor.

Data was processed in custom software and bathymetric data generated in SURFER. Digital data is presented as XYZ dat, GRD, and CAD compatible DXF files.

2.2 Sub-Bottom Profiling (SBP)

A Raytheon PTR-106 Sub bottom profiler system and 24bit ADC controller were used for SBP data acquisition. The 3.5KHz and 7kHz transducer was mounted off the side of the vessel. Measurements were synchronized with the Trimble/ Omnistar DGPS data and were recorded at a boat speed of between 1.5knot (confined areas) and 2.5knots. Multiple runs were recorded over some lines using different acquisition settings to obtain optimum results.

The PTR-106 is a high resolution seismic (acoustic) system that transmits a high power (2kW+) 3.5kHz to 7kHz frequency pulse stream into the water which has sufficient energy to penetrate deep into sand and sediment. The sonar equipment is connected to a USB ADC converter to digitise the data in high resolution and store as seismic SEG-Y format.

Data processing

All measurements were processed using processing software, REFLEX-W seismic processing software, RADAN 6.5 and SURFER v13. Data processing involved;

- converting from SEG-Y to SEG2 and DZT format
- high and low pass frequency filtering
- linear gain ramp
- horizontal background removal
- predictive deconvolution

Positional and height datum

Positional and bathymetric data (seabed elevation) are presented in NZTM and NZVD 2016

3.0 Results

3.1 Bathymetric Survey

Results of the Bathymetric survey are shown as figures 1 to 4.

Figure 2	Bathymetry 200kHz
Figure 3	Bathymetry with aerial photo
Figure 4	Bathymetry – 3D projection

3.2 Sub Bottom Profile (SBP) data

The SBP data is presented as the following figures;

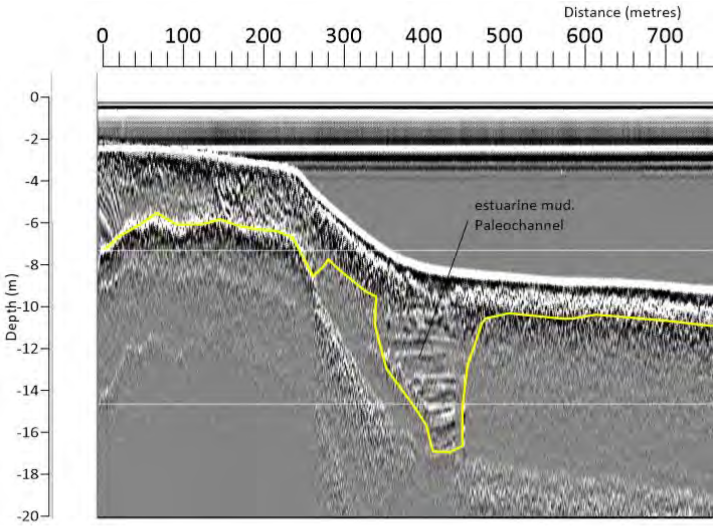
The site geology (GNS QMAP, Kaitaia) indicates alluvial mud deposits overlying moderately indurated mudstone / sandstone (bedrock) of the Mangakahia Complex, which is part of the Northland Allochthon.

The indurated mudstone / sandstone generally provides a strong reflection for the SBP signal, and the top of this formation has been interpreted. Where the reflector is not clearly visible, signal attenuation levels have been used to infer the transition into bedrock.
Th interpretation of the depth to bedrock is presented as contour maps and 3D surfaces (Figures 5,6).

The estimated thickness of sediment lying above the bedrock is shown as Figures 7,8. Thickness is highly variable over this site, and ranges from with a maximum of approximately 8m alluvial sediment thickness observed in some areas, to zero sediment (ie. exposed bedrock interpreted) due to tidal scouring.

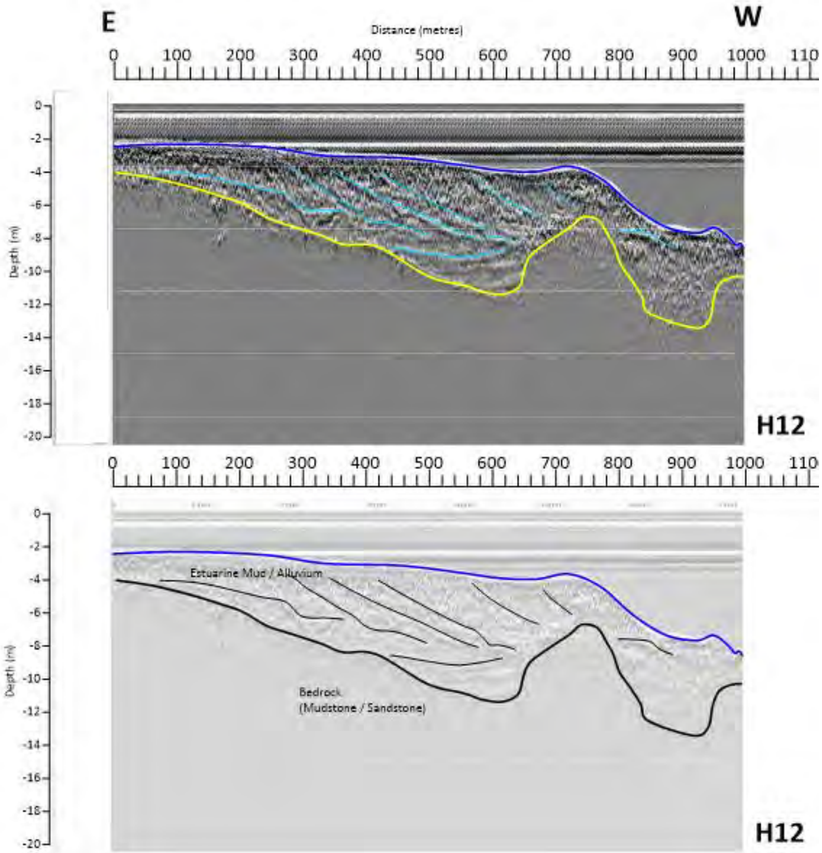
Examples of the SBP lines are indicated as Figure 9,10,11,12. Note that these are vertically exaggerated. The locations of these SBP lines are shown on Figure 5 as the red lines.

Paleochannels are observed which indicate the former positions of stream channels within this part of the Hokianga Harbour. Sedimentary structure (horizontal bedding) is visible within these channels. (see below).



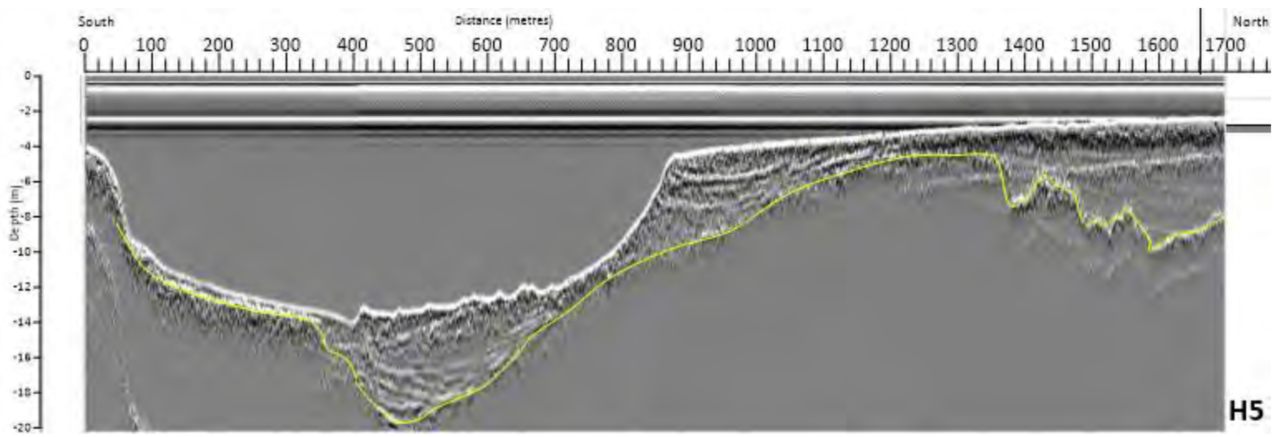
(above) section of SBP Line H10

Sedimentary structure is visible on the edges harbour showing the depositional sequences of alluvial sediment.



(above) *SBP Line H12 showing depositional sedimentary structure at egde of harbour.*

The degree of erosion of the bedrock varies considerably across this site. For example, profile H5 (below) shows that top of the bedrock as a smooth, highly eroded surface (south side of H5 profile) to very rough, undulating surface (north side of profile)



(above) *SBP Line H5 showing variation in bedrock topography.*

It is recommended that all SBP data interpretation is validated using boreholes.
Please contact the author directly if you have any questions relating to this survey data.

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APPENDIX

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PROJECT	Hokianga Harbour - Sub Bottom Profile Survey
DATE	Aug-Nov 2019
PERSONNEL	MW, KH, DM
EQUIPMENT	3.5kHz-7kHz SBP
CONTACT 1	matt@scantec.co.nz
CONTACT 2	021-376-644

Figure 1 - Hokianga Harbour SBP (Sub-bottom Profile) Survey Area

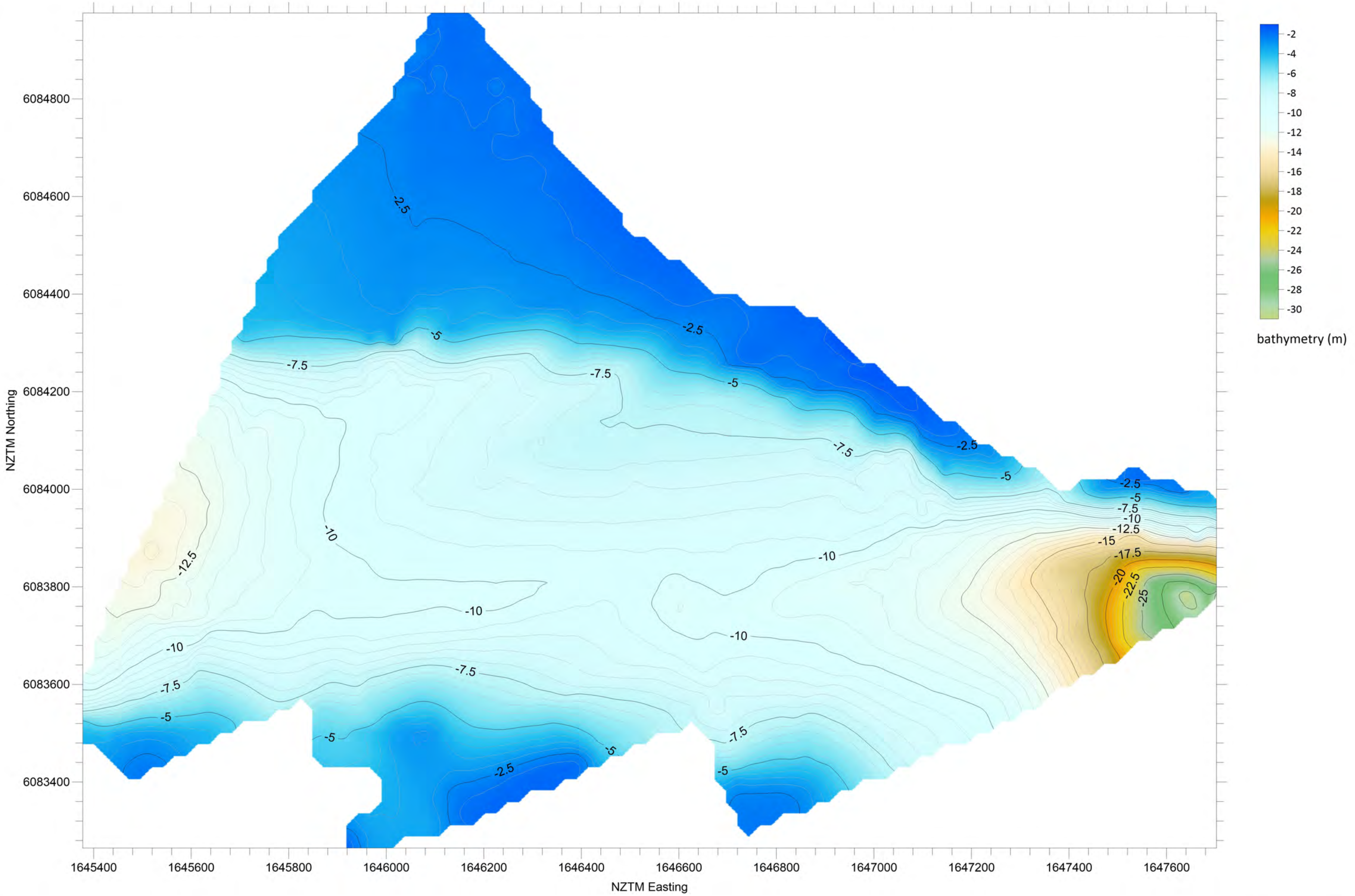

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Figure 2 - Bathymetry 200kHz

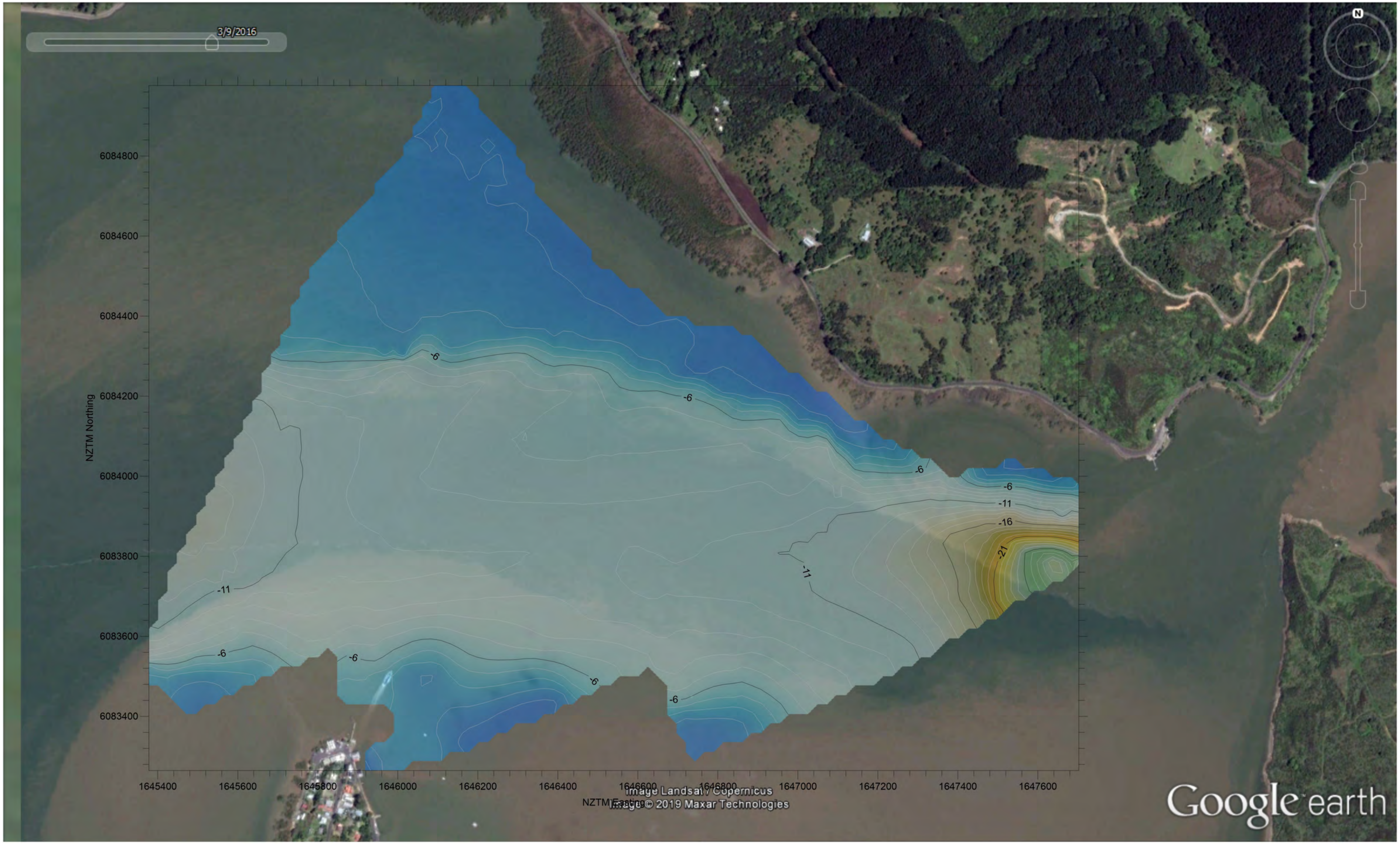

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Figure 3 - Bathymetry with aerial photo

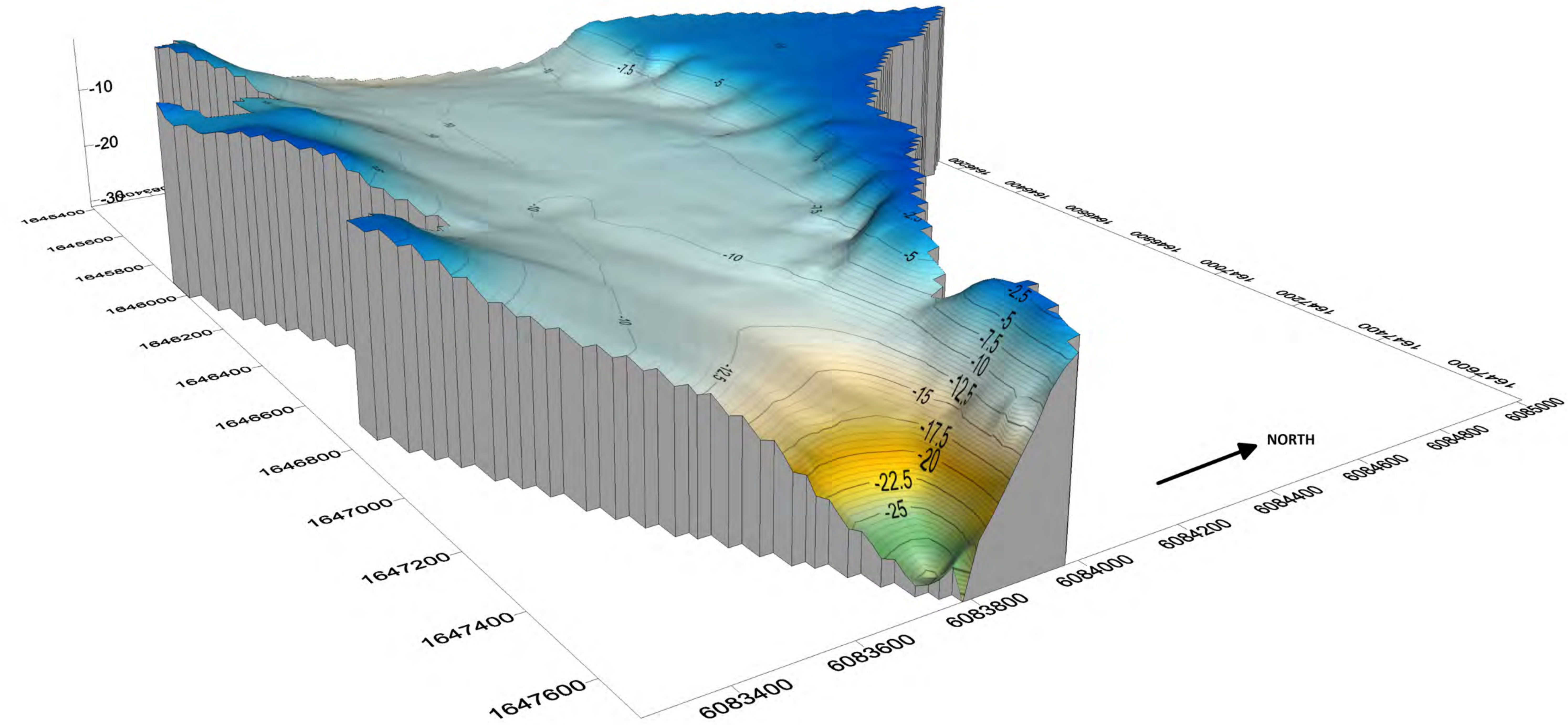

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Figure 4 - Bathymetry - 3D projection

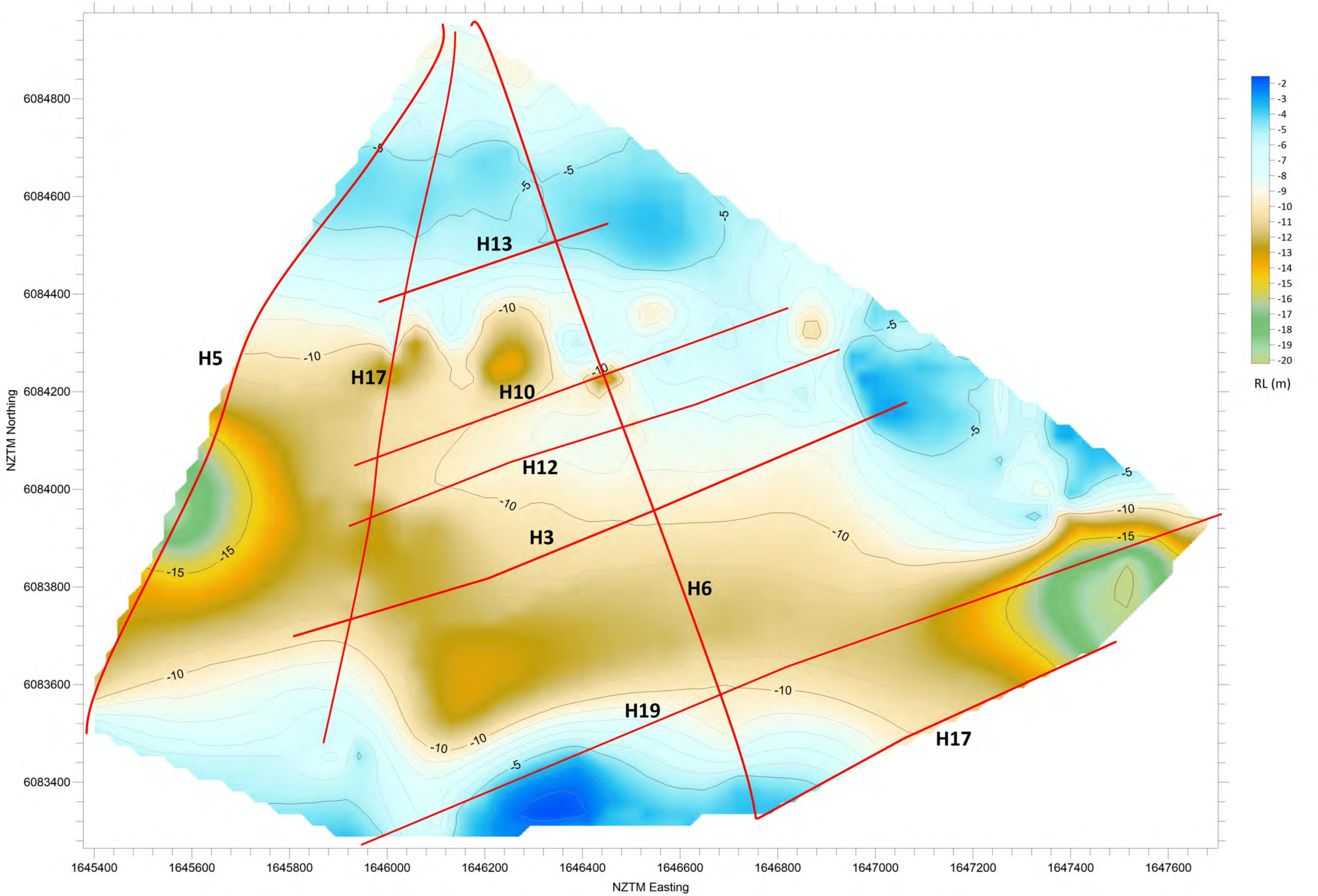

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Figure 5 - Interpretation of depth to bedrock (SBP)

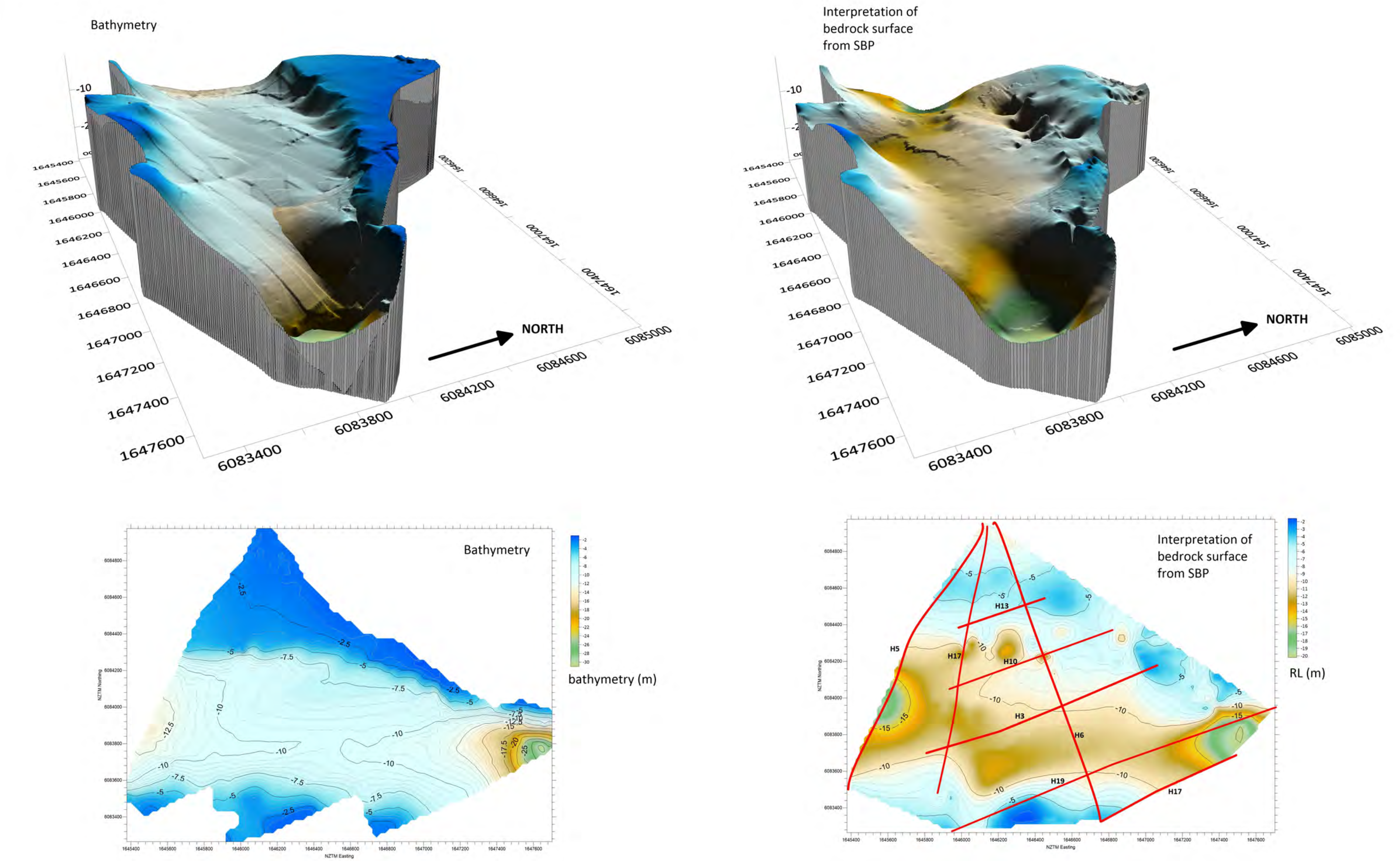

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Figure 6 - Interpretation of depth to bedrock (SBP). 3D projection

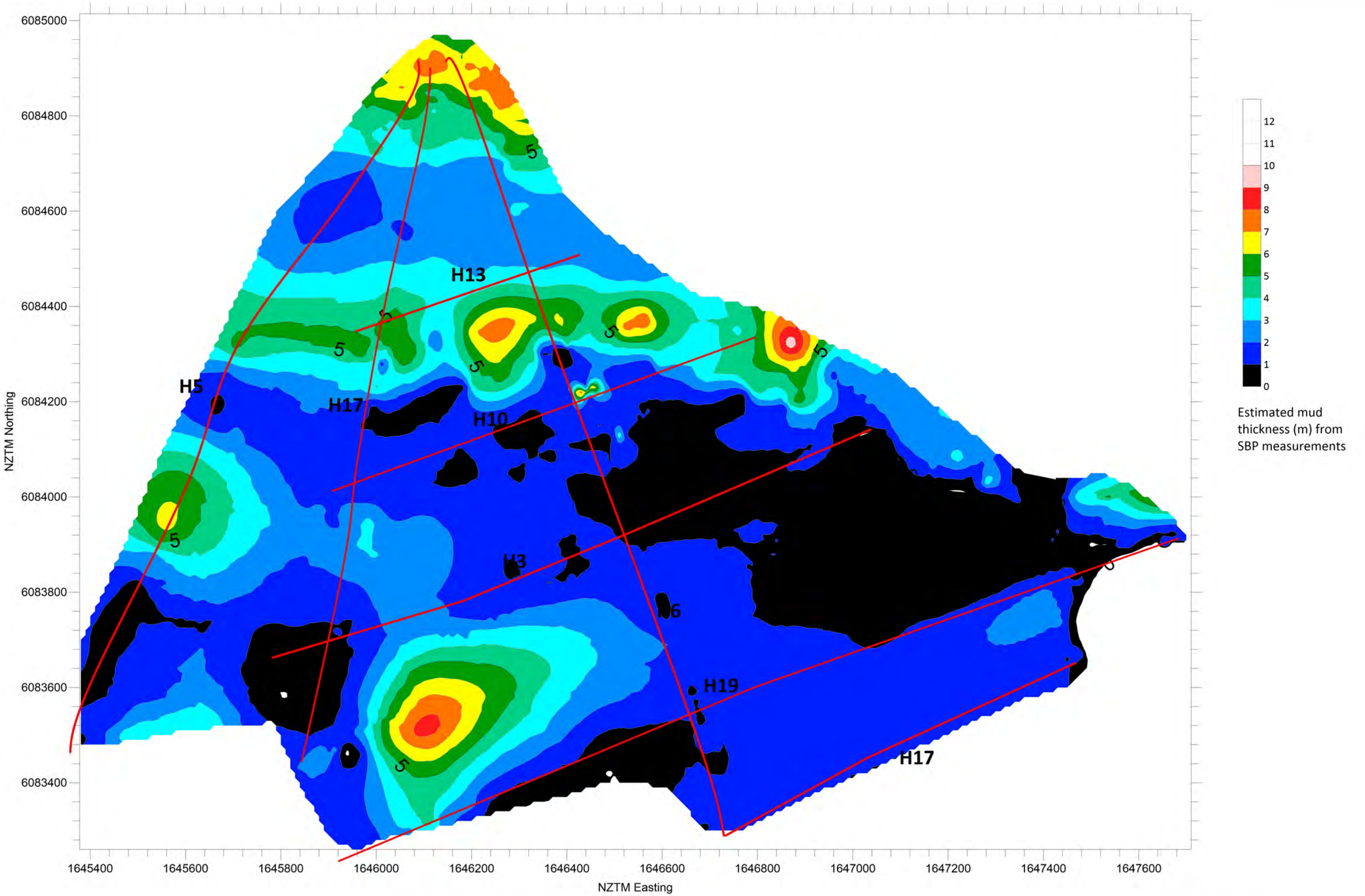

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Figure 7 - Estimate of estuarine mud thickness (SBP)

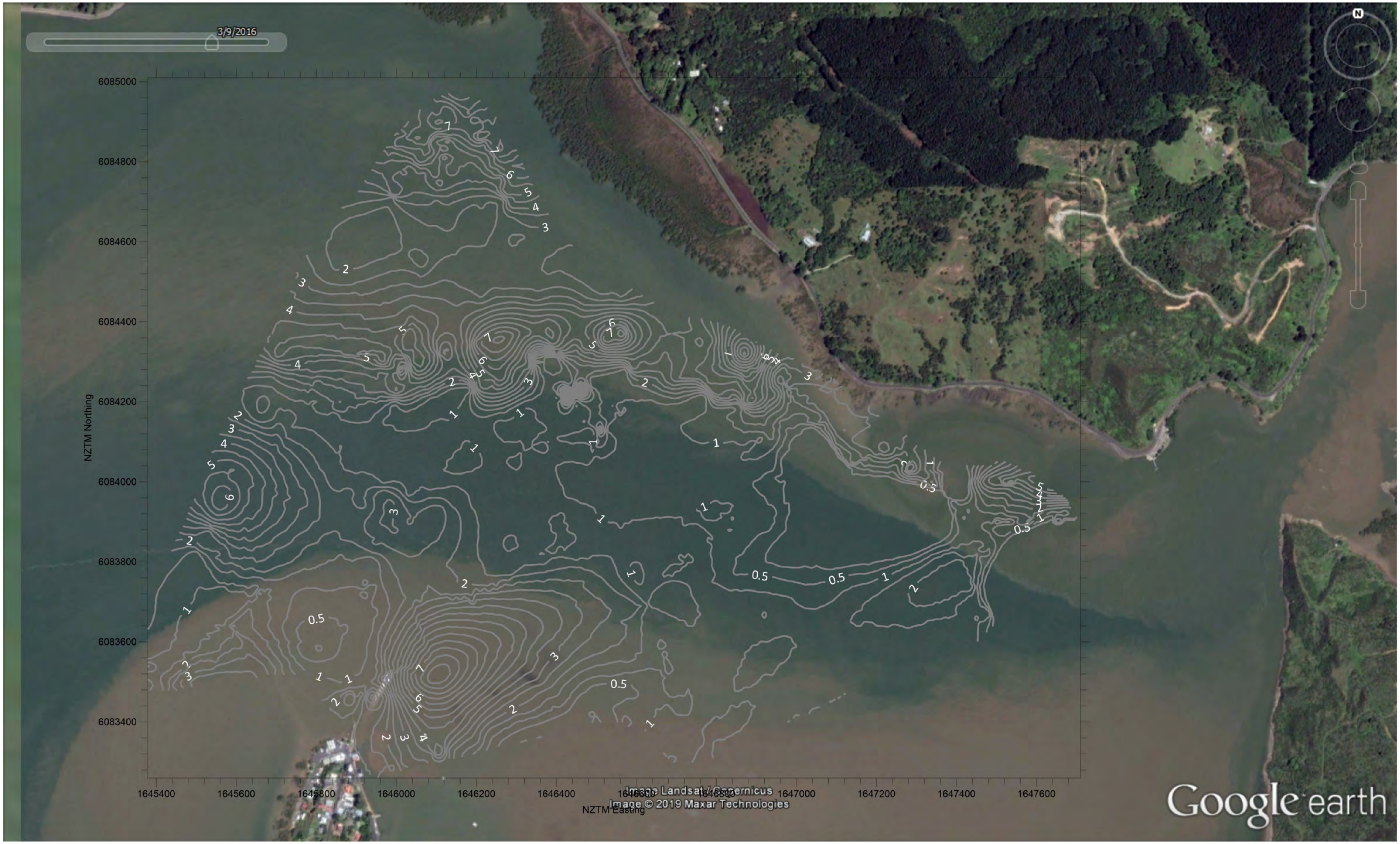

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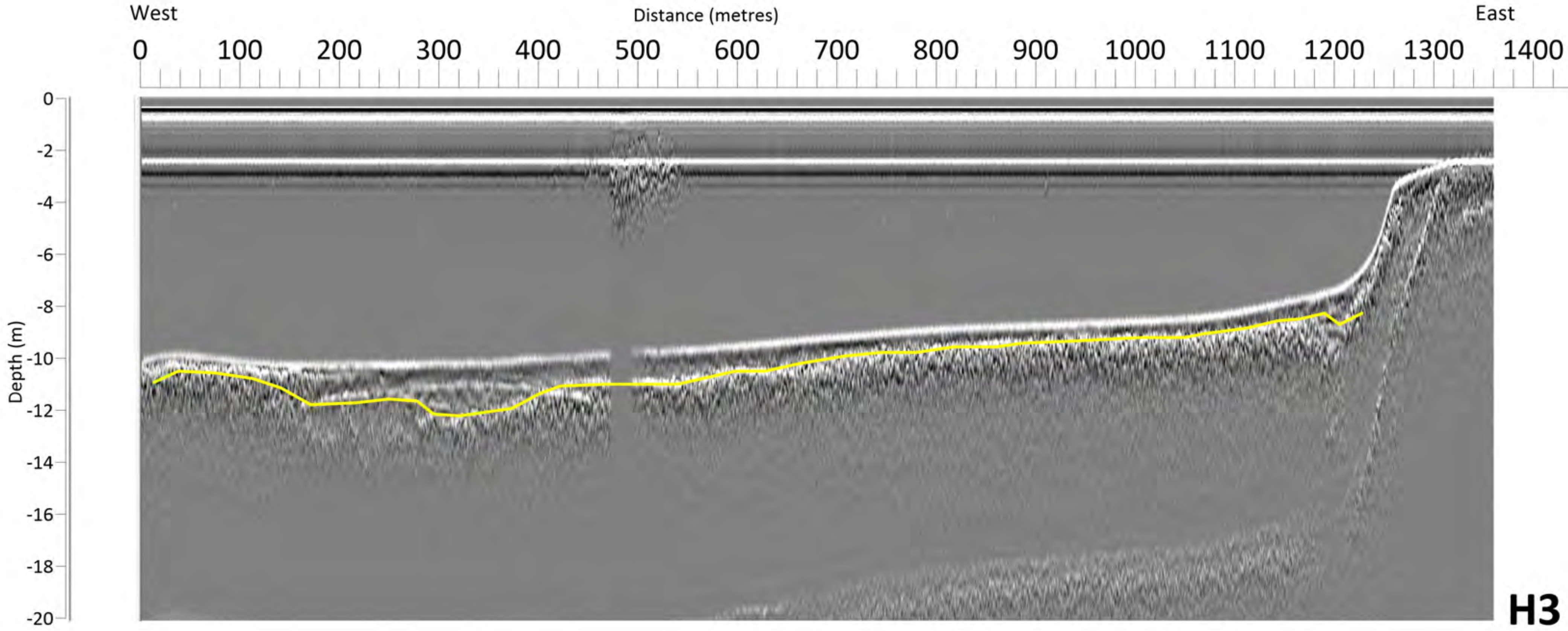
Figure 8 - Estimate of estuarine mud thickness (SBP) with aerial phtoto



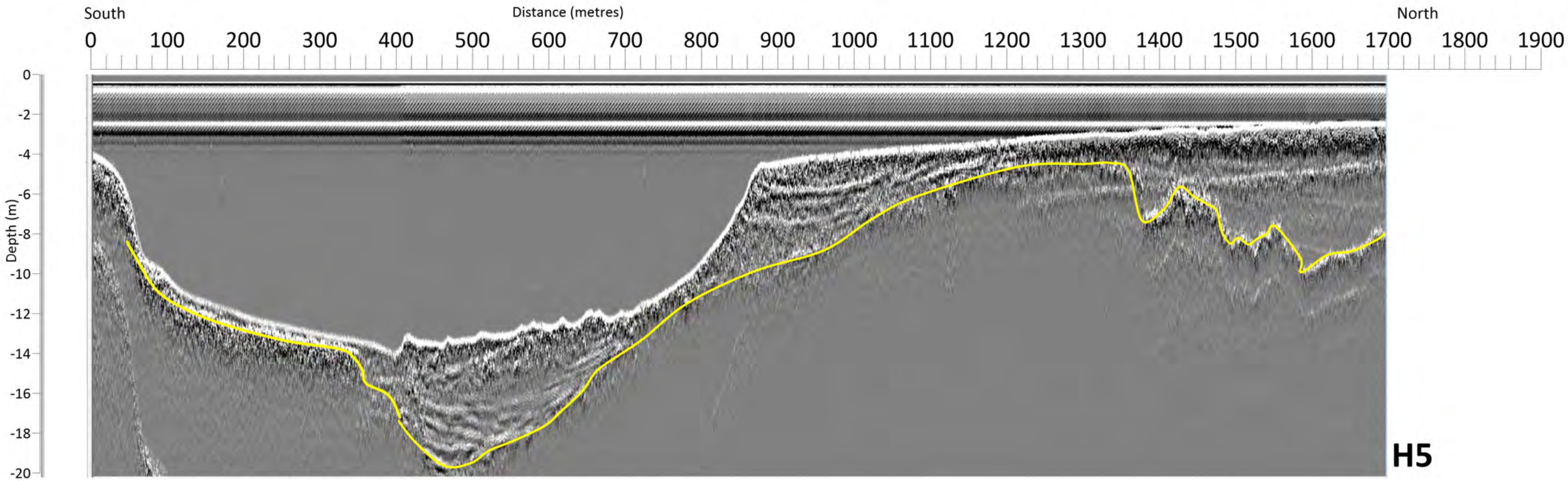


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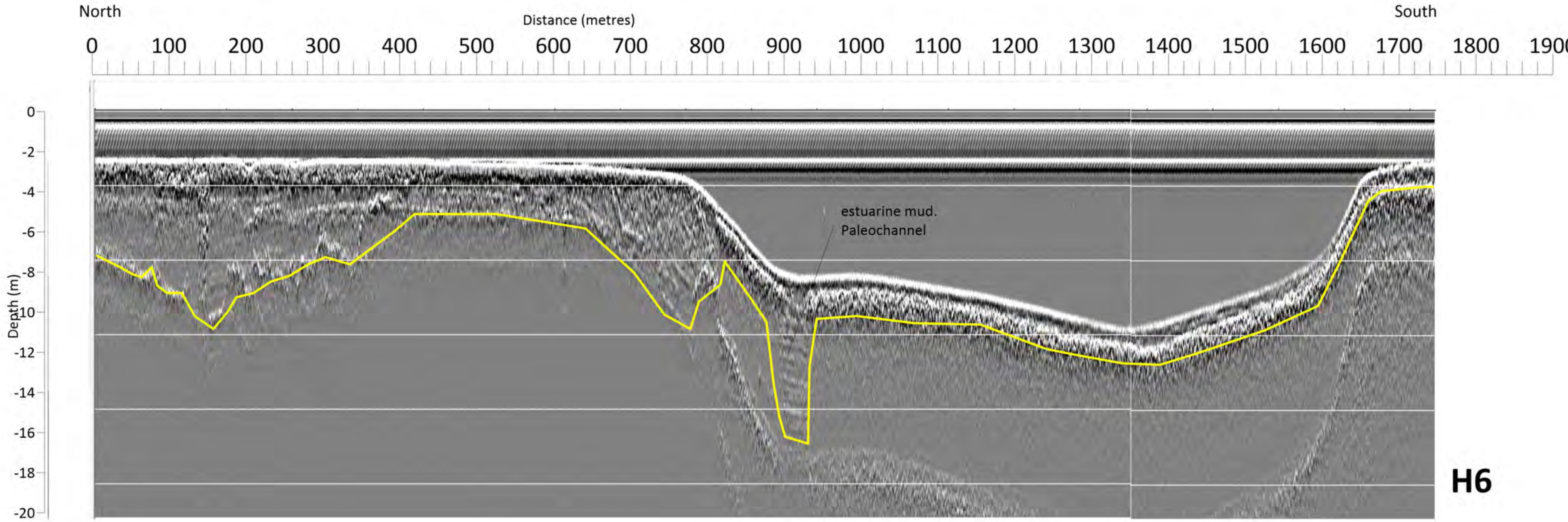
Figure 9 - Section H3, H5



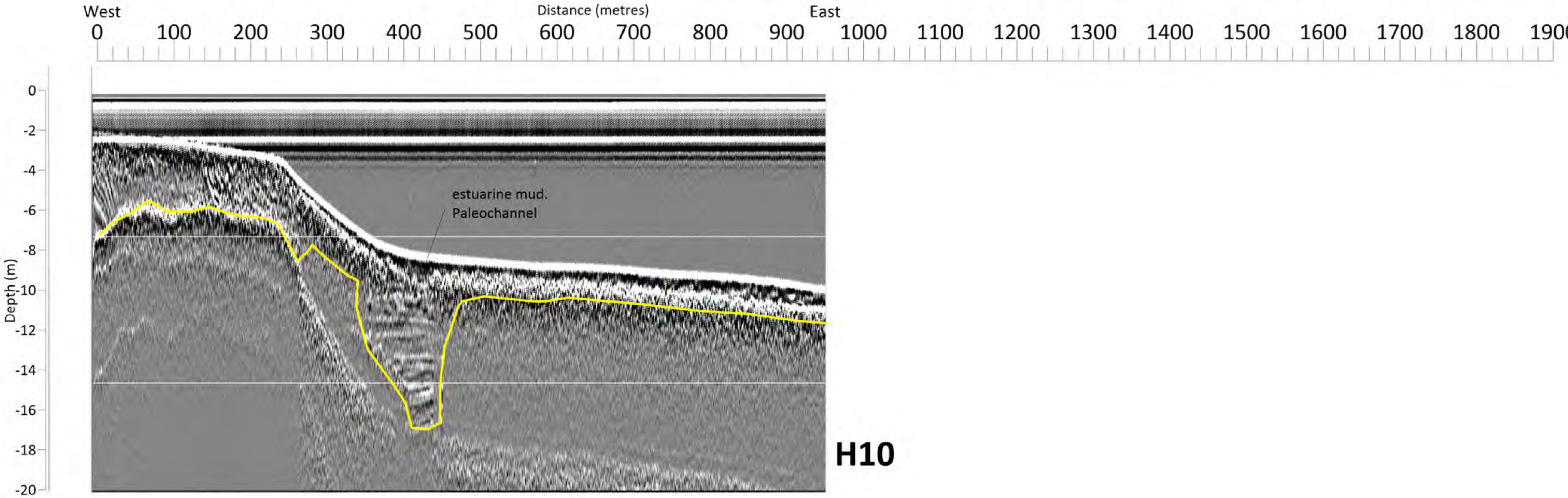


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Figure 10 - Section H6, H10

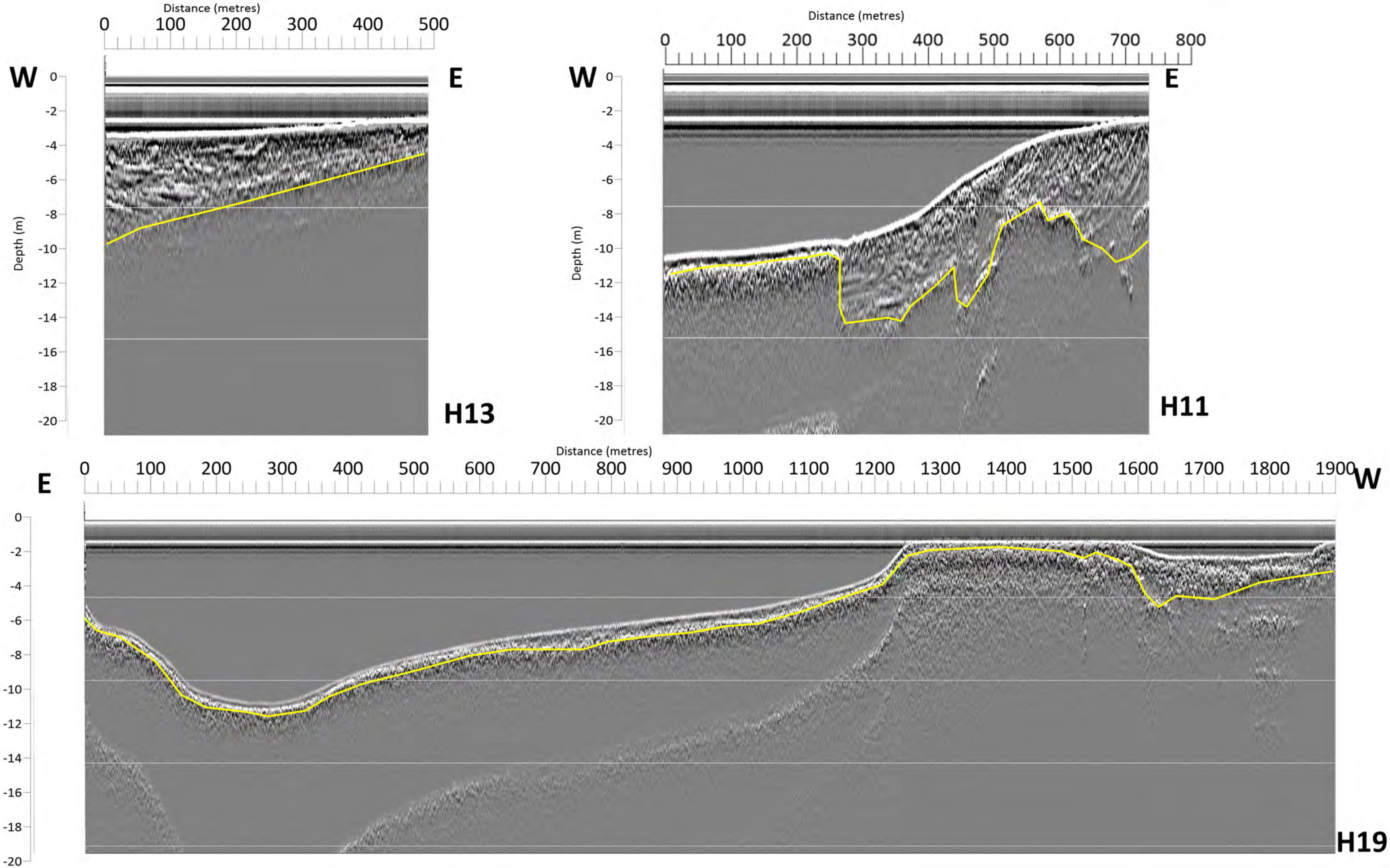

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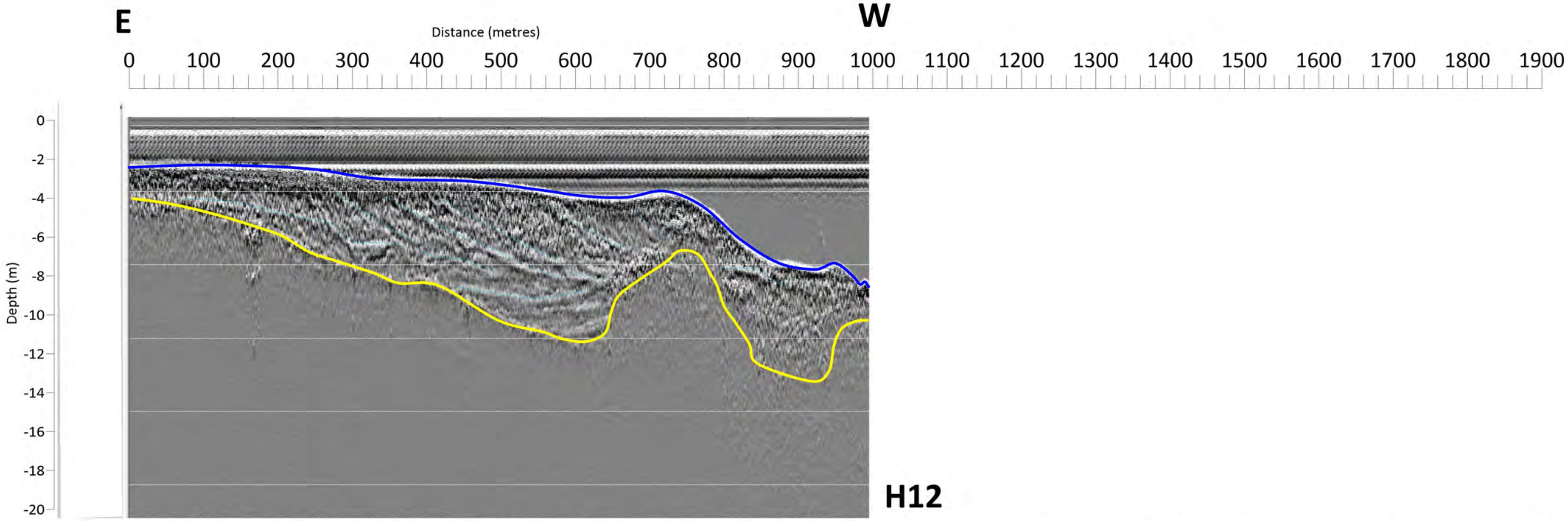
Figure 11 - Section H11, H13, H19



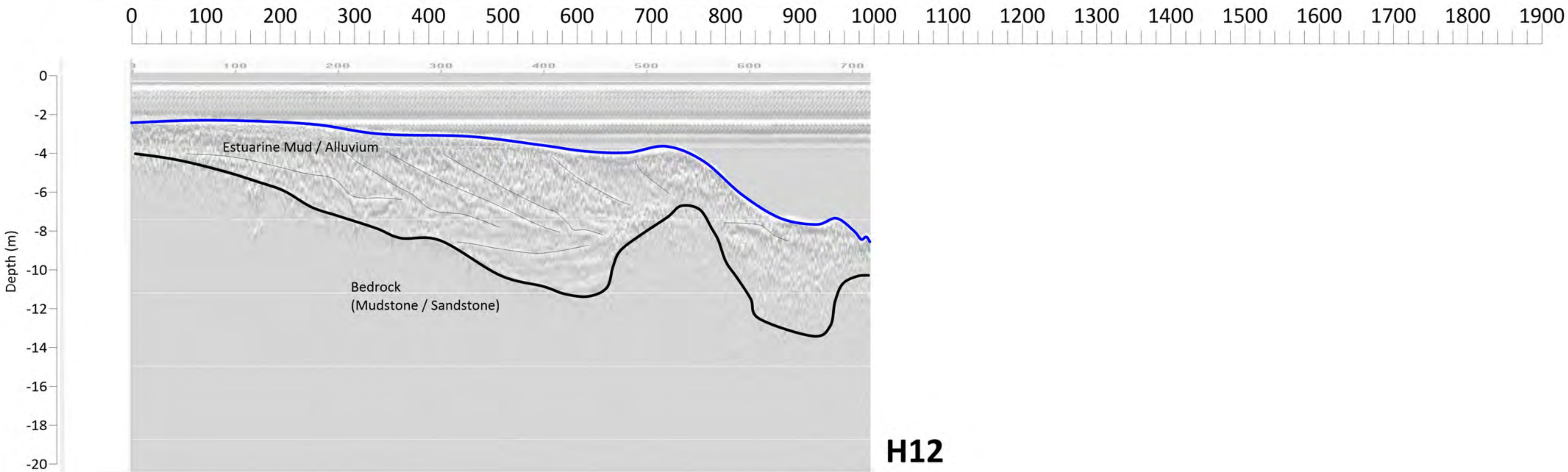


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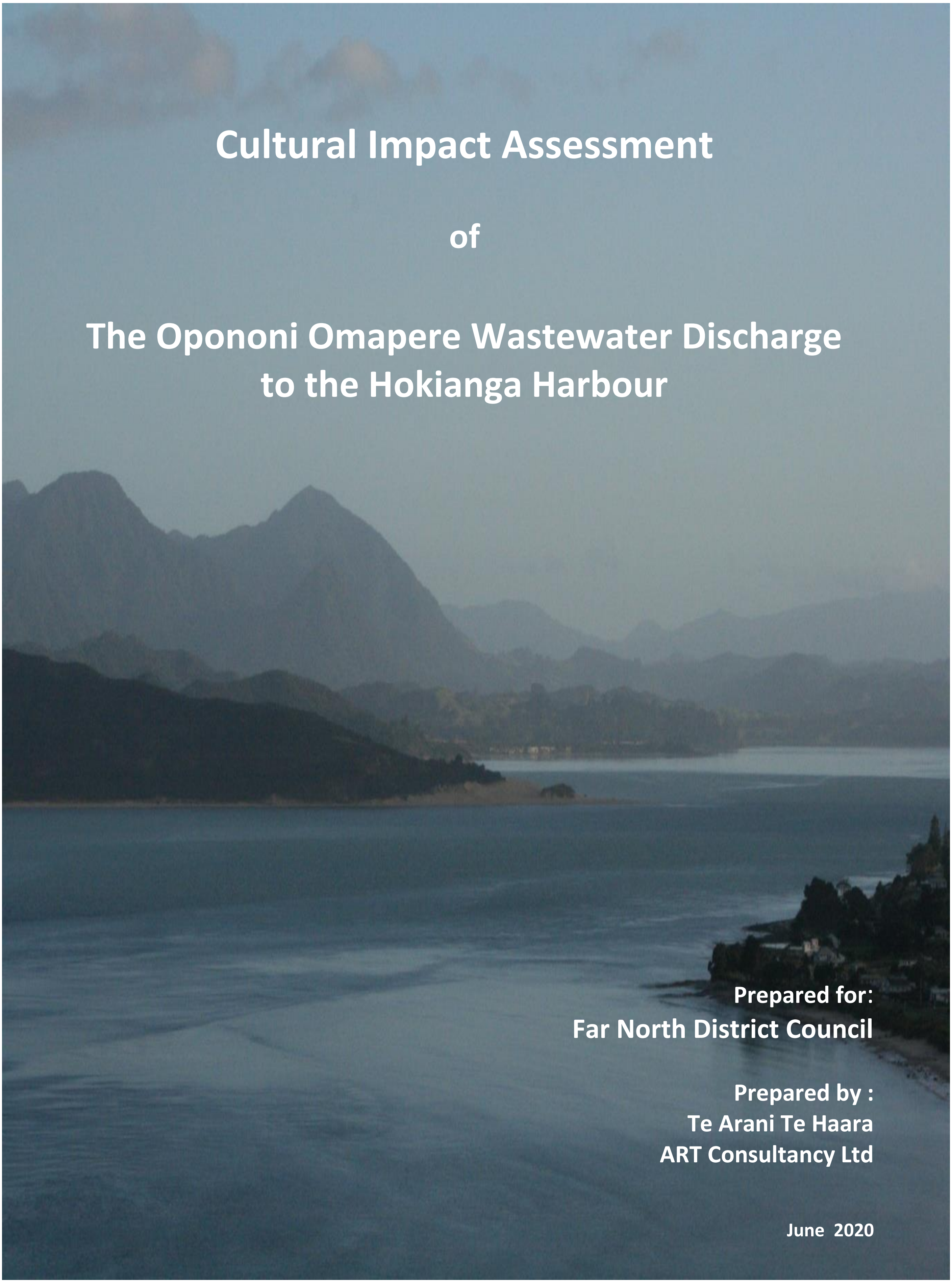
Figure 12 - Section H12



Cultural Impact Assessment

of

The Opononi Omapere Wastewater Discharge to the Hokianga Harbour

Prepared for:
Far North District Council

Prepared by :
Te Arani Te Haara
ART Consultancy Ltd

June 2020

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Cultural Impact Assessment for the Opononi Omapere Wastewater Treatment Plant discharge to the Hokianga Harbour.

This report has been provided for the Far North District Council by ART Consultancy Ltd. No liability is accepted by this entity, any of its employees, or its sub-contractors in respect to its use by any other parties.

Quality Assurance Statement		
Task	**Responsibility**	**Signature**
Prepared by:	Te Arani Te Haara	
Reviewed by:	Andrea Carling	
On behalf of:	ART Consultancy LTD	
Approved for Issue by:		

Revision Status			
Version	**Date**	**Author**	**What Changed and Why**
1	17/05/2020	TNT	Initial draft provided by Te Arani Te Haara
2	20/06/2020	AC	Revised Draft 1 Information analysed, and further contribution made. Initial assessment and further information required to be made.
3	24/06/2020	TNT	Revised Draft 2. Affected Parties provided more information and guidance on report content through email 2020. Draft completed with information available.
4	29/06/2020	TNT	Revised Draft document for sign off by Hapu / Iwi and presented to Council.

1 INTRODUCTION

1.1 Introduction

This Cultural Impact Assessment (CIA) has been commissioned by Far North District as part of its resource consent renewals process for the Opononi Omapere Wastewater Treatment Plant. Cultural Impact Assessments are an important part of assessing the impact that an activity or management approach will have on Manawhenua, Manamoana, Manatangata values associated with a specific area or taonga.

The Māori world view acknowledges a natural order to the universe, a balance or equilibrium, and identifies that when part of this system shifts; the entire system is put out of balance. To better understand the natural order, one must first understand the relationship.[1]

One of the defining principles of Te Ao Maori is whanaungatanga or one's relationship with the World. Whanaungatanga explains how all things are related, assets, birthrights and obligations in relation to each other, the environment and all its resources. In times gone by this matauranga or knowledge was transmitted from generation to generation verbally through pepeha, whakatauki, tauparapara, waiata, place names, as well as whakairo, raranga and ta moko. These ancestral links clearly demonstrate the relationship of the people with their environment and governed how they saw, understood and worked with the different ecosystems and its services.

This assessment provides due recognition to the tribal histories of those Hapu / Iwi who occupied the area in and around the Hokianga Harbour, their genealogical ties to the land, the moana and each other. Equally important is the process that they went through to exercise Rangatiratanga as reflected in the statement derived from the Waitangi Tribunal Report.

> *"When Rangatira gathered, they bought with them an understanding of the world that was based on whakapapa; on the values of Whanaungatanga, Manaakitanga, Kaitiakitanga, and Rangatiratanga; on the imperatives of Mana, Tapu, and Utu. They came from a world in which each Hapu operated autonomously and exercised power over its own territories. Retaining that autonomy, even when acting in alliance with*

[1] Maori Marsden

other Hapu. The Rangatira brought also their own individual experiences and concerns, based on the interests of their Hapu[2]*."*

Whilst there are varying schools of thought as to who holds Manawhenua, Manamoana and Manatangata, acknowledgement and due recognition has been exercised in an effort of maintaining an unbiased opinion, promote active participation and move towards achieving a more sustainable outcome for future generations.

In taking this position, it is fair to say that there are fundamental beliefs and values among the Hapu / Iwi that are shared and linked with the natural environment. These values form the foundation of this Cultural Assessment.

1. 2 Report Production

The drafting of this report has been undertaken by ART Consultancy Ltd with the assistance and contribution of Kaumatua / Kuia, Treaty Claimants, Nga Hapu / Iwi, Takiwa, Community Groups, local Kura and information sourced from key documents. Te Arani Te Haara was responsible for analysing this information and is the principal author of this assessment.

Te Arani has whakapapa ties to the hapu / Iwi within the Hokianga Harbour Catchment, has extensive experience in Indigenous Environmental Management, played a key role in the development and drafting of the Te Kahukura of Ngati Korokoro, Ngati Wharara, me Te Pouka, Nga hapu o Te Wahapu o Te Hokianga- nui- o- Kupe, Hapu Environmental Management Plan. Assisted with the drafting of the Cultural Impact Assessment on behalf of Ngati Rehia for the Kerikeri Wastewater Treatment Plant upgrade and completed cultural audits on 4 Hapu / Iwi Management Plans including Te Roroa Environmental Management Plan. Te Arani has a Post Grad Diploma of Business in Maori Development.

1:3 Purpose

The intent of this report is to provide both the Consent Holder and Consenting Authority with an appraisal of the impact that the proposed activities will have on Mana Whenua, Mana Moana and Mana Tangata cultural values and to more specifically:

[2] Waitangi Tribunal / He Whakaputanga me Te Tiriti / The Declaration / and the Treaty Waitangi Tribunal Report 2014: National Library of New Zealand Cataloguing in Publication Data.

Task	Reference	Page Number
Assess the effects on and access to mahinga kai	Sec 8.3 Effects on Mahinga Kai	Pgs 34 – 35
Damage, destruction, or loss of access to wahi tapu sites or customary value and other ancestral sites and taonga with which Maori have a special relationship	Sec 8:2 Effect of the mauri (life sustaining capabilities)	Pgs 33 - 34
Effects on Indigenous biodiversity in the beds of the waterbody or the coastal marine area where it impacts on the ability of tangata whenua to carry out cultural and traditional activities	Sec 8:4 Effects on Indigenous Biodiversity	Pgs 35 - 36
Effects on taiapure or mataitai or non-commercial fisheries		
Effects on protected customary rights	N/A	
Effects on sites and areas of significance to tangata whenua	Sec 8.5 Case Study – Effects on site of significance	Pgs 36 - 40

In addition to the above, encourage active participation by tangata whenua in Council's decision making processes ie: develop a relationship based on partnership, participation and protection of a taonga which plays an fundamental part in the lives of the people of Hokianga and of our nation. Essentially to:

a) *Identify which tangata whenua are adversely affected by the application in accordance with Policy D.1.3 of the Proposed Regional Plan*

b) *Build Council's capacity and understanding of the tangata whenua values and the effects that the discharge to the harbour has on these values.*

c) *Provide guidance and direction of how any adverse effects on cultural values can be avoided, remedied or mitigation.*[3]

1.4 Scope

The scope of this report includes:

[3] Savill Stuart, Section 91(1) Request for Further Information.20190722

- An overview of the Hokianga Harbour Catchment and work that has is and will be undertaken in the near future.

- Descriptions of the proposed changes to Opononi, Omapere wastewater discharge system.

- Summary of the planning framework for assessing the cultural effects of the discharge.

- Description of relevant cultural values and tikanga specific to the discharge of treated wastewater into the harbour.

- Identification of geographical areas of cultural significance in and around the discharge.

- Assessment of the cultural impacts that the current wastewater discharge has on the Hokianga Harbour and connected environments.

- Recommendations for any cultural mitigation measures; and

- Recommend any appropriate resource consent conditions including cultural health monitoring

2 HARBOUR CATCHMENT

2:1 Hokianga Harbour Catchment

The Hokianga Harbour is the fourth largest harbour in New Zealand in terms of water volume and geographical spread. Originally a large drowned valley, the harbour is long, narrow, and surrounded by dense mangrove forests which contain some of the largest salt marsh areas left in Northland. [4]

It holds some of the last remnants of low-lying swamp forest/ swamp shrub land habitats, large stands of native forests that provide upper catchment and water quality protection that feeds into the harbour river system. Such river systems and underground aquifers start as far inland as the

[4] Natural Areas of Hokianga Ecological Area (2004), Department of Conservation, Conning Linda, Holland Wendy, Miller Nigel, Pg 3

Puketi and Ratea Forest, Te Kauae o Ruru Wahine Ranges, Whakatere Ranges, Mangakahia, and the awha at Ngawha.

The consent application estimates that the total nutrient loading that enters the Hokianga Harbour via these river systems is in the vicinity of 2.8 tonnes per day. Of the total nutrient loading 0.03% is related to Wastewater Treatment Plant discharges. The remaining 97 percent can be traced back to agriculture, forestry, horticulture and other land use activities[5].

Far North District Council owns and operations four Wastewater Treatment Schemes that discharge into the Harbour Catchment. These include.

- Kohukohu, that exits through an unnamed drain into the harbour
- Kaikohe via the Wairoro Stream, that flows into the Punakitere River and onto the Waima River
- Rawene via the Omanaia River, and
- Opononi Omapere via an outflow pipe that discharges into the harbour.

The Opononi Omapere WW Scheme lies at the south west end of the harbour catchment.

2.2 Community Liaison Groups

One of the conditions of the current resource consent was that Community Liaison Groups were to be established. This was considered to be the most effective means of keeping individual communities informed and involved in Council's decision making. A process that would save time, reduce costs and avoid unnecessary lengthy delays in trying to gain consensus from wider community engagement.

Two groups have been set up one in Rawene, Te Mauri o Te Wai and the other in Opononi Omapere Community Liaison Group. Both groups function independently of each other and have representatives from local Marae, Hapu, Iwi and Community.

2.2 Long term Plan

Over the next 10 years all 4 WWTP resources consents will have expired or are due to expire:

- Kohukohu expired 31st October 2016

[5] River Water Quality and Ecology in Northland 2012 -2016 Northland Regional Council,

- Opononi, Omapere expired on the 31st August 2019 and is going through the renewal process at present
- Kaikohe WWTP is due to expire in 2021
- Rawene WWTP will expire 31st October 2023 and

Council's Long-term Plan 2018-28 identifies a number of Capital Works programs that will have a direct bearing on the Harbour Catchment over the next 8 years are.

- Kaikohe Wastewater upgrade
- Kaikohe Stormwater network upgrade and a
- Minor Upgrade to the Opononi Stormwater network[6]

Whilst these projects have been scheduled, these are subject to change pending notification and consultation through Council's Annual or Long-term Plan process.

3 AREA SERVED BY THE SCHEME

3:1 Area Served

The Opononi Omapere WWTP serves the urban area of Opononi and Omapere. This consists of a mix of residential, commercial, educational, recreational, and accommodation properties. Council's rating system for WW connections is based on Separately Used Inhabited Part (SUIP) and not on each pan per se. A residential property might have more than one pan but only one SUIP. There are currently 354 properties connected to the WWTP, 9 commercial properties which each have an addition SUIP and 119 residential sections available for connection. This brings the total number to 482 connections as of March 2020.

3:2 Growth and Development

There is definitely potential for development within the Opononi Omapere area, however, the probability of this occurring in the short term based on statistical data for this area indicates a decline in the number of permanent residents. This coupled with the state of the global economy; the aftermath of Covid19 and the drastic drop in tourist numbers, any potential growth to the area will be the product of holiday home occupation. Even, though Opononi Omapere is considered to be

[6] Far North District Council's Long Term Plan 2018-28, Pg 61-62 Infrastructure Financials, Summary of significant expenditure o

a popular holiday destination, there are no significant service industries connected to the wastewater scheme[7].

4 TREATMENT PLANT

4:1 Treatment Plant

The Opononi Omapere Wastewater Treatment Plant is located on land at the end of Bakers Road, Opononi. The land, plant and reticulated network are owned by the Far North District Council and managed by its alliance partner. The alliance* partner is responsible for the operational and monitoring programme of the plant.

The WWTP is described as a simple pond system. The existing sewerage reticulation consists of gravity sewers, raising mains and 6 pumping stations. Effluent from the Opononi Omapere township is pumped through a single inflow pipe directly onto a mechanical step screen. Screening of effluent before it enters the aerated pond is the first step in the wastewater treatment process. It is critical to removing contents that have the potential to cause damage to and clogging downstream equipment and piping further on in the treatment process. Wastewater moves from the aerated pond to the detention pond via a fixed weir which operates on the basis of what comes in equals what goes out. The pond operates on a 95% threshold before water is transferred over to the next pond or into the wetland as the case might be. A mechanical brush aerator is used as a means of circulating oxygen through the water column resulting in a more effective treatment of contaminants and an overall decrease in sludge production.

From the aerated lagoon, the effluent then flows into a detention pond.[8] This detention pond is used for retention and sludge settling prior to transferring to the constructed wetland. The holding capacity of the aeration pond and the detention pond are 1475 m^3 and 1850m^3 respectively. From the detention pond wastewater is pumped up into the constructed wetland which consists of five surface flow cells and a holding pond. Discharge from the holding pond is controlled by a tidal clock and a control value system. Treated wastewater is discharged from the holding pond on the outgoing tide via a submerged outfall pipe. The outfall pipe is fixed to the seabed in close proximity to the main channel, about 2.6km from the harbour entrance.

[7] Information sourced from Application for Resource Consent – Jessica Crawford.
[8] This is also referred to as the retention or maturation pond.

4:2 Current Discharges

The average daily discharge flow rate is presently 285m^3 /d and varies according to summer or winter flows. For the last 2-year period the average summer flow has been 168m^3 /d with the average winter flow of 229m^3 /d. The following tables provide details of discharge volumes and quality conditions as set by the current consent conditions and discharge rates. As indicated below these figures vary according to community use.

Discharge Rates	Current Consented Conditions	Current Discharge Rates	Proposed Discharge Rates
Discharge Flow Rate	58.9 cubic metres per hour		75 cubic metres per hour
Maximum or Peak Discharge Rate	685 cubic metres per day	685 cubic metres per day	450 cubic metres per day
Average Daily Flow Discharge	240 cubic metres per day	285 cubic metres	240 cubic metres
Average Summer flow for last 2 years		168 cubic metres per day	
Average Winter flow for the last 2 years		229 cubic metres per day.	

Determinand	Median Concentration	90 percentile Concentration	Monitoring for the 2019
5 day Biochemical Oxygen Demand (grams per cubic metre)	20	35	
Escherichia Coli (per 100 millilitres)	3,000	5,500	
Total ammoniacal nitrogen (grams per cubic metre)	30	38	
Total suspended solids (grams per cubic metre)	35	80	

Although, Council has reported that the treated wastewater concentrations are meeting the expected targets for a system such as the OWWTP design as outlined above, however, quarterly monitoring reports state otherwise.

4.3 Monitoring of WWTP

Over the life span of the current consent utilising the testing points within the WWTP envelope, statistical data indicate that:

1. 149 tests have been carried out by the Consenting Authority[9]

2. Of the 149 site inspections completed 145 have been carried by the same Observing Officer with the exception of the last four inspections.

3. Monitoring statistics indicate that of the 149 inspections:
   - 27 Full compliance
   - 6 Low Risk non-compliance
   - 42 Moderate non-compliance
   - 40 Significant non-compliance
   - 34 Follow-up on non-compliance

A further break down of these figures indication that there were:

- 4 formal enforcement notices for non-compliance issued

- Repeated reports that levels of contaminants were exceeded in various areas of the treatment process.

- Significant resources expended on upgrades to the WWTP

- Funds set aside for further technology upgrades to the WWTP.

- Technology upgrades planned but as yet have not been openly discussed with the Community Liaison Group.

- 2 unauthorised or unplanned discharges

- 3 recorded instances of equipment failure

Furthermore, there were:

- Concerns raised by the Community Liaison Group of the impact that Council Infrastructure using the stream or operating in close proximity of the Waiarohia Stream was having on the life generating capacities of the stream.

- Discussions regarding a request for further funds through Council's Long-Term Plan process to assist with wetland refurbishment and much needed rehabilitation work on the Waiarohia Stream.

4:4 Structural Integrity of Sewer Outfall Pipe

[9] Consenting Authority is Northland Regional Council

Inspections of the outfall pipeline are carried out at least once every two years with the last test being completed in 2018. In 2009 it was reported that the outfall pipe along with the diffusers at the end of the pipe had been damaged, thus reducing the length of the outfall pipe by 50 metres. The damaged portion has been replaced by a 10-meter flexible steel wire reinforced rubber hose fastened to a floatation device. This allows the hose to stay above the moving seabed and flex with the current. Regular surveys and maintenance of the structure ensures that the integrity of the structure is kept in good working condition.

4:5 Future Wastewater System and Discharges

Council has expended considerable resources over the last ten years and continues to seek further assistance through Council's Long-term Plan process. As part of the application for renewal, Council is considering the following wastewater system and discharge improvements.

- Technology to improve quality of wastewater discharge
- Install a pump capable of discharging at 75m3 per hour to enable a maximum discharge rate of 450m^3 within the tidal time available
- Wetland refurbishment
- Rehabilitation work on the Waiarohia Stream pending a successful bid for funding
- Seeking a longer term for the consent - 35 years

5 INFORMATION REQUEST

5:1 Sec 92 (1) - Request for Further Information

A Section 92 (1)[10] request allows a Regulatory Authority to call for further information and /or commission reports to quantify and qualify an application for consent. Such requests are to be made available within a specific time frame and submitted to the Consenting Authority before the hearing of an application or if there is no hearing before the decision to refuse or grant consent.

On 20th July 2019, the Consent Authority issued a request for further information which included the following:

- A copy of the Met-Oceans Hydrodynamic Survey Study
- Evidence to prove that the risks to human health had been accurately assessed

[10] Resource Management Act (1991

- Details of land disposal options considered, the decision reached and the reasons why.
- Determination of which tangata whenua are affected by the application
- Provide an assessment of the cultural values and effects that the activity will have on tangata whenua.
- Demonstrate that due consideration has been given to the existing Iwi / Hapu Environmental Management Plans and Statutory Acknowledgement Areas.

In response to this request the following reports and assessments provided.

- Met-Oceans Hydrodynamic Survey Study
- Quantitative Microbial Risk Assessment
- Investigation into Alternative Land Disposal
- An Assessment of the Effects on Cultural Values

5:2 2020 Met-Oceans Hydrodynamic Survey

A Hydrodynamic Survey is a study of fluids in motion. Generation of this motion can be caused by a combination of forces such as tide, wind, waves, gradient, and masses of fluid entering the marine environment.

> *"The release of contaminants into the ocean environment through an outfall pipe is normally continuous overtime but often subject to significant fluctuations that maybe triggered by wet weather or high flows in released quantities. The fate of these pollutants can be calculated on the basis of hydrodynamic modelling using historical conditions (data) enabling estimations of the predicted general spatial dispersion[11]."*

In 2018 Far North District Council commissioned a hydrodynamic survey to investigate the dispersion of wastewater into the harbour. The Opononi Wastewater Treatment Plant releases contaminants into the ocean environment for a maximum of 3 hours each tidal cycle via an outfall pipe. Due to the close proximity of the outfall pipe to the main channel of the harbour the flushing and dilution capacity of the system is considered to be high resulting in almost an immediate dilution of the discharge.

Findings of the study showed that:

> *"The modelled discharge at the Opononi WWTP typically varied from approximately 100 m3/day to the proposed limit of 450 m3/day. Results showed that the dilution*

[11] MOS Hokianga Harbour Hydrodynamic Study – Executive Summary.

factor is about 1 in 25,000 near the discharge for the 50th percentile and about 1 in 1000 for the 95th percentile for both El Nino and La Nina. The plume followed the tidal currents and mostly extended toward the entrance of the harbour with a dilution of 1 in 5,000 at about 750m for El Nino and 500m for La Nina. Near the shoreline the dilution is about 1 in 25,000 or more."

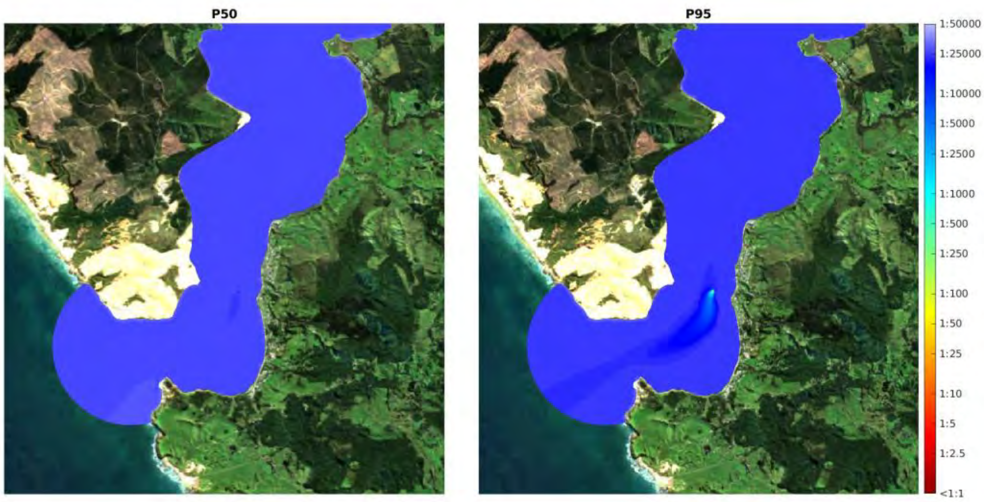


Figure 5:50th Percentile and 95th Percentile Dilution factor for Opononi WWTP during El Nino year.

5:3 2020 Quantitative Microbial Risk Assessment

The QMRA is a fundamental part of the discharge application, not only because it provides an assessment of the health risks associated with the outfall discharge, but also because it provides an indication of the WWTP virus treatment/disinfection required to alleviate those risks.

Wastewater influent from a township like Opononi and Omapere is expected to contain BOD, Ammoniacal-N, Nitrogen, Phosphorus, Faecal Bacteria and Pathogens. To better manage the associated risks to human health, trigger value concentrations have been used as a means of monitoring biological effects as opposed to compliance limits. Streamlined Environmental Ltd has used previously published values from similar treatment systems across New Zealand as means to inform the QMRA report due to the unavailability of influent and effluent virus concentration data for the plant[12].

[12] Page 14, QMRA report Streamlined Environmental

When evaluating viral reduction, the reduction is the difference between the total virus sample in and the total virus sample out. The results of the relative numbers of living microbes eliminated by disinfection are calculated and expressed as log reductions.

The information recorded by QMRA was generated using published values from a similar treatment system to that of the Opononi WWTP. These results indicate:

> *"If 1-log virus reduction (i.e. 10-fold) is achieved by the Opononi WWTP, then at all sites assessed, illness risks associated with ingestion of water potentially containing enterovirus or norovirus from the discharge will be reduced below the "no observable adverse effect level" (NOAEL). However, under this same virus reduction level, the discharge of treated wastewater from the WWTP generally poses "low" risk of illness associated with consumption of raw shellfish (although the IIRs were only fractionally above the 1% threshold for NOAL).*
>
> *Wastewater treatment that reduces virus concentrations in the Opononi WWTP discharge by 2-log reduction (i.e. 100-fold) will reduce health risks associated with the discharge (in relation to inhalation, ingestion during swimming and consumption of shellfish harvested) at all exposure sites, to levels below the NOAEL.*
>
> *In published literature, a 2log virus removal is the most predominantly reported level of reduction in virus concentrations in constructed wetland treatment systems. In line with the QMRA results, if the Opononi wetland treatment system is achieving a 2log virus removal as commonly indicated by available literature, the level of treatment currently applied at the Opononi WWTP is sufficient to reduce illness risks associated with recreation or consumption of harvested raw shellfish below the "no observable adverse effect level" (NOAEL)."*

5:4 Disposal Investigations

5:4:1 Background

One of the requirements of the current consent as set out in Section 105(1)(c) of the RMA requires the consent authority must have regard to any possible alternative methods of discharge, including discharge into any other receiving environment. VK Consulting Environmental Engineers Ltd completed the initial investigation and after due consideration by FNDC and the members of the Community Liaison Group concluded that the investigation did not sufficiently meet the expectations or the requirements of the group. As a consequence, a supplementary investigation was called for that was undertaken by Mott Macdonald.

5:4:2 2011 VK Consulting Environmental Engineering Ltd –Full Land Disposal

VK Environmental Engineering Ltd identified that:

- A very large area of land was required if full land disposal was to be considered
- The area of study had poor soil retention capabilities
- The steepness of the surrounding land increased the risk of run-off
- Pipeline construction costs were significant if the intent was to move the treated wastewater out of the urban area over to Pakanae, Koutu or Waimamaku.

5:4:2 2014 Mott Macdonald – Investigation into Partial Land Disposal.

A further investigation was carried out to look into the practicalities of partial land disposal (a mix between discharge to land during dry periods and discharge to water during wet weather periods.

The report identified that such actions would remove the need for storage and significantly reduced the amount of land required for land-based disposal. In addition to this Mott Macdonald acknowledged that:

a) Both land areas in close proximity to the WWTP were unstable for irrigation due to the steepness of the terrain
b) The soil permeability was considered poor
c) The identified discharge distribution ratio was 5 months to land and 7months to water
d) There are significant physical constraints when moving from land disposal to sea and depends heavily on weather conditions.

Mott Macdonald concluded that:

"After taking every possible scenario into consideration, the most practical option for minimising any resulting adverse effect on the environment was to maintain discharge to water."

5:4:3 Costs of Land Disposal

"Both Consultants reported that the cost of introducing a land disposal scheme was between $2.5 to $5.0 million, with operating expenses around $200,000 to $300,000[13].

5:4:4 Opononi Omapere Community Liaison Group

One of the conditions of the current consent was the establishment of a Community Liaison Group. The Community Liaison Group (CLG) for the Opononi Omapere WWTP was established in 2009. Records identify that the CLG is said to be made up of representatives from Te Whakamaharatanga Marae, Waimamaku, Te Kaiwaha Marae, Waiwhatawhata, Te Whakarongotai Marae, Kokohuia, Maraeroa Marae, Pakanae, Te Runanga o Te Rarawa, a duly appointed representative from each of the Opononi and Omapere Communities and the Consent Holder. The area of interest was specifically limited to the area serviced by the WWTP.

The primary role of the CLG as far as can be ascertained was to act in an advisory capacity. As a result, the members of the CLG or as independent individuals were instrumental in influencing Council's decisions making processes by providing the following guidance and direction as outlined below.

Directive	Action	Outcome	Date
Discharge of wastewater to water body is culturally offensive and degrading.	Appeal against resource consent application	• Submission lodged with Council and Environment Court by the Marae Groups and Iwi Authority.	30 Jan 2009

13

Conditions Imposed by Environment Court	Council to: set up a Community Liaison Group with representatives from the 4 Marae, Te Runanga o Te Rarawa and duly appointed representatives from the communities of Opononi and Omapere • Investigate alternative land areas that can be considered by local iwi to be suitable for treated wastewater discharge from OOWWTP	• Resource Consent signed off by Environment Court	18 Nov 2009
Communication with Appellants	Letters drafted to Marae and Iwi identified as part of the Environment Court process	• Letters sent out to those groups identified in Environment Court ruling. (outlined above)	
First meeting to be held with CLG 1 month of the commencement of the consents	Meeting called with Community Liaison Group to discuss scope, process and timetable of investigation	• Scope of Investigation – "Is land disposal feasible and possible?" Report to include: • Land areas considered by local Iwi to be suitable as discharge to land • Consent Holder to investigate identified land areas for potential discharge • Conclusions as to whether identified land areas can be technically utilised as treated wastewater discharge areas. • Meetings to be held quarterly to discuss progress on the investigation, until such time that the investigation is completed.	18 Dec 2009

Environment Court directive for Council to Investigate alternative land disposal options	Council to engage consultants to carry out investigation	VK Consultant Environmental Engineering Ltd engaged to carry out investigation.	???
Council initiates meeting with Consultant and Local Iwi	• Criteria determined for identifying land blocks • Land available for irrigation of effluent • Well to moderately well drained • Not excessively steep or sloping • A minimum of 10 ha in area	Scope based on technical feasibility of each land block.	30 Sept 2010
Follow-up meeting with CLG, Consultant and Council	• Sites selected for investigation. • Landowners to be notified before the report published	Land blocks identified as potential options	7 Dec 2010

A summary of the findings is presented below:

Parameter	Site					
	1	2	3	4	5	6
Discharge Point	Harbour	Land	Land	Land	Land	Land
Is the site well drained? (1)	N/A	NO	NO	NO	NO	YES
Is the site slope suitable?	N/A	YES	YES	NO	YES	YES
Is there sufficient area of land?	N/A	YES	YES	YES	NO	YES
Is the land available? (2)	N/A	UNSURE	YES	UNSURE	UNSURE	UNSURE
Is the option technically feasible?	YES	YES	YES	NO	NO	YES
Capital Cost	NIL	$3.7M	$2.6M	N/A	$3.6M(3)	$4.3M

Consultant to assess land block suitability	• Land assessment completed	• Summary of findings presented as part of Feasibility Study[14].	2011

[14] Far North District Council Opononi Omapere Wastewater Treatment Plan – Alternative Disposal Options – VK Consulting Environmental Engineering Ltd Feasibility Study

		See Fig 1 Summary of findings[15].	
	• Consultant (VK CEE Ltd) presents findings of investigation	• None of the sites met all of the criteria requirements [16] tions 1, 2,3 & 6 • Options 1,2,3 & 6 were identified as being technically feasible with provisos • Options 2 & 3 only marginally feasible due to poor drainage and there would be times when irrigation would not be possible and storage would be necessary • Option 6 presented the best site in terms of flat land and drainage. • Site limitations include: Site maybe located on a flood plain • Distance • Significant hill along pumping route • Option 4 & 5 not technically feasible	
Review Feasibility Study completed by VKCEE Ltd	Feasibility Study reviewed by CLG and Council	• CLG identified that the study did not sufficiently meet the expectations	

[15] A detailed analysis can be sourced as part of Far North District Council Opononi Omapere Wastewater Treatment Plant – Alternative Disposal Options - VK Consulting Environmental Engineering Ltd Feasibility Study
[16] Criteria requirements outlined in meeting dated 30 Sept 2010

		and requirements. • In particular: Addressing options for improving the wastewater treatment system itself • Provide an assessment of the costs associated with partial land disposal. (e.g. during summer or dry weather conditions only)	
	Mott Macdonald engaged	• Scope of the Assignment • Improve water quality within the treatment plant system • Explore the option of partial land disposal. • Provide an assessment of costs associated with partial land disposal	

6 PLANNING FRAMEWORK

6.1 General

The purpose of the Resource Management Act 1991 (RMA) is to promote the sustainable management of natural and physical resources. A review of all the relevant legislation and planning documents have been completed as outlined in the renewal application. For the purpose of this section of the CIA only those parts of the planning framework that directly influence or impact cultural matters will be discussed. Of particularly relevance are sections 5, 6, 7 and 8.

6.2 Part 2 Provisions

The Resource Management Act (RMA) 1991 recognises the relationship of Maori, their culture and traditions with their ancestral lands, water, sites, wahi tapu and other taonga as a matter of national importance (Part II).

Section 7 of the Act identifies kaitiakitanga as a matter that particular regard must be given in relation to managing the use, development and protection of natural and physical resources, and section 8 establishes that all persons exercising functions and powers under the Act shall take into account the principles of the Treaty of Waitangi.

6:3 Tangata Whenua Affected Party

One of the objectives of this exercise is to identify which tangata whenua groups are affected by the proposed activities. In identifying these groups, a number of key considerations were taken into account.

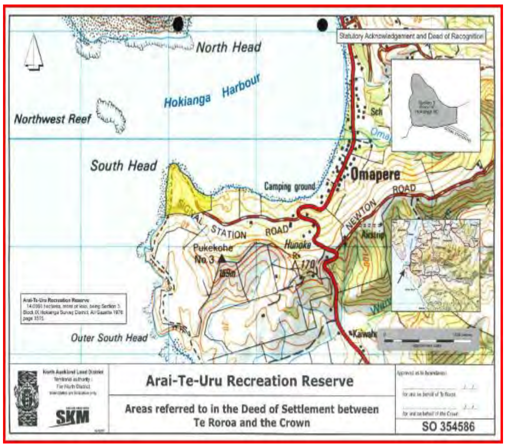
1) The existence of Statutory Acknowledgements areas
2) Tribal overlaps
3) Hapu and or Iwi Management Plans
4) *Treaty Claims*
5) Any other extenuating circumstances

As a result of taking all these key considerations into account the following groups have been identified as having Ahi Kaa status, with overlapping boundaries.

- Nga Hapu o Ngati Korokoro. This Hapu have lodged a claim through the Waitangi Tribunal claiming manawhenua, manamoana and manatangata of the area of study. This is claim is over and above those represented under the Pakanae Resource Management Committee
- Pakanae Resource Management Committee representing Ngati Korokoro, Ngati Wharara and Te Pouka.
- Te Hikutu
- Ngapuhi
- Te Rarawa
- Te Roroa

6:4 Statutory Acknowledgement Areas

Statutory Acknowledgements relate to Crown-owned land and includes land, geographical features, lakes, rivers, wetlands, and coastal marine areas[17]. There are two Statutory Acknowledgment Areas relevant to this report: the Arai-Te-Uru Recreational Reserve and a section of the Hokianga Harbour. Whilst one is land based and the other a section of the seabed; both are intrinsically connected and form part of the cultural landscape as outline in Section 7 Cultural Values and Tikanga.



The Te Roroa Deed of Settlement 2005 records the apology given by the Crown to Te Roroa in 2005 and gives effect to the provisions of the Act in granting a Statutory Acknowledgement area over the Arai-Te-Uru Recreational Reserve. This reserve has been gazetted and is duly noted in the Schedule 4 of the Deed of Settlement Act and also identified as a site of cultural significance within the Far North District Plan, Appendix 1F listing the Pakanae Resource Committee as the requesting party.

Likewise, a Statutory Acknowledgement Area over a part of the Hokianga Harbour has been granted as part of the Te Runanga o Te Rarawa Deed of Settlement 2015. Although provisions have been made through the Settlement process, details will not be finalised until the treaty claims have been addressed and settled under the Marine and Coastal (Takutai Moana) claims.

6:5 Hapu and Iwi Environmental Management Plans

There are two Environmental Management Plans lodged with Council relevant to this study area; Nga Ture mo Te Taiao o Te Roroa and Te Kahukura o Ngati Korokoro, Ngati Wharara me Te Pouka o Te Wahapu o Hokianga-nui a Kupe Hapu Environmental Management Plan. Through whakapapa ties, both the Hapu and Iwi groups recognize this relationship and the overlapping boundaries that exist.

6:5:1 Nga Ture mo Te Taiao o Te Roroa

Of particular importance to this report is Nga Ture mo Te Taiao o Te Roroa 2010. The plan is a statement of the values and policies recorded by Te Roroa in respect to natural resources and the environment. It contains specific policies on sewage disposal, discharge to water and freshwater

[17] www.boprc.govt.nz/your-council/working-with-iwi/statutory-acknowledgements

management. The Iwi Management Plan (IMP) was developed by Te Whatu Ora Trust and adopted by Te Roroa as the Iwi authority, and as such is applicable to RMA planning processes undertaken by district and regional councils. The IMP was lodged with Far North District Council, in February 2010 and is yet to be lodged with Northland Regional Council.

Policies that are most relevant to this CIA are those applicable to discharge of contaminants to water (Section 16)

4. Discharge of human effluent treated or untreated, directly to water is culturally repugnant. All discharges of pollutants or contaminants to natural water bodies, including oceans, should be avoided.
5. NRC will have an integrated catchment management planning and implementation programme that includes all water bodies in our rohe.

6. Activities potentially affecting water bodies will be managed on an integrated catchment basis.

The following Methods of implementation are also relevant particularly to waste discharge

1. Councils and Te Roroa will together jointly develop integrated catchment management strategies including mechanisms for allocating water and monitoring for all water bodies in our rohe.

2. Te Roroa Marae and hapu will be supported to take positive action to enhance water bodies.

3. Te Roroa Whatu Ora and Manawhenua Trusts Board will advocate for the enhancement of all our water bodies and will work with any party promoting or implementing positive actions to improve water quality. We will request statutory authorities to:

   g: ensure that small rural coastal communities have communal land-based treatment facilities and septic tank installations that treat sewerage to a very advanced standard before discharge to soakage fields.

   i: stipulate that consents for works have regular monitoring of cultural health and macro invertebrate. Where data shows that there is an adverse effect on water quality then activities must cease.

6:5:2 Te Kahukura o Ngati Korokoro, Ngati Wharara me Te Pouka o Te Wahapu o Hokianga-nui a Kupe Hapu Environmental Management Plan

Included as part of this planning framework is also the Te Kahukura o Ngati Korokoro, Ngati Wharara me Te Pouka o Te Wahapu o Hokianga-nui a Kupe Hapu Environmental Management Plan was completed in 2008 and was not lodged with Council until 2015.

The policies most applicable to this assessment are those located in the Wastewater section of the plan which identifies:

Policies

- Limiting effluent discharge to sea.
- Increasing effluent discharge quality.
- That land base effluent discharge systems and other effluent treatment options be investigated, ie UV radiation, spray irrigation.

The establishment of a Community Liaison Group has seen considerable steps towards giving effect to these polices, bearing in mind there is still some way to go.

The Moana section is also relevant to this report, particularly the following policies stating:

- Direct discharge of contaminants into water, particularly sewerage and animal effluent is offensive and degrading to the traditional, cultural and spiritual values of the Hapū
- Present infrastructure is not meeting the current demand of increasing development within our rohe and therefore the Hapū will encourage new and existing stakeholders to apply more effective alternative methods for treatment and methods of discharging contaminants.
- To reduce the allowable amount on all land use applications for contaminant discharge.
- The Hapū will support the customary practice of rāhui, where evidence shows that current fish, shellfish, and marine vegetation stocks are unable to sustain present and future generations.
- The Hapū will oppose the construction and development of any future marinas, jetties or wharves that have the potential to cause adverse effects to our harbour.

Finally, policies from the Water Catchment section of the plan identify that:

- Annual audits on the health of all waterways are conducted to determine quality and quantity in line with National Standards.
- No discharges of contaminants to our waterways be allowed.

7 CULTURAL VALUES AND TIKANGA

7:1 Cultural Values

Cultural values are the core principles and ideals upon which a community exists. These values are a combination of beliefs, customs, rituals traditions that are founded on principles of cultural law and practices.

The underlying concepts are to promote, protect, maintain and / or enhance the mauri of the resource. In reviewing the Hapu / Iwi Environmental Management Plans, a number of common threads emerge that are considered to be at the forefront of the Hapu / Iwi relationship within this environment. This understanding is based on the ideology that:

1. Water is a living entity – it has mauri, a life source or life generating capabilities.
2. There are certain rules or laws (tikanga) that govern the maintenance of these life generating capabilities (mauri). These rules or laws are best described as being constant, unchanging and cemented in place.
3. Kawa is the implementation tikanga. These are the practices, processes and procedures that are used in carrying out the implementation of the law. Kawa is considered to be compliant and adaptable to meet specific situations in order to manage the risk. The decision to move forward is based on quality information, robust discussion, and consensus to move forward.

4. The keystone of tikanga and kawa is Karakia. Karakia is an acknowledgment of the Supreme Creator of all things and holds a pivotal role in all operational activities. Nothing is carried out without this acknowledgement before commencement and in closing activities.

5. Wāhi Tapu is the only category of sites of cultural significant that MUST be actively avoided by any development so as to not disturb the mauri and wairua of the area.

7:2 Mauri and wairua

"*We recognize the spiritual existence of all things alongside the physical."* All things we see and touch are made up of a physical and a spiritual element. These elements are best described in the following whakatauki or proverb that states

"Ko au te wai, Ko te wai au."

I am the water and the water is me.

Both entities possess a life force or wairua, both have life supporting capacities or mauri, and both have a genealogical relationship or whakapapa to each other. Te Roroa describes the mauri and wairua of water perfectly with the following statements.

1. *"Water is a sacred resource and a taonga tuku iho a gift from our Tupuna (Ancestors).*
2. *Water in Te Ao Maori is considered to be the life blood of our ancestors.*
3. *It is central to our existence.*
4. *Our mana is intertwined with water.*
5. *It is used to feed, transport, cleanse, purify and is the home to important mahinga kai and cultural materials.*
6. *All water bodies[18] are named, some tapu, and some associated with pa and gardens.*
7. *Traditionally, our tupuna distinguished between types of water, wai tapu, wai noa, wai mate, wai ora etc.*
8. *Water bodies formed traditional boundaries".*

Wairua and mauri are important indicators in assessing the environmental health at both the physical and spiritual levels based on matauranga Maori principles.

7:3 Tikanga

Wastewater is a modern creation. The discharge of contaminants to water, or the mixing of waters from different environments is considered offensive. Ideally, wastewater discharge locations should be land based with wahi tapu avoided at all costs.

[18] Nga Ture o Te Taiao O TE Roroa 2008 Water body: includes creeks, streams, wetlands, swamps, springs, lakes, aquifers, estuarine and coastal waters, all within the domain of Tangaroa.

7.4 Associations with the Harbour

Cultural, spiritual, and historical association reinforces tribal identity and reaffirms the importance of the harbour. In essence, it symbolises the shared responsibility to protect the mauri of the Harbour not only by those who whakapapa to Hokianga but more importantly to future generations.

This report does not individualise references to specific Hapu / Iwi sites, objects or features that have been identified as part of the cultural landscape; it is however suffice to say, that through whakapapa ties, the land, the water and the people are interconnected.

What has been captured in this section is only a snapshot of the cultural landscape within the Wahapu. There are many more sites that have not been recorded perhaps for fear of desecration or because of the sacredness of these areas; and as a result, owners of this information prefer that they remain as silent files. For those sites that are more prominent and well known, information can be source in the public arena.

Those that have surfaced in the public arena, the repository of this information remains the intellectual property of individuals, whanau, Hapu and Iwi as Kaitiaki. Accordingly, this segment has been guided by information sourced from Appendix 1F in the Far North District Plan, Treaty Deeds of Settlement, and key individuals. Acknowledgements will be made accordingly at the end of the report.

7:4:1 Geographical Features

Rising above the coastal marine area are the majestic mountains that stand as sentinels overlooking the vast coastline of the Hokianga Harbour and the wider ocean expanse or Te Moana-nui-o-Kiwa. These sentinels were used as reference points along the navigational pathway. Pa sites were strategically located along the harbour which often included autonomous communal settlements or papakainga. These significant geographical features include Arai-Te-Uru, Pukekohe, Te Hunoke, Maungaroa, Wheoro-oro, Tumarere, Aotea, Whiria, Te Ramaroa, Niwa, Maukoro Pa, Puke Rangatira.

Last remaining relics of Signal Station on the outcrop of Arai-Te-Uru with Niwa in the foreground.

7:4:2 Tauranga Waka or Landing Sites

The harbour has always been a means of transport for hapu living around the shores of the harbour. Te Rarawa refers to these as *"unga ki uta"* or routes that were used to move freely up and down the harbour[19]. Places associated with tauranga waka include, Arai-Te-Uru, Pouahi, Waihuka, Whanui, Matahourua, Te Paraoa, and Kakakaharoa. Safe anchorages to disembark and gather food, visit whanau or set up lodgings.

7:4:3 Settlement Sites

Early settlements were set up throughout the Wahapu close to food rich rivers, beaches and forests. These settlements were often permanent, however, there were many that were occupied on a temporary basis as whanau moved from one seasonal resource to the next, returning when food sources were at their peak. Such sites included, Arai-Te-Uru, Ruaputa, Tangikura, Waihuka, Pakanae, Maukoro, Pouahi, Te Whatupungapuna, and Kakakaharoa.

7:4:4 Mahinga Kai or Kapata Kai

For Hapu and Iwi groups the harbour was their mahinga kai or pantry. Such supplies as koura, kutai, paua, kina, tamure, kahawai, kanae, pipi, tuatua, toheroa, pupu and rimurimu to name a few were in plentiful supply. Food stocks were regulated by seasonal use and gathering would only take place when the resource was at its peak. If a resource were under threat a rahui or a prohibition would be imposed to allow stocks to regenerate.

These food gathering places were often marked by toka or rocks known as "*toka ahika and toka mapuna,*" rocks that lie below the water. Many of these rocks acted as beacons for food gathering, navigation channels, and reminders of events that have been etched in the tapestry of time of the Hapu / Iwi and weaved into the landscape. These places included such locations Arai-Te-Uru, Morunga, Waiarohia, Waimahutahuta, Pouahi, Waitapu, Whanui, and Nuhaka

7:4:5 Wāhi Tapu

While all sites hold significant value to local tangata whenua, none more than wāhi tapu are the only sites to be actively avoided by any development. This position is owed to the spiritual ramification of disturbing concentrated mauri and wairua resident in these areas. Of these particular sacred sites or wahi tapu are Arai-Te-Uru, Morunga, Waihuka, Ahika, Tokotaa, Kahakaharoa also known to Te

[19] Pg 60 Te Rarawa Deed of Settlement Documents Schedule

Rarawa as Waimako, Puke Rangatira, Kakakaharoa, Kawahitiki, Motukauri, Wai-o-te-kauri, Waitapu, and Te Ramaroa. Sites that are constant reminders of our ancestral connections.

7:4:6 Kaitiakitanga

The relationship of the tangata whenua with the landscape - the land, water, and cultural heritage sites – is often expressed through the principle of kaitiakitanga, or the rights and responsibilities associated with holding manawhenua or customary authority over a particular area.

Part 2 of the Resource Management Act 1991 defines kaitiakitanga as: *…the exercise of guardianship by the Tangata Whenua of an area in accordance with tikanga Maori in relation to natural and physical resources; and includes the ethic of stewardship.*
This responsibility is reflective as being part and parcel of being identified as an *"Affected Party."*

8 CULTURAL IMPACT ASSESSMENT OF DISCHARGES

8:1 General

One of the main objectives of this report is to identify the potential effect that the discharge activities have on the cultural values of the Hapu and the Iwi. In assessing the actual and potential effects of renewing the existing consent, during the course of engagement with Hapu and Iwi groups a number of concerns have been raised. These concerns include:

- Effects on the mauri of the Harbour
- Effects on Mahinga Kai
- Effects on Indigenous Biodiversity
- Effects on Areas of Significance
- Case Study - Effects of the mauri of the Waiarohia Stream
- Cumulative effects
- Climate Change
- Consideration of future growth of the Opononi Omapere area

Each point is discussed below.

8:2 Effects on the mauri of the Harbour

One of the main concerns raised by both Hapu and Iwi groups was that the mauri of the water bodies and the degradation or destruction of the associated ecosystems by exploitation, contamination and or abuse.

For tangata whenua the ethos is that the harbour must be managed in such a way that the life bearing capacities or mauri of the water body is not compromised. *"Traditionally, our tupuna distinguished between types of water, wai tapu, wai noa, wai mate, wai ora etc."* Mixing of waters from different environments via discharge activities according to principles of tikanga is considered to have an adverse effect on the mauri of the harbour.

Assessing the actual or potential effects of a discharge activity on the mauri of a waterway involves consideration of two factors:

a) The quality of the discharge entering the waterway, and
b) The ability of the waterway as a receiving environment to absorb or cope with the discharge.

Indicators used to assess the condition, or the mauri of the water body included:

CULTURAL INDICATORS	
Visual water clarity	Abundance and diversity of species
Kai safe to harvest	Debris being washed ashore
Suitability for cultural use	Suitable for human contact
Catchment Land use	

8:3 Effects on Mahinga Kai

Visual observations of the area along the foreshore at low tide back from the outfall pipe have highlighted a number of key concerns that have led the Hapu / Iwi to conclude that the quality of the treated wastewater is having an adverse effect on the receiving environment. More specifically a comparison over the last 10 years has identified the following:

Past	Now
• Sea snails (Littorina littorea) were plentiful in and round the rocks at low tide	• Population counts have dropped drastically over the last 10 years
• Common Limpet (Petella vulgate) numbers in this area were found on almost every other rock.	• Numbers have declined considerably. Inspection of the area at low tide identified as few as one per cubic meter radius.
• Presence of a Crab at the tidal interface and the Waiarohia stream	• The crab at the tidal interface has disappeared.
• Paua gathered have a green residue on the surface.	• Collecting of paua and kina around the toka ahika has now ceased.
• Harbour was once teeming with life	• Loss of intertidal habitats has resulted in loss of fishery nurseries

8:4 Effects on the Indigenous Biodiversity

The lower Hokianga Harbour has been identified as having ecological significances with special and unique habitats[20]. A study completed by Davidson and Kerr in 2005 identified that the lower harbour:

> *"is characterised by relatively high salinity oceanic water, presence of particular truly marine invertebrate and algae species, soft substratum dominated by sands, numerous areas of boulder and rock, strong tidal currents, low water turbidity and relatively short water residence times*".

High volumes of kelp continue to be washed ashore indicating to tangata whenua that the health of the ecosystem is out of balance. This is supported by studies by the University of California, Cheadle Centre for Biodiversity and Ecological Restoration who identified that:

[20] ww.nrc.govt.nz/media/9400/hokiangaharbourentranceandlowerharboursignificantecologicalmarineareaassessmentsheet.pdf

"A *healthy ecosystem is a system that is finely balanced and if certain species disappears, then the whole ecosystem can drastically change*[21]*".*

In 2006 local divers reported a kina population explosion. Sea urchins have been known to clean the sea floor of kelp fragments that litter the seabed and more ominously graze on the stalks of the kelp to the point where they break off.

There are a number of different opinions as to why the kina explosion occurred, that include.

- the loss of predator species, such as snapper and crayfish in this area as a result of overfishing
- a consequence of the wastewater discharge.

Whilst the loss of predator species has not been validated, surveys and reports indicate that

- the wastewater discharge pipe is located adjacent to the main channel
- Wastewater discharge occurs on the outgoing tide
- the residency time of the discharge remaining in the immediate area is relatively short.
- this position is further supported by the Hydrological study.

From a western paradigm , it is highly probable that the effect of the discharge of treated wastewater in the lower section of the harbour has little or no effect on the marine ecology, however, from a cultural paradigm such phenomenon is a clear indication of more serious underlying problems.

8:5   Effects on Areas of Significance

While the discharge of treated wastewater is only one contributor to the present state of the environment, the impacts that human activities on the ecological values throughout the entirety of the catchment has had a significant bearing customary rights. Observations carried by RJ Davidson and V. Kerr in 2005 on the Habitats and Ecological Values of the Hokianga, identified a number of contamination sources and potential sources of entering the harbour which included.

- *"run off from adjacent farms, particularly dairy/cattle lots.*

[21] www.ccber.ucsb.edu/collections-botanical-collections-algae/ecology-seaweed-and-its-environmental-significance

- *enrichment Harbour from a variety of human activities occurring in the catchments.*
- *discharge of the adjacent sewage treatment ponds; and*
- *stormwater from adjacent townships.*
- *leachate from any rubbish dumps (active or closed).*
- *stormwater run-off from townships;"*

Unfortunately, Davidson and Kerr's study did not capture any data on the level of contamination"[22] They did however identify that substantial areas of the harbour had been impacted by human intervention resulting in permanent loss or modification. Furthermore, they noted that particular areas of harbour margins remained accessible to stock especially along river arms and pest weeds along the fringes have all contributed toward the degradation of the ecological values of the harbour.

For tangata whenua the harbour and its tributaries have been an integral part of its cultural fabric. The harbour was once teeming with life is now seriously under threat by

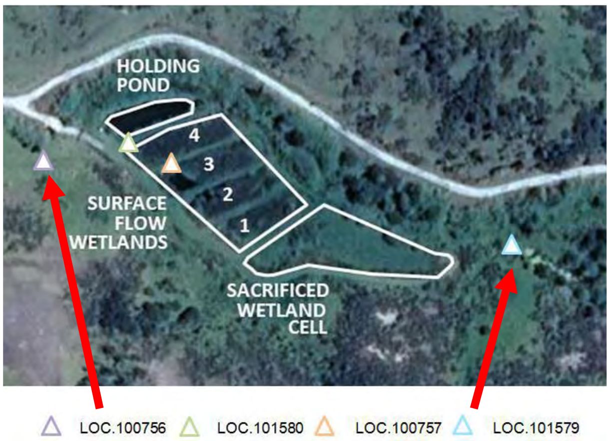
> *"Human and animal effluent, chemicals, fertilisers, pesticides, sediment, stormwater, run-off and litter. Land uses, particularly clearance, the degradation of riparian margins and drainage of wetlands have caused enormous damage."*[23]

An example of this is the effects that Council Infrastructure has had on the Waiarohia Stream.

8:5:1 Case Study - Effects or Potential Effects on the Waiarohia Stream

Discussions with the WWTP Operators identified a number of potential risks that could have a bearing on the receiving environment. These included:

- Contamination by stock, water fowl and runoff as a result of extreme weather conditions
- Lack of a riparian buffer zone along the



[22] Pg 17 – 20 , RJ Davidson, V Kerr, 2005 Habitats and Ecological Values of the Hokianga,
[23] Sec 16, Nga Ture of Te Taiao o Te Rorora

eastern boundary

- Prioritization and affordability of remedial work and improvements to infrastructure

A stream flows around the eastern parameters of the established wetland carrying water that comes off the surrounding hills. Two water quality testing points are marked within the WWTP envelope. One at the top of the sacrificed wetland cell (LOC 101579) and the other just before the stream enters the main channel of the Waiarohia Stream (LOC 100756).

1. During periods of heavy rain, the volume of water from the surrounding catchment increases considerably. Two adverse weather events during the term of the current consent have seen the tributary burst its banks and flow into the established wetlands causing contamination of the treated wastewater. This in turn has caused a flow on effect into the Waiarohia Stream resulting in wastewater having to be discharged via the outfall pipe, outside of the designated timeframe.

2. Over the last 18 months the majority of the WWTP envelope has been re-fenced with only the rear still outstanding. Unfortunately, wandering cattle have broken through at the rear of the property and entered into the restricted area in search of water, further compromising water quality.

3. A riparian buffer zone is considered to be an important conservation tool in reducing the amount of pollutants going into water ways. The lack of a riparian buffer zone along the length of the eastern stream allows pollutants from surrounding land use activities to enter the waterway unrestricted.

4. Prioritization and the allocation of scarce resources towards remedial work or improvements to infrastructure is a major concern especially in the South Hokianga. For example:
    - The area is considered to be a low growth area
    - All budgets are contestable and often driven by public outcry
    - Prioritization and allocation of resources are required to go through a public consultation process prior to adoption
    - There is always a possibility of works being postponed or deferred due to funding constraints or a state of emergency.

8:5:2 Effects on the Mauri on the Waiarohia Stream

A number of concerns have been raised by tangata whenua with respect of the resource consent application and the adverse effect the discharge has on the life bearing capacities or mauri of the Waiarohia Stream.

Indicators used by the tangata whenua to assess the condition, or the mauri, of a waterway include:

• Flow characteristics / movement of water	• Is it safe to gather plants for kai?
• Nature and extent of riparian vegetation	• Abundance and diversity of species
• Clarity of the water	• Suitability for cultural use
• Catchment land use	• Water temperature • Suitability of waterway for cultural use
• Smell of the water and surrounding environment	• Ratio of native plants to exotic and/or noxious weeds

A number of key visual factors lead tangata whenua to conclude that the mauri of the Waiarohia Stream Catchment continues to be compromised.

- Absence of suitable riparian planting around the eastern drain of the WWTP envelope to assist with filtration of contaminants from surrounding land use activities.
- The Waiarohia Stream around the Transfer Station is dominated by exotic species and noxious vegetation which do little in terms of mitigating effects on waterway health from runoff or ground water seepage.
- Dilution is not a mitigating factor in this stream due to low surface flows.
- The Transfer Station setback from the water body of approximately 2 metres due to natural accretion is no longer considered an acceptable distance.
- Non existing water quality testing carried out downstream of the Transfer Station.
- A build up of sand at the mouth of the Waiarohia Stream.

The assumption that the adverse effects of the proposed discharge on the environment will only be minor is culturally unacceptable and does not recognize or provide for the inherent value of the waterway and the loss of life supporting capabilities. Whanau tell of a particular crab species whose habitat was located around the tidal interface that has now disappeared. Not only is there a discharge into the main channel of the harbour, there is also the issue of the water quality that flows on pass the transfer station and out into the harbour. Monitoring of water quality before it flows into the harbour continues to be left unchecked.

8:5:3 Cumulating Effects

The Waiarohia Stream has seven small tributaries that feed into the Waiarohia stream from the surrounding catchment. Far North District Council has three Infrastructure Assets sited along the length of the Waiarohia Stream.

Waiarohia Stream adjacent to the SH 12

Located at the top of the catchment is the Waiarohia Dam. This is used as one of the supplementary water sources that feed the Opononi Omapere town water supply. A weir assists with maintaining an acceptable amount of water in the dam whilst controlling water flow rate down into the lower reaches of the catchment.

The weir at the top of the catchment not only restricts the natural flow of the water from the mountains to the sea but also impedes the longitudinal movement of tuna, small vertebrate, and crustaceans up and down the river.

The Refuse and Recycling Station is the last of the three Council infrastructure assets located in close proximity to the Waiarohia Stream. The Refuse and Recycling Transfer Station is positioned on a berm or an artificial embankment approximately 3.5-meter-high and within 2 metres of the Waiarohia Stream.

The bins, baskets and cages are placed directly on or are slightly raised above a compacted metal, limestone or concrete construct. The area within the service area is constructed of bitumen concrete. The service delivery includes household refuse, recycling of cardboard, newspaper, certain plastics, glass, aluminium cans, plastic bottles, and green waste. Holes in the base of the bins allow water to escape and empty onto the surrounding compacted foundation construct.

The impermeable surface and compacted foundation construct increase the probability of surface runoff or by leaching into ground water in close proximity to the Waiarohia Stream. Embankment along the Stream predominantly consists of flame trees and vegetation plants considered to be noxious plants ie: phoenix palms, oleander trees, bamboo, kikuyu and wandering dew.

8:6 Climate Change

The Opononi Omapere WWTP is one of 15 Council owned and operated schemes throughout the district and 1 of 4 schemes that discharges into the Hokianga Harbour. The reticulated network is approximately 13.5km in length and located in a Coastal Erosion and Coastal Flooding Hazard Zone.

According to the information provided as part of the application, over the next 45 years, 930 metres of the reticulated network will be affected by coastal erosion and flooding. Council has indicated that the relocation of sections of the network will be managed by the 30 year Infrastructure Strategy.

This situation is further exacerbated by extreme rainfall which is predicted to increase in frequency and severity due to global warming. The likely impact on current infrastructure will be:

- An increase in storm water inflows into the wastewater network and
- An increase in ground water infiltration

This increase will result in:

- Network being overloaded
- Reduction in Wastewater treatment capacity
- Reduction in residency time in the treatment system and
- Increase in the frequency of network overflows.

In managing this process moving forward, Council has identified climate change as a strategic priority that will be incorporated as part of its 30-year Infrastructure Strategy. A process that requires active management alongside affected communities. Council is anticipating that the likely responses will be varied from:

- Asset relocation
- Managed retreat
- Reduction of Services.

The expectation of Hapu / Iwi groups is that those key organisations responsible for managing climate change will work in partnership with affected parties to find practical solutions to complex problems, in particular, the development of key management plans and assessments.

8:7 Future Growth

The WWTP serves the residential and commercial population of the communities of Opononi Omapere. The WWTP scheme currently has the service capability of 482 properties, of which 119 properties are yet to be connected. According to Forecast IDNZ, Opononi Omapere is not expected to experience any growth over the next 23 years which suggests that the current system meets current and future demands.

Hapu and Iwi groups are concerned that:

- The current consent does not adequately recognize or provide for future growth in over and above the 119 properties that are yet to be connected.
- In accounting terms, the useful life of the asset is currently estimated to be 35 years which matches the proposed consenting timeframe. Should the timeframe be reduced then the associated costs to maintain the asset will reflect an increase in annual rates payable. With anticipated increasing costs in servicing the plant and no predicted growth over the next 23 years, the cost of maintaining the WWTP will likely exceed the revenue collected, which may result in a reduction in services provided or a possible managed retreat, whatever that looks like.

- Climate change will further impact on ongoing compliance issues.

- Council will take the easy option and actively engage with only one group in the community i.e. Community Liaison Group, when developing the 30 year Infrastructure Strategy which includes the relocation of 930 metres of reticulation network or other key documents that have an direct impact on cultural values.

- Council's Iwi / Hapu contacts database is known to be outdated which theoretically means that if the information recorded in that database is incorrect certain groups could be unintentionally miss out or worst still left out of discussions that have long term implications to overall community wellbeing.

9 ADDRESSING ADVERSE EFFECTS ON CULTURAL VALUES

9:1 Baseline

The benchmark policy set by Hapu and Iwi is that discharge to a water body is unacceptable. This policy is particularly relevant to the discharge of sewage to any water body treated or otherwise. Since 1982 when the WWTP was built the impacts on the health of the harbour and connecting waterways, water quality and mahinga kai areas have been significant. From this baseline, Hapu and Iwi are able to participate via a Cultural Impact Assessment that carries with it no guarantees of avoidance, mitigation, or remedial prioritization timeframes. Such an assessment focuses primarily on the volume and quality of the discharge, the nature of the receiving environment and the available alternatives.

The assessment of the impacts on cultural values associated with the activities has been completed. The results concluded that:

- It is beyond question that the impact on cultural values is significant given the nature of the discharge, the quality of the treated wastewater and the degraded health of the receiving environment.

- Wastewater discharge represents only 0.03% of the total nutrient loading of 2.8 tonnes per day that goes into the Hokianga Harbour. Those Hapu and Iwi that collectively share Kaitiakitanga responsibilities of the harbour are adamant that both local and regional Council's have a statutory responsibility to ensure that responsible land use practices are implement throughout the whole catchment. With the recent announcement by Central Government of financial assistance to clean up waterways across the country, it is timely that both Regional and District Council seriously consider an Integrated Catchment management approach for improving water quality of the Hokianga Harbour as opposed to trying to improve water quality on an individual point or non-point source basis. As a result one of the conditions of consent must include a commitment to undertaking an Integrated Catchment

Management approach to improving water quality coupled with a measure of good will by commencing with the rehabilitation of the Waiarohia Stream and the riparian planting of the eastern stream within the WWTP envelope.

- While public consultation is in accordance with the spirit of democracy, Council has seen fit to adopt a hybrid communication strategy that includes a combination of consultation and engagement. This strategy enabled the establishment of a core advisory group whose main objectives were to inform Council's decision-making processes relevant to the Opononi Omapere WWTP and to keep those organisations they are responsible up to speed with any issues or outcomes. Unfortunately, concerns have been raised by particular groups that those current sitting on the advisory group may not necessarily have the authority or support of all those organisations that were originally enlisted. The general perception is that the advisory group is more exclusive rather than inclusive of other groups that maybe considered an affected party.

- Council has indicated that there is a financial commitment to installing new technologies to improve water quality prior to discharging to the harbour via the outfall pipe. Although this has been highlighted there is no indication what these new technologies are or the time frame as to when this work might be completed. Irrespective of this, what is known is the fact that the current treated wastewater does not meet the current discharge standards as identified by the monitoring statistics recorded by Northland Regional Council.

9:2 Recommendations

A significant part of the CIA process is determining whether adverse effects on cultural values can be avoided, remedied, or mitigated. While the activities associated with the Opononi Omapere Wastewater Treatment Plant are considered as having significant adverse effects on cultural values, consultation with Hapu and Iwi representatives for the purposes of this report indicate that there are options to avoid, remedy or mitigate such effects, through addressing issues such as quality of the effluent and the ability of the receiving environment to absorb or cope with waste. The following recommendations are provided to assist the both Far North District Council (the Applicant) and Northland Regional Council (Consenting Authority) to take note and address cultural concerns, and to provide a basis for active participation in an effort to protect, preserve and conserve the cultural integrity of the harbour.

9:2:1 Recommendation 1: Affected Party Status

It must be acknowledged from a Hapu and Iwi prospective that the representatives on the Community Liaison Committee have been instrumental in promoting and ensuring cultural values are important considerations in the decision making process in respect of the discharge into to the Hokianga Harbour. Whilst there are opposing views regarding representation on the Community Liaison Group one thing has come across loud and clear is the fact that Nga Hapu o Ngati Korokoro will speak for Ngati Korokoro. Nga Hapu o Ngati Korokoro is not to be confused with Ngati Korokoro represented by the Pakanae Marae Resource Committee.

By virtue of whakapapa ties Nga Hapu o Ngati Korokoro and Te Roroa claim affected party status over and above that of the general public. In the case of Nga Hapu o Ngati Korokoro, Nga Hapu o Ngati Korokoro consider themselves to be independent of the owners of the Te Kahukura o Ngati Korokoro, Ngati Wharara me Te Pouka o Te Wahapu o Hokianga-nui a Kupe Hapu Environmental Management Plan and have lodged a claim with the Office of Treaty Settlements in respect of having Manawhenua, Manamoana and Manatangata over the area relevant to this assessment. Irrespective of the fact that this treaty claim has not been settled it is ***recommended*** that should the Community Liaison Group remain as part of the Council / Community interface that representation on the Community Liaison Group be increased by two seats to include Nga Hapu o Ngati Korokoro and Te Roroa in the interim until such time that a determination is made via the Treaty Settlement process. It is anticipated that this would also entail a review of the Terms of Reference for the Group.

9:2:2 Recommendation 2: Updating Council Hapu and Iwi Contact Database

In light of the affected party status, Nga Hapu o Ngati Korokoro ***recommends*** that Council updates its Contact Database to include Nga Hapu O Ngati Korokoro as an affected party to all matters pertaining to community consultation and engagement in relation to Infrastructure Plans, Council's Infrastructure Assessment, Strategies, and resource consent applications.

9:2:3 Recommendation 3: Improvements to the Quality of the Discharge.

The quality of the discharge must be improved. Information provided by Northland Regional Council of recordings taken from LOC 101579 (above the marsh) and LOC 100756 (below the marsh) within the WWTP envelope indicate that were not meeting Compliance Standards. The QMRA report identified that at the time that the QMRA report was generated there was no data available on the influent and effluent virus concentrations for the WWTP. As result the data utilised in this report was a representation of similar New Zealand systems. In as much as this may seem minute and insignificant, unfortunately from a tikanga prospective this is not considered to be a true assessment of the wastewater discharge going into the harbour. Until such time that this can be proven otherwise, Hapu and Iwi remain resolute that the quality of the discharge is without a doubt is having significant adverse effects on the mauri of the Harbour and placing at risk the relationship that Hapu and Iwi have with the Harbour.

Hapu and Iwi are of the opinion that the discharge to the harbour must meet Compliance water quality standards. Council has indicated that the Community Liaison Group are currently discussing options treatment options and that funds are available for the upgrade. Details of both the technology upgrade the funds available are ambiguous. Irrespective of this fact, Hapu and Iwi ***recommend*** Council take immediate steps to address and rectify the issues non-compliance. It is considered that to delay installation of the technology is unwarranted and deemed to be an abuse of power.

9:2:4 Recommendation 4 Term of the Consent

Hapu and Iwi are seriously concerned in respect to the proposed 35 year term. The general consensus is that this timeframe is extremely long given Council's past performance in managing water quality In reviewing the documentation provided by Council the participating Hapu and Iwi Groups in particular those identified as Affected Parties in this report have identified the following steps they would like to be implemented to manage the risk and protect the health of the environment and its people.

Wastewater Infrastructure Improvements	Catchment Advocacy	Community Advocacy
• **Reticulation upgrade and technology upgrades** • Pump upgrade • Technology upgrade to improve disinfection to reduce bugs and add value to current anaerobic treatment process • **Discharge Management** • Making crucial upgrades ie: pump and new disinfectant technology • Development and	• Contribute to driving catchment improvements • FNDC to be part of Catchment decision making • Work with FNDC and NRC to make change • Work with FNDC and NRC to create opportunities • Providing funding for Catchment	• Council and tangata whenua • Review of current CLG representation

Implementation of a more effective Monitoring Program using both Western methodologies and Cultural Health Index • **Relocation Reticulation Pipes** • Input and participation in 30 year Infrastructure Management Strategy	administration • Take active measures towards setting up Catchment Management Board using an integrated approach	

The catchment aspects were proposed in response to community recognition that the harbour is in a serious state of decline even before it reaches Opononi Omapere. Council's application has identified that in comparison to the wider catchment, Council is a comparatively small contributor to the harbour's degradation in respect to other contributors. In terms of tikanga, adopting the attitude of out of sight out of mind is no longer acceptable. Council has demonstrated its commitment to working with community groups such as Te Mauri o Te Wai and tangata whenua groups in an effort to find discharge to land options, however, in as far as an integrated catchment approach to arrest or at very least proactively manage contaminants entering the harbour system Community Groups are of the opinion that both territorial authorities have failed to respond positively.

If consideration were to be given for the term of 35 years the expectation by Hapu and Iwi would be that the prerequisite would and recommendation would be that that each of the items identified in the following tables implement and recorded as one of the conditions in granting consent.

Immediately	**Within 5 years**	**Within 10 years**	**Within 15 years**	**Within 20 years**
• Update Iwi / Hapu Contacts Database • Additional 2 seats on the Community Liaison Group • Review of current Monitoring Program an co-design a program that meets the requirements of both territorial authorities and tangata whenua	• Riparian strip planted along Eastern boundary of WWTP envelop • Monitoring reports provided to tangata whenua along with action taken to mitigate breaches • Initiate Bi-annual Council workshop with tangata whenua reporting	• Continue reticulation improvements • Ongoing Monitoring reports provided to tangata whenua inclusive of any breaches and migration action • Continue Bi-annual Council and tangata whenua	• Ongoing Monitoring reports provided to tangata whenua inclusive of any breaches and migration action taken • Catchment have covered a significant portion (to be determined) of the catchment area	• Ongoing Monitoring reports provided to tangata whenua inclusive of any breaches and migration action taken • Continue Bi-annual Council and tangata whenua workshop on reporting on Capital works

• Installation of new technologies to improve water quality and manage risks. • FNDC to engage with tangata whenua re: 30 year Infrastructure Management Strategy • FNDC to advocate a comprehensive study of the Hokianga Harbour Catchment be carried • Hokianga Harbour Catchment Management Plan initiated	on Capital Works Program for South Hokianga (30-year Infrastructure Strategy milestones and New Accounting Policy, Long Term Plan and Annual Plan. • Rehabilitation of Waiarohia Stream • Hokianga Harbour Catchment Board established • Hokianga Harbour Catchment Management Plan Completed • Transfer Station setback increased at least 30mtres from water body • 1 of the 4 WWTP transferred to land-based disposal • Progress solutions for transfer to land-based disposal for Opononi WWTP	workshop on reporting on Capital works Program for South Hokianga (update on 30 year Infrastructure Strategy milestones) • Hokianga Harbour Catchment Project underway • 2 of the 4 WWTP transferred to land-based disposal • Options for Opononi WWTP identified.	• Continue Bi-annual Council and tangata whenua workshop on reporting on Capital works Program for South Hokianga (30 year Infrastructure Strategy milestones) • 3 of the 4 WWTP transferred to land based disposal • Best Option identified and project plan development started.	Program for South Hokianga (30 year Infrastructure Strategy milestones) • Catchment has had project works established over much of its area and maintenance of these areas will be ongoing. • RC required for Opononi Omapere WWTP (New Consent or Renewal)

9:2:5 Recommendation 5: Integrated Catchment Management Approach

Hapu and Iwi who collectively share kaitiakitanga responsibilities over the expanse of the harbour catchment are adamant that both local and regional Council's have a statutory responsibility to ensure responsible land use practices are implemented according to permitted standards. In addition to this there is an expectation by tangata whenua that those responsible for meeting and monitoring compliance standards should be setting the example.

Tangata Whenua recognise that damage that is being created by the total nutrient loading that is entering the harbour catchment on a daily basis and strongly believe that immediate action is required if the state of the harbour is to be remedied, mitigations measures applied or avoided all together.

Management of coastal waterways and estuaries are spread across a number of agencies with numerous stakeholders' e.g. environmental groups, recreational and commercial fishermen and Hapu and Iwi groups that have claims to manawhenua, manamoana and manatangata who have expressed concerns regarding the current state of the harbour environment. .

The recent announcement by Central Government of financial assistance to clean up waterways across the country is considered a prime time for both Regional and District Council to seriously consider a Integrated management approach towards improving water quality of the entire Hokianga Harbour as opposed to only addressing water quality issues in relation to on individual point or non-point source.

As a result, Hapu and Iwi ***recommend*** that a coordinated and concerted approach to be taken to manage the revitalisation of Hokianga Harbour.

They further ***recommend*** that a comprehensive study of the harbour catchment including cultural impacts be completed and positive steps be taken to secure appropriate resources to support this process and that a Catchment Management Board be established over the harbour.

10 Conclusion

The Hokianga Harbour is a taonga tuku iho, a treasure handed down, that holds significant historic and cultural significance to Hapu Iwi and Ngapuhi-nui-tonu.

The Cultural Impact Assessment has found that the current discharge from the Opononi Omapere Wastewater Treatment Plant in its present state is culturally unacceptable. The CIA supports the work completed by the Community Liaison Group thus far who have been instrumental in their efforts to add value towards finding an amicable solution to the discharging of treated wastewater.

An important component of the CIA is the relationship between tangata whenua and the harbour, and how this relationship influences the response by Hapu and Iwi to these activities such as the discharge of contaminants to water. Unfortunately, many members of our community have adopted an out of sight, out of mind mindset, not only in Opononi Omapere but throughout Aotearoa. As a result, in managing current loading, Hapu and Iwi recognize that there is no short term fix to re-diverting discharge to land and acknowledge that there are some hard decisions that need to be made in regards to the future upgrades, relocation of reticulation infrastructure, affordability and maintenance of the wastewater reticulation scheme.

It is the hope of participating Hapu and Iwi groups that the issues and recommendations highlighted in this report will provide a basis for improvements to occur and a platform for more robust relationships between all parties that have a vested interest in the future of Hokianga Harbour.

In as much as issues relating to the harbour are constantly raised at district and regional level the information held on file is considered to be passed the used by date. Tangata whenua unitedly agree that if significant improvements are to be made quality information is a pre-requisite. As a result, a comprehensive study of the harbour catchment including cultural impacts is considered a priority. However, for this to occur significant resourcing will be necessary.

Central Government's recent announcement to invest $700m into cleaning up waterways is considered to be a prime opportunity for both tangata whenua, key stakeholders, and crown agencies to work together to preserve this iconic heritage treasure. This in itself supports the principles of Te Tiriti and the key baseline values of Hapu and Iwi.

Hapu and Iwi groups acknowledge the fact that Council is well aware of the fact that the current discharge does not consistently meet compliance standards and that immediate improvements are required to bring this up to compliance standards, but are less informed as to how this will be carried out, what technology will be used, and when this will be carried out, given that there's been a recalibration of Capital Work Programmes, and a call from Council to carry out an assessment of the condition the of Council owned infrastructure assets.

Finally, it is important to acknowledge that a late submission was received from Ms Cheryl Turner et al dated 28th July, as this was received after the close of business that day, this submission was not included within the Cultural Assessment process.

As a matter of courtesy and to maintain amicable working relationships, a meeting was held with this group to ascertain their concerns. The three main points of contention identified were:

1) Reference to Nga Hapu o Ngati Korokoro

2) Change from overlapping boundaries to areas overlapping interests
3) Insertion of a new section on Te Takutai Moana.

As the above points are outside of the current contract further consultation would be required, this has not occurred and therefore the Cultural Impact Assessment does not include the late submission concerns.

11 ACKNOWLEDGEMENTS AND REFERENCES

11:1 Acknowledgements

Special acknowledgements are extended to the following individuals / organisations that have contribute their time and efforts towards the development of this document.

Andrea Carling Independent Assessor International Standards of Operations and Risk Management

Special recognition and commendation is expressed to Kaumatua, Kuia, Whaea and Children from the Omanaia Kura and Te Kura Takiwa o Hokianga who have given so gracious of their Matauranga Maori to infuse life and mana to this document. Your support is undeniably invaluable.

Hinerangi and Moka Puru	Marara Rogers-Koroheke
Hammond Ngaropo	Keli Trebilco
Children from the Omanaia Kura	Nga tamariki o Te Kura Kaupapa Maori O Hokianga

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Resource Maps

Northland Land District Territorial Authority Far North District

Memorandum

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Subject	Kohukohu Septage Management Review	Project Name	Opononi/Omapere and Kohukohu Options Assessment
Attention	Jaye Michalick	Project No.	IZ134400
From	Jessica Daniel		
Date	July 9, 2020		
Copies to	Jess Daniel, Melissa Parlane, Ben Bowden, Becky Macdonald, Kate Simmonds, Andrew Slaney		

1. Introduction

In February 2020 Far North District Council (FNDC) engaged Jacobs to review the current sludge management practices for the Kohukohu township. In Kohukohu, wastewater is partially treated by council owned septic tanks located on 76 properties, where primary sludge is removed, and some BOD treatment is achieved. The partially treated wastewater is then conveyed to the Kohukohu wastewater treatment plant (WWTP) which consists of a single oxidation pond followed by a constructed wetland. Treated effluent is then discharged into a catchment drain, which flows for a short distance before discharging into the Hokianga Harbour. Sludge accumulated at the bottom of each septic tank is digested by bacteria present inside the system, reducing its volume and organic content. This sludge is periodically removed by suction tanker and transported to the Rawene WWTP.

The existing resource consent for the Kohukohu WWTP expired on 31 August 2016. An application for a new resource consent was lodged with NRC in May 2016 and the WWTP has been operating under the old consent since that time. In January 2020 NRC issued a Section 92 request to FNDC for further information in relation to the application. This Section 92 request included a request for “an assessment of the effectiveness of the septic tank maintenance schedule and treatment plant desludging schedule” at Kohukohu.

This memorandum will address this Section 92 request by reviewing the current septage management and maintenance practices at Kohukohu and, where relevant, will make recommendations on possible improvements.

2. Kohukohu Township Septage Management

2.1 Review of Current Septage Management in Kohukohu

A request for existing information on desludging of the septic tanks did not uncover any documentation relating to desludging or sludge management. This was due, in part, to the Covid restriction meaning there was no access to paper records held by FNDC or their operations contractor. Hence information was gathered through phone interviews and email correspondence with Jaye Michalick, a planning consultant working with FNDC, and Tommy Gordon, a representative from the operations contractor (Broadspectrum). From these conversations the following was established:

- Septic tank desludging for the entire Kohukohu township is undertaken every 5 years by local vacuum/sucker truck contractor. The collected sludge is transported to the septage reception facility at the Rawene WWTP.
- There are both older and more modern style septic tanks within the township.
- The tanks were last emptied in April/May of 2019 and are currently not due to be desludged until 2024.
- Septic tank desludging is typically carried out across the entire township within a one-month period. The collected sludge is transported to Rawene WWTP and the sudden increase in sludge tends to destabilise the Rawene WWTP for a period.
- Tank inspections had been implemented initially but have not been continued on a regular basis.
- Total suspended solids (TSS) and faecal coliform (FC) loadings at the Kohukohu WWTP reduce after desludging, mostly likely due to the increased capacity of the de-sludged septic tanks.
- Over the past 10 years, the wet weather peaking factor for the Kohukohu WWTP was 15 x, most likely due to infiltration or stormwater connections to the septic tanks.

2.2 Existing Septic Tank Bylaws

There are a number of clauses in the FNDC Bylaw for the “Control of On-site Wastewater Disposal Systems” that are relevant to the maintenance and disposal of Kohukohu septage. Clause 2803 of the bylaw (Far North District Council, 2010) is summarised in Table 2-1 and Clause 2806 is summarised in Table 2-2. FNDC’s compliance with these bylaws is also highlighted, although it should be noted that this assessment is based on the information obtained to date. It is evident from the information regarding septic tank maintenance and assessment provided, and the levels of compliance of the bylaws, that FNDC would benefit from the development of septage management plan for Kohukohu.

Table 2-1 Clause 2083 – Control of Onsite Wastewater Disposal Systems

Point No.	Clause Details	FNDC Compliance
1.	Council requires that every On-Site Wastewater Disposal system of a septic tank, or similar type system, be assessed, and if necessary, maintained at periods of not more than five yearly intervals.	Achieved – desludging is completed on a 5-year cycle.
2.	The owner of the property on which an on-site wastewater system is installed, is required to have assessments and maintenance carried out in accordance with the manufacturer’s instructions and recommendations.	Not achieved – there is no evidence that a system is in place to monitor the property owner maintenance. As the Kohukohu septic tanks are council owned FNDC should be responsible for this.
3.	The maintenance requirements to consist of the cleaning of the tank and a full site assessment, as detailed in the Second Schedule.	Not achieved – there is no evidence that a system is in place to monitor the property owner maintenance
4.	Council may give notice to the owner of the land on which the On-Site Wastewater Disposal System is located, requiring the owner to carry out such work, at the owners cost.	Not achieved – there is no evidence of a programme for regular inspections of individual septic tanks. As the Kohukohu septic tanks are council owned FNDC should be responsible for this.

Table 2-2 Clause 2806 – Supply and Keeping of Records

Point No.	Clause Details	FNDC Achievement
1.	Every owner of a property on which an On-Site Wastewater Disposal system is installed shall provide evidence to Council in the form of a certificate from the contract cleaner, to show that their disposal system has been assessed and maintained in accordance with clause 2805.1 of this Bylaw.	Not achieved – there is no evidence that a system is in place to monitor the property owner maintenance. Where FNDC has arranged cleaning, a copy of the cleaning certification should be put on the property PIM.

2.3 Consequences of the Current Management System

The current septic tank management at Kohukohu does not meet the requirements of the Bylaw and a number of potential consequences have been identified:

- As the septic tanks fill with sludge, there is expected to be increased carry-over of total solids and BOD. This will increase sludge volumes at the WWTP increasing the necessity for dredging of the pond and negatively impacting the treatment performance of the Kohukohu WWTP.
- As the septic tanks fill with sludge the high level of sludge can generate unpleasant odours and attract pests (AS/NZS, 2012).
- The high wet weather peaking factor suggests there is either groundwater infiltration, or stormwater connections to the septic tanks. If the flows are due to stormwater connections, these high flows will result in low retention times in the septic tank and potentially “flushing” of the system. This can result in sludge carryover from the septic tanks, increasing the load on the WWTP.
- Desludging all of the septic tanks in the Kohukohu township over a 1-month period can shock load and destabilise the Rawene WWTP which receives the sludge for treatment.
- A lack of maintenance records, including desludging procedures, makes it difficult to understand the effectiveness of desludging, the septic tanks condition and performance, and the impact of these on the performance of the WWTP.
- Currently the FNDC Bylaw for the “Control of On-site Wastewater Disposal Systems” is not actively enforced, making it difficult to understand how well managed the septic tanks are by the property owners.
- The Bylaw assumes the property owner is also the owner of the septic tanks, which is not the case for Kohukohu.

3. Guidance from New Zealand Authorities

3.1 Water NZ

Water NZ have recommended guidelines for the management of septic tanks, including guidance on maintenance and tank desludging schedules (Water New Zealand, 2012), which is summarized in Table 3-1.

Table 3-1 Water NZ Septic System Maintenance and Inspection Guidelines

Treatment System Type	Inspection and Maintenance Requirements
Older style septic tank	▪ Pump-out at 3-year intervals ▪ Alternatively, check scum and sludge levels and pump-out on demand (around half full of scum and sludge)
Modern septic tank with effluent outlet filter	▪ Check scum and sludge levels (2-yearly) and pump out on demand (around 6 to 8 years) ▪ Check and hose down effluent outlet filter during pump out
Aerobic treatment unit (aerated system)	▪ Periodic effluent quality "sniff and look" inspection (6-months) ▪ Check power consumption (3-months) ▪ Carryout equipment service check at 6-months (as specified in the supplier/installer maintenance contract)
Septic tank/sand filter system	▪ Periodic effluent quality "sniff and look" inspection (6-months) ▪ Confirm sand is draining satisfactorily and not clogging (12-months) ▪ Replace upper sand layer if draining slowly (as required) ▪ Carryout equipment service check at 6-months (as specified in the supplier/installer maintenance contract)

3.2 AS/NZS 1547

The AS/NZS 1547 standard for Onsite Domestic Wastewater Management (AS/NZS, 2012) recommends the following maintenance measures for septic tanks:

1) Annual inspection and regular pumping once scum and sludge occupy two thirds of the tank volume
2) Grease tap should be inspected at least quarterly and cleaned out regularly
3) The vent and access cover of the septic tank should be exposed
4) The outlet filter should be inspected and serviced in accordance with manufacturer recommendations

3.2.1 Other Councils

Guidance from other councils, such as Waimakariri District, Auckland and Taranaki regional councils, generally follow the guidelines proposed by Water NZ and AS/NZS 1547 with regards to frequency of desludging and inspections (Waimakariri District Council, 2015-2018) (Taranaki Regional Council & Nortland Regional Council, 2006) (Auckland Council). These councils have also produced very clear maintenance produces and measures to lower sludge volumes and keep bacterial populations high to aid treatment performance. FNDC would likely benefit from a similar approach to onsite septage maintenance, regardless of whether the septic tanks are owned by FNDC or the individual property owner.

4. Recommended Improvements to the FNDC Septage Process

The review of the available information on the Kohukohu township septic tank maintenance and desludging schedules has identified a number of improvement opportunities:

- The development of a Septage Management Plan for Kohukohu which would align with New Zealand standards and guidelines from Water NZ and be comprised of the following improvements:
  - Increased septic tank inspections – Establish protocol for regular septic tank inspections, by FNDC as the owner of the tank, including frequency, and method of inspection, with documented evidence that this has been completed. This will provide a mechanism for identifying site specific issues such as and poor maintenance and the potential for stormwater connections. FNDC should also clearly relay to Kohukohu residents, proactive measures and guidelines for proper septic tank operation. AS/NZS 1547 (AS/NZS, 2012) advises the following:
  - Increased desludging of septic tanks – Older tanks should be emptied at least every 3 years and newer systems emptied every 5 years or tanks emptied once sludge levels reach two thirds of the total volume.
  - Improved record keeping and development of standard procedures for the desludging of septic tanks (see example in Appendix A).
- Maintenance records and documentation should be retained by FNDC as evidence of the annual inspection
- An assessment of the age and design of individual septic tanks should be undertaken to identify older tanks that require 3 yearly desludging and newer tanks which require 5 yearly desludging.
- Staging sludge disposal at the Rawene WWTP – To avoid shock loading at the Rawene WWTP disposal at the WWTP should be staged, so that desludging occurs on approximately 20% - 30% of the properties every year and is spread over the whole year, rather than a 1-month period.
- In addition to the development of a Septage Management Plan for Kohukohu, FNDC should consider updating the Bylaw "Control of On-site Wastewater Disposal Systems" to clarify the responsibility for maintenance and cleaning of on-site septic systems. Specifically does this sit with the property owner or the owners of the septic tanks.

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Appendix A - AS/NZS Monitoring Records Templates

MONITORING REPORT
ON-SITE WASTEWATER MANAGEMENT SYSTEM
SITE INFORMATION
(available from records of regulatory authority and other sources)

1.0 COUNCIL OR AUTHORITY

1.1 Location details

Locality: ....

Owner: ....

Lot no: .... Address: ....

Phone: .... Mobile: ....

Site plan ref no. or description: ....

Grid reference E: N:

Aerial photo details:.................................... Topographic map no:....................................

Orthophotomap no: ....

1.2 Geology of site

1.3 Soil terrain and soil type

Data source used:

1.4 Climate

Annual rainfall: ....mm Annual evaporation: ....mm

General description of seasonal variations, rainfall intensities, and so on

1.5 Water supply

Public supply ☐ Rainwater ☐ Bore/well/dam ☐

1.6 Performance of this system

Years in service: .... Years of monitoring records: ....

Years satisfactory service: .... Years problems evident: ....

Causes of problems recorded or reported: ....

Details of reports prepared on this on-site system: ....

1.7 Preliminary assessment of sustainability of on-site system:

FIGURE U1 MONITORING FORM – SITE INFORMATION

SUSTAINABILITY REPORT
ON-SITE WASTEWATER MANAGEMENT SYSTEM
ON-SITE ASSESSMENT

(Attach site plan, photographs, and results of any site tests)

2.0 CONDITIONS DURING ASSESSMENT

Date/s: ....
Weather (on day and preceding week): ....

2.1 Reason for on-site assessment
(such as regular monitoring, report of failure or incipiet failure, complaint):

2.2 Description of indications of successful operation or problems
(if space insufficient, attach separate sheet):

2.3 Soil and terrain (where not confirmed)
Type of terrain: ....
Geology: ....
Soil landscape and drainage: ....
Slope: .... Ground cover: ....

2.4 Site constraints (show details on site plan)
Adequacy of boundary clearances: ....
Distances to watercourses, water bodies, wells, bores, or drainable lines downhill: ....
High water table (permanent, seasonal, episodic): ....
Downstream embankments, barriers or other impedances to drainage: ....
Buildings: ....
Unstable soils: ....
Other (specify): ....
Native plants intolerant of high nutrient load: ....

2.5 Site exposure
Site aspect: ....
Predominant wind direction: ....
Presence of shelter belts, trees, or shrubs: ....
Presence of topographical features or structures: ....

2.6 Drainage controls
Cut-off drains, diversion banks, storages: ....

2.7 Reserve areas
Area available: ....
% of land application area: ....

FIGURE U2 MONITORING FORM – ON-SITE ASSESSMENT

Semi-quantitative microbial human health risk assessment of Kohukohu WWTP discharge in the Hokianga Harbour

Action	Personnel	Version	Date
Preparation of draft for internal review	Chris Dada (SEL)	1.0	29th May 2020
Internal technical review	Mike Stewart and Ngaire Phillips (SEL)	1.0b	10th June 2020
Preparation of final draft for client review	Chris Dada (SEL)	2.0	4th June 2020
Client review of final draft	Jaye Michalick and Ruben Wylie (FDC)	2.0b	20th August 2020
Preparation of final report	Chris Dada (QDE)	3.0	27th August 2020
Review of final report	Mike Stewart	4.0	28th August 2020
Preparation of final for client review	Chris Dada (QDE)	5.0	28th August 2020
Client review of final report	Jaye Michalick and Ruben Wylie (FDC)	5.0b	8th September 2020
Preparation of final for release	Mike Stewart	6.0	8th September 2020
Approval of final report	Mike Stewart	6.0	9th September 2020

Report FDC2001-Final v6.0
Prepared for Far North District Council
August 2020

Dada A.C (2020). Semi-quantitative microbial human health risk assessment of Kohukohu WWTP discharge in the Hokianga Harbour. FDC 2001- Final v6.0, Streamlined Environmental, Hamilton, 46 pp.

*Dr Christopher Dada currently works as an Environmental Health/Water Quality Specialist at QMRA Data Experts.

Contents

Executive Summary

As part of the process of renewing the resource consents for the Kohukohu Wastewater Treatment Plant (WWTP) marine shoreline discharge into Hokianga Harbour, a microbial human health risk assessment is required to address the enteric illness risks related to contact recreation and consumption of harvested shellfish.

As such, Far North District Council (FNDC) has contracted Streamlined Environmental Ltd (SEL) to provide a semi-quantitative microbial human health risk assessment for the current discharge of treated wastewater from Kohukohu WWTP to the Hokianga Harbour.

The study used an approach that:

- Applies faecal indicator bacteria (FIB) – namely enterococci for contact recreation, *Escherichia coli* (*E. coli)* in shellfish tissues, and faecal coliforms (FC) for shellfish-gathering waters – as "conservative" proxies of pathogens relevant to public human health risks.
- Relies on the dilution factors generated by a three-dimensional hydrodynamic model, which predicts the fate of the wastewater analyte in the environment (in terms of dilution only) following discharge of treated wastewater from the Kohukohu WWTP.
- Assesses the impact of the wastewater discharge in terms of elevation of enterococci and FC concentrations in the receiving environment, by specifically not including and including background concentrations, respectively.
- Assesses whether this increase in FIB will cause the receiving environment water to breach existing guidelines for contact recreation or shellfish-gathering.

In consultation between SEL and staff at FNDC, 12 key sites were identified in the Hokianga Harbour for recreational water contact and harvesting of shellfish. These sites could be potentially impacted because of wastewater discharge (see Figure ES1; sites 1-12).

We assessed recreational health risk and shellfish harvesting health risk based on the currently consented limits and on worse case scenarios (95th percentile of historic data), under El Niño and La Niña conditions.

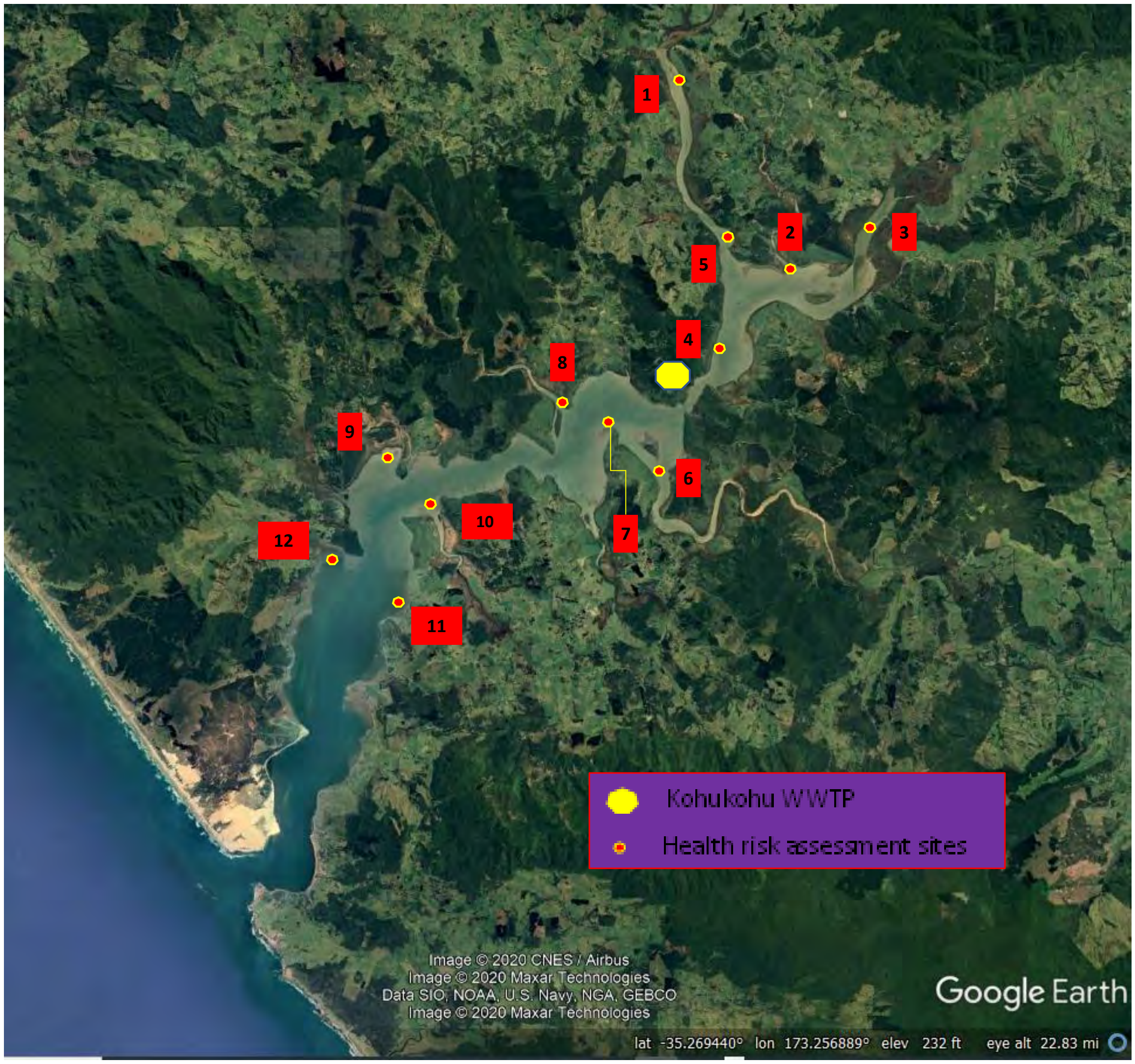

Figure ES1. Location of the 12 selected exposure sites in the Hokianga Harbour.

Recreational health risk

Results from this study show that enterococci in the current Kohukohu WWTP discharge with a worst-case (95th percentile) concentration of 24,400 CFU/100mL <u>does not negatively impact recreational water quality.</u> Based on dilutions occurring in the Hokianga Harbour, increases in faecal coliform in the receiving water due to the discharge from Kohukohu WWTP – even during the worst-case scenario – is +1 CFU/100mL. Additionally, enterococci concentrations at all 12 upstream and downstream sites considered in this study did not exceed the 140 CFU/100mL limit specified for “Acceptable/Green (surveillance) Mode” in the MfE/MoH (2003) policy document.

Shellfish harvesting health risk

The quality of shellfish at the Hokianga sites currently does not meet the New Zealand Food Safety Authority (NZFSA) 2006 guidelines. As stated above, based on the worst-case scenario of Kohukohu WWTP discharge the maximum change in faecal coliform in the receiving water is + 1 CFU/100mL. Given this negligible change in water quality, the discharge is not expected to significantly affect shellfish quality.

1. Introduction

As part of the process of renewing the resource consents for the Kohukohu Wastewater Treatment Plant (WWTP) marine shoreline discharge into Hokianga Harbour, a microbial human health risk assessment is required to address the enteric illness risks related to contact recreation and consumption of harvested shellfish.

As such, Far North District Council (FNDC) has contracted Streamlined Environmental Ltd (SEL) to provide a semi-quantitative microbial human health risk assessment for the discharge of treated wastewater from Kohukohu WWTP to the Hokianga Harbour.

This report is presented into topical sections. Section 2 presents a discussion on the microbial characteristics of the Kohukohu WWTP discharge water in relation to existing resource consent limits, based on historical and current monitoring data. Section 3 discusses the microbial characteristics of the receiving environment in relation to existing New Zealand guidelines as stipulated in the Ministry of Health (MoH) 2003 microbiological water quality guidelines for marine and freshwater recreational areas (MfE/MoH, 2003). Section 4 presents a summary of the health risk assessment methodology, scenarios assessed and results. Section 5 presents conclusions, while Section 6 presents limitations of the study and recommendations for further studies and monitoring.

2. Characteristics of the Kohukohu WWTP discharge water

2.1 Discharge volumes of Kohukohu WWTP effluent

Analysis of Kohukohu WWTP flow monitoring data (2011-2019), provided by FNDC, indicates that:

- Effluent flow[1] ranged from 0.01 m^3/day to 610 m^3/day, with an overall median of 27 m^3/day (Table 1).
- For the majority (99%) of the time, when rainfall is below 50 mm, the effluent flow rate was below 154 m^3/day (Table 1).
- During conditions of significant rainfall exceeding 50 mm (Table 1), effluent flow rate increases by more than 5-fold above median flow rate. The cause of the increased flows is infiltration into the wastewater reticulation network, which is typical for most wastewater networks.
- The highest historical flow rates of 603 m^3/day and 610 m^3/day were recorded in summer 2011 when either daily rainfall or 24-hr antecedent rainfall exceeded 150 mm (Table 1).
- Aside from the significant rainfall events in the summer of 2011, in other years the maximum effluent flow rate recorded was 228 m^3/day.
- Effluent flow was generally lower during summer than during other seasons. For instance, during summer, 50% of the time, effluent flow rate did not exceed 13 m^3/day (compared to 27 m^3/day compared with annual flow rates, see Table 2).

[1] Kohukohu WWTP Flow - constructed wetland discharge (CWL) Out.

Table 1. Percentile distributions of annual Kohukohu WWTP influent and effluent flow rate, as well as 24-hr antecedent rainfall.

Statistic	Kohukohu WWTP Flow - Plant In [m^3/day]	Kohukohu WWTP Flow - CWL Out [m^3/day]	Rainfall - Plant [mm/day]	Antecedent 24-hr rain [mm/day]	Antecedent 48-hr rain [mm/day]	Antecedent 72-hr rain [mm/day]
Minimum	0.00	0.01	0.00	0.00	0.00	0.00
10th Percentile	12	3.0	0.00	0.00	0.00	0.00
20th Percentile	16	9.0	0.00	0.00	0.00	0.00
30th Percentile	18	15	0.00	0.00	0.00	0.00
40th Percentile	20	21	0.2	0.2	0.2	0.2
50th Percentile	23	27	0.4	0.6	0.4	0.4
60th Percentile	27	34	1.6	1.8	1.6	1.6
70th Percentile	32	44	4.0	4.0	3.8	3.8
80th Percentile	39	58	7.6	7.6	7.6	7.4
90th Percentile	53	87	15	15	15	15
95th Percentile	72	109	23	23	23	23
99th Percentile	128	154	49	49	49	49
Maximum	326	610	172	172	172	172

Table 2. Comparison of percentile distributions of summer and annual Kohukohu WWTP effluent flow rate.

Statistic	Kohukohu WWTP effluent flow [m^3/day]	
	Annual	**Summer**
Minimum	0.01	0.01
10th Percentile	3.0	1.0
20th Percentile	9.0	3.0
30th Percentile	15	5.5
40th Percentile	21	9
50th Percentile	27	13
60th Percentile	34	17
70th Percentile	44	23
80th Percentile	58	34
90th Percentile	87	57
95th Percentile	109	90
99th Percentile	154	132
Maximum	610	610

2.2 Analysis of wastewater quality data

Analysis of long-term monitoring data (2010-2019) shows that the Kohukohu WWTP discharge water FC concentrations ranged from 27 to 1.14×10^5 CFU/100mL (Table 3), with a 95th percentile concentration of 2.44×10^4 CFU/100mL (Table 3). At least 50% of the time, monthly FC concentrations were below 900 CFU/100mL (Table 3).

Table 3. Descriptive statistics: Kohukohu constructed wetland discharge (CWL) water monthly and 5-month running median FC concentrations.

Statistic	FC, monthly [CFU/100 mL]	FC, 5-month running median [CFU/100 mL]
Minimum	27	100
10th Percentile	100	200
20th Percentile	200	400
30th Percentile	300	400
40th Percentile	475	582
50th Percentile	900	800
60th Percentile	1,800	1,800
70th Percentile	2,520	2,190
80th Percentile	5,000	2,360
90th Percentile	13,200	4,590
95th Percentile	24,400	7,663
99th Percentile	56,400	10,000
Maximum	114,000	10,000

2.3 FC comparison with existing consent condition limits

Condition 5 of the current resource consent (Consent No. CON20010383901) stipulates that:

- The median concentration of faecal coliforms, based on the five most recent samples from the Northland Regional Council (NRC) Sampling Site 323 should not exceed 5,000 per 100mL, or;
- The concentration of faecal coliforms in any one sample collected from the NRC Sampling site 323 should not exceed 15,000 per 100 mL.

Seven (7) of the 86 samples collected between 2010 and 2020 exceeded the consent monthly limit (~92% compliance level), while five (5) samples exceeded the consent five-monthly rolling median limit (~94% compliance level) (Figure 1).

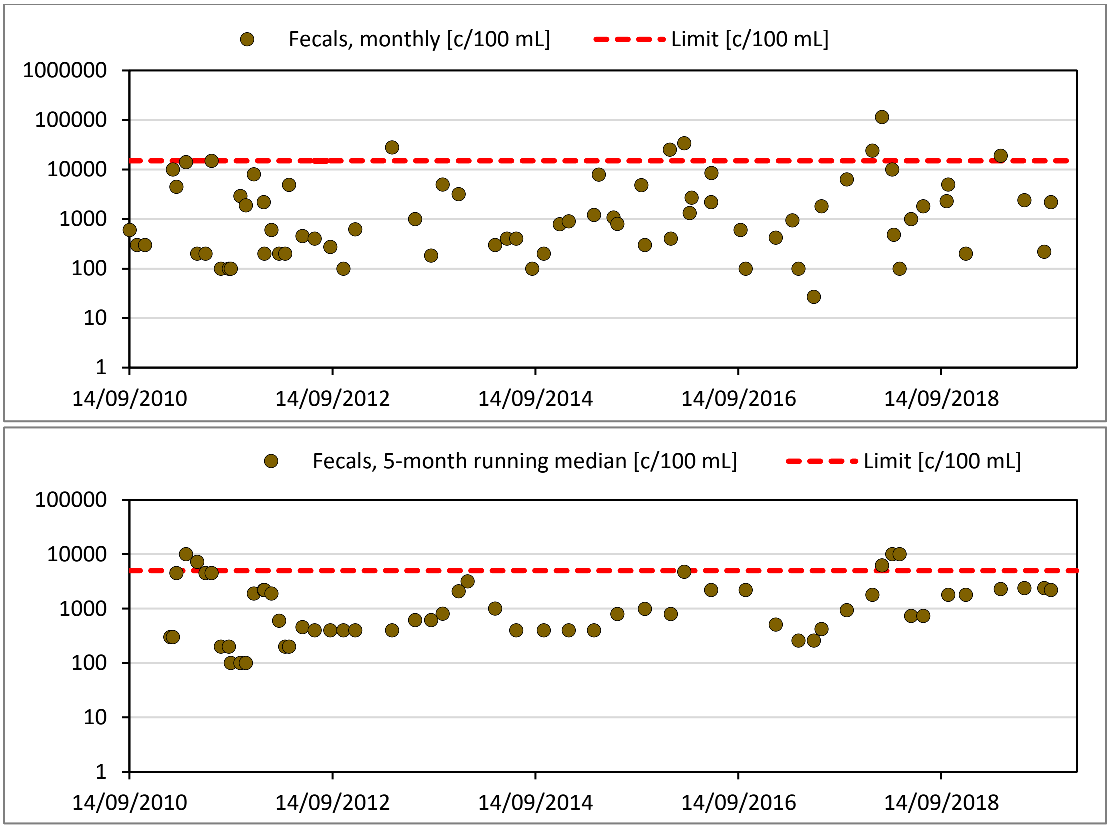

Figure 1. Compliance based on Kohukohu WWTP discharge water (2011-2019). Monthly FC concentrations (top), five-month rolling median FC concentrations (bottom).

The frequency of non-compliance with respect to the consent monthly limit appears to have slightly increased over the last decade (Figure 2). However, compliance with respect to consent five-month rolling median limit has been 100% for 8 years, with the notable exception of samples collected in the summer of 2011 (85% compliant) and 2018 (73% compliant) (Figure 2).

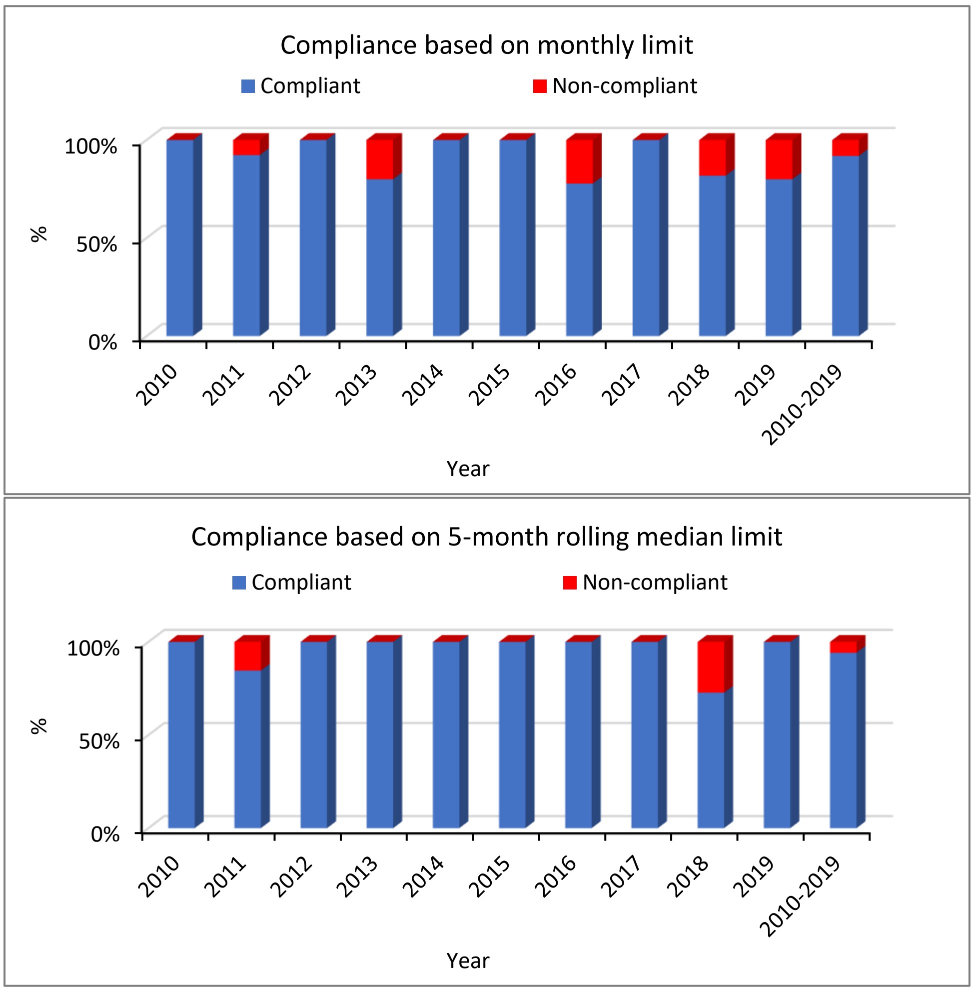

Figure 2. Annual proportion of single sample FC exceeding the 15,000 CFU/100mL monthly limit (top) and 5,000 CFU/100mL five-month rolling median (bottom) for Kohukohu WWTP discharge water (2011-2019).

3. Microbial characteristics of the aquatic receiving environment

Covering approximately 15,414 ha, the Hokianga Harbour is the fourth largest harbour in New Zealand (NRC, 2013). The harbour entrance has been classified as having high salinity, oceanic water, strong currents, high water clarity and short water residence times (NRC, 2013). Previous studies have shown that two major water quality issues exist in the harbour; excessive siltation and water discolouration from accelerated erosion and bacterial pollution from sewage disposal and pastoral run-off (NRC, 2013).

In terms of the Kohukohu WWTP discharge and from a compliance perspective, important receiving environment sites are described below. The receiving environment immediately downstream of the discharge has Site 231 as a compliance site (Figure 3). The outer receiving environment has other locations in the tidally influenced Hokianga Harbour that could potentially be affected by discharge from this WWTP. Microbial characteristics of the immediate and outer receiving environment, in relation to existing guidelines and consent conditions are presented in Sections 3.1 and 3.2, respectively.

Figure 3. Compliance monitoring points identified in the existing consent.

3.1 Immediate receiving environment (Site 231)

Notwithstanding the quality of the discharge stipulated in Condition 5, Condition 7 of the existing resource consent makes additional provision for receiving water quality monitoring at Site 231 in the Hokianga Harbour. According to the consent document, based on no fewer than 10 (ten) samples taken over any 30-day period:

- The median concentrations of the FC bacteria in the water at Site 231 shall not exceed 14 per 100mL, and;
- The 90th percentile concentration shall not exceed 43 per 100 millilitres.

There has been no historic monitoring at this site.

3.2 Outer receiving environment

Aside from Site 231, a number of other sites which are downstream of the discharge could potentially be impacted by the treated effluent, hence the need to consider FIB concentrations at sites other than Site 231. However, it is important to note that, depending on tidal conditions, these outer sites can also be affected by discharges from other WWTPs discharging into the Hokianga Harbour, such as Kaikohe, Opononi and Rawene WWTPs.

3.2.1 Recreational water quality

As part of the Northland region's coastal monitoring exercise, NRC has conducted short-term monitoring of water quality at several sites within the vicinity of the discharge in the Hokianga Harbour, namely:

- A monitoring programme at 16 sites in the Hokianga Harbour between June 2009 and June 2010 (Figure 4).[2]
- Monitoring of 11 sites in the Hokianga Harbour was undertaken in 2013 to assess water quality (Figure 5) (NRC, 2013).

Samples were analysed monthly for FIB (*E. coli*, enterococci and faecal coliforms) and concentrations compared to available MfE/MoH guidelines, which propose a three-tier management framework based on enterococci indicator values, i.e. surveillance (green), alert (amber) and action (red) modes (Table 4). While the surveillance mode involves routine (e.g. weekly) sampling of bacteriological levels, the alert mode requires investigation of the causes of the elevated levels and increased sampling to enable the

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[2] https://www.nrc.govt.nz/resource-library-archive/environmental-monitoring-archive2/state-of-the-environment-report-archive/2011/state-of-the-environment-monitoring/our-coast2/coastal-water-quality/#Harbour

risks to bathers to be more accurately assessed. The action mode requires the local authority and health authorities to warn the public that the beach is considered unsuitable for recreation (Table 4).

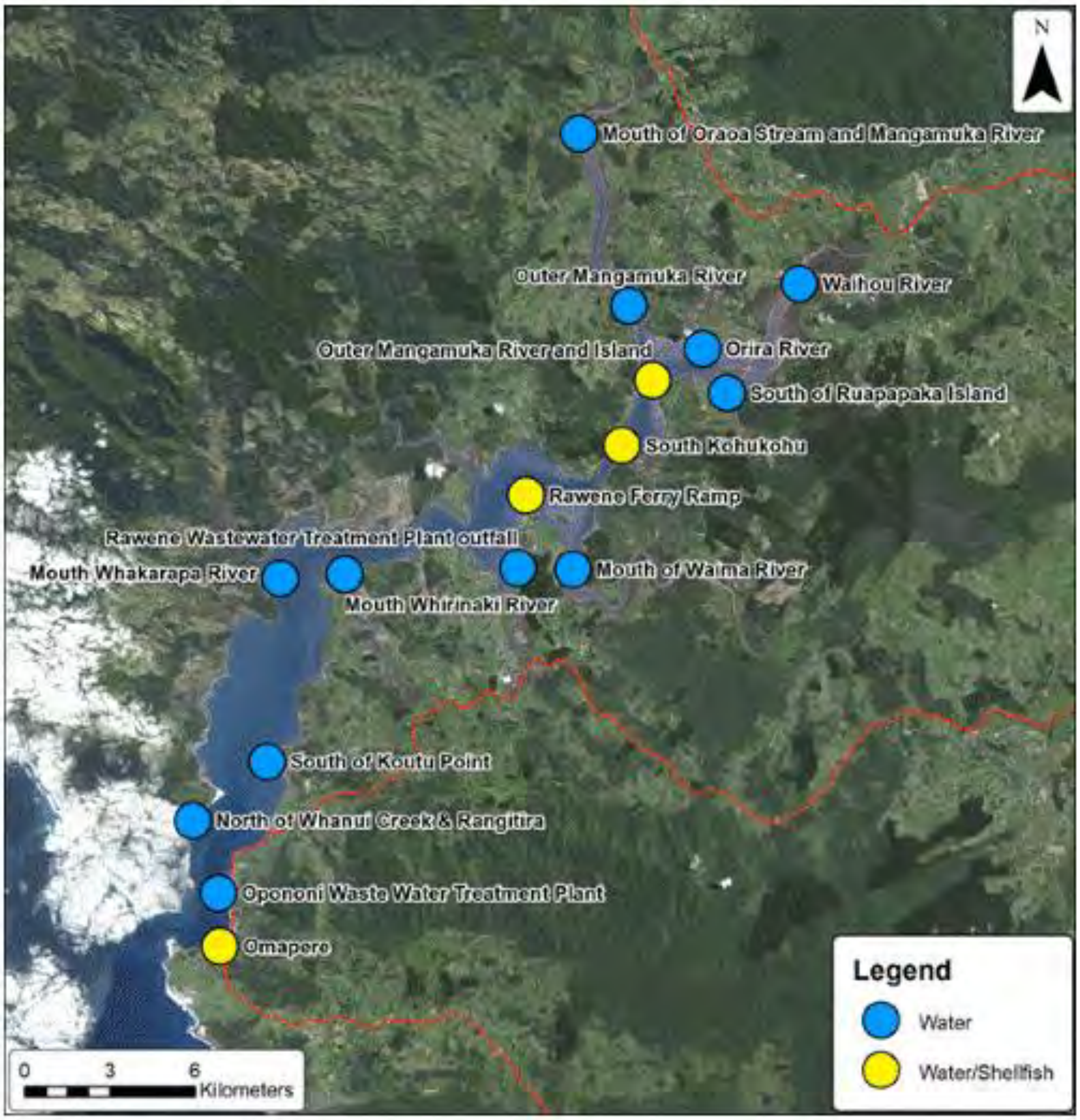

Figure 4. NRC Hokianga Harbour water quality monitoring sites (June 2009-2010).[2]

Figure 5. NRC Hokianga Harbour water quality monitoring sites (2013 monitoring (NRC, 2013)).

Table 4. Surveillance, alert and action levels for marine waters (MfE/MoH, 2003).

Microbiological Assessment Category (MAC)	Threshold	Implication
Acceptable/Green (surveillance) Mode	No single sample greater than 140 enterococci/100 mL	Continue routine (e.g. weekly) monitoring.
Alert/Amber Mode	Single sample greater than 140 enterococci/100 mL.	Increase sampling to daily (initial samples will be used to confirm if a problem exists). Undertake a sanitary survey and identify sources of contamination.
Action/Red Mode	Two consecutive single samples (resample within 24 hours of receiving the first sample results, or as soon as is practicable) greater than 280 enterococci/100 mL.	Increase sampling to daily (initial samples will be used to confirm if a problem exists). Undertake a sanitary survey and identify sources of contamination. Erect warning signs and inform public through the media that a public health problem exists.

Results obtained in the 2009-2010 monitoring showed that the levels of FIB were usually within the MfE/MoH guidelines for swimming/contact recreation (Figure 6).[2]

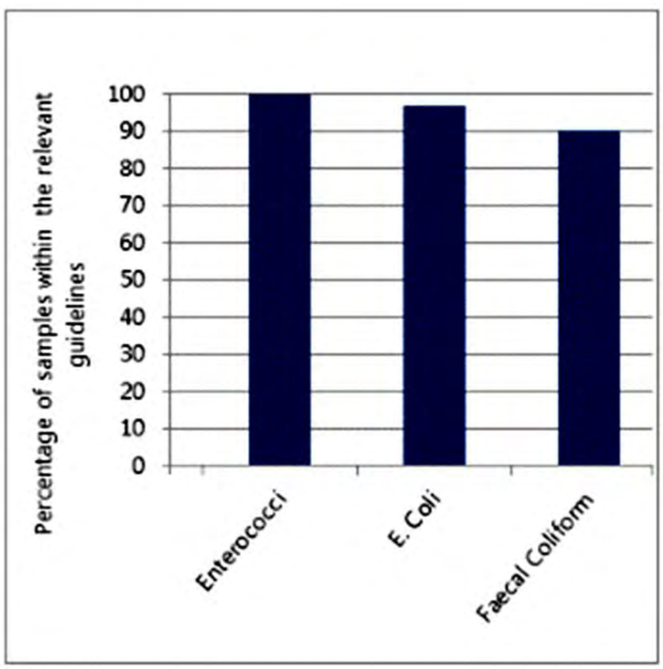

Figure 6. Hokianga Harbour water quality compliance results (2009-2010[2]).

Results obtained in the 2013 monitoring also showed that the levels of FIB were usually within the MfE guidelines for swimming/contact recreation (Figure 7). According to NRC, the total range was from 5 to 41 MPN/100mL for enterococci and 1 to 42 CFU/100mL for faecal coliforms. For eight of eleven sites enterococci levels were below detection limits (5 MPN/100mL) and the remaining sites were within guideline values. The highest reading was 41 MPN/100mL at the upper Mangamuka at Tetekuha (NRC, 2013).

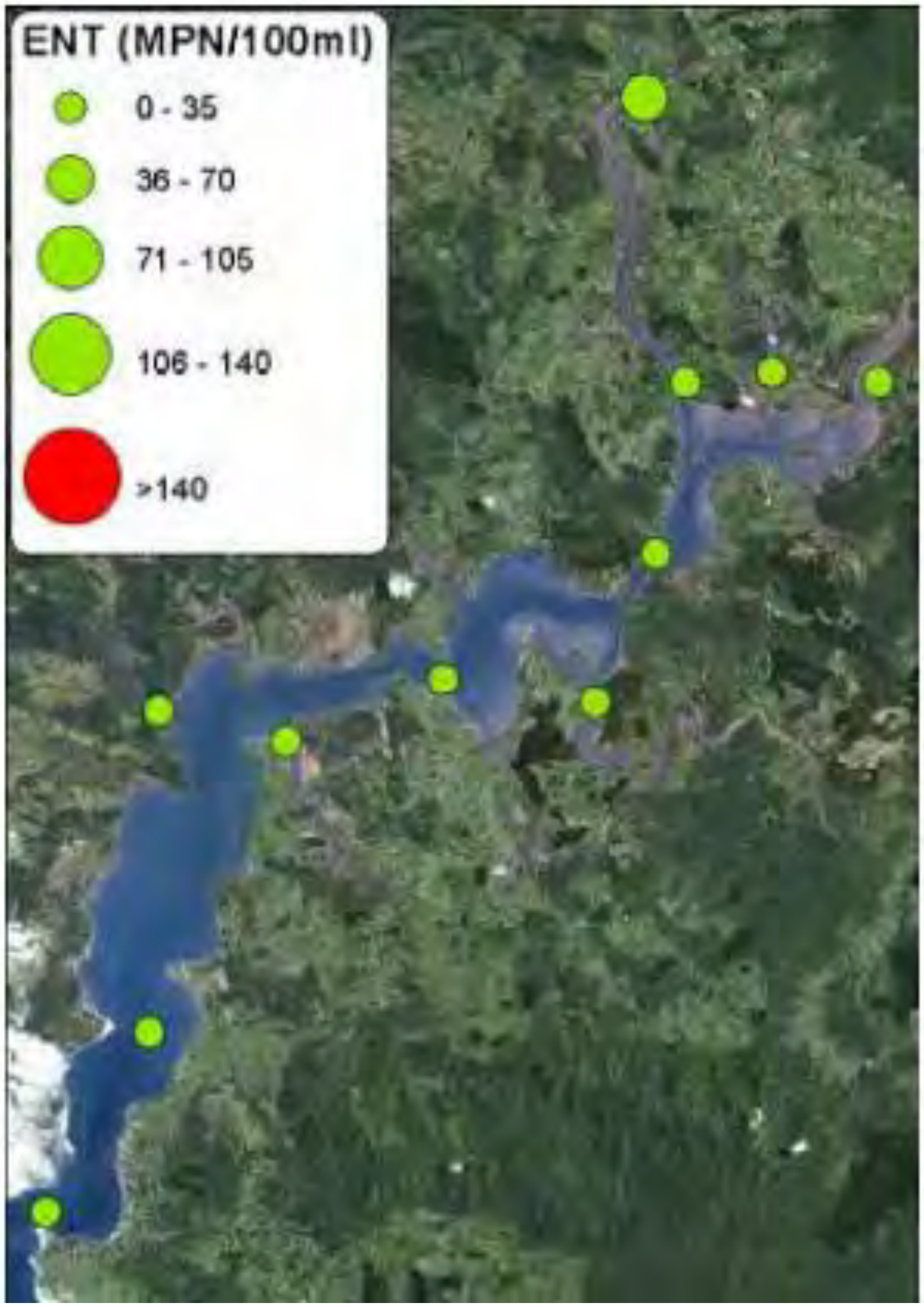

Figure 7. Enterococci levels (MPN/100mL) in the Hokianga Harbour, 2013 sampling.

Aside from results presented in existing reports above, I also assessed historical data routinely collected by the NRC. Available water quality data[3] for the CR3-SF3 site (i.e. Omapere at Old Wharf Road, downstream of the Opononi WWTP discharge) and Hokianga Harbour Opononi LAWA (upstream of the Opononi WWTP discharge) sites indicates that only low health risk exists at these sites if used for recreational bathing. For instance, the 5-year 95th percentile enterococci concentration for Omapere at Old Wharf Road and Hokianga Harbour Opononi are 52 enterococci/100 mL and 70 enterococci/100 mL, respectively[4]. These concentrations are marginally above the threshold for sites classified as A in terms of the Microbiological Assessment Category (MAC) guidelines (Table 4), hence are classified as B. While there are no data on a recent Sanitary Inspection Category (SIC) for these sites, other potential contaminant sources (such as urban runoff, streams draining catchments, etc.) may lead to reduced water quality during storm events. This was reflected in the enterococci data routinely collected by NRC at CR3-SF3 site. For instance, enterococci concentrations at CR3-SF3 site generally did not exceed the acceptable[5] single sample threshold of 140 enterococci/100 mL (Green mode, see upper image in Figure 8), except in one instance on the 3rd of December 2018 *when a lot of storm water was released onto the beach*[6] (observed concentration on storm event day = 680 enterococci/100 mL).

[3] Northland Regional Council has routinely monitored bathing sites, including coastal sites that are upstream and downstream of the Opononi WWTP (i.e. Hokianga Harbour Opononi and Omapere at Old Wharf Road, respectively). While data at the Omapere at Old Wharf Road site has only been collected since 2018, enterococci data has since 2009 been collected at the Hokianga Harbour Opononi site. In terms of the Microbiological Assessment Category (MAC) guidelines (MfE/MoH 2003), enterococci <40 cells/mL =Band A, >40 and <200 cells/mL =Band B, >200 and <500 cells/mL =Band C and >500 cells/mL = Band D.

[4] 2014/15-2019/20 bathing seasons, although Omapere at Old Wharf Road site has only been collected from 2018.

[5] The most recent data (5 year long, 2014-2019) are herein analysed in relation to the guidelines stipulated in MfE/MoH (2003), see Table 4 .

[6] Comments attached to Enterococci data recorded by NRC.

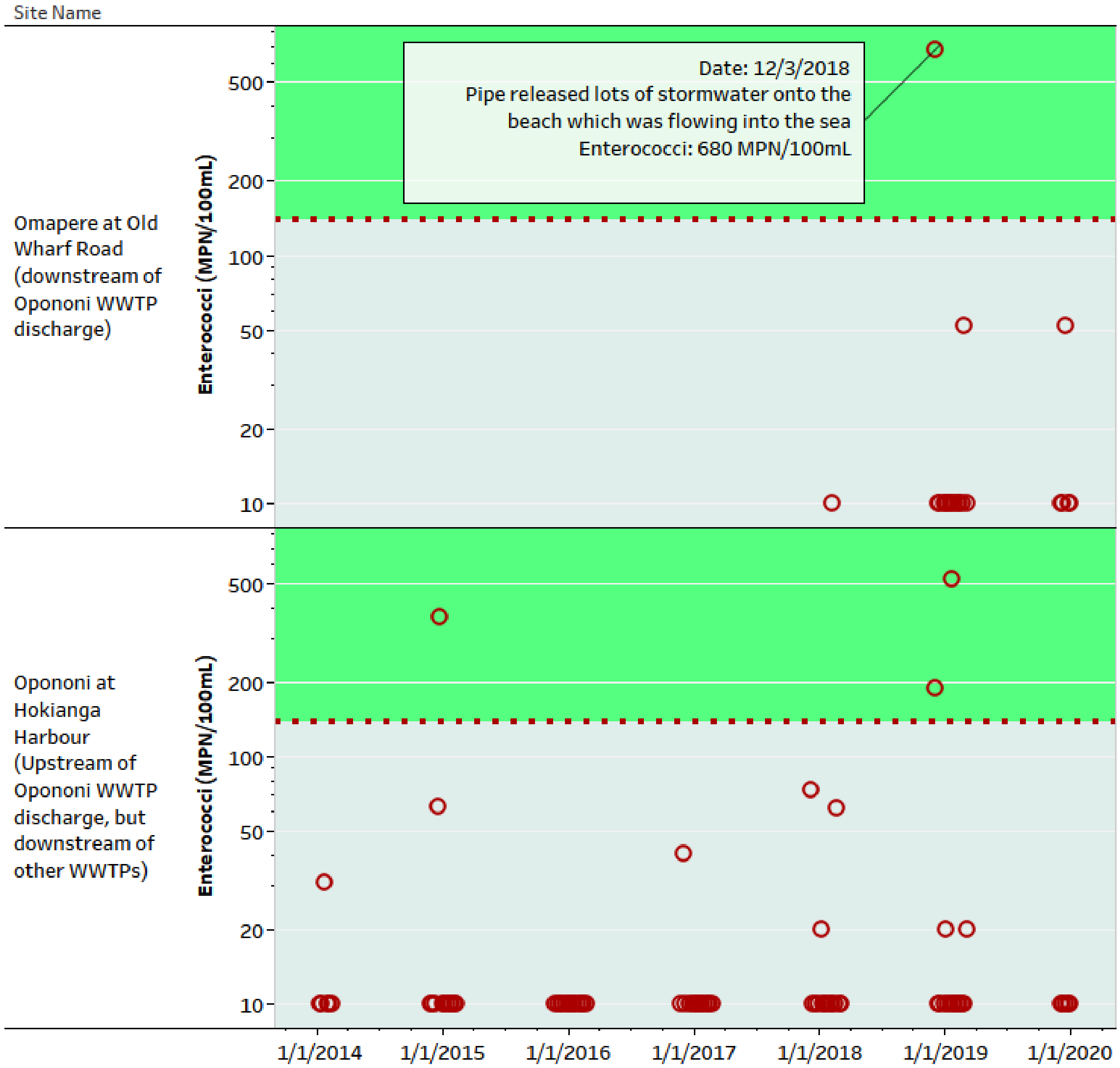

Figure 8. Enterococci concentrations of water samples collected at the Omapere at Old Wharf Road (upper image) and Hokianga Harbour Opononi (lower image) sites. Samples with enterococci concentrations below the acceptable enterococci concentrations of 140 enterococci/100 mL (Green mode) for marine waters are shaded in light blue, otherwise green[7].

[7] While enterococci data at the Omapere at Old Wharf Road site has only been collected since 2018, enterococci data has been collected since 2009 at the Hokianga Harbour Opononi site. Also, there are no data on sanitary inspection categories of the assessment site. Hence, I was not able to analyse the enterococci data based on MfE/MoH (2003) criteria using Microbiological Assessment and Sanitary Inspection Categories (MAC-SIC). Hence, the MfE/MoH (2003) criteria based on surveillance, alert and action levels for marine waters were adopted.

3.2.2 Shellfish microbiological quality

There are no provisions in the existing consent for shellfish tissue monitoring at the shellfish-gathering sites in the receiving environment. Nevertheless, an analysis of shellfish quality is important to assess the effects of the discharge on aquatic foods as they can become contaminated with faecal pathogens from exposure to contaminated water.

In New Zealand, FIB are used as a proxy for determining human health risk in relation to shellfish, these primarily being faecal coliforms (for shellfish-gathering waters) and *E. coli* (for shellfish tissues). While no specific microbiological guidelines exist for shellfish gathered for domestic (non-commercial) consumption, it is recommended that the commercial shellfish limits be applied in non-commercial settings[8] (New Zealand Food Safety Authority (NZFSA), 2006). These guidelines can be applied to point source-affected approved growing areas where relaying, depuration (Oliveira et al., 2011) or other post-harvest treatments are not required.

These guidelines stipulate that:

- Median Most Probable Number (MPN) of shellfish tissue *E. coli* must not exceed 230 *E. coli* per 100 g, and;
- Not more than 10% of the samples may present with shellfish tissue *E. coli* exceeding an MPN of 700 per 100g (NZFSA, 2006).

An alternative guideline not related to shellfish tissue but to shellfish-gathering waters is presented in the microbiological water quality guidelines for marine and freshwater recreational areas (MfE/MoH, 2003). According to these guidelines:

- The median FC content of samples taken over a shellfish-gathering season shall not exceed an MPN of 14/100 mL, and;
- Not more than 10% of samples should exceed an MPN of 43/100 mL (using a five-tube decimal dilution test).

These guidelines are expected to be applied in conjunction with a sanitary survey. There may be situations where bacteriological levels suggest that waters are safe, but a sanitary survey may indicate that there is an unacceptable level of risk.

As part of the Northland region's coastal monitoring exercise, NRC has conducted short-term monitoring of shellfish tissue quality at four selected sites in the Hokianga Harbour (see Section 3.2.1, Figure 4). According to the results of the study, shellfish flesh *E. coli*

[8] Animal Products (Regulated Control Scheme—Bivalve Molluscan Shellfish) Regulations 2006. http://www.legislation.govt.nz/regulation/public/2006/0038/latest/DLM369353.html?search=ts_regulation_bivalve_resel&sr=1

concentrations did not meet the relevant commercial guidelines at any of the four sites tested. Although medians were below 230 *E. coli*/100g at all sites, approximately 23-30% of individual samples exceeded the guideline value of 700 *E. coli* per 100g (Table 5). These results indicate that, at the time of sampling, it was unsafe to consume shellfish harvested at these sites.

Table 5. *E. coli* levels in shellfish flesh collected from the Hokianga Harbour between 2009 and 2010 (Source: NRC).

Site		Median	% of individual samples exceeding NZFSA guideline of 700 E. coli/100g
109685	Outer Mangamuka River and island	42.5	30
109686	South Kohukohu	61.5	23.3
109687	Rāwene Ferry Ramp	80.5	23.3
109692	Ōmāpere	78	24.4
NZFSA Guideline (*E. coli*/100g wet weight)		230	<10

4. Health Risk Assessment

4.1 Overview

The Health Risk Assessment in this study involved three key steps:

- Hazard analysis.
- Exposure assessment, including contaminant fate modelling.
- Effect analysis and risk characterization.

4.2 Hazard analysis

Wastewater can contain several pathogenic species (Jacangelo et al., 2003; McBride, 2007). The majority of pathogens in wastewater are enteric, that is, they affect the digestive system, and may present a serious health risk if ingested (Hai et al., 2014). These include: protozoans, which can cause life-threatening diseases including giardiasis, cryptosporidiosis, helminthiasis, dysentery and amoebic meningoencephalitis (Bitton, 2010); viruses, which can cause paralysis, meningitis, respiratory disease, encephalitis, congenital heart anomalies and upper respiratory and gastrointestinal illness (Melnick et al., 1978; Okoh et al., 2010; Toze, 1997); and bacteria, consisting of the enteropathogenic and opportunistic bacteria which cause gastrointestinal diseases such as cholera, dysentery, salmonellosis, typhoid and paratyphoid fever (Cabral, 2010; Toze, 1997).

Because the tests for pathogens are time-consuming and expensive, it is not practical to implement such testing on a routine basis. Instead, regulatory bodies support testing for faecal indicator bacteria (FIB) (specifically enterococci and faecal coliforms) as a cost-effective means to assessing the quality of treated effluent. This position is supported by the assumption that most pathogens die at the same rate as FIB, and hence the numbers of FIB in the treated effluent can be used as an indicator (or proxy) for pathogens present in the treated effluent.

While focus has been placed on FIB concentrations for regulatory purposes, it is important to note that limitations associated with the use of conventional FIB as an indicator for viruses is well documented (USEPA, 2015; Wade et al., 2010, 2008). Furthermore, as most standard sewage treatment processes are not efficient in eliminating viruses, treated sewage may still contain concentrations of enteric viruses that present a significant public health risk (Lodder et al., 2010; Okoh et al., 2010). Several enteric viruses have been described in published literature as being associated with outbreaks due to exposure to polluted recreational water (Jiang et al., 2007; Sinclair et al., 2009; USEPA, 2015). These include noroviruses, adenoviruses, hepatitis A viruses, echoviruses and Coxsackie viruses (Hauri et al., 2005; Lodder et al., 2010). Literature has also suggested that the greatest public health risk linked with the discharge of treated wastewater relates mainly to viruses (Courault et al., 2017; Prevost et al., 2015). A unique characteristic of viral infections is that a high proportion of the exposed populations could be potentially affected, often leading to very high incidences of gastroenteritis that can then be spread by person-to-person contact to other individuals who were not directly exposed to the polluted waters (Patel et al., 2008; Widdowson et al., 2005). For instance, a single vomiting incident from an individual infected with norovirus could expel up to 30 million virus particles (Tung-Thompson et al., 2015). In community settings, this could result in contamination of surfaces with large numbers of viruses, effectively promoting the further spread of the pathogens.

4.3 Exposure Assessment

Exposure assessment involves identification of populations that could be affected by pathogens. The main individuals at risk of exposure to pathogens in the receiving environment of the Kohukohu WWTP are those that engage in any sort of contact recreation or those who consume raw shellfish collected from any site potentially impacted by the discharge.

Ideally, a typical quantitative microbial risk assessment would involve the incorporation of dose-response models, consideration of how much water an individual will ingest or inhale over a period of time during a particular recreational activity; how much raw shellfish harvested from the impact sites that an individual will consume at one sitting; the amount, frequency, length of time of exposure, and doses for an exposure, to ultimately predict individual illness risks. In this case however a semi-quantitative approach was used instead for the microbial risk assessment. A semi-quantitative approach, in this case:

- Applies faecal indicator bacteria (enterococci-contact recreation, and *E. coli*-shellfish tissues, faecal coliforms-shellfish-gathering waters) as “conservative” proxies of pathogens relevant to public health risks.
- Assesses the impact of the discharge in terms of elevation of enterococci and FC concentrations in the receiving environment (by not including and including background concentrations).
- Assesses whether this increase in faecal indicator bacteria will be such that it causes the receiving environment to breach existing guidelines for contact recreation or shellfish-gathering.

4.3.1 Hydrodynamic modelling

MetOcean carried out 3-dimensional hydrodynamic modelling to predict how contaminants in the wastewater discharge plume will behave in the receiving water, with regards to dilution. Details of this modelling are already reported in MetOcean (2020). The model was based on a conservative tracer. The reasons for the use of a conservative tracer are supported by arguments related to UV inactivation in published literature (e.g. Jin and Flury, 2002; Linden et al., 2007; Silverman, 2013). The effectiveness of sunlight inactivation of waterborne pathogens depends on complex and variable environmental factors (e.g. the intensity and spectrum of sunlight), characteristics of the water containing the virus particles (e.g. pH, DO, ionic strength, source and concentration of photosensitizers), and peculiarities of the microbe. These concerns are well documented (Anders, 2006; Havelaar et al., 1993; Hijnen et al., 2006; Kohn et al., 2007; Kohn and Nelson, 2007; Love et al., 2010; Romero et al., 2011; Sinton et al., 2002, 1999). Despite the uncertainties associated with estimating the actual rates of UV inactivation that would take place in the receiving environment, it is certain that ultraviolet inactivation will occur. The hydrodynamic modelling approach to exclude solar radiation-based ultraviolet inactivation from the hydrodynamic module is thus, a highly precautionary approach, from a public health protection perspective. Consequently, the reported risks from this health risk assessment include the worst-case scenario and may be overstated.

It is important to note that an initial concentration of 1 was applied in the MetOcean hydrodynamic model such that the generated reciprocal dilution factors (in time series format, time scale = every 60 minutes for one year) could be scaled up to the varying concentrations of WWTP faecal coliforms concentrations during the microbial risk assessment.

4.3.2 Selection of exposure assessment sites

In consultation between SEL and staff at FNDC, 12 key sites were identified in the Hokianga Harbour for recreational water contact and harvesting of shellfish (Figure 9). These sites could be potentially impacted because of wastewater discharge. The selected exposure sites are: Sites M_1 and M_5 on Mangamuka River, Site M_3 on the Waihou River, Site M_2 (between Sites M_5 and M_3), Site M_4 (the closest to the Kohukohu wastewater discharge), Site M_6 (on the Tahehe River), Site M_8 (on Te Waipoka Stream), Site M_10 (on Whirinaki River), Site M_9 (adjacent Site 10) and Sites M_11 and M_12 which are further down the Harbour.

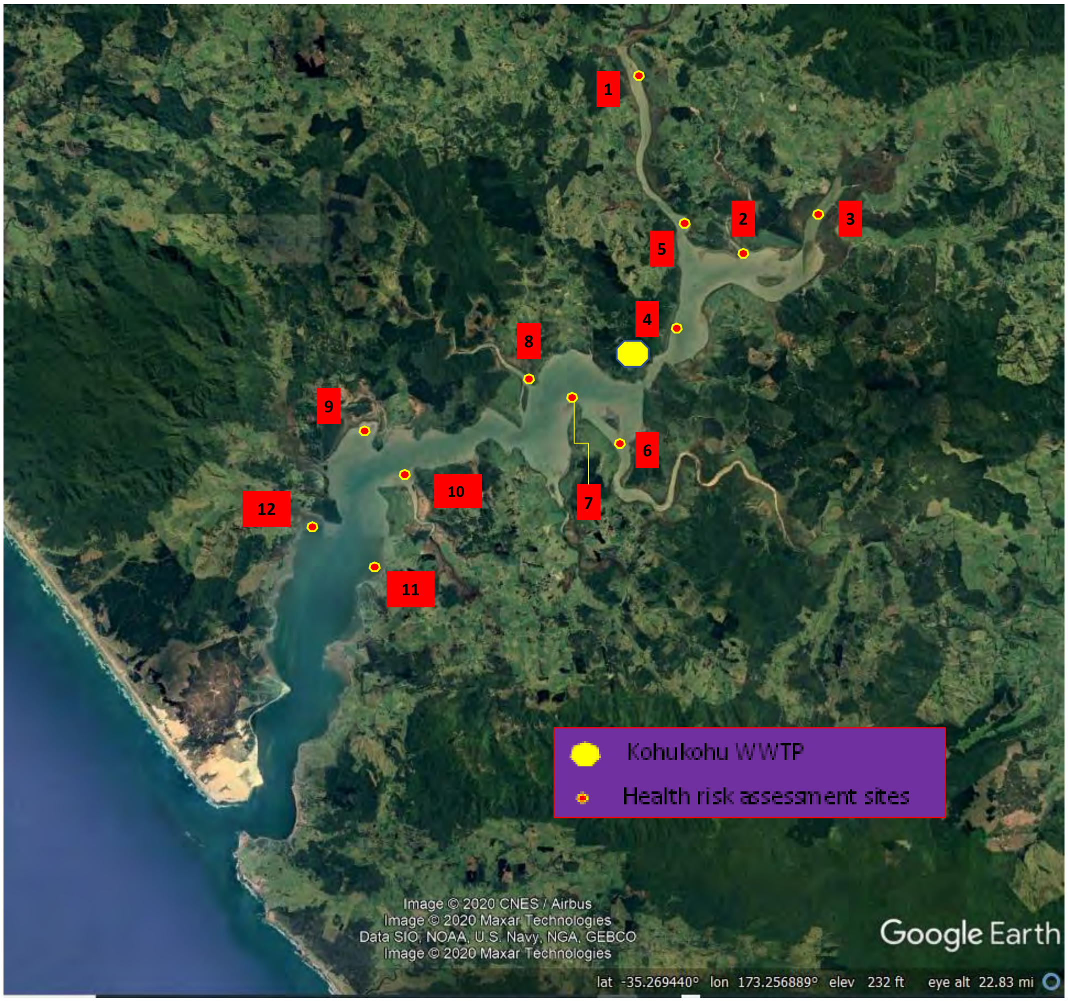

Figure 9. Location of the 12 selected exposure sites.

4.3.3 Dilutions achieved in the receiving environment

An analysis of dilutions supplied by MetOcean indicates that during El Niño conditions (Table 6) 50% of the time dilutions at the 12 sites during summer ranged from 26,561-fold to 47,546-fold. Slightly higher dilutions are achieved in the receiving environment at other times of the year[9]. For instance, 50% of the time, annual dilution at all the 12 sites ranged from 26,817-fold to 64,673-fold.

[9] Based on annual dilution data, Table 6.

During La Niña conditions (Table 7), dilutions achieved in the receiving environment were higher. Fifty percent of the time, summer dilution at the 12 sites ranged from 80,664-fold to101,456-fold.

Table 6. Dilutions of Kohukohu WWTP discharge achieved in the receiving environment during El Niño conditions.

Description	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
El Niño annual	0.1	302,922	138,289	625,795	114,779	140,183	132,652	97,141	93,348	79,021	77,572	69,789	65,791
	0.2	134,821	79,316	285,875	64,039	84,232	69,505	54,721	53,392	45,533	44,186	38,838	35,946
	0.3	78,852	45,069	146,138	39,385	44,939	40,028	35,378	35,031	33,528	33,039	32,225	31,313
	0.4	52,223	37,943	89,788	34,206	38,036	34,248	31,885	31,401	30,108	29,772	29,181	28,645
	0.5	43,373	34,593	64,673	31,774	33,898	31,808	29,768	29,338	28,132	27,761	26,996	26,817
	0.6	38,353	32,736	51,683	30,406	32,235	29,812	28,397	28,116	27,383	27,174	26,728	26,520
	0.7	34,546	31,649	43,575	29,324	31,273	28,629	27,765	27,573	26,951	26,785	26,411	26,238
	0.8	32,102	30,515	38,085	28,540	30,367	28,027	27,383	27,165	26,410	26,328	26,030	25,815
	0.9	30,458	29,308	33,895	27,858	29,307	27,552	26,853	26,778	26,061	25,897	25,330	25,135
	0.95	29,480	28,703	31,624	27,488	28,653	27,201	26,640	26,576	25,747	25,558	24,979	24,637
	0.99	28,248	28,042	29,387	27,108	28,011	26,915	26,250	26,235	25,370	25,089	24,651	24,151
El Niño summer	0.1	80,668	40,785	220,830	34,595	41,243	33,966	32,282	31,757	30,587	30,261	29,712	29,076
	0.2	50,563	36,087	94,848	33,014	35,851	32,522	30,985	30,407	28,932	28,848	28,130	27,706
	0.3	43,072	34,218	68,717	31,760	33,758	31,284	29,888	29,540	28,340	28,006	27,085	26,877
	0.4	38,970	33,014	55,345	30,822	32,456	30,208	29,030	28,660	27,700	27,445	26,904	26,707
	0.5	36,187	32,258	47,546	30,173	31,689	29,229	28,397	28,177	27,448	27,224	26,776	26,561
	0.6	33,994	31,652	42,361	29,517	31,231	28,640	27,974	27,842	27,259	27,065	26,632	26,442
	0.7	32,413	30,913	38,251	28,947	30,682	28,214	27,681	27,561	27,037	26,844	26,473	26,257
	0.8	31,312	30,286	35,326	28,495	29,958	27,930	27,450	27,303	26,581	26,482	26,137	26,053
	0.9	30,218	29,430	33,077	28,014	29,427	27,624	26,985	26,893	26,333	26,230	25,923	25,720
	0.95	29,649	28,943	31,413	27,698	29,042	27,319	26,744	26,693	26,264	26,105	25,792	25,582
	0.99	28,818	28,546	29,661	27,229	28,546	26,881	26,471	26,418	26,061	25,839	25,422	25,388

Table 7. Dilutions of Kohukohu WWTP discharge achieved in the receiving environment during La Niña conditions.

Description	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
La Niña annual	0.1	681639	247780	1417202	197095	266484	226052	161758	151029	120044	117567	106278	102220
	0.2	326048	141212	594936	112106	148920	134303	97222	94932	89730	89412	89012	89692
	0.3	190898	105058	342833	90585	108460	97032	85752	85027	84806	84251	83899	85152
	0.4	126376	93899	196560	86174	93527	86233	82635	81907	81140	80702	79714	80396
	0.5	104562	88474	137107	83140	88592	83663	79551	78631	76054	75955	74659	74464
	0.6	91607	84028	110643	78066	84586	79553	73928	72984	68494	68937	65243	66845
	0.7	85847	79017	97539	71885	79171	73563	67707	66348	62439	62303	60235	59319
	0.8	72094	65897	83646	62243	65349	63061	59938	59046	58606	58421	56434	55121
	0.9	58509	52900	67436	51673	52391	51172	49913	49533	49282	49094	48568	47104
	0.95	52548	50616	59545	48722	49926	47936	46861	46478	44481	44700	42576	41249
	0.99	49593	49211	52443	46375	49132	45850	44558	44462	42433	41549	40176	38901
La Niña summer	0.1	202710	129385	326485	108909	134311	106526	97746	96474	93070	92947	90781	96136
	0.2	125642	99374	164566	90695	99677	87882	87206	87047	88427	87687	88703	89520
	0.3	106779	92841	129894	87421	91764	85982	85044	84724	85018	84478	85279	87061
	0.4	94160	89190	110178	85649	88433	84552	83472	83131	83223	82988	82846	84541
	0.5	89480	85925	101456	83838	86309	83053	81866	81690	81214	80940	80774	81782
	0.6	86573	82347	93840	81095	81960	80688	80141	80270	79389	78969	77938	78394
	0.7	79873	78066	84119	76206	76609	75617	75630	76424	76539	76282	75647	75661
	0.8	64141	63621	70526	66267	62942	67987	70692	71827	70357	71195	70621	71025
	0.9	57667	53953	63354	54593	53600	54897	57009	57187	62391	62903	65029	68923
	0.95	53461	51970	57715	52275	51543	52779	53953	54325	56526	58502	62292	64865
	0.99	50271	50345	52285	49697	50038	49589	50036	49891	51140	51772	54601	55495

4.4 Effect analysis and risk characterisation

To estimate final faecal coliform concentrations for each of the 12 exposure sites, percentile distributions of the reciprocal dilution factors from the hydrodynamic modelling was multiplied by the concentrations of the treated effluent discharged from Kohukohu WWTP. This approach has been used in several previous microbial risk assessment studies (e.g. Dada 2018a, b ,2019a, b, c, 2020, McBride 2011, 2012, 2013, 2016a,b).

The goal was to determine:

- If the resulting enterococci concentrations in the receiving water (after including background concentrations) exceed limits for recreational water quality specified in the microbiological water quality guidelines for marine and freshwater recreational areas (MfE/MoH, 2003).
- If the discharge will cause the receiving water to exceed limits for shellfish-gathering areas specified in MfE/MoH (2003).

We note that the current consent is based on FC compared to enterococci as is used for recreational water guidelines in MfE/MoH (2003). While FC may be an appropriate indicator for the effluent, it becomes a challenge to apply dilutions to the wastewater concentrations in a way that causally relates to enterococci guidelines for recreation in the receiving water.

Despite this concern, we consider it conservative to apply FC concentrations as “presumed equivalent enterococci concentrations” of the treated effluent. This stance is supported by literature. First and foremost, FC concentration usually exceeds or compares with enterococci concentration in sewage and in receiving marine environment. In an investigation of human sewage pollution at Florida Gulf coast Beaches impacted by WWTP discharges (Korajkic et al., 2011), water column enterococci concentrations generally exceeded FC concentrations at all sites tested. In another study that compared concentrations and population diversity of the bacterial groups analysed in the raw (RS) and treated sewage (TS) from five wastewater plants, FC concentration usually exceeded enterococci concentration in sewage at all wastewater plants tested (Vilanova et al., 2004). Secondly, and according to the MfE/MoH (2003) policy document, “while enterococci are easily damaged in WSPs (Davies-Colley et al 1999), FC that emerge from a pond appear to be more sunlight resistant than those that enter it (Sinton et al 1999). Thus, WSP enterococci are inactivated in receiving water faster than WSP FC (Sinton et al 2002).” Our position in this study to apply FC concentrations as conservative estimates of enterococci is thus well supported by literature.

Wastewater concentrations containing different scenarios of FC concentrations were applied:

i. Consent-specified limit for effluent FC concentrations (i.e. 15,000 CFU/100mL).
ii. Worst-case (95th percentile) FC concentration (i.e. 24,400 CFU/100mL).

These scenarios invariably represent:

i. Current normal condition of the plant when consents limits are not exceeded.
ii. Current worst-case condition of the plant (based on 95th percentile concentrations recorded at the plant).

4.5 Recreational health risk

4.5.1 Current normal plant condition when consents limits are not exceeded

The existing consent limit is set at 15,000 CFU/100mL (see Section 2.3).

Assuming no background concentrations, when treated wastewater containing enterococci equivalent concentrations (i.e. FC concentrations) of 15,000 CFU/100mL is continuously discharged into the Hokianga Harbour from Kohukohu WWTP, only very marginal increases in enterococci at all 12 sites will be observed. The maximum increase of enterococci predicted as a result of the WWTP discharge is 1 CFU/100mL during El Niño and La Niña conditions (Table 8, Table 9). <u>The effect of the discharge on recreational water quality is thus negligible.</u>

Based on an analysis of the receiving water quality, the 5-year 95th percentile enterococci concentration for Omapere at Old Wharf Road and Hokianga Harbour Opononi are 52 enterococci/100 mL and 70 enterococci/100 mL, respectively (see Section 3.2.1). This indicates that in terms of recreation, the water at sites closest to the Hokianga Harbour outlet was generally of acceptable quality. Hence, background concentrations of 70 enterococci/100 mL could be considered representative of the receiving environment baseline concentration. I note however, that the concentrations upstream may be higher, for example, at sites further into the harbour, where comparatively lower tidal influence and higher catchment influence may contribute to elevated FIB concentrations.

Assuming background concentrations of 70 enterococci/100 mL, when treated wastewater containing enterococci equivalent concentrations (i.e. FC concentrations) of 15,000 CFU/100mL *or* less is continuously discharged into the Hokianga Harbour from Kohukohu WWTP, enterococci will not exceed 71 enterococci/100 mL during La Niña and El Niño conditions. It is thus predicted that all 12 sites will not exceed the 140 CFU/100mL limit specified for “Acceptable/Green (surveillance) Mode” specified in the MfE/MoH (2003) policy document.

Based on the high levels of dilutions at the receiving sites, consistent with the hydrodynamic modelling, these results show that the Kohukohu WWTP does not negatively impact recreational water quality at all 12 assessed sites when discharge containing indicator bacteria concentrations at or below the current consent limit of 15,000 CFU/100mL is continuously released into the Hokianga Harbour.

Table 8. Predicted increases in FC concentrations (CFU/100mL) in the receiving water as a result of the Kohukohu WWTP discharge when the existing consent limits of 15,000 CFU/100mL <u>are not exceeded</u> during El Niño conditions.

		Site											
Scenario	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
El Niño annual	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	30th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	40th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+1	+1	+1
	50th	+0	+0	+0	+0	+0	+0	+1	+1	+1	+1	+1	+1
	60th	+0	+0	+0	+0	+0	+1	+1	+1	+1	+1	+1	+1
	70th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
	80th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
	90th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	95th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	99th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
El Niño summer	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+1	+1
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+1	+1	+1	+1
	30th	+0	+0	+0	+0	+0	+0	+1	+1	+1	+1	+1	+1
	40th	+0	+0	+0	+0	+0	+0	+1	+1	+1	+1	+1	+1
	50th	+0	+0	+0	+0	+0	+1	+1	+1	+1	+1	+1	+1
	60th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
	70th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
	80th	+0	+0	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	90th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	95th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	99th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1

Table 9. Predicted increases in FC concentrations (CFU/100mL) in the receiving water as a result of the Kohukohu WWTP discharge when the existing consent limits of 15,000 CFU/100mL are not exceeded during La Niña conditions.

		Site											
Scenario	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
La Niña annual	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	30th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	40th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	50th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	60th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	70th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	80th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	90th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	95th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	99th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
La Niña summer	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	30th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	40th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	50th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	60th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	70th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	80th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	90th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	95th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	99th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0

4.5.2 Worst-case current condition (95th percentile enterococci-equivalent concentration)

Between 2010 and 2019, the Kohukohu WWTP discharge had a 95th percentile FC concentration of 24,400 CFU/100mL (Table 3).

When treated wastewater containing enterococci equivalent concentrations (i.e. 95th percentile FC concentrations) of 24,400 CFU/100mL is continuously discharged into the Hokianga Harbour from Kohukohu WWTP, only very marginal increases (+1 CFU/100mL, Table 10, Table 11) in enterococci at all 12 sites will be observed. during El Nino and La Nina conditions. The effect of the discharge is thus negligible.

Assuming background concentrations of 70 enterococci/100 mL, when treated wastewater containing enterococci equivalent concentrations (i.e. 95th perc. FC concentrations) of *24*,400 CFU/100mL is continuously discharged into the Hokianga Harbour from Kohukohu WWTP, 99 percent of the time, enterococci will not exceed 71 enterococci/100 mL during La Nina El and Niño conditions. It is thus predicted that all 12 sites will not exceed the 140 CFU/100mL limit specified for "Acceptable/Green (surveillance) Mode" specified in the MfE/MoH (2003) policy document.

Table 10. Predicted increases in FC concentrations (CFU/100mL) in the receiving water as a result of the Kohukohu WWTP discharge when effluent containing 95th percentile FC concentrations of 24,400 CFU/100mL is discharged into the Hokianga Harbour during El Niño conditions.

		Site											
Scenario	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
El Niño annual	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+1	+1	+1	+1
	30th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	40th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	50th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	60th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	70th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	80th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	90th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	95th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	99th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
El Niño summer	10th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	20th	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	30th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	40th	+1	+1	+0	+1	+1	+1	+1	+1	+1	+1	+1	+1
	50th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	60th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	70th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	80th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	90th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	95th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
	99th	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1

Table 11. Predicted increases in FC concentrations (CFU/100mL) in the receiving water as a result of the Kohukohu WWTP discharge when effluent containing 95th percentile FC concentrations of 24,400 CFU/100mL is discharged into the Hokianga Harbour during La Niña conditions.[1]

		Site											
Scenario	Percentile	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_10	M_11	M_12
La Niña annual	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	30th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	40th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	50th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	60th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	70th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	80th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	90th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+1	+1
	95th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
	99th	+0	+0	+0	+1	+0	+1	+1	+1	+1	+1	+1	+1
La Niña summer	10th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	20th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	30th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	40th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	50th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	60th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	70th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	80th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	90th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	95th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
	99th	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0

4.6 Shellfish consumption health risk

In terms of shellfish tissue *E. coli* concentrations, the quality of shellfish at the Hokianga sites currently does not meet the New Zealand Food Safety Authority (NZFSA) 2006 guidelines (see section 3.2.2). For instance, approximately 23-30% of individual samples exceeded the NZFSA guideline value of 700 *E. coli* per 100g (Table 5).

However, based on dilutions achieved at the Hokianga Harbour after the discharge, predicted increases in faecal coliform in the receiving water during the worst-case scenario is only +1 CFU/100mL. Given this negligible change in water quality, the discharge is not expected to significantly affect shellfish quality.

It is however important to emphasise that shellfish filter feed. Hence, they can take up pathogens directly from the water column and bioaccumulate these over time such that the accumulated pathogens can be present within the shellfish at levels high enough to elevate health risks once ingested (Grodzki et al 2014). In numerical terms, bioaccumulation may range from a factor of 1 to as high as 100 (average of 49.9, McBride 2016, Bellou et al., 2013; Hanley, 2015; Hassard et al., 2017). The actual level of bioaccumulation will depend on so many factors including, the species being considered, their differing body sizes, tissue physiological composition, filtration activity etc (Grodzki et al 2014). Nonetheless, on the average, an increase of +1 CFU/100mL of faecal coliforms[10] in the water column may still translate into higher concentrations in the shellfish tissues.

From a mere analysis of these shellfish concentrations, it is not possible to ascertain what proportion of the elevated shellfish tissue *E. coli* concentrations are due to the discharges from Kohukohu WWTP. Other sources are likely contributing to the elevated *E. coli* concentrations, including re-suspension of bacteria-rich sediment during rough weather conditions, contributions from wild animals (e.g. seabirds), livestock effluent, sewage overflows, and faulty or poorly maintained septic tank systems in the catchment.

It is recommended that a faecal source tracking study be commissioned to determine the cause of elevated shellfish tissue *E. coli* concentrations in the Hokianga Harbour. This approach was successfully adopted in the Northland Region following the observation of elevated *E. coli* concentrations in shellfish harvested from the Whangaroa Harbour. The Whangaroa harbour faecal tracking study results indicated that the sources of contamination were generally ruminant (herbivore) and wildfowl (Reed, 2011). It is not relevant in this instance to apply results from the Whangaroa Harbour to the conditions

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[10] Assuming a conservative approach that most of the faecal coliforms are *E. coli*. Ideally, *E. coli* is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. Some literature have reported up to 90% of the fecal coliforms being E. coli (Hachich et al 2012).

in the Hokianga Harbour, as land use may differ significantly in their contributory catchments.

5. Conclusion

Results from this study show that enterococci in the current Kohukohu WWTP discharge with a worst-case (95^{th} percentile) concentration of 24,400 CFU/100mL does not negatively impact recreational water quality. Based on dilutions achievable occurring at in the Hokianga Harbour, increases in faecal coliform in the receiving water due to the discharge from Kohukohu WWTP – even during the worst-case scenario – is +1 CFU/100mL. Additionally, enterococci concentrations at all the 12 upstream and downstream sites considered in this study did not exceed the 140 CFU/100mL limit specified for "Acceptable/Green (surveillance) Mode" in the MfE/MoH (2003) policy document. The quality of shellfish at the Hokianga sites currently does not meet the New Zealand Food Safety Authority (NZFSA) 2006 guidelines. As stated above, based on the worst-case scenario of Kohukohu WWTP discharge the maximum change in faecal coliform in the receiving water is + 1 CFU/100mL. Given this negligible change in water quality, the discharge is not expected to significantly affect shellfish quality.

6. Limitations and Recommendation

While focus has been placed on faecal indicator bacteria (FIB) concentrations as a "yardstick" for health risk assessment in this study, limitations associated with the use of indicator bacteria as proxies for viruses is well documented (Wade et al. 2008, Wade et al. 2010, USEPA 2015) (USEPA, 2015; Wade et al., 2010, 2008). Furthermore, as most standard sewage treatment processes are not efficient in eliminating viruses, treated sewage may still contain concentrations of enteric viruses that present a significant public health risk (Lodder et al., 2010; Okoh et al., 2010). Several enteric viruses have been described in published literature as associated with outbreaks due to exposure to polluted recreational water (Jiang et al., 2007; Sinclair et al., 2009; USEPA, 2015). These include noroviruses, adenoviruses, hepatitis A viruses, echoviruses and Coxsackie viruses (Hauri et al., 2005; Lodder et al., 2010). Literature has also suggested that the greatest public health risk linked with the discharge of treated wastewater relates mainly to viruses (Courault et al., 2017; Prevost et al., 2015). A unique characteristic of viral infections is that a high proportion of the exposed populations could be potentially affected, often leading to very high incidences of gastroenteritis that can then be spread by person-to-person contact to other individuals who were not directly exposed to the polluted waters (Patel et al., 2008; Widdowson et al., 2005). Notwithstanding the limitations of this current study (i.e. the use of faecal indicator bacteria as proxies for pathogens), if a determination of health risks due to viruses is required, a quantitative microbial risk assessment would be required. This would incorporate consideration of pathogen dose-response curves and amounts of water or shellfish ingested by those who use the water for recreational or shellfish-gathering purposes.

In this study, a conservative approach backed by available literature was to presumptively apply FC concentrations of the treated effluent as "assumed enterococci concentrations" while assessing recreational health risks due to the discharge. This position may not necessarily hold. To resolve these uncertainties, I recommend that a six-month study be commissioned with samples collected fortnightly with a view to comparing concentrations and population diversity of the indicator bacterial groups (enterococci and faecal coliforms) in the treated sewage from the Kohukohu WWTP.

I recommend a faecal source tracking study to resolve the uncertainty associated with elevated faecal indicator bacteria concentrations in shellfish tissues collected at the harbour, as was successfully applied in the Whangaroa Harbour study (Reed 2011).

On the whole, while the results from this study indicate that the Kohukohu discharge is associated with very minor change in faecal indicator bacteria concentrations, careful consideration needs be given to faecal pollutants contributed from other sources in the catchment, for instance, other wastewater treatment plants and catchment inflows into the harbour.

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3rd of August 2022

Northland Regional Council
BY EMAIL

Attention: Stuarts@nrc.govt.nz

Tēnā koe,

RE: Response to Section 92(1) Resource Management Act 1991 Request for Further Information from Northland Regional Council - Resource Consent APP.003839.01-03 by Far North District Council for discharges associated with the Kohukohu Wastewater Treatment Plant.

Thank you for your letter dated 10 January 2020 requesting further information under Section 92(1) of the Resource Management Act 1991 (the Act) in relation to the above resource consent application. The Far North District Council (the Applicant) provides the following responses to this request.

Question

1. *An assessment of the effectiveness of the septic tank maintenance schedule and treatment plant desludging schedule. There are ongoing issues with excessive sludge accumulation in the treatment ponds and wetland of the WWTP. As the purpose of the septic tanks should be to retain the majority of sludge so it does not enter the ponds, it is considered that the current five yearly frequency of cleaning and inspection of the septic tanks is not sufficient.*

   Reason: To assess the current effectiveness of the WWTP.

Response

Common effluent drainage servicing (EDS) is used to reticulate onsite wastewater from each serviced property in the Kohukohu community via gravity where it enters a rising main line (with 3 main pump stations) to a single facultative (oxidation) pond followed by a surface flow wetland before discharging to the Hokianga Harbour.

A historic Operations and Maintenance Manual (dated 2006) is available for these facilities but is considered to be out of date. The current WWTP Operator advises that the WWTP and pump stations are respectively inspected weekly and monthly and that remote monitoring of systematic operations is continuous and that all other maintenance is reactive in general (email comms, G. Potter, 3 June 2016).

Tank inspections had been implemented at the initial outset of the scheme but have not been continued on a regular basis. No other maintenance information has been found for the septic tanks which reside on private property.

The Applicant commissioned Jacobs Consultants Ltd (Jacobs) to review the current sludge management practices for the Kohukohu township in February 2020. Their memorandum (Jacobs 2020a) is attached at Appendix A with findings summarised as follows.

Jacobs (2020a) confirmed[1] that septic tank desludging for the entire Kohukohu township is undertaken every 5 years by local vacuum/sucker truck contractor. The collected sludge is transported to the septage reception facility at the Rawene WWTP. The Operator advised that the septic tanks were last emptied in April/May 2019 and are not due to be desludged again until 2024[2].

There is no influent sampling data and therefore the extent of treatment provided by the septic tanks is currently unknown. However, there were no reported significant issues of concern with the effluent quality as assessed by Jacobs. This suggests that the pre-treatment provided by the septic tanks is not unsuitable for the WWTP to cater for existing influent loads.

The recommendation by Jacob's to develop a Septage Management Plan is adopted by the Applicant and it is proposed as a condition of consent (see Appendix F).

Question

2. *A report on land disposal options for the wastewater which provides details of the cost and viability for each option. This report should provide a decision on whether land disposal is to be undertaken for this discharge and the reasons for that decision.*

   Reason: This is to meet Policy D.4.3(b) of the Proposed Regional Plan which states a discharge to water will generally not be granted unless "a discharge to land has been considered and found not to be economically or practicably viable". Policy 23(2)(b)(i) of the New Zealand Coastal Policy Statement also requires that "there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge".

Response

Jacobs were engaged by the Applicant to undertake amongst other things, an assessment of the potential for discharge to land in accordance with Policy D.4.3 of the PRPN. Their report ((Jacobs) 2020b) on this matter[3] can be found at Appendix B to this letter. In summary, the assessment by Jacobs advises the following;

- *Practical viability of a discharge to land*

The availability of suitable land to discharge treated wastewater was assessed within a 5-kilometre (km) radius of the WWTP. This radius was used as it strikes a balance between cost and identification of practically viable sites. Criteria for site selection also used proximity to sensitive receptors (i.e., residences), waterways, slope, groundwater, and natural hazards.

Within this radius, and subject to the selection criteria, 2 sites (Site 4 and 5) were identified as Being potentially suitable. However, these two were less than the required 3.0 hectares for sustainable land

[1] Conversations with WWTP Operator (Broadspectrum).
[2] Jacobs Memorandum, Kohukohu Septage Management Review 9 July 2020.
[3] Specifically at Section 7 of the Report (Jacobs, 2020b).

application practices. As such, it is concluded that a discharge to land is practicably unfeasible at this time.

- *Economic viability of a discharge to land*

Council's policy on funding wastewater infrastructure is that each scheme must pay its own capital costs. Two targeted rates are levied that fund the provision and availability of sewerage services from each of the District's 16 sewerage schemes:

- Capital rate: Each scheme has a targeted rate to fund capital costs (interest and depreciation) levied against all properties connected to the scheme or properties where connection to the scheme is available.

- Operational rate: Operating costs for all schemes are charged district-wide to all properties connected to any Council wastewater scheme. Council also imposes a pan charge on any property with more than three toilets. This is a flat fee per additional pan.

Business and Economic Research Ltd (BERL) undertook analysis[4] of rates affordability across the Far North District in 2020. BERL established that affordability concerns will arise where rates exceed 5% of gross household income because this exceeds costs relative to income and the ability of ratepayers to earn greater income to support rates increases. For the Kaikohe-Hokianga ward assessed, it was concluded[5] that in most cases, households in this ward were currently spending over 5% of their income with those most vulnerable (i.e., super annuitants) spending much more than 5% due to reduced (and often fixed) incomes.

Jacobs did not carry out a detailed assessment of the economic viability of a discharge to land (DTL) due to the practical limitations relating to available suitable land. Although areas of land could have been scoped for suitability in excess of a 5km radius from the WWTP, essentially the further afield a discharge site is to the treatment plant, the more cost is incurred to install and operate. Given the ward which Kohukohu is located within is currently experiencing rates affordability issues, it is unlikely that the capital expenditure necessary to implement a DTL option would be affordable. It is therefore concluded that a DTL option is not economically viable and a discharge to water must continue to be pursued at this time.

The Applicant is continuing to look into DTL options across the district and will pursue these practices if they become more economical to implement in the foreseeable future.

<u>Alternatives Assessment</u>

When considering the effluent quality achieved through the current WWTP and the hydrodynamic study findings, no major drivers have been identified which substantiate a requirement to look at alternative methods, sites and routes for undertaking the discharge in significant detail.

Jacobs (Appendix C) considered the option to extend the existing outfall pipe by 240 metres into the main harbour channel but concluded that such work was unnecessary due to suitable dilution being available in the tidal mud flat channel as reported in the hydrodynamic study. In addition to Jacobs' findings, the physical disturbance required to extend the outfall pipe would have much greater

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[4] Far North District Council. 2020. *Rates Affordability in the Far North* (#6068). Business and Economic Research Ltd; Auckland accessible at https://www.fndc.govt.nz/files/assets/public/objectivedocuments/water-services-and-waste-management-wwr/wastewater-management/wastewater-schemes/appendix-4-rates-affordability-in-the-far-north.pdf
[5] At page 20 (https://www.fndc.govt.nz/files/assets/public/objectivedocuments/water-services-and-waste-management-wwr/wastewater-management/wastewater-schemes/appendix-4-rates-affordability-in-the-far-north.pdf)

adverse effects than the discharge would, even when managed according to best construction industry standards. This is due to the receiving environments sensitivity to physical disturbances compared to physio-chemical effects of the discharge which can be assimilated more efficiently and with less residual impact within the receiving environment.

The activity as proposed is considered the most suitable method, site, and route for undertaking the discharge when balancing this with the economic and environmental effects of alternatives (i.e., DTL, or extending pipeline).

Question

3. A report on the outcome of quantitative microbiological risk assessment which assesses the level of risk the discharge poses to the health of people contacting the waters of and consuming shellfish gathered within, the Hokianga Harbour. This report shall identify all recreational swimming and food gathering areas that were included in the assessment. If there is identified to be an unacceptable level of risk to public health, then the assessment shall recommend mitigation measures to reduce this risk to an acceptable level.

Reason: To allow council to properly assess the risk to human health from the discharge.

Response

Streamlined Environmental Ltd (SEL) was engaged by the Applicant to prepare a semi-quantitative microbial human health risk assessment (QMRA). Their analysis used WWTP monitoring data from 2011-2019 and the hydrodynamic modelling carried out by MetOcean Ltd. SEL and MetOcean reports can be found at Appendix D and E with summary outcomes of these studies provided as follows.

<u>Recreational water quality</u>

Most results from historic monitoring reports showed that Feacal Indicator Bacteria (FIB) were usually within the MfE guidelines for swimming/contact recreation. The results of the QMRA show that the Kohukohu WWTP discharge generally does not negatively impact recreational water quality, as most receiving environment sites comply with the MfE/MoH criterion for "*Acceptable/Green (surveillance) Mode*" (hereafter MfE/MoH "Green")[6] most of the time.

<u>Shellfish-gathering water quality</u>

Existing guidelines for shellfish-gathering waters are more stringent than for recreation (compared to MfE/MoH guidelines). FIB are used as a proxy for determining human health risk in relation to shellfish, these primarily being faecal coliforms (for shellfish-gathering waters) and *E. coli (*for shellfish tissues).

While no specific microbiological guidelines exist for shellfish gathered for domestic (non-commercial) consumption, it is recommended that the commercial shellfish limits be applied in non-commercial settings[7] (New Zealand Food Safety Authority (NZFSA), 2006). These guidelines can be applied to point source-affected approved growing areas where relaying, depuration (Oliveira et al., 2011) or other post-harvest treatments are not required.

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[6] 140 enterococci/100 mL.

[7] Animal Products (Regulated Control Scheme—Bivalve Molluscan Shellfish) Regulations 2006. http://www.legislation.govt.nz/regulation/public/2006/0038/latest/DLM369353.html?search=ts_regulation_bivalve_resel&sr=1

With continuous discharge of wastewater containing concentrations of faecal coliforms at the current consent limit (15,000 CFU/100mL), 6 out of the 20 sites failed to comply with the MfE (2003) criterion for shellfish-gathering waters, when background concentrations are not included. When background concentrations were included, all 20 sites failed to comply with the MfE (2003) criterion for shellfish-gathering waters.[8]

Assessment

These results suggest that the current discharge limit for Kohukohu WWTP discharge is too high to prevent health risks from FC associated with shellfish consumption, particularly when background concentrations are included.

To protect shellfish-gathering waters in the receiving environment, the existing consent limit will need to be lowered. Results indicate that the consent limit would need to be set at 2,000 CFU/100mL before the MfE/MoH criterion for shellfish-gathering waters can be met at all the sites. With or without considerations for background concentrations, if the consent limit is set at 2,000 CFU/100mL, all twenty sites in the Hokianga Harbour will comply with the MfE/MoH (2003) criterion for shellfish-gathering waters.

Jacobs (Appendix C) have assessed that the current WWTP generally performs well with the median effluent faecal coliform concentration for the past 10 years at **800 CFU/100 mL**[9]. The maximum FC consent limit of 15,000 CFU/100mL was exceeded on six occasions in the past 10 years however. Therefore, although median FC concentration is well below 2,000 CFU/100mL, treatment process upgrades would be beneficial to mitigating the risk to humans from shellfish consumption, in association with amendment to stated consent limits.

The Applicant will install curtain baffles and will move the inlet pipe to the north-eastern corner of the pond as recommended by Jacobs (2020b) in order to improve the treatment process. This is proposed to take place after desludging planned during the 2023-2024 financial year.

A percentile limit on FC concentration to allow for the natural variability of effluent quality from ponds is also proposed as a consent condition.

Question

4. The application acknowledges the continued operation of the WWTP will affect Māori cultural values, however the application does not present a sufficient assessment of adverse effects on tangata whenua, their values and resources. The application also does not include an assessment of the effects on the Te Rarawa statutory acknowledgment area of the Hokianga Harbour. It is therefore requested that an assessment be undertaken on the effects on tangata whenua values and resources by the discharge. As minimum, this assessment should be undertaken in accordance with the criteria of Policy D.1.2 of the Proposed Regional Plan.

Reason: This is to allow the council to determine which tangata whenua are adversely affected by the application in accordance with Policy D.1.3 of the Proposed Regional Plan and to provide potential means of mitigation of any adverse cultural effects. It will also allow council when making a decision on this application to meet the requirements of Policy 23(2)(b)(ii) of the New Zealand Coastal Policy Statement

[8] Dada A.C (2020). *Semi-quantitative microbial human health risk assessment of Kohukohu WWTP discharge in the Hokianga Harbour*. FDC 2001-Final v6.0, Streamlined Environmental, Hamilton, 46 pp.

[9] The consent limit is a rolling median limit of 5,000 CFU/100mL.

which only allows a discharge of treated sewage to coastal water if it is "informed by an understanding of tangata whenua values and the effects on them".

Response
After consultation with Te Rūnanga o Te Rarawa, hapū, and marae, a request for quote was issued to a chosen supplier to prepare a Cultural Impact Assessment (CIA). Their work was commissioned in June 2020. Multiple attempts have been made since then to expediate the CIA with the supplier, hapū, and marae however these attempts have been unsuccessful.

Most recently, the supplier was contacted by phone (pers. conv, 7 July 2022) and advised that the CIA was in draft final form and was due to be consulted on with whānau. They explained that COVID-19 had interrupted the ability to carry out meaningful face to face hui with whānau hence the delay.

The Applicant does not refuse to provide the information, however, without a CIA, this aspect of the s 92(1) of the Act request cannot be responded to at this time.

Question
5. Where the outcome of questions 3 or 4 above identify either an unacceptable level of risk to public health or a minor, or more than minor, adverse effect on Tangata Whenua, then a report on an assessment of the potential upgrade options for the WWTP that would mitigate these effects shall be provided. The report should provide details of the estimated cost of each option and incorporate the outcomes of the assessments required by questions 1 to 4above.

Reason: To allow council to assess what methods are available to the applicant to mitigate any adverse effects. This information is also a requirement of Policy 23(2)(b)(i) of the New Zealand Coastal Policy Statement which requires that "there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge".

Response
Regarding the outcome of Question 3, Jacobs (Appendix C) concluded that no major drivers had been identified from their analysis and that of SELs (Appendix D) which proved a requirement to implement major upgrades to the WWTP. However, an options analysis has been carried out by Jacobs (Appendix C). Three options were identified for analysis all of which included maintaining the use of the existing outfall discharge into the tidal mud flat channel.

Regarding the outcome of Question 4, the magnitude of effects on tangata whenua have not been qualified through a CIA (Question 4). Without an appropriate assessment of effects, it is assumed that the adverse effects on tangata whenua will be more than minor.

The options considered by Jacobs (Appendix C) included, in summary;

- Option 1: No upgrades, only improved maintenance activities such as desludging and vegetation removal from wetland.
- Option 2: Option 1 + installation of baffles in the pond and moving inlet to the north-eastern corner of the pond.
- Option 3: Option 1 + 2 + installation of UV disinfection system on the wetland effluent.

Out of the three options identified, Option 2 scored highest in a Multi Criteria Analysis (MCA), including score sensitivity testing. It should be noted that while the MCA included impacts on Māori Cultural values and practices as a scoring criterion with success being the safeguarding of Māori cultural values and practices, these were developed by staff from past consultation with tangata whenua. The criterion and success factor may not be in accordance with actual tangata whenua views and would need to be corroborated with the CIA.

Conclusions

Although septic tank maintenance has not been prioritised as an operational management matter, there were no reported significant issues of concern with the effluent quality, suggesting that the pre-treatment provided by the septic tanks is not unsuitable for the WWTP to cater for existing influent loads (Appendix A and C). However, the Applicant accepts that improving the operational maintenance planning and record keeping of the septic tanks can assist with minimising the solids loading to the facultative pond and therefore result in treatment performance improvements. Consent conditions are proposed at Appendix F which seek to provide a framework for maintaining the septic tanks which is in accordance with best industry standards. Subject to the proposed consent conditions, the effectiveness of the septic tanks in providing pre-treatment of the influent to the WWTP can be validated with good record keeping over the duration of the proposed consent term.

Land discharge options were assessed (Appendix B) and considered to be practicably and economically unfeasible at this current time. A discharge to water as proposed must continue to be pursued to avoid unreasonable delay.

Upgrade options have been assessed and it was concluded (Appendix C) that improved maintenance activities coupled with installation of baffles in the pond and movement of the inlet would improve disinfection performance. Additionally, Jacobs (Appendix C) have recommended that the consent maximum FC and ammonia limits be changed to include a percentile standard alongside median values as limits. These changes reflect that some high values will be recorded but that the effect of these exceedances is transitory and not significantly adverse on the receiving environment compared with values which occur over sustained periods.

A CIA has not been made available at this time from the mandated writer and therefore the Applicant is unable to provide this aspect of the requested information. The Applicant anticipates that the application will be publicly notified and does not disagree with this being the next step procedurally, unless the Northland Regional Council wishes to have the CIA presented to them prior to a notification decision being made in which case the s 92(1) RMA request would need to remain in place.

The Applicant looks forward to receiving advice of receipt of the information and confirmation that the information that has been able to be submitted is of sufficient detail to consider the application.

Nga mihi mahana,

Martell Letica
Consultant Infrastructure Planner
Martell.Letica@fndc.govt.nz

Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Proposed Conditions (to replace similar, or in addition to, current consent conditions)

1. The Consent Holder must, no later than 1 July 2025, de-sludge the facultative pond, remove the excess vegetation present in the wetland, install baffles and move the influent inlet to the north-eastern corner of the pond as recommended by [*Reference Jacobs (2020b)*] so that the quality of the treated wastewater, as measured at NRC Sample Site 323 (discharge from the wetland) meets the following standards, based on the results of [*TBC but expect fortnightly*] samples collected each calendar year as required by Schedule 1 of this Consent:

Parameter	Unit	Median	95^{th} Percentile
Ammoniacal Nitrogen	g/m^3	20	32
Faecal Coliforms	cfu/100ml	2,500	24,300

2. Septic tanks which are a part of the common effluent drainage service (CEDS) shall be inspected and maintained in accordance with the Septage Management Plan.

3. Within six months of the commencement of consent the Consent Holder shall commission a suitably qualified and experienced person to prepare a Septage Management Plan (SMP) to demonstrate how the CEDS is to be operated and maintained to ensure compliance with the conditions of this consent. The SMP must, at minimum, contain the following information;

   a. A suitable record of each individual tank connected to the CEDS that contains, at minimum, the following information;

      i. Location details (i.e., GPS coordinates), and sketch plan of the septic tank on each property

      ii. Basic property information (legal description, address)

      iii. Contact information for the property owner

      iv. Water supply type

      v. The number of years the septic tank has been in service (the age of the septic tank).

   b. A protocol for tank inspections which includes

      i. The frequency at which tanks will be inspected;

      ii. The methods of inspection that may be used.

Advice note: *A consistent set of inspection methods are necessary to ensure that collected information is comparable for use in any improvement processes and for demonstrating compliance.*

   c. Details on how education and advice will be shared with properties connected to the CEDS for proper septic tank use and operation.

d. A template for recording tank inspection information which generally follows tank inspection requirements under AS/NZS 1547:2012.

e. A desludging programme for the septic tanks connected to the CEDS which recognises that older tanks may need to be desludged more frequently than newer tanks.

APPENDIX B – SURVEY PLANS

AUCKLAND LAND DISTRICT.

13937

ENTERED on Plank
„ „ Record Map MANGAMUKA S.D
„ „ Index
„ „ Selection
Hokianga County 2.10.12

6011, 7789, 4196

FIELD BOOK	2055
TRAV. RECORD	NC 36-38
RECEIVED	20 3 12
EXAMINED	L.J.P. 15.4.12
REGISTERED	21 3 12

L.J.P. Ex. Bk. I Fol. 16-27

Instructions No 13937
Field Book 2055

"ENDORSED ON COURT ORDER FORMS"
R.P.D.
for N. L. DFTSMAN.
16/9/12

PLAN OF
TAUTEIHIIHI No 2A Secs. 1 & 2 & 2B Secs. 1 to 5 Blks.
BLK X MANGAMUKA S.D.

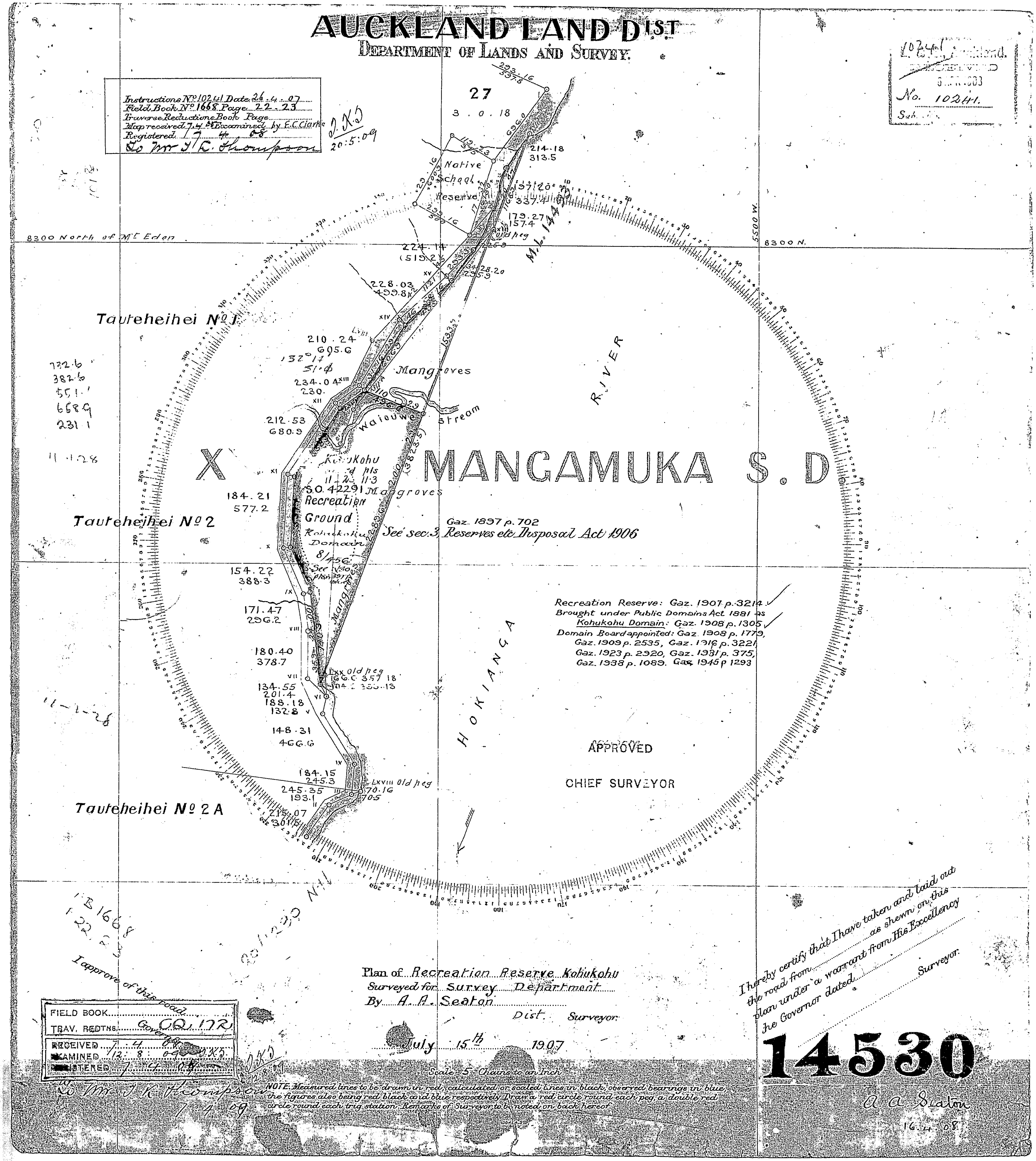
Scale: 10 Chains to 1 Inch.

I hereby certify that this plan has been made from surveys executed by me, that both plan and survey are correct, and that all the rules and regulations with respect to the survey of Native Lands have been strictly complied with.

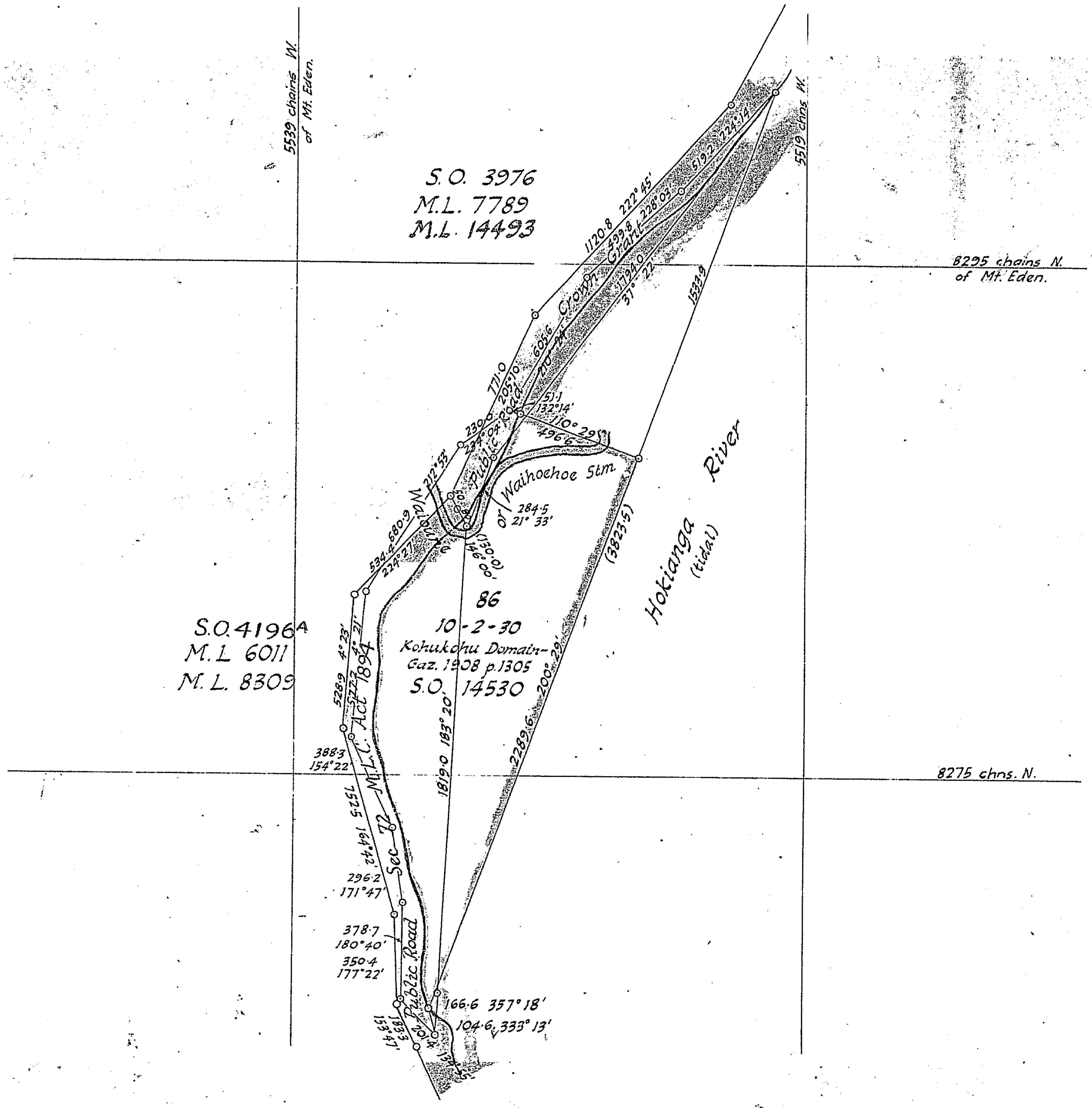
Dated at Auckland this 20th day of March 1912

Licensed Surveyor.

8309


AUCKLAND LAND DIST
DEPARTMENT OF LANDS AND SURVEY.
Instructions No 10241 Date 26.4.07
Field Book No 1668 Page 22.23
Traverse Reduction Book Page
Map received 7.4.08 Examined by E.C. Clarke
Registered 17.4.08
To Mr T.C. Thompson
20:5:09
No. 10241.
27
3.0.18
Native School Reserve
8300 North of Mt Eden
8300 N.
5500 W.
M.L. 14493
Tauteheihei No 1
Tauteheihei No 2
Tauteheihei No 2A
Mangroves
Waiouwe Stream
RIVER
HOKIANGA
X MANGAMUKA S.D
Kohukohu
S.O. 42291
Recreation Ground
Kohukohu Domain
8/456
Gaz. 1897 p. 702
See sec. 3, Reserves etc Disposal Act 1906
Recreation Reserve: Gaz. 1907 p. 3214
Brought under Public Domains Act 1881 as
Kohukohu Domain: Gaz. 1908 p. 1305
Domain Board appointed: Gaz. 1908 p. 1779,
Gaz. 1909 p. 2535, Gaz. 1916 p. 3221,
Gaz. 1923 p. 2920, Gaz. 1931 p. 375,
Gaz. 1938 p. 1089. Gaz. 1945 p. 1293
APPROVED
CHIEF SURVEYOR
Plan of Recreation Reserve Kohukohu
Surveyed for Survey Department
By A. A. Seaton Dist. Surveyor
July 15th 1907
Scale 5 Chains to an Inch
NOTE: Measured lines to be drawn in red, calculated or scaled lines in black, observed bearings in blue the figures also being red black and blue respectively. Draw a red circle round each peg a double red circle round each trig station. Remarks of Surveyor to be noted on back hereof.
I hereby certify that I have taken and laid out the road from .... as shown on this plan under a warrant from His Excellency the Governor dated .... Surveyor.
I approve of this road. Governor
FIELD BOOK
TRAV. REDTNS. CQ. 172
RECEIVED 7.4.08
EXAMINED 12.8.09
REGISTERED 7.4.09
To Mr T.K. Thompson 7.4.09
14530
A. A. Seaton 16.4.08
FB 1668 22.23

File: 8/3/128



Board Appointed (Sec. 86, 10.2.30) Gaz. 1960 p 1651

Plan of
Section 86 Blk. X Mangamuka S.D.
formerly Pt. Foreshore (Hokianga River)

Inst. 374, 381, 382

Received Shields 8.7.60.
File 8/3/128
Instructions
Reference Plans As shown on face of plan
Field book — p. —
Traverse book — p. —
Examined by R. Stewart, 1/9/60
Recorded F Holloway Dec. 60
Plan in order for approval [signature] 6/9/60

KOHUKOHU 5

Survey Block & District X Mangamuka
Land District North Auckland **Local Body** Hokianga County
Scale 4 chains to an inch **Surveyed by** Compiled **Date** July 1960

I, ... of .... Registered Surveyor and holder of an annual practising certificate, hereby certify that this plan has been made from surveys executed by me; that both plan and survey are correct and have been made in accordance with the regulations under the Surveyors Act, 1938

Dated at .... this .... day of .... 19......

Registered Surveyor.

Approved [signature]
Chief Surveyor 7/9/60

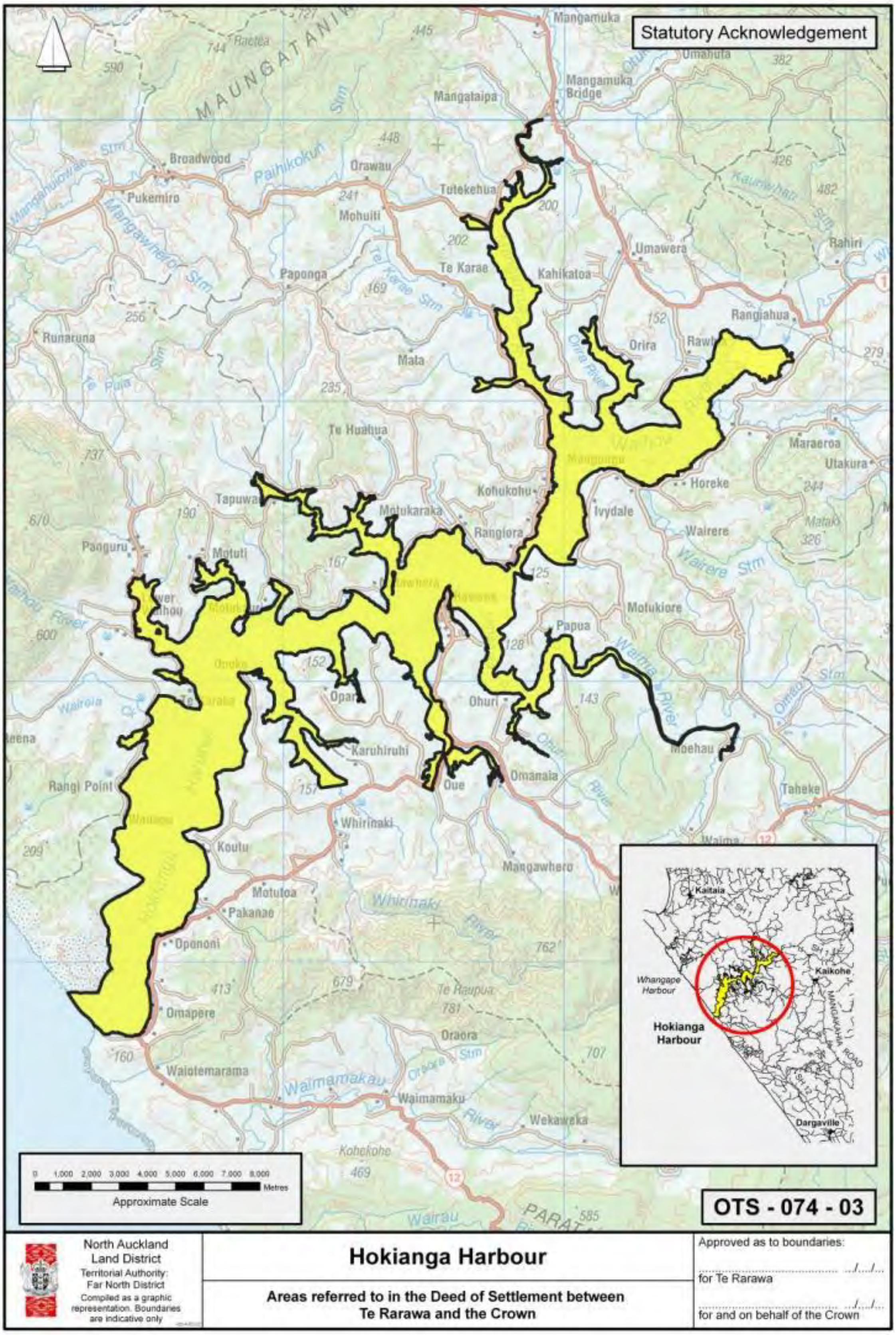
This space reserved for plan numbers

42291

R. E. Owen, Government Printer, Wellington.

APPENDIX C – STATUTORY ACKNOWLEDGEMENT MAP

HOKIANGA HARBOUR (OTS-074-03)



APPENDIX D – ISSUES & OPTIONS REPORT

Kohukohu WWTP Upgrade

Kohukohu WWTP Issues and Options

IZ134400-GN-RPT-002 | F

October 15, 2020

Far North District Council

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	9/3/2020	Draft Issue	AJS/JD	AJS	BM	KS
B	29/04/20	Updated to incorporate comments	AJS/JD	AJS	BM	KS
C	10/07/20	Updated to include cost estimates and client comments	JD	BM	BM	KS
D	24/08/20	Updated to include FNDC MCA criteria	KS	BM	BM	KS
E	23/09/20	Updated to include MCA Outcomes	KS	BM	BM	KS
F	15/10/20	Updated to address comments on costs estimates	JD	BM	BM	KS

Distribution of copies

Revision	Issue approve	Date issued	Issued to	Comments
A				

Kohukohu WWTP Upgrade

Project No:	IZ134400
Document Title:	Kohukohu WWTP Issues and Options
Document No.:	IZ134400-GN-RPT-002
Revision:	F
Document Status:	<DocSuitability>
Date:	October 15, 2020
Client Name:	Far North District Council
Project Manager:	Kate Simmonds
Author:	Andrew Slaney, Jess Daniel, Becky MacDonald
File Name:	IZ134400-GN-RPT-002 Kohu Issues and Options Report_F

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Contents

Executive Summary

The Kohukohu wastewater treatment plant (WWTP) discharges treated wastewater into the Hokianga Harbour. The resource consent for the harbour discharge expired in August 2016. As part of the consent renewal process Far North District Council (FNDC) are investigating options to improve the performance of the WWTP, including potentially removing the discharge from the harbour altogether by moving to a land disposal system. The permanent resident population of Kohukohu was 168 at the 2018 Census. Long-term population forecasting indicates a decrease in the permanent population of the wider South Hokianga area. For the purposes of this report, the permanent resident population of Kohukohu is assumed to remain static over the design period.

The Kohukohu WWTP treats the liquid effluent from the town's septic tanks and consists of a facultative pond (oxidation pond) followed by a surface flow wetland divided into five cells. Effluent from the wetlands is discharged by gravity into a channel running through the tidal mud flats next to the WWTP. The channel joins the main Hokianga Harbour approximately 240 meters south of the WWTP. The Kohukohu WWTP is in generally good condition although the wetlands require vegetation removal.

The current WWTP generally performs well the median effluent faecal coliform concentration for the past 10 years is 800 cfu/100 mL which is comfortably within the consent rolling median limit of 5,000 cfu/100mL; the rolling five sample median has exceeded this limit on two occasions in the past 10 years. The maximum faecal coliform limit of 15,000 cfu/100mL was exceeded on six occasions in the past 10 years. A percentile limit which allows a number of exceedances is more practical for consent compliance, to allow for the natural variability of effluent quality. Similarly, for ammonia, a median or other percentile-based consent limit would be more practical than a maximum value and would reduce the risk of a non-compliance.

The recent hydrodynamic study of the wastewater discharges into the Hokianga Harbour found that a 95th percentile dilution factor of 50,000 was achieved within 100 meters of the discharge point, at a location within the tidal mud flat channel. Based on the hydrodynamic modelling results, there is no discernible effect of the Kohukohu discharge within the main body of the Hokianga Harbour.

When considering the achieved WWTP effluent quality and the hydrodynamic modelling study findings, no major drivers have been identified which substantiate the requirement for an improvement in effluent quality via a substantive WWTP upgrade, although there are some relatively inexpensive measures that would improve the disinfection performance of the WWTP. Any further improvements above this, if desired, could aim at further improving disinfection performance and reducing the public health risks of the discharge.

A desktop analysis of land disposal sites found that most of the land around Kohukohu is steep and unsuitable for land disposal; only two potentially suitable sites were located within the 5 km radius and these were less than the required disposal area of 3.0 hectares. At this time, land disposal is not considered feasible.

The study therefore identifies three upgrade options for the Kohukohu WWTP as follows:

1. Option 1) Maintain the existing system (removing vegetation from the wetlands)

2. Option 2) Plus optimisation of disinfection performance by installing curtain baffles and relocating the pond inlet pipe to the north-eastern corner of the pond

3. Option 3) Plus installation of a new UV disinfection system downstream of the wetland for further disinfection.

High level costs estimates for the shortlisted options have been prepared, and these are summarised as:

Option	1) Maintain Current	2) Optimise current	3) Optimise + UV
Cost	$140,000	$264,000	$422,000

A multicriteria analysis (MCA) has been completed at a collaborative workshop held with FNDC on the 26th August and subsequent sensitivity analysis, which demonstrates that Option 2 is preferred under most scenarios, although if cost becomes a more highly weighted criterion, then Option 1 becomes preferred. However, there is additional risk of short-circuiting with Option 1, therefore installation of curtain baffles and adjusting the inlet to reduce this risk is recommended. Our recommendations is that Option 2 be implemented for the Kohukohu WWTP based on this issues and options assessment, and the MCA outcomes.

1. Introduction

1.1 Project Background

The Kohukohu wastewater treatment plant (WWTP) was constructed in 1984. The WWTP treats liquid septic tank effluent from the settlement of Kohukohu and consists of a single facultative (oxidation) pond followed by a surface flow wetland. Treated wastewater is discharged by gravity into a channel in the tidal mud flats next to the WWTP, from where it flows into the main body of the Hokianga Harbour.

The existing resource consent for the WWTP was granted in 2002 and expired on 31 August 2016. An application for a new resource consent was lodged with Northland Regional Council (NRC) in May 2016 (Opus, 2016) and the WWTP has been operating under the old consent since that time. A copy of the existing resource consent is provided in Appendix A.

In January 2020 NRC requested additional information regarding the consent application. Far North District Council (FNDC) are currently preparing the response to the information request. In response to the request FNDC have engaged Jacobs to assess the current WWTP and identify options for the future direction of the plant, including the consideration of land-based disposal. An agreed strategy will likely be taken forward to include in the consent application and FNDC's long term plan (LTP).

1.2 Purpose of this Report

The purpose of this report is to present the main issues facing the Kohukohu WWTP and improvement options to address these issues. A desktop assessment of potential land disposal sites has also been undertaken and is included as Appendix B.

The report will be used by FNDC to inform assessment of the options to identify a preferred upgrade strategy, as well as informing stakeholders and engaging with the community regarding the options. To aid the assessment of the option proposed assessment criteria are also presented to enable a multi-criteria analysis (MCA).

The impacts of climate change, specifically the impact of sea level rise, specifically storm surge, inundation and flooding the Kohukohu WWTP have not been considered in detail in this report. However, through our desktop assessment of viable land disposal sites we can confirm that the WWTP is not located in an area susceptible to flooding. The WWTP does however lie within the orange tsunami evacuation zone which faces a medium level of risk according to the New Zealand Civil Defence. In the long term, the effects of climate change could disrupt the operation of the WWTP. The wider issue of sea level rise will impact all coastal WWTPs. A long term, district wide approach, will be required that considers the risk posed to each of the FNDC WWTPs and then prioritises mitigation based on the assessed risk.

2. Design Basis

2.1 Design Horizon

The design horizon for this report is 2035, to align with the 15-year consent duration applied for by FNDC (Opus, 2016).

2.2 Design Population

The permanent resident population of Kohukohu was 168 at the 2018 Census. Long-term population forecasting indicates a decrease in the permanent population of the wider South Hokianga area. For the purposes of this report, the permanent resident population of Kohukohu is assumed to remain static over the design period.

2.3 Wastewater Flows

2.3.1 Dry Weather Flows

Dry weather influent flows from 2015 to 2019 are shown in Figure 2-1: Kohukohu WWTP Influent Dry Weather Flows 2015 - 2019. The black line shows the 30-day rolling average dry weather flow (ADWF). A dry weather day is defined as any day where the total rainfall for that day and the preceding two days is less than 0.5mm, which accounts for 27% of the days in the year (201 days out of 360 days).

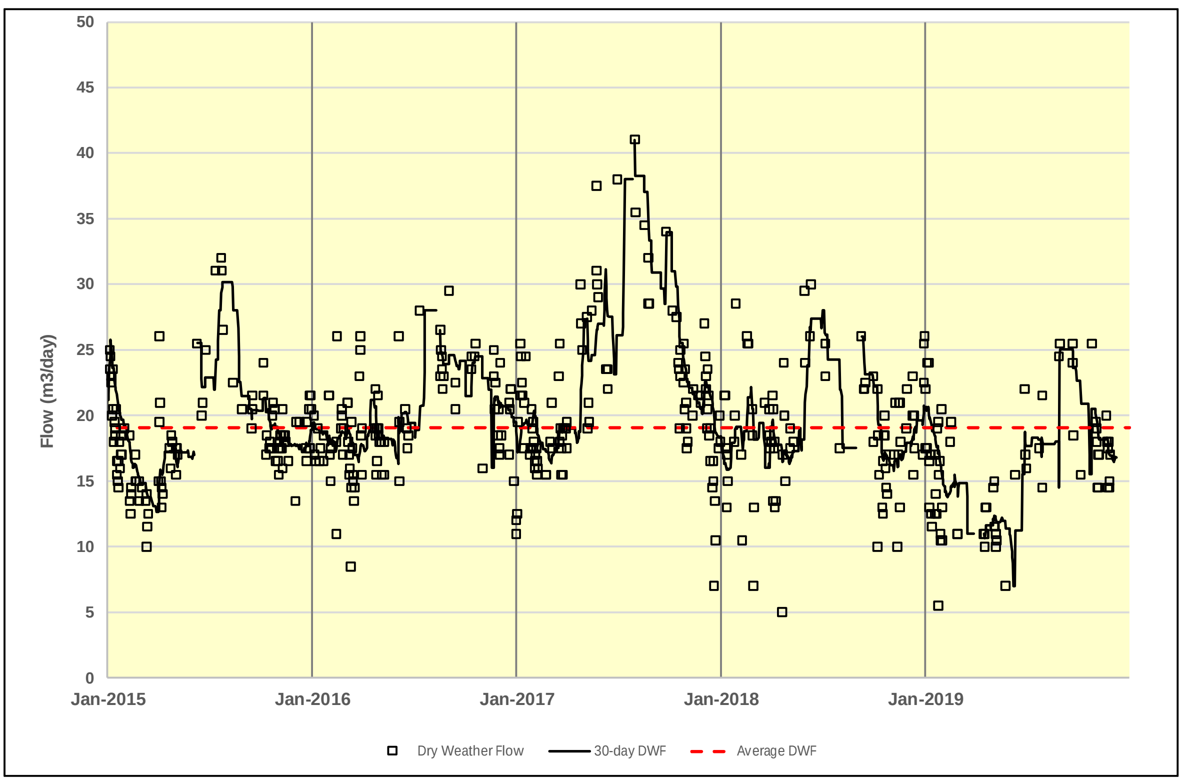

Figure 2-1: Kohukohu WWTP Influent Dry Weather Flows 2015 - 2019

There does not appear to be a peak in 30-day ADWF over the summer holiday season, unlike the Opononi WWTP which experiences a significant increase in flows over the summer. In contrast, there appears to be a peak in dry weather flows in the middle of the year. This could indicate groundwater infiltration or stormwater connections to the system or to the septic tanks feeding the system. This should be investigated further as the project progresses. The peak 30-day ADWF and annual ADWF are presented in Table 2-1: Kohukohu WWTP Dry Weather Flows 2015 - 2019.

Table 2-1: Kohukohu WWTP Dry Weather Flows 2015 - 2019

Parameter	Units	Value
Maximum 30-day ADWF	m^3/day	41
Rolling 30- day ADWF	m^3/day	20
ADWF	m^3/day	19

2.3.2 Wet Weather Flows

A wet weather day is defined as any day with greater than 5.0mm of rain and accounts for 23% of the days in the year. The highest recorded daily peak wet weather flow (PWWF) to the Kohukohu WWTP over the past 5 years was 176m^3/day, and over the past 10 years was 278m^3/day. This is a wet weather peaking factor of approximately 10 based on the 5-year maximum, and 15 on the ten-year maximum, which indicates a high level of infiltration or stormwater connections into the septic tank system, possibly from roof downpipe connections. As noted above, this should be considered further.

2.3.3 Pollutant Loads

The sewer catchment of Kohukohu is predominantly domestic, with no significant trade waste inputs. The influent to the Kohukohu WWTP is the liquid stream from individual on-site septic tanks. A well-performing septic tank should typically remove around 80% of suspended solids and 50% of the biological oxygen demand (BOD) from the raw wastewater (Auckland Regional Council, 2004). Therefore, the BOD and suspended solids concentrations and loads to the WWTP are expected to be significantly lower than for raw wastewater. However, as there is no influent sampling data, the extent of treatment provided by the septic tanks is currently not known.

2.4 Summary

The design basis for the Kohukohu WWTP is provided in Table 2-2: Kohukohu WWTP Issues and Options Report Design Basis (from flow meter data). The wet weather peaking factor of approximately 10, based on the 5-year maximum, and 15, based on the ten-year maximum, indicates a high level of infiltration or stormwater connections into the septic tank system.

Table 2-2: Kohukohu WWTP Issues and Options Report Design Basis (from flow meter data)

Parameter	Units	Current	2035
Permanent resident population		168	170
ADWF	m3/day	19	20
Maximum 30-day ADWF	m3/day	41	40
PWWF	m3/day	176	180

2.5 Land Disposal Design Basis

2.5.1 Hydraulic Loading Rate

The methodology for determining the hydraulic loading rate is based on the procedure for "Type 1" slow rate systems provided in the USEPA Process Design Manual for Land Treatment of Municipal Wastewater Effluents (USEPA, 2006). The method set out in the USEPA manual is a standard water balance methodology based on percolation rate to groundwater. Type 1 systems are designed for year-round deep percolation to groundwater as opposed to deficit irrigation systems, which avoid percolation by irrigating only the amount of water either evaporated or used by the plants (evapotranspiration). Often deficit irrigation is used in locations with long dry summer conditions. In a wetter climate, deficit irrigation is unlikely to be applicable.

Using the USEPA design methodology, a conservative hydraulic loading rate of 2.0 mm/day is derived as shown in Table 2-4: Kohukohu WWTP Land Disposal Design Basis. However, this would need to be confirmed with site specific testing of the ground conditions.

Table 2-3: Kohukohu WWTP Land Disposal Hydraulic Loading Rate Design Basis

Parameter	Units	Value	Comment
Soil type		Clay loam	All potential sites have clay loam soils see Table 7.4
Soil permeability (preliminary design)	mm/day	60	Category 4, Table 5.2 NZS1547 (2012)
Design safety factor		5%	USEPA (2006) type 1 slow rate design methodology
Design annual percolation rate	mm/day	3.0	Soil permeability x safety factor
Annual rainfall	mm /year	1,299	NIWA (2013)
Annual evapotranspiration	mm /year	877	NIWA (2013)
Annual hydraulic loading rate	mm/day	2.0	Percolation – rainfall + evapotranspiration

2.5.2 Irrigation Storage Requirement

For preliminary design purposes, 30-days storage (at ADF) is assumed for the irrigation storage pond. This is a conservative value and provides storage for a period of prolonged wet weather when the land has continuous surface ponding and is unsuitable for irrigation. The storage requirement may be reduced following detailed site investigations and rainfall analysis. However, given the poorly draining soils in the area, at this stage a conservative storage value is considered appropriate.

2.5.3 Land Disposal Design Basis Summary

The design basis for land disposal is presented in Table 2-4: Kohukohu WWTP Land Disposal Design Basis.

Note: The design basis is based on a desktop analysis using available data and is used for screening of options only. Site specific investigations have not been carried out and will be required prior to undertaking any design.

Table 2-4: Kohukohu WWTP Land Disposal Design Basis

Parameter	Units	Value
Average daily flow	m3/day	30
Hydraulic loading rate	mm/day	2.0
Irrigated area	Ha	1.50

Parameter	Units	Value
Allowance for buffer zones and storage pond	%	100
Total land area required	Ha	3.0
Irrigation application method		Solid set or drip line
Number of days storage required at ADF	days	30
Irrigation storage pond volume	m3	900

3. Existing WWTP

3.1 Existing WWTP Overview

The Kohukohu WWTP consists of a facultative pond (oxidation pond) followed by a surface flow wetland divided into five cells. Effluent from the wetlands is discharged by gravity into a channel running through the tidal mud flats next the WWTP. The channel joins the main Hokianga Harbour approximately 240 meters south of the WWTP.

An aerial photo showing the elements of the Kohukohu WWTP is provided in Figure 3-1.

Figure 3-1: Aerial Photograph of Kohukohu WWTP

3.2 Facultative (Oxidation) Pond

The facultative pond has a surface area of approximately 750 m^2 and is 1.5 meters deep. The pond has sufficient capacity to cater for the current population, however, the pond sludge level is reported to be high and is due for desludging.

The pond is square in shape, and the current inlet location is in the middle of the pond (Figure 3-2: Kohukohu WWTP Oxidation Pond). This arrangement means there is a high chance of short circuiting from inlet to outlet. An improvement in disinfection performance could be achieved by relocating the inlet to the north eastern corner of the pond and installing baffle curtains.

Figure 3-2: Kohukohu WWTP Oxidation Pond

3.3 Surface Flow Wetlands

The surface flow wetlands consist of five wetland cells in series. The wetland cells are overgrown and in need of maintenance (Figure 3-3: View of Kohukohu WWTP Constructed Wetland). The main function of the wetlands is to provide additional disinfection (through natural pathogen die-off), and algae removal (through shading of the water). Some ammonia removal can also be achieved through nitrification occurring in the plant root zones.

Figure 3-3: View of Kohukohu WWTP Constructed Wetland

3.4 Water Loss Across WWTP

Water loss across the WWTP can be significant and during dry periods it is common to record influent volumes of 10 to 20 m^3/day with no outflow recorded. The water loss could be due to a combination of seepage, although this is unlikely as the sludge will likely have blinded the base of the pond, as well as evaporation from the oxidation pond and wetlands.

3.5 Climate Change Effects

The Kohukohu WWTP is situated at the Hokianga Harbour coastline. Through GIS analysis, flood and tsunami zones were superimposed at the location of the WWTP seen in Figure 3-4. The WWTP is not located in an area susceptible to flooding. The WWTP does however lie within the orange tsunami evacuation zone which faces a medium level of risk according to the New Zealand Civil Defence. In the long term, the effects of climate change such as the wider issue of sea level rise, could disrupt the operation of many of FNDC's WWTPs. A long term, district wide approach, will be required that considers the risk posed to each of the FNDC WWTPs and then prioritises mitigation based on the assessed risk.

Figure 3-4 Kohukohu WWTP Flood and Tsunami Zones

4. Effluent Quality

4.1 Effluent Quality Results

Under the conditions of the existing resource consent, effluent samples are taken every three months. Compliance against the resource consent faecal coliform and ammoniacal nitrogen median standards is measured using rolling 5-sample median values. There are no consent limits on BOD or total suspended solids (TSS).

Figure 4-1 through Figure 4-4 present the effluent sampling results for faecal coliforms, ammoniacal nitrogen, BOD and TSS from 2010 – 2019 as well as the resource consent median and maximum values (shown as dashed lines).

The overall effluent quality statistics from 2010 to 2019 are presented in Table 4-1: Kohukohu WWTP Effluent Quality Summary 2010 - 2019. The compliance rate is calculated as the number of rolling five three-monthly sample median values or maximum values that comply with the consent standard divided by the total number of samples.

There are no significant issues of concern with the effluent quality, reflecting the pre-treatment provided by the septic tanks and the capacity of the WWTP to cater for existing loads.

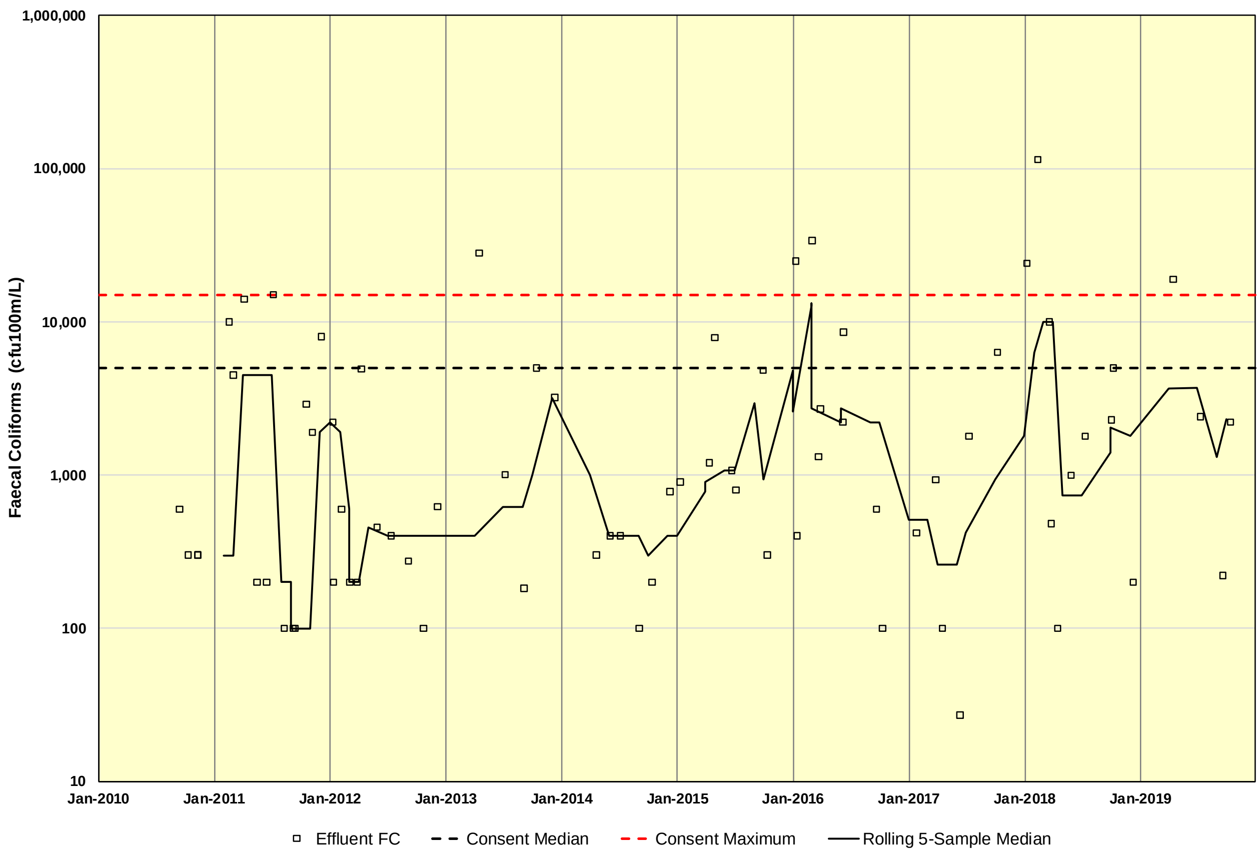

Figure 4-1: Kohukohu WWTP Effluent Faecal Coliform Concentrations 2010 – 2019

The overall median faecal coliform concentration of 800 cfu/100 mL is comfortably within the consent rolling median, however there were two periods where the rolling five sample median exceeded the consent rolling median limit (Figure 4-1). A UV disinfection system would provide more assurance of compliance going forward. However, simply thinning out the plants in the wetlands to provide more sunlight exposure may also promote disinfection.

The maximum faecal coliform limit of 15,000 cfu/100mL was exceeded on six occasions since January 2010. A percentile limit which allows a number of occasional exceedances may be more practical for consent compliance, to allow for the natural variability of effluent quality from a pond-based system.

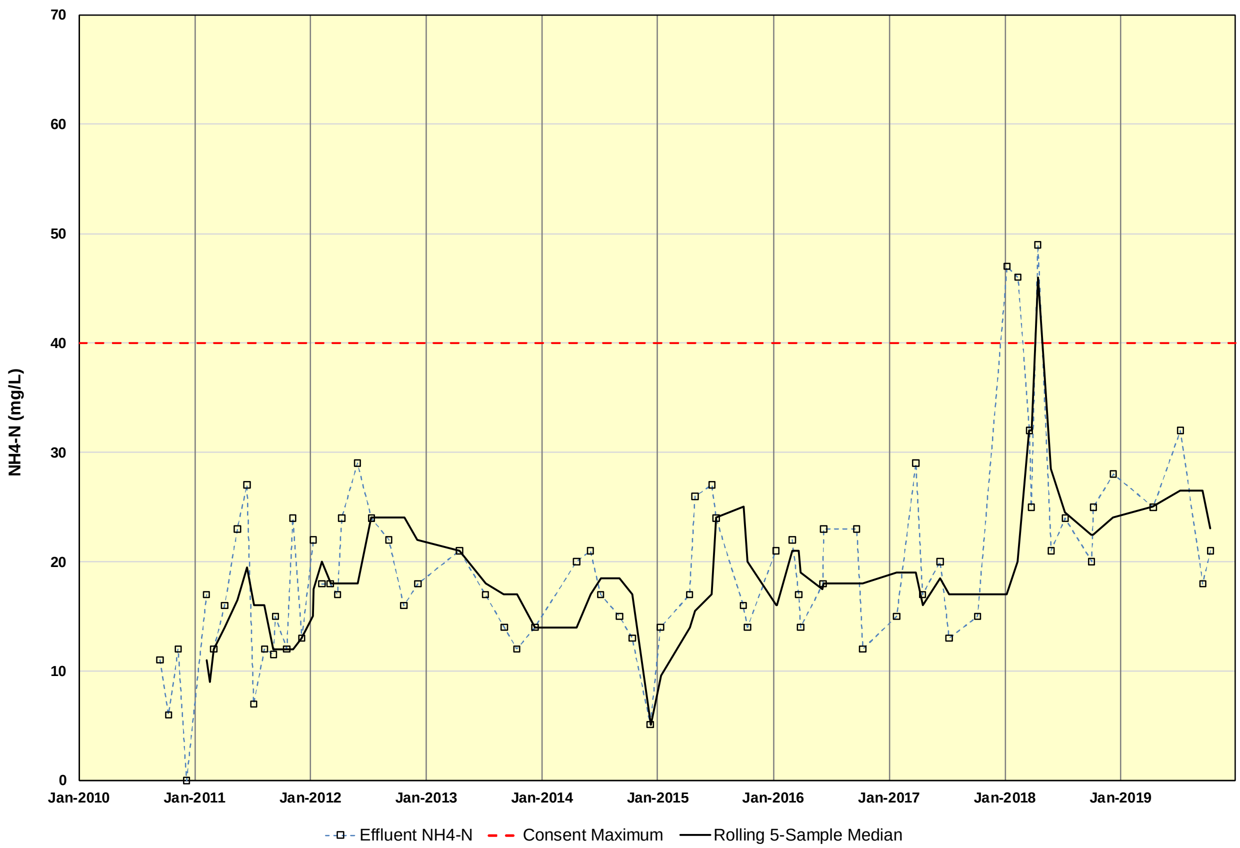

Figure 4-2: Kohukohu WWTP Effluent Ammoniacal Nitrogen Concentrations 2010 – 2019

There was a cluster of high ammonia values in 2018, prior to desludging of the ponds. Once the pond was de-sludged pond performance was restored. Similar to faecal coliforms, a median or other percentile-based consent limit for ammonia, would be more practical than a maximum value and would reduce the risk of a non-compliance.

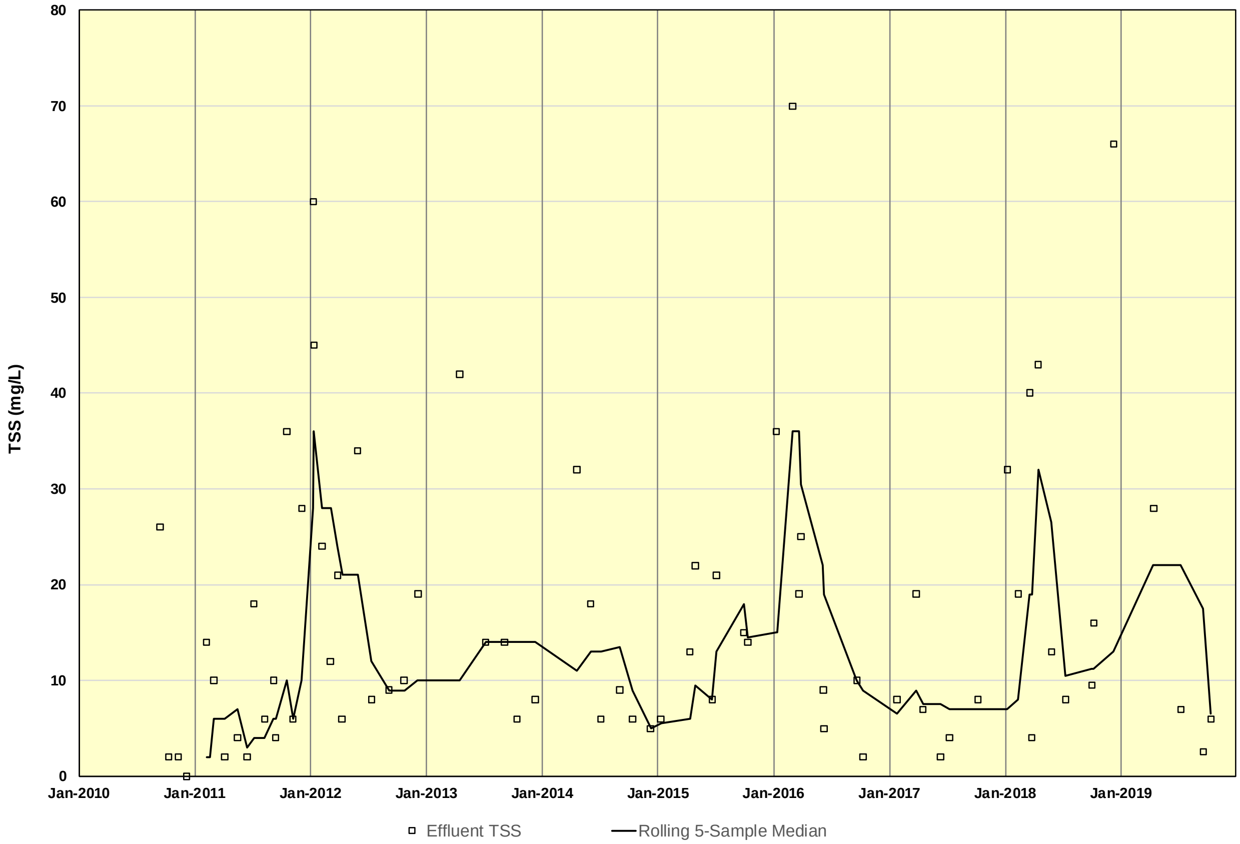

Figure 4-3: Kohukohu WWTP Effluent Suspended Solids Concentrations 2010 - 2019

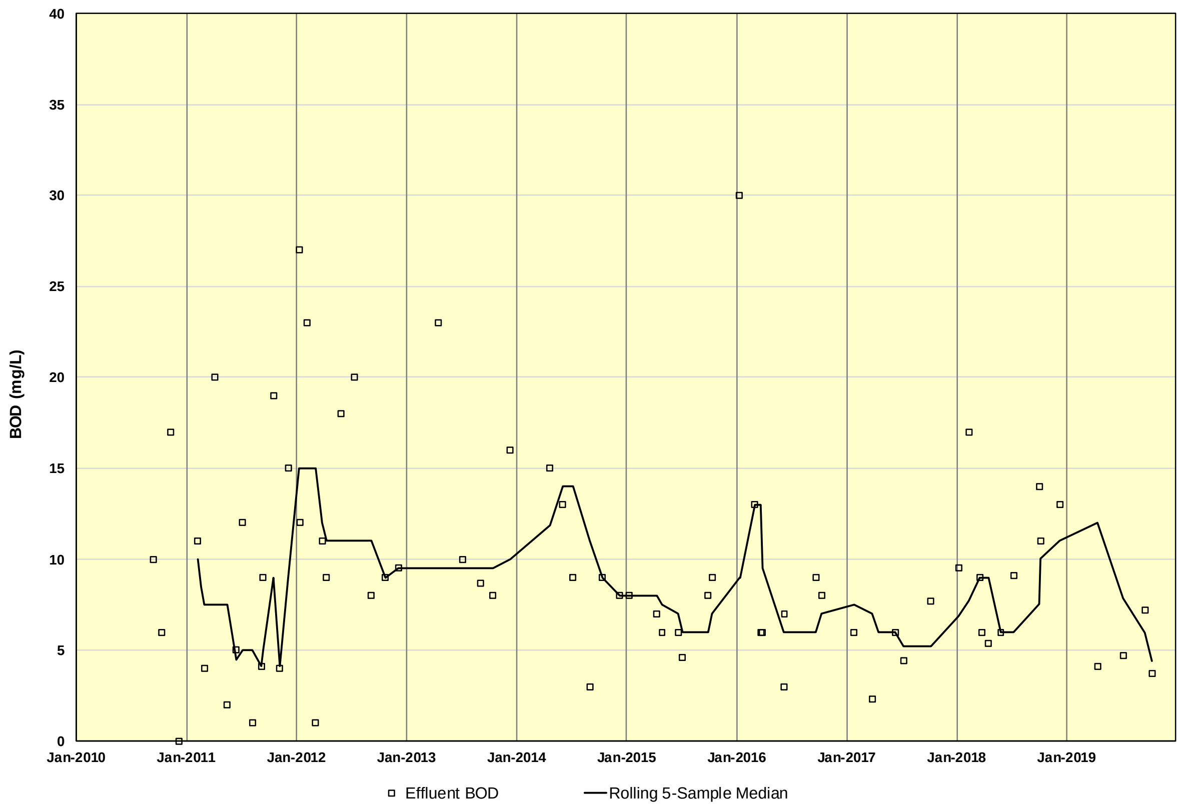

Figure 4-4: Kohukohu WWTP Effluent BOD Concentrations 2010 – 2019

Table 4-1: Kohukohu WWTP Effluent Quality Summary 2010 - 2019 summarises the effluent quality data in a tabular format. This should be considered in light of the pond desludging in late 2018.

Table 4-1: Kohukohu WWTP Effluent Quality Summary 2010 - 2019

Parameter	Units	No. of Samples	Median			Mean	Maximum		
			Consent	Overall	Compliance Rate		Consent	Overall	Compliance Rate
Faecal coliforms	cfu/100mL	75	5,000	800	91.5%	n/a	15,000	114,000	90.7%
NH_4-N	mg/L	72		18		20	40	49	95.8%
BOD	mg/L	72		8.4		9.5		30	
TSS	mg/L	73		10		16		70	

5. Receiving Environment

5.1 Harbour Values and Water Quality Standards

Values of the Hokianga Harbour intrinsically linked to water quality that can be impacted by wastewater discharges include:

- Recreation and aesthetics: Water quality should be suitable for swimming at all times and the visual and aesthetic values of the water should be maintained.
- Shellfish consumption: The Harbour should continue to support the healthy growth and survival of shellfish, and it should be safe to gather shellfish for human consumption at all times.
- Aquatic ecosystem health: The Harbour should continue to maintain the healthy functioning of aquatic ecosystems.

The Proposed Regional Plan for Northland (NRC 2019) Policy H.3.3 (Coastal water quality standards) contains coastal water quality standards that are designed to protect the recreational, aesthetic, shellfish gathering and ecosystem values of coastal waters in the region. The standards are therefore useful to assess whether the discharge could be affecting any of the important harbour values listed above. Standards in Policy H.3.3 of relevance to wastewater discharges are shown in Table 5-1: Proposed Regional Plan for Northland Coastal Water Quality Standards (Estuaries).

Table 5-1: Proposed Regional Plan for Northland Coastal Water Quality Standards (Estuaries)

Parameter	Units	Median	90th Percentile	95th Percentile
Faecal coliforms (shellfish gathering)	cfu/100mL	14	43	
Enterococci (contact recreation)	org/100mL			200
Ammoniacal nitrogen	mg/L	0.023		

The following points are noted in relation to the Kohukohu discharge:

- Phosphorus is not normally a concern in coastal waters as nitrogen is almost always the limiting nutrient (NIWA, 2018). None of the WWTP's discharging directly into the Hokianga Harbour (Opononi, Rawene, Kohukohu) contain phosphorus limits.
- Based on the Estuary Trophic Index toolbox (NIWA 2018) the Hokianga Harbour has a low physical susceptibly to nitrogen impacts and experiences minor stress from catchment nitrogen loads (FNDC 2018). None of the WWTP's discharging directly into the Hokianga Harbour contain total nitrogen limits and total nitrogen is not considered to be an issue for the Kohukohu WWTP discharge.
- A maximum ammoniacal nitrogen concentration limit is included in the current resource consent (Table 4-1) as ammonia is a toxicant to shellfish and fish species.

5.2 Dilution in Harbour

Treated wastewater from the Kohukohu WWTP is discharged into a channel running past the WWTP through tidal mangrove-covered mud flats. The channel discharges into the main Hokianga Harbour around 240 meters south of the WWTP.

The existing resource consent defines the downstream Harbour monitoring point as the Kohukohu channel beacon, located a further 170 meters from the point where the channel discharges into the main Harbour.

An aerial photo showing the WWTP, channel and downstream monitoring point, is provided in Figure 5.1.

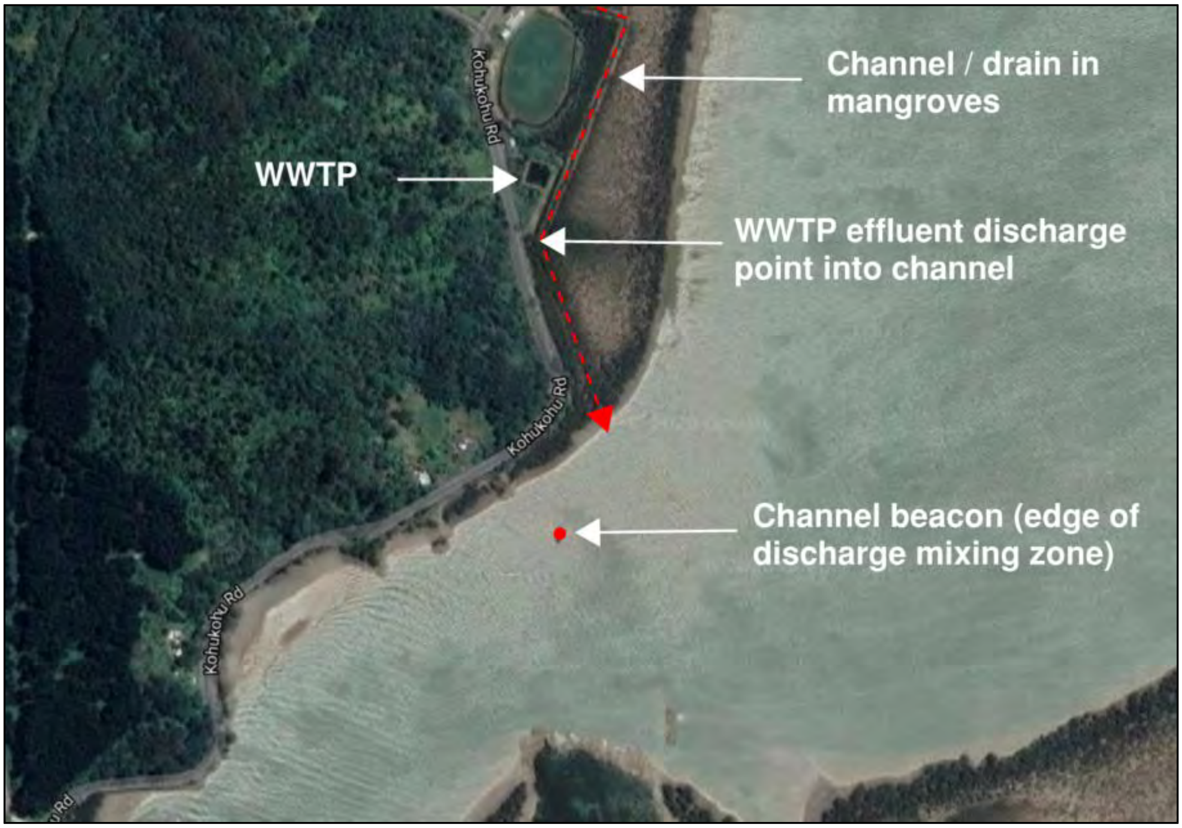

Figure 5-1: Aerial Photograph of Kohukohu WWTP Showing Discharge Location and Monitoring Point

In 2019 FNDC commissioned MetOcean Solutions to undertake a hydrodynamic study of the Hokianga Harbour and the dilution and dispersion of the four treated wastewater discharges into the Harbour (Kaikohe, Kohukohu, Rawene, Kohukohu) (MetOcean, 2020).

For the Kohukohu outfall, the modelling results showed a high level of dilution, with the discharge plume confined to the channel and not reaching the main Harbour. A 95th percentile dilution factor of 50,000 was achieved within the channel, 100 meters downstream of the discharge point.

Using the known effluent pollutant concentrations, and the dilution factors from the hydrodynamic model (MetOcean, 2020), the harbour faecal coliform and ammoniacal nitrogen concentrations near the outfall discharge location can be estimated, based on a desk top calculation. These are presented in Table 5-1. Due to the high level of dilution combined with level of treatment provided, no discernible effect is expected as a result of the Kohukohu discharge within the main body of the Hokianga Harbour.

Table 5-2 Contaminant Concentrations in the Hokianga Harbour based on 2016 - 2019 Effluent Results & Hydrodynamic Model

Parameter	Units	Effluent Results 2016 – 2019	Harbour Near Discharge Point	Harbour Near Shoreline	Harbour Water Quality Standards
Dilution factor			50,000	Not provided	
Median Effluent Quality					
E. Coli concentration	cfu/100mL	800	0.02	-	14*
NH_4-N concentration	mg/L	18	3.6E-04	-	0.023
TSS concentration	mg/L	10	2.0E-04	-	n/a
Maximum Effluent Quality					
E. Coli concentration	cfu/100mL	1.1.E+05	2.28	-	n/a
NH_4-N concentration	mg/L	49	9.8E-04	-	n/a
TSS concentration	mg/L	70	1.4E-03	-	n/a

6. WWTP Improvement Options

The Kohukohu WWTP is generally performing well with the only instances of non-compliance with the consent conditions being for faecals. Maintenance of the wetlands may be sufficient to reduce those exceedances. Some options to provide additional disinfection have been identified and are summarised in the following sections.

6.1 Pond Inlet Relocation and Baffles

The amount of disinfection provided by ponds is a function of hydraulic retention time (HRT), exposure to sunlight and ambient temperature, and can be estimated using a first-order decay model (Mara, 2010). Hence, measures that improve the average residence time in a pond will improve disinfection performance.

Plastic curtain baffles installed in the maturation pond would reduce short-circuiting and improve the disinfection performance of the pond (IWA, 2012). Baffle curtains are commonly used in New Zealand ponds as a means of improving disinfection performance (Ratsey, 2016).

In addition, to curtain baffles, the hydraulic performance of the pond would be improved by relocating the pond inlet pipe from the middle of the pond to the north-eastern corner of the pond. This would reduce the likelihood of short-circuiting from inlet to outlet and increase the HRT.

6.2 UV Disinfection

A UV disinfection system could be installed on the final effluent prior to discharge to the Harbour. UV disinfection of pond or wetland effluent is reasonably common in New Zealand due to increasing effluent bacterial standards; examples include Thames WWTP, and Woodend and Kaiapoi WWTP's (Waimakariri District).

The variable algae content of wetland effluent will result in correspondingly variable UV disinfection performance, as algae reduces UV transmission, shields microorganisms from UV radiation and can also foul the lamp sleeves. To mitigate this, UV systems come with automatic lamp sleeve wipers and some units have a double skinned wiper with acid in the gap to provide a chemical clean of the surface as it wipes.

A 1 – 2 log removal of faecal coliforms could be achieved with a UV system treating the wetland effluent. The unit would be installed in a channel between the wetland and the outfall pipe. During periods of no effluent flow, the unit would be switched off. As the WWTP site has no power supply, a new power supply would need to be provided to the WWTP site for a UV system.

6.3 Other disinfection

Other disinfection options exist, including membrane filtration and chemical disinfection (ozone, chlorine or hydrogen peroxide).

Membrane filtration has not been considered as this has been used at other pond sites around New Zealand with mixed success. It is complicated to operate, has a high ongoing operating cost, and would likely be difficult to procure at such a small scale for the Kohukohu WWTP.

Chemical disinfection is not widely used in New Zealand due to concerns over the potential generation of disinfection by-products in the treated wastewater.

6.4 Ammonia, BOD and Total Suspended Solids

Based on the current effluent quality data and the hydrodynamic modelling study results which showed a high level of dilution in the channel and harbour, additional improvements to reduce effluent ammonia, total suspended solids or BOD concentrations are not required and therefore options to address these contaminants are not presented.

7. Treated Wastewater Disposal

7.1 Land Disposal Site Desktop Study

A desktop investigation of potential land disposal sites was carried out as part of this issues and options investigation. The following criteria were used to screen for potential land disposal sites:

Table 7-1: Kohukohu WWTP Land Disposal Screening Criteria

Criteria		Limit	Basis	Reference
1)	Proximity to WWTP	5 -7 kilometres	Ease of transport of effluent and manageable costs of installing infrastructure and operations within this distance	AECOM Taipa WWTP Upgrade Issues and Options -Land Disposal Site Selection Analysis Report
2)	Proximity to residential dwellings	>20m	Distance was selected based on previous work completed by CH2M Beca for Rawene WWTP	Rawene Issues and Options Report completed by CH2M -Beca
3)	Proximity to cultural dwellings	500m	Distance was selected based on previous work completed by AECOM for the Taipa WWTP completed with additional buffer	AECOM Taipa WWTP Upgrade Issues and Options -Land Disposal Site Selection Analysis Report
4)	Proximity to waterways	≥20m	Distance was selected based on previous work for Rawene WWTP	Rawene Issues and Options Report completed by CH2M -Beca
5)	Slope	<10%	Acceptable land slope for distribution as the risk of erosion and runoff is reduced	Metcalf & Eddy Wastewater Engineer Treatment and Reuse Table 14-51
6)	Groundwater	>1.2m	At least 1m to groundwater is preferred with seasonal fluctuations of +/- 0.5m	Metcalf & Eddy Wastewater Engineer Treatment and Reuse Section 14-17
7)	Flooding	Not on flood susceptible land	Risk to land disposal system	
8)	Tsunami zone	Yellow – Safe	Risk to land disposal system	

Based on the above screening criteria, five potential land blocks were identified as potentially suitable for land disposal (Figure 7-1).

Figure 7-1: Kohukohu WWTP: Potential Land Disposal Sites

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Table 7-2: Potential Land Disposal Sites for Kohukohu WWTP

Parameter	Unit	Site 4	Site 5
Distance from WWTP	km	1.7	0.6
Irrigatable land area	Ha	2..4	2.3
Soil type		Clay	Clay
Land slope		3% - 10%	3% - 10%

Sites 1, 2 and 3 are located within an area marked as flood susceptible in FNDC flooding maps and were therefore excluded from further consideration. Sites 4 and 5 are less than the required 3.0 hectares based on the preliminary design basis (Section 2.5.3) and were also excluded from consideration. Therefore, at this stage, land disposal is not considered viable due to a lack of suitably located and sized land in the area, and is therefore excluded from further consideration.

7.2 Other Disposal Options

The option of extending the outfall pipe 240 metres into the main harbour channel is not considered necessary due to the dilution provided in the tidal mud flat channel as reported in the hydrodynamic modelling study (see Section 5.2). In addition, the tidal mud flat channel is currently within the mixing zone of the outfall based on the downstream harbour monitoring location being in the main harbour (Section 5.2).

8. Combined Solution Options and Costs

Three options for wastewater treatment schemes for the Kohukohu WWTP are presented in the following subsections, which all include maintaining use of the existing outfall discharge into the tidal mud flat channel.

It should be noted that varying levels of risk have been applied to each item in the cost estimate. Items of greater scope and price certainty have a lower risk contingency applied to them and vice versa. The overall risk contingency for each option may be solely contain a low/high or a combination of both lower and higher contingency factors, in this case standard and low risk labels have been used for indication.

8.1 Option 1 – Do Nothing

This option does not require upgrade, and instead focusses on maintaining the existing WWTP to improve performance via emptying the pond of sludge and the removal of vegetation from the wetlands. Option 1 maintains the status quo system and is justified based on the existing WWTP performance and dilution in the harbour. The current ammonia concentrations are generally well within the current consent standard which based on the hydrodynamic modelling results, are adequate to protect the amenity and ecosystem values of the Hokianga Harbour.

There may continue to be the occasional non-compliance with the current faecal coliform maximum standard, due to natural variability. Therefore, a change from maximum to a percentile standard would be recommended. This risk of a consent breach could be further minimised by removing some of the vegetation in the wetland.

Indicative pricing for this option can be found in Table 8-1, refer to Appendix C for detailed cost estimates.

Table 8-1 Indicative Cost Estimate for Option 1

Item	Unit	Quantity	Rate	Total	Comment
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$83,000	$83,000	SiteCare quote date 08/07/20. This price includes team mobilisation, dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies. There is a greater certainty on the scope of this work therefore a lower risk factor has been applied to this task.
Wetland vegetation clearance	Item	1	$28,000	$28,000	SiteCare quote for wetland maintenance 8/07/20. FNDC could execute this work under the Far North Water Alliance rather than an external contractor.
Contingency (lower risk)	%	34	$29,000	$29,000	A reduced contingency factor of 34% has been applied to this option to only the desludging work. A contingency is not necessary to be applied to the wetland vegetation clearance work. The risk allowance is based

					on the contingency stated in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant. The risk allowance has only been applied to the desludging and dewatering item as FNDC can control the wetland clearance cost.
Total Costs				$140,000	

8.2 Option 2 – Optimise Existing System

This option involves the maintenance work described for Option 1 as well as the following improvements works:

- Install baffles in pond
- Move pond inlet to the north-eastern corner of the pond.

This option would improve disinfection performance. However, there is a risk of future periodic non-compliances with the current consent faecal coliform maximum standard. Similar to Option 1, this risk would be minimised by removing some of the vegetation in the wetland, and a change from maximum to a percentile standard is also recommended.

Indicative pricing for this option can be found in Table 8-2 below, refer to Appendix C for detailed cost estimates.

Table 8-2 Indicative Cost Estimate for Option 2

Item	Unit	Quantity	Rate	Total	Comment
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$83,000	$83,000	SiteCare quote date 08/07/20. This price includes team mobilisation, dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies.
Wetland vegetation clearance	Item	1	$28,000	$28,000	SiteCare quote for wetland maintenance 8/07/20. FNDC could execute this work under the Far North Water Alliance rather than an external contractor.
Pond Modifications					
Supply and install baffle curtains	Item	1	$25,000	$25,000	Two Permanthene baffle curtains to be installed at 20 metres in length and $165/m. Includes costs for installation quoted by SiteCare on 08/07/20.
Inlet Relocation		1	$56,000	$56,000	SiteCare quote date 08/07/20.

Contingency (standard risk)	%	54	$72,000	$72,000	The Risk allowance is based on factor recommend in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant (refer to Appendix C). The 54% contingency has been applied to all items with the exception of desludging and dewatering works to which a 34% contingency has been applied. The reason being that the contractor contingency being built-in to the cost. The wetland clearance works currently has no contingency applied to it as FNDC can control this cost.
Total Costs				$264,000	

8.3 Option 3 – Optimise Existing System Plus UV Disinfection

This option includes all of the items in Option 2, plus the installation of a UV disinfection system on the wetland effluent. The UV system would be specified so that the median effluent faecal coliform concentration would be 1 -2 log lower than current plant performance (i.e. less than 100 cfu/100mL). It is likely that the power supply to the WWTP would need to be upgraded in order provide sufficient power to run a UV plant.

Indicative pricing for this option can be found in Table 8-3, refer to Appendix C for detailed cost estimates. Cost estimates for upgrading the WWTP power supply have been included into the price of the contingency and UV unit supply.

Table 8-3 Indicative Cost Estimate for Option 3

Item	Unit	Quantity	Rate	Total	Comment
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$83,000	$ 83,000	SiteCare quote date 08/07/20. This price includes team mobilisation, dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies.
Wetland vegetation clearance	Item	1	$28,000	$28,000	SiteCare quote for wetland maintenance 8/07/20. FNDC could execute this work under the Far North Water Alliance rather than an external contractor.
Pond Modifications					

Supply and install baffle curtains	Item	1	$25,000	$25,000	Two Permanthene baffle curtains to be installed at 20 metres in length and $165/m. Includes costs for installation quoted by SiteCare on 08/07/20.
Inlet Relocation		1	$56,000	$56,000	SiteCare quote date 08/07/20.
Further Wastewater Treatment					
UV unit	Item	1	$49,000	$49,000	Based on Xylem quote for a Wedeco LBX10 from March 2020. The total price includes installation, instrumentation and controls, piping and electrical costs.
Instrumentation costs: 1. Flowmeter 2. Turbidity meter 3. UV Transmissivity	Items	1	$53,000	$53,000	Based on quotes received in 2019 from instrumentation suppliers. The total prices includes installation, instrumentation and controls, piping and electrical costs based on factors recommended in Table 4.4 of the IChemE Guide to capital cost estimation (refer to Appendix C).
Contingency (standard risk)	%	54	$128,000	$128,000	The risk allowance is based on factors recommend in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant. The 54% contingency has been applied to all items with the exception of desludging and dewatering works to which a 34% contingency has been applied. The reason being that the contractor contingency being built-in to the cost. The wetland clearance works currently has no contingency applied to it as FNDC can control this cost.
Total Costs				$422,000	

9. Multi-Criteria Assessment

9.1 Criteria

The proposed criteria for the Multi Criteria Analysis (MCA) have been provided by FNDC and are outlined in Table 9-1.

The risks and benefits of each option have been identified and were considered using an MCA process in a collaborative workshop held with FNDC on the 26th August 2020. The MCA criteria used can be summarised at a high level as follows:

- Cultural acceptability: iwi/stakeholder concerns from consultation including effects on the mauri of the water, amenity and perception of a discharge to water.
- Environmental criteria: ensuring the harbour is safe for recreational activities including the gathering of kai moana, particularly close to the disposal site, and a reduction of nutrient load (N and P) going into the harbour from the WWTP, and that amenity impacts such as noise, visual aesthetics and odours are not significantly impacted
- Practicability criteria: that the option can be consented in a timely manner, and considers the complexity of the construction process, distance from networks and services and the overall time taken to construct and commission the option
- Operational Criteria: technical factors including reliability, technical feasibility, robust & proven technology, operational resilience, staging/flexibility for future upgrading, Health and Safety in design and operational complexity.
- Economic Criteria: Order of magnitude capital and operating cost estimates will inform the affordability of each option as well as the likely impact on rates.

Table 9-1: Kohukohu WWTP Assessment Criteria

Number	Category	Criteria	Description	Success Factors
1	Māori cultural values	Impacts on Māori cultural values and practices.	Gives effect to Te Mana o te Wai. Acceptability of process to local iwi	The option safeguards Māori cultural values and practices
2	Environmental values	Land Use Effects	Visual, Noise, Traffic impacts	The option can meet required discharge standards for wastewater (and carbon where applicable) The option can meet amenity standards, including odour
		Odour	The degree to which odour can be expected to be discharged beyond the property boundary.	
		Ecological Effects	The degree to which the effluent quality exceeds the minimum environmental and consent requirements.	
		Carbon Footprint	Level of energy consumption, secondary discharges and chemicals required.	

Number	Category	Criteria	Description	Success Factors
		Public Health	Impacts on mahinga kai Recreational use of the receiving environment Impact of spills and failure	
3	Practicability	Constructability	Complexity of construction process Distance from networks and services Time taken to commission option	The option can be successfully delivered
		Regulations and Planning	Complexity to obtain a consent or other authorisations	
4	Operability	The ease of operation and maintenance	Complexity of operation Required expertise Ease of access H&S risks of plant process. Sludge management Reliance on and complexity of plant consumables and replacement componentry	The option can be successfully used into the future
		Process reliability and resilience	Known performance of others with similar technologies Consistency of quality in the discharge Ability to maintain compliance with resource consents	
		Expandability/ future proofing	The potential for the site to allow for extensions to the treatment process Proofing against changes in compliance requirements	
		Hazards	Proximity to known and potential hazards, e.g., flood plains, climate change hazards	
5	Financial considerations	Capital Cost	Cost of implementation Site investigations and procurement of land Ability to reuse existing FNDC assets	The costs of the option are understood and able to be paid
		Operating and Maintenance Costs	Operations and maintenance requirements (e.g., chemical costs, sludge removal) Power cost	
		Rating impact	Impact on targeted rate relative to other options	

The weightings for the primary and sub-criteria are shown in Table 9-2. The results of the assessment are presented in Table 9-3 and

Figure 9-1.

Table 9-2: MCA Primary and sub-criteria weightings

Primary Criteria	Weighting	Secondary Criteria	Weighting
Economic Criteria	40.0%	Capital Cost	33%
		Operating and Maintenance Costs	33%
		Rating Impacts	33%
Environmental Criteria	20.0%	Land Use Effects (visual, noise and traffic impacts)	15%
		Odour (degree to which odour will be experienced beyond WWTP boundary)	15%
		Ecological Effects (does effluent quality exceed consent limits)	30%
		Carbon Footprint (level of energy and consumables required)	10%
		Public Health (protection of mahinga kai, impact on recreation, impact of spills or failure)	30%
Maori Cultural Values	20.0%	safeguards Māori cultural values and practices	100%
Practicability Criteria	10.0%	Constructability (complexity, distance from services, time to commission)	50%
		Regulations and Planning (complexity in obtaining consent)	50%
Operational Criteria	10.0%	Complexity of operation / required experience	25%
		Sludge management	25%
		Reliance on and complexity of plant consumables and replacement componentry	25%
		Health and Safety risks or plant process / access to site	25%

Table 9-3: MCA Assessment Results

	Option 1	Option 2	Option 3
Key-Criteria Summary	Maintain existing system - clear wetland vegetation overgrowth	Option 1 plus curtain baffles and move inlet pipe	Option 2 plus UV
Economic Criteria	0.40	0.34	0.00
Environmental Criteria	0.08	0.15	0.18
Maori Cultural Values	0.00	0.00	0.00
Practicability Criteria	0.05	0.06	0.05
Operational Criteria	0.08	0.08	0.03
Results	0.61	0.63	0.26
Rank	2	1	3

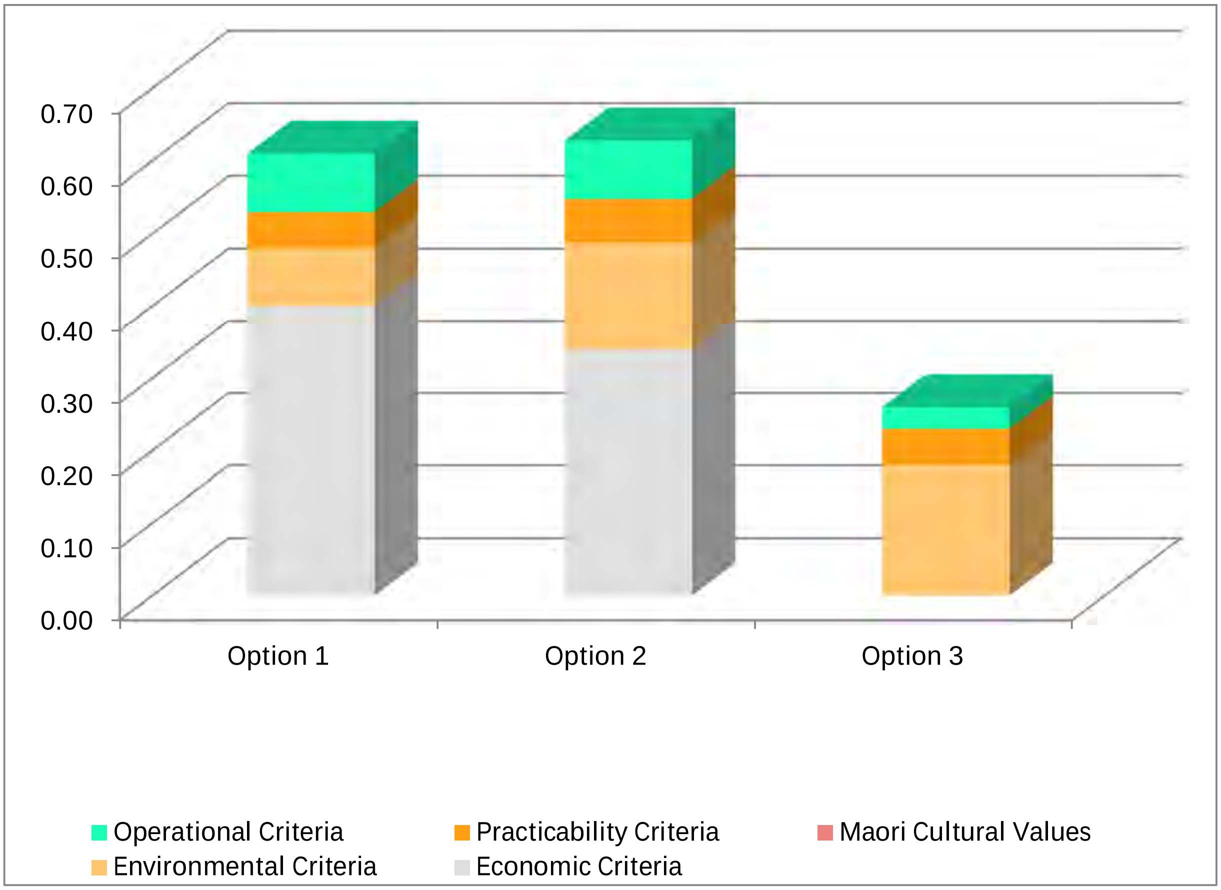


Figure 9-1: MCA Assessment Results – Graphical Representation.

The MCA results show that Options 1 and 2 score very similarly, with Option 2 scoring slightly higher overall – the key benefit being the improved treatment and robustness in the process, with very little additional cost compared to Option 1.

There was concern that if the weightings were changed, the preferred options may also change, so a number of scenarios were run on the MCA outcomes through changing the weightings (sensitivity analysis) to determine if the preferred options changed. The outcomes of the sensitivity analysis and the changes to the weighting which were adopted are summarised in Table 9-4 and Figure 9-2.

Table 9-4: Sensitivity analysis and impact of weighting changes

Primary Criteria	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Base Case
Economic Criteria	40%	80%	20%	20%	40%
Environmental Criteria	10%	5%	30%	20%	20%
Maori Cultural Values	10%	5%	30%	20%	20%
Practicability Criteria	20%	5%	10%	20%	10%
Operational Criteria	20%	5%	10%	20%	10%
	100%	100%	100%	100%	100%

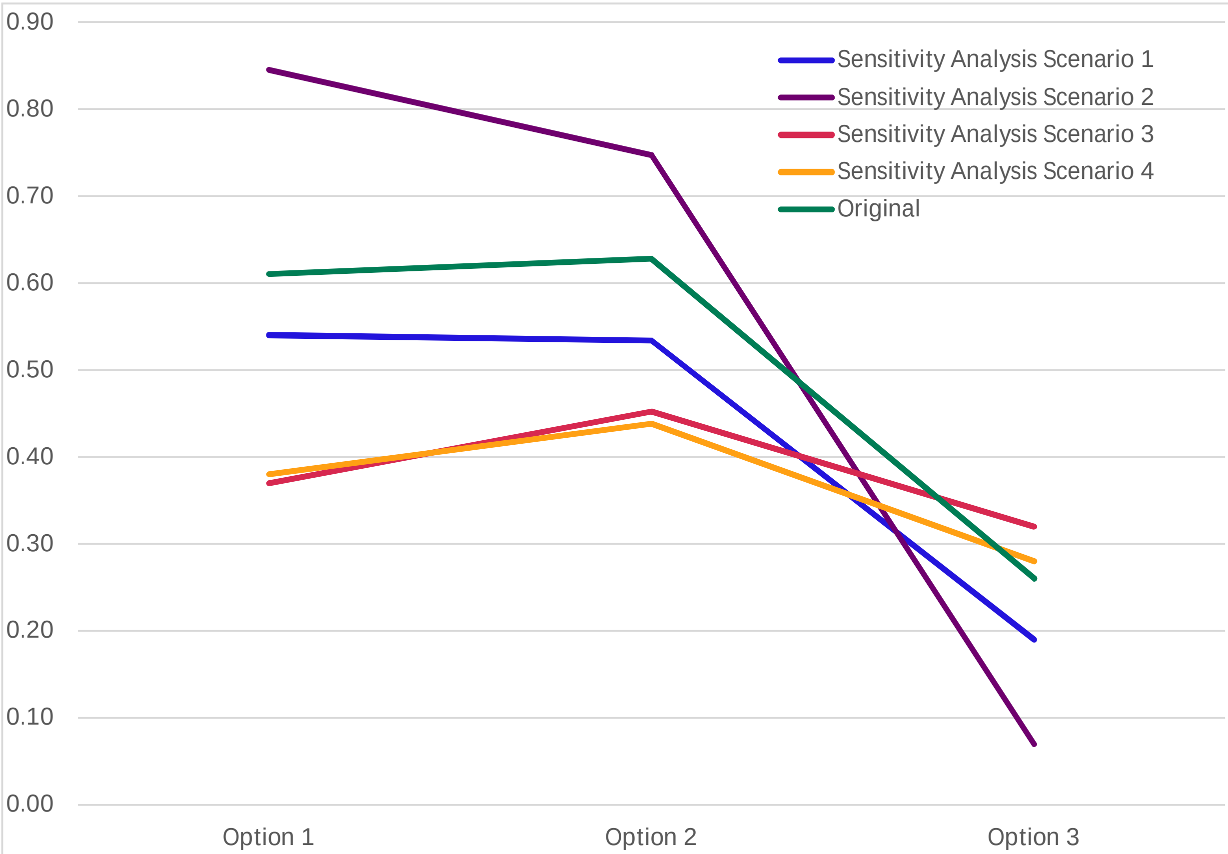


Figure 9-2: Comparison of MCA criteria scores for each scenario

The sensitivity analysis shows that the preferred options do not change under three of the scenarios, but that under Scenarios 1 and 2 Option 1 becomes preferred over Option 2. In both of these scenarios more emphasis is put on cost, and less on environmental outcomes.

10. Conclusions and Next Steps

10.1 Conclusions

- The Kohukohu WWTP is in generally good condition although the wetlands require vegetation removal.
- The median effluent faecal coliform concentration for the past 10 years is 800 cfu/100 mL which is comfortably within the consent rolling median limit of 5,000 cfu/100mL; the rolling five sample median has exceeded this limit on two occasions in the past 10 years.
- The maximum faecal coliform limit of 15,000 cfu/100mL was exceeded on six occasions in the past 10 years. A percentile limit which allows a number of exceedances is more practical for consent compliance, to allow for the natural variability of effluent quality from ponds.
- Similarly, for ammonia, a median or other percentile-based consent limit would be more practical than a maximum value, to allow for the natural variability of effluent quality from ponds.
- The recent hydrodynamic study of the wastewater discharges into the Hokianga Harbour found that a 95th percentile dilution factor of 50,000 was achieved within 100 meters of the discharge point, within the tidal mud flat channel. Based on the hydrodynamic modelling results, there is no discernible effect of the Kohukohu discharge within the main body of the Hokianga Harbour.
- Based on the effluent quality results and the hydrodynamic modelling study, there are no major drivers for upgrade of the WWTP. There are however some relatively inexpensive measures that would improve the disinfection performance of the WWTP (vegetation removal from the wetlands) and reduce the risk of future non-compliances. Any further improvements above this (such as UV disinfection), if desired, should be aimed at further improving disinfection performance, and reducing the public health risks of the discharge.
- Most of the land around Kohukohu is steep and unsuitable for land disposal; only two potentially suitable sites were located within the 5 km radius, however, the footprint of these sites were less than the required 3.0 hectares. At this stage, land disposal is not considered feasible.
- Three options have been identified to take forward for consultation:

  1. Option 1: Maintain the existing system (including vegetation removal from the wetlands)
  2. Option 2: Option 1 above, plus optimise pond performance by installing curtain baffles and moving the pond inlet pipe to the north-eastern corner of the pond
  3. Option 3: Option 2 above plus installation of a UV disinfection system downstream of the wetland.

- Indicative cost estimates for the three options have been prepared and summarised in Table 10-1.

Table 10-1 Summarised Indicative Costs for upgrade options

Option	Indicative Cost Estimate
Option 1	$140,000
Option 2	$264,000
Option 3	$422,000

An MCA has been completed at a collaborative workshop held with FNDC on the 26th August which identified Option 2 as preferred. A sensitivity analysis was also completed, which identified that Option 2 is preferred under most scenarios, although if cost becomes a higher weighted criterion, then Option 1 becomes preferred. It should be noted that there is additional risk of short-circuiting with Option 1, therefore installation of curtain baffles and adjusting the inlet to reduce this risk is recommended. Our recommendations is that Option 2 be implemented for the Kohukohu WWTP based on this issues and options assessment, and the MCA outcomes, given the minimal cost difference and the minimal difference in scores overall.

Therefore, it is recommended that Option 2 be implemented for the Kohukohu WWTP.

11. References

AS/NZS 1547:2012 On-site domestic wastewater management

Auckland Regional Council (2004) On-site Wastewater Systems: Design and Management Manual. Technical Publication Number 58 (TP58).

FNDC (May 2019) Application to Renew Resource Consents for the Opononi Wastewater Treatment Plant.

IWA (2012) Pond Treatment Technology. Shilton (ed). IWA Publishing

Jacobs (2019) Wellsford Treatment Wetland Pilot Study Assessment and Design Recommendations. Technical Memo prepared for Watercare.

MetOcean (January 2020) Hokianga Harbour Hydrodynamic Study of Wastewater Discharges

NIWA (2013) The Climate and Weather of Northland. Third ed. NIWA Science and Technology Series No 59.

NIWA (2018) Assessment of the eutrophication susceptibility of New Zealand Estuaries

Opus (2016) Resource Consent Application Kohukohu Wastewater Treatment Plant

Ratsey (2016) Upgrading Waste Stabilization Ponds: Reviewing the Options. Water NZ Conference Paper

USEPA (2006) Process Design Manual Land Treatment of Municipal Wastewater Effluents

Appendix A. Existing Resource Consent

CON20010383901

Received

24 JUN 2002

Resource Consent

ENV 6/1356

Pursuant to the Resource Management Act 1991, the Northland Regional Council (hereinafter called "the Council") does hereby grant a Resource Consent to:

FAR NORTH DISTRICT COUNCIL,
C/O V K CONSULTING, ENVIRONMENTAL ENGINEERS LTD, P O BOX 10022, TE MAI, WHANGAREI 0130,

To undertake the following activities associated with the treatment and disposal of wastewater from Kohukohu township and environs on Pt Sec 86 Blk X Mangamuka SD in the catchment of the Hokianga Harbour at Map Reference O05: 598 475:

01 To discharge treated wastewater to an unnamed tributary of the Hokianga Harbour.

02 To discharge contaminants to ground from an oxidation pond and a surface flow wetland.

03 To discharge contaminants to air.

subject to the following conditions:

01 & 02: Discharge to Water and Land

1) The quantity of treated wastewater discharged to the unnamed tributary shall not exceed 40 cubic metres per day, based on dry weather flows.

2) The Consent Holder shall, by the 1 December 2002, increase the planted area of at least two cells within the surface flow wetland with appropriate plant species to the extent that there is 80% cover and the plants are at no more than 0.5 metre spacings. The cells to be planted shall include the last cell but not the first cell.

3) The Consent Holder shall, by the 1 December 2002, remove all pampas grass from the embankments around and within the surface flow wetland and replant the embankments with appropriate species.

4) The Consent Holder shall maintain easy access to the NRC Sampling Sites 322, 323 and 2051 at all times.

5) If the median concentration of faecal coliforms, based on the five most recent samples collected from the NRC Sampling Site 323, exceeds 5,000 per 100

millilitres or if the concentration of faecal coliforms in any one sample collected from NRC Sampling Site 323 exceeds 15,000 per 100 millilitres, then additional monitoring shall be carried out in accordance with the **attached** monitoring Schedule B.

6) Notwithstanding Condition 5, if the concentration of total ammoniacal nitrogen in any sample taken from NRC Sampling Site 323 exceeds 40 grams per cubic metre, then additional monitoring shall be carried out in accordance with the **attached** monitoring Schedule B.

7) Notwithstanding any other conditions of this consent, the discharge shall not cause the water quality of the Hokianga Harbour at NRC Sampling Site 231 to fall below the following standards:

(a) The natural pH of the water shall not be changed by more than 0.2 units.
(b) The median concentration of the faecal coliform bacteria in the water shall not exceed 14 per 100 millilitres, and the 90 percentile concentration shall not exceed 43 per 100 millilitres, based on not fewer than 10 (ten) samples taken over any 30 day period.
(c) The visual clarity of the water shall not be reduced by more than 20%.
(d) There shall be no production of significant oil or grease films, scums or foams, floatable or suspended materials, or emissions of objectionable odour
(e) The dissolved oxygen concentration shall not be reduced below 80% of saturation.
(f) The concentration of total ammoniacal nitrogen shall not exceed the following:

Water Quality Criteria for Saltwater Aquatic Life based on Total Ammoniacal Nitrogen [(NH_4 + NH_3)-N] (milligrams per litre) Criteria - Continuous Concentrations

	Salinity - 10 g/kg				
pH	**10°C**	**15°C**	**20°C**	**25°C**	**30°C**
7.0	16	12	7.7	5.4	3.6
7.2	9.9	7.2	4.9	3.4	2.3
7.4	6.4	4.4	3.0	2.1	1.5
7.6	4.1	2.8	2.0	1.4	0.99
7.8	2.6	1.8	1.2	0.91	0.62
8.0	1.6	1.2	0.80	0.57	0.39
8.2	1.1	0.72	0.51	0.36	0.26
8.4	0.67	0.46	0.34	0.24	0.17
8.6	0.44	0.30	0.22	0.16	0.12
8.8	0.28	0.21	0.15	0.12	0.09
9.0	0.19	0.14	0.11	0.08	0.07

pH	10°C	15°C	20°C	25°C	30°C
Salinity - 20 g/kg					
7.0	17	12	8.0	5.4	3.9
7.2	11	7.4	5.1	3.6	2.5
7.4	6.7	4.6	3.4	2.2	1.6
7.6	4.4	2.8	2.1	1.4	0.99
7.8	2.8	1.9	1.3	0.91	0.64
8.0	1.7	1.2	0.82	0.59	0.41
8.2	1.1	0.77	0.54	0.39	0.26
8.4	0.69	0.49	0.36	0.25	0.18
8.6	0.46	0.34	0.23	0.16	0.12
8.8	0.30	0.21	0.16	0.12	0.09
9.0	0.20	0.15	0.11	0.08	0.07

pH	10°C	15°C	20°C	25°C	30°C
Salinity - 30 g/kg					
7.0	18	12	9.1	6.0	4.5
7.2	12	8.0	5.4	3.9	2.6
7.4	7.2	4.9	3.4	2.4	1.6
7.6	4.6	3.0	2.6	1.5	1.1
7.8	2.8	2.0	1.4	0.99	0.67
8.0	1.8	1.3	0.91	0.62	0.44
8.2	1.2	0.82	0.57	0.41	0.28
8.4	0.74	0.51	0.36	0.26	0.19
8.6	0.49	0.34	0.25	0.18	0.13
8.8	0.30	0.22	0.16	0.12	0.09
9.0	0.21	0.16	0.12	0.09	0.07

03: Discharge to Air

8) The Consent Holder shall maintain a concentration of at least one gram per cubic metre of dissolved oxygen in the oxidation pond at all times, as measured in accordance with the **attached** monitoring Schedule A.

9) The Consent Holder's operations shall not give rise to any discharge of contaminants, which in the opinion of an Enforcement Officer of the Regional Council is noxious, dangerous, offensive or objectionable at or beyond the property boundary.

General

10) The Consent Holder shall submit 2 copies of a Site Management Plan that covers all aspects of the operation and maintenance of the Kohukohu wastewater treatment system to the Regional Council by the 30 December 2002. A draft of this Site Management Plan shall be submitted to the Regional Council not later than 1 November 2002 for approval. The Site Management Plan shall cover, but not be restricted to, the operation and maintenance of:

- All septic tanks that contribute to the wastewater volume
- The oxidation pond, including mitigation measures to deal with low concentrations of dissolved oxygen e.g. temporary mechanical surface aeration.
- The surface flow wetland. This section should include a programme that covers how the Consent Holder will retain the vegetative cover that has been established within the cells planted in accordance with Condition 2. It should also include measures to prevent the re-establishment of pampas grass on any of the embankments around and within the wetland.
- Contingency measures for unforeseen or emergency situations.

11) The operation and maintenance of the Kohukohu wastewater treatment system shall be carried out in accordance with the Site Management Plan approved in Condition 10.

12) Changes may be made to the Site Management Plan approved in accordance with Condition 10 with the prior written approval of the Regional Council.

13) The Kohukohu wastewater treatment system shall be correctly operated and maintained in an effective and workmanlike manner. Any maintenance work, which in the opinion of the Regional Council is necessary for the effective operation of the Kohukohu wastewater treatment system, shall be done by the date stated by the Regional Council in writing.

14) The Consent Holder shall monitor the exercise of these consents in accordance with the **attached** monitoring Schedule A.

15) The results of any monitoring carried out in accordance with the **attached** monitoring Schedules A and/or B shall be forwarded to the Regional Council within one month of each monitoring visit.

16) The Regional Council may in accordance with Section 128 of the Resource Management Act 1991, serve notice on the Consent Holder of its intention to review the conditions of this consent. Such notice may be served annually during the month of May. The review may be initiated for any one or more of the following purposes:

(a) To deal with and mitigate any adverse effects on the environment that may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or to deal with any such effects following assessment of the results of the monitoring of the consent and/or as a result of the Regional Council's monitoring of the state of the environment in the area.

(b) To provide for compliance with rules in any regional plan that has been made operative since the commencement of the consent.

(c) To deal with any inadequacies or inconsistencies the Regional Council considers there to be in the conditions of the consent, following the establishment of the activity the subject of the consent.

(d) To deal with any material inaccuracies that may in future be found in the information made available with the application. (Notice may be served at any time for this reason.)

The Consent Holder shall meet all reasonable costs of any such review.

EXPIRY DATE: **31 August 2016**

ISSUED at Whangarei this Nineteenth day of June 2002

Consents Manager

SCHEDULE A

MONITORING PROGRAMME – RESOURCE CONSENT 3839 (01 – 03)

The Consent Holder or its agent shall monitor the exercise of these consents in accordance with the following monitoring programme:

1 MONITORING OF KOHUKOHU WASTEWATER TREATMENT SYSTEM

At not more than four monthly intervals the following sampling and analyses shall be undertaken. The time of sampling is to vary for each sampling visit.

At NRC Sampling Site 322 (Map Reference O05: 598 476), a composite* sample of wastewater will be taken and analysed for the following:

Determinand
Total Ammoniacal Nitrogen
Faecal Coliforms

At NRC Sampling Site 323 (Map Reference O05: 598 475), a composite* sample of wastewater will be taken and analysed for the following:

Determinand
Total Ammoniacal Nitrogen
Faecal Coliforms
Five Day Biochemical Oxygen Demand
Suspended Solids

**A sample made up of equal volumes from three samples taken at least five minutes apart during the same sampling event.*

Temperature, pH and dissolved oxygen concentration are to be recorded at NRC Sampling Site 323 using an appropriate meter, and in accordance with standard procedures.

2 AIR QUALITY

Dissolved oxygen concentration and temperature are to be measured using an appropriate meter at three points, which are at approximately equal intervals around the edge of the oxidation pond. Measurements shall be taken at least 60 cm from the water edge and between 5 cm and 8 cm below the water surface. The median of these values shall be used to determine compliance with Consent Condition 8. Any odours at the site should be noted.

NOTE:
The objective of analysing a composite sample made up from triplicate samples, and sampling at different times of the day, is to ensure that the data gathered is representative of the conditions at the site.

ℓ

All samples taken are to be analysed at a laboratory with registered quality assurance procedures, and all analyses are to be undertaken using standard methods. Registered Quality Assurance Procedures are procedures which ensures that the laboratory meets good management practices and would include registrations such as ISO 9000, ISO Guide 25, Ministry of Health Accreditation, amongst others.

The monitoring specified above is the minimum amount of monitoring that is required.

3 THE HOKIANGA HARBOUR

Once every five years the Hokianga Harbour shall be monitored in accordance with the **attached** monitoring **Schedule B**. The first monitoring visit should take place within three months of the consent being granted.

R

SCHEDULE B

MONITORING PROGRAMME – RESOURCE CONSENT 3839 01

The Consent Holder or its agent shall monitor the exercise of this consent in accordance with the following monitoring programme:

Sampling at NRC Sampling Sites (see attached map)

231; Map Reference O05 2559843 6647261
323; Map Reference O05 2559775 6647500
2051; Map Reference O05 2559783 6647503
2052; Map Reference O05 2559711 6647660
5815; Map Reference O05 2560017 6647564

is to occur on the same day and is to be undertaken on the ebb tide as close to low tide as is practicable.

To determine the most appropriate sampling point and depth at NRC Sampling Site 231, a sufficient quantity of tracer dye (or another suitable tracer material) should be introduced at NRC Sampling Site 323 that results in a visible dye plume at NRC Sampling Site 231. The samples should then be collected from within the tracer dye plume.

Prior to the introduction of tracer dye at NRC Sampling Site 323, an assessment of water clarity should be made at NRC Sampling Sites 5185 and 231. If a conspicuous change in clarity is apparent between the waters at NRC Sampling Sites 5185 and 231, then a standard Black Disk shall be used to measure this difference in clarity.

At NRC Sampling Site 323 a composite* sample shall be taken. At NRC Sampling Sites 2051 and 2052, three samples of equal volume shall be taken at least five minutes apart. All samples taken at NRC Sampling Sites 323, 2051 and 2052 shall be analysed for the following:

Determinand
Total Ammoniacal Nitrogen
Faecal Coliforms

**A sample made up of equal volumes from three samples taken at least five minutes apart during the same sampling event.*

Temperature, pH and dissolved oxygen concentration are to be recorded at NRC Sampling Sites 323, 2051 and 2052 using an appropriate meter, and in accordance with standard procedures.

At NRC Sampling Sites 231 and 5815, ten samples of equal volume shall be taken at least five minutes apart. All samples taken at NRC Sampling Site 231 and 5815 shall be analysed for the following:

R

Determinand

Total Ammoniacal Nitrogen

Faecal Coliforms

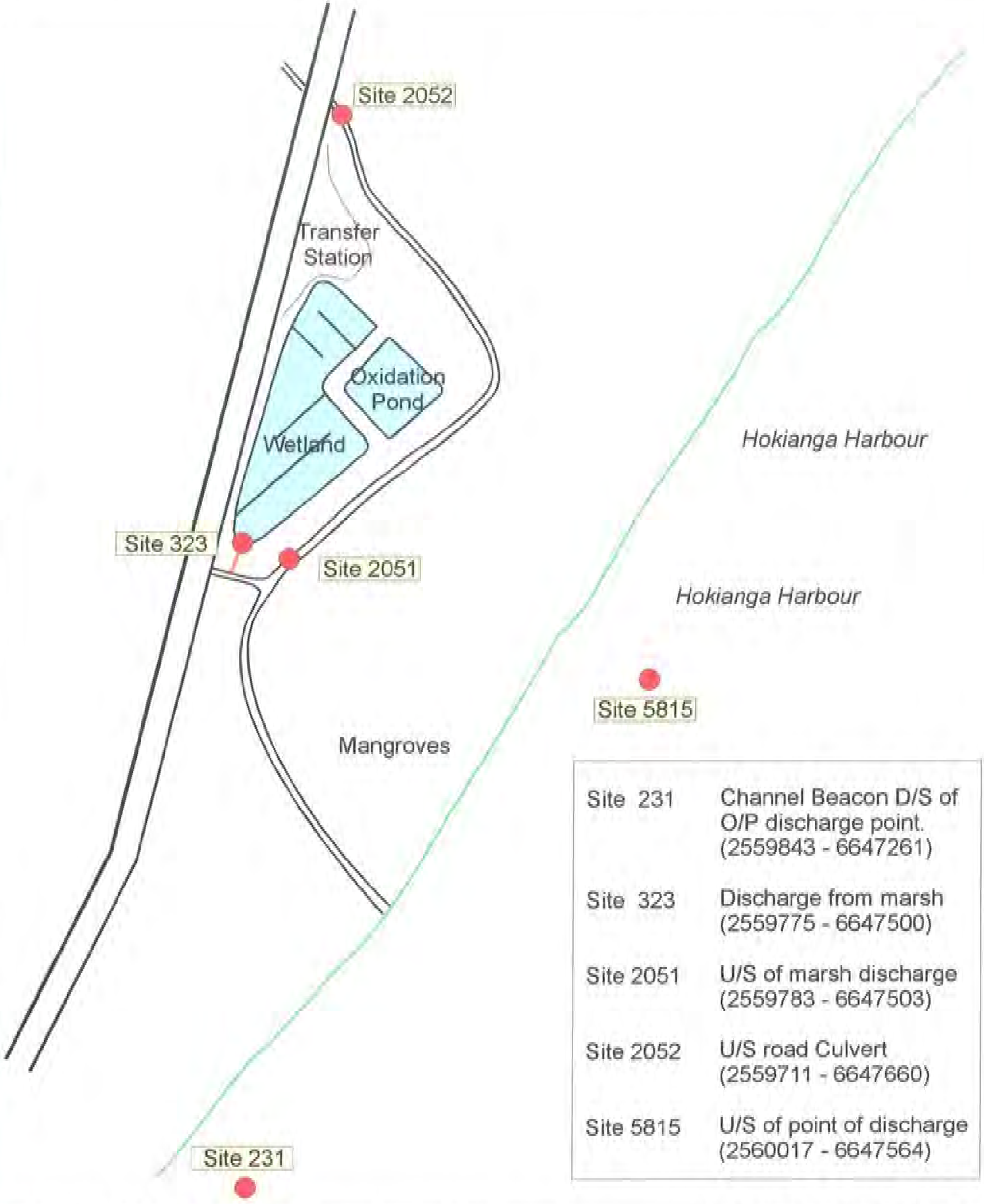
Temperature, pH, dissolved oxygen concentration and salinity are to be measured at NRC Sampling Sites 231 and 5815 using an appropriate meter, and in accordance with standard procedures.

NOTE:
All samples taken are to be analysed at a laboratory with registered quality assurance procedures, and all analyses are to be undertaken using standard methods. Registered Quality Assurance Procedures are procedures which ensures that the laboratory meets good management practices and would include registrations such as ISO 9000, ISO Guide 25, Ministry of Health Accreditation, amongst others.

The monitoring specified above is the minimum amount of monitoring that is required.

R

(01) 3839



	By	Date			
Dwn.	C N Anderson	03/02	**RESOURCE CONSENT NLD 01 3839 01**	NORTHLAND REGIONAL COUNCIL	
App'd			**for**		
Amendment			**Far North District Council**		
No.	By	Date	**Sampling Sites**	Scale	Plan No.
			Kohukohu Waste Treatment Plant	**N.T.S.**	**3316**

Appendix B. Kohukohu Land Disposal Desktop Site Selection Report

Kohukohu WWTP

Land Disposal Site Selection Analysis Report

Document No. | A

February 17, 2020

Far North District Council

Client Reference

Kohukohu WWTP

Project No:	IZ134400
Document Title:	Land Disposal Site Selection Analysis Report
Document No.:	Document No.
Revision:	A
Document Status:	Draft
Date:	February 17, 2020
Client Name:	Far north District Council
Project Manager:	Project Manager
Author:	Jessica Daniel
File Name:	02.03.20 Kohukohu Land Disposal Site Selection Report

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	17/2/2020	Draft Report	JD	TB	BM	KS

Contents

Executive Summary

This report presents the results of a desktop GIS analysis to identify potentially suitable sites for land disposal of treated wastewater from the Kohukohu wastewater treatment plant (WWTP).

This report assumes an annual average flow of 30m^3/day and an average hydraulic loading rate of 2.0 mm/day. A total area of 3.0 hectares is required, including an allowance for 100% disposal buffer area and a storage pond.

A number of constraints were applied to the area of interest, which is sites located within a 7 km radius of the WWTP including:

Table 0-1 Screening Criteria for Land Disposal Sites

Parameter	Constraint	Unit
Proximity to WWTP	7 km	Km
Slope	<10	%
Proximity to waterways	≥20	m
Proximity to residential dwellings	>20	m
Proximity to cultural dwellings	500	m
Groundwater	>1.2	m
Elevation	>2m	m
Tsunami zone	Yellow – Safe	Zone
Flood risk	Preferably outside flood risk zone.	
Irrigation rate	3	mm/day

GIS spatial mapping using data sets from FNDC and Northland Regional Council (NRC) were used. Sites 1, 2 and 3 are located within an area marked as flood susceptible in FNDC flooding maps and were therefore excluded from further consideration. Sites 4 and 5 are less than the required 3.0 hectares based on the preliminary flow estimates and have also been excluded from consideration. Therefore, at this stage, land disposal is not considered viable due to a lack of suitable land area within 7km of the site, and is therefore excluded as an option for further consideration.

1. Introduction

Land disposal of municipal wastewater is a reasonably common method of wastewater disposal in New Zealand and is the preferred method from a Maori cultural perspective

The Kohukohu wastewater treatment plant (WWTP) discharges treated wastewater into the Hokianga Harbour. The Far North District Council (FNDC) are currently renewing the WWTP's resource consent which expired in 2016. As part of the consent renewal process, FNDC wish to investigate the feasibility of a land disposal option which would remove the discharge from the harbour. If potentially feasible, a land disposal option would be presented to the community along with continuing the harbour discharge and a decision made on an agreed strategy for the WWTP.

There are several factors which must be considered in the selection of a land disposal site, including:

- The volume and quality of wastewater to be applied
- Land use
- Soil types and quality
- Flooding and tsunami classifications
- Site elevation and topography

This report presents the site selection analysis completed for land disposal of effluent produced by the Kohukohu WWTP. Analysis has been completed using GIS spatial software and the datasets in the table below. Analysis and data processing were completed using Feature Manipulation Engine (FME) and the edited maps have been created in ArcGIS.

GIS Dataset	Source
Property Parcels	Land Information New Zealand
District Plan Zones	Far North District Council
Elevation (from 15m Digital Elevation Model)	University of Otago - National School of Surveying
Slope (from 15m Digital Elevation Model)	University of Otago - National School of Surveying
Watercourses	Land Information New Zealand
100-year flood plain extents	Northland Regional Council
Tsunami evacuation zones	Northland Regional Council
Marae locations	Maori Maps

2. GIS Screening for Potential Sites

2.1 Flow Summary

The flow data for the Kohukohu WWTP has been provided by FNDC for the period between 1st January 2010 and 8th December 2019. Figure 2-1 Kohukohu WWTP Flow Data shows the data over the past five years. The orange line depicts the average dry weather flow (ADWF) of 19m^3/day.

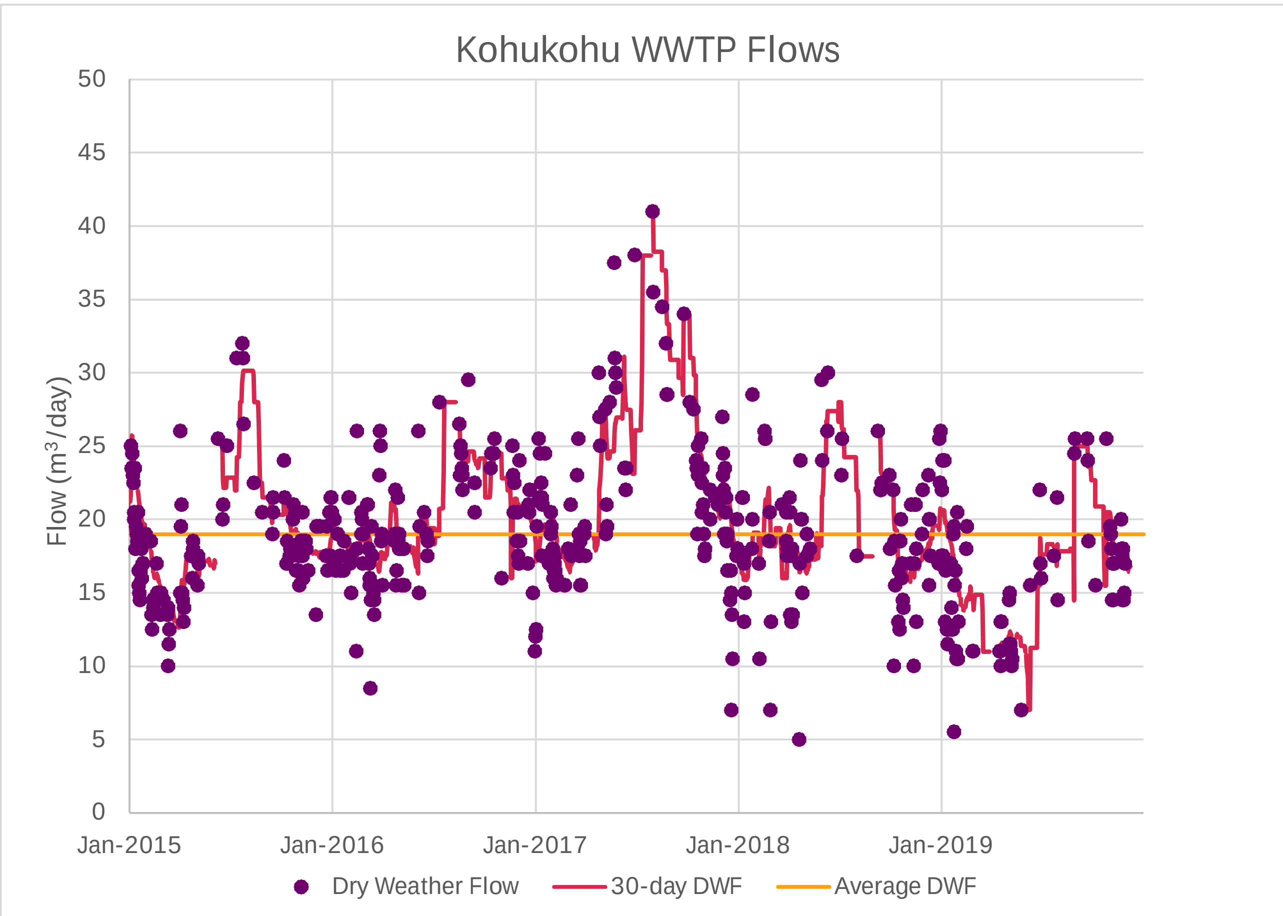

Figure 2-1 Kohukohu WWTP Flow Data

2.2 Required Land Area

For the purposes of this study, the land area requirement has been calculated based on an estimated annual average flow of 30m^3/day. A hydraulic loading rate of 2.0mm/day has been used, based on the poorly draining clay soils in the vicinity of the WWTP, and a water balance which considers evaporation, percolation and rainfall (USEPA Process Design Manual for Land Treatment of Municipal Wastewater Effluents (USEPA, 2006). At the aforementioned hydraulic loading rate and annual average flow, 0.9 hectares is required for land-based disposal as a minimum. In addition, a 50% buffer is required for spacing between the disposal trenches. A total land requirement of 3.0 Ha is recommended which would include a 100% redundancy buffer (typically required in Northland for land based disposal from septic tanks),water storage and a safety factor. This value would need to be confirmed following site-specific testing as part of the design of the land disposal system.

2.3 Site Selection Basis

2.3.1 Site Selection Criteria

The parameters outlined in Error! Reference source not found. contain the constraints applied on sites to assess their suitability for land disposal. The succeeding sections will discuss the application of the screening criteria in Error! Reference source not found. to identify suitable sites for land disposal.

Table 2-1 Site Selection Criteria

Constraint No.	Criteria	Criteria requirement	Basis
1	Proximity to WWTP	5 -7 kilometers	Ease of transport of effluent and manageable costs of installing infrastructure and operations within this distance (1)
2	Proximity to residential dwellings	>20m	Distance was selected based on previous work completed by CH2M Beca for Rawene WWTP (2)
3	Proximity to cultural dwellings	500m	Distance was selected based on previous work completed by AECOM for the Taipa WWTP completed with additional buffer (1)
4	Proximity to waterways	≥20m	Distance was selected based on previous work for Rawene WWTP (2)
6	Slope	<10%	Acceptable land slope for distribution as the risk of erosion and runoff is reduced (3)
7	Groundwater	>1.2m	At least 1m to groundwater is preferred with seasonal fluctuations of +/- 0.5m (3)
8	Elevation	>2m	Elevation was selected based on previous work completed by AECOM for the Taipa WWTP (1)
9	Tsunami zone	Yellow – Safe	Ideal zone.

2.4 Land Use

Figure 2-2 shows the location of the Kohukohu WWTP and the land use of the surrounding area within five and seven-kilometer radii from the Kohukohu WWTP and the Mangamuku River.

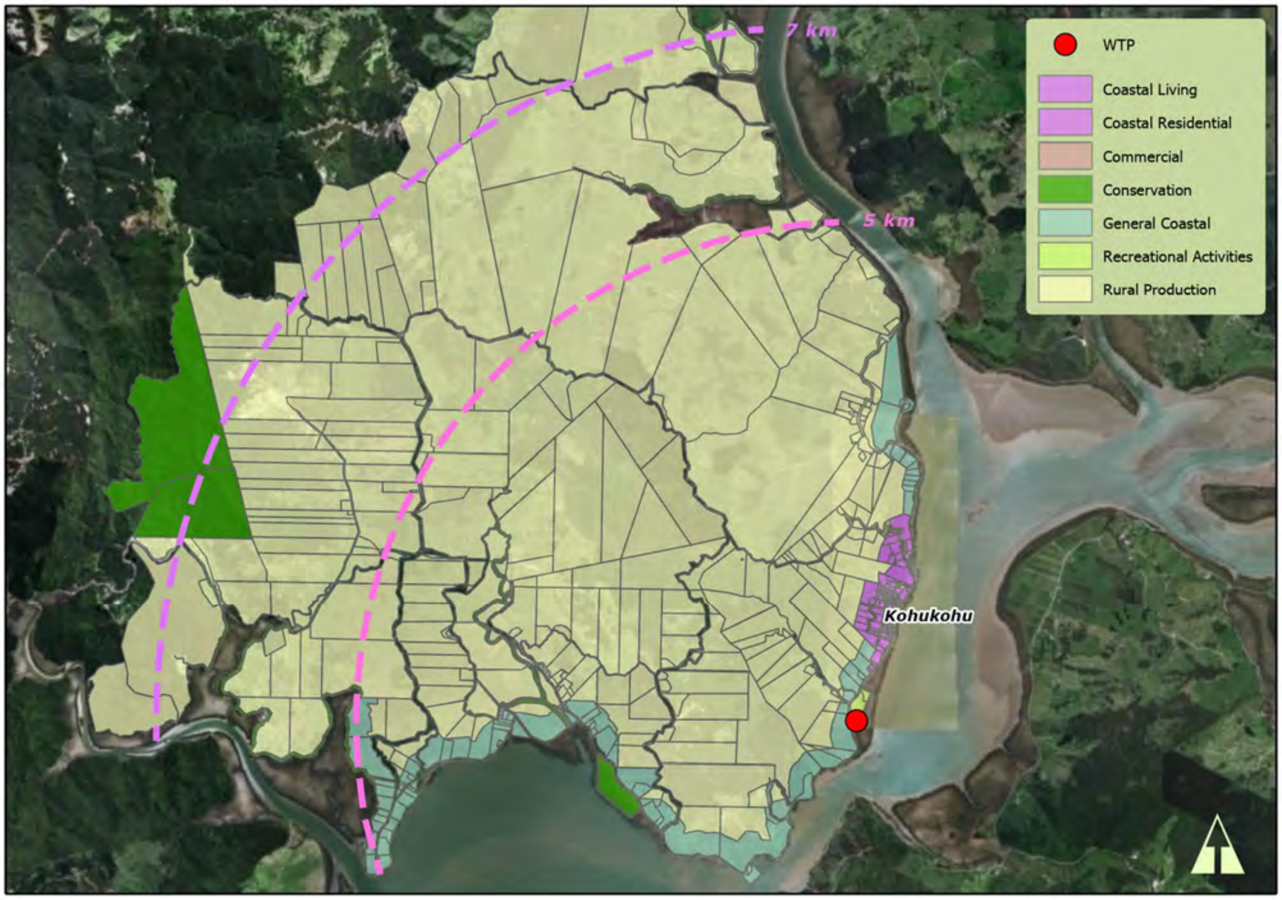

Figure 2-2 Kohukohu WWTP land uses within radius of interest

2.5 Proximity to Residential Dwellings and Conservation Land

A 20 meter minimum buffer distance between a land disposal site and residential dwellings has been applied. The likelihood for travel of effluent aerosols and runoff, which could adversely impact residents should they come into direct contact is diminished using this buffer distance. The same constraint has been applied to conservation land. Figure 2-3 Excluded residential and conservation land within 7 km radius from Kohukohu

WWTPshows the exclusion of residential and conservation land areas with the application of the buffer.

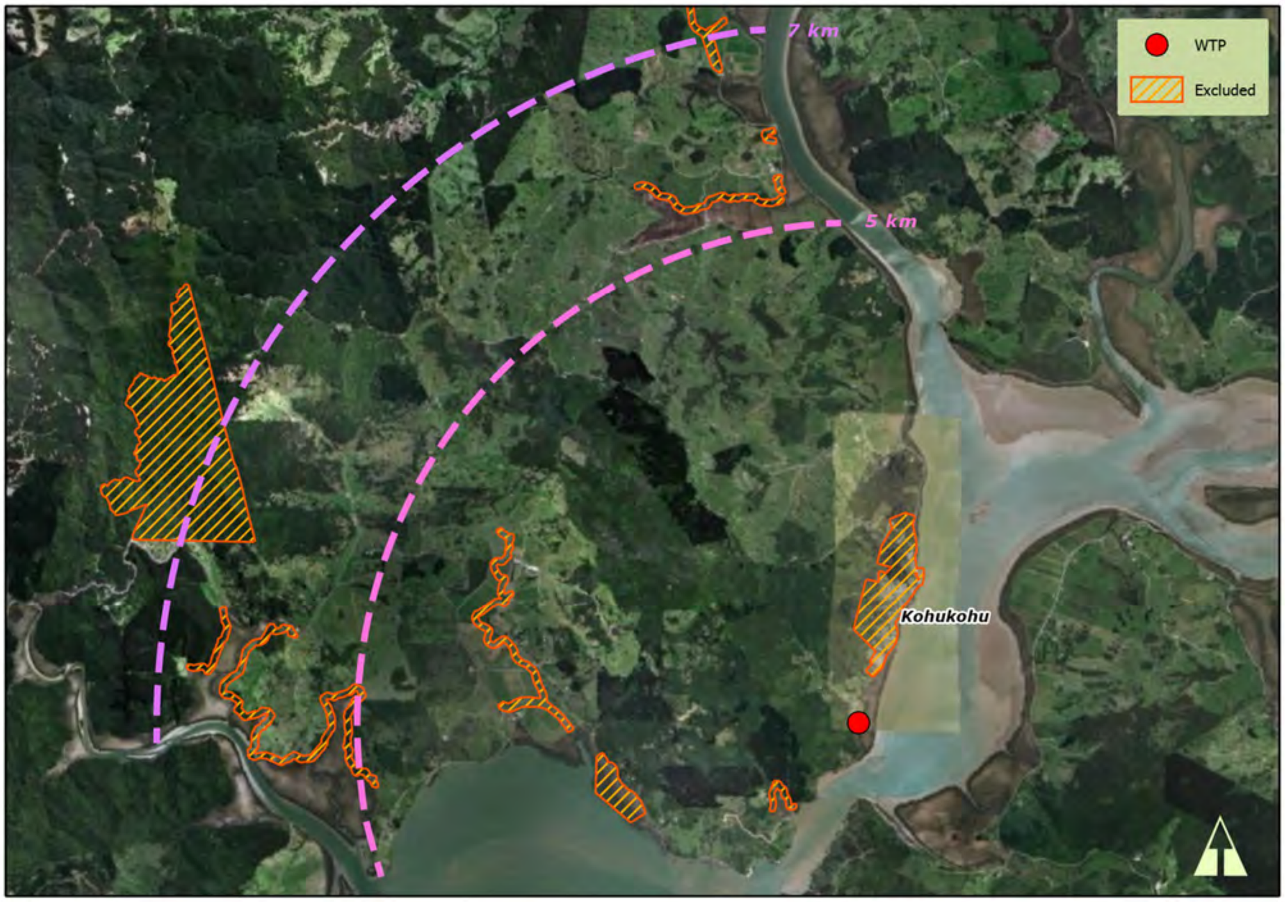

Figure 2-3 Excluded residential and conservation land within 7 km radius from Kohukohu WWTP

2.6 Proximity to Cultural Landmarks

The Ngai Taupoto, Tauteihiihi and Pikiparia maraes are located within 5km of the WWTP as seen in Figure 2-4 Maraes within the 7km boundary from the Kohukohu WWTP. The Ngai Taupoto Marae lies on Motukaraka Point Road at a distance of 7.4 km, Tauteihiihi Marae lies on Kohukohu Road at a distance of 230m and Pikiparia marae lies on Smith Deviation Road at a distance of 3.6 km from the Kohukohu WWTP. The maraes are culturally significant sites for the Kohukohu Maori tangata whenua and the local community, areas within the 500m buffer may also be heritage land and have archaeological significance. Figure 2-5 Excluded residential, conservation and culturally signifcant areas within a 7km boundary identifies maraes and other culturally significant areas and adds to the previously excluded area for residential and conservation land.

Figure 2-4 Maraes within the 7km boundary from the Kohukohu WWTP

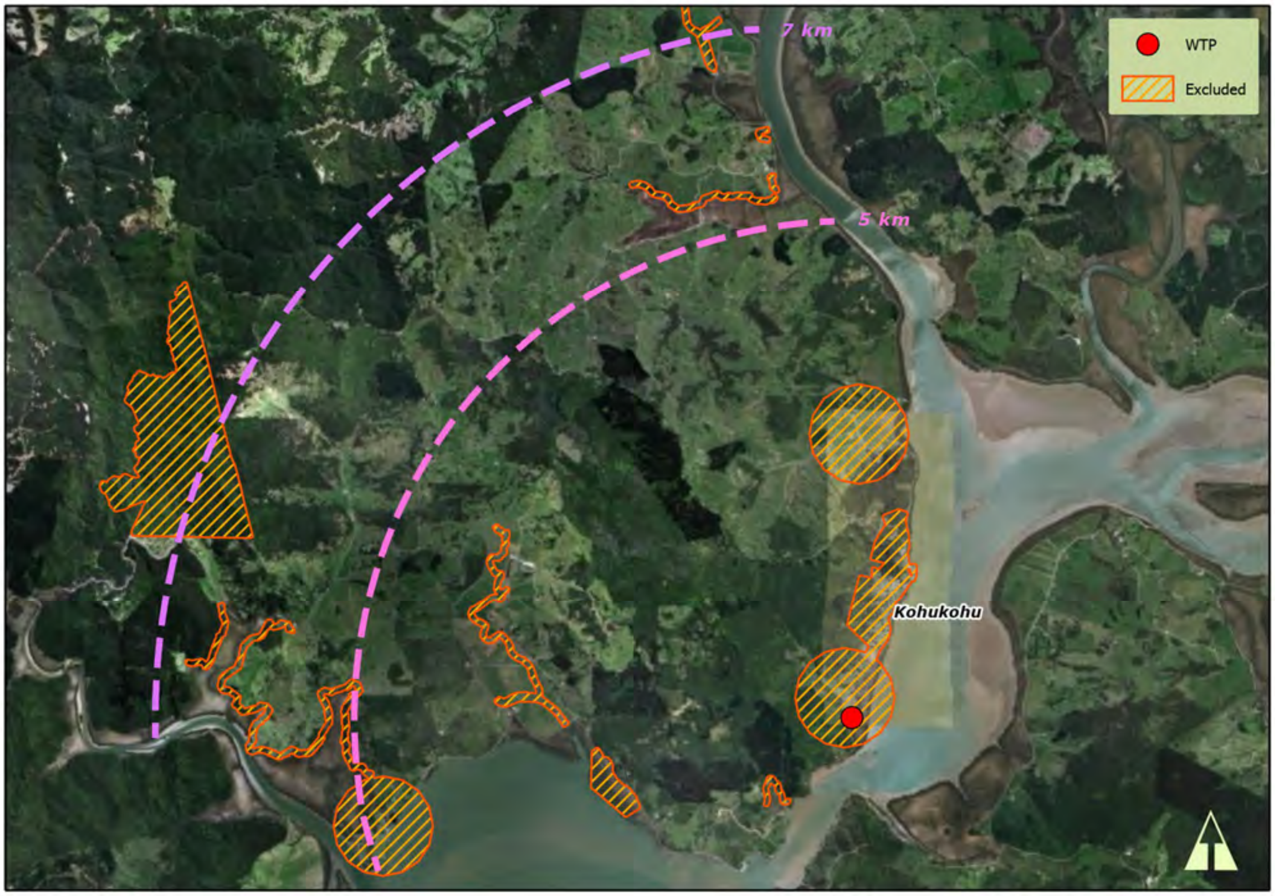

Figure 2-5 Excluded residential, conservation and culturally signifcant areas within a 7km boundary

2.7 Proximity to Watercourses

Watercourses flowing within the 7-kilometer radius from the Kohukohu WWTP have been highlighted and excluded from potential areas of use in Figure 2-6 Excluded residential dwellings, conservation land, cultural landmarks and water courses within a 7km boundary. A minimum buffer distance of 20m has been selected from each side of the waterway to avoid direct contamination of the Hokianga Harbour or the Mangamuka River by runoff of the treated effluent. Watercourses identified include all branches from the Mangamuka river and land drains located within the 7km radius from the Kohukohu WWTP.

Figure 2-6 Excluded residential dwellings, conservation land, cultural landmarks and water courses within a 7km boundary

2.8 Land Slope

The recommended maximum slope for disposal to pasture is below 10% (3). Metcalf and Eddy specifies that slopes below 12% are generally acceptable for land-based disposal with slopes greater than 6% performing better with direct injection measures e.g. Subsoil/ drip-feed irrigation refer to Error! Reference source not found. for detail. Slopes higher than this are unacceptable due to the lack of deep infiltration occurring into the soil, generation of runoff and erosion. Higher slope levels will contribute to the generation of runoff and he logistics of installation will prove to be a challenge.

Table 2-2 Land Disposal Slope Criteria

Slope Percentage	Land Disposal Performance
0 – 3%	Ideal slope range (3)
3 – 6%	Acceptable with minor erosion risks (3)
6 – 12%	Acceptable with direct injection methods, runoff development issues
12 – 15%	Greater runoff development and erosion issues.
15% ++	May be suitable for areas with excellent soil permeability

Using the slope and elevation level datasets from the University of Otago the FME tool was used to identify land with a slope level less than 10°. Figure 2-7 Slope levels within a 5 - 7 km radius from the Kohukohu WWTPidentifies all the slope percentages of land within a five to seven-kilometer radius from the Kohukohu WWTP. The lighter areas indicate sites that have a slope percentage between 1.5 – 10% which lie within the preferable area for irrigation as specified in Table 2-2.

Figure 2-7 Slope levels within a 5 - 7 km radius from the Kohukohu WWTP

2.9 Soil Permeability

The Northland Regional Council Soil factsheet viewer tool was used to estimate the types of soils that are within the 7km radius of interest surrounding the Kohukohu WWTP. Table 2-3 Soil types within 7km of the Kohukohu WWTP identifies the soil types and the drainage properties of each soil below:

Table 2-3 Soil types within 7km of the Kohukohu WWTP

Soil type	Description	Drainage Class	Soil permeability (m/s) (4)
AEH	Young Sandstone Soils - Autea clay loam/silty clay loam	3 – moderately drained (5)	10^{-8} – 10^{-11}
TC	Recent Estuarine Soils – Takahiwai clay	1 – Poorly drained (6)	10^{-11}– 10^{-12}
TFH	Young mudstone soils - Te Tio clay loam	2 – Imperfectly to poorly drained (7)	10^{-11} – 10^{-12}

WF	Whakapara silt loam and clay loam	4-3 Moderately to well drained (8)	$10^{-8} – 10^{-11}$

The soil surrounding the WWTP are generally clay type soils which are moderate to poorly drained. Loamy soils with slow to moderate permeabilities and moderate drainage are preferable for land-based disposal methods (3).

3. Second Stage Analysis of Potential Sites

Applying the criteria outlined in Error! Reference source not found., the areas outlined in Figure 3-1 Available Sites within a 7km radius from the Kohukohu WWTPare valid sites which meet the screening criteria and the total land requirement area of 2 hectares.

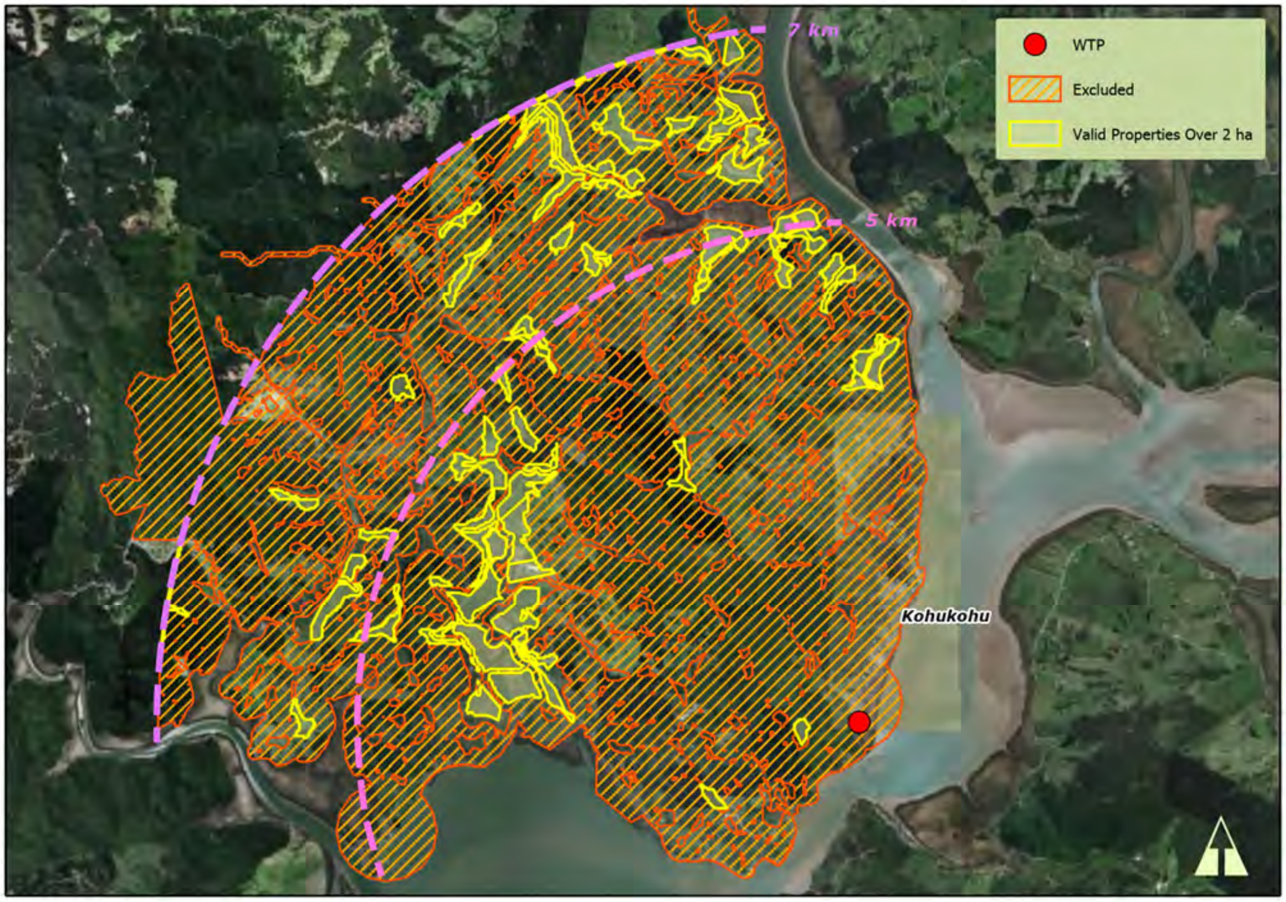

Figure 3-1 Available Sites within a 7km radius from the Kohukohu WWTP

Due to the large number of valid sites which are within a 5km radius, the sites outside this radius will not be discussed any further. The remaining sites were screened further in terms of existing land cover, number of lots affected, ownership of lots and distance from the WWTP. Five sites were chosen for further investigation, these can be seen in Figure 3-2 Selected Sites for Land Disposal, the sites have been investigated further to determine the optimum site.

Figure 3-2 Selected Sites for Land Disposal

3.1 Site 1, 2 and 3

Sites 1, 2 and 3 were assessed in conjunction due to similarities in topography and location. Site 1 lies at a distance of 3071 m from the Kohukohu WWTP. Pipe access for all sites will be along established roadways, access for all sites will be along Kohukohu Road and West Coast Road. Piping for Site 3 would need to travel further along Hawkins Road to reach the site. Site 1 has all four soil types stated in Table 2-3 Soil types within 7km of the Kohukohu WWTP, a majority of the site is the well-drained Whakapara clay (61%), a sizeable portion is the Takahiwai clay (27%) and a smaller portion is the Autea clay (12%). The Whakapara and Autea clays have moderate to well soil permeability however the presence of Takahiwai clay would reduce soil permeability and irrigation levels of the site.

Site 2 lies at a distance of ~3409m from the Kohukohu WWTP. The site contains the Takahiwai clay 96% and the Whakapara clay (4%) soil types. The Takahiwai clay type has poor permeability, is prone to pugging and is have poor soil structure and don't support subsoil drainage systems. This would decrease the levels of infiltration into the soil greatly, though the Whakapara soil type has generally good soil characteristics. Similarly, site 3 is located at a distance of ~3669m from the Kohukohu WWTP. The site soil type is comprised of 91% Takahiwai clay and 9% Te Tio clay loam. Like Site 2, a large percentage of the Takahiwai clay type with poor drainage characteristics would reflect in poor drainage of the soil and poor permeability of treated effluent for irrigation.

Table 3-1 Sites 1, 2 and 3 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (Ha)	Total Property Area (Ha)	No. of Landowners
1	Section 121 Blk X Mangamuka SD	26 Hawkins Road Kohukohu 0491	4.3	5.0100	1
2	Section 98 Blk X Mangamuka SD	190 Hawkins Road Kohukohu 0491	11.0	16.4909	1
3	Lot 2 DP 175963	26 Hawkins Road Kohukohu 0491	6.3	6.7262	1

Sites 1-3 are relatively flat, pasture land with slope levels ranging between 1.5 – 5% (1° - 3°), which is positive for irrigation purposes with respect to infiltration to the desired area and minimize runoff.

Sites 1 – 3 lie within the tsunami yellow zone Figure 3-3 Tsunami Zones surrounding the Kohukohu WWTP. The tsunami yellow is indicative of areas which may need to be evacuated should an earth quake of magnitude higher than 9 take place. Remaining areas of sites 1 – 3 lie within the green zones which would be unaffected in a tsunami scenario. Site 3 primarily lies within the yellow and green zones.

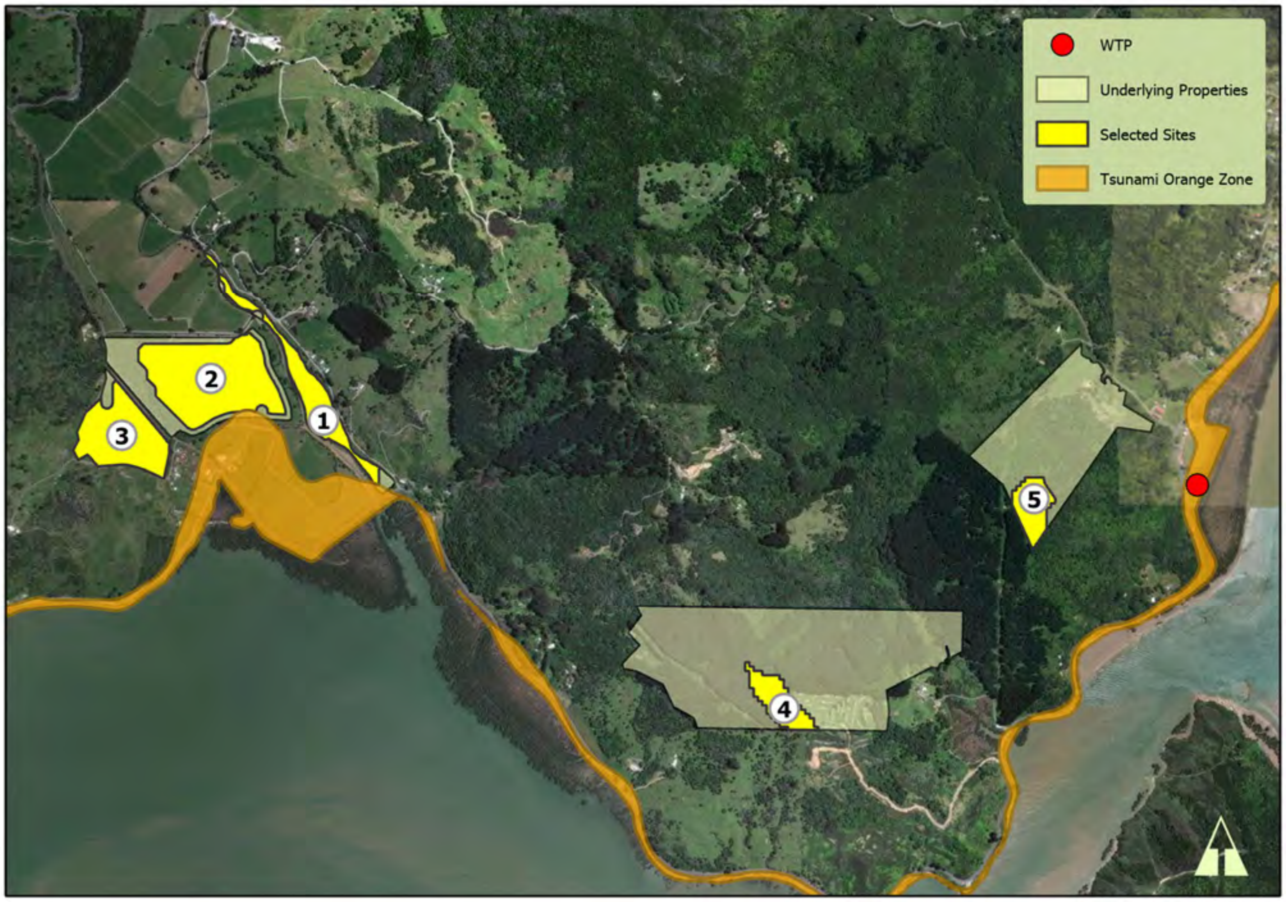

Figure 3-3 Tsunami Zones surrounding the Kohukohu WWTP

The flood risk of the sites was assessed using the Far North District Plan Potential Flooding Maps. (Figure 3-4 Sites 1-3 Flood Risk Map). Sites 1 to 3 were found to be susceptible to flooding and are therefore excluded from consideration due to flood risk.

Figure 3-4 Sites 1-3 Flood Risk Map

3.2 Site 4

Site 4 is located at a distance of 1,7km from the Kohukohu WWTP. Pipe access for the site will be along Kohukohu Road followed by private road RD SO 4196. Consultation with the landowner will need to be sought in order to obtain approvals to install pipe instruction. The Autea clay type soil dominates this site which has moderate drainage properties, the soil is also retains wetness during winter and is prone to pugging which would cause difficulties in terms of irrigation during winter and provision for storage would be required.

The property details for Site 4 have seen summarized in Table 3-2 Site 4 Property Informationbelow.

Table 3-2 Site 4 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (Ha)	Total Area (hectares)	Capital Value	Land Value	No. of Landowners
4	Pt Sec 22 Blk X Mangamuka SD	Kohukohu Road Kohukohu 0491	2.4	40.50	$155,000	$145,000	1

Site 4 slope varies between 3% – 10%, Site 4 lies in the green zone and likely to be unaffected by a tsunami event. The site also has not been found to be situated in a flood risk zone. However, Site 4 does not provide sufficient land area for disposal of the full flow, therefore excluded from consideration on this basis.

3.3 Site 5

Site 5 is located at a distance of 578m from the Kohukohu WWTP. The site is located at the top of a hill opposite the WWTP. There is no road access to the site, and a new access road would need to be constructed. The property details of Site 5 can be seen in Table 3-3 Site 5 Property Information below. The irrigation pipe access route will be along Tauteihiihi Road and across the site to reach the disposal area of in Figure 3-2 Selected Sites for Land Disposal located at the south-eastern corner of the property.

Table 3-3 Site 5 Property Information

Site	Legal Description	Address	Area Suitable for Land Disposal (ha)	Total Area (hectares)	Capital Value	Land Value	No. of Landowners
5	Tauteihiihi 2B 3B ML 422722	33 Tauteihiihi Road Kohukohu 0491	2.3	186,653	$123,500.00	$114,000.00	1

Similar to the features of Site 4, the site is covered by forestation and vegetation. The property is also primarily of the Autea clay soil type and the slope level is within 3% - 10%. Site 5 does not provide sufficient land area for disposal of the full flow, therefore excluded from consideration on this basis.

3.4 Summary of GIS Analysis

Error! Reference source not found. summarizes all the key information on each of the proposed sites and the recommendations for further investigations. It has been concluded that none of the sites are considered feasible for land disposal.

Table 3-4Site Selection Analysis Summary

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5
Distance from WWTP	3071 m	~3409m	~3669m	1697m	578m

Area Suitable for Land Disposal (Ha)	4.3	11.0	6.3	2.4	2.3
Property Area (Ha)	5.0100	16.49	6.73	40.5	18.7
Land ownership	1	1	1	1	1
Soil type	Whakapara clay, Autea clay, Takahiwai clay	Autea clay, Takahiwai clay	Takahiwai clay, Te Tio clay	Autea clay	Autea clay
Soil Permeability	Well - moderate	Poor	Poor	Moderate	Moderate
Tsunami zone	Yellow,	Yellow,	Yellow	Green	Green
Flood risk	Yes	Yes	Yes	No	No
Recommended for further investigation	No	No	No	Yes	Yes

4. Conclusions

Spatial analysis has been performed to find an appropriate land-based disposal of effluent produced at the Kohukohu WWTP. No sites have been identified that meet the required criteria for land disposal, therefore, at this stage land disposal is not considered feasible for the Kohukohu WWTP.

5. References

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5. Northland Regional Council. 3.2.1 Young Sandstone Soils. Northland Soils Factsheet Viewer. [Online] 2020. https://nrcgis.maps.arcgis.com/apps/webappviewer/index.html?id=fd6bac88893049e1beae97c3467408a9.

6. —. 1.1.3 Recent Estuarine Soils. Northland Soils Factsheet Viewer. [Online] 2020. https://nrcgis.maps.arcgis.com/apps/webappviewer/index.html?id=fd6bac88893049e1beae97c3467408a9.

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Appendix C. Kohukohu WWTP Options Cost Estimates and Supplier Information

Jacobs	CALCULATION SHEET		Ref no.	IZ134400-GN-SCH-001
	Project	Kohukohu WWTP Options Assessment	Date	15-10-20
	Client	Far North District Council	Project no.	IZ134400
	Page	1 of 1	Designer	JD
	Subject	Kohukohu Options Cost Estimates	Checked	BM

Item	Unit	Quantity	Rate	Total	Comment
Option 1 - Desludging and Vegetation Clearance Services					
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$ 82,426	$ 83,000	SiteCare quote date 08/07/20. This price includes team mobilisation,dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies. There is a greater certainty on the scope of this work therefore a lower risk factor has been applied to this task.
Wetland vegetation clearance	Item	1	$ 27,400	$ 28,000	SiteCare quote for wetland maintenance 8/07/20. No contingency is to be applied to this task as it is not required. Additionally FNDC could execute this work in house without needing an external contractor.
Risk Allowance (reduced)	%	34	$ 28,024.84	$ 29,000	A reduced risk factor has been applied for this option as only the desludging work will require a contigency and the quote provided has inbuilt contractor contingencies. The risk allowance is based on the contingency stated in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant. The risk allowance has only been applied to the desludging and dewatering item.
Total Costs				140,000	
Option 2 - Optimise Existing System					
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$ 82,426	$ 83,000	SiteCare quote date 08/07/20. This price includes team mobilisation,dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies.
Wetland vegetation clearance	Item	1	$ 27,400	$ 28,000	SiteCare quote for wetland maintenance 8/07/20. No contingency is to be applied to this task as it is not required. Additionally FNDC could execute this work in house without needing an external contractor.
Pond Modifications					
Supply and install baffle curtains	Item	1	$ 24,754	$ 25,000	Two Permanthene baffle curtains to be installed at 20 metres in length and $165/m. Includes costs for installation quoted by SiteCare on 08/07/20.
Inlet Relocation		1	$ 55,700	$ 56,000	SiteCare quote date 08/07/20. Total cost also includes
Risk Allowance (standard)	%	54	$ 71,960.00	$ 72,000	The Risk allowance is based on factor recommend in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant.
Total Costs				$ 264,000	

Jacobs	CALCULATION SHEET		Ref no.	IZ134400-GN-SCH-001
	Project	Kohukohu WWTP Options Assessment	Date	15-10-20
	Client	Far North District Council	Project no.	IZ134400
	Page	1 of 1	Designer	JD
	Subject	Kohukohu Options Cost Estimates	Checked	BM

Item	Unit	Quantity	Rate	Total	Comment
Option 3 - Optimise Existing System Plus UV Disinfection					
Kohukohu WWTP Desludging & Dewatering and Wetland Vegetation Clearance					
Desludging and Dewatering	Item	1	$ 82,426	$ 83,000	SiteCare quote date 08/07/20. This price includes team mobilisation,dewatering and transportation to of waste to the Kaitaia landfill and contractor contingencies. There is a greater certainty on the scope of this work therefore a lower risk factor has been applied to this task.
Wetland vegetation clearance	Item	1	$ 27,400	$ 28,000	SiteCare quote for wetland maintenance 8/07/20. No contingency is to be applied to this task as it is not required. Additionally FNDC could execute this work in house without needing an external contractor.
Pond Modifications					
Supply and install baffle curtains	Item	1	$ 24,754	$ 25,000	Two Permanthene baffle curtains to be installed at 20 metres in length and $165/m. Includes costs for installation quoted by SiteCare on 08/07/20.
Inlet Relocation		1	$ 55,700	$ 56,000	SiteCare quote date 08/07/20.
Further Wastewater Treatment					
UV unit	Item	1	$ 19,920	$ 49,000	Xylem quote for a Wedeco LBX10 from March 2020. The total price includes installation, instrumentation and controls, piping and electrical costs.
Instrumentation costs: 1. Flowmeter 2. Turbidity meter 3. UV Transmissivity	Items	1	$ 21,590	$ 53,000	Based on quotes received in 2019 from instrumentation suppliers. The total prices includes installation, instrumentation and controls, piping and electrical costs based on factors recommended in Table 4.4 of the IChemE Guide to capital cost estimation.
Risk Allowance (standard)	%	54	$ 127,040.00	$ 128,000	The Risk allowance is based on factor recommend in Table 4.4 of the IChemE Guide to capital cost estimation for power, engineering and supervision fees for a Fluid Processing Plant.
Total Costs				$ 422,000	