Mangaheka Integrated Catchment Management Plan

Revision History

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Mangaheka
Integrated Catchment Management Plan

Hamilton City Council
Te kaunihera o Kirikiriro

Revision No	Date	Status	Approved (Stormwater)	TRIM link to authorisations
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Mangaheka Integrated Catchment Management Plan

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ABBREVIATIONS

ARI = Average Recurrence Interval (Rainfall event)

CSDC = Comprehensive Stormwater Discharge Consent

WRC= Waikato Regional Council (formerly Environment Waikato)

GEC = Guardian Establishment Committee - Vision and Strategy

GRMP = Gully Reserves Management Plan

ICMP = Integrated Catchment Management Plan

ITS = Infrastructure Technical Specifications

LOS = Levels of service

ODP = Hamilton City Operative District Plan

Proj Water = Waikato River Catchment Services – Level of Service and Funding Policy (Project Watershed)

PRPS = Proposed Regional Policy Statement

RPS = Regional Policy Statement

RRMP = Riverside Reserves Management Plan

SP = Structure Plan

Sust Strat = Hamilton City Council Environmental Sustainability Strategy

SWMP = Stormwater Management Plan

WDC= Waikato District Council

WRA = Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act

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Executive Summary

This Integrated Catchment Management Plan (ICMP) provides guidance on how stormwater, wastewater and water supply need to be managed considering future landuse in the Mangaheka catchment. The document has been developed utilising commissioned technical studies which include assessments of the catchments' flood capacity, water utilities infrastructure, ecology, stream morphology and erosion, and water quality.

The issues that have been identified for the Mangaheka catchment are:

- Centralised stormwater management devices (both existing and proposed) in the upper catchment need to be designed and maintained to comply with Hamilton City Council's (HCC) Infrastructure Technical Specifications (ITS)
- Flood attenuation is generally required to 70% of the pre-development rate (additional flood attenuation may be required on-lot)
- Secondary overland flow paths need to be considered during the design of developments
- Rainwater re-use tanks, plumbed into on-lot non-potable water systems are required
- Water quality and contaminant removal needs to be managed by a combination of centralised and on-lot devices (treatment train approach)
- Retro-fitting existing centralised devices with litter traps and hydrocarbon separators is to be considered
- Pollution control plans are mandatory for developments 'high risk activities' (i.e. bulk fuel/chemical storage, etc.)

Implementation of the above is considered to result in no significant cumulative downstream effects on the Mangaheka Catchment.

This ICMP is intended to be consistent with central and regional government policies, plans and resource consents, and Hamilton City Council policies and plans. Non-statutory policy and planning documents have also been considered during the development of this document.

Catchment Description

The greater Mangaheka catchment covers an area of approximately 2,080ha with around 86% of the catchment (the "lower catchment") being within the Waikato District Council boundaries and the remaining 14% (the "upper catchment") being within Hamilton City Council boundaries. Hamilton City Council is required to control the effects of landuse within its city boundaries and manage any effects of these activities on adjacent territories.

The Mangaheka stream is the main conveyance feature in the catchment. The headwaters of the stream are channelised drains within the upper catchment. From the upper catchment, the stream continues into the Waikato District Council jurisdiction and flows through agricultural land via modified channels, meandering stream and eventually a wetland before discharging into the Waipa River.

The Rotokauri Structure Plan land within the Hamilton City area of Mangaheka catchment is zoned for industrial use with an area zoned as

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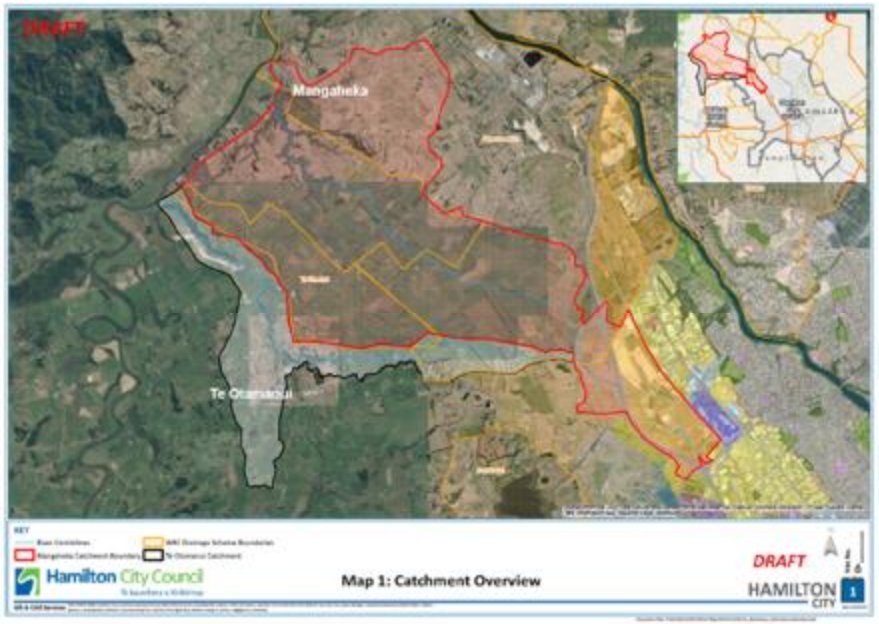
'future urban' on the western side of Te Rapa Bypass. This 'future urban' area has been assumed as having industrial use for the purposes of the technical assessments which inform this ICMP.



Mangaheka Catchment Overview

Catchment Management

General and catchment specific issues and objectives have been identified for the management of stormwater, wastewater and water supply and are provided in Section 3 of this report. For each of these issues, this ICMP identifies a number of management options. The options are evaluated to identify their suitability and a Best Practicable Option (BPO) is developed. The full list of BPOs is provided in Sections 4 and 5. Assessment of the water supply and wastewater infrastructure, both existing and proposed to serve the Mangaheka Catchment have sufficient capacity to service the anticipated development of the catchment.

The following notable catchment issues and mitigation measures have been identified:

Flood capacity

1D flood modelling of Mangaheka Stream catchment was undertaken to assess the effects of development on stream water levels, peak flows and flooding duration. The results of the modelling show that during a 100 year rainfall event (factoring in climate change), there will be up to a 39% increase in maximum flow, and during a 10 year post-development event, up to 45% increase in maximum flow of existing development levels to 2.52 m^3/s at the HCC catchment boundary, following completion of the proposed developments. The modelling results show that implementing all proposed mitigation techniques (e.g. detention ponds) stormwater runoff from MPD can be accommodated to allow a no more than minor increase in peak flows downstream.

Overland flow paths (OLFP's) have been considered in three main locations, which are anticipated during high water flows. These are: discharge from Mangaheka Stream to Te Otamanui catchment; discharge from Rotokauri catchment into Mangaheka Stream; and potential breaching of the stream banks downstream from Porters Pond. These OLFP's require consideration during the development of design proposals for each lot. No primary stormwater from the Mangaheka catchment enters the Te Otamanui catchment at the current time, however this overland flow path could be properly commissioned (ensuring clear and appropriate sizing of drainage channels downstream) for partial

overflow/diversion downstream of Device 6. This is discussed further in Section 2.6.6.

In order to maintain the flood capacity, all stormwater devices would need to be sized appropriately for the sub-catchment they service.

Parameters have been defined to direct stormwater management requirements during development. These are described in Section 6.4 Design Parameters and Section 6.5 Means of Compliance.

ICMP Implementation is provided in Section 6 and catchment monitoring is provided in Section 9. Future actions and opportunities have also been identified and will be assessed for inclusion in ongoing Council programmes and subsequent 10 year Plans and 30 Year Infrastructure Strategy.

Conclusion

Any increases in stormwater discharge resulting from development will require mitigation techniques so that there is no significant adverse cumulative effect downstream.

Developments will need to take the presence of any relevant overland flow paths into account during design.

Centralised devices need to be designed to manage the stormwater volumes anticipated so that a no more than minor increase in downstream peak flows is generated.

Water Quality and Contaminant Removal

The Mangaheka stream has been identified as having poor overall water quality. This mirrors the condition of other urban streams in the Hamilton City area. Nonetheless, some important native species of fish have been identified in the stream including the banded kokopu, the long fin and short fin eels and black mudfish.

The ecology of the stream can be significantly affected by the presence of contaminants including heavy metals, nutrients, suspended sediment and hydrocarbons. In view of the industrial and commercial development currently present as well as proposed in the upper catchment, the potential for future sources of these contaminants is anticipated.

New wetlands are proposed to provide the greatest potential for treatment of the anticipated contaminants. In addition, on-lot contaminant removal and treatment can be used to form a treatment train approach to reduce impacts on stormwater quality. Within the industrial area in the upper catchment, three stormwater management devices are currently in place and a further four are proposed to be developed. Individual sub-catchments have different requirements for pollution control which reflect: the presence or otherwise of a proposed downstream centralised device; or the presence of an existing downstream centralised device.

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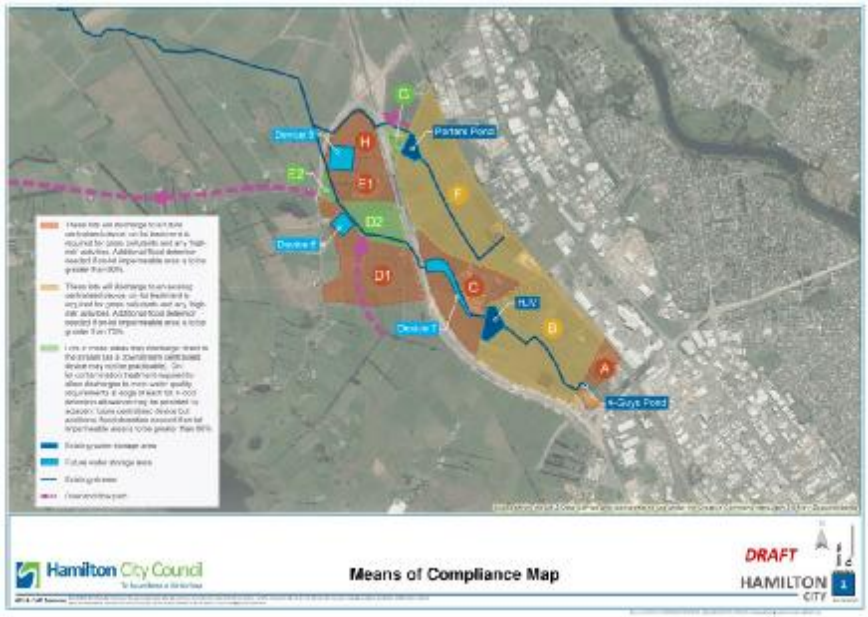
Individual pollution control plans will be required for sites with high risk activities[1]. Details of the requirements for each sub-catchment and any stormwater management devices are provided by the Design Parameters table, Means of Compliance table, and Means of Compliance map



Means of Compliance Map

Conclusion

The Mangaheka Stream, while identified as poor quality overall, is also home to important native species of fish.

Centralised wetland devices will need to be developed to provide contaminant removal. To reduce anticipated contaminant loads from development, on-lot treatment of runoff will also be required.

Developments will need to consider sub-catchment specific requirements for reducing the discharge of contaminants. Water quality objectives will be achieved through the requirement for pollution control plans at high risk activities, as well as other requirements set out in the Means of Compliance and Design Parameters Tables.

[1] High risk activities are those which have the potential to generate contaminants which can cause harm to natural systems such as aquatic ecology - see Appendix F of the Water Quality Report for a list of the main high risk activities.

Watercourse management within the Mangaheka stream

Localised erosion has been identified on stream banks in various locations within the Mangaheka Stream, downstream of the upper catchment area. The erosion identified is in the form of bank slumping and undercutting. The undercutting is considered to be caused by erosion of over-steep bank sides from water flows during storm events and this is contributing to the degradation of the banks which are also affected by stock access and fencing installed too close to the bank crest.

To manage this existing erosion together with the anticipated stormwater flow associated with Maximum Probable Development (MPD), targeted remediation works are required with localised erosion protection and battering of banks to a shallower angle, placement of stock fencing at an appropriate distance from the bank crest and a programme of riparian planting to assist improving of long term bank stability. A concept programme of works has been recommended to stabilise the banks together with maintenance and monitoring in the long term with implementation and cost share to be agreed between Waikato Regional Council, Hamilton City Council, Waikato District Council and relevant landowners.

A restoration vision has been prepared by Boffa Miskel in 2012, to reflect a long term vision of the catchment and any erosion mitigation works will need to align with the intent of the vision.

Conclusion

Existing localised erosion of the stream banks within the lower catchment require targeted management works to prevent ongoing and future erosion in these areas.

In addition, farm management practices are recommended to reduce the potential for future erosion including stock fencing and riparian planting.

Executive Summary Conclusion

The ICMP encompasses best practice stormwater management in the Mangaheka catchment as recommended in HCC's Infrastructure Technical Specifications (ITS) and in the context of the existing strategic legislative framework. Implementation of the guidance provided in this ICMP is considered to result in no significant cumulative downstream effects on the Mangaheka Catchment. Future changes or updates to external drivers and best practice will be considered in reviews of the ITS and any subsequent reviews of this ICMP.

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1 Introduction

1.1 Purpose

This ICMP covers the Mangaheka catchment identified in Figure 1. The catchment comprises approximately 2,080ha of land which straddles the boundary of Hamilton City Council and Waikato District Council. The upper catchment lies within the City Council boundary and the majority of this area is part of the Rotokauri Structure Plan which indicates that much of the upper catchment is designated for industrial development. The lower catchment is within the District Council boundary and comprises predominantly agricultural land. The lower catchment also lies within the boundaries of both the Waipa zone management plan and the Central Waikato zone management plan implemented by Waikato Regional Council.

This ICMP also includes reference to the neighbouring Te Otamanui catchment which comprises approximately 500ha of predominantly farmland lying along the southern boundary of the Mangaheka catchment and includes the Te Kowhai village. The Te Otamanui catchment was previously connected via a small stream channel feeding from the upper Mangaheka catchment. This connection is no longer present and an initial feasibility study is underway to assess the potential for reconnecting the catchments to divert some flow from Mangaheka to Te Otamanui in the future. This option is referred to within this ICMP but not examined further at this stage.

This ICMP and its prescribed best practicable options predominantly focuses on managing urbanisation effects of development area under Hamilton City Council jurisdiction, however, due to the extent of the catchment area some best practicable options extend into Waikato District Council territory and therefore development in this area should recognise these options.

The purpose of this ICMP is:

a. To provide an integrated management approach based upon the best practicable option(s) to avoid as far as practicable and otherwise minimise the cumulative adverse effects of all new stormwater diversion and discharge activities in developing catchments.
b. To meet conditions of the comprehensive stormwater discharge consent (CSDC) number 105279 issued by Environment Waikato (now called Waikato Regional Council). Specifically this includes meeting requirements of conditions 3(a) which requires new stormwater activities to be consistent with all conditions of the CSDC as shown in Appendix J.
c. To provide guidance[2] on how water, wastewater and stormwater management in the catchment can accommodate growth in an

[2] Guidance from this plan is generally to developers, internal HCC Units (City Waters, City Transport, City Planning, Parks and Open spaces, City Development) and regulators (HCC Planning Guidance Unit, Waikato Regional Council and Waikato District Council officers).

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integrated manner and in accordance with proposed new land uses.

d. To ensure that the level of Service (LoS) of the existing three water networks and the Ngaruawahia drainage area are not compromised and to provide a platform for considering the implementation of water sensitive devices to reduce demand for water, minimise wastewater generation and minimise need for three water infrastructure where appropriate.

The duration of this ICMP is the "planning horizon" of the Rotokauri Structure Plan but will necessarily extend beyond the full development of the Structure Plan area to allow for on-going decision making on management and maintenance of water, wastewater and stormwater infrastructure, and to allow for connectivity to adjoining land and catchments. As discussed in Section 8.5, this ICMP is to be reviewed periodically to ensure that it remains relevant and considers the results of any ongoing monitoring and changes within the catchment, the ITS and any strategic or legislative changes driving stormwater management in the Region.

Development of this ICMP has been led by Hamilton City Council with content contributions from Waikato District Council. The Waikato District Council process for dealing with cross boundary issues is described in the Waikato Operative District Plan Chapter 17[3].

This ICMP has been developed to satisfy Condition 30 of the CSDC 105279. In accordance with Condition 30, Table 1-1 shows where each requirement is addressed within this document.

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[3] https://www.waikatodistrict.govt.nz/Documents-Library/Files/Documents/District-Plan/Waikato-District-Plan/Chapters/Chapter17_LocalAuthorityCrossBoundaryIssues.aspx

Table 1-1: Comprehensive stormwater discharge consent checklist

Condition 30	Status
In accordance with Condition 3(c) of this consent (CSDC), Catchment Management Plans which are prepared to guide new stormwater diversion and discharge activities in developing catchments shall be to a standard acceptable to the Waikato Regional Council, and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, prior to the establishment of these activities. Catchment Management Plans shall determine and recommend an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise, the cumulative adverse effects of all new stormwater diversion and discharge activities in developing catchments.	*(General)*
As a minimum, catchment management plans shall include the following information:	
a) Catchment maps/drawings of the catchment delineating the catchment boundary, catchment topography, natural features, surface water bodies, existing drainage systems and infrastructure (if any) and current land uses;	Provided in ICMP Section 2. (Figures 1, 2, 3 & 4)
b) Classification of the surface water bodies within the catchment as detailed in the Waikato Regional Plan;	Provided in ICMP Section 2 (specifically section 2.3.2 and Figure 5)
c) A description of the social, economic, ecological, amenity and cultural objectives being sought for the catchment (likely to stem from a concurrent structure planning process);	Provided in ICMP throughout Section 3.
d) A description of proposed urban growth, development and land use intensification within the catchment;	Provided in ICMP Sections 2.2.3 & 2.2.4
e) A list of the key stakeholders associated with the catchment, and details of their respective views on providing for new stormwater diversion and discharge activities within the catchment;	Provided in ICMP Section 8.1. This can also include details of all other internal and external stakeholders.
f) An assessment of the current status of the catchment and its environs, together with a description of the geological, hydrological, ecological and existing infrastructural characteristics of the catchment, including any existing resource use authorisations within the catchment;	Provided in ICMP throughout Section 2.

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Condition 30	Status
g) An assessment of the environmental effects of all new stormwater diversion and discharge activities on the catchment, in such detail as corresponds with the scale and significance of the effects that these activities will have on the catchment, including but not limited to, effects on: i) Natural features, surface water bodies and aquifers, ii) Sites of cultural and/or historical significance, iii) Public health, iv) Flooding hazards, v) Receiving water hydrology, including base flows and peak flows in rivers and streams and long-term aquifer levels, vi) Receiving water sediment and water quality, vii) Receiving water habitat, ecology and ecosystem health, viii) Receiving water riparian vegetation, ix) The extent and quality of open stream channels, x) Fish passage for indigenous and trout fisheries (refer to the Waikato Regional Plan Water Management Classes for applicability), xi) Natural and amenity values, xii) Existing infrastructure, xiii) Existing authorised resource use activities;	Provided in ICMP Section 2 and Appendix G.
h) An assessment of the cumulative environmental effects of all new stormwater diversion and discharge activities on the catchment over time;	Provided in ICMP Section 2.6, Appendix G and Appendix G.
i) In response to the environmental effects assessment information, an assessment of the available management options (including Low Impact Urban Design measures and stormwater management devices), for all new stormwater diversion and discharge activities within the catchment; followed by	Provided in ICMP Section 5, 6 and 9.

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Condition 30	Status
j) Recommendations on an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise actual and potential adverse effects of all new stormwater diversion and discharge activities on the catchment;	Provided in ICMP Sections 4, 5 & 6.
k) A description of proposed education and promotion initiatives to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6 - ICMP Implementation.
I) A description of key infrastructure works to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6.
m) A prioritised infrastructure works schedule for implementing the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6 (specifically 6.5). Note that this prioritisation will be on a catchment scale and must be integrated into the citywide programme of works.
n) A list of performance measures by which the implementation of the integrated catchment management approach recommended by the Catchment Management Plan will be gauged.	Provided in Section 9 - Monitoring.
Any approved Catchment Management Plan that needs to be updated following changes to the integrated catchment management approach recommended by the Catchment Management Plan, shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, prior to any such changes being implemented within the associated catchment.	
Advice Note: It is recognised that Catchment Management Plans may also include information that provides for the integration of municipal water and wastewater services. Such information and the integration of these services are generally encouraged by the Waikato Regional Council, particularly where they result in environmentally sustainable catchment management outcomes.	Three Waters Management is considered throughout the ICMP

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1.2 Strategic Context

Development within the catchment is influenced by central and regional government policies, plans and resource consents, HCC policies and plans and WDC policies and plans. Most policies and rules ultimately flow out of the Regional Policy Statement (RPS) which is given effect through planning documents such as District Plans and Regional Plans. The RPS also reflects iwi aspirations for the region and National Policy Statements.

The ICMP relies on the current best practice stormwater management in the context of the existing strategic and legislative framework. Any changes to these external drivers will be considered in the future reviews of the ICMP and HCC's ITS to maintain alignment of objectives.

Key planning documents relationships for catchment management planning are shown in Figure 1-1 below:

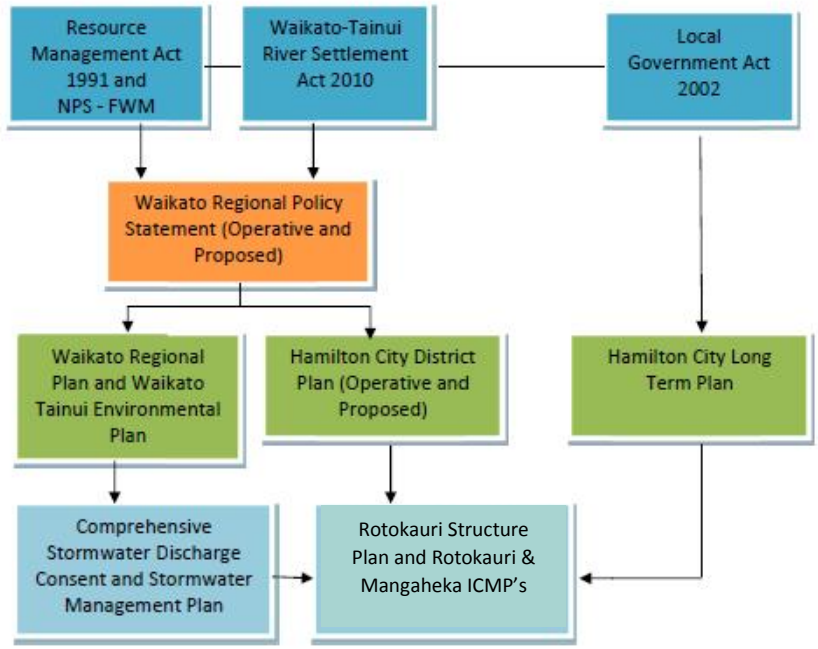

Figure 1-1: Key documents for planning

1.2.1 Legislation

The following legislation informs and guides the requirements for this ICMP.

National Legislation:

- Resource Management Act – specifically Section 15 of the Act includes controls on the discharge of contaminants into the environment, including from stormwater, and states that no person may discharge any water into water or onto land unless

the discharge is expressly allowed for in a national environmental standard, regional plan or resource consent.

- Waikato-Tainui Raupatu claims (Waikato River) Settlement Act 2010. A co-management agreement was signed between Waikato Raupatu River Trust (Waikato-Tainui) and Waikato Regional Council. The agreement clarifies a range of factors and acknowledges Integrated Catchment Management requires coordination and collaboration between each Party's respective planning documents and implementation processes.

Regional Policy:

- Waikato Regional Policy Statement (operative and proposed). This document provides an overview of the resource management issues of the region, and the ways in which integrated management of the region's natural and physical resources will be achieved.

- Waikato Regional Plan - The Waikato Regional Plan contains issues, objectives, policies and rules, relating to the discharge of stormwater into water and the discharge of stormwater onto or into land.

Local policy:

- Hamilton City District Plan - defines the way in which the city's natural and physical resources will be managed to achieve the purpose and principles of the RMA. The Provisions of the plan generally set maximum levels of building coverage, minimum permeable surface areas and water efficiency measures. The plan, together with the Council's Infrastructure Technical Specifications (ITS), are vital tools for managing development within the Mangaheka catchment.

- Waikato District Plan - Most of the Mangaheka catchment in the Waikato district area is subject to a Strategic Agreement (2005) that will see a boundary change transferring it into Hamilton City Council's jurisdiction in 2045 unless agreed differently. This land is included within an Urban Expansion Policy Area prohibiting urbanisation to prevent fragmentation that would hinder future urbanisation. It is expected that this would need to be informed by an updated ICMP. Waikato District Council have commenced a review of the district plan.

1.3 Waikato Regional Council - Resource Consent Compliance

The Comprehensive Stormwater Discharge Consent (CSDC) issued and administered by Waikato Regional Council for the urban catchments within Hamilton City authorises the discharge of stormwater from 'existing' developed areas subject to meeting resource consent conditions and for new developments in growth areas, meeting requirements of any approved ICMP. Hamilton City Council's water take consent has requirements for water demand management and Hamilton City Council's wastewater discharge consent requires network management to avoid events such as wastewater overflows.

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1.4 Regional Council – Land Drainage

The strategic intent of land drainage activity is set out in Waikato Regional Council's Long Term Plan 2012 – 2022. Effective land drainage is provided by maintaining a land drainage network that allows landowners the ability to manage water table on their properties, and that reduces surface flooding resulting from significant rainfall events.

1.5 Three Waters Master Planning and Integration

Three waters means the three key areas of strategic water management (including associated infrastructure) within the City – comprising water supply, wastewater and stormwater. The term 'Three waters integration' is recognition that there is a strong interaction between all three types of waters, natural water systems and land and that they need to be managed sustainably and in an integrated way to ensure the availability of services to growth areas and protection of the environment for future generations.

Application of BPOs must strongly consider Hamilton City Council's established hierarchy for the management of the three waters as follows.

Minimise Demand (water, wastewater) ➔ **Reuse** (stormwater) ➔ **Treat & Dispose to Ground** (stormwater) ➔ **Treatment & Detention** (stormwater) ➔ **Reticulation** (stormwater, wastewater)

Hamilton City Council has adopted this best practice hierarchy, based on sustainability, cost and efficiency principles. This is reflected within the Hamilton District Plan and Infrastructure Technical Specifications[4].

The ideal stormwater management system for a developed site is one that replicates the undeveloped scenario. A range of water sensitive techniques[5] are available to minimise the impact of development and enhance the environment.

Integration of the water supply and stormwater system is most easily achieved by rainwater tanks. Generally the existing city water source and network will be adequate to meet future demand; however, climate change predictions indicate that Hamilton will become drier for extended periods.

It is noted that all new urban premises in the Waikato District are no longer required to have a rain tank under the Waikato District Council Water Supply Bylaw. Rural properties are still required to have a tank with a minimum size of 22,000 litres or equivalent to at least 48 hours storage, whichever is greater. This is relevant as the majority of the Mangaheka catchment is within the Rural Zone of the Waikato District Plan.

[4] Previously referred to as Development Manual

[5] Refer to the definition in Hamilton District Plan Vol 2 Appendix 1.1.2 and the Infrastructure Technical Specifications Three Waters Practice Notes for more details

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1.6 Additional Strategic Considerations

Development within the Mangaheka catchment is influenced by central and regional government policies, plans and resource consents, Hamilton City Council policies and plans and Waikato District Council policies and plans. The following table (Table 1-2) provides a list of some of the key source documents that have been reviewed during the development of this ICMP. During the implementation of the ICMP, (and in future review for the ICMP) HCC will need to consider and take cognisance of these changes.

Table 1-2: Source Documents

Document Title	Date / Version
Waikato River Authority Vision & Strategy	July 2011
National Policy Statement for Freshwater Management	Sept 2017
WRC Waikato Regional Policy Statement	May 2016
WRC Waikato Regional Plan	April 2012
Sub Regional Three Waters Strategy	Sept 2012
HCC Operative District Plan	Sept 2017
Waikato Tainui Environmental Plan	Sept 2013
HCC Comprehensive Stormwater Discharge Consent (#105279)	June 2011

1.7 Strategic Objectives

One of the purposes of ICMPs is for Hamilton City Council to define and set objectives for its catchments. Common strategic objectives have been set across all catchments within the Hamilton City Council jurisdiction (refer to Table 1-3). Strategic objectives for integrated catchment management planning have been developed by HCC to guide decision making.

Table 1-3: Strategic Objectives for all HCC ICMPs

Ref No.	Strategic Objectives
SO1	Protect freshwater systems Maintain, protect and enhance freshwater ecosystems and natural drainage systems by safe guarding the life-supporting capacity, improving water quality where degraded and protecting significant values of wetlands and outstanding freshwater bodies.
SO2	Protect terrestrial systems Maintain, protect and enhance indigenous biodiversity values and functions for terrestrial ecosystems and protect significant habitat of indigenous fauna.

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SO3	<u>Kaitiakitanga</u> Give effect to the relationship of tangata whenua as kaitiaki of receiving water bodies and including the relationship of Waikato-Tainui with the Waikato River.
SO4	<u>Stormwater Management</u> Stormwater management related to land use and development shall encourage and enable low impact design and incorporate best practicable mitigation measures to minimise actual and potential adverse effects on: • Receiving water bodies in terms of quantity and quality of stormwater discharges, • Locations and communities subject to flood hazards, • Natural groundwater levels, • Baseflows for freshwater systems.
SO5	<u>Wastewater Management</u> Wastewater management shall incorporate best practicable options and be managed so that: • Conveyed network volumes are minimised, (e.g. by demand management and management of stormwater infiltration) • Dry weather overflows are prevented and wet weather overflows are minimised.

SO6	<u>Potable Water Management</u> Water supply is planned and provided for in a way that meets existing and future requirements to: • Provide firefighting water supply (flow and pressure) by conforming to the Code of Practice for Fire Fighting Water Supplies. • Meet domestic, commercial and industrial water demand. • Ensure water consumption is managed to minimise peak and total demand.
SO7	<u>Three Waters Management</u> Three waters networks are planned, managed and operated in an integrated manner to: • Meet existing and future development requirements whilst maintaining human and ecosystem health. • Meet design standards, consent conditions and regulatory levels of service. • Ensure assets, technology and resources have capacity, redundancy (n+1), knowledge and plans to prevent or cope with unplanned events. • Minimise the need for new infrastructure including by optimising the use of existing assets.

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SO8	Catchment Specific Objective A catchment specific objective is that the Tangirau wetland function and health is protected.

Specific Operational Objectives have been developed to give effect to these Strategic Objectives and these are provided in Section 3.5.

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2 Catchment Description

In accordance with Condition 30 of the CSDC, Section 2 of this ICMP provides a broad range of data and maps to describe the physical, cultural, environmental, infrastructure, economic and future development characteristics of the hydrological Mangaheka catchment. This section is supported by mapping contained in Appendices A, B, C & E.

This ICMP also considers water and wastewater network matters which extend beyond the hydrological Mangaheka catchment as shown in the maps in Appendix B and Figure 2-9.

2.1 Introduction

The overall Mangaheka catchment area encompasses approximately 2,080ha of flat to rolling Waikato lowlands in the area generally defined by Onion Road in north, the North Island Main Trunk Railway and Tasman Road in the east, Ngaruawahia Road in the west, and Te Kowhai Road to the south. The Mangaheka Stream is a small tributary of the Waipa River which flows southeast-northwest towards it. Refer to Figure 2-1.

Approximately 86% of the catchment lies within Waikato District Council jurisdiction, with the upper catchment upstream of Koura Drive within Hamilton City Council jurisdiction.

Within Hamilton City Council boundaries, the catchment includes the 177ha Rotokauri Structure Plan industrial area between the Waikato Expressway and the North Island Main Trunk railway and an employment zone between the Expressway and Burbush Road/Koura Drive. More than 120ha of industrial land in this area has been developed since 2012. Farm drains have been replaced with stormwater treatment swales and detention basins with discharge points into the downstream drain network. The Waikato Expressway and connecting roads was constructed with stormwater treatment swales discharging into existing, new and realigned drains within the Mangaheka catchment.

Downstream of Koura Drive within Waikato District, the Mangaheka Stream has a rural catchment (mainly dairy farming or grazing) comprised of artificial drains, modified stream, and an extensive gully wetland. The adjacent catchments are Te Rapa Stream to the east (discharging into the Waikato River), Lake Rotokauri to the south (discharging to the Waipa River), and Te Otamanui to the west (discharging into the Waipa River).

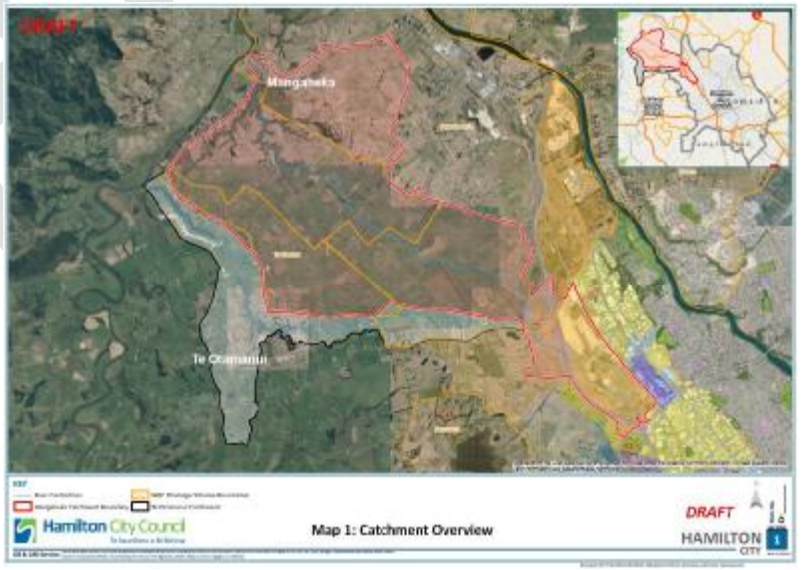

Figure 2-1: Mangaheka catchment map

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2.2 Landuse

2.2.1 Historic and cultural landuse

Most of the Mangaheka Stream catchment is alluvial plains of the Waikato and Waipa Rivers which would originally have supported indigenous forest (Cornes *et al*. 2012). The topography and remnant vegetation indicates that the area would historically have included wetlands, particularly in low-lying flood plains and valley floors where groundwater emerges. Some of these wetlands would have included highly organic and/or peat soils, and peat swamps are known to have existed in the upper catchment. Similar to almost all rural land in this area, by the early to mid-1900s, most wetland areas would have been drained to create farmland, and the vegetative cover changed from predominantly alluvial secondary native vegetation to exotic pasture (Nicholls 2002). Vegetation throughout the catchment is now dominated by exotic pasture with shelterbelts and shade trees associated with rural-residential and rural properties.

2.2.2 Current landuse

The Upper Mangaheka sub-catchment is a peri-urban area that has mix of rural uses including dairying, dry stock, cropping, and an increasing number of industrial activities. There are some small lifestyle sized lots with dwellings. On the eastern flank of the Upper Mangaheka sub-catchment is the North Island Main Trunk Railway. On the western flank of the Upper Mangaheka sub-catchment is the Te Rapa Bypass.

The land within the wider Mangaheka Stream catchment downstream is dominated by rural land uses, including dairying, dry stock grazing and cropping. There are some small lifestyle sized lots with dwellings and livestock. There is a marae at the downstream end of the catchment in the wetland area.

2.2.3 Proposed land-use changes

Upper Mangaheka sub-catchment

The proposed long term land use change is to develop the entire Upper Mangaheka catchment area for urban activities, primarily of an industrial nature. Land use changes will be authorised through land use and subdivision consents.

Rotokauri is identified as a “strategic node” in the Future Proof Strategy and Implementation Plan 2009 with uptake of 130ha occurring by 2022. Given that the development at Rotokauri commenced in 2013, full development of the 130ha is unlikely to occur before 2026. The existing landuse zoning is indicated in Figure 2-2.

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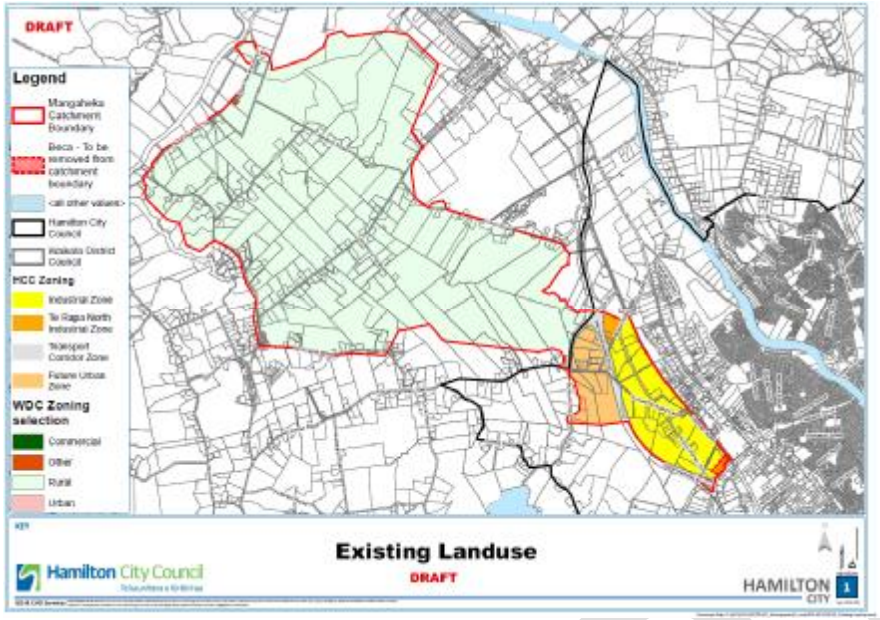

Figure 2-2: Existing landuse

Porter Properties Ltd Land Development Areas

There is approximately 64ha of industrial land in the Porter Properties Ltd (PPL) area. The land is zoned "Rotokauri Industrial".

The development of the PPL land is subject to the "Te Kowhai Road Comprehensive Development Plan". This Plan enables development of the land on a staged basis primarily to ensure that there are no adverse effects on the road network ahead of the Te Rapa Bypass opening.

The Te Kowhai Road Comprehensive Development Plan provisions require the preparation of a "stormwater catchment management plan" to facilitate the principles and proposals of the Rotokauri Structure Plan. Land use and subdivision consents were granted in 2013 for full development of the area. A centralised stormwater management device was developed in this area, referred to as 'Porters Pond'.

A stormwater discharge consent was granted by the Waikato Regional Council in February 2013.

Hamilton JV Investment Company Land Development Area

There is approximately 69ha of industrial land in the Hamilton JV parcels. The land is zoned "Rotokauri Industrial". This land may be developed under a "Comprehensive Development Plan" in terms of land use, staging and traffic.

Resource consent was granted in 2010 for a 22 lot industrial subdivision with 15 ha of developable land. This consent originally assumed that stormwater would be diverted out of the Mangaheka Catchment to Lake Rotokauri in accordance with the Rotokauri Structure Plan concepts. A revised design of stormwater infrastructure has since been approved which maintains the existing stormwater flow to the Mangaheka Catchment. A centralised stormwater management device was developed in this area, referred to as 'HJV Pond'.

A stormwater discharge consent was granted by the Waikato Regional Council in March 2013.

4 Guys Land Development Area

There is approximately 3ha of industrial land in the 4 Guys area. The land is zoned "Rotokauri Industrial". The land is currently occupied by a 4 Guys car yard and a Z fuel station. A centralised stormwater management device has been constructed in this area and is referred to

as '4 Guys Pond". This device provides stormwater detention only and is up stream of the HJV Pond.

A stormwater discharge consent was granted by the Waikato Regional Council in 2010.

The conditions of the discharge consents for all three areas largely mirror those in the CSDC with the express intention that these consents can be transferred to the City Council and implementation merged to maintain a consistent and comprehensive approach.

Other industrial land within ICMP area

There is approximately 20ha of other (undeveloped) land within the upper sub-catchment which is identified for industrial use. Some of this land is zoned "Future Urban" lying on the on the western side of the Te Rapa Bypass. Plan Changes will be needed to bring this land into the urban land supply, at which time the extent of uses and development controls can be considered in detail.

Stormwater discharge consents will be needed for each site for development to proceed. Land use and subdivision consent processes will address the design and construction of stormwater management infrastructure in due course, including the development of assets that will vest in the City Council.

Industrial extension north of Ruffell Road

This land is zoned "North Te Rapa Industrial Zone" but with a "Deferred Industrial Zone" classification under the Operative District Plan.

The land is outside that identified for specific industrial development over the next 20-30 year period, but development will be provided for under future planning instruments.

Wider Mangaheka catchment

No significant development of the lower catchment land area is planned for the near-term at present.

2.2.4 Major transport links

The Rotokauri Structure Plan indicates an existing and planned road network in the upper catchment area. The majority of the roads are classed as 'local' roads which serve the partly developed industrial area and its surrounds. The existing Te Rapa bypass section of State Highway 1 is a major arterial road passing through this area along the edge of the proposed industrial area.

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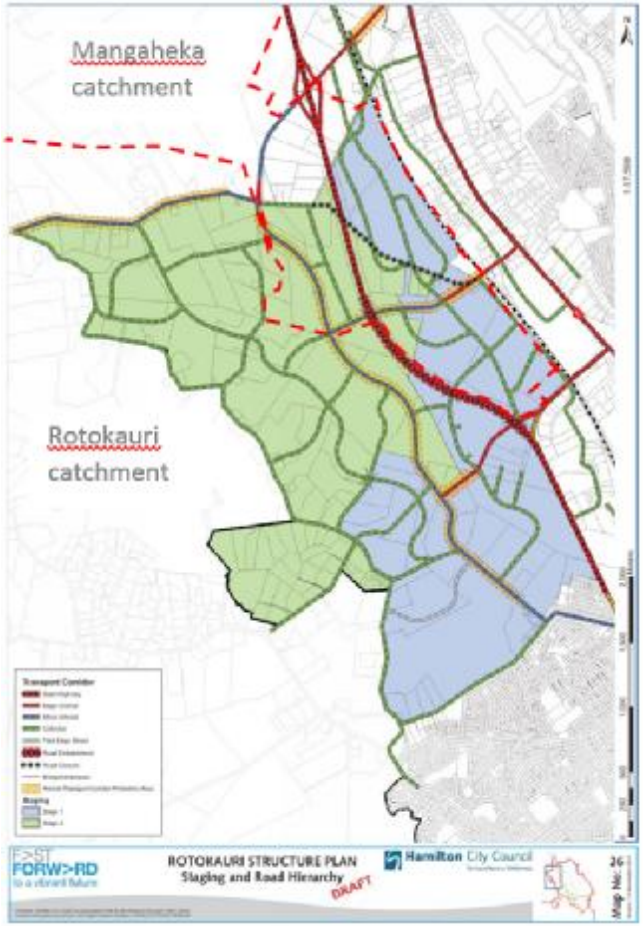

Figure 2-3: Proposed transport corridors

Note: The alignment of future roads is indicative only and will be determined through a future designation process.

2.3 Physical Environment

2.3.1 Topography

The upper catchment area is generally flat-lying and represents one of the higher parts of the catchment. From this area the topography slopes generally to the northwest towards the Waikato River.

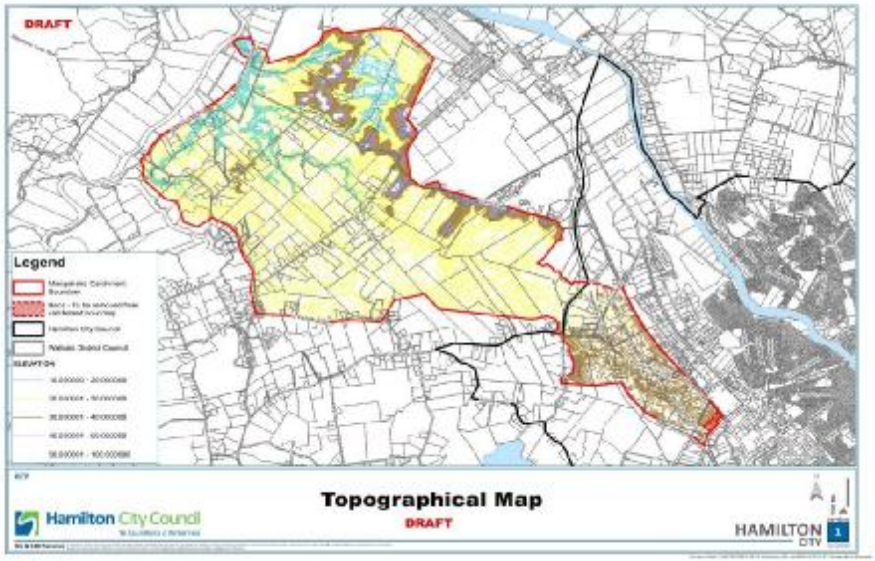

Figure 2-4: Mangaheka catchment topography

The highest ground is located along much of the northern boundary of the catchment with associated steeper slopes trending south and south west. The highest point in the catchment is present in the northern-most area separating two south western-facing gullies. These gullies drain into the wetland area which extends from roughly the centre of the lower

catchment and extends to the north western edge where the catchment drains to the Waipa River before it joins the Waikato River.

2.3.2 Watercourses

In the upper catchment, the two main branches of drain network meet immediately downstream of Koura Drive. Prior to development, the drain networks comprised the stream headwater catchments located within the Rotokauri Structure Plan industrial/employment area, which was originally peat swamps. As a result of development of the industrial area and Waikato Expressway designation, the drains were replaced with planted swales and detention basins. Future development is expected to result in the same waterway conversion process.

Downstream of the industrial area and Waikato Expressway, artificial farm drains flow north and northwest to Koura Drive, where they meet at the drain main stem. The drain then flows northwest through farmland before transitioning to a modified stream channel with perennial flow where natural topography forms a surface drainage channel. Outside the Hamilton City boundary, the catchment of the drains is almost entirely rural (dairy farming), comprising artificial farm drains, with very little riparian vegetation.

Between Koura Drive and Horotiu Road, the waterway is comprised of a single main stem drain or modified stream with drains discharging into it from adjacent farmland. The stream develops a more defined floodplain within an increasingly entrenched gully landform as it approaches Horotiu Road. At Horotiu Road, the road embankment and invert levels of the twin culverts dictate the groundwater levels, flood levels, and peak flows discharging downstream. Given that the culverts are perched at the downstream end, it appears that the road embankment and culverts are resulting in higher shallow groundwater levels and stream water depths than would be expected naturally. The modified stream catchment is entirely rural with almost no riparian vegetation.

Between Horotiu and Ngaruawahia Roads (SH39), the stream transitions into a large willow-dominated wetland in an entrenched gully network as a result of the road embankment impounding the stream upstream of its natural outlet to the Waipa River. Other branches of the stream form arms of the gully network at numerous confluences. The main stem flows northwest through an extensive rural (dairy farming) gully system that becomes increasingly deep and wide. The gully system is fully vegetated with a willow-dominated treeland and indigenous sedge understorey. The outlet to the Waipa River downstream of Ngaruawahia Road is via a short section of artificial drain.

An ecological assessment has been completed[6] which identifies the range of waterway reach classification (Refer to Figure 2-5) within the catchment:

- artificial watercourses (drains) in the upper third of the catchment;
- natural/modified watercourse (stream) in the middle third of the catchment; and
- wetlands in the lower third of the catchment (Tanirau Wetland).

[6] Boffa Miskell, June 2016: Mangaheka Stream Assessment of Ecological Values to inform Integrated Catchment Management Plan.

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The ecological assessment by Boffa Miskell included sampling of water, sediment and aquatic macroinvertebrates in 2012 and 2016 as indicated in Figure 2-6.

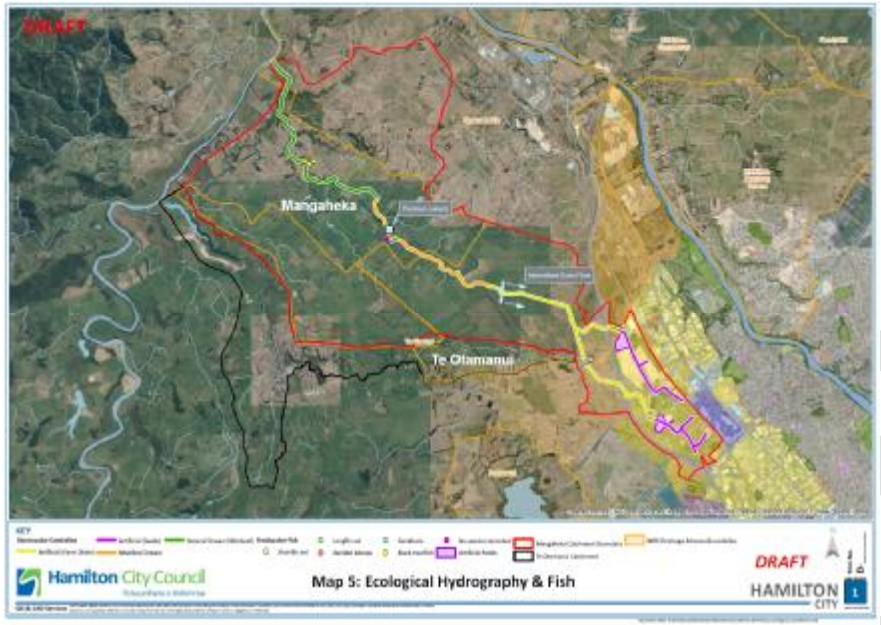

Figure 2-5: Mangaheka waterway classification

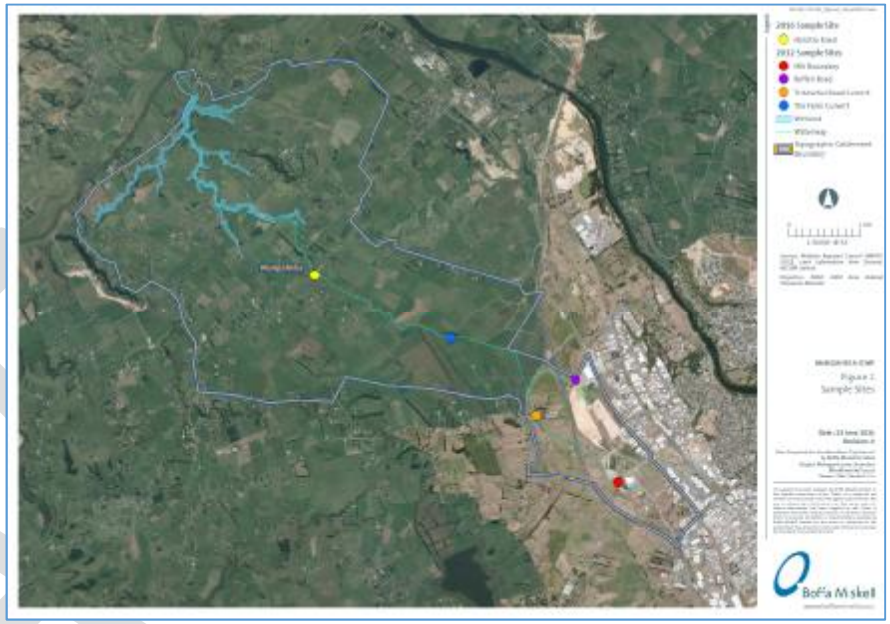

Figure 2-6: Ecological assessment sampling locations

2.3.2.1 Erosion and Scour

A watercourse assessment[7] has been completed for the catchment, which included a walkover of the stream and assessment of erosion susceptibility of a 5km section of the stream in the lower catchment from the Hamilton City Council boundary at Koura Drive, where the stream is channelized to downstream of Horotiu Road at the upstream boundary of the Tanirau Wetland. The assessment informs concept projects and

[7] Morphum Environmental Ltd, March 2017: Mangaheka Watercourse Assessment and Programme of Works

management options that are required to mitigate ongoing erosion within part of the Mangaheka Stream which is managed by Waikato Regional Council (WRC) drainage catchment board. Drainage catchments are divided into separate management zones. The uppermost part of the Mangaheka catchment (east of Ruffle Road) falls within the Central Waikato Management Zone, with the remainder of the catchment (west of Ruffle Road and extending down to the stream discharge into the Waipa River), falling within the Waipa Management Zone. This means that the industrial area in the upper Mangaheka Catchment is split across these two management zones.

The walkover survey identified 10 reaches defined by changes in bank morphology and landforms including roads. The assessment identified four sections of the stream (reaches 6, 8, 9 and 10) which were considered to have a low to moderate susceptibility to erosion and one section (reach 7), which was considered to have a moderate susceptibility to erosion (as indicated in Figure 2-7).

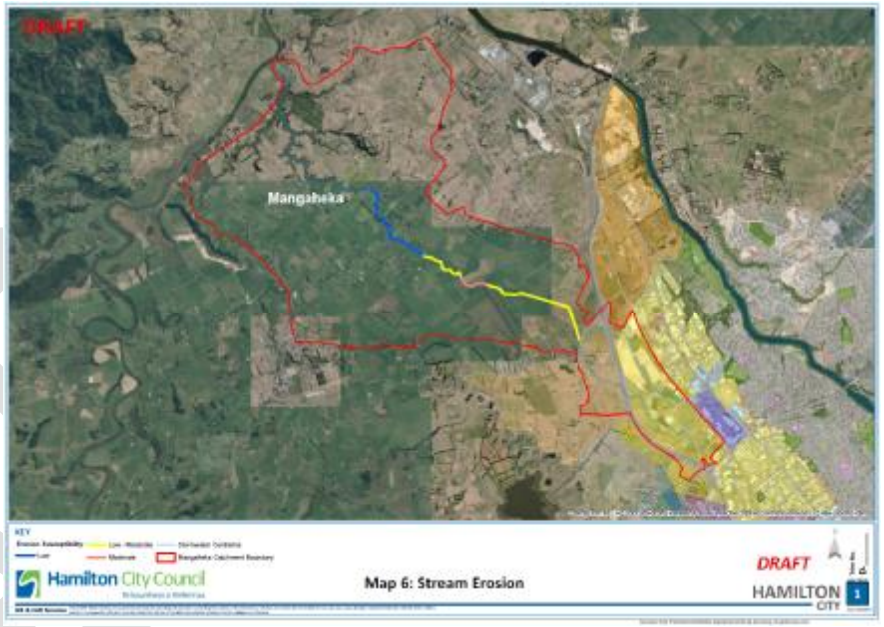

Figure 2-7: Mangaheka stream erosion susceptibility

These reaches are classed as low to moderate and moderate energy systems with localised erosion of the stream bed and undercutting of the stream banks in places. The location of fence posts in close proximity to the bank crest is considered to have destabilised banks in various locations leading to surface erosion and slumping, however over spraying of bank vegetation appears to have exacerbated the problem in many cases.

Reaches 1 – 5 are considered to represent low energy systems and have a low susceptibility to erosion, however it was noted that a lack of fencing in these areas could lead to erosion associated with stock access. Farm management practices are recommended to improve these

conditions, including: riparian planting, stock fencing and erosion protection works. Erosion mitigation works will be required along the stream to reduce the current potential for erosion, particularly in consideration of the proposed development upstream. Minimum mitigation works are considered to include a fenced 3m buffer on either side of the stream with selective planting to improve bank stability and bank toe protection (see Table 6-4: Future Actions).

2.3.3 Hydrogeology and groundwater resources

Ground investigations have previously been carried out associated with proposed development within the industrial area in the upper catchment area. Reports for two of these[8] note the presence of peaty soils over layers of sands, silts and clays, however it is anticipated that the majority of the peaty soils within the industrial area will have been removed or disturbed during platforming works to date.

Groundwater is recorded by these investigations to range from approximately 0.7-1m below ground level during winter months with summer groundwater levels roughly 1-1.5m below this. No geotechnical investigation reports are available for the lower catchment area, however, based on available soils information (Section 2.3.4 below) the lower catchment is anticipated to comprise soils of similar limited poor-drainage capability with shallow groundwater and thus the potential for use of soakage for stormwater management is anticipated to be limited.

There are a number of groundwater takes recorded on the Waikato Regional Council website including for agricultural use and private water supply in the lower catchment area. One water take consent is recorded in the industrial area of the upper catchment for use in dust suppression. Other consents in the upper catchment relate to discharge of stormwater to the Mangaheka stream and one consent is recorded for discharge of treated domestic sewage to land for a rest home on Te Kowhai Road.

Proposed development in the upper catchment is anticipated to significantly increase annual flow volume discharging from this area, as a result of the developable area being up to 90-95% impervious. The effect on baseflows from this change in hydrological regime is considered to be mitigated by the combination, on lot water efficiency measures, wetlands and soakage via the use of unlined wetlands which will likely supplement baseflows during dry periods and particularly during times when the farm drainage channels typically dry up. Wide shallow wetlands function to recharge downstream subsurface waters through infiltration inflows and during dry periods this acts to provide environmental baseflows mitigating baseflow effects.

2.3.4 Soils

The ecological assessment did not assess the different soil types within the catchment, however, examination of the soils map on the WRC soil

[8] AECOM, August 2012: Preliminary Geotechnical Assessment for Proposed Industrial Subdivision – Ruffell Road/Te Kowhai Road for Porter Properties Ltd; and Coffey Geotechnical, August 2012: Factual Investigation Report for Proposed Industrial Subdivision at 103-129 Tasman Road, Rotokauri, Hamilton for Hamilton JV Investment Company

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map viewer website[9] indicates six main soil types across the catchment. The upper catchment comprises mainly organic soils (peaty) as well as some allophanic soils which are a weak soil with low density structure. These allophanic soils together with gley soils are also present surrounding the lower section of the stream within the wetland area from the centre to the northwest edge of the catchment. These soils typically indicate wet conditions with limited drainage. More free-draining granular soils are present in the higher ground on the north eastern side of the catchment and brown soils are recorded on the western side.

The Land Environments of New Zealand (LENZ) database classifies most of the Mangaheka Stream catchment as Environment A5.3 which is comprised of poorly-drained peat soils of low to very low fertility or Environment A7.2 comprised of imperfectly drained soils of low fertility. There are very small patches of Environment F6.1 which is comprised of mid-age well drained soils of low fertility from rhyolitic tephra, outcropping mainly at Horotiu Road and around the Onion Road ridgeline.

2.3.5 Water quality and contaminants

2.3.5.1 Contaminated land

Analysis of soil contamination has been carried out as part of the resource consent process by land owners over approximately 80% of the land within the Upper Mangaheka sub-catchment (within the HCC boundary). The testing undertaken to date[10] has not indicated any exceedances of National Environmental Standards for the parameters analysed. No soil analysis is recorded in the lower catchment and therefore no conclusions can be drawn as to soil quality within the lower catchment.

The presence of contamination within the catchment will be dependent on historical and current land use, in particular, agricultural and industrial activity. Sources of agricultural contamination can include storage and use of pesticides, herbicides and fertilizers; fuel storage; and waste pits. Industrial activity can generate a range of contaminative substances, however the industrial area in the upper catchment is zoned as 'light industrial' with the potential sources of contamination typically reasonably limited to storage and use of chemicals and waste disposal. In some areas surrounding Hamilton, former landfills are present, as well as localized up-filled areas formed to assist development. Such areas of fill are typically regulated by current standards, however, some former landfills and up-filled areas may have had limited regulation and so could potentially contain a wide range of contaminative substances. While no areas of such in-fill are recorded within this catchment there is a potential for these to be present locally.

It is expected that the change in land use from predominantly agricultural to a higher proportion of industrial/employment zone land

9 https://waikatomaps.waikatoregion.govt.nz/Viewer/?map=1aa9c952a38949a68cbe3ca7aed48270

10 As reported in Hamilton City Council, March 2015: Upper Mangaheka Draft Integrated Catchment Management Plan

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and/or roading will change the stormwater contaminant profile. Pre-development stormwater contaminants from rural areas typically include nutrients, sediment, turbidity, bacterial pathogens, and metals associated with agricultural use and land drainage (e.g. aluminium, iron, manganese, nickel, copper and zinc). Industrial stormwater contaminants typically include gross pollutants, sediment, petroleum hydrocarbons, and metals. Land drainage networks and industrial stormwater can both have elevated temperatures. The additional mass load of contaminants from new industrial development will be partly offset by reduced rural contaminant mass loads through land use conversion and loads removed by the wetland/swale devices.

2.3.5.2 Sediment quality

Sediment quality within the waterways was assessed by Boffa Miskell in their report issued in June 2016.

Four sediment samples taken in 2012 and one taken in 2016 were analysed for iron, arsenic, cadmium, chromium, copper, lead, nickel and zinc. The concentration of all metals in all samples but one was recorded to be below the ISQG-Low trigger concentrations. In one sample taken in 2012 at Te Kowhai Road, the arsenic concentration was equal to the ISQG-Low concentration. This in itself does not indicate an exceedance of the guideline value and therefore overall, based on the limited sampling conducted to, there is no evidence of metals concentrations in sediments within the Mangaheka stream representing a significant risk to biota.

2.3.5.3 Water quality

Water quality has been assessed by Boffa Miskell in their report issued in June 2016 which has been used to inform this section. The Mangaheka Stream has water quality and water chemistry that is very similar to other Hamilton waterways. The stream receives ongoing inputs of suspended sediment, turbidity, nutrients, metals, and faecal pathogens.

Turbidity

Observations at Horotiu Road indicated suspended sediment increases rapidly after rainfall so suspended sediment spikes are likely to be common. As is typical for rural streams within this land type, low suspended solids concentrations do not always reflect turbidity, indicating that elevated turbidity is influenced by sources other than sediment. The observed orange staining and iron flocs are likely to be contributing (in part) to elevated turbidity, supported by elevated iron concentrations. There is no guideline value for total iron. Although not analysed, it is expected that concentrations of manganese would be similarly elevated and contributing to turbidity. Although there is no guideline value for turbidity, the ANZECC Guidelines refer to research into banded kokopu avoidance behaviour at turbidity of 20NTU and WRC water quality scientists typically use turbidity of 10NTU or suspended sediment concentration of 10g/m^3 as the threshold above which recreational and ecological effects occur. Turbidity was above 10NTU at all sites in 2012 which is typical of rural streams around Hamilton draining peat/organic wetland soils.

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Metals

Based on the available Mangaheka results and available results from all other Hamilton catchments, the Mangaheka metals concentrations are considered to mirror that of other Hamilton catchments as follows:

– Arsenic, cadmium, chromium, lead, and nickel generally below ANZECC guidelines.

– Aluminium, copper, and zinc exceeding ANZECC guidelines.

– Iron is elevated.

Based on the results in other catchments, phosphorus can be expected to combine with aluminium, iron, manganese, zinc, copper and other metals forming metal phosphates, increasing turbidity, reducing nutrient availability and limiting metal bioavailability and therefore toxicity in the water column. Concentrations of total copper and total zinc exceed ANZECC guidelines indicating potential for biological harm, but concentrations of the bioavailable dissolved fraction are likely to be below ANZECC thresholds.

Because there was little urban stormwater being discharged into these waterways prior to or at the time of sampling, metals are likely to be from agricultural or groundwater sources as a result of land drainage. This is supported by the average total copper, lead, and zinc concentrations being very similar to the median total concentrations of 28 samples taken at 20 rural waterways close to Hamilton, each with little or no urban stormwater discharges. It is considered likely that elevated metals are a normal water quality component resulting from land drainage. Metals complexes may have localised impacts on dissolved oxygen concentrations, especially where iron discharges occur.

Nutrients

Elevated concentrations of nitrogen and phosphorus are ubiquitous in waterways around Hamilton, and generally far exceed the Ministry for the Environment water quality guidelines required to limit algal growth. However, the Mangaheka catchment has the lowest phosphorus concentrations of the Hamilton catchments with concentrations of total and dissolved phosphorus well below the median concentrations. Nitrogen concentrations were also among the lowest of the Hamilton catchments. With respect to algal growth, the sequestration of phosphorus into metal phosphates and the predominance of particulate phosphorus may limit bioavailable phosphorus to concentrations below that required for algal growth to some extent. However, filamentous algal growth was observed frequently throughout the drain reaches during site assessment but was not observed in the modified stream reaches or wetlands. Filamentous algal growth was most noticeable where aquatic macrophytes had recently been sprayed and in reaches downstream of this.

Pathogens

Elevated faecal coliform levels are ubiquitous in waterways around Hamilton regardless of their catchment land uses, although rural drains tend to have lower levels than urban waterways. In the Mangaheka catchment, faecal coliforms exceed ANZECC guidelines for livestock watering and Ministry for the Environment guidelines for human contact at all sampling sites and the average for Mangaheka sites is close to the median for all Hamilton streams.

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Water quality

Petroleum hydrocarbons and carbonaceous biochemical oxygen demand (CBOD) were not detected. However, given the agricultural land uses, it is likely that CBOD fluctuates in response to inputs of organic matter. A preliminary (2011) water sample taken in the Ruffell Road drain adjacent to maize cropland had concentrations of CBOD at almost 5 times the guideline so it is likely that CBOD fluctuates substantially in response to inputs of organic matter associated with crop harvesting.

Temperature and dissolved oxygen will experience diurnal and seasonal fluctuations. Water temperature was cool (10.6 – 15.7°C) at the time of sampling, but observations indicate that summer water temperatures will exceed thermal tolerances of aquatic fauna throughout the upper catchment drains where riparian cover is limited and water depth is shallow. The open water areas in swales and detention basins in the industrial area are likely to experience ongoing elevated turbidity and suspended sediment loads. This may result in thermal storage causing rising temperatures during summer and low dissolved oxygen concentrations downstream of the discharge points.

In the modified stream channel where the stream has perennial groundwater-sourced baseflow and riparian vegetation cover, water temperature is likely to remain below the thermal tolerances of most fish and aquatic macroinvertebrate species.

On balance, the water quality and water chemistry of the Mangaheka Stream catchment is considered to be moderate to poor, but similar to most Hamilton waterways.

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2.3.5.4 Contaminant load

The following are the key stormwater contaminants that are likely to be generated within the Mangaheka Industrial Area.

- Suspended sediment
- Hydrocarbons
- Nutrients (nitrogen and phosphorus)
- Metals with the primary ones being zinc and copper but also lead, cadmium, aluminium, chromium, arsenic, iron
- Bacteria
- Biochemical oxygen demand (BOD)
- Litter

However, a range of other contaminants could be generated depending on the type of industry and activities taking place and the on-lot controls in place.

Predicting likely contaminant loadings in stormwater runoff and comparison against present conditions is useful to determine likely impacts on stream water quality and assess the potential need for particular stormwater devices to reduce specific contaminants. A contaminant load model (CLM) has not been developed for the Mangaheka stream due to the uncertainty around the types and numbers of industrial activities that will eventually occupy the planned industrial area in the upper catchment. In the absence of a CLM, an anticipated contaminant loading has been estimated using information sourced from TP10 and Auckland Regional Council CLM (V2.0 (2010).This information can be used to determine if the proposed treatment devices identified within this ICMP meet the required Means of Compliance requirements.

It should be noted that the Auckland Regional Council CLM only provides loadings in terms of sediment, zinc copper and hydrocarbons. Whilst these are likely to be some of the main contaminants, a range of others are also likely. For the Mangaheka industrial area the most applicable contaminant sources are provided in Table 2-1.

Table 2-1: Expected contaminant loadings g/m^2/year

Contaminant	Roads ARC TP10	Commercial ARC TP10	Roofs (ARC CLM) <1000 VPD	Roads (ARC CLM)	Paved Surfaces other than roads	Industrial area (NIWA)	Value selected
Total suspended solids	281-723	242-1369	5	21	32	133	32
Total phosphorus	0.59-1.5	0.69-0.91				3.31	1.5
Total Nitrogen	1.3-3.5	1.6-8.8				8.5	3.5
Total Zinc	0.18-0.45	1.7-4.9	0.02	0.0044	0.59	0.576	0.59
Total Copper	0.03-0.09	1.1-3.2	0.0016	0.0015	0.107	0.0214	0.107

An assessment of the anticipated quality of future discharges was undertaken, taking into consideration expected contaminant loads and the anticipated level of treatment from the existing and future proposed

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treatment devices. This showed that compared to existing water quality in the Mangaheka Stream, even after treatment, discharges of total phosphorus, total copper and total zinc are likely to be higher than existing. It is therefore possible that the ICMP targets of maintaining or enhancing the existing water quality may not be met without additional on-lot contaminant removal methods required.

Details of the methodology for determining contaminant loading and the anticipated performance of existing devices are provided in Appendix D.

2.4 Values

2.4.1 Aquatic, terrestrial and riparian ecology

The ecological assessment for the catchment (Appendix I) concluded that the Mangaheka stream has poor to moderate habitat diversity, with diversity increasing with distance downstream. Water quality is generally poor but similar to other catchments in the Hamilton area. There is a low abundance of sensitive macroinvertebrate taxa and limited fish species identified in the stream, however 'At Risk' native black mudfish and longfin eels were recorded in the watercourse and therefore has ecological significance under the provision of the RPS.

The majority of the catchment vegetation has been widely modified over time with historic vegetation cover, including peat bog vegetation, replaced with exotic pasture grasses or crops and with exotic shrubs and trees established as shelterbelts. Indigenous plants are recorded as virtually non-existent throughout.

In the upper catchment the watercourse type is an artificial watercourse (excavated drain) which generally provide poor habitat for fish and aquatic macroinvertebrates. Low or no flow, high temperatures, low dissolved oxygen, and very poor water clarity are likely to present fish passage barriers in this section of the catchment.

From midway between Ruffell Road and Horotiu Road, the watercourse type becomes a modified stream and has a relatively natural channel with reaches where historic straightening has occurred.

In the upper and middle reaches, there is typically limited riparian vegetation adjacent to the waterways. Although most waterways have no canopy cover, some have cover from shelterbelt trees. Much of the waterway is fenced at the bank crest and periodically sprayed so riparian vegetation is very limited.

In the lower catchment, which is recorded as largely inaccessible, the riparian vegetation consists of wetland vegetation with a canopy and understorey vegetation providing extensive areas of shading from the sun.

Macroinvertebrate assessments conducted in 2012 and 2016 indicated a range of different macroinvertebrate communities, the stream is characterised by a low Macroinvertebrate Community Index which reflects the low abundance of sensitive taxa and indicates probable severe pollution.

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A Fish survey conducted in 2016[11] identified a total of four native species: shortfin eel (*Anguilla australis*), longfin eel (*Anguilla dieffenbachii*), banded kokopu (*Galaxias fasciatus*), and black mudfish (*Neochanna diversus*); and one exotic species (mosquitofish) which correlates with the findings of surveys recorded by the NIWA Freshwater Fish Database for this stream. It is also noted that prior to development of the industrial land parcels in the upper catchment area in 2011/12, three native species (mudfish (12 individuals), longfin eel (2 individuals) and shortfin eel (16 individuals)) were caught and translocated under permit from the upper catchment to the wetland area near Crawford Road in the lower part of the Mangaheka catchment.

The diversity and abundance of fish species is likely to increase substantially with distance downstream, as flows become perennial, channel morphology is less modified, habitat diversity increases, and riparian vegetation cover increases.

Despite the presence of perched twin culverts at Horotiu Road and the culvert at Ngaruawahia Road, the presence of some non-climbing species found upstream indicate that the culverts are not considered as a significant fish passage barrier.

Riparian vegetation has been controlled by spraying over large sections of the upper and middle reaches of the watercourse causing widespread slumping in the low-cohesion soils. Erosion repair responses have included deposition of rock riprap into slumped areas which has led to further erosion. This has caused further bank collapse and diversion of flows to adjacent banks where toe undercutting and slumping subsequently occurs.

Anecdotal evidence from landowners indicates that there has been an increase in localised flooding events following the construction of the Waikato Expressway and Koura Drive which indicates the potential sensitivity of the catchment to development. As noted in Section 4.3.5.4, proposed development of the Rotokauri Structure Plan industrial and employment areas are considered likely to increase some dissolved contaminants in the stream which has the potential to affect fish diversity. It is anticipated that additional on-lot contaminant removal will be required to reduce the potential for impacts to aquatic ecology.

2.4.2 Cultural value to iwi and archaeological significance

No significant archaeological sites have been identified in the catchment, however, it is classed as being within the Waikato Regional Council Iwi Waikato River Co-management area. It is noted in the ecological assessment that a marae is present downstream, in the wetland area, and that this area is most likely to be used for fishing and other activities **[Hold: text to be finalised following consultation]**.

2.4.3 Amenity, recreational and aesthetic values

The ecological assessment identified that the faecal pathogen load within the stream is high and therefore the water is unsuitable for human contact or livestock consumption. Overall, the water quality is considered

[11] Boffa Miskell, June 2016: Mangaheka Stream Assessment of Ecological Values to inform Integrated Catchment Management Plan.

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to be moderate to poor and generally similar to other waterways in the Hamilton area. Nonetheless the report suggests that access to the wetland area it likely to take place for local fishing and other recreational uses. No specific amenity, recreation or aesthetic values have been identified associated with this catchment which could be negatively impacted by development further upstream.

2.4.4 Economic values

The Mangaheka stream drains rural farmland with economic value to landowners. Management of stream bank stability is important for preservation of land and maintenance of land drainage capacity is vital for pastoral productivity and for delivering the Mangaheka Drainage Area level of service for removing flood waters.

2.5 Existing Utilities and Network

2.5.1 Water network

Given that the majority of the Mangaheka catchment is greenfield, the existing water supply infrastructure in the WDC jurisdiction is minor and the focus of assessments has been provision for growth and mitigating issues related to growth in the upper catchment within the HCC boundary. Accordingly, this section sets out a summary of assessments, issues and the proposed solution in terms of water supply infrastructure. Most of the information contained in this section is from the Hamilton City Water Master Plan (2016).

The existing water supply system in the Mangaheka upper catchment (within the HCC boundary) is described as being serviced by Blue zone pressure (via the Water Treatment Plant).

Under the Water Master Plan Philosophy, this single Blue zone will eventually become 3 separate supply zones called the Pukete Zone (Brown), Newcastle Zone (Green) and the Dinsdale Zone (Orange). Refer to Figure 2-8 below. The timing along with the physical capital works to create these zones has a bearing on the rate of water demand growth that can be serviced in the Upper Mangaheka catchment.

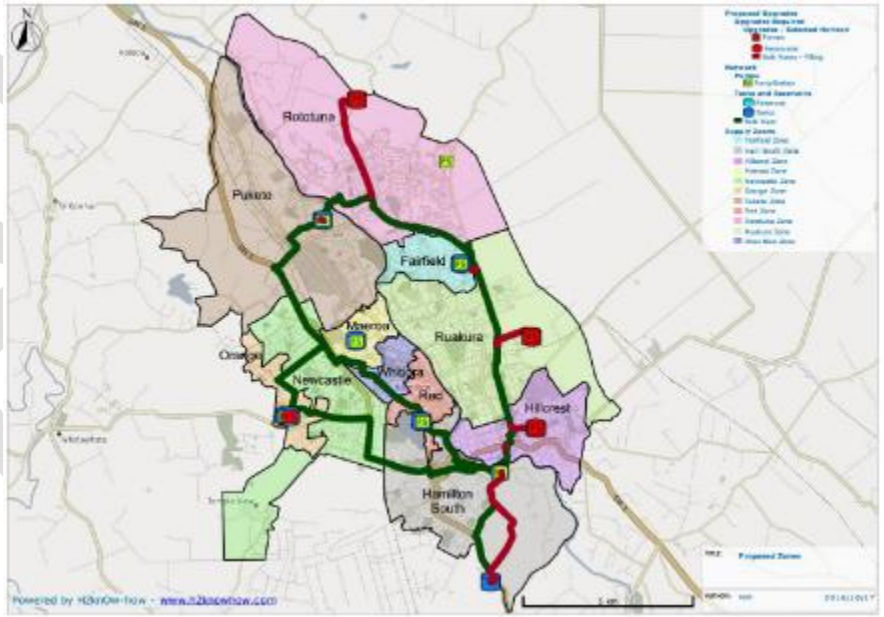

Figure 2-8: Proposed water network zoning

Future demand in green field areas where little or no existing demand is available uses the assumptions in the HCC Infrastructure Technical Specifications for Water Supply: An average daily demand of 260

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l/person/day (0.003 l/s/person average instantaneous) with a peak instantaneous flow rate of five times this amount (0.015 l/s/person). In general, the current storage and zoning approach for Hamilton is to split the City into western and eastern areas, divided by the Waikato River, for water storage and use. The master plan approach keeps the storage within the zone it services without long pipe runs and more risky river crossings. There is currently no need in the Mangaheka catchment for a new reservoir or an additional treatment plant on the western side of the river within the 2061 design horizon.

Summary of assessment and observations

The current water infrastructure installed in the Mangaheka upper catchment allows for the development of the industrial area.

Future water supply performance in the Mangaheka area will ultimately be determined by the creation of 2 new zones called the Newcastle and Pukete Zones and the extension of the existing Dinsdale zone. The commissioning of the proposed Rototuna Reservoir and Zone in 2018 will remove the current reliance on the Pukete Reservoir to supply the Rototuna area at peak demand times. The Pukete reservoir will return to its intended use, servicing the western side of the river. A dedicated bulk main supply line is currently being developed to service the proposed Pukete Zone with the bulk main planned to be commissioned in 2019.

Once the Pukete supply line is completed the Pukete zone will be closed, resulting in significant system performance improvement.

Staged construction is proposed for extension of existing supply lines and trunk mains to service the new development of the Rotokauri area, lying to the south west of the Mangaheka upper catchment.

Stage 1 - relates to any proposed development prior to the future 520mm Bulkmain supply from Pukete Reservoir to the Rotokauri area. To facilitate growth this requires the installation of a 450mm main along Te Wetini Drive connected temporarily to the existing 250mm on Wairere Drive. This extends as a 250mm main from the end of the 450m and connecting to the existing 250mm on Rotokauri Road.

Stage 2 - construction of the 520mm link between Pukete Reservoir and the 450mm on Te Wetine Dr, disconnecting from the 250mm once in place.

Stage 3 - relates to remaining available development east of SH1 to Exelby Rd involving a 450mm bulk main across SH1 and 13km of 250mm trunk mains west of SH1.

Figure 2-9 below shows the existing and proposed water supply infrastructure for the Mangaheka upper catchment and the northern part of the Rotokauri catchment.

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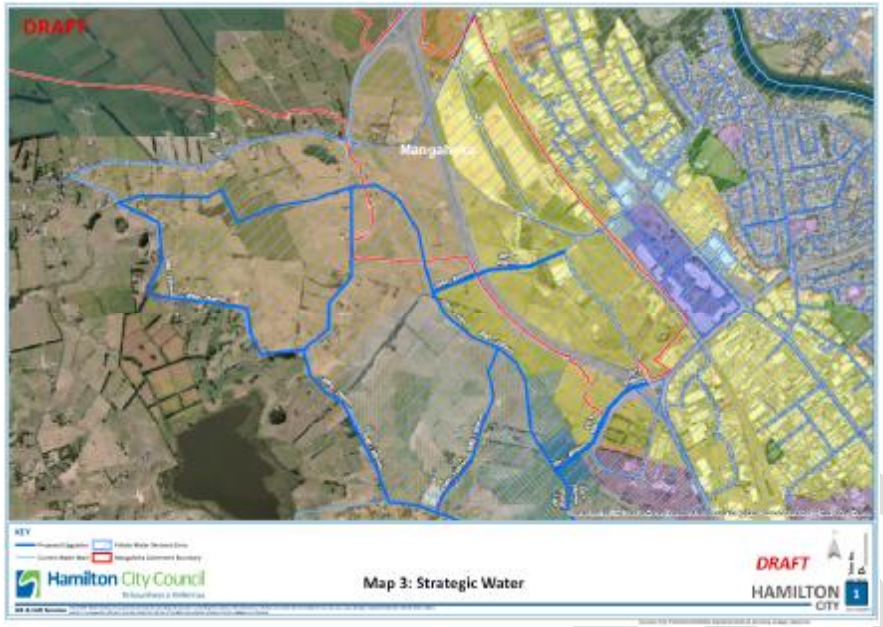

Figure 2-9: Existing and proposed water supply infrastructure

The Mangaheka catchment is currently serviced by the Bulk watermain network in Wairere Drive and sits within the Pukete Demand Zone (Water Master Plan 2015).

Historically, due to the rural nature of much of the catchment, existing dwellings have rainwater tanks and/or a trickle feed system to provide for their water needs. The City water reticulation will be progressively extended by both developers and Council to service growth in the upper catchment area.

A new 24 mega litre reservoir is now operational at Kay Road within the Otama-ngenge catchment. As indicated in Figure 2-9 an existing 520mm dia trunk main along Wairere Drive will be extended along Te Wetini Drive on the western side of the Expressway in 2018 with remaining trunk main extensions within the area between Te Kowhai Road in the north and Lee Road in the south planned to take place around 2060.

This water network will improve the security of supply and match the demand for all of the Rotokauri Structure Plan area. Based on the growth density predictions for the Hamilton City Council area, the Mangaheka catchment is not anticipated to have a significant increase in population, with most development anticipated to be light industrial, hence the water network expansion will largely service the future industrial land use within the upper catchment.

Both the water and wastewater trunk networks will be developed in a staged approach that is timed to meet growth needs by both the private sector and the Hamilton City Council network programmes.

The City Wide Strategic Master Plan identifies that estimated losses from leakages within the HCC water supply network, are predicted to exceed recommended levels of service (i.e. leak-free supply) for the Rotokauri area (2014 Detailed Water Supply Modelling Report). There are no other issues attributed to poor LOS in the catchment.

2.5.2 Wastewater network

The network diagram for wastewater infrastructure in Mangaheka catchment and immediate surrounds is provided in Figure 2-10 and Appendix B-3. Wastewater discharge from existing development and planned future industrial development in the Mangaheka Catchment and

Te Rapa Northern Extension areas 1C (residential) and 1E will be serviced by the Far Western Interceptor (FWI). The existing FWI is 1050mm in diameter and extends southwest from the Wastewater Treatment Plant (in Pukete) under the North Island Main Trunk Railway to the Te Rapa Bypass where it tracks parallel to the road to within 400m of the Te Wetini Drive Interchange. There are several connection points at manholes along the alignment.

There is approximately 20ha of undeveloped land within the Mangaheka catchment. A new 150 mm pipeline flowing west to the FWI will be required in future to collect flows from this area.

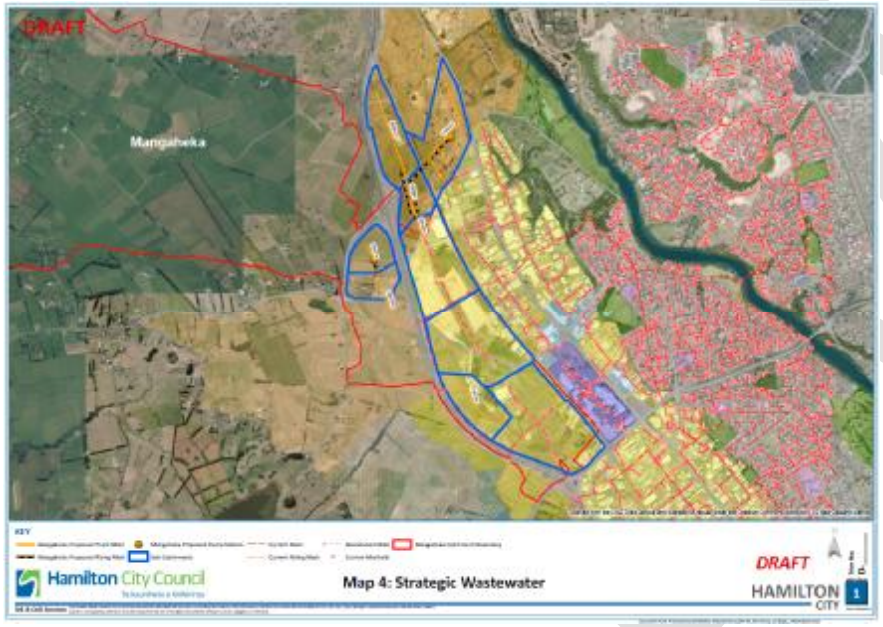

Figure 2-10: Proposed wastewater network extension

Northern extension 1C

There is approximately 25ha of undeveloped land within the Northern Extension 1C (residential) Te Rapa area, which sits outside of the Mangaheka hydrological catchment but will be serviced by the Far Western Interceptor.

The area slopes to the north which makes the northern extremity too low to be collected directly by gravity (based on existing topography). The area is also too low and far away to gravitate to the east to be collected by a pump station in the northern extension 1E area. As a result, approximately half of this area will be serviceable by gravity network and the other half will require a lift pump station to raise flows up to the gravity network.

The proposed pump station may be able to be eliminated through detailed assessment based on future ground levels or flatter gradients than allowed by the ITS. An increase of approximately 1.5 m in ground level in the northern extent would be required to make gravity collection feasible. The portion serviceable by gravity will require an approximate 225 mm diameter pipeline flowing south to the 600 mm trunk pipeline proposed in the Rotokauri ICMP. The downstream elevation of this is constrained by the existing connection point to the FWI (manhole WWK09003) which has an invert level of 25.64 m. The 225 mm pipeline will also collect pumped flows from the northern half of the area and possibly some gravity flow from the Rotokauri catchment along the alignment.

Northern extension 1E

The northern extension 1E area is an area of land north of Ruffell Road with a total sub-catchment area of approximately 82 hectares. The area is bisected by the North Island Main Trunk Railway (NIMT) so a pump station is proposed for either side of the railway. An area of approximately 5.7 hectares from the western half is anticipated be serviceable by gravity to the existing network on Ruffell Road. This area has been accounted for in the existing network (see Section 3.4 operational issues – wastewater below).

Immediately south of Old Ruffell Road there is a 7ha wastewater catchment with an existing gravity sewer. The current proposal is to drain this sewer to an interim pump station located 50m east of the North Island Main Trunk Railway (NIMTR) in Ruffell Road. The pump station will discharge via 90mm diameter rising main which is proposed to run for 400m along Ruffell Road to join into the existing manhole WWJ09001 in Arthur Porter Drive. The capacity of downstream network receiving the pumped flows has been assessed (see Section 3.4 operational issues – wastewater below).

East of NIMT

Approximately 43.6 hectares of the northern extension 1E sub-catchment is located east of the NIMTs (including the 7 hectare area that will be temporarily pumped). This area yields a peak design flow of 18.6 L/s. The area has a central gully with a high bank level approximately 29 m and a base level of approximately 23 m. Based on existing topography the sub-catchment will require a pump station constructed in the low point of the gully with a rising main pumping back up to manhole WWJ09001. The topography is such that a local 150 mm diameter gravity collection network should be sufficient to convey flows to the pump station (subject to detailed design).

West of NIMT

Approximately 38.4 hectares of the northern extension 1E sub catchment, west of the NIMT is not serviceable by gravity. This area yields a design peak flow of 16.3 L/s. The area is generally flat with an elevation of approximately 30 m. The long and narrow sub catchment is suitable for a single central pump station. A central pump station will reduce pipe depths and allow the area to be serviced with one pump station. It may be feasible to locate the pump station at the ends of the area but pipe depths will need to be assessed.

It may be possible to eliminate the western pump station with a gravity network which collects all of the western flows in a central location then flows to the pump station located on the eastern side of the railway. Such a design would have the following implications:

- Eliminate the west pump station
- Increase the design flow for the east pump station. This may also impact the possible discharge connection points for the east pump station.
- A larger rising main and carrier pipe required to cross the NIMT.
- An additional gravity crossing under the railway with trunk main depths potentially in excess of 6m.

The feasibility of the alternative solution could be investigated further by HCC or developers once the future network, topography and road layout is finalised.

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2.5.3 Stormwater network

Two WRC culverts are present in the lower catchment area allowing passage of the stream under Horotiu Road and one providing a tributary passage under Ngaruawahia Road. One WRC culvert is present in the upper catchment on Te Kowhai Road as well as four Hamilton City Council culverts. Hamilton City Council culverts are also present on Burbush Road, Old Ruffell Road and Tasman Road. Stormwater channels are present locally in the south eastern corner of the upper catchment. Two New Zealand Transport Authority (NZTA) culverts are present under Te Rapa bypass.

There are no known issues attributed to poor LOS in the catchment. HCC recoded service requests up to March 2017 indicate routine maintenance only and no ongoing issues. See Figure 2-11 and Appendix B1 for existing and proposed stormwater network.

Three existing stormwater management devices have been developed within the existing industrial area within the upper catchment. These devices have been constructed independently by developers of the Porter Properties Ltd, Hamilton JV Investment Company and 4 Guys areas. The ownership of the structures will be handed over to Hamilton City Council following completion.

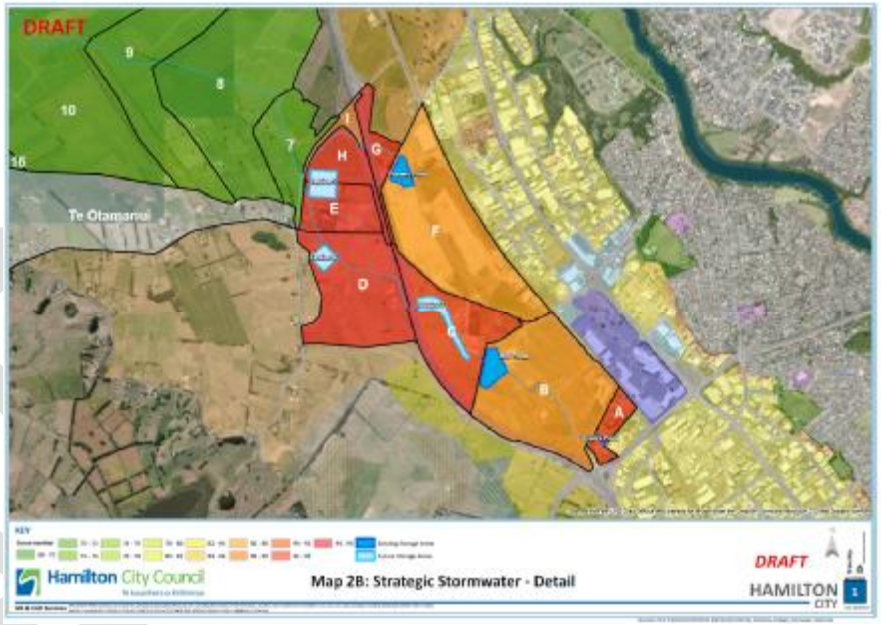

Figure 2-11: Stormwater network – upper catchment

The devices were inspected by CH2M Beca during site visits in June 2016 and a review of the specifications and current condition of each of the devices is provided in the Mangaheka Water Quality Assessment Report in Appendix D. The devices have been designed based on a TP10 wetland, however, none were noted to meet the full specification requirements of a TP10 wetland and so it is anticipated that their performance will be lower than planned. The main differences noted between the design specification and the current devices were limited planting, structural differences and the presence of erosion in places. The 4 Guys Pond, in particular, has been constructed to provide stormwater attenuation only, with the downstream swales and the subsequent HJV pond providing treatment. However, residence times of

stormwater in the swales is reported to be higher than the design specification, therefore this is anticipated to increase the performance of the overall system that is currently in place.

2.6 Surface Water Quantity and Flooding

The planned urban development within the Rotokauri Structure Plan will change the predevelopment rainfall runoff characteristics of the catchment. A greater volume of water will flow off the land in the upper catchment area rather than soaking into the catchment's subsoil as it has previously.

The estimated current impervious area of the full catchment is 9.7 % which includes farm tracks, hardstands, buildings and roads. Under the Operative District Plan light industrial urbanisation is expected to create levels of imperviousness of 90% within the portion of the catchment in the Rotokauri Structure Plan area. The total imperviousness of the total catchment will increase to around 14.9 %[12].

Detailed flood modelling has not been conducted for this ICMP, however a 1D stormwater model[13] has been developed with the primary objective of assessing the impacts of future developments (assuming Maximum Probable Development – MPD scenario) in the catchment on peak water levels and flows downstream, and to confirm what is required to mitigate these effects. The 1D model allows an assessment of flooding potential of a watercourse when there is limited detailed information available.

The model has been based on a previous model of the Mangaheka Stream, developed by Lysaght[14]. The modelling has taken account of the existing and proposed attenuation devices in the upper catchment.

The modelling includes 10-year ARI scenarios however it focuses on the 100-year ARI event as this governs the overall size of attenuation devices and the design of the device outlet structures.

2.6.1 Flood risk

Hamilton City Council plans to undertake a LiDAR survey of parts of the catchment which could be used to develop a detailed 2D flood model in the future. Once undertaken, Hamilton City Council can programme an update to the current flood extent modelling.

No detailed information is currently available on existing flooding within the catchment. The modelling which includes the impacts of climate change indicates that flooding extents in the stream are anticipated to be very similar to those seen in the existing development 100-yr scenario, with the exception of increased ponding at the location of the proposed Device 7 and within Porters Drain area. This similarity between pre and post development is attributed to the design of the proposed stormwater devices, which have been sized to attenuate predicted increased stormwater volumes. Flood maps are included in the 1-D modelling report in Appendix D.

[12] Values determined as part of the stormwater 1D model development

[13] CH2M BECA, June 2017, Mangaheka Integrated Catchment Management Plan - Stormwater 1D Modelling Report

[14] Lysaght Consultants Limited, November 2012: Proposed Te Rapa North Industrial Development, Stormwater modelling – discharge consent

2.6.1.1 Mitigation measures

The 1D model predicts that the effect on water levels resulting from MPD can be mitigated by using the existing and proposed attenuation basins such that there is limited additional downstream flooding effect. This mitigation also results in peak flows from the 100yr event which are at or below existing development water levels (except where increases have been deemed appropriate and acceptable).

One of the overall objectives of this modelling is to confirm that flood levels are not raised by future development. A common method to do this is to reduce peak flows in order to mitigate water level increases. However due to the flat nature of the catchment (the upper catchment in particular), peak flows do not directly correlate with water levels and therefore it is the water levels that have directly governed the device sizing. This has meant that attenuation requirements (in terms of peak flow reduction) are different for each of the devices due to the differing constraints on each (refer to Table 6-2 Design Parameters).

2.6.2 Erosion risk

As noted in Section 2.3.2, downstream erosion of the stream banks appears to be ongoing as a result of a combination of factors including stock access, over spraying and smaller flooding events rather than being the result of larger flooding events such as those investigated by the model. The model does not address potential erosion in the Mangaheka stream such as the potential for destabilisation to stream banks and beds resulting from any increased flows associated with future development.

2.6.3 Land drainage effects

The Mangaheka catchment falls within the Ngaruawahia drainage area administered by Waikato Regional Council. The Waikato Regional Council technical report notes the importance that maintenance of the drainage system results in the same standard right throughout each respective system; as the intention is that ponding is shared equally throughout the system when runoff rates exceed the system capacity. A variation in standard would result in ponding clearing from land with the higher standard and accumulating on land with the lower standard.

Potential effects of urbanisation within the upper catchment that may impact on rural land drainage include capacity issues, ponding after rainfall for longer periods, bank instability in waterways, and increased operation and maintenance requirements. However the means of compliance previously described is considered the BPO for managing increasing urbanisation in the catchment. Flow volumes are predicted to increase due to urbanisation, therefore it is recommended that the downstream rates collection areas are extended into the areas to be urbanised to ensure funding of the waterways maintenance and management is distributed equitably.

O&M and minor Capex costs are likely to increase as a result of this urbanisation as a result of:

- Increased vegetation management
- Erosion protection works to repair existing areas of the stream affected by erosion
- Culvert enlargement of existing structures if required

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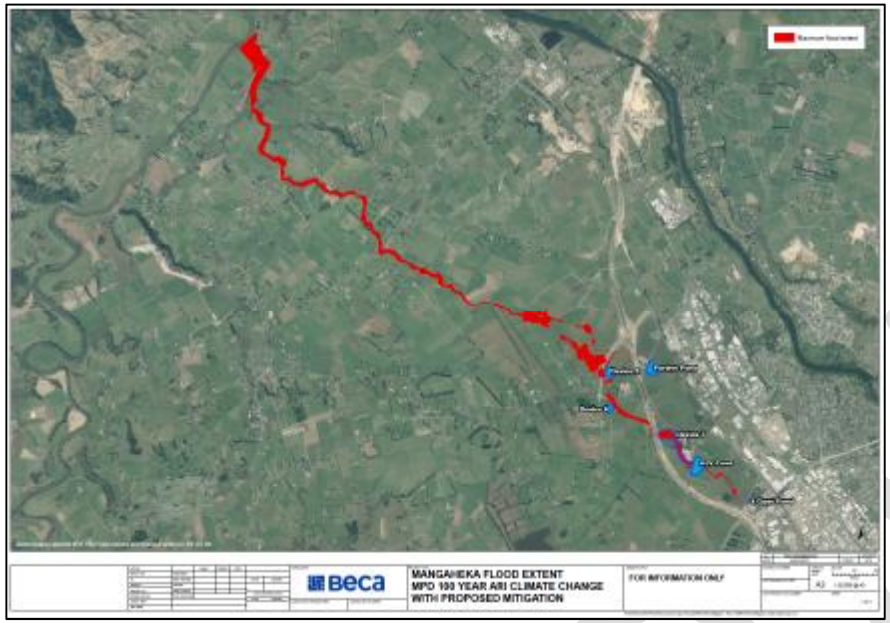

Figure 2-12: Predicted 100 year ARI event flooding extent within the Mangaheka catchment

Drain bank stability may be affected by increased flow velocity, frequency, and duration. However, the proposed wetland and swale devices are expected to attenuate peak flows. Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then on-lot contaminant removal and habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate. Flow conveyance beneath road corridors will be required to maintain land drainage.

2.6.4 Hydraulic analysis

2.6.4.1 Culvert capacity

Detailed assessment of the culverts associated with Mangaheka Stream has not been conducted, however, an indication of each culverts capacity to transfer predicted waterflows during storm events is provided by the 1D modelling assessment.

Mangaheka Stream culverts are identified beneath the following roads:

- Arthur Porter Drive
- Waikato Expressway
- Te Kowhai Road
- Koura Drive
- Horotui Road
- Ngaruawahia Road

The 1D modelling report indicates that culvert capacity restrictions beneath Waikato Expressway (after the proposed Device 7); Te Kowhai Road, Koura Drive and Ngaruawahia Road could lead to localised flooding on their upstream side, however, it has not been assessed if any of these would lead to overtopping of the roads – except at Waikato Expressway which is confirmed to be at an adequate level to avoid overtopping in the 100 year event.

2.6.5 Land drainage

When assessing network capacity the modelling indicated that the proposed mitigation devices do not result in overbank flooding with a duration of longer than 24 hours. This is a key requirement of Land Drainage Board managed by WRC to avoid areas of farmland from being

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affected by surface flooding for longer than 72 hours which can lead to grass die-off.

2.6.6 Overland flow

Stormwater runoff that exceeds the capacity of the reticulation system is required to be safely conveyed by overland flow paths.

To prevent localised flooding as an area is developed, designated overland flow paths need to be incorporated into the design and layout of subdivisions. Overland flow paths shall be provided to convey flows in excess of the design storm, up to and including the 100 year ARI event. Roadways will form these secondary flow paths as far as possible. However, where necessary, overland flow paths required over private land will be formally recognized and protected as part of the consenting and construction processes.

Two potential overland flow paths, during large storms, have been identified associated with the upper catchment (refer Figure 2-13). It is considered that the Mangaheka Stream could potentially overflow into the Te Otamanui catchment as a result of flooding around the culvert exit beneath Koura Drive. This periodic connection between the streams would likely have occurred more frequently in the past prior to Koura Drive being constructed. However, now, it is anticipated that floodwater would flow up the swale on the west side of Koura Drive and overflow westwards into the path of Te Otamanui Stream.

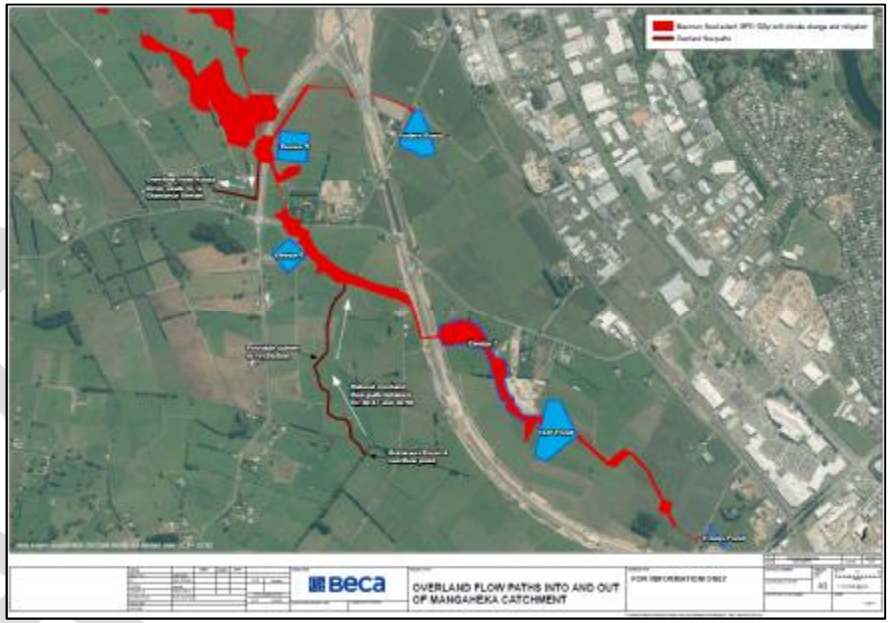

Figure 2-13: Overland flow paths into and out of Mangaheka catchment

The other overland flow path from Rotokauri catchment is anticipated likely to occur should the culvert below Exelby Road become blocked during heavy rainfall. The blockage could lead to a backing up of the stormwater in the Rotokauri swale culminating in overflow approximately halfway between Burbush Road and Waikato Expressway. The predicted flow path is visible as an established feature on satellite imagery indicating that this has occurred in the past.

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3 Issues and Objectives

This section discusses outcomes and issues identified through the technical assessments undertaken for this ICMP, and compares existing and proposed infrastructure to the Strategic Catchment Objectives detailed in Section 1.8. Specific consideration of relevant requirements of the Hamilton District Plan (HDP) and the Rotokauri Structure Plan (RSP) which applies to part of the upper catchment.

The following represents a brief summary of the key findings of the technical assessments in terms of issues to be considered, for which the detailed reports are provided in the appendices to this ICMP.

To put the findings of the technical assessments in context, the key features of the Mangaheka Catchment are:

- The majority of the catchment (forming the lower catchment) is occupied by greenfield and agricultural land utilised for a combination of dairy, dry stock and crops;
- The upper catchment is occupied by existing roads and industrial properties together with land zoned for future industrial development;
- The majority of three waters infrastructure is located in the upper catchment;
- The focus of the technical investigations and assessments has been to identify requirements and options to limit impacts in the lower catchment from alterations in stormwater flows and volumes due to infrastructure and industrial development in the upper catchment.

3.1 Background Context

A number of studies have been completed previously within the Mangaheka catchment relating to proposed development together with periodic monitoring such as ecological and environmental indicators in the Mangaheka stream. Available reports and data have been reviewed to assist in building a picture of current environmental and developmental conditions in the catchment. In addition, the RSP provides information on part of the upper catchment; and details development zones and intended growth of the area and surrounds.

The subsequent focus of the ICMP has been on the requirements needed to limit impacts from changes in stormwater composition and flows associated with development in the upper catchment.

3.1.1 ICMP development

Based on information known about the catchment, issues have been identified that require management under this ICMP.

Operational catchment objectives will address the specified issues and align with strategic objectives of this plan.

In some cases there may be a conflict between developmental yield targets and environmental requirements. There is a clear expectation that in meeting development targets permitted by the District Plan, the receiving environment will not be further compromised. Further, given the ecological significance of the catchment as a habitat for threatened native aquatic species, preference must be given to those methods that enhance water quality and habitat values.

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3.2 Stormwater and Receiving Environment Assessments

Urban development within the Hamilton City Council portion of the catchment will increase the amount of impervious surfaces such as roofs and roadways and can lead to increased runoff, increased flow velocities in streams, and potentially destabilisation of the stream banks. The following identified operational issues have the potential to impact on the way three waters are managed and dealt with within this catchment. These are:

(a) Limited stormwater capacity of Mangaheka stream and erosion risk

In the upper catchment the artificially channelled stream drains are small and have steep banks which are already susceptible to erosion as identified in the watercourse assessment[15]. It is anticipated that any increases in stream flow volumes will lead to an increase in erosion of these banks. A lack of riparian vegetation on the stream banks will also potentially exacerbate erosion of the banks via overland flow and soil saturation in these areas. Remediation measures as discussed above will be required to mitigate any further erosion in the areas identified.

(b) Flood risk

Continued urbanization of the industrial area in the upper catchment will increase the rate of run off with increased flow velocities and volumes due to impervious roofs, roads and pavement areas. The development of appropriate stormwater management structures in the industrial area will be key to minimizing changes to subsequent storm flows downstream. A no more than minor change in flood risk is anticipated under MPD compared to existing development levels. Runoff, ponding, overland flow and infiltration in agricultural areas in the remainder of the catchment is unlikely to change significantly as long as there is no significant change in land use in this area.

(c) Soakage capacity

Peaty soils are recorded to be present over much of the upper catchment area, however, due to existing and planned development of the industrial area it is expected that much of the peat soils will have been, or are planned to be, removed prior to establishment of appropriate building platforms.

(d) Ecological values

The catchment has a predominantly rural land use with little or no native vegetation remaining therefore the ecological values of the catchment are moderate in line with the surrounding similar catchments in the Hamilton area. The Mangaheka stream catchment is considered to be on-par with other Hamilton waterways with a moderate to poor water quality, peat-influenced groundwater baseflows and a low macroinvertebrate community index. Nonetheless it is recorded to provide habitat for three native fish species: longfin eel, shortfin eel and banded kokopu and potential habitat within parts of the stream for

[15] Morphum Environmental Ltd, March 2017: Mangaheka Watercourse Assessment and Programme of Works

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threatened black mudfish. It is also noted that the giant kokopu is present within the adjacent Rotokauri Catchment.

The chemical composition of the stream waters are already recorded to contain nutrients, metals and faecal pathogens. The planned development in the upper catchment is considered likely to have some effect on the metal and nutrient levels within the stream despite the proposed development of swales and stormwater management structures. However the extent of this potential effect will be dependent on the nature of the activities of individual developments. Stormwater runoff from the proposed industrial development area is also anticipated to have the potential to have higher turbidity and increased temperature which can lead to a reduction in dissolved oxygen and detrimental general environmental conditions for aquatic organisms. Despite proposed mitigation measures, there is unlikely to be any positive changes to water quality as a result of anticipated landuse change and development in the upper catchment. The majority of the catchment land use is anticipated to remain as per the current rural use.

Maintaining the planned and existing wetlands within the catchment is considered appropriate to reduce the vulnerability of the catchment to detrimental effects.

(e) Sediment

Sediment arising from earthworks can have temporary detrimental effects by smothering the stream's aquatic habitat. It is important that development provides appropriate local treatment to minimise any potential effects of sediment before exiting the upper catchment and that earthworks activities ensure adequate on-lot sediment and erosion control measures are in place. Effective monitoring and enforcement of this is required.

(f) Risks to public health and safety

While waterways are viewed as both a stormwater asset as well as an amenity feature to the community, some stormwater assets are inherently risky to public safety. The public can access lined channels, deep ponds, inlets and outlets, and on occasions manhole lids can lift. It is important that the stormwater network, especially in urban/future urban environments, is provided in a manner that minimizes the risk to the public health and safety, and adequate consideration is given to the design of such features. Large areas of standing water associated with detention devices that are not shallow wetlands can also be a hazard. The faecal pathogen load is recorded to be high in the stream (as per other catchments in the Hamilton area) and thence this poses a risk to both the public and livestock. The impact of faecal pathogens and metals within the stream water can represent a risk to the public due to transfers to fish and plants (such as watercress) which could be used for consumption in the lower part of the catchment.

(g) Maintenance of proposed devices

The nature and frequency of routine maintenance needs to be factored into device selection in conjunction with access and traffic management requirements. An issue for on lot devices is the ownership and maintenance responsibility (including stormwater collection for re-use). The effect of maintenance, plant control, or lack thereof, on the receiving network, environment or public health must be considered where on lot devices are proposed.

(h) Economic constraints

The stormwater disposal network needs to be provided in a cost effective manner to Council by making use of natural land features and

existing disposal systems. Land developers must provide an efficient stormwater management asset. It is expected the future wetlands will have economies of scale. Collaboration with other developments should be investigated and implemented if feasible.

(i) Land drainage area requirements

The stormwater infrastructure proposed for development must take into account and mitigate potential impacts on downstream rural land and landowners. Potential impacts identified in the Waikato Regional Council Technical Report on Managing Landuse Change include:

- 1. Capacity issues.
- 2. Areas ponding for longer than 3 days
- 3. Bank and channel instability
- 4. Increased inspection and maintenance requirements.

The required Level of Service is to remove ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') within three days." This level of service will need to be maintained post development using proposed mitigation measures and as shown within the network capacity model.

3.3 Key Operational Issues - Water

(i) Water capacity

The main area for development will be in the upper catchment and predominantly in the industrial area. There are currently water mains installed in the industrial area ready for connection by developments. It is expected that water capacity will be sufficient for development of the upper catchment. The development of wet industries in the industrial area is not expected and has not been considered at this stage. The presence of wet industries would potentially have an impact on the water capacity.

(j) Water allocation and pressure

While achieving the Level of Service for the water network is not likely to be a problem, water conservation, non-revenue water and demand management measures will always need to be considered and implemented in order to be resilient and cost effective.

3.4 Key Operational Issues - Wastewater

Existing serviced areas have been assessed for their compliance with the ITS and suitability for conveying flows from other sub catchments (based on current Hamilton City Council GIS asset data). Collection and distribution networks should generally emulate the existing city network in order to maximise commonality and efficient maintenance (i.e. conventional gravity sewers).

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Mangaheka existing network 1 (Arthur Porter Drive & Chalmers Road)

This area has three lengths of 150 mm diameter gravity pipeline flowing south to the FWI. The three branches were assessed based on the average grade and the as-built drawing for the sub-division. Overall, it is concluded the pipe capacity is sufficient for sub-catchment area, although the pipe grade is flatter than ITS standard of 0.55% for 150 mm diameter pipes, 0.33% for 225 mm diameter pipes (*AECOM 2017*).

Mangaheka existing network 2 (south of the FWI)

This area has a central gravity pipeline 150 mm and 225 mm in diameter. The pipeline flows north to the FWI. This gravity pipeline has been assessed as two lengths based on the average grade and the GIS pipe diameter. Pipe capacity is sufficient however pipe grade is flatter than ITS standard of 0.55% for 150 mm diameter pipes (AECOM 2017). The network constructed in this area appears to have sufficient capacity and depth for future development. The upstream reaches of the trunk main are however flatter than the ITS standard.

Mangaheka existing network 3 (north of FWI)

This area has a central gravity pipeline 300 mm and 375 mm in diameter. The pipeline flows south from Ruffell Road to the FWI. This gravity pipeline has been assessed as two lengths based on the average grade and the GIS pipe diameter. The upstream end of the 375mm pipeline is assumed to be the intended future connection point for pumped flows from the northern extension 1E sub-catchment. The upstream end of the 300 mm pipe could also be used as the connection point so has also been assessed for capacity to take pumped flows.

An additional 5.7 hectares of the southern end of the northern extension E1 zone may be able to be serviced by gravity network to this main based on existing topography. Pipes have sufficient capacity and grade to receive pumped flows from the Northern Extension 1E and the local gravity network.

The estimated catchment areas used for the assessment total 79.5 hectares from the following areas:

- 43.6 hectares pumped from the northern extension 1E east of the railway.
- 38.4 hectares pumped from the northern extension 1E west of the railway.
- 5.7 hectares of gravity network from the northern extension 1E west of the railway.
- 35.1 hectares of local gravity flows from Existing Area 3.

The network constructed in this area appears to have sufficient capacity and depth for future development. The upstream reaches of the trunk main are however flatter than the ITS standard.

Pump stations

Due to the existing low lying terrain 3 indicative pump stations design parameters and locations have been assessed, together with emergency storage (Aecom 2017). These are provided in more detail in Appendix I.

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Wastewater conclusion

The majority of the Mangaheka catchment already has gravity trunk network installed or planned. Existing serviced areas have been assessed for their compliance with the ITS and suitability for conveying flows from other sub catchments. Preliminary pipe sizes and strategic network layouts have been identified for the areas where no existing network is installed or planned. The key findings of the assessment are as follows:

- Existing network generally has sufficient capacity for future flows with most pipes meeting or coming close to having capacity for ITS flows. There are however instances where there the ITS minimum gradients are not observed and may require operational cleaning.
- A pump station will be required for the low lying areas of the northern extension 1C subcatchment. The remainder of this area can be served by gravity connection to the 600 mm trunk identified in the Rotokauri ICMP.
- Two pump stations will be required for the northern extension 1E sub-catchment. It may be possible to remove the western of these two pump stations if a gravity connection can be achieved to the east with a new pipeline under the railway.
- A temporary pump station is proposed to for an existing 7 hectare area of development south of Old Ruffell Road. The rising main will need to be constructed under the railway with a carrier pipe to meet the Kiwirail standards. Design of the carrier pipe should consider the rising main sizing for a fully developed situation.

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3.5 Operational Objectives

Table 3-1: Operational objectives for Mangaheka catchment

Operational Objective	Description
Operational Objective 1:	**Maintain or Enhance Mangaheka Stream Water Quality**
–	a. Contaminants derived from urban or road stormwater are managed through appropriately designed treatment devices, so that any increase in mass contaminant loads and concentrations in the receiving environment following development, are minimised as much as practicable. For general guidance purposes the following guidelines (or updates thereof) are referred: i. For in-stream water quality and comparison with baseline contaminant concentrations: ANZECC, 2000 – 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' ii. For in-stream sediment quality and comparison with baseline contaminant concentrations: ANZECC, 2000 – 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality / Interim Sediment Quality Guidelines (ISQG)' iii. For treatment device design and performance efficiencies: HCC ITS b. Primary stormwater treatment devices must achieve at least 75% sediment removal on an average long-term basis. Devices servicing roading should be suitable for the removal of hydrocarbons and heavy metals. c. To avoid increases in temperature in downstream receiving waterways, open water areas must be avoided in treatment devices and wetland vegetation cover must exceed 80% of the device surface area. d. Where it is shown that a single device will not address receiving environment sensitivities, that a treatment train approach should be adopted and to minimise temperature effects and maximise contaminant removal. e. Construction generated sediment shall be controlled to meet Waikato Regional Council standards and shall comply with relevant city bylaws and District Plan requirements. *This objective addresses issues d) ecological quality and e) sediment in Section 3.2, and aligns with strategic catchment objective 6 (refer to Section 1.7).*

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Operational Objective	Description
Operational Objective 2:	**Minimise Alterations to the Natural Flow Regime**
	a. The erosion and scour of the bed and banks of the Mangaheka stream and other catchment waterways is not increased following proposed development within Hamilton City Council boundary. Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then additional mitigation measures will be required (e.g. on-lot treatment / detention). b. Where stormwater discharge to the Mangaheka stream needs to occur, extended detention shall be provided by the proposed stormwater management structures in accordance with ITS to control flow velocities and erosion. c. Energy dissipation and erosion protection measures are provided at all discharge locations, and preference is given to green engineering solutions over hard engineering solutions based on rock and concrete. d. Stream flooding in a land drainage area shall be managed to the extent that the ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') shall be removed within three days. *This objective addresses issues a) stormwater capacity and erosion, and aligns with strategic catchment objectives 4 and 10 (refer to Section 1.7).*
Operational Objective 3:	**Utilise Water Sensitive Practices**
	a. Where on-lot and soil conditions allow, stormwater shall be discharged directly to ground via soakage. This will minimise increases in discharge volume, help to recharge groundwater, maintain stream base flows, and mimic the natural water cycle. b. The use of 'water sensitive practices' shall be incorporated into the stormwater management approach for the catchment. c. Where it is shown that a single device will not address flood risk or receiving environment sensitivities a treatment train approach shall be adopted. *This objective addresses issue a) stormwater capacity and erosion, c) soakage capacity, h) economic constraints and i) land drainage requirements, and aligns with strategic catchment objectives 2, 7, and 10 (refer to Section 1.7).*

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Operational Objective	Description
Operational Objective 4:	**Promote Riparian Margin Enhancement and Re-Vegetation**
	a. Riparian planting shall be undertaken to mitigate effects of urbanisation in potentially affected areas. b. Stock fencing shall be erected along stream banks to reduce bank erosion as well as help reduce suspended solids and pathogens in the water column. c. Works using natural solutions or green engineering which will enhance habitat and maintain natural stream processes in a soft sediment environment are preferred over hard engineering solutions using rock and concrete. *This objective addresses issue d) ecological quality, and aligns with strategic catchment objectives 1, 2 and 5 (refer to Section 1.7).*
Operational Objective 5:	**Have Due Regard for Economic Affordability and Safety**
–	a. Proposed stormwater management systems are cost-efficient during long term operation and maintenance. b. Stormwater and wastewater management systems are designed for public safety. c. Where it is shown that a single device will not address flood risk or receiving environment sensitivities, that a treatment train approach, incorporating an approved at source device upstream of a centralised public device, shall be adopted. *This objective addresses issue g) maintenance of devices and h) economic constraints, and aligns with strategic catchment objectives 1, 4, 8, 9 and 10 (refer to Section 1.7).*
Operational Objective 6:	**Protect Cultural Values**
	a. Riparian planting shall be encouraged by Hamilton City Council throughout the catchment in conjunction with developers, landowners, local iwi and other interested parties. Planting shall include an appropriate mix of native eco-sourced plant species. *This objective addresses issue d) ecological quality e) sediment and f) public health and safety, and aligns with strategic catchment objectives 1, 2, 3 and 5 (refer to Section 1.7).*

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Operational Objective	Description
Operational Objective 7:	**Maintain or Improve Flood Protection Level of Service**
	a. Where existing flooding is known, or potential flooding is predicted, peak flow management is generally required with reduction to 70% of predevelopment flow for the 100 year ARI storm event. b. Overland flow paths shall be provided for all stormwater discharges in accordance with Hamilton City Council standards. Wherever possible, the use of private property for overland flow paths shall be avoided. c. Sufficient freeboard protection, in accordance with Hamilton City Council standards, shall be provided to building floor levels. *This objective addresses issues a) stormwater capacity and erosion b) flood risk, f) public health and safety i) land drainage requirements, and aligns with strategic catchment objectives 1 and 4, (refer to Section 1.7).*
Operational Objective 8:	**Minimise water consumption and wastewater discharge**
	a. That rainwater re-use tanks are installed and plumbed into non-potable water systems on-lot. b. That water efficient fittings are incorporated into businesses and promote sustainable water use practices. c. That the size of infrastructure is minimised by promoting sustainable water use. d. That future infrastructure upgrades are avoided or minimised by identifying and managing inefficiencies such as leakage, inflow & infiltration and unauthorised use. *This objective addresses issues h) economic constraints, j) water capacity, k) water allocation and pressure and l) wastewater network and aligns with strategic catchment objectives 7, 8, and 11 (refer to Section 1.7).*
Operational Objective 9:	**Integrated water management**
	a. Plan and implement three waters networks on a catchment wide basis to minimise the number of public stormwater treatment devices, wastewater pump stations and storage devices. b. Where it is shown that a single device will not address receiving environment sensitivities, that a treatment train approach, incorporating an approved at source device upstream of a centralised public device, shall be adopted and include minimisation of temperature effects, metals, metalloids and PAHs. Construction generated sediment shall be controlled to Waikato Regional Council standards and relevant city bylaws. This objective addresses issues a) stormwater capacity and erosion, g) maintenance of devices and h) economic constraints quality and aligns with strategic catchment objectives 7, 8, 9 and 11 (refer to Section 1.7).

4 Stormwater Management

This section identifies options that will meet operational objectives and cover the nature of the discharges arising from development in the Hamilton City Council Mangaheka catchment. Consistency with Hamilton City Council's stormwater management hierarchy and Stormwater Management Plan (SWMP) is required. Options not considered to be viable are not included in the evaluation. Examples which make an option viable include the following:

- Technical feasibility
- Ability to meet relevant legislative requirements
- Consistent with the principles of the Waikato Tainui Environmental Plan
- Aligned with the catchment specific objectives outlined in this document
- Must have better environmental, social or cultural consequences than doing nothing
- Does not contravene any explicitly stated political objective
- Does not result in an increase in risk
- Does not increase health and safety risks compared with doing nothing.

Water sensitive 'principles' are required to be incorporated for all development proposals. Management principles that would apply under a water sensitive approach include:

- Minimise disturbance of soils
- Preserve and recreate natural landscape features
- Reduce effective impervious cover
- Stormwater disposal should mimic, to the extent possible, the natural drainage processes that currently exist
- Modifications to existing natural drainage patterns should be kept to a minimum
- Riparian margins to be designated, planted and protected
- Effective impervious area increases should be kept to a minimum
- Disconnect impervious surfaces
- Utilise conveyance and stormwater treatment methods that also provide ecological and amenity benefits.

4.1 Option Identification- Stormwater

Table 4-1 provides a list of methods that could be used to potentially address stormwater management issues in the catchment, with commentary regarding how the option could be implemented.

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Table 4-1: Stormwater management options

Management options	Description	Application in the Hamilton City Council Mangaheka catchment
On lot solutions		
Soakage	Soakage minimises the volume of stormwater to be managed by reticulation and provided for groundwater recharge. Soakage systems may need pre-treatment to prevent sediment clogging of the system.	The soil type in the development area generally has limited soakage capability. While soakage is a useful part of the treatment train approach in upper Mangaheka sub-catchment, discharges are required to maintain base-flows in south branch waterways.
Sand Filters	Sand Filters are useful where space restrictions apply and they can be designed to take traffic loads. Sand filters often include a settling chamber for removal of coarse material followed by a tank containing the filter media. Finer materials are trapped or adhere to the filter media. Their limitation is that they can generally only service a small area.	Sand filters could be used for treating water from car park areas and high traffic use areas such as intersections as expected in industrial developments.
Rain Gardens/Bioretention devices	Rain gardens are another form of filtration device that use plants and layers of media (e.g. mulch, planting, soils, gravel under drain) for contaminant removal. There may also be treatment through infiltration of stormwater to the base of the rain garden, depending on the underlying soils. Rain gardens will be suitable for treating runoff from small areas.	Bioretention devices are generally used for treating water from industrial sites and car park areas and so could be applicable within the upper catchment.
Oil separation	Tanks and/or filters used to segregate oils from stormwater. Several products are available that specifically target oils and greases. Devices are most applicable to areas where this is the contaminant of concern e.g. garages.	Useful for industrial areas dependent on specific on-lot activities planned. This may be needed for High Risk activities (refer Stormwater Bylaw)
Rainwater reuse tanks	Rainwater tanks are above or below ground tanks which are used to store rainfall collected from roof areas for non-potable use inside and outside the building. These tanks have two functions. They reduce the total volume of stormwater which runs off your lot, especially from the frequent small rainfall events, and they reduce the demand for potable water from the council water supply system	Suitable for residential homes as well as commercial and industrial developments. Can be used for non-potable water use, including toilet flushing, laundry use and garden watering
Detention	Detention tanks work by temporarily storing the rainwater runoff during a rainfall event and then slowly releasing the water through a controlled small diameter orifice. This storage and slow release of the rainwater reduces the peak stormwater flows	Detention may be suitable where on-lot soakage is not available, however the presence of the wetland area downstream and potential impacts

Management options	Description	Application in the Hamilton City Council Mangaheka catchment
	during a rainfall event and which in turn reduces the impacts on downstream infrastructure and/or streams.	associated with extended peak flows in the lower catchment needs to be considered during design.
Permeable surfaces	Permeable surfaces are surfaces which absorb and detain stormwater reducing runoff to stormwater infrastructure. Natural permeable surfaces include grass and landscape and planted areas. Constructed permeable surfaces generally consist of a layered construction to enable rainwater filtration to either ground soakage or an underdrain connected to an approved stormwater outlet.	The first preference is to retain existing natural permeable surfaces, including grass and planted areas. Where hardstand areas are necessary for the development proposal, constructed permeable surfaces can be used that still achieve infiltration of the stormwater runoff to ground. Constructed permeable surfaces may be required where there is no downstream centralised wetland or pond available within the immediate catchment.
Building and landscape design	Set floor levels above flood levels and away from overland flow paths. Ensure landscaping (including driveways, walls and structures) does not block, divert or convey overland flow in a way that causes ponding or potential flooding of buildings.	Required either specifically under the District Plan or generally under the RMA and/or Building Act
Centralised Devices and Practices (Community based)		
Soakage	Refer to discussion under 'on lot'	Catchpits could incorporate soakage sumps for limited soakage but would still require reticulation.
Rain gardens/ Bioretention devices	Refer to discussion under 'on lot'	Rain gardens could also be used to target intersections for improved water quality should monitoring indicate the proposed wetland devices do not remove sufficient contaminant load.
Reticulation	Reticulation will manage the increased stormwater runoff from impervious areas in a controlled manner and control runoff and nuisance flooding to LOS.	Some form of servicing required as part of development proposal.
Subdivision design for secondary overflow	Secondary overland flow paths are necessary to manage runoff that exceeds reticulation LOS (e.g. 2 year ARI flows) residential Standard.	Required as part of development proposal.
Wetlands (off-line)	Constructed wetlands consist of shallow vegetated pond areas. Wetlands are only practicable where space is available for construction. Wetlands remove contaminants through physical and biological processes. Extended detention can be incorporated to moderate storm flows. Off-line wetlands are	Wetlands are an appropriate form of treatment within the Hamilton City Council Mangaheka Stream catchment for effective contaminant removal, maintaining low downstream temperatures, and attenuating stormwater flows.

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Management options	Description	Application in the Hamilton City Council Mangaheka catchment
	reported to typically allow more efficient contaminant removal than on-line wetlands.	Wetlands may also provide or enhance indigenous biodiversity particularly where the historic environments were wetlands as is the case in the Mangaheka catchment. Three wetland devices have already been consented for the catchment, with the detailed engineering plans yet to be approved.
Water quality ponds	Where space is available, ponds can provide flood mitigation and improve water quality by settling suspended sediment. Potential for adverse temperature effects. Ponds do not provide the potential contaminant removal capacity of wetlands.	Effective at removal of some contaminants but can contribute to reduced water quality for other parameters such as temperature (too high for fish and plants) and dissolved oxygen. Therefore, wetlands are preferred due to enhanced contaminant removal, maintained water quality, and potential for biodiversity enhancement.
Swales	Swales use a combination of slow, shallow flow and vegetation to remove contaminants from stormwater. Swales can be used in place of drainage pipes and to convey flood flows. Swales are most effective on gently sloping lots (1%-5%). In general a width of 3-7m is required to accommodate design requirements (maximum side slope 3H:1V).	In general, Hamilton City Council prefers that swales are used only on limited access roads due to public safety and maintenance requirements. However, in the following circumstances, swales may be considered for local roads and residential areas: • Flat land with high groundwater where the fall required for reticulated stormwater is impractical. • Sensitive receiving environments or sensitive indigenous aquatic species located downstream of discharge points requiring high standards of stormwater treatment. Constrained space or distance within which to achieve stormwater treatment to a sufficient standard using conventional single device-methods.

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Management options	Description	Application in the Hamilton City Council Mangaheka catchment
Filter strips/riparian planting	Filter strips are used to intercept stormwater before it becomes concentrated. The effect of stormwater travelling through the vegetation is to slow down the stormwater allowing some infiltration and removal of contaminants. Riparian planting is a form of filter strip.	Suitable for treatment of diffuse sources of runoff along lengths of a waterway where there is overland flow or shallow sub-surface flow into the waterway, but only in specific circumstances. Riparian planting or filter strips can also contribute widespread habitat, water quality, and bank stability enhancements. Specific methods and plant selection are lot specific but applicable to the main rural Mangaheka waterway downstream of the upper catchment stormwater discharge where there is potential for effects.
Gross Pollutant Traps and Litter Traps	Devices in this category include floating booms, gratings and mesh inserts installed within ponds, culverts and catch pits. Proprietary products are available that use a combination of hydraulic motion and sedimentation to remove contaminants.	The suitability of devices needs to be reviewed on a case by case basis. Application for runoff from industrial/commercial areas with high risk activities may be appropriate but are generally considered unnecessary for the proposed residential areas and roading.
Permeable pavements for car parks and footpaths	Special concrete and aggregate mixes allow water to pass through reducing catchment imperviousness, promoting soakage. There may be a need pre-treatment so permeable matrix does not clog.	Application for treatment of runoff from high traffic or industrial/commercial areas may be appropriate but soils in the catchment are generally unsuitable for soakage from permeable paving.

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4.2 Option Evaluation - Stormwater

Once the options are identified, they need to be evaluated for effectiveness in addressing the Mangaheka catchment risks and sensitivities and meeting the catchment objectives for stormwater management. To facilitate the option evaluation, assessment components are grouped under the framework of economic, environmental, and social and cultural effectiveness. Those options that rank highest in terms of environmental, economic and social/ cultural benefit will form the basis for the Best Practicable Option (BPO) for the catchment.

The qualitative assessment below shows which options are most likely to address catchment issues and meet objectives in accordance with the requirements of the CSDC Condition 30. Relative life cycle costs are considered for those options delivering similar outcomes. Multiple options may be suitable in each situation, and multiple options will be needed to provide full servicing and a treatment train for the developing areas of the catchment.

The effectiveness of a method with respect to each criterion is indicated by ticks (✓) 0-4; the more ticks listed, the more effective the method in addressing the criterion.

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Table 4-2 – Stormwater management option evaluation

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Soakage	Stream channel protection Ground water recharge	Low cost option if soils permit Minimises infrastructure	Very minor flood risk mitigation Reduce discharges at source	Cost effective and provides limited environmental benefits.
	✓✓	✓✓✓✓	✓	Good where soakage is viable. Contributes to meeting operational objectives 2, 3, 6 and 8.
Sand Filters	Contaminant management for car parks and high traffic	High cost and maintenance		Does not provide sufficient benefits to be widely implemented.
	✓	✓		
Rain Gardens/ Bioretention devices	Contaminant management Reduced discharge if infiltration capability included	Moderate cost and maintenance	Amenity value if well planted	Provides some benefits in specific situations
	✓✓	✓✓	✓	Possible limited applicability
Oil separation	Contaminant management for car parks and some industry	Moderate cost and maintenance		Provides benefit if implemented on-lot for relevant activities.
	✓✓	✓		

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Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
Rainwater reuse tanks	Reduces impact of built environment on natural flow regime Capture first flush runoff Reduce peak flows for up to 10 year events	Moderate cost and maintenance. Reduces cost of water supply	Can be used for non-potable water supply including garden watering An option to support resiliency and security of water supply	Cost effective and provides environmental and economic benefits.
	✓✓✓	✓✓✓✓	✓	Good as part of treatment train. Contributes to meeting operational objectives 2, 3, 5, 8 and 9.
Detention	Capture first flush runoff Reduce peak flows for up to 10 year events	Relatively low cost		Cost effective and provides environmental benefits.
	✓✓	✓✓✓		Good as part of treatment train. Contributes to meeting operational objectives 2, 3, 5, 8 and 9.
Permeable Surfaces	Mimics natural flow regime	Moderate cost and maintenance	Can provide functional and aesthetic value	Provides some benefits in specific situations
	✓✓	✓✓	✓✓	Possible limited applicability
Building and landscape design		Relatively low cost as part of overall design	Mitigates flood risk associated with overland flow and ponding	High social and economic benefits.
		✓✓✓	✓✓✓✓	Essential to meet objectives. Contributes to meeting operational objectives 5 and 7.
Centralised Devices and Practices (community based)				
Soakage	Stream channel protection Ground water recharge	Low cost option if soils permit Minimises infrastructure	Minor flood risk mitigation Reduce discharges at source	Cost effective and provides limited environmental benefits. Good where soakage is viable.

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Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
	✓✓	✓✓✓	✓	Contributes to meeting operational objectives 2, 3, 6, 8 and 9.
Rain gardens/ Bioretention devices	Stream channel protection Contaminant management Reduced discharge if infiltration capability included	Moderate cost and maintenance	Minor amenity provided	Provides some benefits, but other options have scored higher
	✓✓	✓✓	✓	Possible limited applicability
Reticulation		Moderate to High cost, relatively low cost maintenance	Mitigates nuisance and flood risk for frequent flows Maintains LOS	Provides high degree of social benefits
		✓✓	✓✓✓✓	Applicable
Subdivision design for secondary overflow	Can incorporate bioretention features	Relatively low cost as part of overall design	Mitigates flood risk Minimises infrastructure	
	√	✓✓✓	✓✓✓✓	Essential to meet objectives. Contributes to meeting operational objectives 5, 7 and 9.
Wetlands (with extended detention)	Stream channel protection Contaminant and temperature management Habitat enhancement Some soakage provided	Economy of scale Less maintenance than pond	Mitigates Flood risk Provides amenity Wetland planting supports mauri Shallowness and planting bench make safer than deep pond	High benefits and already consented in catchment
	✓✓✓✓	✓✓✓	✓✓✓✓	Applicable

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Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
Ponds	Stream channel protection from flow attenuation Can elevate discharge temperature, reduce dissolved oxygen, affect fish passage, and replace stream habitat if online Contaminant management (principally sediment) Some soakage provided unless pond is lined	Economy of scale	Mitigates flood risk Can provide amenity	Provides some benefits, but wetlands with detention score higher and alleviate temperature concerns in this catchment.
	✓✓	✓✓	✓✓	
Swales	Stream channel protection from flow attenuation Contaminant management if densely planted Potential for enhanced indigenous biodiversity if planted	Can reduce reticulation Provide overland flow path	May mitigate flood risk	Cost effective and provides environmental benefits. Good as part of treatment train.
	✓✓✓	✓✓✓	✓✓	Only preferred by Hamilton City Council for limited access roads due to O&M considerations, access complications and conflicts with other services. May be applicable for proposed Waikato Expressway and Arterial

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Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
Filter strips/riparian planting	Contaminant management Stream protection Riparian planting enhances habitat	Very cost effective if space available	Can provide amenity Riparian planting supports mauri	Provides environmental benefits.
	✓✓✓✓	✓✓	✓✓	Applicable in suitable situations.
In-stream channel or riparian modifications	Potential to enhance bank instability Potential to improve aquatic habitat Potential for increased capacity Potential for effects on aquatic life during construction	Can be cost effective if carefully managed	Can be effective in improving cultural and community values on degraded waterways if carefully managed	Must incorporate multidisciplinary approach to design and implementation not limited to a single outcome (e.g. capacity).
	✓✓✓✓	✓✓	✓✓✓	Applicable in suitable situations.
Gross Pollutant Traps and Litter Traps	Contaminant management	Low to moderate cost, maintenance required	Improves visual appearance	On-lot applications can help prevent blockage/ clogging of centralised devices and swales. Potential for use on centralised devices to capture airborne litter etc.
	✓	✓	✓✓	
Permeable pavements for car parks and footpaths	Soakage	Minimise infrastructure	Reduce discharges at source	Does not provide sufficient benefits to be widely implemented.
	✓	✓	✓	

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The above evaluation demonstrates that wetlands and riparian planting provides the highest environmental benefits followed by swales. Rainwater re-use tanks provide water quality benefits and stormwater discharge volume reduction as well as economic benefits. Rainwater tanks are mandatory on new developments and other options with the most economic advantages include soakage, proper building and landscape design, swales and subdivision overland flow paths. Options with good social and community benefits include wetlands, reticulation, overland flow paths and proper building and landscape design. Additionally, wetlands and riparian planting supports the mauri of water.

Based on this evaluation the following stormwater management methods are considered suitable to form the Best Practicable Option (BPO):

On lot devices and practices:

The preferred on lot stormwater management for this catchment includes:

1. Pollution Plan (for high risk activities) to inform on-lot requirements for contaminant management
2. Rainwater reuse tanks (mandatory on all industrial lots, it shall be plumbed back into the toilet and laundry with an option for garden use) as per HDP rule 25.13.4.5.
3. Soakage
4. Stormwater management practices appropriate to industrial land uses when known
5. Standard requirements for all industrial or commercial lots comprise:
    - No exposed zinc or copper building products
    - Gross pollutant traps
    - Carpark areas to drain to stormwater pre-treatment device (e.g swale etc) prior to leaving each lot

Other on lot practices that are encouraged:

- Appropriate building and landscape design

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Centralised devices and practices

1. Wetlands with extended detention and attenuation
2. Soakage (where feasible)
3. Bioretention/raingardens (limited applicability)
4. Subdivision overland flow paths with erosion protection
5. Swales (in limited access roads)
6. Reticulation (treatment required before or after)
7. Riparian Planting

4.2.1 Ownership considerations

Assets that are required to meet a level of service for public good are generally owned and operated by Hamilton City Council, however some categories of private on-lot devices will need to be owned and maintained by the on-lot owner.

Where assets are to be vested to Hamilton City Council, these must meet Hamilton City Council requirements of meeting levels of service, safety, access, flood risk protection, treatment performance, asset life cycle, operations and maintenance and renewals cost (and meet certification requirements of CSDC).

Where assets are to be privately owned, consideration shall be made for how the asset is to be operated and maintained and the risk of asset failure or poor performance accounted for. Private asset ownership is normally limited to on lot assets. Any communal devices are normally vested, and whether public or private must be at the standard of Hamilton City Council Infrastructure Technical Specifications.

Developers must discuss with Hamilton City Council the intent and options of vestment and private ownership prior to approval of development proposals.

The drains in the Mangaheka stream catchment are managed by Waikato Regional Council who manages the expenditure on drain maintenance from land drainage rates (refer Appendix E). Collaboration is required between Hamilton City Council and the drainage board regarding drain performance and future maintenance see Section 6.6 - Future Actions.

4.3 Best Practicable Options (BPO) - Stormwater

This section presents the BPO for the catchment. It includes criteria for managing the discharges that are expected to occur with development in the Hamilton City Council Mangaheka catchment. The BPO organises and integrates the management options, existing standards and consented devices into a servicing approach that addresses issues and objectives in the catchment. This integrated approach to managing stormwater diversion and discharge activities is a key requirement of the CSDC Condition 30.

4.3.1 Flood management

Three existing consented stormwater treatment and attenuation devices are already consented within Hamilton City Council's jurisdiction to manage stormwater from development in the catchment (refer to Figure 4-1). As these are already consented and meet identified flood and network mitigation objectives, they will necessarily form part of the BPO and be reflected in the Means of Compliance table. Stormwater runoff associated with roading projects included in the structure plan is

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expected to discharge into the existing and proposed catchment devices via a swale network.

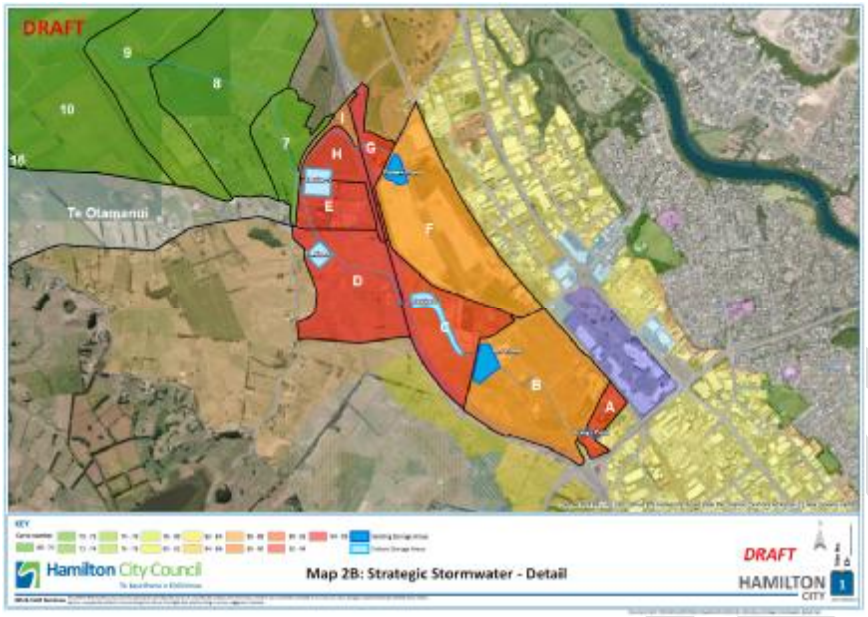

Figure 4-1: Stormwater devices in Mangaheka upper catchment

Therefore the first BPO for the catchment is:

Stormwater BPO 1 – Maintain the existing flood protection Level of Service

a. Due to flood risk, topography and downstream capacity of the Mangaheka stream, flood control shall be installed so that the 100 year ARI post development peak flows are attenuated appropriately as described in the means of compliance table (Table 6-3).
b. Each sub-catchment in the Mangaheka catchment shall be designed with suitable overland flow paths. Where feasible, overland flow should occur within the roading network or through designated paths in public reserve. If needed, suitable energy dissipation and/or erosion protection measures shall be provided.
c. Sufficient freeboard protection, in accordance with Hamilton City Council standards, shall be provided to building floor levels.
d. The stormwater system shall drain to the receiving environment via swales and centralised devices (with a maximum of 1 centralised device per sub-catchment). Refer to [Appendix B3] for existing and indicative location of devices in the development areas.
e. Soakage and attenuation solutions must be designed in order to maintain Land Drainage area Levels of Service requirements. The level of service for flooding in the agricultural areas of the Mangaheka catchment is to be maintained, that is: remove ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') within 72 hours.)

4.3.2 Water sensitive design

Water sensitive works include multiple site-specific stormwater controls that work with the natural landscape and are relatively cost effective. Water sensitive principles must be a part of the design philosophy. Most water sensitive methods assist in controlling runoff at the source in order

to replicate the predevelopment hydrology. Controlling water at the source reduces the stormwater network requirements and may lower costs for developer and the Council. As shown in the option evaluation, options that meet a number of stormwater objectives, are cost effective and that can form part of a treatment train are ranked high and considered suitable for the Mangaheka catchment. Therefore the next two BPOs for the catchment are:

Stormwater BPO 2 – Water efficiency measures

a. Developers are to consider opportunities to implement water sensitive urban design approaches such as on-lot devices, permeable paving, minimising impervious areas and clustering development to retain larger natural spaces within the built form.
b. A water efficiency measures shall be incorporated as part of any new development within the Hamilton City Council boundary, in accordance with HDP 25.13.4.5a and 25.13.4.6. For developments that fall under rule 25.13.4.5a, all measures within the supporting practice notes are considered suitable for the developable area. In accordance with Hamilton City Council's drainage hierarchy, (HDP and ITS) the highest priority for stormwater management from domestic roofs is to capture and re-use rainwater for non-potable uses (e.g. toilets etc and watering landscaped areas) and it should be noted that this is mandatory for industrial lots, followed by soakage and then detention.
c. The opportunity to reconnect stormwater discharges to the Te Otamanui subcatchment is investigated.

Stormwater BPO 3 – Stormwater and soakage opportunities

a. Developers shall undertake sufficient testing to determine if suitable soakage characteristics are present before a piped network is approved. Where soakage is suitable, on-lot soakage shall be the water efficiency measure at the time of Building Consent. See Table 6-3 – Methods to achieve compliance. Requirements for pre-treatment prior to soakage discharge will need to be considered to prevent sediment clogging of the system.
b. Where peat or peaty soils are present, these soils should be retained where possible and on-lot drainage designed to maintain these soils and associated soakage.
c. A development shall attenuate the 2 and 10 year, 24 hour post development events to pre-development levels and attenuate the 100 year, 24 hour post development event to appropriate requirements for specific devices. These calculations should be carried out during detailed design for individual developments.
d. Stormwater devices shall continue to discharge surface waters to the Mangaheka catchment waterways to maintain base flows in downstream ecologically significant habitats.
e. Suitable energy dissipation and erosion protection measures shall be provided at all discharge locations, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions (e.g. using rock and concrete).

4.3.3 Environmental protection

The environmental state of the Mangaheka catchment and downstream areas has already been modified through long term agricultural activities and land drainage. The nature of the stream channels are described in Section 2.3.2. With the change in land use from rural uses to industrial development, further environmental damage could occur but there is also the opportunity for environmental enhancement values. The

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following BPOs are intended to allow development to proceed while maintaining and enhancing environmental values where practicable.

Stormwater BPO 4 – To Maintain or Enhance Mangaheka Stream Water Quality

a. Attenuation will be provided through the swale network and central device.
b. On-lot containment of gross pollutants / improvement of water quality will be achieved through an appropriate at-source device.
c. Swales and wetlands will be designed to remove 75% of suspended solids prior to discharge into the Mangaheka stream.
d. Wetlands will be designed to limit discharges to <23° Celsius at the point of discharge and water temperature increase of no more than 3° Celsius.
e. Wetlands shall be designed to achieve appropriately lowered concentrations of copper and zinc commensurate with greenfield catchments prior to discharge into the Mangaheka stream.
f. Within wetlands, the management of gross pollutants can be achieved through the installation of inlet or outlet screening, such as floating litter traps or net technologies.
g. Swales and wetlands servicing high traffic roading and upgraded roads shall be suitable for the removal of hydrocarbons.
h. High risk activities (i.e. those with the potential for the discharge of unusual or high concentration contaminant runoff (as defined in Waikato Regional Plan and Hamilton City Council Stormwater Bylaw) shall have their own pollution plan and appropriate treatment system to meet the design parameters (Table 6-2) prior to discharge of stormwater from the lot.
i. Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate.

Stormwater BPO 4 – To Maintain or Enhance Mangaheka Stream Water Quality

j. Where it is identified that stormwater discharges will potentially contribute to erosion of channel beds and banks, then bed and bank stabilization works will be included as a mitigation measure.
k. All stormwater devices holding permanent static or flowing water shall have >80% wetland plant cover to provide habitat for indigenous fish where appropriate and reduce the effects of temperature increases and contaminant loads on receiving waters.

Note: For installation of such devices and any in-stream or riparian works in the stream it is highly recommended that a qualified river geomorphologist and aquatic ecologist participate in the design and implementation of engineering solutions to ensure long term performance and effectiveness. In-stream and riparian works on any waterway may require regional council resource consents.

Stormwater BPO 5 – Retention and enhancement of existing riparian areas and vegetation

a. Review and remedy where necessary over-steepened/channelized stream reaches through options including battering back over steep banks, reinstating channel features, riparian planting for bank stability and armouring as far downstream as required. (Works on private property or within the Waikato District Council area will be subject to agreement of affected parties and may require regional council resource consent.)
b. Energy dissipation devices shall be provided at all discharge locations to prevent bed scour and bank instability, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions using rock and concrete.
c. The modified stream channel and its riparian margins shall not to be used to locate stormwater treatment devices. The development of off-line facilities for devices 5 and 6 is required.

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Stormwater BPO 4 – To Maintain or Enhance Mangaheka Stream Water Quality
d. Hamilton City Council shall encourage landowners within the Mangaheka Stream catchment to retain existing riparian vegetation, and undertake riparian planting with indigenous eco-sourced vegetation selected from the Plant Selection Tool for Waikato Waterways, Waikato River Authority (and/or using the advice of a suitably qualified ecologist). A minimum of 5m wide riparian planting either side of all waterbodies, streams and drains shall be required.
e. Any restoration planting will require stock proof fencing and on-going weed control, through hand releasing rather than spraying or machinery to avoid bank instability and by-kill of desirable species.

Stormwater BPO 6 – Construction Controls
a. Specific guidelines for erosion and sediment controls required for earthworks in the ICMP area will be provided by Waikato Regional Council.

5 Water and Wastewater Management

5.1 Wastewater

Wastewater shall be treated and disposed of in a way that minimises effects on public health, the environment, and cultural values.

The entire developable area in the upper Mangaheka catchment can be served by the proposed HCC wastewater network (see Appendix B3). The network will be extended as development occurs in accordance with Hamilton City Council's ITS.

Water and wastewater management should be centralised and three waters networks planned on a catchment wide basis to minimise the number of stormwater treatment devices, wastewater pump stations and storage devices (except for private devices).

The size of infrastructure should be minimised by promoting sustainable water use and where possible, three waters networks are integrated within the catchment prior to discharge to the wider city networks. Future infrastructure upgrades shall be minimised by preventing, identifying and managing inefficiencies such as leakage, inflow and infiltration, and unauthorised use.

5.2 Best Practicable Options (BPO) - Wastewater

There are no Best Practicable Options for this catchment that are not standardised city wide measures as described in Hamilton City Council ITS and HDP.

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Wastewater BPO 1 – General requirements
a. The areas within the northern extension Stage 1C and 1E will be serviced via an appropriately sized trunk network into the Western Interceptor generally in accordance with the strategic wastewater infrastructure map (Appendix B3).
b. The capacity of the wastewater system has been based on a landuse assumption (i.e. dry industry).
c. Sufficient wastewater networks and storage is provided to avoid or minimize wastewater overflows.
d. Wastewater systems shall utilize gravity flow and reduce the need for pumping stations.

5.3 Water Supply and Demand Management

Light industry premises will dominate the water demand within the Mangaheka catchment. Undeveloped areas of the catchment will be serviced by the existing water system. In future, as the area becomes urbanised, the remaining upper catchment area will be serviced by the new water supply network located from a connection at Arthur Porter Drive which will also be reticulated throughout the local roading network. Existing rural residential dwellings however, will continue with their individual rain tank supply, until urban services are practically available for connection.

Notwithstanding the above, viable water sensitive options exist for a more sustainable and integrated approach and will need to be applied in accordance with provisions of the Hamilton Operative District Plan.

In addition, Hamilton City Council has the following initiatives planned to ensure that water demand is met in the Mangaheka catchment as well as other catchments within the city:

- New reservoir in Rototuna and associated bulk mains;
- City wide reticulation upgrades to support infill and intensification;
- Water demand and loss management programme to effectively manage water in the network and reduce loss;
- Continuation of the water model to forecast water demand out to 2061 and beyond;
- Enforcement of Water bylaw which requires water conservation in accordance with trigger levels;
- Education initiatives on water demand management;
- Reducing water demand through universal metering or meet increased growth demand through the construction of additional treatment capacity;
- Continue to work with Waipa and Waikato District Councils to provide a Sub-Regional solution to water as per the Sub-Regional 3 Waters Strategy; and
- Implementation of Public Health Risk Management Plan (Water Safety Plan).

5.4 Best Practicable Options (BPO) - Water

The following section provides details of the selected Water BPO measures and how they will achieve the objectives for the Mangaheka catchment.

Best practicable options are standardised city wide measures as described in Hamilton City Council ITS and HDP.

Water supply infrastructure shall be designed and constructed to meet consumption, hygiene, water-sensitive design and firefighting

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requirements. Undeveloped areas of the catchment will be serviced by the existing water system. New distribution networks shall be compatible with the existing system in accordance with the Hamilton City Council ITS.

A list of suitable BPOs for water supply and conservation for the catchment has been developed as discussed below. The BPOs listed below provide for specific requirements. For items not discussed in this section, refer to the design requirements provided within the Hamilton City Council ITS.

Water BPO 1 – General requirements
a. The areas within Hamilton City including the northern extension Stage 1C and 1E will be serviced via the strategic bulk mains from the Pukete reservoir generally in accordance with the strategic water infrastructure map (Appendix B2). b. The capacity of the wastewater system has been based on a landuse assumption (i.e. dry industry). c. Water supply systems shall ensure that targets required for fire-fighting flow and LOS for water pressure are achieved.

Water BPO 2 – Water use reduction
a. To lower water supply demand and meet multiple three waters integration objectives, rainwater re-use as per BPO 2b in Section 4.3.2.

6 ICMP Implementation

6.1 Implementation Methods[16]

Most of the mitigation measures set out in this ICMP and selected in the planning and design process will be required to be implemented as subdivision proceeds and as individual lot development progresses. In some cases, Council may elect to install major infrastructure in advance of private development.

Funding decisions of Council are made via the Long Term Plan process in accordance with the LGA which is informed by Councils 30 Year Infrastructure Plan and planning documents (e.g. District Plan, Hamilton Urban Growth Strategy).

Developer led provision of key infrastructure is done in accordance with resource and/or building consents.

As required by the CSDC, key infrastructure is provided for in concept network plans with an implementation timeline indicated on the plans provided in Appendix B.

All BPOs identified in Sections 4 and 5 have been translated into a range of actions, projects and compliance requirements that are given in:

- Options Hierarchy (**Table 6-1**)
- Discharge Parameters (Table 6-2)
- Means of Compliance (Table 6-3)
- Future Actions (Table 6-4)

4[16] CSDC / Condition 30(k)

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6.2 Hamilton City Council Preferred Options Hierarchy

The following table shows the hierarchy of stormwater solutions acceptable to Hamilton City Council (also refer to section 1.2.3.1). Unless a specific end solution is provided for, the hierarchy shall be applied from top down in order to meet the objectives of this plan.

Table 6-1: On-lot requirements for new development

Requirements	Primary driver
On lot (refer to Hamilton City Council's Three Waters Practice Notes)	
	The on-lot stormwater management measures for this catchment include standard requirements for all industrial or commercial lots comprise: • Rainwater reuse tanks (shall be plumbed back into the toilet and laundry with an option for garden use). • Overflow and hardstand areas to be directed to soakage where soakage is suitable. • A pollution control plan is required for high risk activities • No exposed zinc or copper building products • Gross pollutant traps • Carpark areas to drain to stormwater pre-treatment device (e.g swale etc) prior to leaving site • Additional on-lot attenuation depending on the downstream device design

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6.3 Catchment Specific Requirements

The CSDC[17] requires an integrated catchment management approach based upon the Best Practicable Option. BPO requirements are to be implemented as part of development and ongoing management in the Mangaheka catchment. The BPO must be appropriate for site conditions such as contours, ecology and geotechnical characteristics. If a developer proposes an option not listed in the ICMP, then the developer must prove the option is the most appropriate and will meet the ICMP objectives. The development's design report should include, but not necessarily be limited to Information Requirements provided in Appendix F. (This may form the basis of a Water Impact Assessment as required under the District Plan.)

Key points are listed below:

- The BPO to be implemented must ensure management of stormwater quality and quantity;
- Unless specifically superseded by the requirements of this ICMP, all development design is to be in accordance with the Hamilton City Council ITS;
- Development design must specifically consider cumulative environmental and infrastructure effects; and
- Development design must provide for long-term management of effects that encompasses the entire area over which potential effects may occur.

[17] Condition 30(j)

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6.4 Design Parameters

The following table outlines the parameters to be achieved for all discharges within the Mangaheka catchment. Refer to Appendix B1 for sub-catchment areas.

These parameters have been selected to address catchment risks and sensitivities set out in the ecological assessment, and to meet the operational objectives. The parameters shall be used in the design of stormwater treatment and flow attenuation devices within catchment where applicable. Some parameters are specific to a particular sub-catchment and based on investigations such as flooding, modelling, geotechnical and ecological studies. For further information in regard to the design of specific solutions, refer to Hamilton City Council Infrastructure Technical Standards (ITS) and *Auckland Council Technical Publication 10* (TP10).

Table 6-2: Mangaheka design parameters for stormwater management within HCC Jurisdiction

Upper Catchment Area (within HCC jurisdiction) in conjunction with Table 6-1	
Environmental flow	
Extended detention	24mm, 24 hours as per HCC ITS
Water quality	
Item / Parameter	Requirement
Either **1: At point of discharge from centralised treatment device or;** **2: At point of discharge from on-lot treatment device (where no centralised device is downstream).**	
Suspended solids	75% removal on a long term average basis (TP10 definition) calculated at the discharge point
Hydrocarbons	No visible sheen – consider installation of submerged or shielded outlets on devices
Contaminants	Removal of other contaminants in a wetland (designed in accordance with the ITS). Developments with High Risk activities will be required to provide additional on-lot treatment for industry specific contaminants over and above requirements detailed here. Refer to HCC guidance on preparing a Pollution Control Plan.
Temperature	<23°C* at the point of discharge to a waterway and existing water temperature change of no more than 3°C. Achieved via wetland planting over >80% of the device area or vegetated swale as per the ITS.
Gross pollutants	No gross pollutants
Turbidity	No greater than 25 NTU in the stormwater discharge in a water quality storm (1/3rd of a 2year 24 hour storm).

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In Receiving Watercourse (achieved after reasonable mixing)		
Colour	No conspicuous changes in colour downstream of the discharge point (WRC Regional Plan)	
Dissolved oxygen	Greater than 80% of saturation concentration. If the concentration of dissolved oxygen in the receiving environment is below 80 percent saturation concentration, any discharge into the water shall not lower it further. (WRC Regional Plan)	
Other Requirements		
No increase in water levels and peak flows downstream unless it can be demonstrated that there is no significant adverse cumulative effect. Location of compliance achievement is downstream from any subcatchment device and also the exit from HCC jurisdiction (west side of Koura Drive).		
Attenuation of 2 and 10 year events may be required on-lot depending on the design of the downstream device. Peak flow management is required with reduction to generally 70% of predevelopment flow for the 100 year ARI storm event.		
Flood storage proportional to development* for 100 year event (To be confirmed at detailed design)	The below equivalent volume (m^3) per hectare of development shall be provided (gross including roads and reserves but excluding the area of the Te Rapa Bypass designation). Volumes are indicative and development specific design and/or modelling shall be carried out to meet requirements (a 1D model is available from HCC, this assumes all devices are installed together). Refer to the Means of Compliance table for the catchment imperviousness that these are based on.	
	Catchment A (undeveloped area)	1080m^3
	Catchment C (Basin 7)	730m^3
	Catchment D (Basin 6)	680m^3
	Catchment E,G,H (Basin 5)	1320m^3
* Note that attenuation requirements differ depending on the development location in the catchment due to the flat nature of the Mangaheka catchment and issues related to coincidence of flows where the Porters and Mangaheka Streams join at Koura Drive.		
100 year peak flows after attenuation (to be confirmed by modelling at detailed design). Design to allow no more than minor increase to peak flows.	Peak flow downstream of device as % of Existing Development	
	Catchment E,G,H (Device 5)	100
	Catchment D (Device 6)	96
	Catchment C (Device 7)	73
	Catchment A (Un-named device)	96
Soakage	Soakage to the maximum extent possible	
Stormwater Volume Control	Match pre-development runoff volume through reduced runoff practices & sub catchment management. If this cannot be achieved, mitigation within the receiving environment will be required such as channel stabilisation.	
Carrying out a High Risk Activity (as defined in HCC's SW Bylaw, WRC's High Risk Facilities Register, and Appendix F of the Water Quality Report	Preparation and review of a pollution control plan in accordance with HCC's Pollution Control Plan template. Implementation of contaminant removal measures identified in your site specific pollution control plan.	

6.5 Means of Compliance

The following table outlines methods to achieve compliance with the discharge requirements and this ICMP. Where there is an approved Water Impact Assessment (WIA)[18] that recommends specific on-lot water efficiency measures, the methods prescribed shall be used as the relevant methods to be implemented to achieve compliance with the Operative District Plan and CSDC.

Where the methods listed below are not practical for a given lot, reference should be made to the relevant authority, including Hamilton City Council Infrastructure Technical Specifications for alternative solutions which are acceptable to Hamilton City Council. It will be important for Developers to have joint pre-application meetings with Hamilton City Council and Waikato Regional Council and if required Waikato District Council to facilitate alignment with ICMP requirements and approval processes. A Means of Compliance Map is provided in Figure 6-1.

Table 6-3: Means of compliance with ICMP

Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
Summary for sub-catchments				
4 Guys catchment	**Catchment discharges to centralised device** (4 Guys Pond) which provides flood attenuation only. **Some water quality treatment provided** by HJV pond and associated swales. Additional on-lot treatment required ('Standard Requirements for all lots') to meet design parameters.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer
A	**Catchment discharges to new centralised device** (4) which will provide flood attenuation up to 90% impervious Lot area for up to the 100 year event. **No centralised water quality treatment is considered feasible** – on-lot treatment required to meet design parameters at point of discharge (except where treatment may be provided by another device). **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer

[18] prepared in accordance with HDP 25.13.4.6

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness.			
B	**Catchment discharges to centralised device** (HJV Pond) which provides flood attenuation up to 75% impervious Lot area. **Some water quality treatment provided** by HJV Pond and upstream swales. Additional on-lot treatment required ('Standard Requirements for all Lots') such that the design parameters are met. **Lots with higher than 75% impervious area** need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 75% imperviousness.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer
C	**Catchment discharges to new centralised device** (Device 7) which provides flood attenuation up to 90% impervious Lot area. **No centralised water quality treatment is considered feasible** – on-lot treatment required to meet design parameters at point of discharge (except where treatment may be provided by another device). **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer
D1	**Catchment discharges to new centralised device** (Device 6) which provides flood attenuation up to 90% impervious Lot area.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	Some water quality treatment provided by Device 6. Additional on-lot treatment required ('Standard Requirements for all Lots') to meet design parameters. **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness. **Overland Flow Path present** – detailed flood mapping required to address any flows expected from the Rotokauri catchment in extreme storm events and/or the Excelby Road culvert block scenario.	Overland Flow Paths to be considered at time of resource consent.		
D2	**Catchment discharges direct to stream.** Off-set flood mitigation provided by Device 6 up to 90% impervious Lot area. **No centralised water quality treatment is considered feasible** – on-lot treatment required to meet design parameters at point of discharge (except where treatment may be provided by another device). **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer
E1	**Catchment discharges to new centralised device** (Device 5) which provides flood attenuation up to 90% impervious Lot area. **Some water quality treatment provided** by Device 5. Additional on-lot treatment required ('Standard Requirements for all Lots') to meet design parameters. **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness.			
E2	**Catchment discharges direct to stream.** Off-set flood mitigation to be provided by Device 5 up to 90% impervious Lot area for all flood attenuation events. **No centralised water quality treatment is considered feasible** – on-lot treatment required to meet design parameters at point of discharge (except where treatment may be provided by another device) **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness. **Overland Flow Path present** – detailed flood mapping required to address any flows expected towards the Te Otamanui catchment.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent Overland Flow Paths to be considered at time of resource consent.	As required by development	Developer
F	**Catchment discharges to centralised device** (Porters Pond) which provides flood attenuation up to 75% impervious Lot area. **Some water quality treatment provided** by Porters Pond and upstream swales. Additional on-lot treatment required ('Standard Requirements for all Lots') to meet design parameters. **Lots with higher than 75% impervious area** need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 75% imperviousness.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
G	**Catchment discharges direct to stream.** Off-set flood mitigation provided by Device 5 up to 90% impervious Lot area. **No centralised water quality treatment is considered feasible** – on-lot treatment required to meet design parameters at point of discharge (except where treatment may be provided by another device). **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent	As required by development	Developer
H	**Catchment discharges to new centralised device** (Device 5) which provides flood attenuation up to 90% impervious Lot area. **Some water quality treatment provided** by Device 5. Additional on-lot treatment required ('Standard Requirements for all Lots') to meet design parameters. **Lots with higher than 90% impervious area** (requiring resource consent) need to provide on-lot attenuation for storm water flows in the water quality device (1/3rd of a 2 year 24 hour storm), 5 year, 10 year and 100 year events, to reduce peak flows to that resulting from 90% imperviousness. **Overland Flow Path present** – detailed flood mapping required to address any overflows from the stream channel.	On-lot treatment and flood attenuation to be assessed at time of resource and building consent Overland Flow Paths to be considered at time of resource consent.	As required by development	Developer
All sub-catchments	Lots with **High Risk activities** require a **Pollution Control Plan** and on-lot source control and treatment.	At time of building consent and/or HCC resource consent and/or as required by the HCC Stormwater Bylaw.	As required by development	Developer
All sub-catchments	Lots with activities anticipated to generate **phosphorus** and/or **nitrogen** in stormwater runoff require to	At time of building consent and/or HCC resource	As required by development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	demonstrate stormwater nutrient removal/ management.	consent and/or as required by the HCC Stormwater Bylaw.		
All sub-catchments	**Rainwater re-use mandatory** in all sub-catchments. Rainwater re-use tanks plumbed into development non-potable water systems. Guidance provided in three waters practice management notes: HCC 02 and HCC 05.	At time of building consent	As required by development	Developer
All sub-catchments	**Centralised devices** to be located and sized to ensure all catchment flows (up to the 100 year event) are captured and managed and operation and maintenance costs are kept to a practicable minimum. Centralised devices located within the Hamilton City boundary to be in accordance with Appendix B1– Stormwater Network Map. Design parameters for centralised devices are provided and referenced in Table 6.2 (Design Parameters Table). Devices must be compliant with design parameters and performance prior to vesting to HCC and for the duration of the defects liability period. If the entire contributing catchment has not been developed at the time of vesting, alternative methods for demonstrating compliance will be required. Detailed operations and maintenance plans shall be provided to HCC prior to vesting.	At time of building consent and/or HCC resource consent	As required by development	Developer
All sub-catchments	Road development within sub catchments are recommended to include stormwater collection/treatment systems following the hierarchy provided in the ITS to reduce or eliminate contaminants prior to stormwater entering the stream.	To be confirmed	Prior to lot development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
All sub-catchments	Additional water quality treatment options for all devices (on-lot and centralised): • Off-line treatment (best practice) • Combining treatment with flood storage where off-line treatment not possible • High flow bypass of forebay for >10 year event • Device bypass for >100 year event	At time of building consent and resource consent	As required by development	Developer
All sub-catchments	**On-lot and centralised devices** Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then specific habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate.	At time of building consent	As required by development	Developer
General Requirements				
All sub-catchments	**Standard requirements** for all Lots include • No exposed zinc or copper building products • Gross pollutant traps • Carpark areas to drain to stormwater pre-treatment device (e.g swale etc) prior to leaving site	At time of building consent	As required by development	Developer
All sub-catchments	**Developers and key stakeholders** shall work together and collaborate with HCC to effectively implement the Mangaheka ICMP to implement the solutions and meet the requirements of the ICMP – actions BPO2.	At time of resource consent	As required by development	-
All sub-catchments	**Overland Flow Paths (OLFP's):** Developments to allow for existing overland flow paths discharging onto each lot and consider allowance for maximum probable development upstream that could pass through each lot. This matter to be addressed during detailed design and may require flood mapping for larger flowpaths. Refer to Stormwater Means of Compliance Map for main OLFP's.	At time of building consent and/or HCC resource consent	As required by development	Developer
All sub-catchments	**All infrastructure sizing**, locations and alignments are preliminary and shall be confirmed by detailed design	At time of resource consent	As required by development	-

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	and integrated with other infrastructure (e.g. roads) to implement the solutions and meet the requirements of the ICMP			
All sub-catchments	**Networks shall be designed to ITS standards** (unless specified otherwise within this ICMP) and sized to service the fully developed catchment to the design parameters and requirements to achieve minimum levels of service	At time of resource consent	As required by development	-
All sub-catchments	**Development proposals** which are lodged with HCC and/or WRC ahead of major infrastructure shall demonstrate how the solutions and requirements of the Mangaheka ICMP will be met. This includes showing that development proposals: - Are consistent with the solutions and requirements of the ICMP - Will not compromise future development or implementation of major infrastructure, and - Can establish interim flood storage and stormwater treatment solutions in the catchment which meet the design parameters in Table 6.2 of this ICMP	At time of resource consent	As required by development	-
All sub-catchments	**Resource consent applications for development activities** shall be lodged with HCC and WRC contemporaneously, and both Councils shall work together to ensure that decision outcomes are consistent with the solutions and requirements of the Mangaheka ICMP Note 1: Small scale development sites may not trigger WRC requirements for soil disturbance activities. In these instances HCC will ensure that site specific erosion and sediment controls (including flocculation treatment systems) are required via HCC land use and/or building consents. HCC may also seek advice and specific input from WRC as required Note 2: Ecological assessments are required for all modified watercourses in the catchment (including farm	At time of resource consent	As required by development	-

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	drains). These watercourses shall be identified by developers at the time of development planning and subject to the 'best practice ecological protection and mitigation measures' required.			
All sub-catchments	**'Future actions'** including ecological enhancements, stock fencing, riparian planting in Waikato District Council jurisdiction, financial contributions for downstream of application lot, retrofitting of existing devices with submerged/ shielded outlets and gross pollutant traps, revising the HCC ITS where appropriate, and the potential re-connection of the Te Otamanui catchment as detailed in Section 6.6 of this ICMP shall be considered for implementation.	Detailed design and ICMP implementation planning	HIGH PRIORITY To inform detailed design of major infrastructure	-
Wastewater				
All sub-catchments	**Within Hamilton City Council Boundary** **Wastewater in all sub-catchments** shall be served by the existing and proposed wastewater network. Gravity mains to access the network shall be extended as development occurs and capacity shall be assessed during the engineering phase for suitability to serve the surrounding areas draining to the nearest pump. Levels of service to be achieved in accordance with Hamilton City Council's requirements. Best practice design, construction and inspection are required to ensure that inflow and infiltration is minimised. Temporary pump stations are proposed at Ruffell road and Tasman road with carrier pipes to be sized based on MPD and meet specific requirements associated with crossing infrastructure (e.g. such as the railway line near Ruffell Road). **Within Waikato District Council Boundary** No change to existing on-lot wastewater disposal requirements.	At time of resource consent		

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
Water				
All sub-catchments	**Low flow fixtures** and other water efficient fittings are to be installed into businesses in accordance with Rule 25.13.4.5a and c of the HDP. Low flow fixtures will promote water conservation, reduce costs associated with water consumption and ensure the size of infrastructure is minimised by promoting sustainable water use. Future infrastructure upgrades can be avoided or minimised by identifying and managing inefficiencies such as leakage, inflow & infiltration and unauthorised use.	At time of building consent	As required by development	
All sub-catchments	**Strategic 450mm water mains** shall be required in specified locations as per Water Master Plan and indicated in Appendix B2. **250mm trunk mains** shall be extended along road corridors as the sub-catchments develop. Levels of service to be achieved in accordance with Hamilton City Council's requirements. Minimum pressure and flows to be achieved, including consideration of adverse effects on the existing built and consented environment.	At time of resource consent	In line with HCC planned staging	
Wider Catchment Requirements – Stormwater Quality				
All sub-catchments	Any stormwater diversion or discharge option that deviates from this ICMP will require technical certification from Waikato Regional Council in accordance with condition 3 of the CSDC.	At time of resource consent (a piped connection will not be provided if adequate soakage is available). Assessment may be provided to Waikato Regional Council in accordance with Hamilton City Council CSDC.	As required by development	Developer
All sub-catchments	**Inside Waikato District Council Boundary**		High priority	

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	Suitable energy dissipation and erosion protection measures shall be provided at all required stream locations, as identified by this ICMP, in order to minimise erosion of stream beds and banks. Natural /green engineering solutions appropriate to the soft sediment environment are preferred over hard engineering solutions using rock and concrete to assist the retention and enhancement of natural features. Requirements for protection measures are detailed in Section 4.	Actions for WDC and HCC to be agreed	Prior to development	WDC and HCC split of funding in WDC jurisdiction
All sub-catchments	**Modified and natural stream channels** and their riparian margins shall not to be used as locations for stormwater treatment devices. This is to assist in the retention and enhancement of existing riparian areas and vegetation. Requirements for the downstream sections of the Mangaheka Stream are provided in sections 4 and 6.	At time of resource consent	As required by development	
All sub-catchments	**Riparian vegetation**, where present, should be retained and any new riparian planting done with indigenous eco-sourced vegetation selected from the Plant Selection Tool for Waikato Waterways, Waikato River Authority as well as the Mangaheka Restoration Vision. A minimum of 3m wide riparian planting either side of all waterbodies, streams and drains with stock proofing is encouraged. This is to assist with retention and enhancement of existing riparian areas and mitigation of effects of urbanisation. Riparian planting shall be promoted by Hamilton City Council throughout the catchment in conjunction with developers, landowners, local iwi and other interested parties.	At time of resource consent	As required by development	Developer / WDC and HCC split of funding in WDC jurisdiction
All sub-catchments	**Entire catchment** **Construction controls:** Application of sediment control measures (refer to ACC GD05 & Erosion & Sediment Control Guidelines for Soil		As required by development	Developer

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Sub- Catchment (where)	Requirement (what & why)	Assessment Timing (Key Approvals) (how)	Priority / Staging (when)	Funding (who)
	Disturbing Activities January 2009) to protect stormwater devices, Mangaheka Stream and its tributaries. In the event of any discovery of threatened native aquatic species, the authorities shall be notified and an appropriate translocation programme shall be developed. In the event of any discovery of artefacts in watercourses that may have potential cultural or historical significance, the appropriate iwi representatives and authorities shall be notified.	At time of resource consent and during construction		

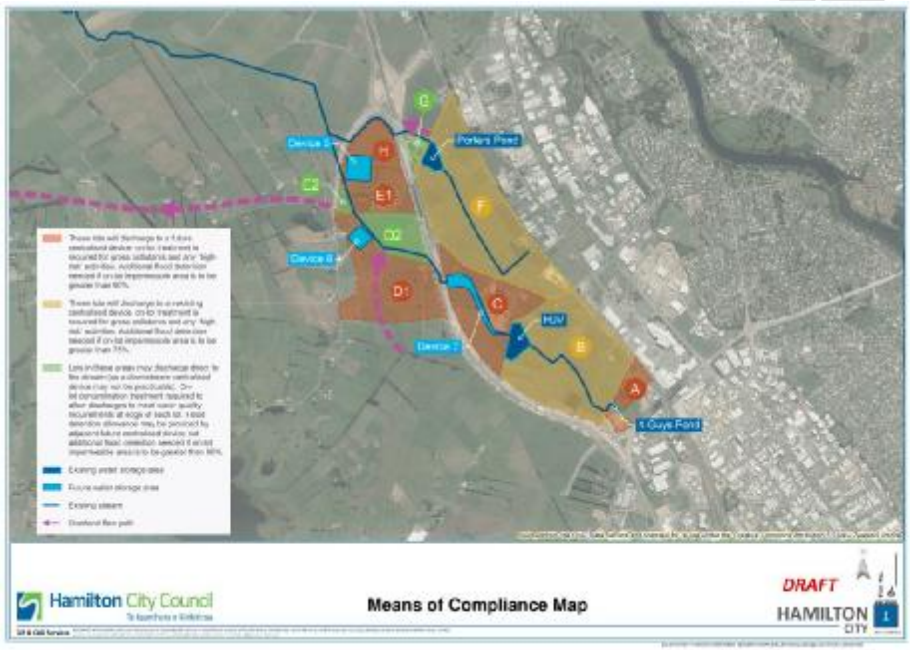

Figure 6-1: Means of Compliance Map

6.6 Future Actions

The following are recognised future actions considered important to meet the outcomes of the Mangaheka ICMP. These will need to be addressed by developers at the time of their proposals or by Hamilton City Council and reflected in future revisions of the ICMP. Opportunities that should be sought by parties in the hydrological catchment are also listed.

Table 6-4: Future Actions

Ref	Future action	Anticipated timeline (responsibility)
	Flood Hazard Assessment	
1	LiDAR survey extent update	Dependent on LTP funding and programme requirements (Hamilton City Council)
2	Detailed flood hazard modelling in accordance with extent assessment using MIKE 11 (or similar). To be in accordance with Hamilton City Council's Stormwater Modelling Methodology	To be undertaken after new LiDAR is flown of the city, and in line with funding prioritisation.(Hamilton City Council)
	Water	
3	Bulk water mains - 550/700mm bulk pipelines (e.g. the Pukete supply main) for water service level	2015-2018 (Hamilton City Council)
	Habitat Restoration	
4	Update and Implement the Mangaheka Restoration Vision	To WRC timeline
	Erosion Prevention	
5	Review and implement programme of works for erosion protection as per Appendix I. Remedial works may include battering back over steep banks, reinstating channel features, riparian planting for bank stability and armouring and stock proof fencing.	Ongoing in collaboration with WRC, HCC, the consent holder and landowners
	Water Quality	
6	HCC officers to review pollution control plans for catchment high risk activities through the building consent process for new development	2018 (Hamilton City Council)

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Ref	Future action	Anticipated timeline (responsibility)
7	HCC officers to review and audit existing developments with a focus on the prioritised activities identified in Appendix F of the Water Quality report.	2018 (Hamilton City Council)
8	Investigate potential re-connection of Te Otamanui Stream to upper catchment when planning Device 6.	Not currently scheduled (Waikato Regional Council and Waikato District Council)
9	HCC officers to discuss recommended improvements to Porters and HJV centralised devices with consent holder prior to vesting	2018 (Hamilton City Council)
10	HCC officers to require completion of the Porters and HJV centralised devices under urgency	2018 (Hamilton City Council)
11	Review of ITS requirements for contaminant removal and device parameters following adoption of Waikato Regional Council Proposed Plan Change 1 – Healthy Rivers.	Following WRC Plan Change 1
	Maintenance	
12	Review HCC Stormwater Device Operations & Maintenance template and ITS checklist. Ensure it refers to ICMP parameters, and stormwater devices have proven performance at the time asset is vested. Compare to city wide monitoring plan.	2018/19 (Hamilton City Council)
	Changes/upgrades to existing stormwater devices to consider litter screens and hydrocarbons (submerged outlets). Consider these changes for standard design in ITS.	2018/19 (Hamilton City Council)
	Opportunities	
13	HCC to recommend to WRC a review/update the High Risk Facilities register to bring in line with that of Auckland Council's register and the stormwater guidelines under development. High risk facilities register should include activities and associated pollutant management solutions.	2018/19 (Waikato Regional Council and Hamilton City Council)
14	HCC to consider updating the Stormwater Bylaw to reflect additional high risk activities recommended in Appendix F of the Water Quality report.	
	Education	

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Ref	Future action	Anticipated timeline (responsibility)
15	Once the ICMP is finalised and approved, key stakeholders will be informed. The ICMP will be placed on the Hamilton City Council website and implementation meetings with Hamilton City Council Development Engineers, City Planning, Planning Guidance Unit and Building Unit to ensure requirements within the ICMP (specifically Parameters and Methods to Achieve Compliance Table) are implemented through Resource Consents and Building Consents as required	2018/19 (Hamilton City Council)
16	The city-wide stormwater monitoring plan shall review and incorporate this ICMP's monitoring requirements.	2017/18 (Hamilton City Council)

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6.7 Mechanisms for Implementing Measures

Mechanisms for implementing measures include:

- **Development applications**: Developments will be assessed against each of these documents at the time of resource consent and/or building consent application. Resource consent conditions will be written and enforced accordingly.

  See Appendix B for network service plans to assist in development proposals. Developers will need to check with Hamilton City Council on the status of the plans in this ICMP, catchment performance and where a resource consent is required, should participate in pre-application meetings to understand requirements prior to development of proposals.

- **Enforcement –proposed district plan and byylaws:** Council has adopted a stormwater bylaw[19] which sets out Councils powers under the Local Government Act to manage, regulate and protect, and to prevent the misuse of Council's land, structures or infrastructure associated with stormwater drainage. This will be supported by an Education Strategy.

- **Waikato regional council drainage networks:** Waikato Regional Council has powers relating to the maintenance of land drainage networks to maintain groundwater levels, manage surface ponding after rainfall, and prevent flooding. Hamilton City Council's Education Strategy will include information relevant to ensuring Waikato Regional Council's land drainage requirements are met.

- **Council's long term plan:** The LTP is used as a funding mechanism for infrastructure required for the Mangaheka catchment. ICMP's will contribute to funding decisions on infrastructure projects in the LTP.

- **Existing programmes** such as:
  - Planned maintenance[20] and operational improvements
  - Asset renewal programmes
  - Design and development in accordance with ITS
  - Customer service level (satisfaction surveys, complaints, monitoring)

- **Education strategy:** this requires effective internal and external communication

Incorporate into City Waters education strategy and assess appropriate communications plan within 1 month ICMP approval. The strategy needs to ensure that affected Units understand and apply ICMP content and implement though mechanisms such as

[19] Hamilton City Council Stormwater Bylaw 2015.

[20] For example road catchpits and sumps are currently cleaned out on an annual cyclic basis. However, streets with known leaf fall problems which are swept up to three times a week to forestall blockages.

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consent approval processes and conditions. The external communication strategy needs to ensure that the ICMP is understood, referenced in consent application documents and by key stakeholders, BPOs are adopted and there are no buildings exposed to unacceptable levels of risk from flood hazards. Measures will include: Roadshow, Intranet, Website – ICMP, Website – FAQ, Territorial authority websites where appropriate.

- **Collaboration with other agencies:** Collaboration with other agencies on ICMP's, District Plan changes and resource consent approvals and bylaw reviews to ensure appropriate quality and quantity requirements are met.

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7 Consultation

7.1 Key Stakeholders

Parties identified as requiring consultation and information are:

- Waikato Regional Council as the Regional authority for the Mangaheka catchment area, Technical assessor for CSDC alignment and Drainage area administrators
- Waikato District Council – territorial authority for large part of catchment
- Waikato-Tainui Raupatu River Trust (in accordance with the Waikato River Settlement Act)
- Department of Conservation, Centre for Biodiversity and Ecological Research and Waikato District Health Board (parties interested in citywide stormwater management)
- Tangirau Wetland Group
- Developers (as landowners) in headwater of catchment and within city boundary
- Landowners outside city boundary adjacent to Mangaheka Stream
- Land drainage scheme parties
- NZ Transport Agency
- Internal Council stakeholders City Planning, City Waters, City Development, City Transportation and Parks & Open Spaces, asset owners, Operations and Maintenance and Regulators.

A Consultation Plan has been developed. The plan has the following key actions:

- Key stakeholder presentation and targeted consultation for a period of 3 weeks
- 'Drop in' sessions where the ICMP can be further explained and feedback provided and individual/group meetings as required [21]
- Follow up letter on outcome and ICMP outcomes and implementation presentation (invite to PCG reps, Unit Managers, Building Unit, PG Unit, DE's, City Waters reps and Compliance team)
- Invite to external parties on finalised ICMP (presentation format)

7.2 Issues Raised

[Hold: this section will be updated following consultation] Responses were received. A summary of key issues raised through the consultation period and how they have been addressed is provided in Table 7-1.

[21] Where possible, opportunities for information dissemination, such as WDC District Plan review sessions will be sought.

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Table 7-1: Consultation - key issues [HOLD: to be completed]

Ref	Item	Addressed
1		
2		
3		
4		
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8 Monitoring

8.1 Catchment Monitoring

Development in the Mangaheka catchment will be monitored as per the requirements of individual land, water and discharge consents as well as the HCC city wide monitoring plan. Stormwater discharges will be monitored under the requirements of:

a) Subdivision discharge consent monitoring conditions prior to being transferred to Hamilton City Council under the City wide consent number 105279.

b) Extended CSDC monitoring plan required under consent number 105279.

8.1.1 Hamilton city council responsibility

Hamilton City Council holds Waikato Regional Council resource consents for stormwater discharges, water take, and wastewater discharges. Hamilton City Council's citywide stormwater discharge consent 105279 covers existing urban development. Hamilton City Council was required to prepare a monitoring plan to assess the adverse effects of municipal stormwater diversion and discharge activities on the environment. The monitoring plan was approved by Waikato Regional Council in 2013 (hereafter referred to as the Tonkin and Taylor Stormwater Monitoring Plan (SMP), December 2012), but it does not include the Mangaheka stream catchment. Hamilton City Council will carry out monitoring in the catchment guided by the methods outlined in the monitoring plan. In addition where the monitoring plan does not provide fit for purpose method, e.g. erosion monitoring, other existing methods will be followed, specifically the Auckland Council Watercourse Assessment Methodology: Infrastructure and Ecology (Version 2.0), Lowe and Young 2015 (referred to as the WAM) and Environment Waikato Environmental Monitoring Methods.

It is recommended that the next version of the Tonkin and Taylor SMP, is amended to include the Mangaheka catchment and catchment specific monitoring requirements so that representative data can be collected to support future planning and management.

The effects from upstream discharges could potentially occur in the Waipa River, outside of the ICMP area and Hamilton City boundaries in to Waikato District.

8.1.2 Development community responsibility

Developers require stormwater consents to allow discharge to the receiving environment in accordance with the requirements of the Regional Plan. The ICMP will help developers in the preparation of these consents and assist the Waikato Regional Council in determining what monitoring of discharge quality and quantity is required. In particular the ICMP will help ensure consents are issued which address cumulative effects. In general, discharge consent conditions need to be consistent with the Hamilton City Council CSDC to provide certainty that the consents can be transferred to Hamilton City Council. A fuller description of the administrative process for incorporating new diversion and discharge activities in to the CSDC is contained within Appendix 2 of the Stormwater Management Plan (Hamilton City Council, December 2012).

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Any stormwater discharge consent held by a developer must have its specific consent monitoring requirements carried out by the developer until the consent is transferred to Hamilton City Council. Performance assessment of stormwater treatment systems that are in private ownership are to be carried out by the owner/operator.

8.2 Proposal for Catchment Monitoring

A catchment specific monitoring plan is provided in Figure 11 - Monitoring Plan- Sampling Locations and Table 11 – Monitoring Plan. This plan has been developed based on technical assessment recommendations. The proposal is designed to take into account the Ecologic Report recommendations (as per Appendix I), to tie in with the citywide stormwater monitoring plan previously developed by Tonkin &Taylor (Dec, 2012) and for Hamilton City Council to satisfy the monitoring requirements of Consent 105279, Condition 37.

Where a method has not been predetermined or is not considered fit for purpose, suitable methods will be agreed with Waikato Regional Council.

At agreed points on the Mangaheka stream, and at pre-determined intervals, the following monitoring program is proposed and will be used for baseline data, remedial actions and monitoring for change over time.

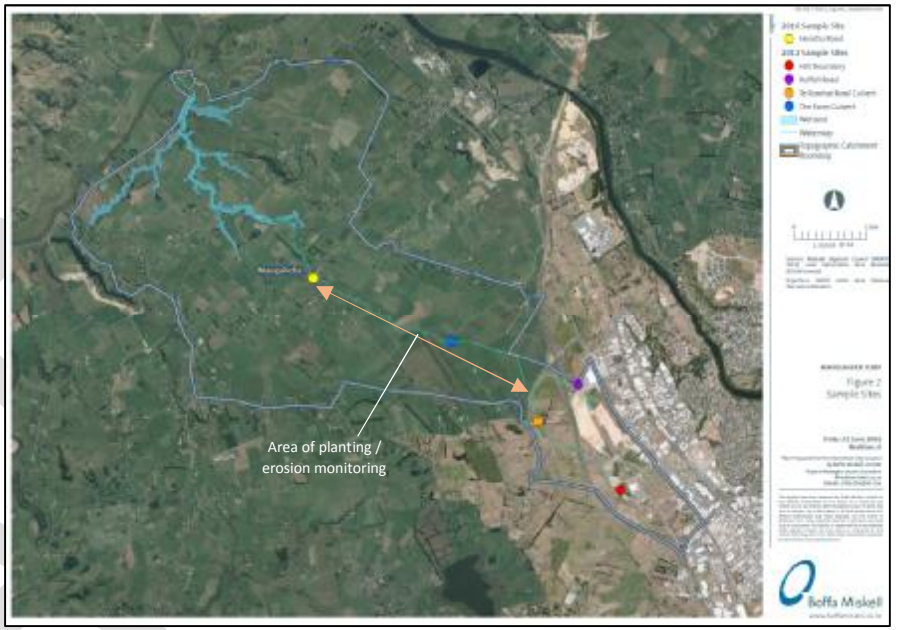

Figure 8-1: Monitoring Plan - Sampling and Monitoring Locations

[Note: to be updated and combined with erosion protection works figure]

Table 8-1: Monitoring plan DRAFT TO BE FINALISED

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
1	**Receiving Environment**				
1a	Visual semi-quantitative, assessment of bank and bed stability	Riparian margins, vegetation type and density, bank stability, sediment deposition, channel width and depth	Site walkover, GIS mapping and photo points along all stream reaches (1 – 10) located between Koura Drive and Ngaruawahia Road. The monitoring and inspection should follow protocols 1,2,7, 8, 9 and 10 from the Auckland Council Watercourse Assessment Methodology including: – Stream morphology and characteristics related to flow – Bank and channel erosion (slumps and slips) – Sedimentation[22] – Debris accumulation – Channel or culvert blockages, stormwater outlets, weirs and channel works – Channel and hotspot erosion – End of pipe scour and erosion – Map stormwater outlets, culverts, weirs and channel works – Change in vegetation type and cover (%) in riparian margins, floodplains and seepages – Fish passage barriers	Riparian margins improve in stability, channel width and depth remain stable. Change in the extent and severity of scour and erosion at identified locations as well as downstream of discharge points compared with baseline erosion information (Morphum, 2017).	Monitoring to be undertaken 2 yearly during low base flows following commencement of discharges until development is complete, 4 yearly thereafter, and following any significant (> 10yr) storm events. The T&T SMP 2012 Report separates Hamilton City Council streams into 5 Rounds for inspection to ensure each stream is inspected and monitored five times over the duration of consent 105279. The monitoring of Mangaheka Stream shall be coordinated into the CSDC SMP and be allocated to a "Round" to facilitate the monitoring programme as per with Table 6 of the SMP.

[22] The majority of the Mangaheka stream is a soft sediment environment, so accumulation of sedimentation is difficult to determine accurately. Some sedimentation is likely to come from internal water chemistry/microbiology processes unrelated to stormwater.

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
			– Presence of undesirable bacterial growths, litter, foams, scums, conspicuous oil or grease films – Aesthetic issues related to drainage structures.		
1b	Semi-quantitative assessment of aquatic fauna presence and/or diversity	Aquatic and riparian habitat quality	Habitat quality will be assessed in accordance with Waikato Regional Council's Regional Guidelines for Ecological Assessment of Freshwater Environments the T&T SMP 2012 Report methods. Results can be compared with results from similar Hamilton City Council Stream catchments in addition to providing year-on-year comparison to assess changes in habitat values.	Results from the visual semi-quantitative assessment provide context in the event of unexpected fish diversity, MCI or sediment quality results.	Monitoring will be repeated 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside fish and macroinvertebrate surveys.
		Aquatic macroinvertebrate community composition and diversity	Aquatic habitat quality will be assessed in accordance with relevant Waikato Regional Council's Regional Guidelines for Ecological Assessment of Freshwater Environments relating to aquatic macroinvertebrates and/or the T&T SMP 2012 Report methods.	Macro invertebrate metric values (e.g. unchanged or improved) compared with baseline information and compared with Waikato Regional Council reference sites as per TR2012/27 The Ecological Condition of Waikato wadeable streams based on the REMS Programme, in addition to a year-on-year comparison of metrics to assess changes in aquatic habitat values.	Macroinvertebrate sampling will be repeated 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will coincide with that proposed for "Visual semi-quantitative, assessment of bank and bed stability" and fish survey.
		Native fish presence and diversity	Aquatic habitat quality will be assessed in accordance with relevant Waikato Regional Council Regional Guidelines for Ecological	Native fish diversity in the catchment is similar or better than baseline results	A baseline for fish species in Mangaheka Stream has been compiled from recent and

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ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
			Assessment of Freshwater Environments relating to native fish and/or the T&T SMP 2012 Report methods.	when assessed in the context of the catchment values.	ongoing monitoring observations. Monitoring will be repeated 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside macroinvertebrate survey and habitat assessment.
		Sediment Quality Sample	Composite sediment samples will be collected from surface sediments at habitat quality monitoring sites: – Ruffell Road – Te Kowhai Road – Farm Culvert – HJV Boundary – Horotiu Road Each sample will be tested for total organic carbon, polynuclear aromatic hydrocarbons and total recoverable copper and zinc. Laboratory analysis of samples would follow the same protocol as used in NIWAs 2012 study of contaminants in Hamilton's urban stream sediments.	Sediment quality data presented in NIWAs 2012 report will be used as a baseline for the CSDS consent monitoring. Sediment quality data should be unchanged or improved compared to the baseline information.	Sediment quality monitoring will be carried out 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside fish and macroinvertebrate sampling and habitat assessment.
1c	Quantitative assessment of stream water quality	In-stream water quality variables to be assessed.	Water samples to be taken at the monitoring sites listed above with sampling following the Waikato Regional Council Water Quality Monitoring Protocol to assess: – pH – Temperature	Results meet ANZECC 2000 guidelines for freshwater aquatic ecosystems to 90% protection of species and MfE 1992 Water Quality Guidelines No. 1.	Baseline water quality established by assessment in 2012 and 2016. Monitoring to be undertaken 2 yearly following commencement of discharges

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ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
			– Dissolved Oxygen – Conductivity (required?) – Turbidity – Suspended sediment[22] – Total and dissolved copper, lead and zinc – Total and ammoniacal nitrogen – Total and dissolved reactive phosphorus – Faecal Coliforms. Each sample will be analysed according to ANZECC 2000 guidelines.	Results should be compared to Waikato Regional Councils water quality standards (satisfactory or excellent).	until development is complete and 4 yearly thereafter.
	Device performance and discharge quality				
1d	Stormwater treatment device performance (by consent owner/operator or via consent conditions)	Criteria per Mangaheka ICMP discharge parameters set out in Table 6-2, using methods specified in developer consent conditions or, if not specified, methods specified in CSDC.	To test performance of large treatment devices in situ is both technically challenging and cost prohibitive. If the treatment devices being wetlands in the majority are monitored to ensure they are built and maintained as per design, the efficiency can be considered to be achieved. This will require monitoring of wetland vegetation cover which must be above 80% of the total wet area of any wetland and hydraulic function to ensure short circuiting is not occurring the device functions as per design as per inspection sheets in TP 10.	Assets meet design 80% vegetated and functions as per design to meet criteria being 75% TSS removal and passes inspection checks as per TP10.	Operational Monitoring to be undertaken annually following commencement of discharges until development is complete, including defects liability. Waikato Regional Council consent conditions remain the responsibility of the consent holder until it is transferred to the local Regulatory authority.
			Water temperature discharge to be monitored using in-situ monitor at discharge point with 5 minute time stamp. This should be done in the summer months from 1 December to March 30. If upstream input flows, particularly from open channels, can be monitored then they should be included in sample design.	Have discharge temperatures below 23 degrees.	Temperature monitoring to be conducted as specified and if Hamilton City Council considers adverse temperature effects are likely.

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
1e	Visual contaminants	Oil, grease, scum, foam, colour, and litter.	Site inspections of devices and walkovers from Ruffell Road to Horotiu Road.	Absence of oil, grease, scum and foam. Less than minor litter. No conspicuous changes in colour downstream of discharge points.	Monitoring to be undertaken annually following commencement of discharges until development is complete, and 4 yearly thereafter following any significant (> 10yr) storm events.
1f	Sediment control of building construction and earthworks	Audit by both Hamilton City Council and Waikato Regional Council	Earthworks, building and construction sites inspected for appropriate use of on-site management controls, including correct design, installation, operation and maintenance. Water samples may be taken downstream of the site to determine overall management performance and to ensure compliance with relevant regulatory provisions, including building permits and/or resource consents where applicable.	Onsite management controls are correctly designed, installed, operated and maintained. All relevant regulatory provisions are met[23]	During construction.
1g	Riparian mitigation works	Bank stability and condition of riparian planting	Visual walkover assessment of condition of completed capital works. Plant maintenance including weed removal.	Bank stability and stock fencing maintained/ improved and establishment of planted vegetation	Assessment walkover within 6 months of completion of capital works, annual walkover assessment. Plant maintenance visits to be conducted 4 times per year for first two years, reducing to 3 visits per year in third and fourth years, subsequently reducing to 2 visits per year thereafter.

[23] Waikato Regional Plan Permitted Activity standard = 100 gm per m3 after reasonable mixing. CSDC turbidity criteria = 25 NTU

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ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
					Full assessment of reaches to be conducted every three years.

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At the time when applicable assets and discharge consents are transferred to Hamilton City Council, responsibility for maintaining and monitoring those assets and discharges also transfer Hamilton City Council. It is important to note that Hamilton City Council will only allow transfer of assets and discharge consents if:

a) Assets have been designed to meet required performance standards
b) Assets have been appropriately maintained and are fit for purpose at the time of transfer
c) Compliance with resource consent conditions has been achieved
d) Monitoring of device performance and discharge effects has been carried out in accordance with the conditions of the consent
e) Appropriate legal protections have been established (e.g. easements)

For detailed monitoring methodologies and scheduling see the Hamilton City Council Stormwater Monitoring Plan, December 2012 (TRIM link D-724659) and protocols 1, 2, 7, 8, 9 and 10 from the Auckland Council Watercourse Assessment Methodology: Infrastructure and Ecology (Version 2.0), Lowe and Young 2015.

8.3 Reporting and Review Process

Monitoring of individual discharge consents will be reported to Waikato Regional Council in accordance with consent conditions, and copies of the reports and monitoring results will also be provided to Hamilton City Council.

Monitoring of discharges required under the CSDC (including where this has been extended to include the Mangaheka catchment) will be presented as part of the Municipal Stormwater Network Operation Annual Report (as required by Condition 38 and 39 of the CSDC).

The report will contain recommendations on any changes that may be needed to the monitoring plan.

Waikato Regional Council and Hamilton City Council will liaise in order to review and, where necessary, alter the CSDC monitoring plan in scale and/or method and/or location after having regard to the consistency and significance of the monitoring data collected, or any other information relating to the stormwater diversion and discharge activities authorised by this consent.

Hamilton City Council will be responsible, on an ongoing basis, for the review of guidelines and procedures for the implementation, performance evaluation, operation and maintenance of Mangaheka Stream catchment and on-lot practices consistent with the approved ICMP.

Hamilton City Council will also be responsible for reviewing the level of subdivision and development occurring in the Mangaheka catchment relative to the land use assumptions underlying the ICMP, with particular emphasis on:

- Monitoring on-lot stormwater management;
- Restoration and management of riparian and aquatic habitat downstream of discharge points ; and
- Compliance with (and performance of) erosion and sediment controls implemented in the Mangaheka catchment for building sites.

Hamilton City Council may direct immediate intervention where significant effects are identified. This may include, but is not limited to:

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a) Building site management enforcement
b) Remedial stream and riparian works for scour and erosion
c) Additional auditing
d) Riparian vegetation management
e) Maintenance or retrofitting of stormwater devices.

8.4 Asset Monitoring

Asset monitoring is carried out on all three networks including condition assessment and capacity reviews. A list of this type of monitoring is provided in respective Activity Management Plans.

8.5 ICMP Review

This document will be reviewed every five to seven years[24]. However, should there be demonstrable adverse effects identified through monitoring, or significant changes in policies and structure plans, the ICMP will be reviewed earlier. For demonstrable adverse effects, the Waikato Regional Council report procedure (as required by condition 10 of the CSDC) shall be carried out. Developers should be aware that changes to ICMP objectives may mean that different BPOs will be required. Such changes will be subject to consultation processes.

Hamilton City Council will monitor designs and construction as development progresses. Where approved designs or as built construction changes the outcome, the application of BPOs or the nature of the BPOs in the ICMP may need to be changed. These could differ from those already implemented by earlier developments in the catchment. Changes will only generally be made if a more practicable option is identified. The exception to this is where implementation results in the identification of an environmental shortcoming (e.g. water quality) which requires a more effective BPO.

A reduction in requirements will not be made for minor improvements against the objectives. For a fundamental change to the ICMP objectives to be made, the positive impact of actual development will need to be significant and measurable. The same approach will generally apply to the application of more stringent requirements, but it is acknowledged that adverse effects and degradation can be a slow and cumulative process. A more proactive approach to managing the effects of stormwater discharges will be undertaken where a minor but consistently measurable reduction in water and/or habitat quality and/or bank stability is observed

Significant ICMP changes will require an internal Hamilton City Council Group review process, stakeholder consultation and approval by Waikato Regional Council. Minor changes will be discussed and agreed with Waikato Regional Council where this is relevant to the Hamilton City Council CSDC.

Potential amendments may also be required to any of the following:

a) Associated Structure Plan/District Plan
b) Hamilton City Council Stormwater Management Plan
c) Relevant bylaw or policy
d) The relevant activity management plan.
e) CSDC Monitoring Programme

[24] This term is considered appropriate on the basis of development. Sufficient monitoring data, flood hazard assessment, ability to review critical requirements through other mechanisms such as SMP reviews and the ability to amend the ICMP at any time if adverse effects are identified.

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9 References

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- AECOM, March 2016: Porters and HJV Model Review
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- http://www.hamilton.govt.nz/our-council/council-publications/districtplans/PODP/Pages/default.aspx
- https://waikatomaps.waikatoregion.govt.nz/Viewer/?map=1aa9c952a38949a68cbe3ca7aed48270

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Appendix A

Hamilton City Council Structure Plan

Hamilton City Council

Appendix B

Network Plans

Appendix C

Soil Map

Appendix D

Contaminant Load Model

Appendix E

Land Drainage Boundary

Appendix F

Water Impact Assessment

Appendix G

Assessment of Environmental Effects

Appendix H

Network Capacity Model

Appendix I

Additional Studies

Appendix J

Comprehensive Stormwater Discharge Consent 105279 (Conditions)

Hamilton City Council