Birch
Planning
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Engineering
LAND DEVELOPMENT CONSULTANTS

STORMWATER MANAGEMENT REPORT

To:

AUCKLAND COUNCIL

On behalf of:

SR AND DS SMITH

70, 70A & 70B Lisle Farm Drive, Pukekohe

DECEMBER 2024

BSL REF: 4553

REVISION D

Stormwater Management Plan – Lisle Farm Plan Change				
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EXECUTIVE SUMMARY

The purpose of this Stormwater Management Plan ('SMP') is to support Smith Lisle Farm Drive Plan Change (PPC) and outline the approach for the management of stormwater when developing the plan change area. This Stormwater Plan shows has been developed to achieve consistency with the objectives and policies of the Auckland Unitary Plan as well as Auckland Council's Guideline Documents and industry best practice options.

This Stormwater Management Plan assesses existing information about the subject plan change site, it demonstrates that the proposed stormwater management is the best practicable option, taking into consideration the existing site features and level of proposed development, ensuring compliance with the Regionwide Network Discharge Consent (NDC), Auckland Council Stormwater Code of Practice ('SWCoP') and the provisions outlined in the following sections:

- Section E1 - Water quality and integrated management,
- Section E8 - Stormwater discharge and diversion
- Section E9 - High contaminant generating carparks and high use roads
- Section E10 - Stormwater management area – Flow 1 and Flow 2
- Section E36 - Natural hazards and flooding
- GD01 - Stormwater Management Devices in the Auckland Region

The PPC proposes a SMAF-1 overlay for the site, and this will invoke the provisions of E10 for future site development. The SMP proposes the use of the existing natural receiving environments to accept the treated and attenuated post development flows, maintaining its current function.

To guide the Stormwater Management Plan (SMP), the following overarching principles have been established:

- Recognise the key constraints and opportunities on site and in the receiving catchments being the Oira Creek and Whangapouri Creek catchments
- Prioritize a water-sensitive design approach that addresses the impact of transitioning from the current rural use to the proposed urban land use. The focus is on safeguarding and enhancing stream systems, preserving natural hydrology, mitigating hydrological alterations, and managing potential flooding effects.
- Implement an integrated stormwater management approach to support urban development effectively.
- Develop a set of Best Practicable Options (BPO) for stormwater management that can be incorporated into the development
- Minimise the generation and discharge of contaminants/sediments into the receiving environment
- Protect key infrastructure, people and the environment from significant flood events.

To achieve these outcomes, the proposed stormwater management approach is to: ·

To achieve the stormwater management approach set out above, a treatment train strategy is adopted for the PCA. A toolbox of BPO (refer to Table 1.1) has been prepared to assist in the selection of appropriate stormwater management devices and approaches to achieve water quality, hydrological mitigation, and water-sensitive design outcomes for corresponding land-use. The designs and approaches are associated with stormwater management in accordance with the regulatory and requirements from AUP Chapter E1.3, B7 and B8.

To achieve the most effective stormwater management outcome, the proposed approach involves the utilization of stormwater communal devices, and these devices play a crucial role in mitigating stormwater effects, as a result of the proposed urbanisation, protecting the downstream environment from adverse effects

Activity	Component	Minimum requirements	Recommended approaches	Guidelines
Residential lots – Roof Area	Water Quality	Not applicable	- Use inert roofing materials	GD01
	Hydrological mitigation only	SMAF-1 treatment: - Retention of at least 5mm of runoff depth from impervious surfaces - Detention with a drain down period of 24-hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24-hour rainfall event less any achieved retention volume.	- Above/underground rainwater re-use and detention tanks	GD01
	Water Quantity/Attenuation	Hydrological treatment: - Attenuation for 10% AEP rainfall event (post-catchments A, B, C & D) - Overflow for rainfall events greater than 10% AEP, to be attenuated by the communal stormwater device (post-catchment B) Attenuation for the rainfall events greater than 10% AEP is not required (post-catchment A, C, D, E, F and G)	Above/underground rainwater re-use and detention tanks	GD01
Residential lots – Hardstand	Water Quality	Stormwater management of runoff from all impervious surfaces before discharging into the receiving environment. Minimise the generation of contaminants as much as possible. Runoff from proprietary permeable pavement in small area with limited traffic movement does not need water quality treatment. (post-catchment A, C, D, E, F and G), but water quality treatment is required if the impervious material is utilised for the driveway. Runoff from the hardstand area from post-catchment B to be treated by communal stormwater device.	- Pre-treatment Device – Litta Trap - Communal Bioretention Device (post-catchment B) - Permeable pavement optional (post-catchment A, C, D, E, F and G) - Proprietary water quality device is required for impervious pavement (post-catchment A, C, D, E, F and G), such as proprietary Filterra, grassed swale or other approved measures in accordance with GD01	GD01

	Hydrological mitigation	Same to "Residential Lots - Roof Area" but not applicable for re-use	- Underground rainwater detention tanks	GD01
Public roads, carparks,	Water Quality	Quality treatment of post-runoff from all impervious surfaces before discharging into the receiving environment. Minimise the generation of contaminants as much as possible. Where contaminants are generated, the preferred approach is to use green infrastructure to treat runoff at-source or as close to the source as practicable.	- Pre-treatment Devices – Deep sump Cesspit - Detention Tanks - Communal Bioretention Device (post-catchment D road reserve only) - Communal Bioretention Device (post-catchment B), open top stormwater pond	GD01 GD04 Auckland Council Unitary Plan Stormwater Management Provisions TR2013/35
	Hydrological mitigation	SMAF-1 Treatment: - Retention of at least 5mm of runoff depth from impervious surfaces - Detention with a drain down period of 24-hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24-hour rainfall event minus the achieved retention volume.		
	Water Quantity/Attenuation	Hydrological treatment: - Attenuation for 1% and 10% AEP rainfall event by communal stormwater attenuation		
Open Spaces (stormwater reserve)	Stream hydrology and erosion protection	Enhance water quality, flows, stream channels and their margins and other freshwater values for the existing vegetation/bush area and the existing wetland	Riparian margin enhancement and planting, where necessary to mitigate identified adverse effects. Refer to the Ecological Assessment Report	

1 EXISTING SITE DESCRIPTION INTRODUCTION

1.1 OVERVIEW AND LOCATION

While the PPC site is located at 70A & 70B Lisle Farm Drive, Pukekohe. This SMP covers all the land contained at 70, 70a & 70B Lisle Farm Drive, incorporating a small portion of existing residential that is integral with and to be developed in conjunction with the PPC. The site is located on the eastern side of Lisle Farm Drive and the current owner accesses the site from Lisle Farm Drive.

This report indicates the preliminary design approach for the management of stormwater resulting from the development. The report addresses treatment and flow management to ensure compliance with policies and standards in accordance with Auckland Unitary Plan and Stormwater Guidelines. The SMP (except #70 Lisle Farm Drive) is located within the Future Urban Zone of the Auckland Unitary Plan Operative in Part (AUP-OP), identified in yellow within Figure 1. An assessment of effects related to stormwater management and receiving environment effects is provided as a solution-based approach.

Table 1 Private Plan Change Legal Description Details

LEGAL DESCRIPTION	
The legal description of the land parcel is as follows:	
Appellation:	Lot 1 DP 143272 & Lot 2 DP 143272 and Lot 1 DP 169148
Title Reference:	NA84D/710 & NA84D/711 and NA103A/604
Parcel Area:	19.185Ha (more or less)
AUP(OP) Zoning:	Future Urban (Residential) Zone (70A & 70B Lisle Farm Drive) Residential – Mixed Housing Suburban (70 Lisle Farm Drive)

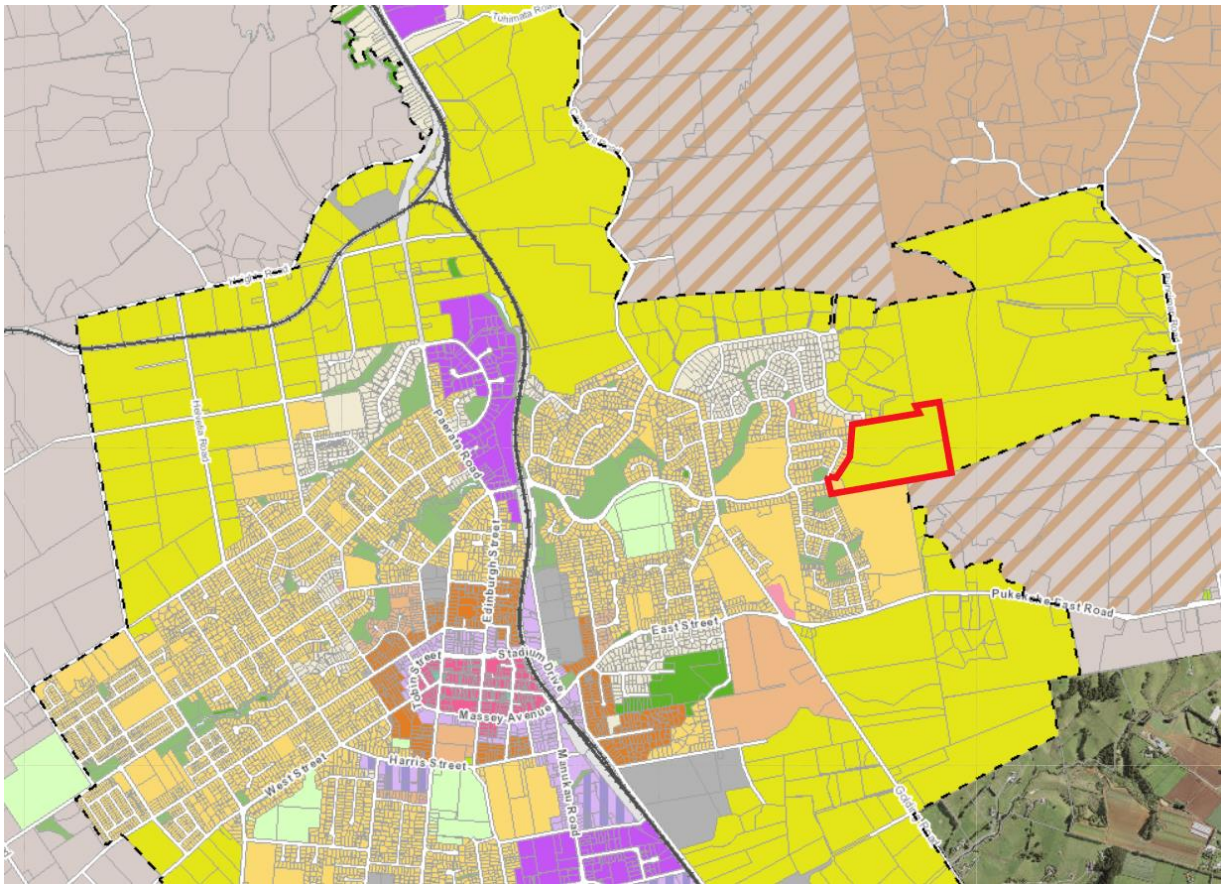


Figure 1 Private Plan Change site location and current zoning

1.2 TOPOGRAPHY AND GEOLOGY

The PPC Area generally sloping to the east and south, the broad main dividing ridgeline runs through the site from west to east, refer to Figure 2. This is generally comprised of relatively flat land and is geotechnically competent. The ridge is flanked by various incised gullies to the north east and south, with natural ecological features present (wetland/stream) at the base of the gullies.

A Geotechnical Report has been prepared by Land Development & Engineering ('LDE') in May 2022, (refer to Appendix B of Infrastructure Report prepared by Birch), indicates the site as being within the area encompassing the South Auckland Volcanic Field, with the site having a thick soil mantle over ash, lapilli and lithic tuff, with basalt lava flows in the north-east portion. Groundwater was not encountered within any of the investigation boreholes undertaken to a depth of at least 3.0m.

The geotechnical report identifies that the site is in three portions:

The north-eastern portion of the site, located east of the ridgeline and comprises elevated steep slopes generally greater that 1(v) in 4(h), with evidence of larger scale land movement (deeper seated) east of the ridgeline and gully flanks.

The southern portion of the site comprises elevated steep slopes (steeper than 1(v) in 4(h), south of the ridgeline, with large scale land movement near the ridgeline and gully flanks, becoming steeper towards the base of the gully.

The central portion of the site comprises elevated steep slopes (approximately 1(v) in 3(v), with large scale land movement near the ridgeline and gully flanks.

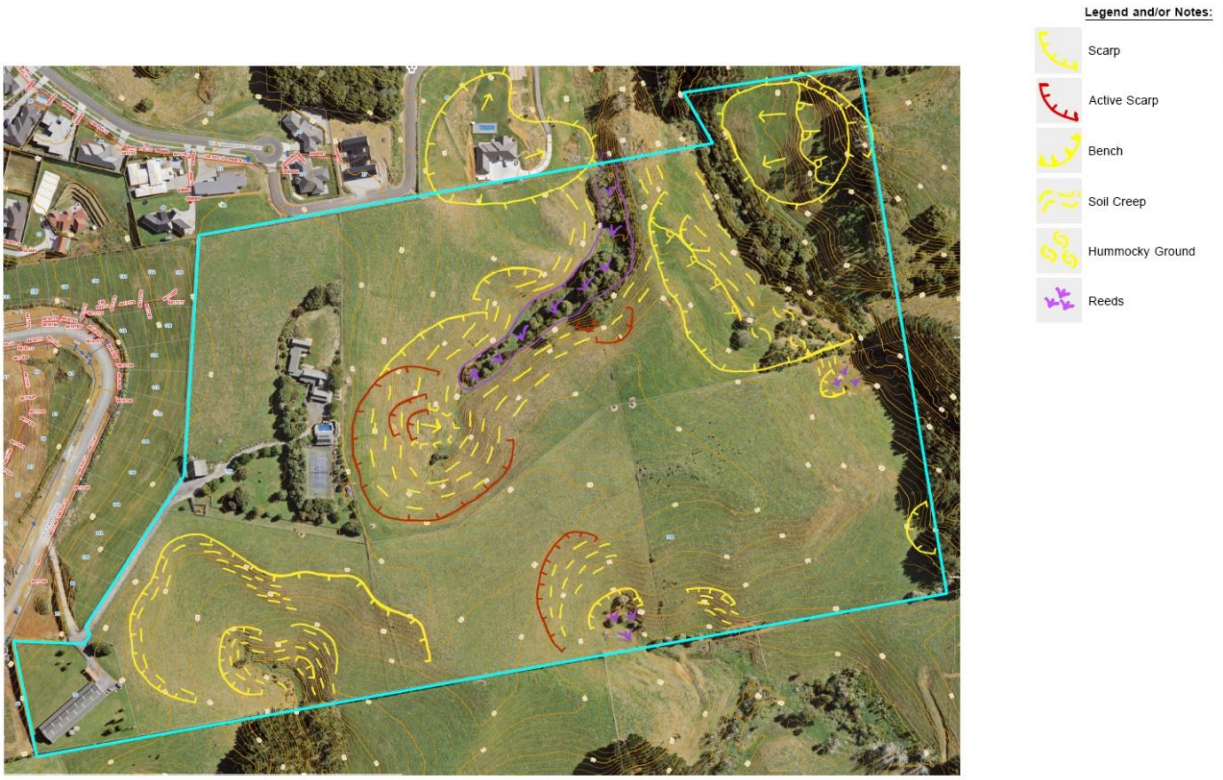


Figure 2 Plan Change Area Topographical Features

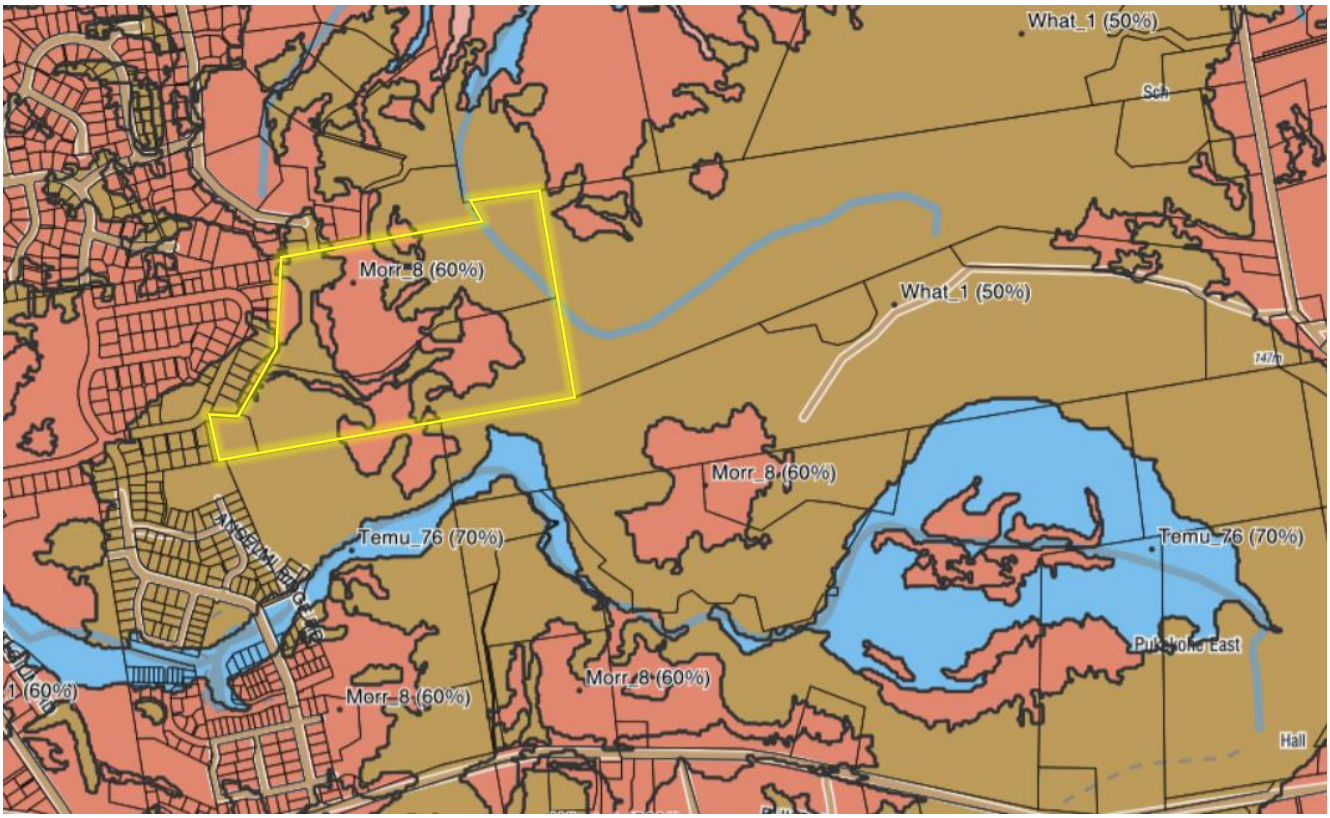


Figure 3 Soil-map Hydrological Group

Soil Map New Zealand data indicate the natural soil within the PPC as having SCS classifications as Group B for the elevated ridge areas (Morrinsville*f* shaded red above) and Class C for the gullies and lower elevations by streams and wetlands (WhatitiriCL*f* shaded brown above).

1.3 Existing Drainage Features and Stormwater Infrastructure

The site is bisected by an unnamed tributary of the Oira Creek to the east, and contains the heads of three gullies, two draining south and one draining north and contain wetlands and streams on the gully floors.

The Ecological Assessment prepared by Wildland Consultants Ltd expands on the ecological features and a copy is attached as **Appendix C.**

There are no existing public stormwater networks within the site nor within the immediate vicinity.

1.4 STORMWATER CATCHMENT

The site straddles two different stormwater catchments, the Oira Creek catchment and Whangapouri Creek catchment, refer to Figure 4 below.

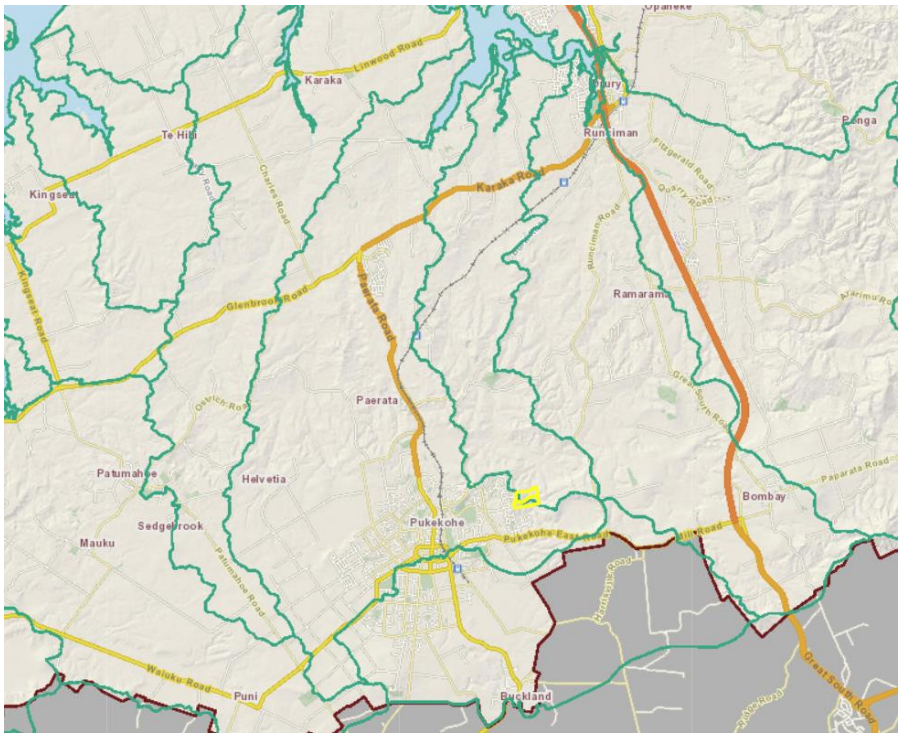


Figure 4 Oira Creek and Whangapouri Catchment

The northern and eastern portion of the PCA drains north, into the Oira Creek catchment via an unnamed tributary of the Oira Stream. This flows into the Oira Creek and discharges to Manukau Harbour (Papakura Channel) at Bremner Esplanade Reserve. The southern and western portion of the PCA drains south to the Whangapouri catchment, flowing through Pukekohe and into the Whangapouri Stream at Cape Hill Road. The Whangapouri continues north, past Paerata and empties into the Manukau Harbour (Papakura Channel) at Blackbridge Road Esplanade Reserve.

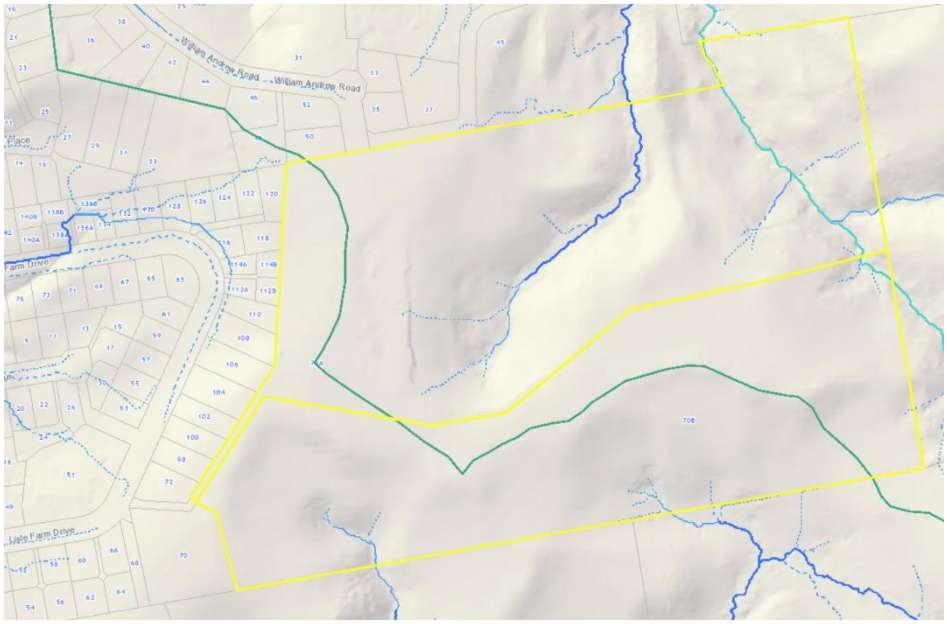


Figure 5 Catchment Breaklines for PCA

The earthworks have been modelled to ensure a cut fill earthwork balance within PCA is achieved and that the total volume of earthworks is minimised as much as practicable. The layout is designed to provide optimal connectivity to the existing and future road network and other infrastructure that the proposed development will connect to. Any minor changes in stormwater catchment areas as a result of the proposed earthworks has been taken into account with the flood modelling.

The contributing catchment is predominately grass and is used for grazing livestock.

1.5 Existing Flooding and Overland Flow Paths

As shown on Auckland Council Geomaps, there are four overland flow paths ('OLFP') exiting in the PCA to the north and south, refer to Figure 6 below. The 1% AEP flood plains associated with these OLFPs are also displayed.

OLFP 1 starts in the middle of the subject site, flows towards the north through the existing wetland and exists the property. This merges with OLFP 2 within the property to the north. OLFP enters the site from the eastern boundary and exits the site on the northern boundary. The identified OLFP 1 & 2 on Figure 6 is derived from Auckland Council Geomaps Rapid Flood Hazard Assessment prepared by Stantec Ltd, produced in 2021, the name of the report is Oira Creek and Ngakoroa Creek RFHA Model Build Report. OLFP 3 & 4 also start within the subject site, and both flow towards the south through two existing gullies at the southern boundary, then merge with an existing unnamed tributary of Whangapouri Creek. The data of the identified OLFP 3&4 is derived from Auckland Council Geomaps Flood Hazard Assessment prepared by WSP Opus Ltd, produced on 2021, and the name of the report is Whangapouri Creek Catchment – Model Building and System Performance Report 2019.

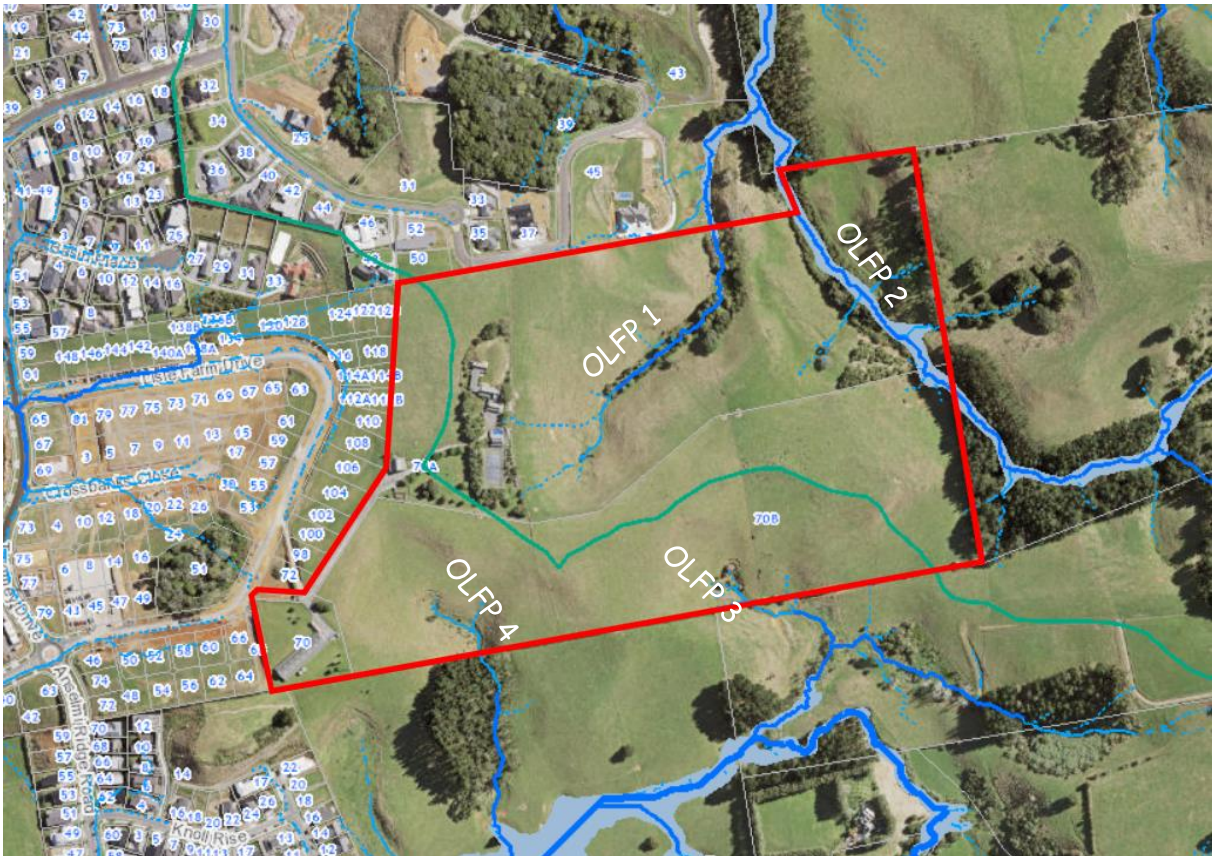


Figure 6 Existing Overland Flow Paths and Floodplain (derived from Auckland Council Geomap in August 2023)

1.6 Coastal Inundation

Based on the AUP management layers on Auckland Council GeoMaps, Coastal inundation is not identified as a risk to the proposed development.

1.7 CULTURAL AND HERITAGE SITES

Based on the information provided on the AUP management layers in Auckland Council Geomaps, there are no known natural heritage, historic heritage, or places of significance to Mana Whenua within the proposed development.

1.8 CONTAMINATED LAND

The history of the site was stablished through a review of historical aerial photographs which were obtained from Retrolens website and Auckland Council Geomaps and the site walkover. The historical aerial photographs cover the date from 1942 to 2017, details refer to the table below:

Table 2 Historical Aerial Photos for PPC

Date	Source	Description
1942	Retrolens	 The image shows the subject PCA is predominantly pastureland with no evidence of aboveground structures, no cropland can be observed.
1963	Retrolens	 The image shows the subject PCA is predominantly pastureland with no evidence of aboveground structures, no cropland can be observed, similar to the aerial photo taken on 1942.

1981	Retrolens		The features which the image shows about the subject PCA is similar to the previous historical aerial photography with the pastureland across.
2001	Geomaps		The image shows the subject PCA generally comprises predominately pasture with multiple structures (dwellings and shed), surrounded by grassed properties. The access to the site is from Valley Road through a farm track.
2017	Geomaps		The image shows that PCA generally comprises predominately pasture with multiple structures (dwellings and shed). The surrounding area (western side) is either under the construction for development or has already been developed as residential properties.

- If there is any contaminated soil discovered during a more detailed assessment or during earthworks, the applicant will undertake any identified remediation works and to dispose of all contaminated material to an appropriate off-site facility authorised to receive such material.
- Erosion and Sediment Controls are to be established for the duration of the works to prevent any discharges from the site during site works. All erosion and sediment controls shall comply with Auckland Council's Guideline Document 2016/005 Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05).

2 DEVELOPMENT SUMMARY AND PLANNING CONTEXT

A review of relevant stormwater guidelines and regulatory requirements were carried out to determine the appropriate stormwater approaches, flooding mitigation or other requirements to adopt in the Stormwater Management Plan to support this plan change application. The details and requirement are listed in the table below:

Table 3 Relative Planning Context and Guidelines

Requirements	Relevant guidelines/regulatory to follow
Significant Ecological Areas	AUP Chapter D9
Water Quality and Integrated Management	AUP Chapter E1
Stormwater Management Devices	GD01
Water Sensitive Design	GD04
Discharge and Diversion	AUP Chapter E8
High Contaminant Generating Areas	AUP Chapter E9
Hydrological Mitigation	AUP Chapter E10
Natural Hazards and Flooding	AUP Chapter E36
Auckland Council Regionwide Network Discharge Consent	NDC Schedule 4
Existing Catchment Management Plan	• Oira Creek and Ngakoroa Creek RFHA Model Build Report - (Stantec Ltd) • Whangapouri Creek Catchment – Model Building and System Performance Report 2019 – (WSP Opus Ltd)

2.1 SIGNIFICANT ECOLOGICAL AREAS

AUP Chapter D9 indicates the regulatory and policies regarding the management of stormwater runoff to receiving environments within a Significant Ecological Area (SEA) overlay. The relevant stormwater policy is summarised below:

Adverse effects on indigenous biodiversity values in significant ecological areas that are required to be avoided, remedied, mitigated or offset may include, but are not limited to, downstream effects on wetlands, rivers, streams, and lakes from hydrological changes further up the catchment in accordance with AUP D9.3.2.

Wildland Consultants has undertaken a site visit on 17th November 2021 to assess the ecological area and the existing natural hydrological features within the subject plan change area, the location of the identified hydrological features are shown on Figure 7, and the detailed ecological features refer to the Ecological Assessment, refer to Appendix C.

Figure 7 Vegetation and habitat types location within plan change area

2.2 WATER QUALITY AND INTEGRATED MANAGEMENT

AUP Chapter E1 contains the following relevant stormwater management regulatory and policies:

Table 4 Auckland Unitary Plan Chapter E1 Summary Table

AUP Chapter E1.3 Policies	comments
(E1.3.1) Manage discharges, until such time as objectives and limits are established in accordance with Policy E1.3(7), having regard to: a) the National Policy Statement for Freshwater Management National Bottom Lines; b) the Macroinvertebrate Community Index as a guideline for freshwater ecosystem health associated with different land uses within catchments in accordance with Policy E1.3(2); or c) other indicators of water quality and ecosystem health.	Subject to the recommendations provided in the ecological report from Wildland Consultants Ltd
(E1.3.2) Manage discharges, subdivision, use, and development that affect freshwater systems to: a) maintain or enhance water quality, flows, stream channels and their margins and other freshwater values, where the current condition is above National Policy Statement for Freshwater Management National Bottom Lines and the relevant Macroinvertebrate Community Index guideline in Table E1.3.1 below; or b) enhance water quality, flows, stream channels and their margins and other freshwater values where the current condition is below national bottom lines or the relevant Macroinvertebrate Community Index guideline in Table E1.3.1 below.	Proposed communal pond (specific designed stormwater system) will maintain the quality control for the post-development flow from the impervious area, and the designed riparian planting area will be provided along the existing natural wetland to achieve the required fresh water system requirements, in accordance with the ecological report from Wildland Consultants Ltd and the future landscape plan at Resource Consent stage.
(E1.3.3) Require freshwater systems to be enhanced unless existing intensive land use and development has irreversibly modified them such that it practicably precludes enhancement.	Subject to the provided ecological report from Wildland Consultants Ltd
(E1.3.4) When considering any application for a discharge, the Council must have regard to the following matters: a) the extent to which the discharge would avoid contamination that will have an adverse effect on the life-supporting capacity of freshwater including on any ecosystem associated with freshwater; and b) b) the extent to which it is feasible and dependable that any more than a minor adverse effect on freshwater, and on any ecosystem associated with freshwater, resulting from the discharge would be avoided.	Best Practice Option ('BPO') and the most practical treatment/design to be utilised to ensure the controlled flows will be discharged to the fresh water systems, with the support of the recommendations provided in the ecological report from Wildland Consultants Ltd
(E1.3.5) When considering any application for a discharge the Council must have regard to the following matters: a) the extent to which the discharge would avoid contamination that will have an adverse effect on the health of people and communities as affected by their secondary contact with fresh water; and b) the extent to which it is feasible and dependable that any more than minor adverse effect on the health of people and communities as affected by their secondary	Same to E1.3.4 comment above
(E1.3.6) Policies E1.3(4) and (5) apply to the following discharges (including a diffuse discharge by any person or animal): a) new discharge; or b) a change or increase in any discharge of any contaminant into freshwater, or onto or into land in	Same to E1.3.4 comment above

circumstances that may result in that contaminant (or, as a result of any natural process from the discharge of that contaminant, any other contaminant) entering freshwater	
(E1.3.7) Develop Freshwater Management Unit specific objectives and limits for freshwater with Mana Whenua, through community engagement, scientific research and mātauranga Māori, to replace the Macroinvertebrate Community Index interim guideline and to give full effect to the National Policy Statement for Freshwater Management.	No response from Mana Whenua
(E1.3.8) Avoid as far as practicable, or otherwise minimise or mitigate, adverse effects of stormwater runoff from greenfield development on freshwater systems, freshwater and coastal water by: a) taking an integrated stormwater management approach (refer to Policy E1.3.10); b) minimising the generation and discharge of contaminants, particularly from high contaminant generating car parks and high use roads and into sensitive receiving environments; c) minimising or mitigating changes in hydrology, including loss of infiltration, to: d) where practicable, minimising or mitigating the effects on freshwater systems arising from changes in water temperature caused by stormwater discharges; and e) providing for the management of gross stormwater pollutants, such as litter, in areas where the generation of these may be an issue.	BPO and the most practical treatment/design to be utilise to reduce the adverse effect: • 5mm Retention Volume • SAMF 1 equivalent design • Water quality approaches • Controlled discharge recommendation in accordance with the provided in the ecological report from Wildland Consultants Ltd
(E1.3.9) Minimise or mitigate new adverse effects of stormwater runoff, and where practicable progressively reduce existing adverse effects of stormwater runoff, on freshwater systems, freshwater and coastal waters during intensification and redevelopment of existing urban areas by all of the following: a) requiring measures to reduce contaminants, particularly from high contaminant-generating car parks and high-use roads; b) requiring measures to reduce the discharge of gross stormwater pollutants; c) requiring measures to be adopted to reduce the peak flow rate and the volume of stormwater flows: d) taking an integrated stormwater management approach for large-scale and comprehensive redevelopment and intensification (refer to Policy E1.3.10 below) and encourage the restoration of freshwater systems where practicable; and e) ensuring intensification is supported by appropriate stormwater infrastructure, including natural assets that are utilised for stormwater conveyance and overland flow paths.	Same to E1.3.8 comment above

(E1.3.10) In taking an integrated stormwater management approach have regard to all of the following: a) the nature and scale of the development and practical and cost considerations, recognising: b) the location, design, capacity, intensity and integration of sites/development and infrastructure, including roads and reserves, to protect significant site features and hydrology and minimise adverse effects on receiving environments; c) the nature and sensitivity of receiving environments to the adverse effects of development, including fragmentation and loss of connectivity of rivers and streams, hydrological effects and contaminant discharges and how these can be minimised and mitigated, including opportunities to enhance degraded environments; d) reducing stormwater flows and contaminants at source prior to the consideration of mitigation measures and the optimisation of on-site and larger communal devices where these are required; and e) the use and enhancement of natural hydrological features and green infrastructure for stormwater management where practicable.	Subject to the provided ecological report from Wildland Consultants Ltd
(E1.3.11) Avoid as far as practicable, or otherwise minimise or mitigate adverse effects of stormwater diversions and discharges, having particular regard to: a) the nature, quality, volume and peak flow of the stormwater runoff; b) the sensitivity of freshwater systems and coastal waters, including the Hauraki Gulf Marine Park; c) the potential for the diversion and discharge to create or exacerbate flood risks; d) options to manage stormwater on-site or the use of communal stormwater management measures; e) practical limitations in respect of the measures that can be applied; and f) the current state of receiving environments.	BPO and the most practical treatment/design to be utilise to reduce the adverse effect: • 5mm Retention Volume • SAMF 1 equivalent design • Water quality approaches • Controlled discharge recommendation in accordance with the provided in the ecological report from Wildland Consultants Ltd
(E1.3.12) Manage contaminants in stormwater runoff from high contaminant generating car parks and high use roads to minimise new adverse effects and progressively reduce existing adverse effects on water and sediment quality in freshwater systems, freshwater and coastal waters.	Same to E1.3.11 comment above
(E1.3.13) Require stormwater quality or flow management to be achieved on-site unless there is a downstream communal device or facility designed to cater for the site's stormwater runoff.	The individual stormwater devices and communal stormwater devices are designed to achieve the required stormwater quality or flow management
(E1.3.14) Adopt the best practicable option to minimise the adverse effects of stormwater discharges from stormwater network and infrastructure including road, and rail having regard to all of the following: a) the best practicable option criteria as set out in section 2 of the Resource Management Act 1991; b) the reasonable timeframes over which adverse effects can be avoided as far as practicable, or otherwise minimised or mitigated; c) the scale and significance of the adverse effects; d) infrastructure investment priorities and the consequences of delaying infrastructural improvements in other areas;	

e) the ability to prevent or minimise existing adverse effects having regard to the effectiveness and timeframes of other feasible methods, including land use controls; f) opportunities to integrate with other major infrastructure projects or works; g) the need to maintain and optimise existing stormwater networks and provide for planned land use and development; and h) operational requirements and space limitations.	
(E1.3.15&16) Ground Soakage	Not Applicable
(E1.3.17 – 52) Wastewater	Not Applicable, wastewater reticulation is designed to service the PCA to discharge to the existing public network
(E1.3.26) Other discharge	Not Applicable

2.3 DISCHARGE AND DIVERSION

AUP Chapter E8 sets out policies which regulate the diversion and discharge of stormwater runoff from impervious areas into or onto land, or into water, or into the coastal marine area. The requirements/regulatory for E8.6.1 are listed below:

- The design of the proposed stormwater management device(s) must be consistent with any relevant precinct plan that addresses or addressed stormwater matters.
- The diversion and discharge must not cause or increase scouring or erosion at the point of discharge or downstream.
- The diversion and discharge must not result in or increase the following:
    - flooding of other properties in rainfall events up to the 10 per cent annual exceedance probability (AEP);
    - inundation of buildings on other properties in events up to the 1 per cent annual exceedance probability (AEP).
- The diversion and discharge must not cause or increase nuisance or damage to other properties.
- The diversion and discharge of stormwater runoff must not give rise to the following in any surface water or coastal water:
    - the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
    - any conspicuous change in the colour or visual clarity;
    - any emission of objectionable odour;
    - the rendering of fresh water unsuitable for consumption by farm animals; or
    - any significant adverse effects on aquatic life.
- Where the diversion and discharge are to ground soakage, groundwater recharge or peat soil areas any existing requirements for ground soakage, including devices to manage discharges or soakage, must be complied with. [not applicable to this PCA]

2.4 HIGH CONTAMINANT GENERATING AREAS

AUP Chapter E9 outlines the regional land use rules for managing stormwater runoff quality from high contaminant generating areas (HCGAs). Subject to the PCA, the site is not currently used for HCGAs purpose, treatment of runoff is required for the proposed activities of HCGAs (as defined in the AUP E9.6) are listed below:

- High use roads
    - a motorway, state highway, regional primary arterial and or district secondary arterial road that carries more than 5,000 vehicles per day
- High contaminant generating car park
    - Exposed to rainfall and designed for more than 30 vehicles
- Building roof, spouting, and external walls cladding and architectural features using material:
    - exposed surface or surface coating of metallic zinc or any alloy containing greater than 10% zinc;
    - exposed surface or surface coating of metallic copper or any alloy containing greater than 10% copper;
    - exposed treated timber surface or any roof material with a copper-containing or zinc-containing algaecide.

According to Stormwater Management Devices in the Auckland Region Guideline Document 2017/001 (GD01), it outlines the design requirements to treat the stormwater runoffs from the HCGAs which need to comply with at the detailed designed stage.

2.5 HYDROLOGICAL MITIGATION

The main objective of AUP Chapter E10 is to protect the high value rivers, streams and aquatic biodiversity which may be affected by the stormwater runoff associated with urban development and where possible enhanced. This framework must be applied to developments within the AUP management Stormwater Management Area Control – Flow 1 and Flow 2 (SMAF) overlay.

The subject PCA is a greenfield activity, classified by NDC does not fall within the SMAF overlay according to AUP. The general approach of this SMP is to provide a minimum of the SMAF 1 framework to provide hydrological mitigation for all impervious surfaces within the PCA. The SMAF 1 hydrological mitigation requirements in the AUP are:

- Retention (volume reduction) of at least 5 mm of runoff depth from impervious surfaces where possible with limitations set out in Table E10.6.3.1.1.
- Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from a 95th percentile, 24-hour rainfall event minus the achieved retention volume, over the impervious area for which hydrology mitigation is required.

The retention volume may be taken up by detention subject to the further detailed investigation, including:

- The geotechnical stability limitation given the topographical features constraints
- Whether the soil infiltration rates are suitable for the soakage/recharge purpose
- no activities occurring on the site that can re-use the full 5 mm retention volume of water

2.6 NATURAL HAZARDS AND FLOODING

AUP Chapter 36 outlines the regulatory and policies about the management of natural hazards, such as flooding, coastal erosion, fresh water erosion and land instability. All of these hazards can affect people, property and the wider environment. Flooding is the most significant natural hazard that could affect the PCA based on the assessment in Section 2 of this report and the land instability will also need to be considered due to the topography constraints. The relevant policies are summarised below:

- (E36.3.1) Identify land that may be subject to natural hazards, taking into account the likely effects of climate change, including all of the following:
    - Flood hazards
    - Land instability
- (E36.3.4) Control subdivision, use and development of land that is subject to natural hazards so that the proposed activity does not increase, and where practicable reduces, risk associated with all of the following adverse effects:
- (E36.3.17) On greenfield land outside of existing urban areas, avoid locating buildings in the 1 per cent annual exceedance probability (AEP) floodplain.
- (E36.3.19) Require fences, storage of materials and goods and car parking in the 1 per cent annual exceedance probability (AEP) floodplains to not exacerbate the flood hazard to other properties upstream or downstream of the site.
- (E36.3.20) Require earthworks within the 1 per cent annual exceedance probability (1% AEP) floodplain to do all of the following:
    - No earthwork is proposed within the existing floodplain shown on Auckland Council Geomaps
- (E36.3.21) Ensure all development in the 1 per cent annual exceedance probability (1% AEP) floodplain does not increase adverse effects from flood hazards or increased flood depths and velocities, to other properties upstream or downstream of the site.
- (E36.3.24) Enable the planting and retention of vegetation cover to enhance amenity values, green linkages and ecological values in floodplains as long as it does not create or exacerbate flooding upstream or downstream or otherwise increase flood hazards.
- (E36.3.27) Enable the construction and maintenance of flood mitigation works to reduce flood risks to people, property, infrastructure and the environment.
- (E36.3.28) Take into account any authorised earthworks or drainage infrastructure which avoids, remedies or mitigates flood hazards when assessing proposed subdivision, use or development.
- (E36.3.29) Maintain the function of overland flow paths to convey stormwater runoff safely from a site to the receiving environment.
- (E36.3.30) Require changes to overland flow paths to retain their capacity to pass stormwater flows safely without causing damage to property or the environment.
- (E36.3.31) Identify land that may be subject to land instability taking into account all of the following features:
    - Steepness of land or geological characteristics, subject to the detailed investigation at the further stage

2.7 NETWORK DISCHARGE CONSENT (NDC)

In October 2019, the Auckland region-wide network discharge consent (NDC) was implemented. This consent allows the inclusion of stormwater diversion and discharges from developments to be incorporated under the consent from Auckland Council. Additionally, assets will be vested to Auckland Council, given that they adhere to the specified conditions outlined in the NDC.

The NDC requirements for greenfield developments, relevant to the PCA, and as stipulated in the NDC Schedule 4, are:

- Treatment of all the impervious areas by a water quality device designed in accordance with GD01/TP10 for the relevant contaminants, or an alternative level of mitigation subject to SMP
- Achieve equivalent hydrology (infiltration, runoff volume, peak flow) to pre-development (grassed state) levels. A method of achieving equivalent hydrology to pre-development (grassed state) is to provide retention (volume reduction) and detention (temporary storage) for all impervious areas equivalent to SMAF 1
- Ensure that there is sufficient capacity within the pipe network downstream of the connection point to cater for the stormwater associated with the development in the 10% AEP rainfall event, including incorporating flows from contributing catchment at MPD
- Avoid increasing flood levels upstream and downstream.
- Existing Buildings must not be flooded in the 1% AEP event.

It is common practice on greenfield developments to have treatment for all impervious areas (at least those generating contaminants, so if inert building materials are adopted it is expected that roofs can be excluded). The intention is for this SMP to eventually be adopted into Auckland Council's Network Discharge Consent.

3 MANA WHENUA MATTERS

Notwithstanding that the PCA is not identified as a site or place of significance to mana whenua on the planning maps, this application will provide an opportunity for Iwi to be consulted with the applicant and obtain their views on the Plan Change for 70A & B Lisle Farm Road after the lodgement. We note that stormwater concerns are at the forefront of Iwi responses and the following outcomes are proposed:

- A rain tank (dual purpose) will be proposed for each dwelling to collect the roof water for re-use and mitigation and to comply with SMAF requirements.
- An underground rain tank will be proposed for the driveway within some sub-catchments to comply SMAF and attenuation requirements.
- Flow reduction via detention tanks with restricted outlets for larger storm events will be required for each Lot. The post-development runoff from Right of Way ('ROW') will be "offset compensated" by increasing the detention required by the Lots to account for the Road and RoW runoff, ensuring development mitigation.
- Road water (such as public roads) will be conveyed to the communal stormwater devices for quality and SMAF treatment before discharging into the receiving environment.
- Green Outfalls will be provided at the discharge points to enhance and protect the receiving environment.
- All cesspits in roads (such as public roads and ROW) are proposed with "deep sump" or "half syphon" for pre-treatment.
- Designed riparian set-back and planting to be provided along the existing stream to avoid the potential stream degradation.
- The stormwater principles applied to the site area are adopted and in compliance with the GD01 and GD04 guidelines.

The SMP has been referred to the mana whenua for comments but no response has been received from Auckland Council's Iwi groups list that have a registered interest in the area.

4 PROPOSED DEVELOPMENT/PCA

This section of the report summarises the current understanding for potential future development subject to the PCA, particularly as they relate to stormwater management.

4.1 GENERAL DEVELOPMENT INFORMATION

It is expected that following the PCA, the re-zoned properties (#70A & B Lisle Farm Drive) will be developed as residential lots and services by multiple public roads. The current preliminary master plan outlines that up to 184 residential lots will be created, on #70, #70A & #70B Lisle Farm Drive.

4.2 SITE LAYOUT

Refer to the master plan (refer to Concept Plan prepared by Birch), it outlines the preliminary design for this PCA.

4.3 EARTHWORKS

Application for earthworks consent will be made to the Auckland Council after obtaining approval for PCA. Given the topographical constraints of the existing site, the associated earthwork activities will be required to support PCA and the future development, within the site area of approximately 125,000m² and with an earthwork volume of approximately 484,100m³. The volume consists of 18,750m³ of topsoil cut, 245,000m³ of cut and 201,600m³ of fill, the topsoil re-spread is not included at this stage. The current designed earthwork activities include the following purpose:

- The public roads with the berm/footpath
- Site re-contouring to create suitable building platforms

Proposed measures for erosion and sediment control will be designed under the guidelines of Auckland Council's GD05 document at the later stage. Resource consent will require that erosion and sediment control measures are implemented and maintained in accordance with the Engineering Drawings and GD05.

Silt control measures will need to be installed onsite prior to the earthworks commencing. All silt control measures will be checked and confirmed acceptable by the Engineer before works commence. The site will be progressively stabilised with appropriate approaches, including topsoil respread, temporary mulch stabilisation, hardfill (within the site) or etc.

A geotechnical report has been undertaken by Land Development and Engineering (LDE) to support the PCA, whether a detailed and specific investigation is required to be confirmed at Resource Consent/Building Consent Stage.

5 STORMWATER MANAGEMENT

This section presents guidance on how stormwater will be managed in the future subject to PCA. A review of the relevant stormwater guidelines and polices was undertaken to support the assessment of the Stormwater Management Plan ('SMP'), including the following documents:

- AUP Chapter E1
- AUP Chapter E8
- AUP Chapter E9
- AUP Chapter E10
- AUP Chapter E36
- Auckland Regionwide NDC Schedule 4

The above documents' policies and details are addressed under Section 3.0 in the report

5.1 PRINCIPLES OF STORMWATER MANAGEMENT

The following principles will guide the management of stormwater for the PCA:

- Recognise the key constraints and opportunities on site and in the Oira Creek catchment and Whangapouri Creek catchment
- Water Quality
    - Manages the impact of land use change for PCA
    - Protect and enhance stream systems and natural hydrology
- Stream Hydrology, discharge to streams via the public stormwater network outside of AUP SMAF overlay area
    - retention for the first 5mm of runoff for impervious areas where appropriate
    - detention (temporary storage) with a drain down period of 24 hours for the difference between the pre-development (grassed state) and the post-development runoff volume from the 95th percentile, 24-hour rainfall event minus the retention volume for all impervious areas
- Ensure that the stormwater pipe network has sufficient capacity to convey the stormwater runoff associated with the future development in the 10 % AEP rainfall event with the consideration of Maximum Probable Development (MPD) where applicable
- For the flows in excess of the stormwater pipe network capacity in the 10% AEP rainfall event should be demonstrated through the assessment that the flooding risks to the downstream properties will not be increased
- 3.8°C climate change factor is used for assessment
- Minimise the generation and discharge of contaminants/sediments into sensitive receiving environment, the existing streams and wetlands
- Develop a set of BPO for stormwater that can be incorporated into the development
- Protect key infrastructure, people and the environment from significant flooding events
- All new assets that are intended to become part of the public stormwater network are to be designed and constructed to be durable and perform to the required level of service for the life of the asset, subject to reasonable asset maintenance.

5.2 PROPOSED STORMWATER MANAGEMENT

This section of the SMP presents the detail of the proposed stormwater management approaches. The approaches generally meet the AUP, Guidelines and NDC requirements, and where it does not, this section demonstrates why the preferred option is the BPO for the development.

5.2.1 GENERAL

The proposed stormwater management strategy to achieve water quality, hydrological mitigation and water sensitive design outcomes for the PCA is to use a treatment train approach, the devices which will be used in this train approach should be designed in accordance with GD01.

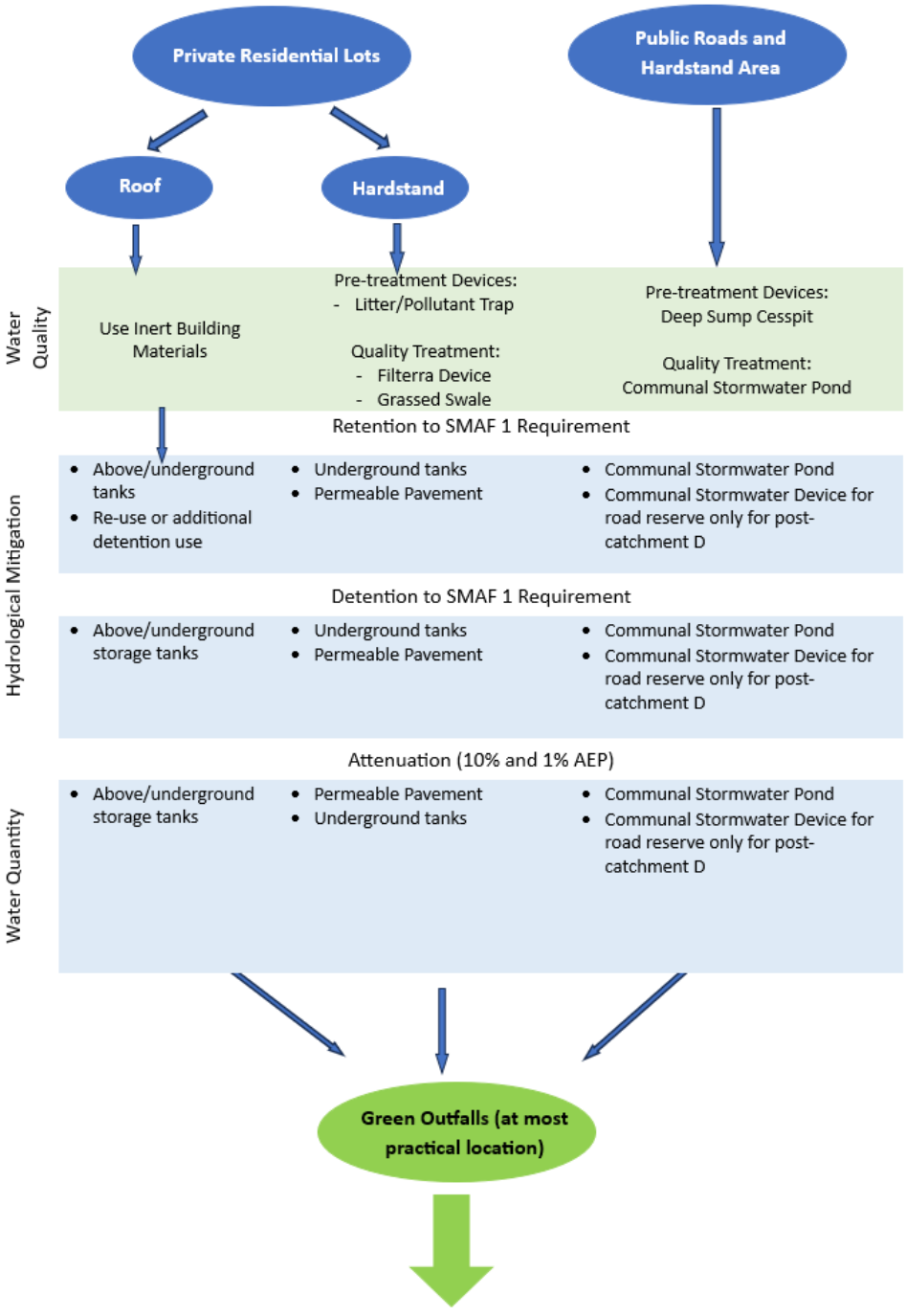


Figure 8 Stormwater Flow Chart

5.2.2 WATER QUALITY

Development of the PCA could result in increased contamination of stormwater runoff due to the land-use changes and the increased impervious area, including the proposed roof area for the residential lots, the associated hardstand area (pavement and driveway) and the public roading formation. The stormwater quality will, therefore, be adversely affected and cause negative impact to the receiving environment, to the area recommended for protection and the intermittent streams.

The water quality management approach seeks to minimise the generation of contaminants from the proposed development. Where contaminants will be generated, the preferred approach is the use green infrastructure to treat runoff at-source, or as close to the source as practicable, such as:

- Eliminate or minimise the generation and discharge of contaminants
- Treat as much as practicable contaminant from the impervious areas at or near source by the appropriate devices designed in accordance with GD01/TP10, like the sediment, metals and gross pollutants. The ability of Auckland Council's GD01 best management practices to comply with any quality requirements and to provide enhanced treatment is summarised in Table 7 of TR2013/035, refer to Figure 8:

Table 7. Ability of TP10 BMPs to comply with DEQRs and to provide enhanced treatment

	TSS		Total Copper		Total Zinc		Temperature	
	DEQR Compliant	Enhanced Treatment	DEQR Compliant	Enhanced Treatment	DEQR Compliant	Enhanced Treatment	DEQR Compliant	Enhanced Treatment
Pond	✓		✓	✓	✓			
Wetland	✓	✓	✓	✓	✓		✓[1]	
Swale	✓		✓		✓		✓	
Filter Strip	✓		✓		✓		✓	
Wetland Swale	✓		✓	✓	✓	✓	✓	
Sand Filter	✓	✓	✓		✓	✓	✓	
Bioretention (lined)	✓	✓	✓		✓	✓	✓	
Bioretention (unlined)	✓	✓	✓	✓	✓	✓	✓	✓
Permeable Paving (lined)	✓		✓		✓	✓	✓	
Permeable Paving (unlined)	✓	✓	✓	✓	✓	✓	✓	✓
Living Roof	✓	✓	✓[2]		✓		✓	✓

[1] Providing the wetland is highly vegetated and well shaded
[2] Providing design is compliant with Auckland Council guidance (Fassman, Simcock, & Voyde, 2010)

Figure 9 Abilities of Stormwater Treatments

These water quality objectives could be met through the following measures and stormwater management devices:

- Use of inert building materials to prevent generation of contaminant-laden runoff within residential lots. For example, avoid use of high contaminant yielding building roofing, spouting, external wall cladding and architectural features.

- Under National Discharge Consent (NDC), there is a preference for wider applications for water quality treatment for all impervious surfaces.
- Use of pre-treatment devices such as catchpits with half-syphon outlets or gross pollutant traps to protect the stormwater network by capturing solids, litter, sediments and gravels. Promote swales and filter strips where appropriate.
- Promote use of permeable paving for future trafficable surfaces including accessways, driveways and carparking on private residential lots to achieve the AUP requirements and water quality control target.
- the public roads and carparks should still be treated using bio-retention devices such as swales, rain gardens and tree pits. Approved bio-retention devices provide the multiple benefits of green infrastructure along road corridors as well as water quality treatment close to the runoff source. Bio-retention devices can also be designed to provide hydrological mitigation treatment alongside with the water quality treatment.
- Riparian margins that provide protection and enhancement to the existing area recommended for protection and intermittent streams, and act as a secondary benefit to stormwater management through the disconnection of impervious areas from the receiving environment.

5.2.3 Stream Hydrology

The PCA currently discharges to the area recommended for protection and intermittent streams. Although the PCA is separated into two stormwater catchments, both catchments eventually discharge to Manukau Harbour (Papakura Channel). The stormwater runoff from the northern catchment of the subject site currently discharges into Bremner Esplanade Reserve and merges with the stormwater runoff from the southern catchment from Blackbridge Road Esplanade Reserve, to Papakura Channel.

To protect stream hydrology, the following SMAF 1 equivalent hydrological mitigation is proposed for the PPC:

- Reuse of 5mm of roof runoff into the proposed dwellings for non-potable use (laundry and flushing purposes):
    - This will be implemented by the individual stormwater tank on each individual lot as per PPC for capturing roof runoff and feeding these back into the dwellings for non-potable reuse.
- No soakage is proposed for the residential lots due to the geotechnical constraints and steep site features
- No soakage for communal stormwater area will be feasible to support the SMAF 1 and NDC requirements, due to the proposed bulk earthwork activities, including the major cut and fill.
- 5mm retention of runoff from the proposed private pavement area or hardstand area in Commonly Owned Access Lot (COAL) within post-catchment B to be managed and treated in the communal stormwater devices
- 5mm retention of runoff from the proposed private pavement area or hardstand area within post-catchment A, C, D, E, F and G to be managed and treated by the individual stormwater devices.
- No soakage is proposed for Road Reserve due to risks around undermining the structure of the roading formation and the small soakage/rain-gardens within the Road Reserve which are not accepted by Auckland Transport.
- 5mm retention of runoff from the proposed impervious area within Road Reserve will be achieved by the communal stormwater devices

- Detention (temporary storage) with a drain down period of 24 hours for the difference between the predevelopment (grassed state) and post development runoff volumes from the 95th percentile, 24-hour rainfall event minus the retention volume for all impervious areas:
    - This will be achieved by the individual dual-purpose stormwater tank for each residential lot (PCA) to slowly release the runoff
    - This will include communal stormwater devices within the PCA for capture, detention, treatment and slow release of runoff from the Road Reserve and the excess flows from the residential lots.
- No mitigation is required for the open space area
- The proposed residential lots with direct frontage to the wetland shall discharge SMAF 1 equivalent retention and detention flows direct to the existing wetlands to ensure the ongoing wetland recharge.

5.2.4 Stormwater Connections

Where there is no existing stormwater infrastructure that can be utilised to service the subject PCA, the designed most practical stormwater solution is discharging to the existing wetland/streams with appropriate designed treatment.

The proposed stormwater reticulation within the PCA to be designed at Resource Consent and Engineering Plan Approval Stage, but the feasibility was checked in the stormwater assessment and the preliminary reticulation drawing is enclosed to the Infrastructure Report and Engineering Drawing Set (refer to **Appendix A** of Concept Plan prepared by Birch).

5.2.5 Best Practice Option (BPO) Device Selection

Green Outfalls

The green outfalls design and energy dissipation design are required for the post-development outlet pipes before discharging to the receiving environment (wetlands or stream) from the designed communal stormwater devices.

For these reasons, the green outfalls are considered a BPO for this PPC to protect and enhance the existing stream and receiving environment, also minimise the erosion risks.

Communal Stormwater Pond

A Stormwater Pond is a storage device that provides Water Quality Treatment through retaining water so the contaminants can settle out, as well as providing attenuation in the form of a low flow-controlled release of water to protect the receiving environment for up to 95 percent of rainfall events as well as providing flow attenuation for large storm events, attenuating flows to be no greater than pre-development flows under the storm event with the same climate change increasing.

The volume calculation of the proposed stormwater pond can be found in the HEC HMS Report, refer to **Appendix B**. The details and schematic plan to be designed and confirmed at Resource Consent or Engineering Plan Approval stage and subject to the final version of the concept plan.

The site has geographic and topology constraints, and a Stormwater Pond will give the necessary treatment while being able to fit with the contours. A Wetland is not considered suitable in this instance due to a larger footprint that would necessitate greater earthworks, and leading to requiring retaining walls which would disconnect the device from being able to be integrated within the open space.

Raingardens

Raingardens can provide water quality treatment through infiltration, filtration, absorption and biological uptake. Runoff is passed through an organic filter medium soil from the vegetation cover, then infiltrated to the subsurface drainage layer. Given Auckland Transport does not accept any proprietary devices to be installed within the Road Reserve, a communal raingarden (or Filterra Bio-retention Device or Filterra Bioscape or similar approved) to achieve water quality treatment requirements for the road reserves before discharging to the designed communal attenuation device. Bio-retention media should be used in the raingarden or Filterra Devices to ensure the effective infiltration rate remove pollutants and sediments.

Raingardens can also be utilised in the residential lot to treat the runoff from the impervious area (pavement, and hardstand area) if required.

For these reasons, the raingardens or Filterra Devices are considered a BPO to treat the impervious area from the road reserve or other impervious pavement area from individual residential lots for this PPC.

Stormwater Tanks

Stormwater tanks can provide required retention and detention (dual purpose) requirement for SMAF 1, and re-use the collected water on private lots. It can also be utilised to achieve attenuation requirement for 10% AEP rainfall events for residential lots. They contribute to reducing stormwater flowrates and the negative effects to the environment. Stormwater tanks can be aboveground or underground and come in a range of shapes and sizes to fit the design and requirement of the private lot.

The PCA has multiple sub-catchments towards different stormwater catchments, individual stormwater tank (aboveground tanks for the roof and underground tanks for the driveway) for each private lot is required to ensure SMAF requirements are achieved and peak flowrates are managed for up to the 10% AEP rainfall event.

For these reasons, the stormwater tanks are considered a BPO for this PPC.

Pre-treatment Cesspits and Traps

Pre-treatment cesspits and traps are structures that can pre-treat runoff by using a physical process and form the start of the stormwater treatment train, including deep sump cesspits, half-syphon cesspit and similar products from Stormwater 360. Pre-treatment cesspits and traps can be utilised not only for the road reserves but also can be useful in private residential lots where the new impervious area (driveway, pavement or hardstand area), to improve the water quality by screening out larger, non-biodegradable pollutants.

For these reasons, the pre-treatment cesspits and traps are considered a BPO for this PPC.

Swales

A swale (either grassed or vegetated) is the structure that can provide water quality treatment, primarily via interception by vegetation, as runoff flows along the surface of the swale. Swales are generally easier to be constructed but require a minimum 30m in length to achieve hydraulic residence time for water quality and in reasonable gradient, normally no more than 8%.

Detailed design is required to utilise swales to achieve water quality in either road reserves or private residential lots based on the catchment area, runoff flows, design surface gradient and other parameters which will be confirmed at consenting stage.

For these reasons, the swales are considered as an alternative BPO for this PPC.

5.2.6 Existing Overland Flow Paths

The Auckland Council GIS, (refer aforementioned Figure 5) identifies multiple existing overland flow paths within the PCA. These flowpaths are very minor where the proposed development is planned and these will be managed through the road network. The extensive overland flows through Wetlands and the Stream are not subject to improvements and will remain in their natural state.

The appropriate attenuations and treatments for the proposed PPC are designed to ensure the receiving peak flow from the post-development will not exceed the pre-development, and not adversely affect the existing overland flow paths and the downstream properties.

5.2.7 Flooding/Flow Calculation Parameters

In terms of flood management, the Stormwater Management Plan proposes to:

- Utilise the existing wetlands/streams to discharge the stormwater flow from the post-development PCA.
- Ensure the proposal within the PCA does not increase adverse effects or increased flood depths or velocities to other properties upstream or downstream of the site.
- Identify overland flowpaths and ensure that they remain unobstructed and able to safely convey runoff.

The hydrological model was created by using HEC HMS Software to model the pre- and post-development catchment. The proposed modelling scenario has the following characteristics/assumptions:

- The proposed 10 % and 1% AEP rainfall events (including Climate Change) are the same
- Catchment characteristics as per pre-development TP108 parameters with CN numbers:
    - Group B Pervious area (Grass) sub-catchment A CN = 61
    - Group C Pervious area (Grass) sub-catchment H) CN = 74
    - Impervious area CN = 98
    - CN for sub-catchments B-G is composite Group A/B based on soil map and as per table overleaf.

Table 5 Pre-development sub-catchments CN number

PRE	Sub-catchment A	Sub-catchment B	Sub-catchment C	Sub-catchment D
Combined CN	61	63	62	66
	Sub-catchment E	**Sub-catchment F**	**Sub-catchment G**	**Sub-catchment H**
Combined CN	69	65	68	74

- Rainfall details which used for the calculation were sourced from TP108 rainfall maps
- Climate change has been applied in accordance with Auckland Council with allowance for climate change effects in accordance with Table 4.3 of *NIWA, 2020 Auckland Region Climate Change Projections and Impacts,* using a temperature increase of 3.8°C for the secondary system and 2.1°C for the primary system. As per Table under Section 4.2.11, below extracted from the Auckland Council Stormwater Code of Practice v4.0. The 3.8°C Climate Change Factor has been applied to the assessment given it is for the stormwater design for a 1% AEP storm event under the MPD scenario, for the further individual stormwater tank design and the primary stormwater network design at the subdivision stages, the 2.1°C Climate Change Factor to be applied.

Rainfall Depth and Intensity (with 2.1°C and 3.8°C Climate Change) shows below:

Table 1: Percentage increase in TP108 24-hour design rainfall depth

Annual exceedance probability (AEP)	Percentage Increase in 24-hour design rainfall depth due to future climate change – 2.1°	Percentage Increase in 24-hour design rainfall depth due to future climate change – 3.8°
50%	15.1%	27.4%
20%	16.4%	29.6%
10%	17.0%	30.8%
5%	17.2%	31.2%
2%	17.6%	31.9%
1%	18.1%	32.7%

Figure 10 Percentage increase in TP108 24-hour design rainfall depth - 2.1 and 3.8 degree

5.2.8 HEC HMS Report

HEC HMS Report is implemented to model the pre- and post-development flow results to support the PPC, refer to **Appendix B**.

Three communal stormwater devices are designed to support PPC based on the current concept plan to accumulate the surface water from the road reserves.

Flow depths within the Road Reserve are generally no more than 150mm, but the maximum flow depth before discharging to the communal stormwater device for post catchment B is 220mm, based on the typical cross section design for a 6.0m wide formation road, the required maximum allowable flow depth x velocities are 0.6m²/s as per Auckland Transport Standard for pedestrian safety consideration, the maximum flow depth x velocities before discharging to the designed communal stormwater device is 0.67m/s by using the maximum inlet flow to the communal stormwater device, but the western portion of post-catchment B (Lot 46-56 and the stormwater reserve area) does not flow to the designed road. It is anticipated the required 0.6m/s safety requirement can be generally achieved, detail to be confirmed at the subdivision stage.

Based on the HEC HMS Report conclusion, all four outlets (discharge towards four different directions) can be appropriately attenuated by using the stormwater mitigation train approaches, the post-development peak flows do not exceed the pre-development peak flows before discharging to the receiving environment. According to the preliminary earthwork recontouring design, roading layout design and the post-development catchment calculation, the post-development catchment area contribute to the north outlet is much larger than the pre-development catchment area, which are 9.850 Ha compared to 7.19Ha. In order to ensure the peak flow is attenuated properly from each residential lot within the post-catchment B, C and D, except to achieve the SMAF 1 equivalent mitigation, the post-development runoff should be attenuated to 73% of the pre-development runoff under the 10% AEP rainfall event. The excess flows will be passed by the individual stormwater tank, merges and conveys within the road reserve and being directed to the communal devices within the designed stormwater reserves.

At each private residential lot in post-catchment A, C, D, E, F, and G, a dual-purpose retention/detection tank is proposed to facilitate the SMAF 1 requirements, as well as all rainfall events up to and including the 10% AEP rainfall event for the lots in post-catchment A, C and D. Due to the post-catchments for E, F and G is smaller than the pre-development catchments, no mitigation is required.

HEC HMS indicates the comprehensive peak flow mitigation assessment and result to support the post-development; the modelled individual stormwater tank includes the typical SMAF 1 equivalent retention and detention requirements. But the modelled communal stormwater devices were designed to accommodate the attenuation target under 50%, 10% & 1% AEP rainfall events, the recommended volume of the device does not include the SMAF 1 equivalent retention and detention requirements, including the impervious area (not connect to the tank), and the impervious area from the road reserves.

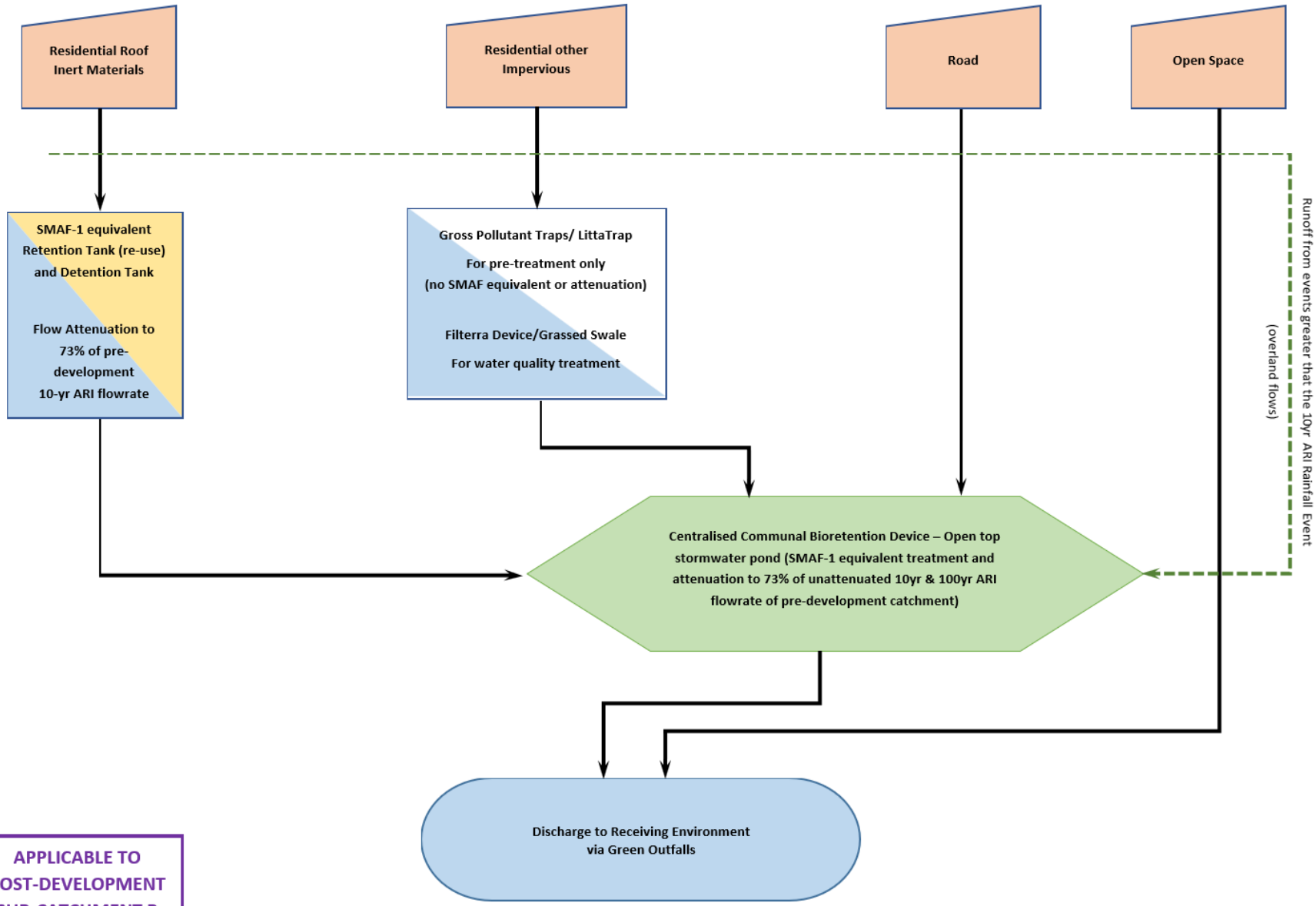
5.2.9 Stormwater Treatment Flowchart

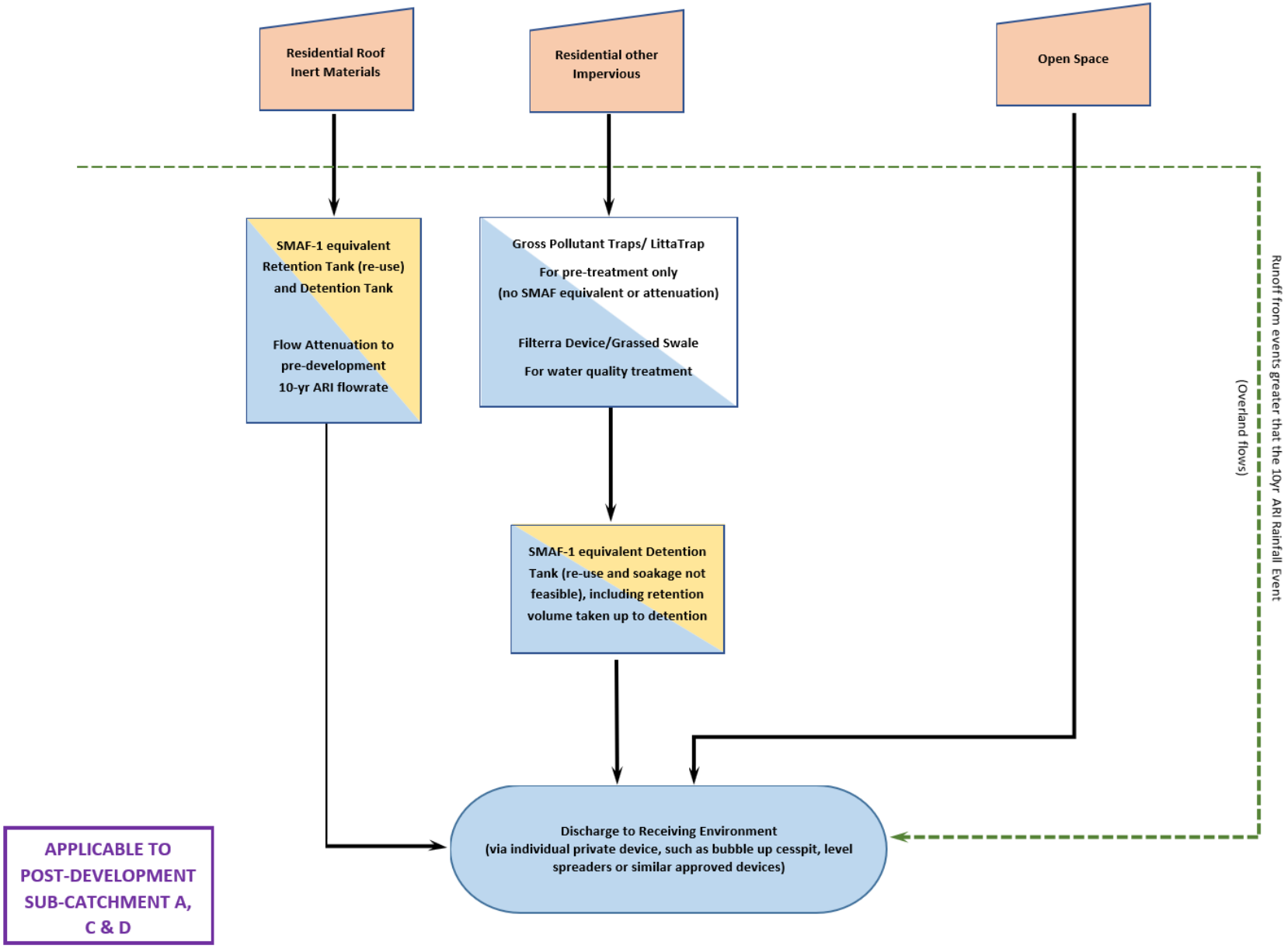
The post-development sub-catchments can be assessed by two circumstances.

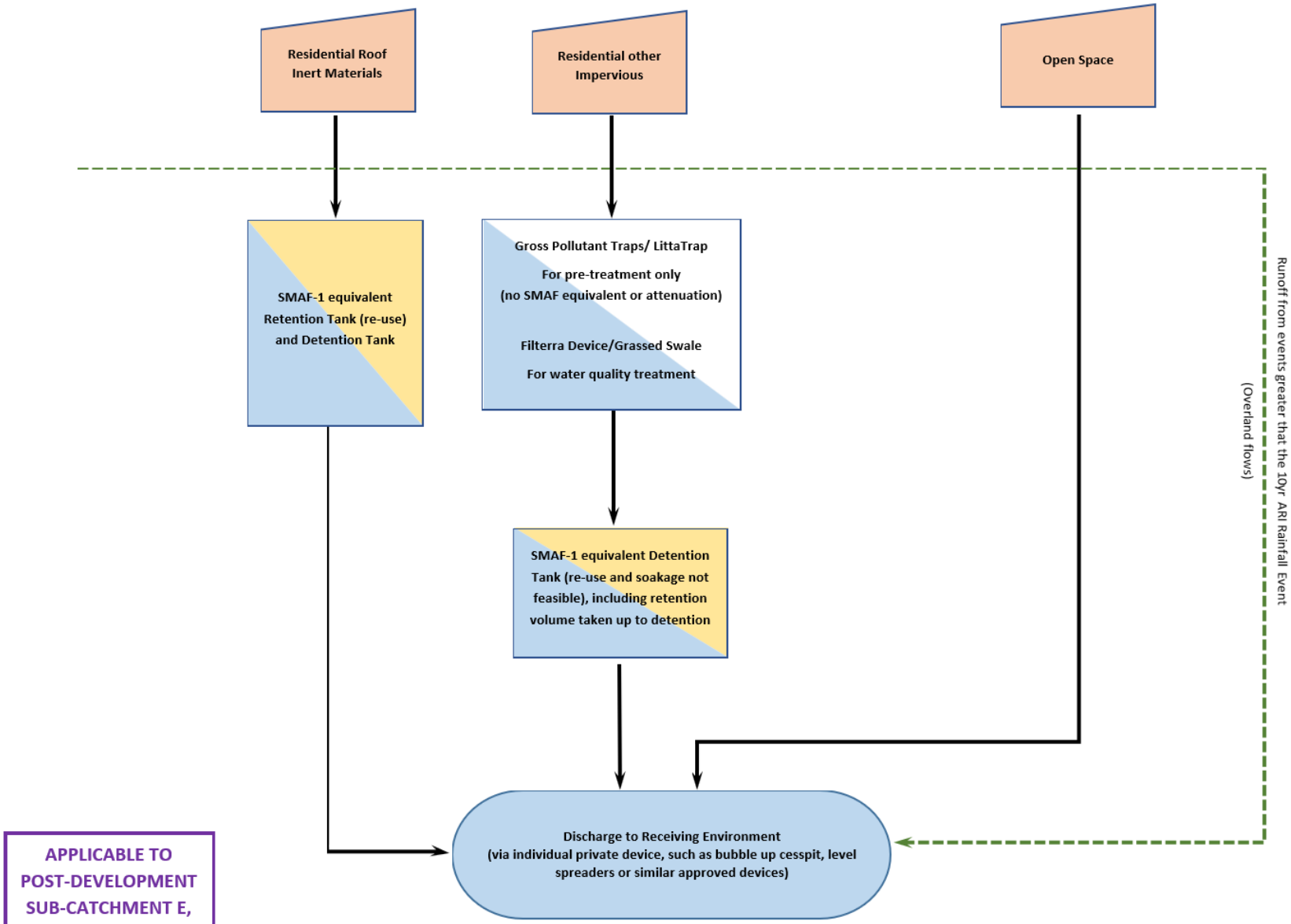
The first one is the sub-catchments can be treated by a communal stormwater device, including sub-catchment B, which are comprised by individual residential lots and road reserves. Each residential lot will have the dual-purpose stormwater tank to service the roof area for SMAF 1 equivalent requirement and 10% AEP rainfall event mitigation. The un-connected impervious area (pavement and hardstand) from the residential lots can be either replaced by permeable pavement without water quality treatment or pre-treated by the LittaTrap and the designed communal bioretention devices will do water quality treatment, such as Filterra device. The road reserves can be treated by the communal bioretention device for water quality requirement and the communal stormwater device at the low point to achieve the required SMAF 1 retention/detention requirement and 10% and 1% AEP rainfall event mitigation. The overflow from the roof area (event greater than 10% AEP) can also be attenuated by the communal stormwater device.

The second one is the sub-catchments located along the gully flanks where the site slope away from the road reserves and face towards the existing wetlands, including post-catchment A, C, D, E, F and G. Each residential lot will have the dual-purpose stormwater tank to service the roof area for SMAF 1 equivalent requirement and only the residential lot within post-catchment A, C, and D need to achieve the 10% AEP rainfall mitigation. The individual pavement area will have the underground detention tank to achieve SMAF 1 equivalent requirement for the residential lots within the post-catchment A, C, D, E, F and G and 10% AEP rainfall mitigation for the residential lots within the post-catchment A, C, and D, or either replaced by approved pervious material. Re-use the retention water from the driveway detention tank is not applicable, the retention SMAF 1 volume is taken up to detention only. Given the post-development catchment areas E, F, and G are smaller than the pre-development sub-catchment area due to the proposed bulk earthwork and recontouring, the 10% and 1% AEP rainfall event mitigation is not required, the post peak flows are lower than pre-development situation, details refer to HEC HMS Report from **Appendix B**.

The typical stormwater treatment flowcharts are indicated below:


Residential Roof Inert Materials
Residential other Impervious
Road
Open Space
SMAF-1 equivalent Retention Tank (re-use) and Detention Tank
Flow Attenuation to 73% of pre-development 10-yr ARI flowrate
Gross Pollutant Traps/ LittaTrap
For pre-treatment only
(no SMAF equivalent or attenuation)
Filterra Device/Grassed Swale
For water quality treatment
Runoff from events greater that the 10yr ARI Rainfall Event
(overland flows)
Centralised Communal Bioretention Device – Open top stormwater pond (SMAF-1 equivalent treatment and attenuation to 73% of unattenuated 10yr & 100yr ARI flowrate of pre-development catchment)
Discharge to Receiving Environment via Green Outfalls
APPLICABLE TO POST-DEVELOPMENT SUB-CATCHMENT B


Residential Roof Inert Materials
Residential other Impervious
Open Space
SMAF-1 equivalent Retention Tank (re-use) and Detention Tank
Flow Attenuation to pre-development 10-yr ARI flowrate
Gross Pollutant Traps/ LittaTrap
For pre-treatment only
(no SMAF equivalent or attenuation)
Filterra Device/Grassed Swale
For water quality treatment
SMAF-1 equivalent Detention Tank (re-use and soakage not feasible), including retention volume taken up to detention
Discharge to Receiving Environment
(via individual private device, such as bubble up cesspit, level spreaders or similar approved devices)
Runoff from events greater that the 10yr ARI Rainfall Event
(Overland flows)
APPLICABLE TO POST-DEVELOPMENT SUB-CATCHMENT A, C & D


Residential Roof Inert Materials
Residential other Impervious
Open Space
SMAF-1 equivalent Retention Tank (re-use) and Detention Tank
Gross Pollutant Traps/ LittaTrap
For pre-treatment only
(no SMAF equivalent or attenuation)
Filterra Device/Grassed Swale
For water quality treatment
SMAF-1 equivalent Detention Tank (re-use and soakage not feasible), including retention volume taken up to detention
Runoff from events greater that the 10yr ARI Rainfall Event
(Overland flows)
Discharge to Receiving Environment
(via individual private device, such as bubble up cesspit, level spreaders or similar approved devices)
APPLICABLE TO POST-DEVELOPMENT SUB-CATCHMENT E, F & G

5.2.10 Minimum Floor Level

The Auckland Council Unitary Plan and Code of Practice for Stormwater specifies the following requirements of freeboard from flood levels:

The minimum freeboard for overland flow paths shall be as per Section 4.3.1 of E1/VM1 (*Compliance Document for New Zealand Building Code: Clause E1 Surface Water* (Department of Building and Housing, 2011)), using the flow generated by the 1% AEP flood event, except where the flow is in excess of $2m^3/s$. Table 4.5 shows freeboard requirements for different situations.

Table 4.5: Freeboard Requirements for the 1% AEP Event

Freeboard	Minimum height
Vulnerable Activities*	500mm
Less Vulnerable Activities*	300mm
Overland flow paths where flow is less than $2m^3/s$	• 500mm where surface water has a depth of 100mm or more and extends from the building directly to a road or car park, other than a car park for a single dwelling • 150mm for all other cases
Overland flow paths, where flow is equal to or in excess of $2m^3/s$	• 500mm for Vulnerable Activities* • 300mm for Less Vulnerable Activities*

* As defined in the PAUP

Figure 11 Building Code Requirement for Minimum Floor Level

The finished floor levels of the buildings adjacent to or within a flood plain are also required to comply with the New Zealand Building Code Compliance Document – Surface Water: E1 - Clause 4.3.1 of Verification Method (VM1) which states that the level of the floor shall be set at the height of the secondary flow plus an allowance for freeboard.

The freeboard shall be:

- 500mm where surface water has a depth of 100mm or more and extends from the building directly to a road or car park, other than a car park for a single dwelling.
- 150mm for all other cases.

The anticipated Minimum Finished Floor Levels may be required to ensure the compliance with the Building Code and the Unitary Plan, which can be addressed in the future at Building Consent Stage.

5.2.11 Development Staging

Construction is intended to be staged subject to the final version masterplans and the scheme plans provided to council for Resource Consent Stage.

Not applicable within this SMP and PPC

5.2.12 Further Refinement and investigation

It is noted that the stormwater devices, including communal devices to service road reserves and proprietary devices to service residential lot need detailed and further investigation at next stage. As well as other site investigations and test, including the followings:

- Infiltration test for site specific devices after the bulk earthwork to check if the minimum infiltration rate can be achieved to utilise soaking devices in accordance with GD07
- Detailed design for the proposed roof area, driveway area and other impervious area to determine the actual volume for achieve SMAF 1 equivalent requirements, water quality and mitigation requirements
- Discharge points detailed design to be confirmed at later stage, including the public green outfalls from the communal attenuation devices and the private energy dissipation devices for the lots within post sub-catchment A, C, D, E, F and G.
- Stormwater public network design and capacity assessment at Resource Consent and Engineering Plan Approval stage.
- Erosion study once the stormwater pipe reticulation and green outfalls are designed at Resource Consent or Engineering Plan Approval stage to ensure the protection to the existing hydrological features.

5.2.13 Hydraulic Connectivity

Hydraulic connectivity refers to the hydraulic interaction between water sources, commonly between aquifers, between different parts of the same aquifer, and between surface water and ground water systems.

Hydraulic connectivity is improved when surface runoff is in contact with the ground rather than piped as soon as possible. The proposal seeks to treat the runoff and discharge to the receiving environment through green outfalls, to maximise the hydraulic connection of treated runoff with the natural receiving environment.

5.2.14 Asset Ownership

All public stormwater infrastructure within the PCA, including the reticulated stormwater pipe network (to be confirmed at Engineering Plan Approval stage), and any communal stormwater devices (subject to Resource Consent design), are intended to be vested to Auckland Council upon completion of construction.

5.2.15 Ongoing Maintenance Requirements

All public stormwater devices which are being vested to Auckland Council will be maintained by the Council. All private stormwater devices will be maintained by the landowners.

Appropriate operation and maintenance guides and plans will be provided for all stormwater management devices will be submitted to Council upon future subdivision. Consent Notices will be registered on future titles to ensure awareness/construction and maintenance of required on-site devices.

5.2.16 Implementation of Stormwater Network

This will be addressed upon development of the site.

5.2.17 Dependencies

No off-site Stormwater infrastructure upgrades are currently proposed.

5.2.18 RISKS

The table below identifies risks to the proposed stormwater management for the PCA and identifies management of the risks throughout the design (and later the construction) phase.

What is the risk to the proposed stormwater management?	How can this be mitigated / managed?	What other management / mitigation could be used?	When does this risk need to be addressed?	What is the resultant level of risk?
Auckland Council Floodplain & Overland Flow mapping incorrect	Field Survey of site		At Resource Consent Stage	Low/Medium
Existing Drainage Network different to GeoMaps	Field Verification and Topographical Survey		At Resource Consent Stage	Low

6 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

This SMP for the PCA comprising 70A & 70B Lisle Farm Road has been assessed based on AUP regulatory policies, Auckland Council Code of Practice and standards and NDC requirements.

The overarching principles of the SMP are summarised below:

- Recognise the key constraints and opportunities on site and in the Oira Creek catchment and Whangapouri Creek catchment.
- Devise an integrated stormwater management approach to facilitate urban development
- Develop the BPO or BPO combination treatment for stormwater that can be incorporated into the development.
- Emphasise the water sensitive design approaches that effectively addresses the land use consequences of transitioning the subject site from rural to urban. These approaches aim to protect and enhances stream systems and natural hydrology while also mitigating potential hydrological alterations and managing flooding impacts.
- Minimise the generation and discharge of contaminants/sediments into sensitive receiving environment from the urbanisation to the Manukau Harbour (Papakura Channel).
- Ensure the key infrastructure, human being, the private assets and the environment can be protected properly from significant flooding events.

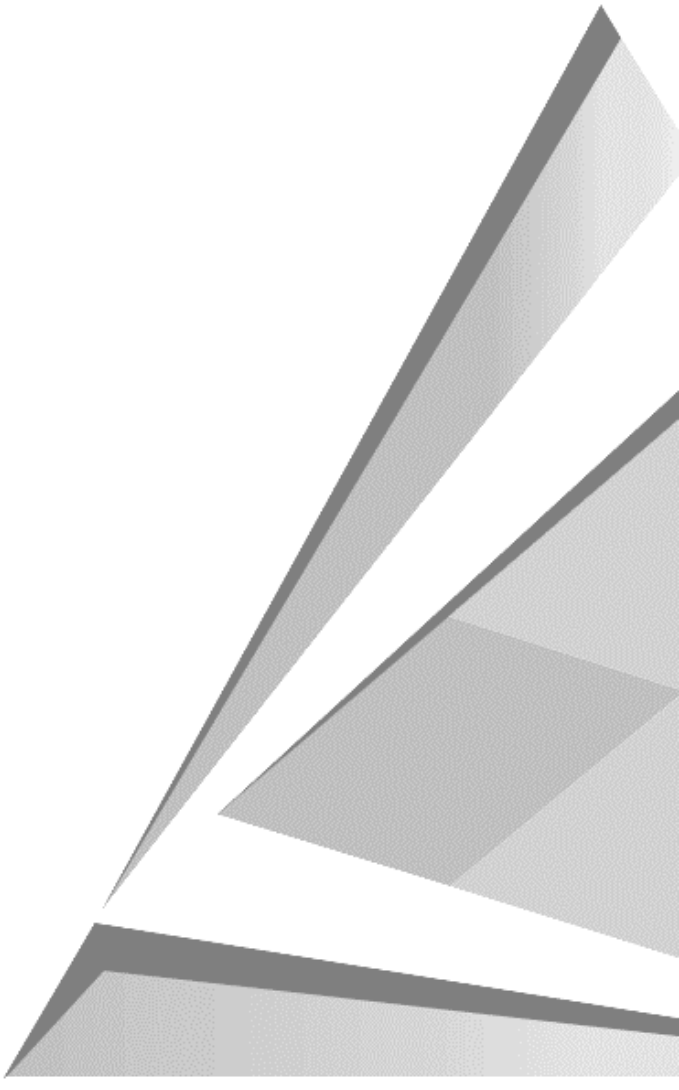
Stormwater management for the PPC has been divided into two management zones based on the natural and post-development topography and sub-catchments. The general approaches for hydrological mitigation, water quality treatment and SMAF 1 equivalent treatment are following the recommendations for each sub-catchment, including:

- Providing a minimum of SMAF 1 equivalent hydrological mitigation, including 5mm retention and temporary detention and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24 hour rainfall event minus the 5 mm retention volume (or any greater retention volume that is achieved) for all post-development impervious surfaces within the PCA.
- The 10% AEP rainfall event can be safely conveyed through a new public drainage network system within the site.
- The 1% AEP rainfall event can be safely conveyed through the site (road reserves) and mitigated at the communal devices before discharging to the existing wetlands/streams
- The proposed development will not increase flood risk for surrounding/downstream properties through the mitigation of peaks flows under 1% AEP rainfall events.
- Minimising the generation of contaminants as much as possible. Where contaminants are generated, the preferred approach is to use green infrastructure to treat runoff at-source or as close to the source as practicable.
- The existing Area Recommended for Protection and intermittent streams will be maintained/enhanced.

7 LIMITATION

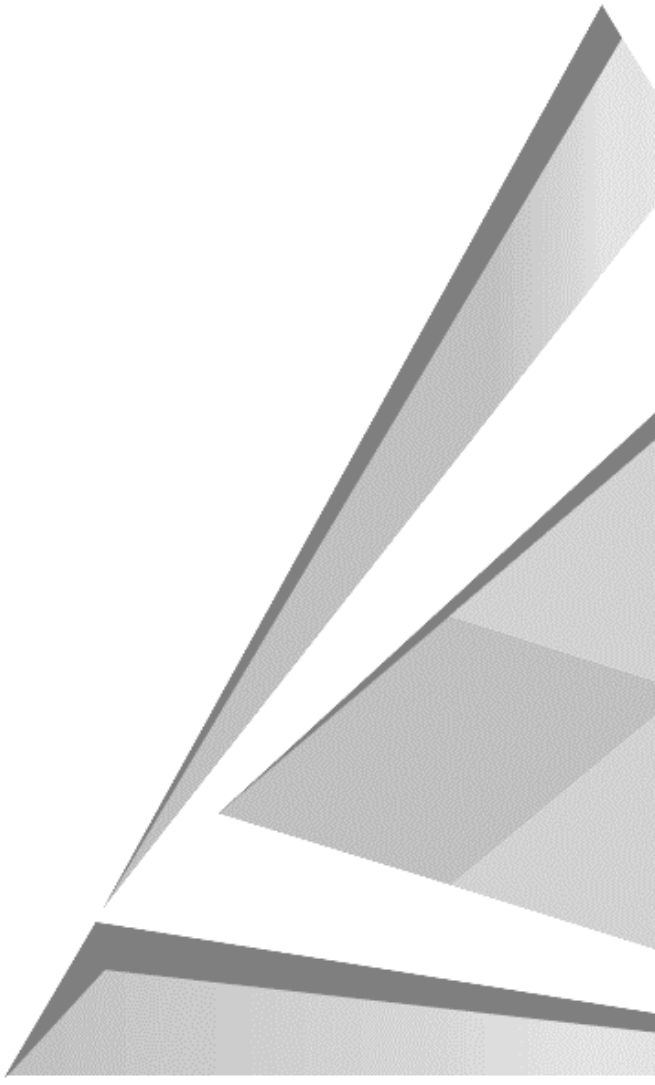
Information about the applicability and limitations of this report is contained here: https://www.birch.nz/client-information/limitations.

APPENDIX A
ENGINEERING PLANS



APPENDIX B
HEC HMS REPORT

(Refer to the separate report)



APPENDIX C
ECOLOGICAL ASSESSMENT
(PREPARED BY WILDLAND CONSULTANTS)