Performance Indicator Summary

Performance Indicator(s): Area of land lost and economic value of land lost

Technical Workgroup: Coastal TWG – Lower River

Research by: Pacific International Engineering Corp. (Michael Davies and Neil MacDonald)

Modeled by: Neil MacDonald (in the CPE and RRM models) and also Bill Werick (in the STELLA Shared Vision Model)

Activity represented by this indicator: The area of land lost due to erosion is computed throughout the domain and expressed in terms of the number of square meters of land lost. Land-use and assessment data is used to compute a nominal dollar-value of land lost based on the area of land lost.

Link to water levels: The relationship between these two erosion performance indicators and water level varies considerably depending on location and time of year, although there is a general trend towards increased losses with higher water levels.

Importance: The total area of land lost is an important measure of the impact of water levels on the shoreline. The land losses have a measurable economic impact in areas where the land use is agricultural, commercial or residential in nature. These two performance indicators have been presented separately because the area of land lost can also be used in supplementary analyses, especially those for environmental impacts (e.g. loss of habitat, turbidity).

Performance Indicator Metric(s): Area (in square meters) and value (in dollars).

Temporal validity: This performance indicator will remain valid until certain rapidly eroding islands vanish completely or until shore protection is constructed on currently unprotected areas or removed from currently protected areas.

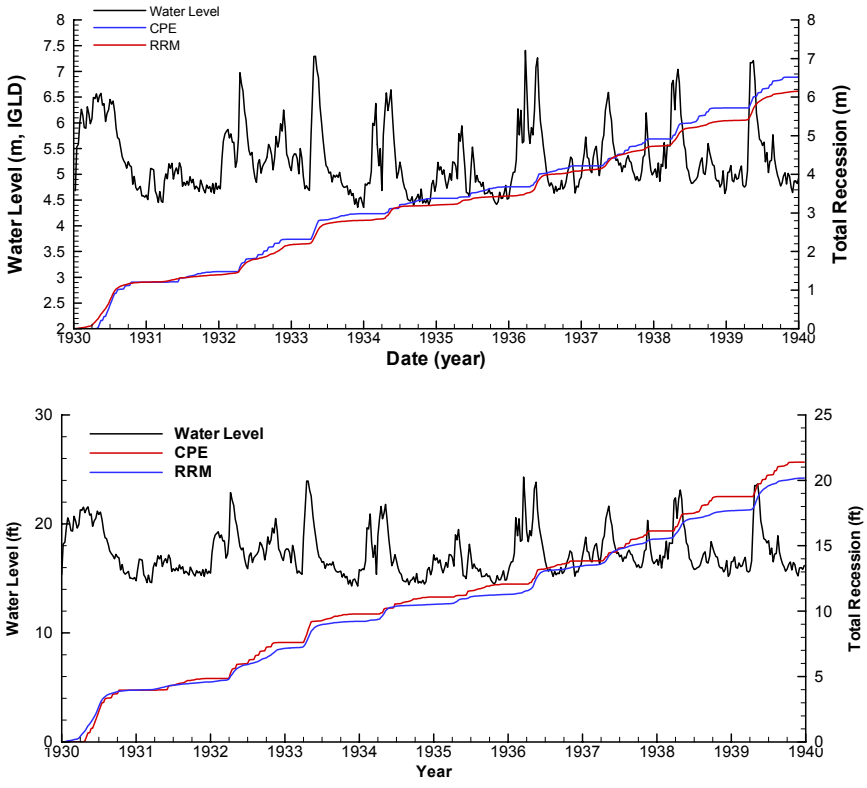
Spatial validity: Detailed modeling has been performed at 27 recession indicator sites along the river where significant erosion exists. Based on this exercise, unique relationships have been developed for the erosion at each site. These relationships are

therefore based on the local wind wave, river flow and level, and shipping climate and on the specific soil conditions and morphology of the site. They are not interchangeable.

Links with hydrology used to create the PI algorithm: The performance indicators are determined from a set of 27 broad-scale erosion equations. The form of the equations and their coefficients vary from site to site and from month to month to account for local and seasonal variability. The dependent variable in the equations is the local quarter-monthly average water level.

The algorithm: The area of land lost is computed from the product of the recession at a site and the length of eroding shoreline. The recession is computed from a power function of the total cross-sectional area of the profile eroded. The total cross-sectional area of the profile eroded is determined from a set of polynomial equations with coefficients that vary according to the month. The economic losses are determined from the product of the area of land lost and the land value.

Validation: The approach used to quantify the performance indicators was validated in several ways. The detailed numerical modeling (CPE model) was calibrated and validated at each site using recession data obtained from air photos over a 14-year period. The broad-scale performance indicator equations (RRM model) used in the SVM model were validated by comparison with the results of the detailed modeling. The predictions given by the broad-scale model equations compare well with the more detailed modeling.



Documentation and references:

Davies, M.H. and MacDonald, N.J. (2002). *Erosion Processes in the Lower St. Lawrence River: Data Needs and Physical Processes Final Report*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR.

Davies, M.H., MacDonald, N.J., Timpano, M.E., and Boisvert, A. (2003). *Shoreline Response – Data and Models*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR.

Davies, M.H. and MacDonald, N.J. (2004). *Shoreline Response Lower St. Lawrence River*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR, 2 volumes.

Risk and uncertainty assessment: The detailed modeling performed to generate the equations used in the SVM has been calibrated and validated only over a 14-year period and only under the conditions experienced during that period (1983-1997). Two points should be identified. Firstly, areas with shore protection were assumed to be fully protected from erosion, regardless of the quality of the shore protection. Secondly, only those areas that have been eroding at a rate greater than 0.2 m/year (7.87 inches/year) under the present operating conditions were studied. This limit is derived from the accuracy of the air photo analysis from which the calibration data is derived. Therefore, the influence of areas with erosion rates less than 0.2 m/year (7.87 inches/year) is not directly included in the performance indicators.