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Indigenous Reserve Lands in Canada Face High Flood Risk

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Key Points

- Indigenous peoples in Canada face substantial risks from annual flooding, including property damage, disrupted livelihoods, deteriorated health, and psychological trauma associated with prolonged, sometimes repeated evacuation.
- Indigenous reserve lands are disproportionately exposed to flooding, with almost 22 percent of residential properties at risk of a 100-year flood.
- Having only limited information about flood defences, critical infrastructure assets and emergency services significantly impedes a comprehensive flood risk assessment for Indigenous nations.
- Addressing the financial and social burden of flooding on Indigenous reserves must be a top priority under the Pan-Canadian Framework on Clean Growth and Climate Change.

Introduction

In recent years, considerable public and media attention has focused on the risk that flooding poses for Indigenous peoples in Canada. Nearly every year, Indigenous peoples face property damage, disrupted livelihoods and the severe social and psychological burdens associated with evacuation due to flooding. Between 2006 and 2016, for instance, nearly 70 Indigenous communities across Canada experienced flooding; 25 percent of these communities experienced multiple floods, and 10 percent experienced three or more (McNeill, Binns and Singh 2018). Perhaps the most striking example is the recurrent flooding that afflicts the Kashechewan First Nation in Northern Ontario, whose residents have been forced to evacuate their homes every spring for 17 years (Dehaas 2019; Johnson 2019). As Mushkegowuk Council Grand Chief Jonathan Solomon describes it, “You get tired of living in a cell block room. The families are stressed out. The kids are stressed out because they want to go to school. It is total displacement” (cited in Talaga 2019). In many ways, the flood-related hardships endured by Indigenous peoples reflect the broader injustice of climate change, whereby those least responsible for causing the problem are suffering disproportionately from its effects (Brake 2018; Talaga 2019).

However, there has been relatively little research on the scope and magnitude of the current flood threat to Indigenous communities and how the risk might evolve under climate change (Khalafzai, McGee and Parlee 2019).

About the Authors

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This policy brief reports on research at the University of Waterloo that sought to assess, quantify and map the flood risk to Indigenous peoples living on reserve lands. It begins by contextualizing the flood threat to Indigenous peoples and discussing its general impacts. The second section describes the study's methodology and high-level results. The final section offers policy recommendations by which to better understand and to reduce the flood risk to Indigenous peoples.

Background

Indigenous peoples in all parts of Canada are affected by flooding (McNeill, Binns and Singh 2018). Many of their communities are small and remote, with poor access to food and water resources, which makes them especially vulnerable to the social and economic consequences of flooding (Furgal and Seguin 2006). Indeed, a 2013 report of the Auditor General of Canada reported that flood emergencies occur more often in First Nations communities than elsewhere in Canada (Auditor General of Canada 2013).

Flooding has tremendous social and economic impacts in any community, including physical destruction of property (Bubeck, Otto and Weichselgartner 2017), population displacement (Levine, Esnard and Sapat 2007), disruption of critical infrastructure (Kidd 2011), business and livelihood interruption (Ingirige and Wedawatta 2011), loss of economic output due to capital damage and displacement of workers (Davies 2016) and threats to physical and mental health (Burton et al. 2016; Carroll et al. 2010; Fernandez et al. 2015). People who experience flood-related property damage and the loss of their personal belongings often also experience negative psychological effects, including post-traumatic stress disorder, depression and anxiety (Lamond, Joseph and Proverbs 2015; Stanke et al. 2012). Clearly, the experience of living through a flood is devastating.

Those who evacuate to avoid flooding often experience serious negative impacts on both their psychological and physical well-being. Displacement is linked with a variety of negative outcomes, for example, premature death and worsening of chronic health conditions such as heart disease, hypertension and diabetes (Brodie et al. 2006; Hayakawa 2016; Munro

et al. 2017). In 2011, for instance, the Lake St. Martin First Nation in Manitoba was evacuated to escape unprecedented flooding that made the lands permanently uninhabitable. Analysts who studied the effects of this displacement on the community reported a range of negative impacts, including income levels well below the provincial median, substance abuse, stress and disrupted youth education (Thompson, Ballard and Martin 2014). The stress of the evacuation was also linked with suicides, violence against women, and health problems such as depression and miscarriages (Ballard and Thompson 2013).

The negative impacts on Indigenous communities of exposure to flooding, and climate risk more broadly, are undoubtedly intensified by the deep inequities and vulnerabilities entrenched by colonization (Cameron 2012), in particular resource exploitation, which contributes to higher flood risk, and forced settlement. These inequities create unique social and cultural impacts that are consistently overlooked in existing flood management practice. For example, in the aftermath of the 2013 Calgary flood, provincial authorities required that members of the Siksika Nation, in exchange for recovery funding, move from their traditional settlement areas along the river to higher ground, into a conventional subdivision. This approach “exemplifies a colonial position of the state disconnected from the values of place-based Indigenous people” (Patrick 2017). Indeed, areas of settlement near the river reflect deep cultural links with access to the ecosystem and the clan organization that has existed for generations. Traditional knowledge that favours property-level mitigation designed to accommodate changing flooding conditions also tends to be ignored.

Flood Risk on Reserve Lands

This study focused on 985 Indigenous reserves — parcels of land classified as a “reserve” by Statistics Canada for the census. The analysis included three types of flooding: fluvial (riverine overflow); pluvial (intense precipitation-caused inundation of lands that are not necessarily proximate to a body of water); and coastal (storm surge). Maps showing the extent of flooding with a return period of 100 years

were provided by JBA Risk Management, a global, market-leading flood catastrophe modelling firm, through a research partnership with the University of Waterloo. The 100-year flood is the generally accepted regulatory standard for most of Canada; it has a one percent probability of occurring annually, or a 26 percent chance over 30 years. Data for exposed assets — roads, residential properties and critical infrastructure facilities — were produced by DMTI Spatial Inc., a company with world-renowned expertise in location analytics.

To provide a relative measure, a comparison was made between Indigenous communities and the general Canadian population using four indicators of flood hazard exposure, namely, length of road, number of residential properties, number of critical infrastructure facilities and population count within flood hazard areas (see Table 1). It is important to note that exposure is a narrow measure of risk, limited to capturing potential economic loss for physical assets rather than broader considerations around socio-economic vulnerability. This limitation is particularly significant in the case of Indigenous exposure, since impacts to other land uses that might have special social or cultural significance to the community are omitted. Road types used in the analysis included expressways, primary highways, secondary highways, major roads, local roads and trails. Residential buildings were identified using geocoded address points.

Critical infrastructure assets were limited to those deemed essential to health, safety, security and economic well-being, including hospitals and health-care facilities, community centres, educational institutions, fire stations and police stations. Unfortunately, critical infrastructure data was available for only 113 of the 985 reserves. At-risk populations were calculated using dissemination blocks (DBs), the smallest geographic area for which population and dwelling counts are reported by Statistics Canada. If any road length, residential property or critical infrastructure was found to intersect with the flood hazard area, it was classified as at risk. For population, exposure to flooding was calculated by multiplying the land area exposed to flooding by the population density (people per km²) for each Statistics Canada DB (see Figure 1).

The analysis found that almost all reserves (91.4 percent) have some exposure to fluvial, pluvial or coastal flooding at the 100-year return period. For three of the four indicators, flood exposure

of Indigenous communities was higher than other communities in Canada (see Figure 2). Specifically, exposure for residential properties (21.5 percent versus 19.1 percent), population (14.8 percent versus 14.7 percent) and road length (13.6 percent versus 10.7 percent) were all higher for Indigenous communities, but exposure of critical infrastructure was lower in Indigenous communities than in other communities (13.7 percent versus 21.5 percent). This latter result could be due to the limited data available on critical infrastructure on reserves used in the analysis.

While some of the indicators reveal marginally higher levels of exposure, it is likely that the gap is more significant due to a lack of resources to support and maintain these assets before and after a flood. For example, housing conditions are also a significant risk factor: about 19 percent of Indigenous peoples live in residential dwellings that are in need of major repairs, compared to six percent of the non-Indigenous population (Statistics Canada 2017b).

Fluvial (riverine) flooding is the predominant hazard threatening Indigenous reserve lands and poses a serious public safety risk due to the high velocity and depth of overflowing rivers. Moreover, rising global temperatures associated with climate change are projected to exacerbate both the frequency and the magnitude of riverine flooding in Canada into the future, which would expose more people and property to its impacts (Alfieri et al. 2016).

Policy Recommendations

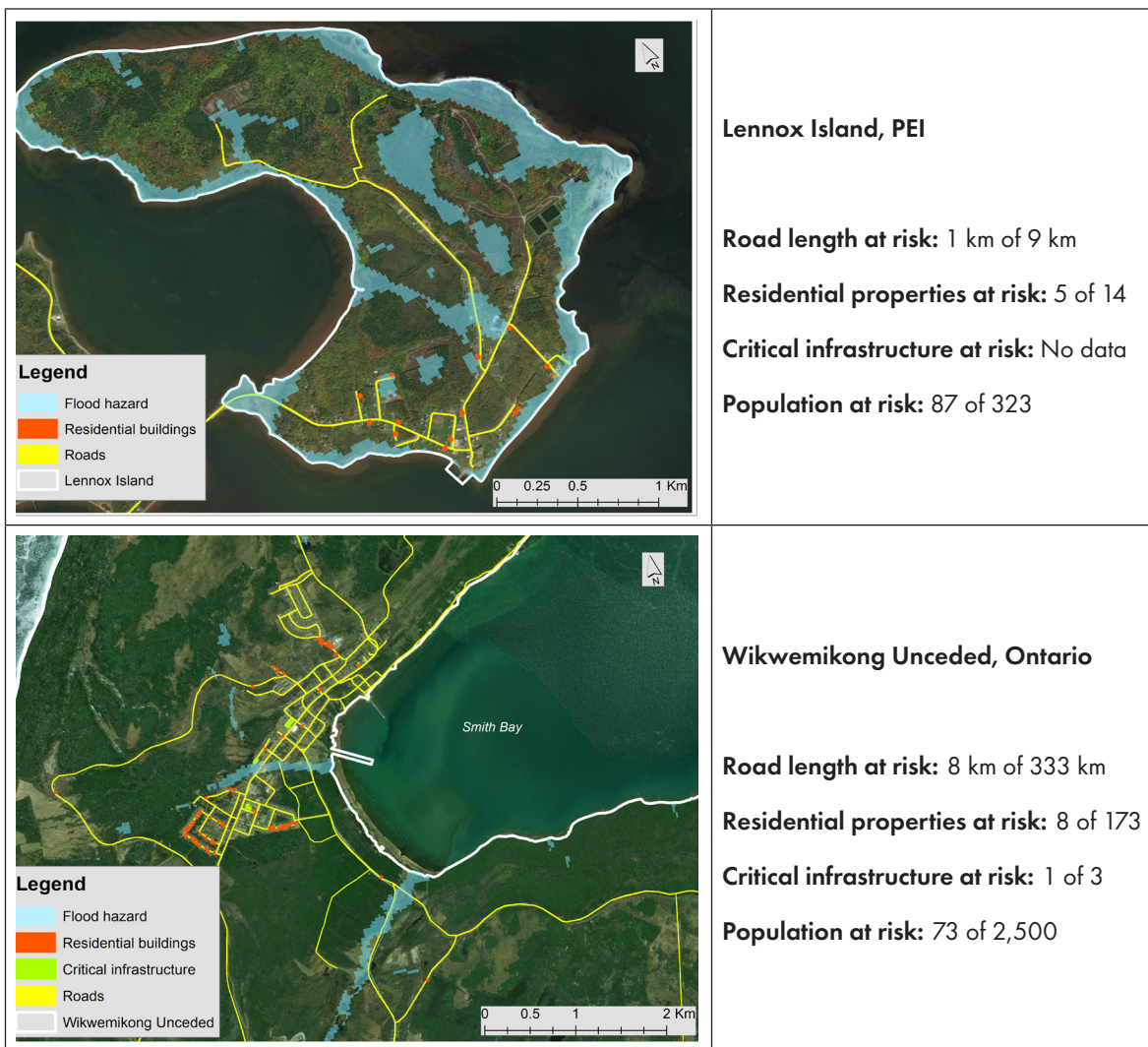
The results of this study show that Indigenous peoples face a greater flood risk than the general Canadian population. This finding reinforces the Auditor General's 2013 conclusion that flood emergencies occur more often in First Nations communities (Auditor General of Canada 2013). The findings are also congruent with internal briefings to the federal Cabinet in 2016, which warned that Indigenous reserve communities are disproportionately suffering from the impacts of climate change (Smith 2016).

Table 1: Flood Risk Indicators for Indigenous Reserve Lands

Flood Risk Indicators	Data Sets
Road length (km)	Roads, DMTI Spatial 2018
Residential properties (count)	Address points, DMTI Spatial 2018
Critical infrastructure assets (count)	Building footprints, DMTI Spatial 2018
Population (count)	Census DBs, 2016 census data, Statistics Canada (2017a)

Source: Authors.

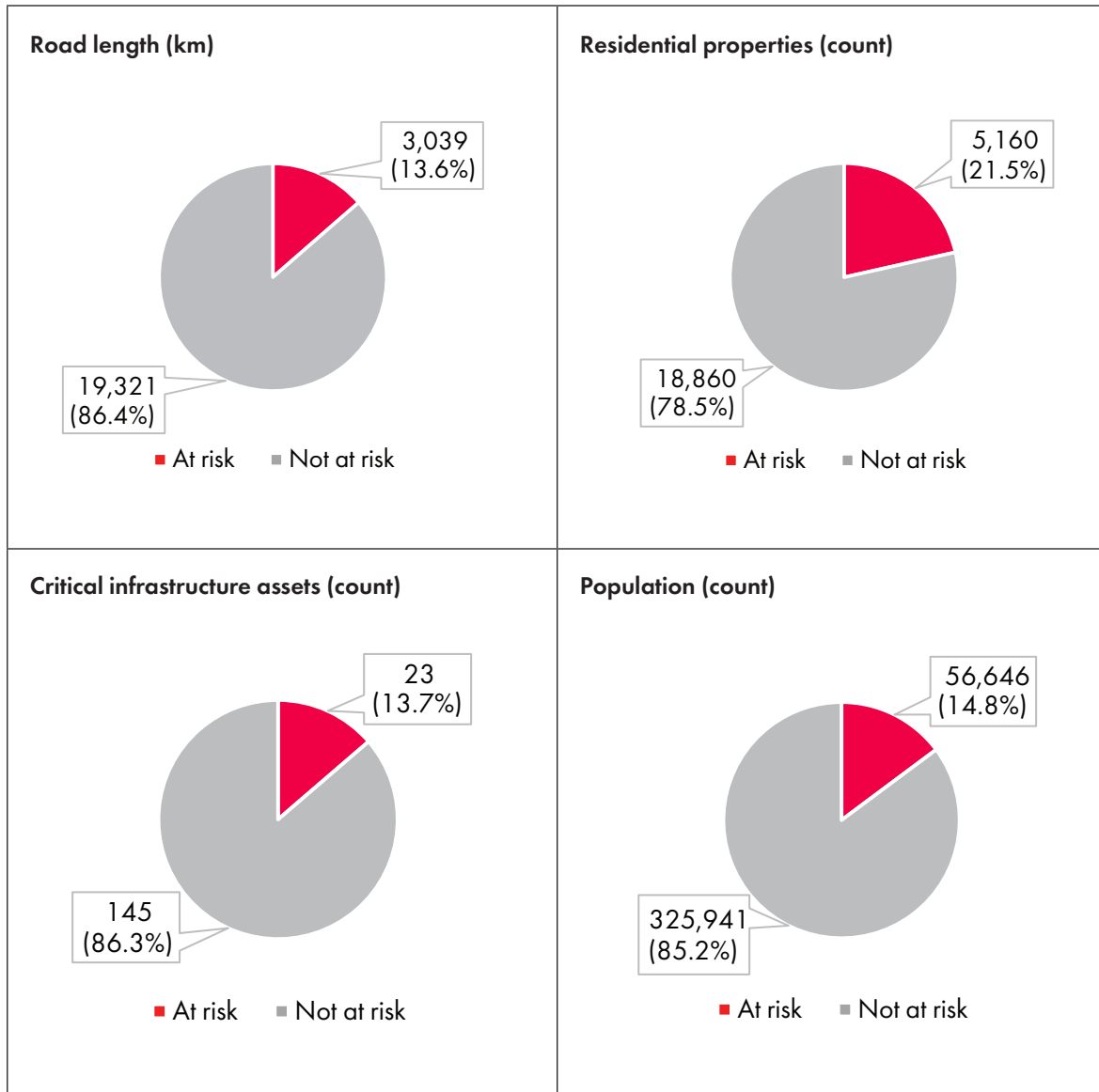
Figure 1: Examples of Map Outputs



Data sources: Mapping imagery © JBA Risk Management. Risk indicator data from DMTI Spatial (www.dmtispatial.com). DBs derived from 2016 census data (Statistics Canada 2017a).

Note: Flood hazard area includes land exposed to 100-year fluvial, pluvial or coastal flooding. Flood extent assumes no flood defences.

Figure 2: Flood Risk to People and Assets on Indigenous Reserve Lands



Data sources: DMTI Spatial (www.dmtispatial.com); Statistics Canada (2017a).

Under the Pan-Canadian Framework on Clean Growth and Climate Change, the federal, provincial and territorial governments committed to “reducing climate-related hazards and disaster risks” (Government of Canada 2016, 35). Specifically, these governments agreed to three key actions:

→ investing in infrastructure to protect communities from climate-related hazards such as flooding and wildfires;

→ collaborating through the National Disaster Mitigation Program to modernize flood maps and to assess and address flood risks; and

→ supporting adaptation in Indigenous communities to “address climate change impacts, including repeated and severe climate impacts related to flooding” (ibid.).

There is some ongoing work to support these objectives. Indigenous Services Canada has committed funding for flood mitigation, including the upgrading of flood infrastructure.¹ Crown-Indigenous Relations and Northern Affairs Canada has also committed \$25 million to reduce long-term flood risk, including support for flood mapping.²

In support of these objectives, we offer the following recommendations.

Analyze data from multiple sources to further understand flood risk to Indigenous peoples and to prioritize risk reduction measures. Our study had several limitations, including a lack of information about culturally significant land and infrastructure and community- and lot-level flood defences, as well as incomplete data on critical infrastructure and housing assets. Governments have access to a wealth of geospatial, social, economic, health and administrative data that could be mined and combined to better assess and visualize at-risk areas.

Indigenous communities also have a wealth of traditional and local knowledge that must be incorporated as an important source of information for flood risk management. Some projects are already adopting this approach to better understand how local ecological conditions and settlement patterns require different solutions than those currently prescribed by provincial and federal authorities. For example, in some cases, rebuilding in high-risk areas with additional property-level mitigations, rather than relocation, could be justified to preserve local traditions. The results of such a comprehensive analysis would be beneficial to inform resource allocation to protect those facing the greatest threat.

Adopt a portfolio of policy instruments to reduce flood risk to Indigenous peoples.

Effective flood risk management is achieved by combining tools that prevent flooding, reduce its impacts on people and property, prepare people for flood-related emergencies and facilitate a swift recovery after flooding occurs (Hegger et al. 2016). Analysts have identified dozens of tools to manage flood risk (Filatova 2014; Mees

et al. 2014; Thistlethwaite and Henstra 2017). For instance, information-based measures, such as flood maps and climate change visualizations, can make people more aware of the risk and encourage household preparedness. Economic instruments, such as grants and subsidies, can be used to encourage property-level flood protection. Regulatory tools, such as codes and standards, can be adopted to increase the quality and durability of new or retrofitted construction.

The selection and combination of these tools, however, must be appropriate for the local context and population. Indeed, as is well established in existing research, these policy solutions often ignore the systemic influence of colonization, which poses a barrier to their implementation and legitimacy (Cameron 2012). Indigenous nations are geographically and culturally distinct, so meaningful engagement with identified high-risk communities is required, especially to mobilize traditional Indigenous knowledge about flood risks and potential risk-reduction solutions.

¹ See "Flooding in First Nations communities" at www.sac-isc.gc.ca/eng/1397740805675/1535120329798.

² See "First Nation Adapt Program" at www.aadnc-aandc.gc.ca/eng/1481305681144/1481305709311.

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