PL090678

Ontario Municipal Board

IN THE MATTER OF an appeal by Friends of the Greenspace Alliance

Witness Statement of Darlene Conway, P. Eng.

November 23rd, 2009

A. Introduction

1. I am a Professional Engineer, as designated by Professional Engineers Ontario. I am employed as a Senior Project Manager in the Infrastructure Services and Community Sustainability Department of the City of Ottawa. I have been employed by the City of Ottawa since 2002, but provide this testimony as a private citizen. I have 21 years of experience in water resources and municipal engineering, both in the public and private sectors. I have extensive experience in the management of or participation in a wide range of planning and environmental assessment projects in support of the City's Official Plan updates, Community Design Plans, and other master planning exercises. A copy of my Curriculum Vitae is included as **Exhibit A.**

2. This witness statement is comprised of the following sections:

   A. Introduction

   B. Background to my involvement with the Fernbank Community Design Plan file;

   C. General overview of stormwater and floodplain management concepts;

   D. Issue 3:

   Does the information in Section 5 in the Carp River Third Party Review, p.102-103 and Table 3-6 of the phase 1 report indicate that development in accordance with OPA No. 77 will cause an increase in peak flood levels in the Carp River? If so, has this been properly considered in the City's review and approval of OPA 77? Has the assessment of peak flood levels in support of approval of OPA No. 77 been completed consistently with the Ontario Ministry of Natural Resources "Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002)?"

   E. Issue 4:

   Is the application of quantity control up to the ten year event the appropriate standard for the two ponds in the Carp River Watershed?

3. The opinions in this witness statement are based upon a review of the analyses and recommendations in the following documents:
   i)Third Party Review - Carp River Restoration Plan (TPR), Greenland International Consulting Ltd., March 2009, in particular Table 3-6 and pages 102 and 103;
   ii)Fernbank Community Design Plan, Environmental Management Plan (EMP), Volumes 1 and 2, Novatech Engineering Consultants Ltd., June 2009;
   iii) Carp River Watershed/Subwatershed Study (Robinson Consultants Inc., December 2004);
   v)Flow Characterization and Flood Level Analysis: Carp River, Feedmill Creek and Poole Creek (CH2MHill, October 2005); and
   v)Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, June 2006).

4. It is my opinion that:
   i) Contrary to the conclusions of the EMP, the development, in accordance with OPA 77, will cause an increase in regulatory (100 year) flood levels in the Carp River; "flood level" refers to the maximum elevation that occurs at a given location in a watercourse resulting from a given rainfall event;
   ii)The assessment of flood levels as set out in the EMP in support of approval of OPA 77 has not been completed consistently with the Ontario Ministry of Natural Resources "Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002);"
   iii)The assessment of flood levels as set out in the EMP in support of OPA 77 is not consistent with the recommendations of the Third Party Review - Carp River Restoration Plan;
   iv)The application of quantity control up to the ten year event is not the appropriate standard for the two ponds in the Carp River Watershed; and that the appropriate standard or criterion remains to be determined; and
   v)Increased flood levels resulting from inappropriate quantity controls will increase flood risk to the flood-prone community of Glen Cairn located immediately upstream of Fernbank.

5. Based on the above, it is my opinion that the planning completed for OPA 77 was not consistent with the Provincial Policy Statement (PPS), the City's Official Plan, nor the City's Council-approved Stormwater Management Policies given that:
   i)The assessment of the development's impact on flood levels and the determination of the appropriate quantity control criterion has not been completed on a watershed/subwatershed basis as per the following policies:

- **PPS**: *"2.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by: a) using the watershed as the ecologically meaningful scale for planning;"*
- **Official Plan** (see **Exhibit B**):

"2.4.3 - Watershed and Subwatershed Plans
7. A subwatershed plan will be undertaken:
c. As a basis for City Council consideration of a community design plan or an application to amend the Official Plan which provides for new development areas or redevelopment areas, or applications to subdivide land in locations that are largely undeveloped."

- **Stormwater Management Policies** (see **Exhibit C**):

"The City will: Undertake SWM planning on a subwatershed basis."

ii) Proceeding with OPA 77 as currently proposed will result in increased flood levels in the Carp River that will increase risks to public health and safety, which is inconsistent with:

- **PPS:** *"1.1.1 Healthy, liveable and safe communities are sustained by: a) avoiding development and land use patterns which may cause environmental or public health and safety concerns."*
- **Stormwater Management Policies** (see **Exhibit C**):

"The City will: Require the implementation of stormwater management measures, where required, that will ensure no increase in the regulatory flood elevation resulting from changes in land use."

B. Background to my involvement with the Fernbank Community Design Plan file:

6. From late 2006 to May 2009 I was a member of the Technical Advisory Committee for the Fernbank Community Design Plan ("Fernbank") on behalf of the City of Ottawa ("City"), but provide this testimony as a private citizen.

7. The Fernbank lands are located on the west side of the Carp River, immediately upstream of Hazeldean Road and a large development area known as Kanata West. The portion of the Fernbank development area draining to the Carp River is approximately 200 hectares, a location plan of which is provided in **Exhibit D**.

8. Because of my participation on the Fernbank file, I reviewed the 2006 Class Environmental Assessment studies ("Class EAs") prepared in support of the Kanata West

plan in late 2007/early 2008. These Class EA studies had already been approved by the City and Mississippi Valley Conservation ("MVC") but were then (and still are) under Part II Order requests to the Minister of the Environment as well as an order under Section 16(3) of the *Environmental Assessment Act*.

9. The development of the Fernbank lands was not accounted for in the modeling undertaken for the Kanata West Class EAs. As such, the proponents of the Fernbank Community Design Plan were directed by the City to complete an impact analysis of the development of these lands on the Carp River and the proposed Carp River restoration plan ("restoration") through the Kanata West development area. This proposed restoration includes a regrading of the channel and floodplain including the creation of approximately 28 hectares of developable land through filling of the regulatory (100 year) floodplain. The location of the Kanata West plan and extent of the restoration plan is shown in **Exhibit D**.

10. The impact analysis for the Fernbank lands would require updating the modeling prepared by the Kanata West proponents for the restoration (i.e., updating to include Fernbank in a developed condition). In order to review this updated modeling work completed by Fernbank, I began to familiarize myself with the Kanata West modeling in late 2007, including:

    - Flow Characterization and Flood Level Analysis: Carp River, Feedmill Creek and Poole Creek (CH2MHill, October 2005);
    - Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, June 2006); and
    - Kanata West Master Servicing Study Volumes 1 and 2 (Stantec, June 2006).

11. At the time, these documents provided the technical support for the restoration, including existing and post-development hydrologic and hydraulic modeling. (Hydrologic modeling provided flow information (how much and how fast water runs off a given catchment or drainage area during a rainfall event). This flow information was then input to the hydraulic model of the Carp River which generated resulting flood levels.) "Existing" referred to 2005 land use conditions and post-development referred to the future build-out of most lands designated urban within the Official Plan but did not include development of the Fernbank lands.

12. Through this review, I discovered coding errors in the modeling that resulted in the total runoff volume from the Kanata West lands not being accounted for in the calculation of post-development flood levels. As a result, the documented post-development flood

levels were lower than they should have been, in the order of 0.2 to 0.3 meter. I subsequently notified my supervisor and the City manager responsible for the Kanata West/restoration file.

13. Concurrent to my review of the Kanata West Class EAs, the Carp River restoration file was also being audited by the City's Auditor General ("Auditor General").

14. As a result of the modeling errors identified and the findings of the Auditor General, on May 14, 2008, City of Ottawa Council ("Council") directed that a "Third Party Review" (TPR) of the file be undertaken.

15. The Fernbank proponents were advised that the supporting technical studies for the Community Design Plan (CDP) could not be finalized in advance of completion of the TPR.

16. The TPR was completed in early 2009 and adopted by Council on May 27, 2009.

17. The Fernbank CDP was adopted by Council on June 24, 2009.

18. Throughout the period of my involvement with the Fernbank file, I had noted my concerns with the restoration project both as a City employee, a professional engineer, and as a private citizen:

- January 2008: Review of Kanata West Class EAs: As noted above, I discovered the error of the missing hydrographs that resulted in an underestimation of post-development flood levels.

- February 2008: OMB Hearing: City of Ottawa By-law No. 2007-359, OMB Case no. PL070851: As a private citizen, I provided expert testimony on behalf of the appellant, Ted Cooper, that the flood level information being used to delineate the limit of hazard lands on the subject site plan was inaccurate and had not been completed consistently with the Ontario Ministry of Natural Resources "Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002);" also that the application of two-zone floodplain policy as proposed was not appropriate.

- May 13, 2008: Audit of Carp River Restoration and Associated Projects: As a private citizen, I presented my concerns to the Planning and Environment Committee of Council (PEC) regarding City management's response to the Auditor General's recommendations.

- June 8, 2008: Terms of Reference for Third Party Review: As a private citizen, I submitted an alternative Terms of Reference for the Third Party Review to the City that were, in my opinion, more appropriate to the review of this project.

- June 19, 2008: As a private citizen, I provided a written response to a memo dated May 12, 2008, prepared by MVC, that suggested MVC's approach to floodplain management was in keeping with other Conservation Authorities (CAs) across the province. Based upon my own experience with many other CAs, I disagreed and provided that response to members of Council and City management.

- June 24, 2008: Terms of Reference for Third Party Review: As a private citizen, I provided my comments to PEC regarding what were, in my opinion, an inadequate terms of reference to address concerns with the project.

- August 2008: Duty to Report to Professional Engineers Ontario: I fulfilled my Duty to Report to Professional Engineers Ontario (PEO) on the basis that the City intended to allow for interim approvals of development within Kanata West before the recommendations of the TPR were available and without defensible stormwater management criteria.

- April 2009: Release of Third Party Review: As a private citizen, I provided comments to the City on the TPR, which, in my professional opinion, did not address the fundamental problems with the project.

19. Subsequent to Council adoption of the TPR on May 27, 2009, I requested removal from the Fernbank file. My request was made on the basis of my concerns with the TPR recommendations and that I would be unable to sign off on the Fernbank file, which would depend on the TPR modeling for its impact analysis on flood levels. Through my request for removal, I reiterated my concerns with the TPR recommendations.

20. I did not review the technical documents supporting the Fernbank CDP (EMP, June 2009, Volumes 1 and 2) until October 2009, after being requested by the Friends of the Greenspace Alliance to provide expert testimony on behalf of their appeal of OPA 77.

C. General overview of stormwater and floodplain management concepts:

21. **Exhibit E** illustrates the change in surface runoff that occurs after development: increased hard surfaces dramatically increase the amount and rate of surface runoff compared to pre-development conditions.

22. **Exhibit F** provides a graphic depicting schematically the change in volume and rate of runoff that occurs after development. The graph provides a plot of two hydrographs, a hydrograph being a graphical representation of the change in flow that occurs in a watercourse during a given rainfall event: at the start of the rainfall event, flows in the receiving watercourse will start to increase, gradually reach a peak (or maximum) flow and then recede as the rainfall event ends and the runoff stops. In other words, a hydrograph illustrates how much and how quickly water runs off the land during a rainfall event. The total area under a hydrograph curve represents the total volume of runoff for that rainfall event.

23. SWM quantity controls and SWM ponds: As indicated on the graph (**Exhibit F**), in the pre-development condition, the runoff volume and peak flow achieved are considerably less than in the post-development condition. Further, in the post-development condition, the peak flow occurs sooner than under the pre-development condition reflecting the ability of storm sewers and other engineered drainage systems to convey the water much more rapidly to the receiving watercourse. Without the implementation of appropriate SWM quantity controls in conjunction with development, these impacts of development – increased volumes and peak flows, faster rates of runoff – will typically result in increased flood levels in the receiving watercourse. Typical SWM measures to control flooding include storage ponds to which uncontrolled runoff is directed before discharge (at a controlled rate) to the receiving watercourse. A schematic of a typical SWM pond cross-section is provided in **Exhibit G**. The storage provided by these ponds attenuates or reduces the post-development peak flows back down to the peak flow that would have occurred before development (the pre-development peak flow). By not increasing peak flows in the receiving watercourse, flood level increases following development can be avoided. Generally speaking, and particularly for receiving watercourses with a relatively small total drainage area, increased peak flows result in increased flood levels. Although appropriate quantity control must be determined on a subwatershed-specific basis, in situations where the receiving watercourses have relatively small catchments, quantity controls requiring that pre-development peak flows not be exceeded are typically required. The Carp River through the Fernbank development (i.e., to immediately upstream of Hazeldean Road) would be considered to have a relatively small total drainage area (approximately 900 hectares).

24. Cumulative impacts of development and SWM quantity controls: SWM ponds can result in a "lagging" effect on peak flows. In other words, the effect of attenuating or choking back the uncontrolled post-development peak flows through the SWM pond is to

"stretch out" or extend the duration of that controlled peak flow following a rainfall event. This effect is illustrated on **Exhibit H:** note the duration and timing of the (controlled) peak flow for Watershed A in the post-development condition as compared to the pre-development condition. If the impact of this "lagging" is not accounted for when multiple SWM ponds are required, the unintended consequence can be increased post-development flood levels as the timing of peak flows from multiple ponds may become additive and exceed pre-development peak flows in the receiving watercourse on a cumulative basis (even though the SWM ponds were ostensibly proposed to avoid this very occurrence). This situation is a key justification as to why stormwater management planning should be undertaken on a subwatershed basis. In other words, the cumulative impacts of all proposed development (and the effects of the associated SWM controls) within a subwatershed area are to be assessed at the same time, such that the interaction of various SWM facilities can be determined and appropriate SWM quantity controls can be confirmed on a comprehensive basis. Such an approach also allows for and recognizes that different levels of SWM quantity control may be required at different locations in the subwatershed. For example, development at the upper end (headwater area) of a subwatershed (where the total drainage area can be relatively small and therefore sensitive to development impacts) would typically require more stringent quantity controls than a development at the lower end of a large subwatershed where the larger drainage area may result in less sensitivity to the impacts of development on peak flows and flood levels.

25. Planning for development on a subwatershed basis, a key element of which includes the determination of the appropriate SWM quantity control criterion, is a requirement of the PPS, the City's Official Plan and the City's Stormwater Management Policies:

- **PPS**: *"2.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by: a) using the watershed as the ecologically meaningful scale for planning;"*
- **Official Plan** (see **Exhibit B**):

"2.4.3 - Watershed and Subwtershed Plans
7. A subwatershed plan will be undertaken:
c. As a basis for City Council consideration of a community design plan or an application to amend the Official Plan which provides for new development areas or redevelopment areas, or applications to subdivide land in locations that are largely undeveloped."

- **Stormwater Management Policies** (see **Exhibit C**):

"The City will: Undertake SWM planning on a subwatershed basis."

D. Issue 3:

Does the information in section 5 in the Carp River Third Party Review, p.102-103 and Table 3-6 of the phase 1 report indicate that development in accordance with OPA No. 77 will cause an increase in peak flood levels in the Carp River? If so, has this been properly considered in the City's review and approval of OPA 77?

26. The Fernbank lands tributary to the Carp River, located between Hazeldean Road to the north and the TransCanada trail to the south, comprise some 200 hectares (see **Exhibit D** for location plan). Based upon the typical impacts of urbanization, development of these lands will increase the amount and rate of runoff entering the receiving Carp River due to the increased imperviousness from roads and houses, and the improved efficiency with which runoff will be conveyed to the river by engineered drainage systems.

27. It is understood that the Fernbank proponents have made use of the "model of record" from the March 2009 Third Party Review (TPR) to assess the impacts of developing the 200 hectares draining to the Carp River upstream of Hazeldean Road, although the specific date and version of the model used is not explicitly documented in the EMP.

28. The "model of record" includes hydrologic and hydraulic analyses to demonstrate the effect or change to existing peak flows and flood levels as a result of the build-out of a large development area called Kanata West (some 700 hectares) located immediately downstream of Fernbank, the build-out of some additional future development lands outside Kanata West and the implementation of the Carp River Restoration that includes the filling of floodplain to create some 28 hectares of developable land. "Existing conditions" for this modeling is defined as 2005 land use. As summarized in Table 3-6 of the TPR (included in **Exhibit I**), the model of record indicates that 100 year flood levels will increase at several locations throughout the study reach from 3 cm at the outlet of the existing Glen Cairn SWM facility to a maximum of 28cm at Palladium Drive.

29. Since this previous work completed for the Kanata West development Class EAs and the subsequent TPR did not include the Fernbank lands in a developed condition, the Fernbank proponents undertook this analysis, which is documented in the EMP, Section 8, p. 64-67 (**Exhibit J**). The results of the hydrologic and hydraulic analyses completed by the Fernbank proponents are summarized in Tables 10-1 and 10-2 of the EMP, Volume 1

and are also included in **Exhibit J.** As indicated, it is contended that flood levels at every section, from the upstream limit of study at the existing Glen Cairn SWM facility to the downstream limit at Richardson Side Road, are reduced with the development of the Fernbank lands.

30. Based upon my detailed review of the modeling results made available in the EMP, it is my opinion that these results are not defensible and cannot be reconciled with the Fernbank consultant's own hydrologic (hard copy) output provided in Volume 2 of the EMP, Appendix D. This finding has been confirmed by a recent e-mail from legal counsel for the City of Ottawa (**Exhibit K**) which indicates that the Fernbank consultant has admitted to an error in the modeling. From the e-mail:

    "We can advise you that Novatech has determined that 50 year hydrographs were mistakenly used in the final draft as approved by city council (an administrative error was made attaching an incorrect file)."

    The resultant effect of the error is that lower (50 year) flood levels have been represented as 100 year flood levels in Tables 10-1 and 10-2 (**Exhibit J**) for the post-development modeling scenarios.

31. Given the identified error in the modeling, the 100 year flood levels documented in the EMP cannot be used to support OPA 77. As of the writing of this witness statement, the respondent has failed to provide a digital copy of the hydrologic and hydraulic modeling completed in support of OPA 77 as originally requested on October 25, 2009. Notwithstanding the lack of digital modeling files, I have been able to come to the conclusion that the modeling is flawed and that flood levels will rise if OPA 77 is permitted to proceed as currently proposed. These conclusions (which are explained in detail below) are based upon a review of the (hard copy) modeling information provided in the EMP.

32. <u>Recommendations of the TPR with respect to development of Fernbank lands</u>: As noted previously, the Fernbank modeling was dependent on the previous modeling completed for the TPR. Also noted previously, the Fernbank lands, in a developed condition, were not accounted for in the TPR. Rather, the TPR indicated this was not necessary as long as:

- *"The Fernbank lands when modelled would have to match the peak flows generated in the XPSWMM [hydrologic] model and also match the same runoff volume for existing conditions.*

- *A target [excess runoff volume] of 40,000 m^3 has been suggested and should be reviewed with the updated models presently being prepared by the developer consultants for the Fernbank lands.*

- *The key finding is that the Fernbank lands, in the developed condition, do not need to be incorporated in the models now because it is sufficient to require that peak flows not exceed existing conditions in the upper Carp River and that runoff volume not exceed the suggested 40,000 m^3 above existing conditions"* (TPR, p. 102, 103). See **Exhibit I.**

33. As indicated in the TPR, these requirements for the Fernbank lands were set " *To ensure that the schemes that are being developed for the Carp River restoration plan and the general servicing strategy will not be impacted by the future development of the Fernbank lands...."* (TPR, p.102, **Exhibit I**)

34. Notwithstanding the above recommendations, there is no indication in the TPR that any hydraulic modeling analysis was actually done (for the TPR) with Fernbank's post-development hydrographs to confirm that 40,000m3 of excess runoff volume following development would not increase existing condition flood levels based on the quantity control criterion assumed by the Fernbank proponents.

35. <u>Overview of Fernbank modeling results (existing conditions):</u>

i) The Fernbank consultant proposes in the EMP that the total existing condition 100 year runoff volume between the Glen Cairn SWM facility and Hazeldean Road exceeds the existing condition 100 year runoff volume documented in the TPR by approximately 39,600m3. This is not consistent with the TPR recommendation which required that Fernbank "..... *match the same runoff volume for existing conditions."* (TPR, p. 102, **Exhibit I**). This increase in existing condition runoff volume results in higher existing condition 100 year flood levels through the Fernbank lands. The significance of this is that Fernbank is proposing a different (higher) baseline condition against which the impacts of development will be assessed. Without consistent baseline flood levels from which to compare the impacts of development, there is no means of ensuring that cumulative development impacts will be adequately mitigated because the targets to meet (peak flow and flood level) have now shifted upward. Should every development choose to similarly increase existing condition runoff volumes, then flood levels would inevitably rise more than documented in the TPR. This higher baseline condition invalidates the TPR recommendation that the additional runoff volume from the Fernbank development should not exceed 40,000m3, since this requirement was set assuming a consistent (lower) baseline flood level.

ii) More specifically, as summarized in Tables 10-1 and 10-2 of the EMP (**Exhibit J**), the Fernbank proponents re-calculated the existing condition flood levels (i.e., as compared to the existing condition flood level modeling completed for the TPR), contending that existing condition flood levels are higher than shown in Table 3-6 of the TPR (**Exhibit I**). Based upon the hydrologic analysis completed by the Fernbank consultants, an additional runoff volume of about 39,600m3 is generated in Fernbank's version of existing conditions. A comparison of existing condition runoff volumes between Fernbank and the TPR is summarized in **Exhibit L**. **Exhibit L** is a summary of modeled results taken directly from the hard copy hydrologic output provided in the EMP, Volume 2, Appendix D. I have provided no additional analyses but have only reported the Fernbank consultant's modeling results. This increase in existing condition runoff volume translates into a flood level increase of 5cm (for existing or baseline conditions) downstream of the Glen Cairn SWM facility compared to the TPR flood level at this location, i.e, 94.97m (Fernbank existing) vs. 94.92m (TPR existing).

ii) This difference in existing condition flood levels highlights the need to complete development impact assessments on a subwatershed basis as required by the PPS, the City's Official Plan and the City's Stormwater Management Policies. Using the watershed/ subwatershed as the "ecologically meaningful scale for planning" allows for the assessment of cumulative impacts of development such that appropriate mitigative measures (such as SWM quantity controls) can be identified. Planning on a subwatershed basis ensures consistent analytical approaches such that differences in existing conditions as noted above are avoided and the impacts on flood levels can be more accurately assessed from a common baseline (or existing condition).

iii) That being said, as noted above, the TPR did not recommend that the Fernbank lands be included in the TPR modeling in a developed condition. But the TPR did recommend that, *The Fernbank lands when modelled would have to match the peak flows generated in the XPSWMM [hydrologic] model and also match the same runoff volume for existing conditions* (TPR, p. 102).

iv) In fact, as noted above, the Fernbank existing conditions runoff volume considerably exceeds the TPR existing conditions runoff volume by about 39,600m3. This is inconsistent with the TPR recommendations that were intended to ensure no impact on the downstream Kanata West lands as a result of the Fernbank development. This additional runoff volume in the existing condition by the Fernbank consultants effectively means that flood levels should increase (compared to the TPR levels in Table 3-6), given that the existing condition or baseline flood level target to meet is higher. In other words, with this higher existing condition flood level, less storage (smaller SWM ponds, reduced land for the

SWM ponds) would effectively be required and post-development flood levels would be expected to rise higher than anticipated in the TPR.

v)To ensure a consistent baseline against which to measure the impacts of development, the Fernbank existing conditions modeling should have been adjusted or calibrated to the TPR existing conditions modeling, such that Fernbank total runoff volumes under existing conditions were consistent with the earlier, City Council-approved TPR analysis, but this was not done.

vi) To summarize for points i) to v):
The information on p. 102-103 of the Carp River Third Party Review phase 1 report indicates that development in accordance with OPA No. 77 will cause an increase in peak flood levels in the Carp River. Since the City approved the OPA 77 on the basis of existing conditions that were not consistent with the TPR recommendations, this was not properly considered in the City's review and approval of OPA 77.

Has the assessment of peak flood levels in support of approval of OPA No. 77 been completed consistently with the Ontario Ministry of Natural Resources "Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002)?"

36. The determination of regulatory flood levels and the resulting extent of flood hazard lands is a process that informs land use planning: increased flood risk to public health and safety can be avoided by ensuring development is directed away from such hazard lands. A defensible methodology to generate flood peak flows and flood levels is required for these purposes which the Ministry of Natural Resources provides in its Technical Guide: River and Stream Systems: Flooding Hazard Limit (MNR, 2002), ("the Guide"). The Guide documents standardized approaches to manage flood susceptible lands across the Province. As noted on p. 8, the Guide also "assists in the approval process and in explaining, or if necessary defending, the methodology when challenged" (see **Exhibit M**).

37. The Guide notes on p. 50 **(Exhibit M),** *"Future extent of urbanization should be extracted from Official Plans or other Municipal land use planning documents and the planning horizon should preferably extend 20 years into the future."* The Kanata West/restoration Class EAs (2006) and subsequent TPR (March 2009) did not account for Fernbank in a developed condition although it has been designated urban since August 2005. The Guide further notes on p.50, *"Where stormwater management facilities, existing or*

future, can affect the magnitude and/or timing of the flows, the cumulative effects of these structures should be incorporated in the floodplain studies." Likewise, future Fernbank SWM facilities were not modeled in the Kanata West/restoration Class EAs and subsequent TPR. Finally, the additional modeling completed by Fernbank (that finally shows the impact of Fernbank in a developed condition), fails to account for the OP build-out of some lands outside the boundary of CDP, in particular lands draining to Hazeldean Creek and the future employment lands adjacent to the western limit of Fernbank (demonstrated by no change in peak flows or runoff volumes at location 43966 (**Exhibit N**). The noted lands are shown in **Exhibit O**.

38. Accordingly, the assessment of peak flood levels in support of approval of OPA No. 77 has not been completed consistently with the Ontario Ministry of Natural Resources "Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002).

39. The planning relevance of this shortcoming is that the methodologies outlined in the Guide inform the land use planning process by ensuring, as the PPS requires, that *"development shall generally be directed to areas outside of hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards....."* If the methodology used is not consistent with the Guide then the resulting flood levels and flood hazard areas generated cannot accurately inform land use planning decisions and ensure risk to public health and safety is not increased as a result of land use change. Finally, without a methodology that consistently and defensibly accounts for all anticipated impacts of development within the planning horizon of a municipality's Official Plan, flood levels can become a "moving target" resulting in increased flood levels from the cumulative impacts of land use changes over time, effectively defeating the intent of the PPS' natural hazards policies.

E. Issue 4:
Is the application of quantity control up to the ten year event the appropriate standard for the two ponds in the Carp River Watershed?

40. Overview of Fernbank modeling results (post-development conditions):

i) With respect to the post-development condition, the Fernbank hydrologic modeling indicates an excess or additional runoff volume of about 35,000m3 (see **Exhibit N**). This excess runoff (resulting from urbanization) is within the 40,000m3 target for excess runoff from the Fernbank lands recommended in the TPR, as noted above.

ii)To summarize, the Fernbank hydrologic modeling indicates an additional 75,000m3 of runoff volume will be added to the Carp River as a result of different modeling results for the existing condition as compared to the TPR results (about 39,600m3) and from the impacts of urbanization (about 35,000m3).

iii) Taking these hydrologic results, the Fernbank proponents then applied the proposed quantity control criterion to the "uncontrolled" developed condition flows. The proposed criterion from the EMP, Volume 1, p. 55, are provided below (**Exhibit J**):

- *"The proposed stormwater management strategy will need to adhere to all applicable policies and guidelines of Mississippi Valley Conservation; the City of Ottawa, MOE, and other approvals Agencies".*

- *"Increases in runoff volume resulting from development are not to exceed an additional 40,000 m3 above existing conditions for the 100-year event;....."*
- *".....The proposed development must not result in any increase in downstream flood risk in the Carp River. Any proposed increases in flood elevations will need to be reviewed to ensure that they do not represent an increase in flood risk. Provided this criterion is met, the following design criteria are to be applied to proposed SWM facilities:*
  o For SWM Facilities outletting directly to the Carp River, peak flow control is not required for major storm events (> 10 year event).
  o For SWM facilities outletting to tributaries of the Carp River, peak flow control is required for all storms up to the 100-year event."

iv) "Peak flow control" refers to providing sufficient storage volume in SWM facilities such that pre-development peak flows are matched in the post-development condition. Peak flow control up to the 10 year event means that for events larger than the 10 year event, peak flows from a given drainage area will exceed the respective pre-development peak flows. Peak flow control to the 100 year event means that pre-development peak flows for all events up to and including the 100 year event will not be exceeded.

v)There are three SWM ponds proposed for the Fernbank plan as indicated on Figure 8.1 from the EMP (**Exhibit J**). The Fernbank consultants applied the following SWM quantity control criterion to the ponds:

- Pond 1: peak flow control is required for all storms up and including to the 100-year event. Pond 1 discharges to a tributary of the Carp River. A total area of about 82 hectares drains to Pond 1, representing about 40% of the 200 hectares of the Fernbank lands that drain to the Carp River.
- Ponds 2 and 3: peak flow control is not required for major storm events (> 10 year event). Ponds 2 and 3 discharge directly to the Carp River. A total area of about 118 hectares drains to Ponds 2 and 3, representing about 60% of the 200 hectares of the Fernbank lands that drain to the Carp River.

vi) A summary prepared from the hydrologic modeling outputs provided in the EMP, Volume 2, Appendix D, is provided in **Exhibit N. Exhibit N** is a summary of modeled results taken directly from the hard copy hydrologic output provided in the EMP, Volume 2, Appendix D. I have provided no additional analyses but have only reported the Fernbank consultant's modeling results.

vii)As indicated, under future "SWM-controlled" conditions, 100 year peak flows increase at two of the three locations noted (44751 and 44548) while the peak flow at the third location (43966) is essentially unchanged. The numbered locations (44751, 44548 and 43966) represent locations in the hydraulic model where the hydrographs generated via the hydrologic model are input to calculate the resulting flood levels in the Carp River.

viii)Note also from **Exhibit N** that the times to peak (the time during the rainfall/runoff event when the highest flow is achieved) remain coincident or not significantly changed from existing conditions. This indicates that in the post-development condition increased peak flows will become additive in the receiving Carp River and resultant flood levels would therefore be expected to rise. This is contrary to what is indicated in the EMP, Volume 1, p. 97 (**Exhibit J**):

SWM Facilities P2 & P3 have been designed for storms up to a 10-year event. Runoff from larger storms will not be attenuated prior to outletting to the Carp River. This design allows peak flows from the Fernbank Lands to enter the Carp River in advance of peak flows from the upstream area (Glen Cairn), and significantly mitigates the impact of development. Model results indicate a slight reduction in the 100-year flood elevations under post-development conditions (refer to Tables 10-1 and 10-2).

ix) A plot of the 100 year outflow hydrograph from the Glen Cairn SWM facility (**Exhibit P**) further demonstrates that post-development flows from Fernbank are not entering

the Carp River in advance of the Glen Cairn outflows. Since a digital copy of the modeling was not made available by the respondent, it was not possible to plot the Fernbank hydrographs. However, the peak flow at location 44751 (where outflows from all 3 SWM ponds enter the Carp River) is plotted as a single point against the Glen Cairn facility hydrograph, showing clearly that the peak flow from Fernbank is coincident (additive) with the peak flow from the Glen Cairn hydrograph. On this basis, with increased peak flows in the post-development condition (as documented in **Exhibit N**), flood levels will rise in the post-development condition, contrary to what is documented in the EMP.

ix)The summarized results in **Exhibit N** do not support the conclusion that, *"peak flows from the Fernbank Lands....enter the Carp River in advance of peak flows from the upstream area (Glen Cairn), and significantly mitigates the impact of development."* If the analysis provided by Fernbank were correct, it would effectively mean that an additional 75,000m3 of runoff can be added to the receiving watercourse with some 60% of the development (about 118 hectares out of 200 hectares) having less than 100 year quantity control, with resulting times to peak being coincident or close to coincident, and the result is flood levels that are lower than the TPR existing conditions (which were lower to begin with than the higher Fernbank existing condition flood levels – refer to Tables 10-1 and 10-2 in **Exhibit J**).

x)Further, at the Glen Cairn SWM facility, the resultant post-development flood level decrease from existing conditions is 7 to 9cm. Not only does this analysis contend that the Fernbank development will not increase flood levels at the Glen Cairn facility, it will considerably decrease flood levels there and will actually remediate some of the flood level increases experienced downstream in the Kanata West lands (as documented in Table 3-6 of the TPR). Again, these results are not defensible, suggesting that part of the solution to increased flood levels is to allow even more development to proceed uncontrolled – which is counter to the very need for stormwater management in the first place as a means of mitigating the impacts of development on flood levels.

xi) Such flood level decreases would be expected only when significant SWM over-controls (more storage, larger ponds) are implemented, not the 10 year control proposed for two of the three ponds representing 60% of the total drainage area being developed. Where has the additional 75,000m3 of runoff volume gone? For these reasons, the post-development flood levels documented in the EMP are not supportable.

xii) Notwithstanding the admission that errors were made in the modeling, and the respondent's failure to provide a digital copy of the modeling, the foregoing parsing of the Fernbank consultant's own hard copy hydrologic modeling provided in the EMP demonstrates that 100 year flood levels will inevitably rise if OPA 77 proceeds as currently proposed: significantly increased runoff volumes combined with increased peak flows that are coincident with the upstream Glen Cairn SWM pond cannot result in anything *but* increased flood levels. Accordingly, the application of quantity control up to the ten year event is not the appropriate standard for the two ponds (Ponds 2 and 3) in the Carp River Watershed.

xiv) Further, I note there has been no defensible analysis provided in any of the supporting studies prepared in the last several years that demonstrates the validity of the suggested quantity control criterion for the Fernbank lands:

- Carp River Watershed/Subwatershed Study (Robinson Consultants Inc., December 2004): This study did not include the Fernbank lands in a developed condition (refer to Figure 8.5 from the study, **Exhibit D**) given that these lands were not designated urban until August 2005, after the study was complete. This study therefore provides no basis for assuming the quantity control criterion recommended therein is appropriate for the Fernbank lands.

- Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, June 2006): This study did not include the Fernbank lands in a developed condition (refer to Figure 3b from the study, **Exhibit O**, which shows the Fernbank lands in an undeveloped condition). This study therefore provides no basis for assuming the quantity control criterion recommended therein is appropriate for the Fernbank lands.

- Third Party Review - Carp River Restoration Plan (Greenland International Consulting Ltd., March 2009): This study did not include the Fernbank lands in a developed condition (refer to p. 102-103, **Exhibit I**). This study therefore provides no basis for assuming the quantity control criterion recommended therein is appropriate for the Fernbank lands.

- Fernbank Community Design Plan, Environmental Management Plan, Volumes 1 and 2, (Novatech Engineering Consultants Ltd., June 2009):
  The recommended quantity control criterion (shown to be inadequate above) was referenced directly from the Carp River Watershed/Subwatershed Study, the Third Party Review and input from MVC (EMP, p.55, **Exhibit J**), studies which provide no basis for

assuming the recommended quantity control criterion would be appropriate for the Fernbank lands. Given all of the above studies provided no analyses accounting for the Fernbank lands in a developed condition, the validity of the quantity control criterion should have been verified by the Fernbank consultants through an independent analysis but the EMP does not indicate such an analysis was undertaken.

xv)To summarize, the quantity control criterion recommended for the Fernbank lands has never been demonstrated to be appropriate.

xvi)The increased flood levels documented in Table 3-6 of the TPR, as well as what should be showing up as further flood level increases resulting from the development of Fernbank, demonstrate the inadequacy of the recommended quantity controls (up to 10 year control only) for the two ponds draining directly to the Carp River. Additional SWM controls are required for the Fernbank lands to ensure no increase in post-development flood levels.

xvii) Finally, a further indication that the quantity controls recommended for the Fernbank lands are inappropriate is provided by comparing the quantity controls recommended for the portion of the Fernbank lands draining to the Jock River watershed. Post- to pre-development control is provided for all SWM ponds located within the portion of the Fernbank CDP draining to the Jock River watershed (see Table 8-2, p.66 of the EMP, **Exhibit J**), that indicates pre-development flows are matched in the post-development condition for all ponds). Like the SWM ponds draining to the Jock River watershed, the ponds draining to the Carp River watershed are located at the top end or headwater area of the Carp River watershed. The impact of development on peak flows in such areas is typically much greater than the impact of development located further down in the watershed because the relative change in runoff volume is much greater in the headwater area. Again, this basic understanding of the impacts of development on headwater areas speaks to the inadequacy of the quantity control criterion recommended for OPA 77.

<u>41. Glen Cairn SWM facility and existing flood risk to Glen Cairn neighbourhood:</u>

i) The Glen Cairn SWM facility is located upstream of the future storm drainage outlets of the Fernbank plan. It was originally built in 1977/78 to control runoff from approximately 400 hectares of upstream development. Currently, it drains about 580 hectares, the large majority of it urbanized.

ii) **Exhibit Q** provides a summary of the history of how 100 year water levels (or maximum design operating levels) in the pond have changed since it was first commissioned. As indicated, the calculated 100 year water level in the pond has risen from 94.72meters in 1978 to 95.65 in 2003 - an increase of almost 1 meter.

iii) The storm sewer systems upstream of the Glen Cairn facility ultimately drain to this pond. And all basements in the area (unless the development was built without basements) are hydraulically connected to the storm sewer by an individual service lateral (a pipe) connected to a "weeper" (foundation drain) to allow drainage of groundwater from around the foundation. Basements lower than the maximum (100 year) pond level would therefore be subject to flooding (see **Exhibit R** for a schematic illustrating a typical storm service connection).

iv)**Exhibit S** documents underside of basement footing (USF) elevations in the Glen Cairn area as low as 95.28m (312.6 ft.), or almost 0.40 m below the maximum pond level of 95.65 m. As such, Glen Cairn basements are already at risk of flooding from pond levels that will rise too high during a 100 year event.

v)The flood level increases that will result from the development of Fernbank as currently proposed will raise the flood level downstream of an existing SWM facility with a 100 year maximum pond level that is already higher than existing basement elevations in the Glen Cairn neighbourhood. Such an increase in flood levels downstream of the facility could translate into an increase in the upstream maximum water level, i.e., a higher downstream water level would make the outlet structure of the pond less efficient, pushing up water levels in the pond further (at least until the water level overtops the pond berm), potentially putting even more basements at risk of flooding.

42. Glen Cairn Flooding Investigation:

i)The City of Ottawa has recently undertaken a comprehensive study to determine the causes and recommend solutions to prevent a recurrence of the widespread basement flooding that occurred in the Glen Cairn and other Kanata/Stittsville neighbourhoods on July 24th, 2009. (This was the third significant basement flooding incident in Glen Cairn the last thirteen years.) The flooding investigation is anticipated to be complete by August 2010. Given the identified problems with existing 100 year water levels in the Glen Cairn pond, existing flood risks to this community, and the need to avoid any flood level increases downstream in future, it would be premature and present unacceptable

risk to allow Fernbank to proceed until a comprehensive solution is determined by the flooding investigation.

ii) The City's Request for Proposal (RFP) for the Flooding Investigation notes on p. 11 (**Exhibit T**): "*The City will provide outlet boundary conditions along the Carp River for the storm system.....*" What outlet boundary conditions (i.e., flood levels) can the City now provide when the post-development flood levels resulting from the development of OPA 77, as currently proposed, will result in increased flood levels? When the modeling supporting OPA 77 has been shown to be inconsistent with the recommendations of the TPR?

iii) Also from p. 11 of the RFP: "*Should undue constraints to improved system performance be imposed by water levels on the river or in the Glen Cairn Pond, opportunities to address this constraint would also have to be addressed.*" In other words, this requirement identifies that the City currently acknowledges that maximum water levels in the Glen Cairn pond may be contributing to the flood susceptibility of the Glen Cairn community. In turn, this situation may require changes to the SWM facility that could impact flows and flood levels downstream of the facility through the Fernbank lands. Proceeding with the Fernbank development independently of the outcome of the Glen Cairn Flooding Investigation is therefore premature.

iv) Previous sections in this witness statement have identified the problems and inconsistencies that can arise when determining SWM (quantity control) criterion and flood levels on a piece-meal basis as has occurred for the last number of years on this watershed, specifically:

- inconsistencies with respect to existing condition runoff volumes (the Fernbank existing condition runoff volume exceeds the TPR runoff volume by about 39,600m3); and
- dependence on SWM (quantity control) criterion determined without consideration of the actual development in an urbanized condition.

43. Kanata West and Carp River Restoration Class EAs:

i) The Kanata West and Carp River Restoration Class EAs remain under Part II Order requests and will require re-posting of a Notice of Completion. Proceeding with that posting – whenever it takes place – without incorporating the Fernbank lands in a developed condition and without taking into consideration the Glen Cairn flooding investigation will continue the piece-mealing approach that has been shown to create problems that are avoidable when a comprehensive, subwatershed-based approach to planning is undertaken.

This approach – as required by the PPS, the City's Official Plan and Stormwater Management Policies – is warranted in completely undeveloped areas. It is essential from the perspective of protecting public health and safety in areas where there are existing flood prone communities such as Glen Cairn.

44. In summary, the increase in flood levels that will occur if OPA 77 proceeds as currently proposed presents unacceptable increased risk to public health and safety and hence, is not consistent with good planning. The appropriate quantity control criterion to ensure no increase in existing flood levels upon development should be determined in coordination with the various Class EA processes that are on-going in the same subwatershed, consistent with the requirements of planning on a subwatershed basis. The post-development flood levels must also be determined consistent with the MNR's Technical Guide. To ignore the need for such coordination and diverge from standardized approaches when public health and safety is involved is not good planning. OPA 77 should not proceed independently of these on-going Class EAs.