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Mapping the Farmer's Narrative: The political ecology of the Nooksack River Basin floods

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Abstract:

In November 2021, a combination of two atmospheric rivers and warmer temperatures led to catastrophic flooding within the Nooksack River Basin (NRB) in Whatcom County, USA. The aim of this paper is to understand the importance of the farmers role within flood management and the complexity of participatory flood risk governance (PFRG). Forty different stakeholders were surveyed using semi-structured interviews and meeting observations. A mixed methodology of Critical Narrative Mapping (CNM) and common thematic grouping was implemented to contextualize the political ecology (PE) of the NRB floods. The case study found that the common issues impeding farmer participation in flood risk management include: jurisdictional boundaries, inter-agriculture representation, preservation of agriculture land, and the regulatory process. To improve equity in future flood risk management, rigid constraints on both funding and regulations concerning disaster events should be reviewed and relaxed. The PE of the Nooksack River flooding is a prime example of complex governance where citizen's participatory efforts are evident, yet are highly influenced by the push and pull of bureaucratic regulations. The political ecological narrative of the farmer does have the power to transform communities into examples of socio-ecological resilience by working towards more collaborative and equitable modes of governance.

Key words: Participatory flood risk governance, critical narrative mapping, political ecology, agriculture

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What an honor it has been to be a part of a program that empowers critical international changemakers. I am so grateful to be a part of a network of people who love, learn and give so radically. This program has opened my eyes and my heart to the power that sharing good food can initiate inspiring change. Thank you to both NMBU and ISARA for facilitating open and honest conversations that challenge the norm. Chuck and Aurélie, thank you for your time, energy, and being open to new forms of Agroecology. Thank you to Nate Stacey for volunteering your time and providing unwavering enthusiasm throughout this process. Annie and Daniel, my lovely hosts, thank you for warm meals and a safe space to transition. To Lyon Allstars, our epic adventures have kept me fed, loved, happy, and inspired…what more could a girl ask for.

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Link for interactive maps: https://arcg.is/1CqCbW

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List of Abbreviations

AWB: Agriculture Water Board

AR: Atmospheric River

CFHMP: Comprehensive Flood Hazard Management Plan

CNM: Critical Narrative Mapping

DID: Diking and drainage Improvement Districts

FCZD: Flood Control Zone District

FLIP: Flood Integrated Planning team

GIS: Geographic Information System

NOAA: National Oceanic and Atmospheric Administration

NRB: Nooksack River Basin

NRIT: Nooksack River International Taskforce

PE: Political Ecology

PFRG: Participatory Flood Risk Governance

RCW: Revised Code of Washington

SWIF: System-Wide Improvement Framework

USA: United States of America

USACE: United States Army Corps of Engineers

WFF: Whatcom Family Farmers

WCD: Whatcom Conservation District

WID: Watershed Improvement District

WRIA1: Water Resources Inventory Area 1

1. Introduction

Flooding is a global, natural phenomena that has played an important role in continually shaping and re-shaping landscapes. Floodplains are low-lying areas adjacent to waterways and are a consequence of natural fluctuations in river flow which, carve away watersheds, alter soils, and deposit sediment. Overtime, this mineral detritus evolves into alluvium – a fertile and productive soil utilized in agricultural production. As humans settled floodplains, biodiversity in these bioregions was negatively impacted. Researchers eventually established the connection between flooding events and ecological stability and learned that restricting water flow was more damaging to the surrounding environment than the seasonal overflow of rivers (Hutchings and Campbell, 2005). Even so, the pressure to judiciously manage water volumes along with accelerating climate extremes have resulted in disaster level floods (Camargo and Cortesi, 2019); as Cons noted 'we live in a moment of global flooding' (2017). Owing to their economic value (i.e., fertile agricultural land and transportation), floodplains are often densely populated, but with the increased force and frequency of flooding rivers, society's current relationship with land and water is challenged. For example, in the Pacific Northwest of the United States of America, the Nooksack River Basin (NRB) (Washington State University Extension, 2022) is a floodplain now considered an agricultural hub. In order to maintain the now permanent community within the NRB, comprehensive flood risk management is essential.

In November 2021, a combination of two atmospheric rivers[1] and warmer temperatures led to catastrophic flooding within the NRB. These floods spilled out over the floodplain, breaching levees and connecting the Nooksack and Sumas rivers. The floods continued north spreading across the Sumas Prairie crossing the political barrier of the USA and Canada and ending its journey by filling the Fraser Valley. *Figure 1* displays the flooded area within Whatcom County. The flooding event caused an estimated $1 billion in damages in Canada and around $100 million and one death in Whatcom County (Whatcom Family Famers, 2022). The floods in November caused severe socio-ecological destruction across political borders yet, this paper will focus on the impact on the agriculture community in Whatcom County (Ewbank, 2019; Mauger, 2017). Within the bioregion of these temperate floodplains, flooding events are customary, however, the increased speed and

[1] An Atmospheric River (AR) is a 'flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of precipitation'. An AR can deliver as much as 7.5-15 times the average flow of water at the mouth of the Mississippi River (National Oceanic and Atmospheric Administration, 2015).

frequency of these floods (like the 2021 event) have been hastened by changes in regional land use and political dynamics. Studies indicate that the NRB will experience an increase of winter flooding resulting from less seasonal snow accumulation and more severe winter rainstorms, thus, changing peak streamflow from the spring to the winter season (Dickerson-Lange and Mitchell, 2014; Mauger et al., 2015). Due to the Nooksack River's glacial origins, approximately forty percent of the streamflow is derived from snowmelt (Dickerson, 2010). Like the November 2021 floods, these rain-on-snow events will become more frequent due to warmer winters and extreme climatic events, in turn making winter peak flows harder to predict. One study found that the streamflow volume is projected to increase by an average of twenty-seven percent by the 2080s (Mauger et al., 2015). Along with drier summers – some of which may lead to extended periods of drought -, the higher concentration of winter precipitation in this winter-rain-dominant system will result in more frequent and severe flooding in the NRB (Dickerson, 2010).

Figure 1. Whatcom County Floods November 2021 (satellite imagery)

Farmers within the NRB *today* have a large claim to the land use within Whatcom County, they occupy 102,523 acres of farmland (National Agricultural Statistics Service, 2017), are responsible for four percent of Washington state's agricultural sales (Vance-Sherman, 2021), and contributes eighty-seven percent of raspberry production for Washington State, which is the largest producer of raspberries in the USA. As a result, Whatcom County farmers are heavily invested in flood risk management. To account for the diversity inherent to farming (i.e., size and crop production)

participatory forms of flood risk governance[2] (PFRG) allow for flexible decision-making by responding to changes across multiple scales of stakeholder involvement (Ostrom, 2009; van der Molen, 2018). Due to the place-specificity of risk governance, stakeholders, such as farmers, provide local knowledge that is imperative for an adaptive form of management. Studies show that socio-ecological resiliency can be supported through adaptive governance, this type of governance includes actively engaged communities that are responsible for monitoring ecosystem change, while learning from a diverse social perspective which includes citizen or farmer-led knowledge (Ostrom, 2009; van der Molen, 2018; Wehn et al., 2015).

In order to understand the farmer's role within PFRG it is important to identify the social and ecological factors that influence flood risk management (Haeffner and Hellman, 2020). Political ecology (PE) can deepen our understanding of the socio-ecological context of the flooding, and is an approach that can help analyze factors such as politics, history, power, and decision-making structures that influence flood risk management within Whatcom County (see *Appendix I* for historical context) (Haeffner and Hellman, 2020). Quandt (2016) suggested that PE can help improve how we deal with hazards (i.e., floods), by recognizing 'the tension between ecological and human change'. By understanding the PE of the flooding event, we can address the barriers and needs of the agricultural community as active participants in flood risk management. PE provides the opportunity to address power inequalities and their causes within flood risk management in order to create a more resilient socio-ecological system (Norman, 2014). Flood risk management includes preparation, response, and recovery, but for a community to remain resilient following a disaster, equitable representation is needed.(Rendon et al., 2021).

Due to the complexity of factors influencing the November 2021 floods this paper will look at the role of critical narrative mapping (CNM) as a tool to visualize the political ecology of flood management within the NRB. CNM is a tool that visualizes the political, historical and ecological complexity of a given event (Harris, 2021). In this paper, we aim to answer the question: can a critical narrative map emphasize the farmers voice while still analyzing the collective social-ecological narrative of the flood? The power of the map can build upon the shared experience of the flood by identifying barriers and needs that inhibit equitable PFRG (Caquard and Cartwright, 2014;

[2] The use of the term governance differs from the term government by 'shifting state-centered management towards a greater reliance on horizontal, (Wehn et al., 2015) hybrid and associational forms of government' therefore engaging in a wider scope of stakeholders involving citizens (Wehn et al., 2015).

Harris, 2021; Movik et al., 2021). Research shows that the legitimacy of local stakeholder participation can be challenged by trust when risk governance fails to include those 'at risk' as part of the decision making (Ardaya et al., 2019; Okada et al., 2018). The narrative map will illustrate the complexity of socio-ecological factors that influence farmers and their involvement in flood risk management.

Due to the political, social and economic weight the farmers voice has within the NRB it is imperative to consider the farmer's narrative and the potential benefit farmer participation has in risk governance to empower socio-ecological resiliency. Farmers currently play an active role within flood risk management based on the number of initiatives that are farmer-led or farmer-represented (see *Appendix II* for evolution of flood management). Yet, power inequalities can still be present due to inequality in participation (Quandt, 2016). In order to deepen the level of participation farmers have within flood risk governance the barriers and needs of all stakeholders must be addressed. With a greater understanding of the challenges stakeholders face the farmers role has the potential to support a collaborative effort to initiating transformative and just change within the flood risk governance of Whatcom County (Alexander et al., 2016; Ardaya et al., 2019; Fung, 2006; Wehn et al., 2015).

The aim of this paper is to understand the importance of the farmers role within flood management and the complexity of participatory flood risk governance. Critical Narrative Mapping will be utilized to emphasize the farmers voice while analyzing the collective socio-ecological narrative of the flood by addressing commonalities in barriers and needs identified by stakeholders.

The following are my guiding research questions;

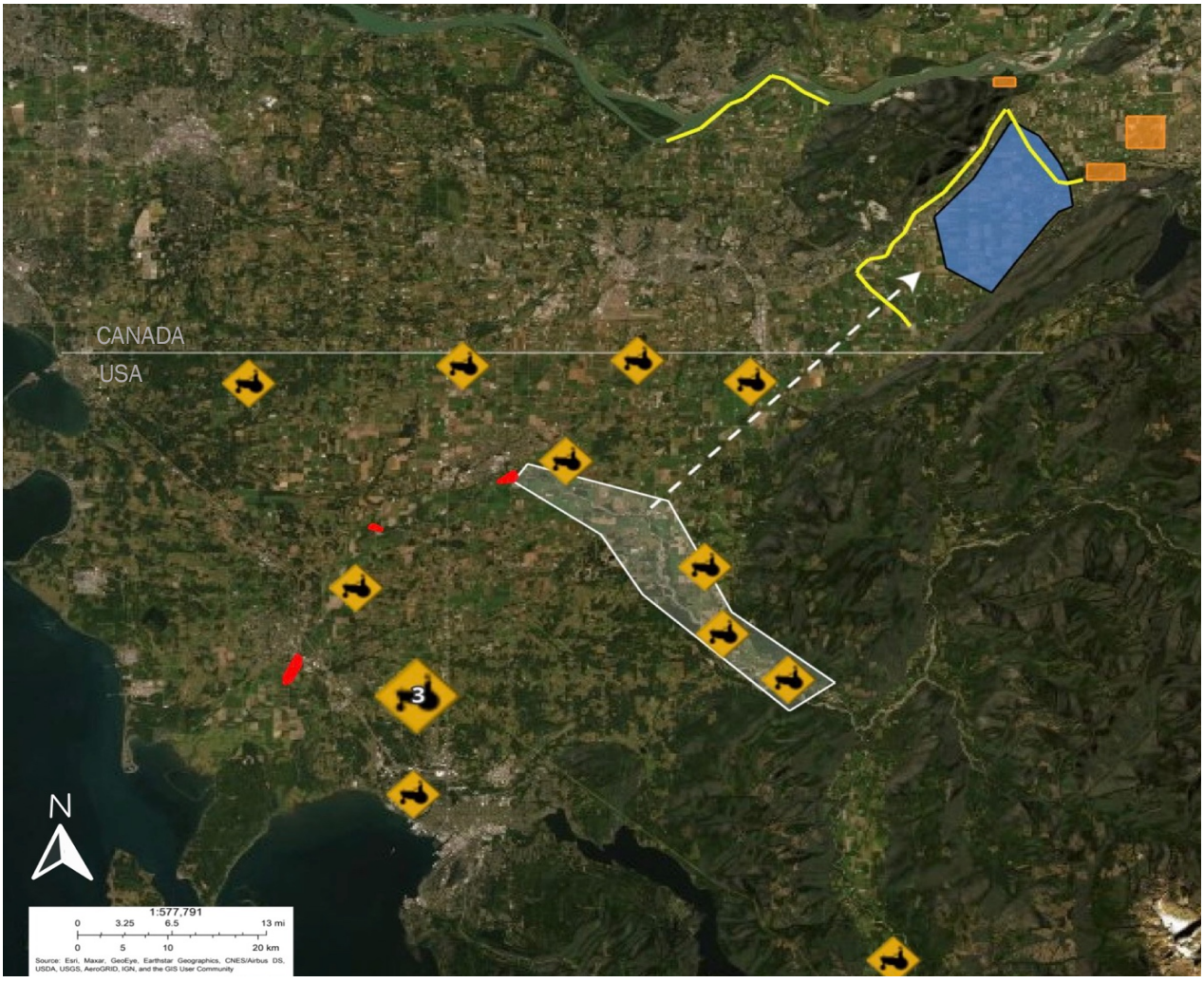
1) What is the context of the flooding events (political, socio-ecological and economic)?
2) How are farmers involved in mitigating flood risk?
3) What are the barriers and limitations to farmer participation in mitigating flood risk?
4) What needs are identified by farmers to overcome said barriers and limitations?

2. Methodology

2.1 Study Area

The NRB was chosen for two reasons: 1) recent catastrophic flooding in November 2021 and, 2) the detrimental impact it had on the surrounding agriculture community. The NRB is carved by the Nooksack River originating from the glaciers of the North Cascade Mountains. The river is fed by

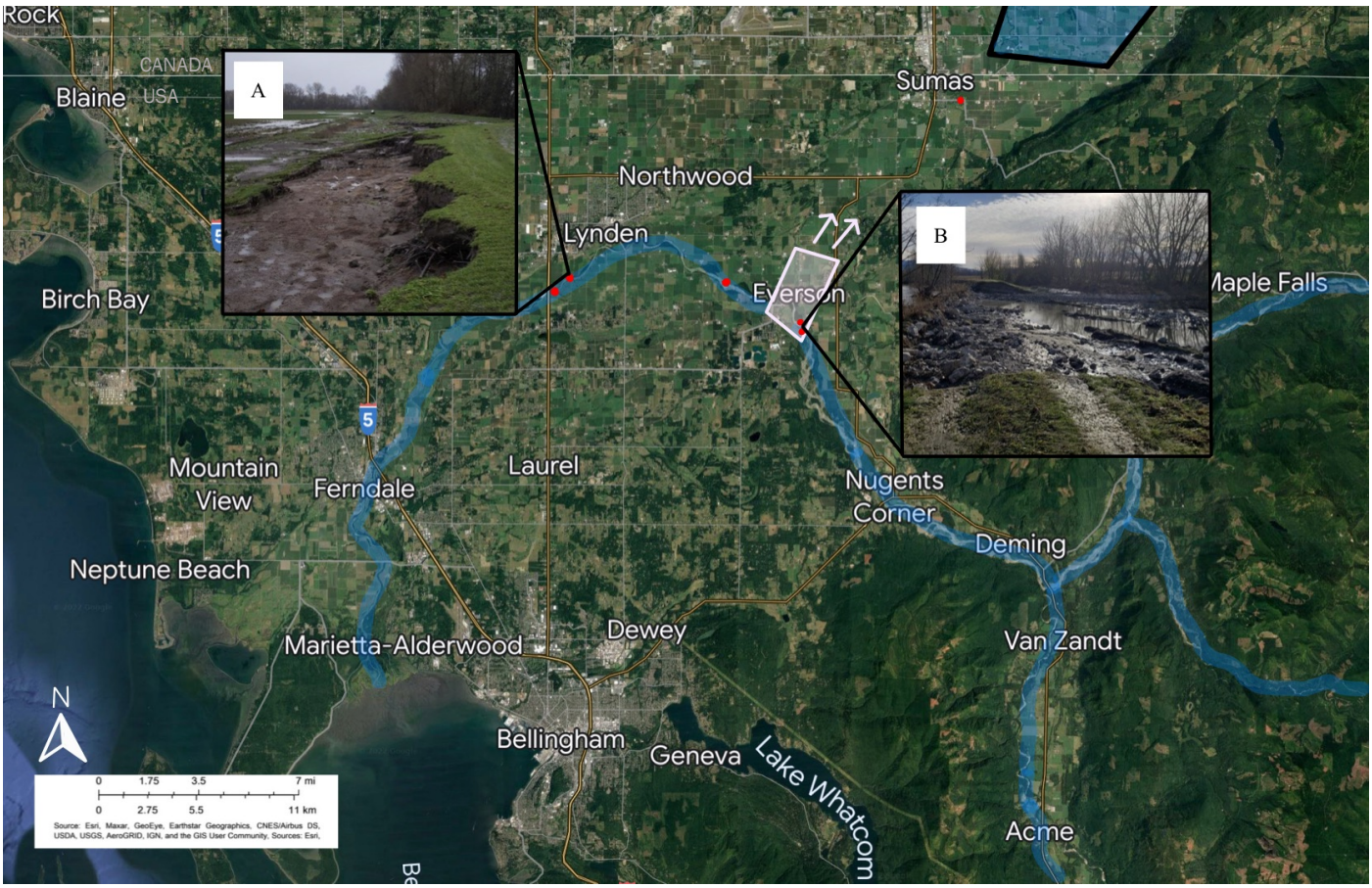
glacial snow melt and seasonal snowpack and is vulnerable to unpredictable late warm temperatures. The NRB was shaped through glacial cycles which carved away channels and filled the rivers and streams across the intersecting valleys between the USA and Canada ("Nooksack River," 2021). Over time buildup of fine river sediment caused a fifteen mile, downward slope from Everson (eighty-five feet elevation) to the dried Sumas lake bed (five feet elevation) (Reimer, 2019), and now this geographic area is susceptible to flooding overflow which, could cause more frequent devastation for those towns along the USA/Canada border. Due to transboundary flooding in 1990 the Nooksack River International Taskforce was created in order to mitigate future severe overflow from the Nooksack River. The transboundary taskforce's goal was to mitigate flood damage while modeling the flood overflow into Canada (Norman and Bakker, 2005).



Map 1. Overlays the surveyed farms within historical attributes of the NRB. The red shapes indicate the natural logjams that use to inhabit the Nooksack River. The white area indicates the traditional migratory area of the Nooksack Indian Tribe transitioning between four temporary villages. The white line indicates the northern overflow route toward the now drained Sumas Lake (blue) and its surrounding wetlands (orange). The yellow lines indicate diking structures now in place after the draining of the lake. The tractors indicate farms surveyed within this study (KCM Inc., 1994; Reimer, 2019).

The Nooksack River flows approximately east to west today. According to oral history from a Chilliwack elder, the original Nooksack River channel flowed north into Canada, spilling into a now drained Sumas Lake (Reimer, 2019). This historic lake covered over 20,000 acres and during the seasonal flood cycles the lake swelled to over 30,000 acres. This lake was essential for biodiversity and ecological stability. During the seasonal flood cycles the lake would fill the surrounding wetlands creating a biodiverse habitat that supported almost 200 species of birds alone (*Map 2*). Wetlands today are some of the most ecologically diverse environments. Less than one percent of the earth is wetlands. Yet, these wetlands provide habitat for eighty percent of land based species which includes humans (Reimer, 2019). The lake held all five species of native salmon migrating and spawning along the Sumas and Nooksack Rivers as well as their tributaries. Sumas Lake and its surrounding wetlands were essential for stabilizing the seasonal flood waters. The lake and the surrounding wetlands have the ability to store and hold water (*Map 1*). Reimer quotes research that states wetlands have the ability to 'reduce flooding in wet weather and to maintain flow of streams and rivers during dry weather' (2019). However, over the course of three years the Sumas Lake was eventually drained in 1924. With the lake drained, new land was utilized for its fertile ground and was transitioned into agricultural land. Through a series of dikes, dams, and new drainage systems the water was now under intensive management dictated by the White settlers. With no consideration for the First Peoples who lived within the natural and seasonal flooding, the draining of the lake led to severe complications to their livelihood. Not long after the draining of the lake a significant flood in 1948 demonstrated the necessity of Sumas Lake and its surrounding wetlands for natural flood water management (Reimer, 2019).

Today the main stem of the Nooksack River is fed by three divisions the north, middle, and south fork (*Map 2*). At the confluence of the three river forks the Nooksack meanders thirty-five miles west until it divides into multiple branches just before flowing into the Bellingham Bay within the Lummi Nation (Kleinknecht, 2019a). *Map 2* identifies the path of the Nooksack River as well as the significant overflow areas of the November 2021 floods (Whatcom County Public Works, 2021). The significant overflow areas led to levee breaches. The map identifies six levees that were damaged and prioritized for emergency repair. Two of the levee sights are highlighted on *Map 2*: the Lynden Levee (picture A) and the Twin View Levee (picture B).



Map 2. Overview of the study area indicating levee breaches (red) along the Nooksack River (blue) and the common overflow path (white) toward the drained Sumas Lake (blue/black) in Canada. Picture A is the Lynden Levee breach and Picture B is the Twin View Levee breach (Whatcom County Public Works, 2021).

2.2 Data Collection

Both qualitative and quantitative data were collected in two ways: 1) semi-structured interviews and, 2) observations of jurisdictional based meetings, councils, and inter-agency planning groups. Over the course of three months, farms were contacted after consulting the Eat Local First map which, is a collaborative project supported by Pierce County Fresh, Sustainable Connections, The Local Food Trust, Tilth Alliance, Washington State University Food Systems Program and Washington State University Regional Small Farms Program. Every farm located within Whatcom County and in production, was contacted. Additional farms and stakeholders were contacted when referred during the farmer interviews. In total, thirty-one interviews were conducted and nine meetings were observed. Farmer interviews routinely included farm visits which provided visual and spatial context to the interview content. The interviews were structured based on three guiding themes: the stakeholders flood experience, the barriers to participatory flood management, and needs for the future (see *Appendix III*). More detailed demographics were asked of the farmers, however the

interviews were intentionally open-ended to give space for stakeholders to share their narrative true to their experience. These open-ended questions were probed with additional follow-up questions on a case by case basis directed by the farmer's story-telling of their flood experience. Each farmer's personal experience was contextualized within broader historical, political and socio-ecological circumstances by identifying the barriers and needs for flood risk management (Marrero et al., 2022). Due to the open-endedness of the interviews, transcripts were analyzed verbatim in order to honor the emotion and explicit constraints the stakeholders faced before, during, and after the flooding.

Following the survey, stakeholders were categorized into three different groups: farmers, Supporting Agencies, and Planning & Management. Stakeholders were deemed Supporting Agencies if their role was non-regulatory providing resources and information to support farmers and/or the general community. Planning & Management stakeholders were most commonly a government entity or people working to provide technical solutions for natural resource management. Both of these groups were involved in the preparation, response, and recovery to the November 2021 floods. These groups were routinely involved with farmers whether through direct support or flood risk management planning, which in turn impacts farmers within the NRB.

2.3 Data Analysis

Critical narrative mapping (CNM) and thematic grouping were utilized to identify the barriers and future needs within the three stakeholder groups. Based on the socio-ecological context (*Appendix I and II*) it is recognized that farmers are often members of various political groups whose ideologies don't always align with other stakeholders within this case study. The November 2021 flooding was an ecological disturbance exacerbated by historic and inequitable land use change and power dynamics within the NRB. In order to further contextualize the interconnectedness of the floods to the historical political events (e.g., draining of the Sumas Lake), a CNM was constructed to visualize the complexity of the farmer's role within PFRG. Due to stagnancy on paper the CNM is best visualized within an interactive program such as ArcGIS. However, maps were best translated to encompass the complex problems within this case study (link to maps: https://arcg.is/1CqCbW). CNM is the embodiment of a collaborative story visualizing a spatio-temporal event (Caquard and Cartwright, 2014; Harris, 2021). The concept of CNM is to use individual oral stories in order to (re)construct collective narratives regarding a specific disaster. These individual oral stories are integrated into Geographic Information System (GIS) in order to layer ecological and historical aspects to a given spatio-temporal event. By building on these individual stories a map can be used

to create a collaborative narrative that deepens our understanding of the PE of the disaster in question (Harris, 2021). These maps present alternative ways of thinking by visualizing an array of perspectives embedded within the historical context of this disaster (Caquard and Cartwright, 2014). For example, the November 2021 floods within Whatcom County can be visualized critically by highlighting community stakeholders' stories as well as layering the ecological and political history of the flooding events.

Learning through a shared, lived experience, such as flooding, can lead to adaptation, especially if the mutual understanding is based on failed management. By visualizing the historical context of the flood alongside current individual narratives, CNM has the potential to identify the power inequalities which have influenced flood management within Whatcom County. CNM provides the opportunity to go beyond just 'human worlds' and analyze the socio-ecological complexity of a disaster event (Harris, 2021). As a collective narrative, the stories of those affected by the November 2021 Whatcom County flooding (i.e., farmers and other community members) can challenge the dominant flood risk management frames, making their shared lived experience a tool to initiate change (Harris, 2021; Norman, 2014).

Common thematic groupings were also utilized to establish shared barriers and needs for the future within the stakeholder groups. By analyzing the discourse of each individual narrative, self-identified flood experience, barriers, and stakeholder future needs were categorized within similar

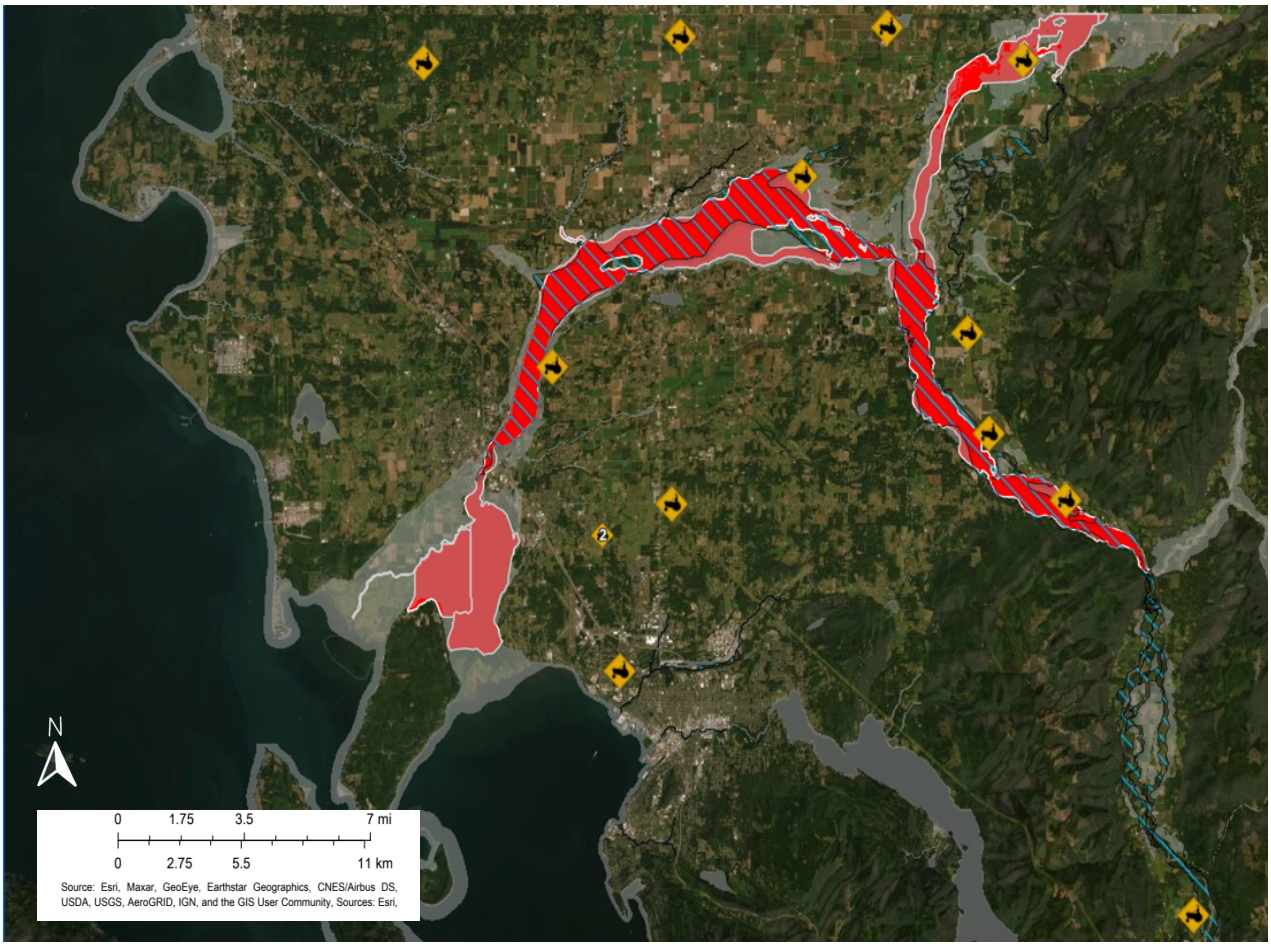
Table 1. A fictive example of common thematic groups based on farmer interview

Flood Experience	Flood Themes	Barriers	Barrier Themes	Needs	Need Themes
Woke up at 5am with water up to door. No warning of the severity of flood. Had to pump water out of barn. Cows were standing in half a foot of water for two days. Used tractor to assist with evacuations. Highest and worst I've ever seen.	*No communication* *Farmer responders* *Most severe*	Lack of sediment and gravel cleanup that falls to farmers. The process of permitting takes time and knowledge that I don't have.	*Lack of management* *Regulatory process and time* *Knowledge*	Basic communication system that comes from collaboration between county and municipalities. Trust in leadership. Keep farmers on their land.	*Collaboration and communication* *Build trust* *Preservation of farmland*

groupings. *Table 1* provides a fictive example of the raw interview data similar to a farm surveyed within this case study. To stay true to the narrative of the stakeholder only minor verbiage was grouped as one. For example, 'new building' and 'new development' were categorized as 'new construction' to create uniformity. This uniformity of verbiage provided the opportunity to translate common flood experience, barriers, and future needs into quantitative data. This quantitative data supported the CNM by visualizing the most identified influences on PFRG. The thematic groupings were informed by the research questions and identified commonalities between stakeholder groups by addressing overarching relationships within the socio-ecological context of the flood.

2.4 Research Approach and Limitations

As stated above Political Ecology provides a framework for the barriers and needs for the future to be contextualized within the CNM. The oral stories of the stakeholders or the 'political ecological narratives' provide insight on the historic and socio-ecological barriers that determine participation within flood risk governance in Whatcom County. For example, *Map 1* visualizes the historic flow



Map 3. The farms surveyed (yellow tractors) within the FEMA floodplain (white), current floodway (blue diagonals) and draft floodway (red) (FEMA, 2021)

path toward the now dried Sumas Lake. *Map 1 and 3* highlight the farms within this survey. Due to historic complexities of natural resource management, numerous farms and the town of Sumas now lie in the historic northern flow path. These maps combined with thematic grouping can identify the common barriers and future needs towards addressing historic socio-ecological complexities. By identifying commonalities between stakeholder groups, the potential increases for collaboration to address human and non-human forces that inhibit equitable PFRG increases. However, there are numerous limitations to this study as framing critical disaster narrative mapping within a political ecological framework is a relatively new research methodology.

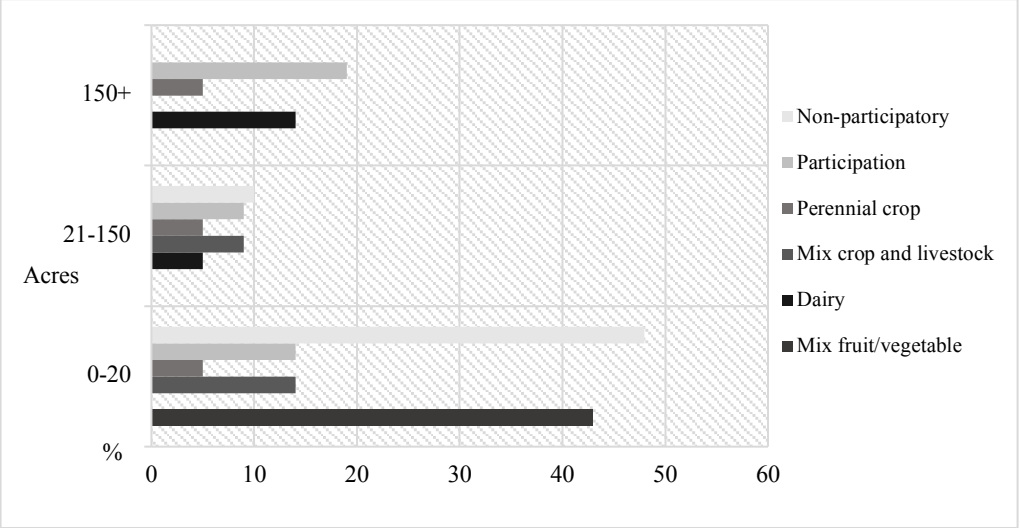


Figure 2. An overview of farm demographics indicating the likelihood of production and participation based on farm acreage.

To clarify, this case study was not focused on engineered solutions for flood management. As numerous stakeholders stated within their interviews addressing comprehensive flood management requires relationship building and collaboration. Focusing on merely engineered solutions can result in further misrepresentation and therefore unsustainable decision-making. The main limitation of this study is our ability to implement the methodology when stakeholders desire anonymity. Due to political and legal implications related to the flooding that occurred in November, as well as the adjudication[3] of water rights proposed by Washington state's Department of Ecology, seven farmers asked to be anonymous throughout his study. These farmers were not placed on any maps as they did not feel comfortable sharing their narrative publicly. This study does not address the adjudication of water rights proposed by the Department of Ecology due to legal implications for all stakeholders involved including those within this study. This may impact the methodology of the

[3] "A water right adjudication is the legal process to resolve conflict and competition on a water source" (Washington State Department of Ecology, n.d.).

study due to desired stakeholder anonymity, yet it does not make their November flooding experience any less impactful even if they are not included within the CNM. As a collective narrative the farmers experience is valuable to understand what needs to be addressed to improve flood risk management within Whatcom County. Even though farmers could be negatively impacted by the potential adjudication of water rights it was only mentioned as a barrier by Supporting Agencies and Planning & Management stakeholders. Farmers mentioned the adjudication but did not declare it was a barrier or a future need, but redirected the question and stated that the main need for them was for comprehensive water management solutions that include fisheries, floods and water rights.

This case study did not address participant identity as supporting or influencing equitable PFRG. In order for PFRG to be representational, identity characteristics such as race, class, gender, etc. need to be considered. The farms surveyed within this study do not truly represent the diverse array of producers within Whatcom County. Producers/farmers within the Tribal Nations were not considered in this study, which could have provided an imperative insight into the importance of farming and fisheries. Another demographic vital to the agriculture community in Whatcom County is migrant farmworkers. During the flood, migrant workers were solely reliant on the lead farmer for assistance and communication. WCF discussed the inherent political complications that the floods impact had on the migrant farmworkers within Whatcom County. Including their voice could have emphasized additional socio-political barriers that impact the agricultural community participating in flood risk management. As mentioned above, only the affected farmers in the U.S. were interviewed.

Table 2. An overview of the stakeholder demographics within this study

Total Respondents (n)	40
Farmers	21
Additional Interviews	10
Jurisdictional Meetings	9
Farm Demographics	
n=21	Average
Age	53.7
Race	White (19)
Gender	Male (15)
Total Land (acres)	143
Flood Experience	
Percentage land affected	59.4
Production affected	Yes (18)
Equipment damage	No (15)
Water depth (ft)	3.6
Financial assistance for loss	No (15)
Type of water on land	Standing and flowing
Location (%)	
Floodway	14
100-year Floodplain	29
Experienced flooding ('21)	86
River flooding	52
Upland flooding	48

3. Results

3.1 Demographics

Of the thirty-one interviews, twenty-one interviews were of farmers. *Table 2* provides an overview of the farmer demographics. All farmers who participated in this study are actively growing, but several experienced delays in production as a result of the floods. Production delays included road closures and loss of pasture and/or crop, among others. Three farms experienced both river flooding and upland flooding, meaning flooding at higher elevation outside of the river's overflow, while other farms were left untouched. Farmers who experienced upland flooding identified this type of flooding as backflow or overflow of watercourses combined with excessive rainfall. *Map 3* layers the surveyed farms within the FEMA determined floodplain and floodway. The red on the map indicating FEMA's new draft based on the increase of flooding to the North. Forty-three percent of the participating farms are in the current floodway or floodplain while over eighty-five percent of the farms experienced flooding during the November 2021 floods (FEMA, 2021). With acreage ranging from half of an acre to 1200 acres, the size of farms surveyed were diverse. *Figure 2* provides an overview of the likelihood of production based upon size of farm. The table also presents the farms who participated in flood risk management efforts. The participatory efforts reference flood risk management within a governing board rather than individual efforts. Less than half of the farmers surveyed are engaged in participatory flood risk management efforts. Based on the surveyed farms, the larger the farm, the greater the chance they participate in flood risk governance. All farms with acreage greater than 150 are involved in flood risk management and every farmer participated in response and recovery efforts during the November 2021 floods; some shared resources and provided cleanup support, while others led evacuations often using their own tractors.

Ten additional interviews were conducted and nine meetings were attended, all of which included either Supporting Agencies or Planning & Management stakeholders. *Table 3* provides an overview of the demographics of the additional stakeholder groups. All non-farmer stakeholders surveyed were referenced within farmer interviews. The additional stakeholders were categorized into two

Table 3. Overview of the demographics of the Additional stakeholder groups

Additional Stakeholders	Farmer participation	Government affiliated	Interview	Meeting
Supporting Agencies (n=9)	22%	11%	78%	22%
Planning & Management (n=10)	60%	70%	30%	70%

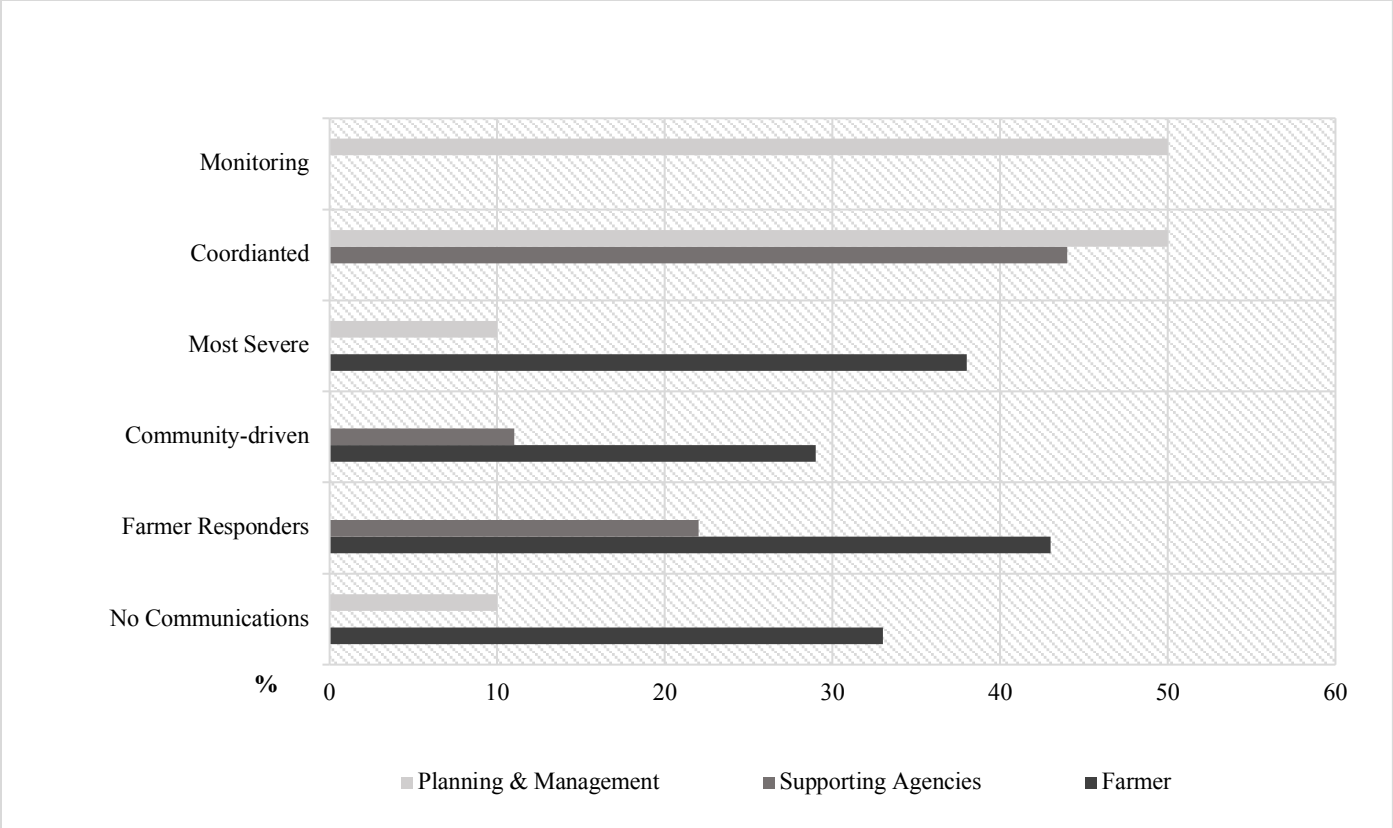


Figure 3. An overview of preparation and response commonalities addressed by stakeholder groups

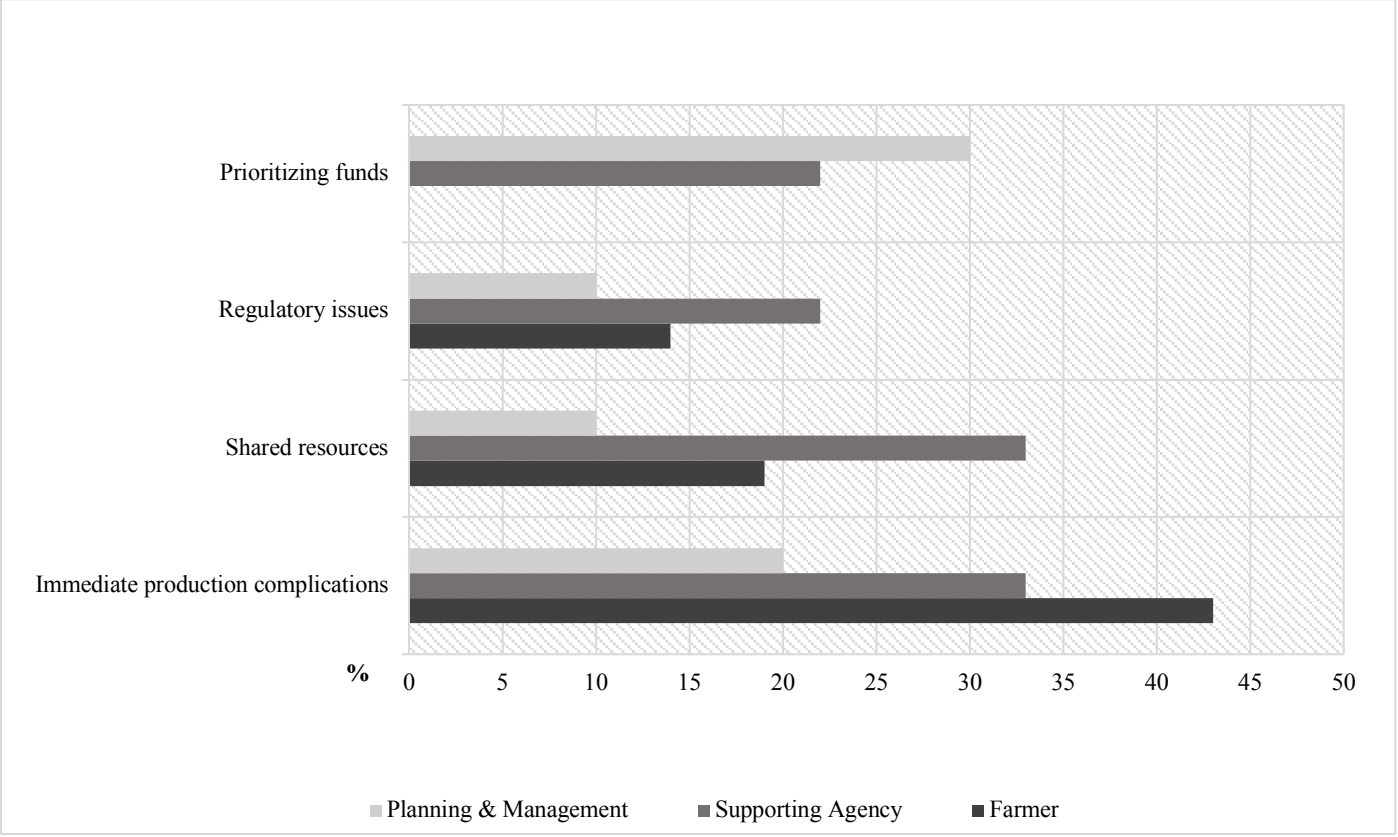
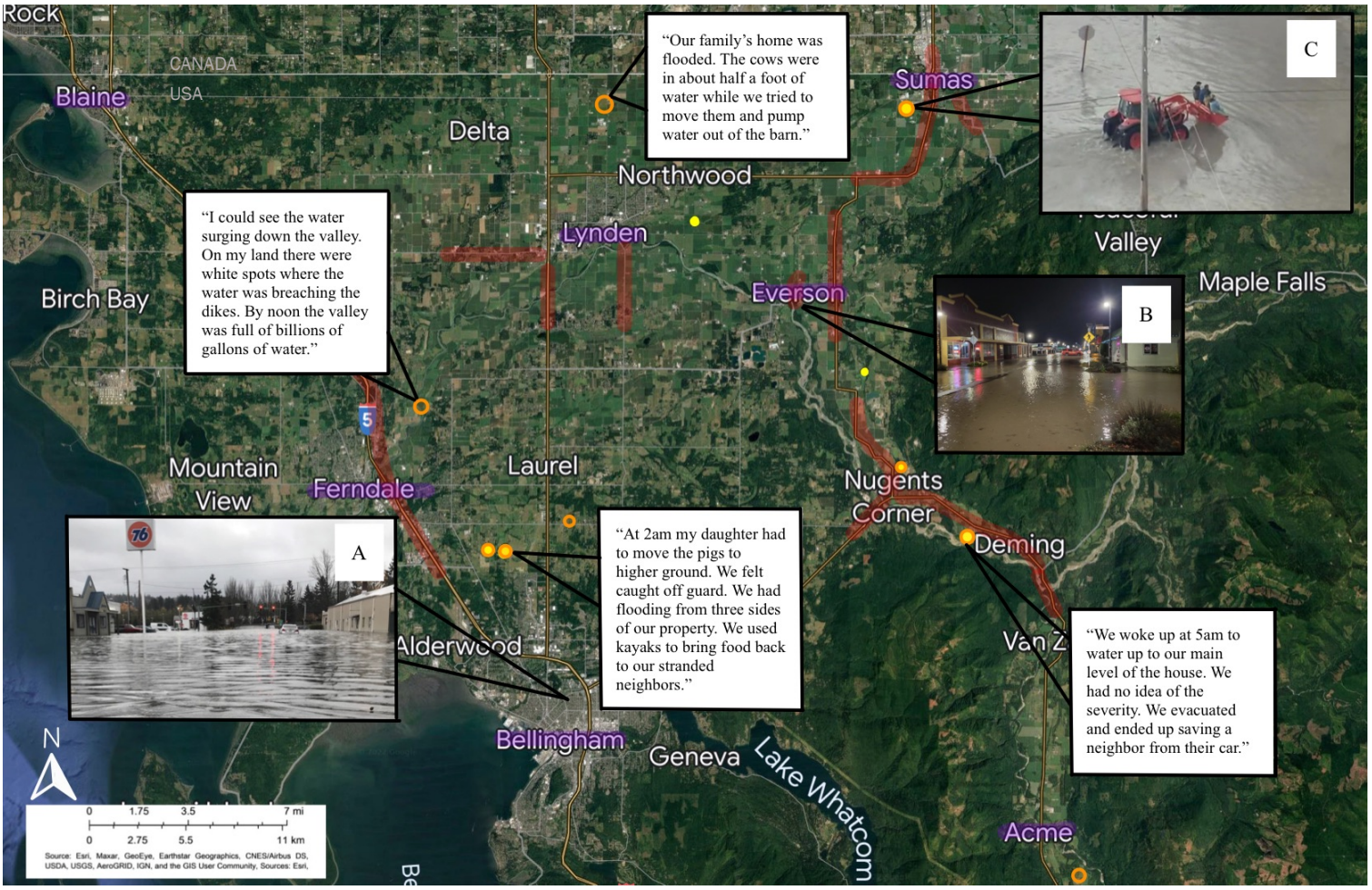


Figure 4. An overview of recovery commonalities addressed by stakeholder groups

groups to depict the difference in stakeholder involvement surrounding the November 2021 flooding. The Supporting Agencies stakeholder group encompasses organizations that are directly affiliated with supporting the agriculture community during the floods. The Planning & Management Stakeholders are governing boards and/or initiatives directly affiliated with water and flood management. *Appendix II* is an overview of flood risk management within Whatcom County and presents the majority of additional stakeholders surveyed within this study. *Appendix IV* provides a visual displaying the interconnectedness of the all stakeholders within the study while highlighting the Whatcom Conservation District (WCD) as the most interconnected stakeholder within this study. WCD was identified by the most diverse array of stakeholders by interviews throughout all three stakeholder groups.

3.2 Flooding Event

Figure 3 provides an overview of the preparation and response commonalities between the three stakeholder groups. Numerous stakeholders praised the community driven flood response while others (nearly twenty percent) felt that there was no leadership within local government. One farmer and one county worker were concerned that some farmers were left with no warning. There were few commonalities across all three groups regarding preparation and response to the floods. Fifty percent of Planning & Management stakeholders were monitoring and coordinating preparation and response efforts. Coordination between the local government Flood Watch and city mayors was the main source of disseminating information to citizens throughout the county. *Figure 4* provides an overview of the recovery commonalities during and after the flood across all three stakeholder groups. Eighty-five percent of farmers stated that their production was affected due to the floods. However, fifty-seven percent of farmers stated that they had immediate production complications due to the flooding, such as loss of crop and livestock issues. Common livestock issues farmers referenced were loss of feed, milking complications and even death of animals. *Map 4* visualizes an overall timeline of the flooding events through the narratives of all three stakeholder groups focusing on the first flooding event on November 15, 2021 (KVUE, 2021). Due to the fact that there was a series of flooding events over a period of two weeks the timeline for response and recovery remains complex. However, stakeholders were descriptive and clear about their experience during the floods.



Map 4. Overview of the flooding events highlighting the farms that had immediate production complications (orange) and/or no communication (yellow) regarding the flood. The major approximate road closures are indicated in red and the coordinating cities are highlighted in purple. Picture A is flooding in the city of Bellingham. Picture B is flooding in downtown Everson. Picture C is farmers evacuating people on their tractor (KVUE, 2021).

3.3 Barriers to participation and needs for the future

The two most common responses for farmers when addressing barriers to participation was: the lack of management and, the regulatory process/time. When farmers discussed the lack of management as a barrier, the focus was on a lack of ditch and watercourse maintenance due to sediment build up. Thirty-three percent of Supporting Agencies and thirty percent of Planning & Management stakeholders mentioned sediment directly, across all stakeholder groups sediment management was mentioned when addressing the need for comprehensive water management. Planning & Management stakeholders had the largest variety of barriers. Some outliers include low staff numbers, different estimation of flows and lack of compromise. Thirty percent of the Planning & Management stakeholders indicated the difficulties in gauging instream flows. The County's River

& Flood Manager was adamant about the complications to predict or gauge high flow rates within the Nooksack River. Factors that affect gauging the Nooksack River flow rates include movement of the river channel, natural debris, and loose sediment.

Across all stakeholder groups the 'regulatory process & time' are barriers to participation in flood risk management. Even stakeholders that uphold the regulatory process that shapes flood risk management within Whatcom County identify that this is a barrier. Another barrier that is agreed upon across all stakeholder groups is location. Across all stakeholder groups jurisdictional boundaries were identified as inhibiting all aspects of flood risk management (preparation, response and recovery). *Figure 5* gives an overview of the barriers identified by all three stakeholder groups. Comprehensive water management was the most common need addressed by farmers. When farmers spoke about comprehensive water management the main topics they wanted to be addressed were fisheries, watercourse maintenance and land use change for people within the floodplain. Many farmers simply stated that you cannot separate water issues, as fisheries, flooding and preservation of farmland are all interconnected. Funding was identified as a need by the majority of Supporting Agencies and Planning & Management stakeholders yet, only fourteen percent of farmers stated that is a need. *Figure 6* provides an overview of needs for the future identified by the three stakeholder groups.

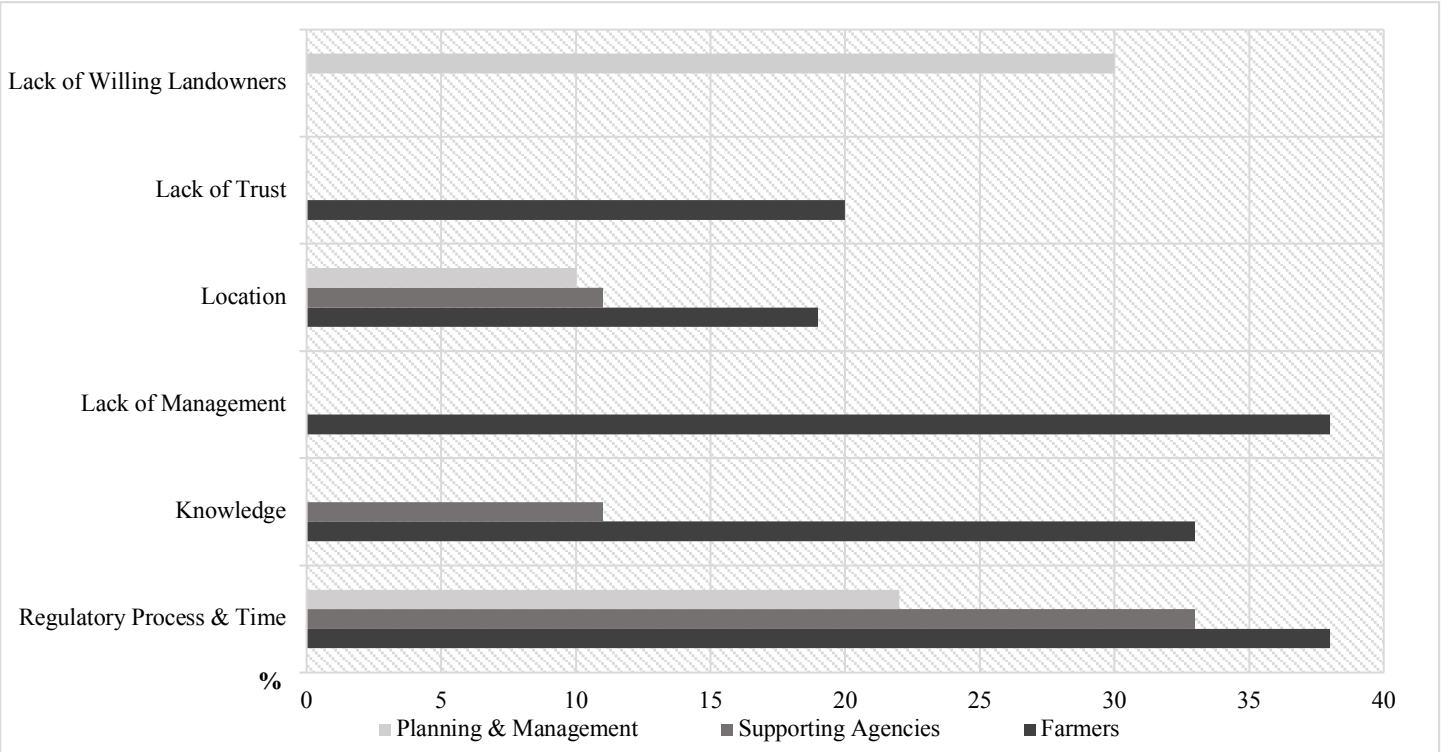


Figure 5. Barriers to participating in flood risk management

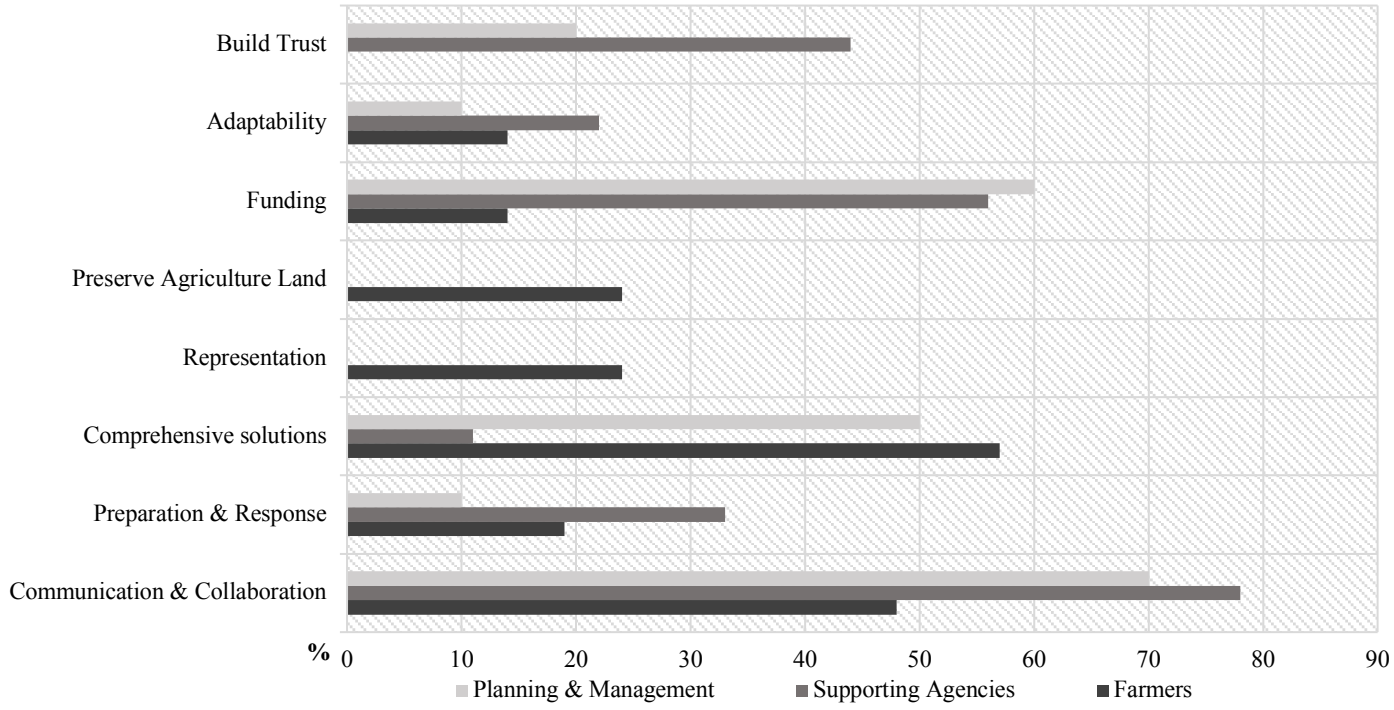


Figure 6. Needs for future flood risk management.

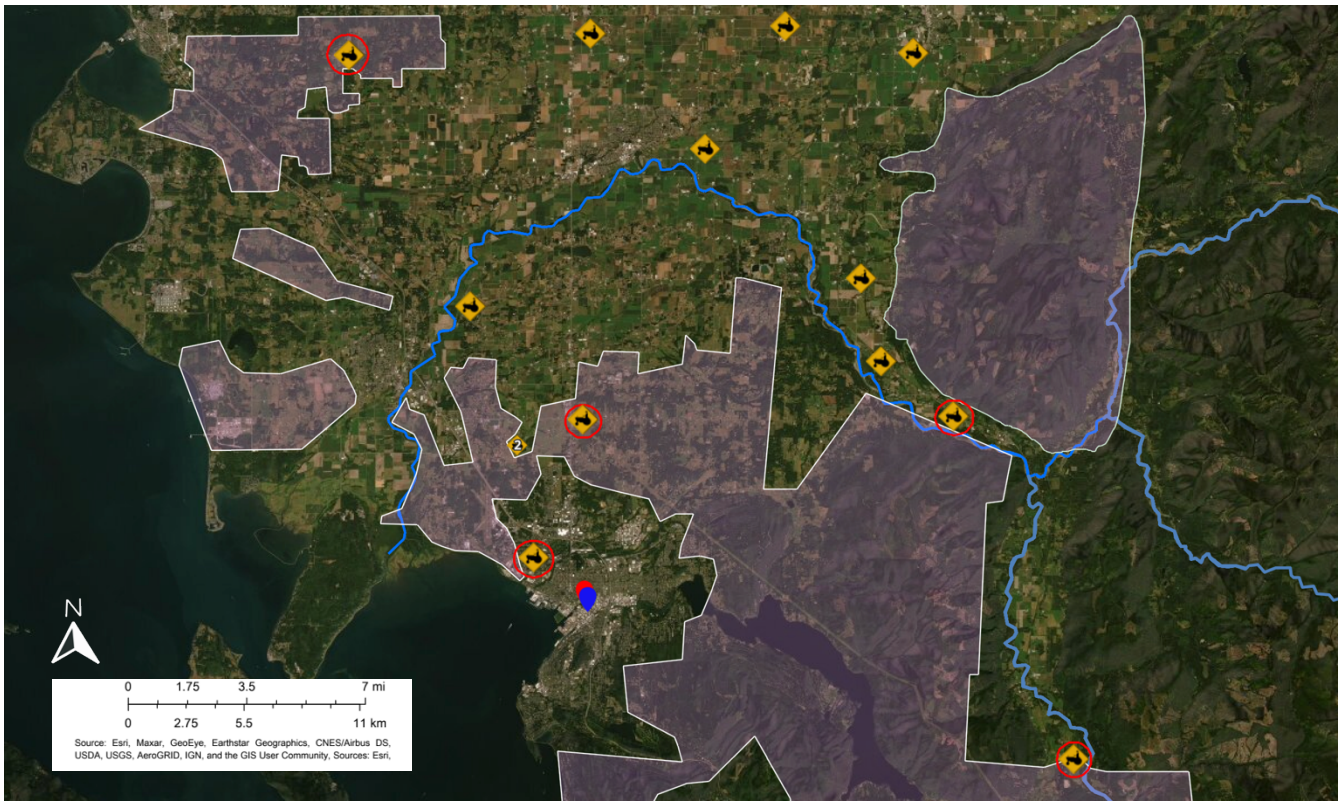
4. Discussion

Flood risk management is a complex, politically charged topic within Whatcom County. Flood risk management encompasses a wide range of issues related to water governance. Throughout history, the water management strategies that support both agriculture and fisheries are difficult to implement. Now with the increased severity and occurrence of flooding and drought, managing water has become increasingly political (Gerlak et al., 2022; Kleinknecht, 2019b; *WRIA 1 Salmonid Recovery Plan*, 2005).

4.1 Jurisdictional Boundaries

Critical Narrative Mapping illustrated relationships between farm location and farmers flood experience due to political boundaries that are acting as barriers to participating in flood risk management. *Appendix V* provides an overview of the different jurisdictional boundaries that influence farmers water and flood management. *Appendix V* visualizes the complexity and the vast number of jurisdictions that impact PFRG in Whatcom County. Jurisdictional boundaries play an important role not only for preventative measures for flood management but response and recovery efforts as well. Whatcom County has the second highest number of Diking and Drainage Districts in Washington State (eighteen districts). As identified by the farmers and additional stakeholders these

districts can provide avenues for landowners to engage with Whatcom County water management. However, farmers and stakeholder acknowledge the confusion due to the variety of districts such as: Drainage, Diking, Watersheds, Watershed Improvement, Flood Subzones, Tribal Land, City limits, Whatcom County and even the USA/Canada international boundary. Another study along USA/Canadian border found that without one agency providing a 'coherent set of mappings, jurisdictions, and responsibilities' (Taylor, 2020) understanding the complexity of water systems is challenging. These districts are intended to represent the citizens within each district through elected officials, yet, identifying and understanding what jurisdiction applies to what situation is a barrier for farmers and stakeholders. Thirty-eight percent of farmers identified a lack of management as a major barrier for them to participate within flood risk management. Two common concerns regarding lack of management is mismanagement of the diking and drainage systems and representation within the districts. *Map 5* provides a visual of the farms and stakeholders who identified location as a barrier to participation as well as the area of Whatcom County that lacks jurisdictional boundaries therefore provides little to no representation for landowners. Three farms

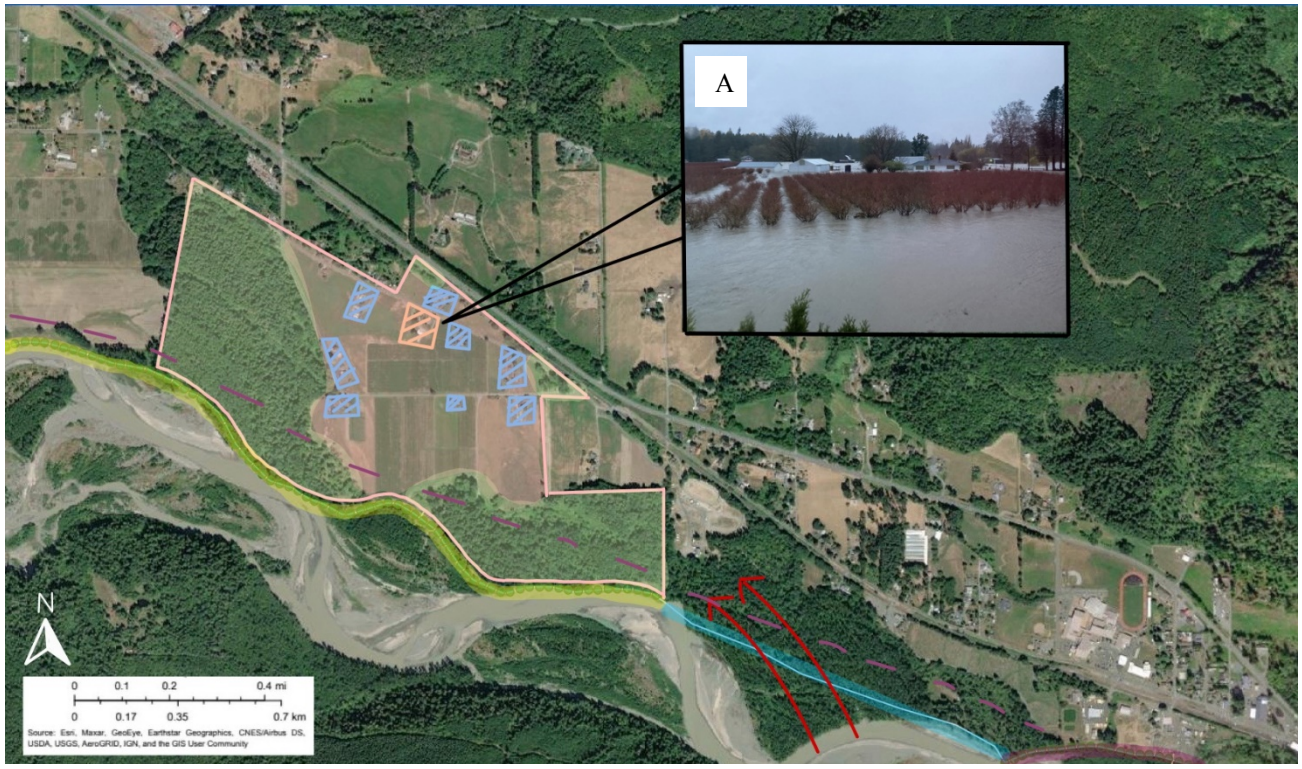


Map 5. An overview of the stakeholders (Supporting Agencies (blue) and Planning & Management (red) farms (yellow tractor) that identified location as a barrier (red circle). Also, the area in Whatcom County that lacks representational jurisdictions (white) for farmers regarding flood risk management. The branches of the Nooksack River are in blue.

that stated ‘location’ as a barrier to participation fall into the geographic area with no jurisdictional representation related to flood risk management (i.e., WID or DID). One study along the USA/Mexico border found that unincorporated areas or those outside of city jurisdictions were subject to a lack of water management which in turn led to an inconsistent water source (Gerlak et al., 2022).

An example that illustrates jurisdictional boundaries as a barrier for farmer participation is the Williams Blueberry Farm. In the Williams Family narrative their flood experience was influenced by jurisdictional boundaries which they feel is due to lack of representation and lack of management. The William’s farm is located within the unincorporated area of Deming and therefore is not represented by any government entity besides Whatcom County. However, they are within the Diking District #2 where the farmer is the commissioner for the district. Not only is the Williams Farm active in the Diking Districts they are also increasingly vocal in the Flood Control Zone District meetings. Yet, even with their willingness to participate and advocate for themselves, they feel as though they do not have effective flood risk management representation. *Map 6* shows the path of the flooding through the Williams Blueberry Farm which, was caused by ~1500 feet gap in the levee system along the Nooksack River. At the first Whatcom County FCZD Advisory Committee meeting after the flood in January the Williams Farm asked an elected official to speak about the Deming to Sande-Williams Levee gap. According to the meeting minutes, sandbagging was not an option due to downstream effects as well as logistical difficulties in the forested area. Also stated was that the ‘committee prioritizes the work and the committee can decide if this issue is more important than what staff is currently doing.’(“Whatcom County Flood Control Zone District Advisory Committee,” 2022) The motion to support Diking District #2 to protect homes between the Deming and Sande-Williams Levee failed. Whatcom County River and Flood has led proposals providing three different levee setback alternatives focusing on Reach 4, which is the section of the levee system where the Williams Blueberry Farm is located. *Map* 6 indicates a general idea where the proposed levee setback would be within the William’s Farm. Within all three alternatives the William’s will lose a portion of their agriculture land. The cost estimate for any of the alternatives ranges from $66 million to $80 million if constructed by 2025 (Shannon & Wilson, Inc., 2016). Almost $2 million of these costs is land acquisition. Thirty percent of Planning & Management stakeholders stated ‘lack of willing landowners’ as a barrier to flood risk management. However, almost thirty percent of farmers stated ‘preservation of agricultural land’ as a need. Loss of agriculture land within local government proposals partnered with confusion surrounding

jurisdictional based representation the ability and willingness for farmers to participate in flood risk management is a challenge. At this point there is a standstill between Planning & Management stakeholders and the landowners within the flood path due to the gap between the Deming and Sande-Williams levee. Based on the political context of the CNM and their location, the Williams Farm is jurisdictionally aware and understands how to participate in flood risk management. There are farms in the spatial confines of this study and those beyond that fall within the area of Whatcom County and have no advocative jurisdiction regarding flood risk management for landowners. How can farmers participate in flood risk governance if they have no representation due to the location of their farm? Two out of the three farms in this study that reside in the 'no jurisdiction zone' experienced flooding (*Map* 5). If farmers must be represented by a district such as the WIDs or DIDs to participate on governing boards (i.e., FCZD), yet don't have access, how is this an equitable form of flood risk governance?



Map 6. The Williams Blueberry Farm (pink) as an example of catastrophic flooding due to political complications. The residential structures on the farm are indicated in blue where the cannery is labelled in orange. The Sandee-Williams Levee is highlighted yellow visualizing the gap (blue) between the Deming Levee where the floodwaters breached. The approximate proposed levee setback by Whatcom County River & Flood is indicated in purple. Picture A is flooding on the Williams Farm in November 2021 (Shannon & Wilson In., 2016; *Nooksack River System-Wide Improvement Framework*, 2017).

4.2 Inter-agriculture representation

There are a number of Whatcom County, farmer-driven initiatives focusing on mitigating flood damage within the NRB. The most prominent is the Agriculture Water Board of Whatcom County (AWB). This governing board is comprised solely of farmers, it was created to allow the division of water and irrigation districts, and is managed as 'cooperative watershed actions and interlocal agreements'(Ag Water Board of Whatcom County, 2021). The board is broken into six Watershed Improvement Districts (WID), all of which have their own governing board under the umbrella of the AWB. These six districts focus on water associated issues relevant to agriculture within Whatcom County (Bertrand, Drayton, North Lynden, Laurel, South Lynden and Sumas). Flooding is listed as a top priority in each of the six districts. For example, the most common goal or action related to flooding management within the WIDs is to address drainage systems associated with farmland (Ag Water Board of Whatcom County, 2021; Ewbank, 2019).

Similarly, another farmer-represented committee is the Diking and Drainage Improvement Districts (DID). These districts were the first type of specialized districts within Washington, governed by elected officials who must be property owners within that given geographical area. There are numerous DIDs within Whatcom County that focus on agriculture water issues related to structural drainage systems and how the management of the Nooksack River influences these watercourses (Boggs and Corey, 2009). The most common issue related to drainage is watercourse maintenance which is inherently complicated because protected fish end up in constructed waterways. This is an on-going political debate that stems back to the initial clearing of the Nooksack River in the 1800s. Farmers are putting a lot of effort into local initiatives, yet the political complexity of the stakeholders involved raises a question: Are all voices being justly heard?

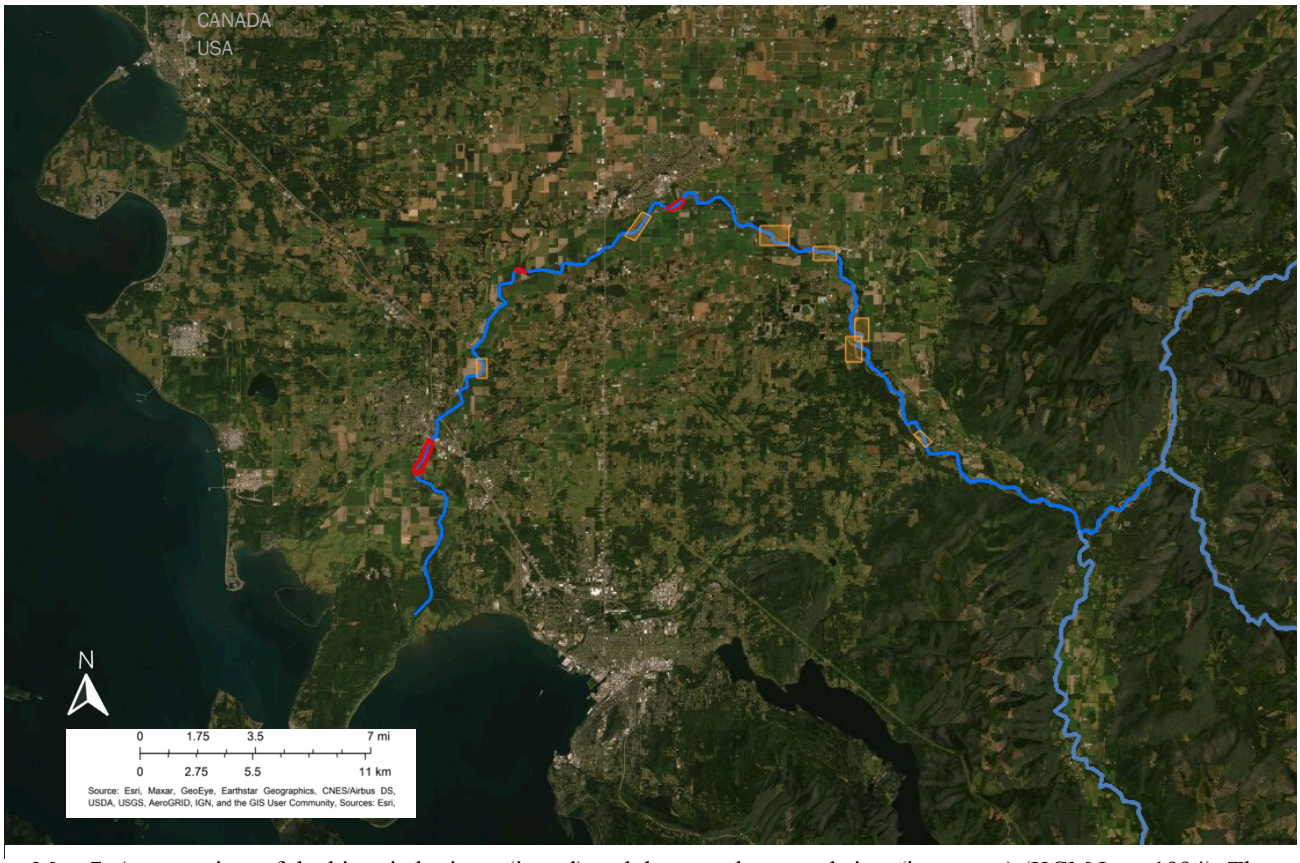
Eighty-six percent of farms surveyed experienced flooding. However, the trend shows that the larger the farm the more likely they are to participate in flood risk governance. Based on the governing boards observed, the same larger-scaled farmers are being asked or are volunteering to participate as an agriculture representative. Fifty-six percent of the flooded farms surveyed are under twenty acres. The small farmer is experiencing flooding. The rise of smaller scale vegetable/fruit farms is evident. In Whatcom County fruit and vegetable producers combined increased from roughly ten percent of agricultural sales in 1997 to approximately thirty-six percent in 2017 (Washington State University Extension, 2017). No farm less than twenty acres indicated utilizing or having knowledge about the WIDs or DIDs in order to address water management issues. These districts are vital for representing farmers within water management, advocating for farmers at a larger scale. Forty

percent of the small-scale farms that experienced flooding indicated that they lack the knowledge to participate in flood risk management. Within this study, small-scale farmers acknowledge the weight that dairy and berry farms have in regards to water within Whatcom County. Of the farms surveyed fourteen percent stated that there was a 'lack of leadership within agriculture'. One small-scale farm called upon the larger farms to 'start the paradigm shift' toward inclusive flood risk governance. Organizations like Whatcom Family Farmers and Save Family Farming have the opportunity to include small-scale farmers in their advocacy, as they rely on them to engage with the public in order to educate and build support for Whatcom County family farms. As indicated by WFF, these small farms are represented by mid-to-large farms and are actively engaged in flood risk management participating in WIDs, DIDs, and WIRA1 meetings, Ag Water Board, FCZD meetings and FLIP through their representatives. Owing to their active participation across a multi-scale level of governance WFF has the potential to include an equitable inter-agriculture representation during their advocacy.

Small farms need to be part of the conversation. There is a trend where the same farmers are representing the agriculture voice across all planning and management governing boards. The number of small farms is increasing in Whatcom County, and it is imperative to include them in flood risk management in order to preserve agriculture land while engaging in equitable PFRG. Within this study there is a higher likelihood for small-scale farmers to be women. Sixty-seven percent of farms zero to twenty acres were owned and operated by women. Eleven percent of farms twenty acres and greater were owned and operated solely by a female farmer. One study found that gender-associated socio-culture norms, gender roles, stereotypes, and resources politics can negatively influence women's participation within water management. Even though formal decision-making spaces can be supportive for women, inequality can stem from the traditional patriarchal leadership that undermines women's voices as farmers (Haeffner et al., 2020). However, inter-agriculture representation goes beyond size of farm and gender prejudices. Intersectionality within PFRG can enhance equitable decision-making process and therefore lead to a reduction of flood risk. Collaboration amongst farmers can be informal or not associated with governmental jurisdictions, however intersectionality within agriculture must be addressed within farmer networks to support socio-ecological resiliency (Haeffner et al., 2020; Marrero et al., 2022).

4.3 Regulatory Process

The 'regulatory process and time' was listed as a barrier amongst all three categories of stakeholders. Farmers, the County, WCD, WDFW and the Tribes all are managing the watercourses in order to keep instream flows at an acceptable level for fisheries and agriculture usage. Thirty-eight percent of farmers stated that they experienced flooding due to a buildup of sediment which caused severe backflow. In order to manage on-property watercourses, landowners need the proper permit. Throughout the interviews, as well as during WID meetings there was general confusion of the classifications of watercourses and proper steps to take in order to obtain a permit to manage a watercourse that is causing flooding. *Appendix V* describes the regulatory process of obtaining a permit for the different classifications of watercourses. Numerous farmers indicated that there was 'illegal' watercourse maintenance occurring at the time of flooding due to sediment buildup within watercourses. However, the WCD indicated that there are emergency HPA permits given out by the WFWD in times of flooding. WCD stated that in November these permits were distributed within the hour in order for farmers to keep the flow within a designated watercourse. However, no farmer



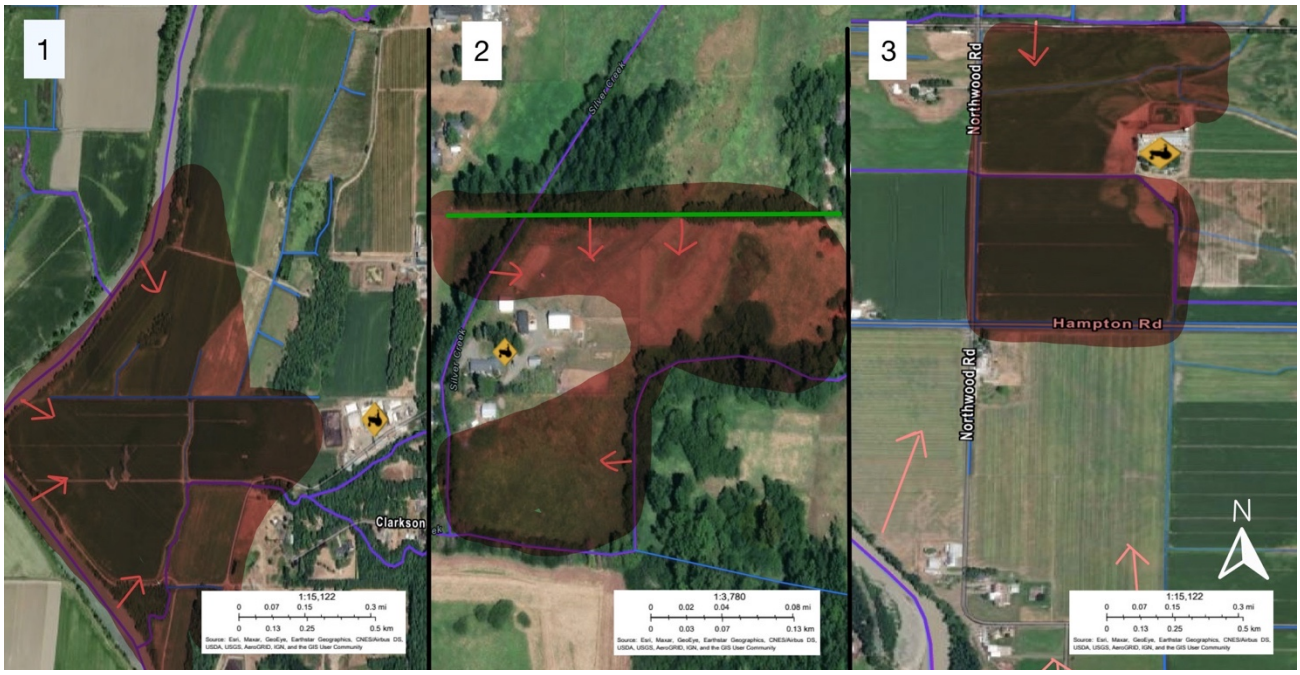
Map 7. An overview of the historic logjams (in red) and the gravel removal sites (in orange) (KCM Inc., 1994). The branches of the Nooksack River are indicated in blue.

within this study mentioned the ability to obtain an emergency permit. As thirty-eight percent of farmers stated that the 'regulatory process and time' were a barrier, it is not a surprise that farmers did not rely on said process during the flooding emergency. With a lack of knowledge regarding the process of permitting and classification of watercourses, partnered with little confidence in the regulatory process, farmers actions during the flooding stem from necessity to save their livelihood. Fifty-seven percent of farmers indicated the need for a 'comprehensive solution' to water management which included addressing watercourse maintenance. Forty-eight percent of farmers mentioned watercourse maintenance as a need for the future. Sediment and gravel buildup were stated as the biggest issue to watercourse maintenance.

The NOAA defines dredging as the 'removal of sediments and debris from the bottoms of water bodies…it is a routine…focusing on maintaining or increasing the depth of channels' (National Oceanic and Atmospheric Administration, 2021). Within this case study farmers are aware of the complications of dredging as a solution to flooding, only one farmer stated dredging as a solution for flooding. However, when farmers spoke about the need for watercourse maintenance they described the need for 'sediment cleanup'. Farmers were consistent when mentioning sediment/gravel cleanup as part of a wider more comprehensive set of solutions. One farmer spoke about the history of dredging for gravel mining along the Nooksack River. *Map 7* indicates leased areas utilized for gravel removal and mining from the 1960s to the early 2000s. An early version of the CFHMP shows that up until 1993, between Deming and Everson, 928,577 cubic yards of gravel had been removed from the main stream of the Nooksack River. From Everson to Haskell Rd. 1,225,970 cubic yards of gravel had been removed (Whatcom County Public Works and KCM Inc., 1994). *Map 7* also visualizes three historic logjam sites the most southern being "Big Jam" followed by "Little Jam" and "Upper Jam" (*Lower Nooksack River Comprehensive Flood Hazard Management Plan: Nooksack River Flood History*, 1995). The partnered history of removing logjams and gravel mining along the Nooksack River puts pressure on the downstream neighbor due to higher speed of flow rates during flooding events. Dredging also complicates fish habitat impacting their migration, spawning capabilities, and could lead to increased temperatures with potential for mortality (Juárez et al., 2021).

As co-managers of the watershed the Lummi Nation, Nooksack Indian Tribe, and Washington Fish and Wildlife collaborate together to 'restore disrupted ecological processes'. This collaboration controls the watercourse permitting for two reasons, to maintain fish habitat and to reconnect the floodplain. The Fisheries and Resource Protection Program Manager for the Nooksack Indian Tribe

emphasized the importance of building trust between landowners and the Planning & Management stakeholders. They reiterated that trust is essential to engage in collaborative flood risk management that supports a comprehensive solution encompassing short- and long-term projects. While attending the WIRA1 management team meeting, representatives from the Lummi Nation and Nooksack Indian Tribe stated their disappointment in the mortality event of 2,500 chinook salmon which, was caused by a bacterium due to high river temperatures and lack of habitat in 2021. They called for salmon habitat targets to be addressed in future flood projects supported by FLIP. Farmers who are routinely participating in Whatcom County-led flood projects stated fish and flooding need to be a part of the same solution. *Map 8* visualizes three different farm properties and their surrounding watercourse classifications while identifying which watercourses are fish bearing. The watercourses were overlaid with purple to indicate they were fish bearing, none of the watercourses were considered 'natural' within the three farms (*Appendix VI*). If a watercourse is identified as 'fish bearing' the regulatory process becomes more complicated and as *Appendix VI* states is the main basis for a permit to be denied (Boggs & Corey, 2009). Multiple farmers within this study declared their frustration for watercourses on their property being misclassified due to a lack of fish in their watercourse, yet still being labelled as 'fish bearing' or even a permanently dry channel classified as a watercourse. WCD and the WIDs are working on mapping the different classifications of watercourses. However, as stated by the Fisheries and Resource Protection Manager for the



Map 8. Three farms (yellow tractors) and the approximate areas that flooded on their land (red). The different watercourse includes; constructed/modified (blue), fish bearing (purple) and undocumented (green) (Boggs and Corey, 2009).

Nooksack Indian Tribe they respect 'presumed' fish distribution as well with the intention to address the barriers to fish migration. With the ability for farmers to receive an emergency HPA permit during flooding events there could be the potential for a collaborative initiative to keep fish bearing streams abundant. PFRG has the potential to bring both parties together in support of both fisheries initiatives and addressing watercourses that have been mismanaged. With the revitalization of fisheries farmland will also thrive due to a decrease in flood risk (Taylor, 2020).

4.4 Flexible Funding and Regulations

Due to response and recovery concerns, non-farmer stakeholders identified location as a barrier as well. At the six-month anniversary of the November 2021 flooding, community stakeholders gathered to update the community about the flood recovery. Funding opportunities meant to assist with recovery were directly affected by county and district lines. A stakeholder who worked with Whatcom Community Foundation stated that 'flexible funding' was a necessity due to the inability of local government to act due to firm jurisdictions and strict qualifications.

Stakeholders identified that response efforts were community-driven, even with farmers as first responders. During the WCF meeting, many stakeholders called for 'flexible funding' or a 'rainy day fund' that would support equitable preparation and response efforts during a disaster event. Farms from Deming to the Everson overflow indicated their disappointment in the lack of communication from local government. Twenty-eight percent of all stakeholders identified farmers as being first responders who utilized tractors and equipment to assist evacuations, while others (20 percent) indicated there was 'no communication' during, before, and after the flooding, which leaves community-driven response as the sole communication network. Flexible funding during disaster events could support communities in creating a professional system of communication within neighborhoods when local government communication systems fail. Also, flexible funding could provide tangible resources during a flood such as immediate access to sandbags. Nearly twenty percent of farmers indicated the need for preparation and response resources accessible by the community, rather than those dictated by the government.

Flexibility of funding and regulations is imperative for qualifications for flood assistance as well. Twenty-nine percent of farms received financial assistance after the floods, but of those that received financial assistance, only thirty-three percent received funds from the government. Direct aid or grants from local farmer supported organizations, provided the remaining assistance. Six months after the floods, WCF found that over $1.5 million was donated in direct aid. Due to size of their farms, farms like the Williams Farm struggled with finding financial assistance. Because of

their larger production they were unable to qualify for small local funding opportunities and because they are not considered a 'commercial' size farm, they also did not qualify for the majority of government assistance. With increased flexibility, farms would have the ability to recover faster therefore leaving less impact on the local supply chain and local economy. With farmers ability to have financial adaptability during disasters PFRG could become more achievable due to a lesser need for funding for all stakeholders.

Flexibility within watercourse maintenance regulations could be a potential benefit for both fish and agriculture leading to less watercourse blockages and later need for funding for cleanup. With collaboration between the Tribes, local government, WFWD, and farmers, acceptable guidelines could be set that dictate flexibility in watercourse maintenance during a disaster-level event. Therefore, watercourses can be saved from catastrophic overflow, fish habitat can be maintained and downstream neighbors can be considered during response efforts. Flexibility of the regulatory process during an emergency can lead to both the preservation of the fisheries population and agriculture land due to less reactive solutions taking time and money with little benefit to both parties.

An example of flexible regulations and funding that is currently being implemented is the monitoring of manure lagoons within dairy operations. In an interview with a WCD representative they discussed their role as an apolitical, non-regulatory, grant funded, confidential technical service. They have no intention to regulate, just to support how farmers can be better stewards to the land. Just two days after the flooding in partnership with state governmental entities WCD surveyed Whatcom County by air to visualize and identify the manure lagoons and address the farmers immediate needs. Lagoons are required to be two feet higher than collection amount and have stricter regulations when within the 100-year floodplain. During the flooding WCD and numerous state government entities partnered together to fund a cost-share Emergency Manure Transfer program. This cost-share program would assist farmers in moving manure that is at risk of overflow due do floodwaters or excessive rain. However, farmers must engage in an agreement before the manure is moved and are not eligible for reimbursement if they did not go through the regulatory process before the transfer (Whatcom Conservation District, 2022). This program has potential for farmers to have flexible funding during a flooding emergency. However, there needs to be further flexibility in the regulatory process because if famer do not have the time to go through the regulatory process during the flooding they may not receive the money even if they transferred the manure to protect water quality.

In response to the flooding WCD received a grant to implement a survey for dairy farmers that would address the needs of the farms both in operation and out of business to assist with pumping manure out of lagoons that are at risk for overflow. The Department of Ecology is motivated by 'not polluting' thus, funding grants to monitor water quality in partnership with the Washington State Department of Health. Another funding opportunity that the WCD is currently waiting on would create a plan to address manure lagoon overflow based on manure runoff, manure collection, and rain water. This plan would encompass flood risk management to avoid water contamination from manure lagoons. During the flooding one dairy farmer stated that when pumping water out of his barn he had no choice but to pump the contaminated water back into the flood waters. Of the farms that were surveyed that have livestock two of them are within the floodplain and floodway based on the new draft map from FEMA (*Map 3*). These farms will now face stricter regulations for their manure lagoons. *Figure 7* is an image of a farm (not surveyed in this study) impacted by the November 2021 floods in Whatcom County.

4.5 Preservation of Agriculture Land

As indicated in *Appendix I* agriculture land in Whatcom County is decreasing and is the fastest loss of agriculture land within Western Washington (Washington State University Extension, 2017). Climatic extremes partnered with socio-political pressures agriculture land within Whatcom County now more than ever shows the need for land to be preserved in order to maintain economic and ecological value of the Nooksack River Basin. Within this study, sixty-two percent of farmers stated that loss of land is there biggest concern if another disaster level flood occurs. Within this study a total of 3,016.8 acres is in agriculture production just from the 21 farms surveyed. Of that 3,016.8 acres 2,372 acres were impacted by the November 2021 flooding event. If the majority of farmers are concerned about losing land and the future technical solutions involve giving up agricultural land there could be conflict between farmers and local decision-makers.

Figure 7. Image of a farm's manure lagoons and the November 2021 floods (Washington State Department of Agriculture)

Multiple Planning & Management stakeholder meetings and interviews focused on technical solutions for flood risk management, the most common being levee setbacks and a flood buyout program. Thirty percent of Planning & Management stakeholders mentioned 'willing landowners' as a barrier. The buyout program focuses on acquiring land within the floodplain in order to reduce catastrophic impacts of flooding on private property. Forty percent of Planning & Management stakeholders identified flood buyouts as a possible solution to lessen the impact of flooding. The buyout program partnered with restricted new construction within the floodplain Planning & Management stakeholders believe this is an ideal step to mitigate flood risk. One Planning & Management stakeholder who works for Whatcom County Public Works stated that these voluntary buyouts could provide a long-term strategy with the intention that the acquired land can be reintegrated into the natural ecosystem or be utilized as agriculture land. Twenty-four percent of the farmers surveyed stated that new construction in the floodplain is a barrier for flood risk management as well. Due to heightened runoff from neighboring new construction, farmers within this study identified multiple complications to the new building within the floodplain. One farmer addressed the damage that was done to his tractor due to debris from a new building being hidden in his crop after the flood. Three farms identified the increase of storm water runoff from residentials properties causing detrimental impacts on their crop during high rain events. Overall, between farmers and Planning & Management stakeholders there is an understanding that new construction within the floodplain can lead to detrimental impact during a disaster event. The discrepancy between the two stakeholder groups is if the voluntary buyouts can lead to viable agriculture land or merely a loss of land that is in production. In British Colombia, Canada after a series of detrimental floods within the Fraser Valley, which lies just north of the Whatcom County, they conducted a review of governmental jurisdictions that were influencing flood risk management. Their report led to an investment in non-structural flood initiatives and a general review of Washington State's initiatives. It found that due to FEMA dictating the floodplain and floodway mapping, flood insurance companies have been incentivizing subsidized construction within these high-risk areas. Thus, little effort has been made to rechanneling these floods that impacted properties in order to mitigate future risk. The FEMA mapping does not take climate change into consideration and is only reviewed after a flooding incident as seen in *Map 3* (Muir and Woo, 2021).

As seen in *Figure 6*, there is strong agreement across all stakeholder groups that 'communication and collaboration' is a top need for effective flood risk management. In order to enhance the collaboration across a diverse array of stakeholders the county initiated a Design Charette to discuss

flood risk management and solutions. Forty-three stakeholders were in attendance focusing on collaborative solutions to mitigate flood risk. Seven agriculture representatives were recruited from WID meetings as well as through WFF. The idea of a comprehensive adaptable plan was addressed. An agriculture representative spoke about dairy farms transitioning to berry operations and the negative impact loss of agriculture land would have on Whatcom County's traditional dairy production. In turn, technical experts agreed that with more berry operations floods can have a greater negative impact due to disruption of flow when healthy pastures are removed. Based on this study it's clear Supporting Agencies and Planning & Management stakeholders are trying to 'build trust' where there is 'lack of trust' amongst farmers. Research shows that legitimacy of flood risk governance is lost if there is a lack of trust from both directions. One study found that low participation in risk governance was due to government and institutions believing there was a lack of interest rather than a lack of support to local stakeholders (Ardaya et al., 2019). By organizing collaborative sessions that expand beyond regulatory agencies or governmental entities, farmers have a higher likelihood of participating in flood risk management. A non-regulatory trusted agency such as the WCD has the potential to navigate the political complexities regarding the barriers and needs for PFRG across all stakeholders.

5. Conclusion

This case study of the Nooksack River Basin flood critically assesses the importance of individual experience within Critical Narrative Mapping. From a diverse group of stakeholders, weaving individual narratives together, builds a shared, lived experience. By identifying the needs and barriers within these individual narratives, common ground can be found among stakeholder groups which allows group of people to build community and face numerous socio-political pressures. Based on this case study, it is clear that the farmer's hold power within Whatcom County, and are essential towards gaining socio-ecological resiliency. One hundred percent of the farmers within this study agree that another, more severe flood will occur if no action is taken. However, what is evident within this study is the vast network of stakeholders that were involved and impacted by the Nooksack River Basin flooding in November 2021. In order for flood risk management to be representational in all stages (preparation, response, recovery and mitigation) the governance needs to support horizontal methods of decision-making and highlight inherent power dynamics (Ardaya et al., 2019; Okada et al., 2018; Wehn et al., 2015). PFRG can only be achieved if all stakeholders are willing to learn from each other's lived experiences and participate in adaptive decision-making

(Harris, 2021; Quandt, 2016). The political ecology of the Nooksack River flooding in November 2021 is a prime example of complex governance that citizen's participatory efforts are evident, yet are highly influenced by the push and pull of bureaucratic regulations. In order to emphasize the importance of comprehensive PFRG, common ground must be found to achieve equitable community participation (Ostrom, 2009). The number of boards, committees, plans, advocacy groups, rallies, etc. all are ineffective if the members of these governing bodies are not willing to adapt and learn from each other's expertise.

Through CNM, this case study identified the common barriers and needs to address that support farmer participation in flood risk governance across the stakeholder groups. Jurisdictional boundaries and the regulatory process were two of the most common barriers identified by the majority of stakeholder groups. Flexible funding and less strict regulations during disaster-level flooding is needed to support farmer adaptability during response and recovery of flooding events. Even with the historic conflict over land use in Whatcom County fisheries and farming can both be prioritized within PFRG by adaptable approaches and equitable means of collaboration. For the participation of farmers to support equitable PFRG inter-agriculture representation is important to consider. Small-scale farms are increasing within Whatcom County and are a vital part of socio-ecological resiliency against a disaster event. The small-scale farms within this study represent a voice within Whatcom County that is willing to participate and engage in a critical form of PFRG. In order to preserve agriculture land, collaboration and communication are key when addressing future flood risk management. It is important to emphasize that across all stakeholders in Whatcom County when addressing flood risk management there is common ground. Everyone within this study unanimously believes that there is a reason to plan for the future. The passion and hope are evident within all stakeholders within this study. The care for community and the land they steward was not inhibited by the disaster-level floods in November 2021. Yet, what makes a good 'upstream neighbor' is cooperation in times of crisis and non-crisis (Norman, 2014). During the six-month anniversary of the floods update by WCF, stakeholders emphasized that disasters are not something you can do right, but equity can be the grounding tenet in response efforts.

Globally, participatory disaster management is and will be more relevant than ever. This report provides a small window into one community that has faced historic socio-ecological power inequalities in which, influence the current complexities of flood risk management. The political ecological narrative of the farmer does have the power to transform communities into examples of socio-ecological resilience by working towards more collaborative modes of governance.

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7. Appendix

I. Additional historical context of flooding within the Nooksack River Basin

History

The name "Nooksack" is derived from the indigenous Salishan word referring to the 'bracken ferns', these ferns, in addition to salmon, were considered a staple to the native people's diet (Kleinknecht, 2019a). This delta, stretching from the North Cascades to the Pacific Ocean, is an historic floodplain, first cultivated by non-indigenous people in the mid-1800s; for centuries, this land has been embattled by struggles of power and control.(Kleinknecht, 2019a). The native peoples of the NRB, now identified as the Nooksack Indian Tribe and Lummi Nation, have evidentiary ancestral roots from "time immemorial" (Nooksack Indian Tribe, n.d.). Spread across the valley without a centralized location, the Nooksack people utilized the land for hunting, fishing and gathering; they traveled up and down the river in sync with seasonal fish stations and used cedar canoes to navigate the 'log jammed' waters (*Lower Nooksack River Comprehensive Flood Hazard Management Plan: Nooksack River Flood History*, 1995). The Native People's utilized the now drained Sumas Lake and its surrounding wetlands for fisheries and other necessary natural resources for their livelihood. Their movement was determined by the natural flood patterns and fisheries (Reimer, 2019). Native People's movements traditionally aligned with the surrounding bioregion of the given area where now political boundaries add complexity to the governance of natural resources (Norman, 2014). To this day the Nooksack Indian Tribe relies on fishing from the Nooksack River as an economic and dietary necessity (Nooksack Indian Tribe, n.d.). Their traditional livelihood faces numerous political barriers, thus making fishery regulations a top concern when addressing water rights, land conservation and flood risk management along the Nooksack River and its tributaries (Kleinknecht, 2019c; Nooksack Indian Tribe, n.d.).

Agriculture

The first white settlers in the 1850s took advantage of the flat delta and rich soils and cleared areas along the river for farming. There was an abundance of timber which resulted in clearing the naturally occurring log jams to utilize the river for transportation of goods (Kleinknecht, 2019c; *Lower Nooksack River Comprehensive Flood Hazard Management Plan: Nooksack River Flood History*, 1995). With loss of native riparian habitat and natural log jams to slow the river's flow, dikes and levees were constructed to alleviate overflow (Kleinknecht, 2019c). Due to its abundance

of natural resources, the NRB became an agricultural hub widely known for its dairy and berry production (National Agricultural Statistics Service, 2017).

Whatcom County is unique in the state of Washington as it is home to one third of the state's dairy cows (e.g., averaging about 80,000 cows) (Washington State University Extension, 2022). As prominent as the Whatcom County dairy industry is, fifty percent of agricultural sales in 2017, the rise of smaller scale vegetable/fruit farms is also evident. From 1997 to 2017, total agricultural sales from fruit and vegetable producers increased by twenty-six percent (Washington State University Extension, 2017). Today nearly seventy-five percent of crops produced within this region include grain, hay and pasture, while the remaining land producing berries, vegetables, flowers and others (Ewbank, 2019). Yet, overall farmland is decreasing; since 1997 farmland decreased by ten percent which is three times the loss compared to all of western Washington (Washington State University Extension, 2017). This decrease in farmland is due to a number of factors, but the increase in extreme climatic events, such as severe agricultural land flooding, could exacerbate the loss of farmland in Whatcom County.

II. Evolution of flood management

Year	Title	Goal	Proposed by	Citation
1855	Point Elliott Treaty	Native peoples relinquish 'title to land' in exchange for hunting, fishing and gathering. Reservations allocated.	USA Government	(Nooksack Indian Tribe, n.d.)
1895	Diking District	Alter watercourses to protect land from overflow	Washington state legislature	RCW 85.05
1913	Diking and Drainage Improvement Districts (DID)	Established diking and drainage systems represented by elected landowners	Washington state legislature (added irrigation in 1933)	RCW 85.20
1918-1935	Untitled flood spending	Spent up to $832,000 on flood control measures	n/a	(*Lower Nooksack River Comprehensive Flood Hazard Management Plan: Nooksack River Flood History*, 1995)
1939	Conservation districts	Conserve soil and prevent flood damage	Washington state legislature	RCW
1990	Nooksack River International Taskforce (NRIT)	Mitigate future overflow from Nooksack River across borders	Both governments	(Norman and Bakker, 2005)
1991	Flood Control Zone District (FCZD) *Current committee includes eight farmers	New zoning districts implementing a flood tax	Whatcom County	("Floodplain Management in Whatcom County: Who Does What," 2021)
1998	Water Resources Inventory Area No. 1 (WRIA1)	Washington state legislation provided funding for local watershed planning	Whatcom County, Lummi Nation, Nooksack Tribe, City of Bellingham, Public Utility District 1	(*WRIA 1 Salmonid Recovery Plan*, 2005)
1999	Lower Nooksack River Comprehensive Flood Hazard Management Plan (CFHMP)	Mitigate future flood damage, reduce risk, and direct development and use within the floodplain	Whatcom County	(*Lower Nooksack River Comprehensive Flood Hazard Management Plan: Nooksack River Flood History*, 1995)
1999	Whatcom Family Farmers (WFF)	Preserve the legacy and future of family farming by unifying farmer community	Seven family farmers	(Whatcom Family Famers, 2022)
2003	Watershed Improvement Districts (WIDs)	Cooperative watershed management actions- WIDs address critical issues related to agricultural landowners	Washington state legislature, governed by elected farmers	RCW 87.03.019
2005	Salmon Recovery Plan	Conserve salmon populations	Water Resources Inventory Area No. 1	(*WRIA 1 Salmonid Recovery Plan*, 2005)
2010	US Army Corps of Engineers (USACE) routine inspection	Levee inspections six out of thirty-three levees were deemed 'minimally acceptable' or 'unacceptable'	US Army Corps of Engineers (USACE)	(*Nooksack River System-Wide Improvement Framework*, 2017)
2013	System-Wide Improvement Framework (SWIF)	'Develop a maintenance and improvement plan for Whatcom County levees…net gain in fish habitat and reduce risk of flood damage'	Whatcom County FCZD and USACE	(*Nooksack River System-Wide Improvement Framework*, 2017)
2017	Floodplain Integrated Planning Team (FLIP)	Create an adaptive management plan associated with SWIF and update CFHMP	Whatcom County (River and Flood)	(Roberts, 2017)
2017	The Portage Bay Partnership	Created in reaction to high levels of fecal coliform in water resulting in shellfish death	Lummi Nation, farmers, Whatcom Conservation District (WCD)	(Relyea, 2019)
2022	Nooksack River Water Management Solutions	Addressed 2021 floods and fishery issues	Whatcom Family Farmers	(Whatcom Family Famers, 2022)
2022	Design Charrette	Brought 43 stakeholders together to address flood risk management	Whatcom County (River and Flood)	Interviews

III. Interview guidelines

Informed Consent
Yes or No
(*photos, location on map)*

Participant Name: _____ Name of Farm:_____
Age:_____ Race:_____ Gender:_____
Location:_____

Year farm was founded:_____ Total Land:_____ Certifications:_____

Type of farm (*circle all that apply*): Dairy Mix crop/livestock Vegetable Fruit

Percent of land affected by floods:_____ Depth of water:_____

Standing and/or flowing water?_____ Equipment Damage: Yes or No

Production effected: Yes or No Assistance for loss: Yes or No

The following will remain anonymous

Gross sales:_____ Percent agency assistance:_____

1. Flood/water experience

To the best of your ability please give a detailed account of your experience with the November flooding. If you can please include communication channels that were utilized, any preparation and response efforts that you saw, and how you/your land is affected. *If you do not feel you were affected by the flooding please elaborate on any water-related issues your farm has/is facing (i.e., quality, drought, drainage, etc.) and describe the political and climate complications of said issue.*

…

2. Barriers/limitations

To the best of your ability address the barriers you feel and see as a farmer regarding flood management. Please elaborate how farmers are and can be involved in flood and/or water management. *Do you feel farmers are represented and heard effectively within water management related issues?*

…

3. Future outcomes

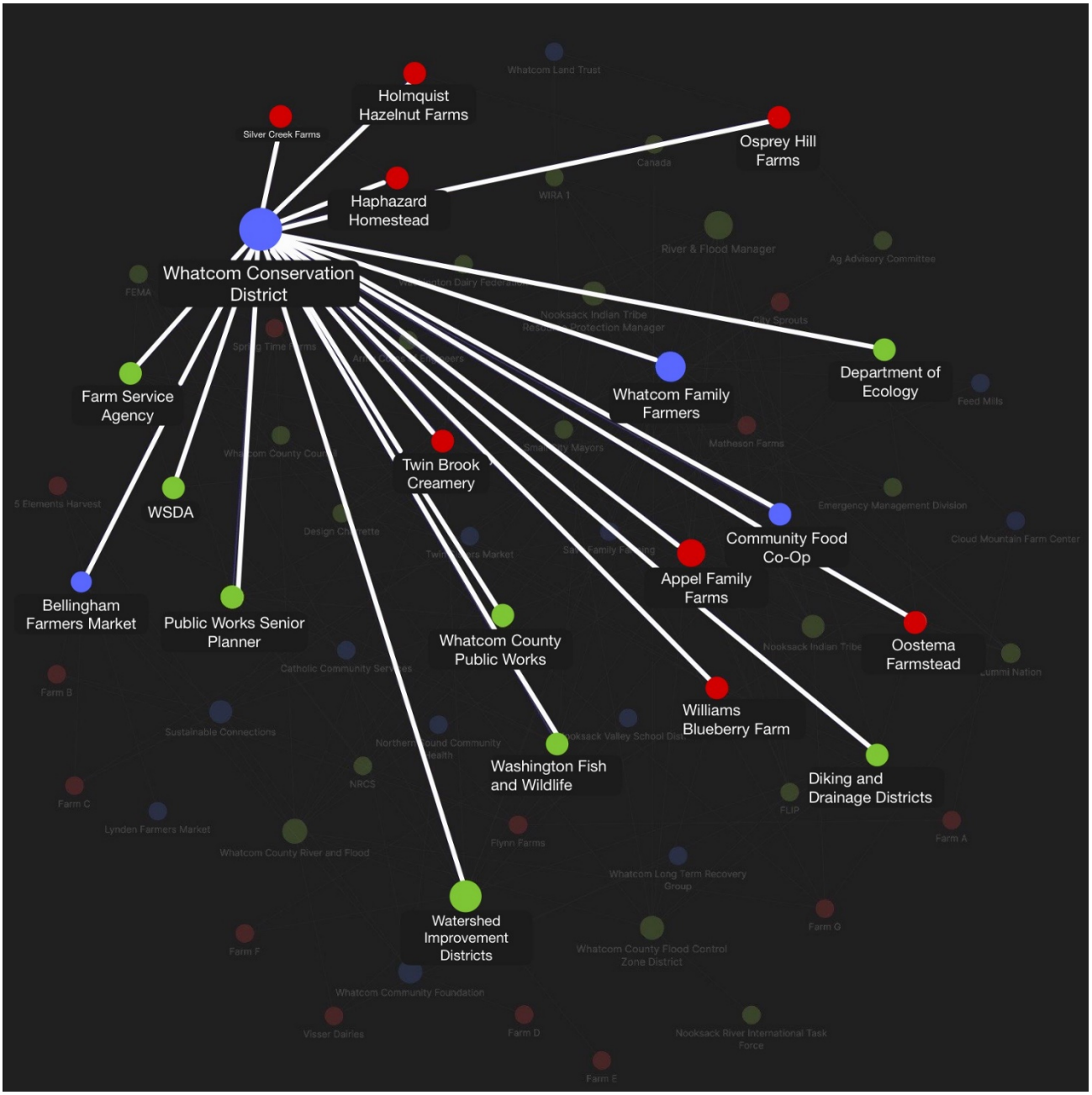
To the best of your ability please envision a potential 'what if' scenario based on your current feeling of flood management within Whatcom County. To the best of your ability address any needs you have as a farmer in order to address future flood and water-related risk. *Do you feel as a farmer you have the knowledge and resources to be prepared for a future water-related 'disaster' (i.e., drought, flood)?*

…

Do you have any photos of the flooding that can be used for the map? (please attach if you do)
Do you have any additional contacts who you think would be beneficial for me to speak to?
Any additional comments:

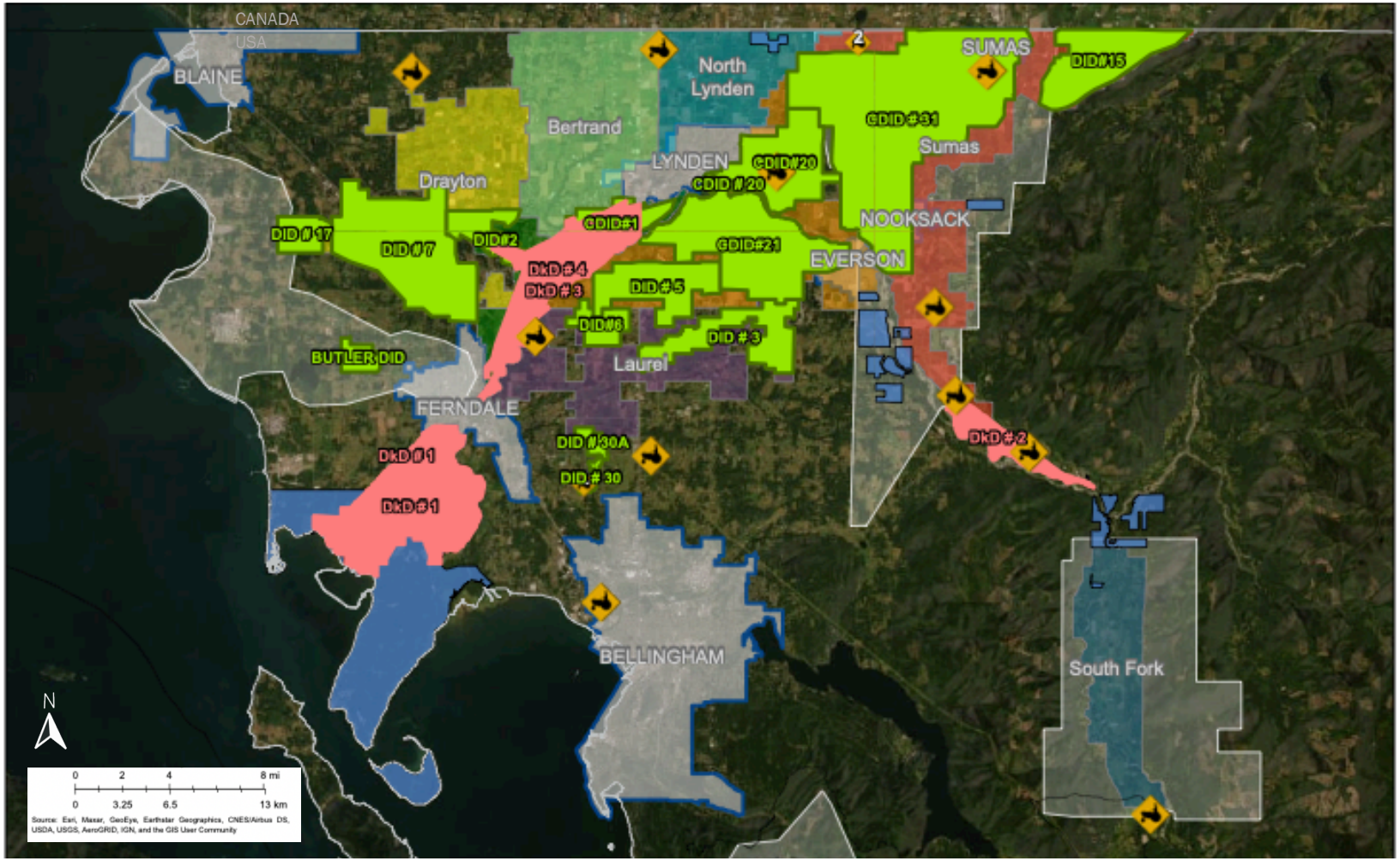
…

IV. Stakeholder interconnections



This image highlights the interconnectedness of the WCD. The WCD had the most connections within all three stakeholder groups. Within the figure the red dot represents farms, the green dot represents Planning & Management stakeholders, and the blue dot represents Supporting Agencies.

V. Map of jurisdictional boundaries



The map above visualizes the complexity of the jurisdictional boundaries that have an impact on flood risk management within Whatcom County. The farms surveyed within this study are identified as the yellow tractors. The districts above are as listed: DkD (diking districts in pink), DID (Drainage Improvement Districts bright green), Municipalities (white), Tribal land (dark blue), Flood Subzone Districts (white), Flood Control Zone District, WIRA 1 and Whatcom County (white line), Watershed Improvement Districts (labeled in different colors) (Boggs and Corey, 2009; "Floodplain Management in Whatcom County: Who Does What," 2021).

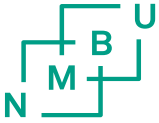
VI. Regulatory process of watercourse maintenance

Watercourse Classification	Definition	Maintenance Process	Permitting	Further Regulations	Type of Maintenance	Description	No Contact	WC Natural Resource	WC ESA Checklist	WDFW HPA Permit	Ecology Stormwater	Ecology Permit	ACOE
Modified	Historically natural systems that have been previously diverted, dredged, straightened, and/or diked.	A permit and a Drainage Management Plan is required and Best Management Practices need to be incorporated*.	Hydraulic Project Approval (HPA) permit from WDFW is typically needed with approved DMP by Whatcom Planning and Development Services if maintenance is within 100 feet from any watercourse. Permit applications must be sent to ACOE.	Timing for maintenance is typically between August 1 to September 30. Any diversion, obstruction or changing the bed or flow waters must have an HPA under RCW 77.55. Protection of fish life is the only basis for a permit to be denied**	Dredging	Removal of channel bottom sediments		X	X	X	X	X	X
					Bank Vegetation Management	Mow noxious weeds		X		X			
					Culvert Maintenance	Debris removal or headwall repair		X	X	X		X	X
					Bridge Maintenance	Debris removal or abutment repair		X		X		X	X
					Herbicide Applications	Aquatic herbicide applications		X				X	
					Beaver Dam Removal	Modify or remove beaver dam		X	X	X			
					Sediment Trap Removal	Remove sediments		X	X	X	X	X	X
					Hand Maintenance	Vegetation removal		X	X	X			
Constructed	Also known as ditches, used for drainage or supplying water for an individual farm. They do not have natural headwaters or other natural water source. Water may be permanent or intermittent	Presence of water requires implementation of Best Management Practices within a Drainage Management Plan*.	Any drainage maintenance on constructed watercourses does not require permit as long as it does not impact natural or modified watercourses downstream**	If watercourse lies within Whatcom County 'Critical Area' or 'Critical Area Buffer' notification must be sent to Whatcom Technical Administration ten days before maintenance. Frequently flooded areas are considered 'Critical'. If channel is dry maintenance can be done at any time.	Dredging	Removal of channel bottom sediments	X						
					Bank Vegetation Management	Mow noxious weeds	X						
					Culvert Maintenance	Debris removal or headwall repair	X						
					Bridge Maintenance	Debris removal or abutment repair	X						
					Herbicide Applications	Aquatic herbicide applications	X					X	
					Beaver Dam Removal	Modify or remove beaver dam	X						
					Sediment Trap Removal	Remove sediments	X						
					Hand Maintenance	Vegetation removal	X						
Natural	Not significantly alerted from historic flow	Not within DID	Individual permit basis	Special permitting can be approved usually not for individual	Rare to alter natural watercourses	Emergency measures can be taken							

*Best Management Practices within Drainage Management Plans are necessary to align with State Water Quality Standards or Tribal Water Quality Standards for lands within the jurisdiction of Lummi Nation and Natural Resources Department.

**Presence of fish can occur in all three classifications of watercourses with potential of further regulations

(Boggs and Corey, 2009)



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