Awakino Precinct Stormwater Management Plan

for Private Plan Change – Awakino Views Dargaville

Prepared For:
Moonlight Heights Limited

Chester Job Number:
14974

Date:
31/05/2022

Revision History

Revision No.	Prepared By	Description	Date
0	D. Teh	First Issue	31 May 2022

Action	Name	Signed	Date
Prepared by	D. Teh		31 May 2022
Reviewed by	S. Rankin		31 May 2022
Approved by	S. Rankin		31 May 2022

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1 Introduction

Chester Consultants Ltd (Chester) has been engaged by Moonlight Heights Limited (MHL) to provide a Stormwater Management Plan (SMP) with respect to the proposed Private Plan Change (PPC) referred to herein as 'the PPC' at Awakino Road, Dargaville, Kaipara District.

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 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. All vertical levels stated in this report are in New Zealand Vertical Datum 2016 (NZVD2016) unless stated otherwise. 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 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 located east off Awakino Road to the northwest of the Dargaville township, refer to Figure 2-1. The site is primarily accessed from 163 Awakino Road, Dargaville. Table 2-1 shows the legal descriptions of each parcel that makes up the area. The PPC is currently zoned Rural but abuts the Residential zone, and is located within the within a Future Residential and Business Growth Area and Greater Structure Plan Policy Area.

Table 2-1: Existing Parcels within the PPC Area.

Parcel ID	Legal Description	Property Address	Note
4800834	Lot 1 DP 169115	115 Awakino Road	
4849026	Part Lot 12 DP 36083	117 Awakino Road	
5015743	Lot 2 DP 116318	163 Awakino Road	Part of Parcel
5073665	Lot 1 DP 201626	145A Awakino Road	
5073668	DP 36083	-	Parcel Intent: Road
5101990	Lot 1 DP 55899	161 Awakino Road	
5263453	-	-	Parcel Intent: Road
6783016	Lot 1 DP 355519	-	
6945183	Lot 1 DP 380979	145 Awakino Road	
6945184	Lot 2 DP 380979	135 Awakino Road	
7613209	Lot 1 DP 487184	151 Awakino Road	
7613210	Lot 2 DP 487184	153 Awakino Road	
7624332	Lot 2 DP 488951	-	Part of Parcel
7848567	Lot 2 DP 517950	123 Awakino Road	Part of Parcel
8132261	Lot 2 DP 553122	159 Awakino Road	
8132262	Lot 1 DP 553122	-	

The PPC is situated on an elevated flat area that projects eastwards from Awakino Road forming a peninsular surrounded by kumara fields and the Awakino flood plains. The topography slopes gently away from the centre then steepens at the outer extents down into the lower surrounding areas. Various water courses originate at the area and flow off in each direction eventually becoming tributaries of the Awakino River.

The PPC Area is predominantly in pasture with little tree cover. There are a few existing houses and some ancillary farm buildings throughout mainly located in the western area of the PPC.

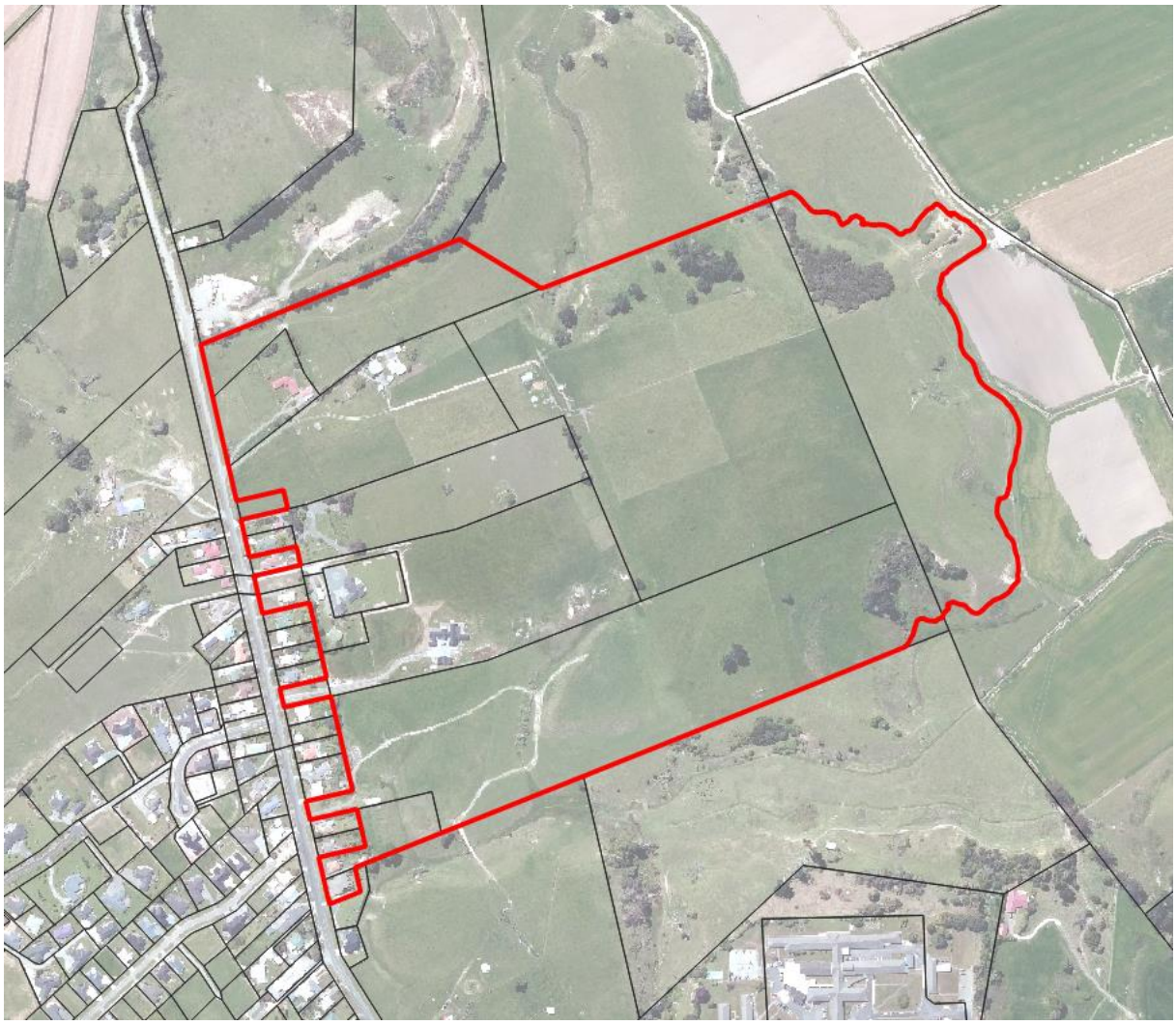

Figure 2-1: PPC Area.

3 Catchment Description and Context

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

3.1 Natural and Physical Characteristics

3.1.1 Topography

The topography of the catchment is generally characterised as gentle sloping areas with steeper areas that descend towards the gully features around the perimeter of the PPC Area and towards the Awakino River floodplains along the eastern side of the PPC Area. There are two gully heads forming within the area along the northern and southern areas of the PPC Area. Please refer to Figure 3-2 which illustrates the topography over the catchment and Figure 3-3 which illustrates the slope of the land within and adjacent to the PPC Area.

Using the 2018/2019 Northland Region LiDAR dataset provided by NRC we provide the following specific comments around the PPC topography. The land in the middle of the area is flat with the land to the north sloping down to the north, the land to the east sloping down to the east and so on for the remaining two cardinal directions. However, as the middle of the area is so flat the boundaries between catchments are at approximate at the resolution of this assessment. Flows on-site are estimated to be predominantly sheetflow with channelisation only potentially occurring at the base of the two gully heads.

The Northern, Eastern and Southern catchments drain towards existing ephemeral streams or wetlands but the Western catchment drains towards the road side drain of Awakino Road before eventually flowing into the same water course that the Southern Catchment drains into. All four catchments discharge into the Awakino River via a series of artificial drains along the farmlands to the east of the PPC Area.

Estimated catchment areas are as follows:

Northern Catchment = 6.40ha

Eastern Catchment = 12.45ha

Southern Catchment = 17.53ha

Western Catchment = 2.88ha

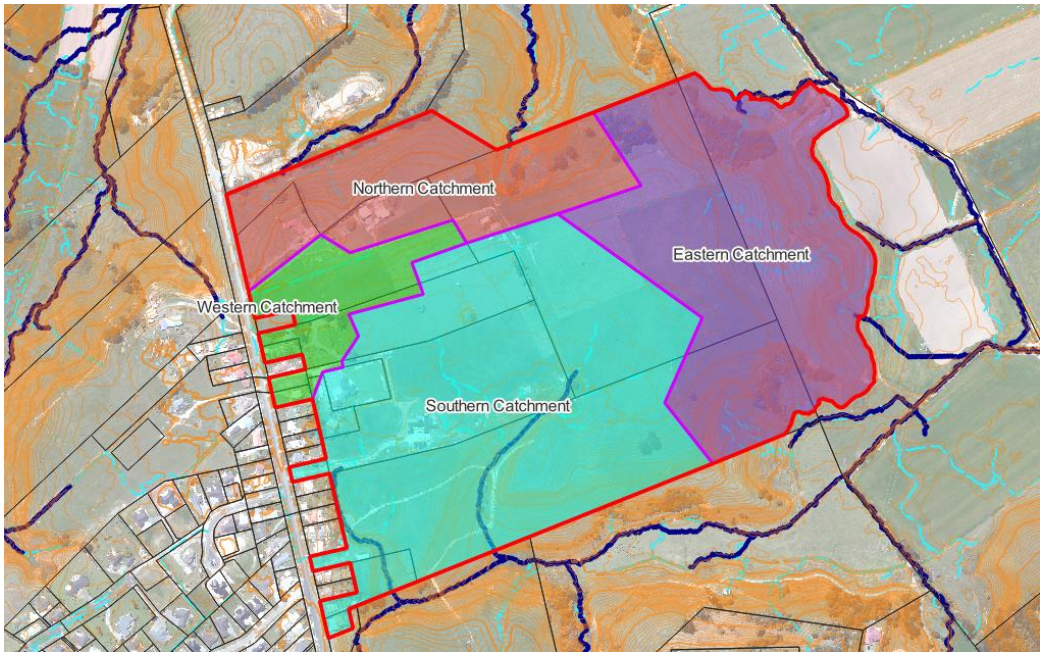

Figure 3-1: Stormwater catchments identified within the development extent.

Figure 3-2: Elevation map showing the different elevation areas for the land within and adjacent to the PPC.

Figure 3-3: Slope map showing the different slope areas for the land within and adjacent to the PPC.

3.1.2 Ecology

An ecological report has been produced by Rural Design to identify the specific ecological areas present within the PPC Area as well as in the downstream receiving environment. Based on their assessment, the following ecological features were identified:

- The majority of the land within the PPC is pasture.
- Artificial drains present within the pasture areas within the PPC Area.
- Two areas of native vegetation (Kanuka and Towai) in the east within the PPC Area.
- Areas of exotic vegetation (Exotic pines) in the north within the PPC Area.
- A wet steep area in the east within the PPC Area.
- Multiple wetland areas to the north, east and south located within and outside the PPC Area.
- Ephemeral streams draining into the wetlands originating within the PPC Area.
- Intermitted streams located at the base of the wetlands with one being present within the Southern Catchment of the PPC Area.
- An artificial pond located in the north outside the PPC Area.

Refer to Figure 3-4 below showing the ecological features found.

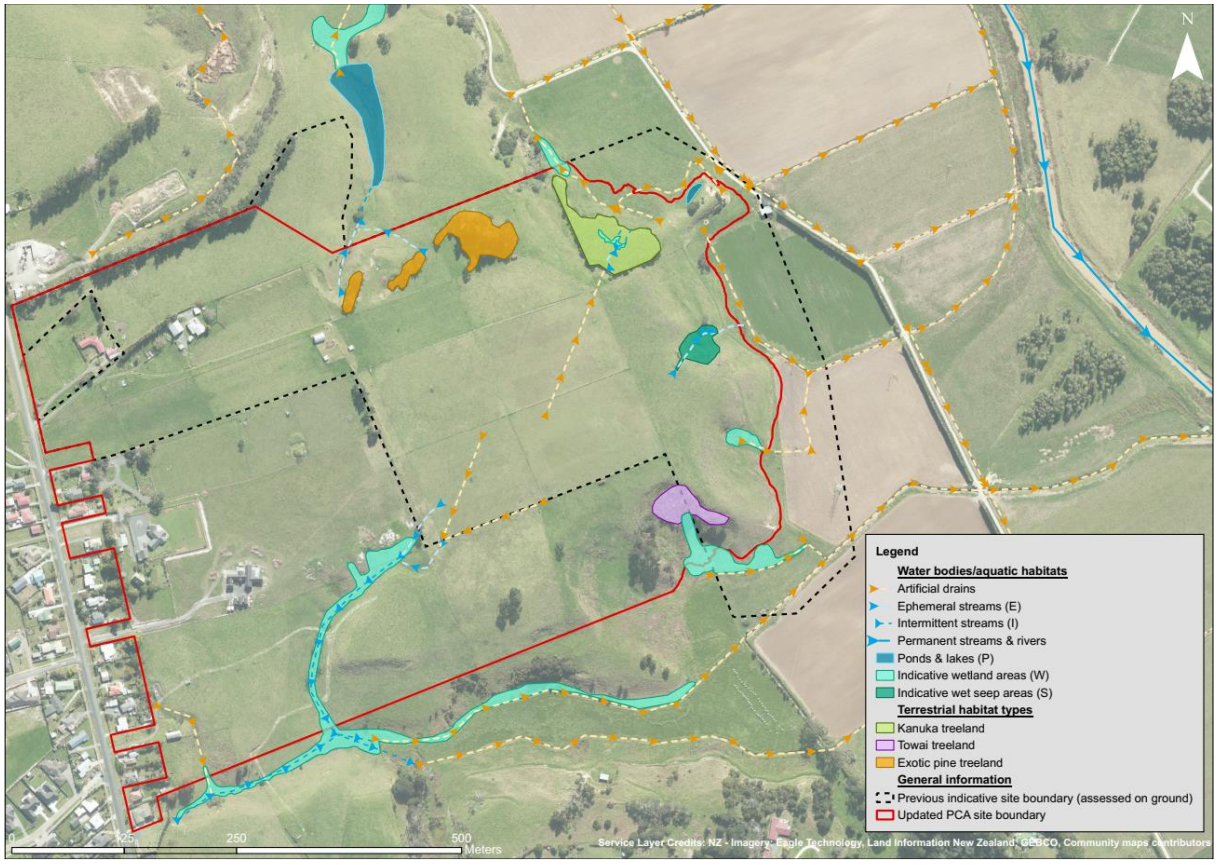

Figure 3-4: Figure extract provided by ecologist showing the ecological features within the PPC Area and adjacent to the PPC Area.

3.1.3 Flooding & Overland Flow Paths

The PPC Area is located away from the coastal environment and is located on ground above RL 20m, so is not considered to be subject to coastal inundation.

The NRC has completed a flood model of the Awakino River under the Priority Rivers[1] modelling; the completed modelling estimates that the flooding hazard does not encroach into the PPC Area. Refer to Figure 3-5 below from the NRC's Natural Hazard mapping webpage that shows the Priority Rivers flooding hazard (100 Year event and accounting for climate change effects) and coastal flood hazard Zone 3 (100 Year event and including rapid sea level rise scenario).

Fluvial flooding is not considered to be a constraint for any future development within the PPC Area as the site is the head of the catchment with flow contributing to downstream receiving networks rather than having flood flow conveyed through the area.

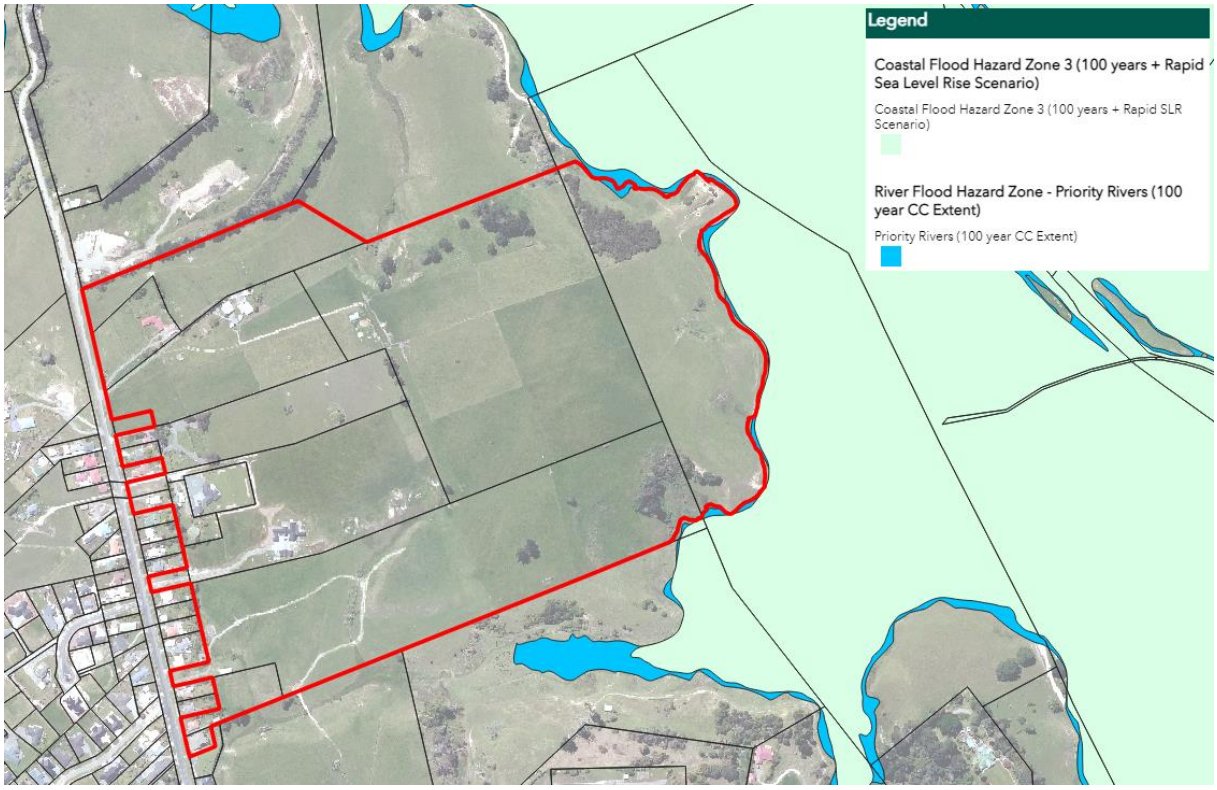

Figure 3-5: Flooding and Coastal Flood Hazard Zone 3 with information provided by NRC Open Data webpage.

Secondary flow is expected to be sheetflow within the PPC Area and as such not considered to be a natural hazard. Figure 3-6 below shows the existing sheetflow directions and where the start of overland flow paths where sheetflow runoff concentrates.

[1]Flood catchments that have been identified as having the highest level of potential flood risk.

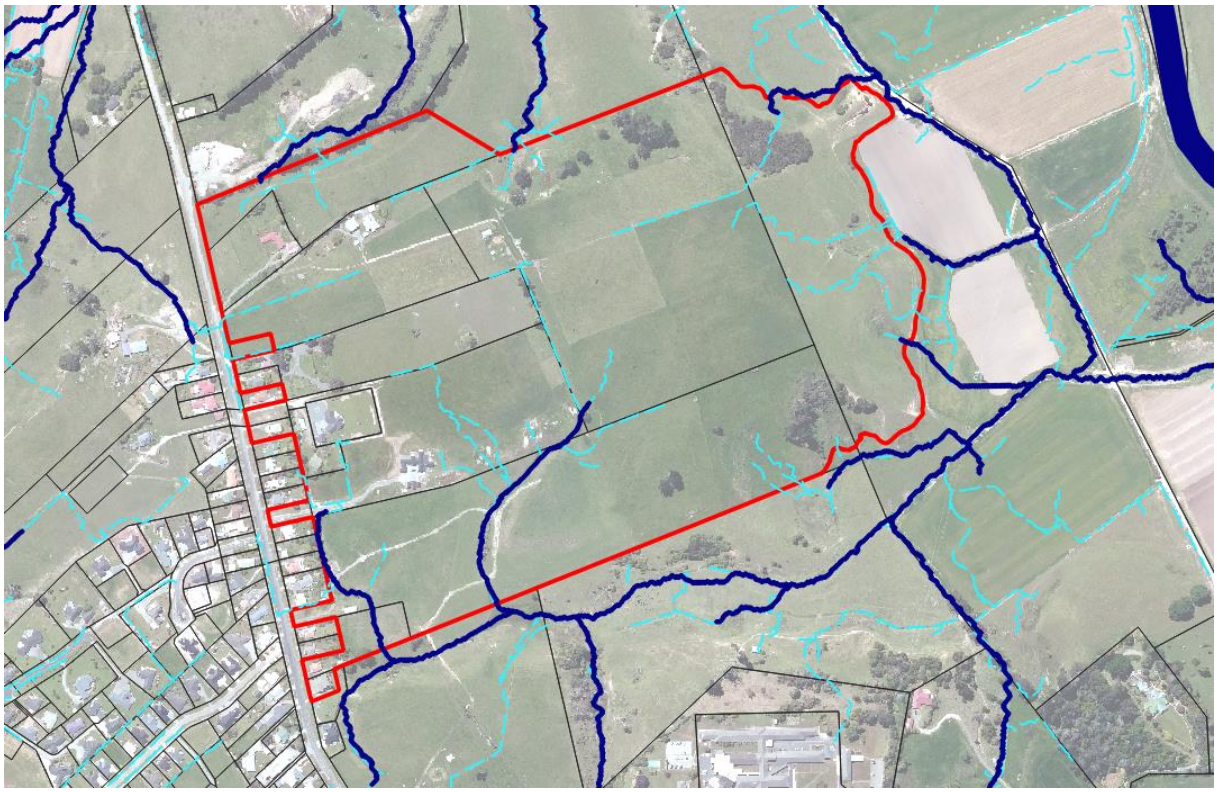

Figure 3-6: Sheetflow estimated in light blue dash lines and channelised flows in dark blue lines (please note flow path assessment above is indicative only as assessment uses LiDAR data which does not accurately capture culverts).

3.2 Receiving Environments

This section of the report briefly outlines the receiving environments characteristics, current state and existing stressors to provide context for the stormwater management requirements. For more details, please refer to the Ecological Report prepared by Rural Design.

3.2.1 Rivers, Streams and Wetlands

Runoff from the PPC Area will flow towards the Awakino River which is one of the rivers that discharges into the Wairoa River. The Awakino River has an approximate total catchment area of 116km^2 while the Wairoa River has an approximate total catchment area of 3,650km^2. The PPC Area has an approximate area of 39.26ha and makes up 0.34% of the Awakino River and 0.01% of the Wairoa River.

The PPC Area is located approximately 500m west of the Awakino River and is located approximately 1.7km north from the Wairoa River, and features the heads of ephemeral and intermittent streams which flow into the wetlands located at the edge of the PPC as seen in Figure 3-4.

3.3 Current Land Use and Infrastructure

This section describes the existing land use and infrastructure within the PPC Area. We note that most of the catchment is greenfield so there is relatively little existing infrastructure/urban development.

3.3.1 Current land use

The land cover within the catchment is predominantly farmland containing a few scattered dwellings. The land is currently zoned as Rural but it is indicated to be within a Future Residential and Business Growth Area and Greater Structure Plan Policy Area on the Kaipara EPlan website.

Figure 3-7: Growth Areas from Kaipara Eplan website.

3.3.2 Existing Stormwater Infrastructure

There are no existing public stormwater infrastructure within the PPC Area. The existing development density and age would mean the existing structures have either onsite stormwater disposal or no formal disposal system.

4 Proposed Private Plan Change

The PPC is seeking to rezone 39.26ha of land in the Dargaville area from Rural zoning to Residential zoning with an approximate net site area of 20.93ha (excludes public road reserves, future open space and ecological features such as buffer/setback zones).

Currently under the Rural zoning the permitted threshold for impervious areas is 15% for sites not within an Overlay which amounts to 3.14ha of permitted impervious area (15% of the net site area). The residential Awakino Precinct zone is proposed to have a permitted threshold of 60% which will mean the total permitted future impervious areas from the residential sites can amount to 12.56ha (60% of the net site area). This extra 45% increase in permitted impervious area amounts to an additional 9.42ha when compared to the current 15% permitted threshold for Rural zoning.

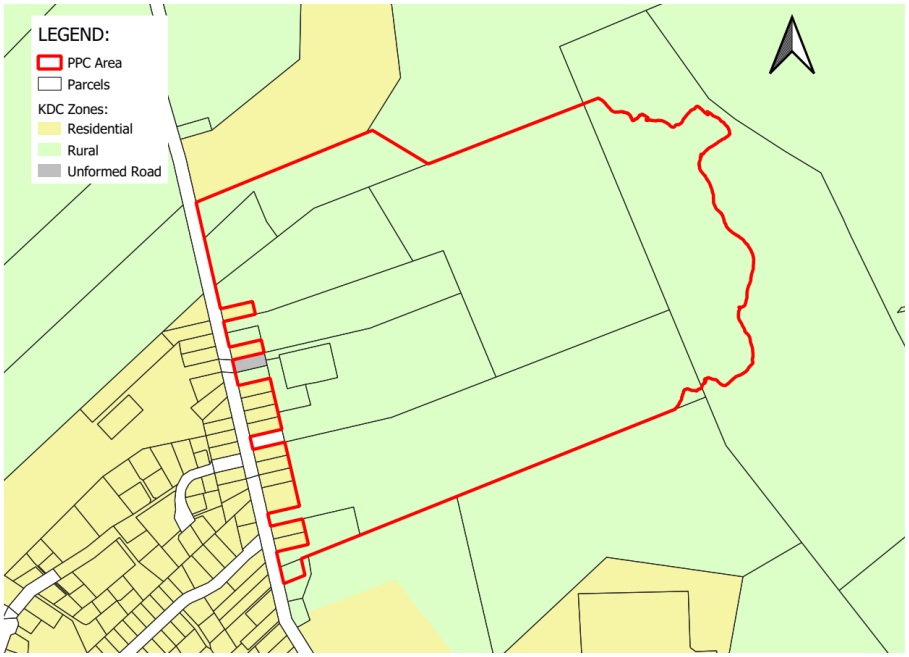

Figure 4-1: Existing zoning map.

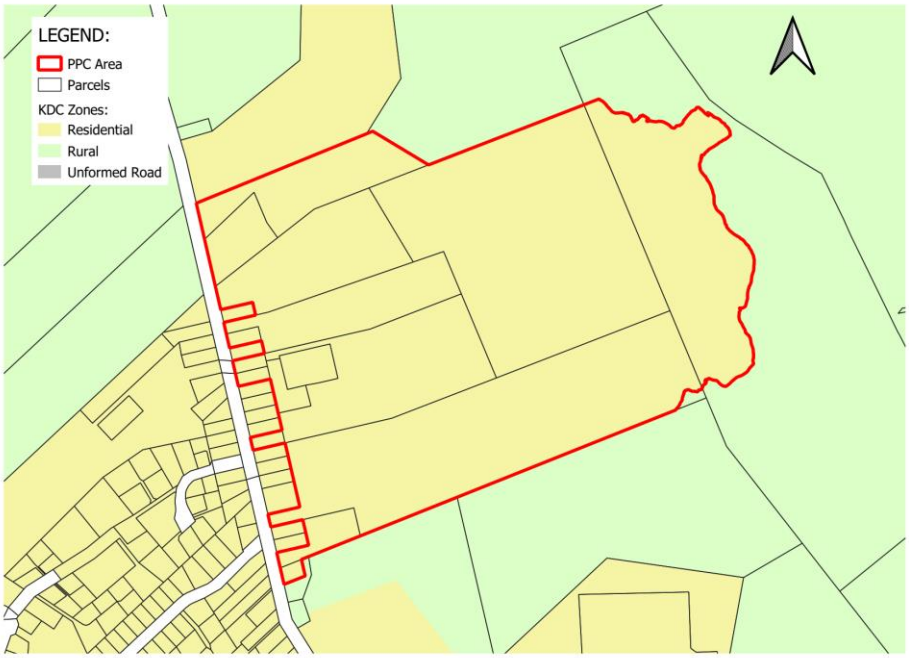

Figure 4-2: Proposed zoning map.

5 Planning Context

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

5.1 Policy Statements and Plan 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
- The Kaipara Spatial Plan - Ngā Wawata 2050
- Kaipara District Infrastructure Strategy Revision 6 February 2021
- Kaipara District Council Engineering Standards 2011
- NZS 4404:2010 Land Development and Subdivision Infrastructure

5.1.1 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 with the Development site located within the Northern Wairoa 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 is not fully operative until all current appeals have been resolved. More information on the new Regional Plan is discussed further on.

5.1.2 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.

5.1.3 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 such as the levels of contaminations caused by heavy metals, sedimentation, hydrocarbons and lack of quality controls in the stormwater system.

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 5 Year ARI 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.

5.1.4 Proposed Regional Plan for Northland March 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 March 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 Dargaville 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.

5.1.5 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.

5.1.6 The Kaipara Spatial Plan - Ngā Wawata 2050

The Kaipara Spatial Plan provides a strategic direction for Kaipara town to develop into. The spatial plan has identified the Development extent to be within a potential area suitable for residential growth and encourages the use of Low Impact Design to be incorporated into the future stormwater system in this area.

5.1.7 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.

5.1.8 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 5 Year ARI is to be gravity piped.
- Protect buildings from flooding via providing freeboard requirement
- In urban areas, provide on-site stormwater detention for attenuation up to the 100 Year ARI 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.

5.1.9 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

5.1.10 Dargaville Stormwater Management Plan

A Stormwater Management Plan was produced by Opus dated 24th July 2015 (Opus SMP) to identify critical areas of existing stormwater infrastructure for improvements. As the development site contains no existing public stormwater there are no comments in that Opus SMP that relate to the development site.

6 Low Impact Stormwater Design

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.

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 runoff 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 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

6.1 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 of these methods have specific limitations; rainwater tanks relates 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. 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, there are no specific volume reduction requirements stated therefore, it is proposed to utilise the strategy outlined in Auckland Council's GD01 document given it status as the current best practise document. GD01 outlines 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 Dargaville but these values can be approximated by using a third of the 2 Year ARI 24-hour rainfall depth (1/3 of 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, it is proposed that any future development would be designed in accordance with GD01.

Specifically, provide retention to capture the first 5mm of runoff and to provide detention for the difference of runoff volume between the pre and post-development scenario for the 1/3 of the 2 Year ARI 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, then detention of the volume is to be substituted instead with the volume to be discharged over a 24-hour period.

6.2 Stormwater Peak Flowrates

Based on provided flood modelling information from the NRC the 24-hour duration storm event over the Awakino River catchment has been identified to be the most critical with respect to the flooding hazard within the Awakino River. From the information provided, the peak flow of the Awakino River arrives near the development site at hour 30 for the 10 Year ARI event and hour 22.5 for the 100 Year ARI event based on a 24-hour rainfall duration event.

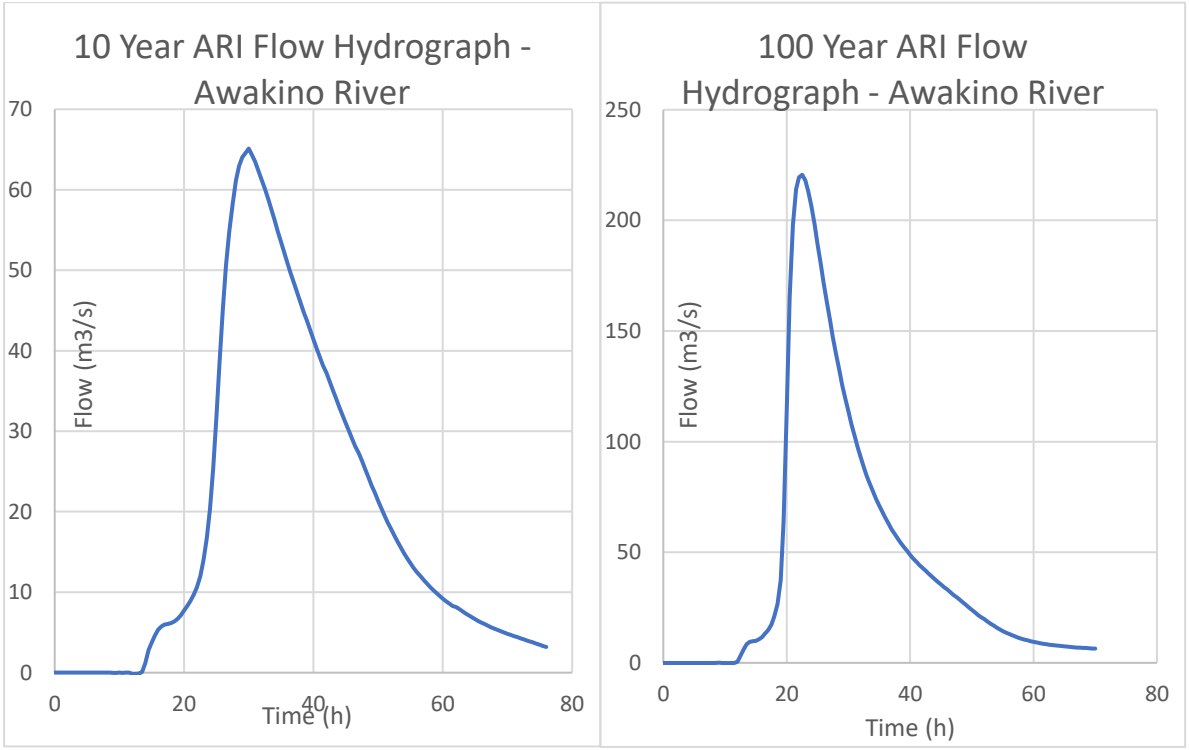

Figure 6-1: 10 and 100 Year ARI Flow Hydrographs for the Awakino River provided by Northland Regional Council.

Using a maximum probable development of 60% within the development net site area of 20.93ha (12.56ha of impervious area) and no detention or retention the following flow hydrographs in Figure 6-2 was produced using HEC-HMS showing the flowrates from the development along with the flows from the Awakino River. The HEC-HMS model uses the USDA Soil Conservation Service TR-55 type IA

storm profile over 24 hours with rainfall data obtained from HIRDS and adjusted for an increase in temperature of 2.1°C to account for climate change.

The hydrographs show that the unmitigated peak flowrate from the development site during MPD scenario does not reach the level of the peak flowrate of the Awakino River and that the peak flowrate from the development area flows through the Awakino River much sooner than the peak flowrate from the Awakino River. Therefore, as the site does not increase the flood elevation downstream during the 10 Year ARI and the 100 Year ARI rainfall event it is proposed to let these larger rainfall events flow unmitigated as it does not exacerbate the flooding hazard downstream. There is a risk if peak flow mitigation is proposed for these larger rainfall events that the mitigated peak flow from the PPC Area could align time wise to a larger flow from upstream which could then increase the peak flood elevation downstream which will exacerbate the flood risk.

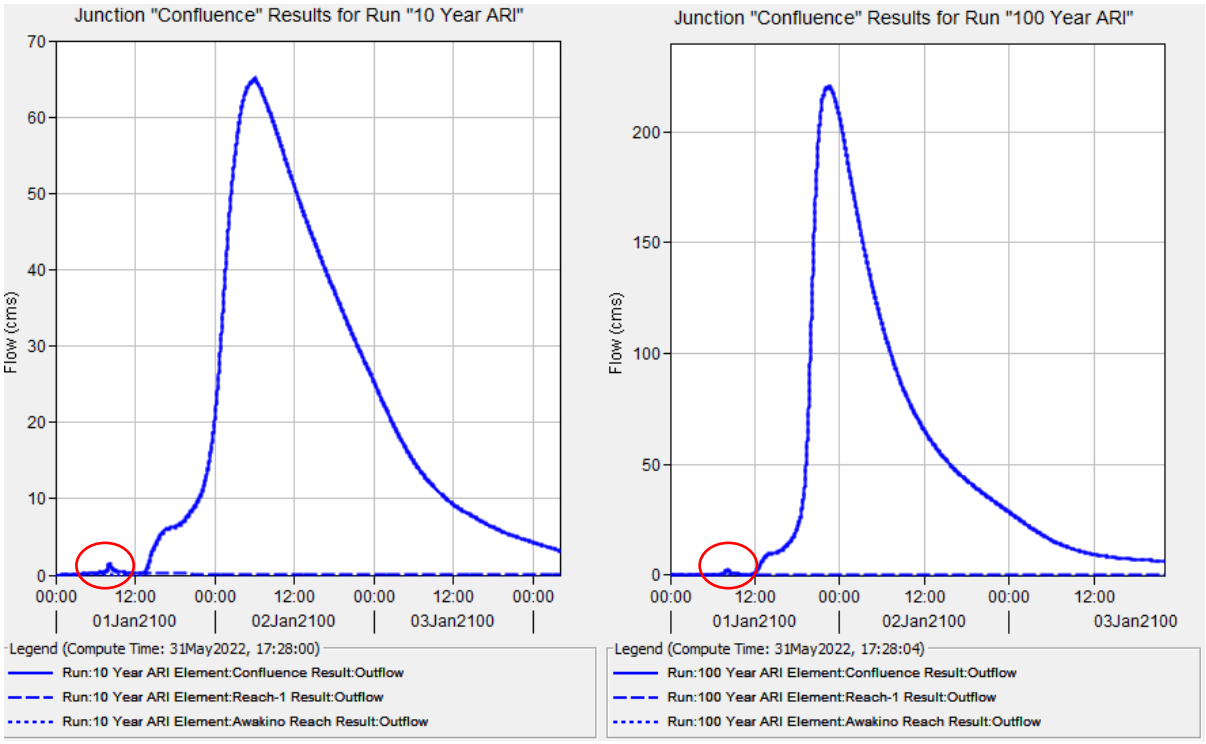

Figure 6-2: 10 and 100 Year ARI Flow Hydrographs for the Awakino River and the development site (circled in red) for the 24 hour rainfall duration event.

6.3 Stormwater Quality

To comply with the NPS-FM and the NRC PRP 2022 Appeals Version, stormwater quality treatment is required. From a residential suburban/urban setting, the main source of contaminants are heavy metals and hydrocarbons from vehicle traffic and heavy metals from building materials. There are also concerns of 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 proposed 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 bioretention device and permeable paving can be also used for infiltration and if designed 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 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.

6.4 Stormwater Management Devices

To achieve the above objectives, 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 6-3.

6.5 Stormwater Conveyance

A public stormwater network is required within the development site to collect and dispose of stormwater to their respective natural drainage points. The public network is to be sized for the 5 Year ARI rainfall event for the Maximum Probable Development within the upstream catchment and for any future catchment areas that can discharge into the network.

All runoff above the 5 Year ARI rainfall event 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, to be designed to convey the 100 Year ARI rainfall event.

6.6 Wetland Setbacks

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

6.7 Flooding and Coastal Hazards

Flooding and coastal hazards are expected at the base of the gullies of any streams and along the Awakino River. As there are 10m setback requirements from the NES-F from any wetland, then any proposed buildings will be situated away from these streams. As the development site is at the head of the catchments for these local streams, it is not expected that the flooding hazard will be wider than the 10m setback requirement. Furthermore, the majority of the site sits on land that is above RL 20m and so it is not expected that coastal hazard will affect any future residential sites. We recommend that all buildings are to be located outside the flooding and coastal hazard zones.

	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 6-3: Auckland Council's GD01 list of stormwater management devices and their effectiveness for different mitigation requirements. In the above table, the 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change is to replace the 90th and 95th percentile detention column.

7 Awakino Precinct Stormwater Management Objectives

From the planning and guidance documents available at the time of this report, any future development regardless of zoning will require a WSD approach for stormwater wherever practical with national regulations placing emphasis on water quality while the regional and local regulations placing importance on water quality and also downstream erosion effects and flooding from the increase in stormwater volume and flowrates.

The list below summaries the stormwater objectives required for any development within the PPC Area. This list is summarised from the stormwater requirements provided primarily by the relevant planning documents seen in Section 5. 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.

7.1 Stormwater Quality

- Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from all contaminant generating impermeable surfaces by a water quality device for the relevant contaminants.
- 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.

7.2 Stormwater Retention

- Stormwater retention is to be provided for the first 5mm of rainfall for all impermeable surfaces with the retention volume to be re-used or infiltrated within a 72-hour period.
- Re-use / rainwater harvesting is the preferred method to achieve retention for roof areas with rainwater to be reused within the dwelling for at a minimum non-potable re-use functions.
- 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.

7.3 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.
- Pre-development scenario to be considered as 100% grass cover.
- Stormwater detention for the 10 and 100 Year ARI for flood management is not required.

7.4 Stormwater Conveyance

- Runoff up to the 5 Year ARI rainfall event to be collected and piped into a proposed public stormwater network and discharge into their respective natural drainage points.
- Fish passage to be provided for any infrastructure constructed across streams where an upstream habitat exists.
- Roadways to be designed as secondary flow networks where practical and are to accommodate up to the 100 Year ARI rainfall event.
- Ensure identified overland flow paths remain unobstructed and can safely convey runoff.

7.5 Stormwater Discharge

- To accommodate the NES-F, stormwater catchments (as identified in Figure 3-1) that discharge into natural wetlands are to ensure that the post-development scenario also discharge/runoff into the same natural drainage point to prevent drying up of the downstream environment.

7.6 Setbacks

- To accommodate the NES-F a 10m setback is proposed from all natural wetland edges.
- Buildings and infrastructure to be located outside the 100 Year ARI flood and coastal hazards.

7.7 Impermeable Surfaces

- If the impervious permitted threshold of 60% for the residential zoned sites is exceeded in the final layout of the individual site, then an assessment of Rule 13.10.12 of the KDC District Plan is required.

8 Assessment of SW Management Devices

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 8-1 with a comment on their suitability within the development site based on available site-specific information at the time of this document.

Table 8-1: Assessment of stormwater management devices for different stormwater mitigation targets.

Mitigation Target	SW Management Devices	Discussion
Water Quality	Swales	- Topography on-site is predominantly flat which increases hydraulic residence time. - Due to distance required, can only be used within the public roadways - Private properties will need to discharge either into the roadside swale (swale needs to account for private property runoff) or a public network (two stormwater systems located along same location). - 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.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes greater than 25%. - Topography on-site is predominantly gentle which promotes sheetflow into the device and reduces scour and erosion along the surface. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required.
	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.
	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).
	Inert Building Materials	- Avoid copper and zinc building materials, and unpainted galvanized roofing and gutters. - Utilise inert material for building exterior. - Required unless there is a downstream water quality treatment device that treats contaminant leachate from roof runoff.
	Pervious / Permeable Paving	- Topography on-site is predominantly gentle which promotes runoff to flow into the device rather than sheetflow off the device. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas.

		- 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.
	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%. - Topography on-site is predominantly gentle which promotes sheetflow into the device and reduces scour and erosion along the surface. - Only provides retention if unlined, via infiltration, provided a site-specific soakage assessment confirms that soakage is viable. - Can provide water quality treatment and detention.
	Pervious / Permeable Paving	- Topography on-site is predominantly gentle which promotes runoff to flow into the device rather than sheetflow off the device. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas. - Provides some water quality treatment. - Only provides retention if unlined, via infiltration, provided a site-specific soakage assessment confirms that soakage is viable.
	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.
Detention	Rainwater 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.
	Pervious / Permeable Paving	- Topography on-site is predominantly gentle which promotes runoff to flow into the device rather than sheetflow off the device. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas. - Provides some water quality treatment. - Only provides retention if unlined via infiltration. - 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.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes greater than 25%.

		- Topography on-site is predominantly gentle which promotes sheetflow into the device and reduces scour and erosion along the surface. - Only suitable for detaining small rainfall events (such as up to the 1/3 of the 2 Year ARI rainfall event) Larger rainfall events will require a separate detention device. - Can provide water quality treatment and retention if unlined.
	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 larger surface area.
	Wetland	- A downstream wetland will be able to provide water quality treatment for upstream catchment. - Does not normally provide retention unless specifically designed. - Device can provide cultural values, public amenity and ecological values. - Requires a large surface area.

The three primary runoff sources from the development site are the residential buildings, private on-grade impervious areas (e.g. driveways and patios) and public roads. Table 8-2 below shows the available stormwater treatment device that is appropriate for each of the stormwater mitigation requirements per stormwater runoff source.

Table 8-2: SW mitigation devices for each potential runoff source.

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

9 Assessment of Stormwater Management Options

The following section will discuss the possible stormwater management options that could be implemented within the development site. All Stormwater Management Plan options listed in the following sections are based on the following assumptions:

- Inert building materials are to be used on all lots.

- Appropriately sized gross pollutants traps (e.g. catchpits and silt traps) throughout the catchment.

If a site-specific geotechnical assessment determines that retention via soakage is not feasible or that a suitably qualified geotechnical engineer does not give approval for infiltration, then it is proposed to replace the retention volume with detention volume.

9.1 Option A

This option presents a Stormwater Management Plan that composed of primarily at-source stormwater devices with infiltration capabilities. This option assumes that there are no limitations throughout the entire development extent from a geotechnical perspective and that soakage is possible. This option will have the most number of stormwater devices required throughout the development site. The stormwater management option will outline the following:

<u>Water Quality</u>

Buildings:	- Inert building materials
Driveways and other areas:	- Permeable paving - Bioretention device
Public Roads:	- Bioretention device

<u>Retention</u>

Building Areas:	- Rainwater tank - Infiltration device
Driveways and other areas:	- Permeable paving - Bioretention device - Infiltration device
Public Roads:	- Bioretention device - Infiltration device

<u>Detention</u>

Building Areas:	- Stormwater retention tanks
Driveways and other areas:	- Permeable paving - Bioretention device - Detention tank
Public Roads:	- Bioretention device

9.2 Option B

This option presents a Stormwater Management Plan that composed of primarily end-source stormwater devices without infiltration capabilities. This option assumes that there may be limitations throughout the development extent from a geotechnical perspective and/or that soakage is not possible. As infiltration is assumed to be not possible then detention is to be provided in lieu of retention for on-grade impervious areas as the runoff from these areas contain contaminants and sediments that are not suitable for water reuse activities. This option also takes into account the public water supply network concerns in the area and that rainwater tanks could be proposed within each of the residential properties. This option will have the fewest number of stormwater devices required throughout the development site. The stormwater management option will outline the following:

Water Quality

Buildings:	- Inert building materials
Driveways and other areas:	- Wetland
Public Roads:	- Wetland

Retention

Building Areas:	- Rainwater tank
Driveways and other areas:	- Wet pond (retention to be replaced with detention) - Wetland (retention to be replaced with detention)
Public Roads:	- Wet pond (retention to be replaced with detention) - Wetland (retention to be replaced with detention)

Detention

Building Areas:	- Wet pond - Wetland
Driveways and other areas:	- Wet pond - Wetland
Public Roads:	- Wet pond - Wetland

9.3 Option C

This option presents a mix of at-source and end-source stormwater mitigation devices that tries to minimise the size of the end-source stormwater devices and to reduce the number of stormwater devices required to be vested to Council. The stormwater management option will outline the following:

Water Quality

Buildings:	- Inert building materials
Driveways and other areas:	- Permeable paving - Bioretention device
Public Roads:	- Wetland

Retention

Building Areas:	- Rainwater tank
Driveways and other areas:	- Permeable paving - Bioretention device - Infiltration device
Public Roads:	- Wet pond (retention to be replaced with detention) - Wetland (retention to be replaced with detention) - Conventional hard engineered storage (retention to be replaced with detention)

Detention

Building Areas:	- Detention Tank
Driveways and other areas:	- Permeable paving - Detention Tank - Bioretention device
Public Roads:	- Wet pond - Wetland

10 Stormwater Management Plan

The dominant characteristic on-site is the predominantly gentle sloping terrain and that there is no single direction that stormwater flow and channelise into. As such, the development site allows for all types of devices to be installed and so there is no clear distinction on the final Stormwater Management Plan approach.

As there are no distinct known limitations that restrict the development to a certain stormwater management approach, we believe that the deciding factor may come down to the life cycle cost of the stormwater devices. As such we proposed Option C to be the preferred as this minimises the number of devices that is required to be vested to Council by providing at-source devices within the residential properties.

However, we conclude that as there are no subdivision plans produced at the time of this report, it is stressed that the final stormwater management design can be altered provided that it achieves the stormwater objectives outlined in Section 7 of this report.

We note that at the time of consent a Best Practical Option (BPO) might be determined where a departure is considered required from the full compliance options outlined above. The adoption of a BPO is not precluded but it is not a departure that seems necessary given the site parameters and the Toolbox available for the designers. A fully compliant design is anticipated as being achievable.

Below sets out an indicative schematic on how the development site can be mitigated as per the stormwater objective is in Section 7 using Option C. The below design is indicative only and is intended to provide a guideline or a reference for any developer looking to construct within the development site after the rezoning.

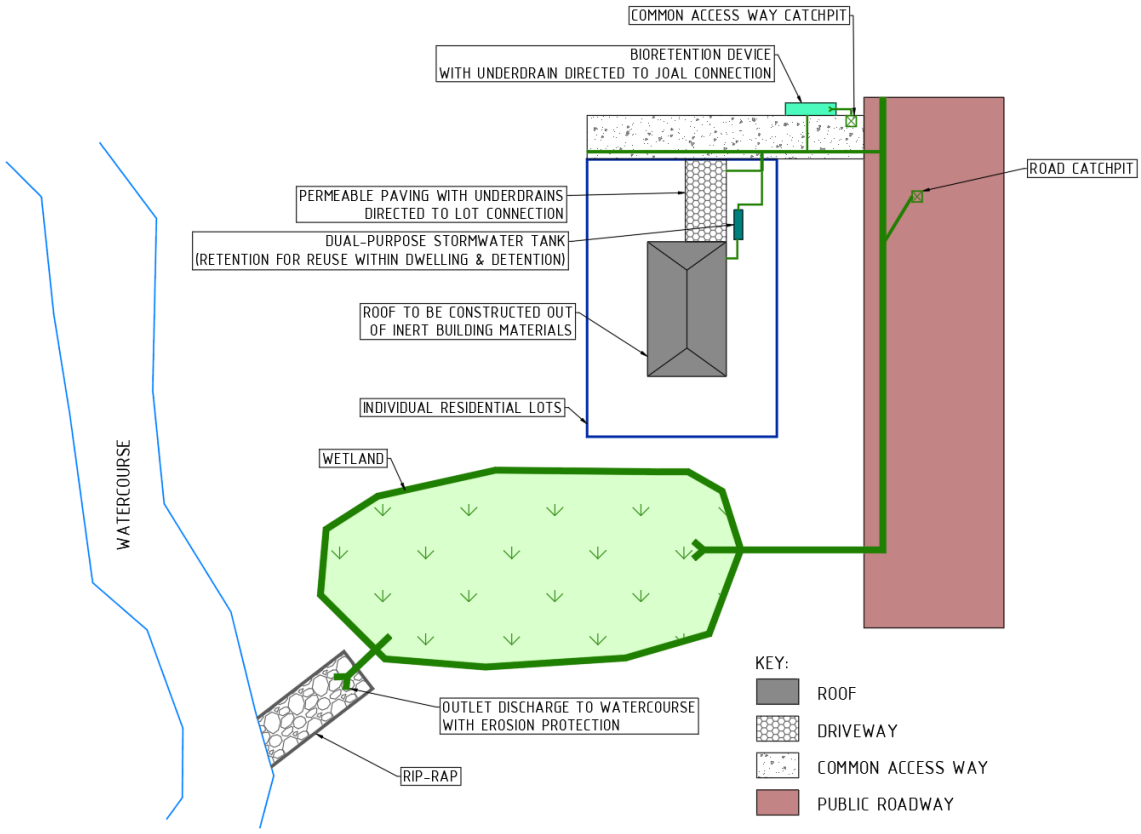

Figure 10-1: Schematic diagram of the proposed Stormwater Management Plan based on Option C.

11 Funding Timing and Responsibility

11.1.1 Funding

The landowners and developers of the land area within the PPC Area will fully meet the construction costs of the new stormwater infrastructure to service the area.

Where a network or a device provides benefit to more than one developer or landowner a cost share agreement may be created for the benefit of those parties. The formation and management of any such agreements is between the private parties and does not require management or intervention by KDC.

Where the infrastructure required provides a benefit greater than that required to enable the development a cost share arrangement may be formalised through a developer agreement or infrastructure funding agreement. No formal commitment has been made and any such application is subject to specific approval by KDC.

11.1.2 Timing

Infrastructure can be built as required to service the area being developed.

11.1.3 Responsibility

The landowners and or developers are responsible for the following:

1. Fully fund all infrastructure works unless a developer agreement or infrastructure funding agreement is agreed;
2. Obtain all the necessary consents to construct the infrastructure;
3. Comply as much as practical with the Kaipara District Council Engineering Standards 2011 with any departures reviewed and approved through the engineering approval process;
4. Vest the infrastructure to Kaipara District Council on completion.

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.

To achieve this a list of stormwater objectives has been outlined Section 7 of this report that any future development will be required to achieve. In our opinion the PPC Area doesn't present any limitations to the full implementation of WSD principles.

We have recommended an approach (Option C) in the PPC Area which consists of at-source stormwater devices within the residential properties and end-source devices to serve the public roadways. However, it is stressed that as no subdivision plans have been provided at the time of this report, we acknowledge that the final stormwater management design can be altered to fit in with the final layout scheme once it is known provided that it achieves the stormwater objectives outlined in Section 7 of this report.

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 Blue Moon 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 2022 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		