

# Collaborative Systems Thinking for Effective Engagement

Research report on water  
quality in the Lower Cataraqui  
region of the Rideau Canal

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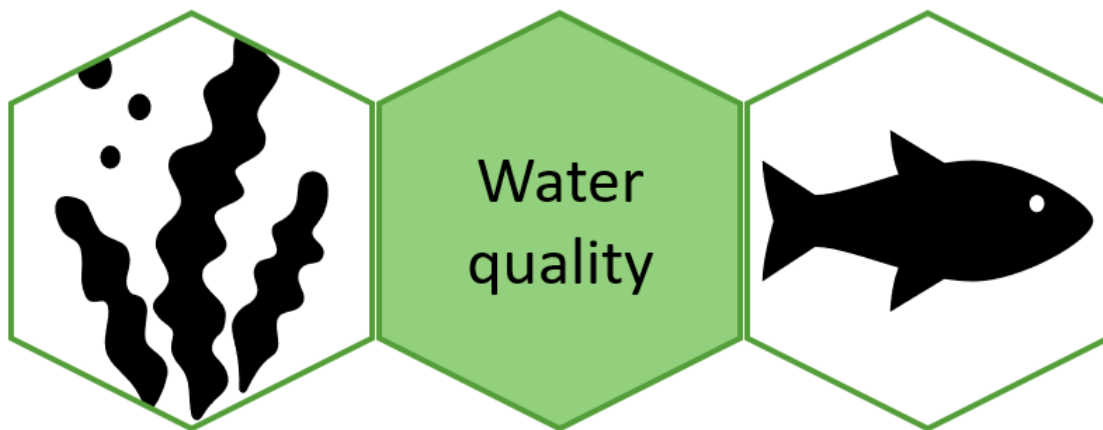
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# EXECUTIVE SUMMARY

In this research report, we share insights from our research on water quality in the Lower Cataraqui region of the Rideau Canal. We unpack three key insights from our research that can help grassroots initiatives address local concerns and work towards positive action. We showcase an approach for effective stakeholder engagement that supports the mobilization of local knowledge in governance processes.

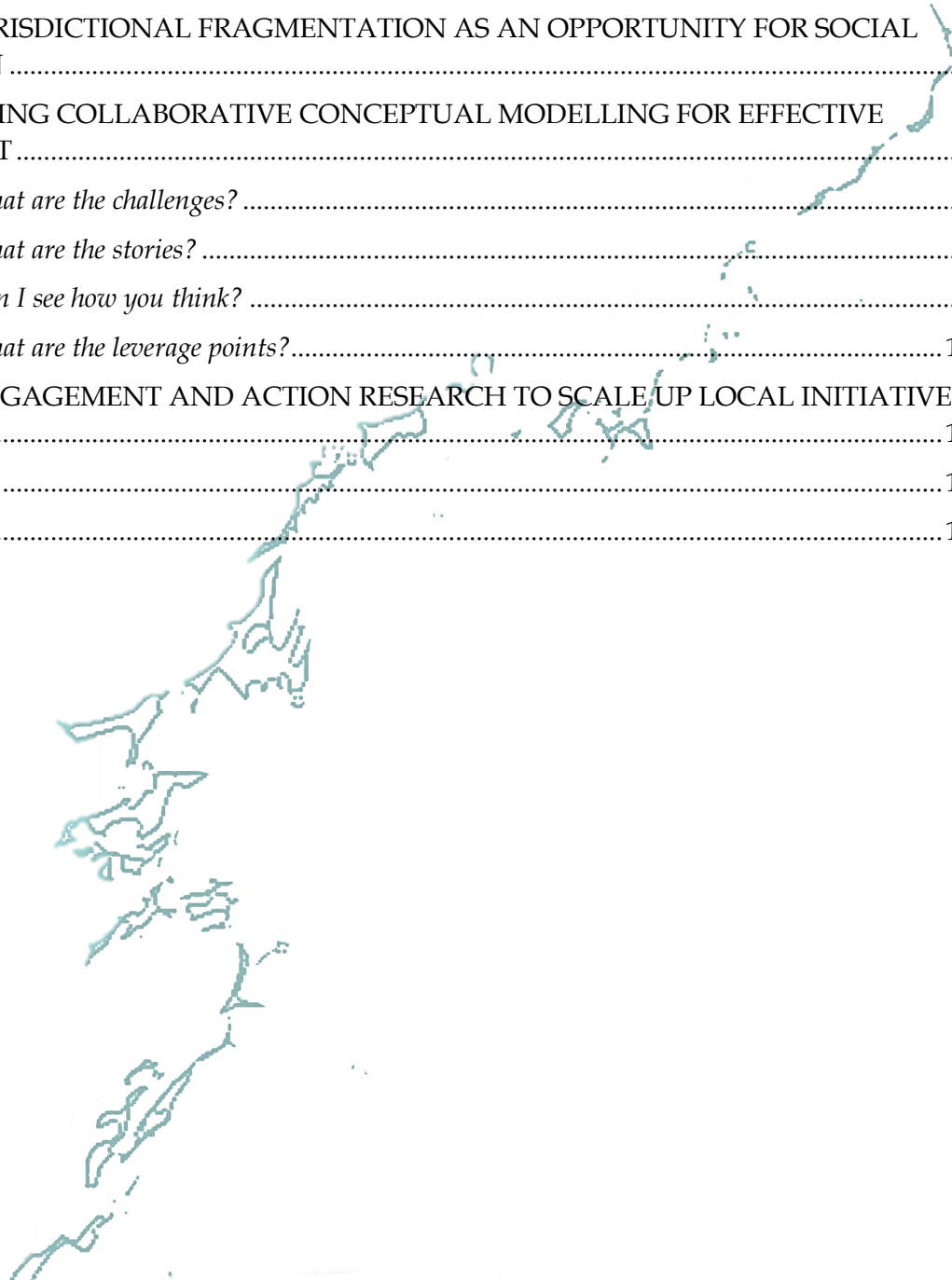
- 1 Jurisdictional fragmentation is a significant challenge for environmental governance of multi-use and multi-boundary waterways. This challenge creates barriers to address environmental issues, but it also creates opportunities to engage the local community for positive action.
- 2 Collaborative systems thinking is an effective approach to critically engage diverse, or conflicting, stakeholder perspectives in order to address water quality management challenges. We unpack the benefits and limits of a specific approach called Collaborative Conceptual Modelling.
- 3 Action research involves researchers working with the community to simultaneously understand social phenomena and support change led by local actors. It is an effective strategy for local groups to scale up their initiatives and to meaningfully impact environmental governance.

We conclude that collaborative systems thinking and action research could be used by a variety of local groups who want to work with partners to address environmental concerns. This report provides tools to help groups mobilize these methods in their own projects. Please read our publication (Mistry et al., Submitted 2020) or contact the authors of this report if you would like more information.



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# INTRODUCTION

## CONTEXT AND OBJECTIVES

Local environmental issues are often tied to social processes such as environmental management, lack of communication or lack of understanding of perspectives of resource users. It is important to consider these social factors to effectively improve environmental conditions.

Engaging various stakeholder views and their knowledge is a necessary step to gain a thorough understanding of environmental issues. Thinking about the linkages between social and ecological factors helps identify points of agreement and contention between stakeholders and provides a common ground for dialogue. These discussions can lead to recommendations for local action and can inform decision-making.

The objective of this report is to inform local community groups on how they can collaboratively tackle local environmental issues, especially in the context of multiple jurisdictions. We use the case of water quality in the Lower Cataraqui region of the Rideau Canal in Ontario, Canada (Figure 1) to illustrate how local groups can reshape environmental governance<sup>1</sup> through effective stakeholder engagement.

## OUR RESEARCH

This report is based on the manuscript “Action research to improve water quality in Canada’s Rideau Canal: How do local groups reshape environmental governance?” (submitted for consideration to a scientific journal in 2020) which focuses on the activities of a grassroots group called the Three Lakes Group (TLG). The publication presents findings from our action research in partnership with the TLG. The TLG was created in 2018 by residents from Dog, Colonel By and Cranberry Lakes of the Lower Cataraqui region who were concerned about the increasing frequency of algal blooms they observed in their respective lakes. The group emerged in part because Cranberry and Colonel By Lakes did not have lake associations; these are groups that represent their membership consisting of local residents. The Dog Lake Association has a Water Quality Committee that has taken action to assess and monitor the state of water quality.

Our research aimed to understand how members of the TLG and other concerned stakeholders view the issue of water quality, as well as the governance system that they must navigate to improve environmental conditions. We used systems thinking and qualitative research methods to analyse perceptions on the causes of poor water quality and relationships among stakeholders with the goal of including them in governance

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<sup>1</sup> We use the term governance to refer to the decisions and actions of multiple levels of government.

processes. Systems thinking involves considering the various components (social, ecological, economic, institutional, etc.) of a system and their linkages.

### WHAT CAN YOU FIND IN THIS REPORT?

In this report, we provide an approach to stakeholder engagement and use specific examples from our work in the Lower Cataraqui region that demonstrates the potential for action research to bridge the knowledge to action gap. The methodology can be used to address other sustainability issues in a variety of contexts. We first outline the challenges of jurisdictional fragmentation and the barriers it creates. Second, we explain how to host a workshop with collaborative systems thinking, as well as the benefits and limits of this approach. Finally, we detail the advantages of action research for local groups.

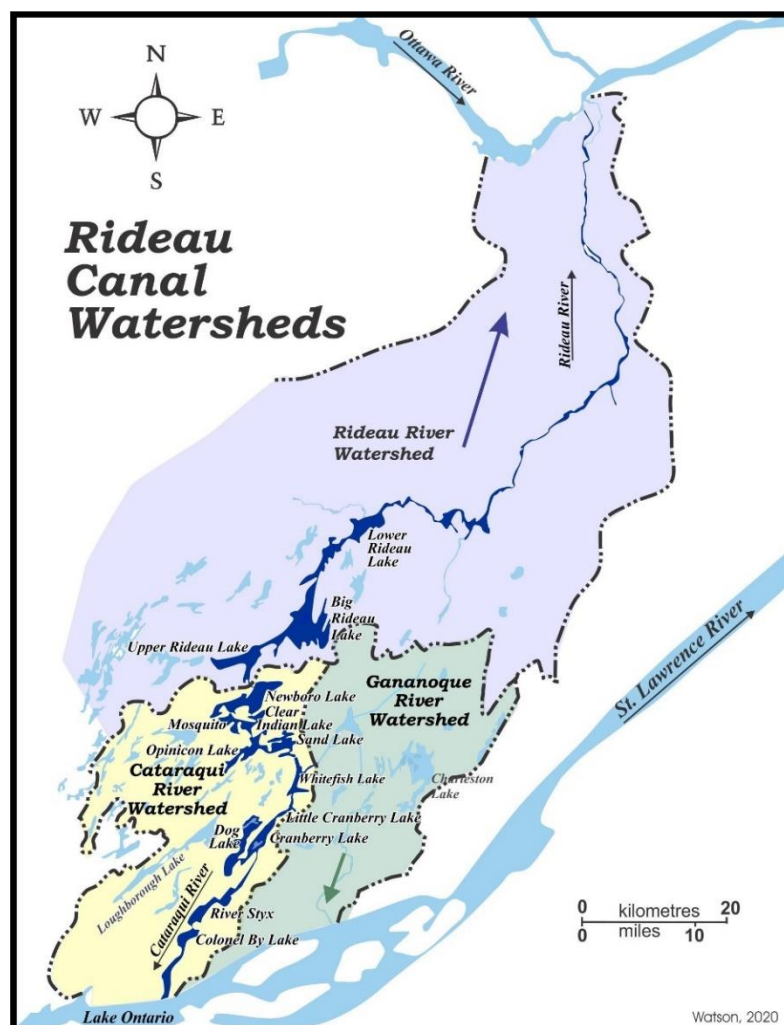


Figure 1: A map of the RC showing, in yellow, the Cataraqui Region watershed. Residents of the TLG are based in Cranberry Lake, Dog Lake and Colonel By Lake. Image credit to Ken W. Watson (2020), used with permission.

## INSIGHT 1: JURISDICTIONAL FRAGMENTATION AS AN OPPORTUNITY FOR SOCIAL CONNECTION

**Jurisdictional fragmentation is a significant challenge for environmental governance of multi-use and multi-boundary waterways. This challenge creates barriers to address environmental issues, but it also creates opportunities to engage the local community for positive action.**

### WHAT IS JURISDICTIONAL FRAGMENTATION?

Jurisdictional fragmentation is the segmentation and fragmentation among and within government levels and agencies which have distinct yet overlapping jurisdictions for managing natural resources. It is “a feature of the institutional complexity of water management that can be mobilized to develop unique solutions to multi-scalar water governance challenges.” (Cook, 2014, p. 192).

In Canada, water governance is generally impacted by jurisdictional fragmentation and a political climate of decentralization (Cook 2014). It is common for various aspects of environmental and water resources to be under the jurisdiction of both the province (for example, the provinces have authority of most water bodies) and federal agencies (for example, international trade, commerce, fisheries and navigation fall under the authority of Fisheries and Oceans Canada and Transport Canada among others).

### **BOX 1: Jurisdictional fragmentation in the Rideau Canal**

The Rideau Canal is a National Historic Site that is primarily managed by Parks Canada. It spans 200 kilometers including 13 municipalities and townships, multiple provincial and federal departments as well as several local groups and associations. Many residents from the Lower Cataraqui region and other sections of the Rideau Canal are frustrated by the jurisdictional fragmentation. There is confusion about which agency has authority over a given issue or problem, and residents do not know where they should direct requests and advocacy. Water quality, water level management, shoreline development, land use and in-shore construction are all related yet managed by different authorities.

Residents in the Lower Cataraqui region were concerned by the recurring algal blooms and poor water quality in their lakes. In the absence of support from more influential authorities (i.e. federal and provincial governments), residents turned to their community (business owners, researchers etc.) and local authorities (e.g. Conservation Authorities and councilors). However, the usual town halls are not enough to effectively engage local actors. This is where collaborative systems thinking can be useful.

## WHAT ARE THE BARRIERS AND SOLUTIONS?

Jurisdictional fragmentation perpetuates environmental governance challenges. For example, multiple legislations make it difficult to untangle the responsibilities of different authorities, authorities have competing priorities based on differing mandates, and a lack of regular, transparent communication among authorities and with the public can create tensions.

## LEVERAGING THE POWER OF COLLABORATION

We can overcome some of the barriers of jurisdictional fragmentation by increasing social connectivity. Jurisdictional fragmentation can be tackled by improving institutional integration (Cook 2014) and supporting strategic collaborations among local actors and with governmental authorities. This can be achieved by building trust and long-term working relationships that include processes for the community to bring concerns to authorities, and vice versa. Another significant obstacle is the potential conflict among the perceptions of multiple user groups on the root of environmental problems and how they should be managed. Knowledge gaps can also lead to confusion as people make assumptions about the causes of a problem and related impacts. We propose collaborative systems thinking and action research to help address these challenges.

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## **INSIGHT 2: USING COLLABORATIVE CONCEPTUAL MODELLING FOR EFFECTIVE ENGAGEMENT**

**Collaborative systems thinking is an effective approach to critically engage diverse, or conflicting, stakeholder perspectives in order to address water quality management challenges. We unpack the benefits and limits of a specific approach called Collaborative Conceptual Modelling.**

### WHAT IS COLLABORATIVE CONCEPTUAL MODELLING (CCM)?

*Collaborative Conceptual Modelling (CCM) is an approach created by Newell and Proust (2012)<sup>2</sup> that brings together various stakeholders to understand the complexity of a given problem. It can be used to find solutions to a problem while creating opportunities to build new relationships. We propose a workshop using an adapted version of the CCM approach that includes four activities (see Figure 2). The workshop can be conducted multiple times with increasingly precise questions to generate in-depth understandings and explore new concerns as they emerge.*

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<sup>2</sup> Read Newell & Proust's working paper to learn about the steps we did not include in our workshop.

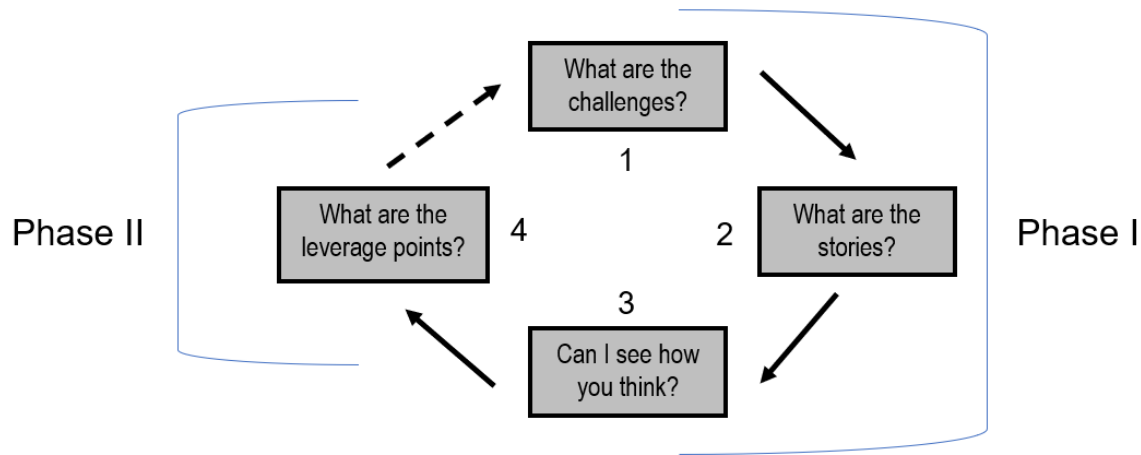


Figure 2: Collaborative Conceptual Modelling steps adapted from König and Ravetz (2018, p. 101).

### LOGISTICS OF A CCM WORKSHOP

A CCM workshop is organized around a specific issue or concern. There needs to be an overarching question to guide the workshop. This question should be based on the issue or problem that needs to be addressed. This approach is best suited to explore complex problems for which we have limited knowledge. In our case, we focused on water quality. We also conducted workshops in other areas of the Rideau Canal where our question focused on the environmental health of the waterway. A precisely formulated question is helpful to get all participants thinking about the same problem from their own perspectives. The workshop takes three hours to conduct, but the length can

### **BOX 2: Understanding water quality in the Lower Cataraqui region**

Initial discussions between our team and the TLG brought to light local concerns about water quality and uncertainties around the causes of increasing algal blooms, as well as frustration about the lack of government response to the problem. To better understand these concerns, researchers from the University of Ottawa and the Queens University's Beaty Water Research Center convened a workshop in partnership with Cataraqui Conservation and the TLG. This workshop brought together various stakeholders including provincial and municipal governments, scientists, residents, the conservation authority, a real estate agent, the owner of a campground and farmers. We conducted a knowledge mapping exercise based on the Collaborative Conceptual Modelling (CCM) approach. The overarching question for the water quality workshop was: "What can be done to maintain or improve water quality in the Rideau Canal?" This workshop helped participants collaboratively build understanding of water quality issues and identify areas of action.



be adjusted depending on the number of participants and their availability. We recommend between 10 to 15 to keep the discussion manageable. Participants should represent different organizations, groups or views that are directly or indirectly related to the problem or phenomena being addressed. A full day workshop is a significant commitment, so it is important to keep that in mind when planning a longer workshop.

Below, we provide details about each activity that can help guide other groups to conduct the same exercise. Although the analysis of results is a complex process, we provide some suggestions for a simple analysis. Conducting the workshop itself is a beneficial form of engagement for spurring action, building relationships, and filling knowledge gaps.

Prior to the workshop, you should send participants the overarching question you will be tackling in the workshop, as well as an overview of the activities and an agenda. If you want, you can also send briefing material about the day's topic to ensure everyone is on the same page. Choose a location that is easily accessible for participants - this is especially important if people are coming from different locations. Offering snacks and allocating time for breaks helps the workshop run smoothly. Participants also valued time allotted for networking. The room should be arranged so that participants can sit in a roundtable, but also so that they can break up into smaller groups. It is recommended to use a projector to display the questions of each activity so that all participants can easily follow. You can plan ahead to determine areas of the room that can be used to post the outcomes of each activity.

This type of workshop is easy to do without an experienced facilitator, but it can be beneficial to have someone with more experience to facilitate these activities, especially if there are high tensions among stakeholders. These workshops should not be advertised as meetings, but rather an opportunity to collaboratively develop solutions to the problem in question. Recruiting efforts should clearly state the objective of the workshop, the need for active participation during the workshop, and the possibility of follow-up meetings to discuss implementation of solutions that may result from the workshop.

### **ACTIVITIES IN A CCM WORKSHOP**

Before the first activity, we recommend that you explain to participants how the workshop will unfold. It is also helpful to provide an overview of the problem you wish to tackle with the workshop (i.e. what is the question you are interested in, situate the group geographically). You should also introduce the group to causal mapping and the idea that different types of factors (social, ecological, political, etc.) can influence the problem you are interested in.

*Activity 1: What are the challenges?*

Table 1: Workshop planning and facilitation details for Activity 1.

Objective	Facilitation Technique	Facilitation Environment	Question (case of water quality)
To list the top five factors that have an influence on the central theme. They must be stated neutrally (e.g. water level instead of low water level) and they can have a positive or negative influence (e.g. level of pollution or interest in local stewardship).	Provide large post-its or chart paper for participants to individually write their top five factors and have them post it on the wall. Encourage participants to think about social but also ecological, economic and political factors.	Give 10 minutes for this activity.  Encourage reflection and critical thinking. Lists should reflect the perspective of the stakeholder.	What factors enhance or diminish the water quality of the Lower Cataraqui reach of the Rideau Canal?

**Analysis:** Frequency count of factors can provide an overview of the most important factors that a majority of stakeholders view as influencing the problem.

*Activity 2: What are the stories?*

Table 2: Workshop planning and facilitation details for Activity 2.

Objective	Facilitation Technique	Facilitation Environment	Question (case of water quality)
To collectively create a timeline of significant events that have influenced these factors including pieces of information relating to the central theme.	Before the workshop, ask participants to bring some historical information with them. Post large chart paper on the wall and draw a timeline. Do a roundtable for each participant to share their event or information. Ask a colleague or a volunteer to write these down on sticky notes and post them on the timeline with dates.	Give 15-20 minutes for this activity.  Ensure everyone has an opportunity to speak and share their information. At the end of the roundtable, open the floor for discussion and to add more dates on the timeline.	How did these factors come to be?

**Analysis:** After the second activity, you will have a collective timeline. This is insightful to understand how your problem came to be. You can transfer this timeline in digital form and emphasize the events and dates that were mentioned by multiple participants.

*Activity 3: Can I see how you think?*

A causal map is a schematic created to make sense of how factors relate to each other. It is essentially a mind map that uses arrows to represent a linkage between factors. The direction of the arrows indicates cause and effect relationships. The causal mapping can be simplified depending on your needs. For this activity, you select your problem or main topic as a central factor. For example, in our Rideau Canal workshops, we asked participants to start their maps with “Environmental health” in the center. They added factors they believe influence environmental health, and added arrows showing how these factors relate to each other. The arrows can go one way or both ways to indicate a reciprocal relationship. It is possible to ask participants to annotate relationships with a plus or a minus sign, indicating a positive or negative correlation between factors. We recommend using correlations with groups already familiar with the concept.

*Table 3: Workshop planning and facilitation details for Activity 3.*

Objective	Facilitation Technique	Facilitation Environment	Question (case of water quality)
<p>There are two objectives:</p> <p>(1) To create causal maps that represent the perspective of each participant.</p> <p>(2) To combine the perspectives of participants by blending individual causal maps.</p>	<p>(1) Direct participants to take 15 minutes to individually create a causal map using the factors they listed and information from the timeline (maximum of ten factors should be in their map).</p> <p>(2) Pair participants with someone that may have a different perspective and ask them to combine their maps.</p>	<p>Give 15 minutes for the first part of the activity, and 20 minutes for the second part.</p> <p>(1) Encourage reflection and critical thinking.</p> <p>(2) Encourage a collaborative environment, prompt participants to ask their partner questions like “why do you think that?”</p>	<p>What are the relationships among the factors?</p>

**Analysis:** This is the hardest outcome of the workshop to analyse and there are many different ways to use the maps. The group or people hosting the workshop can merge the maps created by the pairs of participants to generate one final community map that includes all of the participants’ factors and their links. You can merge the maps informally, by drawing on chart paper as was done in the workshop. You can also use more sophisticated techniques related to fuzzy cognitive mapping and network analysis

- our publication outlines this technique. The community map, as well as the blended maps created by each pair, can then be reviewed to (1) generate a better understanding of your central topic or problem, and (2) identify potential leverage points or areas of action by showcasing the indirect and direct relationships between factors.

### BOX 3: Creating maps about what influences water quality in the Lower Cataraqui

We asked participants at our workshop to put “water quality” in the middle of their sheet of paper. They could then add factors relating to water quality. Participants were instructed to add arrows to show how the factors are connected. Below is an example of an individual map which shows how water quality influences and is influenced by nutrients, among other factors. We can also see that nutrients cause algal blooms, and the plus sign indicates this is a positive correlation (when nutrients increase, algal blooms increase). After each participant drew their individual map, we paired them with someone from a different stakeholder group to blend their maps. Partners had to agree on the most important factors they would include in their blended map, including how to link them. We took each pair’s map and created a merged community map as shown in Figure 4.

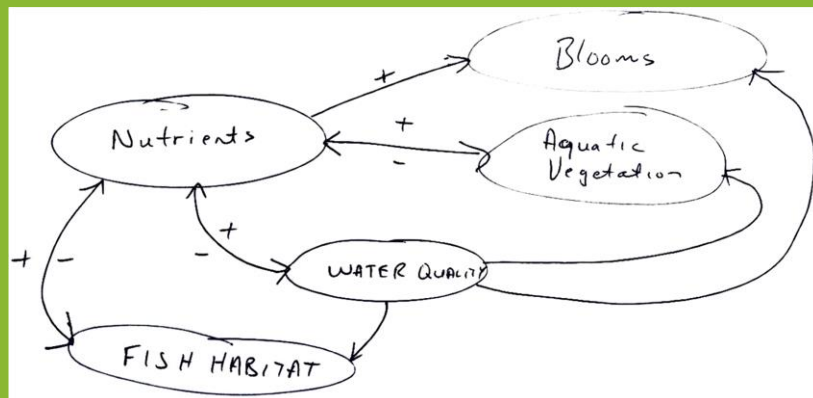


Figure 3: Positive and negative correlations in a map.

Whether you reach your final community map using complex tools or simply by sitting down and drawing a community map, the outcome can seem overwhelming. However, there is a lot of useful information in this kind of map such as learning about the different factors influencing the central topic through examining linkages with other factors.

Figure 4 is an example from the water quality workshop we held. You can see the community map on the left and on the right is an example about direct and indirect linkages among factors. increasing education about invasive species, climate change and boating practices are all ways to indirectly improve water quality, according to

workshop participants. As such, these maps can help identify leverage points or actions to take around the main issue or theme.

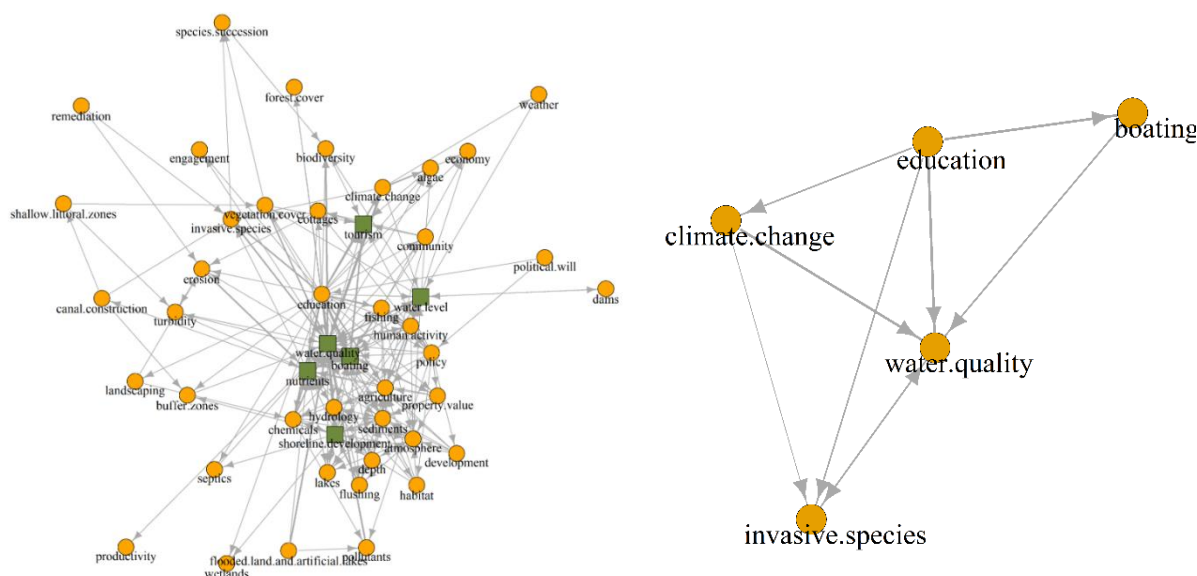


Figure 4: On the left is the community map we created by merging the pair maps. The different green boxes represent the most central factors i.e. those that have the highest importance in the network, which was determined through network analyses. On the right is a portion of the map on the left.

*Activity 4: What are the leverage points?*

Table 4: Workshop planning and facilitation details for Activity 4.

Objective	Facilitation Technique	Facilitation Environment	Question (case of water quality)
To create a list of leverage points based on the mapping exercise. Leverage points are action items that can have a significant impact on the central theme based on the number of indirect and direct connections with and among other factors.	Facilitate a roundtable discussion on leverage points and list them on chart paper. Allow for open discussion at the end of the roundtable.	Give 20 minutes for this activity.  Ensure equal participation and opportunities for open discussion. Encourage follow-up questions and use this list to connect with participants after the workshop. Create a sense of accountability for stakeholders to act on leverage points.	What can be done to improve the water quality of the Lower Cataraqui Region of the Rideau Canal?

**Analysis:** Items from this list can be organized and grouped to create potential areas of action to work on the problem. The areas of actions can be used to create committees among stakeholders or within an organization, or to plan programs and events. It is also possible to conduct a second CCM workshop using the results of the first workshop. The second workshop can pose a more detailed research question or can be conducted with other stakeholders. Follow-up workshops aids in iteration of the CCM cycle, which could result in more effective outcomes.

Table 5 shows the benefits and limits of the CCM approach.

*Table 5: Benefits, limits and applicability of the CCM approach.*

Benefits	Limits	Use CCM if...
<ul style="list-style-type: none"> <li>• Gathers different stakeholders to think collaboratively and express their differing views</li> <li>• Provides tools to understand complex issues</li> <li>• Generates outputs that can inform formal plans</li> <li>• Encourages relationship building</li> </ul>	<ul style="list-style-type: none"> <li>• Limited number of participants</li> <li>• Not a lot of time for networking built into the steps of the workshop</li> <li>• Requires follow-up</li> </ul>	<ul style="list-style-type: none"> <li>• There is a complex issue where there is conflict among views or uncertainty</li> <li>• You can bring together a small group of people (10 to 15) to understand or find solutions to an issue</li> <li>• You need concrete outputs to show your members, partners and governments</li> <li>• You want to work collaboratively</li> </ul>

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### **INSIGHT 3: ENGAGEMENT AND ACTION RESEARCH TO SCALE UP LOCAL INITIATIVES**

Action research involves researchers working with the community to simultaneously understand social phenomena and support change led by local actors. It is an effective strategy for local groups to scale up their initiatives and to meaningfully impact environmental governance.

Action research and CCM are both collaborative approaches that when used together can be an effective strategy for local groups to scale up their initiatives and meaningfully impact environmental governance. Partnering with researchers is a good way for community members to better understand social phenomena and explore ways to investigate complex problems. The CCM approach allowed us to identify important factors through the linkages and by finding the most frequently mentioned factors. Information from the timeline activity and mapping exercises can help inform areas of action. These activities can thus help identify recommendations to address the problem or main topic in addition to making recommendations about policy and engagement processes.

Overall, bringing together different stakeholders is a strength. This workshop could inform policy- and decision-making if the right people are in attendance. We recommend leveraging existing relationships with local organizations and authorities to identify suitable participants and recruiting them through professional and social networks.

From our case study, participants hoped to repeat this activity, but maybe with a link to policy

#### BOX 4: CCM for action research in the Lower Cataraqui

The most frequently mentioned factor in the first activity were nutrients and chemical inputs into the lakes of the Lower Cataraqui. Taken together with the timeline, this helps us develop a narrative of how water quality issues came to be in the Lower Cataraqui region:

*The lakes in the LC region were created in the 1830s through flooding for canal construction. According to participants, this significantly impacts the current state of lake water quality. The newer, shallow lakes warm up more quickly than deeper lakes in the summer, and now for longer periods throughout the year because of climate change. Additionally, these lakes have historically shown excess nutrients which participants believe makes them prone to eutrophication and algal blooms. Increased human activity in the past 20 years, such as intensified fishing and boating, are also seen as contributing to poor water quality.*

Results of the mapping activity helped us find the most central factors that influence water quality: nutrients, boating, sediments, agriculture, shoreline development, atmosphere, water level, education and policy. We also identified many relationships between the factors as previously shown. Finally, the discussion around leverage points helped us identify 3 areas of action to address water quality in the Lower Cataraqui. These are: determining the sources of nutrient loading through a nutrient budget, investigating temporal and spatial differences in the health of the lakes, and sharing stories by creating an educational narrative to engage property owners and politicians.

development or decision-making processes. There must be a concrete plan of action associated with the workshop to effectively influence change. Relationship building should be ongoing with a plan for follow-up after the workshop. Participants should leave with a sense of accountability to revisit the outcomes or carry them forward to inform their networks. Another workshop may be beneficial depending on availability and if there are any remaining gaps in knowledge or understanding of other views.

### **LINKING TO POLICY DEVELOPMENT**

Linking such outcomes depends on the partners involved. Since we partnered with the Conservation Authority, Cataraqui Conservation, the community group is able to leverage this relationship to influence government policy. Other contexts may not need government support to resolve their issue, but private or individual entities (businesses or community members) could support changes in policies or community norms. Groups should identify partners in the region who have connections to decision-making agencies (e.g. Conservation Authorities, non-governmental organizations, universities, municipal programs). We also recommend that groups analyze the roles and responsibilities of authorities in their area to inform partnerships and workshop objectives. There should be a plan to present workshop outcomes to decision-makers.



## CONCLUSION

### RECOMMENDATIONS

Here are the recommendations for local groups from our research:

- Results from CCM workshops should be used as evidence in specific policy- and decision-making processes
- Locals should attempt to develop strong ties with higher-level authorities
- Grassroots initiatives and local groups should pursue a diversity of local partnerships to ensure a variety of perspectives are taken into account. They should especially consider building relationships with youth, Indigenous voice and early-career researchers which are often underrepresented
- There should be some follow up after a CCM workshop to facilitate building strong and meaningful relationships that can influence governance
- People across geographical and institutional boundaries should come together and use systems thinking to help achieve desired outcomes
- CCM workshops can be conducted multiple times to generate increasingly precise understandings of an issue, to include new voices and/or to adapt to a changing world

Addressing ecological problems requires us to examine related human systems. Our research revealed that we must create learning opportunities to better understand the viewpoints of various stakeholders and consolidate local, scientific and traditional knowledge to enhance understandings of our environment. CCM and action research provide this learning opportunity in addition to being a venue for local concerns to reach the agendas of decision-makers. Our approach provides a democratic way for stakeholders to develop outputs that could be used as evidence for changes in policy, regulations or community practices. Relationship building and developing trust among stakeholders is essential and our activities can help foster stronger social networks to address ecological problems as they are both connected.

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