Stormwater Management Plan

Cove Road and Mangawhai Heads Road (West), Mangawhai
The Rise Private Plan Change – PPC83

Job No.: 15484

Rev: 0 **Date:** 22 January 2024

Prepared For:
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Revision History

Revision No	Description/comments	Prepared By	Date
0	Plan Change	D. Teh	22 January 2024

Document Control

Action	Name	Signed	Date
Prepared by	D. Teh Civil Engineer		22 January 2024
Reviewed by	S. Rankin Director BE (Env) CPEng (NZ & Fiji) CMEngNZ IntPE(NZ) MFIE(Fiji)		22 January 2024

Distribution

Business/company	Attention	Role
The Rise Limited		Client

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1 Introduction

Chester Consultants Ltd (Chester) has been engaged by The Rise Limited to provide a Stormwater Management Plan (SMP) with respect to the proposed Private Plan Change (PPC83) for the rural area to the east of Cove Road, Mangawhai and to the north of Mangawhai Heads Road (West), Mangawhai, referred to herein as 'the PPC'.

This report has been prepared solely for the benefit of this specific project, and the Kaipara District Council (KDC). Chester accepts no liability for inaccuracies in third party information used as part of this report. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

This report is based on development data provided by third party contributors to the private plan change application as well as data obtained from the KDC and Northland Regional Council (NRC) maps current to the site at the time of this document's production. Should alterations be made which impact upon the development not otherwise authorised by this report then the design / comments / recommendations contained within this report may no longer be valid.

In the event of the above, the property owner should immediately notify Chester Consultants Ltd to enable the impact to be assessed and, if required, the design and or recommendations shall be amended accordingly and as necessary.

2 Site Description

The PPC Area is comprised of multiple lots and is approximately 56.9ha in size. Refer to Appendix 1 of Barker & Associates Limited's Assessment of Effects and Section 32 Evaluation Report for a list of the legal descriptions, title references and property address of each parcel that making up the PPC Area.

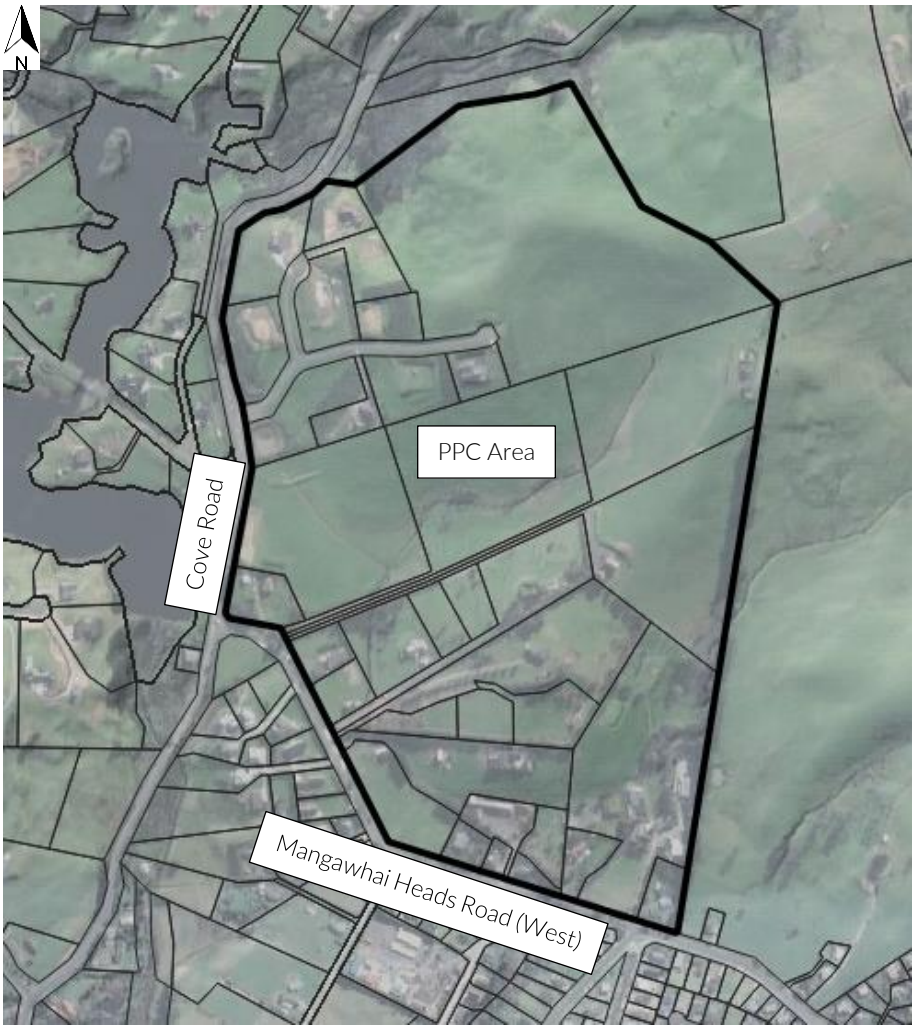

Figure 2-1: Private Plan Change Area.

3 Purpose

The purpose of this document is to provide a Stormwater Management Plan (SMP) for the PPC Area and to inform stormwater provisions for the plan change Precinct.

4 Area Description and Context

This section of the report describes the natural and physical characteristics that make up the PPC Area to provide context for the stormwater management requirements.

4.1 Natural and Physical Characteristics

4.1.1 Topography

The PPC Area comprise of land to the east of Cove Road and to the north of Mangawhai Heads Road (West). The land within can be descried as consisting of two hills and two gullies.

One of the hills is in the northern half of the PPC Area with the other located in the southern half of the PPC Area. In between the two hills, a gully feature starts to form in the north-eastern area of the PPC Area and this gully runs downhill through the centre of the PPC Area and around the south-western boundary and converging with the other gully at the southern border of the PPC Area. The second gully originates to the east of the PPC Area and enters the site along the eastern boundary of the PPC Area. This gully then runs towards the southern boundary converging with the previously described gully. Refer to Figure 4-1 below that shows the topography of the PPC Area and the neighbouring land with contour intervals at every 2m.

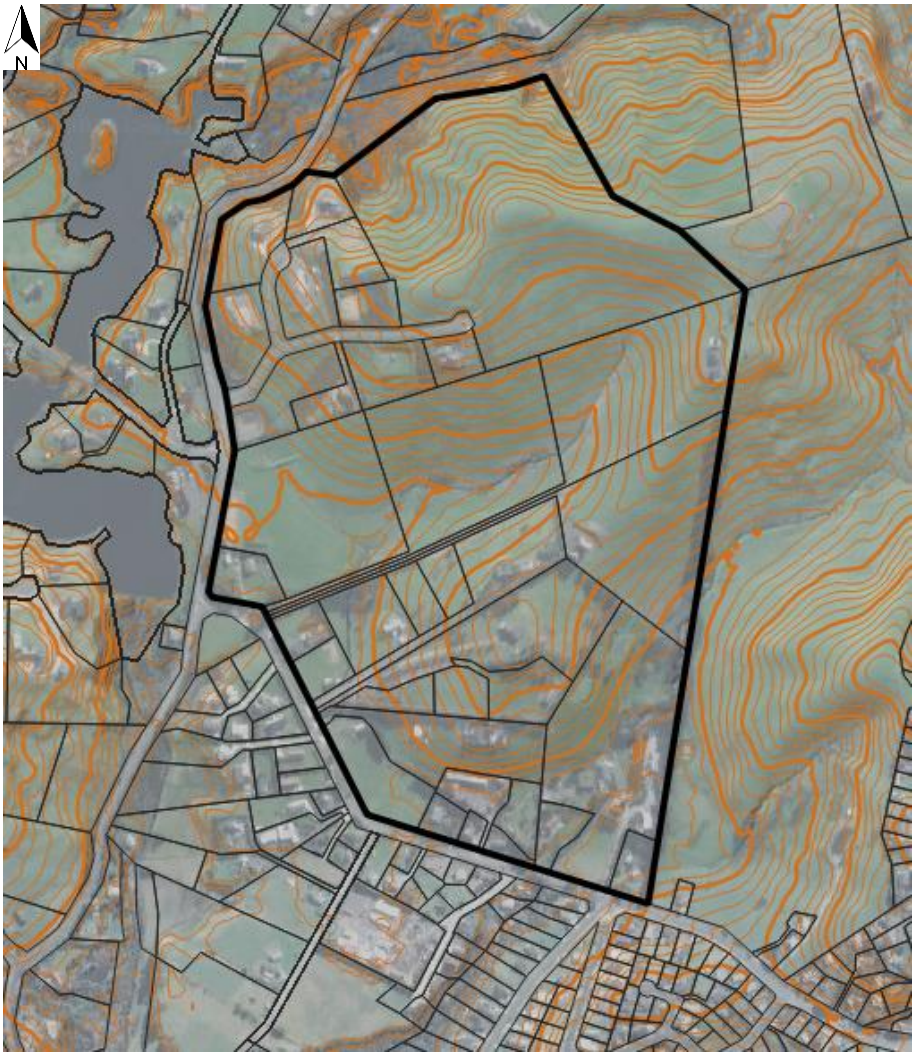

Figure 4-1: Topography within the PPC Area with contour intervals at every 2m.

4.1.2 Geotechnical

A geotechnical statement by Wiley Geotechnical Limited titled "Proposed Private Plan Change at 30 Cove Road, Mangawhai", dated 10th June 2022, was produced in support of the private plan change application.

The geotechnical statement concludes that the PPC Area is generally suitable for subdivision with no significant geotechnical constraints.

4.1.3 Ecology

An ecological report by Wild Ecology titled "Ecological Report prepared for proposed Private Plan Change at Cove Road, Mangawhai 'Cove Road North Precinct'", dated 3rd October 2022, was produced in support of the private plan change application.

The following excerpts from the ecological report summarises the ecological assessment of the PPC Area.

> *"The site is primarily dominated by exotic pasture, and most terrestrial habitats within the site are highly degraded. The exception is an area of regenerating bush extending along the site's northern boundary (subject to an existing conservation covenant), and some small, scattered areas of indigenous vegetation extending primarily along the central aspect of the site and isolated areas identified as indicative wetland areas, which are of moderate ecological value in the context of the site location on the residential fringes of Mangawhai."*

> *"Aquatic habitats within the PPC area boundaries generally drain through exotic pasture within the northern and central aspects of the site and through built-up residential areas along the southern aspect. The stream and indicative wetland habitats have been degraded through a long history of rural and residential land use practices associated with stock grazing, riparian vegetation clearance, stream channelisation, culverting, realignment and continuous dredging."*

> *"Collectively the ecological significance of both terrestrial and aquatic habitats within the PPC boundaries ranges from low (exotic pasture) to moderate (northern bush area, scattered indigenous vegetation, stream and indicative wetland habitats), although the ecological condition overall is considered to be low (apart from the northern bush area which is of fair ecological condition) due to historical disturbance, land clearance and significant modification to both terrestrial and aquatic environments."*

> *"The protection of freshwater and ecological features within the proposed PPC boundaries is proposed to ensure that adverse ecological effects can be avoided, remedied or mitigated. This includes protecting all existing bush areas, natural watercourses and drainage patterns, wetlands, and if practical, connecting these features throughout the site and immediate surrounds through establishing green corridor connections."*

Figure 13: Showing the general hydrological patterns as observed on site during site field visits

Figure 24: Showing the indicative wetland areas on site (please note this may not be reflective of all wetland areas within the proposed Plan Change area boundaries)

Figure 4-2: Excerpt from the ecological report showing waterbodies within the PPC Area

The ecological report recommends the following with regards to stormwater management:

- *"All stormwater infrastructure should be designed to maintain natural drainage and landform where possible will help to reduce a reduction in overland flow."*
- *"Onsite detention and retention of stormwater should be considered as should the treatment of stormwater (i.e., swales, raingardens and offline wetlands)."*
- *"Stormwater treatment devices (i.e. stormwater wetlands or ponds) should be kept offline if possible."*

4.1.4 Flooding & Overland Flow Paths

The PPC Area is located 1km away from the Mangawhai Estuary. The land at the southern end of the PPC Area is expected to experience coastal inundation but this coastal influence reduces as the elevation increase upstream.

The PPC Area has numerous watercourses on-site with the majority flowing to the south. Figure 4-3 below, shows the two main hydrological catchments within the PPC Area, the Northern and Southern PC Catchments.

Figure 4-3 below also shows the estimated overland flows on-site based on existing ground terrain data and provides an indication of where overland flow paths may be present on-site. Please note that overland flow paths were created by estimating drainage direction based of terrain slope from the 1m Northland 2018-2020 LiDAR data and only shows flows with a minimum drainage area of 200,000m^2. Therefore, this assessment only provides a visual indication of where topography is depressed relative to its' surrounding which may concentrate runoff.

The Northern PC Catchment has an area of 113,250m^2 and consists of a mix of pastureland and rural-residential land with some native indigenous vegetation, as identified in the ecological report, along the northern border. This land drains to the west and the north.

The Southern PC Catchment has an area of 428,730m^2 and consists of primarily pastureland with some residential land and contains two noticeable watercourses on-site. This land drains to the south via watercourses.

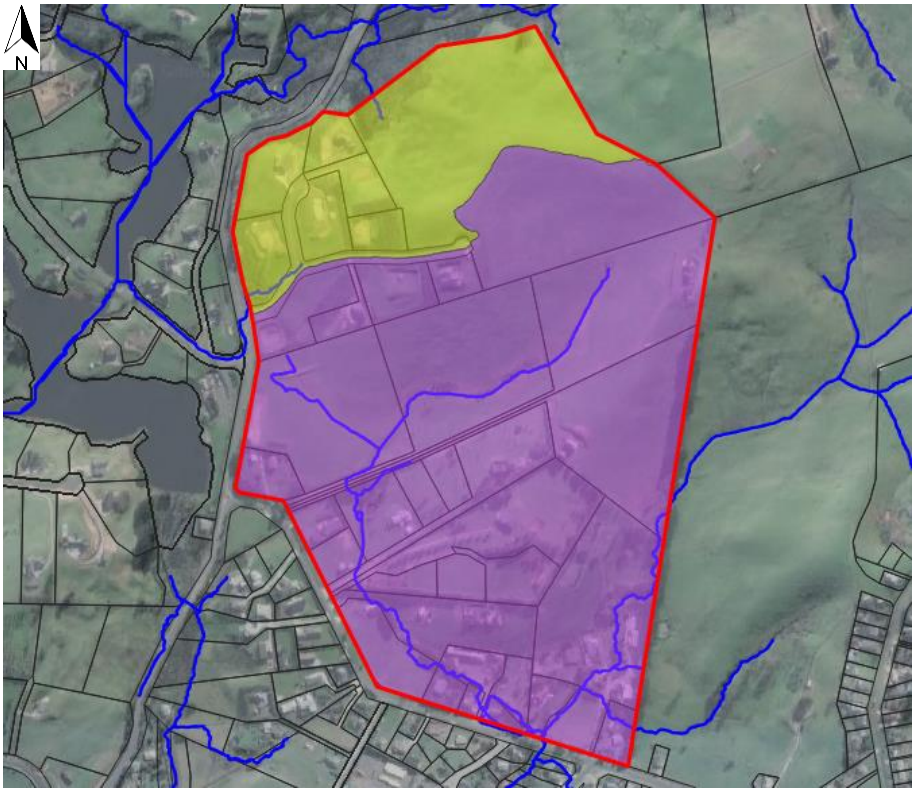

Figure 4-3: Hydrological catchments and overland flowpaths within the PPC Area. The Northern Catchment shown in yellow, Southern Catchment shown in purple and overland flow paths shown in blue.

Based off the NRC's Natural Hazard mapping webpage the 1% AEP flood hazard associated with the two watercourses identified within the Southern Catchment on-site, refer to Figure 4-4 below.

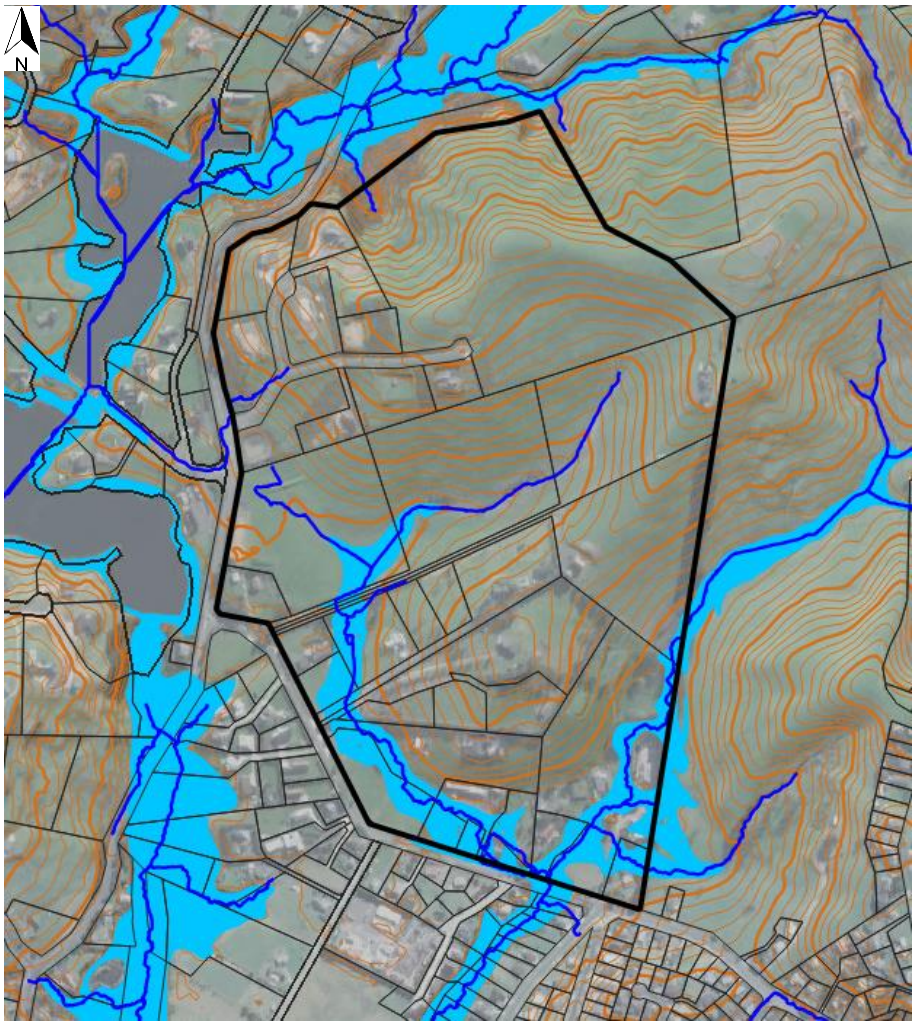

Figure 4-4: KDC 100 Year ARI Regionwide floodplains within the PPC Area.

4.2 Receiving Environments

The Northen Catchment drains into the waterbodies to the west of Cove Road which drains into the Mangawhai Estuary.

The Southern Catchment drains into the two noticeable watercourses on-site which then drains into the low-lying land to the south of Mangawhai Heads Road (West) before draining into the Mangawhai Estuary.

4.3 Current Land Use and Infrastructure

The landcover within the catchment is predominantly pastoral land which is currently used for farming purposes with some lots being developed to a large lot residential setting.

There is limited existing public stormwater infrastructure within the PPC Area as indicated on KDC GIS with a small amount located at the intersection of Pigeonwood Place and Cove Road. This minor network manages stormwater around the intersection before flowing into an open drain.

The two watercourses on-site flow towards a twin culvert system consisting of 1.2m diameter culvert barrels under Mangawhai Heads Road (West). It is noted from a site visit that this twin culvert system is located on low—lying land that is influenced by tidal forces and so the culverts are typically partially submerged regularly throughout the day depending on tidal elevation.

5 Proposed Private Plan Change

The private plan change application involves the rezoning of 56.9ha of Rural zoned land to Residential zoned land, and the creation of the "Cove Road North Precinct" over the rezoned land. Refer to Figure 5-1 below showing the existing zoning of the land and the proposed zoning of the land.

The proposal includes increasing the permitted impervious threshold for Residential zoning within the PPC Area from the typical 40% as per the current KDC District Plan to 60%.

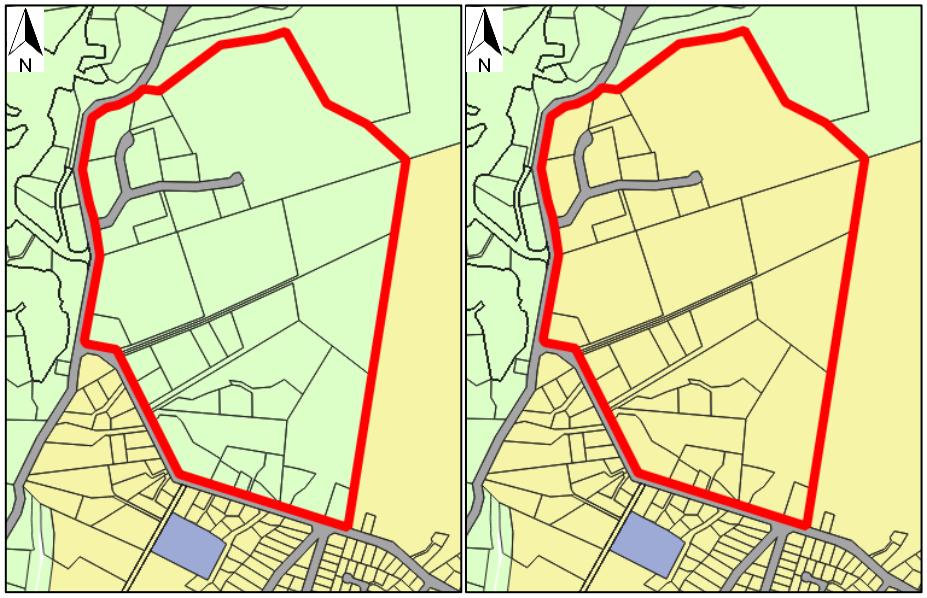

Figure 5-1: Existing zoning (left) and proposed zoning (right) within the PPC Area.

6 Planning Context

This section of the report lists the various documents considered for growth in the PPC catchment as they relate to stormwater management and summarises the requirements and considerations from an engineering point of view.

6.1 Policy Statements and Provisions

The relevant policy statements and plan provisions of the following documents must be considered in developing the stormwater management approach for the catchment;

- National Policy Statement for Freshwater Management 2020
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020
- Regional Water and Soil Plan for Northland
- Proposed Regional Plan for Northland March 2022 - Appeals Version
- The Operative Kaipara District Plan 2013
- Kaipara Infrastructure Strategy Revision 6 February 2021
- Kaipara District Council Engineering Standards 2011
- NZS 4404:2010 Land Development and Subdivision Infrastructure
- Mangawhai Spatial Plan
- Mangawhai Stormwater Infrastructure Strategy
- Mangawhai Stormwater Network Discharge Consent (NDC)

6.1.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater 2020 (NPS-FM) provides directions, via objectives and policies, on how local authorities are to manage freshwater under the Resource Management Act 1991 (RMA).

In summary, the NPS-FM aims to prioritise the health and well-being of water bodies and freshwater ecosystems and aims to improve degraded water bodies and freshwater ecosystems and water quality and prevent further loss of natural wetlands and rivers.

The NPS-FM has tasked every regional council to identify freshwater management units (FMU) in their respective region and set environmental outcomes within their respective regional plans. Northland Regional Council has identified 13 FMUs and the PPC Area is located within the Bream Bay FMU.

Currently, the existing Northland Regional Plans were made operative before the release of the NPS-FM but the new Regional Plan has been updated to take into account the NPS-FM but it is not currently fully operative until all current appeals have been resolved. More information on the new Regional Plan is discussed further Section 6.1.4.

6.1.2 Resource Management (National Environmental Standards for Freshwater) Regulations 2020

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-F) provides consistent standards for regional and district councils to target by prescribing minimum technical standards, methods or requirements.

Under the NES-F, earthworks or vegetation clearance for building development purposes is considered a non-complying activity within 10m of a natural wetland. Furthermore, the taking, use, damming, diversion, or discharge of water within a 100m setback from a natural wetland is also considered a non-complying activity for building development purposes.

6.1.3 Regional Water and Soil Plan for Northland

The Northland Regional Council's Regional Water and Soil Plan (NRC W&S Plan) identifies that past stormwater engineering focuses on stormwater pipe networks and their capacity with little mention on stormwater quality.

The NRC W&S Plan has outlined policies to manage the diversion and discharge of stormwater to safeguard against flooding and enhances water quality via low impact stormwater management design and requires Stormwater Management Plans to be prepared.

Under the NRC W&S Plan some of the following rules regarding stormwater are summarised below:

- Rule 21.01.02(a), new subdivisions and development will require the best practicable option for on-site stormwater disposal to avoid or minimise changes to stormwater flows for the 5 Year average recurrence interval (ARI) rainfall event.
- Rule 21.01.02(d), the stormwater network is to have capacity up to the 20% AEP rainfall event with secondary flow paths designed to cater up to the 50 Year ARI rainfall event when the stormwater network is exceeded.
- Rule 21.01.02(e, g, and h), discharge of stormwater to meet certain water quality controls (e.g. heavy metals, hydrocarbons and etc)
- Rule 21.01.02(f), prevent erosion and scour do the receiving water environment.
- Rule 21.01.02(i), discharge does not cause flooding of adjacent properties.

  **The NRC W&S Plan outlines the following measures that should be considered for best practicable option for on-site stormwater disposal:*

  - *Infiltration facilities in permeable soil types;*
  - *The retention of natural stream channels;*
  - *Minimise areas of impermeable surfaces;*
  - *Stormwater detention before dispersal into waterways.*

Any breaches to the above rules will result in the activity being a non-permitted activity.

6.1.4 Proposed Regional Plan for Northland December 2022 - Appeals Version

Currently, the Northland Regional Council is working on a creation of a new Regional Plan for Northland. At this stage, this new regional plan is in the appeals stage and will not be fully operative until all appeals are resolved. The most current proposed regional plan at the time of this document is the Proposed Regional Plan for Northland December 2022 - Appeals Version (NRC PRP 2022 Appeals Version). The NRC PRP 2022 Appeals Version is very brief on issues, explanations, methods and assessment criteria, and only summarises the different rules compiled within the document. Under the NRC PRP 2022 Appeals Version, the discharge of stormwater from a public stormwater network within the Mangawhai-Mangawhai Heads urban area is classified as a Controlled Activity and will require the following matters to be controlled:

- The maximum concentration or load of contaminants in the discharge;
- The size of the zone of reasonable mixing;
- The adequacy of measures to minimise erosion;
- The adequacy of measures to minimise flooding caused by the stormwater network;
- The design and operation of the stormwater system and any staging of works.

The NRC PRP 2022 Appeals Version's water quality standards and guidelines are attached in Appendix A.

6.1.5 The Operative Kaipara District Plan 2013

Under Chapter 13 of the Kaipara District Plan for Residential zone, the following rules with regards to stormwater have been taken into account:

- Rule 13.10.12, where the impervious area on-site is greater than 40% (permitted threshold) of the net site area then attenuation of stormwater flows is required.
- Rule 13.11, for general residential subdivisions low impact stormwater design is to be incorporate into the subdivision design and that the subdivision complies with the requirements in the Kaipara District Council Engineering Standards 2011.

Furthermore, under Chapter 3 Outcome 'g', the Kaipara District Plan encourages development to include low impact stormwater design and water quality enhancement solutions.

6.1.6 Kaipara Infrastructure Strategy Revision 6 February 2021

The Kaipara Infrastructure Strategy has identified water quality and climate change as key issues and anticipates Council to enact more stringent measures when issuing resource consents and enforcement of engineering standards to ensure stormwater discharges meet current best practice.

6.1.7 Kaipara District Council Engineering Standards 2011

The District Council Engineering Standards 2011 encourages the use of Low Impact Design for stormwater infrastructure and have made reference to Auckland Regional Council's TP124 document (which has now been superseded by the GD04 Water Sensitive Design for Stormwater document) and also to the NZS 4404 document.
The Engineering Standards outlines the following stormwater design requirements and guidance notes applicable to the Development:

- Provide for future increase in runoff from the upstream catchment as per maximum Probable development (MPD) scenario.
- In residential zones, stormwater runoff up to the 20% AEP is to be gravity piped.
- Rural road culverts are to service up to the 10% AEP event.
- Protect buildings from flooding via providing freeboard requirement.
- In urban areas, provide on-site stormwater detention for attenuation up to the 1% AEP rainfall event to pre-development peak flows.
- Where stormwater attenuation is required, stormwater detention ponds or basins should be provided to serve the entire site catchment.
- When discharging into natural waterways, stormwater treatment devices which provide water quality in accordance with the requirements of the NRC should be provided.
- When discharging into a Council-managed system, Council should be consulted as to water quality requirements and existing or planned treatment devices which the discharge may flow through.

Refer to Section 6 of the Engineering Standards for the full stormwater requirements.

6.1.8 NZS 4404:2010 Land Development and Subdivision Infrastructure 2011

NSZ 4404 summarises the aims of a low impact design as follows:

- Reducing peak flow discharges by flow attenuation
- Eliminating or reducing discharges by infiltration or soakage
- Improving water quality by filtration
- Installing retention devices for beneficial reuse

6.1.9 Mangawhai Spatial Plan

Kaipara District Council commissioned the development of a Spatial Plan for Mangawhai to provide high-level 'spatial picture 'of how Mangawhai could grow over the next 20-25 years. The spatial plan was produced by Campbell Brown Planning Ltd and Urbanismplus Ltd and is dated December 2020. The spatial plan identifies the PPC Area as an area identified for new residential growth areas.

The spatial plan provides the following stormwater considerations when developing stormwater catchment management plans:

- Groundwater conditions and capacity of land to accommodate additional development.
- Rules to ensure future development increases riparian planting and protects significant native vegetation, waterways and the coastal edge.
- Low Impact Design (LID) stormwater management to achieve clean water discharges.
- The use of wetlands for the collection and management of stormwater, including Mangawhai Community Park, the Golf Course.
- Reduction of the number of stormwater outflows into the estuary to the east of Wood Street.
- Rules to manage overland flow paths and flooding.
- Mechanisms to ensure that any future rural residential subdivisions do not increase stormwater flows (hydrological neutrality).

6.1.10 Mangawhai Stormwater Infrastructure Strategy

A stormwater report was produced by Stantec dated 9th March 2018 titled "Mangawhai Stormwater Infrastructure Strategy - Stage 2" (MSIS report) and outlines stormwater management options and measures to manage the effects of stormwater discharges from both existing and proposed development within Mangawhai.

The report's guiding principles includes the following:

- Requirement for on-site rainwater collection and tank storage.
- Incorporating blue-green infrastructure (biofiltration devices) such as swales, retention ponds and raingardens.
- Utilise soakage systems wherever possible as a primary means of disposal even if the full design soakage is not achievable. This is to reduce volumes and peak flows form stormwater discharges as much as practically possible.
- Keep water on the surface via swales for treatment and conveyance avoiding kerb and channel wherever possible.

The PPC Area has been identified to be primarily within Catchment 13 and a small portion to be within Catchment 14 of the MSIS report, refer to Figure 6-1 below.

Figure 6-1: Locations of catchment 13 and 14

The MSIS report has identified six issues within Catchment 13 while no issues were identified within Catchment 14.

Refer to Appendix B for the identified issues within Catchment 13, along with their respective locations, management options and Stantec's recommended stormwater management approach.

The identified issues are summarised below:

- Performance of the natural watercourses, open channels and public stormwater network in the catchment is no understood and flooding risks within the catchment may be worsened by intensification.
- The dual culverts under Mangawhai Heads near 82 Mangawhai Road is noted to have capacity issues which may impact flood levels within the vicinity.
- Properties upstream of Mangawhai Heads Road (West) located within the vicinity of the overland flow path have been reported to have flooded. It is noted that these properties are within the PPC Area.

The MSIS report's recommendations are summarised below:

- Redirect some flows from catchment 13 to catchment 14 along 130 Mangawhai Heads Road (West) area and upgrade culvert under Mangawhai Heads Road (West).
- Redirect some flows from catchment 12 to catchment 12 along Mangawhai Heads Road (West).
- Upgrade the dual culvert under Mangawhai Heads Road (West) in front of 82 Mangawhai Road and increase road levels in that area.
- Provide mitigation requirements within the District Plan to include flow and volume reduction and erosion protection for the rural areas of catchment 13.

6.1.11 Mangawhai Stormwater Network Discharge Consent (NDC)

Kaipara District Council was granted a 35-year stormwater discharge consent for Mangawhai on the 26th of July of 2017 (expires on 1st of June of 2052) and this has been integrated into this Stormwater Infrastructure Strategy. Relevant consent conditions include the following:

Condition 7:
The stormwater discharge does not result in any permanent scouring or erosion of the bed of a waterbody or the coastal marine area. For compliance purposes, "permanent" is defined as scouring or erosion that will not be fully remediated by natural processes during the following 3-month period.

Condition 9:
The assets within the stormwater network system that are owned by the Consent Holder, including stormwater ponds, outlet structures, cesspits, energy dissipation devices, and overland flow paths, shall be adequately maintained to ensure that they operate efficiently and effectively at all times.

Condition 10:
All sediment removed from the stormwater network system shall be disposed of at a site that is authorised to accept such waste material.

Condition 11:
Within 12 months of the date of commencement of these consents, the Consent Holder shall forward to the Northland Regional Council's assigned monitoring officer an Operation and Maintenance Plan that details how Conditions 9 and 10 will be complied with. This Plan shall include, as a minimum:

(a) a schedule of inspection frequencies for all sediment traps and stormwater treatment devices;
(b) the maintenance requirements for sediment traps and treatment devices;
(c) a schedule of inspection frequencies for obstructions within open watercourses, drains and overland flow paths.

Condition 15:
The exercise of these consents shall not result in the concentration of metals in sediment, as measured at or beyond a 30-metre radius from any final outlet from the network system into water, to exceed the following:

Ecosystem type	milligrams per kilogram dry weight
Copper	65
Lead	50
Zinc	200
Chromium	80
Nickel	21
Cadmium	1.5

Condition 20:
The exercise of these consents shall not result in any of the following effects on water quality, as measured at or beyond a 30-metre radius down current from any discharge final outlet from the network system:

(a) The production of any conspicuous oil or grease film, scums or foams, or floatable or suspended materials, or emissions of objectionable odour;
(b) The destruction of natural aquatic life by reason of a concentration of toxic substances;
(c) Shellfish to become tainted so as to make them unpalatable or contain toxic substances to the extent that they are unsafe for human consumption.

7 Stormwater Assessment

From the relevant planning and guidance documents above, the local and regional government authorities place importance on having a Low Impact stormwater Design (LID) (also known as Water Sensitive Design (WSD)) with the Kaipara Engineering Standards referring to the (now current) Auckland Councill's GD04 Water Sensitive Design for Stormwater document. Auckland Council's GD04 document outlines the following aims for a WSD:

- Protect and enhance the values and functions of existing natural ecosystems
- Address stormwater effects as close to source as possible
- Mimic natural systems (the water cycle) and processes for stormwater management

The toolbox to enable the above aims are described within Auckland Council's GD01 document Stormwater Management Devices in the Auckland Region.

The Auckland Council documents listed are currently considered to be the Best Practise documents from the implementation of WSD currently available in New Zealand.

In summary there are three parameters that are potentially affected by development which could cause degradation and deterioration of the environment and alteration to the natural water cycle. These are stormwater peak flowrates, stormwater total volume and stormwater quality.

Historical urban development would typically have new areas of impervious areas that inhibits infiltration of stormwater on-site (more noticeable for small rainfall events) with all runoffs being collected and piped to the discharge point usually without any quality or quantity control. This total diversion of runoff has the effect of increasing stormwater runoff volume, decreasing time of concentration for all runoff (i.e. flows from different sources coincide with each other at the discharge point), increasing peak flowrates and introducing new contaminants (which in a primarily residential urban setting the main containment of concerns are primarily hydrocarbons and heavy metals caused by vehicle traffic, and general litter and sediments) and deposit them into the receiving environment which degrades the environment.

In response the current best practise to mitigate the potential effects is to utilise WSD principles which are:

- Reducing stormwater runoff volume
- Moderating stormwater peak flowrates
- Manage stormwater runoff quality

7.1 Stormwater Runoff Volume

Larger runoff volumes can cause an increase in the erosion potential of the receiving environment and will also prolong the erosion event which extends the time that a stream is exposed to erosive flow which ultimately increases the volume of eroded material. In response WSD proposes to provide stormwater mitigation devices that reduce as much runoff as practical or to control the increase in stormwater runoff volume to prevent downstream erosion.

Currently, the two methods available for reducing runoff volumes is either through retention and reuse of stormwater, specifically rainwater tanks or infiltration of stormwater via infiltration devices. Both methods have specific limitations; rainwater tanks relate to the actual demand for the stored water and infiltration methods need to be reviewed against geotechnical considerations with respect to the existing soil as well as the developed soil eg. following earthworks. Given these constraints it is not always feasible or practical to reduce stormwater runoff volumes to the pre-development scenario.

In the above planning documents, The MSIS report recommends stormwater mitigation to reduce runoff volume.

Auckland Councils Technical Report 2013/035 (TR35) provides a method on how areas within the Auckland region were considered to be susceptible to erosion and so highlight areas that require runoff volume mitigation. Therefore, we completed an assessment of the downstream receiving environment in general accordance with the assessment methodology set out in section 6.2 of Auckland Councils Technical Report 2013/035 (TR35) to provide a site-specific analysis on whether runoff volume mitigation is beneficial or not. For further context on the methodology please refer to TR35.

In summary, the assessment methodology is to obtain a score out of 35 from three key factors, stream slope (out of 10), cumulative imperviousness (out of 10) and Macroinvertebrate Community Index (MCI) (out of 15). Once the score is established a reassessment process considering seven moderating factors of the catchment is undertaken to refine the final score for the catchment. The assessment results in one of the following:

- Score 0-15 (No SMAF) – No volume control warranted.
- Score 15-20 (SMAF 2) – 90th percentile volume control warranted.
- Score 20-25 (SMAF 1 or 2) – 90th or 95th percentile volume control warranted dependent on moderating factors.
- Score 25-35 (SMAF 2) - 95th percentile volume control warranted.

From the assessment, several watercourses, have been identified around the PPC83 Area as sensitive to increased stormwater flows and so warrant consideration of volume control as per the criteria in TR35 to minimise erosion and protect/enhance watercourse health. The level identified is equivalent to that of SMAF 1 which in TR35 requires volume control of the 90th percentile rainfall event. This is comparable to 1/3 of the 2 Year ARI 24hr rainfall depth which has been proposed in the provisions in lieu of 95th percentile data not being available in KDC. This approach is consistent with what has been adopted in the Whangārei District for water quality volume control. Figure 7-1, Figure 7-2 and Table 7-1 following set out our assessment results.

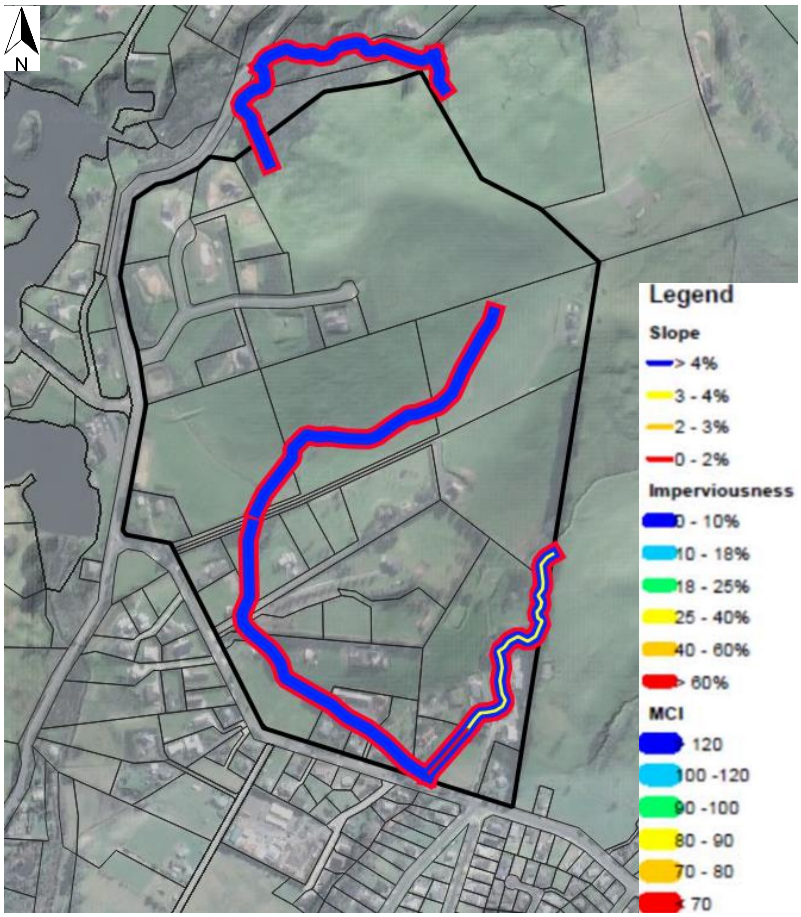

Figure 7-1: Colour coded individual criteria scores

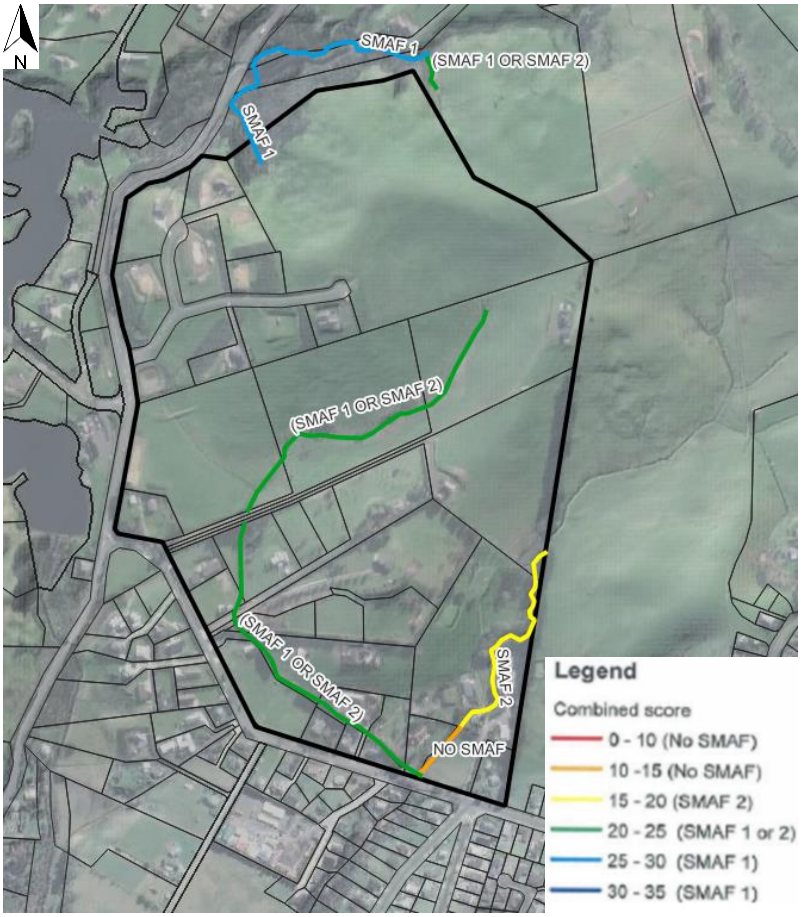

Figure 7-2: Colour coded SMAF 1 and SMAF 2 score map

Table 7-1: Moderating factors

Moderating Factor	Score (Low, Medium, or High)	Discussion (To be read in conjunction with Sections 6.3.4 to 6.3.10 of TR35 and represents the opinion of Chester only)
Fish species distribution	Low	No formal survey was conducted but the ecological report concludes that site contains some potential habitat for indigenous fish but is likely limited to disturbance tolerant climbing species such as banded kokopu and short-fin eel
Potential growth	High	The catchment is predominantly 'greenfield' with a high chance of growth. This assessment is part of the early planning stages for the catchment so there is a greater opportunity to make a difference.
Percent natural streams	Medium	Watercourses on-site lack riparian vegetation cover and are associated with typical agricultural use (artificial farm drainage and animal grazing). Watercourses are interrupted with multiple culverts and driveways.
Existing Erosion	Low to Medium	From observation roadside drains show some signs of scour and erosion near culvert openings. From the topography it is assume that the upper reaches of the watercourses on steep land will be prone to erosion and will be exacerbated by any increase in surface runoff. From observation, the bottom reaches of the watercourses near the twin culverts under Mangawhai Heads Road (West) is located on low-lying land tidal influence areas.
Existing Investment	Low	We are unaware of any existing significant investment to enhance or protect the streams in the catchment
Community use	Medium	A 'focus on the river' was a key aspiration of the community as identified in the most recent spatial planning for Dargaville. The stream reaches being assessed intertwine with rural and residential areas in Dargaville, but they do not present a significant opportunity for community use since they are within existing private properties.
Other	Medium	No existing reserves (1), no areas of combined sewer (3), there are pipe daylighting opportunities (3), the streams are important to the local area but likely less so on a region wide scale (2), there is little to no existing stormwater management in the catchment (1), we are not aware of a specific community program (1) and the area is not of significant groundwater soakage (3). (1) being Low, (2) being medium and (3) being High Average = 2
Overall	Low to Medium	(1) being Low, (2) being medium and (3) being High Average = 1.7 Based on the moderating factors and that only two of the assessed streams in the catchment scored less than 20 we are of the opinion that SMAF 1 equivalent for volume control is appropriate for the catchment

From the above assessment and from the above planning documents, we believe that runoff volume mitigation is required to mitigate the proposed intensification within the PPC Area.

The MSIS report or the KDC Engineering Standards does not provide any specific guidance on how the reduction in runoff volume should be undertaken. Therefore, we have opted to refer to Auckland Council's GD-1 document for guidance on runoff volume mitigation.

GD01 outlines both retention and detention for stream erosion to mitigate the 90th or 95th percentile rainfall events for the Auckland Region. These are smaller and more frequent events that if left uncontrolled have been identified to contribute more to the erosion of the environment compared to the larger and more infrequent rainfall events. There are no 90th or 95th percentile data available for Mangawhai but these values can be approximated by using a third of the 20% AEP/2 Year ARI 24-hour rainfall depth (1/3 of 20% AEP/2 Year 24-hour ARI rainfall depth).

On the basis of implementing a WSD approach and thus complying with the overall and broader objectives of the planning documents sighted above, it is proposed that any future development would be designed in accordance with GD01.

Specifically, provide retention to capture the first 5mm of runoff which will reduce volume leaving the site and to also provide detention for the difference of runoff volume between the pre and post-development scenario for the 1/3 of the 20% AEP 24-hour rainfall depth (minus any retention volume provided) with a drain down period of 24 hours to reduce as much as practical the erosion effects downstream.

The detention volume is not required if the amount of retention volume provided is greater than the required detention volume provided that the entire retention volume can be re-used or infiltrated within a 72-hour period.

If retention is unfeasible (e.g., there is not enough water demand or soil permeability to provide retention via reuse or infiltration over a 72-hour period or a geotechnical assessment does not recommend soakage) then detention of the volume is to be substituted instead with the volume to be discharged over a 24-hour period.

7.2 Existing Stormwater Network Infrastructure

Identified stormwater networks or infrastructure includes:

1) Twin 1.2m diameter culverts under Mangawhai Heads Road (West) in front of 82 Mangawhai Heads Road (West).
2) 0.3m diameter culvert under Mangawhai Heads Road (West) in front of 136 Mangawhai Heads Road (West).
3) Box/bridge culvert under Cove Road next to Tangaroa Road (private road).
4) Public stormwater network along Pigeonwood Place and adjacent stormwater pond.
5) Private accessway culverts within the PPC Area.

Figure 7-3 below shows the location of the above identified infrastructure.

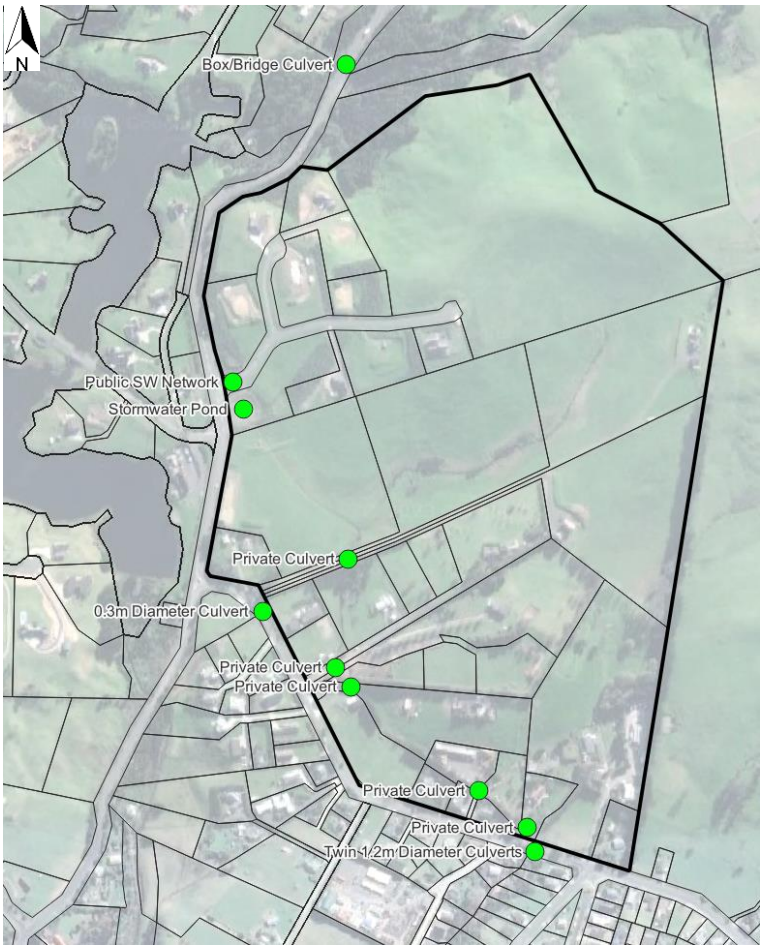

Figure 7-3: Identified existing stormwater network that have been identified in this report.

7.2.1 Twin 1.2m Diameter and 0.3m Diameter Culverts under Mangawhai Heads Road (West)

From the accompanying Chester Flood Risk Assessment, we (Chester) have assessed the 10% AEP event and found the culvert to be underperforming at current zoning (rural within the PPC Area) and the current catchment extent (i.e., does not include any catchment flows form the additional areas recommended in the MSIS report).

We believe that the culvert is underperforming due to the culvert located on low-lying tidal influence land that is almost flat and so culvert gradient is minimal, and the culvert is partially submerged during high tides.

Figure 7-4: Twin 1.2m diameter culverts under Mangawhai Heads Road (West).

The accompanying Chester Flood Risk Assessment assessed whether the performance can be improved if the twin 1.2m diameter culverts were upgraded. In the flood model, the twin 1.2m diameter culverts were replaced with a box culvert that is 6m wide and 1.2m deep. This has an opening surface area of 7.2m^2 compared to the existing twin culvert surface area of 2.26m^2, and so has an opening that is three times greater. However, even with this surface area opening, the culvert is still underperforming for the 10% AEP event with headwaters reaching up to the road level though flood levels reduce by approximately 0.20m along Mangawhai Heads Road (West).

The MSIS report mentions some areas towards this twin culvert system, but this was not taken into account in the Chester Flood Risk Assessment as we wanted to assess the existing condition of the culvert. As the culvert is currently underperforming based on existing conditions, redirecting flows towards the culvert system will exacerbate the culverts poor performance.

Another recommendation made in the MSIS report in relation to this twin culvert system is to increase road levels. This is not a practical approach as this will increase the 1% AEP flood depths upstream of the road as culverts are not designed to service the 1% AEP flood events and so headwater levels will increase until it can overtop the new road level.

The MSIS report does recommend that part of the upstream catchment could be redirected away from the twin culverts. They identify a potential reroute of flows to the 0.30m culvert under Mangawhai Heads Road (West).

We believe that the works required to reroute flows will require works approval from multiple different property owners outside land that is not held by the client and will require significant changes within these private properties to redirect flows. The works required will most likely affect existing property development specifically the driveways within 142 to 146 Mangawhai Heads Road (West). We do not believe the owners of these properties would be receptive to these works. Furthermore, redirecting flows towards the culvert will likely increase flooding within the southern neighbouring properties (139 Mangawhai Heads Road (West)), it is unlikely these properties will be agreeable to any works that will increase flooding within their properties.

Based on the above, we believe that the only practical method to ensure that downstream stormwater infrastructure is not worsened is to attenuate peak lows from the 20% and the 10% AEP events. The 20% and 10% AEP events are considered as the 20% AEP event is the requirement for residential zoning while the 10% AEP event is required for rural road culverts as per the KDC Engineering Standards. Since, the majority of the PPC Area is owned by others, existing developments built to rural standards within the PPC Area will be discharge up to the 10% AEP events and so this design event needs to be accounted for.

7.2.2 Box/Bridge Culvert under Cove Road

KDC Utilities webpage shows a culvert under Cove Road. From observations, it is either a box culvert or a bridge structure. This services predominately rural land extending to the north with a catchment area of 4.5km^2.

NRC Hazards webpage shows the 10% AEP as overtopping the road and further downstream again past the water bodies, refer to Figure 7-7. It is unlikely that a site-specific flood assessment will provide results that disproves that due to the large catchment size and the generally flat/gentles sloping channel.

Figure 7-5: Box/bridge culvert under Cove Road

Figure 7-6: Catchment draining towards the box/bridge culvert (the PPC Area outlined in black)

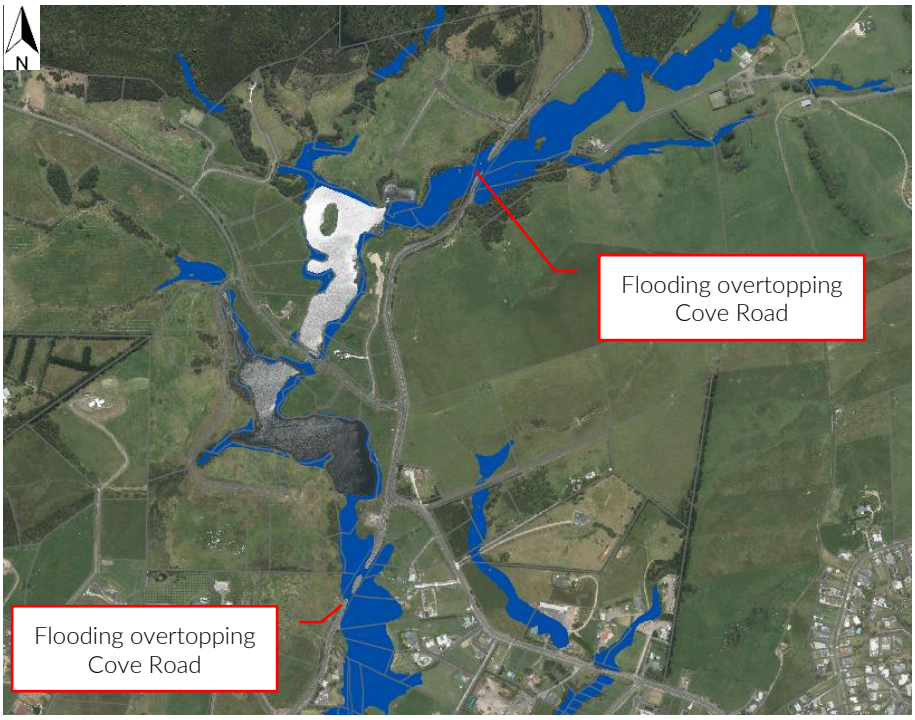

Figure 7-7: KDC Hazards webpage showing the 10% AEP Regionwide floodplain extent.

7.2.3 Public stormwater network along Pigeonwood Place and adjacent Stormwater Pond

The KDC Utilities webpage shows the start of a public stormwater network in Pigeonwood Place. We understand that the primary drainage for the existing development along Pigeonwood Place and Pipit Place that slopes towards the stormwater pond via private pipes. The public stormwater network drains the roadside drain of Cove Road and pipes it to the outlet into the waterbodies to the west.

Development in the PPC Area will increase runoff to both the public stormwater network and the stormwater pond. The stormwater pond and roadside drain is unlikely to have capacity for the proposed increase in permitted impervious area of 60% (as current KDC DP specifies a permitted the hold of 40% for resieditnal and) and so we recommend that stormwater attenuation for 20% and 10% attention is provided to ensure that future development does not exacerbate both the stormwater pond and stormwater networks and the roadside drain.

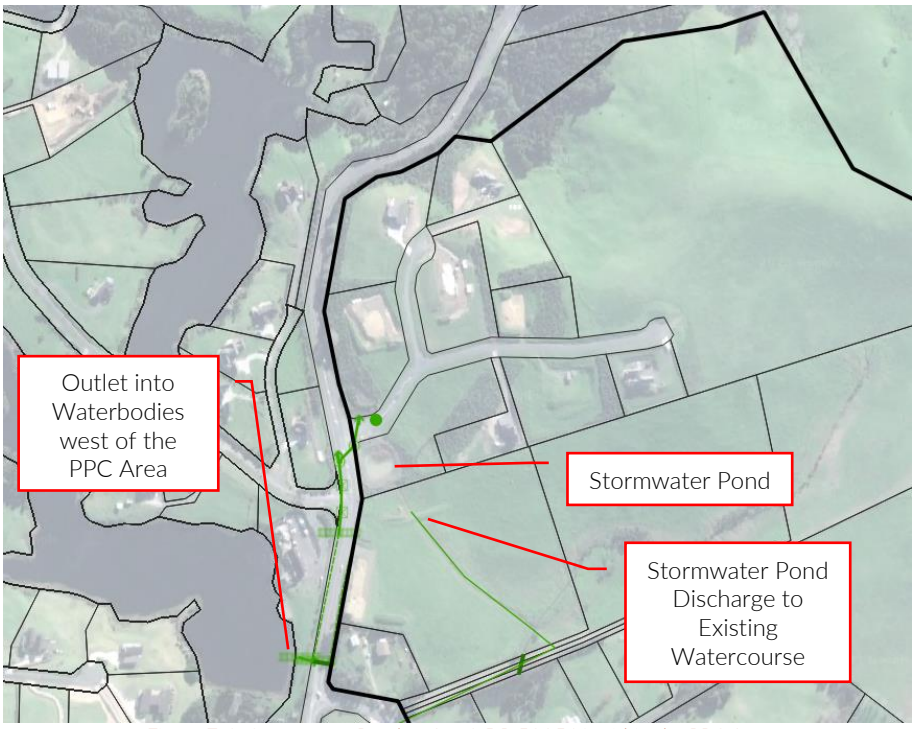

Figure 7-8: Stormwater Pond on Lot 8 DP 533510 within the PPC Area

Figure 7-9: Stormwater pond on Lot 8 DP 533510 within the PPC Area

7.2.4 Private Accessway Culverts within the PPC Area

The KDC Utilities webpage shows three private culverts under various private accessways within the PPC Area although from observations there are more than three driveways crossing the watercourses, so the number of private culverts within the PPC Area will be higher. These culverts provide continuity of the watercourse that originates within the PPC Area.

It is unlikely that these private culverts were designed as per the KDC Engineering Standards requirements for the current zoning, for example the three identified culverts in the KDC Utilities map shows larger diameter culverts located upstream of smaller diameter culverts. Thus, we can assume these culverts are most likely constructed without any formal design.

Therefore, the proposed 60% impervious zoning within the PPC Area will mean that these private culverts will likely be undersized and runoff once the PPC Area is developed will likely cause flooding issues due to culvert capacity.

We understand that these private culverts are owned by other parties and not the client. Therefore, we believe that there is no opportunity at the current stage to upgrade these culverts to the required standard to service the proposed 60% impervious area and there is no guarantee that these culverts will be upgraded by the current owners before development occurs in the PPC Area. This signals that stormwater mitigation will be required to ensure that any current stormwater issues with the private stormwater infrastructure are not exacerbated. Accordingly, we believe that 20% and 10% AEP stormwater attenuation of peak flowrates back to the pre-development scenario (current greenfield scenario) represents the most practical method to ensure that the change in zoning does not exacerbate downstream issues.

7.3 Stormwater Peak Flowrates

Based on the above assessment of the existing stormwater network infrastructure, we can summarise that upgrading stormwater infrastructure is impractical due to fragmented land ownership, tidal influence on low-lying lands and other catchment areas contributing flow that cannot be mitigated (as it is located outside the PPC Area).

Furthermore, the companying Chester Flood Risk Assessment estimates downstream flooding issues that has been assessed to not be improved through stormwater infrastructure upgrades.

Accordingly, we recommend that attenuation of the peak flow rates for the 20%, 10% and 1% AEP events back to pre-development levels will as much as practicable prevent exacerbation of the stormwater capacity performance and the flood hazard in the area.

The 20% and 10% AEP mitigation were recommended as these are the respective design standards for residential and road culverts as per Table 6.2 of the KDC Engineering Standards. The 1% AEP is recommended due to downstream flooding hazards.

7.4 Flooding and Coastal Hazards

Both the flooding and coastal inundation hazard are estimated to be located along the watercourses with coastal inundation located on low-lying land near the existing twin 1.2m diameter culverts. Provided that the 10m setback requirement from the NES-F is applied, it is not expected that future residential development is to be constructed on or near these flood and coastal inundation hazard areas. However, where development is proposed adjacent or on

similar elevation land compared to these watercourses these properties would need sufficient freeboard (0.50m to habitable floor levels) from the floodplain and coastal inundation hazards.

Overland flow paths are the expected hazard that residential properties will need to manage. Flow paths are areas where usually sheet flow surface runoff flows through are channelised at the watercourses on-site or any other low points in the terrain. Apart from the northern part of the PPC Area, overland flow paths will flow into one of the watercourses within the PPC area.

7.5 Stormwater Quality

To comply with the NPS-FM, the NRC PRP 2022 Appeals Version, and the Mangawhai NDC stormwater quality treatment is required. One of stormwaters guiding principles in the MSIS report is incorporating blue-green infrastructure (biofiltration devices) to keep in line with the overall community expectations and vision. To comply with the Mangawhai Stormwater Network Discharge Consent there are certain water quality standards that stormwater outlets are required to comply with.

From a primarily residential suburban/urban setting, the main source of contaminants are heavy metals and hydrocarbons from vehicle traffic along public roads and heavy metals from building materials. There are also concerns regarding general rubbish/litter and sediments however the use of catchpits in the urban environment being a standard practice mitigates these kinds of contaminants.

To mitigate the source of heavy metals from building materials, it is recommended that all materials used in the construction specifically the areas exposed to rainfall to be constructed out of inert materials or to be coated to prevent leachate forming when exposed to runoff. This will mitigate this source of contaminants and protect the downstream receiving environment.

To mitigate the contaminates resulting from vehicle movements (heavy metals and hydrocarbons); stormwater quality treatment devices are required to capture and treat the contaminated stormwater runoff from the public roads. Regarding residential driveways including common ownership, a dedicated bioretention device could be installed or since the level of contamination is much lower than a public road, permeable paving which has some water quality treatment capabilities can be used to treat water quality. Depending on the infiltration rates on-site, both the bioretention device and permeable paving can be also used for infiltration and if required also for detention for small rainfall events.

Depending on the device proposed all stormwater quality treatment devices are to be designed as per Auckland Council's GD01 for either the water quality flow (WQF) of a rainfall intensity of 10mm/hour or water quality volume (WQV) with the 1/3 of the 20% AEP/2 Year ARI 24-hour rainfall depth used as the target rainfall event in the WQV calculations instead of the percentile rainfall events as specified in GD01.

We recommend the above to be included in the KDC District Plan as part of the precinct rules to help provide a clear method to treat contaminant laden stormwater from relevant impermeable surfaces.

As the SMP's offers recommendations regarding the incorporation of regulations governing the proposed permitted 60% impervious threshold into the Kaipara District Plan, through a Precinct Plan procedure, the term "impermeable surface" is to follow the definition of "impermeable surface" under the Kaipara District Plan which is listed below.

> *Impermeable Surface*
> *In relation to a site means any part of that site which does not allow natural percolation of water into the ground and includes:*
> *a. Roofs;*
> *b. Solid or non-slotted decks less than 1m in height about the ground;*
> *c. Any paved surface used for manoeuvring, access, loading of motor vehicles or parking; and*
> *d. Any paved area with a continuous surface or with open jointed slabs, bricks, gobi or similar blocks.*

It is noted in the above, that the definition of impermeable surface includes surfaces such as decks that do not require treatment as there is no relevant contaminants from decks that requires treatment, and that the precinct rule may give be interpreted as treating all impervious areas indiscriminately, regardless of land use or size. However, this is not the intended purpose.

Its purpose is to serve as a clear method (WQV or WQF) for treating water from impervious areas known to contribute contaminants.

To ensure that no meaningless treatment is provided, the full wording of the recommendation proposed is as follow:

i. Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from contaminant generating impermeable surfaces.

For clarification, the proposed provisions rely on the existing definitions in the Kaipara District Plan for **contaminant** which is:

> ***Contaminant****
> *Includes any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat –*
>
> *e. When discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or*
> *f. When discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged.*
>
> *(*as being from the Resource Management Act 1991)*

Given the above, we believe that the recommend statement allows scope at Land Use or Subdivision stage, for further site-specific analysis to be done to assess what the relevant contaminants are for the specific land use and receiving environment and implement design thresholds appropriately.

For example, a concrete footpath around a dwelling does not produce contaminant runoff, and therefore, no water quality treatment is necessary. In the case of a driveway servicing a single dwelling, there may be contaminant runoff, but at a limited rate. Thus, it is the responsibility of the future engineer to assess whether water quality treatment is required. When evaluating common access ways or public roads, these land use activities generate sufficient contaminants that warrant treatment. The below provides a method to help classify impermeable surfaces in relation to contaminant runoff. Please note that he below is for residential land use activities only.

- Disconnected impermeable surfaces that do not experience vehicle traffic –No contaminant runoff
- Driveways servicing one dwelling – Limited contaminants which can be addressed by permeable paving or sufficient justification that contaminant runoff is less than minor.
- Impermeable surfaces servicing more than one dwelling – Contaminant runoff expected and treatment of WQV and WQF is required.

For any activities not mentioned above, then GD01 remains the reference document for the best management approach.

7.6 Stormwater Management Devices

GD04 promotes the use of water sensitive stormwater management devices. These devices are described within Auckland Council's GD01 document Stormwater Management Devices in the Auckland Region. Stormwater management devices recommended in GD01 for use in controlling the effects of stormwater include the following devices as seen in Figure 7-10.

	Quantity control					Quality control								
Key ● Effective o Partially effective - Not effective	1% AEP	Detention of 50% and 10% AEP	90th & 95th percentile detention	Groundwater recharge	Retention	Sediment	Gross pollutants	Heavy metals	Oils and grease	Nutrients	Organics	Hydrocarbons	Indicator bacteria	Temperature
Pervious pavement - unlined	-	-	●	o	●	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Pervious pavement - lined	-	-	●	-	-	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Living roof	-	-	●[a]	-	●	o	NA	o	NA	o	o	NA	o	●
Rainwater tank (no reuse)	-	o	●	-	-	●	NA	o	NA	o	o	NA	o	o
Rainwater tank (with reuse)	-	o	●	-	●	●	NA	o	NA	o	o	NA	o	o
Infiltration device	-	o	●[a]	●	●	-	-	-	-	-	-	-	-	●
Swale (lined)	-	-	-	-	-	●	o	o	o	o	o	o	o	●
Bioretention swale (unlined)	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Rain garden	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Stormwater tree pit[c]	-	-	o	o	●	●	●	●	●	●	●	●	●	●
Planter box	-	-	o	o	●	●	●	●	●	●	●	●	●	●
Constructed wetland	-[d]	●	●	-	o	●	●	●	●	●	●	●	o	o
Wet pond	●	●	●	-	-	●	●	o	o	o	o	o	o	-
Dry pond (detention basin)	●	●	●	-	-	-	-	-	-	-	-	-	-	●

Notes:

NB: Assumes sizing, construction and maintenance are compliant with this guideline's requirements

NA: Not applicable, does not treat this pollutant because it is generally not present in the drainage area

●[a]: Assumes retention of up to the 90th and 95th percentile events

-[b]: Assumes limited water quality treatment for active pervious paving systems. Passive pervious paving is assumed to have some treatment effectiveness if maintained correctly

[c]: Stormwater tree pits are different to street tree pits in that they are specifically designed for stormwater management and must be sized accordingly.

-[d] Wetlands designs should bypass large storm events to protect vegetation and ensure sediments are not resuspended

Figure 7-10: Stormwater management devices listed in GD01.

7.7 Stormwater Conveyance

A public stormwater network is anticipated within the PPC area to collect and dispose of stormwater to their respective natural drainage points. The MSIS report highlights that part of the community vision conveyed in the Mangawhai Community is to avoid the use of kerb and channel to keep the feeling of a beach area. As such we recommend where practical that swales or open channels are to be utilised to convey runoff from public roads and are to convey at least the 20% AEP rainfall events for the Maximum Probable Development (MPD) as per KDC Engineering Standards unless it also services rural areas then the 10% AEP design event is to be considered.

Catchpits and scruffy dome manholes with an internal sump or other similar products to be used along swales/open channel to ensure that gross pollutants are captured. In the event where swales/open channels discharge into the receiving environment without the use of any piped infrastructure, then the ends of the swales/open channels are to be heavily vegetated to allow gross pollutants to be caught by the vegetation.

However, we understand that the majority of the PPC Area is located on steep terrain and so we believe that in these areas swales or open channels are not practical. Therefore, pipe networks are anticipated to be the main method of conveying collected stormwater runoff.

As typically done throughout New Zealand all runoff above the capacity of the primary network is to overflow into secondary flow paths. To avoid placing dwellings in risk of these secondary flows, it is recommended that where possible the proposed roadways, within the PPC Area, are to be designed to convey the 1% AEP rainfall event.

Where public roads cross the watercourses, culverts are to be designed in accordance with the KDC engineering standards. Additionally, all culverts will need to consider fish passage and include where required.

7.8 Stormwater Infiltration

The MSIS report has identified that soakage is the preference for stormwater disposal within the Mangawhai area. From the MSIS report soakage is to be utilised wherever possible even if the design soakage volume cannot be achieved.

Considering the watercourses on-site and steep topography in some area's full disposal of stormwater up to the design event is probably not achievable. However, any form of soakage is recommended to ensure the groundwater system is not affected by the proposed zoning.

Therefore, provided that a geotechnical assessment confirms that soakage on-site does not create any slope stability issues then a soakage system is to be utilised to dispose as much as practically possible with an overflow system to provide an alternative route for stormwater discharge once on-site soakage has reached its limit. A soakage assessment will be required to determine the amount of soakage volume that can be practically disposed of on-site.

7.9 Stormwater Temperature

Temperature is also another contaminant that needs to be considered as high temperatures in stormwater runoff can have adverse effects on the receiving environment.

There are limited guidance documents that go into detail but GD01 does provide some commentary on managing temperature, such as providing sufficient shading over exposed volumes of water (wet pond and etc) or outlets drawing water from deeper, cooler parts of a wetland/wet pond.

GD01 references an Auckland Council Technical Report "Temperature as a contaminant in streams in the Auckland region, stormwater issues and management options" (TR2013/034) which provides more context and discussion regarding the effects of temperature and outlines options to optimise temperature mitigation.

From TR2013/034 there are no specific devices that can be installed to single-handedly treat temperature. Instead, a holistic approach consisting of the following is recommended:

- At-source control (minimising impervious surface areas, using materials that do not readily heat up, or maximising shading)
- Optimising devices with regards to temperature (maximising shading over wet ponds/wetlands, infiltration to dispose stormwater runoff or placing tanks underground)
- Designing outlets with considerations to temperature (device outlets drawing water from the bottom levels, stormwater outlet devices to be setback from the receiving water body, discharge via spreader/dispersal bars to promote sheetflow runoff.

7.10 Wetland Setbacks

To accommodate the NES-F a 10m setback is proposed from all natural wetland edges (this is also a recommendation made in the ecological report). This will enable the land in between to act as a buffer between any upstream flows from the downstream wetland. This buffer protects the downstream wetland by filtering out any pollutants and sediments from runoff not captured by the upstream network (i.e. runoff from pervious areas of the private properties that are not directed to catchpits) and will enhance the ecological values of the wetland by the vegetation within this area and also provides further erosion protection from larger rainfall events.

7.11 Wetland Base Flows

Wetland base flows need to be maintained to ensure the ongoing health of the natural wetland. Specific consideration needs to be given by the designers to the ongoing health of the wetland, piped systems and subsoil drainage to control ground water has the potential to impact the health of natural wetlands. Existing discharge points need to be maintained as much as practical and baseflows recharged.

The use of water sensitive design e.g. swales, bio-retention are key principles that enable base flows to be maintained.

8 PPC Stormwater Management Plan Objectives

The list below summaries the stormwater objectives required for any development within the PPC Area. This list is summarised from the stormwater requirements provided by the relevant planning documents seen in Section 6 and from the low impact stormwater assessment in Section 7.

Historical rainfall depths for the events below are to be obtained from NIWA's High Intensity Rainfall Design System (HIRDS) and are to be adjusted for 2.1°C climate change as per the HIRDS climate change percentage change factors in Table 6 of the HIRDSv4 Technical Report and summarised in the following webpage https://niwa.co.nz/information-services/hirds/help.

We recommend obtaining the latest rainfall data using NIWA's HIRDS tool instead of the rainfall data in KDC's Engineering Standards as the current HIRDS version (at the time of this document) is Version 4 while the rainfall data in KDC's Engineering Standards were from HIRDS version 2.

8.1 Stormwater Quality

- Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from contaminant generating impermeable surfaces.
- WQF to use the 10mm/hr rainfall intensity and WQV to use the 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change as substitution for the percentile rainfall event in Auckland Council's GD01.
- Inert building materials are to be utilised (e.g. inert roof material) to prevent leaching of contaminants.

8.2 Stormwater Retention

- Stormwater retention of the first 5mm of rainfall for all impermeable surfaces is to be provided with the retention volume either to be re-used or infiltrated within a 72-hour period.
- If it has been determined that there is not enough water demand or soakage available to provide retention via re-use or infiltration over a 72-hour period, then retention is to be substituted with detention with the volume to be discharged over a 24-hour period.

8.3 Stormwater Detention

- Stormwater detention for the difference between runoff volumes between the pre- and post-development scenario for the 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change to be provided minus any retention volume provided for all impermeable surfaces with the discharge to be over a 24-hour period.
- Stormwater attenuation for the 20%, 10% and 1% AEP 24-hour rainfall events between the pre and post-development scenario.
- Pre-development scenario to be considered as 100% grass cover.

8.4 Stormwater Conveyance

- Primary stormwater networks to be designed up to the Design AEPs in Table 6.2 of the KDC Engineering Standards. Kerb and channels along roads are to be avoided where practical. Culverts are to be designed in accordance with KDC engineering standards.
- Fish passage to be provided for any infrastructure constructed across the two identified watercourses.
- Roadways to be designed as secondary flow networks where practical and are to accommodate up to the 1% AEP rainfall event.
- Ensure identified overland flow paths remain unobstructed and can safely convey runoff.

8.5 Stormwater Discharge

- Utilise soakage systems wherever possible as a primary means of stormwater disposal even if the full design soakage is not achievable.
- Where the full design soakage cannot be achieved, an overflow to the approved discharge point is to be provided.

- All soakage systems are subject to a soakage and geotechnical assessment.

8.6 Stormwater Temperature

- Buildings, infrastructure, stormwater devices and outlets are to consider temperature control where appropriate/possible.

8.7 Setbacks

- To accommodate the NES-F a 10m setback is proposed from all natural wetland edges.

9 Stormwater Management Devices

Table 9-1: Relevant District Plan Rules to Stormwater

Rule	Parameter	Residential Permitted Activity Performance Standard	Activity Status if the Activity does not meet the Performance Standard	Assessment Criteria
13.10.12	Permeable Surfaces	(1) Residential Zone Any activity is a ***Permitted Activity*** if: a) The area of any ***site*** covered by ***buildings*** and other ***impermeable surfaces*** is less than 40% of the ***net site area***. (2) Cove Road North Precinct Any activity is a ***Permitted Activity*** if: a) The area of any site covered by buildings and other impermeable surfaces is less than 60% of the net site area; and b) All stormwater management for the site shall comply with any stormwater management plan approved under rule 13.14.5 Stormwater Disposal. **Note 1:** For the purposes of this Rule, any area regularly used by vehicles whether metalled, sealed or concreted shall be considered an impermeable surface.	Restricted Discretionary Activity	Where an activity is not permitted by this Rule, ***Council*** has restricted its discretion over the following matters when considering and determining an application for Resource Consent: i) Control of stormwater run-off; ii) The ***effects*** of increased stormwater flows downstream; iii) Methods of attenuating stormwater flows to pre-development rates, iv) Whether and the extent to which the activity meets the relevant Performance Standards or the Kaipara District Council Engineering Standards 2011; v) Effects on water quality; and vi) The extent to which low impact design principles are utilised. vi) Within the Cove Road North Precinct, whether the proposal utilises low impact and/or water sensitive stormwater management devices and designs, outfalls that mitigate concentrated flows and detail of any obligations for lot owners to construct and maintain such devices. vi) Within the Cove Road North Precinct, the extent to which stormwater quality treatment has been provided to protect the environment from contaminants generated from the activity including whether the proposal includes appropriate stormwater quality monitoring associated with the design and construction stages as well as the consent holder's maintenance obligations.

				(3) Cove Road North Precinct Precinct Information Requirement: Any application shall be supported by a detailed stormwater assessment report prepared by a suitably qualitied engineer to confirm that the proposal will achieve the following: i) Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from contaminant generating impermeable surfaces. ii) Retention (volume reduction) of a minimum of 5mm runoff depth for all impermeable surfaces. iii) Detention (temporary storage) with a drain down period of 24 hours for the difference between the pre-development (grassed state) and post-development runoff volumes from the 1/3 of the 2 Year ARI, 24-hour rainfall event minus any retention volume provided for all impermeable surfaces. iv) Detention and Attenuation of the post-development runoff peak flow rates to at or below the pre-development (grassed state) peak flow rates from the 20%, 10% and 1% AEP events for all impermeable surfaces. v) Conveyance and discharge of primary and secondary flow in accordance with the Kaipara District Council Engineering Standards 2011. Note 1: Within the Cove Road North Precinct Precinct, 1/3 of the 2 Year ARI rainfall event runoff volume is to be used as the Water Quality Volume (WQV) when designing a treatment device, and 10mm/hour is to be used as the Water Quality Flow (WQF). Note 2: Within the Cove Road North Precinct Precinct, good management practice for stormwater management is equivalent to those set out in the guideline document, Stormwater *Management Devices in the Auckland Region (GD01).*
13.14.5	Stormwater Disposal	(1) Where available all allotments are provided, within their net site area, with:	Discretionary Activity	***Council*** will have regard to the following matters when considering an application for Resource Consent under this Rule:

a) A connection to a ***Council***-maintained stormwater system, excluding sites within the Cove Road North Precinct Precinct.; or

(2) Where no Council system is available:

a) All ***allotments*** are provided with the means for the transport and disposal of collected stormwater from the roof of all potential or existing ***buildings*** and from all impervious surfaces, in such a way as to avoid any adverse ***effects*** of stormwater runoff on the receiving ***environment*** in accordance with the Kaipara District Council Engineering Standards 2011, excluding sites within the Cove Road North Precinct Precinct.

(3) Cove Road North Precinct Stormwater Management

a) All allotments are provided with the means for the transport and disposal of collected stormwater from the roof of all potential or existing buildings and from all impervious surface, in such a way as to mitigate any adverse effects of stormwater runoff on the receiving environment by providing:

i) Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from contaminant generating impermeable surfaces.

ii) Retention (volume reduction) of a minimum of 5mm runoff depth for all impermeable surfaces.

iii) Detention (temporary storage) with a drain down period of 24 hours for the difference between the pre-development (grassed state) and post-development runoff volumes from the 1/3 of the 2 Year ARI, 24-hour rainfall event with climate change minus any retention volume provided for all impermeable surfaces.

iv) Detention and Attenuation of the post-development runoff peak flow rates to at or

i) Whether there is sufficient control of water-borne ***contaminants***, litter and sediment; ii) Whether there is sufficient land available for disposal of stormwater;

ii) Whether and the extent to which the capacity of the downstream stormwater system is able to cater for increased runoff from the proposed ***allotments***;

iii) Whether and the extent to which measures are necessary in order to give ***effect*** to any drainage or

iv) ***Catchment*** Integrated ***Development*** that has been prepared for the area;

v) Whether and the extent to which measures proposed for avoiding or mitigating the effects of stormwater runoff, including low impact design principles are effective;

vi) Whether and the extent to which the stormwater infrastructure within the ***subdivision***, is able to link with existing disposal systems outside the subdivision;

vii) Whether and the extent to which the development meets the relevant performance standards or the ***Kaipara District Council Engineering Standards 2011*** or the Cove Road North Precinct Stormwater Management Plan;

viii) Whether there is a need for land to be set aside and vested in the Council as a ***site*** for any public utility required to be provided;

ix) Within the Cove Road North Precinct:

- The extent to which run-off from a developed catchment is discharged back into its natural catchment.
- The applicability of retention to be provided within a 72-hour period.
- The extent to which inert building materials are to be utilised (e.g., inert roof material).

below the pre-development (grassed state) peak flow rates from the 20%, 10% and 1% AEP events for all impermeable surfaces.

v) Conveyance and discharge of primary and secondary flow in accordance with the Kaipara District Council Engineering Standards 2011.

Note 1: Stormwater discharges may require Resource Consent under the Regional Water and Soil Plan for Northland. Applicants should contact the Northland Regional Council to determine whether or not a Resource Consent is required.

Note 2: Where parallel Resource Consent for stormwater discharge is required from the Northland Regional Council, Kaipara District Council will seek to undertake joint processing of both applications, via delegated authority from the Northland Regional Council.

Note 3: The discharge of stormwater into the rail corridor is an offence under the Railways Act 2005 unless the written consent of the New Zealand Railways Corporation has been provided.

Note 4: 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change is to be used to determine the Water Quality Volume (WQV) when designing a treatment device.

Note 5: Good management practice for stormwater management is equivalent to those set out in the guideline document, Stormwater *Management Devices in the Auckland Region (GD01).*

10 Stormwater Management Toolbox

The following section will discuss the suitability of various stormwater management and treatment device options with respect to the conditions within the PPC and the stormwater management objectives.

A list of all stormwater mitigation devices grouped for the different stormwater mitigation requirements are listed in Table 10-1 with a comment on their suitability within the development site based on available site-specific information at the time of this document.

Table 10-1: Assessment of stormwater management devices for different stormwater mitigation targets.

Mitigation Target	SW Management Devices	Discussion
Water Quality	Swales	- Topography on-site is predominantly moderate to steep slopes with only the southern perimeter located on gentle sloping land. - Private properties will need to discharge either into the roadside swale (swale needs to account for private property runoff) or a public network. - Bioretention swales is more effective at water quality treatment but will require a larger cross-section. - Device only provides water quality functions and no other functions (detention or retention) can be incorporated into the device. - Due to topography, it may only be practical for roadways along the gentler sloping land portions of the southern perimeter of the PPC.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes greater than 25% if infiltration is proposed. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required for smaller rainfall events (1/3 of the 2 Year ARI rainfall event) only. - Limited efficacy in capturing water from road carriageways when slopes are greater than 5%. - Due to topography, it may only be practical for roadways along the gentler sloping land portions of the southern perimeter of the PPC.
	Wet Pond	- A downstream wet pond will be able to provide water quality treatment for entire upstream catchment. - Efficacy of wet pond is less compared to a wetland due to lack of vegetation features. - Potential for high temperatures in stagnant waters. - Does not have retention capability. - Requires a large surface area at the downstream location which seems limited due to existing topography within the PPC.
	Wetland	- A downstream wetland will be able to provide water quality treatment for entire upstream catchment. - Does not normally provide retention unless specifically designed. - Requires a large surface area at the downstream location (larger than that of a wet pond) which seems limited due to existing topography within the PPC.
	Inert Building Materials	- Avoid copper and zinc building materials, and unpainted galvanized roofing and gutters. - Utilise inert material for building exterior. - Due to scarcity of suitable land to install a large downstream device, this is highly recommended to reduce the number and/or size of downstream treatment devices.
	Pervious / Permeable Paving	- Topography on-site is predominantly moderate and steep which makes it unsuitable for pervious/permeable paving. - Not to be used in high contaminant generating areas (e.g. public roadways). - Provides some water quality treatment.

		- Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events (5 Year ARI and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events. - Due to topography, it may only be practical for driveways along the gentler sloping land portions of the southern perimeter of the PPC.
	Filter/Propriety Treatment Devices	- Not considered a 'green' mitigation device. - Expensive for individual residential lots but can be used to treat a suitably sized catchment before discharge. - Only to be used if no other mitigation devices are practical and feasible.
Retention	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes greater than 25% if infiltration is proposed. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required for smaller rainfall events (1/3 of the 2 Year ARI rainfall event) only. - Limited efficacy in capturing water from road carriageways when slopes are greater than 5%. - Due to topography, it may only be practical for roadways along the gentler sloping land portions of the southern perimeter of the PPC.
	Pervious / Permeable Paving	- Topography on-site is predominantly moderate and steep which makes it unsuitable for pervious/permeable paving. - Not to be used in high contaminant generating areas (e.g. public roadways). - Provides some water quality treatment. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events (5 Year ARI and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events. - Due to topography, it may only be practical for driveways along the gentler sloping land portions of the southern perimeter of the PPC.
	Rainwater Tanks	- Provides retention by reusing water if there is source available to use the water (toilets and washing machine). - For reuse within the dwelling (either non-potable or potable activities). - Reduces demand, although limited, on the public water supply network.
	Infiltration Devices	- Provides retention via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Device only provides retention functions and no other functions (detention or water quality) can be incorporated into the device. - Infiltration of the first 5mm with an overflow system to capture higher rainfall events will allow sites to satisfy the retention requirement at-source. This is useful as there is limited land downstream for large downstream devices.
Detention	Detention Tanks	- On-site dual-purpose stormwater rainwater tanks can provide retention (reuse within the building) and detention to achieve detention requirements in the same device. - Does not rely on soakage rates on-site and provides another method to achieve retention at-source. This is useful as there is limited land downstream for large downstream devices.
	Pervious / Permeable Paving	- Topography on-site is predominantly moderate and steep which makes it unsuitable for pervious/permeable paving. - Not to be used in high contaminant generating areas (e.g. public roadways). - Provides some water quality treatment.

		- Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events (5 Year ARI and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events. - Due to topography, it may only be practical for driveways along the gentler sloping land portions of the southern perimeter of the PPC.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes greater than 25% if infiltration is proposed. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required for smaller rainfall events (1/3 of the 2 Year ARI rainfall event) only. - Limited efficacy in capturing water from road carriageways when slopes are greater than 5%. - Due to topography, it may only be practical for roadways along the gentler sloping land portions of the southern perimeter of the PPC.
	Pond (dry and wet Ponds)	- A downstream wet pond will be able to provide water quality treatment for upstream catchment. - Potential for high temperatures in stagnant waters. - Does not have retention capability. - Device can provide some amenity values. - Requires a large surface area at the downstream location which seems limited due to existing topography within the PPC.
	Wetland	- A downstream wetland will be able to provide water quality treatment for entire upstream catchment. - Does not normally provide retention unless specifically designed. - Requires a large surface area at the downstream location (larger than that of a wet pond) which seems limited due to existing topography within the PPC.

The three primary runoff sources from the PPC are most likely going to compose of the residential buildings, private on-grade impervious areas (e.g. driveways and patios) and public roads based of the proposed Residential zoning of the PPC. Table 10-2 below shows the available stormwater treatment device that is appropriate for each of the stormwater mitigation requirements per stormwater runoff source.

Table 10-2: SW mitigation devices for each potential runoff source.

SW Runoff Source	Water Quality	Retention	Detention
Residential Buildings	*NA*[1]	- Rainwater Tanks - Infiltration Devices[2] - Unlined Bioretention Device[2]	- Detention Tanks - Bioretention Device[4] - Pond - Wetland
Private driveways and similar on-grade impervious areas	- Permeable Paving[2,3] - Bioretention Device[2] - Wet Pond - Wetland - Filter/Propriety Treatment Devices	- Unlined Permeable Paving[2] - Infiltration Devices[2] - Unlined Bioretention Device[2]	- Rainwater Tanks - Bioretention Device[4] - Pond - Wetland
Public Roads & Common Accessways	- Bioretention Device[2] - Wetland - Filter/Propriety Treatment Devices	- Infiltration Devices[2] - Unlined Bioretention Device[2]	- Detention Tanks - Bioretention Device[4] - Pond - Wetland

[1] Provided that inert building materials are used.
[2] Provided a site-specific soakage assessment confirms that soakage is viable and geotechnical acceptable.
[3] Unsuitable in areas with high contaminant generating activities.
[4] Only suitable for small rainfall events such as up to the 1/3 of the 2 Year ARI rainfall event.

11 Indicative Stormwater Management Plan

From the stormwater toolbox in the section above, the following indicative stormwater management plan is proposed. It is important to note that this report was written in support for a private plan change application whereby future development throughout the PPC is not finalised, the stormwater management plan below is to be taken as indicative only whereby the plan provides an option on how best to service stormwater based on the assessment and assumptions undertaken at the time of this report.

The PPC area is primarily composed of varying steepness of ground terrain with only the southern perimeter of the PPC area consisting of gentler sloping terrain. The gentler sloping terrain though contains watercourses that flow along this area and so are prone to flooding. Due to the topography and flooding hazards, it is unlikely that all parts of the PPC area can be serviced by downstream 'end-point' stormwater devices as there is limited space downstream. Furthermore, considering that all lots within the PPC are owned by separate owners, it is extremely unlikely that an owner will concede a majority or a significant amount of land within their lot for a stormwater device. Therefore, we believe that at-source stormwater devices are the more feasible and practical method to achieve the stormwater objectives of the PPC.

At-source devices includes rainwater tanks within the lots for retention and detention with water quality treatment provided by inert building materials and a filter device on-site. Common accessways and public roads may use underground detention tanks with either filter or biofiltration device for water quality with retention via infiltration. The figure below shows a schematic of the indicative stormwater management plan for the PPC area.

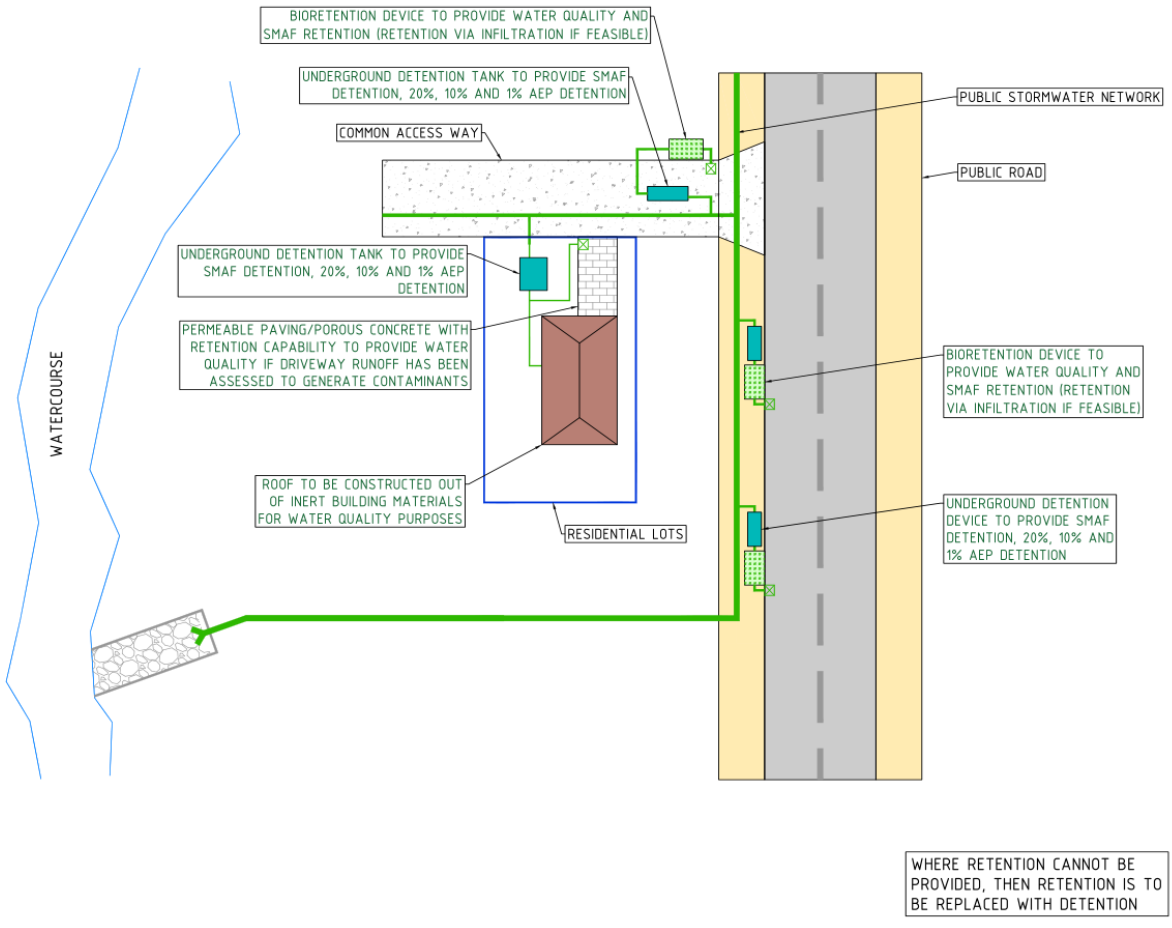

Figure 11-1: Indicative Stormwater Management Plan.

12 Conclusions and Recommendations

The national, regional, and local regulations and guidelines have outlined the requirement of a WSD approach to be undertaken for stormwater for any future development to protect and enhance downstream environments and mimic natural water systems and processes for stormwater management.

Section 7 of this report examined a range of stormwater matters in relation to the site-specific attributes of the PPC Area and the surrounding region. From this analysis, stormwater objectives, listed in Section 8, have been recommended for potential future development within the PPC Area. These recommendations aim to ensure that any forthcoming development complies with current regulations and minimizes its impact on the broader environment downstream.

In our opinion the PPC Area doesn't present any limitations to the full implementation of WSD principles.

Based on the stormwater assessment, we have recommended the following precinct stormwater rules that will provide guidance eon any future development within the Cove Road North Precinct.

13 Limitations

This assessment contains the professional opinion of Chester Consultants as to the matters set out herein, in light of the information available to it during the preparation, using its professional judgement and acting in accordance with the standard of care and skill normally exercised by professional engineers providing similar services in similar circumstances. No other express or implied warranty is made as to the professional advice contained in this report.

We have prepared this report in accordance with the brief as provided and our terms of engagement. The information contained in this report has been prepared by Chester Consultants at the request of The Rise Limited and is exclusively for its client use and reliance. It is not possible to make a proper assessment of this assessment without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Chester Consultants Ltd. The assessment will not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this assessment by any third party.

The assessment is also based on information that has been provided to Chester Consultants Ltd from other sources or by other parties. The assessment has been prepared strictly on the basis that the information that has been provided is accurate, completed, and adequate. To the extent that any information is inaccurate, incomplete or inadequate, Chester Consultants Ltd takes no responsibility and disclaims all liability whatsoever for any loss or damage that results from any conclusions based on information that has been provided to Chester Consultants Ltd.

14 Appendices

Appendix A – NRC PRP 202 Appeals Version's Water Quality Standards and Guidelines

H.3 Water quality standards and guidelines

Policy H.3.1 Water quality standards for continually or intermittently flowing rivers

The water quality standards in *Table 22: Water quality standards for ecosystem health in rivers* apply to Northland's continually or intermittently flowing rivers, and they apply after allowing for reasonable mixing.

Table 22: Water quality standards for ecosystem health in rivers

Attribute	Unit	Compliance metric	Outstanding rivers	Other rivers
Nitrate (toxicity)	mg NO_3-N/L	Annual median	≤1.0	≤1.0
		Annual 95th percentile	≤1.5	≤1.5
Ammonia (toxicity)	mg NH_4-N/L	Annual median	≤ 0.03*	≤0.24*
		Annual maximum	≤ 0.05*	≤0.40*
Temperature	mg/L	Summer period measurement of the Cox-Rutherford Index (CRI), averaged over the five (5) hottest days (from inspection of a continuous temperature record).	≤ 20^{o}C	≤ 24^{o}C
Dissolved oxygen	mg/L	7-day minimum	≥ 8.0	≥ 5.0
		1-day minimum	≥ 7.5	≥ 4.0
pH	pH units are dimensionless	Annual minimum and annual maximum	6.5 < pH < 8.0	6.0 < pH <9.0
Periphyton biomass (chlorophyll a) – hard-bottomed wadeable rivers	Mg chl-a/m2^{2}	Exceeded by no more than 8% of samples (default class rivers). Exceeded by no more than 17% of samples in productive class rivers. Based on monthly samples collected over three years	≤50	≤200

Temperature change*	Degrees Celsius	Summer period measurement of the Cox-Rutherford Index (CRI)**, averaged over the five (5) hottest days (from inspection of a continuous temperature record).	≤1C	≤3C
OMCI (wadeable rivers)change*	Index value	Equivalence test between five(5) replicate 01m^2 Surber samples (protocol C3 hard-bottomed quantitative as per Stark et al. (2001)** from each upstream and downstream site	≤20 (not more than 20% reduction)	≤20 (not more than 20% reduction)
Toxicants, metal sand metalloids (excludes nitrate or ammonia toxicity)	Default guideline value (DGV) fir toxicant, metal or metalloid in Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018: ANZG (2018)	Maximum	99% species protection	95% species protection
Visual clarity change*	Metres	Maximum	≤20% Not more than20% decrease in black disc or eq2uivalent measurement	≤30% Not more than 30% decrease in black disc or equivalent measurement
Deposited fine sediment change – hard-bottomed wadeable rivers*	Percent cover	Sample average (All transect observations at each site using SAM2 protocol Clapcott et al. 2011**	≤10% (Not more than 10% increase in cover)	≤10% (Not more than 10% increase in cover)

**Based on pH 8 and temperature of 20 degrees Celsius. Compliance with the water quality standard should be undertaken after pH adjustment.*

1 Unless **naturally occurring processes** as defined in the NPS-FM (2020) prevent the waterbody from achieving the standard.

2 At low risk sites monitoring may be conducted using visual estimates of periphyton cover. Should monitoring based on visual cover estimates indicate that a site is approaching the relevant periphyton abundance threshold, monitoring should then be upgraded to include measurement of chlorophyll-a.

3 Rivers are categorised as productive according to types in the River Environment Classification (REC). Productive rivers are those that fall within the REC "Dry" Climate categories (i.e., Warm-Dry (WD) and Cool-Dry (CD)) and the REC Geology categories that have naturally high levels of nutrient enrichment due to their catchment geology (i.e., Soft-Sedimentary (SS), Volcanic Acidic (VA) and Volcanic Basic (VB)). Therefore, productive rivers are those that belong to the following REC defined types: WD/SS, WD/VB, WD/VA, CD/SS, CD/VB, CD/VA.

* Note: Change is to be measured between appropriately matched habitats upstream and downstream of discharges to water or, where there is no suitable upstream site, between reference condition and downstream site.

**As referenced in: Davies-Colley R, Franklin P, Wilcock B, Clearwater S, Hickey C 2013. National Objectives Framework Temperature, Dissolved Oxygen & pH thresholds for discussion, NIWA Client Report No:HAM2013-056. Prepared for the Ministry of the Environment. Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Searsbrook MR, 2001. Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute: Nelson, New Zealand.

Table 23: Water quality standards for human contact in rivers

Attribute	Unit	Compliance metric	Outstanding rivers	Other rivers
Escherichia coli (E. coli)	*E. coli*/100ml	Does not exceed any of the four attributes states in Table 9 of the NPS FM (2020) % exceedance over 540 % exceedance over 260 Median concentration95th percentile of *E. coli*	≤20% ≤34% ≤130 ≤1200	≤20% ≤34% ≤130 ≤1200
E. coli in primary contact sites during the bathing season	*E. coli*/100ml	95th percentile	≤540 All rivers	≤540 All rivers
Periphyton cover (periphyton weighted composite cover – periWCC) – hard-bottomed wadeable rivers	Percent cover	Seasonal maximum weighted composite cover on visible stream bed in a reach (1 November to 30 April)	≤30%	≤30%

Policy H.3.2 Water quality standards for lakes

The water quality standards in *Table 24: Water quality standards for ecosystem health in lakes* apply to Northland's lakes, and they apply after allowing for reasonable mixing.

Table 24: Water quality standards for ecosystem health in lakes

Attribute	Unit	Compliance metric	Shallow lakes (≤ 10m)	Deep lakes (>10 m)
Phytoplankton (chl-a)	mg Chl-a/m^3	Annual median	≤ 1.0	≤ 1.0
		Annual maximum	≤ 1.5	≤1.5
Total nitrogen	mg/m^3	Annual median	≤ 800	≤ 350
Total phosphorus	mg/m^3	Annual median	≤ 20	≤ 10
Ammonia (toxicity)	mg NH_4-N/L	Annual median	≤ 0.03*	≤ 0.03*
		Annual maximum	≤ 0.05*	≤ 0.05*

**Based on pH 8 and temperature of 20 degrees Celsius. Compliance with the water quality standard should be undertaken after pH adjustment.*

Policy H.3.3 Coastal water quality standards

The water quality standards in *Table 25: Water quality standards for ecosystem health in coastal waters, contact recreation and shellfish consumption* apply to Northland's coastal waters, and they apply after allowing for reasonable mixing.

Table 25: Water quality standards for ecosystem health in coastal waters, contact recreation and shellfish consumption

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coastal water
Dissolved oxygen	mg/L	Annual median	>6.2	>6.3	>6.9	No discernible change
		Minimum	4.6			
Temperature	°C	Maximum change	3			
pH	pH units are dimensionless	Annual minimum and annual maximum	7.0 - 8.5			8.0 - 8.4
Turbidity	NTU	Turbidity must be maintained at or below the current annual median or at or below pre-existing levels, whichever is lesser.	<7.5	<10.8	<6.9	No discernible change
Secchi depth	m	Annual median	>0.8	>0.7	>1.0	No discernible change
Chlorophyll-a	mg/L	Annual median	<0.003	<0.004	<0.004	No discernible change
Total phosphorus	mg/L	Annual median	<0.119	<0.040	<0.030	No discernible change

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coastal water
Total nitrogen	mg/L	Annual median	<0.860	<0.600	<0.220	No discernible change
Nitrite-nitrate nitrogen	mg/L	Annual median	<0.580	<0.218	<0.048	No discernible change
Ammoniacal nitrogen	mg/L	Annual median	<0.099	<0.043	<0.023	No discernible change
Copper	mg/L	Maximum	0.0013			0.0003
Lead	mg/L	Maximum	0.0044			0.0022
Zinc	mg/L	Maximum	0.0150			0.0070
Faecal coliforms	MPN/100mL	Median	Not applicable		≤14	≤14
		Annual 90th percentile	Not applicable		≤43	≤43
Enterococci	Enterococci /100mL	Annual 95th percentile	≤500	≤200	≤200	≤40

Advice Note: *Water quality values will vary throughout the year and the values stated as annual median or percentile values may be exceeded for short periods of time during that annual period without the median or percentile standard being exceeded.*

Policy H.3.4 Coastal sediment quality guidelines

A discharge of a contaminant into coastal water or any surface water flowing to coastal water must not cause any of the following benthic sediment quality standards to be exceeded in the coastal marine area.

Table 26: Coastal sediment quality guidelines for Northland coastal marine areas

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coast
Copper	mg/kg	Maximum	65	18.7		
Lead	mg/kg	Maximum	50	30.2		
Zinc	mg/kg	Maximum	200	124		
Chromium	mg/kg	Maximum	80	52.3		
Nickel	mg/kg	Maximum	21	15.9		
Cadmium	mg/kg	Maximum	1.5	0.68		

Appendix B – MSIS Catchment 13 Issues and Recommendations

	Issue	Site Location	Management Options	Stormwater Management Recommendation	Rough Order of Cost Stormwater Management Proposal	Risk category
Catchment 13						
2	Performance of the existing natural system, open channels and public stormwater network is not well understood. This includes primary (piped and open channel) as well as the secondary overland flow, ponding systems and stream. Risk can be worsened by intensification of the upstream development and system capacity restrictions.	Channel in the back of 130-138 and 90-126 Mangawhai Heads Road 82-83 Mangawhai Heads Road- dual culvert. Stream at Clemway Holding subdivision. Existing subdivision Clemway Holding – Jack Boyd Drive (RM06007A) – Incorporate the information for mapping and flood level information. Parklands avenue to Te Whai Street	1. Do nothing, accept lack of information and limitations on confidence in long-term decision making. 2. Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages.	Gather more accurate information on the existing asset and topography, update GIS and use in modelling system performance	$50k $20k	Medium
3	A number of private properties and houses are in hollows and/or on an existing overland flowpaths and potentially subject to a flood hazards. Flooding has been reported upstream of Mangawhai Heads Road.	130-138 Mangawhai Heads Road.	1. Do nothing, accept lack of information and limitations on confidence in long-term decision making. 2. Gather more accurate information on the existing asset, update GIS and use in modelling system performance. 3. Redirect flow to catchment 14 at 130-138 Mangawhai Heads Road. 4. Upgrade culvert under 130-138 Mangawhai Heads Road.	Gather more accurate information on the existing asset and topography, update GIS and use in modelling system performance Redirect flow to catchment 14 at 130-138 Mangawhai Heads Road. Upgrade culvert under 130-138 Mangawhai Heads Road.	$50k $200k	High
14	Existing stormwater pipes or channel located on site but not identified in KDC GIS and therefore performance unable to be quantified.	130-138 and 90-126 and 76 Mangawhai Heads Road.	1. Do nothing, accept inaccuracy in GIS data. 2. Gather and update As-Built data in the GIS and model the system performance.	Gather and update As-Built data in the GIS and model the system performance.	$70k	Medium
13	Road crossing forms a constraint on flood levels. Mangawhai Heads Road dual culvert capacity restrictions	82-83 Mangawhai Heads Road	1. Do nothing, accept effects and resolve future problems as they arise if possible. 2. Increase the capacity of the existing dual culvert for level of services of the Mangawhai Heads Road. Increase the level on the road as it is an existing low point. 3. Possible diversion of some section of catchment 13 through catchment 14 through overland flow modifications.	Increase the capacity of the existing dual culvert for level of services of the Mangawhai Heads Road. Increase the level on the road as it is an existing low point. Divert section of catchment 13 through catchment 14 through overland flow modifications. Formalise and protect OLFP. Downstream channel improvements by on-going operational and maintenance.	$320k $100k $100k	High

	Issue	Site Location	Management Options	Stormwater Management Recommendation	Rough Order of Cost Stormwater Management Proposal	Risk category
			4. Downstream channel improvements by on-going operational and maintenance.			
16	Existing rural zone land (outside of existing urban zonings) considered for more intensive development	Development pressure upstream of 140 Mangawhai Heads Roads	1. Do nothing, accept effects and resolve future problems as they arise if possible. 2. Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. 3. Divert section of catchment 13 through catchment 14. 4. Provide guidance to developers around the information requirements and planning requirements. 5. Include requirements for mitigation within the District Plan including flow and volume reduction and erosion protection. 6. Include requirements for developers to demonstrate impact to downstream properties is managed. 5. Provide guidance to future developers with respect to on-site management techniques to mitigate their effects off-site, including: operation, maintenance and monitoring strategies.	Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. Provide guidance to developers around the information requirements and planning requirements. Include requirements for mitigation within the District Plan including flow and volume reduction and erosion protection. Include requirements for developer to demonstrate impact to downstream properties is managed. Provide guidance to future developers with respect to on-site management techniques to mitigate their effects off-site, including: operation, maintenance and monitoring strategies.	$50k	High
5	Lack of design of Roads to act as overland flow paths and inadequate sized road crossings	Jack Boyd Drive	1. Do nothing, accept inadequate overland flowpaths and consequences in high rainfall events 2. Formalize and protect existing OLFP within the roads 3. Incorporate the overland flow function into the road as part of future road upgrading	Formalise and protect existing OLFP within the road and incorporate the overland flow function into the road as part of future road upgrading. Scoping of proposed works to be included in LTP process.	$100k	Medium
Catchment 14						
Catchment 15						
19	Manage flows under and across Molesworth Drive from the Estuary Estates Structure Plan	Molesworth Drive	1. Do nothing, accept effects and resolve future problems as they arise if possible 2. Gather more accurate information and use in modelling system performance with different scenarios 3. Include management of flows at Molesworth Drive as part of the stormwater study for the Estuary Estates Structure Plan. 4. Design Molesworth Drive to allow for possible overtopping. 5. Understand existing consider culvert size and condition.	Gather more accurate information and use in modelling system performance with different scenarios Include management of flows at Molesworth Drive as part of the stormwater study for the Estuary Estates Structure Plan. Design Molesworth Drive for possible overtopping On-going operation and maintenance requirements Understand existing consider culvert size and conditions	$200k	Low