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RESEARCH SYMPOSIUM

MEASURING & REDUCING SOCIETAL IMPACTS

Equitable Adaptation to Climate-Related Flood Risks: Part 1

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University of Alberta

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UCLA Luskin Center for Innovation

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Frequent Spring Flooding Impacts, Evacuation Experiences, and Perceived Adaptive Capacity of Kashechewan First Nation, Northern Ontario, Canada

Frequent Spring Flooding Impacts, Recurring Evacuation Experiences, and Perceived Adaptive Capacity of Kashechewan First Nation, Northern Ontario, Canada

UCLA (University of California, Los Angels)
Climate Change Adaptation Symposium

7-8 Sep 2021

Dr. Arshad K. Khalafzai, Ph.D.
Post-positivist Researcher / International Consultant DRR-CCA

Presentation Contents

Community Background

- **1743:** Initial settlement at Old Post, Albany Island.
- **1905:** Treaty 9, Reserve 67 (1910).
- **1957:** Relocated to Kashechewan, the existing site.
- **2006:** 5 Relocation Options of the Govt.

Source: www.google.ca

From Plane after Completing Fieldwork (Photo: 3 December 2016)

Background…continued

Old Post Major Floods:	**Kashechewan Major Floods:**
1914; 1922; & 1928.	1966; 1972; 1976; 1985; 2006; & 2008.

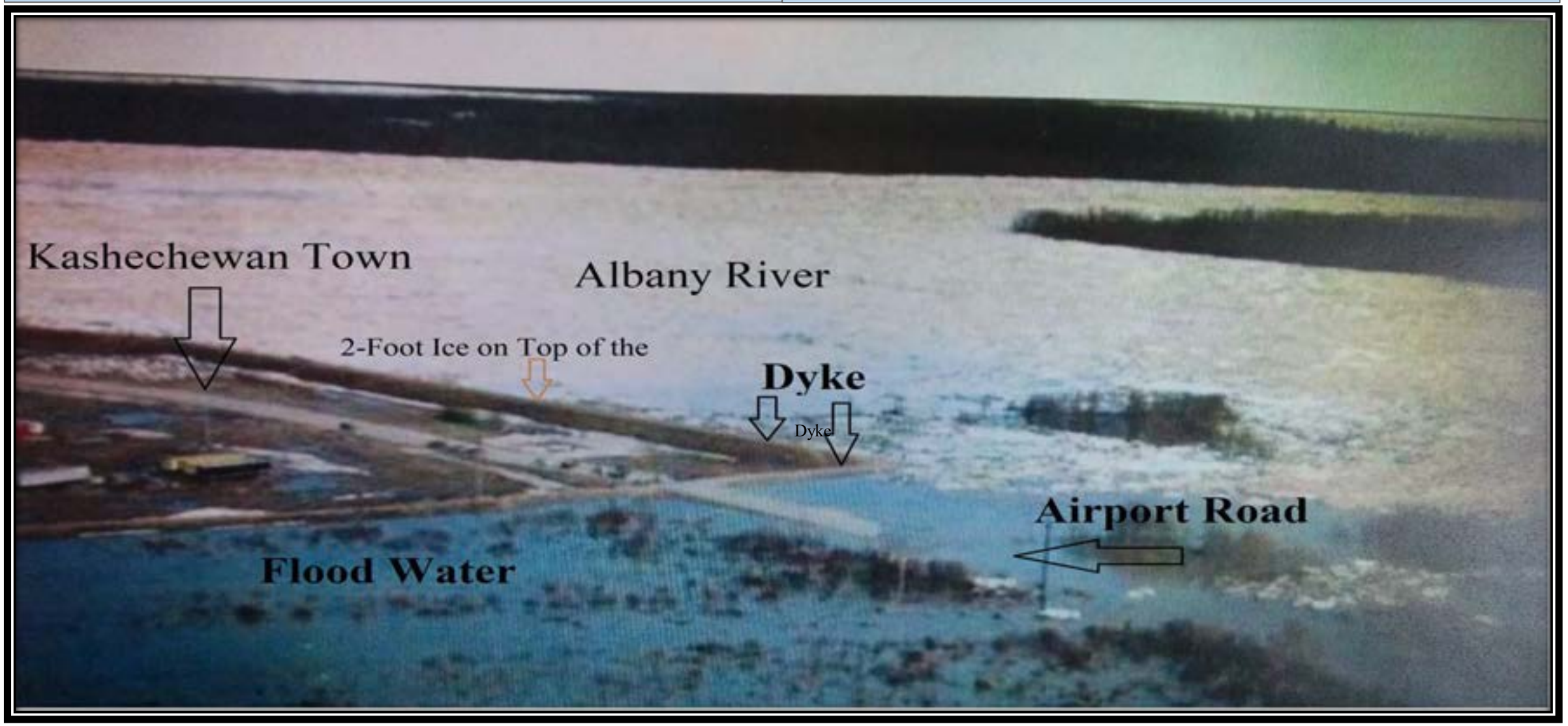


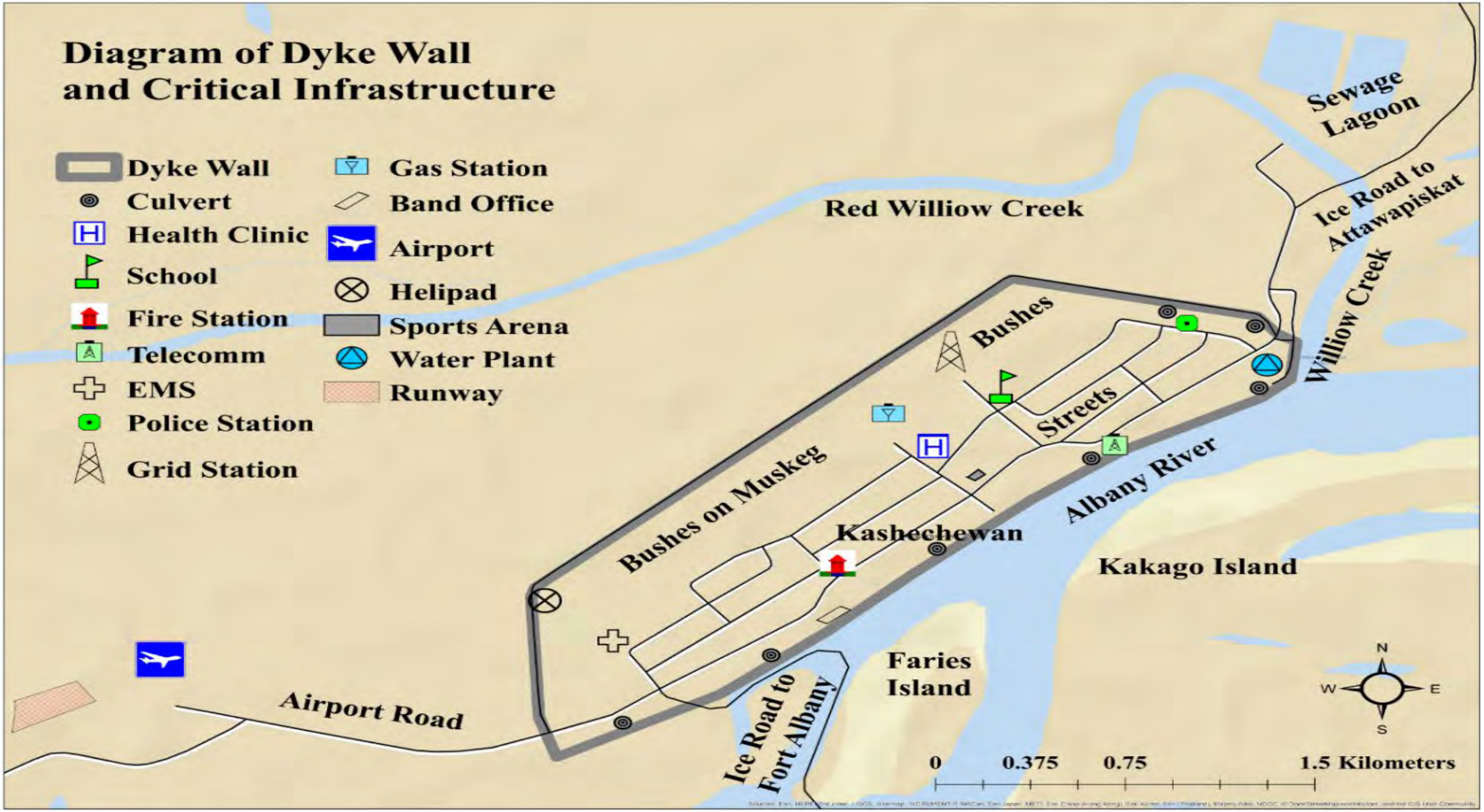
Photo of the Photo: The 2006 Flooding (Courtesy - Kashechewan Band Office)

The Problem

- Increased flood risk
- Uncertainty every spring
- Regularly impacts the community

- Frequent evacuations:
  - 14 times since 2004
- Consecutive evacuations:
  - 2004-2008
  - 2012-2019
  - twice in 2005 (spring & fall)

Taken from Plane; Northwest to Southeast (Photo: 3 December 2016)



Designed in ArcMap, GIS

Research Aim and Objectives

Aim:

How Kashechewan First Nation is affected by and responds to floods.

Objectives:

There are three specific objectives.

Elder William Sutherland drawing flood features during mapping workshop (Photo: 20 Nov 2016)

Research Methodology

Meeting with Kashechewan Chief & Council (Photo: 13 November 2015)

Collaborative Research

- Initial community engagement in 2015.
- Formed Community advisory committee (CAC) for guidance.
- Hired and trained community research assistant for fieldwork assistance.
- My role and responsibility and rights of the community agreed and followed.
- 5-year interaction with the community leaders and elders.

Research Methodology… continued.

Research Approach

- Mixed case study approach.
- Combination of qualitative and quantitative.

Multiple Methods and Sources of Information

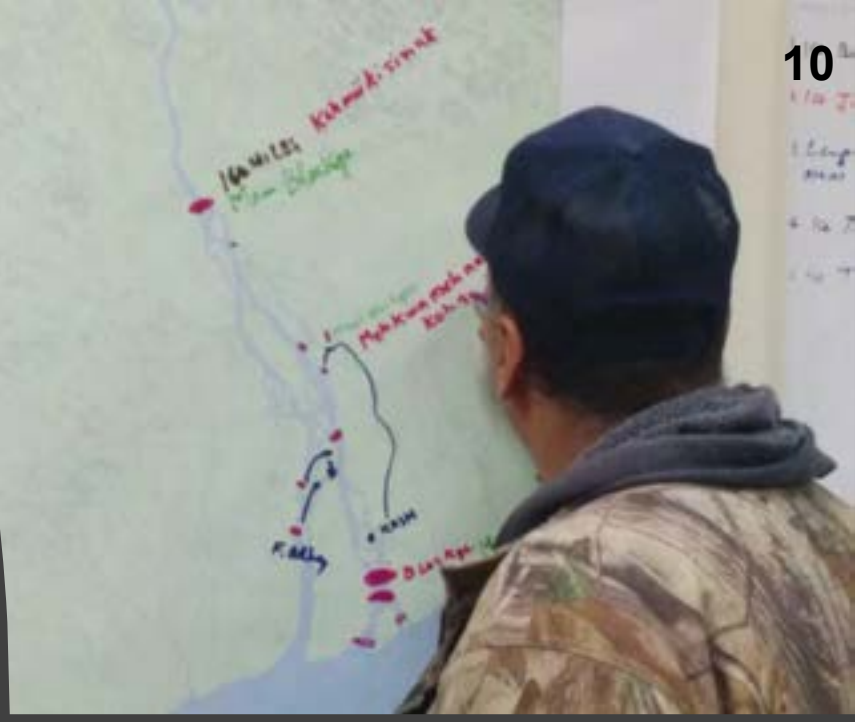
- More practical strategy (e.g., triangulation).
- 12.9% individuals of the sample frame.
  - Flood mapping workshops,
  - Sem-structured interviews, and
  - Structured interviews.

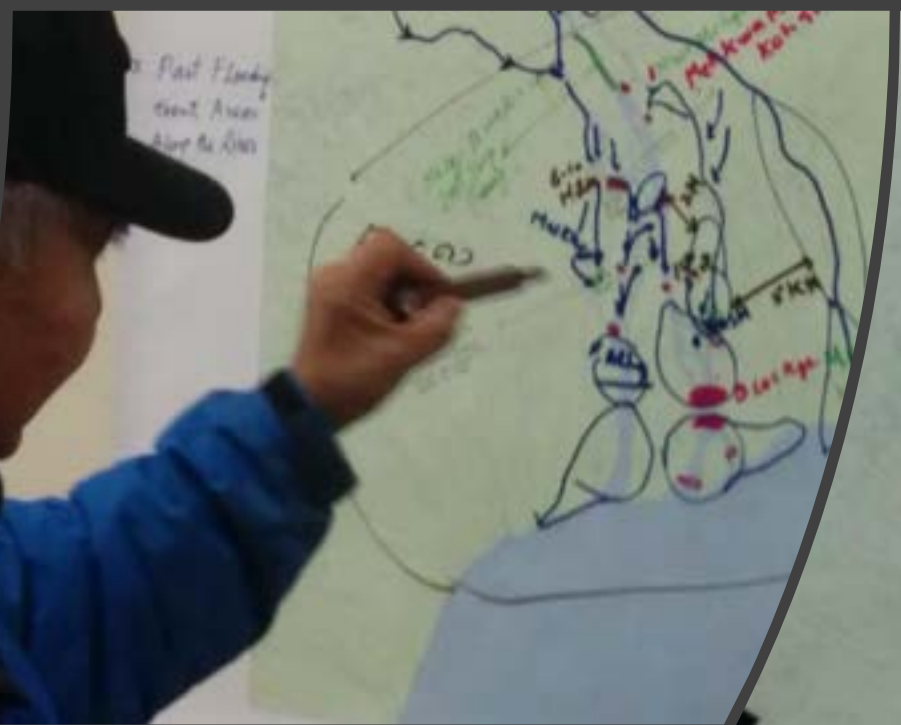
Structured Interview, Northern Store/Tim Horton's (Photo: 1 December 2016)

Methodology continued.

Participatory Techniques

1. Flood Mapping
2. Photography
3. Onsite Walks
4. Qualitative Interviews





Data Collection Methods

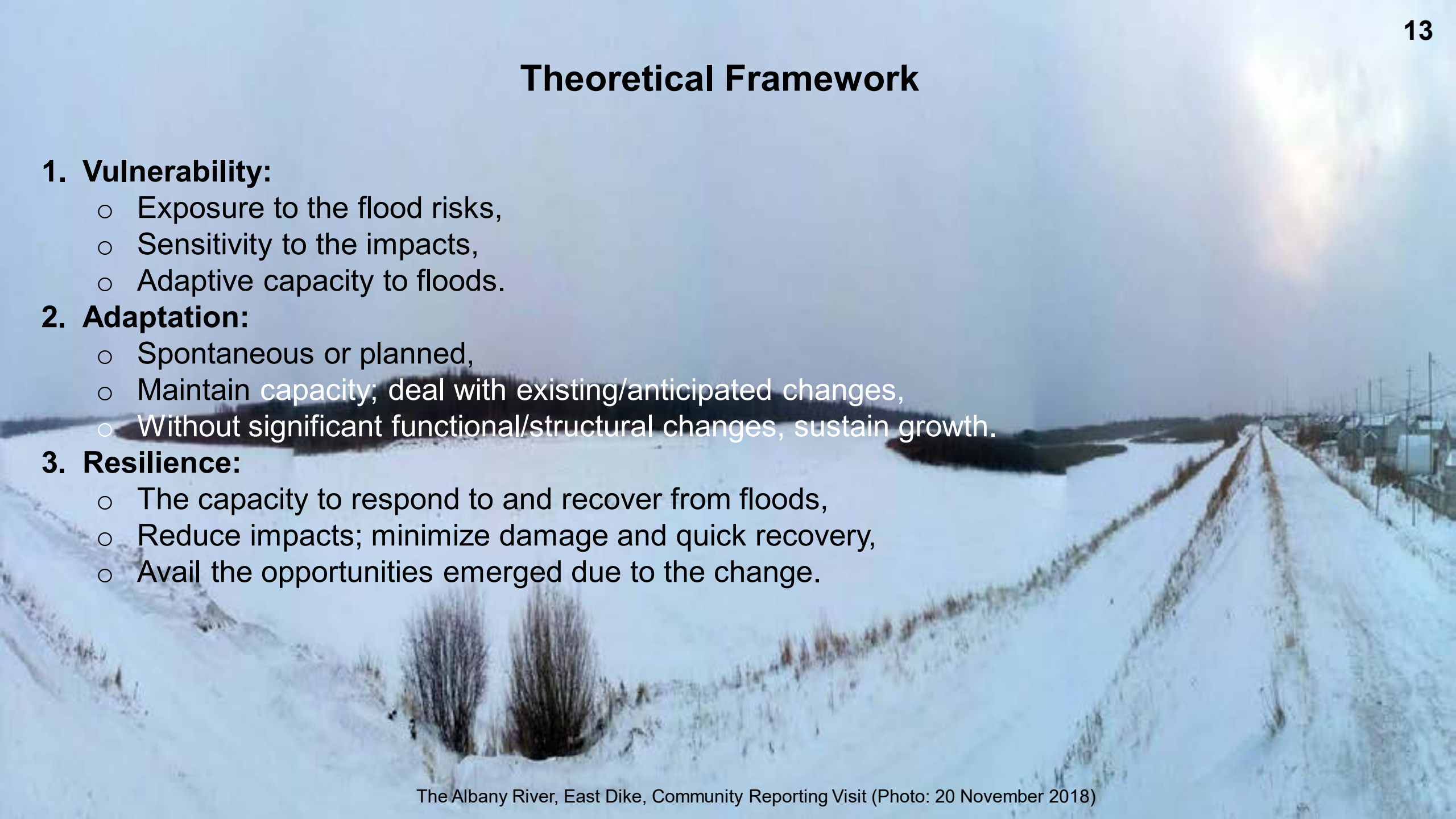
Qualitative	Quantitative
1. Objective 1: to explore the elevated flooding risk... ○ Flood mapping workshops ○ Onsite walks, photography ○ Semi-structured interviews. **2. Objective 2:** to examine experiences of floods and evacuations… ○ Semi-structured interviews ○ Flood(risk) impacts ○ Short-term evacuations ○ Long-term (3-year) evacuation.	**3. Objective 3:** to determine perceived adaptive capacity… ○ Structured interviews ○ Socio-cognitive determinants ○ Social capital ○ Human capital ○ Governance ○ Others ○ Likert Scale (strongly agree to strongly disagree; 5-1) ○ 21 ordinal variables ○ Demographic information.

Sampling, Sample Size, and Data Analyses

Obj.	Method	Sampling Technique	Sample Size	Data Analyses
1	Flood Mapping, Onsite Walk, Photography, Semi-structured Interview	Purposeful, Snowball	Mapping Workshops 5 Onsite Walks 2 Interviews 17 24	**Software:** ○ ArcMap(GIS) ○ Google Earth ○ NVivo.
2	Semi-structured Interview	Purposeful, Snowball	41	**NVivo:** Mix Coding Scheme ○ Descriptive ○ Analytical.
3	Structured Interview	Convenience	90	**SPSS:** Chi-square, Spearman's Correlation, Friedman's Two-Way ANOVA, Kendall's W, and PCA

Theoretical Framework

1. **Vulnerability:**
   - Exposure to the flood risks,
   - Sensitivity to the impacts,
   - Adaptive capacity to floods.
2. **Adaptation:**
   - Spontaneous or planned,
   - Maintain capacity; deal with existing/anticipated changes,
   - Without significant functional/structural changes, sustain growth.
3. **Resilience:**
   - The capacity to respond to and recover from floods,
   - Reduce impacts; minimize damage and quick recovery,
   - Avail the opportunities emerged due to the change.



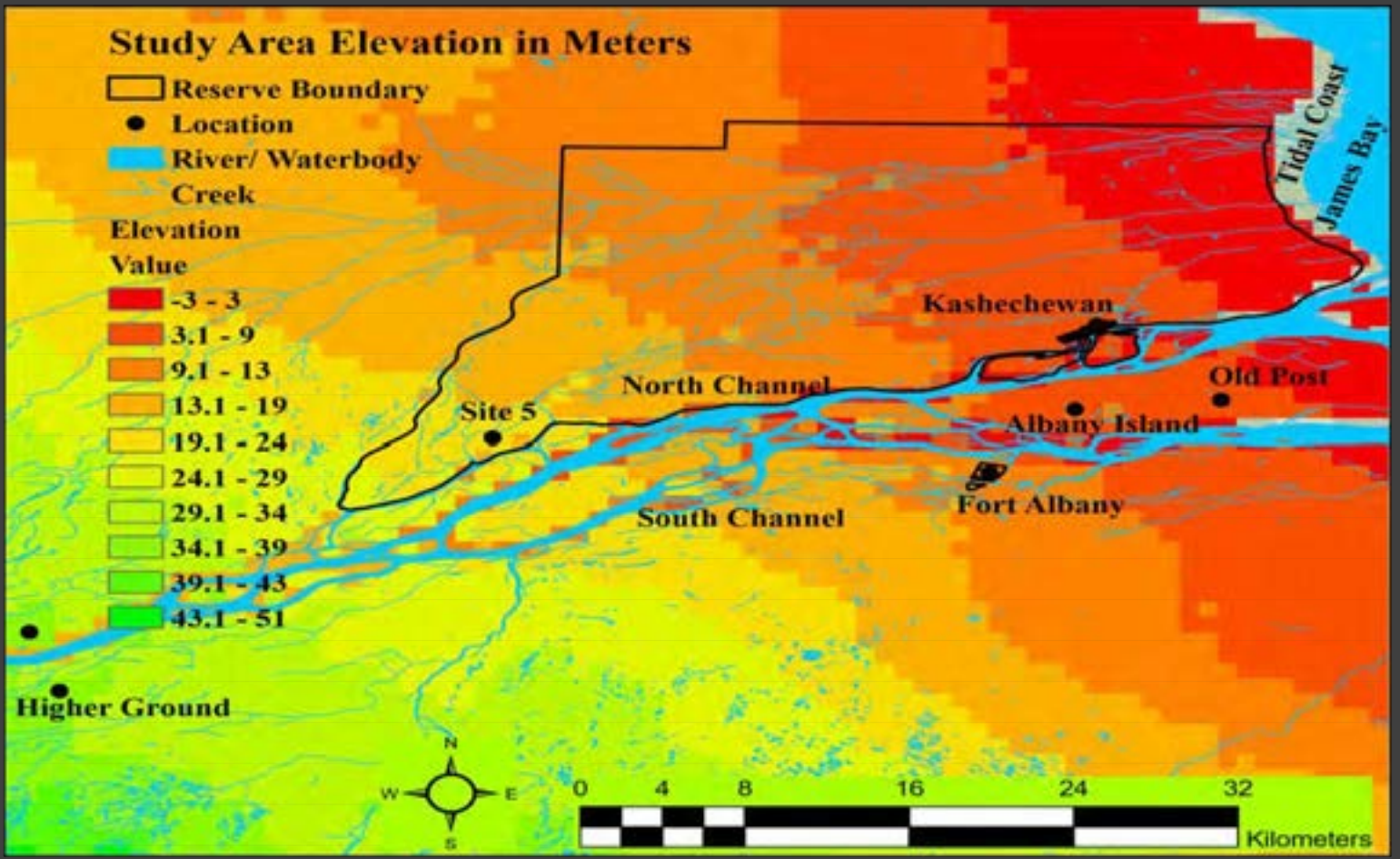
The Albany River, East Dike, Community Reporting Visit (Photo: 20 November 2018)

Results…1.1. Flood-Prone Location

Topography: Flat, Low-Lying, Muskeg

"The elders said to the Indian [Aboriginal] Affairs, 'you can't have a reservation [settlement] here because it's [the place is] always flooded,' it will flood".

(Edward Sutherland)



"[…] So, this place has been wet [muskeg] for way too long. I don't like that."

(Elder Kenneth Hughie)

Results….1.2. Community Infrastructure

Dike Deficiencies: Concerns and Fear of Breach

"It [2006 flood] almost over top the dike. Thank God for the dike being there in 2006. It prevented a major disaster. Maybe another Winisk (First Nation) that was wiped out. Because of deficiencies in the dike, the engineers say we have to evacuate every spring."

(Chief Leo Friday)

East Dike, The Albany River (Photos: 10 November 2015)

"It's on record by engineers saying that the dike is high risk. It's in a state of negligence already because you know the situation, but you are not doing anything about it. You know what is it gonna take to be heard? A Disaster? I hope not."

(Grand Chief Jonathan Solomon)

1.2. Community Infrastructure…continued

Community Infrastructure: The Albany River & Dike, Kashechewan (Photos: 10 November 2015)

2006 Floodwater Level

2016 Flood: The airport runway and parallel road were under floodwater.

2016 Flood: The airport road floodwater mark (Elder William Sutherland)

Results….1.3. Early Spring Breakup

Breakup Ice Jamming

“See that curve there [typical jam site] that’s where it jammed downstream when the 1976 flood occurred. That’s where it jammed, the ice, and that water built up–it accumulated–the water level, and that’s how we got flooded because of the ice jam.”

(Oliver Wesley)

Spring Breakup 2018, The Albany River, Kashechewan (Elder William Sutherland)

Spring Breakup 2017, The Albany River, Kashechewan (Holly Woodhouse)

Results….1.4. Climate Change

Changes in Climate and Weather

“‘You tend to see something is coming, and all of a sudden it’s not, and sometimes you don’t see something that’s coming, and all of a sudden it is. That’s how sneaky the weather is right now”.

(Chief Leo Friday)

Vegetation: Mid Nov 2015, Kashechewan

Migratory Bird: Mid Nov 2015, Albany River

“Way back, we used to hunt late April. Now, the geese start arriving late March. It [flood risk] affects the hunting because of early spring, early warmth”.

(Edward Sutherland)

Results… 1.4. Resource Development

Warmer Spring: Affecting Winter Ice Road

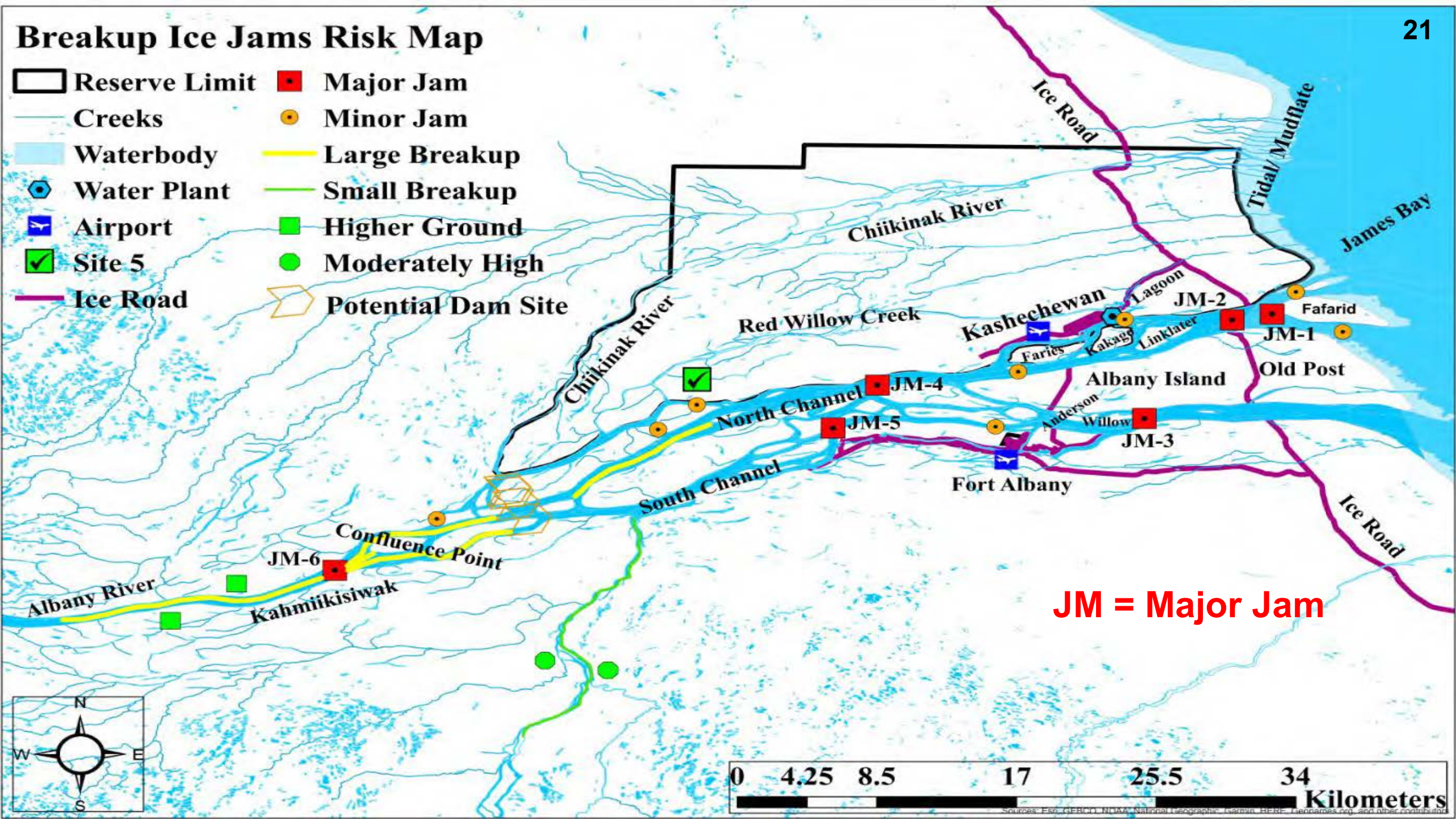
"The first time [16 March 2013] I experience when the road was all gone–it [ice road] was all melted [due to warming]".

(Band Official)

"It [drilling holes] doesn't help, and since then, we have problems with the flooding [2006 flood]. That's where the ice stops–downriver from Kashechewan–and that's where it creates flooding".

(Elder William Sutherland)

Photos: 312 KM Winter Ice Road Connects Attawapiskat, Kashechewan, Fort Albany, and Moosonee (Source: http://www.winterroadcompany.ca/)


Breakup Ice Jams Risk Map
Reserve Limit
Creeks
Waterbody
Water Plant
Airport
Site 5
Ice Road
Major Jam
Minor Jam
Large Breakup
Small Breakup
Higher Ground
Moderately High
Potential Dam Site
Ice Road
Tidal/ Mudflate
James Bay
Chiikinak River
Chiikinak River
Red Willow Creek
Kashechewan
Lagoon
JM-2
Fafarid
JM-1
Old Post
Faries
Kakagi
Linklater
Albany Island
JM-4
North Channel
JM-5
Anderson
Willow
JM-3
Fort Albany
South Channel
Ice Road
Confluence Point
JM-6
Albany River
Kahmiikisiwak
JM = Major Jam
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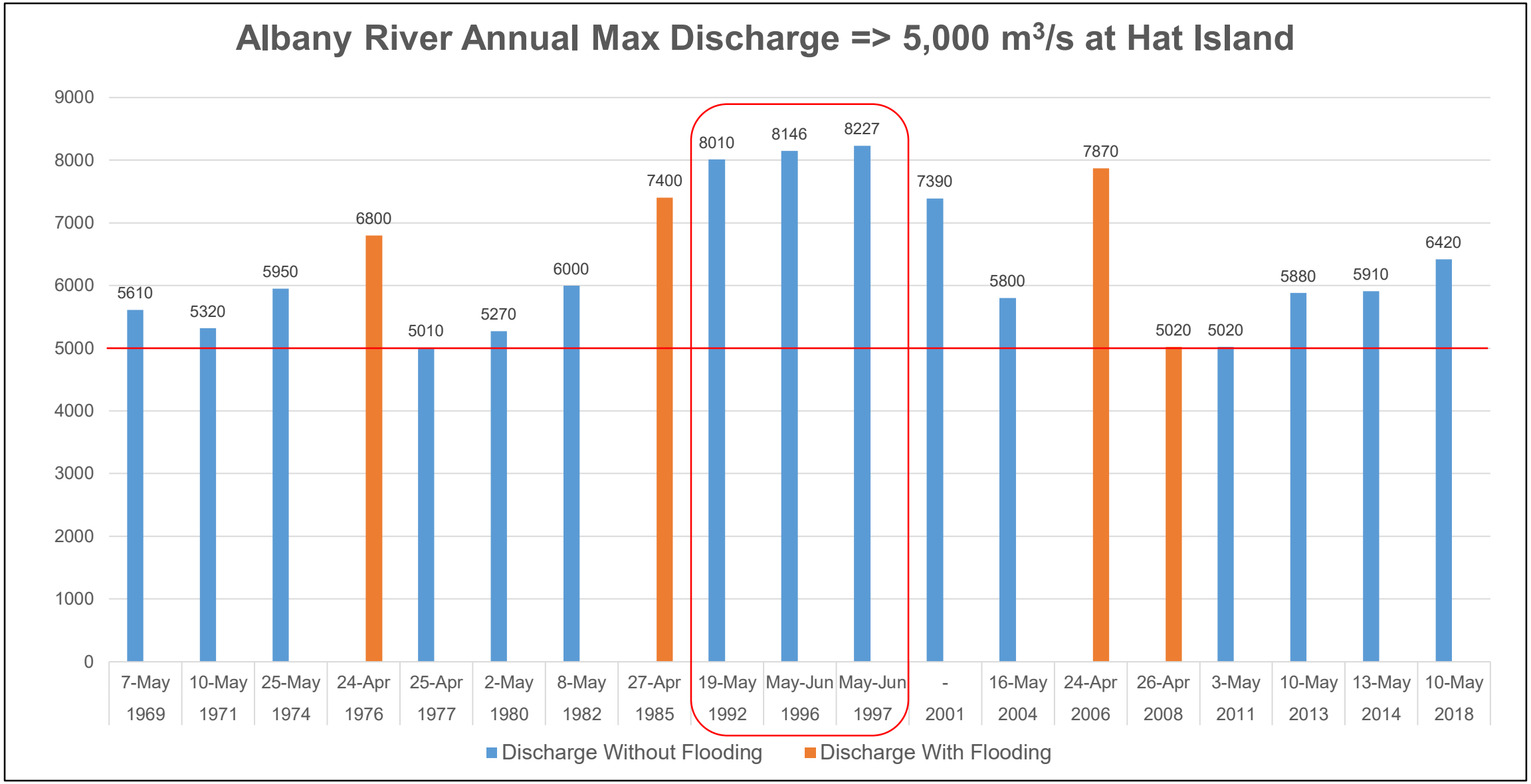
25.5
34
Kilometers


Albany River Annual Max Discharge => 5,000 m³/s at Hat Island
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5610
5320
5950
6800
5010
5270
6000
7400
8010
8146
8227
7390
5800
7870
5020
5020
5880
5910
6420
7-May 1969
10-May 1971
25-May 1974
24-Apr 1976
25-Apr 1977
2-May 1980
8-May 1982
27-Apr 1985
19-May 1992
May-Jun 1996
May-Jun 1997
- 2001
16-May 2004
24-Apr 2006
26-Apr 2008
3-May 2011
10-May 2013
13-May 2014
10-May 2018
Discharge Without Flooding
Discharge With Flooding

Results… 2.1. Flooding Risk Disrupts

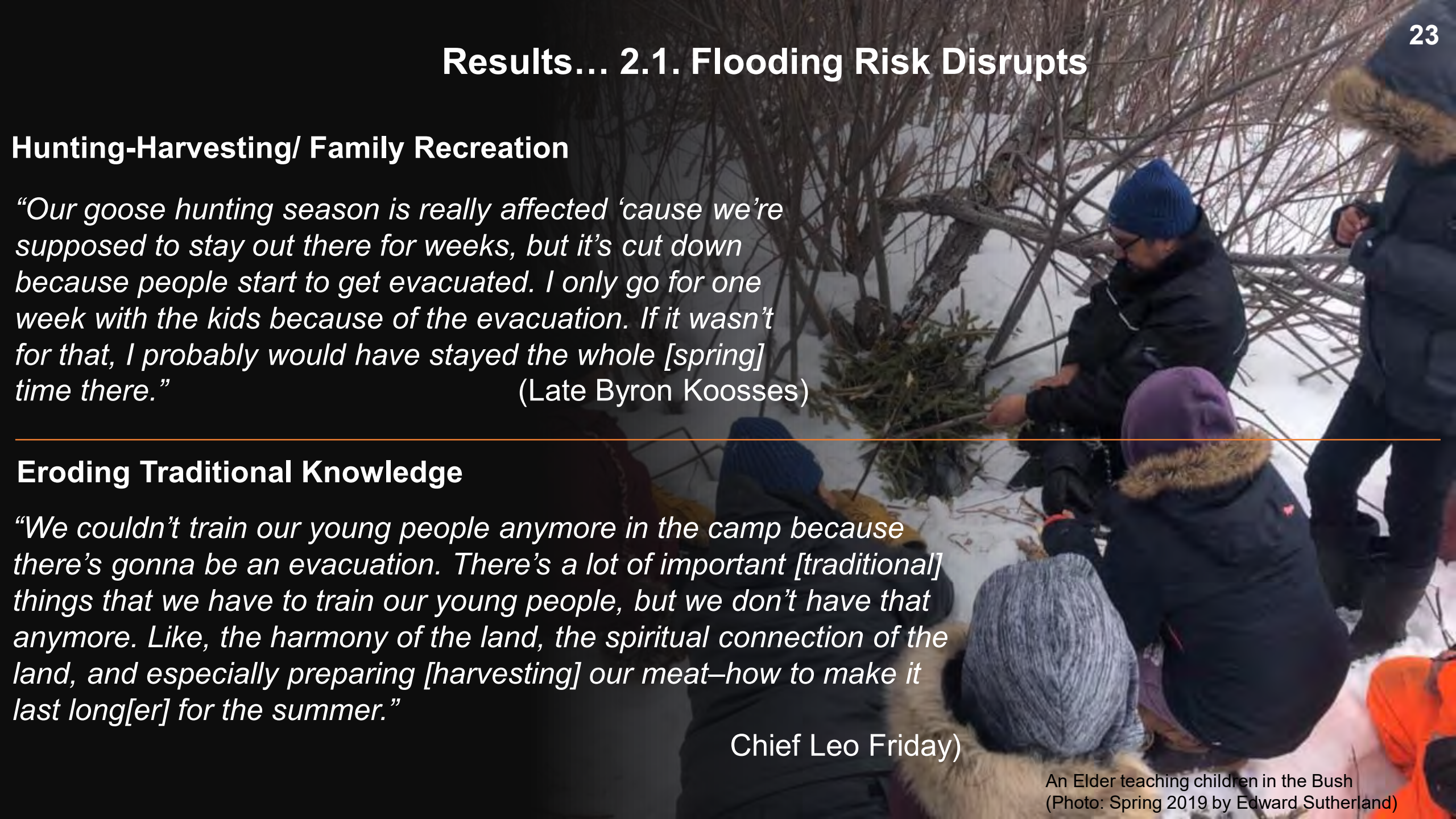
Hunting-Harvesting/ Family Recreation

"Our goose hunting season is really affected 'cause we're supposed to stay out there for weeks, but it's cut down because people start to get evacuated. I only go for one week with the kids because of the evacuation. If it wasn't for that, I probably would have stayed the whole [spring] time there." (Late Byron Koosses)

Eroding Traditional Knowledge

"We couldn't train our young people anymore in the camp because there's gonna be an evacuation. There's a lot of important [traditional] things that we have to train our young people, but we don't have that anymore. Like, the harmony of the land, the spiritual connection of the land, and especially preparing [harvesting] our meat–how to make it last long[er] for the summer."

Chief Leo Friday)



An Elder teaching children in the Bush
(Photo: Spring 2019 by Edward Sutherland)

Results… 2.2. Flooding Risk Impacts

Local Economy

"We have 50 employees–the majority are women. They're the first ones on the flights out [evacuated]. It'll be good for the community to have everybody back, and it'll also be good for the Store as well for sales. I mean, 'cause, if you think about it, we've lost 450 customers. We've lost those sales, so we're trying to make up those sales through the last three years."

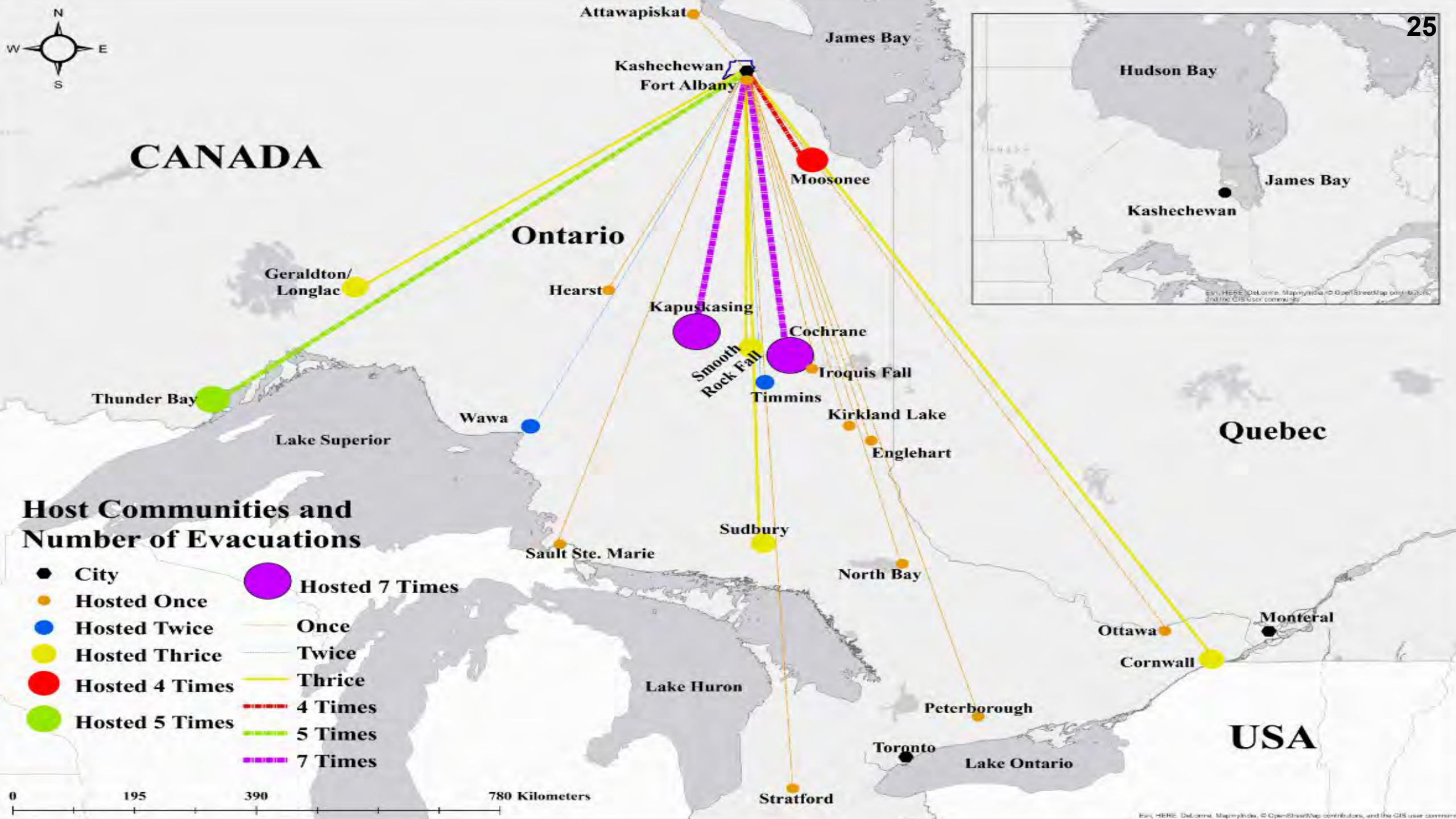
(Manager, Northern Store)

Socio-Cognitive: Pre-Evacuation

"When spring comes around, and they [residents] know there's gonna be a [ice] breakup. When I go to the kids in the classroom, they talk about it, they say, ''Cause of breakup are we gonna get flooded?'. People start to get worried lots when spring comes around. It really is stressful. It's too stressful and it's too dangerous."

(Elder William Sutherland)

Northern Store & Tim Horton's, Kashechewan (Photo: 25 November 2016)


N
W
E
S
CANADA
Ontario
Quebec
USA
Attawapiskat
James Bay
Kashechewan
Fort Albany
Moosonee
Hudson Bay
James Bay
Kashechewan
Geraldton/
Longlac
Hearst
Kapuskasing
Cochrane
Smooth
Rock Fall
Iroquis Fall
Timmins
Kirkland Lake
Englehart
Thunder Bay
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
North Bay
Ottawa
Monteral
Cornwall
Lake Huron
Peterborough
Toronto
Lake Ontario
Stratford
Host Communities and
Number of Evacuations
City
Hosted Once
Hosted Twice
Hosted Thrice
Hosted 4 Times
Hosted 5 Times
Hosted 7 Times
Once
Twice
Thrice
4 Times
5 Times
7 Times
0
195
390
780 Kilometers

Results… 2.3. Short-term Evacuations (1 Week–3 Months)

Evacuation Stress and Anxiety

"Every spring, every little child you talk to is just, 'Are we gonna evacuate now?' It's already set in their mind that when March comes around, they know there's gonna be a breakup, and they know there's gonna be an evacuation. So, it's already settled in their mind."

(Elder William Sutherland)

Longer Evacuations are More Stressful

"The longer you stay, the more stress you have–you stress out 'cause people are missing their traditional lifestyle. They want to come back. The biggest [thing] we miss out the traditional lifestyle–every year. Now, we get that evacuation to the city life–we don't want that."

(Elder David J.B Wesley)

Photo: Kashechewan Evacuees Land in Timmins, 15 April 2019 (timminstoday.com)

Results… 2.3 Short-term Evacuations

Family Separation

"It was very frustrating. I got separated from my family every time. When we get evacuated, we [siblings] all got sent to different places, and that takes even more away from the support that I have as a single parent. So, it was very frustrating."

(Tamara Koosees)

Death During Evacuation

"My uncle died in Thunder Bay when I was at the Longlac. We had to ask Liaison 'drive me to Thunder Bay where my family is'. A different place. [I was] sad because my family members weren't there. My dad, my mom, my granny, and my aunts, my uncles, they were wondering. We have to come home [Kashechewan] for a day trip only. Put [bury] our uncle in the graveyard. Two flights of big planes, maybe 40-50 [extended family]. I was happy that they [authorities] help[ed] out. I hate leaving him [dead] alone, going back to [host community]."

(Mathew Wesley)

Kashechewan Cemetery (Photo: 10 November 2016)

Results… 2.3. Short-term Evacuations

Racism

"I was sent out [evacuated] with my son 7-8 times, and I've been sent out every year since I was pregnant with her [2nd child]. We're isolated up here [Kashechewan]. Us being sent [evacuated] to a city, you've got racism; you got people [host cities] who don't want us there. People are being hollered at; stuff being thrown at them–'Go home! You're not wanted here!', teasing, you know."

(Tamara Koosees)

Other Fears

"A man grabbed them [kids] while they were playing in the hallway and took them into a room–that affected the whole community. Everybody was talking about it; not just the people that were based in that [host] community, and that brings out fear. It's fearful. Nobody wants their kids to be kidnapped or anything done to them–I was on guard."

(Tamara Koosees)

Photo: Kashechewan Evacuees Arrive Thunder Bay (tbnewswatch.com)

Results… 2.3. Short-term Evacuations

Recurring Evacuations and Preparedness

"People are usually prepared by that time [March], that they don't plan anything around it [spring]. I'm prepared. I prepare my stuff 1-2 weeks ahead of time. If I have to go in a matter of hours, this is what I'll take important documents and clothes. The preparedness is a little bit more organized each year as it goes."

(Participant 15)

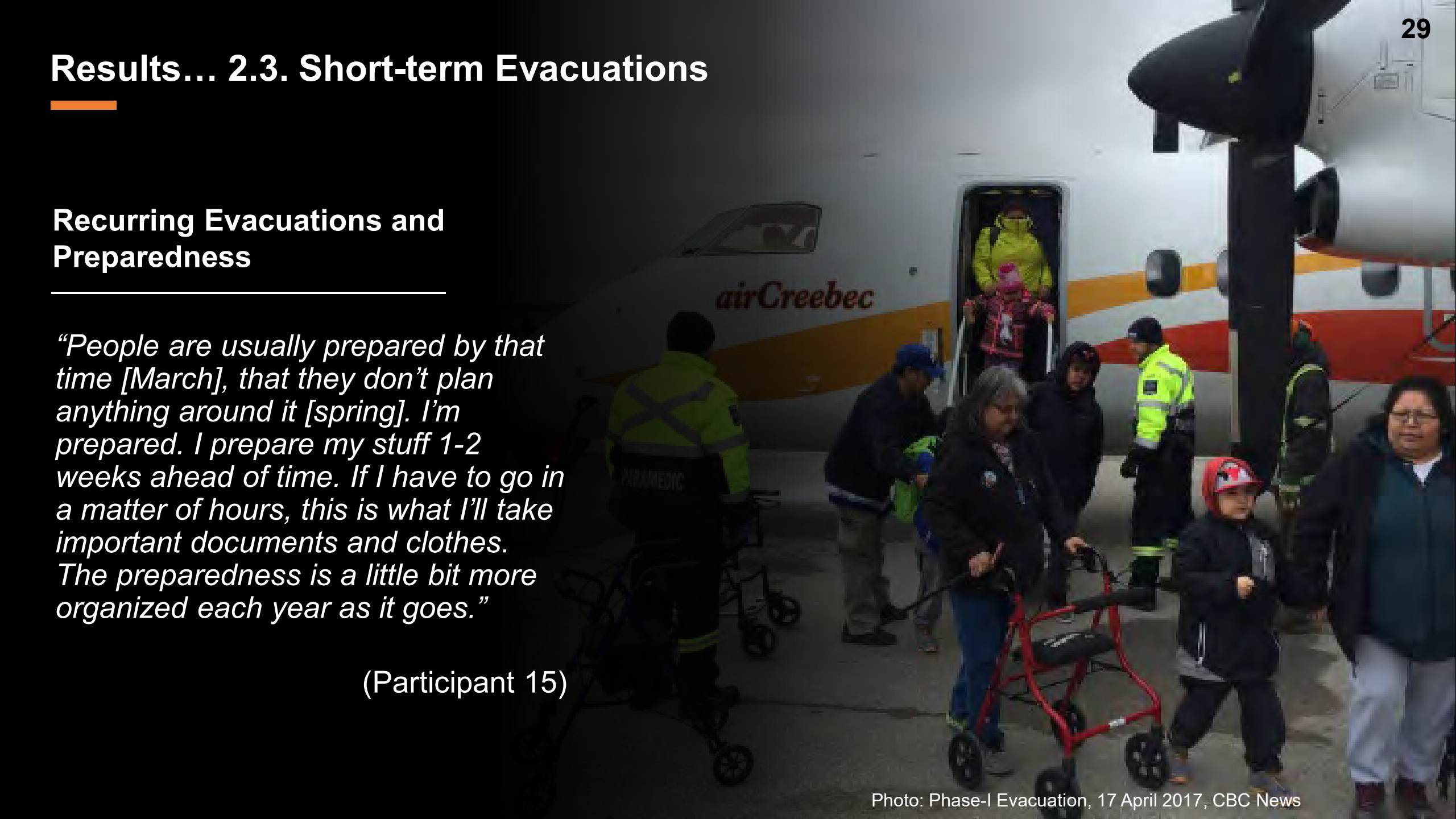


Photo: Phase-I Evacuation, 17 April 2017, CBC News

Results… 2.4. Long-term Evacuation (3 Years; 2014-2017)

Socio-Cultural Disconnect

"There was no relationship anymore with our people. Strange, you know. They all have their heads down each time we come [to Kashechewan] and bury someone. No more handshakes; no communication. When that happened and we went back to Kapuskasing, it felt strange. Our own people are departing from us. Like, we don't want to come home. Because we adjusted over there [Kapuskasing] now."

(Paul Wesley, Long-term Evacuee)

Newly Built Houses for Long-term Evacuees (Photo: 15 November 2016)

Results… 3.1-2. Perception and Willingness

Flood Risk:

- 65% perceive the risk is very high or high; 7.7% think low or very low.
- Age and education has positive relationship with risk perception.
- 76% think relocation is the best solution.
- 82% are willing to relocate 30 km upriver .

(1957-2017)

Preparedness:

- > 82% strongly agree or agree they are prepared for future floods.
- > 77% think frequent emergencies have better prepared them.

60th Kashechewan Anniversary Celebrations (Photo: 20 November 2016)

Results… 3.3-4. Correlation and ANNOVA

Spearman's Correlation:

Determinant	rho	Effect Size (%)
1. Social Capital–Human Capital	0.356	12.67
2. Social Capital–Governance	0.352	12.39
3. Social Capital–Others	0.467	21.81
4. Human Capital–Governance	0.467	21.81
5. Human Capital–Others	0.476	22.66
6. Governance–Others	0.299	8.94

Friedman's ANOVA:

Determinant	χ2	Effect Size (%)
1. Social Capital	52.163	19.3
2. Human Capital	104.569	29.0
3. Governance	49.687	11.0
4. Others	119.760	26.6

Conclusion

- Flood timing and extent has changed with warming springs;
  - earlier spring,
  - snowmelt,
  - rapid runoff.
- Flood impacts on infrastructure are exacerbated by landscape and resource development.
- Hydro-meteorological and ecological changes have increased the frequency and scale of breakup ice jams; caused an increased flood risk.
- Significantly increased physical and socio-cognitive vulnerability.
- The increased flood risk is impacting community;
  - infrastructure,
  - Hunting-harvesting,
  - local economy,
  - stress and anxiety (pre-evacuation).

Albany River, East Dike, Kashechewan (Photo: 10 November 2015)

Conclusion… continued.

- Repeated evacuations have increased residents' social, cultural, and psychological vulnerability; negatively affecting well-being.
- Risk perception and perceived capacity are high: Reshaped adaptive behavior.
- Evidence from multiple sources → Improved preparedness, coping capacity.
- Strong + correlations → high perceived capacity.
- Higher perceived capacity → greater total adaptive capacity → enhanced community resilience.

South Dike, Kashechewan (Photo: 10 November 2015)

The Way Forward

- The First Nation should be evacuated to neighboring reserves near their camping and hunting grounds with permission to hunt.
- Methodological approach and participatory techniques can be useful for ongoing flood mapping, monitoring, and DRR activities in the region.
- Perceived capacity equally important: Both perceived and objective capacities determine total adaptive capacity.

West Dike, Kashechewan (Photo: 10 November 2015)

Acknowledgements

"You [Arshad] have to be an 'Indian' to understand [spring flooding]."

(Elder William Sutherland)

Thanks to all funding agencies, Dr. Tara McGee and Dr. Brenda Parlee, and special thanks to Chief Leo Friday, Elder William Sutherland, advisory committee, all research participants, and the entire First Nation community.

Sunset at Kashechewan; Project Fieldwork Closing (Photo: 22 November 2018)

Arun Pallathadka

Ph.D. Student, Portland State University

Urban Flood Risk and Green Infrastructure: Who is exposed to risk and receives benefits?: A case study of three US cities

URBAN FLOOD RISK AND GREEN INFRASTRUCTURE: WHO IS EXPOSED TO RISK AND RECEIVE BENEFITS?: A CASE STUDY OF THREE US CITIES

ARUN PALLATHADKA (PSU), JASON SAUER (ASU), HEEJUN CHANG (PSU), NANCY GRIMM (ASU)

Portland State UNIVERSITY

ASU

NSF

URExSRN

WHAT IS PLUVIAL FLOODING?

- Pluvial flooding occurs when precipitation intensity exceeds the capacity of natural and engineered drainage systems (Rosenzweig et al., 2018)
- Also known as urban flooding, nuisance flooding, and may in some instances be known as flash flooding

This Photo by Evan bell, KATU

WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure (GI) encompasses a variety of water management practices, such as vegetated rooftops, roadside plantings, absorbent gardens, and other measures that capture, filter, and reduce stormwater. In doing so, it cuts down on the amount of flooding and reduces the polluted runoff that reaches sewers, streams, rivers, lakes, and oceans. Green infrastructure captures the rain where it falls (EPA)

This Photo by © Environmental Services, City of Portland Oregon

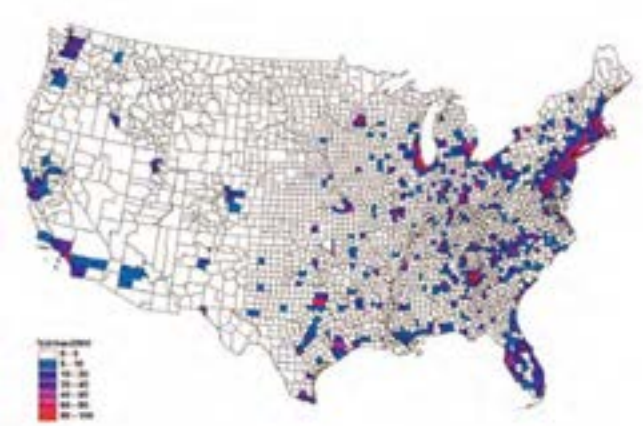
BACKGROUND

- The growth of urban areas is estimated to increase from 3.1% in 2000 to 8.1% in 2050 (Nowak & Walton, 2005)

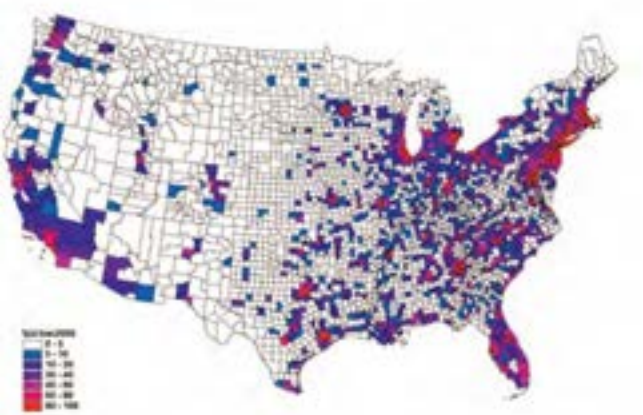
- Impervious surfaces (roads, walkways, driveways, patios, etc.) have increased as a result of urbanization, limiting rainwater runoff and infiltration. This is a primary source of urban pluvial flooding, causing enormous losses of property and life (Cutter el al. 2018)

- Flooding is the most frequent and expensive disaster in the United States; 90 percent of natural disasters in the United States involve a flood (Wright, 2017)

2000



2050



Source: Nowak, D.J. & Walton, J.F. (2005). Projected Urban Growth (2000 – 2050) and Its Estimated Impact on the US Forest Resource. Journal of Forestry

NOT SO EQUAL FLOOD!

- In the United States, people of color face socioeconomic challenges rooted in racial inequality

- Communities of color suffer disproportionate damages from natural disasters including floods (Peacock et al. 1997; Peacock et al. 2006; Fothergill et al. 2004; Zahran et al. 2008)

- As pluvial flooding worsens, communities of color could face the greatest harm

Photo by Michael Lloyd/The Oregonian

THE ROLE OF GI

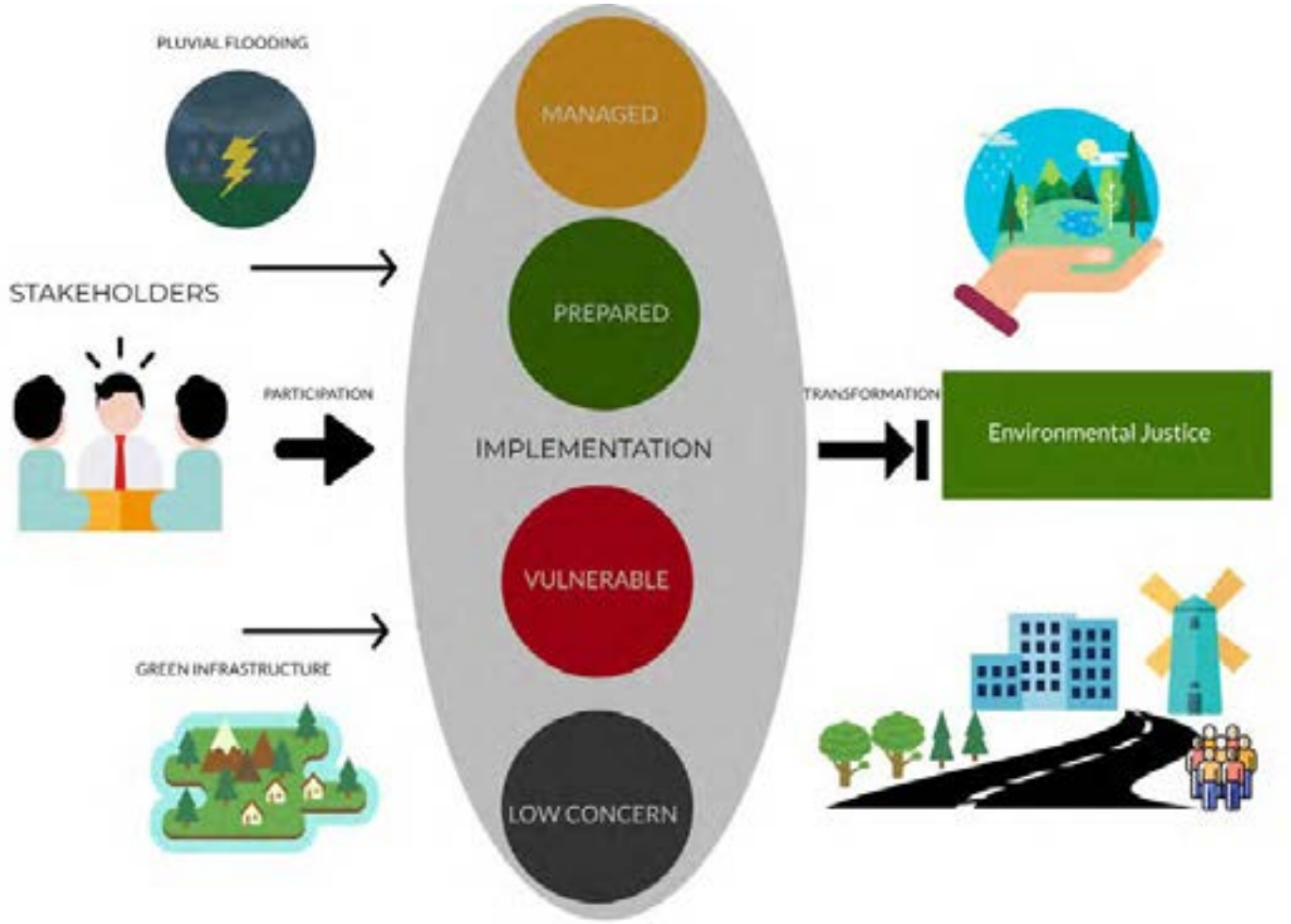
- Cities have increasingly deployed GI in recent years

- Though many cities have deployed GI with the primary intent of managing water quality rather than quantity (Rosenzweig et al., 2018), **models have shown that GI can be effective at reducing the risk of pluvial flooding** (Maragno et al., 2018, Pappalardo et al., 2018)

- However, GI is often allocated unequally (Nesbitt et al., 2019)

CONCEPTUAL FRAMEWORK

- Cities with a thorough knowledge of flood and social vulnerability will guarantee adequate stakeholder engagement (Eberts et al., 2006)
- Stakeholder participation will make it easier to identify trouble areas (Benner & Pastor, 2016)
- An optimal system must guarantee that **all four circles** cross the line of adequate environmental justice to transform as a city that works for all



Classification

Name	Consequence
Vulnerable	High Risk
Managed	Moderate Risk
Prepared	Low Risk
Low Concern	Low Risk

Research Questions

Q1

How are GI and racial and ethnic minority groups distributed among areas at risk of pluvial flooding?

We hypothesize that racial and ethnic minority groups are more likely to live in areas of greater pluvial flood risk and have relatively fewer nearby GI elements

Q2

Are cities prepared, managed or vulnerable to pluvial flooding (based on our conceptual framework?

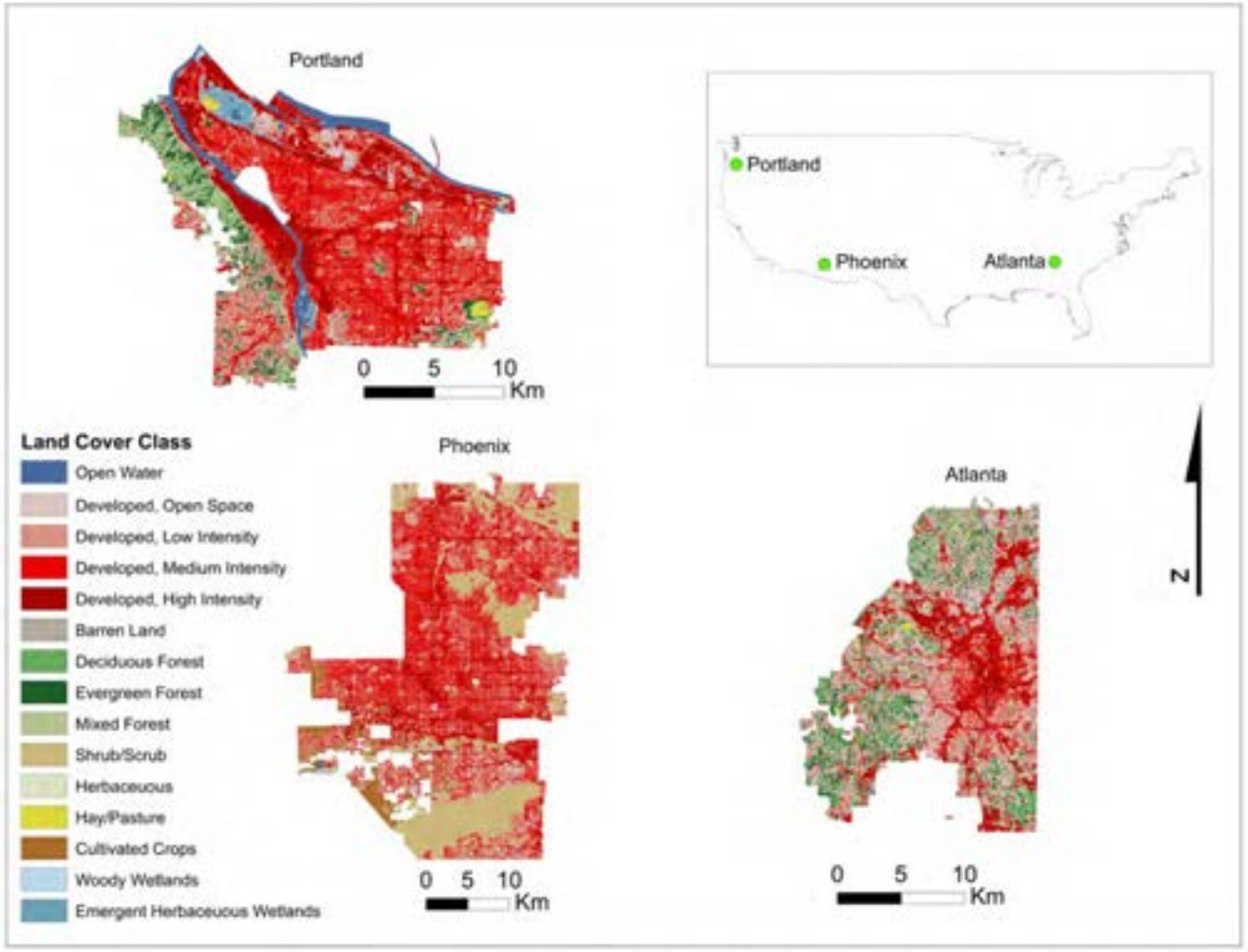
We hypothesize that areas (represented by their census block group hot spots) of significant racial and ethnic population are more likely to be vulnerable, whereas areas (represented by their census block group hot spots) of significant white population are more likely to be prepared or managed

Q3

Is GI distribution becoming more or less concentrated in neighborhoods of racial and ethnic minorities?

We hypothesize that GI distributing is becoming more concentrated in areas of flood risk, but not necessarily in areas of racial and ethnic minorities which may have significant flood risk

STUDY AREA



Why these cities?

- Severe and Extreme Flood cases are projected to increase
- All cities are growing
- All cities are located inland

	DATA	SOURCES
1	• Lidar Digital Elevation Model (0.5 - 1.83 m resolution)	• USGS / State Data Clearinghouse / City GIS Department
2	• Socioeconomic Data	• American Community Survey-2018 (5-year estimates), US Census Bureau
3	• Green Infrastructure Layer	• City GIS Department

Methods

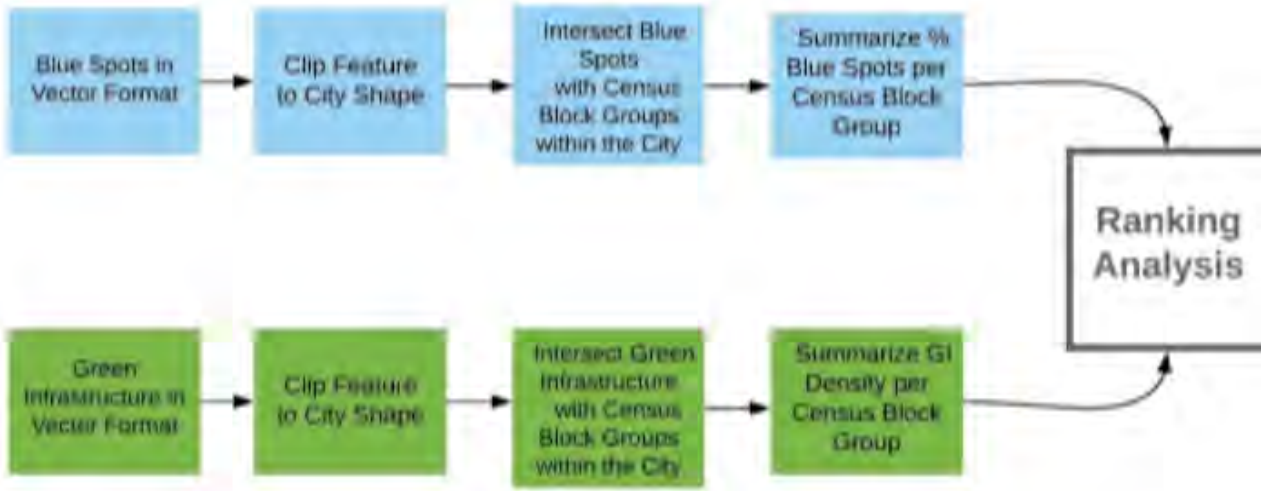
- We employed the Arc-Malstrøm method developed by Balstrøm and Crawford (2018) To estimate areas where pluvial flooding is likely to occur during intense precipitation events in our study cities

- This method uses high resolution digital elevation models (DEMs), typically generated through LiDAR methods, to create a 1-dimensional model of sinks in the landscape, hereby referred to as blue spots

Spatial Analysis

- Using standard normalization method, we normalized the values of bluespot and GI

$$V_i = \frac{X_i - X_{imin}}{X_{imax} - X_{lmin}}$$

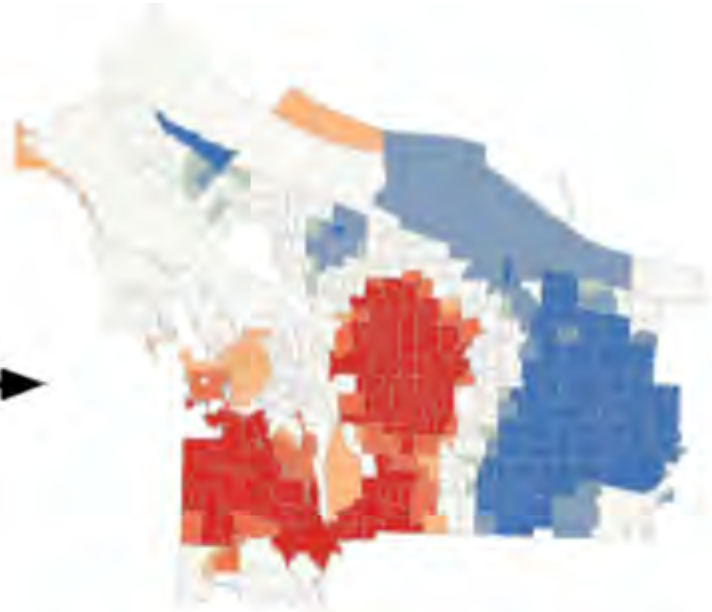


- The top quartile values were then isolated and ranked using the following method

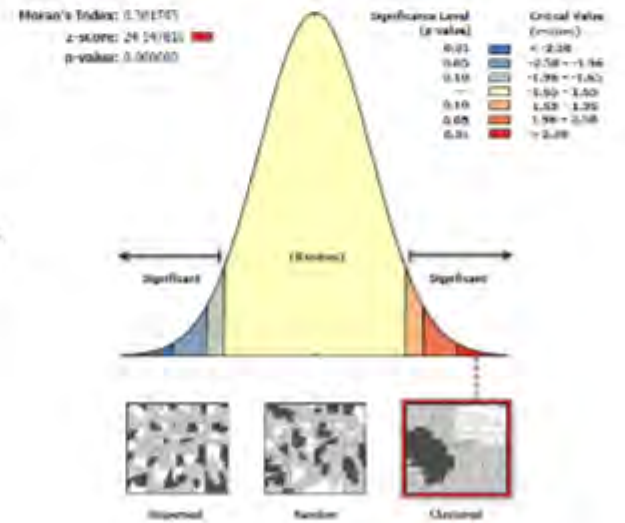
Top 25% GI	Top 25% Blue Spots	Prepared (High GI + Low Blue Spots)	Vulnerable (High Blue Spots, Low GI)	Managed (High Blue Spots, High GI)	Low Concern (Low Blue Spots, Low GI)
Rank 1	Rank 2	1	2	1+2 = 3	0

Statistical Analysis

- We used the Getis-Ord Gi* method of hotspot analysis to identify tendencies for positive spatial clustering of demographic characteristics in cities, and to distinguish between block groups of high and low spatial associations (Getis et al. 1992, Ord et al. 1995)

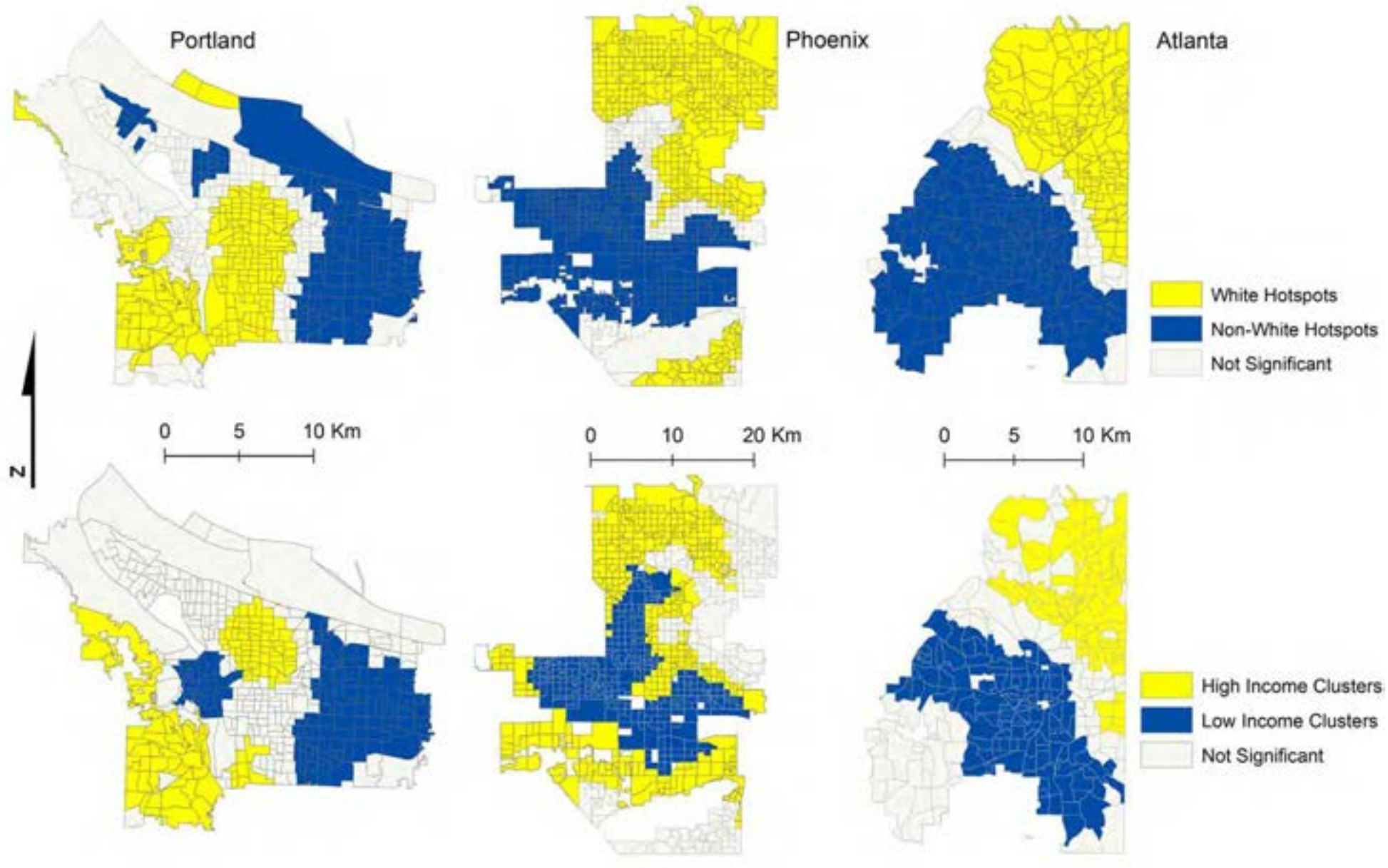


- We also used Global Moran's I to test the significance of variables



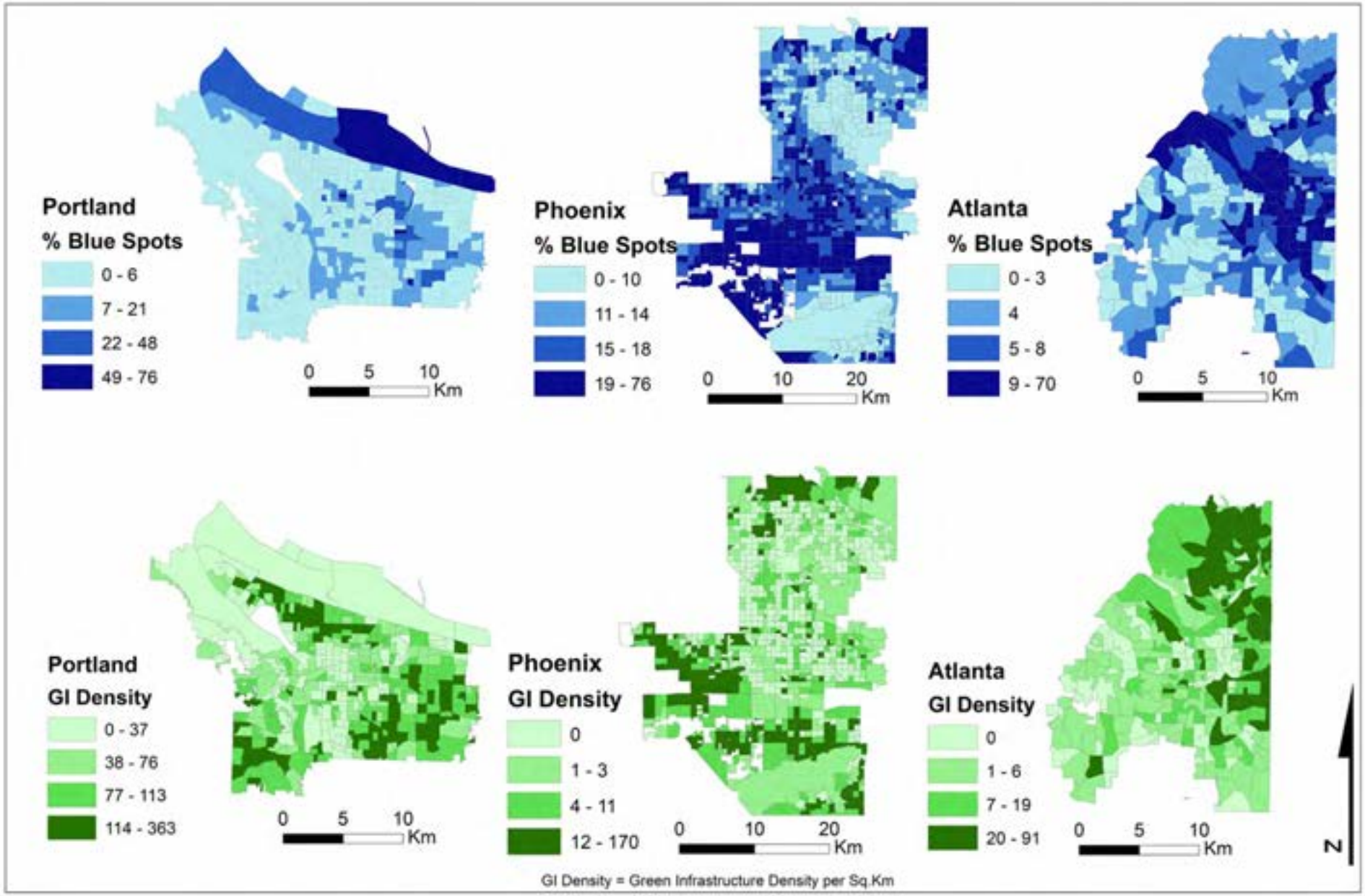
Examples of Hotspot Analysis and Global Moran's I Test for Portland's White Population at Census Block Group-scale

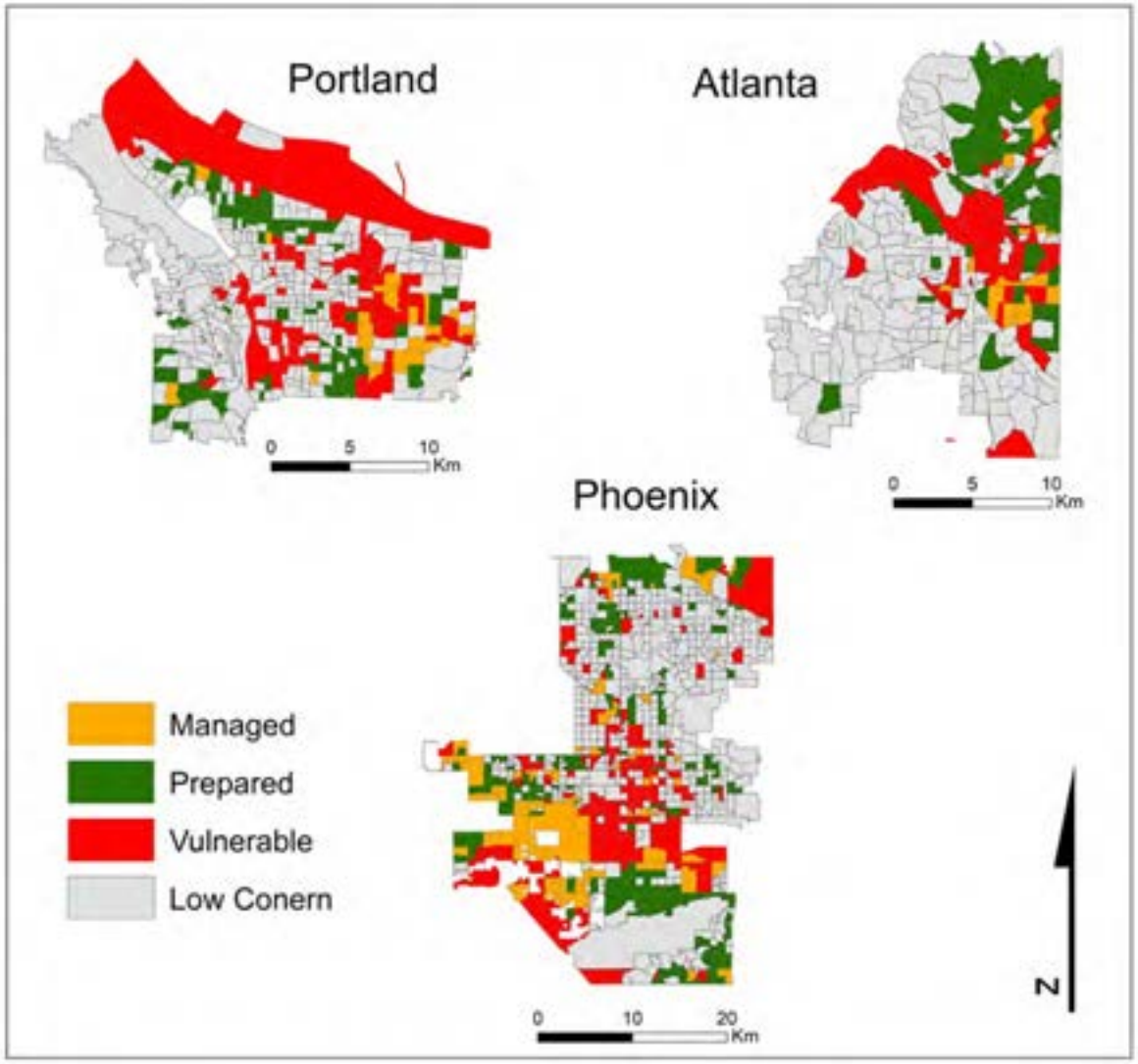
Hot Spot Analysis



All Spatial Patterns show clustering at **p < 0.01 or p < 0.05**

Spatial Analysis Results

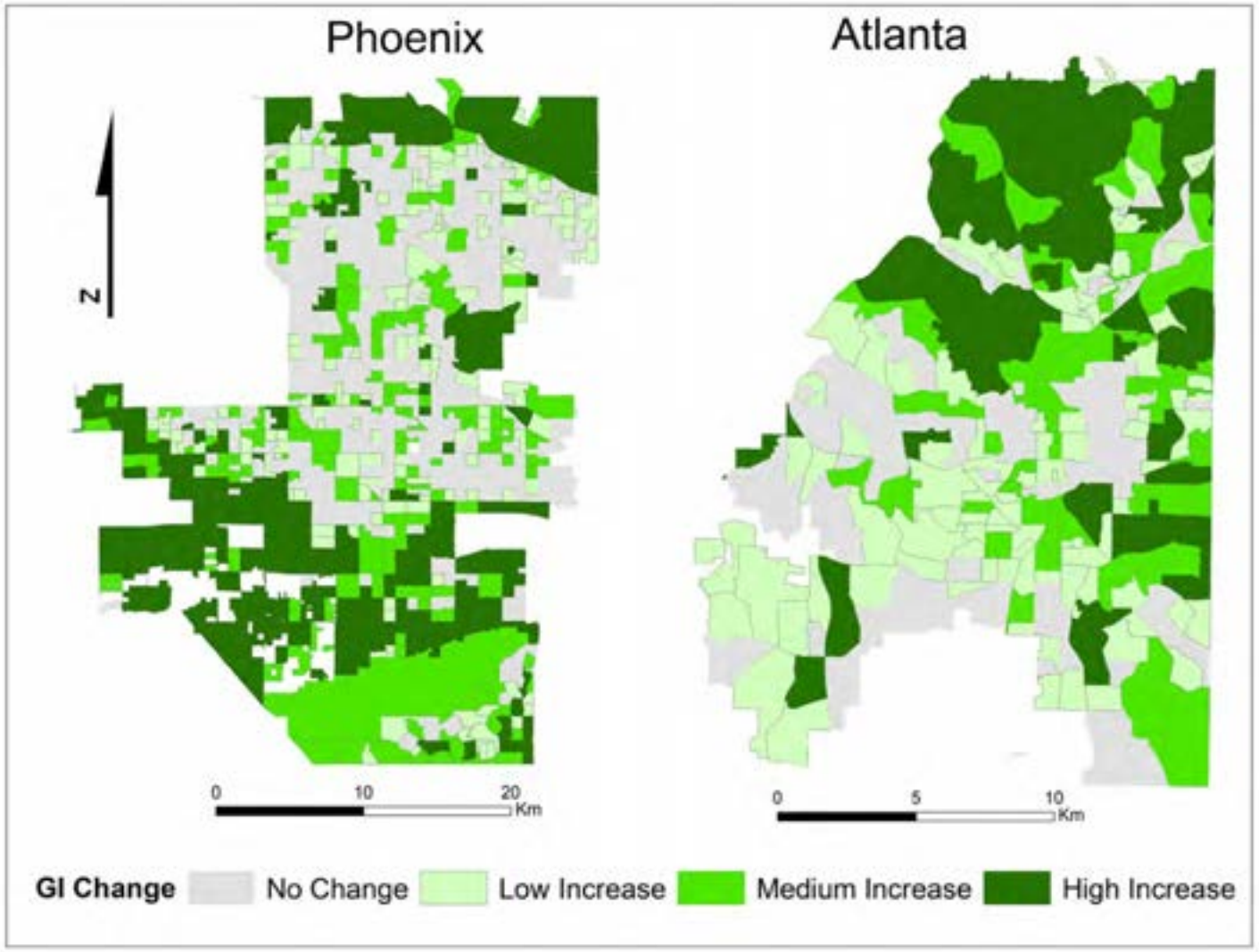




Rank Analysis Result

Name	Consequence
Vulnerable	High Risk
Managed	Moderate Risk
Prepared	Low Risk
Low Concern	Low Risk

Temporal Analysis Result



Statistical Analysis Result

City	Atlanta (n=302)	Phoenix (n=944)	Portland (n=449)
Correlation Coefficient (r) X = % Blue Spots Y = GI Density		**0.15****	- 0.10*
X = % Blue Spots Y = White Population		**-0.34****	**-0.17****
X = % Blue Spots Y = Non-white Population		**0.33****	**0.17****
X = GI Density Y = White Population	**0.50****	**-0.20****	**0.28****
X = GI Density Y = Non-white Population	**-0.49****	**0.19****	**0.29****

**p < 0.01
* p < 0.05

Correlation Coefficient Test

MAJOR FINDINGS

- Non-white population communities are more likely to live in areas of greater pluvial flood risk
- Non-white population communities in Portland and Phoenix are increasingly receiving GI protection in their neighborhoods
- Non-white population is more likely to be “Vulnerable” or “Managed” according to our framework, compared to White population, which is more likely to be “Prepared” or “Managed”
- Our findings of vulnerable and managed neighborhoods align with a 2013 City of Portland study of neighborhoods under risk of gentrification

- Bluespot limitations - single input (DEM), non-consideration of pre-existing infrastructure, lack of physical verification of water networks, etc.

- GI limitations - definition unclear and implementation uneven

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- Gentrification is a huge obstacle to the equitable distribution of GI

- Other social and economic factors need to be considered in flood mitigation planning

- Parcel level flood analysis would provide an even clearer view of flood risk and who is impacted

Acknowledgements

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Portland State UNIVERSITY

ASU

UREx SRN

NSF

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Appendix 1

Field	City	Atlanta (n=302)	Phoenix (n=944)	Portland (n=449)
% Blue Spots	Moran's Index Value	0.16**	0.22**	0.10*
	Spatial Pattern	clustered	clustered	clustered
Green Infrastructure Density	Moran's Index Value	0.11*	0.15**	0.31**
	Spatial Pattern	clustered	clustered	clustered
White Population Hotspots	Moran's Index Value	0.76**	0.66**	0.30**
	Spatial Pattern	clustered	clustered	clustered
Non-White Population Hotspots	Moran's I Index Value	0.76**	0.67**	0.32**
	Spatial Pattern	clustered	clustered	clustered

**$p < 0.01$
* $p < 0.05$

Global Moran's I Test

Sara Hughes

Assistant Professor, University of Michigan

@Prof_Shughes

The Implications of Urban Flood Risk Data for Policy, Planning, and Racial Justice: A Case Study of Detroit, Michigan

The Implications of Urban Flood Risk Data for Policy, Planning, and Racial Justice: A Case Study of Detroit, Michigan

Sara Hughes
University of Michigan

Sarah Dobie
University of Michigan

Climate Adaptation Research Symposium
September 8, 2021

SCHOOL FOR ENVIRONMENT & SUSTAINABILITY
UNIVERSITY OF MICHIGAN

The Problem

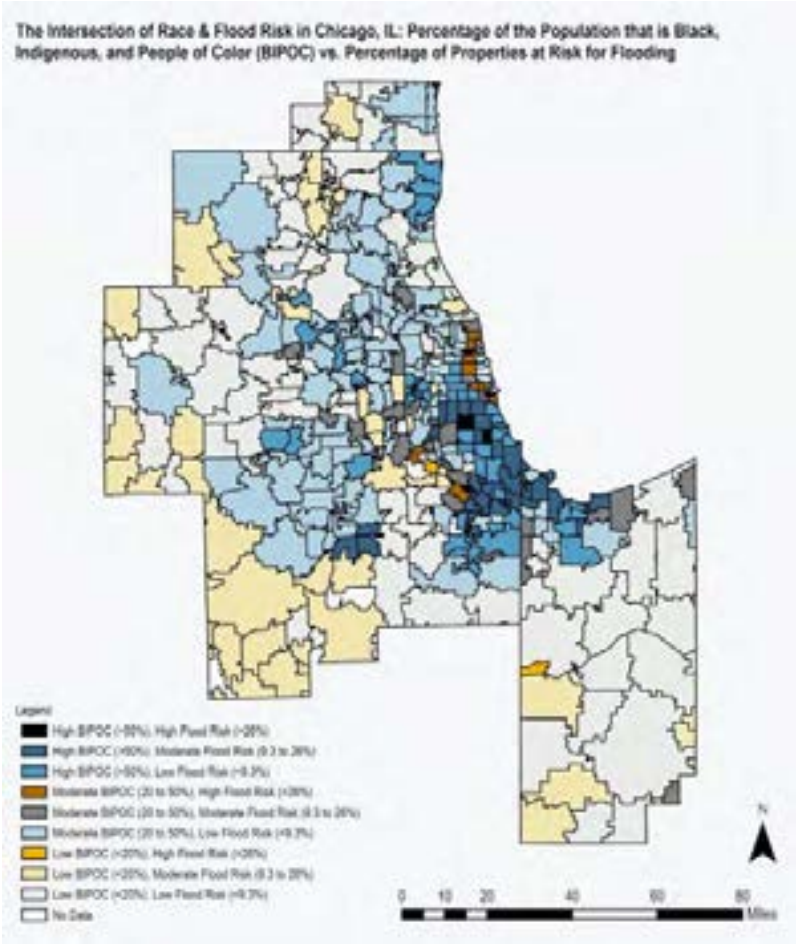
U.S. cities face intertwined challenges of climate change and racial inequality; decision makers are increasingly aware but not always sure how/where to start.

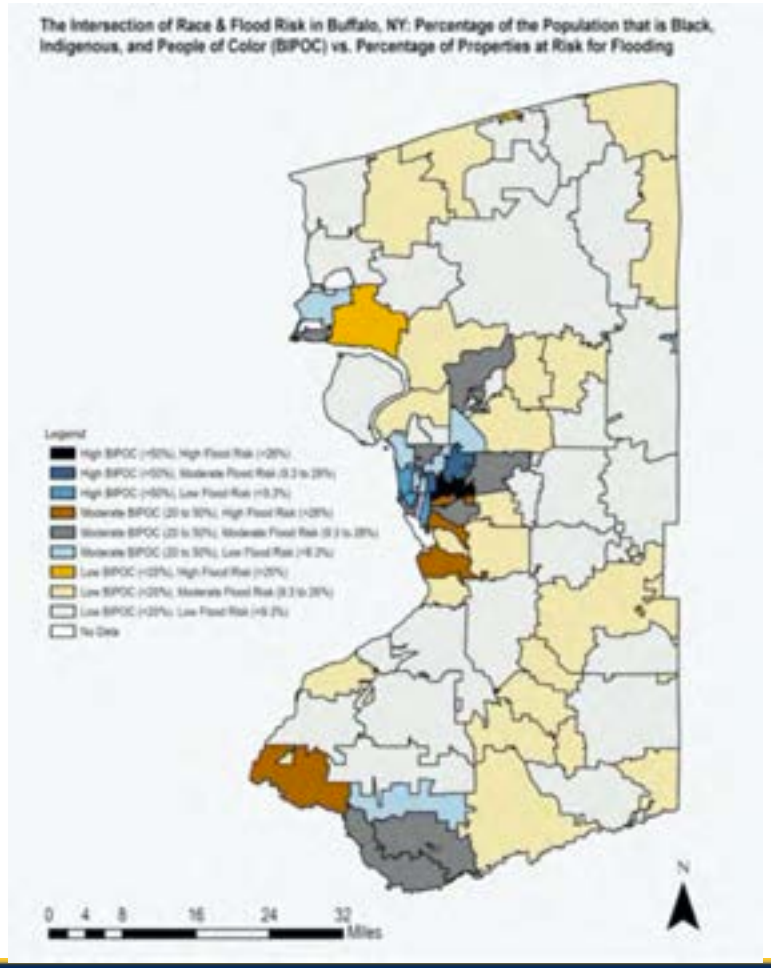
Source: Detroit News, August 27, 2021

Initial Focus: Great Lakes Region

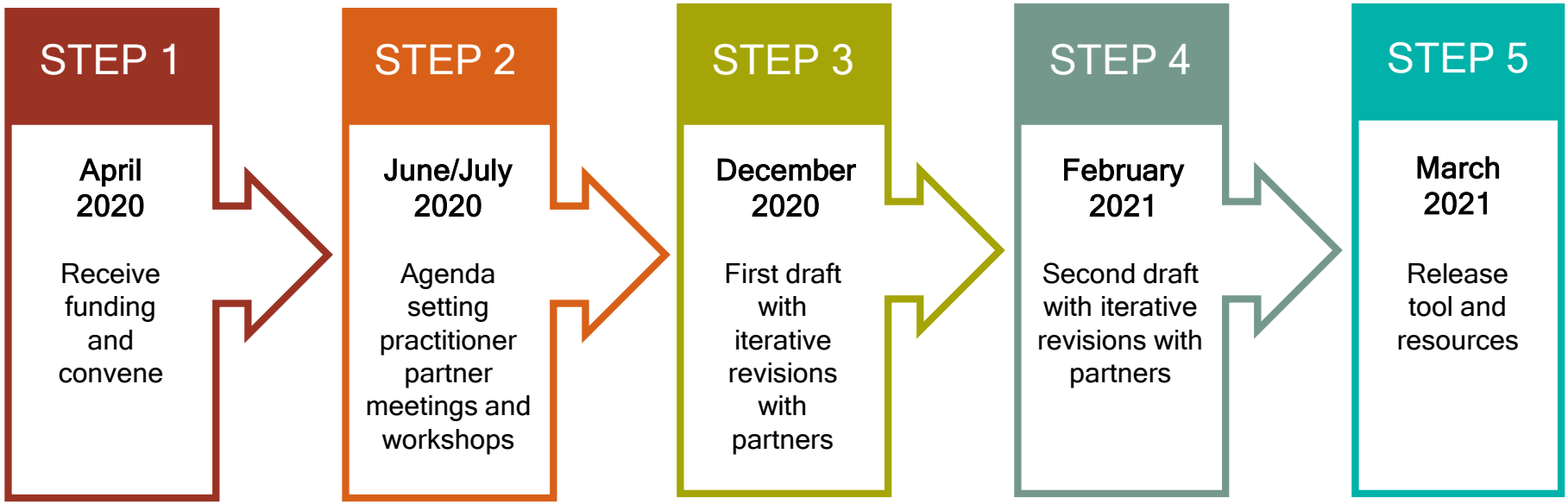
- Great Migration saw more than 6 million African Americans move to the region
- Today, 15 of the 25 most segregated U.S. cities are here
- High levels of income and wealth inequality
- Region faces increased flooding risk from climate change

Great Lakes Region





Co-Creating Racial Justice Resources and Tools for Urban Adaptation Planning



Result:

http://graham.umich.edu/just-resilience-planning

5 Principles for Centering Racial Justice

1. Focus on Root Causes
2. Institutionalize Representation
3. Co-Own Planning Efforts with Communities
4. Center Equity in Data Collection and Analysis
5. Facilitate Cross-Sector Collaboration

1. Focus on Root Causes

1. **FOCUS ON ROOT CAUSES.** Urban flood resilience plans and policies can address root causes of racial injustice, such as poverty, racial segregation, income and wealth inequity, and loss of social capital and cohesion. Adopting an anti-racist approach to flood adaptation will ensure that racial injustice is not perpetuated in the pursuit of resilient cities.

Bounce Forward: Urban Resilience in the Era of Climate Change is a strategy paper released by Island Press and the Kresge Foundation in 2015. The paper provides an Urban Resilience Integrated Framework which can be used as a guide for making equitable decisions in the initial stages of flood adaptation planning and continuously revisited. https://www.resilience.org/resources/bounce-forward-urban-resilience-in-the-era-of-climate-change/

2. Institutionalize Representation

2. **INSTITUTIONALIZE REPRESENTATION.** Representation in decision-making and local government is key to racial justice in urban flood resilience. Representation supports implementation of urban flood resilience plans and helps center racial justice concerns. City governments should ensure equitable representation in their workforce composition and advancement, retention, and hiring practices.

The Urban Sustainability Directors Network has published a fact sheet providing guidance on centering equity in recruitment, hiring, and retention for sustainability departments, environmental organizations, and any practitioners who might find it useful: https://www.usdn.org/uploads/cms/documents/usdn-equity-in-recruitment_hiring_retention.pdf

3. Co-Own Planning Efforts with Communities

3. **CO-OWN PLANNING EFFORTS WITH COMMUNITIES.** Urban flood resilience planning must share decision making power with communities and center their lived experiences and histories. Planners can support this co-production of urban flood resilience plans by using participatory design and community engagement strategies.

People United for Sustainable Housing (PUSH Buffalo) founded the Green Development Zone (GDZ) program to address resident concerns of vacant lots and unaffordable utility bills in the West Side neighborhood. As a community developer, PUSH Buffalo purchased several lots and hired and trained neighborhood residents to redevelop them into green spaces and sustainable, energy-efficient housing.

4. Center Equity in Data Collection and Analysis

4. CENTER EQUITY IN DATA COLLECTION & ANALYSIS. The evaluation of urban resilience solutions must also center racial justice. Evaluations should engage frontline communities in the design of the data collection process and evaluation, and incorporate both quantitative and qualitative forms of data.

Detroiters Working for Environmental Justice (DWEJ) ran a program that trained a cohort of local youth organizers in identifying spatial hazards and sites for rehabilitation using GIS. The program, called Build Up Detroit, became a widely-recognized example of centering equity in data operations and co-ownership of planning initiatives within a community.

5. Facilitate Cross-Sector Collaboration

5. **FACILITATE CROSS-SECTOR COLLABORATION.** There are often multiple departments and agencies directly or indirectly involved in flood management and adaptation and helping to determine their consequences for racial justice. Watersheds and floodplains cross jurisdictional boundaries, necessitating cooperation at a regional scale as well. Policy makers and planners should not only engage other government entities but also non-profits, community groups, and neighborhood associations, as well as partners in the public sector to ensure actions are coordinated and well-integrated.

Milwaukee Metropolitan Sewerage District (MMSD) is a regional agency providing water reclamation and flood management services to the Greater Milwaukee Area. MMSD runs a business development program offering coaching and consulting services as well as networking opportunities to local small businesses owned by veterans, minorities and women. This program demonstrates one way to promote equity in flood management while reaching across sectors to facilitate greater collaboration.

Data Inputs and Flood Risk Planning

- Riverine (fluvial) and stormwater (pluvial) flooding risks have very different drivers
- Typically operating with outdated or incomplete information on flood risks, especially at smaller scales
- Range of methods for collecting this information

Data Inputs and Flood Risk Planning

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- Typically operating with outdated or incomplete information on flood risks, especially at smaller scales
- Range of methods for collecting this information

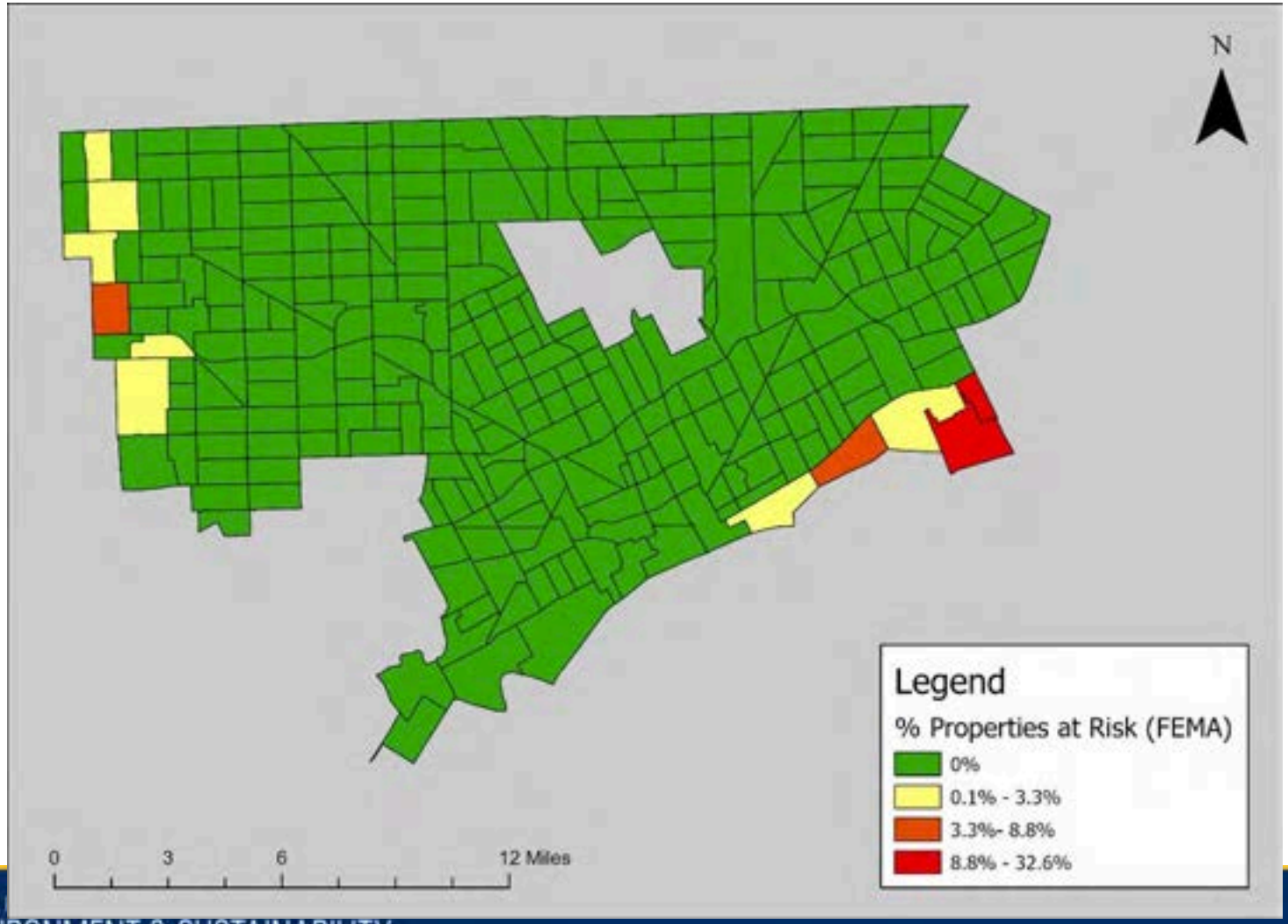
How do different measures of flood risk change our understanding of: (1) the extent of flood risk in a city; (2) the location of risk geographically; and (3) the distribution of risk based on race and income?

Detroit Case Study: Comparing Three Measures of Flood Risk

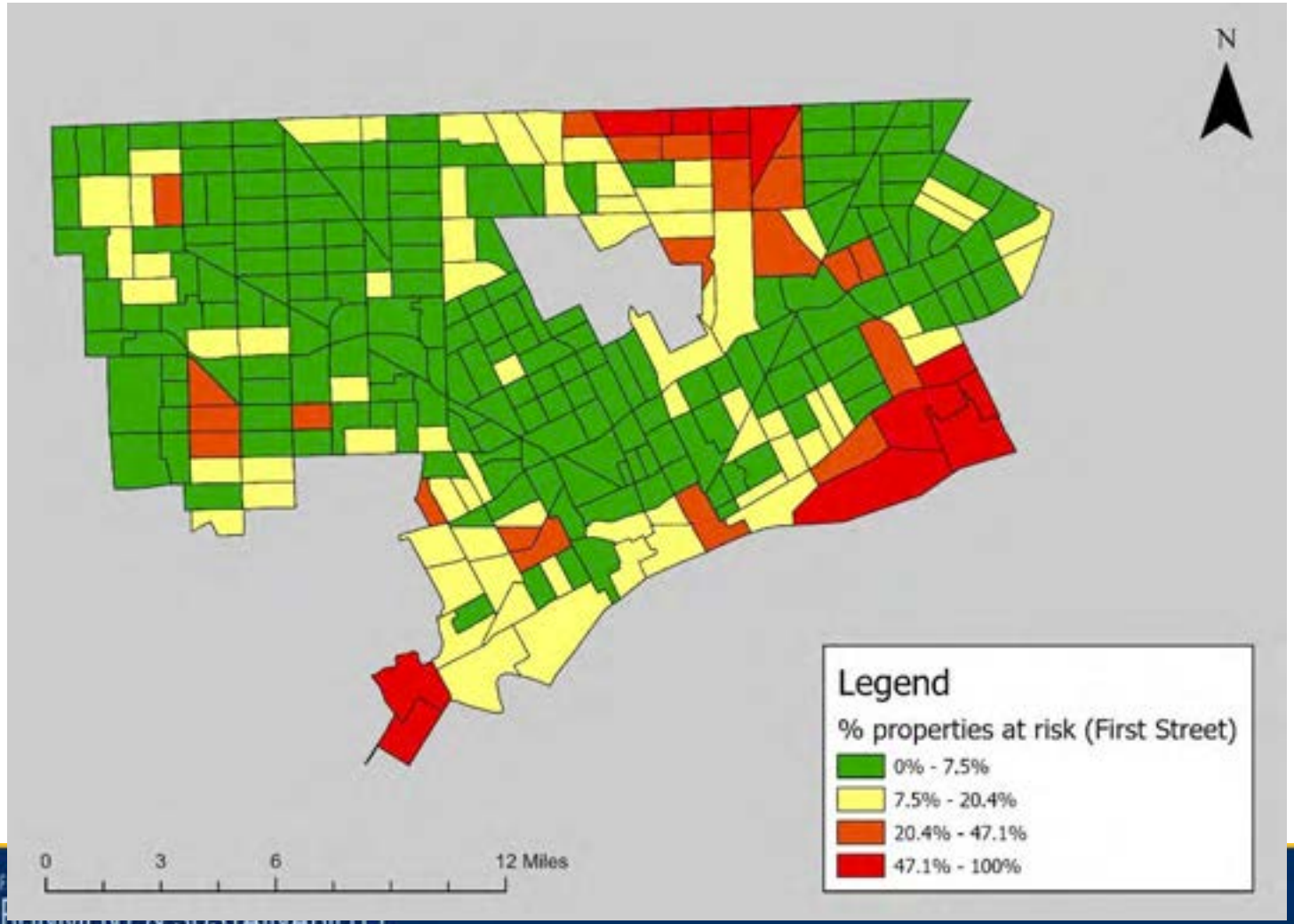
1. FEMA flood maps (100-year floodplain)
2. First Street Foundation Flood Factor Data (>2)
3. Survey data (report flooding in their homes)

% of properties at risk at census tract scale

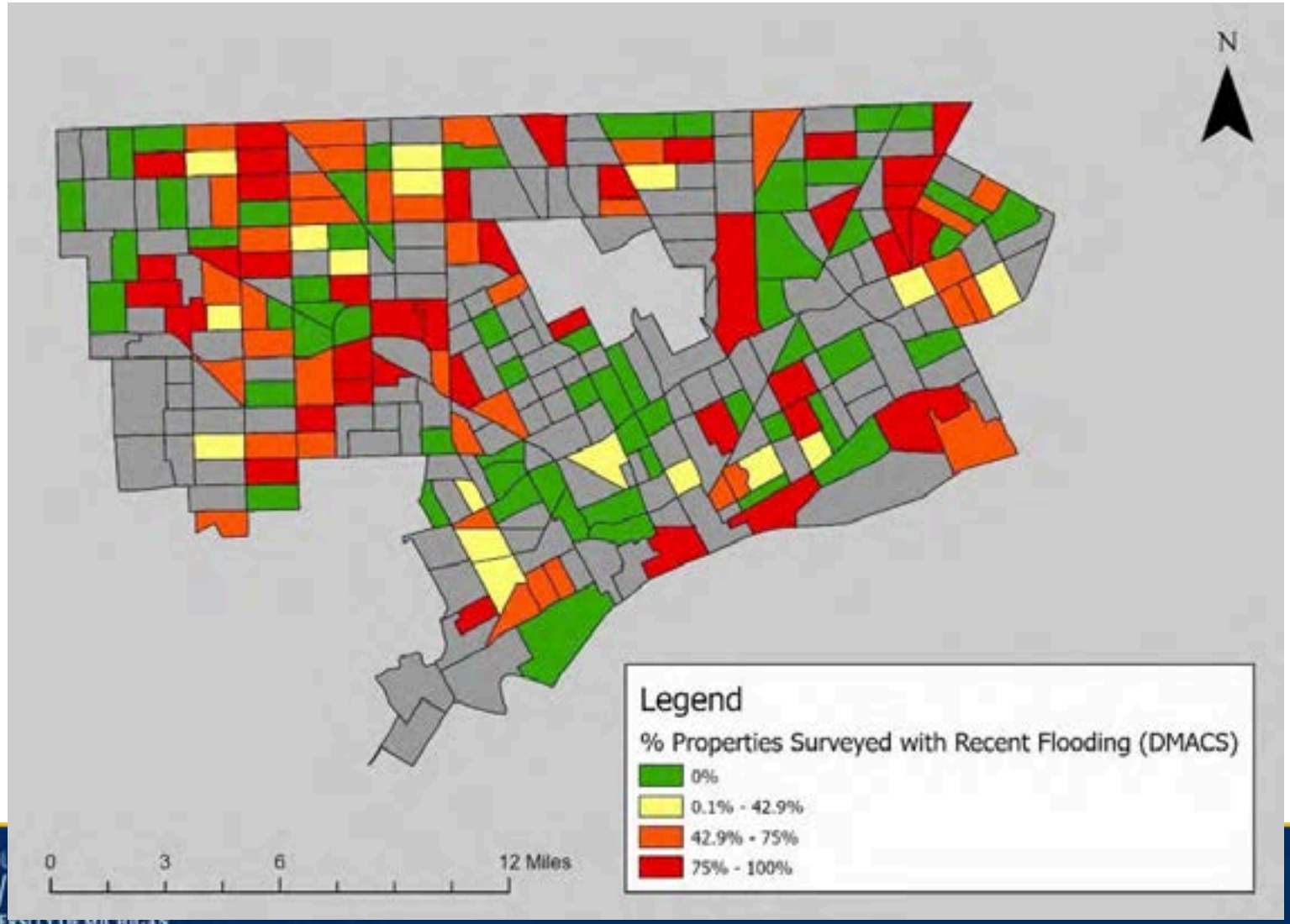
FEMA 100-year Floodplain



First Street Foundation Flood Factor



Survey data


N
Legend
% Properties Surveyed with Recent Flooding (DMACS)
0%
0.1% - 42.9%
42.9% - 75%
75% - 100%
0
3
6
12 Miles

Some potential implications and next steps

1. Different flood risk data generate different understandings of *who* is at risk (and therefore who needs investment)

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2. FEMA's flood risk data is more easily available and easily interpretable – but does not tell the whole story

Some potential implications and next steps

1. Different flood risk data generate different understandings of *who* is at risk (and therefore who needs investment)
2. FEMA's flood risk data is more easily available and easily interpretable – but does not tell the whole story
3. Next steps:
   - Developing new tools for measuring and monitoring stormwater flood risk that not only improve accuracy but center equity in data collection and analysis
   - Understanding the historical policy and political drivers of these risks
   - Supporting adaptation strategies that center justice

Up next – 10:45am-12:15pm PT

SESSION 2.1

International Lessons on Climate Adaptation

SESSION 2.2

Before the Storm: Responses to Forecasts

SESSION 2.3

Quantifying and Minimizing the Impacts of Wildfires

SESSION 2.4

Proactive Planning for Resilient and Equitable Communities

CLIMATE ADAPTATION
RESEARCH SYMPOSIUM

MEASURING & REDUCING SOCIETAL IMPACTS

Thanks for tuning in!

UCLA Luskin Center for Innovation