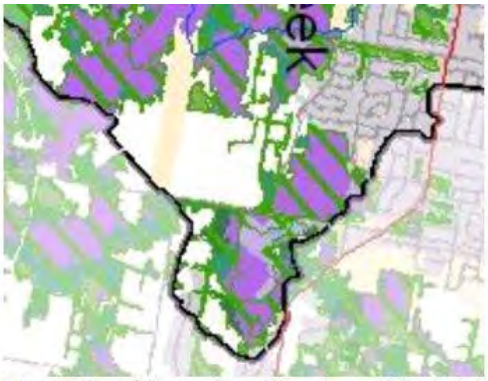

[DP/SD markup red = edge of marsh; green = adjacent properties impacted; yellow = topographic lines]


BING maps viewed 20 Aug 2013

# Public Comment on 6279 Fernbank Development Applications and the

# Fernbank Creek Catchment



Map 12B Land Cover - Carp River, Lower Mississippi and Ottawa West 200901 [purple = swamp]

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21 Aug 2013

This report comprises a public comment on the 6279 Fernbank Draft Plan of Subdivision (File D07-16-13-0016) and Zoning By-law Application (File D02-02-13-0057) and research and comments relating to the Fernbank Creek Catchment. In reviewing the development applications for 6279 Fernbank, it soon became apparent that this development will cause major problems and that the issues are broader than this development.

The first issue is the reconciliation of the topographic differences (shown on the title page) which should not have occurred if this developer had originally planned a Phase 3 for Cypress Gardens. The developer cannot change the drainage on the adjacent properties without agreement of every landowner, and should not be expecting adjacent landowners to pay for the drainage changes which are required to make the new development compatible with existing development.

The major issue, however, is that the developer plans to build on a wetland which may be hydraulically landlocked and which may have no effective outlet, and on top of the remainder of the Fernbank Creek tributary which was entombed in the 1980s and called the Cypress Gardens Storm Sewer. This storm sewer outlets to the Church Street Storm Outfall at Poole Creek and is a primary source of Poole Creek baseflow in the reach which sustains the cool-coldwater fishery. The Cypress Gardens Storm Sewer provides constrained services to the Westwood Subdivision and a large part of Cypress Gardens. A ditch on the developer's site is the outlet for the remaining remnant of the tributary and is contributing flows to this sewer, which surcharged in the 24 July 2009 flood. The additional research on this issue indicated that the issues are much broader than 6279 Fernbank – the issues need to be resolved for the entire Fernbank Creek Catchment and involve the prevention of apparently rising groundwater levels in the Site area, and the survival of the Fernbank Wetlands (UNF) and the fishery and cool-coldwater environment of Poole Creek.

Research has also indicated that the approval of all development involving infiltration systems within the Fernbank Creek Catchment was based on experimental stormwater management measures, that these infiltration systems are not appropriate for areas which have high groundwater and bedrock levels (this is a characteristic of the Fernbank Creek Catchment area), and that other research indicates that measures which prevent infiltration are more appropriate where high groundwater and bedrock levels exist.

Prior to any further development or intensification in the Fernbank Creek Catchment, a major study needs to be undertaken by the City, MVCA and RVCA, and should include at minimum:

- Review of subwatershed plans, boundaries and recommendations, MOE COAs, SWM and servicing reports, flood investigation records and reports, etc.
- Studies to determine geotechnical, hydrological, hydrogeological, and ecological systems which have impacted existing development and will impact future development, and the impact on the remaining Fernbank Wetlands and Poole Creek baseflow and fishery
- Evaluation of the condition, capacity, and performance of all infiltration system infrastructure and the Cypress Gardens Storm Sewer, and the Church Street Outfall.
- Evaluation of the wetland hydrology and water balance

I am opposed to the development application and the use of infiltration systems in the Fernbank Creek catchment where groundwater and/or bedrock levels are high, and where the Cypress Gardens area has no stormwater flood mitigation identified.

**Cypress Gardens Storm Sewer is an Entombed Tributary of Poole Creek**
The storm sewer is not a traditional storm sewer. It is an entombed tributary which is a primary contributor of baseflow and groundwater flow as well as stormwater runoff to Poole Creek. On maps from at least 1925 to date, a tributary of Poole Creek is shown as being between 2 bedrock ridges with wetlands north and south of Fernbank Road possibly being the tributary headwaters. This tributary was called Fernbank Creek in the 23 May 2000 *ROC PEC Minutes*. A 1978 GSC map shows a possible continuation of the tributary as far as Stanley Corners. The 1976 GeoOttawa map shows the tributary with a number of culverts under roads and the Trans Canada (TC) Trail and extending to Poole Creek west of the former Methodist Campgrounds, where the Forest Heights subdivision was subsequently built soon after the Campgrounds closed in 1979. This subdivision resulted in the tributary being entombed north of the TC Trail as its path is the rearyards between Jonathan Pack (which existed pre-1979) and the new subdivision. There does not appear to have been any planning for the lands south of the TC Trail or consideration of the impact this entombment would have on the ability to manage stormwater or the Poole Creek fishery. The 1991 GeoOttawa map shows the storm sewer being constructed on the tributary path.

One would wonder why Goulbourn Township would entomb a tributary which could have provided a stormwater outlet for the entire catchment area, as the area south of the TC Trail now has major constraints.

The tributary/storm sewer outlet is called the Church Street Outlet in the May 2000 *Upper Poole Creek Subwatershed Study (UPC SWS)* and is located between Jonathan Pack and Stittsville Main Street, both of which have capacity constraints. The *UPC SWS* indicates that storm sewers (plural) contribute baseflow and groundwater to Poole Creek between the Crossing Bridge SWMP and Stittsville Main Street culvert. These storm sewers are said to be critical to the continuation of the fishery. However, in a site visit in the early fall of 2011, the Crossing Bridge Storm Outfall had no baseflow, as the invert is raised a considerable distance from the channel bottom. The SWMP has sediment build-up which may impact capacity. The Jonathan Pack twin culverts restrict flow and the only outfall sustaining this Poole Creek reach appears to be the Church Street Storm Outfall (see photo in Appendix B). The UPC SWS) indicated that the upstream PSW only provides intermittent flows in wet weather events. The recent approval of the Hazeldean Municipal Drain may also impact the PSW and the remainder of Poole Creek.

There should be no further entombment of the tributary until the major studies have indicated this will have no adverse impact. The UPC SWS needs to be revisited to determine the current conditions, capacity, constraints, and performance of all the stormwater management infrastructure, and to determine why the Crossing Bridge Storm Outfall has such a high invert.

**Fernbank Wetlands (UNF) and the 6279 Fernbank Site Wetlands May Be Hydraulically Landlocked**
As development progressed in the area, the tributary has been entombed from the south curve of Elm all the way to Poole Creek, and most of the original wetlands have been developed (see maps showing the shrinkage of the wetland between 1976 and 2011 in Appendix B). The 2 Westwood Dry SWMPs, in particular, resulted in cutting off the tributary floodplain and any surface water flows from the wetlands. The area in which these ponds were built has high groundwater levels which may impact their ability to achieve their infiltration targets. The result of these changes is that the surface water flows from the southerly wetlands headwaters have been cut off, and the impact on groundwater flows does not appear to have been studied.

Cypress Gardens Phase 2 along Elm, Westwood Phase 2A along the Fernbank Wetland, and Coyote Park, increased runoff to the Fernbank Wetland north of Fernbank Road. Fernbank Road receives runoff from the ridges near Stittsville Main Street and West Ridge Drive, and the road elevation appears low in the middle in relation to the wetlands. Development south of Fernbank Road also has increased the flow to the Fernbank Wetland in that area. What is happening underground in relation to the hydraulic connections is unknown.

Logically, the portions of the tributary south of Fernbank should be flowing towards Poole Creek. There are conflicting reports as to whether there is a hydraulic connection via a culvert under Fernbank Road which would be the outlet for the Fernbank Wetlands (UNF) south of Fernbank. This culvert may possibly be the one mentioned in the Oct 2005 *Report on Flow Characterization and Flood Level Analysis Carp River, Feedmill Creek and Poole Creek* Pg 76 diagram as MHST07694 which is associated with the 108P 132.0ha catchment and the Church Street Storm Outfall. In this diagram, subcatchment 104P which contains the northwest part of Westwood south of the TC Trail and West Ridge Estates north of the TC Trail, are being shown as being separate from the 108P subcatchment. This may be why Westwood Phase 3 is approved to drain to a marsh area rather than the 2 SWM Ponds.

The overall result of the progressive development on wetlands, is that the tributary remnant and wetlands flows have been increasingly confined to a basin between the 2 bedrock ridges (west and east), the Westwood SWMPs (north) and Fernbank Road (south), at least on the surface, while developments have been increasing the amount of surface runoff to the Fernbank Creek Catchment area. The ditch appears to be the only surface outlet from what may essentially be a hydraulically landlocked wetland basin due to the topographic and storm sewer constraints. If the 6279 Fernbank development is approved as proposed, the developer will encounter major problems with surface water and groundwater, and the basin will have no outlet. If the groundwater level is rising, the impact on all existing developments and infrastructure would need to be determined. If the water has no outlet or a constrained outlet, water levels in the Fernbank Wetland may increase and impact the UNF viability and all of the developments, which already have high groundwater levels due to having been developed on wetlands, and the Poole Creek baseflow supply will be reduced. It would also be necessary to determine whether there would be an impact on the Westwood SWMPs, which appear to be a similar to elevations provided in the 6279 Fernbank *DP/SD* and Grading Plan (*Serviceability Study* Pg 42).

The relationships of the tributary and wetlands to the Cypress Gardens Storm Sewer, the sewer condition and capacity, as well as the hydrology and hydrogeology of the Fernbank Wetlands, the Site Wetlands and the tributary need to be studied to determine if the basin is landlocked, to what degree the outlet is constrained, the potential impact of more development in the Fernbank Creek Catchment, how the remainder of the UNF will be impacted, whether the Poole Creek fishery an temperature will be impacted, whether the current high groundwater level problems can be resolved, and whether the 6279 Fernbank development and future intensification are feasible.

**Wetland Hydrology and Water Balance Needs to be Understood**

Based on the Toronto and Region Conservation Authority Dec 2011report titled *The Impacts of Urbanization on the Hydrology of Wetlands: A Literature Review*, and other related documents, it appears that there is very little understanding by the engineering profession of the hydrology of wetlands, of urban development on or adjacent to wetlands, of groundwater fluctuations and impacts, or of impacts on adjacent properties or wetlands, let alone the relationships and impact of, or on, stormwater management systems or wetlands, or vice versa.

The report states:

> Pg 46 4.1.10 Conclusions
>
> Protection of a wetland through the development process is highly linked to the preservation of hydrology. It is critical the water balance of the wetland is accurately determined in the preliminary analysis stages to ensure water inputs are maintained via the correct pathways and in the correct proportions.
>
> In the case of the Keele Wetlands, the consultants used a surface water-based modelling approach for the wetland as they determined that groundwater was not a factor. For future water balance studies and baseline monitoring, proper instrumentation for at least one year, including a series of piezometers may be necessary to adequately characterize groundwater conditions
>
> Pg 47 An adequate baseline period instituted prior to any grading or construction activity within the catchment of the feature needs to be established. These data need to be compared to the post-development data in order to assess if hydrological, or related ecological, changes have resulted from the development.

As the Fernbank Wetlands have been increasingly developed, and with the cut-off of the north outlet by the Westwood SWMPs and the Cypress Gardens Storm Sewer constraint limiting flow, the wetland and adjacent areas are experiencing similar conditions to those described in the critique (Pg 51) of the Wilcox-St. George Wetland Complex (Richmond Hill) case study of a development on a PSW which is said to have an outlet constraint, surface-fed groundwater (0.6m fluctuation is characteristic), which increased groundwater levels by 0.5m, summarized as follows:

- boundaries of vegetation communities have changed
- larger areas of standing water
- decline in the shallow water marsh areas
- large scale die-backs of the same vegetation that the consultants assured would be tolerant of water level changes
- complaints from the older community to the south about flooding problems in their backyards resulting from increased water levels within the wetland

The report (Pg 51) proposes several reasons for the 0.5 metre increase in water level observed in the wetland in the three years following earth works:

- increased runoff volumes from the development site;
- partial blockage of the wetland outlet;
- climatological factors; and
- synergistic actions of all the factors.

Comparison of the Fernbank Wetland north of Fernbank Road in maps between 1976 and 2011 (see Appendix B) indicates a significant change in the amount of green vegetation, and a site visit revealed a disproportionate number of dead or dying trees on the north side of Fernbank Road in comparison to the south side (see photos in Appendix B).

The TRCA Report (Pg 54+) identifies questions which need to be asked, indicates regional guidelines are required, and indicates that acceptable thresholds for hydrological changes must be developed.

Unless the City and agencies ensure that the Fernbank Creek Catchment and the Fernbank Wetlands catchment area hydrology, water balance, constraints and impacts are understood, there should be no further development or intensification in the Fernbank Creek Catchment. Based on the description of the problems with the modelling tools available, it will be many more years before this understanding can occur. While the City's current and past policy and concerns and development delays have related to PSWs, because a large number of households flooded in the 24 July 2009 event which the Auditor claimed did not reach 100-year levels in residential areas, and because adjacent landowners are experiencing problems related to high groundwater levels, the fact that the Fernbank Wetlands and the Site Wetlands are locally significant or insignificant is irrelevant.

The Aug 2012 TRCA *Stormwater Management Criteria Appendix D: Water Balance for Protection of Natural Features*, which focuses on preservation of the significant natural features, state the requirements:

> Pg 3 It is important that the proponent's consulting team meet with staff from the conservation authority (CA) early in the process to detail the works required as part of the water balance evaluation. Factors that will be considered when looking at field investigations, instrumentation, and modeling include but are not limited to, the following:
>
> - The extent that the feature is supported by ground water and the extent that is surface water;
> - The extent of the catchment (surface or ground water) that is going to be modified by the proposal;
> - The nature of the feature's vegetation and habitat characteristics and their ecological amplitude or range of conditions that they are suited to;
> - The extent to which it has been agreed that the feature can be modified through the development process (e.g. headwater features where the functions are to be replicated through modifications).

To this should be added, the impact on the Poole Creek baseflow and ability to sustain the fishery and cool-coldwater temperatures.

Proper studies, including a vegetation analysis to confirm whether the tree death has been caused by high water levels, need to be done to understand the constraints, opportunities, and any mitigation required to resolve problems created by not analyzing the wetland hydrology and water balance for previous developments. Previous development decisions related to the Fernbank Creek Catchment have focused on protection of wetlands and fish habitat. None have focused on what is happening underground and how this can impact development, and none have focused on understanding the natural systems in relation to groundwater and stormwater. Protection of public health and safety and prevention of property damage need to have much higher priority than in the current legislative and regulatory regime which places fish and other species above people and property.

**Cypress Gardens Storm Sewer was Surcharged in the 24 July 2009 Flood – Is Capacity Available?**

In the 24 July 2009 flood, the *WEFI Appendices* Jan 2010 Pg 66 shows all of the storm sewer manholes, which were inspected, as being surcharged. The *WEFI Phase 1 and 2 Report* Jan 2010 states:

> Pg 46 Design reports for this cluster noted groundwater to be high, which could further have aggravated the situation
> Number of reported floods 29 (9 were floor drain/sanitary, 10 unknown)

There was also extensive flooding in Westwood Phase 2. This was blamed primarily on the failure of backwater valves, as reported on the 17 May 2020 *Report to PEC and Council*:

> 62% of all BWV covers were in place at the time of the inspection.
> 38% of all clean out threaded covers were not in place at the time of the inspection.
> 67% of all BWV covers that were in place, were screwed down tightly.
> 33% of all BWV covers that were in place, were not screwed down tightly.

There were 119 BWV failures, of which 29 were studied. Converting the percentages to number of BWVs results in the 18 in place were ok, 6 were not, and 11 were not installed (most of these may be in Jackson Trails). The report also noted that stormwater BWVs are only designed to handle 5psig vs 15

psig protection provided with sanitary BWVs. The *2010 Audit Report* on the flood placed the blame on the lack of ICDs, and noted that Phase 1 had not flooded due to the presence of ICDs.

The City's flood mitigation focused on BWVs and ICDs, with a problem with the Westwood SWMP orifice also needing to be resolved.

The City's initial investigation provided no information on the performance of the storm outfalls, and there was no recognition that there might be a connection between the manhole surcharging in Westwood and Cypress Gardens. There was no investigation of the performance of the Cypress Gardens Storm Sewer. No questions were asked as to why there was so much pressure in the storm sewer or what had changed which might account for the extent of flooding, despite this flooding having occurred in a catchment which was said to have no overland flow outlet and which has a major constraint on the Westwood SWMP connection to the Cypress Gardens Storm Sewer.

Not only did Cypress Gardens residents in the vicinity of the 6279 Fernbank site flood in 2009, but some have been experiencing basement and rearyard flooding, sump pump overtaxing, and other foundation problems being caused by high groundwater levels. Spring melt, particularly, is causing problems. The developer only provided groundwater level for 1 borehole in winter conditions.

It is unknown whether the flow from the wetlands and tributary ditch are overloading the storm sewer system in the area or whether the entire system has been backed up by conditions in Poole Creek, or from a point in between. The few serviced residences at the edge of the catchment north of Fernbank Road contribute very little flow so there should logically not be a large amount of flow here. The *6279 Fernbank Serviceability Study* Pg 30 May 1998 Storm Sewer Design Sheet has only a 600mm (397L/s peak flow) and a 675mm (417L/s peak flow) upstream of the 6279 Fernbank connection to the 900mm. There are also a number of sump pumps and several (pre-1980 ERIS) water wells in the area which may pump groundwater to the storm sewer or the ground surface. As well, Goulbourn Township extensively used rearyard swales and catchbasins which would divert more flow to the storm sewers than the standard design methods would have accounted for.

The presence of surface groundwater in dry weather and the groundwater problems experienced by area residents in minor storms suggests that the groundwater levels in the area have risen. The apparent increase in dead trees in the wetland (see photos in Appendix B) could also be a sign of higher levels. It would not be coincidental if the levels have increased since 2002 as development increased in Westwood and contributed more stormwater runoff to the area. Logically this could happen due to the reduction of the wetland areas when there has been no provision for an adequate overland flow outlet, and where the storm sewer has capacity constraints.

In addition, some of the non-serviced areas in Cypress Gardens have ditches, culverts, swales, and ponding areas, while some have none. One side of the road may have these and the other side doesn't. Over the years, landowners have made changes or have not maintained the capacity of these ditches, and there is considerable flow from areas with higher topography. Piecemealing the West End Flood Investigation studies resulted in inconsistent analysis of problems, with some areas being identified as requiring mitigation (e.g. Vanstone ditches in Katimavik-Hazeldean) and others not (e.g. Cypress Gardens). The only mitigation for the Cypress Gardens (Old Stittsville) area has been replacement of the sanitary manhole covers, despite 29 reported flooding incidents.

There are major drainage problems in Cypress Gardens and Westwood which are potentially being caused by the increased level of development and rising groundwater levels. The normal process for designing the storm sewer infrastructure does not generally account for groundwater and large topographic differences which increase the land area and result in faster runoff.

Additional investigation is required to determine solutions which will resolve these problems. Before any additional development or intensification is approved in this catchment, the Cypress Gardens Storm Sewer capacity, condition, and performance need to be determined, as well as the contributions from the Fernbank Wetlands and their impact on the performance of the storm sewer system and groundwater levels. A stormwater retrofit project is required for the Cypress Gardens community.

**Capacity Allocation versus Capacity Availability and Quantity Control Needs Review**
A site visit reveals that the Elm area appears to be a very small catchment in relation to the size of the Cypress Gardens Storm Sewer, as part of the area is in the Faulkner Drain catchment (Jock River watershed), topography restricts flow, and many houses do not have municipal storm sewer servicing. This raises the question as to whether the capacity which is said to have been allocated in May 1988 was allocated for residential development or for the wetlands and tributary remnant, or both. If it had been allocated for residential development, it would not have been for a high density development such as is being proposed by this developer, or for the entire property, as part of it is zoned as Environmental Protection (EP) which appears to coincide with a large portion of the tributary remnant.

Generally, a capacity allocation made in May 1988 would need to be reviewed when the 2013 DP/SD was submitted, as since that time there have been significant changes in design standards, SWM practices have evolved, and intensification is occurring. This developer's proposal for 140 units far exceeds what would have been expected in May 1988 if a Phase 3 were to be built on the residentially-zoned lands.

The UPC SWS quantity control requirement is tied to the Cypress Gardens Storm Sewer capacity constraint, and the fact that this sewer is contributing groundwater input to Poole Creek, as stated:

> Pg 6 2.1.4 Stormwater Drainage
> Stormwater management reports are in place for the majority of developments that have been constructed after 1980. Quantity control has not been required for flood protection, but **has been required as a result of limits to the storm sewer capacity**. From monitoring studies, it appears that there is a considerable amount of baseflow in some of the storm sewers due to infiltration
> Pg 7 Flows from the Church Street storm sewers enter just downstream of Jonathan Pack Street. The storm sewer flows are groundwater-based and quite cold.
> Pg 10 The sewers have likely intercepted groundwater flow, which follows the sewer out to the creek
> Temperatures consistent with "coldwater" generally occur very close to the storm sewer discharge points.
> Pg 13 The existing aquatic ecosystem is now dependent on the existing storm sewers and the groundwater inputs that they provide.

While the intent of the UPC SWS appears to require quantity control and restrict the Westwood development flows due to a constraint at the junction with the Cypress Gardens Storm Sewer, the fact this sewer surcharged in the 24 July 2009 rain event, should have raised concerns as to whether that "promised" capacity is still available. The statements concerning the groundwater input by the storm sewers should raise concern that there may be more water in the sewer than intended in the design, particularly as older sewers tend to have more groundwater infiltration.

While the UPC SWS appears to have limited the sewer constraint to Westwood, there are a number of statements which indicate that little was known about the Westwood and the southeast sector, as stated:

> Pg 35 6.0 GROUNDWATER SYSTEM
> There is very little detailed information for the lands west of the West Ridge Estates (Phase I and Phase II) and the proposed Westwood Subdivision.
> Pg 37 6.2 Results
> 6.2.1 Surficial Geology and Soils
> Pg 38 Based on the test pits and test holes completed by MGS (1998) and GA (1999), respectively, there **appear to be areas of organic sediments in the southwest corner of the Westridge Phase II subdivision and along the southeast, northeast and northwest boundaries of the Westwood subdivision.** The depth of the organic sediments on the Westwood property reaches up to 0.60 metres in the southeast.
> Pg 41 **In the undeveloped areas where organic sediments were observed, the water table has been observed at the ground surface elevation during high flow periods (i.e. Spring).** This may include the flood plain area of West Ridge II (GA 1999) and includes parts of Westwood identified as containing organic materials. It is not known whether the high watertable at these locations is perched above the non-permeable material or whether it actually represents the shallow groundwater table in the overburden unit.

The UPC SWS, however, did identify the high groundwater levels. This should have raised concerns that there might be additional water which required an outlet.

The quantity control requirement and capacity of the Cypress Gardens Storm Sewer need to be reviewed in relation to the additional capacity needed to provide sufficient outlet for the high groundwater levels, this development, and intensification which has occurred or will be increased in future. There are also concerns that there has been potential for conveyance of organic material and sediment over the past 26 years which could have impacted the capacity of the Cypress Gardens Storm Sewer.

**The UPC SWS, SWM Reports, and MOE Certificates of Approval Have Conflicting Information**
Review of various reports and the MOE COAs identified conflicting information and raised concerns as to whether the Cypress Gardens Storm Sewer has the capacity approved for Westwood, particularly as the storm sewer surcharged in the 24 July 2009 flood event.

The *UPC SWS Appendix A* Pg 10 to 11 quotes the OMM July 1998 *Storm Water Management Report, Westwood Subdivision, Stittsville, Township of Goulbourn*, as stated:

> ... specific stormwater management details ... include:
>
> > The area, which drains to the Cypress Gardens storm sewer, requires stormwater quantity control, because there is no overland flow outlet from the Cypress Gardens development. In addition, the Cypress Gardens' reports outlined that only pre-development flow would be accepted from the Westwood Subdivision. As a result, minor system flows will be limited to 1,280 l/s. Surface storage will be provided for the 1:5 year event, 9,260 m3, and for the 1:100 year event, 24,760 m3, in two stormwater ponds along the east perimeter of the site.
>
> The remaining area draining directly to Poole Creek will provide stormwater quantity control for the 1:5 year and 1:100 year storm events to pre-development peak flow levels. The storage required to limit flows to the 1:5 year pre-development peak flow rate of 420 l/s is 2,820 m3 for the 1:5 year storm event and 7,720 m3 for the 1:100 year storm event.

The *MOE COAs* and the Jan 2010 *Westwood (Deer Run) Subdivision Former School Site Stittsville Serviceability and Stormwater Management Report* (based on the 2007 analysis) Pg 37 identifies the capacity of the 2 SWMPs as 7,741.1 m3 for 45.53ha for Phase 1 and 2 and the school site (part of Phase 3; alternately called Phase 4). The *MOE COA* for Westwood Phase 3 does not include a SWMP and only

indicates that flow will be to a marsh area (the PSW?). If this marsh area is close to the TC Trail and also has no outlet, problems may arise by increasing groundwater levels in the area and negatively impacting vegetation. This may be why the UPC SWS indicates that a SWMP near the TC Trail is a requirement.

The 12 April 2000 (Phase 1), 25 Aug 2004 (Phase 1 and 2), and the 9 Aug 2005 (Phase 1 and 2) MOE COAs are all approved as "collecting up to the 100 year storm event runoff", with total storage of 7,741.4m3 for 41.9ha. This appears to be much closer to the *UPC SWS Appendix A* 5-year event (above), than for the 100-year event, and does not agree with 45.53ha in the 240 WRD Study (no COA has been located for this site which was approved by OMB on the 8th of Dec 2011).

The *MOE COAs* and *240 WRD SWM Study* have conflicting statements as to the maximum discharge rate to the 900mm which discharges to the Cypress Gardens Storm Sewer:

| | |
|---|---|
| 12 Apr 2000 Westwood Phase 1 | 1,280 L/s |
| 25 Aug 2004 Westwood Phase 2A | 1,166L/s |
| 9 Aug 2005 Westwood Phase 2B | 1,166 L/s |
| 240 West Ridge Drive Study | 1,280 L/s - requirement is 1241.1 L/s |

The *240 WRD Study* Pg 48 identifies a peak flow at MH121 of 1117.15 L/s with a pipe size of 914.4 mm and pipe capacity of 845.45 L/s.

What is not identified in the documents consulted, is the peak flow and pipe capacity of the Cypress Garden Storm Sewer. The sewer diameter at Elm near the 6279 Fernbank site is said to be 900mm and at the Westwood SWMP/Cypress Gardens junction 1650mm. The 2 Westwood SWMPs are constrained by this junction.

According to the May 1988 Storm Sewer Design Sheets on Pg 30 in the *6279 Fernbank Serviceability Study*, the larger culverts on Elm Crescent have the following design characteristics:

| | | |
|---|---|---|
| 900mm sewer | peak flow 1,019 L/S | capacity 1,035 L/s |
| 1200mm sewer | peak flow 1,149 L/s | capacity 1,149 L/s |
| 1350mm (2d) sewer | peak flow 1,740 L/s | capacity 1,827 L/s |

While sewer pipes often carry peak flows smaller than their pipe size, it is realized that peak flows within sewer pipes may, in certain conditions, carry peak flows considerably higher than their apparent capacity. In this case, the 1,650mm Cypress Gardens Storm Sewer may possibly have the capacity to carry 1,280 L/s of Westwood flows, 1,827 L/s of the 1,350mm Elm pipe flows (total of 3,107 L/s to this point), as well as the remaining sewers downstream of the 1,350mm, however, because the storm sewer system had significant surcharging, the assumption that the sewer can carry a significant amount of flow may not be valid.

The *UPC SWS Appendix A* indicates that the Church Street Outfall contributes groundwater via flow in the sewer bedding (it is believed that Goulbourn Township did not use clay dykes in the early years), and infiltration. Pg 11 also indicates that the Church Street Storm Outfall has a baseflow of 6 – 14 L/s. These, and the ditch flows from the tributary remnant and wetlands into the 900mm sewer at the lower curve of Elm, are not likely to be accounted for in the storm sewer designs. The developer claims that 602 L/s was allocated in the May 1988 Storm Sewer Design Sheets. Given that the conveyance needs for the local area were very small, and that the tributary and wetland flows needed an outlet, it is highly likely that this capacity was allocated for that purpose.

There is also the possibility that the 15 Jan 2001 MOE COA, which is said to discharge to a "tributary of Pool[sic] Creek" may impact the flows if there is a connection:

> 6189 to 6329 Abbott Street West (from West Ridge Drive to approx. 70 m west of Regional Road No.5), owned by 1252051 Ontario Inc. & 561650 Ontario Inc., **servicing the road reconstruction for Westwood Developments**
> Stormwater management Facility
> a stormwater management facility (on site) includes source controls (e.g. grass filtration, catchbasins with sumps & goss traps for control of runoff from the paved areas) and stormwater outlet (at the intersection of Abbott Street West and West Ridge); **discharging to a tributary of Pool Creek**;

All of the possible sources of stormwater or groundwater flow or infiltration need to be identified. The conflicts in the requirements and numbers need to be reconciled, and the actual and effective capacity of the Cypress Gardens Storm Sewer needs to be determined.

**Cypress Gardens Park Dry SWMP Does Not Appear to be a Traditional SWMP**

A site visit to the Cypress Gardens Park SWM dry pond (see photos in Appendix B) raises questions as to the intent of the Pond and the relationship of the Pond to the storm sewer. The 1976 GeoOttawa map shows the park area as wetlands (see Appendix B). In 1999, the park area appears wet or vegetated, as a park. In the 2002 map, soccer lines and goalposts have been added. From the ground at the outlet near the pathway, the centre of the park appears to be significantly elevated and the only apparent SWM storage appears to be ditches around 3 sides which drain to a grate near the path (the culvert under the path is small and deteriorating) which is believed to be connected to the Cypress Gardens storm sewer. By visual inspection of the topography in the area, it appears that there is no significant source of overland flow to this pond, as berms exist to stop rearyard flows and the curb on Elm prevents some flows. The only drainage catchment area appears to be the wooded/playground area and parking lot. The east side ditch, which was checked in the site visit, had standing water. Because this area was wetlands, the infiltration ability may be impacted. The primary question which arises is why a 1+ha SWM facility (the UPC SWS says it is 2.0ha) would be built for such a small catchment area. In the 24 July 2009 flood, residents reported approximately 3 inches of water towards the north end. This would suggest that the Cypress Gardens Storm Sewer may have surcharged into the Park.

The city had identified a flood mitigation for this SWMP, but the need for it is being reviewed.

The Cypress Gardens Park SWMP should be re-evaluated to determine whether the objectives are being realized, and whether there is any possibility that this Park could perform additional storage functions to alleviate some of the constraints in the Cypress Gardens Storm Sewer or to store flows from the tributary remnant and wetlands to alleviate the high groundwater levels in the area and to store the 100-year flows.

**Feasibility and Compatibility of Drainage with Adjacent Properties Requires Landowner Agreements**

On the Draft Plan of Subdivision (DP/SD), the rearyard topography overlaps property lines (see the DP/SD markup on the title page). If the developer had intended to build a Phase 3 development on the wetlands, one would have expected that the topography would have been designed to be more compatible with the addition of a 3d phase. If it is even topographically feasible to connect the new and adjacent properties, agreements with adjacent residents will be required to ensure that their drainage is not impacted. If the drainage mitigation is to provide rearyard swales, this will need to be added to the storm sewer capacity requirement. A potential alternative would be to provide a natural buffer between the properties, but even with this alternative, a drainage outlet may need to be provided.

No decisions on the DP/SD or the ZBA should be made until the analysis of the feasibility of reconciling the topography and drainage has been determined, and until agreements with all the adjacent landowners are in place. Subsurface bedrock contours and groundwater flows also need consideration.

**Infiltration Systems Feasibility is Questionable Where Groundwater and Bedrock Levels Are High**
The UPC SWS indicates that these systems are "innovative", and unsuited for areas with high groundwater levels, as stated:

> Pg 64
> 2. High groundwater table elevations have been observed in a number of areas within the site. In some cases during the spring period these would be above the proposed invert of the perforated pipe. In several cases, the levels would be above the proposed invert of the gravel trench throughout the year. This would normally be of concern when designing an infiltration based system. In Maryland, where infiltration facilities have been used for more than 20 years, many facilities had failed because of high groundwater levels. In the case of the proposed system, there will clearly be a loss of storage and infiltration capacity during periods of high groundwater table. However, the system should retain its ability to filter incoming stormwater providing a satisfactory degree of water quality treatment.
> 3. During low flow periods, the storm sewers from the existing developments capture groundwater and discharge significant quantities of cool water to Poole Creek. With the proposed infiltration/filtration system, any water captured by the system during dry periods will infiltrate into the ground in a distributed manner around the entire system. While this will eventually reach the stream as groundwater discharge, it will not provide a point discharge of cool flow. However, soil conditions in the area are such that the amounts anticipated would be much lower than from the existing areas that are located in areas of much more permeable soils.
> Overall, the proposed approach appears to meet the needs of the subwatershed plan for water quality control while avoiding the negative impacts on water temperatures that other approaches would create. Given that the system is innovative, a period of monitoring should be completed after its construction to verify its performance.

Other studies have confirmed that these systems do not work well in areas with high groundwater levels and high bedrock levels, both of which exist in much of Westwood and the Fernbank Creek Catchment. Logically, if an area already has a high groundwater level and there is soil space between it and the invert of the system, and additional water is added which would normally be removed from the surface, but which is now being retained and infiltrated to the ground, this could increase the groundwater level.

The 10 June 2004 *Final Report Assessment Tool to Determine Potential Risks of Urban Salinity (Phase ll)* conducted for the Mildura (Australia) Rural City Council indicates that the water budget must be managed, and that the opposite approach is required where groundwater levels are high, as stated:

> Pg 17 [this is level 5 in the 5 level evaluation system]
> Very High: Groundwater is less than 2 m bgl. In these areas shallow saline groundwater is an immediate threat to urban development and some land may have already become salinised. The presence of salt tolerant plant species, although not specifically identified in the Assessment Tool, would automatically classify the affected land with a very high level of risk. If development were to proceed in such areas then the very high level of risk is an acknowledged liability and must require the most rigorous management approach.
> Pg 18 5.0 Water Budget Management
> If development is to proceed in very high risk areas, where shallow regional groundwater is a threat, a detailed hydrogeological investigation should be undertaken, including groundwater modelling to assess the impact of development on groundwater levels. The regional nature of the groundwater system means that, unlike perched groundwater, shallow regional groundwater cannot be effectively managed on a local scale with subsurface drainage. Management strategies must therefore be concerned with maintaining groundwater at a safe depth below ground level and efficient water use practices to minimise groundwater recharge. For example, imported clean fill may be used to elevate the ground surface above the
> Pg 19 groundwater capillary fringe zone. However, the **potential for disruption to groundwater flow up gradient of the development must be thoroughly investigated and addressed with suitable drainage prior to implementation**.
> Pg 34 [extract from table under the heading Actions required from the developer for Level 5]

Groundwater wells for ongoing monitoring; Detailed hydrogeological assessment including groundwater modelling to assess the impact of development on groundwater levels;
Water management strategy to address regional groundwater and off site impacts

While the focus of this, and related reports, is on salinity and areas with clay subsoil barriers, many of the statements and measures (subsurface drainage system installation, limiting lawn watering, etc.) would be applicable to areas where the soils or soil depth impact the groundwater levels and ability to infiltrate. Mildura requires rigorous investigation and measures and undertakes groundwater contour mapping to understand what is below ground. Of most importance is the requirement to consider off site impacts.

The 6279 Fernbank developer has indicated that the groundwater level is 1m below ground surface in winter conditions. The *MOE SWM Manual* refers to the **high seasonal** groundwater level. This development should not proceed until the high seasonal groundwater level and salinity impact on site vegetation and the Fernbank Wetlands (UNF) and all existing developments is determined and until a review of the feasibility of using infiltration systems in all of the Fernbank Creek Catchment areas which have high groundwater and/or bedrock levels has been undertaken by the Conservation Authorities and the City. This study should include water budget and water balance management issues and recommendations for mitigation of the problems being caused by the experimentation with a system which may not have been the correct solution in this catchment which has high groundwater levels and a constrained outlet.

**Rearyard Stormwater Infrastructure Feasibility Needs Review**

The Township of Goulbourn provided rearyard swales and rearyard catchbasins on private property without registering the requirement for maintenance on title. Most landowners are not aware of the need to maintain this infrastructure, and the cleanout of a catchbasin would likely be impossible due to the need for large vacuum trucks. Many landowners build tight fences and place structures in the flowpath of the rear yard swales. Rearyard infiltration systems also require regular maintenance and will likely be ineffective in areas where the groundwater and bedrock levels are high. In addition, all of the infrastructure on ICI, Planned Unit Developments and Plans of Condominium is privately-owned. This issue was raised in the WEFI Investigation because the privately-owned infrastructure was not being analyzed or mitigated (with minor exceptions in Glen Cairn).

The City should not be relying on privately owned infrastructure to perform stormwater management functions which, due to lack of consistency, structural changes by landowners over time, or lack of maintenance, may impact adjacent landowners.

**Porter SWMP Sizing and Catchment Area Needs More Analysis for Feasibility and Impact**

The developer provides no analysis for the recommended Porter Street Dry Pond which appears in fine print on diagrams with elevations indicated and a catchment area larger than the site. The SWMP is located in an area with high groundwater conditions which would impact the ability to infiltrate, and there is no mention of if, or how, the external drainage will be directed to the Pond and the impact this would have on the adjacent property owners. In addition, the SWMP has 2 inlets and no outlet. This SWMP is in a low area which floods. This would need to be mitigated to ensure that events greater than the 100-year event would not cause flooding problems in the area.

Correct sizing of the SWMP requires greater analysis before the DP/SD is approved.

**Lessons Need to Be Learned About Developing on Wetlands and Entombing Tributaries**
In the past, development on wetlands has been routinely approved and the stormwater and groundwater issues have not played the required part in the evaluation of this development. If staff oppose development on wetlands, OMB approves it. Arguments to OMB almost always focus on preservation of the wetland and not on the water issues. The response of Councillors is that much of the City is built on wetlands. This may be true, but it may also explain why there are flooding problems (e.g. Preston Street is former swamp). When farmers want to put their crops on wetlands, they drain the wetlands. When developers want to build on wetlands, they raise the grade. This may be satisfactory if there are no nearby adjacent developments, but when the groundwater levels can be kept high due to natural features above or below ground, or when the underground flows can be adversely impacted and cause damage (e.g. underground parking lots built with 0m setbacks), the precautionary principle should be used.

Stittsville and Glen Cairn are excellent examples of both situations – development on wetlands and former floodplain and entombment of a river.

- 1972 Rickey Place reach of the Carp River entombed
- 1991 Hazeldean Co-op built on wetland with crawlspaces – crawlspace flooded – was raised in the Ontario Legislature
  Infill in southwest Glen Cairn cut off the 1st of 2 drainage channels
- 1996 Carp River overflowed – entombed portion restricted flows
- 2001 Castle Glen built on wetlands – no basements, extreme grade cut off the 2d of 2 drainage channels
- 2002 Carp River overflowed - entombed portion restricted flows
- 2003 entombed portion daylighted to resolve problems
- 2009 extensive flooding in Stittsville, much of which was built on wetlands

Stormwater, groundwater and drainage issues and potential impacts need to be addressed before zoning and subdivisions are approved. Leaving it to the Site Plan stage is too late. Defending wetland developments at OMB needs to focus on the water and infrastructure issues. Drainage requirements need to be registered on title so that landowners are aware of their responsibilities.

Because there are groundwater problems and stormwater infrastructure constraints in the area, groundwater conditions, impacts and mitigation need to be understood before this development is further considered for approval. If it is to be approved, the City and agencies need to ensure that the issues have been thoroughly reviewed and that there is agreement that there will be no further adverse impacts on the communities in the Fernbank Creek Catchment, or on the UNF-designated Fernbank Wetlands.

The revised July 2013 TRCA *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* discuss why headwaters drainage features are important, as stated:

> Since 2006, TRCA and partners have been undertaking a series of studies to better understand the natural functions of headwater drainage features. Headwater drainage features are small, temporary streams, swales and wetlands. These studies were undertaken by the study team because agencies and scientists are beginning to recognize that the natural functions associated with headwater drainage features are poorly understood and underestimated. While the functions of perennial headwater streams are fairly well accepted, temporary systems that may flow for only parts of the year are virtually unstudied and unmonitored. Their small size and the fact that they do not necessarily flow year-round, makes them particularly vulnerable to impacts such as piping, channelization, flow diversion, grade lowering and realignment. However, there is a growing body of evidence to suggest that headwater drainage features are

> important sources of food, sediment, nutrients, and flow to downstream aquatic systems, and they also provide water quality, storage and attenuation functions as well.
> Improving our understanding of these systems is critical, and the timing for developing land use policies and guidelines for protecting headwater functions is now. The Greater Toronto Area and surrounding municipalities are expected to grow by 2 million additional people over the next 20 to 25 years. Much of this growth could be concentrated towards the upper reaches of our watersheds where the concentration of headwater drainage features is higher. This growth has the potential to have substantial impacts on our watersheds, hence it is essential that we understand the functions of headwater drainage features such that we can properly protect these important functions.

It is even more important when there are stormwater infrastructure constraints.

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*Basic Stormwater Management: First, Do No Harm*

The best solution to a problem is to prevent the problem from occurring in the first place

From *Catching the Rain: a Great Lakes Resource Guide to Natural Stormwater Management 2004 pg 15*