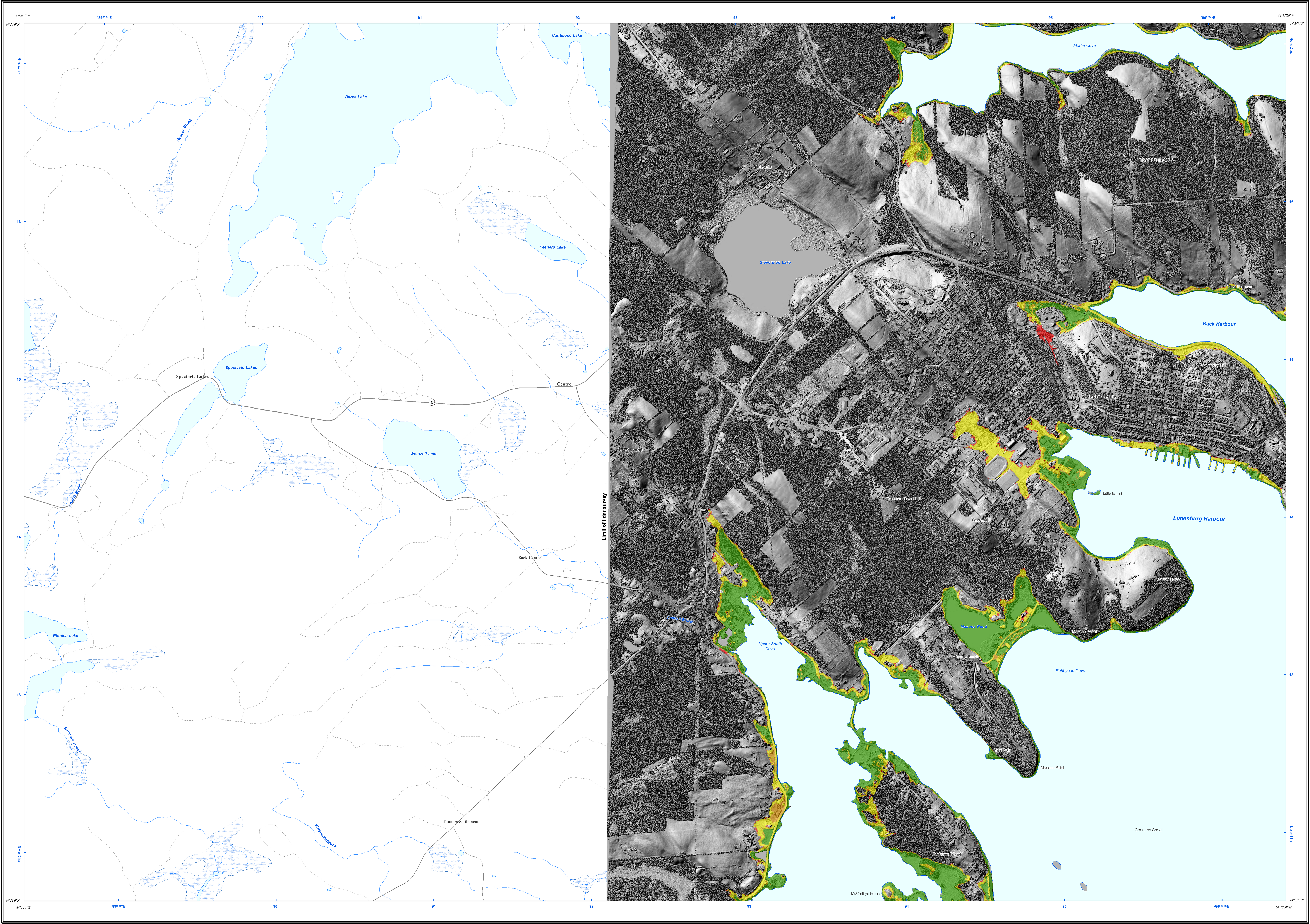


LEGEND*

25 year return period estimated water level expected in 2025 (2.6 m)	green
100 year return period estimated water level expected in 2025 (2.7 m)	orange
25 year return period estimated water level expected in 2100 (3.5 m)	yellow
100 year return period estimated water level expected in 2100 (3.7 m)	red
Ocean (mean high tide)	light blue

Symbols

- Arterial highway (102)
- Trunk highway (4)
- Collector highway (333)
- Hard surface road
- Loose surface/resource access road
- Trail, footpath, cart track
- Railway (active, inactive)
- River, stream
- County boundary
- Wetland
- Lake /ocean

* Note: Legend is for map series. All units and symbols may not appear on each map.

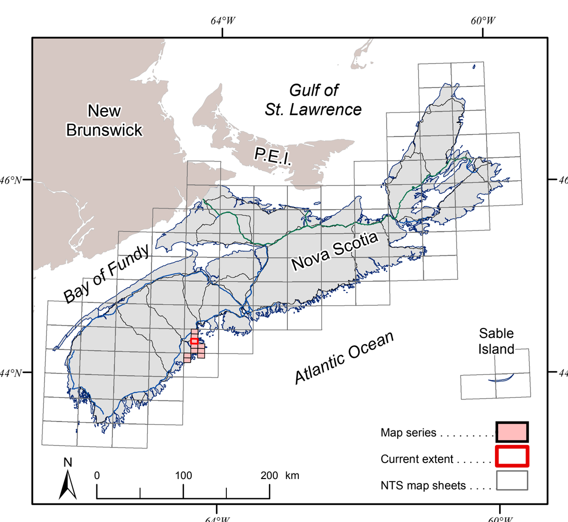
Explanation of Flood Risk Map Legend

The different water levels on the map and in the legend represent estimated levels expected during storm surge events. High water levels associated with storm surges have a return period in years which is related to their annual probability of occurring. A lower water level is expected to have a higher probability of occurring and therefore will have a lower return period, meaning we expect to see that storm surge or water level more often.

The other feature of the water levels in the legend is that they are projected into the future with estimated relative sea-level rise factored in. We know sea level has been rising steadily around Nova Scotia at a rate of 32 cm/century based on tide gauge records going back to the early 1900s in Halifax, Yarmouth and Charlottetown for example. The water levels in the legend represent storm surges that have a 95% chance of occurring at least once every 25 years and every 100 years. The return periods of storm surges were calculated by examining the past storm surge events recorded by tide gauges and, where no gauges exist, by modelling the storms using past wind records. Sea level for Nova Scotia is expected to increase with the effects of climate change in the future. Richards and Daigle (2011) have estimated relative sea-level rise to increase by about 100 cm by 2100. This is a combination of global sea-level rise and local crustal subsidence. As sea level rises, the total water level from a given storm surge will increase over time, so a water level associated with a storm surge that at present floods an area once every 25 years will flood the same area more frequently, say every 5 years in 2100. Thus the risk of flooding from the same storm increases over time because sea level is continuously rising. It is important to identify the areas at risk for coastal flooding today and also into the future so we can adapt and consider these risks when building new infrastructure such as roads or sewage treatment plants for communities.

The legend represents the expected estimated water levels of the 25 year storm event and the 100 year storm event in the year 2025. These levels are typically only about 10 cm higher than the water levels we are experiencing today for the 25 and 100 year events. The expected water levels for the same storms, once in 25 years and once in 100 years, are projected to be higher by approximately 100 cm by the year 2100. These events are also shown on the map. So the legend item '25 year return period…in 2025' states the total water level associated with a storm we expect at least once every 25 years in the year 2025. The legend item '100 year return period…in 2025' states the total water level associated with a storm we expect at least once every 100 years in the year 2025. The other legend items '25 year return period…in 2100' refers to the water level of a storm that is expected once every 25 years in the year 2100, and '100 year return period…in 2100' refers to the water level of a storm that is expected once every 100 years in the year 2100.

These predictions do not take into account a possible increase in storm intensity or in the number of storms that occur in a given year. Some researchers believe that with increased ocean temperatures we could see more intense storms more frequently in the future than we do now in Nova Scotia. If that turns out to be the case, the water levels on this map represent conservative projections and we may see coastal flooding at higher levels and more often in the future.



Descriptive Text

The flood risk limits were extracted from flood inundation layers, which were derived from the digital elevation model (DEM) that was constructed from ground points measured by a Light Detection and Ranging (lidar) survey. The flood inundation layers were modelled in a geographic information system (GIS) and represent still water levels. Only low lying areas that are connected to the ocean were shown to be flooded with this modelling method. These water levels represent the ocean as a horizontal plane and do not incorporate wave run-up during storms. Wave run-up is controlled by the wind direction and associated wave direction during storms and the local offshore and nearshore topography.

The estimated return periods and water level scenarios for 2025 and 2100 were determined from Richards and Daigle (2011). The return periods represent the time between high-water events occurring with a 95% probability according to Richards and Daigle (2011). Since this estimate of a return period of a high-water event is based on a 95% probability, it could happen any time in the future, but is predicted to have a 95% chance of occurring within a time interval such as 25 years or 100 years. These high-water events can be thought of as the 25 or 100 year events. These return-period water levels were reported in Chart Datum (CD) for Halifax. These have been converted from CD to the Canadian Geodetic Vertical Datum of 1928 (CGVD28, land elevation vertical datum) based on the Halifax CD-CGVD28 offset of 0.8 m.

The lidar survey and flood risk maps were produced by the Applied Geomatics Research Group (AGRG), Nova Scotia Community College (NSCC) (Webster *et al.*, 2011). The background topography on the maps represents a shaded relief image derived from a 2 m lidar digital surface model (DSM), azimuth of 315° and sun angle defined from the northwest at 45° with the terrain vertically exaggerated five times. This model incorporates both ground elevations as well as those from vegetation (trees) and buildings.

Map Notes

GIS data produced by Tim Webster, Kevin McGuigan and Candace MacDonald of AGRG/NSCC. Data were collected in 2008 and processed to flood layers from 2010-2011.

Cartography and reproduction by Angie Ehler of the Nova Scotia Department of Natural Resources, Geoscience Information Services Section, 2012. The maps were developed using ArcGIS® 10.

Universal Transverse Mercator Projection (UTM), Zone 20, Central Meridian 63°00' West. North American Datum (NAD) 1983 Canadian Spatial Reference System (CSRS) 98.

Base and digital data derived from the Nova Scotia Topographic Database (NSTDB). Copyright Her Majesty the Queen in Right of the Province of Nova Scotia. The NSTDB is available from Service Nova Scotia and Municipal Relations (SNSMR), Land Information Services Division (LIS), Nova Scotia Geomatics Centre (NSGC), Amherst, Nova Scotia.

The lidar was acquired by the Applied Geomatics Research Group, NSCC over a period of three separate missions. All data were acquired using an Optech ALTM 3100 lidar sensor; see Webster *et al.* (2011) for further details on the lidar processing, surface construction and accuracy validation. The areas around Kingsburg and Rose Bay were flown October 4, 2005 and August 4, 2006. The rest of the coastal areas were acquired on October 27, 2009.

Nova Scotia Department of Natural Resources
Mineral Resources Branch

Open File Map ME 2012-032

Map of Coastal Flood Risk from Sea-level Rise and Storm Surge of the Lunenburg Area, Lunenburg County, Nova Scotia

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*Applied Geomatics Research Group, Nova Scotia Community College, Middleton, Nova Scotia

Scale 1:10 000

0 0.5 1 km

Halifax, Nova Scotia
2012

References

Richards, W. and Daigle, R. J. 2011: Scenarios and guidance for adaptation to climate change and sea-level rise - NS and PEI municipalities; Atlantic Climate Adaptations Solutions Association, Nova Scotia Environment, 78 p. http://atlanticadaptation.ca/node/267/

Webster, T., McGuigan, K. and MacDonald, C. 2011: Lidar processing and flood risk mapping for coastal areas in the District of Lunenburg, Town and District of Yarmouth, Amherst, County Cumberland, Wolfville and Windsor; Atlantic Climate Adaptation Solutions Association, 130 p. http://atlanticadaptation.ca/acasa/node/128/

Acknowledgments

This project is part of the Atlantic Climate Adaptation Solutions Association (ACASA) project, a joint undertaking between the Atlantic Provinces, Natural Resources Canada, regional municipalities and other partners. It was made possible with funding from the Province of Nova Scotia and federal support from Natural Resources Canada's Regional Adaptation Collaborative Program.

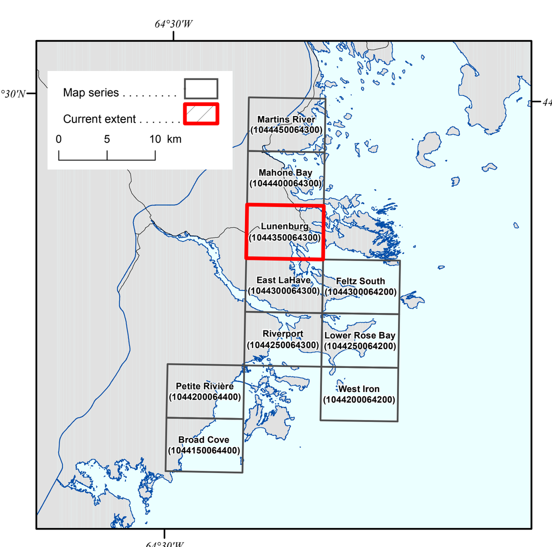
We thank the following people from the Applied Geomatics Research Group, Nova Scotia Community College: Allyson Fox and Chris Hopkinson for some of the lidar collection, Bob Maher for administrative support, Nathan Crowell and Charity Mouland for lidar and flood inundation processing, and Theresa Smith and Wayne Reiger for cartographic assistance.

Disclaimer

The information on this map may have come from a variety of government and nongovernment sources. The Nova Scotia Department of Natural Resources and partners of the Atlantic Climate Adaptation Solutions Association do not assume any liability for errors that may occur. This map is intended for use at the published scale of 1:10 000.

Recommended Citation

Webster, T., McGuigan, K. and MacDonald, C. 2012: Map of coastal flood risk from sea-level rise and storm surge of the Lunenburg area, Lunenburg County, Nova Scotia; Nova Scotia Department of Natural Resources, Mineral Resources Branch, Open File Map ME 2012-032, scale 1:10 000.



Series or Map Name
Open File Map ME 2012-032
Jun 28, 2012