USING DATA-RICH, INTERACTIVE AND ACCESSIBLE TOOLS TO SUPPORT CATCHMENT PLANNING

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ABSTRACT

Stormwater planning in New Zealand has experienced many changes over the last few decades with more changes anticipated for the future. We have increasingly been using advanced tools such as modelling and GIS to support catchment analysis, strategy development and planning activities, to deliver catchment planning outputs.

The process of defining the performance, values and critical issues within in a catchment requires that significant amounts of information and data is analysed. Most of the data, gathered or generated as part of the planning process, such as stream data or overland flow paths, are very useful and of value to multiple parties. Additionally, it is expensive to gather this information and it tends to be a limited to a few, often needing specialised skills and custom platforms to access information.

So, the traditional "big-paper-based" technical reports with maps and large appendices are only accessible to a few parties. Getting more (cross council) return from these investments is achievable by taking advantage of the new software tools and online functionalities, which are now commonly available, to share the rich information sets which are collated and/or derived through these types of studies.

The paper will present ways to access (consolidated) information using (for example) ESRI StoryMaps, interactive web-based tools and GIS information resources to support City scale master planning and catchment scale studies. This can enable the user to read about all aspects of stormwater management and while easily scrolling through the presented narrative while having access to contextual geospatial visual information such as maps or graphics in the adjoining pane, which changes while scrolling through the story.

Many data layers used in such an application can be directly linked to existing council systems so that these have the potential to be updated as council's information changes. Data management is therefore an important part of the process and mapping of data sources and structure are key. The better data is integrated, and management systems are in place, the easier and more efficient the process tends to be.

The interactive web based 'catchment plan' also allows for the story and the maps to be relatively easily updated as planning information gets added on an as and when required basis. This allows for the completeness and reliability of the information to be improved over time and only where required, rather than having to have a full revision of a catchment plan.

As part of this paper learnings from Horizons Regional Council, Hamilton, Whangarei and Richmond City Councils will be used to illustrate the process of using interactive web-

based tools and GIS information resources to support City scale master planning and catchment scale studies.

KEYWORDS

Interactive, Web Based, Dashboard, Data Management, Contextual

PRESENTER PROFILE

Damian is the Environmental and Geospatial Services Director of Morphum Environmental, managing clients, deliverables and business development for Morphums offices in the North and South Islands of New Zealand and in Australia.

His career started in 1993 in Green retail working in the first environmentally friendly retail outlet in New Zealand, called Green Planet, and continued in the sustainable products with a role in production and distribution with the Clean Green Shirt Company. After training in Environmental Engineering, he went on to be a co-founder of Morphum Environmental (est. 2000) one of Australasia leading boutique environmental consultancies. He now works on city scale stormwater and environmental management projects.

1 INTRODUCTION

Integrated Stormwater Planning is and has always been very complex when done to the best practice standards. This is compounded by the fact the "stormwater" is in effect the environmental resource so important to the functioning of our urban rivers, streams and lakes. Its quality being a key determinant on the health and well-being of the freshwater resources which surround our urban and build up communities. Consequently, the planning part of the exercise has to be flexible and adaptive.

Council and stakeholder groups are typically very interested in the subject matter that supports stormwater planning and management. Traditional "big-paper-based" technical reports with maps and large appendices are only accessible to a few parties and do not provide the sort of access to information required for such strategic studies.

1.1 OBJECTIVES

The integration of information sets through GIS and documented management systems can allow multi-department/organisational collaborations to flourish. Under a "total watershed management approach" that includes infrastructure, such as roads, wastewater/water supply and multiple landuses, it is possible to combine visions and resources to achieve more sustainable results.

The following provides a list of objectives, clients have shared, that can be achieved through taking advantage of the new software tools and online functionalities, while also considering business objectives:

- To create an overarching strategy for Stormwater Planning in defined single catchments and multiple "cityscale" catchments.
- To establish Geospatially based frameworks for use by Council Officers and wider Stakeholders.
- To design tools to support guidance on design, development, and delivery of Catchment Management Plans.
- To develop a strategy's to support cost effective decisions on the collection and collation of new and historic data.
- To define appropriate data analysis methodologies to support decision making.
- To provide guidance on the development of a GIS-based platforms to access, use and share catchment data and analysis outputs.
- To develop web-based tools and information sharing portals

1.2 OVERVIEW CURRENT STATE OF PLAY

Catchment planning has seen many changes over the last 20 years. Historically has been substantively more focused on the management and assessment of flooding, but now encompasses many more facets, subject matters and interdependencies. A good example of which being stormwater treatment, which is equally about the state and potential

effects on the receiving environments, as it is pipe sizes and water quality volume discharge.

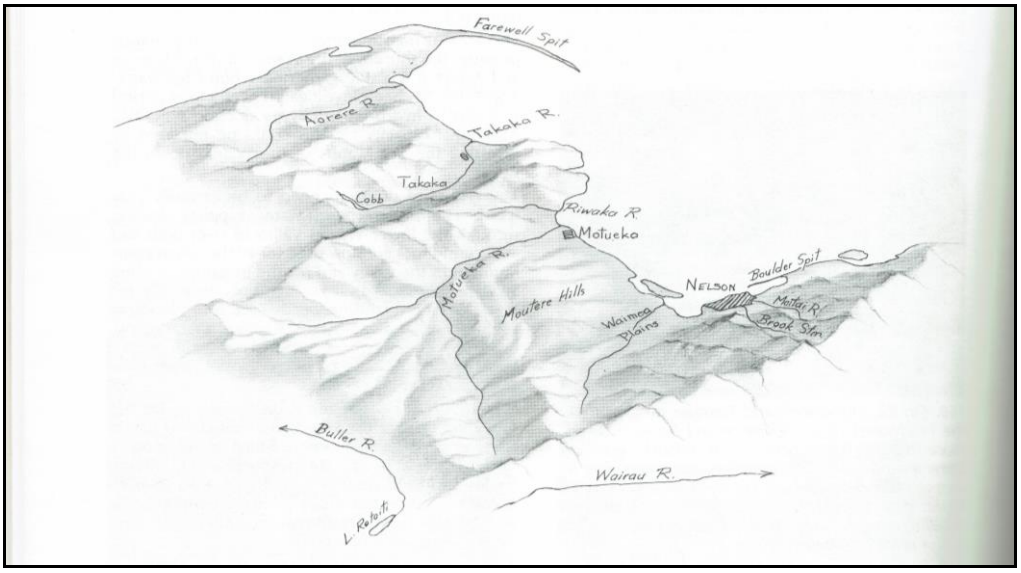

Figure 1: An early depiction of the Tasman/Nelson catchments

There has been an exponential increase in the utilization of geospatial data, which tends to highlight opportunities for more value add and multi-benefits, over recent times. For example, the potential to capture multi-variable data to support catchment planning i.e. while acquiring stream cross section geometries (for conveyance modelling), assess erosion geomorphic state and potential restoration works to provide a multilayered information output.

There has been some huge investment in capturing data to acquire and transform paper-based plans and information into geospatial or network data. This has been conducted across the country to various standards, extents and quality.

This tends to indicate the need maximise use/value out of this information and to manage supporting data in a more controlled and orderly manner. This then supports the sharing of collated information in a more transparent and accessible manner.

Overall from the observations made across New Zealand in developing plans and undertaking detailed catchment analysis the following is considered to apply in many areas;

- There are small budgets and high expectations.
- Urgent issues (e.g. flooding), often localized and sit within the context catchment scale influences and inputs which are easily missed at the site level.
- Increasing amount of data / information (Often available but typically located in numerous locations and not always easy to access).
- Increased need to service growth, define required infrastructure and operate a financial model to account for these.
- Need to be flexible – respond as and when required (Not simply catchment by catchment).

- Often top down – identify priority issues first with the risk other issues and/or opportunities missed.
- Increased expectation to go digital vs single big documents with e.g. Story Maps being a modern tool to achieve this.
- Value and investment in the data is not typically realized to its full potential.
- Need data management and strategy's are not well understood by stormwater practitioners.

2 THE BUILDING BLOCKS FOR INTERACTIVE TOOLS AND STORMWATER PLANNING

Adaptive management and planning, that utilizes interactive webtools, requires that existing policy, strategic documents or other guidance documents are available and are actively used. In addition, the geospatial information that underpins these should ideally be available to support ongoing assessment and management.

Fundamental to the adaptive management of catchments, are the policy guidelines and key strategies, that cover the main infrastructure and hydrologic units for management. An example of this might be having a defined overland flow path geometry, with a clear policy framework to define how its managed and its status and guidelines, available to support the lot and catchment scale management of overland flow i.e. design guidance.

A targeted search list is provided following (based on experience in other jurisdictions) to form a "straw man" in the development of an adaptive planning framework which is can be supported by interactive webtools such as Story Maps. The targeted search list could include;

- Stormwater management strategies/master plan (typically at either catchment or urban extent scale).
- Strategy related to unintended wastewater network discharges (in terms of identification and/or alleviation).
- Integrated catchment plans which integrate engineered and natural assets (at TA level) and associated data.
- Stream management strategies which encompass urban reaches (including watercourse classification, rules, regulation e.g. ability to pipe, etc).
- Flooding strategy (emergency management strategy and levels of service).
- Overland flow strategy (including agreed level of service) and data.
- Cumulative effects of stormwater discharges translated in regional/district plan requirements (e.g. monitoring data).
- Defined levels of service for; flooding, pipe conveyance, stream deletion, riparian margins and stormwater discharges.

- Engineering standards for; reticulation design, overland flow, stream modifications, sediment management, water sensitive urban design, detention/attenuation design and stormwater treatment devices.

- Discharge standards for point source discharges including wastewater overflows.

Where such documents and data are used to manage catchments/infrastructure, define network performance/standards and manage risks, they need to be available to be utilised in the design of a platform for targeted tools development. Interactive web-based tools are a flexible, updatable and readily shareable platform to express and communicate this information.

2.1 DATA AVAILABILITY AND DEVELOPMENT

The provision of up to date data on a range of natural (Refer Figure 2), engineered or social parameters is required to adaptively manage stormwater. These data are necessary to inform decision making around efficient and effective responses to stormwater management and to enable the evaluation of either hypothetical scenarios or implemented strategies.

Long term monitoring of water quality improvements (or degradation) must also rely on robust data to ensure that any conclusions drawn are relevant and reflective of the actual status of the receiving environment of network location in question.

The following provides a list of the type of data and information which might be required in the development of advanced tools such as modelling and GIS when undertaking catchment planning activities, they include but are not limited too the following;

Conveyance and Structures

- Stormwater pipe networks (including as-builts and verified GIS layers)
- Stormwater outfalls (including condition assessments)
- Overland flow paths (locations and geometry's)
- Existing stormwater treatment devices (public and private)
- Wastewater overflows (including popping manholes which ultimately connect with stormwater) and Inflow/Infiltration/Exfiltration rates

Environmental (Water and Sediment Quality)

- Urban streams (spatial location and characteristics as minimum)
- Natural wetlands
- Lakes (both natural and constructed)
- Riparian margins
- Fish passage barriers

Ecological

- Macroinvertebrate Community Index (MCI)
- Fish presence

- Water quality (including robustness of method)
- Sediment quality
- Urban stream/watercourse condition assessments (incl erosion)
- Flow data

Base Data

- Up to date LiDAR
- Digital elevation models (with suitable accuracy)
- Impervious layer for urban areas
- Building footprints
- Stormwater catchments
- Existing land use layers
- Future land use layers
- Parks and reserves
- Significant natural areas
- Contaminated land and landfills
- Roads (including vehicle densities)
- Population model outputs

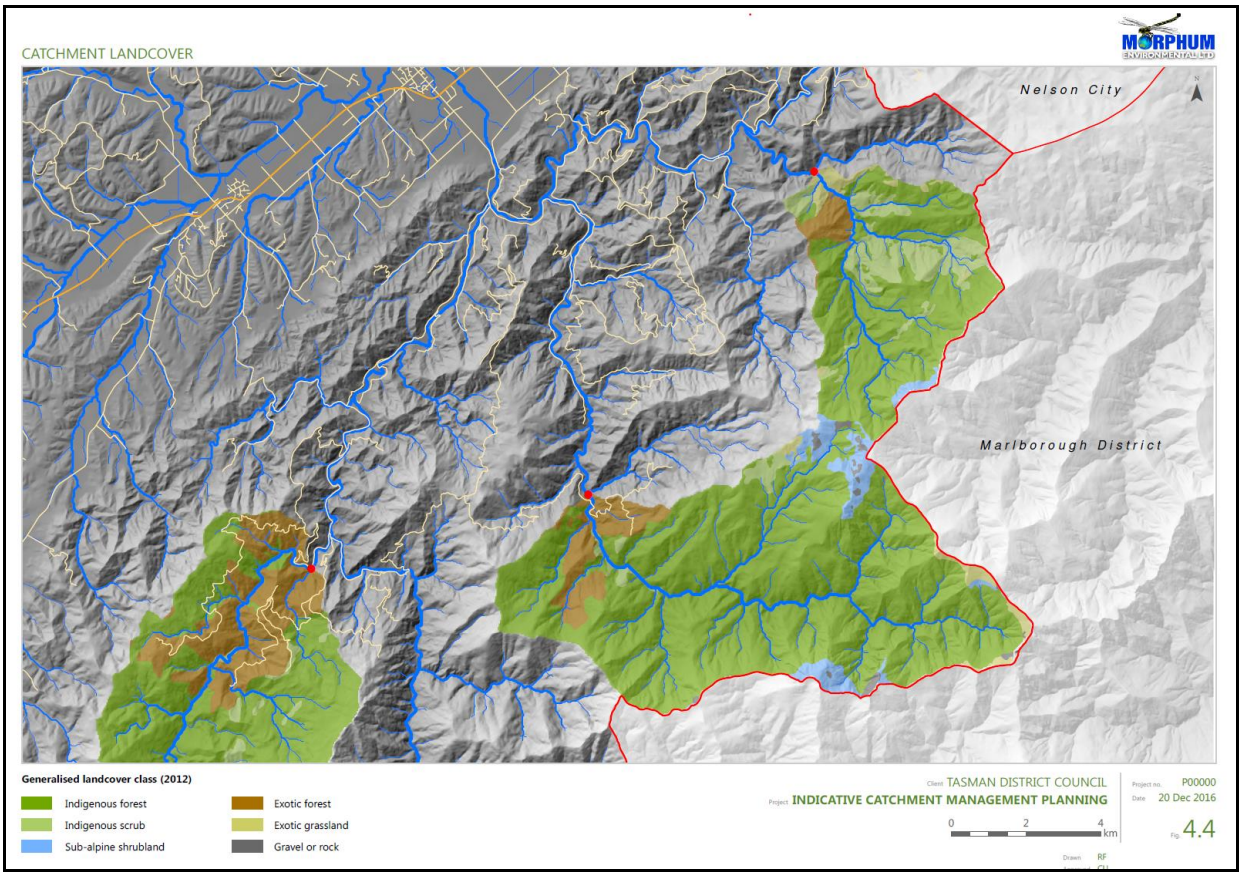

Figure 2: An example base dataset development map for forest cover to inform the Richmond Catchment Story Map

2.2 TYPICAL DATA GAPS

Urban water quality data in existing streams, and modified waterways within urban boundaries, is expensive to collect and not historically well collated, or collected. With

samples (and associated data) needing to be event based, with multiple samples collected, to reflect discharge of contaminants during rainfall events.

There is often limited data relating stormwater outfalls to existing waterways (natural or modified). Councils often do not have a program, or documented process, for the assessment of these structures to define condition which in turn impacts on localised scour, fish passage, asset performance and public safety.

Limited data on the ecological condition/value of existing urban watercourses. This data would typically include physical parameters (such as substrate conditions and riparian margins) and observed metrics such as MCI, periphyton measures and fish counts. However, regions like Auckland have a comprehensive Stream Assessment and Management progamme, supported by guideline methodologies e.g. Watercourse Assessment Methodologies (Young et al 2016).

Whilst some data is typically collected as part of SoE reporting by Regional Council, this is typically restricted to a limited number of urban watercourses with more focus on rural streams and rivers (overall). Occasionally data on the presence of indigenous fish and/or macroinvertebrates is sporadically collected as part of consent applications where it is perceived that land development may have a direct.

Limited data on location of wastewater overflows (either designed or not) with a reliance on anecdotal reports and known long term problem areas. This is compounded by the lack of water quality data whereby discharges to the stormwater network (through either illegal cross connections or leakage) are not necessarily detected and recorded.

Unsatisfactory data on existing levels of contaminant load generation across urban centres. Loads correlate with landuse and are discussed further in the technical methods and tools section. For example, the nationwide River Environment Classification (REC) has limited accuracy in urban areas.

3 EXAMPLE STORY MAP USE

The following provides an insight into how catchment scale planning an assessment can be prepared to present a narrative through to contextual geospatial visual information such as maps or graphics which change while navigating and exploring through catchment story.

3.1 RICHMOND STORMWATER CATCHMENT PLAN (TASMAN DISTRICT)

A draft Story Map to support public consultation, was created Tasman District Council for the Richmond Catchment. This is the first truly online and interactive catchment plan to be completed in the Region refer Figure 3.

This has been designed to assist the community to set out how a sustainable, cost effective, stormwater service for housing, businesses and community services. An overarching aim to deliver on tangible positive outcomes for both the waterways, environment and people within the Richmond urban area.

The Tasman Council used catchment management plan and webtool to incorporate the views of iwi partners and incorporated Te Ao Māori, the Māori worldview, values and interests to inform protection of the environment.

These values and concepts have been woven throughout the plan. A holistic approach to stormwater management is promoted to ensure a healthy environment and healthy communities.

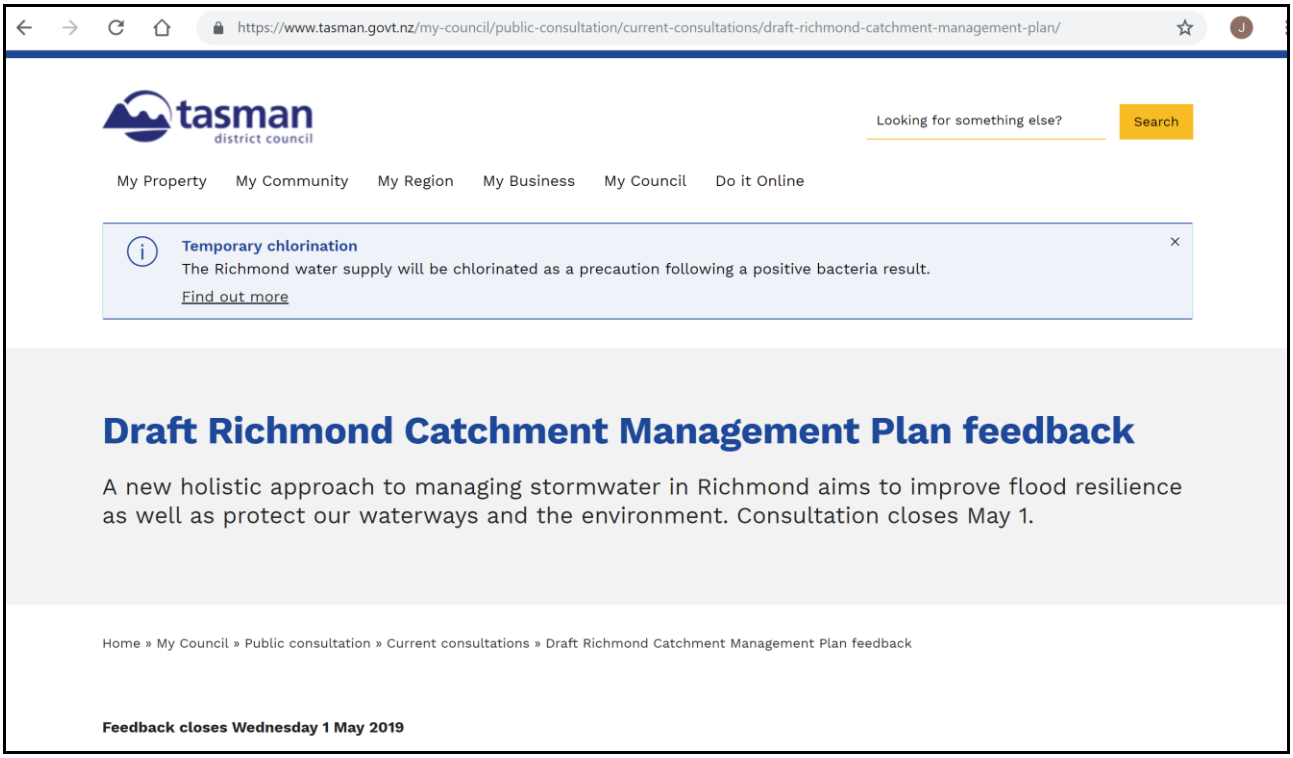

Figure 3:Web Page for Catchment Consultation Page Tasman District Council

The purpose of this plan being bring together the current knowledge of the catchment and stormwater networks, to identify issues, to set out a series of actions and to help achieve Council vision and aspirations.

The plan provides long-term direction for the management of stormwater within the Richmond area. It brings together stormwater and flooding information, environmental information, and social and cultural information on a whole-of-catchment basis.

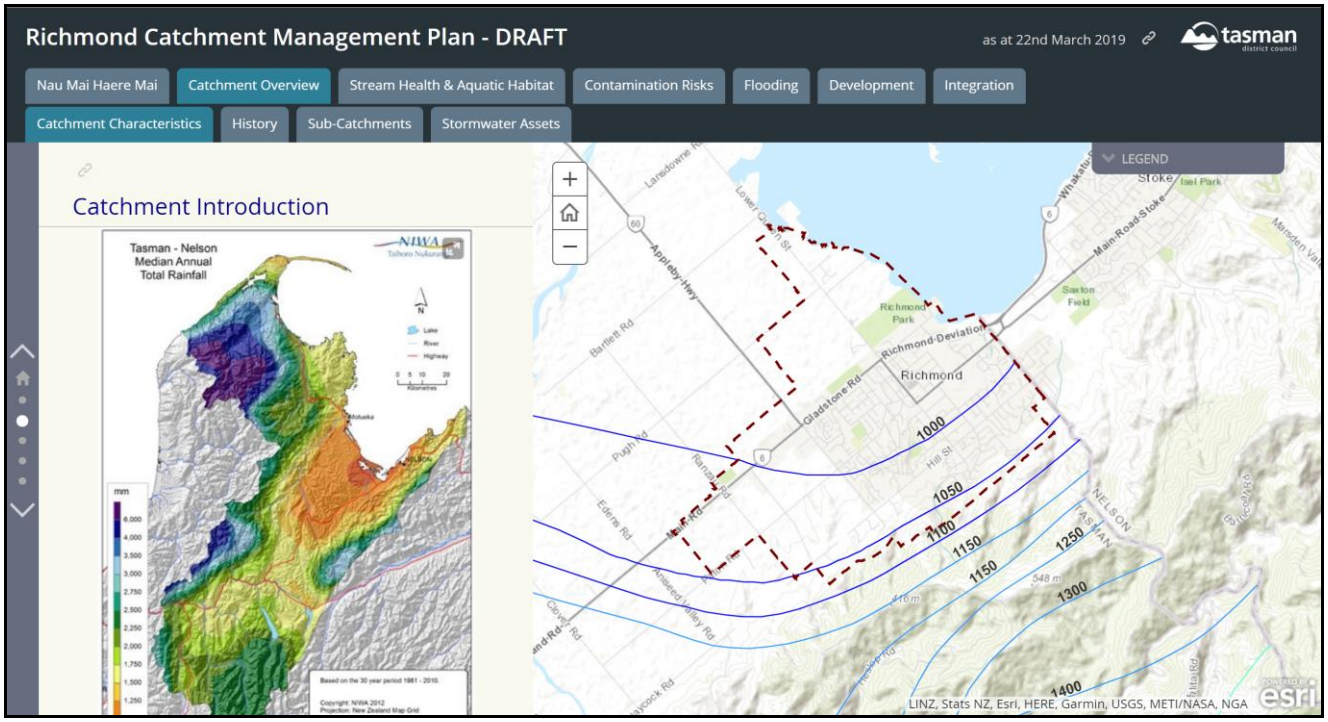

Figure 4:Richmond Catchment Management Plan Story Map online for Community Feedback

Aspirational goals, key issues and improvement actions are presented in this interactive platform. For example, urban stream and aquatic habitat health aspirations i.e. to maintain and or/protect fish passage are highlighted with the potential to then display the significant amount of work Tasman has been undertaking, in this area of aquatic resource management, refer Figure 5.

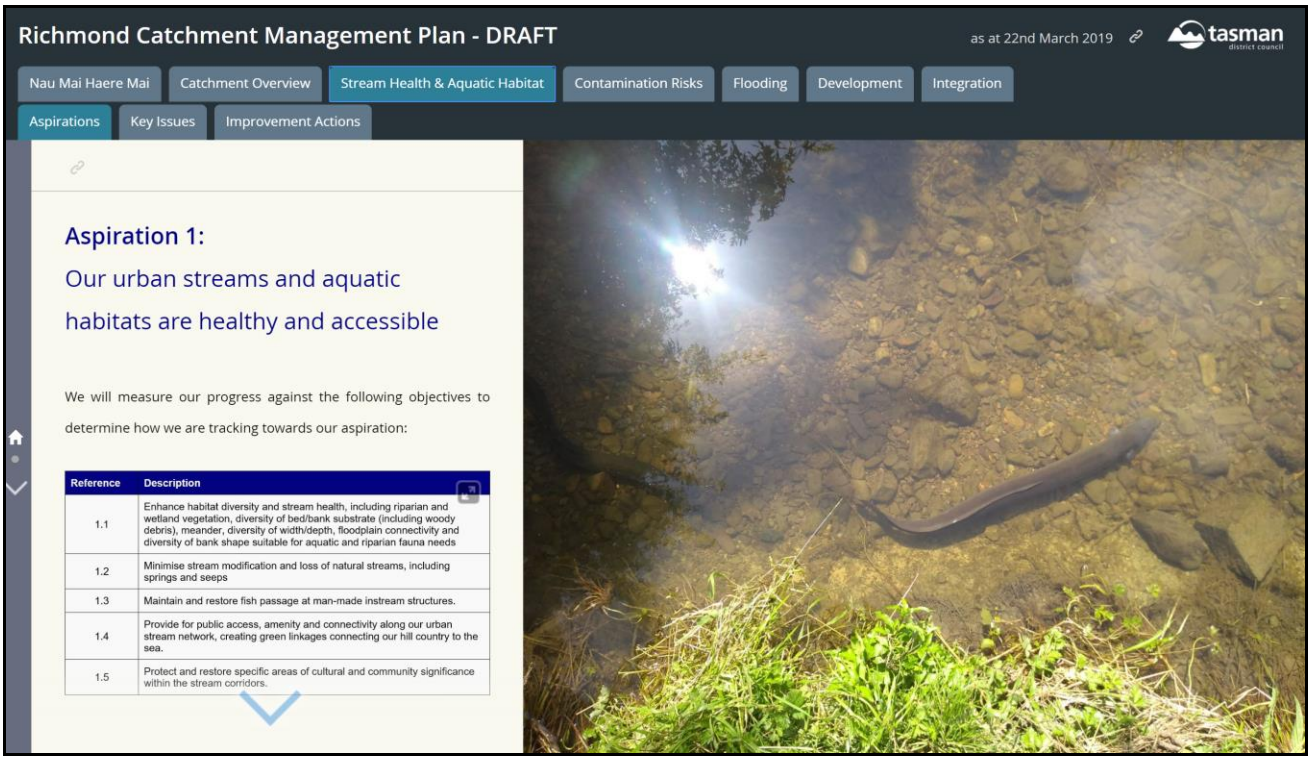

Figure 5: Urban stream and aquatic habitat health aspirations reflected on the Tasman Story Map

3.2 HAMILTON CITY (MASTER PLAN)

The Stormwater Master Plan (SMP) is a document and set of spatial layers that help to provide a framework for management of stormwater in Hamilton and inform individual integrated catchment plans. The storymap is designed provides an overview of the master planning process and an opportunity to interact with the spatial layers.

The SMP project vision is as follows:

"To provide a dynamic, well documented and geospatial platform to support the analysis, planning and management of stormwater for Hamilton City".

The objectives of the SMP, for Hamilton City, were as follows:

- Provide a high-level understanding of stormwater quantity and quality and associated effects now and in the future for Hamilton City.
- Provide a dynamic, well documented and geospatial platform that is able to be updated and maintained, and supports analysis, planning and management of stormwater.
- To inform the stormwater planning required to facilitate growth and define compliance requirements and actions.
- Enable efficiencies to be achieved in carrying out stormwater management activities including the development of stormwater catchment plans.

The landing page, refer *Figure 6*, of the Master Plan Story Map, provides the navigation for the rest of the customized site. This has been created from a paper-based report using many many new and collated datasets to communicate the values and issues identified during the course of the Study.

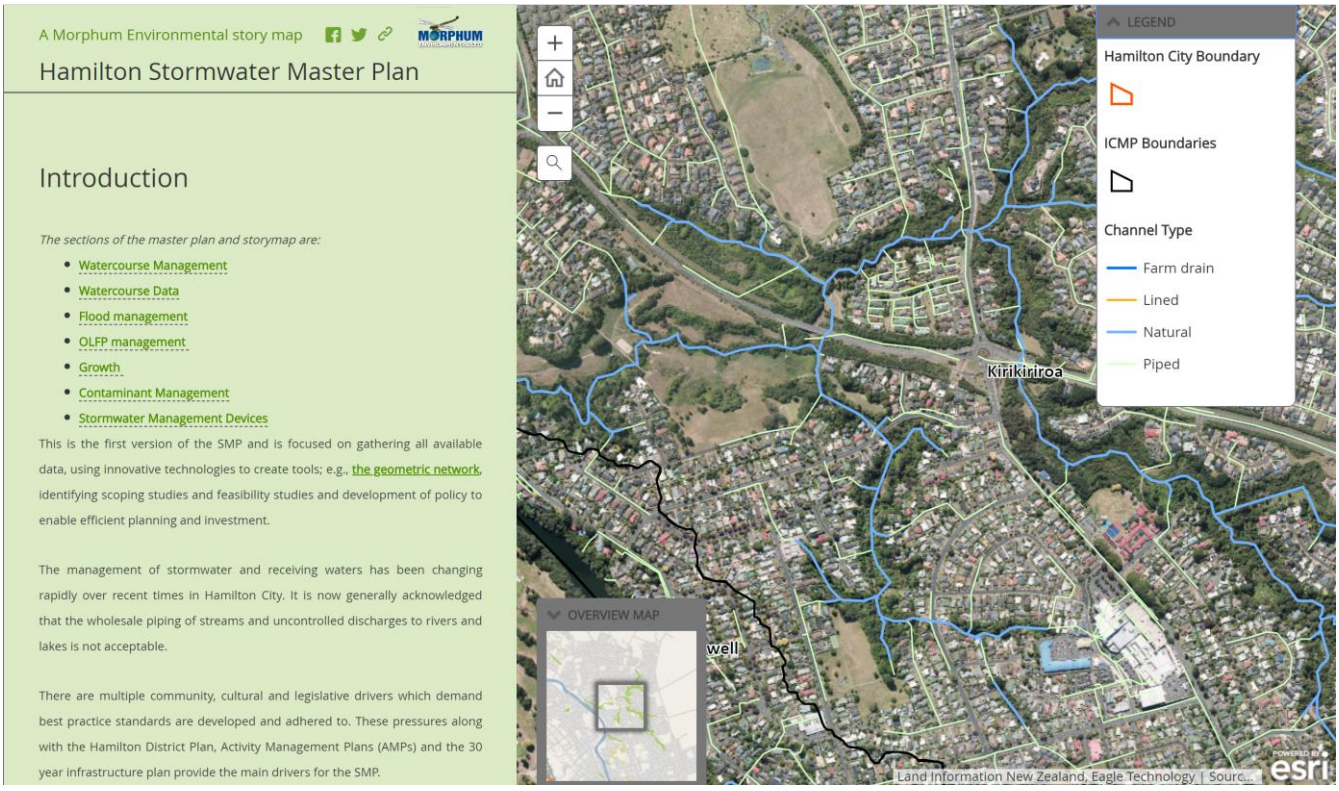

Figure 6: The landing page of the Hamilton City Master Plan Story Map

The sections of the HCC Master Plan and Storymap are as follows:

- Watercourse Management
- Watercourse Data
- Flood management
- OLFP management
- Growth
- Contaminant Management
- Stormwater Management Devices

This was the first version of the SMP and is focused on gathering all available data, using innovative technologies to create tools; e.g., a geometric network, identifying scoping studies and feasibility studies and development of policy to enable efficient planning and investment.

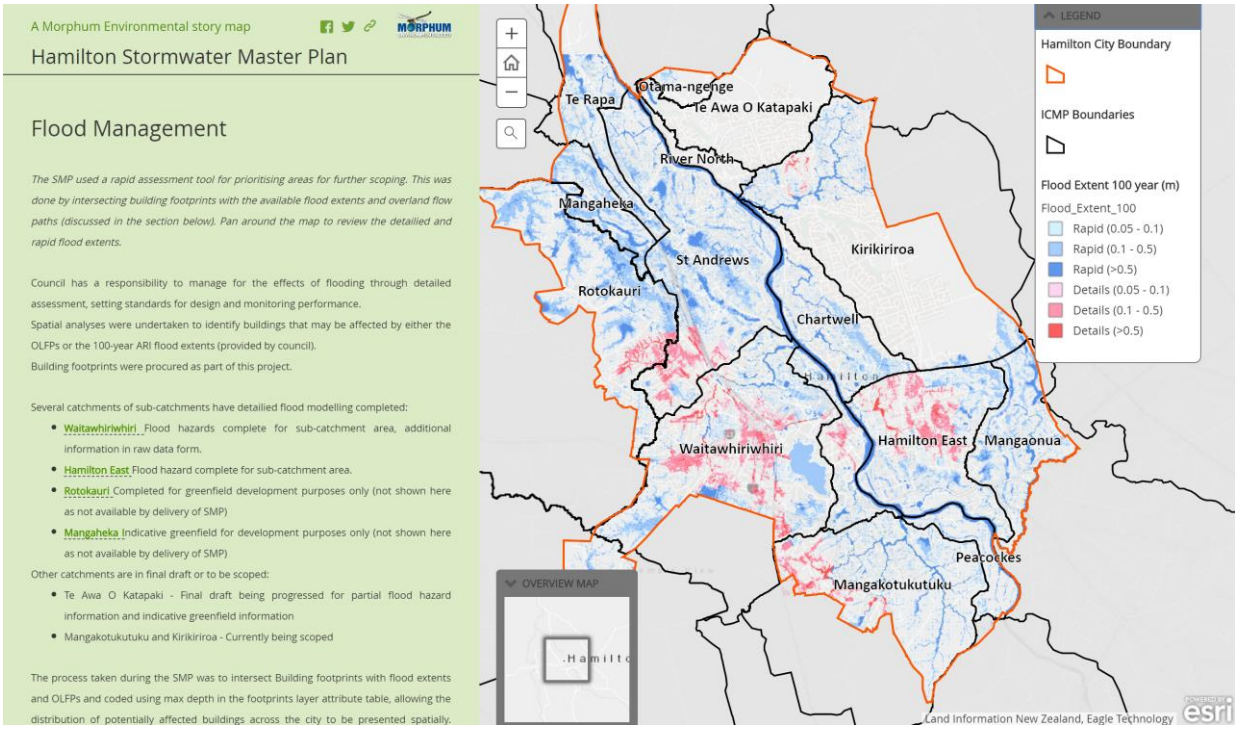

Figure 7:Modelled and predicted flood extents Hamilton City 2016 (Source HCC: Draft Story Map)

The SMP used a rapid assessment tool for prioritising areas for further scoping of potential projects. This was done by intersecting building footprints with the available flood extents and overland flow paths. The map allows for panning around the map to review the detailed and rapid flood extents for any area in the City.

4 SUMMARY AND CONCLUSIONS

Stormwater planning in New Zealand has experienced many changes over the last few decades with more changes anticipated for the future. We have increasingly been using advanced tools such as modelling and GIS to support catchment analysis, strategy development and planning activities, to deliver catchment planning outputs.

The process of defining the performance, values and critical issues within in a catchment requires that significant amounts of information and data is analysed. Most of the data, gathered or generated as part of the planning process, such as stream data or overland flow paths, are very useful and of value to multiple parties. Additionally, it is expensive to gather this information and it tends to be a limited to a few, often needing specialised skills and custom platforms to access information

Catchment plans are often produced to satisfy high level regional council requirements without addressing District or City Council needs. They are often unrelated to council structures and workflow processes resulting in lack of ownership of data and recommendations. Additionally, Catchment plans often developed by external consultants without buy-in and engagement of key staff.

The historic focus has often been on hydraulic modelling which does not usually result in effective or integrated stormwater management. In summary traditional catchments plans are:

- Paper based
- Snapshot in time
- Hard to update
- Difficult to access (mostly technical reports for staff)

Interactive web-based tools are a flexible, updatable and readily shareable platform to express and communicate this information, they are;

- Interactive
- Build on info-payers
- Easy accessible – access possible to public
- Do need story-telling and expert input
- Much easier to update / expand over time
- Allows for modular approach – following NCC priorities
- Needs ongoing commitment to update

Interactive web-based tools and GIS information resources support City scale master planning and catchment scale studies. Allowing the user to readily scroll through the presented narratives, pictures and data while having access to contextual geospatial visual information such as maps or graphics, which change while scrolling through the story.

Data management is an important part of the process and mapping of data sources and structure are key. The better data is integrated, and management systems are in place, the easier and more efficient the process tends to be to develop these kinds of tools.

The interactive web based ‘catchment plan’ also allows for the story and the maps to be relatively easily updated as planning information gets added on an as and when required basis. This allows for the completeness and reliability of the information to be improved

over time and only where required, rather than having to have a full revision of a catchment plan.

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