APPENDICES: City of Ottawa Kanata West and Carp River Restoration Class EA Notices of Completion: Part II Order Request

These Appendices provide detailed support for my request for an Order under Section 16 of the *EAA* and consist of the following sections:

Appendix A: Previous involvement with the file.

Appendix B: Reasons for Part II Order Request:

1. Failure to recommend a preferred solution that meets all relevant policies, guidelines, standards of practice.
2. Model errors and shortcomings in the technical assumptions supporting the hydraulic modeling and Carp River restoration plan:
    - i) Model errors;
    - ii) Application of an inadequate SWM quantity control criterion;
    - iii) Assignment of inconsistent and unsupported Manning's 'n' (roughness) values in the future condition modeling;
    - iv) Limitations of the "worst case scenario" and interim development SWM criteria; and
    - v) Allowance for 10cm flood level increases on the basis of "model tolerance."
3. Significant shortcomings in the Class EA planning process:
    - i) Failure to consider all reasonable alternatives;
    - ii) Failure to acknowledge a change in environmental setting and avoid piecemealing of projects; and
    - iii) Failure to achieve transparency in the planning process.

Appendix C: Tables and Attachments

APPENDIX A: Previous Involvement with this File

My involvement in the planning of this project has been as an employee of the City of Ottawa and as a private citizen and professional engineer and is briefly summarized as follows:

- In late 2007/early 2008, I reviewed the City and external agency-approved (but under Part II Order request) 2006 Kanata West Class EAs and supporting studies while I was working as a City staff member on the adjacent development file known as the Fernbank lands. It was through this review that I became the first City staff member to discover the coding errors that resulted in the total runoff volume from Kanata West not being accounted for in the calculation of post-development flood levels, a finding that precipitated the events leading to the previous Minister's issuing of an order on this file.
- In June 2008, as a private citizen, I provided detailed comments on the draft Terms of Reference for the Third Party Review, and in April of 2009, provided detailed comments on the Third Party Review itself, which, in my professional opinion, did not address the fundamental shortcomings of the project.
- After reviewing the Third Party Review "model of record" (as a private citizen) made available to me in late November 2009, I made known my concerns in writing regarding the assignment of Manning's 'n' (roughness) values in the post-development modeling to the review agencies involved (MTO, MNR, MOE, MVC) and the City on January 18 and 24, 2010.
- The City's consultant provided a response to my correspondence of January 18, 2010 on February 17, 2010. My concerns not being addressed, I provided a further detailed response on March 2, 2010, for which no further response has been provided by the City or Ministry staff.

Subsequent to my initial review of the Class EA documentation posted on July 30, 2010, I provided preliminary comments to the City on August 11, 2010. A response was provided by the City on August 23, 2010, to which I further responded on August 24, 2010 (see Attachment 1, e-mail thread of responses in Appendix C). As the City's response did not adequately address my concerns, I have found it necessary to proceed with this request for an Order under Section 16.

APPENDIX B: Reasons for Part II Order Request:

B.1. Failure to recommend a preferred solution that meets all relevant policies, guidelines, standards of practice:

The preferred solution for the CRRP and associated stormwater management undertakings recommended in the re-posted Class EAs is fundamentally flawed in its proposed design and implementation, failing to meet the requirements of virtually every policy/guideline/standard of practice developed in this province over the last 30 years to guide stormwater and floodplain management.

Table 1 attached provides a detailed accounting of the CRRP's failure to meet this full range of policies/ guidelines/standard practices. Briefly:

- existing condition peak flows have been significantly exceeded for all events (2 to 100 year) within and downstream of the study reach;
- existing condition 100 year peak flows have been exceeded by 25 to almost 100%;
- the existing condition 100 year reach travel time has been reduced by almost 2 hours or over 20%;
- 100 year flood levels have been exceeded by up to 16cm hundreds of meters upstream and downstream of the restoration reach.

Guidelines generally represent minimum requirements. When these are not met, it is incumbent upon the proponent to justify any exceptions. While many, if not most, of these exceptions have been justified by the promise of future model calibration and the suggestion that application of the "worst case scenario" will serve as an adequate safeguard for interim development to proceed, these factors do not obviate the need to address fundamental requirements to ensure that the impacts of the undertaking on the environment and riparian landowners are adequately mitigated and do not create long-term liabilities for the City. The lack of model calibration should not be used as justification to avoid revisiting the SWM quantity control criterion or suggest that excessive peak flow, velocity and flood level increases can be approved now under a Class EA process on the suggestion that calibration *may* prove otherwise in the future. While there is unavoidable uncertainty with the use of an uncalibrated model, it still provides a means of assessing the relative impacts of urbanization and floodplain filling that can inform interim SWM criteria.

More details regarding the limitations of the "worst case scenario" are provided in section B.2.

B.2. Model errors and shortcomings in the technical assumptions supporting the hydraulic modeling and Carp River restoration plan:

i) Model errors: Based upon modeling results provided by the City on August 23, 2010 (in response to a request or this information), there are evident errors in the model that result in negative flows and impossibly high peak flows and flood levels in some locations (see Table 2 in Appendix C, the 25 year event model output in the vicinity of sections 41789.8 to 41349.4). It is surprising that these errors were not caught before the re-posting of the Class EAs. Unfortunately, this reflects a troubling pattern with this project's modeling that brings into question whether the most recent results have been adequately reviewed and approved by qualified professional engineers or checked by the engineer of record.

ii) Application of an inadequate SWM quantity control criterion:

Table 3 in Appendix C provides a comparison of pre- and post-development peak flows for most events throughout and downstream of the restoration reach. As indicated, existing condition peak flows have been significantly exceeded for all events (2 to 100 year) within and downstream of the study reach; existing condition 100 year peak flows have been exceeded by 25 to almost 100%. (From these results, it would appear that the 2 to 10 year controls are not effective either, however, there is no discussion of this issue, presumably because these results were not documented in the Widening Alternative report or the TPR.)

All Class EA documents since 2006 have relied on the SWM criterion derived from the 2005 Carp River Watershed/Subwatershed Study. This Class EA was approved in January 2005 and has now lapsed. Regardless of that detail, the findings of this study are based upon (now) obsolete modeling which showed only marginal increases in peak flows when quantity control was not provided (see Section 8.3.1.1 Flood Control, p.143: http://www.mvc.on.ca/water/carpriver.pdf). Further, the Watershed/Subwatershed Study itself recommended that the modeling be completely redone - which it has been over the last 5 years - but with very different results that indicate unacceptable impacts.

Obsolete and uncalibrated modeling results from the Watershed/Subwatershed Study have been used to justify a criterion that, when implemented in the current modeling, grossly exceeds the objective of no or minimal increases in peak flows that the original criterion achieved in the Watershed/Subwatershed Study. If such excessive peak flow increases had resulted with the original subwatershed study modeling, it is a virtual certainty that post- to pre-development controls (or, if necessary, some amount of overcontrol) would have been recommended. Instead, the outdated criterion has been maintained to date.

The Third Party Review and previous Class EA supporting studies (2006) make note of the apparently grave concern regarding the potential for increased flood levels to result from coincident peaks if post- to predevelopment controls are implemented. In other words, the rationale for the relaxed SWM criterion has been that it is preferable to let the Kanata West/Fernbank flows (above the 10 year event) be released uncontrolled and not lag them via full SWM controls to the 100 year event so that this peak will have passed and not become additive with the upstream peak (mostly from Poole Creek). While this phenomenon may, in fact, be a valid concern, it has not been demonstrated with the revised modeling developed via the Third Party Review/Widening Alternatives report. What has been demonstrated is that relaxed SWM controls result in significantly increased flows, not a surprising finding. If some of this *is* due to the coincidence of peak flows, then some amount of overcontrol may be necessary but alternatives to the relaxed 10 year control have not been considered or evaluated.

However, this rationale re: avoiding the lagging of flows is then contradicted in the Widening Alternatives report on p.7: *"The TSH/Aecom future conditions HEC-RAS model had modified Manning's n parameters directly under bridge structures that were employed in earlier versions of the model to assist in lagging flows through the corridor."* It is not explained how the original concern with the lagging of peak flows via 100 year (or over) control in SWM facilities can be reconciled with an approach (now dispensed with) that had the objective of lagging of flows behind bridge structures.

There are further references in the Widening Alternatives report that appear to indicate a puzzling resistance to acknowledging that the relaxed SWM criterion is resulting in, or at least contributing to, excessive peak flow increases. On p. 27, a note below Table 4-1 indicates: *"The small conveyance improvements show a small increase in water levels between Richardson Side Road and Huntmar Drive (within model tolerance of 10 cm)."* It is suggested that the 96% increase in the 100 year peak flow at Richardson Side Road (from 27cms to 52cms) may also be contributing to the increases in water level downstream of Richardson. Similarly, on p.8: *"It is important to note that there are other factors that impact the water levels between the future transitway and Campeau Drive crossings. The original watercourse alignment will be shifted with the proposed corridor design. Portions of the existing watercourse invert are slightly lower than the proposed corridor low flow channel. This feature causes a slight increase in the 100 year water level with the future corridor design."* Again, it is suggested that the 60% increases in peak flows in this part of the reach may have something to do with increased water levels. (Also, as per the post-development assignment of 'n' values discussed below in section B.2.iii), it would appear that recommending a manicured area in this part of the reach, contrary to the

CRRP objective of increasing natural riparian cover, may again be related to managing excessive increases in peak flows.)

Defending a SWM criterion based upon conclusions regarding a phenomenon that has not been proven to exist (peak flow increases resulting from attenuation causing coincident peaks) is not acceptable, particularly when the application of said relaxed criterion indicates otherwise. With or without calibration, the SWM criterion should be revisited before the CRRP Class EA can be approved.

iii) <u>Assignment of inconsistent and unsupported Manning's 'n' (roughness) values in the future condition modeling</u>:
As documented in previous submissions circulated to all approval agencies and the City on January 18 and 24, 2010 and March 2, 2010 (available in the Kanata West 2010 Public Consultation Update, Delcan, Appendix E), there are significant differences between the roughness values assigned in the existing and future condition hydraulic models.

The Manning's 'n' value is a modeling parameter used to reflect how "rough" the channel and floodplain of a watercourse is. Higher roughness ('n') values generally result in higher flood levels. The existing Carp River floodplain is generally bereft of any significant riparian vegetation in the study reach. Therefore a key objective of the restoration plan is to increase riparian cover, which would be expected to result in higher future roughness values for the floodplain or overbank areas. However, for almost 50% of the future (restored) reach, 'n' values have been considerably lowered (refer to Table 4 in Appendix C which compares existing and future 'n' values). Specifically:

- channel 'n' value: lowered to 0.035 (from existing values of 0.060 to 0.0525) for the full length of the reach;
- overbank areas: in the vicinity of SWM ponds and habitat pools lowered to 0.04 (from existing values ranging from 0.06 to 0.09); and
- additional length of corridor (some 500m or 10% of total corridor length) with no ponds or pools lowered to 0.04 (from existing values of 0.06 to 0.09).

Section B.1 in this Appendix B has dealt with the shortcomings of this approach of significantly reducing 'n' values from the perspective of its failure, in combination with 10 year SWM controls, to meet virtually all provincial guidelines related to stormwater and floodplain management. Subsequent section B.3 addresses this approach from the perspective of the Class EA planning process: no evaluation has been provided of alternatives that would not require such a lowering of 'n' values and no information has been provided related to increased risk and maintenance burden/costs. This section will deal with the technical shortcomings of this approach, specifically,

- inconsistency with respect to how 'n' values have been assigned in the existing and future condition models; and
- the use of an excessively low 'n' value (0.001) to represent the surface of pools/ponds.

Table 5, attached, provides a summary of the various interpretations of how 'n' values have been assigned since 2005 from relevant excerpts from various Class EA documents. As indicated, for the (2005) existing conditions report, values were assigned based upon air photo review and field visits. An initial value of 0.035 to 0.04 was assigned for the low flow channel and overbank areas were assigned values ranging from 0.04 to 0.07. These values were then increased by 50% in an attempt to calibrate the existing condition model to observed levels. These increased values – notwithstanding that the initial assignment was based on field verification – were then also deemed to be reflective of the maximum vegetation condition (late summer) that would have been present during the September 2009 event for which water levels were measured – in other words, the 50% adjusted values were also concluded to represent existing conditions.

Move forward to 2006 and the (original) post-development flood level analysis. In this case, the 50% adjusted (but existing condition) 'n' values were deemed to be *"reflect[[ive of] the vegetation cover that would be representative of the proposed channel restoration project, and are equivalent to the modified flood elevations determined from the September 9, 2004 flood event which was completed as part of the Flow Characterization and Flood Level Analysis report (October 2005 CH2MHill)."* In other words, the 50% adjusted values were calibrated to the September 4/09 event (i.e., reflective of the vegetation condition at *that* time) but *also* representative of the restoration plan that calls for a significant increase in riparian vegetation (i.e., a *70%* riparian cover target along the length of the corridor). Based upon these assumptions, the 2006 modeling assigned equivalent 'n' values in all locations for the existing and future/restored conditions. This equivalency is difficult to follow considering the existing lack of significant vegetation over the majority of the corridor and the proposed 70% target for increased vegetation (see Attachment 7, Appendix C and compare to Attachment 8, Appendix C, a representative planting plan (outside of pond/pool areas) proposed in the May 2007 Final Design Drawings (TSH/AECOM), prepared before the missing hydrographs error came to light. The planting plan shows a significant increase in vegetation over almost the complete overbank area, suggesting a considerable increase in future roughness in these areas over existing conditions).

Move forward again to model adjustments made some time after the missing hydrographs error was found in early 2008 and/or during the Third Party Review (March 2009): the same 'n' values as assigned in 2005 (50% adjustment) for the existing conditions model are maintained – providing the existing flood levels against which the impacts of floodplain filling and urbanization must be measured. However, for the future/restored condition model, the low flow channel 'n' value is reduced to 0.035 (from 0.525 to 0.60) – notwithstanding that the 2005/2006 modeling specifically identified 0.0525 to 0.06 as *"reflective of the restored condition" and* a calibrated value. Recognizing that 0.0525 and 0.06 are admittedly on the high side for a low flow channel, one cannot use this value to calibrate, maintain it for the existing condition, suggest it is reflective of the restored condition and then reduce it back down to 0.035 for the restored condition. Over time, the restored channel bed and banks will be subject to some sedimentation and will fill in with riparian vegetation/debris, emergent vegetation, etc., so there should be no marked difference between existing and future condition 'n' values. The proposed low flow cross-sections (plotted on the existing channel cross-sections) provided in Appendix B of the Post-Development Flow Characterization and Flood level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, 2006) confirm this: a re-shaping/benching of the existing channel is proposed but the overall depth and cross-section (though somewhat narrower in width) is very similar.

Consistent values should be used for the low flow channel to avoid overestimating existing conditions which form the baseline to measure impacts, otherwise, impacts are inevitably underestimated. Alternatively, existing condition channel values could be lowered back to their original values to be consistent, but given the uncertainty associated with the lack of calibration, this would not be advisable. Further, the suggestion in the Third Party Review (p.31) that, "…..*adjusting these "n" values by less than 50% gives very little change to flow conditions"* is not a completely accurate statement. The 'n' values were, in fact, adjusted by 50% and this had a marked effect on water levels in the 2005 calibration exercise. It is true that adjusting by perhaps 10 or 20% would have less impact but increasing values by higher percentages generally results in increased water levels. To suggest otherwise appears to ignore the fact that Manning's 'n' values are one of the most important parameters in the calculation of flood levels.

Further, as noted previously, 'n' values are lowered to 0.04 – the equivalent of grasses – on some 500 meters (about 10%) of the corridor length for no apparent reason other than to make the corridor smoother and assist in keeping flood levels down. The justification for lowering the 'n' values in these areas without ponds or pools is either not given ("can be debated" as indicated in correspondence dated February 17, 2010 on behalf of the City, available in Kanata

West 2010 Public Consultation Update, Delcan) or that these areas *"include the transition areas between two new bridge crossings (future transitway and Campeau Drive)"* – the response provided by the City to my reiteration of this issue in preliminary comments on the re-posted Class EAs (see Attachment 1 in Appendix C). Overbank areas of lengths from 300 to almost 500 meters (assigned an 'n' value of 0.04) are difficult to accept as "transition areas."

Assigning an 'n' value of 0.04 in this area is arbitrary: there are no overbank areas in the existing condition model with such a low 'n' value (the lowest being 0.06), and most of this area was assigned an 'n' value of 0.09 in the existing condition model. There is no indication in the restoration plan that this area has been singled out to remain a manicured area requiring perpetual maintenance, let alone that a future 'n' value of 0.04 suggests that any existing vegetation beyond high grass will have to be removed during construction and a manicured area maintained in perpetuity. This is inconsistent with a key objective of the restoration plan – a naturalized corridor with increased riparian vegetation. In effect, the tail of avoiding flood level increases (that would result from the excessive peak flow increases) would appear to be wagging the dog of river restoration. This manicured area will further provide several hundred meters of ideal habitat for Canada geese with their prolific droppings that will contribute to degraded water quality and aesthetic issues – well-known problems in riverfront locations that have manicured riparian areas. It is difficult to understand why the potential for such problems would be included in a restoration plan, except for the need to "smoothen" the corridor to deal with excessive peak flow increases resulting from inadequate SWM controls.

Further there are sections of overbank length approaching a total of 300 meters where 'n' values are reduced or transitioned at interpolated sections (i.e., reduced proportionally by the model between input cross-sections where the 'n' value increases or decreases.) This is a function of the model and does not reflect what will actually occur given the planting areas will be continuous, not transitioned. Even if the actual planting areas were so transitioned, natural succession would eventually fill in such areas over time. One example of this is particularly questionable in the overbank area between sections 40956 and 40703. In the existing conditions model, this section of some 250 meters has an 'n' value of 0.09 assigned. In the future condition model (there are no ponds or pools in this overbank area), the intermediate section has been assigned an 'n' value of 0.04 for no apparent reason. The result is that between the main sections upstream and downstream of 40901 (that have values of 0.09), the model has automatically calculated transitional (lower) 'n' values (see output appended to February 17, 2010 correspondence from City's consultant). This has a lowering effect on flood levels that would appear to be unjustified (why would an 'n' value of 0.04 be applied where there are no ponds/pools for one cross-section only?), is inconsistent with the riparian planting target for the reach, and cannot practically be maintained to achieve this transitional effect anyway. Interpolated transition areas should be corrected to the actual intended 'n' value.

The rationale for the use of an 'n' value of 0.04 for the surfaces of the SWM pond and habitat pools (lowered from existing condition 'n' values of 0.06 to 0.09) is explained in the February 17, 2010 correspondence, provided in response to my submission of January 18, 2010. The justification provided is that the surface areas of the ponds/pools have been assigned an 'n' value of 0.001. With adjacent areas assigned a value of 0.08, the weighted value in these areas becomes 0.04 or less, which is the value input to the model.

The use of this extremely low 'n' value of 0.001 (one tenth the roughness of *glass*) to characterize the surface of ponds/pools, has been recommended with no reference to published values. This is concerning given the significance of Manning's 'n' values in hydraulic computations. Ideally, Manning's 'n' values are calibrated to observed water levels but this is not possible when modeling a future condition, so values must be assigned on the basis of comparison to other similar situations where empirical values have been determined. I have been unable to find any reference to such an extremely low value of 0.001. When I requested that a reference to such a value in the literature be provided (see Attachment 1, Appendix C), the response given was that the pools were "quite deep." This is a very questionable justification given the significant (lowering) impact the use of this extremely low value has on the resultant post-development flood levels.

It is well-recognized that roughness effects are related to depth – but if that is the rationale for using an exceedingly low roughness value over the habitat pool surface areas, then the same argument could be made to lower every single 'n' value throughout the corridor with the depths of flow experienced during a 100 year event. But this is not defensible without calibration of such values. Further, the assumption seems to be that the flood flows will somehow simply "skim" over the surface of the habitat pools - which is physically impossible given there will be no distinct surface between the flood flow and the pool water as the flood wave moves through: recirculation cells will form and there will be inevitable turbulence as the flood wave moves over the pond berms and side slopes, all such effects increasing roughness. The smoothness suggested by an 'n' value of 0.001 is not physically achievable in the conditions proposed, and likely not achievable in open channel flow at all.

It is recognized that the pool surfaces may represent a "smoother surface" than mature vegetation, so some lowering of 'n' values in pool areas where existing values were higher (e.g., 0.09) may be justified. However, the potential for these pools to change over time must be considered when assigning an appropriate value. The pools will be surrounded by emergent vegetation and submergent vegetation may be present as well; lowered water levels, perhaps as a result of long-term water table lowering due to servicing could result in increased vegetation colonization; eventual disconnection from the river and filling via siltation or vegetation growth over the connecting channels, etc., etc. All of these factors – that have been given no consideration notwithstanding the inevitable uncertainties associated with restoration of a natural system - have potential to increase the roughness associated with the pool surfaces. The alterative – as previously noted – is a stringent maintenance program that ensures in perpetuity that the pool surfaces' "smoothness" is not lost. Even with such an annual effort, the use of 0.001 is still not justified without supporting empirical data.

Further, as discussed in section B.3, to meet a mandatory requirement of the Class EA process that all reasonable alternatives be considered, the standard and conventional approach of post- to pre-control (or, if necessary, overcontrol) should be evaluated. In this case, the 5 SWM ponds would have to be bermed up to the 100 year level so the 'n' value in these overbank areas would have to be increased from 0.04 to 0.08 or 0.09. However, with sufficient peak flow controls provided this should not contribute to significant water level increases over existing conditions.

The values assigned to the pool surfaces should be revisited and a reasonable, conservative value be assigned (considering the many uncertainties with the long-term function of these pools). Based upon these results, in combination with the consideration of an alternative that provides sufficient peak flow reduction, the proliferation of habitat ponds now proposed – and the considerable additional restoration cost incurred – could also be reduced accordingly.

The Widening Alternatives report alludes to reducing the number of pools on p.31: *"A simpler consideration would be to keep these three habitat pool locations* [HP-1A, HP-5A, HP-6A] *but to convert them into a less expensive wet meadow feature. The model was adjusted to consider this alternative. The overbank area in the vicinity of these three locations was adjusted to an average Manning's n of 0.06. The permanent pool elevation is considered as a grassed area. The additional volume is the area between the feature bottom and where the overbank elevation would have been. In* ***Figure 5-3****, the original overbank elevation would have been 93.7 m +/-, whereas the feature bottom elevation is around 93.05 m. The model results indicated that local water levels increased by less than 1 cm. This feature can be given consideration during detailed design for the three additional habitat pools only."* Again, when an 'n' value of 0.08 has been assigned to overbank areas in the weighted 'n' value calculation for pool area, it is not clear why the same value (0.08) would not be applied to future meadows. This again necessitates maintenance over the long term.

While it may be argued that some of the factors identified above have more or less impact on flood levels, all of them consistently contribute to either lower flood levels in the future condition (notwithstanding excessive peak flow increases) or increased flood levels in the existing condition, the end result being that the full impacts of development with relaxed SWM controls are effectively masked.

There are numerous references in the Third Party Review and Widening Alternatives report indicating that future calibration will address concerns and uncertainties with Manning's 'n values. This is certainly true from the perspective of developing an (existing condition) model that responds as similarly as possible to the actual watershed. But the lack of calibration does not preclude a valid relative comparison based upon a consistent and defensible assignment of 'n' values to simulate the impacts of change in the watershed. The assignment of 'n' values in the post-development condition should be revisited for the reasons outlined above.

The preceding detailed review requires an effort to follow the trail of assumptions and Manning's 'n' value revisions over the last 4 years. Revisions to these values began after the missing hydrograph error came to light. Analyses I completed in early 2008 – re-entering the missing hydrographs into an unadjusted future condition model, resulted in flood level increases of 0.2 to 0.3m over existing conditions. Events surrounding the discovery of this error then precipitated the Minister's order in 2008. Almost a year later, the Third Party review was endorsed with flood level increases of up to 0.28m, as high as the flood level increases I found in early 2008 that essentially brought about the Minister's Order. Now, in 2010, there are still flood level increases of up to 16cm several hundred meters upstream and downstream of Richardson Side Road – even with the significantly lowered 'n' values applied over almost 50% of the corridor. In exchange for this flood level reduction, peak flows and velocities have gone up significantly and the reach travel time has been reduced by over 20%. In other words, none of the (generally provincial level) criteria that were required and presumed met when the 2006 Class EAs were posted have been met in the 2010 version of the CRRP.

iv) <u>Limitations of the "worst case scenario" and interim development SWM criteria:</u>
The "worst case scenario" put forth in the Third Party Review has been proposed as a safeguard to allow development to proceed in the interim until the model is calibrated and validated. While I have no objection to the provision of additional storage volume, this approach does not address the fundamental shortcomings of the CRRP as currently proposed nor ensure that the maximum extent of interim development will not result in unacceptable impacts.

The "worst case scenario" essentially applied the modified rational method to the whole of the 5000 hectare Carp River upper watershed (to Richardson Side Road), treating this area as a large bathtub or pond with a maximum release rate of 40cms. This approach is volume-based and cannot provide insight into water level increases at specific locations in the corridor which are influenced by more than the total volume in the corridor (peak flows, timing, etc.). This insight can only be provided by detailed hydraulic modeling. Infrastructure design depends on this level of detail.

It is troubling that hundreds of thousands of dollars have been spent on detailed modeling that shows clearly unacceptable impacts, and yet a brief, simplified exercise (derived from an uncalibrated model) is deemed sufficient to assuage all uncertainties in the interim. Even more concerning is the recommendation of the Third Party Review regarding development thresholds, incorporated in the Implementation Plan (Delcan, 2010, p.9, Table 1). This Threshold Summary indicates that 65% of the Kanata West and Fernbank developments can proceed in the interim *"with no Carp River restoration and no monitored data to validate model, an additional 85,600m3 of storage to be provided on a pro rata basis by development within Kanata West or through other areas with the drainage area."*

Further, on p.24 (emphasis added): *"Until there is validated watershed modeling to determine otherwise, the sizing criteria to be applied in any interim development proposed in the watershed is as follows:*
The greater of the two following criteria:
• Post to predevelopment controls for all return periods up to the 100 year return period.
Predevelopment conditions will be determined by the original site conditions and not tied to any other watershed models.
• A 170 m^3/ha active storage volume excluding volume provided for water quality. The post development strategy was established with a 50 m^3/ha storage criteria to be met by all development. The 120 m^3/ha deficit volume is added to this volume."

65% of the combined the combined development area of Fernbank and Kanata West equates to a total interim development area of over 500 hectares. Half a decade of modeling on a watershed basis has taken place and yet for interim development, "***Predevelopment conditions will be determined by the original site conditions and not tied to any other watershed models."*** In other words, with this approach some 500 hectares of greenfield development would be permitted to proceed as if it were 1980 and planning on a subwatershed basis was not a provincial interest or an Official Plan policy; as if stormwater management practitioners had not yet learned of the fundamental shortcomings and liabilities of proceeding to develop hundreds of hectares in such a fashion. The threshold of 65% is not supportable in the absence of a watershed level (hydrologic and hydraulic) analysis to confirm appropriate interim peak flow/storage targets that will ensure no increases in existing condition flood levels in the unrestored Carp River. Such interim watershed-based targets could be applied by all development proponents consistently, rather than require this critical task to be re-invented every time an individual interim development comes forward. Such a watershed-based interim analysis could be completed relatively quickly and would undoubtedly streamline approvals of interim development, avoiding the repeated review of site-specific pre-development targets and limiting the number of required revisions to the model of record.

While it could be argued that the interim targets would be based upon an uncalibrated model, the "worst case scenario" itself is also derived from the same uncalibrated model. Likewise, the CRRP and ultimate SWM criteria are informed by the same uncalibrated modeling. If uncalibrated modeling can be used to seek Class EA approval of a multi-million dollar restoration plan, then surely it can be used to determine more defensible interim SWM criteria than can be provided by the "worst case scenario."

v) <u>Allowing for 10cm flood level increases on the basis of "model tolerance</u>:"

The Third Party Review asserts that, with respect to post-development flood levels, there should be an allowance for a 10 cm increase over existing conditions on the basis of "model tolerance." From p. 75 of the Third Party review:

"It is better to qualify the acceptable fluctuation in water level with seasonal changes in vegetation and the undulation in flows with any field measurements. A 10 cm range of flow level change should be acceptable for comparison purposes. This is valid only if there is no change to flood risk at the particular location. Water level changes greater than 10 cm could be supported with field data to support there is no change to flood risk. MVC requests a field confirmation for water level changes greater than 5 cm and no change in areas where there is an identified flood risk."

This recommendation confuses calibration matters, model accuracy in the absolute sense, and the role of modeling as a tool to assess the relative impacts of change in a watershed (e.g., urbanization, floodplain filling, etc.). It also fails to acknowledge the necessity of avoiding cumulative impacts.

Firstly, regardless of any undulation in flows with field measurements, during calibration, a representative level and velocity must ultimately be chosen to determine flow and runoff volume against which simulated results can be compared. Likewise with seasonal vegetation changes, 'n' values are calibrated based on the vegetation conditions observed at the time of the event. Once a reasonable fit is achieved (which undoubtedly has an overall accuracy much less than 10cm given the complexity of the system being modeled), that reasonable fit is used to represent the “reality” against which changes to the watershed must be measured. Once the calibrated model is achieved, it cannot then be suggested that inherent model inaccuracies allow flood level increases up to 10cm when those inherent inaccuracies are found in both the (calibrated) existing condition and future condition models – this inherent inaccuracy is essentially “canceled out” for the purposes of impact assessment. It is correct to be concerned with the absolute accuracy of the model, i.e., where will the resultant floodline end up in the “real world?”: this means using appropriate base mapping, the best available information and calibrating the runoff response to real storm events, but there is no getting rid of this inherent model inaccuracy in the absolute sense. If this were an acceptable approach, one could as easily and justifiably argue that existing condition flood levels can be reduced by 10cm if that serves a given purpose. For the purposes of impact assessment, the flood level generated by the model, whether existing or future condition cannot “float” up or down 10cm indiscriminately. To accept such an approach is to disregard what the model generates as measurable impacts (detectable within the model’s own limits of accuracy).

Perhaps most simply, if a 10cm increase were acceptable on the basis of “model tolerance,” there would be no point in documenting flood levels to the second decimal place.

Secondly, from a watershed management perspective, this proposed 10 cm allowance fails to acknowledge the need to avoid cumulative impacts over the long term and as such, is inconsistent with many past decisions of the Ontario Mining and Lands Commissioner (OMLC). A review of many of these decisions (available here: http://www.mnr.gov.on.ca/en/Business/OMLC/2ColumnSubPage/STEL02_163868.html) turns up no mention of model accuracy or tolerance or any acceptable level of flood level increase. A few examples (emphasis added):

- Brinks vs. Niagara Peninsula Conservation Authority:

  Appeal of a refusal to grant permission to construct a dwelling in the floodplain of 20 Mile Creek. The building and associated fill would have had the effect of increasing the level of Twenty Mile Creek during a 100 year event in the Smithville area by an estimated **0.5 to 1.0 cm**.

  In refusing the appeal, the OMLC noted: *“Another important issue in the hearing was the principle of "cumulative effect." This principle cannot be examined in isolation from an important principle of this Tribunal: that all owners of land within a regulated flood plain must be treated fairly and equitably. A more important test for this Tribunal is not the level* *of cumulative effect but whether or not there is evidence to indicate any negative effect on other landowners in the flood plain, either upstream or downstream from the property in question. On this test the application to build a structure on this site fails".*

- Chalmers vs. Grand River Conservation Authority:

Appeal of a refusal to grant permission to build a dwelling in the floodplain. The required filling would have resulted in a calculated flood level increase of **1.9 inches (less than 5cm)**. The Appeal was denied. *"The tribunal finds that……the proposed filling and construction poses a dangerous precedent, both in terms of the Chalmers land itself and on the ability of this and other conservation authorities to manage watersheds within their jurisdictions."*

- Eyrie Estates vs. Grand River Conservation Authority:

Refusal to grant permission to erect a subdivision of thirty single dwelling units.
The appeal was denied notwithstanding that the effect of the required fill would, by best estimate, raise the flood level one-sixteenth of an inch (**0.2 cm**), the concern being the displacement of flood storage capacity and the precedent such an approval would set.

- Dragevic vs. Central Lake Ontario Conservation Authority:

Appeal of a refusal to grant permission to place 400 cubic yards of fill in the floodplain. In denying the appeal, the OMLC noted:
"It is the understanding of this tribunal that unlike other safety legislation there is no margin of safety built into the legislation and consequently every intrusion into the flood plain, whether it results in loss of storage capacity or constriction of the flow of the regional storm or both, has the effect of increasing the elevation of the regional flood and conservation authorities should, in creating exceptions to the general prohibition contained in their regulations, have regard to principles of flood plain management in determining whether permission should be granted."

The need to manage cumulative impacts on a watershed basis precludes the allowance of a 10cm flood level increase. More simply, should 10cm flood level increases be acceptable for this amount of new development with these increased levels becoming the new floodline/benchmark, there is presumably nothing to prevent even further increases from being accepted in future if/when the urban boundary expands and future proponents argue for a *further* 5 or 10cm increase above what will then have become the "existing condition" flood level.

Accordingly, there is no technical or policy basis to allow for a 10cm increase in flood levels based upon "model tolerance." Rather, the resulting flood level increases indicate that the proponent has not adequately mitigated the environmental impacts of the undertaking and should revisit this matter.

3. Significant shortcomings in the Class EA planning process:

i) Failure to consider all reasonable alternatives:

The MEA Class EA and Code of Practice require that all reasonable and feasible alternatives be considered in the Class EA planning process. From p.A-26 of the Municipal Class Environmental Assessment (Municipal Engineers Association, 2000):

> *PHASE 2 — ALTERNATIVE SOLUTIONS*
> *The planning process in Phase 2 will involve the following Steps:*
> *Step 1 Identification of alternative solutions to the problem.*
> *There is usually more than one way to solve a problem. All reasonable and feasible solutions shall be identified and described.*
> *Step 4 Evaluation of all reasonable alternative solutions, identified in Step 1, taking into consideration the environmental and other factors identified in Steps 2 and 3.*

And from p.16 of the Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario (MOE, November 2008):

> *3.1.2 Consider a Reasonable Range of Alternatives*
> ***A reasonable range of alternatives must be considered.***
> *During the class environmental assessment process, applicants and proponents should consider a reasonable range of alternatives. This should include examining "alternatives to" which are functionally different ways of approaching and dealing with the defined problem or opportunity, and "alternative methods" of carrying out the proposed project which are different ways of doing the same activity. Depending on the problem or opportunity identified, there may be a limited number of appropriate alternatives to consider. If that is the case then there should be clear rationale for limiting the examination of alternatives. The "do nothing" alternative must also be considered.*

The evaluation of alternatives for stormwater management and the Carp River restoration plan has excluded feasible and reasonable solutions to addressing the problem.

In terms of stormwater management, the conventional and standard methods of providing post- to pre-development control of peak flows, or if required, overcontrol of flows, have not been considered as alternatives, nor evaluated. All Class EA documentation since 2006 has deferred to the quantity control criterion recommended in the Carp River Watershed/Subwatershed Study (Robinson Consultants, Dec. 2004, p.143, http://www.mvc.on.ca/water/carpriver.pdf) which recommended against quantity control for post-development runoff. This oversight invalidates the Class EA process undertaken and does not meet the requirements laid out in the Code of Practice: ***A reasonable range of alternatives must be considered.*** An objective evaluation of all reasonable and feasible solutions has not been undertaken as explicitly required by the Class EA process.

The recommended approach to stormwater management – provision of runoff controls up to the 10 year event only– has resulted in 100 year peak flow increases from 25% to almost 100% throughout the study reach (see Table 6 in Appendix C). To mitigate the impacts of such excessive peak flow increases on resulting flood levels, roughness values have been significantly reduced in the post-development condition requiring stringent maintenance of the corridor in perpetuity to ensure that the roughness values assumed are not exceeded through the processes of natural succession, sedimentation, etc. (see section B.2 in Appendix B for more details on Manning's 'n' assignment). Failure to so maintain almost 50% of the corridor overbanks will result in flood level increases that have not been accounted for, yet there has been no information provided in the posted Class EA documents regarding the perpetual maintenance efforts and costs of this alternative, nor the associated risk of depending on regular human intervention in an (ostensibly) naturalized stream corridor to ensure the design roughness levels are maintained in perpetuity.

The fact that the Ministry of the Environment has confirmed that this approach will require that a Certificate of Approval under Section 53 of the *Ontario Water Resources* Act be obtained is further evidence that the "operation" of this so-called on-line SWM facility, if approved, would have to be formalized with the identification of specific water levels, storage volumes, maximum roughness values in specific areas of the corridor, restrictions on future upgrades to watercourse crossings, strict maintenance schedules to maintain the design "smoothness," etc. There is, however, no acknowledgement of these future implications in the Class EA documents.

Life cycle costs and the risks associated with this approach are fundamental criteria to be considered in the evaluation process that have not been acknowledged. Neither the general public nor City Council have been apprised of the long-term financial impact of this additional maintenance burden or been given the opportunity to consider whether such an approach is preferable in comparison to other more conventional alternatives. It is worth noting that the City operations budget dedicated to the maintenance of SWM facilities was reduced in 2010 – notwithstanding continuing growth and the acquisition of numerous additional facilities to maintain. The cost of maintaining the corridor as an on-line facility, and the resultant liability and increased flood risk should the City not keep up the required level of maintenance (a not unlikely circumstance given the continuing strain on municipal budgets) must be accounted for and compared against other alternatives.

The Class EA process explicitly requires that the conventional alternative of providing sufficient stormwater management controls to achieve pre-development peak flows be objectively evaluated against the current preferred solution of providing a "smoother" post-development corridor to artificially keep flood levels down. The lack of model calibration and the proposed "worst case scenario" volumes do not preclude this requirement of the Class EA process. (More detail regarding the lack of calibration and the proposed "worst case scenario" is provided in section B.2 of Appendix B.)

ii) Failure to acknowledge a change in environmental setting and avoid piecemealing of projects:
On July 24, 2009, a year before the Kanata West Class EAs were re-posted on July 30, 2010, a significant rainfall event resulted in hundreds of homes in the Glen Cairn and other Kanata/Stittsville neighbourhoods experiencing basement flooding with sewage and stormwater. In response to that event, the City of Ottawa undertook the Glen Cairn Flooding Investigation (GCFI), the completion of which is imminent (early fall 2010).

A key contributor to the flooding problems was water levels in the Glen Cairn SWM facility well exceeding the original design level, leading to basement flooding via the storm sewer system. The Glen Cairn SWM facility is located just upstream of the Carp River restoration reach. The potential impact of the Glen Cairn facility was identified as early as late 2009 in the Request for Proposal for the GCFI issued by the City. From p. 11 of the RFP (see Attachment 10, Appendix C): "*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."* At a Public Open House for the GCFI on May 19, 2010, it was confirmed that, *"The high water levels in the Glen Cairn pond restricted the flow from the storm sewer system during the July 24, 2009 storm particularly in the southwest area of Glen Cairn"* and further, that potential solutions to this problem included *"Modify Glen Cairn SWM Pond to provide lower operating levels, divert flow to Monahan Drain, pump flow, modify Carp River, etc."* (see Attachment 11, Appendix C). In other words, the GCFI and the Carp River Restoration plan are projects that are fundamentally linked, the preferred solutions to which cannot properly be determined independently.

The need to undertake the GCFI represents a fundamental change in the environmental setting of the CRRP that the City has not considered or accommodated in the project planning before re-posting the Class EA. Lowering water levels in the Glen Cairn pond could have implications for the Carp River Restoration plan: can the release rate from the pond be increased? Is lowering the Carp River by extending the restoration plan further downstream a feasible option? As noted previously, the Kanata West Class EAs have not considered or evaluated the alternative SWM control option of ensuring pre-development peak flows are not exceeded. Apart from fulfilling a basic requirement of the Class EA (i.e., consider all feasible alternatives), this should be considered in light of the GCFI and the need to lower operating levels in the Glen Cairn pond, possibly by increasing the existing release rate. If allowing several hundred hectares of greenfield development to discharge uncontrolled beyond the 10 year event can be evaluated as a feasible alternative, then surely examining the potential to increase release rates from a facility that serves an existing community plagued with flooding (in combination with increased SWM controls for Kanata West/Fernbank) must be considered a feasible alternative to evaluate as well.

Seeking approval of the CRRP EA in advance of the completion of the GCFI prejudices the evaluation of these and other potential alternatives, or alternatively could require the CRRP Class EA to be updated once again. To address the change in environmental setting and avoid the piecemealing of fundamentally related projects, the GCFI and Kanata West/CRRP Class EAs should be coordinated.

iii) Failure to achieve transparency in the planning process:

The Code of Practice: Preparing, Reviewing and Using Class Environmental Assessments in Ontario (MOE, November 2008) notes on p.18:

> *3.2.3 Openness and Transparency*
>
> *The class environmental assessment process should be open and transparent. This will enable all interested persons to follow the project through its various stages of project planning and decision-making until the final project details are known. Anyone should be able to trace the results of the class environmental assessment project planning process using the evaluation approaches set out therein.*
>
> *Means of achieving transparency can include, but are not limited to:*
>
> *• Using appropriate, well-established and easily understood evaluation methods;*
> *• Making the process clear, rational and logical;*
> *• Sharing complete information with all interested persons to support conclusions and recommendations at each phase in the process;*
> *• Documenting the process in easy to understand language with explanations of the rationale for making certain choices.*

In contrast to the "s*haring [of] complete information with all interested persons to support conclusions and recommendations at each phase in the process,"* there has been a marked lack of transparency in the reporting of modeling results in studies supporting the CRRP Class EA. Standard reporting for hydrologic and hydraulic studies requires that a range of input parameters and modeling results be documented to clearly demonstrate the extent of change over existing conditions (due to the effects, in this case, of urbanization, floodplain filling and restoration of the river) and the reasonableness of parameter selection and overall modeling results.

In the supporting studies prepared for the original 2006 Kanata West/CRRP Class EAs (CH2MHill, 2005 and 2006), the documentation of modeling results was clear and comprehensive, including: Manning's 'n' values in all locations; pre and post-development peak flows, flood levels and velocities at all sections for the 2 to 100 year events; expansion and contraction coefficients; pre-and post-development riparian storage volumes and travel times.

In contrast, The Third Party Review (2009) and Widening Alternatives report (2010) supporting the July 2010 re-posting only document 100 year flood levels and none of the other results and parameters listed above. Full and transparent reporting of input parameters and output is essential to facilitate the review and understanding of model results. These items are a standard requirement of documentation for projects of this nature.

On a final note related to transparency, the proponent has not accounted for the impacts of developing the Fernbank plan, an additional 200ha of development located immediately upstream of Kanata West, which was approved to proceed over a year ago (including the strategy to address stormwater management requirements for the site). Given the SWM criterion of 10 year controls only (for direct discharge to the Carp River) was also approved for Fernbank, this will result in additional peak flow increases over those already documented.

Considerable efforts were undertaken in the Widening Alternative report (May 2010) – generic Manning's 'n' modifications and revisions at bridges; various widening alternatives that included georeferencing of all cross-sections/various hydraulic model adjustments; additional model tests regarding the July 2009 storm, etc. Notwithstanding this considerable effort, the City declined to make a very minor revision to the hydraulic model that would have involved replacing the 3 hydrographs representing existing runoff from the Fernbank lands with the corresponding post-development hydrographs from the same area, available from the Fernbank analyses. The hydraulic modeling supporting the CRRP is effectively already out-of-date and the public has not had the opportunity to review the impact of full development on the CRRP undertaking.