The Flood Resilience Challenge Game

Report (Draft 1)

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The flooding problem

Around the world, flooding is a significant challenge to tackle due to the combination of climate change extremes, land use change, and stakeholders' demands to be included in decision-making. Local communities aiming to build flood resilience often grapple with balancing competing interests and deciding which trade-offs are tolerable. The power differentials between stakeholders means that some have more resources such as finances, knowledge, and social influence. Consequently, there is an uneven 'playing field' in decision-making, having a voice, and even vulnerability to flooding.

Flooding is Canada's most common and most costly hazard, and its impacts are expected to increase with climate change. Historically, flood risk management in Canada has focused on 'fighting water' with physical infrastructure (structural measures), such as dams and dikes, which emphasizes scientific and technical solutions but these are expensive and can fail.
In contrast, nonstructural measures are often less expensive and more effective but not politically popular. Nonstructural approaches can be divided into natural mitigation (e.g. protecting wetlands, making room for rivers) and social mitigation (e.g. relocation/buyouts, regulations).

Image 1. High River, Alberta, 2013
Source: https://www.macleans.ca/news/canada/alberta-flood-then-and-now/

The most common type of stakeholder engagement regarding flooding in Canada is decision-making processes that do not involve all stakeholders in meaningful ways (e.g. one-way communication) and do not accommodate diversity or provide opportunities for sufficient interaction among stakeholders to understand different viewpoints or tensions between values.

Serious games are one approach to learning about complex socio-environmental problems such as flooding. Serious games are games that serve a purpose other than just entertainment such as education. Games can create safe spaces in which stakeholders can interact and explore diverse views and innovative ideas. Numerous disciplines apply serious games, including leadership training and natural resource management, and more recently there is a growing number of serious games on climate change.

The Flood Resilience Challenge game

The Flood Resilience Challenge (FRC) game is a serious role-playing game designed to strengthen stakeholder capacity for (collective) decision-making. The FRC game achieves this purpose, as an educational and engagement tool, by:

1. Increasing flood literacy;
2. Fostering social learning[1]; and
3. Creating a safe space for exploring risk management and communication strategies.

In the FRC game, players take on the roles of a range of stakeholders (can choose from 20 different stakeholder roles), including various levels of government, scientists, insurers, developers and other private businesses, and media. In the first round, players plan for different types of flooding and communicate with each other on which flood risk management measures to employ. In the second round, there is a flooding event and players re-evaluate their past decisions and make future flood management plans. Players then debrief about their strategies and experiences, providing further opportunities for learning.

Although there are several serious games on flooding, the FRC game provides a combination of unique features:

- Additional content to enhance flood literacy
- Tailored to the Canadian context (including regulations)
- Game play includes policy objectives, trade-offs, and values
- Financial component with payments (e.g., insurance and taxes)
- Socio-political dynamics (e.g., voting)

The FRC game was developed in 2019 by Dr. Evalyna Bogdan, environmental and disaster sociologist at the University of Waterloo with Heather Murdock, hydrotechnical engineer and flood risk specialist at Northwest Hydraulic Consultants. The FRC game is part of Dr. Bogdan's postdoctoral research *Building Capacity for Difficult Conversations on Flood Risk Management in Canada's Communities.* The development of, and research on, the FRC game is part of a broader research study lead by Dr. Daniel Henstra at the University of Waterloo, titled Effective Flood Risk Governance in a Changing Climate (https://www.floodgov.ca/).

[1] Social learning occurs when individuals are able to look beyond their individual perspectives and interests and shift towards shared interests and collective well-being, working towards mutually acceptable solutions. Social learning is an iterative process and involves active experimentation.

In the Spring of 2020, COVID-19 prompted moving the FRC game online. To assist in the online version, an interdisciplinary FRC Team was developed consisting of the FRC game co-designer who is a professional engineer, a part-time research assistant from engineering, and a communications assistant who is also the MEOPAR Canadian Coastal Resilience Forum coordinator.

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The FRC game in action

In total, six FRC game workshops were held in Canada extending from the east to west coast (see Image 1).

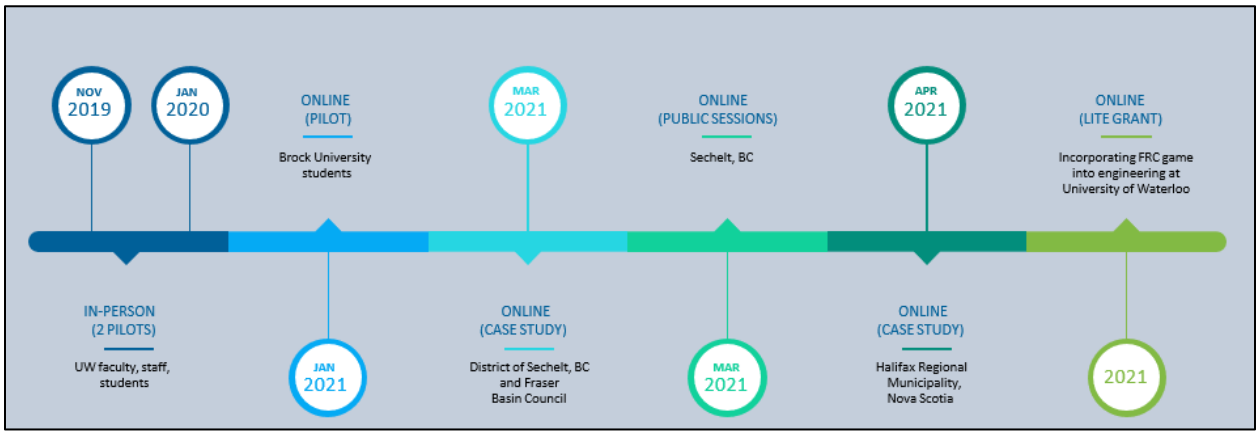


Image 2. Timeline of the FRC game workshops

In 2019 and 2020, the in-person version of the FRC game was piloted in two workshops at the University of Waterloo with faculty, staff, and students. The pilots were successful based on the results from participants' pre-game and post-game questionnaires and debrief questions. Participants indicated that more such innovative teaching and learning tools are needed. The pilots also provided excellent feedback for further improving the game.

Image 3. University of Waterloo pilot #2 FRC game
Photo by Sina Golchi used with permission

The in-person version of the FRC game consists of the following:

- Gameboard
- Play money
- Handouts describing player's roles, gameplay, and flood risk management concepts
- Cut-outs of structural and non-structural measures

The online version was piloted in January 2021 in a fourth-year geography course taught by Dr. Julia Baird, Canada Research Chair in Human Dimensions of Water Resources and Water Resilience and Assistant Professor at Brock University.
Next, two case studies were conducted to examine the effectiveness of the (online) FRC game as an educational and engagement tool with decision-makers involved in flooding issues. In March 2021, the FRC game was held in British Columbia (BC) with employees of the District of Sechelt, the Sunshine Coast Regional District, and Fraser Basin Council (FBC).[2] In April 2021, in Halifax Regional Municipality, Nova Scotia the FRC game was implemented with a range of stakeholders (employees of municipal and provincial departments, and NGOs).

As a result of the success of the BC FRC workshop, the participants asked if the full version of the game (3 hours) could be simplified for a public session. Through collaborations led by Erica Crawford at Shift Collaborative,[3] the BC game participants and the FRC Team developed a simplified version of the game (1.5 hours) and training material to assist the BC FRC participants to run the game. Next, an online two-part public session was held in Sechelt, BC on flood risk scenarios and climate change adaptation: the simplified FRC game was a feature activity.

The online FRC game consists of the following components:

- Zoom for discussions throughout the game and debriefs (Image 4)
- Moodle learning management system for material on flooding concepts, stakeholder roles, and gameplay (Image 5)
- Miro whiteboard for online collaborative gameboard (Image 6 and 7)

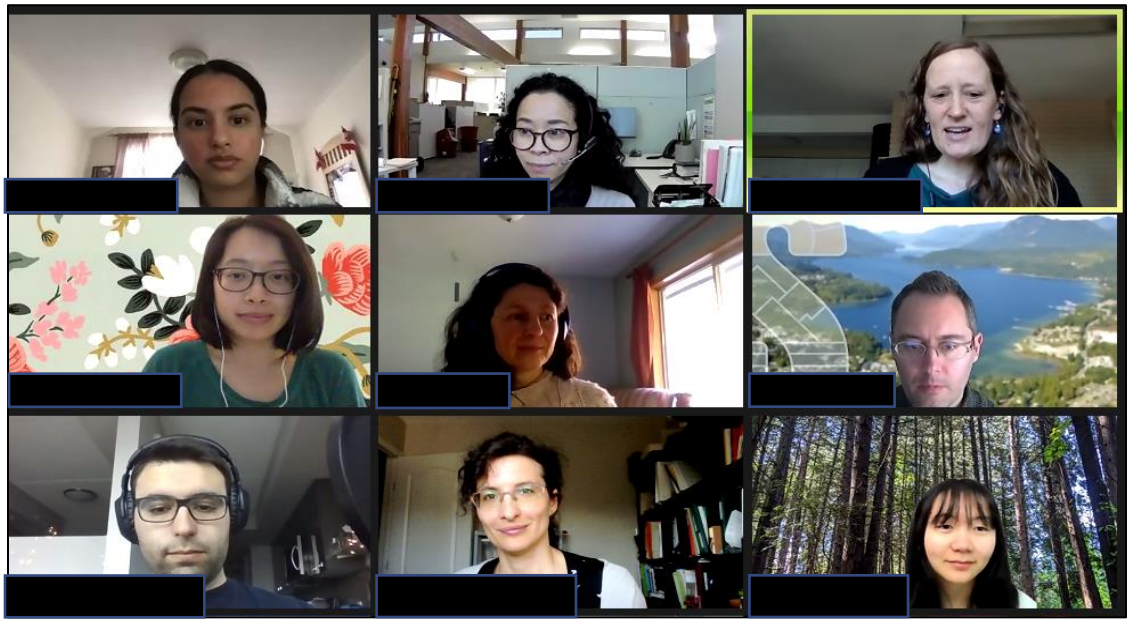


Image 4. Zoom (partial) screenshot

[2] FBC is a charitable non-profit organization devoted to advancing sustainability in the Fraser Basin and across BC and one of their main foci is flooding. For more information visit https://www.fraserbasin.bc.ca/.
[3] Shift Collaborative is a registered cooperative that is focused on addressing difficult social and environmental challenges collaboratively. For more information visit https://shiftcollaborative.ca/.

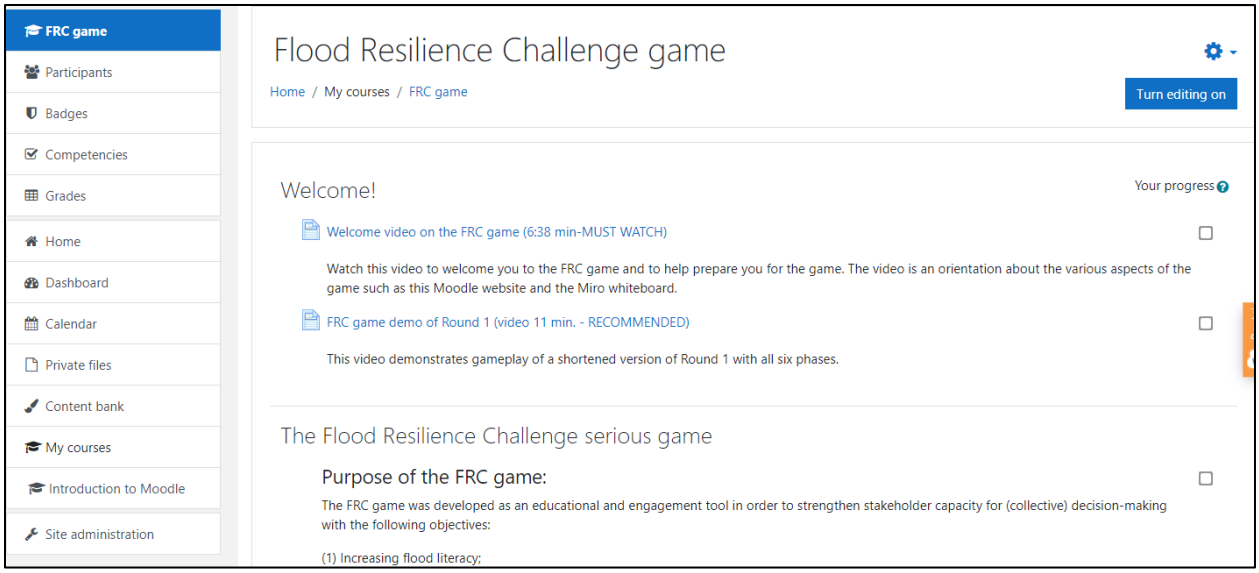


Image 5. Moodle (partial) screenshot

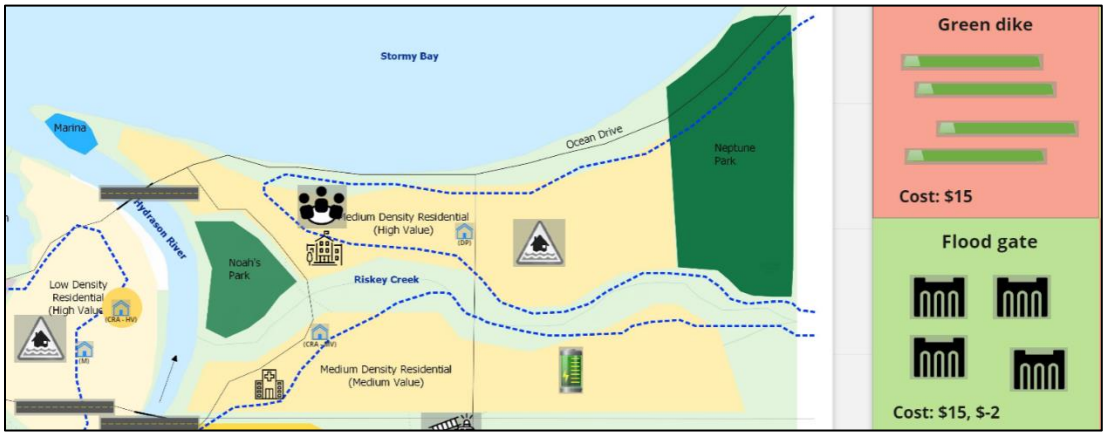


Image 6. Miro (partial) screenshot of gameboard and flood management measures

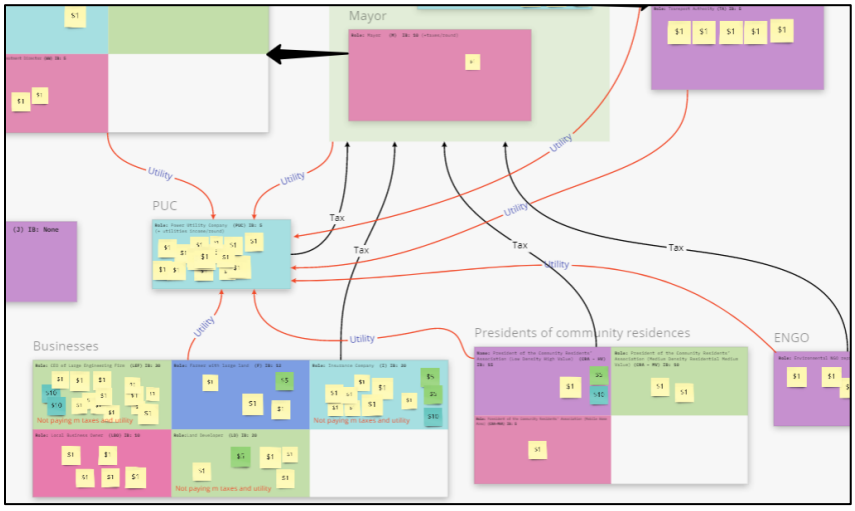


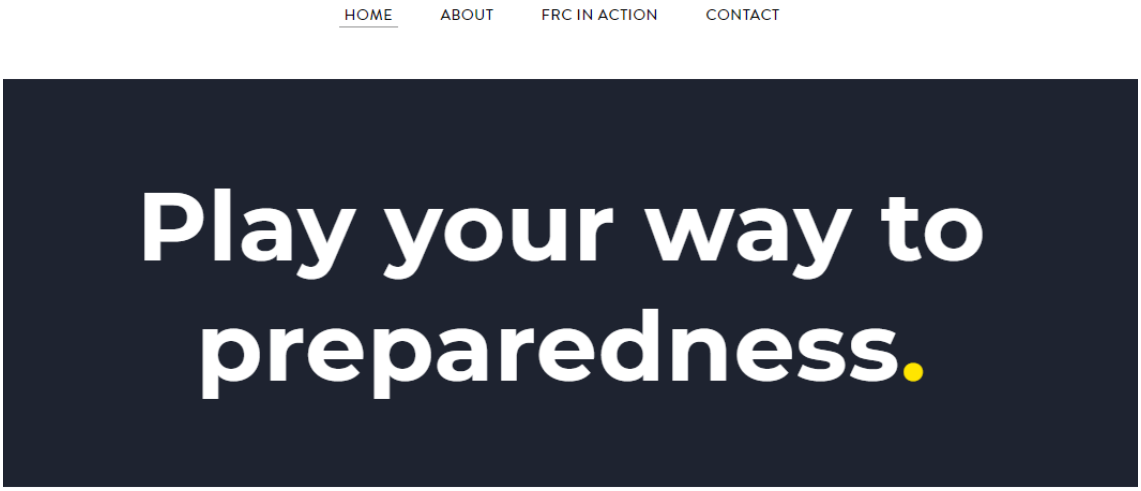
Image 7. Miro (partial) screenshot of the financial component of the game

For a demonstration of how the FRC game is played online and more details about the various components, view a 10-minute demonstration of Round 1 of the game: https://youtu.be/4UQQUiJMhsU.

There are six phases in each round and each workshop consisted of 2-3 rounds of play:

- **Phase 1: Discussion of priorities**
  Each player expresses their policy objective/trade-off and which flood risk measures they initially want implemented or to explore.
- **Phase 2: Payments: taxes, utilities, & insurance**
  Payments are made at the beginning of the round such as taxes to the three levels of government, utilities to the Power Utility Company, and it is an opportunity to purchase insurance. Players update their own budgets.
- **Phase 3: Decision-making for flood risk management**
  Other discussions and decisions can continue to such as examining what the flood risks are and what types of measures (structural and nonstructural) players want to implement.
- **Phase 4: Flooding event or not**
  Decision-making stops and the die is rolled to see if there is a flooding event or not, and if there is, what type of flooding. An overlay will be added to the gameboard to show the flooding impact.
- **Phase 5: Gains and losses**
  Players assess their gains and losses depending on whether there is or is not any flooding and the degree to which the chosen flood risk management measures were effective. Players update their own budgets.
- **Phase 6: Voting**
  This is an opportunity for the stakeholders to express their vote of confidence for their elected leaders (mayor, premier, prime minister). Everyone gets to vote.

For more information about the Flood Resilience Challenge game, visit https://www.frcgame.com/.



Research methods

The research component of the FRC game consists of the following evaluation methods:

- Pre-game questionnaire
- Post-game questionnaire
- Debrief with players at the end of the game
- Follow-up interview (optional)

Ethics clearance for conducting the research was obtained from the University of Waterloo Research Ethics Board. Six FRC game workshops were implemented between 2019 and 2021 as depicted in Table 1.

Table 1. FRC game workshop details

Workshop number	Location	Delivery	Version of game	Number of participants	Organizational roles	Type of organization
1	University of Waterloo, ON	In-person	Full	13	Professors, staff, & students (graduate)	Academia
2	University of Waterloo, ON	In-person	Full	9	Students (graduate), researchers, & 1 professor	Academia
3	Brock University, ON	Online	Full	19	Students (undergraduate) & 1 professor	Academia
4	Sechelt, BC	Online	Full	11	Engineer, program and project managers/coordinators, planners, youth leader, adaptation and sustainable development specialists	Municipal government, NGO
5	Sechelt, BC	Online	Simplified	35	Public	n/a
6	Halifax, NS	Online	Full	13	Engineers, project managers, planners, climatologist, climate change specialists, policy analyst, water specialists	Municipal & provincial governments, NGOs

In total, 65 participants played the full version of the FRC game and 35 members of the public played the simplified version of the game. The Sechelt public engagement session with the FRC game had the highest attendance for an online event, demonstrating that citizens are interested in, and concerned about flooding and climate change, providing support for decision-makers to address these issues.

Brief summary of results

The FRC game was fun, of value and useful for:

- Revealing the complexity of flood risk governance (including the number of stakeholders involved or that should be involved and the many legislative aspects) but also the fragmentation and silos between governments and other organizations.

"…Things fall through those cracks, so we need to have more checks and balances to have these things in place."

- Helping people see the 'whole picture' or systems view of governments, regional districts, industry, public, and NGOs.
- Providing insights into different stakeholders' perspectives, values, and roles.

"Just kind of remembering, kind of actualizing that it is all very interconnected. The systems are not silos, as much as we try to silo our world, this is a very complex system with different points to remember."

"Making the right decisions as an engineer might be easy but not as a politician."

- The dynamics and issues that played out in the game accurately simulated 'real life' experience. Highlighting the human dynamics (emotions, issues, and conflicts) that could arise.
- Exposing knowledge gaps of what players thought they knew before playing the game, but discovered they did not actually know (especially regarding flood risk management measures).

"This game also taught that when it comes to managing a resource necessary for survival, relationships become volatile."

- Raising awareness of what should be considered before, during, or after a flooding event.
- A different way to raise awareness and increase capacity for change.
- Provides a community approach and community building opportunity: the game is a fun way to educate and engage residents, it's not just another open house or the typical town meeting.

"And you play the game and it does not work out the way you intended. Anything is possible."

"The game provides an alternative mechanism to really draw people into how we go about making these kinds of decisions."

Innovations and applications

The FRC game creates a safe space for creativity and to explore unknown futures for participants in government, academia, private sector, and NGOs. The FRC game has several applications:

"FRC was fun and could think outside-of-the box and provides opportunities for people to be more creative."

"A real eye-opening experience."

"Much more applicative than sitting and listening to a lecture."

1. An educational tool about the complexity of flood risk management and stakeholder dynamics as well as develop communication and conflict resolution skills.

2. An engagement tool with stakeholders who affect, and are affected by, flooding to facilitate collective decision-making to reduce flooding risks and disasters.

"A Public Engagement Tool - a community gathering around the [FRC] game potentially before the conversations, to try and build that empathy and understanding in that sphere."

3. The FRC game can played by government departments, organizations, and companies as a team-building activity or to kick-off events.

4. A fun way to engage in meaningful conversations about flooding and climate change with family, friends, and neighbours.

"Enabled self-reflection of how prepared own municipality or community is, which further enabled planning next steps."

"…friends you could have deeper conversations, that could be a fun game…"

In summary, the role-playing aspect of the FRC game is an effective way to gain insight into different perspectives, develop communication and conflict resolution skills, and facilitate collective decision-making. The FRC game is an interactive and fun educational and engagement tool that can provide a safe space for stakeholders to interact and to test out ideas, including about climate change adaptation.

Next Steps

1. In October 2021, the FRC game will be one of the feature activities at ISTAS. The IEEE[4] International Symposium on Technology and Society (ISTAS)[5] is the flagship conference of the IEEE's Society on Social Implications of Technology (SSIT).

2. In Winter 2022, the FRC game will be incorporated into an engineering course (100+ students, available to multiple disciplines) at the University of Waterloo, funded by the Learning Innovation and Teaching Enhancement (LITE) Seed Grant. To foster deep learning for students, the FRC game seeks to promote a better understanding of the complexity of flooding issues (i.e., governance, risk management) as well as enhance their interpersonal and communication skills.

3. Discussions are in progress with the Regional Public Work Commissioners of Ontario (RPWCO) Climate Change Committee to position the FRC game to assist municipalities in reaching their flood risk management and climate change adaptation goals.

More detailed evaluation of the FRC game will be available in a forthcoming publication:

Bogdan, E. A. & Murdock, H. Enhancing flood risk governance and resilience with a serious role-playing game as an educational and engagement tool.

Updates on the FRC game and workshops will be announced on the website:
https://www.frcgame.com/

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[4] IEEE is "the world's largest technical professional organization for the advancement of technology." (Source: https://www.ieee.org/).
[5] "ISTAS is a multi/inter/trans-disciplinary forum for engineers, policy makers, entrepreneurs, philosophers, researchers, social scientists, technologists, and polymaths to collaborate, exchange experiences, and discuss the social implications of technology." (Source: ISTAS21).