

## **Appendix K      TRCA Flood Damage Assessment Memorandums**

**Phase 2 Flood Damage Cost Estimate Revised**

**Phase 3 Flood Damage Cost Estimate**



## **Phase 2 Flood Damage Cost Estimate Revised**



# Technical Memo

**To:** File  
**From:** Robert Chan, M.Eng., P.Eng., TRCA  
**Cc:** Nick Lorrain, Melody Brown, TRCA  
**Date:** 03/29/2022  
**Re:** Rockcliffe Riverine Flood Mitigation Project MCEA - Phase 2 Flood Damage Cost Estimate Revised

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The Rockcliffe Riverine Flood Mitigation (RRFM) Project Municipal Class Environmental Assessment (MCEA) seeks to determine a preferred strategy to provide riverine flood mitigation to the Rockcliffe-Smythe area. There are three EA Phase 2 Alternatives Solutions that have been short-listed for additional evaluation. Average annual damage (AAD) costs from riverine flooding was calculated for existing conditions and the three alternatives. AAD costs are useful to compare the relative benefit of the three alternatives.

The financial benefit of fully implementing each alternative is the avoidance of these flood damages. Toronto and Region Conservation Authority (TRCA) completed all flood damage estimation work, and the resultant values were provided for financial cost-benefit analysis. This technical memo summarizes the work completed by TRCA for documentation in the project's Environmental Study Report.

IBI Group had completed a Toronto Flood Risk Assessment and Ranking Project in October 2019 under contract to the TRCA. This project outlined a methodology for estimating both tangible and intangible flood damages, including the development of a database of the information required for these estimates, and a methodology for ranking flood risk for various communities. Tangible damages produced a dollar value of costs, intangible damages (community impacts and social vulnerability) produced an impact/vulnerability score, and the flood risk ranking was based on a weighted calculation using both numbers and other inputs.

For the purpose of financial cost-benefit analysis for the RRFM EA project, only actual dollar costs were required, as such only the tangible damages were calculated for the EA Scoped Study Area. The methodology for estimating average annualized flood damages as well as the building, residential and business data required to complete the estimation were all sourced from the IBI Group project (Toronto and Region Conservation Authority Flood Risk Assessment and Ranking Project, October 2019). Total tangible damages include:

- Direct damage to structures and contents – based on restoration and replacement costs for each building type of residential, commercial, industrial and institutional buildings.

- Business interruption – based on estimated building restoration times and the associated loss of productivity or value added for each industry.
- Household displacement – based on estimated building restoration times and the associated temporary accommodation required and related costs to households.

The damage calculation is based on the depth of flood water adjacent to each building. For added conservatism a 2m buffer was applied to each building such that if flood waters were present within the 2m buffer, the building was considered impacted. GIS tools were used to extract the building flood depth data.

Under existing conditions buildings are flooded as early as the 2-year storm. As such, building flood depths were determined under all design storm events (2, 5, 10, 25, 50, 100, 350-year return period design storm events and the Regional Storm). Similarly, the same storms were run for each of the three alternatives. The calculated total tangible damages were then annualized to give an Average Annual Damage.

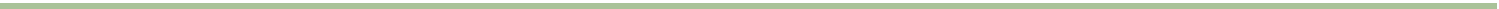
*The Average Annual Damage (AAD) cost from flooding is a common performance indicator used to measure the level of potential flood damages. It expresses the costs of flood damage as a uniform annual amount based on the potential damages inflicted by a range of flood magnitudes. In other words, AAD are the cumulative damages occurring from various flood events over an extended period of time, averaged for the same timeframe (IBI Group, October 2019).*

All three alternatives provides near-full riverine flood mitigation up to the 350-year storm event with some buildings still flooded during the Regional Storm (Hurricane Hazel). As such, the AAD costs are similar between the three alternatives and are significantly lower than existing conditions.

*Table 1 - Average Annual Damages from Riverine Flooding for the Three RRFM EA Alternatives*

Storm Return Periods	Total Average Annual Damages			
	Existing	Alternative 1	Alternative 2	Alternative 3
2 to 50 Year	\$7,208,000	\$0	\$0	\$0
2 to 100 Year	\$7,366,000	\$0	\$0	\$0
2 to 350 Year	\$7,566,000	\$0	\$0	\$0
2 to Regional	\$7,920,000	\$44,200	\$43,500	\$43,500

## Phase 3 Flood Damage Cost Estimate



# Technical Memo

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**From:** Robert Chan, M.Eng., P.Eng., TRCA  
**Cc:** Nick Lorrain, Melody Brown, TRCA  
**Date:** 03/29/2022  
**Re:** Rockcliffe Riverine Flood Mitigation Project MCEA - Phase 3 Flood Damage Cost Estimate

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The Rockcliffe Riverine Flood Mitigation (RRFM) Project Municipal Class Environmental Assessment (MCEA) seeks to establish a preferred strategy to provide riverine flood mitigation to the Rockcliffe-Smythe area. Phase 2 of the EA determined that Alternative 1 is the preferred alternative solution. Phase 3 of the EA developed multiple Design Concepts, three for Black Creek (BC1, BC2, BC3) and four for Lavender Creek (LC1, LC2, LC3, LC4), based off of Alternative 1 for additional evaluation.

Average annual damage (AAD) costs due to riverine flooding was calculated for existing conditions and the Design Concepts. AAD costs are useful to compare the relative benefit of the Design Concepts. One of the Black Creek concepts (BC2) was screened out and all four Lavender Creek concepts produce the same floodplain extents. As such, only AAD costs for BC1 and BC3 plus any LC option was needed to reflect the full range of Design Concept options.

The financial benefit of fully implementing each alternative is the avoidance of these flood damages. Toronto and Region Conservation Authority (TRCA) completed all flood damage estimation work, and the resultant values were provided for financial cost-benefit analysis. This technical memo summarizes the work completed by TRCA for documentation in the project's Environmental Study Report.

IBI Group had completed a Toronto Flood Risk Assessment and Ranking Project in October 2019 under contract to the TRCA. This project outlined a methodology for estimating both tangible and intangible flood damages, including the development of a database of the information required for these estimates, and a methodology for ranking flood risk for various communities. Tangible damages produced a dollar value of costs, intangible damages (community impacts and social vulnerability) produced an impact/vulnerability score, and the flood risk ranking was based on a weighted calculation using both numbers and other inputs.

For the purpose of financial cost-benefit analysis for the RRFM EA project, only actual dollar costs were required, as such only the tangible damages were calculated for the EA Scoped Study Area. The methodology for estimating average annualized flood damages as well as the building, residential and business data required to complete the estimation were all sourced from the IBI Group project (Toronto

and Region Conservation Authority Flood Risk Assessment and Ranking Project, October 2019). Total tangible damages include:

- Direct damage to structures and contents – based on restoration and replacement costs for each building type of residential, commercial, industrial and institutional buildings.
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The damage calculation is based on the depth of flood water adjacent to each building. For added conservatism a 2m buffer was applied to each building such that if flood waters were present within the 2m buffer, the building was considered impacted. GIS tools were used to extract the building flood depth data.

Under existing conditions buildings are flooded as early as the 2-year storm. As such, building flood depths were determined under all design storm events (2, 5, 10, 25, 50, 100, 350-year return period design storm events and the Regional Storm). Similarly, the same storms were run for each of the combined Design Concept scenarios (BC1 + LC 1-4 and BC3 + LC 1-4). The calculated total tangible damages were then annualized to give an Average Annual Damage.

*The Average Annual Damage (AAD) cost from flooding is a common performance indicator used to measure the level of potential flood damages. It expresses the costs of flood damage as a uniform annual amount based on the potential damages inflicted by a range of flood magnitudes. In other words, AAD are the cumulative damages occurring from various flood events over an extended period of time, averaged for the same timeframe (IBI Group, October 2019).*

All Design Concepts provide full riverine flood mitigation up to the 350-year storm event with some buildings still flooded during the Regional Storm (Hurricane Hazel). As such, the AAD costs are relatively similar for all Design Concepts and are significantly lower than existing conditions.

*Table 1 - Average Annual Damages due to Riverine Flooding for the RRFM EA Design Concepts*

Storm Return Periods	Total Average Annual Damages		
	Existing	BC 1 + LC 1-4	BC 3 + LC 1-4
2 to 50 Year	\$7,208,000	\$0	\$0
2 to 100 Year	\$7,366,000	\$0	\$0
2 to 350 Year	\$7,566,000	\$0	\$0
2 to Regional	\$7,920,000	\$40,800	\$101,000