Adapting to Climate Change: **Inland Flooding**

Grand Bay-Westfield

Figure 1:
Location of Grand Bay-Westfield

The Community

Grand Bay-Westfield is located on the western shore of the lower Saint John River in southern New Brunswick. Although the town is inland, its climate is influenced by the cool waters of the Bay of Fundy. The Saint John River, as it passes the town, has a significant tide. The town lies on the boundary between the Fundy Coastal ecozone and the more continental Valley Lowlands ecozone.

The area was settled by United Empire Loyalists who were given land grants along the river at the end of the American Revolution in 1783. Their farm and logging operations relied on the river for transport until the railway opened in 1869.

Grand Bay-Westfield – like many New Brunswick communities – was hit by the historic Saxby Gale in October 1869. Storm flooding overturned the engine intended to lead the first run of rail cars on their newly constructed local line to Fredericton Junction. As a result, a replacement engine had to be brought from Saint John for the opening festivities.

By World War I, the area was growing in popularity as a summer destination. In 1921, a major fire destroyed more than 100 buildings. Cottagers and permanent residents returned to the area and quickly rebuilt it, leading to the distinct architectural style the community is known for today.

By 2011, Grand Bay-Westfield was home to 5,117 people. Many residents commute to work in Saint John, Fredericton and the New Brunswick Power facilities at Lepreau, but the town is also an important service centre for the surrounding area. The Province provides a cable ferry service across the Saint John River from Brundage Point (also the location of the town's River Centre) to the Kingston Peninsula. The River Centre is a Stonehammer Geosite, part of North America's first UNESCO designated Geopark.

Climate Change and Community Vulnerability

Grand Bay-Westfield is experiencing many of the climate changes documented elsewhere in southern New Brunswick, including rising temperatures, increased annual precipitation, less snowfall, extreme rainfall events, and warmer winters. Residents describe much stronger winds, more intense storms and rainfalls, and shorter winters that start later and bring much less snow. They say that none of their seasons are as well defined as they once were, and offer examples that range from 'yo-yoing' winter temperatures and green Christmases, to river ice that forms later, breaks up earlier, and is much thinner than it used to be.

The impacts of these changes are wide-ranging; while not all of them are negative, there are definitely trade-offs. For instance, residents need to heat their

homes fewer days each year, but those savings may be offset by the increasing number of days they use their air conditioners. More intense storms are also increasing the number of power outages. A shorter winter season means less time for ice fishing and snowmobiling, but the regional warming trend is extending the local golf and growing seasons. Area residents rely on private wells for their drinking water; their reports suggest that well water levels are up due to increased rain. However, sediments carried in the runoff from Base Gagetown into the Nerepis River by those same rains, produce murky chocolate-coloured waters downstream in Grand Bay-Westfield. The extra sediment is making river bottoms muddier and filling in some coves.

The town experiences river flooding in the spring, when meltwater and ice break-up increase river flows. While these flood cycles enrich local marshlands, ice jams occasionally lead to more significant flooding and property damage. In the spring of 1889, a serious ice jam destroyed the original wooden Nerepis Bridge, as well as portions of the local railbed. Similar conditions led to serious property losses in 1936 (Figure 2). Significant spring flood events also occurred in 1973, 2005 and 2008.

Since the 1920s, sea-levels in the area have risen 23.5 cm. Fluctuating temperatures may continue to trigger ice jams, but the degree of infrastructure damage they cause could be lessened in future by declining amounts and duration of river ice. River levels year- round are much higher than they used to be though. Increasingly, heavy rains are triggering flash flooding, eroding banks, overflowing ditches, washing out roads, and damaging adjacent properties. In the past, river flooding affected mostly private properties, but more intense rains are increasing localized flooding, creating potential problems for municipal infrastructure throughout the town.

Local Climate Change Adaptation to Date

Its history of flooding has already led Grand Bay-Westfield to make a number of adaptations. The town prides itself on having excellent emergency plans and preparations in place. In addition to its Emergency Response Plan, the town has also developed detailed plans to deal with more serious floods and storms. The town periodically updates all these plans and keeps its

Figure 2:
Infrastructure damaged in Westfield by a river ice jam on the Lower Saint John River in the Spring of 1936
Town of Grand Bay-Westfield

contact list current by sending out regular update requests; in the event of an emergency, first responders can count on having an up-to-date resident contact list on file. The provincial Emergency Measures Organization (EMO) also has a very effective flood information service that broadcasts peak-of-flood notifications for the Saint John River through the internet and local media.

The town maintains a municipal watch list that identifies areas flooded in the past. Most of these sites have been subject to river flooding; they lie along the Nerepis and Saint John rivers and include a trailer park, the Brundage Point River Centre and ferry dock, a riverside subdivision dating from the 1960s, and some low-lying waterfront roads. The town has also identified areas subject to localized flooding. Localized flooding tends to result from a problem with the town's drainage infrastructure: for example, when the river level rises above an outflow or a culvert gets clogged with debris. The Town of Grand Bay-Westfield conducts regular inspections of its drainage systems to ensure they are clear and in good repair.

In 2012, the Atlantic Regional Adaptation Collaborative (RAC) included Grand Bay-Westfield, along with Saint John, Rothesay and Quispamsis in a pilot initiative called the Lower Saint John River Project. As part of this project, Grand Bay-Westfield agreed to participate in a test application of a flood risk assessment workbook developed by Memorial University in Newfoundland and Labrador as a component of a larger adaptation planning workbook. In February 2012, a facilitator presented the flood assessment workbook at a local adaptation planning

workshop. At this workshop, the facilitator also introduced participants to a LiDAR (Light Detection and Ranging) based wet-areas map developed by the University of New Brunswick's Forestry and Environment Department for the RAC project (Figure 3). The Wet Areas Mapping (WAM) system used the detailed elevation maps produced with LiDAR data to identify the corridors along which flooding would occur under varying conditions. According to the workshop facilitator, participants were positive about the flood assessment risk workbook, but it was the WAM-produced high-resolution wet-areas map that made it much easier for people to visualize potential flood risks. One participant remarked, "If the LiDAR tool is available for us to use, we'll use it."

Within two weeks of the adaptation planning workshop, Grand Bay-Westfield's Development Officer was able to review a development application using the LiDAR-based wet-areas map. The Planning Advisory Committee and Public Works Department now use it to check sites and to support their interpretation and their decisions. The staff is also using the map to help other people, such as prospective buyers, understand the potential constraints of specific properties.

The town's Public Works Commissioner and Fire Chief also moved quickly to demonstrate the new map to their Emergency Management Committee. As a result, when the town receives a forecast water level for St. John River flooding from the provincial EMO, the town will be able to use the map to determine what effect that level will have on the local landscape.

Next Steps and Opportunities

Grand Bay-Westfield town staff have provided an in- depth demonstration of the LiDAR-generated wet- area map to their town council. The staff would like to expand the use of LiDAR mapping: for example, the tool could be used to provide information for drainage infrastructure maintenance and upgrades by identifying problematic culverts, likely stream channels, and locations where new storm sewers are required. Similarly, when the town is planning its development control measures, it could use the wet- areas map to help decide where building setbacks need to be increased or where development should be limited or revised. The staff also would like to use the map to facilitate the town's dealings with engineers and other contracted professional staff.

Figure 3:
Wet Areas Mapping (WAM) of the community's golf course illustrating flow channels with the greatest likelihood to conduct stormwater during (top) the dry period of late summer, and the wettest weather (bottom) in the spring.

Jae Ogilvie and Paul Arp, Forest Watershed Research Centre, Faculty of Forestry & Environmental Management, University of New Brunswick (http://watershed.for.unb.ca)

The Emergency Management Committee plans to use the LiDAR-derived wet-areas map to model emergency flood scenarios for preparedness training purposes. The Committee also plans to approach the provincial Emergency Measures Organization (EMO) to arrange for the use of an emergency radio channel to broadcast continuous flooding information when electricity is lost and residents are unable to access the EMO's website or other news outlets.

Finally, the Town of Grand Bay-Westfield is very conscious of the need to develop an in-house public education program to inform residents about the risks of flooding in their community. The town staff also plan to make greater use of resources such as the provincial Department of Environment's NB Climate Change presentation, as well as LiDAR modeling tools like WAM.

For More Information

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