INTEGRATED CATCHMENT MANAGEMENT PLANS –A HAMILTON CITY EXPERIENCE FROM CREATION TO IMPLEMENTATION

Andrea Phillips (Hamilton City Council), Nathanael Savage (Hamilton City Council)

ABSTRACT

Hamilton City Council (Council) has a number of drivers requiring the preparation of catchment management plans. These include a specific condition of a Comprehensive Stormwater Discharge Consent (WRC 2011) from the Waikato Regional Council (WRC) and legislative imperatives to protect and enhance the Waikato River reflecting the Waikato River Vision and Strategy (Waikato River Authority 2011), and national drivers such the National Policy Statement for Freshwater Management (2014).

Understanding the effects of Hamilton's stormwater and assessing options and opportunities for mitigation, improvement and enhancement can be specific to each catchment and their associated receiving environment. Potable water and wastewater assessment is also included to ensure the best outcome from an overall 3-waters perspective, thus creating Integrated Catchment Management Plans (ICMPs).

Council has embarked on a comprehensive 10-year programme to complete ICMPs for each of its catchments. The assessments incorporated in the ICMPs are critical in supporting strategic landuse and infrastructure planning and investment.

To date Council has completed two ICMPs, at contrasting ends of detail and cost. A further three are underway. There have been many lessons learnt along the way, culminating in Council pausing its programme in order to develop a set of ICMP modules to provide guidance to the many technical disciplines preparing individual reports to inform the overall ICMP report. This allows the programme to progress consistently across each separate catchment and creates a robust platform for prioritisation of infrastructure works within the City.

Implementing the direction established by each ICMP is complex. It relies on a number of development stages, with holistic catchment solutions potentially requiring on lot devices (at the time of Building Consent), sub-catchment devices (at the time of Resource Consent), large strategic solutions (Council's 10-Year Plan) and watercourse protection (City or Regional Councils, Drainage Boards, Land owners).

This paper will consider the drivers, methods and tools used to support delivery of ICMPs, along with implementation and examples of the types of outcomes, pre and post ICMPs.

KEYWORDS

3-waters infrastructure, integrated catchment management plans, stormwater strategic planning

PRESENTER PROFILE

Andrea Phillips is an Infrastructure Engineer – Water at Council, where she has worked in various roles over the last 12 years. She has project managed the Stormwater Master Plan, is programme manager for Integrated Catchment Management Plans along with being involved in various updates to Hamilton stormwater guidelines.

Nathanael Savage is an Infrastructure Planner at Council. Over the last 3 years he has provided planning support on a range of infrastructure related projects. Previously he has worked as a policy planner for Council (3 years) and the former Papakura District Council (10 years), including working on the Hamilton District Plan review.

1 INTRODUCTION

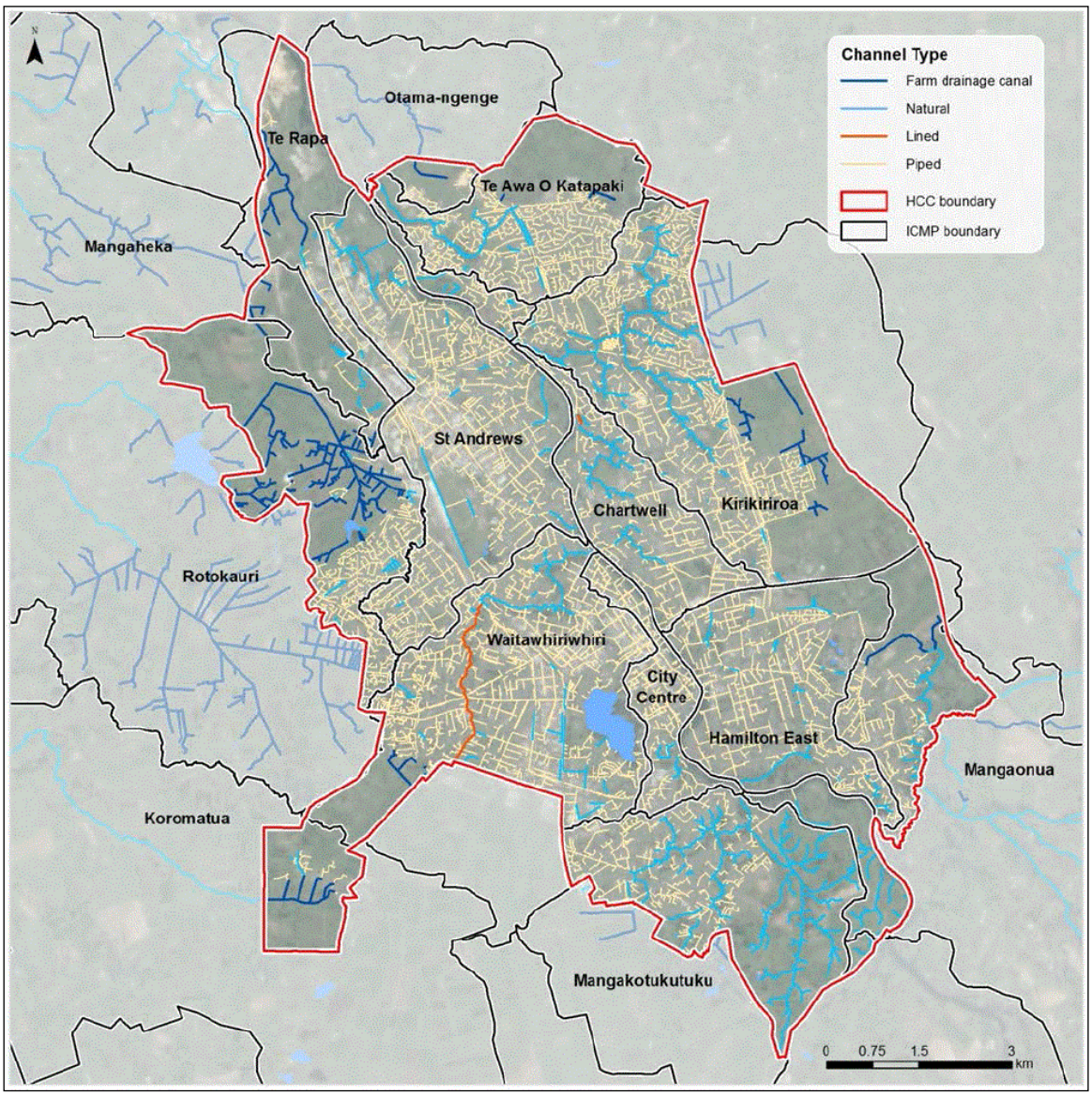
Hamilton City's population is projected to grow rapidly from 160,000 in 2017 to 236,500 in 2046. This growth is expected to occur within identified greenfield growth cells and intensification areas, and through the gradual infill development of existing residential parts of the city.

There are a range of drivers for Council to develop a robust understanding of the effects of urbanisation and intensification and the resulting increased demands on infrastructure networks. A key driver is providing the basis for supporting strategic land use and infrastructure planning and investment decisions.

Council's response to this growth and associated potable water, wastewater and stormwater (three waters) effects and demands has been to embark on a comprehensive 10-year programme to complete ICMPs across the whole city. The current focus is on greenfield growth areas where the most growth pressure and environmental changes occur.

Hamilton City has sixteen separate hydrological catchments discharging to the Waipa or Waikato River (refer to Figure 1). Investigation and assessment is not limited to within Hamilton City's boundaries.

Figure 1: Indicative hydrologic catchments of Hamilton



Source: Morphum Environmental Ltd, Hamilton City Council (2016)

2 DRIVERS

2.1 WHY ARE WE PREPARING ICMPS?

National, regional and local policy and plans have been evolving in response to environmental, economic and social pressures involving water resources and associated infrastructure. This has seen a particular focus being placed on the following principles:

- Protecting and enhancing the Waikato River and its tributaries
- Protecting the safety, health and wellbeing of people and the natural environment
- Making the best use of our resources
- Ensuring we provide the right infrastructure at the right time for the right cost

For Hamilton the Waikato Regional Policy Statement (WRC 2016a), Waikato Regional Plan (WRC 2012) including the Healthy Rivers plan change (WRC 2016b), Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 and Waikato Tainui Environmental Plan (Waikato-Tainui Te Kauhanganui Incorporated 2013) require greater scrutiny of

development effects on water resources. In particular, cumulative and climate change effects are being given greater emphasis.

Council holds comprehensive stormwater and wastewater discharge consents, and a water take consent for its network from the Waikato Regional Council (WRC). This places monitoring requirements and limits on Council's use, and discharge of, water. The comprehensive stormwater discharge consent (CSDC) requires Council to prepare Catchment Management Plans (CMP) for its greenfield areas by specified dates. These CMPs must be certified by the WRC. The stormwater component of the ICMPs is structured to satisfy the CMP requirements of the CSDC.

Alongside environmental drivers sit pressure on high growth Councils to provide infrastructure to support the delivery of housing whilst maintaining an appropriate financial profile. This drives an approach that looks to optimise existing infrastructure, manage demand, and align delivery of infrastructure. This supports continued development while staying within legislative debt limits and not exposing Council to unacceptable levels of financial risk.

While they do not negate the need to apply for regional consents, an ICMP will provide developers with a degree of certainty on what needs to be done for their proposals to be acceptable to Council and the WRC.

ICMPs provide for informed decision making that enables development to occur in a way that protects and enhances the environment whilst integrating land use with three waters infrastructure planning.

2.2 WHAT IS AN ICMP?

An ICMP is a single, evidence based document that examines a specific hydrological catchment and its associated infrastructure networks to identify future infrastructure needs and development requirements. All three waters are considered in an ICMP as opposed to a CMP which only considers stormwater. ICMPs are developed with experts from a range of disciplines, and involve extensive consultation with a variety of stakeholders. Preparing an ICMP involves gathering and assessing a wide range of technical information and assessing adverse effects arising from existing development, predicted land use changes and the projected impact of growth with and without mitigation measures in place.

For most catchments stormwater quality and quantity issues are the most complicated to respond to. Potable water and wastewater matters in ICMPs to date have mostly aligned with the city-wide master plans (GHD Ltd, Hamilton City Council 2017, Mott MacDonald Ltd, Hamilton City Council 2016) noting that these ICMPs are predominantly greenfield catchments. As we embark on brownfield areas the focus will shift to assessments of existing infrastructure performance and optimisation opportunities will need to be considered and assessed through a cost/benefit exercise.

ICMPs consider cumulative effects and network issues which might otherwise be difficult for individual development proposals to identify, assess and respond to. Council's approach to ICMPs provides a framework ensuring that necessary investigation, analysis and planning is done in a clear, consistent and robust way.

ICMPs ultimately provide guidance on catchment, sub-catchment and single site approaches. ICMPs provide design parameters to manage the effects, of development on natural water resources such as streams, rivers and groundwater, and physical resources such as infrastructure networks.

2.3 WHAT DO WE WANT FROM AN ICMP

2.3.1 EXPECTATIONS

We expect an ICMP will:

- Determine the environmental values of a catchment and its receiving environment;
- Set objectives reflecting these values and relevant statutory and non-statutory plans, policies, standards and conditions;
- Identify the adverse cumulative effects of development that need to be avoided or mitigated;
- Define Best Practicable Options (BPO) to manage these effects and meet the objectives;
- Explain what individual developments need to do in order to comply with the ICMP;
- Explain what Council needs to do to in the way of programmed works, education, monitoring and other initiatives to support ICMP implementation;
- Consider the needs of everyone with an interest in the catchment including stream or lake care groups, property owners, developers, local and regional authorities, and Iwi;
- Produce flood hazard information that can be used to manage development so as to minimise flood related risks; and
- Demonstrate compliance with the conditions of Council's regional consents and satisfy the requirement for certified CMPs in support of new discharges.

2.3.2 MANAGING POTENTIAL RISKS

Council considered the potential risks of not investing in ICMPs for the city. These informed the business case (Hamilton City Council 2016a) to support funding for the ICMP programme. A range of considerations are outlined in table 1 below.

Table 1: Benefits with, and potential risks without, an ICMP

With an ICMP we can:	**Without an ICMP we run an increased risk that:**
Help minimise stormwater generated and the effects of urban development and intensification on our rivers and streams.	… we allow development and infrastructure without understanding all its effects and it causes new or increased erosion, flooding, ecological damage, contamination. This then becomes a potential compliance issue with a costly retrofit to fix.
Make sure that planning for stormwater from new development is integrated with planning of other infrastructure and future land uses.	… we allow development and provide infrastructure in an inefficient way – which wastes land and money that could be used for other things.

Help optimise the use of existing infrastructure and minimise the need for new infrastructure - e.g. the number and/or size of wastewater pump stations, stormwater treatment and detention devices, which avoids unnecessary operation and maintenance costs into the future and is a more efficient use of land.	… we miss opportunities to use existing assets to their full potential and spend money on new infrastructure now, when instead we could have spent it on infrastructure where it is needed more.
Make sure we support water conservation and demand management.	… we miss water conservation and demand management opportunities which would let us do more with the infrastructure capacity and the consented water take we currently have.
Help minimise the amount of wastewater we generate so that the existing wastewater network capacity is not compromised which results in overflows of wastewater.	… we allow development to happen in a way that results in more wastewater overflows (at worst) or takes up the resilience we are trying to build into the system through future upgrades to help with our existing wastewater network compliance issues.
Make sure future discharges in growth areas will be able to meet the stormwater discharge consenting requirements of the WRC and Council's CSDC.	… we allow development and infrastructure that is inconsistent with the conditions of Council's CSDC. This may have a costly retrofit to fix when Council wants to integrate this part of the city into the network to be administered under its CSDC.
Help reduce or not make worse any flood hazards on private property.	… we allow development and infrastructure that creates new or worsens existing flood hazards, exposing people, property and the environment to risk. This may have a costly retrofit to fix.
Create a chance for other stakeholders (such as tangata whenua, recreational and local interest groups) to contribute to the management of the catchment's waterbodies.	… we have excluded iwi, authorities, land owners and other people and groups with a legitimate interest from involvement in determining how we manage our water resources.

3 METHODS AND TOOLS

3.1 IN THE BEGINNING

Council's CSDC was primarily set up to manage multiple discharges from the public stormwater network as constructed at the commencement of consent. While it principally dealt with discharges from existing 'brownfields' parts of the city it also included conditions for the mitigation of effects of subsequent 'infill' development and required Council to prepare CMPs for its greenfields catchments. When the current Operative in Part District Plan (Hamilton City Council 2016b) for Hamilton was notified in 2012 it included provisions requiring ICMPs (sub-catchment scale) to be prepared where development proposals were of a significant scale.

Hamilton made some early inroads into the ICMP programme, developing an ICMP template, and engaging a consultant to prepare ICMPs for Te Awa O Katapaki and

Otama-ngenge (Hamilton City Council 2015d), which are developing catchments in northern Hamilton. While this was underway, other developing catchments such as Mangakotukutuku and Rotokauri were progressed as growth pressures increased. During the scoping of these ICMPs, it became clear that there would be efficiencies if some activities were undertaken at a citywide scale. For example, the following parts could be done at a citywide level:

- Collation of existing data;
- Preparing standard methodologies for technical components; and
- Establishing a data framework to hold deliverables so that outputs could be easily understood and comparisons made between different catchments.

This prompted a pause to most ICMP projects whilst modules were developed that would ensure a consistent and efficient approach. At the same time the Stormwater Master Plan (Morphum Environmental Ltd, Hamilton City Council 2016) was being scoped to inform citywide stormwater investment decisions. A programme of further investigative and physical works became a deliverable for individual ICMPs in order to inform the master plan.

3.2 MODULES AND STANDARD OPERATING PROCEDURE

Council developed a set of 'modules' (Hamilton City Council 2015b) to assist with the preparation of ICMPs. Modules explain what and how data should be gathered to compile an ICMP, data quality requirements, and how it should be interpreted, displayed and used. These covered the following eight core topics:

- Soil – soakage suitability, bores, contaminated land;
- Topography – covering hydrological catchment maps, Light Detection and Ranging (LiDAR) and specific topographic data;
- Flooding and overland flow paths (OLFP) – covering the location of flood plains and OLFP, and assessment of actual and potential impacts;
- Hydrogeology – covering the assessment of effects on natural features, surface water bodies and aquifers, receiving water hydrology including base and peak flows, long term aquifers and peat deposits;
- Primary infrastructure – assessing the capacity of the 3 waters primary infrastructure networks with growth;
- Receiving Environment – assessing the receiving water sediment and water quality, receiving water habitat, ecology and ecosystem health, receiving water riparian vegetation, extent and quality of open stream channels, fish passage for indigenous and trout fisheries, natural and amenity values, and stormwater infrastructure that interacts with open watercourses;
- Growth and planning assessment – defining the current growth forecast including type, rate and timing of development and growth; and
- Contaminant load and treatment – determining existing contaminant concentrations in the catchment and predicts future contaminant levels based on proposed landuse scenarios and proposed mitigation options.

The modules are structured to include scope and background, definitions, existing data, gap analysis, new data and methodologies, issues and opportunities, options and actions and deliverables. The module detail includes available information such as likely sources, analysis of information, methods to collect new information, and deliverable format.

As a consequence of writing and reviewing the modules, other supporting documents needed to be amended, for example Council's stormwater modelling methodology (Morphum Environmental Ltd, Hamilton City Council 2016). This document was largely focused on existing flood development and needed additional input to ensure maximum probable development scenarios were considered with appropriate and well documented assumptions to validate the outputs and ensure consistency across catchments.

Council also developed an ICMP Standard Operating Procedure (SOP) (Hamilton City Council 2015c) which provided clarity on internal process, steps and approvals. This informed individual ICMP project managers, and detailed when key stakeholders should be engaged, what approvals were required before targeted external consultation, as well as the final approval of the ICMP document itself.

The modules and SOP reflect a 'do-everything' approach which is expected to be refined to reflect the specific characteristics of the catchment. It is not necessary or financially viable to answer every potential question for every catchment. During the development of an ICMP scope it is a critical task for the project manager to determine information gaps and whether they actually need to be filled to produce a robust ICMP.

Version 1 of the Stormwater Master Plan (Morphum Environmental Ltd, Hamilton City Council 2016) has been completed. This plan collates known existing data and presents it in city-wide scale GIS layers. Interrogation and analysis of this data has resulted in the creation of a city-wide projects database. The Stormwater Master Plan has gone some way to collating catchment data, prioritising catchment issues across the city, and providing a GIS structure for further deliverables. This assists with the scoping of individual ICMPs, and provides a platform for the more detailed ICMP outputs to update.

3.3 COMPILING THE ICMP

To remain relevant and reflect emerging best practice the modules have stayed as a 'working draft'. They are currently being reviewed in light of completing the Rotokauri ICMP (Hartland Environmental Ltd, Hart R, Hamilton City Council 2017).

Changes that arise from a 'lessons learnt' approach are valuable. For example, Council will be amending the Receiving Environment Module to take the data a step further towards establishing a prioritised watercourse programme of works. Edits during the use of the modules have included ensuring technical experts are involved as required in the review of other technical scopes (for example, the water quality assessment may be informed in part by results from the flood modelling assessment).

Other issues that emerged were that some stormwater objectives were in conflict with each other, creating tensions and challenges in setting design parameters that all subject matter experts agree with. Examples include wanting to keep operations and maintenance costs low while ensuring resilience through a robust treatment train approach, achieving low temperature discharges (to protect aquatic life) compared to standard stormwater treatment devices (that may not be able to achieve the required discharge temperature). Ultimately, all subject matters experts will ideally reach a consensus on the compiled ICMP document, and agree on how their technical component is captured in the ICMP requirements.

ICMPs are a complex technical document. Conveying the findings and requirements in a clear and meaningful way is a critical factor to support implementation. ICMPs include

several key maps and tables to define and summarise the core requirements for future development. These include design parameters (the targets for the catchment e.g. 90% suspended solids removal) and means of compliance (a way to comply with the parameters, including the party responsible, e.g. on site soakage at the time of Building Consent). An example of stormwater design parameters from the Rotokauri ICMP is contained in Table 2 below:

Table 1: Example of stormwater design parameters for Rotokauri

Total Phosphorous (TP)	Greater than 70% removal achieved via overall treatment train/system (source controls and central sub-catchment wetlands)
TP / Source Controls	An average 40% removal achieved via source controls (upstream of central sub-catchment wetlands)
TP / Central Sub-catchment Wetlands	An average of 50% removal achieved via central sub-catchment wetlands on a catchment-wide basis
Total Suspended Solids (TSS)	Greater than 90% removal achieved via overall treatment system (including erosion and sediment controls during development and housing construction)

Source: Hartland Environmental Ltd, Hart R, Hamilton City Council 2017

A key recommendation for the compilation step of ICMP preparation is to use a main author to lead the subject matter experts. This ensures a coherent, strategic, well integrated document with a series of balanced and practical solutions. It is also important to keep key stakeholders involved during the development of the ICMP. For Council it is particularly important to ensure the WRC is kept informed given their eventual role in certifying the stormwater component of the ICMP for compliance with Council's CSDC.

4 IMPLEMENTATION

Implementing the direction established by each ICMP is complex. Implementation occurs across all stages of development, with holistic catchment solutions potentially requiring on lot devices (set at the time of Building Consent), sub-catchment devices (set at the time of Resource Consent), large strategic solutions (determined by master planning with funding approved as part of Council's 10-Year Plan process) and watercourse protection (implemented at various times by City or Regional Councils, Drainage Boards, Land owners).

4.1 LIFE OF THE ICMP AFTER APPROVAL

The SOP includes an implementation step, which occurs after approval and is critical to the documents effectiveness. Steps include: publicising the completion of the ICMP by uploading the ICMP onto Council/s website, notifying internal and external key stakeholders and holding workshops with staff responsible for implementation.

The requirements of an ICMP can vary by catchment and will be implemented at different times in the development process through different mechanisms. This has required an adjustment to Council processes and updates to various guidance documents.

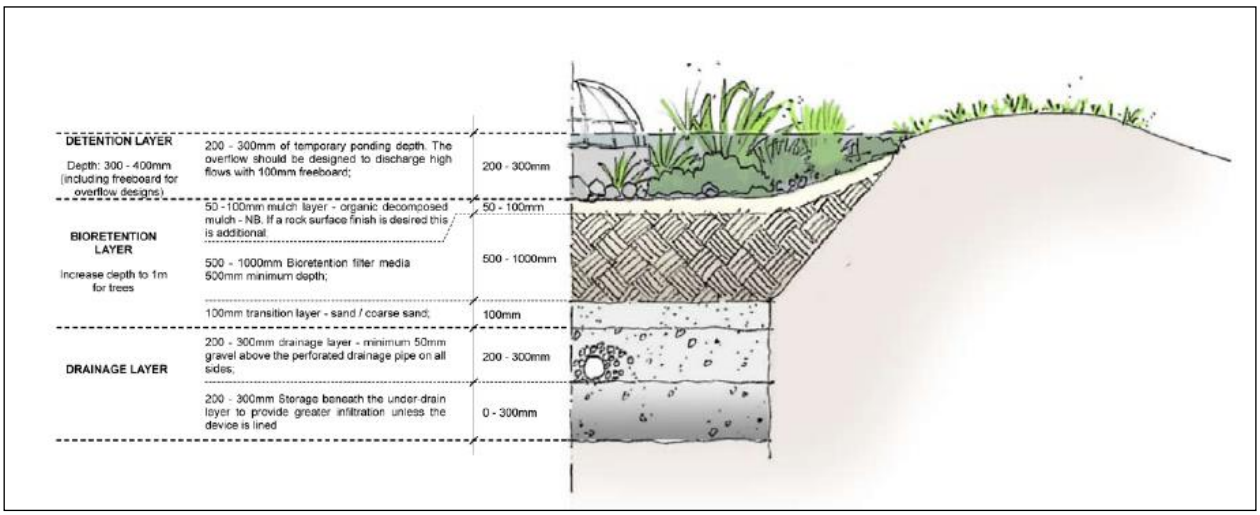
4.2 IMPLEMENTATION STAGES

4.2.1 ON LOT

Council has developed Three Waters Management Practice Notes describing several common stormwater approaches that may be suitable at an individual site scale. These align with District Plan requirements, and support compliance with Council's CSDC. For convenience and consistency an ICMP might specify the use of one or more of these

measures, or could introduce additional alternatives or require more stringent measures when justified for the catchment. Figure 2 below contains an example of an on-lot raingarden from the Three Waters Management Practice Notes (Hamilton City Council 2016c).

Figure 2: Example of an on-lot measure - Raingarden



Source: Hamilton City Council 2016c

4.2.2 SUBCATCHMENT

Council has updated its Infrastructure Technical Specifications (ITS) (Hamilton City Council 2017), based on the findings of ICMPs and best practice. The updates prioritise land based sub-catchment stormwater treatment devices that mimic natural hydrology such as soakage, wetlands, swales and raingardens. Wetlands are now required to be shallow to allow 80% vegetated cover to reduce temperatures and provide treatment. ICMPs can reference these devices, or specify certain devices to achieve the outcomes required.

4.2.3 STRATEGIC CATCHMENT SOLUTIONS AND WATERCOURSE PROTECTION

In some situations there may be a need for a strategic scale solution to enable development of a catchment. The scale of investment required and / or the fragmented ownership of a catchment generally pushes delivery of large scale solutions to Councils. An example of this is the Rotokauri Central Green Corridor which integrates major drainage (storage and conveyance) and central sub-catchment wetlands into a single footprint area.. The alignment of the Central Green Corridor crosses multiple landholdings and is estimated to cost $90m.

Council's Stormwater Master Plan collates strategic stormwater projects for the City and is informed by ICMPs. It maintains a project database which informs the 10-Year Plan process for prioritising funding.

Strategic solutions may be required where the effects of multiple landowners are best mitigated by jointly funded projects Residual effects that cannot be addressed by on lot and sub-catchment infrastructure may include riparian planting or erosion prevention measures. Sometimes these are outside the city jurisdiction creating other difficulties in monitoring and implementation that are currently being discussed between Councils. Council is developing a working process with the WRC to fund erosion prevention and mitigation projects along gullies and streams in response to the residual effects of

increased stormwater volume from urbanisation. These are effects that cannot practicably be addressed on-site, and in some cases deal with effects that manifest outside the jurisdictional boundary of Council.

4.3 ROTOKAURI EXAMPLE

4.3.1 BEFORE THE ICMP

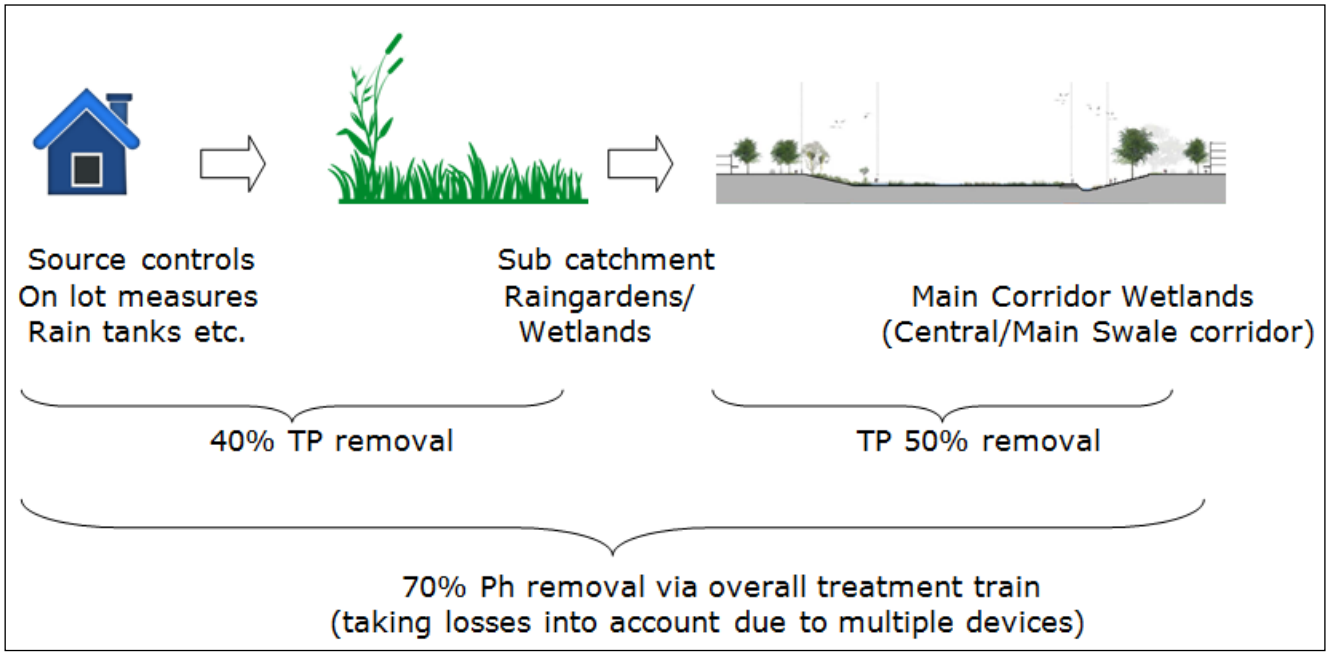
Subdivisions approved prior to the development of the Rotokarui ICMP were not informed by the catchment scale assessment and the consideration of cumulative effects of other growth. In most cases all that was required was a standard single treatment device, and any on-lot measure as required by the District Plan (Hamilton City Council 2016b).

4.3.2 AFTER THE ICMP

The Rotokauri ICMP has produced various design parameters and a list of compliance criteria that include multiple treatment devices, temporary and permanent flood storage, along with a long list of future actions around Council processes, operations and maintenance considerations and strategic funding.

The Rotokauri ICMP includes a relatively stringent stormwater treatment requirement for nutrients (Nitrogen and Phosphorous). This is to ensure against further degradation of the two downstream and already nutrient enriched, peat lakes. This will generally mean three treatment devices (refer Figure 3) are needed to achieve water quality targets: including on-lot scale, sub-catchment and central sub-catchment wetlands of which several may be located within the Central Green Corridor footprint as discussed above.

Figure 3: Example of stormwater treatment train for Rotokauri



With regard to major drainage requirements, the large and relatively flat nature of the catchment, combined with downstream flood protection constraints, has resulted in the need for large flood storage capacity within the developing catchment area. The concept design, which further incorporates central sub-catchment wetlands and wider urban design elements, is currently undergoing development and will lead to a designation process in the foreseeable future.

The large scale of investment in stormwater infrastructure has featured several times within the key risks summary prepared as part of the ICMP implementation phase. Risks include stormwater management during Building Consents (both ensuring the required

device is installed on-lot, and the downstream sub-catchment device is protected from sediment), long term maintenance considerations and ensuring the full opportunities are realised e.g. improved urban design outcomes. Mitigation measures include recommending the establishment of a new role to ensure the implementation and protection occurs. .

5 CONCLUSIONS

ICMPs are valuable documents that can identify and help ensure appropriate measures are required to protect the receiving environment while driving efficiencies through the optimisation of existing infrastructure and consolidation of stormwater devices for multiple developments. They can provide certainty for developers for on-lot and sub-catchment requirements, and inform Council's 10-Year Plan to fund strategic catchment solutions and watercourse protection initiatives. The process for preparing an ICMP can also bring key stakeholders together to identify opportunities to create integrated, and optimised solutions within the catchment.

ICMPs provide critical information and assessments to inform land use changes. All structure planning processes for greenfield areas should be underpinned by an ICMP. Without the comprehensive catchment-based assessment and analysis of the potential effects of development there is a significant risk that mitigative responses will be inadequate, resulting in adverse effects on the environment that are contrary to national, regional and local policy directives and requirements.

Consistent methods for preparing ICMPs are needed to ensure robustness. Council struggled to find a suitable pre-existing set of methods and guidance suitable for the preparation of an ICMP in the Hamilton context. In response Council prepared its own modules which have gone some way to providing consistent methods and deliverables.

It is an important step to ensure that the preparation and implementation of ICMPs are affordable and prioritised, and that the identified benefits are realised through supporting tools such as regional plans, district plans, bylaws and technical specifications. With rapid growth Council's priorities are greenfield areas, as these areas represent the best opportunity to influence the strategic provision and management of three waters infrastructure.

Recording of private, as well as public, devices used as part of an integrated response to effects mitigation was recognised as an organisational gap. It is critical that Council maintain a full record of all devices that are installed to manage effects (particularly cumulative) effects on the environment, whether public or private. This will also facilitate monitoring and enforcement programmes in the future.

Key challenges include time, cost and complexity of engaging and managing multiple experts, the technical nature of data required, and balancing development aspirations with long-term environmental objectives and outcomes.

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