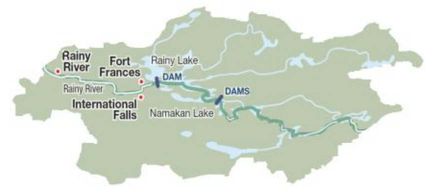
International Rainy and Namakan Lakes Adaptive Rule Curve Committee Newsletter



September 19, 2016

This is the first newsletter of the Adaptive Rule Curve Committee under the Rainy-Namakan Lakes Rule Curves Study Board. The plan is to put one newsletter out twice a month or so to facilitate a more thorough and collaborative effort to consider alternatives to the current 2000 Rule Curves. The focus will be on alternatives and performance indicators, but anything that influences the Study Board's recommendations to the International Joint Commission (IJC) is fair game. The Practice Decision Workshop this fall should flow naturally from the 2-4 newsletters we publish before then.

This newsletter will cover the flood damage performance indicator, which was just programmed into the Shared Vision Model (SVM).

Future newsletters will cover other issues such as whether inflows were higher after the 2000 Rule Curves went into effect, a look at indicators of spring flow, other performance indicators and other alternatives, including ideas for adaptive rule curve alternatives and Jean Morin's "environmental rule curve", other performance indicators and climate change.

Flood Damage Performance Indicator

The SVM now includes an estimate of flooding damage based on a flood damage estimation tool developed by W.F. Baird & Associates Coastal Engineers Ltd. and an evaluation of that work done by Mike Shantz at the Canada Centre for Inland Waters (Environment and Climate Change Canada). The Flood Damage report has been peer reviewed and is available on the Rainy Lake Study website.

Baird has experience in using large digital elevation maps and water balance models to estimate damages to shoreline structures, having developed the Flooding and Erosion Prediction System (FEPS) for the IJC's review of Lake Ontario regulation rules. Mike is is very familiar with that system and was a natural choice for the review. The SVM takes the information from the Baird Flood Tool and makes it easier and faster to use and understand. The SVM and the Flood Tool produce essentially identical damage estimates.

How does it work?

Detailed explanations are included in the Baird and ECCC reports, but here is the explanation in a nutshell. ECCC developed a geospatial database that catalogued various building, boathouse, and dock structures along the Rainy Lake and Namakan chain of lakes shoreline that might flood. Interviews with a sampling of property owners by Kenora Resource Consulting in 2013 were used to supplement the database inventory, providing a better understanding of how high water affected people. The Flood Tool was going to be based on this work, but no one knew there would be a major flood in 2014. Because people had just lived through this flood, an additional online survey was undertaken in 2014. The information from both those surveys along with other shoreline photographs and elevation measurements was used to characterize the critical shoreline vulnerabilities and the expected impacts under various water level conditions.

In many cases, it was possible to assign elevations to individual structures by using very accurate digital elevations maps and standard relationships between land and building elevations. In other cases, the elevations for the land were not accurate enough to support a structure by structure estimate. In those areas, ECCC assumed that buildings would be distributed vertically similarly to the vertical distribution of structures with known elevations. Structure values were based on per square meter assumptions that could be varied and on areas estimated from air photo interpretation. Standard tables were used to estimate the percent of the structure's value damaged for different depths of inundation. Structures were divided into lived-in structures, non-lived-in structures, two types of docks (floating and fixed-combo) and boathouses. Every structure is associated with a lake (Rainy, Namakan or lakes connected to Namakan), with 3-6 cm. increases in flood levels for the connected lakes where appropriate. Water levels simulated elsewhere can be pasted into the Flood Tool database and are analyzed. The maximum level each year is used to calculate annual damages. The database containing all the structure and elevation information is stored in a specific folder on the hard drive and the Flood Tool queries the database to calculate damages. One database can support two rule curve alternatives, and each alternative takes a couple of minutes to run the simulation. The Flood Tool produces multiple tables on several worksheets to hold the results of these runs.

The SVM uses stage-damage curves developed by running a series of water levels through the Flood Tool such that the annual maximum elevation increases one centimeter a year. The Flood Tool was run several times to get a wide range of levels and damages. The SVM can evaluate damages for any alternative or water supply in the SVM in a few seconds and it displays the results graphically (Figure 1, page 2). There is a lot of information in the graphic now; as we work with it we may change it a little to put the information people want front and center.

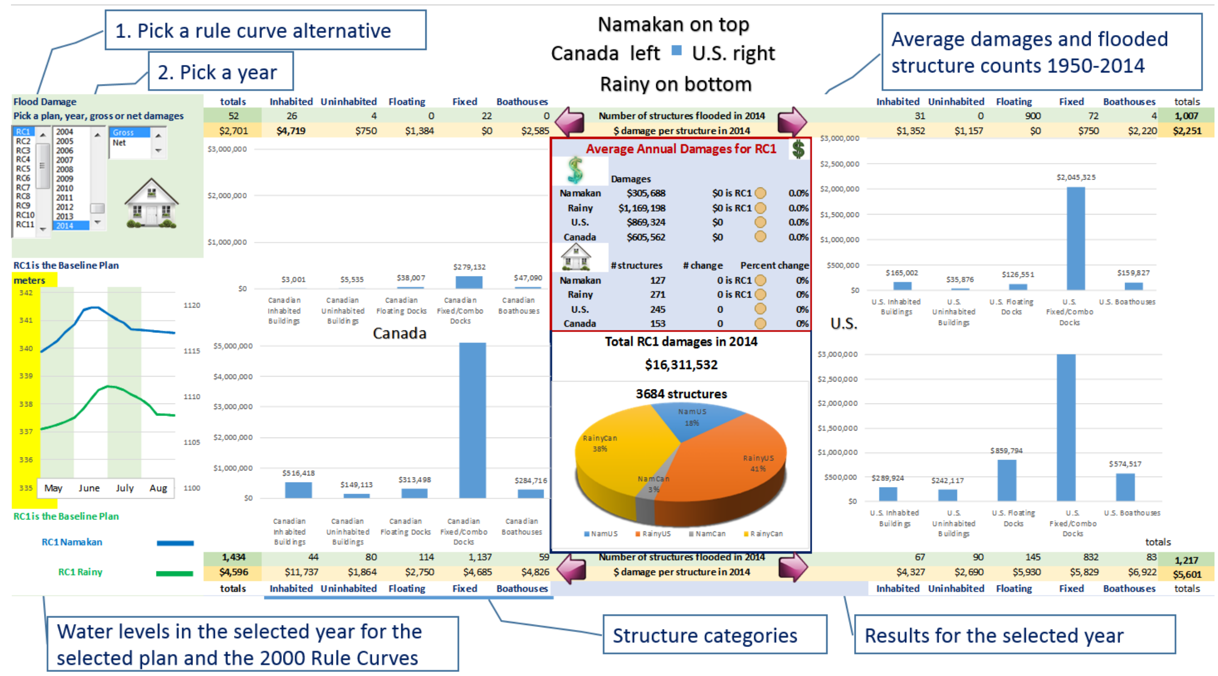


Figure 1 SVP Flood Damage Display when the 1970 Rule Curves (RC2 alternative) is selected; focus on 2014 damages

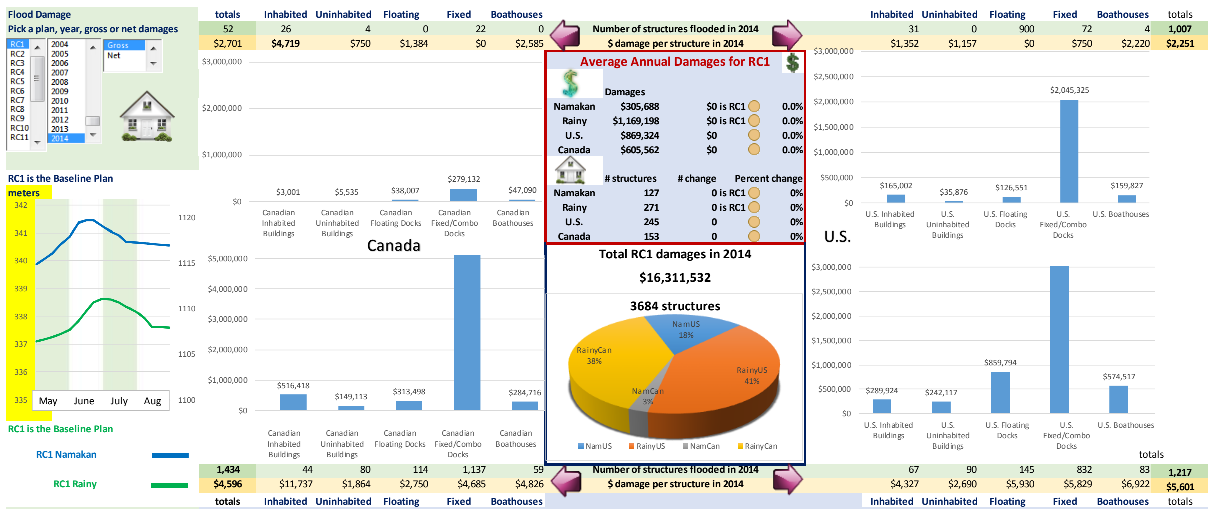


Figure 2 The SVM Flood Damage display, metric units, with the baseline 2000 Rule Curves (RC1); focus on 2014 damages

How well does it work?

There is no absolute damage survey we can use to determine whether the Flood Tool estimates flood damages precisely. Mike Shantz (ECCC) compared the Flood Tool results to the information that was available from the 2014 flood and concluded that the tool estimates were reasonable. But the actual 2014 damage estimates consider only a sample of the structures that flooded, while the Flood Tool estimates that nearly 3,700 structures would have been flooded in 2014, including 3,222 docks.

The absolute damage estimates are highly dependent on the estimated values of the structures, and the method used to estimate those values is thoughtful, but necessarily simplistic. Values for a particular structure are based on the area of the structure times a universal per square meter value for that type of structure. The default values used within the Flood Tool and SVM are considered reasonably representative, but they will always be arguable. Changing the per square meter values makes the damages change, but it doesn't change whether one plan causes more damage than another.

Typically, the use of a Shared Vision Model constitutes a tough "peer review" because multiple users will use the model and will ask whether the results are reasonable. We will start that process in this newsletter by comparing the 1970 and 2000 Rule Curve Results.

What does the flood damage model tell us?

The model depicts a basin in which substantial flooding occurred in ten years between 1950 and 2014, about 15% of the record. If the 1950 flood were to occur today, the model estimates that it would cause two and half times as much dollar damage as the 2014 flood.

The 2014 Flood, with the 2000 and 1970 Rule Curves

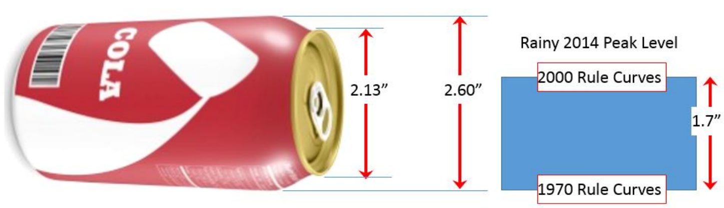


Figure 3 Scale of difference in 2014 Flood elevations, 1970 and 2000 Rule

With the 2000 Rule Curves in place (the RC1 baseline alternative in the SVM), the 2014 flood is estimated to cause $16.3 million damage to 3,684 structures including 70 lived-in structures in Canada and 98 in the U.S. (Figure 2) The per structure damages are $2,701 (Canada-Namakan), $2,251 (U.S.-Namakan), $4,596 (Canada-Rainy) and $5,601 (U.S. Rainy).

The 1970 Rule Curves (Figure 2) reduce the peak levels on Namakan and Rainy by 4 cm, less than 2 inches, but the difference in damages is noticeable. Damages are reduced to $15.0 million, although the number of structures flooded is close to the same (3,605 versus 3,684). In lesser flooding events, the number of structures flooded increases rapidly; in the 2014 and 1950 floods, the incremental damages per inch of flooding are mostly the result of the standard flood damage tables, which assume a certain percentage damage increase for every additional centimeter or inch of flooding (see Figure 6 and Figure 7). For example, the $5,601 per structure damage to U.S. structures on Rainy under the 2000 Rule Curves becomes $5,316 per structure with water 2 inches lower under the 1970 Rule Curve. Can we really estimate the difference in damage caused by less than 2 inches of water (Figure 4)? No. But we know that an extra two inches is not good, and the damage model will give us a consistent metric we can apply to all rule curve alternatives so that we can compare one to another over a range of different flooding conditions.

The 1950 Flood, with the 2000 and 1970 Rule Curves

The 1950 Flood under the 2000 Rule Curves would cause $37.6 million in damage to 4,321 structures, a 131% increase in damages and 17% increase in number of structures flooded compared to the 2014 flood. Under the 1970 Rule Curves (RC2), peak water levels would be 5 cm (2 inches) lower and would cause about $2.6 million less in damages ($35.0 million) to 4,251 structures, a 1.6% reduction in the number of structures.

Average annual damages

There are ten years that have more than a million dollars in damages; 1950, 1954, 1966, 1968, 1974, 1996, 2001, 2002, 2008 and 2014. On average, flooding will cause about $900,000 damage to an average of about 400 structures. RC2 reduces the annual damages by about $220,000 and the average number of structures by about 41.

Next Steps

There will be an SVM Webinar on September 26th at 9 am central, 10 eastern. During that webinar the newest parts of the SVM, including the flood damage estimator will be displayed and discussed, and the new SVM will be published for that webinar.

Meeting Number: 550 715 038; Meeting Password: RNRC

Call-in toll-free number: 1-877-413-4788 (Canada)

Conference ID: 210 172 2

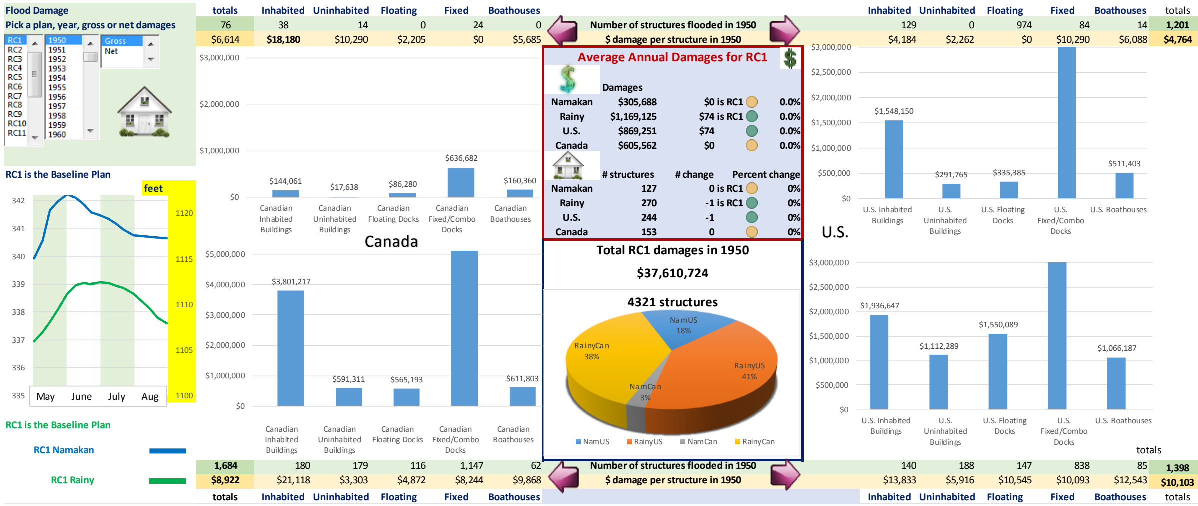


Figure 4 1950 Flood Damages, 2000 Rule Curves (RC1)

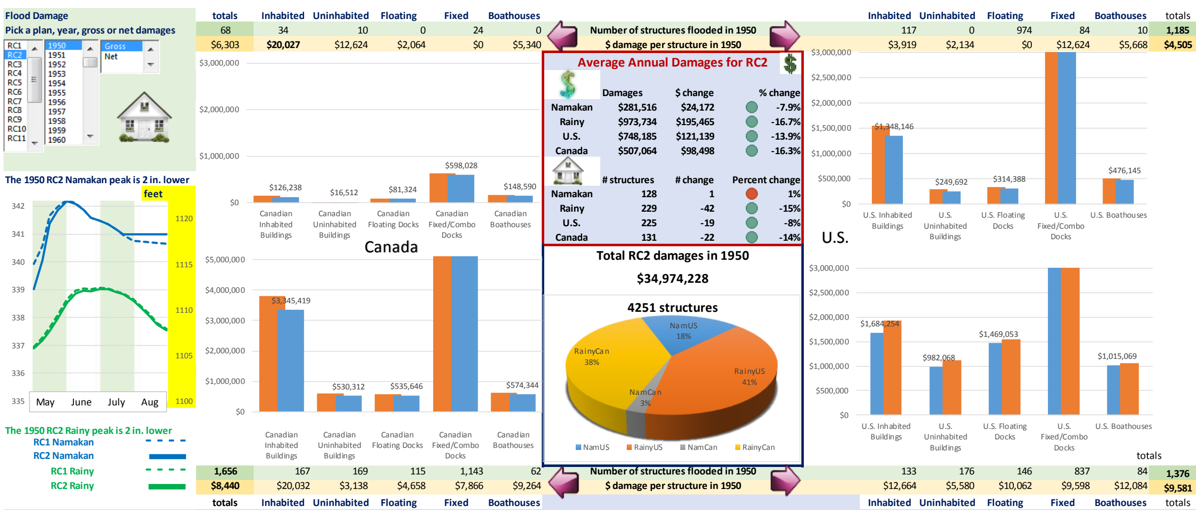


Figure 5 The 1950 Flood with the 1970 Rule Curves

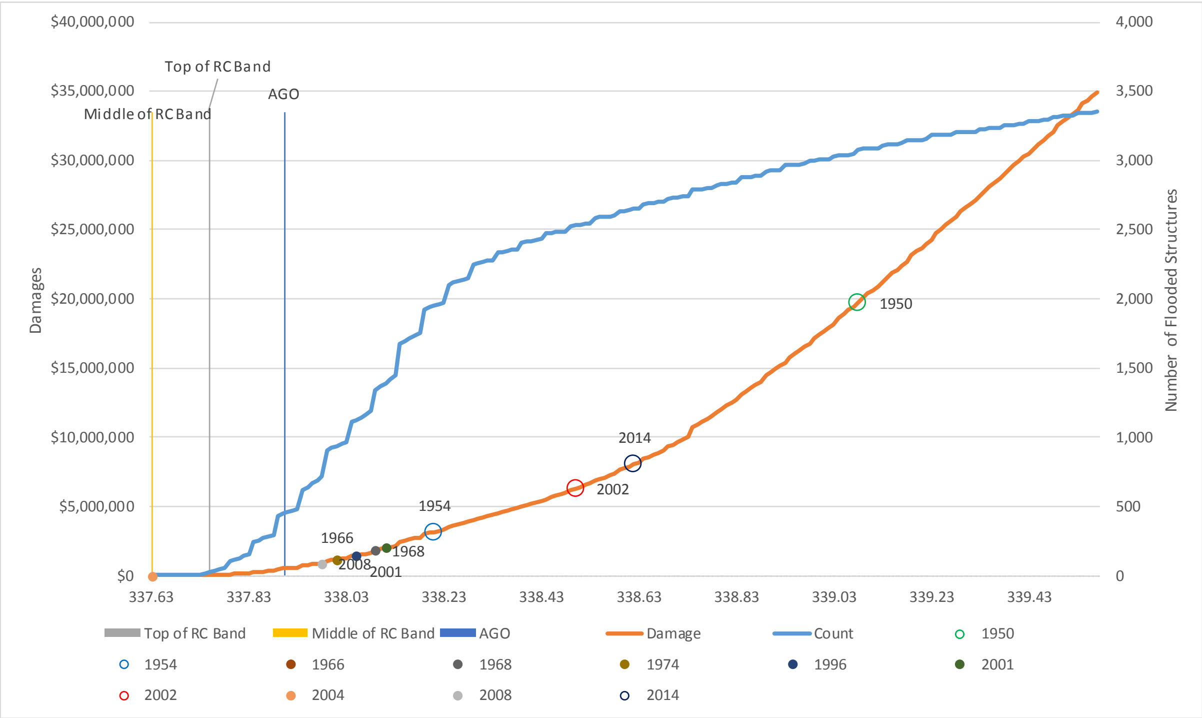


Figure 6 Rainy Lake Damages and Number of Flooded Structures at Different Water Elevations

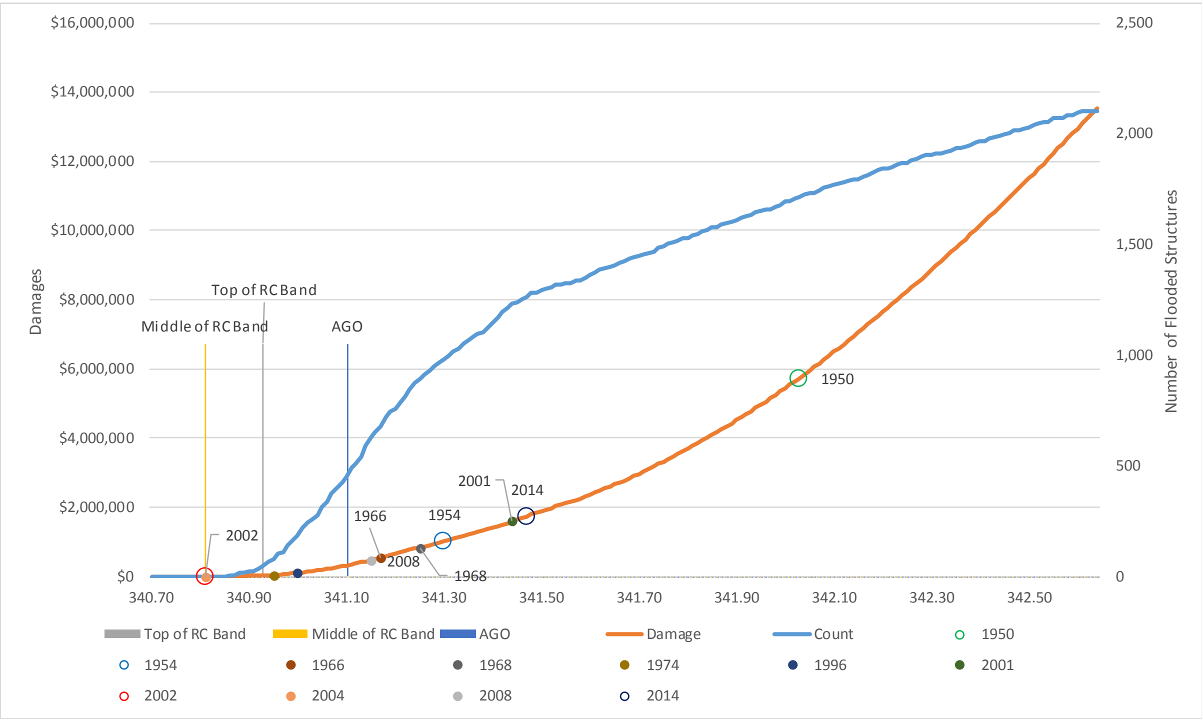


Figure 7 Namakan Reservoir Damages and Number of Flooded Structures at Different Water Elevations