SUSTAINABLE PATHWAYS 2

Applied Systems Thinking: Freshwater Management Units

Report for Auckland Council

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Executive Summary

A series of workshops were held to bring together staff across Auckland Council (AC) working in freshwater-related positions to scope the establishment of Freshwater Management Units[1] (FMUs) using a (System Thinking) ST approach. This involves taking a whole of systems view while respecting the parts. The aim was to use ST to start a dialogue to support cross-council understanding of freshwater management working towards the National Policy Statement for Freshwater 2014 (NPS-FM).

The secondary tier of the workshops was to train people in ST using learning-by-doing. Rather than having a fragmented departmental approach to freshwater in the Auckland Region the goal was to develop many stories (that interrelate at a higher level) to facilitate communication with others not at the workshops.

The workshops introduced ST initially from a 'problem-based' perspective and worked toward a solution-oriented application. ST incorporates feedback loops from causes to effects and makes you consider 'when' things are happening and what the 'behaviour over time' trend is likely to be. Archetypes were used to identify generic behaviour patterns.

Ecological Economics Research New Zealand (EERNZ) at Massey University was commissioned to design and facilitate a process that applied ST as a methodology to make visible scenarios for implementing FMUs at large, medium or small scale. Emphasis was placed on how aspects relevant to different AC departments interconnect. For example, small scale FMUs might be effective for engaging and linking people with their waterways, but this scale might be difficult for monitoring and data collection.

This report gives an overview of: 1) the context in which the seven workshops took place, 2) the process that evolved, including feedback from participants through surveys, and 3) the content to consider for FMU criteria development. The core report is brief with more substantial detail and workshop summaries included as appendices.

The workshop dialogue highlighted common possibilities, concerns, and questions across departments. Some of these possibilities and concerns have been captured in a collated Causal Loop Diagram (CLD). The CLD (Figure 11, page 16) helps tell 'a story' of how relevant issues interrelate when considering different scales of FMU implementation and the associated setting of limits for freshwater quality and quantity. The CLD was developed in a context where the exact requirements for FMU implementation were uncertain. It highlighted for participants the flow-on effects and different options for setting FMUs. For example, FMUs could be implemented to align with existing management practices and plans or alternatively as a new way to organize freshwater management. During the workshops current practices were explored (i.e. staff from different departments learned about what each was doing) and possible solutions suggested (e.g. freshwater monitoring could be a community task, where AC provides

information and resources to interested citizens). Discussions highlighted that FMUs can be set solely for the purpose of the NPS-FM, or provide a starting point for a broad conversation across council about boundary alignment and management. The workshop format was designed to

[1] A FMU as defined in the NPS-FM (2014) 'is the water body, multiple water bodies or any part of a water body determined by the regional council as the appropriate spatial scale for setting freshwater objectives and limits and for freshwater accounting and management purposes'.

structure dialogue and to explore the implications of alternatives in a qualitative manner. The workshops also created a forum for cross-departmental conversations at the appropriate depth, i.e. 1) Are we doing things right?, 2) Are we doing the right things?, 3) How do we decide what is right? See text box on page 15: 'Single, Double and Triple Loop Learning'.

The pros and cons of different FMU scales were discussed, often in terms of practical limitations. For example, integrated catchment management is only possible in larger catchments as small areas do not have the necessary flexibility. Rather than pitching large scale and small scale as an either/or option, the merits of a multi-scale, tiered approach was discussed and reflected in the collaboratively collated CLD.

An important finding among the participants was that definitions and terminologies used across AC departments in relation to FMUs are not in sync. It was emphasized that community engagement does not need to be at the FMU scale. Broad evaluation criteria for FMUs were developed and are set out in Figures 8 and 9. It was identified that at least 24 different water spatial units are used at AC.

Going forward, recommendations from the participants include:

- The need to build a common glossary of terminology for use in freshwater management, to facilitate cross-departmental collaboration
- Three 'what-if' scenarios (large-, medium- and small-scale) should be developed for the FMUs to test the criteria set out in Figures 8 and 9 and using the CLDs generated. This could facilitate determining outcome priorities, additional criteria, and trade-offs.
- Different departments/teams organize spatial representations to carry out their functions in the freshwater space. A need for alignment of a more consistent spatial framework was highlighted for departments/teams to work together more effectively. (see Appendix B "List of Water Spatial Units used by different teams of Auckland Council" for the current situation).
- Participants signalled a desire to follow up and report on the findings and recommendations from the workshops to the new Wai Ora Wai Maori – Tamaki Makaurau steering committee on FMUs.
- When evaluating FMU options the processes undertaken should at a minimum include the 'assessment criteria' developed to date (currently in the shape of the spider diagrams and CLDs). The FMU process should also pay regard to other council processes – social, economic and cultural – by looking at CLDs.
- Developing the skills that are required to update and adapt the 'assessment criteria' and to communicate how they work across departments.

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Main Acronyms used in Report

FMU	Freshwater Management Unit
ST	Systems Thinking
ISE	Integrated Spatial Explorer
MM	Mediated Modelling
RIMU	Research and Investigations Unit
AC	Auckland Council

1. Background

In 2013, Auckland Council (AC) commissioned Ecological Economics Research New Zealand (EERNZ) at Massey University to undertake a Systems Thinking (ST) project on freshwater management. This project aligns with, and contributes to, the on-going Sustainable Pathways 2 (SP2) programme. SP2 is a 6-year programme (2009–2015) to foster the development of processes and tools to support dynamic, integrated, spatially explicit, adaptive urban planning in New Zealand[2]. The tools include Mediated Modelling (MM), i.e. model building *with* stakeholders, and Integrated Scenario Explorers (ISE), i.e. elaborate spatially dynamic models that can be used by stakeholders to simulate the flow-on effects of alternative planning scenarios. Figure 1 illustrates the continuum of toolbox development. 'Systems Thinking' was added to the SP2 project after AC identified advancing this skill as a prerequisite to the successful internal use of Mediated Modelling and the Integrated Spatial Explorer model.

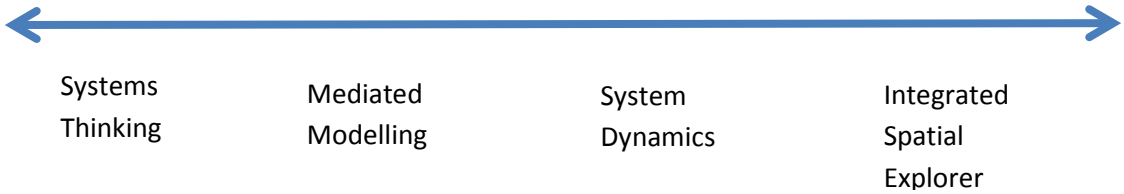


Figure 1: SP2 Modelling toolbox

Systems Thinking is the study of system structure and behaviour using established tools such as Causal Loop Diagrams (CLDs) and archetypes. Through system s thinking awareness of complexity, interrelationships, non-linearity, change and feedbacks is built and this insight helps identify leverage points to bring about effective change. Maani and Cavana (2009, p.7) define Systems Thinking as "a scientific field of knowledge for understanding change and complexity through the study of dynamic cause and effect over time. Complexity underlies most business, economic, natural and social systems." More information on systems thinking can be found in Appendix A.

[2] SP2 is based on a close collaboration with three regional councils. In addition to AC, staff members from Greater Wellington Regional Council (GWRC) and Waikato Regional Council (WRC) work on the co-development of tools to ensure usability and relevance. For more information see www.sp2.org.nz

The following quote from Paul Polman, Unilever chief executive, on the skills business leaders need to have in the current global environment recognises the importance of Systems Thinking:

> "Capitalism needs to evolve, and that requires different types of leaders from what we've had before. Not better leaders, because every period has its own challenges, but leaders who are able to cope with today's challenges. … Most of the leadership skills we talk about – integrity, humility, intelligence, hard work – will always be there. But some skills are becoming more important, such as the ability to focus on the long term, to be purpose driven, to think systemically, and to work much more transparently and effectively in partnerships" (May 2014)

For the rest of the article see:

http://www.mckinsey.com/Insights/Sustainability/Business_society_and_the_future_of_capitalism?cid=other-eml-alt-mkq-mck-oth-1405

After involvement in the MM workshops undertaken by EERNZ for the Auckland Region (van den Belt et al., 2012), Dr Karen Creagh (AC) recognized the potential for a systems approach to provide more integrated, cross-departmental solutions to freshwater management challenges. Rather than using MM with AC and external stakeholders it was decided there was a need to: 1) foster a structured dialogue across the various departments within AC tasked with an aspect of 'water'; i.e. water supply, storm water, waste water, and maintenance of water quantity and quality in the Auckland Region ecosystem; and 2) develop and test the usefulness of System Thinking (ST) skills in the workplace. Such skills, it was assumed, would be a necessary prerequisite to engage meaningfully with the increasingly advanced integrated decision support tools available, such as, but not limited to, those developed under the SP2 programme. The next step was to identify an appropriate topic relevant for staff across departments and important enough to allocate scarce time and resources toward. Potential topics considered included 'the implementation of the National Policy Statement for Freshwater Management (NPS-FM)' and 'Water Strategy'. The Ministry for the Environment (MfE) requires Regional Councils to establish Freshwater Management Units (FMU) as part of the National Freshwater Objectives Framework. This created an opportunity both to initiate a cross-departmental dialogue on the content of FMUs and to develop cross-departmental ST skills.

The workshops introduced ST from a 'problem-based' perspective. ST incorporates feedback loops from causes to effects and makes you consider 'when' things are happening and what the 'behaviour over time' trend is likely to be. Archetypes were used to identify generic behaviour patterns.

The report is organized as follows: First, a brief overview of the context relevant to FMUs is given. Second, we reflect on the workshop process and the iterative feedback from the participants. Third, the outputs are presented in the format of Spider Diagrams, a Causal Loop Diagram (CLD) and a list of findings and recommendations from the participants.

2. Context of 'Freshwater Management Units'

Through the Auckland Plan and with the statutory responsibility to implement the National Policy Statement for Freshwater Management (NSP-FM), Auckland Council (AC) has significant commitments to improve the region's freshwater. Wai ora-Wai Māori Tāmaki Makaurau, Auckland's Freshwater Programme has been established to meet these commitments. Achieving required freshwater outcomes entails management of different aspects of water (water supply, waste water, storm water, water quantity and quality to maintain or enhance ecological integrity) and requires involving Mana Whenua. Collaborating cross-departmentally to develop policy to determine how freshwater management is undertaken is a way to fulfil these commitments effectively and efficiently.

A key requirement of the NPSFM is to establish values, objectives and limits for freshwater throughout the region based on effective community engagement. This can be undertaken at the FMU scale or at a different scale, as long as FMUs are used to set the limits. According to the NPSFM a ***"Freshwater management unit"*** *is the water body, multiple water bodies or any part of a water body determined by the regional council as the appropriate spatial scale for setting freshwater objectives and limits and for freshwater accounting and management purposes*" (Ministry for the Environment, 2014, p. 6). Objectives, limits and targets are to be incorporated into regional plans.

A broad range of factors must be considered when determining appropriate FMU spatial scale. These include the internal management systems and boundaries of the different operations and activities within council. Currently, Auckland Council staff work in the freshwater area across multiple spatial scales (see Appendix B "List of Water Spatial Units used by different teams of Auckland Council").

The setting of FMUs requires consideration of the AC regional legislative framework in place and facilitation of working toward common goals at multiple scales. Appendix C summarizes the key planning tools relevant to setting FMUs, as understood by EERNZ. These tools include the Proposed Auckland Unitary Plan, the Long Term Plan, Area Spatial Plan, and the Auckland Plan. The Coastal Policy Statement, Marine Spatial Plans and Local Board requirements should also be considered.

Workshops using systems thinking were the first step to scope out the different uses and **perspectives on FMU-scale across council and as a way to work towards a shared** understanding of appropriate spatial scales for NSP-FM purposes.

3. Workshop Process

3.1 Workshop preparation

3.1.1 Selection of participants

The aim was to select about 15 participants from different departments related to water issues with a specific interest in how FMU's are formulated. An additional aim was to identify and invite key staff, who, after training, would benefit from being able to communicate systems thinking skills and narratives with their units and teams.

3.1.2 Invitations to participants

The purpose of the workshop was communicated by AC. Prospective participants received an invitation outlining the project with the following key message:

"The proposed process brings people with diverse interests, different needs and different perspectives together through a series of workshops. Systems thinking structures this collaborative process, which allows experts from different fields and with different functions to produce a coherent, high level story. The process will serve to raise the understanding of the diversity within the group, and with that knowledge, offer opportunities to progress to a common agreement or consensus.

Following from systems thinking, system dynamic models can be developed to simulate cause and effect – the interactions between key components of systems. Mapping or modelling these relationships and behaviours over time allows users to explore what-if scenarios and consider intended and unintended outcomes.

The process offers shared learning opportunities and potential for building consensus in a shorter timeframe with fewer resources than other forms of deliberative processes, and a way to identify strategic opportunities and constraints.

Outputs from this process can vary, depending on the commitment of the individuals and the complexity of the issues to be resolved. At this juncture, we hope to achieve the following:

- Increased understanding across council of how different functions use spatial scale in managing freshwater.
- Knowledge of the factors that need to be considered when establishing objectives and limits for the NSP-FM.
- Consider and agree a preferred spatial scale for freshwater management units most appropriate for the needs of all council functions working with freshwater."

3.1.3 Pre-interviews

Even though the project had been conceived early 2013, an appropriate topic to use for the introduction ST to AC staff, i.e. FMUs, was not decided on until March 2014. The AC requirement that the series of workshops be finished by the end of June 2014 left little time to perform the methodologically important first step of one-to-one interview conversation between participants and the workshop facilitator. The general purpose of the pre-interview, based on a semi-structured survey, is 1) for the participants to ask questions about the process they are about to engage in, and 2) for the facilitator to get a basic understanding of how participants perceive the challenge posed by the topic; in this case understanding and designing appropriate FMUs. Due to the short timeframe, only 5 interviews were conducted.

The five pre-interviews identified the following different motivations for participating in the process: (1) learning-by-doing systems thinking; (2) addressing the FMU challenge across departments; and (3) both. Figure 2 illustrates the 3 resulting perspectives.

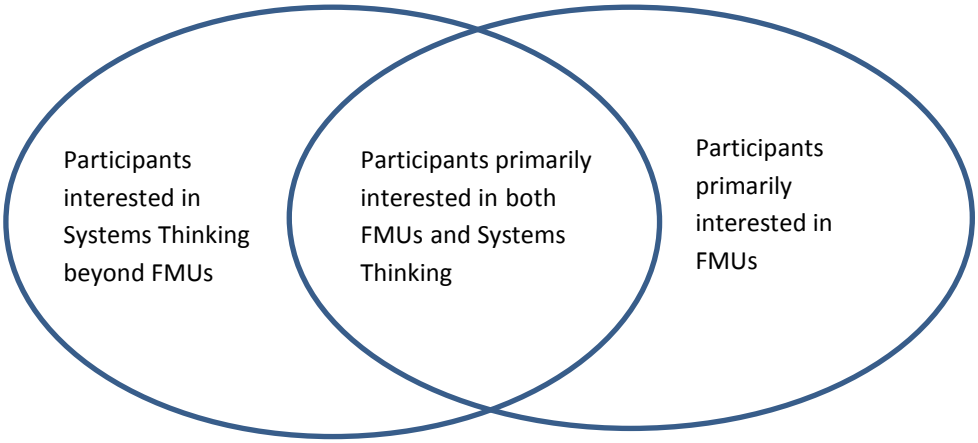


Figure 2: Participants reasons for engagement in the workshops

3.1.4 Supporting STREAM site

The five pre-interviews revealed 'systems thinking and system dynamics' was, in the main, an unfamiliar approach. Intuitively interviewees thought it would be a useful skill to learn, improve, or make explicit – if they were already implicitly applying such skills. All confirmed participants were given access to a STREAM website, through Massey University. This site provided background information, including an overview of systems thinking. Appendix A provides a basic overview of this approach. In addition, all supporting PowerPoints that guided the workshops and summaries of the narrative during the workshops were made accessible on this site. The summaries were emailed to the participants shortly after each workshop for review, before being posted in STREAM. The site statistics, however, show that not many participants used this resource.

3.1.5 Workshop schedule

The workshop dates and topics were originally communicated to the participants as part of the invitation. Topics were subsequently adjusted to accommodate participants' expressed desire to emphasize FMUs in the content.

Table 1 shows the finalised schedule.

Table 1: ST/FMU workshop programme

Workshop #	Date and Time	Topic
Workshop 1	April 29, 30 9.30–12.30	NSP-FM context. Introduction to systems thinking. System Archetypes to create Causal Loop Diagrams (CLD).
Workshop 2	May 6, 7 9.30–12.30	May 6 workshop was cancelled due to flight cancellations by AirNZ. Creating solution-oriented archetypes (CLDs).
Workshop 3	June 4, 5 9.30–12.30	Assessing leverage points and practicalities, using CLD. Data and information requirements.
Workshop 4	June 25, 26 9.30–12.30	Introduction to system dynamics scenario modelling. Presentation by RIMU of the Integrated Scenario Explorer. Findings and recommendations.
Workshop 5	22 August 10–12.30	Report and overall CLD. System Dynamics simulation model based on CLD, as an example only. Questions and Answers.

3.2 Attendance

Eighteen participants attended the first workshop. Three participants from 'Consents and Compliance' formally withdrew after the first set of workshops due to time constraints. Over the course of the workshops, 24 staff were involved in some capacity, attendance totalling close to 300 person hours. Participants came from six departments, with different responsibilities within these departments. Workshop 4, when the findings and recommendations were discussed, was the least well attended (8 participants). Reasons for the decline in attendance included restructuring and other work priorities taking precedence over the luxury of learning a new skill. A table with the names of Council staff attending each workshop is presented in Appendix D. Figure 3 illustrates the attendance rate per participant, starting with the 4 people present at all seven events.

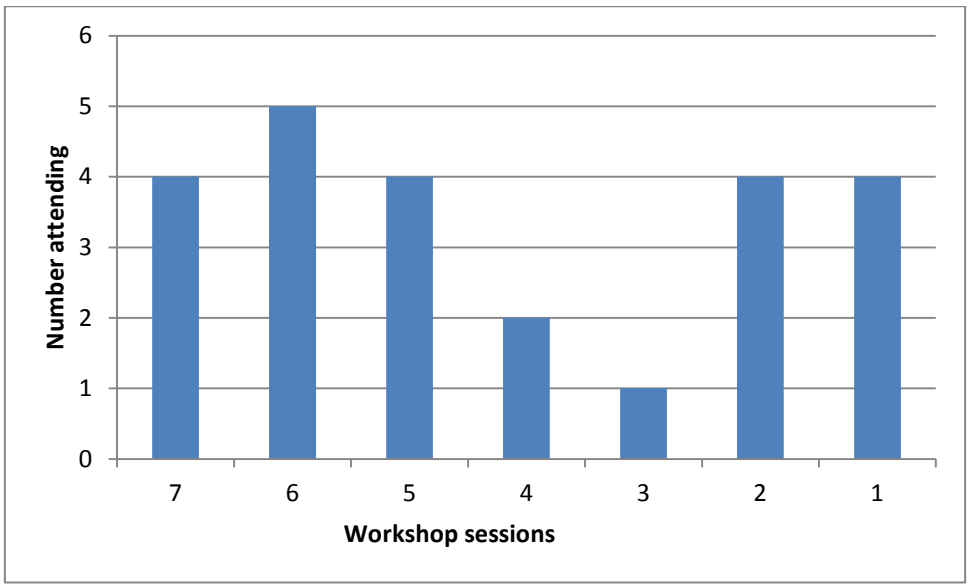


Figure 3: Attendance per event attended

3.2.1 Feedback received through workshop surveys

All attending participants were briefly surveyed after each workshop. Appendix E graphs the collated survey results to key questions. The following summarises feedback:

1. The statement *'Systems thinking is a useful tool to think about things in an integrated way'* was consistently answered with 'agree' and 'strongly agree', with a shift toward 'strongly agree' as the workshops progressed.
2. The feedback regarding the *usefulness of the dialogues during the workshops* showed an almost identical positive pattern.
3. The statement '*My understanding of System Thinking as a way to communicate complex challenges has increased'* was asked to reflect participant's readiness toward more active engagement with systems thinking. The answers were all 'agree' and 'strongly agree'. This statement was answered with increasing positivity as the workshops progressed with the majority of respondents settled at 'agree'.
4. The surveys also endeavoured to gauge the extent to which participants became increasingly active users of systems thinking. Figure 4 gives the responses to the question regarding *confidence of introducing systems thinking to others.* While predominantly positive, only a few participants were very confident and a substantial number were neutral to this idea.

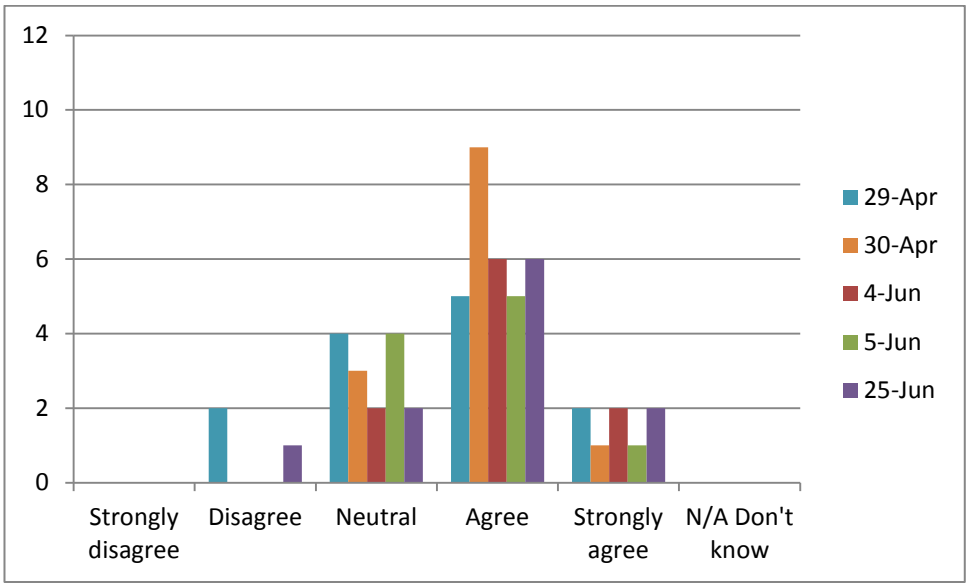


Figure 4: I am confident I can introduce others to System Thinking

In the final workshop System Dynamics, as a quantitative expression of systems thinking was introduced. System dynamic models can be developed to simulate cause and effect – the interactions between key components of systems. Mapping or modelling these relationships and behaviours over time allows users to explore what-if scenarios and consider intended and unintended outcomes. The statement 'Systems Dynamics is a useful tool to explore integrated and quantitative scenarios' was answered positively with 5 'agree' and 6 'strongly agree'.

3.2.2 Final workshop

The fifth and final workshop was held on 22 August. Attended by 25 people it covered:

- Why use Systems Thinking.
- How Systems Thinking was applied to FMUs.
- The process used, lessons learned and unanswered questions.
- Simulation of a System Dynamics model based on the ST workshops.

Participants were surveyed at the end of the workshop for feedback. Surveys were completed by 3 people who had attended the ST workshops and 7 people who had not attended. The full survey results can be found in Appendix E. In summary the respondents indicated:

1. ST was considered a useful tool to help think in an integrated way.
2. Developing ST skills was considered beneficial to AC work and useful for continuing work on the wider implications of the NSP-FM and with other topics.
3. The cross-departmental dialogue during the ST workshops was useful in fostering collaboration for meeting the FMU requirements. It was uncertain whether this could have been achieved without the workshops.
4. The CLD presented a relevant story relating to setting FMUs.

5. System Dynamics appears to be a useful tool to identify leverage points, and a way to explore integrated and qualitative scenarios for the wider implications of the NSP-FM and other topics.
6. The System Dynamics model presented was easy to follow for most (7 respondents), provided useful insights (7 respondents) and more skills in this area could benefit future work (7 respondents).
7. There was interest in learning more about ST through EERNZ.

The detailed summary of the narrative of each of the workshops can be found in Appendix F1-F4.

The workshop content largely progressed as initially conceived (Table 1) except for two fundamental adaptations.

First, as indicated the motivation for participants to attend, was primarily for the FMU topic and less so for Systems Thinking (ST). This initially led to substantial information sharing in parallel with the use of ST.

Figure 5illustrates the relative emphasis during the workshops and how the two objectives seemed to become more congruent toward the end of the project.

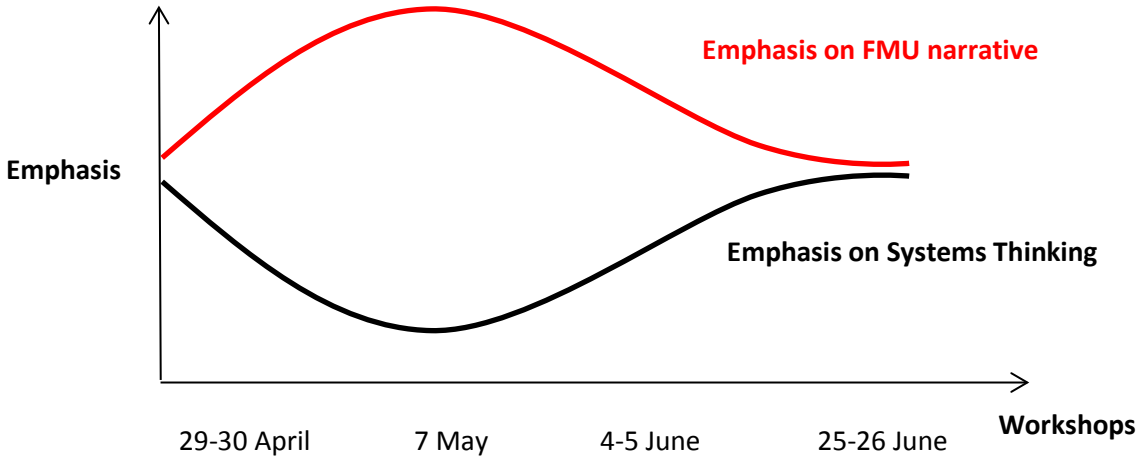


Figure 5: How the emphasis between the FMU narrative and use of ST tool changed during the workshops

Second, ST was introduced by working with causal loop diagrams (CLDs), which are visual aids to interrelate variables in a system. Figure 6 is an example of a CLD. This CLD represents 'the story' that as word spreads about council staff providing assistance to Local Boards more requests are made. Therefore, R1 is a reinforcing loop. The associated graph shows how this behaviour overtime results in exponential growth in demand from Local Boards for support. This example, generated by workshop participants, is detailed in Appendix F1, along with many more examples.

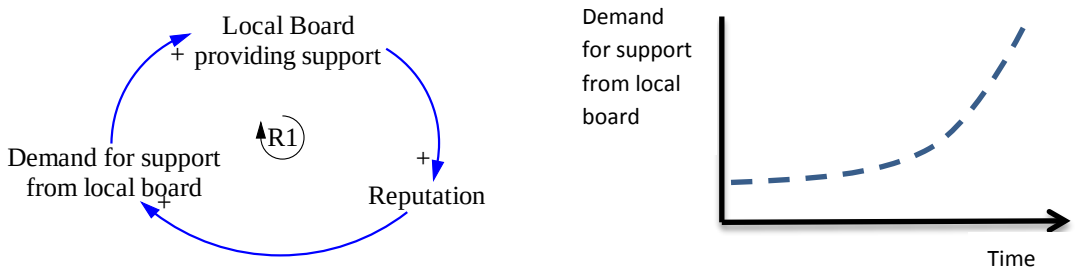
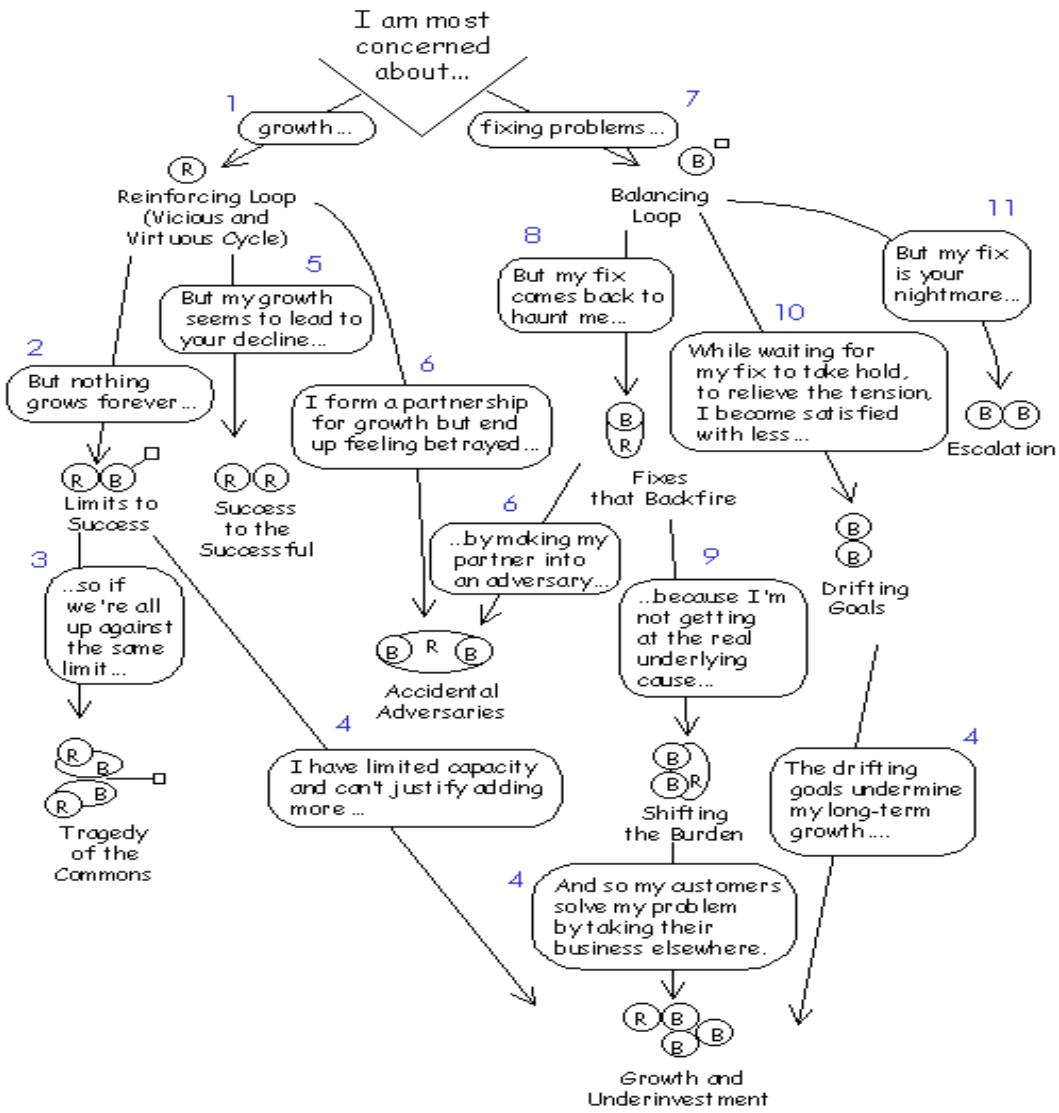


Figure 6: Example of a re-enforcing feedback loop and a graph of 'behavior over time'

When drawing a CLD variables are linked (with an arrow to show direction) if there is a relationship between them. When linked variables form a loop this is called a feedback and these show the dynamics in the system. Loops are labelled according to whether they act to counteract change (usually labelled '**B**' for balancing or negative feedback) or reinforce change (usually labelled '**R**' for reinforcing or positive feedback). A balancing loop has an uneven number of '**-**' or '**o**' in the loop when counted up. A reinforcing loop has an even number or no '**-**' or '**o**' in the loop.

A CLD can be configured in multiple ways to support thinking and learning about a system. The literature discusses 9 CLDs[3] that are combinations of re-enforcing and balancing feedback loops that reflect archetypical behaviour over time and time lags. These ST archetypes can be a useful way to recognize and start discussing similar situations that arise in organizations and systems. For example, the archetype 'Fixes that Backfire/Fail', is common. This shows a fix determined in isolation of the rest of the system instead of providing a solution leads to unintended consequences that slowly increase the problem. Figure 7 links well-known archetypes as a decision tree.

[3] Systems thinking archetypes include: Fixes that Fail/Backfire; Limits to Success; Success to the Successful, Tragedy of the Commons; Escalation; Drifting Goals; Shifting the Burden; Accidental Adversaries; Growth and Underinvestment.



Source: http://www.pegasuscom.com/course_preview/module6/6-03-0-0-tree.htm

Figure 7: Example of a 'decision tree' connecting ST archetypes

A CLD tree that links selected, previously constructed CLDs was presented to the group. The aim of the tree is to show individual CLD stories and how they interlink. In the CLD tree there were more CLDs about organisation than about freshwater outcomes and as a result it did not resonate with participants. It was decided not to go any further with this as the CLDs in the tree were not relevant to the FMU setting.

Instead of trying to interconnect the individual stories developed in the AC workshops a 'spider diagram' was developed to define the predominant criteria a FMU should address.

Figure 8 shows the spider diagram compiled by participants. The assumed time frame was 30 years. The 'spider legs' represent a qualitative range for evaluation from low/small/easy (at the core) to high/big/difficult (at the tip).

FMU Criteria – over 30 yr timeframe

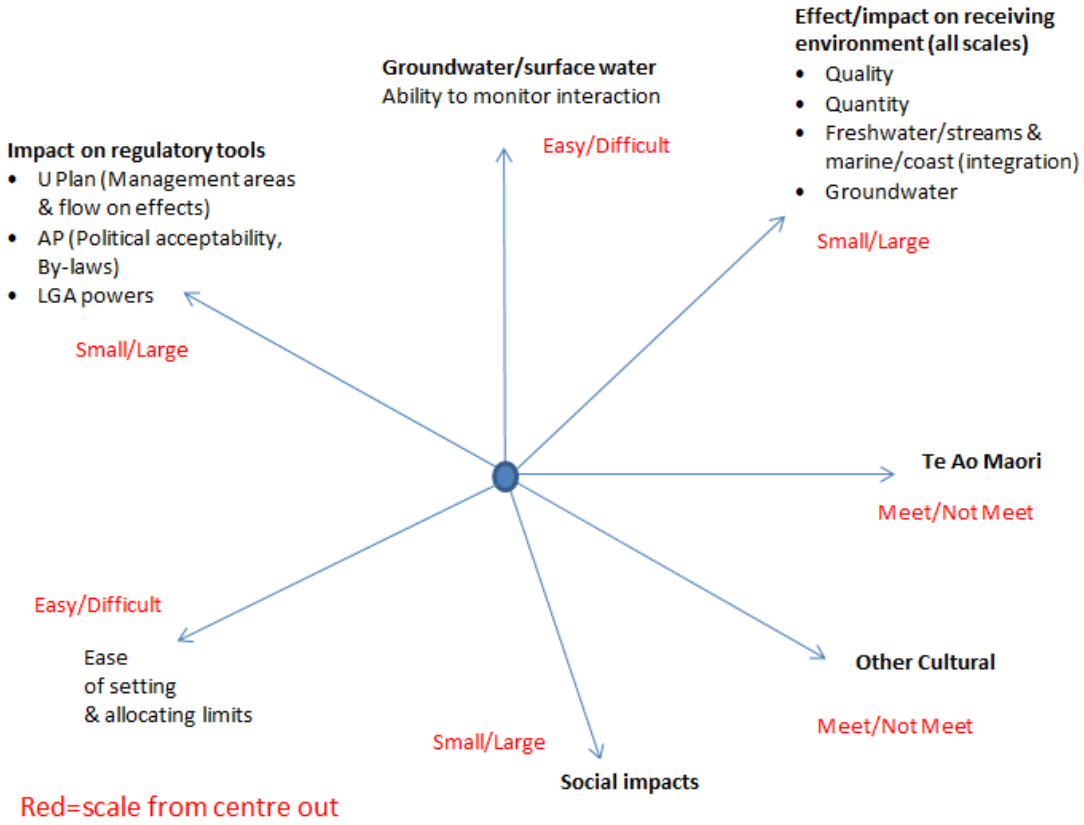


Figure 8: Spider diagram for FMU criteria compiled from participant's contributions

In addition, the question *'what and to whom are the potential costs for FMUs apportioned?'* was also addressed. This led to a second spider diagram (Figure 9) setting out cross-departmental and other costs. A blind poll was taken in which each participant submitted their perception of potential costs and where they would be incurred.

FMU Criteria – over 30 yr timeframe

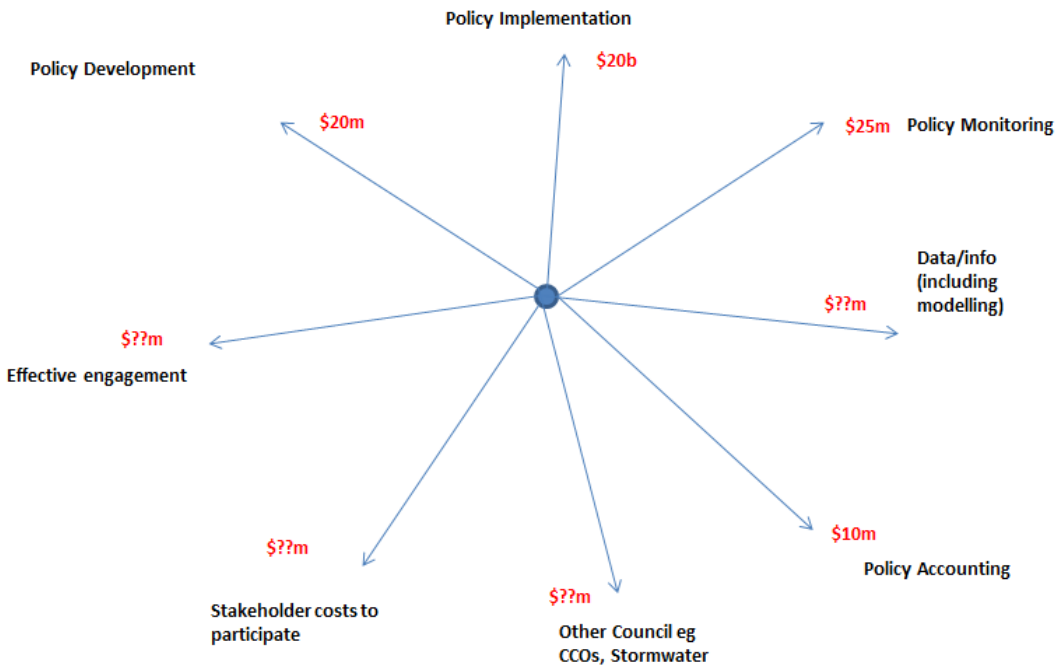


Figure 9: Cost to whom?

Appendix G1 details how participants intuitively proportioned costs over the different phases of the FMU management cycle. Appendix G2 provides the detailed cost guesstimates for a 30-year time frame. Summarised data are:

- 10 out of 10 participants agreed that **Implementation** is the most costly part (Range $50m (council only) to $20b)
- 6 out of 10 participants see **Policy Development** as the second highest cost (Range $5m (council only) to $20m)
- 4 out of 10 participants see **Monitoring** as the second highest cost (Range $3m (council only) to $25m)
- 8 out of 10 participants see **Accounting** as the lowest cost (Range $500,000 to $10m).

ST is a particularly helpful method to advance to deeper levels of deliberation. This is often referred to as progressing from 'single' to 'double' to 'triple loop learning'. This progression requires reflecting on correspondingly harder questions such as: 1) Are we doing things right?; 2) Are we doing the right things?; 3) How do we decide what is right? Figure 5 illustrates how the group moved from single to double loop thinking.

Single, Double and Triple Loop Learning

Are we doing things right? This question aligns with 'single loop learning' and the reflective practice of looking at what we have done and using that observation to make our next decision.

Are we doing the right think? This question requires challenging norms, attitudes and assumptions that are the basis for the decision-making and is referred to as 'double loop learning'. It requires people to think about the way they think and reflect on their mental models.

How do we decide what is right? This question requires considering how knowledge and power are interlinked and the risk of repetitive endorsement when looking for a solution

Senge et al, (2012) and Flood and Romm (1996)

Developing the spider diagram provided insights for the cross-departmental conversation about FMUs but this approach did not allow progress to double or triple loop learning . This 'single loop learning' exercise led to the realization that understanding the spatial aspect of FMUs is crucial if alignment with existing spatial unit boundaries is important. As a result, the participants listed the multiple spatial units that drive AC activities. A compilation is included in Appendix B. In essence there are: 1) four different spatial units used for managing water; 2) five natural spatial water units; and 3) 15 other types of spatial units used for political and management purposes.

Having established the perspectives on costs and the multiple spatial drivers across departments, participants re-engaged with Systems Thinking to try to interconnect the 'spider legs' and understand the underlying FMU system and implications for intended and unintended consequences over time.

3.3 Causal Loop Diagram

During the June workshops, participants increasingly used ST independently both in small groups and in plenary sessions. Some participants actively mediated the dialogue by drawing CLDs on a white board to illustrate the underlying story as it was unfolding.

Figure 10 pictures this activity

Figure 10: Interactive workshop

The EERNZ team collated what we think represents most of the story that developed. The resulting CLD (Figure 11) is based on the collectively developed CLDs with some re-work (from the EERNZ team) for consistency. Each loop is labelled and the associated narrative detailed below the CLD.

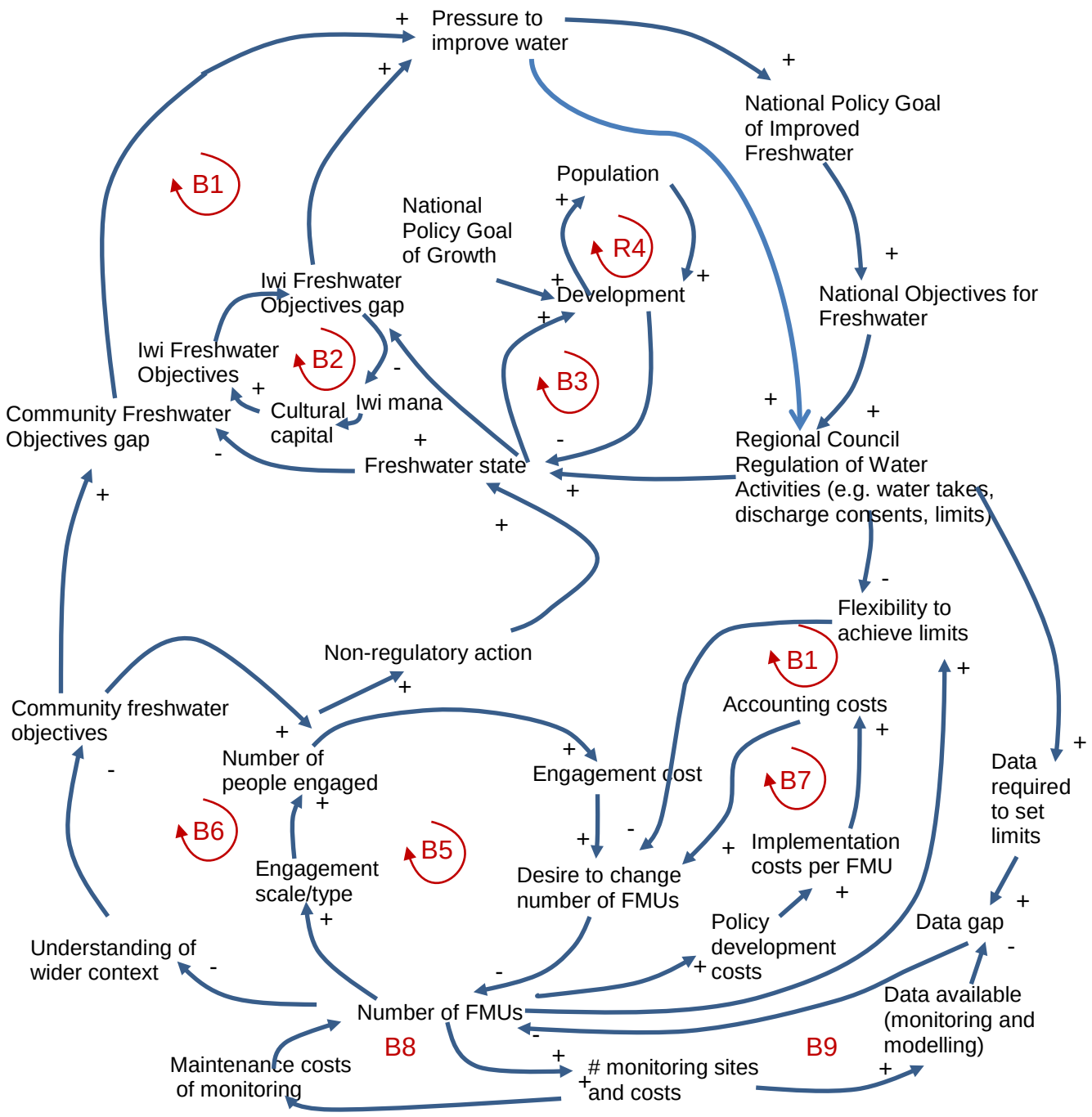


Figure 11: Final CLD: The story of the state of freshwater and considering a scale for FMUs for limit setting

B1: This story starts with a particular 'Freshwater State'. Depending on the community's objectives for freshwater, there is a gap: community objectives for water quality/quantity are either higher or lower than the actual freshwater state. If there is a negative gap between the Freshwater State and Community objectives there is pressure to improve freshwater and set National Objectives for Freshwater. The NPS (as well as direct pressure) leads to increased Regional Council Regulation of water take, discharge consents, limits, etc. Over time, this improves the freshwater state and reduces the community objective gap.

B2: If the state of freshwater is below the desired water quality or quantity level this creates a gap with iwi aspirations. Cultural objectives bring pressure to improve freshwater.

B3: Development is limited by the state of the freshwater. After a time, Regional Council regulation improves the state of freshwater which allows more development.

R4: Development and population reinforce upward or downward influences, depending on the dominance of the driver. An external force in this story is the National Policy Goal of Growth. This is 'outside' the system, competing with signals within the system. This highlights the need to understand the drivers and their relative rates of change.

So far, the story connects communities and iwi, with national and regional government and economic drivers. The next part of the CLD covers FMU scale.

B5: Workshop discussion indicated that an increase in the number of FMUs would increase the AC engagement requirements (scale and/or type). Greater opportunity for engagement increases the number of people involved in setting community freshwater objectives. More engagement increases associated costs. (Note there may be scope to engage more efficiently and at lower costs.) Engagement costs influence the desire to change the number of FMUs, which leads to pressure to reduce the number of FMUs and increase the geographic scale.

R6: An increased number of FMUs where people primarily consider their localised situation decreases understanding of the wider context. Decreased understanding of the wider context (e.g. high uniform water standards impacts on jobs, housing, farming, etc.) leads to increased (higher) localised community standards for freshwater quality. Proposed higher community freshwater objectives will galvanise people impacted (through job loss, housing affordability, farming restrictions) to become engaged. More engagement increases associated costs. Engagement costs influence the desire to change the number of FMUs, which leads to pressure to reduce the number of FMUs.

B7: An increased number of FMUs increases policy development costs, implementation costs per FMU, and accounting costs. This leads to a desire to change the number of FMUs.

B8: An increased number of FMUs increases the number of monitoring sites required. Higher maintenance and monitoring costs will bring pressure to lower the number of FMUs. Again cost driven!

R9: More monitoring sites provide more data, which reduce the data gap. The data gap is the difference between data provided by monitoring and the data the Regional Council needs to meet limits. The reduced gap allows for a higher number of FMUs as there is more localised spatially distributed data available.

B10: If the FMUs increase there is more flexibility to achieve limits. This also reduces the desire to change the number of FMUs.

Last, regulation increases the data required to set limits, regardless of FMUs. With a time lag, regulation may reduce flexibility to achieve limits. The more people who are engaged will increase scope for non-regulatory action. This will improve freshwater and reduce the gap.

In addition to this report, a PowerPoint presentation is developed where the CLD is presented in steps and tells a story (as presented at the workshop on 22 August). The interactive version of the CLD can be found at:

http://www.sp2.org.nz/project-outputs/auckland-council-freshwater-workshop/

This CLD is easy to change, if AC staff wish to do so. It is one of your possible tools to create and share a collective story and the associated learning!

The spider diagram has eight categories (spider legs) and which also emerged under slightly different labels in the CLD. Table 2 aligns the terminology used in the spider diagram more than with the CLD.

Table 2: Comparing the FMU criteria per spider diagram with some of the corresponding nodes in the CLD

Spider Diagram	CLD
Policy implementation	Implementation costs per FMU
Policy monitoring	Monitoring & modelling costs
Data/info (including modelling)	Data requirements
Policy Accounting	Accounting costs
Other Council operations	Not covered
Stakeholder costs to participate	Number of people engaged
Effective engagement	Engagement scale/type; Engagement costs
Policy development	Policy development costs

It is not mandatory that terminology be identical. The CLD is ideally moving learning to 'double loop', where it is possible to consider 'Are we doing the right things?'

4. Findings and Recommendations

Below are general discussion points that surfaced consistently throughout the process. At the final workshop, participants reflected on findings and observations and then listed recommendations.

4.1 General Discussion Points

- A caution with small-scale FMUs is that while they might be effective for linking people with their waterways they may prevent people seeing the bigger picture.
- The NPS states that each FMU can only have one limit or objective for each attribute. A discussion emerged over whether you can you set limits and objectives for a FMU and then divide up how they are achieved over the FMU, as with nitrates into Lake Taupo? With this approach it would be necessary to identify special communities or ecological areas needing tighter restrictions.
- The FMU scale is what is expedient for management purposes.
- At present AC monitors problem areas first. If it is not possible to monitor at a small scale should the FMUs be set at a small scale? A possible solution is for freshwater monitoring to be a community task. AC can provide the information and resources to interested people.
- Integrated catchment management is only possible in larger catchments. Small areas do not have the necessary flexibility. There are 10 catchment management plans for stormwater management so that was the scale at which waterways were aggregated.
- Progress can be shown more readily in large areas and there is more scope to direct resources where they are most needed.
- Engagement does not need to be at the FMU scale. What engagement scales will be most effective to increase buy in?

4.2 Findings, Observations and Reflections

- One size fits all is not practical and less likely to achieve NPS outcomes.
- A nested or tiered approach has potential.
- The workshops led to constructive discussions and common understanding. This has provided insights into other participants' professional worldview and operating space.
- There is an opportunity to link with other processes, e.g. marine spatial plan, stormwater, spatial planning, receiving environments, integrated management, etc., so overall outcomes are emphasized.
- Definitions and terminologies used across AC departments in relation to FMUs are not synchronised.

- The NPS is driven by the RMA process. However, FMUs need to be structured to efficiently enable other council freshwater related responsibilities and the fact that Aucklanders may want higher water standards than the NPS National Objectives Framework. FMUs can be set for the purpose of the NPS or by starting a broad conversation across council. The ST workshops helped participants to understand the *associated implications.*
- Broad systems implications have been identified for 3 'what-if' FMU scenarios scenarios (large-, medium- and small-scale).
- A structure to evaluate options is provided with the spider diagrams and CLD.
- There are at least 24 different water spatial units used at AC (see Appendix B "List of Water Spatial Units used by different teams of Auckland Council").
- Engagement scale does not have to be the same as FMU scale, but alignment would be useful.
- Output of workshops (i.e. discussion summaries and CLDs) could be used in the consultation process.

4.3 Recommendations

- A common glossary is needed.
- Scenarios should be developed for the following FMU options and tested using the spider diagrams and CLDs:
  1. Large FMUs / Harbour scale (3 FMUs)
  2. Medium scale (50–100 FMUs)
  3. Small scale (>4000 FMUs)
- Test outcome priorities and/or criteria and trade-offs. Expand the pros and cons document already started by AC.
- Different departments/teams organize spatial representations to carry out their functions in the freshwater space. A need for alignment of a more consistent spatial framework was highlighted for departments/teams to work together more effectively. (see Appendix B "List of Water Spatial Units used by different teams of Auckland Council" for the current situation).
- Values, objectives and limits for FMU need to aggregate to achieve high level objectives and be useful at the large receiving environment scale. Reporting needs to be at the FMU scale.
- Meet after this report is finalised to agree on a summary for the steering committee.
- The FMU process should use CLDs to take into account Council social, economic, and cultural processes.
- Evaluation processes undertaken should include, but not be limited to, the assessment criteria developed to date (currently in the shape of spider diagrams and CLDs).

- Skills are required to update and adapt the 'assessment criteria' and to communicate how they work across departments.
- External consultation on FMUs takes place, with or without the product of the ST workshops.

5. Link to Sustainable Pathways 2

This ST project leveraged off and worked together with the SP2 programme, which works with Auckland Council to co-develop and test systems tools. These system tools range from qualitative to quantitative and aim to foster the use of Systems Thinking and of modelling System Dynamics to support decision-making.

The SP2 project has three objectives. Objectives 1 and 2 involve the development of different computer-based modelling tools that can be used to simulate projected changes over a 30-year time frame. Objective 3 involves embedding these tools within Councils for day-to-day use. Objective 1 centres on Mediated Modelling (MM), which provides a process to bring stakeholders together to explore a core issue from a system dynamics perspective. Objective 2 has developed the Integrated Scenario Explorer (ISE) that models future land-use change based on assumptions about the relationships between land use, economics, and environment. Objectives 1 and 2 can be closely linked with the development of the ISE model for Auckland being informed by the MM. Stakeholders can define key elements and drivers through the process of mediation. The integration of outputs from Objective 1 into Objective 2 allows for learning, consensus building, and participation in scoping for the linkages between social, cultural, economic, and environmental considerations pertinent to the Auckland region.

To accommodate AC's needs in the governance of freshwater, this project was developed as a pre-cursor to running a MM process, so that AC staff can make a better informed decision regarding the use of MM. The choice was made to focus on ST skills and test the extent to which such skills make a difference to how AC staff interact with a System Dynamics based simulation model. To this effect, we have 1) delivered evidence that ST skills have been and are being developed and 2) worked with a System Dynamics student from Bergen University (Jacynta Spicer) to develop a system dynamic simulation model for AC incorporating (parts of) the CLDs staff constructed.

The Integrated Scenario Explorer (ISE) was presented by RIMU (Research and Investigations Unit) at Workshop 4. The ISE model is spatially explicit and could, in principle, be configured to assist the FMU scale setting in a spatially dynamic manner.

The extent of the links between Systems Thinking, System Dynamics and the ISE model will be reviewed as part of the SP2 research programme before it ends in October 2015. Updates are available on the SP2 website: www.sp2.org.nz

6. Conclusion

During seven half-day workshops between April and June 2014, staff from six departments have explored how Freshwater Management Units (FMUs) could be developed. A Systems Thinking approach was used to consider the links between relevant aspects of the FMU scale setting Skills were developed in using Causal Loop Diagrams (CLDs) to create a common understanding across departments. The output of this process is a collated CLD representing one interpretation of the FMU story. Findings and recommendations provide a starting point to further test the advantages and disadvantages of large-, medium-, and small-scale FMUs.

Disclaimer and Acknowledgements

Disclaimer: This report is primarily a reflection from the provider's (EERNZ) perspective. However, a draft has been circulated among the AC water team. Participants have also been given an opportunity to provide feedback on the final draft.

The Sustainable Pathways 2 (SP2) project is funded by the New Zealand Ministry for Business Innovation and Employment (MAUX0906). We thank Auckland Council for the opportunity to work collaboratively on this systems thinking project, which was executed in parallel to Objective 1 of the on-going SP2 project. The SP2 team is grateful to the participants from across Auckland Council's departments and we trust participants received value from this project.

We also thank the two reviewers Dr Catherine Murray (M.E) and Katherine Short (Terra Moana) for their contribution to the final report.

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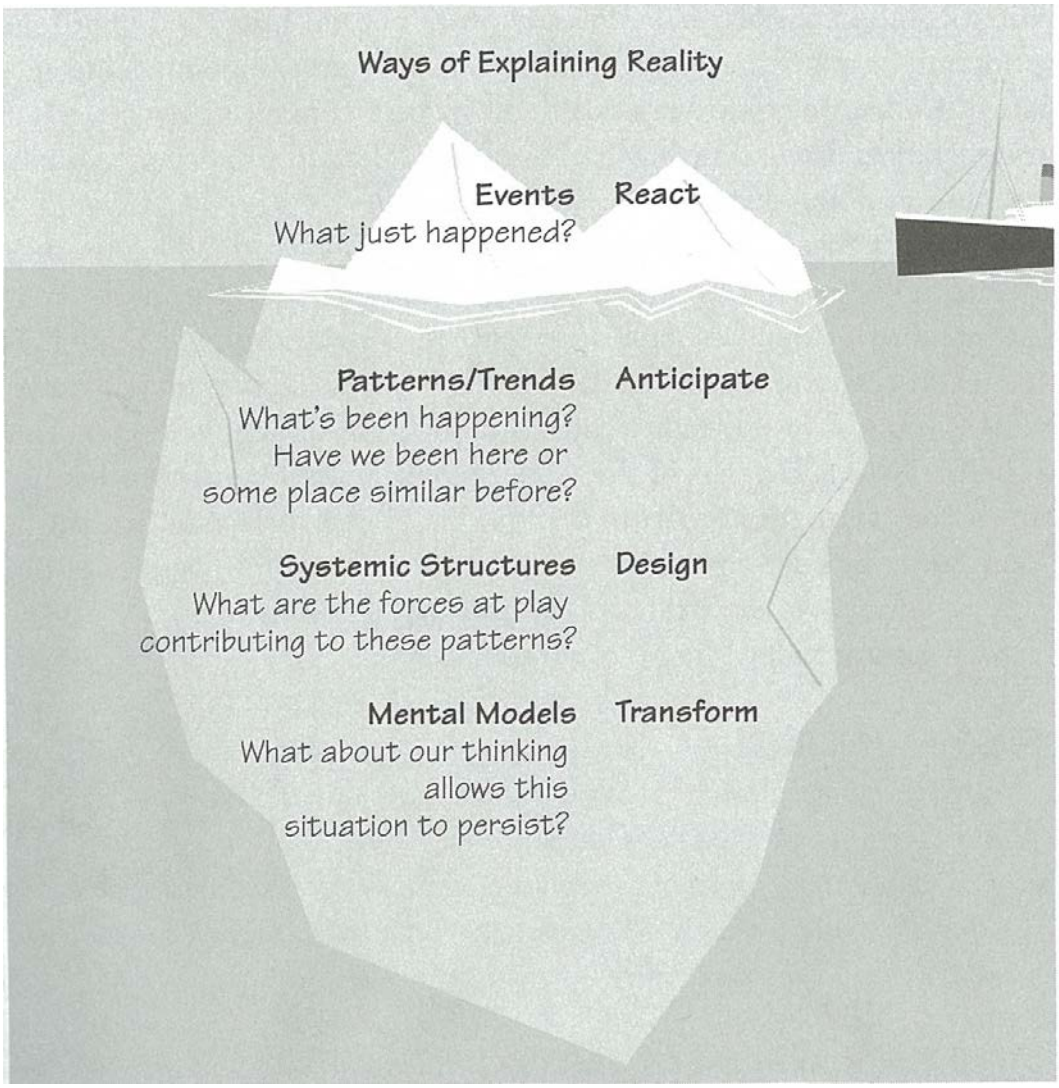
Appendix A: Brief introduction to Systems Thinking

Senge et al. (2012) presents four steps for explaining reality and increasing learning. Most people react to the visible level 'events'. However, events are usually just the 'tip of the iceberg' and to act appropriately requires finding out what the underlying causes that are require understanding of patterns and trends, systemic structures, and mental models. The objective of systems thinking is to allow people to move down the iceberg to better understand the events, patterns/trends, systemic structures, and mental models. Moving down the iceberg provides increased and opportunity for learning and intervention.



Source:(Senge et al., 2012, p. 127)

How Causal Loop Diagrams Work

Causal loop diagrams (CLDs) and causal relationships are used to depict the interconnections between variables and provide insight into the purpose and behaviour of the system.

CLDs are constructed following specific rules to ensure consistency and precise meaning. Variable names are generic and should not predetermine movement in any one direction. They have a

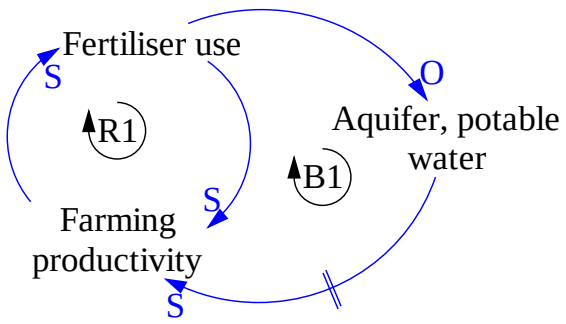
qualitative orientation and are able to increase or decrease. There are four types of cause and effect relationships possible between variables in a CLD:

1. The cause *increases* and the effect of the given change is an *increase* (notated with '**+**' or '**s**' to show that change is in the same direction).
2. The cause *decreases* and the effect of the given change is a *decrease* (notated with '**+**' or '**s**' to show that change is in the same direction).
3. The cause *increases* and the effect of the given change is a *decrease* (notated with '**-**' or '**o**' to show that change is in the opposite direction).
4. The cause *decreases* and the effect of the given change is an *increase* (notated with a '**-**' or '**o**' to show that change is in the opposite direction).

When interpreting a CLD it is assumed that the change that results between the cause and effect is more than it would otherwise have been with everything else held constant.

When drawing a CLD variables are linked (with an arrow to show direction) if there is a relationship between them. When linked variables form a loop this is called a feedback and these show the dynamics in the system. Loops are labelled according to whether they act to counteract change (usually labelled '**B**' for balancing or negative feedback) or reinforce change (usually labelled '**R**' for reinforcing or positive feedback). A balancing loop has an uneven number of '**-**' or '**o**' in the loop when counted up. A reinforcing loop has an even number or no '**-**' or '**o**' in the loop.

Example:



R1 is a reinforcing loop that says: An increase in 'Fertiliser use' will increase 'Farming productivity', which will increase 'Fertiliser use'. There is no '**o**' in this loop.

B1 is a balancing loop that says: An increase in 'Fertiliser use' will decrease the 'Aquifer, potable water' and, after a delay (notated with \\), this will decrease "Farming productivity'. There is an uneven number (one) of '**o**' in this loop.

Appendix B: List of Water Spatial Units used by Different Teams of Auckland Council

CURRENT CONSTRUCTION WATER SPATIAL UNITS	
UNITS	**NOTES**
Consolidated Receiving Environments (CREs)	These are managed by the Stormwater Unit. 10 CREs.
Natural 'Drainage' Catchments	The Stormwater Unit has a mapping layer of 235 units (the number '400' has been raised as well; these are an aggregation of the 235 catchments).
Catchment Prioritisation Process	This is currently being undertaken by Environmental Services Unit. There are likely to be around 50 catchments prioritised based on a certain criteria. This is a work in progress.
Proposed Unitary Plan	There are a number of Management Areas or other classifications in the Proposed Unitary Plan, e.g. water management areas and macroinvertebrate community Index classification areas.

CURRENT 'NATURAL' WATER SPATIAL UNITS	
UNITS	**NOTES**
Catchments (discharge points to sea) approximately 4500	These are discharge points to the sea (or natural drainage areas – some are overland flow paths). This work was completed by the Water Policy Team and is available in a GIS layer.
Harbours – Kaipara, Harauki Gulf, Manukau	East coast estuaries and west coast need to be included. The Hauraki Gulf contains multiple Harbours though. The Integrated Kaipara Harbour Management Group boundary for Kaipara includes the west coast.
Aquifers	Only aquifers of 'high use' are currently provided for in the Proposed Unitary Plan.
Lakes (including dunes) and associated catchments	
Groundwater catchments	

CURRENT 'OTHER' SPATIAL UNITS (which includes external stakeholders)	
UNITS	**NOTES**
Local Board Boundaries	This would include State of Environment report card areas for Freshwater and to a lesser degree marine (harbour/estuary based).
Iwi Rohe (external)	
Land Use Zones (internal Auckland Council)	
Council boundaries/wards (internal Auckland Council)	
Ecological units	
Stream Order / classifications	This is a tool / framework.
River values Assessment System (RIVAS)	http://www.envirolink.govt.nz/PageFiles/31/Leap%2024A-The-River-Values-Assessment-System-Vol-1.pdf
Integrated Spatial Explorer (ISE) model 50 x 50m grid	
Infrastructure Strategy	This is part of the Forward Land Infrastructure Programme (32 sectors). The Infrastructure Strategy in draft form has six sub-regions.
Other key stakeholder areas (e.g. Hort/Dairy NZ, Fonterra, Federated Farmers)	
Other Auckland Council structures, such as Watercare and Auckland Transport	
Census meshblocks	
Community-group scale	
Freshwater Ecosystems of New Zealand (FENZ)	http://www.doc.govt.nz/conservation/land-and-freshwater/freshwater/freshwater-ecosystems-of-new-zealand/
National River Environment Classification	

Appendix C: Key planning tools forming the context for ST/FMU project

Unitary Plan

The Unitary Plan is the principal regulatory tool to implement policy and objectives in the Auckland Region (The Local Government (Auckland Transitional Provisions) Act). This plan sets the rules for how to protect the environment and Auckland's built and cultural heritage. It will also direct future development by determining what can be built and where. Under the Resource Management Act the Unitary Plan must be reviewed at least every 10 years. In reality, to keep it relevant, the Council will look to update the plan much earlier.

Long Term Plan (2012–2022)

The Long-term Plan (LTP) outlines what Council plans to do, its priority projects and activities, and how it plans to pay for it over the next 10 years (2012–2022). The LTP seeks to turn the aspirations of the 30-year Spatial Plan into action through outlining the projects and services the Council will deliver on the vision that Auckland becomes 'the world's most livable city' (Draft Auckland Plan).

Auckland Plan

The Auckland Plan is the mechanism by which Auckland plans for its future. It provides the long-term strategy (20–30 years) to work towards Auckland's social, economic, environmental, and cultural well-being. It sets out:

- "long-term objectives – social, economic, environmental and cultural – for Auckland and its communities
- Auckland's role in New Zealand
- existing land use patterns and how Auckland will grow and develop in the future
- existing and future locations of critical infrastructure facilities, such as transport, water supply, wastewater and stormwater, other network utilities, open space and social infrastructure
- areas of national and regional significance for ecology, recreation and open space, landscapes, heritage, natural features and environmental importance
- what policies, priorities, land allocations, programmes and investments will be needed to achieve the Auckland Plan's strategies." (Draft Auckland Plan, p. 8).

Area Spatial Plans

Auckland Council is embarking on a programme to develop 21 Area Plans. Area Plans are based on the same geographic areas as Local Boards. These plans:

- help implement the directions and outcomes of the Auckland Plan at a local level
- reflect local aspirations such as those included in Local Board Plans, where these are consistent with the direction set by the Auckland Plan
- provide strategic direction to progressively inform the policies and rules of the new Unitary Plan which will eventually replace the existing regional and district plans of the former councils
- inform future versions of the Long-Term Plan (which determines council spending over a 10-year period). This will enable the council to prioritise and budget for projects to achieve area plan goals.

Area Plans will analyse local issues, challenges, and opportunities and, when complete, will provide a long-term (30-year) vision for:

- implementing the Auckland Plan at a local level
- identifying the timing of development projects and infrastructure needs
- how we use land to live, work and play
- the size, role and function of town centres
- key transport routes and improvements
- recognition of heritage, landscape, landmarks, and natural features
- social and cultural facilities
- public open space
- local business and employment opportunities

Area Plans are not required by legislation but are an important part of the new planning framework for Auckland. They effectively translate the macro-scale vision as described in the Spatial Plan into a different spatial frame of reference. Area Plans will be implemented through:

- the Unitary Plan
- new council policies
- Council investment (through the Long Term Plan)
- advocacy to other organisations (e.g. central government) – seeking to influence the investment and activity of these organisations to support Area Plan aspirations
- asset management plans

Area Plans will be implemented not only by Auckland Council, but also through partnerships and alignment with other organisations and delivery partners. They will be delivered over a 4-year programme, from 2012 to 2016, and the sequence of release of Area Plans has been confirmed by the Council's Auckland Plan Committee.

Appendix D: Workshop attendance

	Dpmt	29 April	30 April	May 7	June 4	June 5	June 25	June 26
Christine Mitchell	**ESP – water**	✓	✓	✓	✓		✓	
Sam Turner	**ESP – water**	✓	✓	✓	✓	✓	✓	✓
Katie Collins	**ESP – water**	✓	✓	✓		✓		
Sue-Ellen Fenelon	**SWU**	✓	✓	✓	✓	✓	✓	✓
Laura Buckthought	**RIMU**	✓	✓	✓	✓	✓		
Claudia Hellberg	**SWU**	✓	✓	✓	✓	✓	✓	✓
Karen Creagh	**ESP – water**	✓	✓	✓	✓	✓(p)	✓	✓
Carolyn Blackford	**ESP – land**	✓	✓	✓	✓	✓	✓	
Kirsteen MacDonald	**ESP – water**	✓	✓	✓	✓	✓	✓	
Marcus Cameron	**RIMU**	✓		✓	✓	✓	✓	✓
Gillian Crowcroft	**ESP – Water**	✓		✓		✓(p)		
Phil Brown	**ESU – land and water**	✓	✓		✓	✓	✓	✓
Viv Sherwood	**ESU – Catchment Management and Incentives**	✓						
Mark Bishop	**ESP – Land**	✓	✓	✓	✓			
Kim Morresey	**ESU – sustainable catchments**	✓	✓	✓	✓	✓	✓	
Rod Dissymer	**Consents and Compliance – Land and Air**	✓	✓					
Greg Murphy	**Consents and Compliance – Water Allocation**	✓	✓					
Andrew Benson	**Consents and Compliance – Water**	✓	✓					
Kath Coombes	**ESP – Coast**		✓	✓	✓	✓	✓	
Lauren Lawrence	**ESP – Land**			✓	✓	✓	✓	✓
Bodo Hellberg	**Consents and Compliance – Natural resources**					✓		
Susan Andrews	**ESP – Water**						✓	✓
Regan Solomon	**RIMU, SP2**						✓(p)	
Paul Owen	**RIMU**						✓(p)	
Total		18	16	15	14	15	15	8

(p) = only attended part of workshop

ESP = Environmental Strategy and Policy – CPO
ESU = Environmental Services Unit – COO
SWU = Stormwater Unit – COO
RIMU = Research and Investigations Unit – CPO
Consents and Compliance – COO

Appendix E: Feedback from participants on workshops

Feedback was collected at the end of each workshop to help the project team adjust the workshop process to specific needs, within the outlined scope.

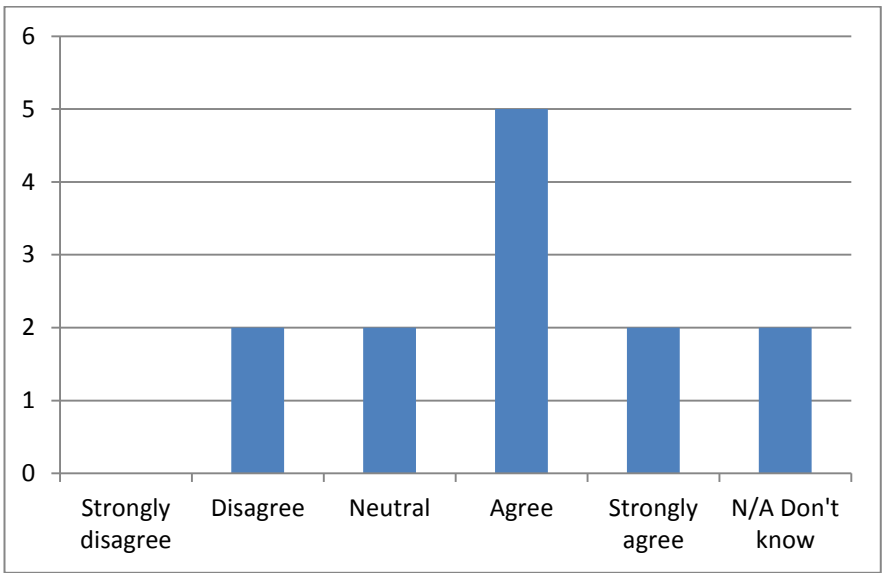


Figure D 1: Do we have the right people at this workshop for the purpose set out?

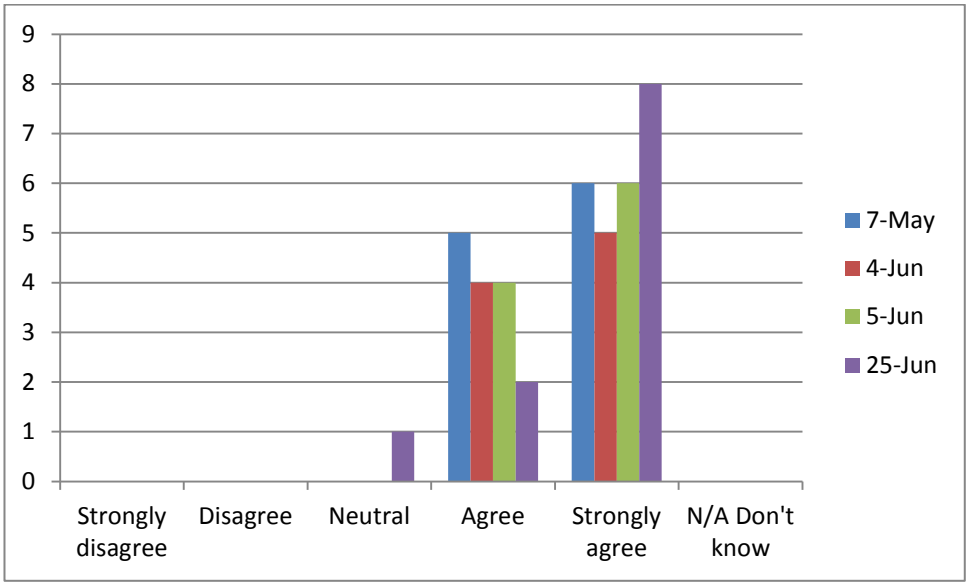


Figure D 2: Systems thinking is a useful tool to think about things in an integrated way

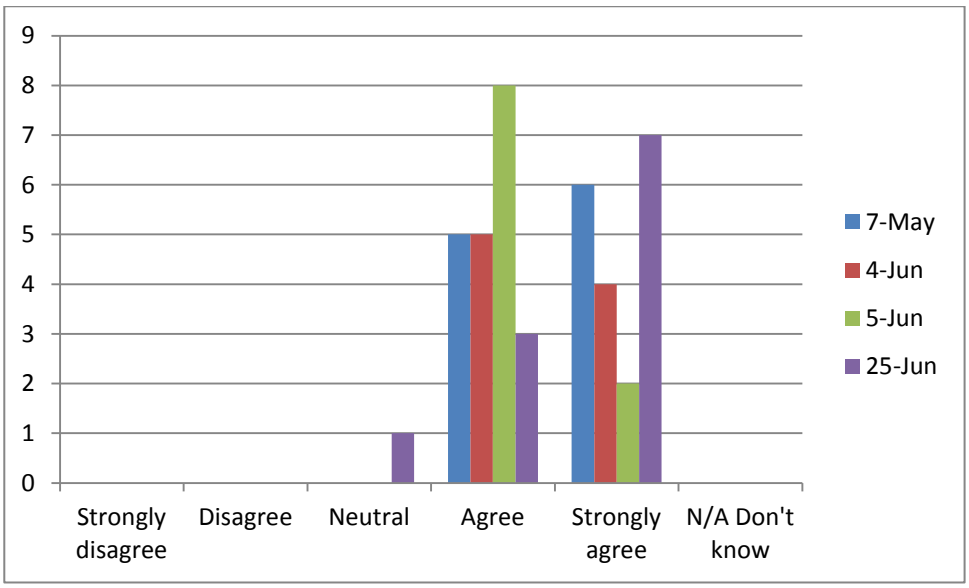


Figure D 3: Systems thinking is a useful to explore the wider implications of the NPS-FM

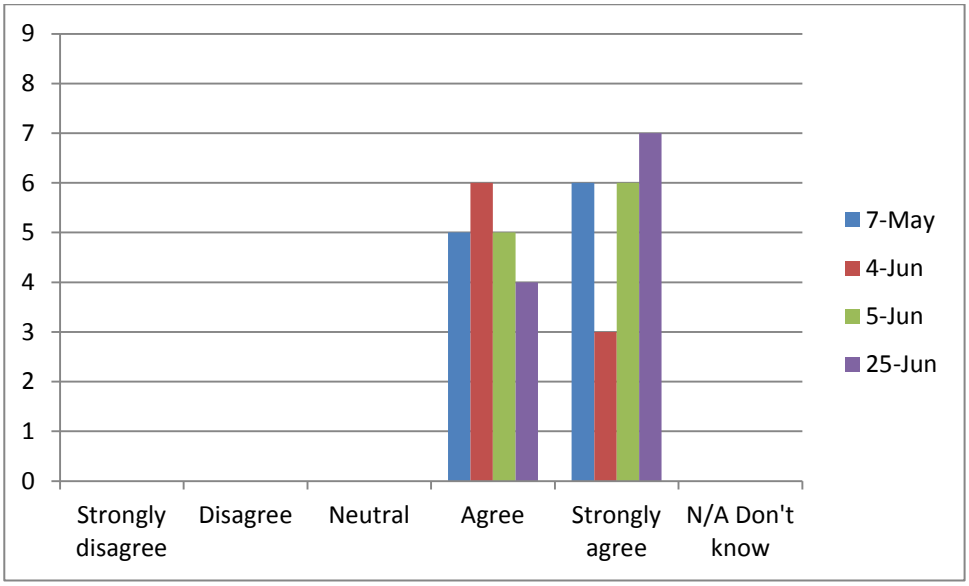


Figure D 4: The narrative from the workshops is a useful way to foster collaboration for the FMU requirements

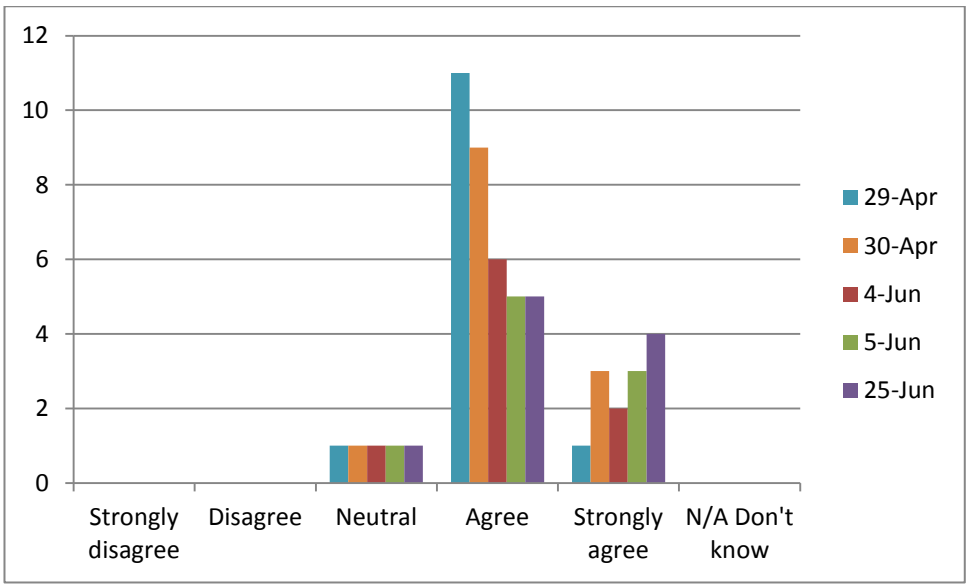


Figure D 5: My understanding of System Thinking as way to communicate complex challenges has increased

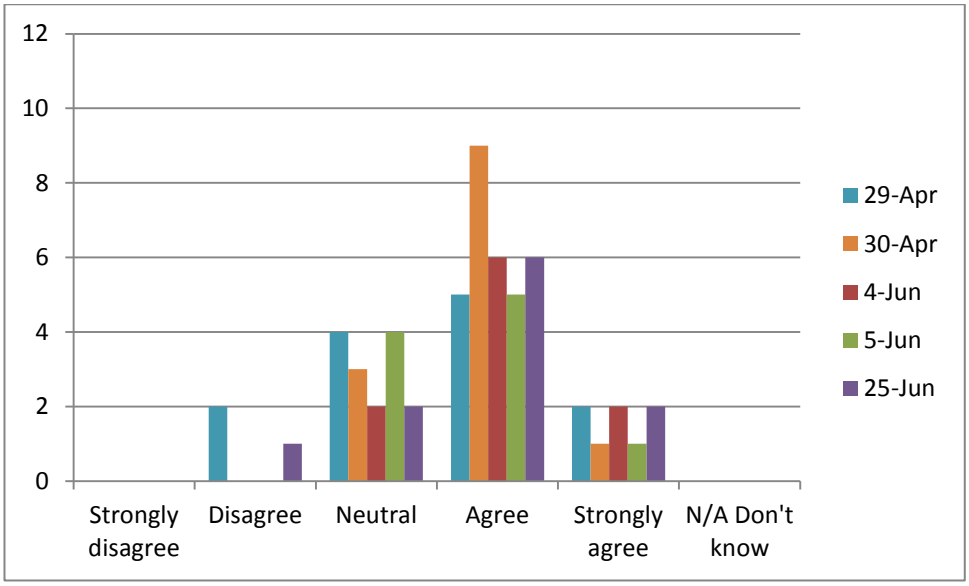


Figure D 6: I am confident I can introduce others to System Thinking

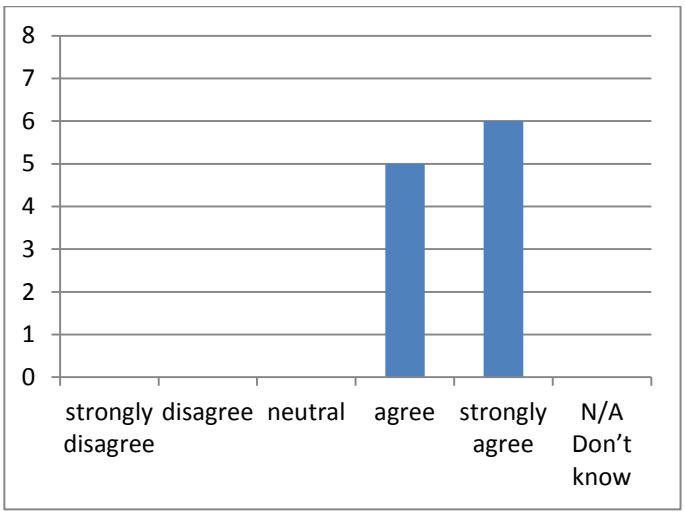


Figure D 7: Systems Dynamics is a useful tool to explore integrated and quantitative scenarios

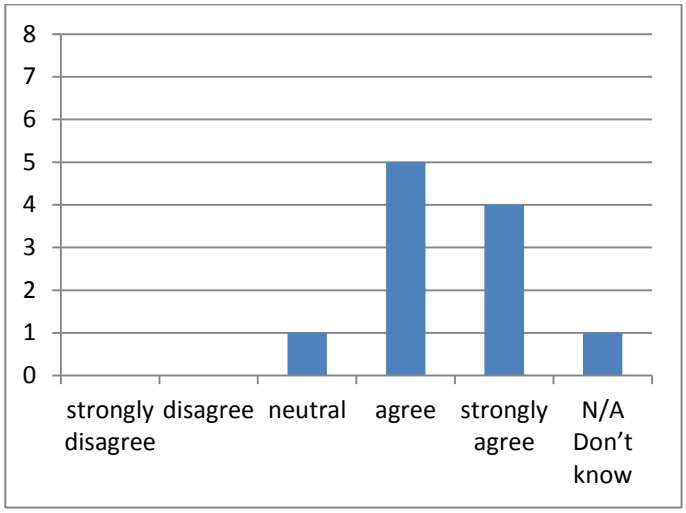


Figure D 8: Systems Dynamics is a useful tool to explore integrated and quantitative scenarios on the wider implications of the NPS-FM

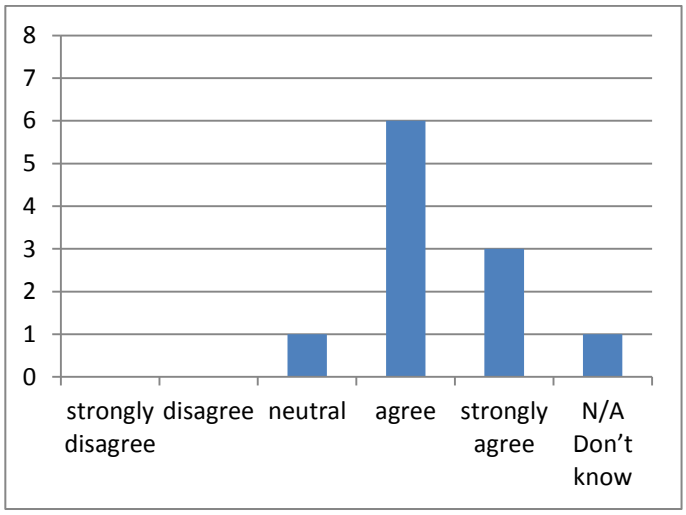
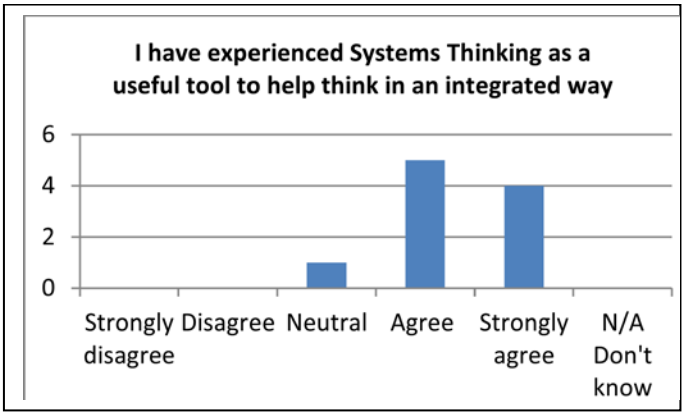
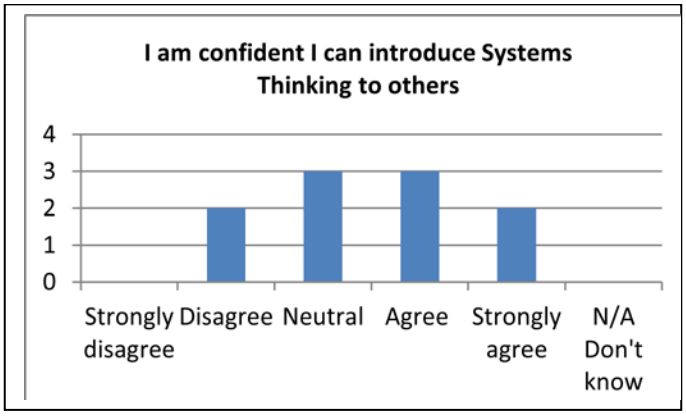
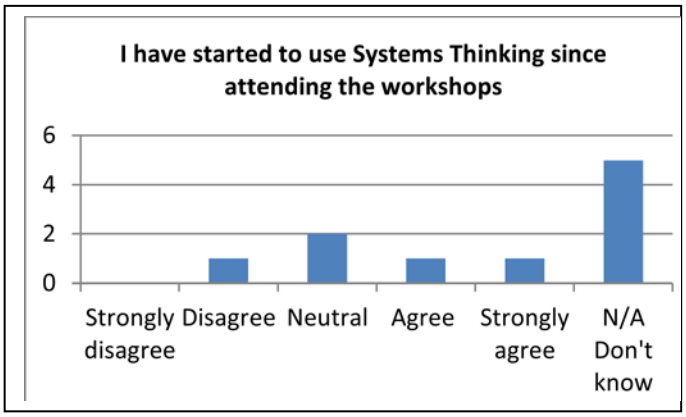


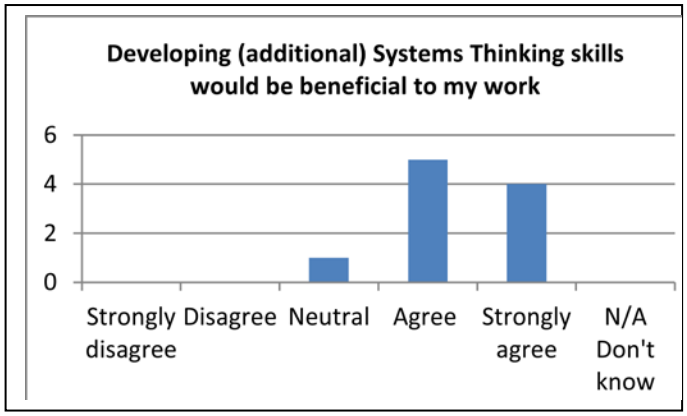
Figure D 9: Scenarios from a Systems Dynamics model could increase understanding of freshwater management issues under the NPS-FM

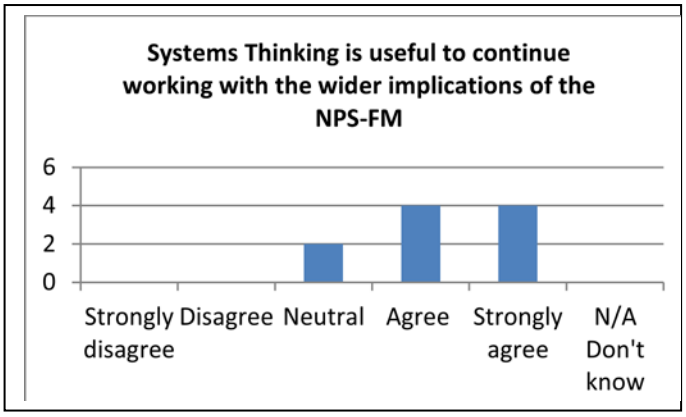
Summary of Survey Results from final workshop August 22, 2014

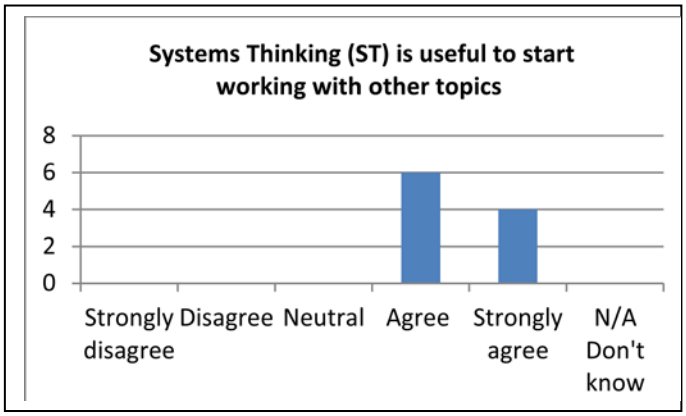


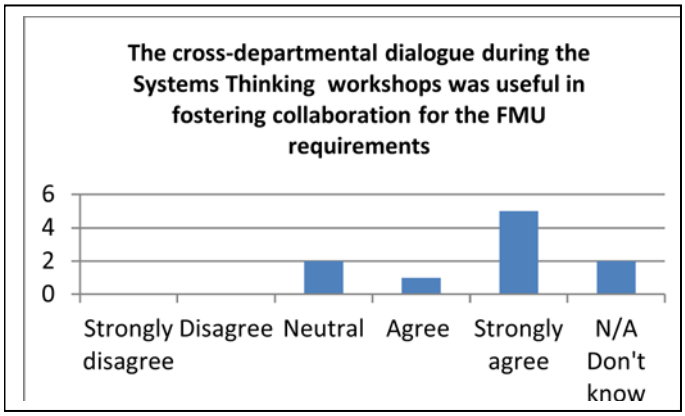


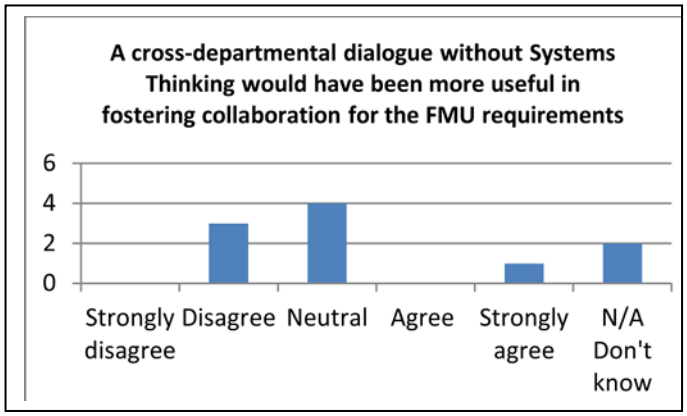












Appendix F1: Summary of Workshop 1, April 29–30, 2014

These series of workshops are to bring together staff across Auckland Council working in freshwater-related positions to work together to scope Freshwater Management Units (FMUs) using a (System Thinking) ST approach. This involves taking a whole of systems view while respecting the parts.

The secondary tier of the workshops is to train people in ST using learning-by-doing. Rather than creating one big story about freshwater in the Auckland Region that links everything, the goal is to have many stories (that interrelate at a higher level) to facilitate communication with others not in this workshop.

The definition of FMU in the NPS-FM is a 'freshwater management unit is the water body, multiple water bodies or any part of a water body **determined by the regional council** as the appropriate spatial scale for setting freshwater objectives and limits and for freshwater accounting and management'.

Workshop Discussion April 29

This workshop introduced ST from a 'problem-based' perspective. ST incorporates feedback loops from causes to effects and makes you consider 'when' things are happening and what the 'behaviour over time' trend is likely to be. Archetypes were used to identify generic behaviour patterns.

The question was asked, "How will ST feed into FMU?

Concern was expressed about how ST as a tool could be used to define FMU and scale. It was re-iterated that the goal of the workshops was first to determine the fundamental questions to be answered, before setting freshwater quality and quantity limits. ST takes into account feedback loops and time lags and is a different type of collaborative process from the more commonly used linear decision-making process..

The ST approach will be used to discuss FMU from the perspective of different departments, identify gaps in knowledge, interlinkages between variables, and consider boundary issues. There are key organisational boundaries, and what works within one boundary for one department may not work for another. Boundaries can be organisational, geographical, and/or time-based.

The NSP-FM will potentially operate at 2 scales: (1) the council-imposed scale; and (2) the scale at which communities operate and at which you need to talk and engage with communities.

The aim is to use ST to start a dialogue to support cross-council understanding of freshwater management working towards the NSP-FM.

Workshop Discussion April 30

Overview of FMU

AC is at the early stage of NPS-FM. There is a need to engage in a collaborative process on FMU to overcome performing roles in a rigid way, and these workshops are the opportunity to do this.

The goal is to use ST to extract different perspectives but also have an output that will contribute to the on-going decision-making process.

Roger Blakely has appointed a new board (steering committee) across council for NPS-FM. The finding from this series of workshops will feed into the steering committee decisions. The NPS-FM has not been a priority at the top level but there is now increased awareness of the importance of this legislation. These workshops are intended to develop a sound understanding of the context that the FMU fit into in the Auckland Region. This is being explored using ST, and we will develop CLDs that are targeted to the FMU topic.

The goal is to use ST to share ideas about problems and solutions and map the landscape to work on in the future to determine the best outcome for the Auckland Region. The ST approach will bring issues together. The task to define practical FMUs also needs to be done. Therefore the ST workshops will also cover assumptions and data requirements or gaps but from a systems perspective.

Issues raised by participants so far:

1. From the perspective of the Consent's team there needs to be time frame for the NPS-FM process. This team needs to know when things are going to happen as outcomes will have impacts when making decisions on consents.

2. The multi-scale nature of FMU. A range of scales can be considered as well as multiple scales for particular aspects at different locations. For example, in the Kaipara Harbour area there is more high level governance. Elsewhere there is a need to work with individual land owners.

3. The NPS-FM can be considered a tool to achieve FM outcomes. What is the nature of the NPS-FM as a tool? What is the cost/feasibility of implementing NPS-FM objectives?

4. NPS-FM is going to impact on the Unitary Plan so we need to look at implementation of the NPS-FM. For example there are currently wetland management areas, water supply and lake management areas in the Unitary Plan. Will FMU mean a change to what we already have?

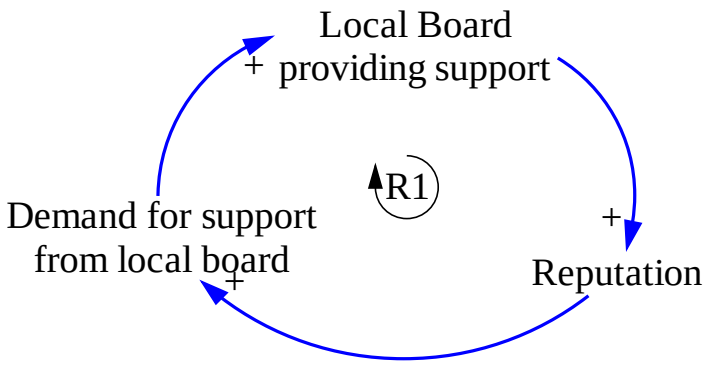
5. It may be necessary to use an adaptive process and not have FMU that are fixed but rather change over time.

6. FMU, as set out in the NPS-FM, may not be the best way to organise freshwater in the Auckland Region.

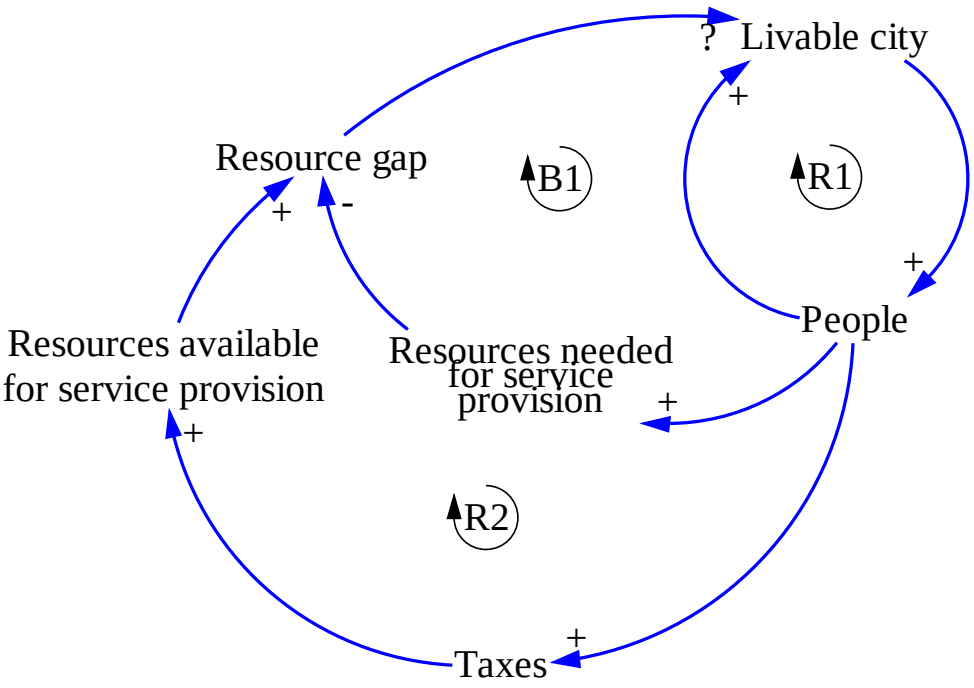
System Thinking stories generated by participants

As part of the workshops AC staff developed their CLD skills and understanding. The following CLDs were produced.

Council staff providing support to Local Boards



R1 is a reinforcing loop. As word spreads about council staff providing assistance this leads to more requests.

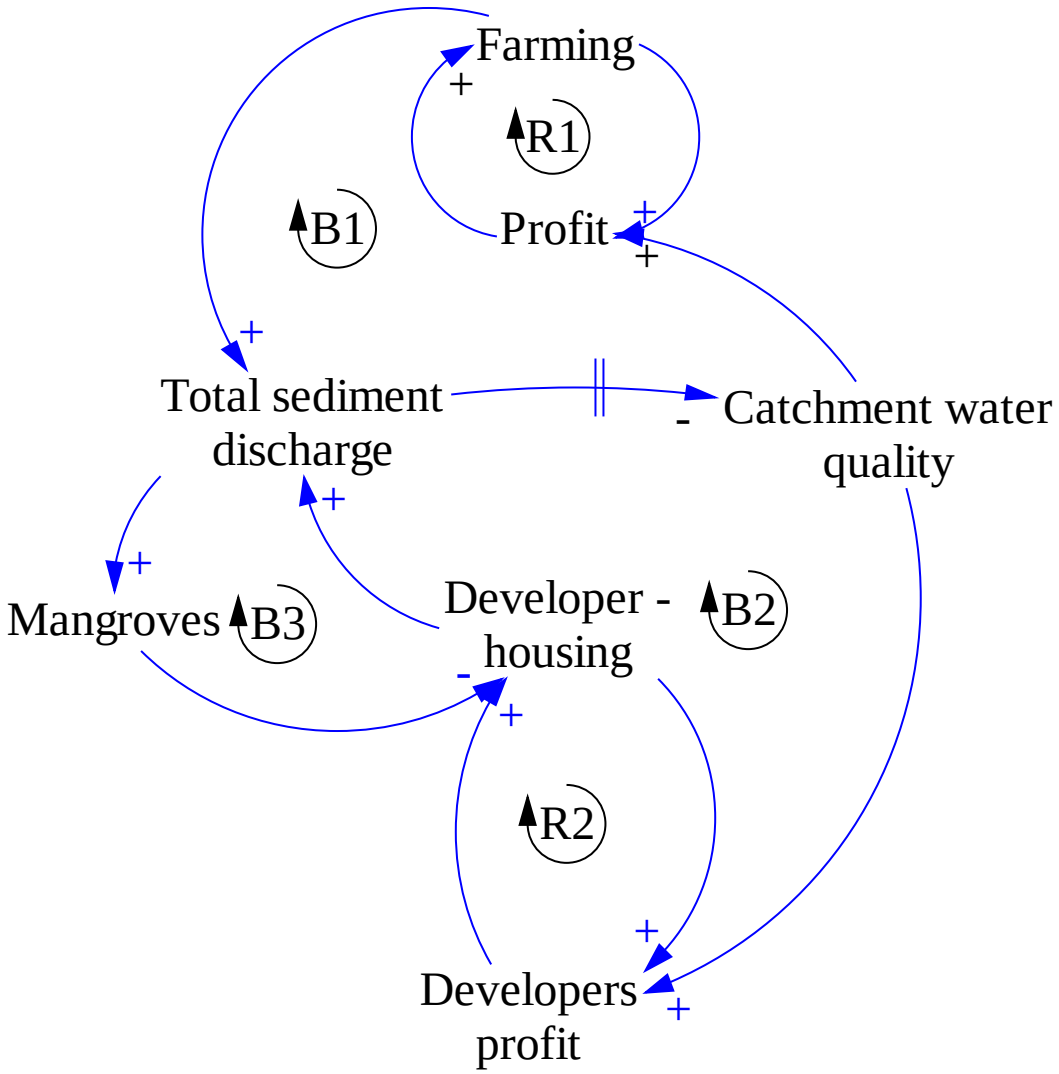


R1 is a reinforcing loop: The Liveable city label attracts more people, which at first makes the city more Liveable (more diversity, more economic opportunities, etc.). B1 is a balancing loop. If there are more people than resources needed per person for service provision (amenities, health, education, infrastructure) a resource gap can result in a city that is no longer a Liveable city. R2 is an alternative reinforcing loop. Here the growth generated by more people provides additional resources so there is no resource gap and the Liveable city continues to attract more people.

With this 'story' it is important to know 'when' things happen, which will determine if an oscillating trend will move up or down over time.

Tragedy of the Commons

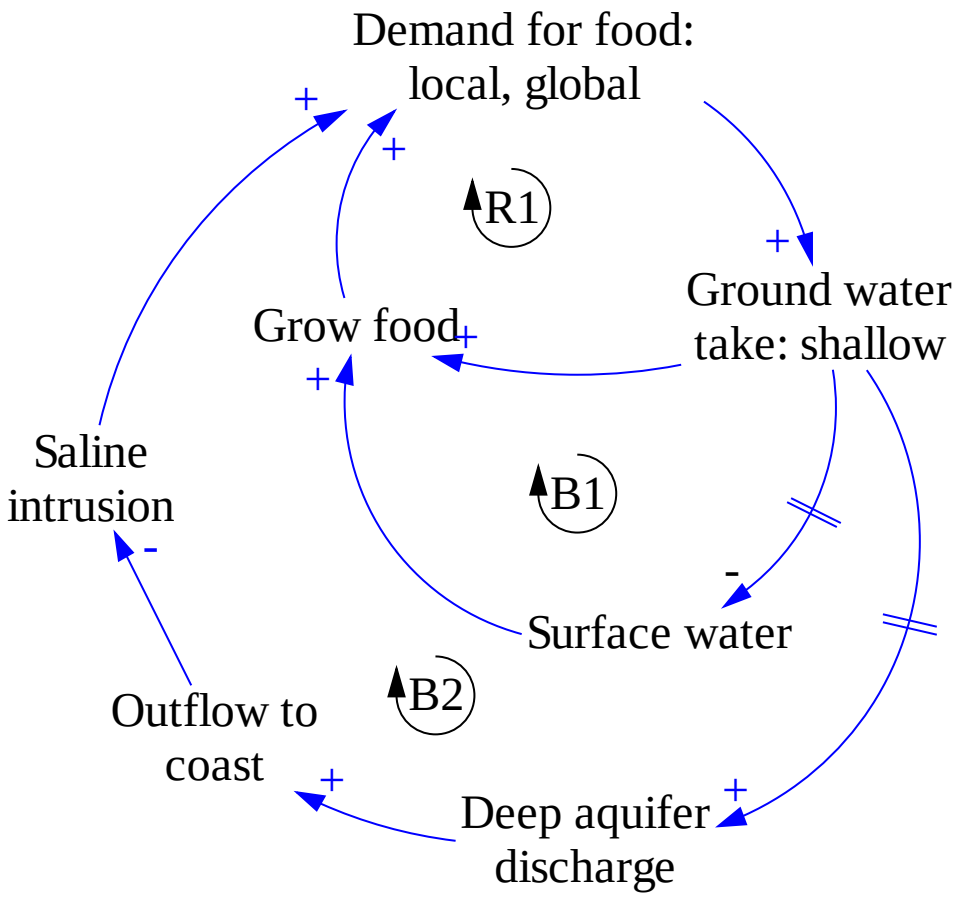
Sediment Generation in a Catchment



Var:spring discharges

RI and R2 are reinforcing loops where profitability drives more economic activity in two affected sectors – farming and housing construction. B1, B2, and B3 are balancing loops where total sediment discharge reduces catchment water quality sufficiently to impact on farming profitability and developers' profitability and cause mangroves to expand, thus reducing the desirability of the catchment for housing.

Over-extraction of Groundwater

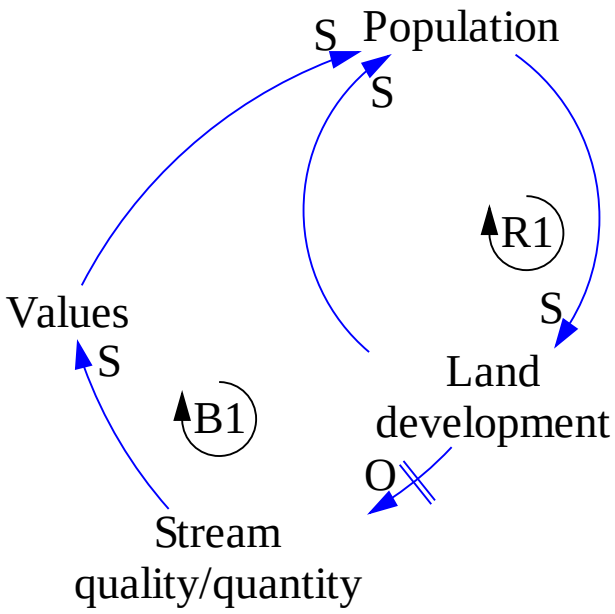


Var:spring discharges

R1 is a reinforcing loop where greater demand for food results in increased allocation of shallow ground water resources. This increases food production. After a delay, B1 and B2 balancing loops come into play. Over-extracted ground water reduces surface water flow so food production falls. B2 shows how over-extracted ground water prevents the recharge of deep aquifer resources, which reduces water outflow to the coast and allows saltwater intrusion. This in turn reduces food production.

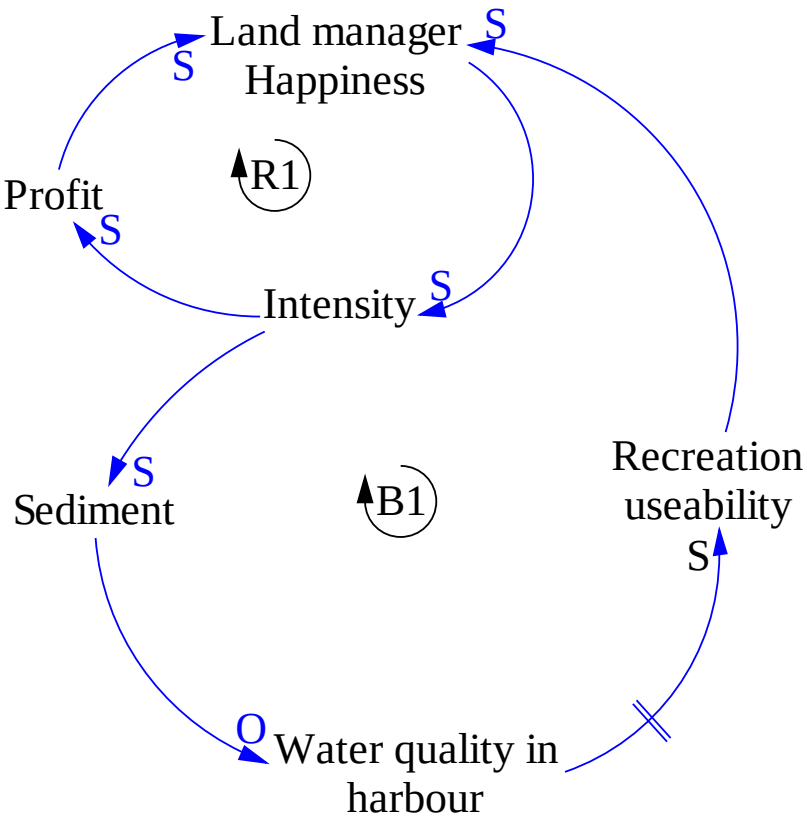
Notes: Ground water limits in Unitary Plan are from Regional Policy Statement. Only some aquifers have limits. The science for where limits are imposed is limited.

Population impact on water quality

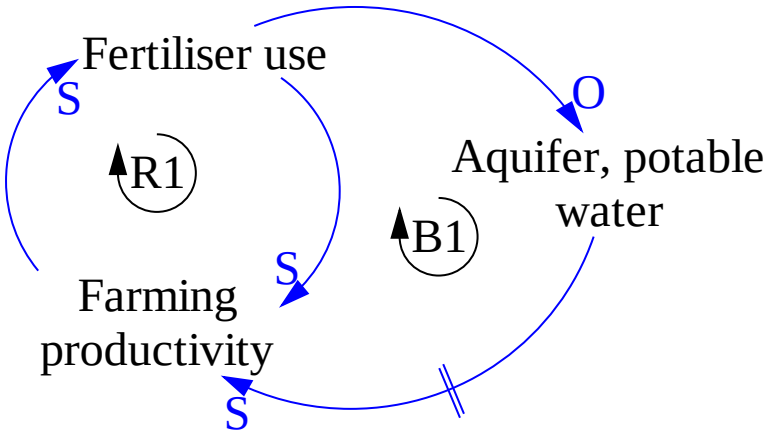


R1 reinforcing loop shows how increased population increases land development, which in turn increases population. B1 balancing shows land development has a delayed negative impact on water quality and values, which will ultimately lead to a decrease in population.

Increased intensification leads to loss of 'commons' water quality



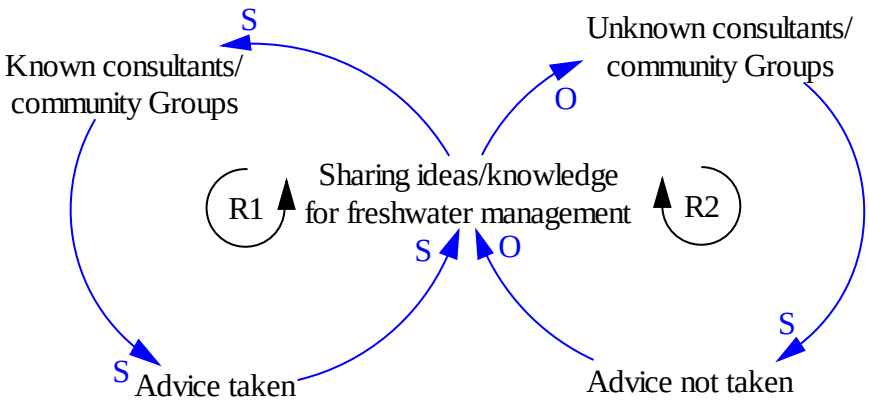
Increased Fertiliser Use



R1 Fertiliser use increases farm productivity, which in turn requires increased fertiliser for maintenance. B1 balancing loop shows that fertiliser use decreases water quality, which after a delay decreases farm productivity.

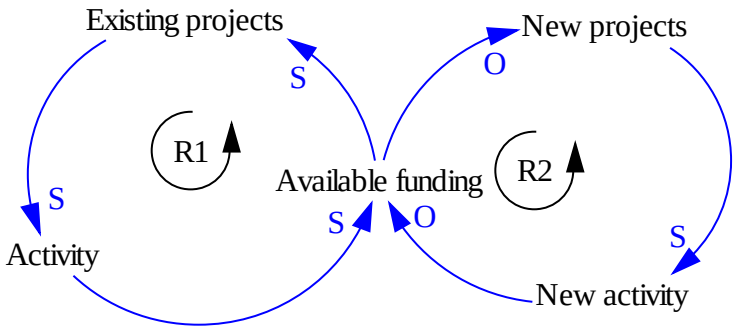
Success to the Successful

Known groups get consulted



R1: Known consultants/Community Groups get asked for advice and people return to them as they are known. R2 People on the fringes are not approached, which leads to no sharing of ideas/knowledge (and a loss of what could be valuable input).

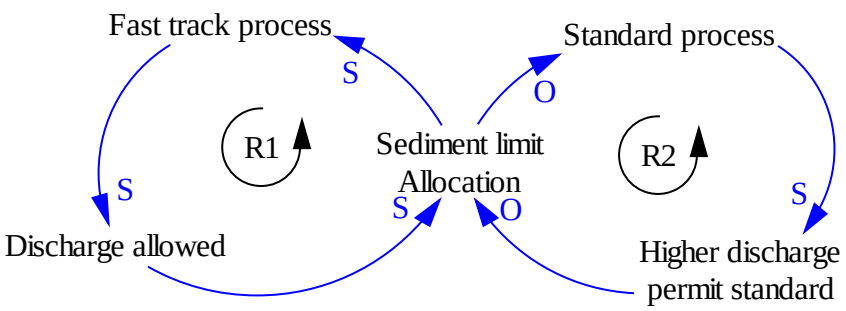
Existing projects get funded rather than new projects



R1: Available funding goes to existing projects to support existing activities. R2 New projects do not get funded, therefore new activities are not undertaken and funding continues to go to existing projects.

First in, First Served

Fast track process takes most of allocation



R1: Developments put on fast track are allowed to discharge sediment as they get the first bit of the allowed sediment limit. Developments on the standard track have to meet higher standards as the allowed sediment limit is reached.

Appendix F2: Summary of Workshop 2 on May 7, 2014

In the 2nd workshop participants worked with CLDs to answer starter questions relating to FMUs and the NSP-FM.

The questions addressed were:

1. What are the implications if FMUs were defined separately for ground and surface water?

2. If FMUs do not align to natural catchment boundaries, what implications would eventuate? For example: Local Board boundaries, Mana Whenua rohe.

3. What are the implications of defining FMUs at a small or large scale? How are management practices, data and information requirements, costs, engagement, etc., affected by large or small FMU scale?
4. What implications would defining FMUs by a classification methodology have? For example, management areas in the Unitary Plan, grouping by resource type (lowland soft bottom streams, etc.).
5. What is the interaction between the scale of the FMU and the scale of engagement?
6. What are the implications of FMU scale on the work of the teams across Council? For example, three harbours to 4,000 catchments.

Workshop Discussion

Exploring issues using System Thinking is intended to broaden thinking and make connections on the context and identify topics of interest to support the process of setting FMUs. It is also a way to keep the process transparent and collaborative as well as reveal where disconnects may exist, or are anticipated between different council working groups and departments. Understanding the feedback loops in the system is one way to help identify out-of-boundary issues.

The intention is to develop lots of small CLDs that are easy to communicate. These may be useful for engaging with communities and to tell/develop a coherent story. At a later stage, if desired, the CLDs can be combined into a more comprehensive CLD or interconnected via a 'decision tree or flow chart'.

Additional questions raised by participants during the 2nd workshop:

1. What are the implications if you work at a catchment scale where there are different ecological zones? Do you set a median FMU for the catchment? And is this valid when there are special unique features to protect? →This points to a link with Spatial Planning.
2. How to address annual average values (for limits) being applied to whole catchments with different upper, middle, lower zones, e.g. ecosystem or hydrology types? →This points to a link with Spatial Planning.

3. Central government (i.e. MfE) have said they will provide regional councils with guidance.
   Can we ask Central government when guidance on criteria to assist with setting FMUs will be available? → This requires checking with MfE and considering if this is a 'boundary issue'.
4. Who is expected to implement the NPS-FM?
5. At what point does council involve the community in determining the spatial scale of FMUs? The reference group said the community should be consulted but proposed NSP-FM amendments say 'regional councils' to determine. → Can the CLDs help in that consultation process?
6. Does the desired outcome need to be included in a CLD to help progress setting FMUs?

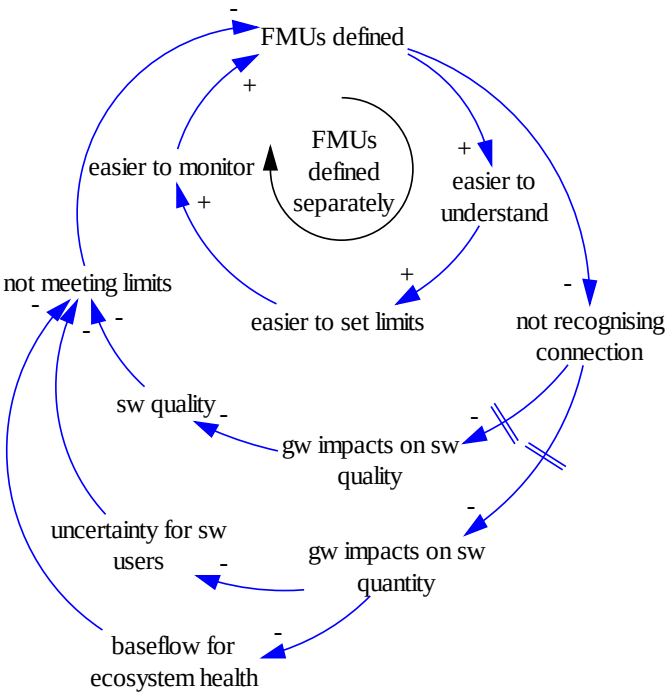
Issues Covered so Far

The following lists the topics covered so far and what we have worked to interlink.

Implementation	Engagement with community	Groundwater/Surface water relation	Unit Scale 3–4000	Costs	Monitoring
Management	FW Parameters	Local Boards	Stormwater CMP	Unitary Plan	

System Thinking stories generated by participants to answer questions set out on p. 1.

Question 1: What are the implications if FMUs were defined separately for ground and surface water?



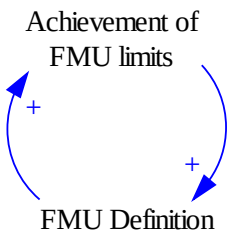
Story

1. It is easier to set FMU limits and monitor Ground Water (GW) and Surface Water (SW) separately (FMUs defined separately loop). If limits are met, this reinforces and confirms the units are correct. If limits are not met it will be necessary to define them differently.
2. Defining the FMU limits separately does recognise the inter-connectedness of GW and SW. GW takes impact on SW quantity and quality and ecosystem health.

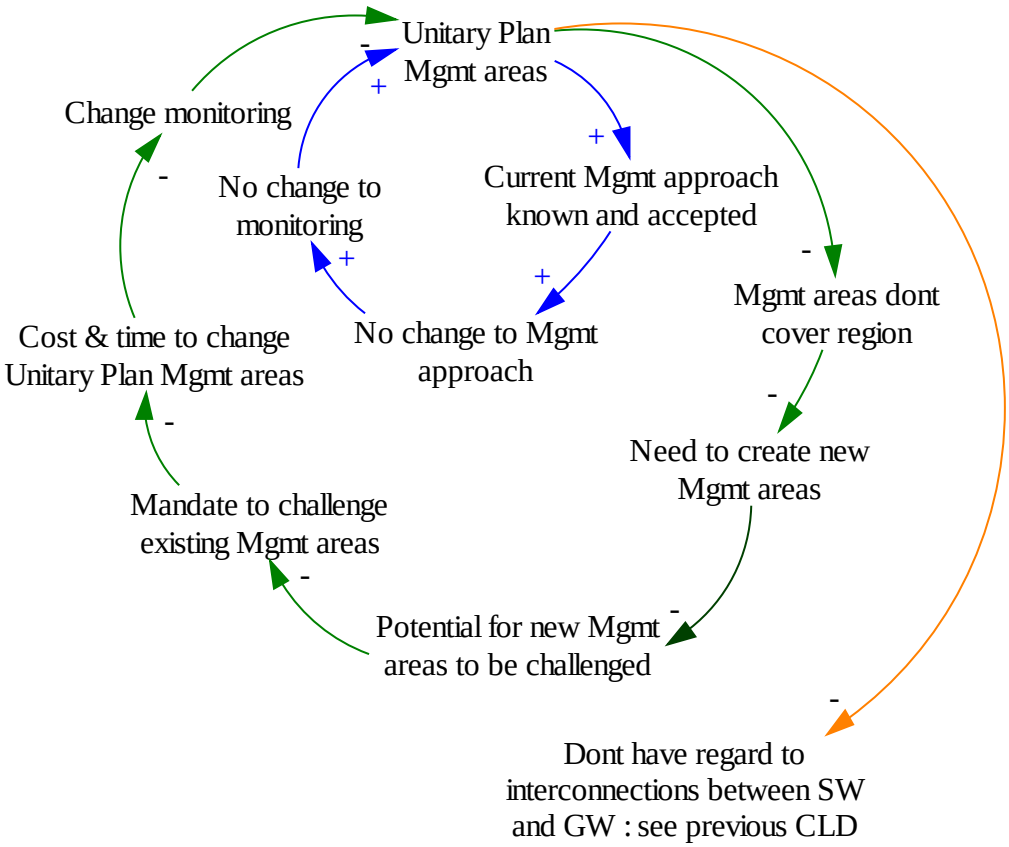
Comment

If FMU limits are met, having GW and SW FMU limits and monitoring carried out separately is a positive reinforcing loop. This is easier for council management. However, if FMUs limits are not met, this will require understanding the interaction between GW and SW and redefining the system using an adaptive process.

The core outcome is achieving the limits – not setting limits. However, it is important to recognise the strong relationship between achieving the limits and the limits set.



Question 4: What implications would defining FMUs by a classification methodology have? For example, management areas in the Unitary Plan, grouping by resource type (lowland soft bottom streams, etc.).



Story

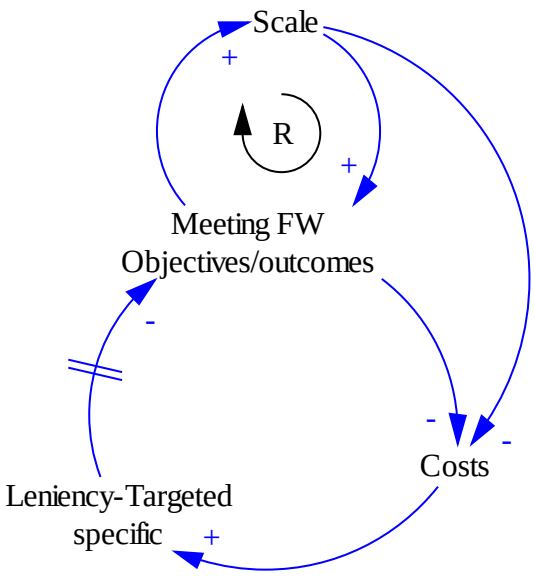
1. Unitary Plan management areas are currently 'quality and quantity sensitive management areas'. Using the Unitary Plan management areas to define FMUs has advantages: (i) known by people; (ii) they require no change to management or monitoring.
2. Disadvantage is Unitary Plan management areas do not cover the entire region, therefore new management areas would be needed to fill gaps. This may result in challenges to the existing Unitary Plan management areas. If a reorganisation was required this would involve costs and time to change the Unitary Plan and monitoring.
3. The current Unitary Plan management areas do not connect GW and SW

Comment

This CLD is useful for querying the current UP management area model. It does not connect GW and SW or cover the entire region. There are two different costs and benefits involved: (i) management; (ii) monitoring.

Question 3: What are the implications of defining FMU at a small/large scale? How are management practices, data and information requirements, costs, engagement, etc., affected by large/small FMU scale?

A Tiered Approach as a Solution to the Scale Issue?



Story

1. To begin, limits are set at a regional scale/national scale. If limits are met, this level is appropriate.
2. If this scale does allow limits to be met then a finer scale is required. When you go to a finer scale costs increase but limits are more targeted.
3. A possible unintended consequence of working at a regional scale level is that you might think objectives are being achieved when they are not. Costs at a higher scale might be less but might not be able to achieve the required FW objectives.

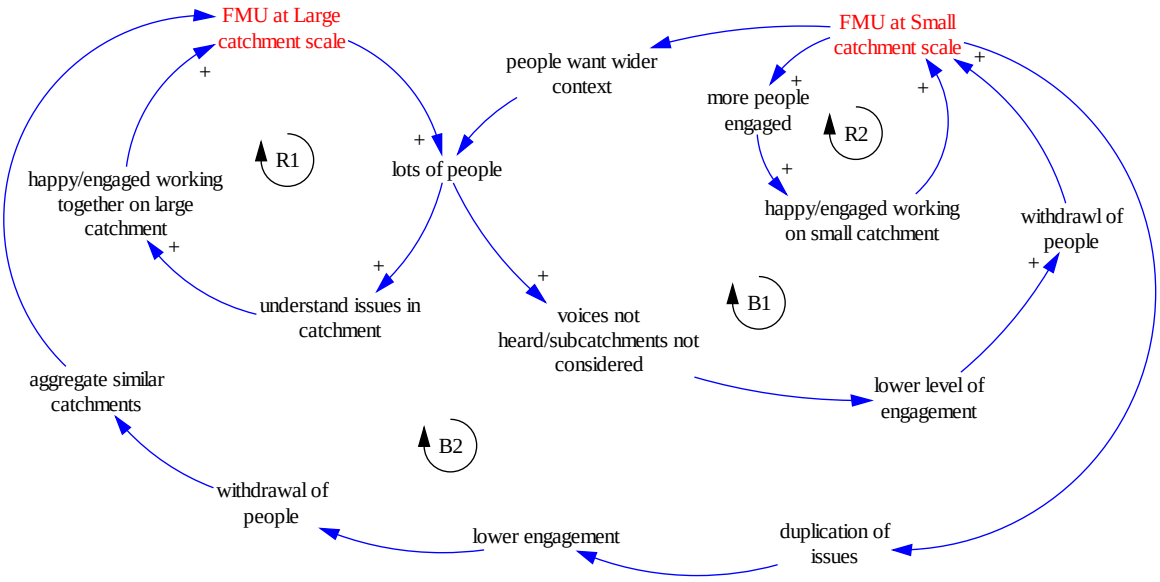
Comment

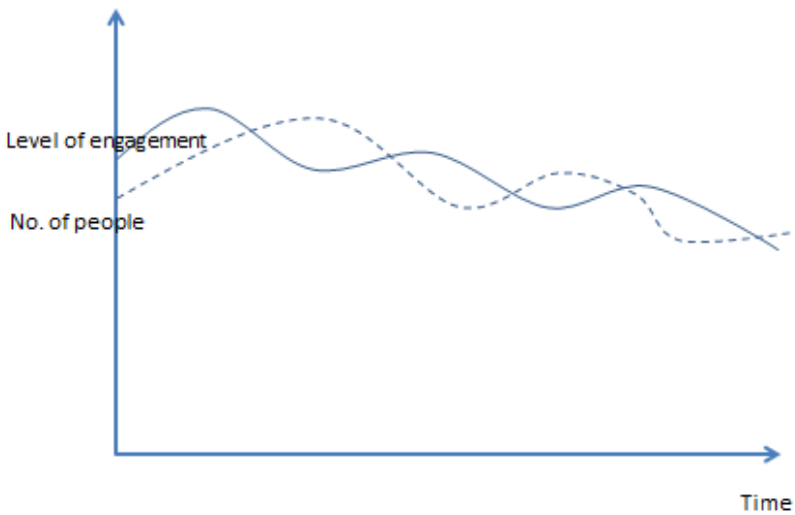
Canterbury started with a default set of objectives for the region. Objectives were broke down further only if limits were not met or if objectives were subsequently established at a sub-regional level.

With this example the participants tried to move from a process map to a CLD. This discussion was seen as easier as a process map/conversation rather than being interpreted as a CLD. Generally with CLDs, if the loop is hard to complete it shows there is a gap in knowledge/understanding.

An observation was made that many scales might be optimal, rather than one scale.

Question 5: What is the interaction between the scale of the FMU and the scale of engagement?





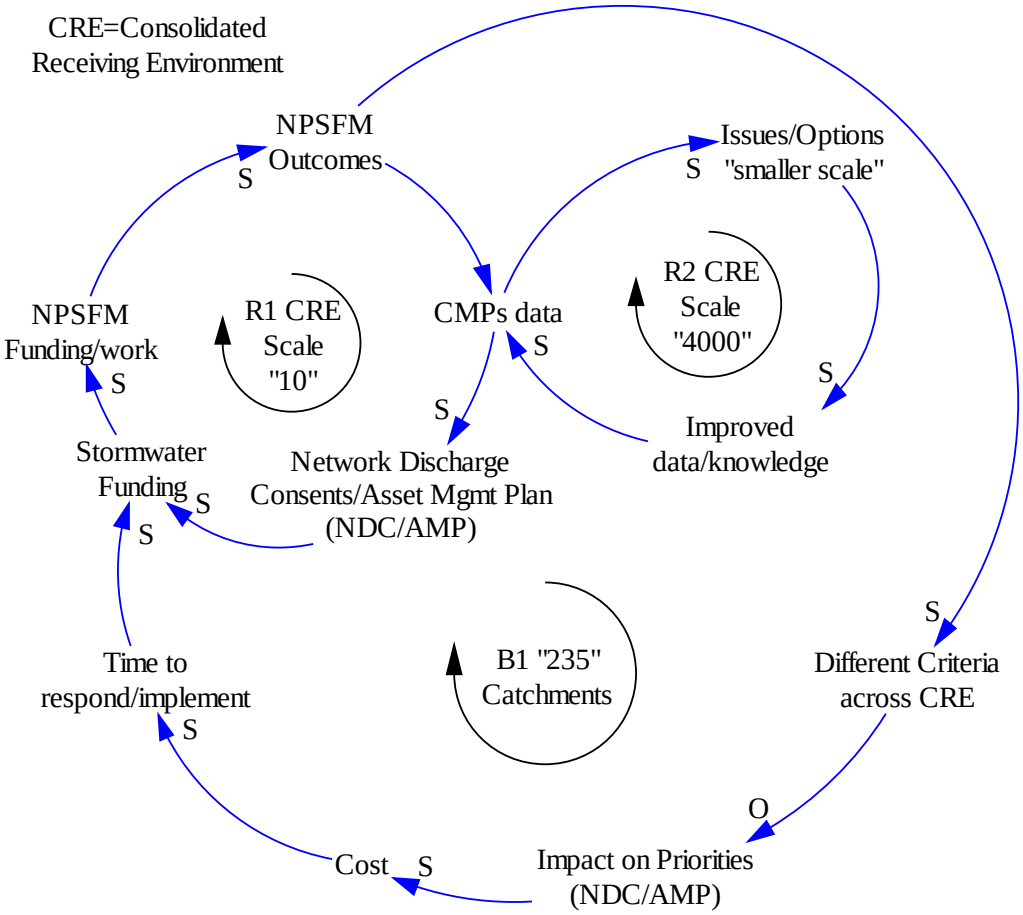
Story

1. Large catchments cover a large number of people. When knowledge is brought together it is possible to get a good understanding of issues in the catchment. If people are happy/engaged working together at a large catchment scale this is a positive reinforcing loop.
2. If the large number of people involved feel they are not heard and their sub-catchment is not considered they withdraw from the large catchment process and set up small catchment groups.
3. Small catchment groups can function well if people engage and are happy to work at this level.
4. Small catchments do not provide a wider context.
5. With small catchments there is duplication of issues between catchments and lower engagement with experts/council staff, which might lead to people withdrawing and a need for catchments to be aggregated into larger catchments.

Comment

People are interested at different levels; they do not engage for the sake of engagement but for outcomes. This engagement CLD could also be repeated for cost, which is an important variable to consider. This CLD suggests the solution could have two scales at the same time or a tiered approach where it is possible to go down a level if needed. For example, N levels could be set for the whole of a harbour scale, but for a stream running through pasture N levels might be higher. The scale required may need to change over time.

Question 6: What are the implications of FMU scale on the work of the teams across Council? For example, three harbours to 4,000 catchments. CLD is from the Stormwater Unit perspective.



Story

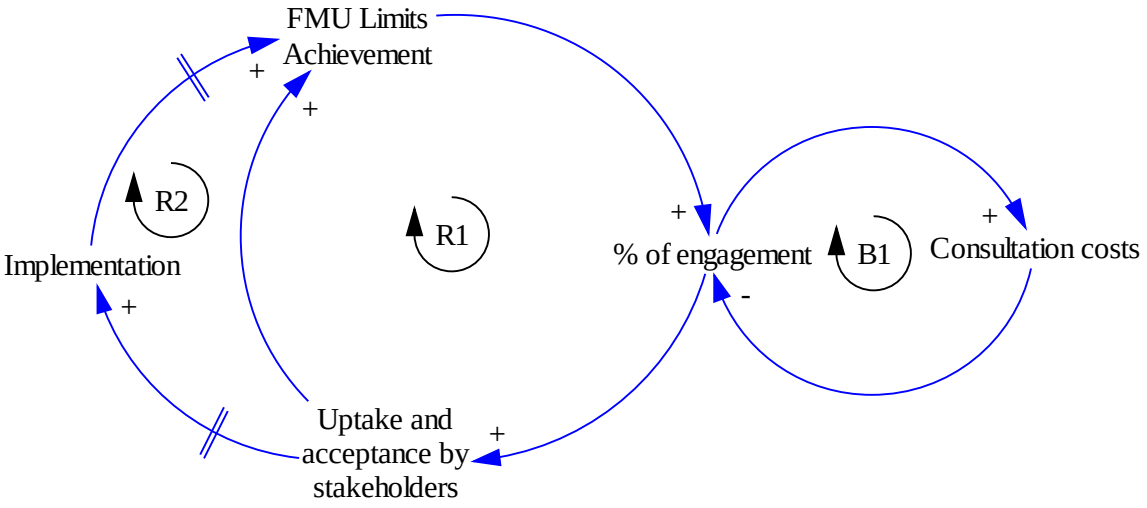
1. Stormwater currently operates at different scales. There are 10 catchments for Auckland region. Catchment Management Plan (CMP) data is collected, funding decisions made monitoring done at this level.
2. The CMP identifies where more attention is needed and should zoom in. Could do this to the "4000" unit scale if desired.
3. If under the NSP-FM 10 catchments become, for example, 235 it is more difficult to have this approach.

Comment

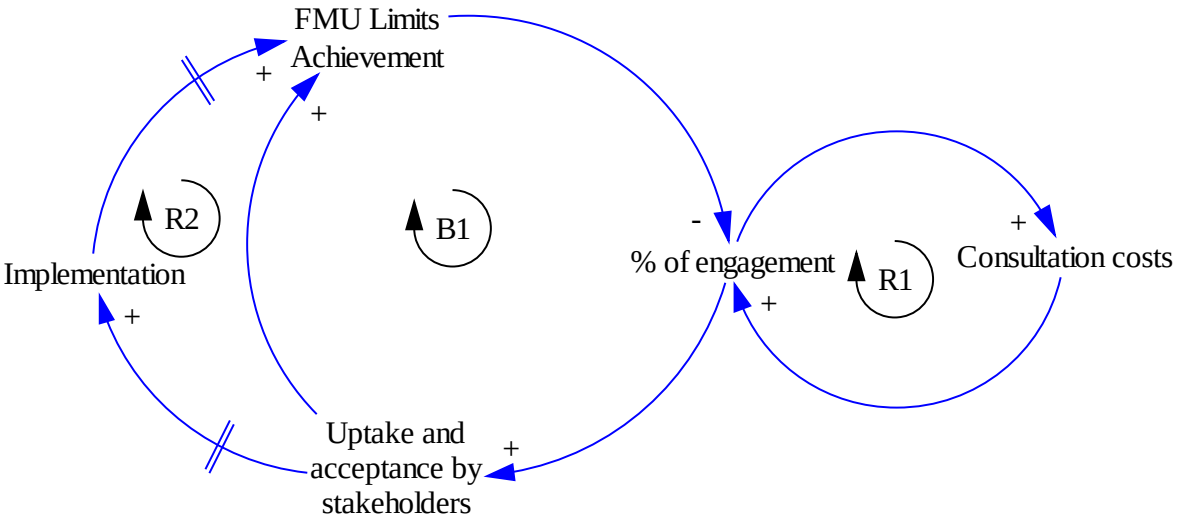
Good to share this perspective. A tiered approach with bigger FMU areas could work. Tiers allow you to work at different levels, e.g., community, ecological. Need to ensure the sub-parts add to the total.

Question 5: What is the interaction between the scale of the FMU and the scale of engagement?

Small scale



Large Scale



Story

1. If FMU limits are set at a small scale there is likely to be more interest and engagement. This will increase uptake and acceptance by stakeholders, which will increase the ability to achieve FMU limits (R1). Over the longer term increased uptake will improve implementation (costs reduced or shared with others, management time, etc.). Improved implementation will increase the ability to achieve FMU limits (R2). More engagement will increase the cost of consultation and use up the consultation budget, which will lead to less engagement being possible (B1).

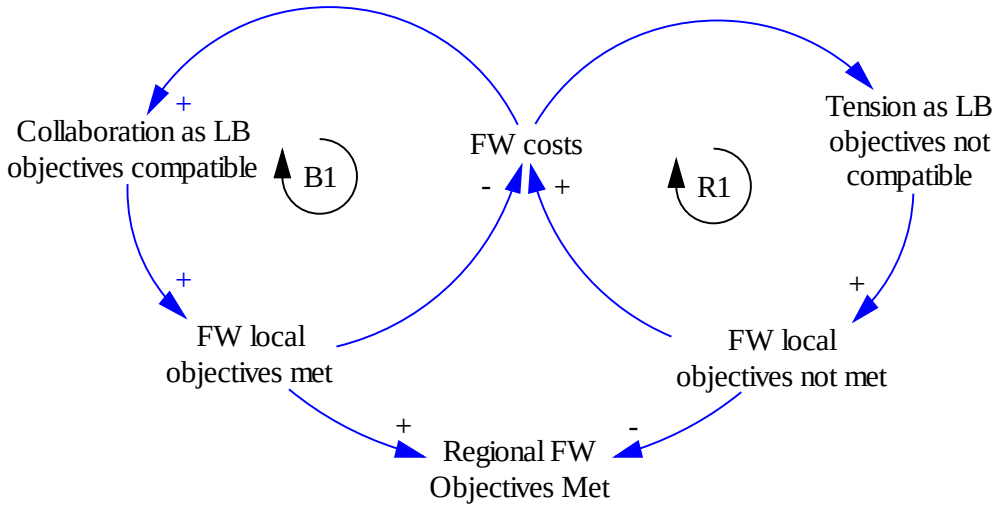
2. If FMU limits are set at a large scale (e.g. Hauraki Gulf) and most people are interested in their local issues/area then the % of people engaged will decrease. Uptake and acceptance will decrease, and effort to achieve limits will decrease (B1). Over the longer term a decrease in uptake and acceptance will decrease the ease of implementation (costs increase, more management time, etc.). Harder implementation will decrease the ability to achieve FMU limits (R2). Lower levels of engagement reduce consultation effort and costs (R1).

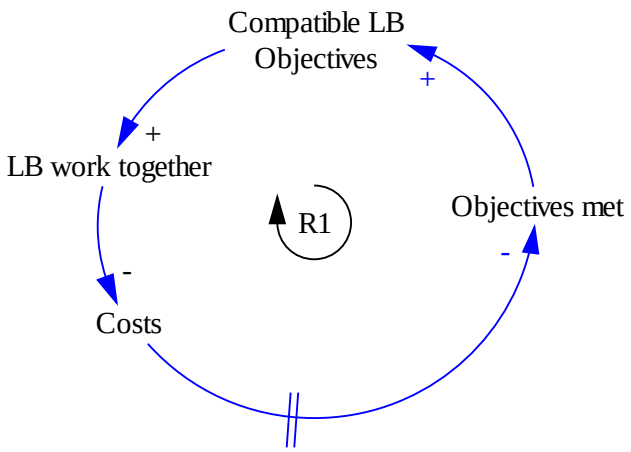
Comment

Scale can determine how much community input can influence implementation of the NSP-FM. It was noted there are other ways to communicate with communities not just via the NPS, e.g. landowners can get grants and other funding.

Question 2: If FMUs do not align to natural catchment boundaries, what implications would eventuate? For example, Local Board (LB) boundaries, Mana Whenua rohe.

Local Board (LB) Freshwater Management Units





Story

1. If the LB FMU objectives are compatible this will increase the scope for LBs to work together. As a result costs will decrease and more objectives will be met. This success will encourage making LB objectives compatible.

Comment

If FMUs are to be set at LB level objectives needs to be compatible for LB to work together. LB boundaries cross natural boundaries and you cannot, for example, have a river that runs through two LB areas with different FMU limits. Primary objectives can also differ between LBs, e.g. coastal swimming vs flood control. If people engage with the stories it will provide a way to get a list of data needed, etc. Then can take to LBs, communities, etc., to see if willing to work together in some areas.

Appendix F3: Summary of Workshops on June 4 and 5, 2014

The June 4 workshop began with a general discussion on the desired outputs from the freshwater workshops. These are (i) recommendations for FMUs to the FW steering group and a presentation on the process undertaken to formulate these recommendations, and (ii) development of System Thinking skills at AC.

Three possible ways have been identified (there may also be others) to determine FMUs:

1. **Spatial scale.** This is by area cover, e.g. Harbour scale (Kaipara, Manukau, Hauraki) or other spatial ways organizations and/or departments divide the Auckland space.
2. **Classification.** E.g. by ecological priority area or ecological zones, at risk/priority areas, land use, receiving environment, community and iwi values.
3. **By issue.** E.g. sediment, nitrogen.

Fundamental questions that need to be answered when deciding on preferred FMUs:

1. Can you set limits and then set FMUs or does it HAVE to be the other way round? If you set limits and then set FMUs this would support the classification approach, e.g. by forest.
2. Do water quality issues determine the scale to use? E.g. there might be a different scale for sediment to that of nitrogen. Could you have a tiered approach based on issues?
3. Should the receiving environment dictate the scale? E.g. the FMU for sediment might be at a big scale whereas the FMU for temperature at a small scale.
4. If different limits are set for upstream compared with downstream what feedback needs to be provided for in the system? If we have ecological zones in the middle of a catchment how do we manage upstream? (Are FMUs to have multi-scale functionality and apply a mountain-to-sea approach?)
5. How FMUs are set links to the objectives/limits. Therefore the process for setting FMUs needs to be clear.
6. Water quality and quantity issues impact surface water and ground water. Does this mean FMUs have to be linked?
7. The purpose of FMUs is to set the spatial unit for rules. Is this purpose of FMUs different from the purpose of existing freshwater management units in AC?
8. FMUs can be an organising tool for council business. This would be a more radical reorganisation than the NPS requirements which are driven by the RMA.
9. Is there a FMU design that gives a best overall result for water quality in the AC region?

Action Point: The pros and cons of (i) **Spatial scale;** (ii) **Land cover and land-use classification;** and (iii) **By issue** to be listed by participants as an off-line activity. Christine Mitchell, Carolyn Blackford and Sam Turner to coordinate completion before next workshop.

Costs

It is assumed small FMUs will be more expensive for AC to manage than a few larger FMUs.

Data gathering issues

1. RIMU collates data. Data collection needs to be set up to be 'representative', because monitoring can't happen everywhere and all the time. Data are 'inferred or modelled' if there is no actual collection.
2. Stormwater has detailed data for some catchments and scale aligns with Ecological Services Units (ESU). Inconsistent scale is currently an issue between stormwater, (data collected at the old legacy scale of 52 catchments) and the scale RIMU monitoring data is collected at.
3. Consents have and generate data.
4. There is an on-going Information Management project bringing data sources together.
5. Hauraki Gulf has own data.
6. ESU has priority catchments where the ecological state of the receiving environment is important. This is for freshwater receiving environments only. Marine is not covered.
7. There are technical requirements for water quality and an ever changing baseline to measure from.
8. Both water quality and quantity monitoring data are needed.

Implementation

There is no council-wide water strategy. No management unit in AC owns or leads the catchment management or integration space. When FMU scales are determined AC also needs to consider implementation and whose role this is. Currently everyone is responsible for implementation but this causes problems as different units have different objectives and implementation is not consistent.

Implementation of new FMUs will possibly require changes to the limits and rules in the UP. This has the potential to impact on the cohesiveness of the UP. Changing rules will not be sufficient to achieve the outcomes the community or the iwi want. To achieve the limits set will require community support as there are likely to be costs, for example, to meet a bacteria limit may require additional water treatment. Other approaches will also need to be implemented, e.g., community monitoring and more stringent consent monitoring.

Central Government

FW is one of 3 priority areas for central government and the plan is to have recommendations to councils by mid-year. It is still not clear whether councils or communities are ultimately responsible for setting FMUs. Before setting FMUs the legislative/management limitations need to be known. If these are not taken into account any outcome from these workshops will be over-ruled. For example, there will be a conflict between FMUs and the National Accounting System for Freshwater if the FMUs at regional level cannot be aggregated up to the national level.

Community engagement

Communities want to be involved from the outset. If they are to understand the whole conversation the first step is for AC to have information with pros and cons to take to community, advisory and stakeholder discussions. Conversations with communities need to cover what actions need to be in place to support achieving limits and what changes need to occur in the community, given FMUs are not just for objectives and policy but also for goal setting for the area. As any objectives need to empower people and reflect community values, extensive engagement is necessary.

Do FMUs and engagement units need to be the same? If FMUs are larger/smaller than engagement scale what are the implications?

The idea of a pilot study was proposed to talk with a community to see what issues were likely to arise from setting FMUs. A suggested location is the Whao River (Avondale/New Lynn), which currently has 30 different community groups working in the catchment. The stormwater group has also carried out work there.

Canterbury Process Followed (established before NPS)

1. Have classification as primary step. Mountains to the sea.
2. Zone committees at river-catchment scale.
3. Engagement can take place at a smaller zone level where communities can set higher limits (can only be more stringent not lower limits).

CLD Tree

The CLD tree that links selected, previously constructed CLDs was presented to the group. In the CLD tree there are more CLDs about organisation than about freshwater outcomes. The aim of the tree is to show individual CLD stories and how they interlink. It was decided not to go any further with this as the CLDs in the tree were not relevant to the FMU setting.

Existing units/scales (for both water and non-water)

There is a choice for FMUs to take a fresh approach OR align with existing scales. It was noted that while aligning more closely with existing scales may speed up the process of FMU setting this may result in overlooking the scale that is best.

The existing units/scales (for both water and non-water) that departments and AC stakeholders work with must be taken into account when deciding on FMUs. A preliminary list was drafted and the following added:

- Dune lakes
- West coast, East coast, 3 harbours
- Aquifers (though only high use are currently in the UP)
- Other AC structures: Water Care, Stormwater network catchments, Auckland Transport, etc.
- Stakeholder regions: Fonterra, federated farmers (might not want to have to attend multiple stakeholder meetings)

- Boundaries that extend beyond AC region
- River environment classifications
- Integrated Spatial Explorer (ISE) model 50 x 50 m grid

Action Point: The final version to be collated by Christine Mitchell and Sam Turner.

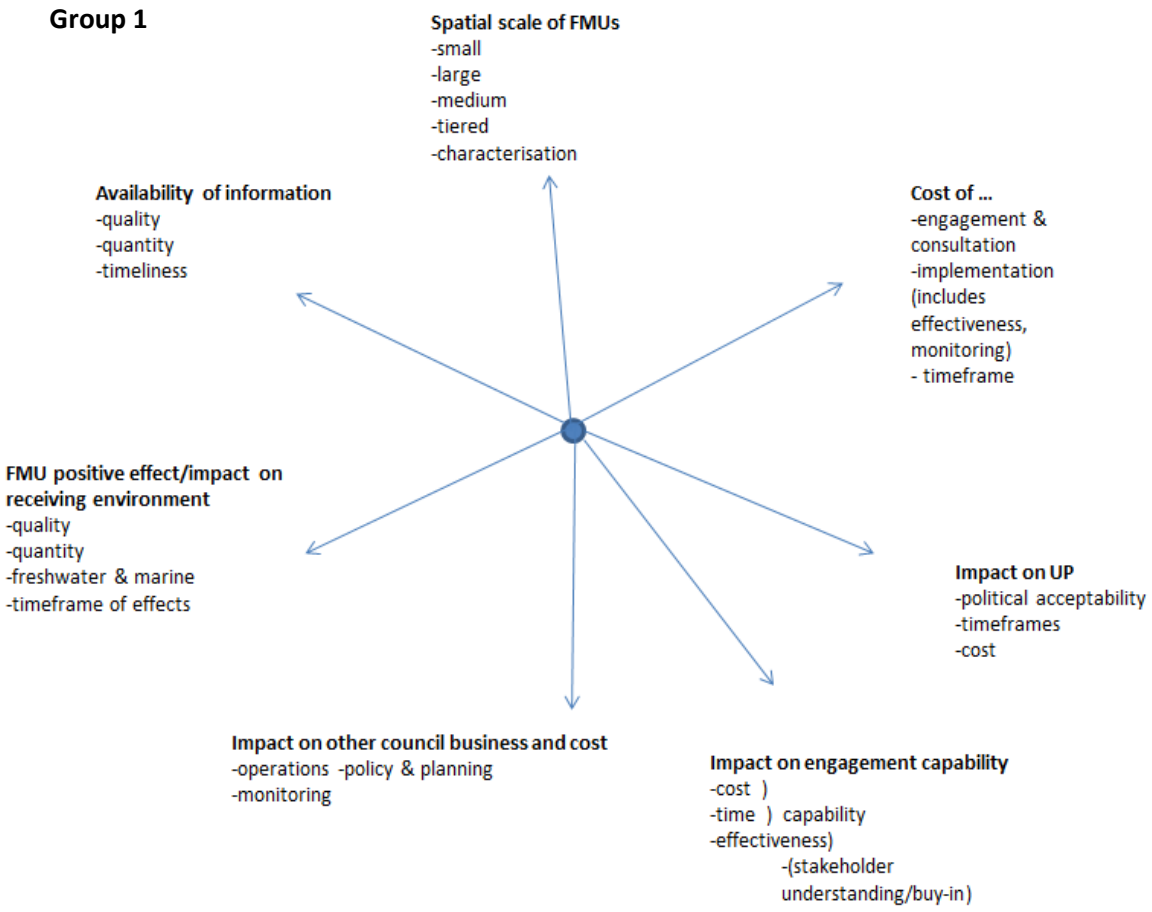
Spider Diagrams to Determine FMU Evaluation Criteria

Small groups sketched their evaluation criteria for FMUs using spider diagrams. This step was undertaken as it was decided by participants that an evaluation criteria would help ensure CLDs were for the right topics going forward.

Action Point: Five different spider diagrams were completed (see following pages). It was agreed that participants work together to bring these into one diagram before the next workshop.

Also to be worked on are: (i) what analysis is required to give each axis a ranking; (ii) what process will be used to ensure that the ranking arrived at is transparent; (iii) what should the evaluation criteria be for each axis; (iv) what scale should be used on the axis.

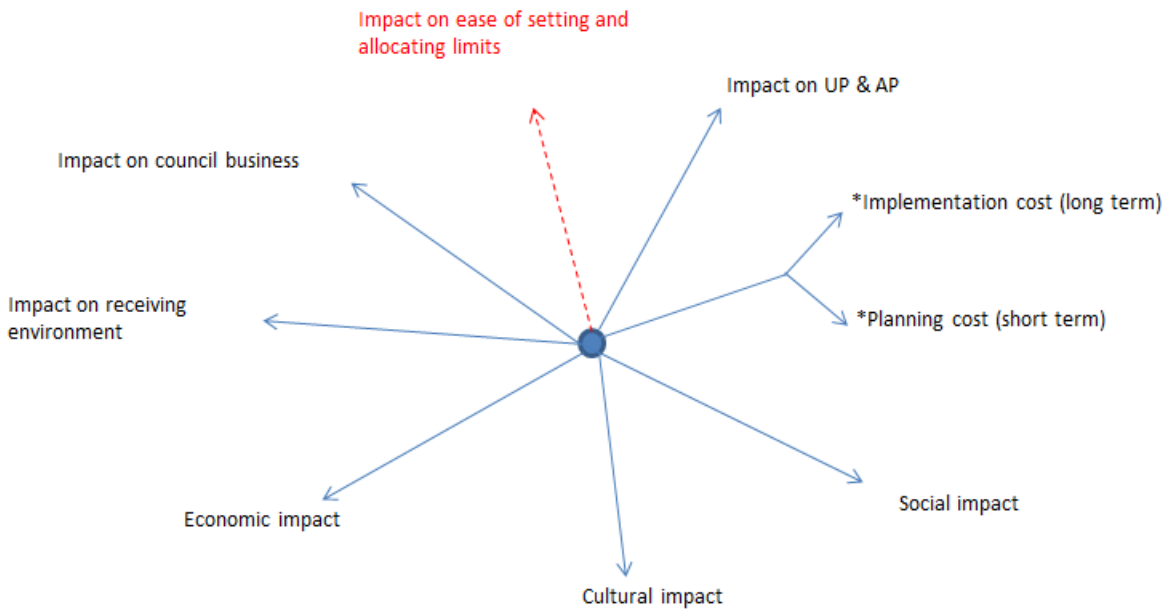
Person to coordinate for completing before next workshop: Carolyn Blackford



Notes

1. Spatial scale has multiple characterisations.
2. Engagement, Implementation and Timeframes all have associated costs. If objectives can be achieved quickly this should be less costly than it would be over a longer time period.
3. Any change to the UP needs to be politically acceptable. There will be costs associated with this.
4. Costs ($ and time) are not the only factors that determine the effectiveness of engagement, capacity and capability are also important. There are non-council costs for groups like DairyNZ if they need to participate in many different stakeholder groups.
5. Receiving environment – the level of impacts (both positive and negative) will be different at different scales and for freshwater and marine ecosystems.
6. Information has costs. Costs determine the coverage of the RIMU monitoring network: (i) if the number of monitoring sites increases costs will increase; (ii) if existing monitoring sites are reorganised costs don't have to increase; (iii) if data can be modelled rather than collected on the ground this may reduce costs. Any new monitoring system developed around FMUs ideally needs to link with SOE reporting and national accounting frameworks.

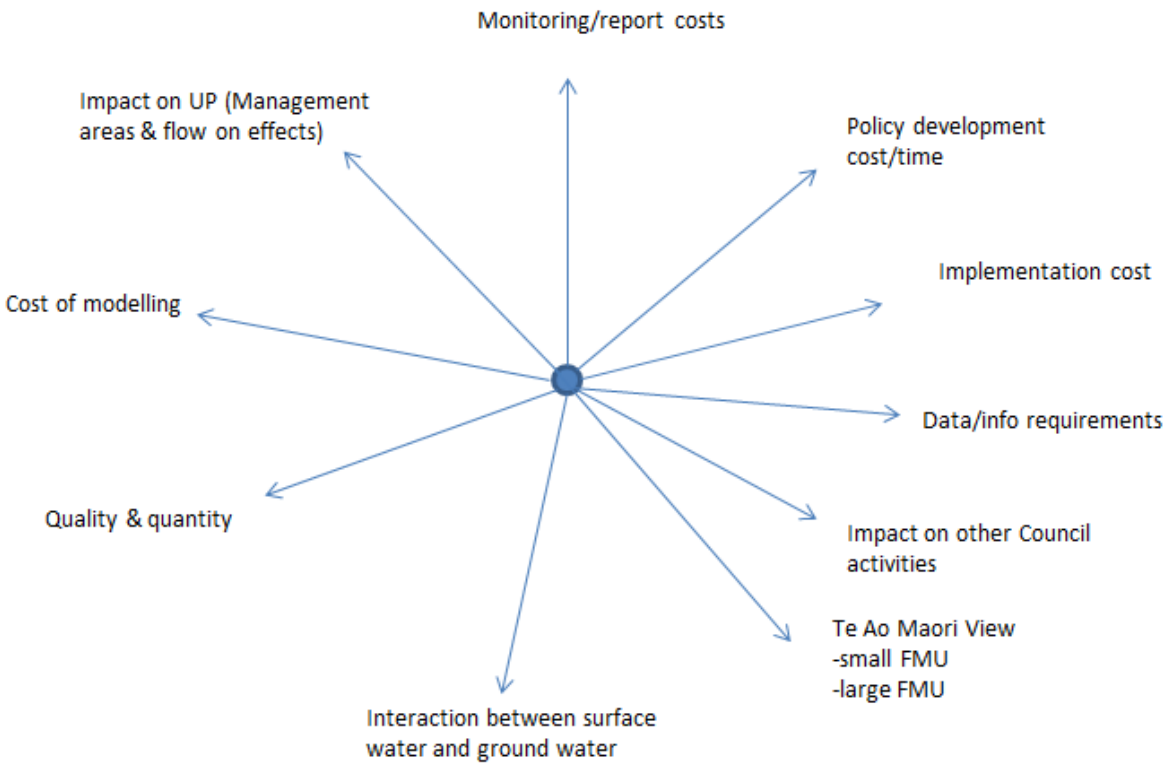
Group 2



Notes

1. Impacts of FMUs are not just on the receiving environment. There are also social, cultural and economic impacts associated with the FMUs' set.
2. FMUs will impact on both the UP and AP.
3. Costs to council are both long term and short term and include (1) planning costs, (2) implementation costs. There are also costs to the community.
4. Cultural protocol may impact on ability to set limits. Iwi prefer mountains to sea at the 3-harbour scale. An 'issue-based' approach would not fit this. There are 19 iwi in the region and interests overlap. Is it possible to engage at the right level with a 3-harbour scale? Other migrants (60% of Aucklanders are from overseas) are in "other" category under the NPS.
5. Different classifications will have social and economic impacts – both long term and short term.
6. Ease and costs of setting limits, cost of monitoring, and costs of implementation need to be compared for: (1) spatial scale; (2) land cover and land-use classification; (3) by issue.

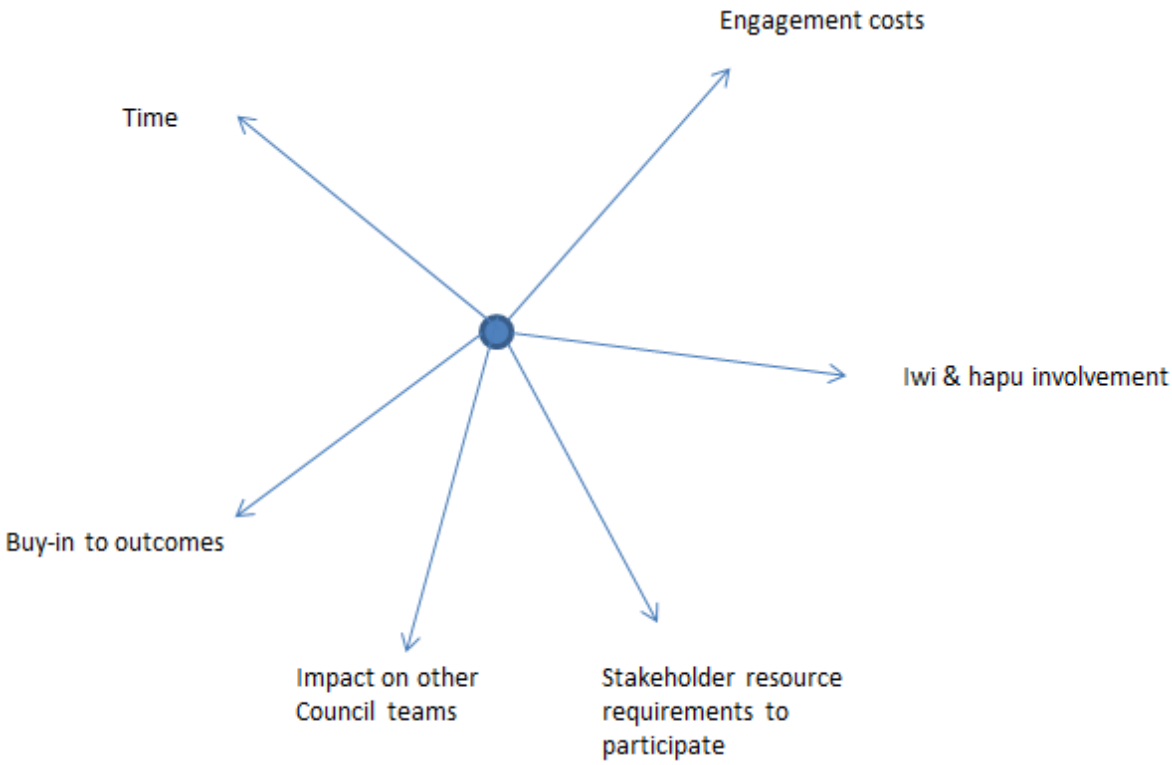
Group 3: FMU Criteria



Notes

1. Covers similar things to other spider diagrams. Decided to separate engagement from setting FMU limits.
2. Purpose of FMU under the NPS is to be the management unit for which objectives/limits are set.
3. Are the criteria for data (i) ease of collection (i.e. what's available) or (ii) what's needed to improve water quality?
4. There are costs associated with modelling data.
5. The interaction (quality and quantity) of surface water and groundwater may be a good scale to set FMUs.
6. Impacts on the UP will have flow on effects.

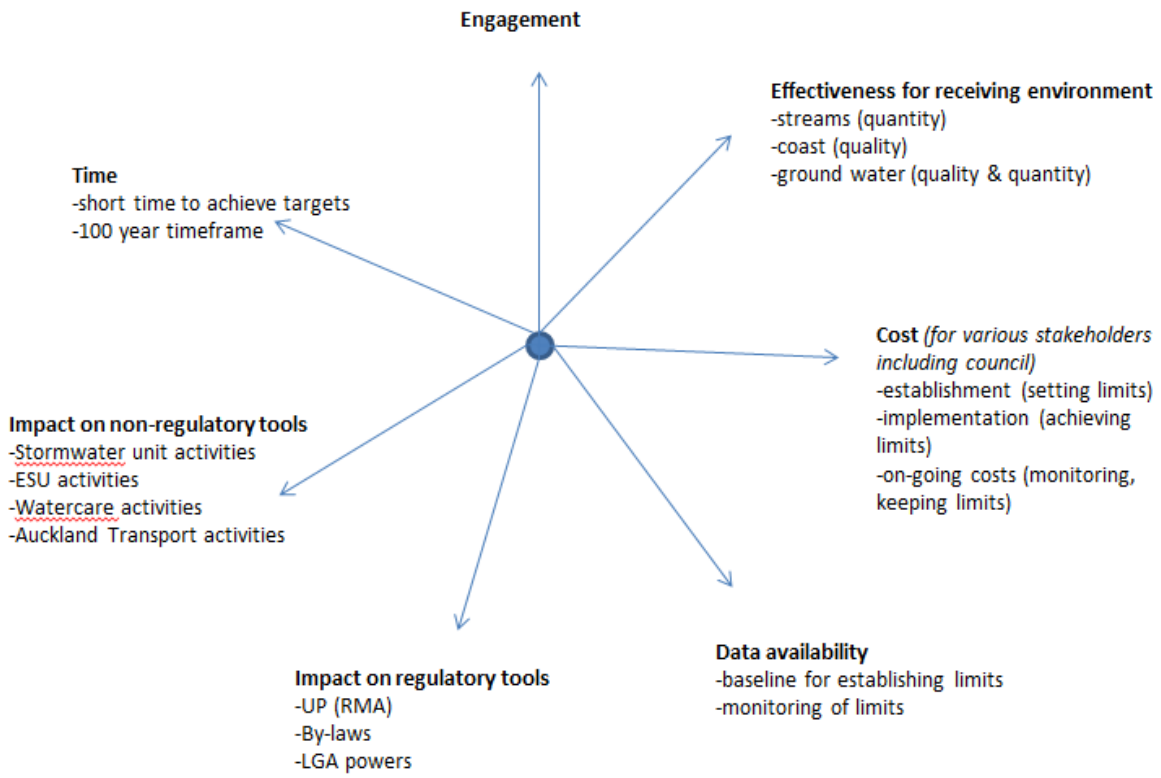
Group 3: Engagement Scale Criteria ≤ FMU Criteria



Notes

1. Engagement criteria could be used to evaluate (i) small/large FMUs, (ii) organisation scale, (iii) classification, and (iv) issue-based options. Different consultative approaches could be another layer on top.
2. There are costs to iwi. Limits need to be set at a meaningful level for iwi – catchment scale rather than rohe.
3. Stakeholders need resources to engage.
4. On-going engagement impacts on other council teams.
5. Engagement at both large and small scales could take a long time to do well.
6. Buy-in to outcomes from the process is important.

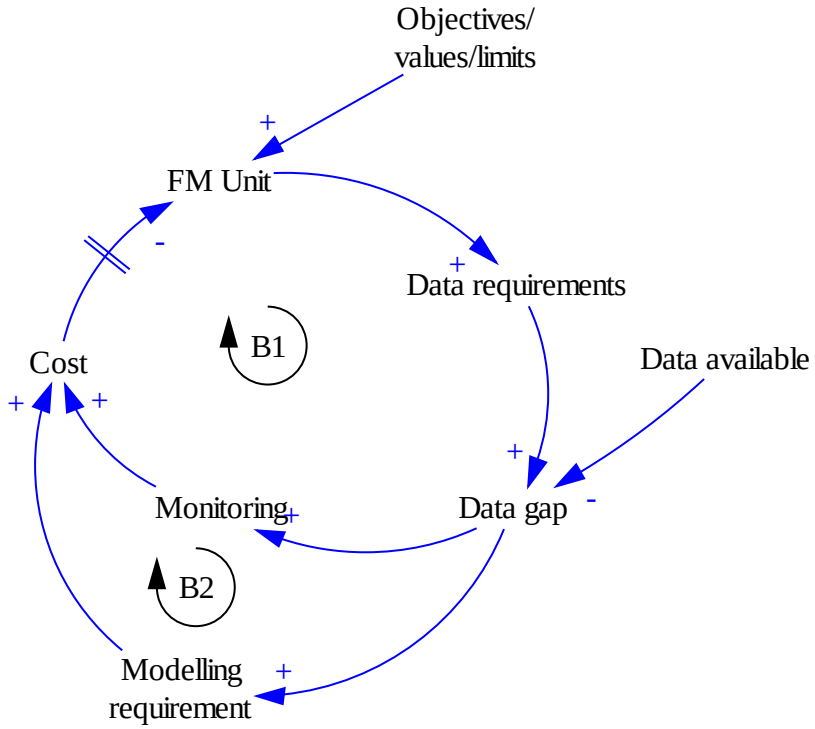
Group 4



Notes

1. If data availability is driving the size of FMUs this assumes monitoring requirements are known.
2. Monitoring of limits is easier at a large scale/resolution than small scale/resolution. However, outcomes (good or bad) can take a long time to see at a large scale/resolution. A characterisation approach allows data to be inferred/modelled as it is not possible to monitor everywhere. Should high use areas be monitored more than low use areas?
3. FMUs will impact on regulatory tools (UP, by-laws, etc.).
4. FMUs will impact on non-regulatory tools and what they can achieve (e.g. stormwater, parks, Auckland Transport).
5. Need to know the timescale to which the FMUs are working. Is the timeframe 15–20 years or 100 years?
6. Effects on the receiving environment will be different for coasts than for groundwater.
7. Costs associated with establishing limits, implementation, monitoring, for other non AC groups, need to be estimated.
8. If the 'value' (e.g. can swim) is being achieved is this a good enough guideline for the community rather than achieving limits set?

Participants CLD connecting spider diagrams



CLD story

1. The NSP-FM requires objectives/values/limits to be established for FMUs within a region.
2. If the number of FMUs increases data requirements will increase.
3. There will be an increasing gap between data requirements and data available.
4. The growing data gap will require an action (e.g. increased monitoring or modelling of data).
5. This will increase costs.
6. At some point cost increases will bring about pressure to reduce the number of FMUs.

Next workshop: 25–26 June, The Strand, Council Chamber (Level 3):

- Report from Carolyn Blackford on collated spider diagrams
- Report from Christine Mitchell, Carolyn Blackford and Sam Turner on scales used and pros and cons of 3 main FMU options.
- Continue with CLDs
- Presentation of ISE by RIMU
- Reflection on findings, recommendations and possible continuation

Postscript on recognising the importance of System Thinking:

May 2014 quote from Paul Polman, Unilever chief executive, on the skills business leaders need to have in the current global environment:

Capitalism needs to evolve, and that requires different types of leaders from what we've had before. Not better leaders, because every period has its own challenges, but leaders who are able to cope with today's challenges. … Most of the leadership skills we talk about – integrity, humility, intelligence, hard work – will always be there. But some skills are becoming more important, such as the ability to focus on the long term, to be purpose driven, to think systemically, and to work much more transparently and effectively in partnerships.

For the rest of the article see:

http://www.mckinsey.com/Insights/Sustainability/Business_society_and_the_future_of_capitalism?cid=other-eml-alt-mkq-mck-oth-1405

Appendix F4: Summary of Workshops on June 25–26, 2014

Stream site link: http://stream.massey.ac.nz/course/view.php?id=17927

The workshops covered: (1) System Dynamics; (2) Integrated Spatial Explorer model; (3) Concerns not already addressed for setting FMUs; (4) CLDs to cover missing concerns; (5) Possible FMU scenario; (6) Findings/Observations/Reflections; (7) Recommendations

1. System Dynamics

System Dynamics, as a quantitative expression of systems thinking was introduced. STELLA was illustrated as the supporting software. A flood protection model was demonstrated as an example of the 'storytelling' capacity of STELLA. Discussion identified: (1) Hard engineering is easier to attach numbers to than the less definite green engineering; (2) System Dynamics has the scope to provide more transparency about numbers and what they mean; (3) There are many overseas examples of the ways ecosystem services are part of green engineering (a database with 45,000 examples) but few NZ examples.

2. Integrated Spatial Explorer (ISE) model

Paul Owen from AC gave a presentation on the ISE model being developed as part of the Sustainable Pathways 2 (SP2) project. The model shows the interactions between economic, demographic, land use and spatial suitability parameters at a 50 x 50 m. grid for Auckland Region. The focus of SP2 is sustainable urban futures and systems tools to assist decision-making. AC, through RIMU, is part of this MBIE funded project (2009–2015). The ISE model uses transition rules to change cells to the land use for which it has the highest potential until regional demand is met (dominant output is >51% of cell). ISE also incorporates neighbourhood rules so each potential land use is influenced by adjacent activities.

ISE can be used for:

- 'What if' analysis.
- Decision-support for issue identification and policy options (e.g. urban/rural boundary shifts or natural hazards).
- Analysing spatial options.

While hydrology is not included, it could be. Flood plains are included under land-use suitability. The current situation in the Auckland Region is demand for housing is so strong that even if a small opportunity is provided to expand urban areas on floodplains or productive soils, further sprawl is hard to stop. There is no 'Impermeable Surface Area' score in ISE at present but this is possible. It is also possible to have FMU objects and limits included as a suitability criterion for a future case study. To run a scenario for setting limits for FMUs you could start at the receiving environment and work backwards grid by grid to achieve the specific output you desire.

3. Concerns not already addressed for setting FMUs

- Axis in the spider diagram (developed in Workshop 3, June 4–5) shows the breadth of factors to consider when setting FMUs. Question: is everything adequately covered by CLDs? Answers to the following are missing: (i) Te Ao Maori; (ii) Engagement

capacity and capability. The quality of engagement will impact on the ability to set objectives and get buy-in for implementation; (iii) Social capital impacts. For example, the scale at which the FMU is set can facilitate/prevent people connecting with their waterways to achieve limits.

- Scale is essentially the question– not a criterion. Will need to complete a spider diagram for each potential FMU scale.
- There are different types of costs, for different groups occurring over different time frames. [Note: costs are an aspect of many of the CLDs]. Costs are perceived differently and apportioned differently depending where you work in council (see Appendix G1: Proportioning of Costs over different Phases and Appendix G2: Actual $ amounts).
- FMU size will impact engagement capacity. This does not mean FMUs have to be set at engagement scale as it is also not possible to engage with 50+ groups. Will the level of consultation determine the objectives and limits set if these are to be community decisions?
- Economic capital – Small FMUs with different limits and Unitary Plan rules will make it difficult for business. Two closely located similar businesses could have different restrictions. Improving amenability will attract people. Therefore development needs to be done in a way that enhances ecosystems so amenability is not lost.
- The ability of FMUs to meet Maori aspirations will depend on scale. The current preference expressed is for Mountain to Sea, a holistic harbour scale. This scale will make it difficult for Maori to be heard and their values understood at the community or hapu level. At the 3-harbour FMU scale Maori are just one of many voices. At a smaller scale hapu voice will be stronger. Cultural capital will decrease or increase depending on FMU scale. What are the Te Ao principles that need to filter down?
- What communities want to achieve is the FMU driver. FMUs need to be set according to "you need to work at this scale to achieve this".
- How are effects of future urban/rural change taken into account? FMUs have to be dynamic enough to cope with this change overtime.
- The NPS-FM requires all water takes (annual reporting) and discharges (likely to be 5-yearly reporting) to be accounted for at the Regional Level. Currently water takes are being accounted for [A clarification question: Does 'all' include groundwater and surface water?]. This accounting requirement might drive the scale FMUs need to be set at if they are to be aggregated to a national level.

The Unitary Plan allows changes to land use. When this takes place FMU limits will also need to be revisited. Community drivers can improve or degrade water quality. New communities may have different community outcomes. Change in land use will require a Plan change and a zone change. This will reopen the FMU process for limits and objectives but should not change FMU scale.

- Nature shows how things should be managed. The actual FMU level of disaggregation needs to be decided, as do which classification layers need to be included.

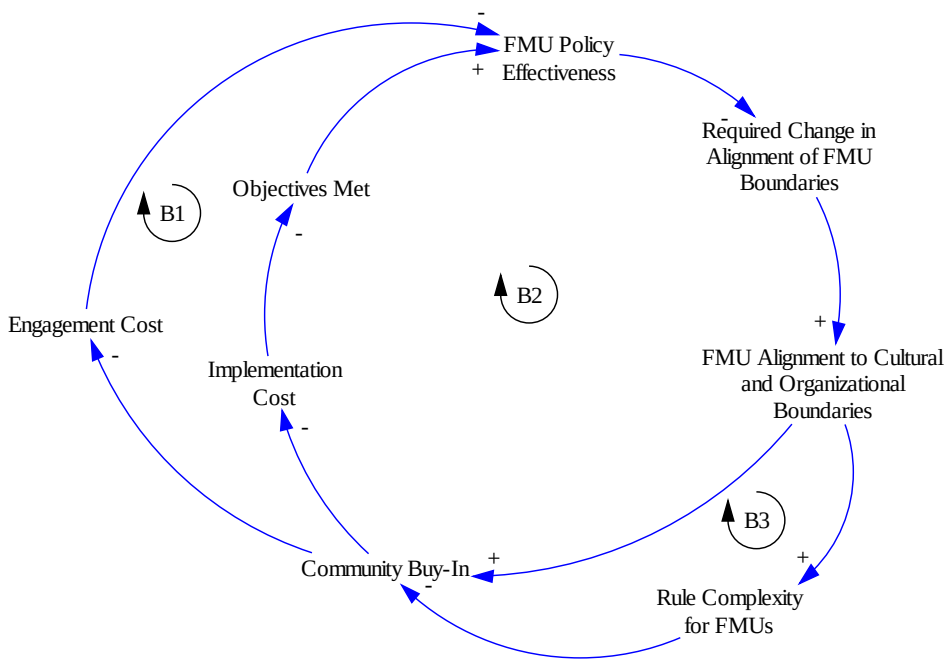
Classification is a type of spatial/scale allocation (for all of a stream, part of a stream, forest, receiving environment, etc.).

- If land-use change causes a threshold to be breached you do not change the FMU but undertake mitigation somewhere in the catchment. Larger FMUs provide more flexibility for mitigation in a FMU.

The goal of the CLDs is to create a story that will show the thinking that has gone into FMU scale discussion and provide a structure to the FMU setting. For example, if you take this solution these are the consequences or implications you need to consider.

4. CLDs to cover missing concerns

a) Alignment of FMUs with Boundaries



CLD Story and Discussion

B1:

a. An increase in FMUs alignment with cultural and organisational boundaries will increase community buy-in
b. An increase in community buy-in will decrease engagement costs
c. Decreased engagement costs will increase the FMU policy effectiveness
d. Increased FMU policy effectiveness will decrease the need for future change to FMU boundaries
e. Decreased need for FMU boundary change reduces need for FMU alignment.

B2:

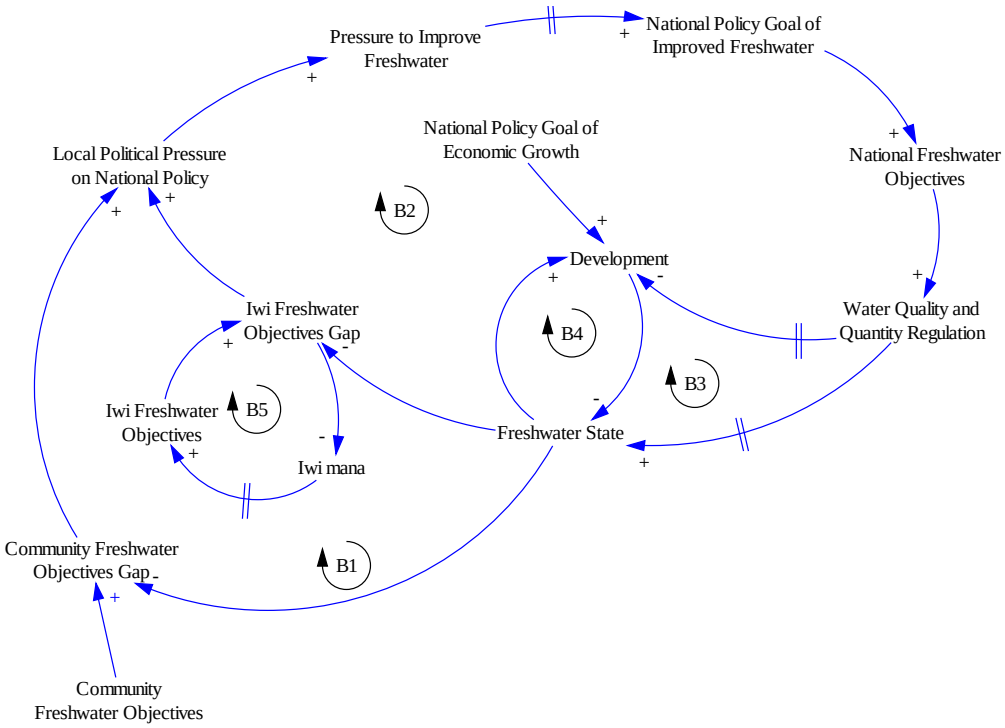
a. An increase in FMUs alignment with cultural and organisational boundaries will increase community buy-in
b. An increase in community buy-in will decrease implementation costs
c. Decreased implementation costs will increase ability to meet objectives

d. Increased meeting of objectives will increase FMU policy effectiveness
e. Increased FMU policy effectiveness will decrease the need for future change to FMU boundaries
f. Decreased need for FMU boundary change reduces need for FMU alignment.

B3:

a. An increase in FMUs alignment with cultural and organisational boundaries will increase the complexity of the rules required for FMUs (as they naturally align with waterways)
b. An increase in rule complexity will decrease community buy-in
c. Decreased community buy-in will increase implementation costs
d. Increased implementation costs will decrease the ability to meet objectives
e. Decreased meeting of objectives will decrease FMU policy effectiveness
f. Decreased FMU policy effectiveness will increase the need for future change to FMU boundaries
g. Increased need for FMU boundary change increases need for FMU alignment.

b) National Policy and Conflicting Effects on Community and Iwi Objectives



CLD Story and Discussion

B1:

1. An increase in the size of the gap between community objectives for freshwater and the actual state of freshwater results in local political pressure
2. An increase in local community concern (Local political pressure) about water quality increases the pressure on national government to introduce a National Policy to improve freshwater
3. The increase in pressure (after a delay) leads to the national policy goal of improved freshwater (NPS-FM)

4. The NPS-FM allows regional councils (working with their communities) to set values and objectives for freshwater
5. These values and objectives are achieved by regulating activities that impact on water quality and quantity
6. Stricter regulation (an increase) improves the state of freshwater
7. Improvement in the state of freshwater reduces the gap between community objectives for freshwater and the actual state of freshwater
8. Gap reduction means the community exert less local political pressure.

B2:

1. An increase in local community concern (Local political pressure) about water quality increases the pressure on national government to introduce a National Policy to improve freshwater
2. The increase in pressure has (after a delay) led to the national policy goal of improved freshwater (NPS-FM)
3. The NPS-FM allows regional councils (working with their communities) to set values and objectives for freshwater
4. These values and objectives are achieved by regulating activities that impact on water quality and quantity
5. Stricter regulation (an increase) improves the state of freshwater
6. Improvement in the state of freshwater reduces the gap between iwi objectives for freshwater and the actual state of freshwater
7. Gap reduction means iwi exert less local political pressure.

B3:

a. An increase in local community concern (Local political pressure) about water quality increases the pressure on national government to introduce a National Policy to improve freshwater
b. The increase in pressure has (after a delay) led to the national policy goal of improved freshwater (NPS-FM)
c. The NPS-FM allows regional councils (working with their communities) to set values and objectives for freshwater
d. These values and objectives are achieved by regulating activities that impact on water quality and quantity
e. After a delay increased regulation of water quality and quantity activities decreases development [This is a conflict with the National Policy goal of increased economic growth.]
f. Decreased development increases (improves) the state of freshwater
g. Improvements in the state of freshwater decrease the Community Freshwater Objectives gap
h. A decrease in the gap decreases local political pressure.

B4:

a. An increase in development reduces the state of the freshwater
b. Reduced water quality will impact (decrease) development.

B5: (depending on water quality mana will increase or decrease)

a. An increase/decrease in the Iwi Freshwater Objectives gap will decrease/increase iwi mana
b. The decrease/increase in mana will decrease/increase iwi freshwater objectives
8.
9. Decreased /increased objectives will decrease/increase the Iwi Freshwater Objectives gap

5. Possible FMU scenario

Scenario 1: Tiered FMU setting process

Harbours (receiving environment)

↓

Stream attributes
If all attributes the same only need one FMU. If there are special stream characteristics (good or bad) need a separate FMU

↓

Continue FMU scale down to the level that is possible given cost/engagement/monitoring/interest/political constraints

This tiered approach requires starting at a large scale and drilling down to the level where interest, money or political will run out. Criteria could be developed that need to be met to go down to a lower level FMU with specific limits and objectives. Each lower level still needs to aggregate up.

General Discussion Points

- A caution with small scale FMUs is that while they might be effective for linking people with their waterways they may prevent people seeing the bigger picture.
- The NPS states that each FMU can only have one limit/objective for each attribute. Can you set limits and objectives for a FMU and then divide up how they are achieved over the FMU as with nitrates into Lake Taupo? Identifying special communities/ecological areas requiring tighter restrictions would be needed with this approach.
- A FMU is just what is expedient for management purposes.
- At present AC monitors problem areas first. If it is not possible to monitor at a small scale should the FMUs be set at a small scale? A possible solution is for freshwater monitoring to be a community task. AC can provide the information and resources to people interested.
- Integrated catchment management is only possible in larger catchments. Small areas do not have the necessary flexibility. In the case of stormwater management it was only possible to do 10 catchment management plans so that was the scale that waterways were aggregated at.

- Progress can be shown more readily in large areas and there is more scope to direct resources where most needed.
- Engagement does not need to be at the FMU scale. A question is what engagement scales will be most effective to increase buy-in?
-

6. Findings/Observations/Reflections

1. One size fits all is not practical and less likely to achieve NPS outcomes.
2. Nested or tiered approach has potential.
3. The workshops led to constructive discussions and common understanding. This has provided insights into each other's professional worldview and operating space.
4. There is an opportunity to link with other processes, e.g. marine spatial plan, stormwater, spatial planning, receiving environments, integrated management, etc., so overall outcomes are emphasized.
5. Definitions and terminologies used across AC departments in relation to FMUs are not in sync.
6. NPS is driven by the RMA process. FMUs need to have regard got other council responsibilities and the fact that Aucklanders may want higher water standards than in the NPS. FMUs can be set for purpose of NPS or by starting a broad conversation across council. ST workshops helped in trying to understand the implications.
7. Broad systems implications have been identified for 3 FMU scenarios.
8. A structure to evaluate options is provided by the spider + CLD.
9. There are at least 24 different water spatial units used at AC (see Appendix B "List of Water Spatial Units Used by different teams of Auckland Council").
10. Engagement scale does not have to be the same as FMU scale, but alignment would be useful.
11. Output of workshops (i.e. discussion summaries and CLDs) could be used in the consultation process.

7. Recommendations

1. A common glossary is needed.
2. Scenarios should be developed for the FMUs we want to look at.
3. Test the following 3 FMU scenarios using spider and CLD's:
   i) Large FMUs / Harbour scale
   ii) 50–100 FMU scale
   iii) + 4000 FMU scale.
4. Test outcome priorities/criteria and trade-offs. Expand pros/cons document already started.
5. Analyse the synergies between the different ways of cutting up the region (see Appendix B "List of Water Spatial Units Used by different teams of Auckland Council").
6. Values, objectives and limits for FMU need to aggregate to achieve high-level objectives and large, receiving environment scale; reporting needs to be at FMU scale.

7. Meet after draft report to agree on summary to put forward to steering committee.
8. The FMU process should pay regards to other council processes; social, economic and cultural processes, by looking at CLDs.
9. Processes undertaken should include but not be limited to the assessment criteria that are developed to date (currently in the shape of spider& CLDs).
10. Skills are required to update/adapt the 'assessment criteria' and communicate how they work across departments.
11. External consultation takes place, with or without the product of the workshop.

Appendix G1: Proportioning costs over different phases

Participants estimated their 'gut sense' about how costs would need to be divided over the phases of the policy cycle: development, implementation, monitoring and accounting. This was done to assess if participants were in sync about their perspective (i.e. the elephant and the blind men).

Assumptions	Policy Development %	Implementation %	Monitoring %	Accounting %
Assign all the bells and whistles of delivering on the NSP-FM to the decided FMUs in the first instance. Will be on-going cycle of review and contesting of the UP and other implementation measures To develop the size of the boundaries of FMU for Auckland (i.e. Draw some lines on a map)	15% 69%	70% 1%	5% 1%	10% 30%
Policy implementation means implementing policy set within Auckland Plan, UP etc. Policy development includes cost of developing policy with communities to point is established into UP 10% policy development costs can be split 8%/2% with 2% being the cost of putting objectives into the Auckland Plan etc.)	10% 8%/2%	84% on-ground implementation	15%	1%
Policy development will be higher the more FMUs there are. This cost includes modelling, scenario exploration, stakeholder engagement, target setting etc.	10%	Getting into UP 5% (increases with more FMUs) Delivering activity on the ground to meet objectives = 80% (maybe 90%). Includes operating cost and losses due to higher cost of compliance.	Combined 3–5%. Will be higher the more FMUs that have to be monitored and reported on.	
Few FMUs Many FMUs	3–5% 5–10%	80% 65%	10% 20%	5% 5%
Implementation and monitoring is long-term (i.e. many years). Policy development includes engagement to set objectives and limits. Accounting is setting up framework and long-term reporting. Implementation is after UP and includes on the ground work to achieve limits. Costs are just for Council.	15%	60%	20%	5%
Implementation costs are for all Aucklanders including AC, CCOs, individuals, companies, etc.	10%	87% (=achieving limits by all stakeholders)	2.9%	0.1%
Low number of FMUs High number of FMUs	Lower Higher	Same Same	Same Same	Lower Higher
Storm Water Unit (SWU) – must comply. Implementation = mgmt. options including education;	See Carolyn, Christine, etc.	UP ->goes to consents/land use, etc.	Monitoring of physical attributes.	Don't know about this.

Assumptions	Policy Development %	Implementation %	Monitoring %	Accounting %
enforcement back to others who use SW system; physical works; development contributions to developers etc. (lots). Also all LGA responsibilities.		Implementation – many different ways (see assumptions) ESU – see Kim & Phil	Monitoring of effectiveness of SWU CMPs. Effectiveness of conditions of consent. Also all LGA responsibilities.	
Development = developing the objectives and limits and getting them into the UP. Implementation = the work that is needed to implement the policy and objectives that are set in the UP. Monitoring = to establish whether or not the policy and how it is being implemented is working, i.e. are we achieving objectives? Accounting = as required by NSP-FM need to account for all takes and discharges including diffuse discharges and permitted takes and discharges.	30%	60%	6%	4%
Policy development= engagement, modelling impacts of setting objectives and limits. Policy implementation = LTP (Council) and Community (Rules and non-regulatory requirements) Policy monitoring = council tends not to do this, hence low number.	30%	59%	1%	10%
The NSP-FM has immediate effect – so resource consents have to take into account now! Policy development -> development of UP provisions and development with community. Policy implementation-> where consents applicants comply with "rules" and where the community also manages effects and catchment (possibly without regulation). (see Hunui catchment case-study in Christchurch – this shows how a community can choose to take a "regulatory" path or manage themselves "self-regulation".	20%	75%	3%	2%
Policy development = All cost to develop and set objectives, values and limits in conjunction with community. Includes development of bottom lines not current in NOF. Timescale 5–10yrs or longer as constantly needs updating?	15%	60%	20%	5%

Appendix G2: Actual $ amounts

Participants then estimated their 'gut sense' about their assumptions, and how the size of the costs would need to be divided over the phases of the policy cycle, i.e. development, implementation, monitoring, and accounting. This was done to assess whether participants were in sync about their perspective.

Assumptions	Policy Development	Implementation	Monitoring	Accounting
Timeframe = 30 years. Costs are for council. Policy development can be either rules in UP or "self-management" in a catchment.	$20m	$500m	$20m	$10m
Cost to achieve values, objectives, and limits over all timeframe that is realistic, i.e. several decades 30–50 years for all costs to all parties involved, assuming that the community is not happy with the status quo and has aspirational values and objectives.	Overall cost over 30–50yrs will be hundreds of millions probably into the billions.			
Achieving the targets therefore long time frames. Implementation = on ground post rules into the UP.	$20m (total) $5m (council)	$200m (total) $50m (council)	$25m	$2.5m
30-year timeframe.	$5m (<10%)	$20billion 87%)	$3m (>2.9%)	$500K (0.1%)
30 year timeframe. Council costs only.	$8m	$60m	$5m	$2m
Policy development = Cost to council of setting limits and objectives and getting them into UP and stakeholders.	$5–10m over 10 years (council) $3–8m (stakeholders)	$ billions over 50–100 years		
	$2 billion over 30 year timeframe.			
	$10,000 per new house built over next 30 years within Auckland Region.			