

Terms of Reference - Third Party Review of Carp River Restoration Project

1. Background

The Carp River is located in the west end of the City of Ottawa, discharging into the Ottawa River at Fitzroy Harbour. It has a total watershed area of 306 square kilometres and is predominantly rural in character, except for the upper watershed (approximately 5500 hectares to Richardson Side Road), which is partly urbanized and subject to considerable urban growth pressure. The upper reaches of the Carp River have been identified as a heavily degraded stream, significantly altered and characterized by shallow gradients with limited baseflow and aggraded conditions. A Restoration Plan has been prepared for the Carp River in order to mitigate development impacts on the watercourse, improve the sediment transport and balance, increase fish habitat, and provide aesthetic and environmental benefits to the community of Kanata West.

The Carp River Restoration Plan (CRRP) has been under development- for approximately eight years, beginning with the Carp River Watershed/Subwatershed Study (CRWSS, Robinson Consultants Inc., December 2004), which was undertaken in 2000 and ultimately approved by City Council in 2005. (available here: <http://www.mvc.on.ca/planning/carpriver.pdf>).

A key recommendation of the CRWSS was the implementation of a two-zone floodplain policy through a reach of the upper Carp River within a proposed development area known as Kanata West, a 725 hectare area brought into the urban boundary in 2000. The Kanata West Concept Plan, outlining general land use and development principles for this area, was approved by City Council in 2003. The CRWSS included a preliminary analysis of the ~~of the~~ proposed filling of the present flood fringe areas using a conservative assumption of a minimum 100 metre wide floodway along the entire reach of the Carp River from Richardson Side Road to Hazeldean Road and the existing channel configuration. Further assessment of the impact of the specific restoration design and specific proposed alterations to the flood plain took place during the EA process.

A series of Municipal Class Environmental Assessment (Class EA) studies were undertaken in support of the CRRP and the servicing and transportation needs for the Kanata West development area. The Kanata West Landowners' Group (KWOG) and the City of Ottawa were co-proponents in the Class EA process. As proposed in the Class EAs, the CRRP was based on the application of the two-zone concept and would result in the creation of 28 hectares of developable land from the regulatory (100-year) floodplain in exchange for the rehabilitation of an upper reach of the Carp River, to be largely paid

for by the Kanata West development proponents. Through land use changes and re-alignments, the net reduction in floodplain area is presently estimated to be 14 hectares.

Modeling completed as part of the CRWSS indicated that post- to predevelopment peak flow controls were not required. The preliminary restoration design completed in support of the Class EAs, concluded that pre-development riparian storage within the reach would be matched in the post-development condition and that flood levels would be reduced in the post-development condition. The Class EAs were supported by the City, Mississippi Valley Conservation (MVC), the Ministry of Natural Resources (MNR), and the Ministry of Transportation (MTO). The Class EA studies and supporting documents included:

- i) Flow Characterization and Flood Level Analysis: Carp River, Feedmill Creek and Poole Creek (CH2MHill, October 2005);
- ii) Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, June 2006);
- iii) Carp River, Poole Creek and Feedmill Creek Restoration Class Environmental Assessment (Totten Simms Hubicki, June 2006).
- iv) Kanata West Master Servicing Study Volumes 1 and 2 (Stantec, June 2006); and
- v) Kanata West Transportation Master Plan (Delcan, June 2006).

A total of four Part II Order requests were submitted to the Minister of the Environment for the Kanata West Class EAs.

State of the art hydrologic and hydraulic models have been applied to define the flows and water levels along the Carp River within the Restoration Reach (Hazeldean Road to Richardson Side Road) and downstream under both existing and future development conditions. The objective was to develop a river restoration plan within a defined corridor that would not increase flood risk based upon the land use and development conditions prevailing in 2005, and to minimize any downstream impacts of development.

The different models that have been applied include QUALHYMO, HEC-RAS, and several versions of SWMM / XP-SWMM. Due to the wide, flat overbank areas, and the general sluggishness of the upper watershed, the HEC-RAS dynamic model was used to route the sub-catchment hydrographs along the river to depict the floodplain storage-flow interactions. This model has been set up for the project reach in support of the approved EA's , utilizing about 100 field surveyed cross-sections (from Hazeldean Road downstream to the Village of Carp).

Since approval of the Class EAs in 2006, a number of errors in the supporting hydrologic and hydraulic modeling have been identified. In particular, in early 2008, City staff identified that hydrographs representing runoff from the 700 ha Kanata West development area had not been read by the post-development hydraulic model. In

addition, the City of Ottawa's Auditor General has investigated the file and recently released findings that raised a number of other related issues.

(available here: <http://ottawa.ca/calendar/ottawa/citycouncil/ara/2008/05-08/Carp%20Audit%20APRIL%202022%2008.htm>)

At the request of the City, the consultants who completed the post-development hydraulic modeling in support of the Class EAs have corrected the model to read all flow hydrographs. Adjustments to the drainage area were also made. Resulting flows and water levels have been recalculated and adjustments made to the restoration plan design in order to minimize any flow and water level increases. The consultants indicate that the revised flows and water levels are very close to the original targets and within the normal accuracy limits for modeling of this kind.

The management response to the AG report recommended the following be referred for third party review.

- Geotechnical hazards - Advise on the appropriate timing within the process for examination of geotechnical hazards.
- Suspended Solids Criteria - Review the criteria for suspended solids removal.
- Sediment Balance - Confirm whether a sediment balance was achieved, and for advice on the need for quantitative estimates in regard to the volume of sediment and sediment transport capacity.
- Drainage Area Error – Review the impacts of the drainage area error on hydrology, hydraulics and other aspects
- Calibration – Review the issue of calibration and whether the steps undertaken, including sensitivity analysis, were reasonable.

City Council has directed staff to engage a third party consulting firm or firms with municipal land development and water resources capabilities to undertake an independent review of the project. These Terms of Reference outline the objectives, scope of work, and detailed tasks required of the independent review.

2. Objective

The objective is to review, validate, re-run and objectively ensure that appropriate hydro-technical modeling and floodplain management practices have been incorporated into the design of the Restoration Plan, and that the projected flows and water levels can be applied with confidence to implement the Restoration Project and approved development within Kanata West.

3. Scope of Work

The scope of work includes three phases; 1) review/validate/re-run the hydrologic and hydraulic models used in order to assess the adequacy of the modeling results to proceed with the Carp River Restoration Plan; 2) examine the overall project including a review

of other related issues raised in the Auditor General's report released 23 April 2008 and public input subsequently received (Public); and, if the City so decides, 3) updating and adjusting the Restoration Plan to correct any identified deficiencies.

4. Project Description

The current assignment is to carry out Phases 1 and 2 of these Terms of Reference.

Phase 1 - Technical Model Review and Re-Run

Conduct a ~~full~~ complete objective review and re-run (other source) of the hydrologic and hydraulic models used to establish flows and water levels for the Carp River Restoration Project, including their design and setup, calibration and verification, and application to depict existing and future development conditions. This review must include as a minimum:

1. Confirmation of the accuracy of the basic data and information used in the models.
2. The models used in the Auditor General's report and the results obtained.
3. Assess ~~the choice-~~ appropriateness of models used and the application of the design storms used to establish the flows and water levels along the Carp River.
4. The corrected hydrologic and hydraulic models representing the original restoration plan and the corrected models representing the modified Restoration Plan, including all return periods (i.e. 2 year to 100 year flows).
5. The impact of reported drainage area errors.
6. The criteria used in the Hydraulic Design Brief for (Public, other) the allowable increases in upstream and downstream (Public, other) flood levels, ~~downstream~~ flows and velocities.
7. The infiltration and runoff parameters used in the model to estimate surface runoff volumes and how these were accounted for in model calibration (other source).
8. The hydrologic and hydraulic model calibration procedures used, including the sensitivity analyses carried out and potential utilization of available stream flow records on the Carp River, Manning's "n" factors, etc.
9. The selection and orientation of cross sections used to model the existing and proposed floodplain conditions.
10. The hydraulic routing procedures used to combine the hydrologic inputs and produce the water level estimates, including the steady flow and unsteady flow computations.
11. The appropriateness of the hydraulic model criteria parameters used to establish water flow, volumes and water levels, such as cross-sections, slope, crossing details, existing and proposed fill in the floodplain, and floodplain storage. (other source)
12. The method of demonstrating the maintenance of floodplain storage in the restoration reach for interim and future development conditions, including balancing cut and fill on a range of return period basis for the entire reach (i.e. 2 year to 100 year flows), versus balancing on a 0.30-metre incremental elevation basis for individual applications.

13. The impact of existing and proposed (Public) culverts and bridges on flows and water levels within the restoration reach and downstream and the potential impact of ice and ice jams on water levels through the restoration reach and downstream.
- 13a. Assess the requirements for flow and water level monitoring for the Carp River to calibrate the models and implement the restoration plan (MOE).
14. The adaptive management (Public) measures established in the draft Implementation Plan for updating the models as development progresses and monitoring data becomes available to assess flows and water levels, and minimize flood risk.
15. The analysis of storm water management facilities, ~~and~~ habitat restoration pools and floodway width (MOE) and their impact on flows and water levels.
16. Review the stormwater management criteria and whether additional storm water quantity controls are required to mitigate development impacts.
17. Validate and re-run the models and produce final flows and water levels for the restoration reach and the downstream Carp River. Consider the MNR Technical Guide “River and Stream Systems: Flood Hazard Limits” with regards to how the Restoration Project is designed (MOE).
- 17a. Comment on the acceptability of any increases in existing flood levels and/or velocities for the 2 to 100 year return period events for the restoration reach and existing upstream and downstream developments (Public).
18. Prepare a Phase 1 report outlining the findings of the model review/validation/re-run in terms of flows and water levels and implications for the Restoration Plan and the other Class EA projects in the Kanata West area (MOE).
19. Briefing and presentation of Phase 1 findings.

Phase 2 – Review of Other Related Issues

Based on the results of Phase 1, assess the following related issues, as a minimum:

20. The appropriate timing within the process for geotechnical investigations and examination of geotechnical hazards within the floodplain, including slope stability issues, the impact of fill on clay/peat soils, etc.
21. Examine the *Flow Characterization and Flood Level Analysis, Carp River, Feedmill Creek and Poole Creek* (CH2M Hill, October/December 2005) report and advise on the timing of the requirement for updated floodplain mapping to the MNR Technical Guide standards (other source).
22. The measures established by the City for development in Kanata West to proceed in those areas outside of the flood plain where there are approved EA’s, using interim servicing facilities and any recommended conditions on such approvals, such as additional SWM criteria (Public), protecting opportunities for mitigation of runoff (MOE).
23. The need and the timing for incorporating other tributary catchments, such as the upstream Fernbank lands (in the developed condition), into the hydrologic models.

24. The threshold at which the impacts of increased runoff from interim development (i.e. prior to the Restoration Plan being fully implemented) needs to be further mitigated or development staging/phasing (MOE) to be reconsidered.
25. Assess the geomorphology and whether a sediment balance can be achieved, and the need for quantitative estimates of sediment volumes and sediment transport capacity, and the impacts of any erosion and sedimentation within the restoration reach and downstream.
26. The criteria used for storm water quality treatment following the Ministry of Environment Storm Water Management Planning and Design Guidelines, including suspended solids removal.
27. Prepare a summary of all of the work above and its impact on the Carp River Restoration Plan including the implications for all Class EA Projects (MOE).
28. Estimated budget required to complete the revised restoration plan.
29. Briefing and presentation of Phase 2 findings.

Phase 3 – Plan for Adjustments and Updates

As a result of the review of Phase 1 and 2, changes, adjustments or updates may be recommended as it relates to the Restoration Plan. The City may decide to incorporate such changes into the Carp River Restoration Plan in a subsequent Phase 3.

The City will review the information provided by the 3rd Party review and make a determination as to the amendments required, if any, to the EA documents. (MOE)

5. Project Organization

In order to facilitate the understanding of the project history, the third party reviewers will be assisted by an Advisory Committee consisting of:

1. City project staff
2. Agency staff from MVC, MTO, MNR and MOE
3. Academic

The Advisory Committee will be available on an as required basis to provide background and clarification. They will receive presentations at the conclusion of Phases 1 and 2.

Available Resources and Materials (to be added)