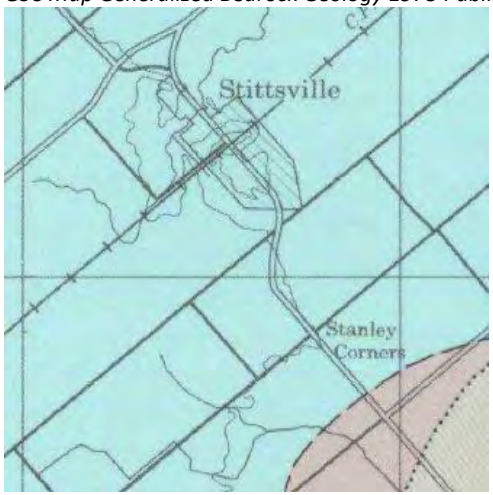
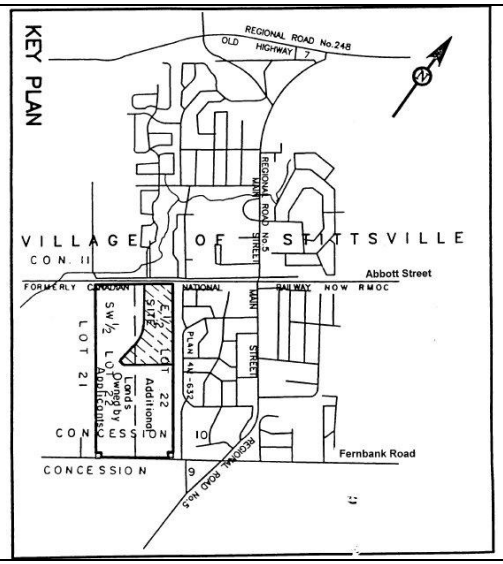
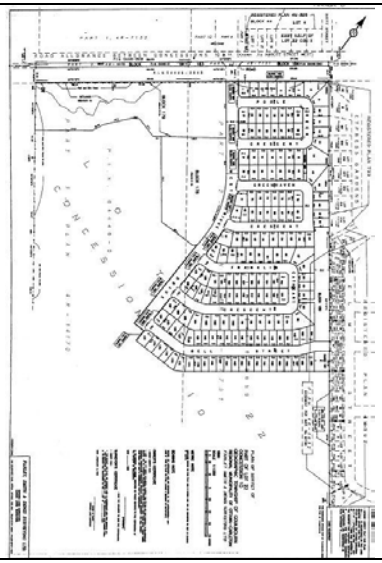
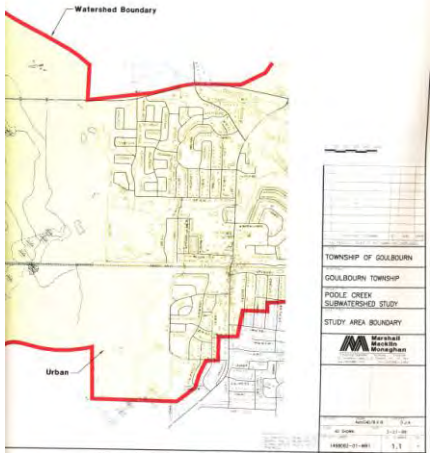
Public Comment on 6279 Fernbank Development Applications and the Fernbank Creek Catchment Part 2 By Faith Blacquiere, Glen Cairn 20130821		
	APPENDIX A **Chronological Review of Fernbank Creek Catchment Development and Problems**	
Date	**Reference**	**Comments/Questions**
1925	*DND Geographical Section 1923 Survey Map* Published 1925  	Topographic lines: 400 feet = 121.92m
1978	*GSC Map Generalized Bedrock Geology 1978* Published 1980  	Note that Fernbank Creek appears to go as far as Stanley Corners. This is also in later maps and reflected in some subwatershed boundary maps

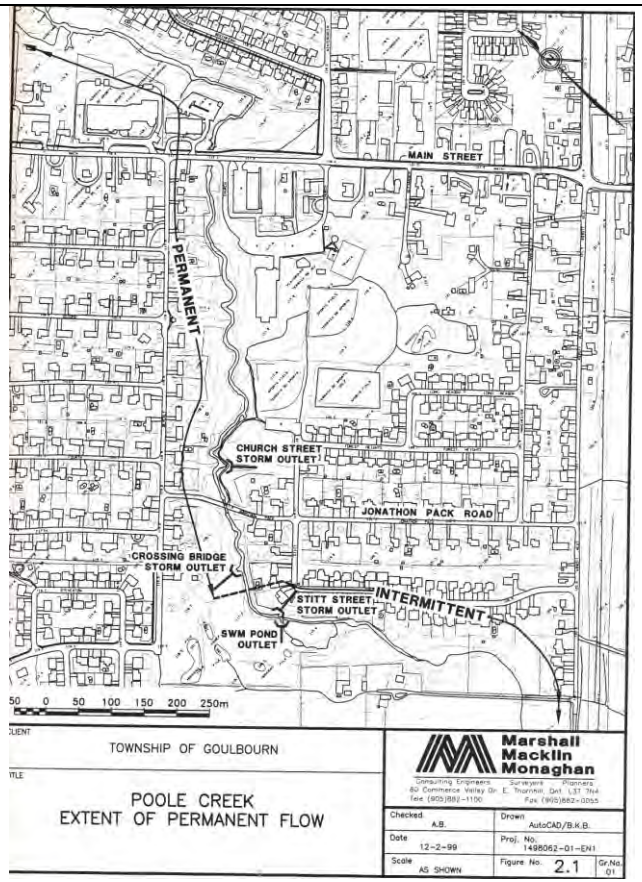
1959	*Air Photo Library 1959 from Lowes Phase 1 ESA* 	Cypress Gardens Phase 1 under construction
1988 to 1991	*Cypress Gardens Phase 2 constructed*	
1999 Feb 24	*ROC Report to Transportation Committee > Transportation Committee 3 Mar 1999* *Proposed Crossing Regionally Owned Former Railway Corridor Westwood Subdivision (O6t-98002)* *Township of Goulbourn* http://www.ottawa.ca/calendar/ottawa/archives/rmoc/Transportation/03Mar99/Rail2.pdf DEPARTMENTAL RECOMMENDATION It is recommended that Transportation Committee recommend to Regional Council that a permanent easement be granted, subject to the conditions outlined in this report, across the regionally owned former railway corridor south of Abbott Street in the village of Stittsville to the Corporation of the Township of Goulbourn to permit the construction of West Ridge Drive. BACKGROUND On the **18th of January 1999, the Ontario Municipal Board gave draft approval** to a plan of subdivision on lands owned by Rocco Meliambro in Trust and 561650 Ontario Inc., the general location on the lands being shown on Annex A to this report with the draft plan being shown as Annex B. As shown on Annex A, this draft plan is located on lands located to the south of Abbott Street in the Village of Stittsville. The subject lands are separated from Abbott Street by the former railway corridor now owned by the Region. It is proposed in the draft plan that the main road to serve the subject lands, West Ridge Drive, would cross the railway corridor now owned by the Region. Pg 3 PUBLIC CONSULTATION ... At the O.M.B. hearing held on the 18th of January 1999, no one showed up to oppose any of the planning documents before the Board and they were therefore all approved. Pg 4 Pg 5	

	 	
2000 Apr 12	http://www.environet.ene.gov.on.ca/instruments/0317-4H9KHG-14.pdf Westwood Phase 1 [Storm sewers, filtration system +] Bell Street West Ridge Drive Stormwater Management Pond Stormwater Management System a stormwater management system for the Westwood Subdivision, Phase I, **collecting up to 100-year storm event runoff** from an area of approximately18.7 ha conveyed via overland swales and subdivision storm sewer to the two stormwater retention ponds having a total storage volume of 7,419 m; complete with inlet structures, rip rap, culvert connecting the two ponds, perforated subdrain pipe and modification to the existing Manhole No. 121 to include an orifice plate allowing a **maximum flow of 1,280 L/s to the existing 900 mm diameter storm pipe** downstream of the Manhole No. 121 discharging to the storm sewer on Cypress Gardens	Phase 2A 25 Aug 2004 COA and Phase 2B 9 Aug 2005 say 1,166 L/s *UPC SWS Appendix A* Pg 11 indicates that greater volume was required: 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 MOE COA allows for less than the 1:5 year event in the UPC SWS The *240 West Ridge Drive Serviceability Study* Pg 7 indicates that the 1:5 year flow is 952.8 L/s and the 1:100 year is 1241.1 L/s for 45.53ha. The UPC SWS Appendix Pg 10 is for 56.8ha – where is the missing land? *240 West Ridge Drive Serviceability Study* Pg 48 [extract: MH121 peak flow 1117.15 **pipe size 914.4 pipe capacity 845.45**
2000 May 2	*Upper Poole Creek Subwatershed Study* by Marshall Macklin Monaghan with WESI [transcribed from original; extract from map between Pg 2 and 3]	Photo taken 16 Oct 2009 Stittsville Main Street Bridge which constrains flow downstream



Section 1: Phase 1 – Background Review
Pg 5 **2.1 Surface Water System** 2.1.1 General
Poole Creek's surface water regime is influenced by flows from the upstream wetland complex and by runoff from urban lands within Stittsville. In general, each of these sources is intermittent in nature. The wetlands tend to contribute flow on a seasonal basis, with the majority of flow occurring in the spring, early summer and fall. In many years, day-to-day flow from the wetlands stops in mid-summer. Urban runoff from within Stittsville occurs during parts of all seasons, but is limited to a few hours after a rain event or for a few days during a melt.
Pg 6 **2.1.2 Flooding**
Flood damage potential exists to a limited extent in Upper Poole Creek under the regulatory flood event. Four structures would be affected. Previous studies have established that the **flooding would occur because of the inadequate size of the culvert at Main Street.** It has further been concluded that the **flooding potential cannot be alleviated through the application of quantity controls on future development. As a result, stormwater quantity control is not required within the study area.**
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**. Some of the more recent developments that [sic] have incorporated water quality control. Recent developments for which future phase are anticipated are discussed in Chapter 7.2.5.
[map between Pg 6 and 7; Cypress Gardens Storm Outfall is labelled Church Street Storm Outlet]

The 6279 Fernbank developer used the "no quantity control" statement without considering the other statements in the UPC SWS which indicate that quantity control is required due to there being no outlet for Cypress Gardens



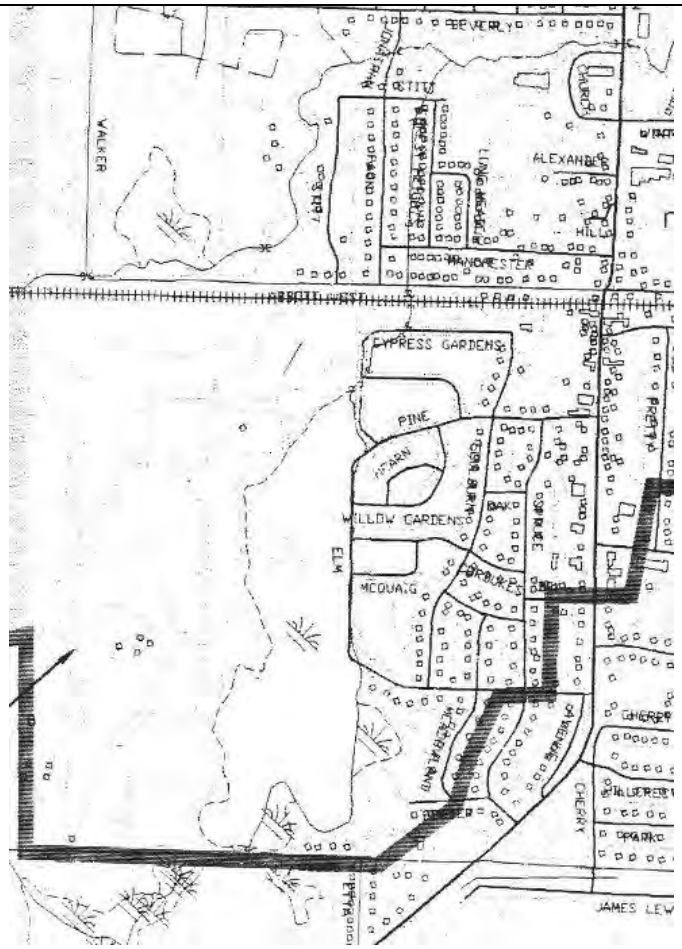
Pg 7 In Poole Creek today, the sources of baseflow are influenced by urban development. Groundwater discharge seems to be concentrated at several storm sewer outfalls (see Figure 2.1) along the Creek. As often occurs, the existing storm sewer systems intersect and appear to have lowered the water table and replaced more dispersed ground water inputs.

There were no stream flow records for Poole Creek within the study area at the beginning of the study. Monitoring was undertaken in Phase 2 and the results are discussed in Chapter 7.2.1.

2.1.6 Stream Temperature

Stream temperature is determined by many factors such as the mix of groundwater and surface water inputs, the amount of shading, the stream morphology (e.g. the number of pools, width and depth of the stream) the amount and rate of flow, and the ambient air temperature. In Poole Creek the most important factor is the mix between groundwater and surface water inputs.

	Reports from the late sixties indicate that Poole Creek was a self-sustaining Brook Trout fishery. … Since that time there has been substantial development and consequent change to the watercourse. A major portion of the cold baseflow in the stream is now discharged through sewers that have "french-drained" the area. Flow in the upper portion of the Creek is largely dependent upon attenuated surface discharge (from wetland areas) for baseflow. Moving downstream, flows from the Stitts Street and Crossing Bridge storm sewers enter the stream upstream of Jonathan Pack (Figure 2.1). Discharge from the existing stormwater management pond also enters above Jonathan pack Street. **Flows from the Church Street storm sewers enter just downstream of Jonathan Pack Street. The storm sewer flows are groundwater-based and quite cold.** The discharge from the stormwater management pond is typically very warm. A stream can be classified as cold, cool or warmwater. The uppermost section of Poole Creek is warmwater. Baseflow discharge from the storm sewers changes the stream temperature markedly so the stream becomes a cool to coldwater stream by Jonathan pack Street. The Creek warms, rising to a definite coolwater classification at Main Street. It is clearly warmwater by the time that Amberwood is reached. Pg 8 **Groundwater System** The background geological data available is extensive in the areas where residential development has occurred or is proposed. 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. Data is however available for the upper reaches of the study area on a large scale regional geology map and MOE water well records. 2.2.1 **Recharge/Discharge Areas (Hydrogeological Discussion)** The baseflow in Poole Creek results from a combination of groundwater discharge and attenuated surface flow from areas of organic soils. The distribution of these sources and their seasonal availability has a major effect on the Poole Creek ecosystem. The greatest potential for groundwater recharge to Upper Poole Creek appears in areas where porous materials (i.e. sand and gravel, sandy till) overlay the bedrock unit. The majority of porous soils lie to the east of the areas currently undergoing development, in areas that have been developed over the last several decades. As a result, the recharge potential has been reduced by the removal or covering of porous materials during subdivision development. ?? last page of main report =Pg 135] *Appendix A Background Report April 1999* Pg 1 1.1 Study Area Within the urban area of Stittsville, Poole Creek is the most important part of the system. In particular, the watercourse between Main Street and Jonathan pack Street supports a cold/coolwater fishery. [extract from map between Pg 2 and 3]	



Pg 5 **2.1.2 Flooding**

There are currently two studies in place, which deal with flooding issues in the Township of Goulbourn. The *Poole Creek – Feedmill Creek Master Drainage Study and Floodplain Mapping* (Novatech Engineering Consultants Limited, May 1985) was undertaken by the Mississippi Valley Conservation Authority to assess the effects of future urban development on the creeks. The *Stittsville Master Drainage Plan* (A.J. Robinson & Associates, November 1995) was prepared for the Township of Goulbourn to assess the impact of substantial urbanization on the water resource features in Stittsville.

The floodplain mapping from 1985 was prepared using hydraulic profiles along Poole Creek from the

Map shows culverts in the vicinity of Cypress Gardens North and the TC Trail Houses built in Cypress Gardens Phase in 1988 are missing from the map

	HEC-2 backwater model. While several scenarios were modeled, the Regulatory Floodlines were set based on full development of lands within the Goulbourn Official Plan in effect as of December 1984, with no additional stormwater management measures I place. Fill lines were added using the Mississippi Valley Conservation Authority criteria. Some of the significant findings of this report included: • Flood levels were calculated for the addition of 250 hectares of development to the Official Plan area with and without stormwater management controls. Only small fluctuations in the flood elevations resulted; therefore, post development flow control Pg 6 using storage measures was not recommended as an effective means of reducing the Regulatory flood elevations. • At most road crossings the flood levels were controlled by the road elevations, not the channel characteristics. Most roadways are overtopped during the 1:100 year flood. Any crossing reconstruction or future crossings should be designed with 1:100 year flow capacity. • The Main Street culvert was identified for replacement with a new culvert designed to accommodate the 1:100 year flow. At the time of the study, four structures were located within the regulatory floodplain at Main Street, but this was not viewed as a substantive enough reason to warrant immediate culvert replacement. It was felt that interim flood proofing measures (berming and grading) would be sufficient. The Regulatory flood lines were revisited in the Master Drainage Plan prepared in 1994. Flows in Poole Creek were recalculated for existing and future conditions. The HEC-2 model was adjusted to analyze the impact of the predicted flow values. The issues of road overtopping, structures in the flood plain and the effectiveness of providing stormwater quantity storage were reviewed. Some of the significant findings of this report included: • The potential flood damages west of Main Street were found to be the same (still only four structures). Since the options to eliminate these and other minor damages were relatively inexpensive, it was concluded that the attenuation of major storm flows within new developments was still unnecessary. • The 5-year flood levels at Main Street and Jonathan Pack Street are expected to increase 1.4 m and 1.1 m respectively. The 100-year flood levels at Main Street and Jonathan Pack Street are expected to increase 1.1 m and 0.5 m respectively. This results in both Main Street and Jonathan Pack Street overtopping during relatively minor storm events (they are not currently overtopped at the Regulatory Flood level). Under the five-year storm, Jonathan Pack Street and Main Street will be overtopped by 0.1 and 0.4 m respectively. Replacement of the Main Street culvert or flow reduction was to be reviewed in conjunction with development in West Ridge Estates and the Westwood Subdivision. • In 1994, constraints limiting development to a maximum of 6,000 units placed restrictions on construction in the present study area, including West Ridge Estates and the Westwood Subdivision. Pg 7 • In addition to providing fish and wildlife habitat, maintaining and improving water quality,	

	the upstream wetlands in the Poole Creek watershed likely provide significant flood storage, which lowers peak flow levels downstream. Much of the area adjacent to Poole Creek upstream of Main Street is existing development. While the flood plain mapping shows that the Regulatory flood will be backed up behind Main Street and Jonathan Pack Street, there are no negative flooding impacts to the existing development except for the four structures mentioned in the previous reports. … The existing flood plain mapping (Figure 2.1) was reviewed in the context of future development adjacent to Poole Creek in West Ridge Estates and the Westwood Subdivision. The following was noted. • The regulatory Floodline has recently been revised throughout the West Ridge lands based on more accurate mapping. • The proposed Westwood Subdivision is locates south of Abbott Street. It appears from the existing flood plain mapping that Abbott Street and the railway embankment divides the regulatory flood plain, with spill areas being indicated on the south side. It is unclear as to the impact the regulatory flood lines have on the Westwood Subdivision adjacent to Abbott Street. Pg 8 2.1.4 Stormwater Drainage Stormwater management reports are in place for the majority of developments that have been constructed after 1980. The evolution of stormwater management quality and quantity control is evident in the reports. The majority of the lands draining to Poole Creek upstream of Main Street appear to be serviced with a conventional 1:5 year capacity minor storm sewer system which outlet to Poole Creek at a number of locations. **Flows greater than the 1:5 year event are left on the surface to be conveyed to Poole Creek**. There have been no efforts to retrofit systems for water quality or quantity control. From monitoring studies, it appears that there is a considerable amount of baseflow in these sewers due to infiltration. Some of the more recent developments that have incorporated various combinations of water quality and quantity control are discussed below. [has West Ridge Estates; extract from Feb 1999 map titled Regulatory Floodline between Pg 8 and 9] Pg 9 **Cypress Gardens** The Cypress gardens development is located approximately 400 m west of main Street directly south of Abbott Street. This development includes approximately 25.0 hectares of single family housing which includes a 2.0 hectare park site. The municipal servicing was split into two phases of 15.9 hectares in 1987 and 9.1 hectares in 1997. There remains a 9.3 hectare parcel on the south boundary that is undeveloped, but proposed for additional residential development. There are currently two stormwater management reports which outline the proposed stormwater servicing for the Cypress Gardens area: *Cypress Gardens Storm Water Management Report* (Oliver, Mangione, McCalla & Associates Limited, March 1987) and *Cypress Gardens North Stormwater Management Plan* (A.J. Robinson Consultants Incorporated, October 1997). Two additional reports were referenced which included Cypress Gardens area: *Bell Subdivision Storm Water Management Study* (A.J. Robinson & Associates Incorporated, July 1980) and *Addendum to Bell Subdivision Storm*	Pg 8 This is impossible for the lands south of the TC Trail Cypress Gardens starts at Stittsville Main Street – 400m is Phase 2 15.9 + 9.1 = 25.0ha The 15.9ha is Cypress Gardens Phase 2; the 9.1ha is Cypress Gardens North. Development did not occur until 1999/2000 in the latter Cypress Gardens Phase 1 has been omitted The 6279 Fernbank developer is the only 1 who has land zoned residential – the supporting documents claim the site is 6.8ha

	Water Management Study (A.J. Robinson & Associates Incorporated, November 1984). The stormwater management details include: • Stormwater quantity control was required, because there is no overland flow outlet from the Cypress Gardens development. The abandoned C.P.R. railway berm provides a Pg 10 physical barrier to overland flow. As a result, all runoff is to be piped under the right-of-way in the minor system at the 1:5 year **post development** peak flow rate. The original phase in 1987 included a 2.0 hectare park site, which provides approximately 3,200 m3 of storage with a maximum release rate of 28.3 l/s. The more recent development of 9.1 hectares adjacent to Abbott Street included a provision of 1,900 m3 of storage using temporary ponding in back yards with a controlled release rate of 20 l/s. No provisions were made in either report for overland flow storage for any external drainage areas. • The minor system sewers have been designed with a 1:5 year flow capacity. There is a 1650 mm sewer under the abandoned C.P.R. railway which services the Cypress Gardens development, the 9.3 hectare undeveloped parcel, and flow from 76.7 hectares of external lands (54.3 hectares from the proposed Westwood Subdivision which is to be controlled to the 1:5 year **pre-development** peak flow rate). • Water quality control was not an issue when the original 15.9 hectare development was serviced. Pervious catchbasins were installed in the 9.1 hectare development adjacent to Abbott Street. The catchbasins were designed to store runoff from a 15 mm storm event, but only from areas directly contributing to the storm sewer system (4.2 hectares or 48% of the total development). **Proposed Westwood Subdivision** The proposed Westwood Subdivision is approximately 1,000 m west of Main Street directly south of Abbott Street and immediately west of Cypress Gardens. This proposed development includes approximately 74.7 hectares of single family housing, townhouses, a school and a park area. The site drainage is split between direct discharge to Poole Creek (17.9 hectares) and the Cypress Gardens sewer (56.8 hectares). The first phase of development (19.4 hectares) is scheduled to proceed in the near future. In addition to being mentioned in the Cypress Gardens' reports, the Storm Water Management Report, Westwood Subdivision, Stittsville, Township of Goulbourn (Oliver, Mangione, McCalla & Associates Limited, July 1998) was prepared to address specific stormwater management details which 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, Pg 11 minor system flows will be limited to 1,280 l/2. 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	Pg 10 Cypress Gardens Park is smaller than 2.0ha There is no apparent outlet control on this SWMF The TC Trail ditch system along the rearyards may also contribute? The MOE COAs are now saying less The 2 Westwood SWMPs do not achieve this target volume There is no apparent MOE COA for a SWMP – the COA for Phase 3 only mentions drainage to a marsh area, likely the PSW south of the TC Trail

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 stormwater management pond will be located adjacent to the abandoned C.P.R. railway and drain to a concrete box culvert.

- The minor system sewers will probably be designed with a 1:5 year flow capacity.
- There is no mention in the current report regarding stormwater quality control.

Could some of this flow impact the TC Trail ditch and adjacent properties on the south side?

2.1.5 Base Flow

Base flow is one of the two most important constraints affecting Poole Creek's aquatic ecosystem (the other being stream temperature). During the summer, the watercourse upstream of the Crossing Bridge box culvert tends to dry up except after rainfall events. This limits the available summer habitat to about 650-700 m of watercourse (Figure 2.2) between Crossing Bridge and Main Street. This is a relatively short reach and as a result, coolwater fish are concentrated in one small area. In these conditions, the fishery is vulnerable and could be seriously affected, if any accident were to occur. Further, the lack of flow tends to "de-couple" the **upstream wetlands from the downstream watercourse, leaving two separate ecosystems**.

There are no stream flow records for Poole Creek within the study area. Flow estimates have been made however, based upon rough velocity and depth measurements (conducted by Mississippi Valley Conservation and Goulbourn Township. The following are estimates of flow at selected locations.

Crossing Bridge Sewer Outfall	40 – 50 l/s
Inflow to Existing Stormwater Pond	0 – 6 l/s
Outflow from Existing Stormwater Pond	0 – 10 l/s (design maximum)
Church Street Sewer Outfall	**6 – 14 L/s**
Main Street	260 l/s

The storm outfalls between Crossing bridge and Stittsville Main Street are critical to the fishery and cold/coolwater environment.
The Crossing Bridge Storm Outfall is raised above groundwater level – there is no possibility of baseflow as indicated in this photo dated 20110902.
Cattails in the channel indicate that groundwater is near surface

Was the Crossing Bridge Storm Outfall obvert designed to be below baseflow level? If so, this photo would indicate sever loss of baseflow
Was the Church Street Storm Outfall baseflow amount accounted for in the SWM reports?

Pg 12

It is clear that there are unaccounted sources of flow upstream of Main Street. Normally it would be expected that the extra sources were springs within the Creek. However, anecdotal reports indicate that the number of springs has been reduced over the past ten years, and a detailed in-stream mapping of the Creek (MNR, 1993) found only one spring. Further, stream temperatures are observed to rise by about 2 [degrees] C between Jonathan Pack Street and Main Street. This increase would not be expected if the flow sources were groundwater based.

In natural watercourse, base flow is generated by groundwater discharge and by attenuated discharge from surface storage areas (eg **wetlands**, lakes, ponds, etc.). Groundwater inputs are usually dispersed, with discharge through numerous seeps and springs (both within and on adjacent lands). Groundwater discharge is normally consistent during dry periods and quite cold compared to air temperatures. The base flow derived from surface water sources is usually less consistent, especially in the summer. It is more susceptible to losses due to evaporation and the rate of discharge from surface sources will often decrease substantially during extended dry periods. Surface sources tend to

Are the remnant tributary and wetlands the source of the flow which is not accounted for?

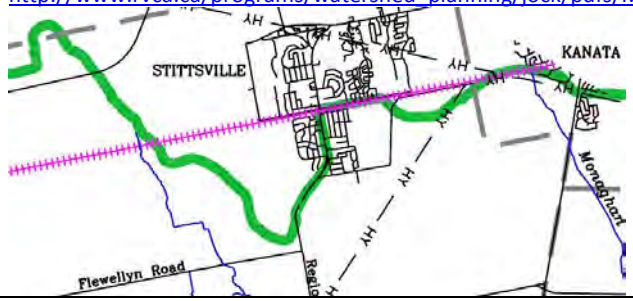
The Hazeldean Municipal Drain changes may further impact the ability of the upstream PSW to contribute flows

The Fernbank Wetlands which previously provided flow have been eliminated, leaving only a small remnant of the original wetlands

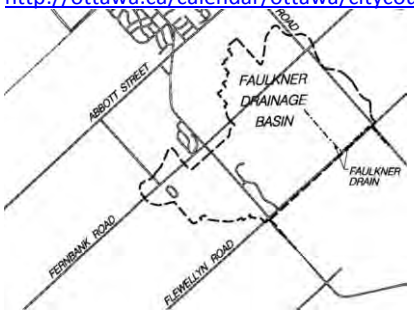
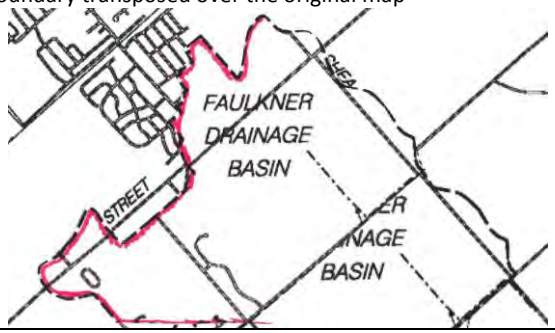
	acclimate to air temperatures fairly rapidly. The characteristics of a watercourse, and often its aquatic ecosystem, are typically a function of the mix or relative importance of the surface and groundwater contributions. In Poole Creek today, the sources of baseflow are influenced by urban development. Groundwater discharge seems to be concentrated at several storm sewer outfalls along the Creek. As often occurs, the existing storm sewer systems intersect and appear to have lowered the water table and replaced more dispersed ground water inputs. **The existence of remnant springs will need to be evaluated in the next phase of work.** **Surface water sources of base flow have been impacted less by historic development**. The existing stormwater pond in fact acts as an attenuated flow source, albeit a very warm water source. Proposed developments will have some affect on surface sources as a result of the removal of organic soils, which tend to retain water like a sponge. New development is expected to have a similar impact on the groundwater source than has occurred in earlier developments. This is because the soils and hydrogeology of the new areas are not particularly conducive to groundwater movement or discharge and are currently a poor source of groundwater derived baseflow. Pg 13 In summary, it is expected that there **will be some loss of baseflow as a result of the proposed developments.** This is not likely to have a severe impact on the existing stream because it currently dries up. However, the reduction in baseflow may further impede efforts to improve the quantity and quality of habitat in Poole Creek. It is not possible to quantify the expected reduction in baseflow as a result of the **proposed development**, with the available soils information. **2.1.6 Stream Temperatures** As noted in the previous section, flow in the upper portion of the Creek is largely **dependent upon attenuated surface discharge for baseflow**. Moving downstream, flows from the Stitt Street and Crossing Bridge culverts enter the stream upstream of Jonathan Pack Street. Discharge from the existing stormwater management pond also enters above Jonathan Pack Street. Flows from the **Church Street culvert** enter just downstream of Jonathan Pack Street. The storm sewer flows are groundwater-based and are generally quite cool. Pond discharge is very warm during summer conditions. Pg 35 6.0 **GROUNDWATER SYSTEM** [map between Pg 35 and 36: MW1 = near the Church Street Storm Outfall] Pg42 The depth to watertable in the overburden unit prior to development around Upper Poole Creek ranged from: • 1.3 to 1.8 mbgs between Church and Beverly Streets (GA 1988). In the undeveloped areas where organic sediments were observed, the water table has been observed at 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 the parts of Westwood identified as containing organic materials. It is not known whether the high watertable at these location is perched above non-permeable material or whether it actually represents the shallow groundwater table in the overburden unit. The direction of flow in these areas is interpreted to be locally dependent on the	Was this followed up? Did this statement apply to all developments? There would have been no analysis of the impact on groundwater or baseflow in the plan of subdivision process. Is information now available as to the impact on groundwater and baseflow? Both the Stitt Street and Crossing Bridge SWMPs have sediment buildup and had low water levels on the 2 Sep 2011.

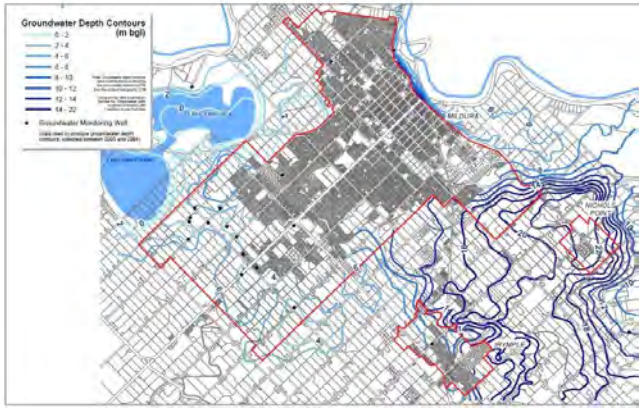
	ground surface topography and likely corresponds with surface, or near surface, water flow. On August 6, 1999, the watertable elevation in the overburden unit at MW1 was 114.96 metres or 1.13 mbgs and the surface water elevation in Upper Poole Creek adjacent to MW1 was 115.05 metres. The base of the creek appears to be positioned on top of a clay unit approximately 2.0 metres above the sand unit intersected by MW1, but the water level data suggests that the sand unit is not confined by the clay and that the overburden is relatively well connected.	Comparison to MVCA High Water Marks 24 July 2009 see 30 July 2009: JP d/s 116.7m minus MW1 surface water elevation 115.05 = 1.65m MW1 watertable 114.90m + 1.13m to ground surface = 116.03m HWM 116.70m minus ground surface = 0.67m above ground surface
	Pg 59 **7.2.5 Stormwater Management** [based on the 1994 MOE Manual] … the primary purpose for stormwater management in the Poole Creek subwatershed is to control water quality inputs. Local runoff control to meet a constrained downstream sewer capacity (such as is the case for the Westwood subdivision) may also be necessary.	
	Pg 63 **Westwood Subdivision** At the time of preparation of this report, the stormwater management system proposed for this **75 ha subdivision** … consisted of the following component: 1. Two **quantity control** dry ponds designed to restrict the peak flow from a 100 year storm to a rate of 1280 L/s to meet the available capacity in a downstream storm sewer in Cypress Gardens. The 100 year storm will be controlled since there is no separate major system outlet available. 2. A system of infiltration/filtration devices based upon the "Etobicoke system" which will be constructed as part of the storm sewer system 3. Roof leaders will discharge directly to landscaped area to promote infiltration into the subsoil. 4. A reduced rear yard gradient of 1% will be used to promote infiltration. In order to meet existing municipal grade control standards. Sub-drains will be constructed through about 90% of the site in rear yards. All of the practices proposed appear to be consistent with the requirements previously described. The **quantity control proposal is not specifically mandated by the watershed plan but by local conditions**. However, it is not inconsistent with the goals of the plan since dry facilities are proposed. The three distributed infiltration/filtration measure are all consistent with the plan's goals and with the preferred treatment-train approach. The lot level measures are commonly employed and require no specific evaluation. The **storm sewer infiltration/filtration system is innovative** and was therefore considered in more detail. [describes the system]	Only part of this development was supposed to be tributary to the ponds While each component may have been successful, the combination of components should have been evaluated. The Cypress Gardens North system should also have been considered
	Based upon a review of the proposed design of the system … the following comments are noted: 1. [designed to capture runoff from the first 15 mm .. trench bottom was sized at 2m … Pg 64 will be excess storage … will more than adequately meet the 25 mm criteria during summer periods. Evaluation from monitoring of the original "Etobicoke" infiltration/filtration systems indicated that a similar situation occurred and during the 2 year evaluation period no outflow was observed from the storm sewers of the monitored system. …	Was 2 years sufficient time to evaluate this system?
	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**	Much of Westwood was built on wetlands with high groundwater levels – was this not considered in the proposals for the phases?

	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.	This would only happen if the i/f system was distributed If the groundwater level is already high, this will increase it if there is sufficient soil between the groundwater level and the i/f system invert The system is intended for water quality and temperature control Should the region have been considering an innovative system when the UPC SWS indicated that not much was known about the south parts and when the groundwater level is high?
2001 Jan 15	http://www.environet.ene.gov.on.ca/instruments/4603-4RHQFA-14.pdf 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**;	Was drainage for the upgrade of Abbott included in the capacity allocation for the Fernbank Creek outfall? GeoOttawa viewed 20130810  West of WRD = 6337, east of WRD greenspace then 6331 the 6329 No relevant numbers near Stittsville Main Street (RR5) – east of RR5 = Unnamed tributary would be Fernbank Creek and this COA would have increased flow to the Outfall – **has there ever been a total capacity review of the Fernbank Creek catchment and the implications of the Stittsville Main Street constraint which was identified in the 2000 UPC SWS?**

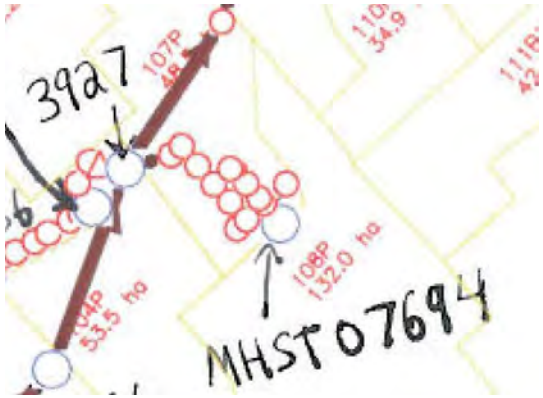
2001 Nov	*Jock River Watershed Management Plan, Final Report* Map 2 Watershed [extract] http://www.rvca.ca/programs/watershed_planning/jock/pdfs/Map%202.pdf  	Watershed boundary extends to approximately Healey's Heath, but not all
2003 Apr 10	*OMB Decision 0469 Westwood Subdivision Phase 2* 10 Apr 2003 http://www.omb.gov.on.ca/e-decisions/pl011151_%230469.pdf 561650 Ontario Inc. and 1252051 Ontario Inc. have appealed to the Ontario Municipal Board under subsection 22(7) of the *Planning Act*, R.S.O. 1990, c. P.13, as amended, from Council's refusal or neglect to enact a proposed amendment to the Official Plan for the City of Ottawa to redesignate land located in Part of Lot 22, Concession 10, former Goulbourn Township, City of Ottawa from Provincially Significant Wetland to General Urban Area and Other Wetlands to permit the development of 512 single detached homes [has more] Pg 4 The subject parcel of land is approximately 55 ha. (136 ac.) in size and is located in the former Township of Goulbourn, now the City of Ottawa. It is bounded on the north by Abbott Street, on the east by Elm Street, on the south by Fernbank Road, and on the west by the western boundary of the former Village of Stittsville. The subject parcel is the **second phase of a subdivision locally known as "Westwood**" and is owned by two landowners operating as two numbered companies. **The first phase has been developed and is in the final stages of construction**. The second phase or the current proposal consists of 512 single detached dwelling unit residential lots, a stormwater retention pond, and parkland. The subject parcel includes a part of the Fernbank Wetland whose boundary is the principal issue in this dispute. Pg 12 As a result of this site visit, Mr. Thompson came to the conclusion that there was more wetland north of the 1999 MNR boundary and that the boundary extended up to the southern edge of the of phase one development on the subject parcel. He then determined the distance between the southeast boundary of the Upper Poole Creek Wetland and the northwest boundary of the newly revised boundary of the Fernbank Wetland. He found the distance to be 603 metres – a separation distance that is less than 750 metres, thus enabling the two wetlands to be complexed. Once the two wetlands are complexed, the Fernbank Wetland on the subject parcel is declared to be Provincially Significant. Pg 15 The most instructive part of his oral evidence was his description of the features in the video and his concluding remark, "**the wetland has been destroyed by Phase 1**." Using the aerial photograph taken in August 1993 (Exhibit 28, Sheet 6) he pointed out how the wetland had been	Should development on wetlands be dependant on whether they are designated as PSWs? The issues differ – protection of the wetland from development vs protection of the development from the impact of the wetlands? Should OMB be required to evaluate all infrastructure when overriding municipal decisions?

	removed by the Phase 1 subdivision and expressed deep disappointment at the demonstrable loss. Using the photographs of site preparation for phase 1 (Exhibit 27) he stated that Phase 1 had effectively removed the land from being a wetland notwithstanding the finding of certain plant species north of the 1999 MNR boundary. Pg 16 What is troubling to the Board is that a senior officer of the MNR relied upon the evidence by GWG without a critical analysis of the evidence to come to his conclusion and extend the boundary of the wetland to the 2000 MNR boundary to encompass virtually the entire subject parcel. Pg 18 Although the landowners could have relied upon the legal boundaries shown in the two Official Plans, i.e., the smaller 1991/1993 MNR boundaries, they elected to accept the larger 1999 boundary and forego some developmental rights in exchange for an agreement among the interested parties. Having entered into an agreement, the **landowners undertook the upgrading of Abbott Street, constructing the storm water pond, water and sewer outlets**, and revising their subdivision proposal – all involving substantial costs. Pg 20 On the basis of an analysis of all of the pertinent evidence, the Board finds that the boundary accepted by the Ontario Ministry of Natural Resources in 1999 is the appropriate boundary for the purposes of assessing the four applications before the Board within the context of planning instruments. The Board, therefore, also **finds that the wetland is not Provincially Significant.** There was a concern by some witnesses on how storm water runoff from the proposed residential development would be managed and what its impact would be on the Fernbank Wetland. Using a report (Exhibit 4, Tab 3) prepared by him, the professional engineer, Mr. Simmering, explained the potential impacts and how the storm water would be managed on the subject parcel and in the vicinity. His opinions were not contradicted by any other duly qualified and experienced professional witness. Based upon an examination of the pertinent evidence, the Board finds that the proposed development does not cause an unacceptable adverse impact upon existing development – both natural and built. Pg 22 Accordingly, the Board allows the appeals with respect to the two Official Plans and the Zoning By-law. The Board's **Order will not issue until the applicants/appellants file the most up-to-date plan of subdivision together with any appropriate conditions** in consultation with the City of Ottawa. The applicants/appellants shall file such a plan of subdivision within ninety (90) days from the date of issue of this decision.	

2003 Sep 9	*Report to ARAC Sitting as the Committee of Revision Faulkner Municipal Drain* http://ottawa.ca/calendar/ottawa/citycouncil/ara/2003/10-17/ACS2003-TUP-UTL-0020.htm  	Drain boundaries have been displaced because of confusion as to the location of Abbott Street Correct boundary transposed over the original map 
2004 Jun 10	*Final Report Assessment Tool to Determine Potential Risks of Urban Salinity* *(Phase II)* Mildura Rural City Council [Australia] http://www.mildura.vic.gov.au/Files/Assessment_Tool_to_Determine_Potential_Risks_of_Urban_Salinity_Phase_2_REM_Resource_Final_Report_IN_0417446.pdf Pg 3 Where there is potential for perched groundwater to develop the installation of a subsurface drainage system to manage perched groundwater is an essential requirement of urban development. Other options to manage the water budget included efficient water use practices, effective stormwater management and increasing ground surface elevation. Pg 8 Two potential processes were identified that may result in the development of urban salinisation in areas of Mildura where future urban expansion is proposed: i) Areas where the regional watertable approximates 2.0 m below ground level (bgl) (4 m bgl was recommended as a conservative measure); and ii) Areas where a perched watertable may develop on top of a subsurface clay layer, where the depth to clay was less than 4 m bgl). Pg 17 **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 WATER BUDGET MANAGEMENT** A land use change from agricultural (eg. vineyards) to urban (eg. residential) would result in change to the inflows and outflows that make up the water balance of the area affected. In general there would be a reduction in the amount of evaporation and evapo-transpiration, from the surface and plants respectively, due to a higher impervious area of roads and houses. Although the irrigation of crops would no longer occur, over watering of lawns and gardens may result in significant groundwater	This report and related reports indicate that the opposite approach is required in areas where groundwater levels are high and that salinity needs to be considered

	recharge. The effect of reduced evaporative outflow and sustained recharge from poor water management could cause perched groundwater to develop where subsurface clays are present. Pg 18 In all cases the promotion of good water management practices such as efficient lawn and garden watering and appropriate disposal of stormwater and grey water should be encouraged. This would include stormwater management systems that ensure ponding and subsequent groundwater recharge do not occur in areas susceptible to perched or shallow groundwater. In the higher risk areas and particularly where shallow regional groundwater is a threat, efficient water use should be a requirement of development. In general, urban development should be avoided on land at very high risk of urban salinisation, particularly where the presence of salt tolerant vegetation indicates that the land is already salt affected. 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 26 Groundwater Contour map  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	

2004 June 29	29 June 2004 http://www.environet.ene.gov.on.ca/instruments/0310-627PPB-14.pdf Westwood Subdivision, Phase 2A Sanitary sewers	
2004 Aug 25	http://www.environet.ene.gov.on.ca/instruments/3424-628JN8-14.pdf Westwood Phase 2A storm sewers, filtration system and stormwater management system New Storm Sewer Block 194 Coyote Crescent inlet of stormwater retention pond on Block 194 Block 180 Manhole before inlet of Stormwater Connection to existing storm Retention Pond sewer at existing Catch Basin on Easement east of Westwood Subdivision Existing Perforated Pipe Easement east of existing Catch Basin existing storm sewer on Westwood Subdivision Cypress Gardens Pg 2 Existing Storm Sewers and Filtration System Bell Street West Ridge Drive Stormwater Management Pond Stormwater Management System modification of the southern retention pond, located on Block 194 of the westwood Subdivision, to increase the overall storage volume from 7,419 to 7,741.4m; in order to provide a stormwater management system for the Westwood Subdivision, Phase 1 and Phase 2, **collecting up to 100-year storm event runoff** from an area of approximately 41.9 ha conveyed via overland swales and subdivision storm sewer to the two stormwater retention ponds having a total storage volume of 7,741.4 m; complete with inlet structures, rip rap, perforated subdrain pipe and outlet structure allowing a **maximum discharge rate of 1,166 L/s to the existing 900 mm diameter storm pipe** downstream of the Manhole No. 121 discharging to the storm sewer on Cypress Gardens	12 Apr 2000 Phase 1 COA has 1,280 L/s
2005 June 24	http://www.environet.ene.gov.on.ca/instruments/1952-6DKRXS-14.pdf Westwood Subdivision Phase 2B storm and sanitary sewers	
2005 Aug 9	http://www.environet.ene.gov.on.ca/instruments/5991-6DKPLJ-14.pdf Westwood Subdivision, Phase 2B PROPOSED WORKS New Filtration System complete with infiltration trenches and perforation pipes Mazari Crescent West Ridge Drive West Ridge Drive Landswood Way West Ridge Drive West Ridge Drive including rear yard subdrain, swales, catch basins and catch basin leads from the rear yards of the lots to the street storm sewers Bell Street West Ridge Drive Stormwater Management Pond Existing Stormwater Management System modification of the southern retention pond, located on Block 194 of the Westwood Subdivision, to increase the overall storage volume from 7,419 to 7,741.4 m; in order to provide a stormwater management system for the Westwood Subdivision, Phase 1 and Phase 2, **collecting up to 100-year storm event runoff** from an area of approximately 41.9 ha conveyed via overland swales and subdivision storm sewer to the two stormwater retention ponds having a total storage volume of 7,741.4 m; complete with inlet structures, rip rap, perforated subdrain pipe and outlet structure allowing a **maximum discharge rate of 1,166 L/s to the existing 900 mm diameter storm pipe**	12 Apr 2000 Phase 1 COA has 1,280 L/s

	downstream of the Manhole No. 121 discharging to the storm sewer on Cypress Gardens	
2005 Oct	*Report on Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek* [CD; no link available] Pg 23 Figure 2.1 Hydrology Sub-Areas [extract]  Pg 76 [extract]  	MHST07694 appears to be the culvert under Fernbank Road 3927 is the Cypress Gardens/Church Street Storm Outfall with subcatchment 108P Subcatchment 104P which contains the northwest part of Westwood south of the TC Trail and West Ridge Estates north of the TC Trail, is being shown as being separate from the 108P subcatchment. The Westwood northwest area in subcatchment 104P was subsequently directed to the SWMP in the Cypress Gardens 108P subcatchment.

2006 Oct	*Post-Development Flow Characterisation and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek* [CD; no link available] Pg 9 Figure 1 Upper Carp Pre-Development Catchment Areas [extract]  	
2005 Nov	*Synthesis of Monitoring Studies Conducted Under the Stormwater Assessment Monitoring and Performance Program A report prepared by the Stormwater Assessment Monitoring and Performance (SWAMP) Program for Great Lakes Sustainability Fund of the Government of Canada* for Toronto and Region Conservation Authority Municipal Engineers Association of Ontario & Ontario Ministry of the Environment [Black highlights are in the original text] http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/01/Final_SWAMP_Synthesis.pdf ***Pg 6 The two exfiltration systems provided on-site water budget control by substantially reducing stormwater flow volumes.*** Runoff volumes were reduced in the North York and Etobicoke exfiltration systems by approximately 89 and 95%, respectively. In both cases, exfiltration capacities exceeded design criteria. The high exfiltration rates into soils that were identified prior to installation of the systems as having limited permeability was attributed to localized sand lenses or cracks in the clay matrix. ***Hydraulic tests at the exfiltration system sites demonstrated that the capacity of the systems to store and infiltrate runoff during high intensity rain invents is primarily limited by throughput capacity, rather than soil permeability.*** The problem appears to be a result of air entrapment either within the pipe network or the gravel trench, although further investigations are needed to confirm this hypothesis. Installing vent pipes in the upper portion of the gravel bed to facilitate air displacement or increasing the diameter of the perforated exfiltration pipes for at least a few meters downstream of each maintenance hole are suggested as possible solutions to the problem.	

	Observed runoff coefficients during the May to November period were generally lower than predicted coefficients used in the design of the facilities. The runoff coefficient, which represents the proportion of rainfall that is converted to stormwater runoff, is an important parameter in the sizing of facilities. It is appropriate that average seasonal runoff coefficients would be less than design runoff coefficients because the design coefficients are based on flood flows when runoff coefficients are usually higher than the seasonal average. Designing with higher than average runoff coefficients also helps to ensure Pg 7 adequate levels of treatment during the late winter and early spring when rain on snow and frozen soils can result in unusually large volumes of runoff. Pg 10 **Facility Maintenance** The importance of regular facility maintenance can not be over-emphasized. A pond sediment maintenance guide was prepared in 1999 by Greenland International under contract to SWAMP and other agencies to provide direction on stormwater facility maintenance. SWAMP studies provided estimates of clean-out schedules based on influent loading rates and data on the quality of trapped sediments was characterized in order to assess disposal options. ***Estimated clean-out intervals varied widely: small ponds may require cleaning after only 10 years, whereas larger 'enhanced' level ponds may only require facility wide clean-out after 50 or more years.*** In most cases, forebays will need to be cleaned at more regular intervals since these areas accumulate sediment much more quickly. Regular cleaning of forebays will prolong the time required to cleanout the larger main pond. **Maintenance programs should include direct measurements of sediment accumulation each year at a minimum to establish clean out schedules**. Pg 29 In Ontario, there have been few comprehensive (non-SWAMP) studies of exfiltration systems designed to control stormwater on residential catchments. One study of note was conducted in 1991-1992 by Paul Wisner and Associates at two neighborhood subdivisions with perforated pipe and conventional pipe systems in Ottawa (formerly the City of Nepean) (Paul Wisner and Associates, 1994). J.F. Sabourin and Associates undertook a follow-up study at the same locations in 1998 to evaluate the longevity and longterm performance of these systems (J.F. Sabourin and Associates, 1999). Drainage areas at the two exfiltration sites (McFarlane and Heart's Desire) and the conventional sewer system (Amberwood, for comparison) were less than 15 ha of predominantly residential land use. Soils Pg 30 were silty loam till and sandy silt till at the Heart's Desire and McFarlane sites, respectively. The **McFarlane site had a higher groundwater table and greater baseflow** than the Heart's Desire site. In the 1991/1992 study ... The lower runoff reduction at the McFarlane site was attributed to the high groundwater table in the deeper reaches of the system. Pg 86 Geotechnical investigations conducted prior to installation of the systems revealed that the soils in the area were a combination of sand and silt at the exfiltration sites, and clay loam at the filtration site. **Groundwater tables were well below the base of the trenches at all but the Queen Mary's site, which had considerably higher water tables, ultimately reducing the effectiveness of the system** (see below). The North York system had groundwater within 2 m of the surface at a few locations, but borehole logs showed these to be a result of perched water tables that were not representative of local or regional groundwater levels.	

Pg 87 [extract from table]

Table 4.14: Site characteristics and design elements of exfiltration/filtration systems monitored under SWAMP

	Princess Margaret Drive Perforated Pipe Exfiltration System	Queen Mary's Drive Perforated Pipe Exfiltration System	Braecrest Ave. Perforated Pipe Filtration System	North York Swale/Perforated Pipe Exfiltration System
SITE CHARACTERISTICS				
Soil texture	clay to clay-silt till over silty sand	sand to sandy silt	clay loam	silty sand
Hydraulic Conductivity*	10^{-5} to 10^{-9} m/s	10^{-4} to 10^{-6} m/s	10^{-8} to 10^{-10} m/s	2 to 8 x 10^{-5} m/s
Groundwater Elevation Below Surface	>14.0 m	1.2 – 2.5 m	n/a	> 5 m+
Drainage Area	30.5 ha.	13.3 ha.**	2.4 ha.	64.0 ha.

Pg 88 The Queen Mary Drive system also reduced runoff, but much less effectively than expected based on the 15 mm 1-hour design storm. The **high groundwater table**, which intersected the perforated pipe **at the downstream end** of the system, was thought to be a contributing factor. In addition, design drawings revealed that an appreciable area drained by conventional sewers was discharging to the exfiltration system. Thus, the hydraulic load placed on the system was greater than it would have been for a system consisting exclusively of the exfiltration design. Despite these limitations, an examination of runoff coefficients revealed that up to two-thirds of the runoff was being exfiltrated.

Pg 105 [> 7.0 CONCLUSIONS AND RECOMMENDATIONS; re water quality] ... The same is true for exfiltration facilities – volume reduction rates will likely be as good as, or better than the manual indicates if Ontario design guidelines are followed, but the **long term effects of infiltrating stormwater runoff on groundwater resources requires further study**.

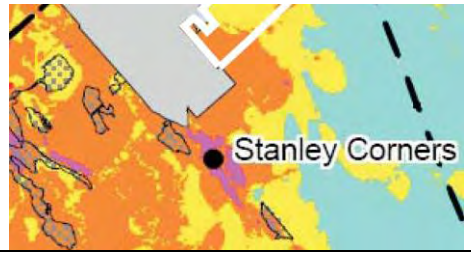
The issue of receiving water protection is an important point because available literature reviewed in chapter 3 suggests that aquatic communities downstream of end-of-pipe facilities show substantial alterations from predevelopment

or reference site conditions, despite the presence of relatively clean effluents. Increased water temperature, greater runoff volumes and infrequent but erosive overflows are thought to be important causes of these alterations. Downstream channels are also not necessarily more stable because the larger post-development surface runoff volumes have been shown to increase the frequency of geomorphically significant mid-bank flows (MacRae, 1996). The **shift in stormwater management over the last 5 years (see chapter 2) from an approach that focuses on controlling for water quantity, water quality and downstream erosion to one emphasizing volume (or water budget) control through implementation of a combination of practices is in part a response to the limitations of the previous approach from a receiving water protection perspective**.

Pg 110 ***Further research needs***

- Studies that relate stormwater BMPs directly to the health of receiving waters are needed to determine the benefit stormwater practices are having on downstream aquatic ecosystems and channel morphology. Wherever possible, these studies should consider the cumulative effect of

	several practices (*i.e.* combinations of source, conveyance and end-of-pipe facilities) on receiving waters at subwatershed and watershed scales. • While there have been several studies of infiltration practices (*e.g.* soak-away pits, infiltration trenches, roof leader disconnection) on relatively permeable soils, few if any have been conducted on tight (clay and silty clay) soils. Understanding the capacity of these practices to reduce runoff volumes will help to determine the type and size of additional stormwater management measures required downstream. • Long-term studies are needed on the performance and maintenance requirements of infiltration practices, and the potential water quality impacts these may have on groundwater resources. • The effect of winter conditions, such as frozen soils and ice build-up, on the performance of BMPs, and the benefit of facility design modifications that help overcome limitations caused by cold weather are in need of further study. Pg 111 • A detailed field survey of accumulated sediment in existing OGS should be conducted to determine whether or not owners and operators of these facilities are maintaining their separators according to manufacturers' recommendations. If OGS are not being appropriately maintained, the cause of these failures and the need for enforcement mechanisms required to correct them should be further investigated. • Research is needed on the relationship between climate change effects (*e.g.* temperature increases, changes in intensity-duration-frequency curves, seasonal changes in precipitation, etc.) and the design of stormwater BMPs.	
2007 Mar	*The Natural Functions of Headwater Drainage Features: A Literature Review* 69 pages http://trca.on.ca/dotAsset/79264.pdf Pg 7 Currently, development is at or approaching the headwaters of these larger systems, which could have broad implications for water quality and quantity, recharge/infiltration, and the overall health of downstream habitats. There is a need for a better understanding of headwater drainage features (HDF) to determine if and/or how development will impair the functioning of our watersheds as urban development continues to advance to the upper parts of our catchments throughout Southern Ontario. There is a lack of clarity around how Conservation Authorities (CAs) should be treating small drainage features through planning and permitting processes in order to properly protect ecological functions and contributions to watershed health. These features may constitute direct or indirect fish habitat, both of which are included in the definition of fish habitat under the Federal Fisheries Act. Some headwater systems will support fish year-round because there is a permanent supply of water. In these types of features it is relatively simple to confirm fish presence. However, some features with intermittent or ephemeral flow may not provide direct fish habitat, but may provide indirect fish habitat via the contribution of flow, detritus, and invertebrates, others will provide seasonal fish habitat when the water table within the feature is seasonally high or provide refugia. Pg 8 3) What other important hydrologic, hydrogeologic, geomorphologic, and water quality functions do headwater drainage features provide? For instance, how is the hyporheic zone linked to water quality	

	in HDFs? How much recharge contribution do headwaters cumulatively provide in a watershed? How do HDFs contribute to sediment regulation? 4) What are the ecological, hydrological, and fluvial geomorphological impacts of enclosing headwater drainage features on both in-situ direct and indirect fish habitat and downstream fisheries? 5) Do open headwater drainage features in urbanized areas function in the same manner as streams in agricultural or forested areas? Pg 15 Because the **available literature that specifically examines headwater drainage features is scarce**, we will be discussing the findings in the science that focus on the broad concept of headwaters and make specific correlations to HDFs where possible. This is important because the functions that can be related to first- and second-order streams may also be true of HDFs; except the **science may not be presently available** to support this. Understanding the functions of permanently flowing and/or first- and second-order streams may inform the understanding of headwater drainage features and provides a context for the type of functions that may exist. Similarly, while first- and second-order streams may be intermittent or even ephemeral, we draw from literature examining the functions of non-permanently flowing streams in order to understand how flow permanence may affect functionality in the context of headwater drainage features.	
2007 Sep	*Fernbank CDP Existing Conditions Report: Hydrogeology* by JFSA May 2007 (revised September 2007) http://www.fernbankcdp.com/dmdocuments/Fernbank%20Community%20Design%20Plan%20Existing%20Conditions%20Report%20-%20Hydrog.pdf Figure C-1 Intrinsic Vulnerability [extract; pink = very high, orange = high] Source: Preliminary Evaluation of Relative Aquifer Vulnerability: City of Ottawa 2001, CH2MHill and Waterloo Hydrogeologic 	
2007 Sep 13	*Report to PEC and Council 240 West Ridge Drive* *?? link* Rezoning from I to R Plan of Subdivision approved Jan 1999 by OMB, registered Dec 2000 – OCSDB 7 year option expired – 1.1ha – initial devapp for 72 TH, revised to 63 mix of singles and TH	Jan 2010 SWMP Report has a higher number of hectares
2007 Oct 30	http://www.environet.ene.gov.on.ca/instruments/4911-78FGHV-14.pdf 1384341 Ontario Ltd. Harris Lands Subdivision 6350 Fernbank Road, Ward 6 Lot 22, Concession 9 *You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:* storm and sanitary sewers to be constructed in the City of Ottawa on Eckerson Crescent, West Ridge	WEFI Appendices Pg 66 24 July 2009 Storm Sewer Surcharge 1. additional rearyard drainage will go to the wetland from all homes adjacent to it 2. shows 4 flow arrows to the wetland area

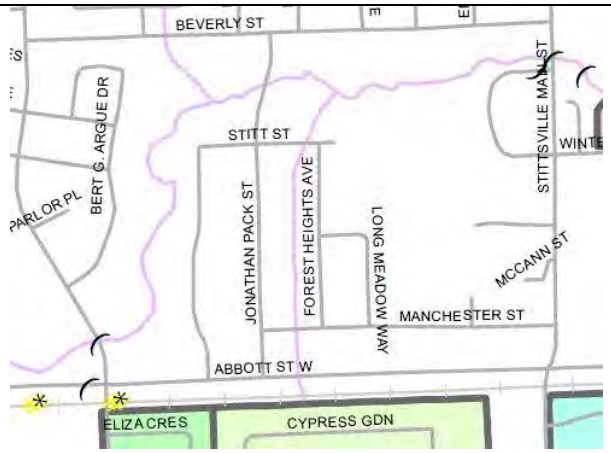
	Drive, Dalewood Crescent, Barracks Way, Creswell Court and Part of Block 177 to Stittsville Main Street; all in accordance with the application from 1384341 Ontario Ltd., dated 13 August 2007, including final plans and specifications prepared by the IBI Group.	3. shows storm sewer surcharge in all storm sewer manholes which were inspected 4. Was West Ridge Drive drainage accounted for?  GeoOttawa viewed 20130810 
2008 Feb 26	Westwood Subdivision (Deer Run) Phase 2C Part Lot 22, Conc. 10 Letter re update to Environmental Impact Study Westwood Subdivision, Phase II, Upper Poole Creek wetland Review of Draft plan of subdivision on former school block http://webcast.ottawa.ca/plan/All_Image%20Referencing_Subdivision_Image%20Reference_Environmental_Impact_Statement_D07-16-08-0006.PDF [relates to the school site, EIS, and PSW]	The evaluation of all Westwood development and OMB decisions approved to date has focused on whether the Westwood lands belonged to the PSW and on the adjacency to the PSW, rather than whether the development, and the infiltration systems should be done on land which has high groundwater levels, and high bedrock levels in some area There has been no apparent Fernbank Wetland Impact analysis, analysis of the overall capacity of the Fernbank Storm Outfall at Poole Creek, or review of the 1988 Cypress Gardens design standards
2009 Apr 20	*Report to PEC Westwood Community – Coyote Run Park (Progress Report) Motion 60/30* http://ottawa.ca/calendar/ottawa/citycouncil/ec/2009/04-28/7-ACS2009-ICS-PLA-0078%20-%20Coyote%20Run%20Park%20.htm The subdivision agreement for Westwood Phase 2, located in the vicinity of West Ridge Drive south of Abbott Street required the developer to provide a park. The drawings referenced in the subdivision	How much runoff to the Fernbank Wetland would be contributed by the Park and adjacent houses? Did the SWM analysis include the impact of the topographic extremes? Photos taken at Coyote Park entrance 20130806

	agreement indicated that, amongst other facilities, the park was to contain a soccer field. The **plan of subdivision was registered on March 2, 2005.** The development of this subdivision is largely complete. However, until recently (March 2009) no work had been done on the park at all. **Prior to the Ontario Municipal Board hearing which approved the development of the Westwood subdivision, it was the position of the City and the Ministry of Natural Resources that much of the area was Significant Wetland. As such, there are areas which significant deposits of peat.** In the interim period between the December discussions and the execution of the agreement in February, this matter came before **Planning and Environment Committee on 27 January 2009. At that meeting, Committee directed the inclusion of the condition as Document 2 as one of the conditions of draft approval for Westwood, Phase 3.** While there had been indications that the work might commence in December, **the removal of the peat did not start until March. It only proceeded for a few days, at which point half-load restrictions came into place on municipal roads and the work stopped.** City staff have not yet been advised as to when work will recommence.	  Fernbank Road is at the far end
2009 July 24	*West End flood event*	
2009 July 30	*MVCA High Water Levels July 24, 2009* http://www.mvc.on.ca/index.php?option=com_content&view=article&id=123:high-water-levels-july-24-2009&catid=30:regulations&Itemid=54 Following the severe rainfall event on July 24, 2009, Mississippi Valley Conservation (MVC) engaged the firm of J. F. Sabourin and Associates Inc. to stake the high water marks in the field for the Carp River, Poole Creek and Feedmill Creek watersheds. The high water marks were staked in the field on July 30, 2009. Approximately 60 locations were staked including the upstream and downstream locations at all major road crossings, some footbridges in parks and some stormwater management facilities. The staked locations are an estimate from the indications left in the field after the storm (debris piles, flattened vegetation etc.) of the highest water level that occurred as a result of the July 24, 2009 storm. While the results recorded in the following tables are the best information available, it must be stressed again that the recorded levels are estimates of the extent of the high water along the watercourses. The ground elevations at the stakes were surveyed over a four day period during the weeks of August 28th, 2009 and September 1st, 2009. Most of the original stakes were located and	

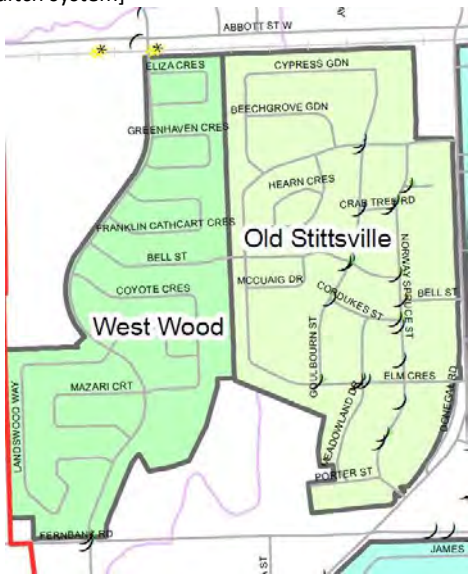
	surveyed, however, some stakes had been removed sometime after they were placed. Generally at road crossing/channel locations four stakes in total were placed (right and left bank upstream and downstream of the crossing). As described above, since the stake locations represent an estimate of the highwater marks the survey of the ground at the left and right bank stakes did not result in the same elevation. [provides the protocol for determining the level] Jonathan Pack u/s 116.7 d/s 116.7 Main Street u/s 116.0 d/s 115.4	
2009 Dec 4	*MOE COA* *http://www.environet.ene.gov.on.ca/instruments/0583-7T6NAM-14.pdf* Westwood Subdivision, Phase 3 *You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:* the establishment of stormwater management *Works* for the collection, transmission, treatment and disposal of stormwater runoff from a catchment area of 6.52 hectares, to provide Enhanced (80% long-term TSS removal) water quality protection, discharging to a marsh area draining to the Upper Poole Creek, which flows to the Carp River, for all storm events up to and including the 100-year return storm, consisting of the following: Stormwater Management System - a stormwater management system relying on the "Modified Etobicoke Filtration System", servicing 4.03 hectares of the proposed development, consisting of a series of network of interconnected catchbasins and manholes with perforated 200 mm diameter pipe wrapped in filter cloth, located in a trench with the conventional storm sewers; with the entire storm sewer and perforated pipe being contained within a 2 meter wide clear stone filled trench that is entirely wrapped in filter cloth. - roof leaders discharging directly to landscaped areas to promote infiltration into the subsoil (servicing remaining 2.49 ha).	Is the "marsh area" the PSW?
2010 Jan	*WEFI Appendices* Pg 65 July 24 2009 Flood Event Storm Sewer Surcharge [extract from map; red = evidence of surcharge; black = not checked]	Shows storm sewer surcharge in all storm sewer manholes which were inspected for Cypress Gardens and the area north of the TC Trail WEFI focus was on faulty backwater valve installation in Westwood versus why the storm sewer had so much pressure in it ICD installation was not done for other than the Westwood area 29 flooding events were reported in the Cypress Gardens area – no mitigation was included

Pg 66 July 24 2009 Flood Event Storm Sewer Surcharge [extract from map; red = evidence of surcharge; black = not checked]

Pg 95 [Key: Impact Rating - D has green dots; D = Structures with moderate maintenance needs; shows Poole Creek linkage to Cypress gardens and culvert problem at Main Street]

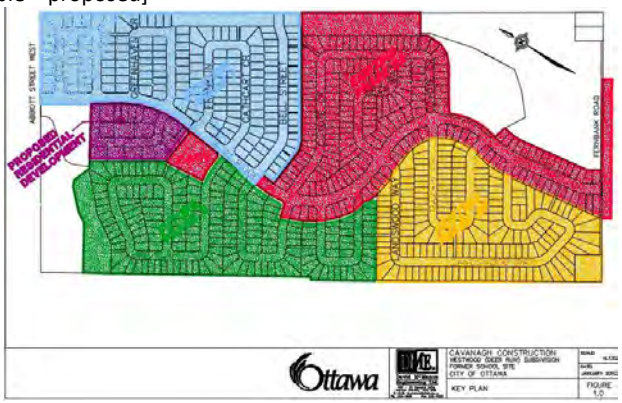


Pg 95 [Key: Impact Rating - D has green dots; D = Structures with moderate maintenance needs; shows culvert problems in ditch system]



Pg 106
L755250 Goulbourn Street 0.01 km from Elm Crescent towards Bell Street Small culvert CSP 0.60 Poole Creek N/A Fair 1/4 full of silt
L755260 Goulbourn Street 0.34 km from Elm Crescent towards Bell Street Small culvert CSP 0.60 Poole

	Creek N/A Fair Light silting L755265 Goulbourn Street 0.01 km south of Elm Crescent Small culvert RCSP 0.60 Poole Creek N/A Good Light silting L755270 Goulbourn Street 0.01 km from Elm Crescent towards Cypress Garden Small culvert CSP 0.60 Poole Creek N/A Good Minor debris L755390 Meadowland Drive 0.01 km from Elm Crescent Small culvert CSP 0.60 Poole Creek N/A Good Light silting and debris buildup at inlet and outlet. On flooded road section L755450 Norway Spruce Street 0.18 km from Stittsville Main Street towards Elm Crescent Small culvert CSP 0.25 Poole Creek N/A Fair Light silting Pg 107 L755460 Norway Spruce Street 0.2 km from Stittsville Main Street towards Elm Crescent Small culvert CSP 0.30 Poole Creek N/A Good Minor silting/debris L755470 Norway Spruce Street 0.3 km from Stittsville Main Street towards Elm Crescent Small culvert CSP 0.30 Poole Creek N/A Good Minor debris L755480 Norway Spruce Street 0.06 km from Elm Crescent towards Crab Tree Road Small culvert CSP 0.60 Poole Creek N/A Good No drainage concerns L755485 Norway Spruce Street 0.02 km south of Corduke Street Small culvert CSP 0.60 Poole Creek N/A Good Light silting at east end L755490 Norway Spruce Street 0.28 km from Elm Crescent towards Crab Tree Road Small culvert CSP 0.40 Poole Creek N/A Good 1/4 silt at extensions, minor at centre L755500 Norway Spruce Street 0.01 km from Crab Tree Road towards Elm Crescent Small culvert RCSP 0.60 Poole Creek N/A Good 1/4 silt at extensions, minor at centre Pg 129 Appendix 11 – Summary of Community Member Concerns [extract from table] Pg 130 Provided a Professional Opinion on the flooding in Stittsville - 'When the capacity of the 1500mm and 1650mm storm sewers was exceeded by the deluge that occurred on July 24, 2009, there was no where for the drainage of the Westwood subdivision to drain. This was caused by: **The loss of the Poole Creek tributary;** **The reliance of the design of the Westwood subdivision on a storm sewer outlet that never accounted for urban runoff from the Westwood subdivision;** The design of a storm drainage system and grading plan in the Westwood subdivision that failed to consider the major system design constraints that exist in the Cypress Gardens development area; and The elevations of the under-side of footings in the Westwood subdivision that were set too low, and were subject to flooding when the outlet storm sewer system was over-whelmed and surcharged because of the lack of an adequate major system outlet to convey excess runoff."	
2010 Jan	*Westwood (Deer Run) Subdivision Former School Site Stittsville Draft Serviceability and Stormwater Management Report* by DME 80 pages [240 West Ridge Drive] http://webcast.ottawa.ca/plan/All_Image%20Referencing_Subdivision_Image%20Reference_Serviceability%20&%20Stormwater%20Management%20Report%20D07-16-08-0006.PDF Pg 3 Phase 1 (177 lots) of the subdivision was constructed in 1999 while construction for Phase 2A (189 lots) began in the spring of 2004, and Phase 2B (168 lots) began construction in the summer of	Stormwater analysis is from the Mar 2007 Report [aka April 2007] Requirement of 1241.1 L/s is based on a 1280 L/s Cypress Gardens constraint and the 12 Apr 2000 COA which is 1280 L/s; also in the UPC SWS. The COA has been updated twice: 25 Aug 2004 COA for Phase 2A max is 1166 L/s 9 Aug 2005 COA for Phase 2B max is 1166 L/s

	2005. Phase 3 (158 lots) is expected to begin construction this year. The former school site is ~ 2.43 ha in size and fronts onto West Ridge Drive (see Figure 1.0, Key Plan). Recently, the ownership of the land has changed hands and the new owner wishes to develop the former school site block as a mixture of 60 townhomes and 5 single family units. Pg 4 [map rotated; blue = existing Phase 1, red = existing Phase 2A, yellow = existing Phase 2B, green = future Phase 3, purple = proposed]  Pg 10 *6.2 Stormwater Management Design* The former school site lands are located within the Upper Poole Creek Subwatershed boundary. The Upper Poole Creek Subwatershed Study, prepared by Marshall Macklin Monaghan (May 2000), outlined the quality, quantity and erosion criteria for the entire Westwood Subdivision. Specifically, the applicable recommendations for this portion of Pg 11 the subdivision, as identified in the subwatershed study (see Appendix E for excerpts from the Subwatershed Study), are the following: 1. The potential impact from downstream flooding and erosion was not an area of concern. However, quantity control, **to 1280 l/s using 2 dry ponds**, was required for the areas tributary to Cypress Garden sewer infrastructure (i.e. Phases 1, 2A and 2B lands and a 1.59 ha portion of the former school site lands). **Approximately 0.4 ha of this phase of development cannot be treated by the proposed Etobicoke System. This is due to the depth of bedrock being less than 1 metre below surface in some areas.** Pg 12 Design calculations have also been included in Appendix E and show that the proposed Etobicoke System will provide approximately 85 m3 of exfiltration storage (i.e. quality treatment). The required storage for quality treatment, for the 15 mm design storm, is approximately 62 m3. Therefore, quality treatment will be provided for greater than the 15 mm storm for those areas treated by the Etobicoke System. Pg 13 8.0 CONCLUSIONS / RECOMMENDATIONS This serviceability and stormwater management report is being submitted to support obtaining approval to construct a proposed 60 townhome and 5 single family residential subdivision	Why is 240 West Ridge Drive using 1280L/s when the others are using 1166L/s? Elevations are similar to those proposed for the 6279 Fernbank development upstream of most of Westwood e.g. *6279 Fernbank Servicing Study Pg 42* 1st new house at Elm near bottom of rearyard 120.69m Porter SWMP top of berm 120.6m, pond bottom 119.10, inverts from south and north inlets 119.18m *240 WRD Pg 63* invert 119.3m Rainfall used in 5-year and 100-year calculations: 6279 Fernbank Servicing Study Pg 30 May 1988 varies 240 WRD 67mm (Pg 55) 82mm (Ph 64)

within the former school site block of the existing Westwood Subdivision.
Pg 24 [water] The following are boundary conditions, HGL, for hydraulic analysis at the West Ridge Drive and Green Haven Crescent intersection … estimated ground elevation is 1220m [corrected by hand to 122.0m]
Pg 31 Westwood Subdivision Townhomes Stittsville Site Servicing Design Brief March 2007
Pg 35 4. STORM SEWER DESIGN
The existing school site was originally designed to drain to two outlets, 1.59ha to Phase 1 and 0.54ha to Phase 3. Due to the configuration of the proposed townhome development, it is proposed to drain the entire 2.13ha parcel to the existing Phase 1 storm sewer system and stormwater management facility.
Pg 36 The rainfall intensities used for both the 5-year and the 100-year rainfall events were determined using Intensity Duration (IDF) Curves determined from the Ottawa International Airport Data (1967-1990).
Pg 37

Table 2.0 Existing SWM Pond Characteristics

Design Parameters	Existing Pond①	Existing Pond②
Bottom Elevation	119.30	120.00
Top Elevation	120.55	120.80
Side Slopes H:V	5:1	5:1
Storage Volume	3383.0	4358.1
Total Storage Volume	N/A	7741.1

①Existing pond – SWM pond north of Bell Street.

②Existing pond – SWM pond south of Bell Street.

Table 3.0 Summary of Stormwater Modeling Results

Rainfall Event	SWM POND			CONTROL STRUCTURE (MH 121)		
	Inflow (L/s)	Maximum Water Elevation	Outflow (L/s)	Inflow (L/s)	Maximum Water Elevation	Outflow (L/s)
Existing 5-Year Rainfall	*2641.8*	*120.02*	*870.5*	*870.5*	*119.45*	*870.5*
Proposed 5-Year Rainfall	2905.0	120.07	952.8	952.8	119.54	**952.8**
Existing 100-Year Rainfall	*3963.4*	*120.23*	*1,166.1*	*1,166.1*	*119.81*	*1,166.1*
Proposed 100-Year Rainfall	4330.3	120.29	1,241.1	1,241.1	119.91	**1,241.1**

***Bold** numbers indicate the ultimate discharge rate to the Cypress Garden sewer*

Italicised numbers indicate existing conditions from 'Westwood Subdivision Phase 2 Stormwater Management Report', Dated April 2004, prepared by David McManus Enginnering

Pg 38

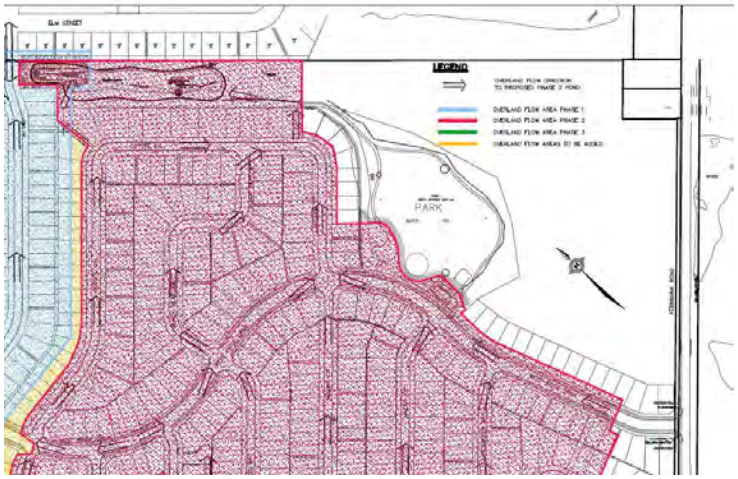
As shown in the above table, the maximum post-development discharge rate for the 5-year and 100-year rainfall events are 952.3 L/s and 1,241.1 L/s, respectively. The corresponding **surface water elevations are 120.07 and 120.29, which are below the design elevation of 120.50 established by the control structure located in existing Manhole 121.** The **maximum outflow of 1241.1 L/s is below the allowable discharge rate of 1280 L/s to Cypress Gardens**, (see *'Westwood Subdivision Phase 2 Stormwater Management Report'*, Dated April 2004, prepared by David McManus Enginnering).

CONCLUSIONS

An amendment to the Certificate of Approval for the SWM facility will be required to include the additional area proposed for the townhome development. The amended Certificate of Approval will be obtained once the detailed design has been completed.

Pg 39 APPENDIX A

Pg 41 [extract of Westwood drainage being directed to Fernbank Wetland; **top of wall for the north ponds is 120.75 (n), 120.72 (s); for south pond is 120.70 both ends]**



Pg 48 [extract: MH121 peak flow 1117.15 **pipe size 914.4 pipe capacity 845.45**; runoff coefficient 0.45 for all areas except 0.15 for Park]
Pg 62 [extract: CB Existing **MH121** inflow area 45.53ha peak elevation 119.912m at 12.61 hours; invert **118.610m**]
Pg 63 [extract: Stormwater to North Ponds 3/29/2007 Type II 24-hr 100 year rainfall 82mm; inflow area 45.5ha peak elevation 120.289m storage 5477.4m3 available storage 7741.4m3 at **elevation 120.500m, invert 119.300m**, 900mm Vert. orifice/grate C- 0.60]
Pg 67 APPENDIX E
Pg 68 Upper Poole Creek Subwatershed Study Final Report Pg 106
It is therefore recommended that the proposed stormwater management system for the future development phases for West Ridge Estates be upgraded by adding infiltration/filtration components (similar to Westwood below) rather than discharging to the existing pond.
3. In addition to having the dry weather flows from all phases be diverted to the Crossing Bridge storm sewer, it is recommended that the proposed
Stormwater management system for Phase 3B be upgraded by adding exfiltration or infiltration/filtration components rather than discharging to the existing pond.
4. If the recommendation in 3 above proves infeasible for all or parts of Phase 3B (due to rock or groundwater considerations, the residual impact may be addressed by a financial contribution …
Pg 69 Westwood Subdivision
At the time of preparation of this report, the stormwater management system proposed for this 75 ha subdivision … consisted of the following components:
1. Two quantity control dry ponds designed to restrict the peak flow from a 100 year storm to a rate of 1280 L/s to meet the available capacity in a downstream storm sewer in Cypress Gardens. The 100 year storm will be controlled since there is no separate major system outlet available.

	Pg 70 The infiltration system, as proposed, is judged to meet the requirements for level 1 water quality protection and temperature mitigation throughout the development area. The only question is whether areas with permanently high water tables will be encountered (where the use of the system may prove inefficient).	
2010 May 17	*Report to PEC and Council Comprehensive Review of Storm and Sanitary Service Backwater Valves – Council Motion 71/11* http://ottawa.ca/calendar/ottawa/citycouncil/occ/2010/06-09/pec/4%20-%20ACS2010-ICS-INF-0006%20-%20Comprehensive%20Review%20of%20Storm%20BWV.htm Committee recommendation That Council approve an amendment to the City's Sewer Design Guidelines to require the installation of a backwater valve on the sanitary service lateral for all new home construction. Storm Backwater Valve Performance In late August 2009, staff from the City's Building Code Services Branch conducted inspections on a representative sample of storm BWV for 29 properties, about 25% of the 119 properties, identified as having had BWV failures during the July 24th flooding event. A summary of their findings follows: All BWV, and flaps, were installed correctly. 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. City staff determined that the main mode of failure of the BWV was likely through the valve cover (or cap). Either the cover had not been installed correctly, could have dislodged during the flooding event or the cover had not been screwed in place tightly. Staff also confirmed that of the 29 properties investigated, there was no failure of either the valve body or flapper mechanism that controls the flow of water. 5. Consult with Backwater Valve Manufacturers The review identified a difference between the test pressure for the cap of a storm BWV (5 psig) and the cap for a cleanout (15 psig). The cap on a full-port sanitary BWV also has a higher pressure test standard (15 psig) than the cap on a storm BWV. Follow up discussions will take place with manufacturers to raise the following issues: a. The cap on storm BWV should be able to sustain a surcharge pressure of 15 psig; the same standard as a clean-out cap and the cap used on the BWV for the sanitary service lateral (Mainline Fullport BWV). This will assist in reducing the risk of a failure of the cap should the City sewer experience surcharged conditions. b. Include maintenance literature with the BWV.	
2010 June 29	*Report to ARAC and Council Upper Flowing Creek Muncipal Drain* [extract from map] http://www.ottawa.ca/calendar/ottawa/citycouncil/ara/2010/09-07/01%20-%20ACS2010-ICS-ESD-0016%20-%20Upper%20Flowing%20Creek%20MD.htm	Healey's Heath and possibly part of Stanley Corners are not in this subwatershed. The alternatives are Faulkner Drain or Upper Poole Creek

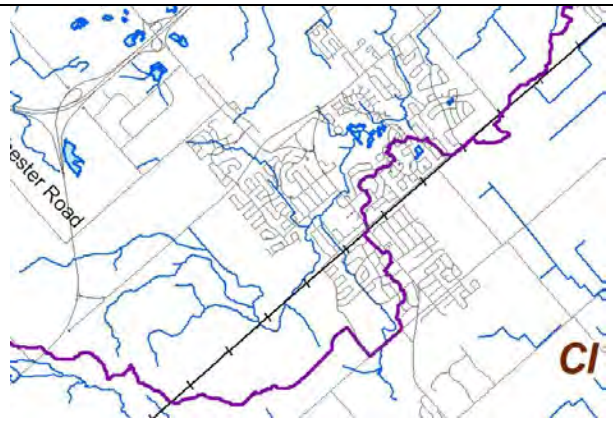
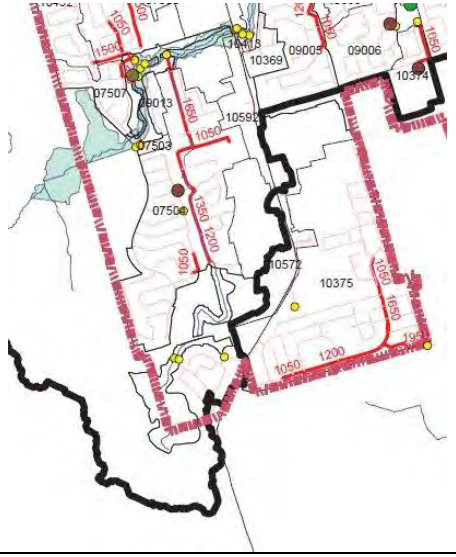
		
2010 Oct	*Audit of the West End Flooding Event and the Development Review Processes within the Carp River Watershed* http://ottawa.ca/sites/ottawa.ca/files/migrated/files/con064280.pdf	
2011 Feb	*WEFI Flood Investigation Stittsville Clusters by City of Ottawa Water Resources Group* [no link available] Pg 11 4.3 Westwood Cluster Westwood was investigated internally by City Staff. The XP-SWMM modelling simulations showed very good correlation with known hydraulic performance (i.e. Basement flooding reports) for the minor system. The cluster was found to have at least a 5-year level of service. The overland flow depth results from the DD-SWMM simulations for the Westwood subdivision within the Westwood cluster showed good correlation with anecdotal flooding reports. However the DD-SWMM results for the downstream subdivisions of Cypress Gardens and West Wind Farms did not correlate well with flooding reports. The DD-SWMM model shows increasing overland flow moving east from Cypress Gardens Park, to Bell Park, to Friendly Crescent. The Cypress Gardens subdivision shows moderate depth of overland flow that should not have been a significant source of flooding. Cypress Gardens Park was designed as a stormwater management facility but flooding reports from downstream areas indicate that it was not operating ideally. Modifying the park and making better use of the available storage will reduce the risk of flooding in the area and reduce the depth of downstream overland flow. The West Wind Farms subdivision is downstream of Cypress Gardens. The lands to the south of the intersection of Fernbank Road with Hartsmere Drive were predicted to have extreme flow depths in the model though no photographs were found to confirm the results and no flooding from overland flow was reported. Surcharge and backwater problems occurred widely in the Westwood subdivision with Phase IIA and IIB being significantly affected, whilst Phase I had a small area with some surcharge. The hydraulic analysis showed poor hydraulic conditions symptomatic of the reported flooding. Phase IIA and IIB were designed without inlet control devices (ICDs) instead using the Westwood dry pond to manage Pg 12 stormwater flow. The inclusion of ICDs in Phase I allowed a significantly lower amount of flow into the minor system, that reduced flood impact on July 24th, 2009. The **Westwood stormwater management pond was designed as an off-line dry pond that receives water from the minor system via two 450 mm diameter pipes** once the minor system is under surcharge (i.e. when the on-line orifice backs the water into the pond). The pond drains back to the	Is this physically possible due to the topography and having to cross Stittsville Main Street? That area is in the Faulkner Drain Subwatershed Could the model have been impacted by not accounting for the wetlands and groundwater flow? But where di the overland flow go?

	minor system after the flow peak has passed. The problem with this configuration is that when the pond is filling, the system HGL puts basements at risk. Controlling flows in the pipe at the CB level and filling the pond through overland flow routes is therefore preferable. Figure 3 shows the location of the Westwood Stormwater Management Dry Pond, found north and south of Bell Street as well as the orifice, which prevents excess minor system flow from affecting the downstream minor system. Consideration should be given to using the Westwood pond as a major system storage facility. Pg 19 The Cypress Gardens Park, located at 33 Elm Cres, was constructed as a stormwater management facility but requires modification for improved performance. This temporary storage location, presently painted as a soccer field, **does not have the required outlet structure to receive** and detain significant overland flows. The field needs to be retrofitted with a low elevation restricted outlet, to maintain the dry pond status, together with a higher unrestricted outlet to fulfil the mandate of storage without surface flooding risk. Improved overland flow routes directed to the field will also increase the capture of surface flow and reduce the chance of surface flooding. Pg 20  Pg 21 6.0 COST ESTIMATES The estimated cost for the proposed solutions in the basins can be found below. Install ICDs and replace Sanitary MH covers $0.650M* Modify Cypress Gardens Park outlet structure $0.040M	Why would a SWMP need an “outlet structure” to receive flow – would this not be an “inlet structure”? It has an grate which is believed to be an outlet to the Cypress Gardens Storm Sewer There are no apparent overland flows routes other than those within the park It is unclear whether the low restricted outlet and the high unrestricted outlet are existing or needed. There is only one apparent grated outlet Email from Curtis Ramparsad 7 Aug 2013 ICD’s and sealed Sanitary MH covers have been installed in Westwood as per the Stittsville Flood Investigation Report, however, there are a small number deficiencies that still needs to be addressed. Please note that Flood Investigation report did not recommend this work for Cypress Gardens. With respect to the modification to the Cypress Garden Park outlet structure and the orifice relocation for the Westwood SWMM pond, we are in the process of reviewing these recommendations to confirm if works are warranted. The ICD installation and sealed sanitary MH covers in Westwood represent the main flood control strategy against sewer back up

		and basement flooding. Our analysis for Cypresses Gardens did not call for these works and the recommended outlet modification for the park was an enhancement. As previously conveyed to you, during the design process for the WEFI projects some may be found, not to be feasible or to provide little benefit when compared to cost. Conversely, other projects may be added if found to be advantageous and consistent with the intent of the EA.
2011 Mar 9	*OMB Westwood Decision* http://www.omb.gov.on.ca/e-decisions/pl011151-mar-09-2011.pdf The matter before the Board arises from a Decision and Order it issued on January 14, 2004, (Decision No. 0075). Through that decision, the Board approved a Pg 2 draft plan of subdivision and delegated final approval of the plan to the City pursuant to Subsection 51(56.1) of the Planning Act. Since that time, two of three phases of the plan of subdivision have been registered. A **dispute has arisen with respect to concerns the City maintains about sanitary and storm sewer capacity for the final phase**. In its 2004 Decision, the Board stipulated that it would remain seized of any dispute that arises. The Parties have attempted to resolve their differences, but have not been successful. The proponents provided City staff with additional technical details and drawings; however, the City reports that those materials remain deficient. Based on the foregoing, the Board directs as follows: 1. Through Ms Turner's office, the City is directed to articulate in detail the deficiencies it concludes remain following its review of the materials submitted by the proponents. These are to be provided to Mr. Kelly no later than Tuesday, March 8, 2011. 2. A hearing is set for April 6, 7, and 8, 2011, beginning at 11:00 a.m. on the 6th, at the City of Ottawa Municipal Offices. Ms Turner is directed to confirm a venue forthwith and provide that information to Martin Stefanczyk, the Board's planner having administrative carriage of this file, and to Mr. Kelly.	
2011 Mar 29	*Review of Submission "Westwood Subdivision Phase 3 – Ottawa Ontario Storm Sewers and Exfiltration Trenches Hydrologic Modelling"* Prepared by EXP (Trow) March 29, 2011 Prepared by Curtis Ramparsad, P.Eng, Program Manager, Asset Management Branch, Water Resources Assets City of Ottawa [unable to copy – parts have been transcribed] Documentation This review is based on the information received as of the end of the business day on April 19, 2011 and includes: 1. Westwood Subdivision Phase 3 – Ottawa Ontarion Storm Sewers and Infiltration Trenches *Hydrologic Modelling"* Prepared by EXP (Trow) March 29, 2011 2. MIDUSS Model manual and digital output files via email dated April 8, 2011 3. Summary of Storm Catchment Parameters used in March 29, 2011 MIDUSS Model via email dated April 8, 2011	

	4. Letter references "WSL00002214-00 Westwood Phase 3 Subdivision MIDUSS Modelling – Catchment Parameters" dated April 15, 2011 received via email dated April 15, 2011 ?? finish this – it is in CR … file from Legal Pg 18 **References** A.M. Candaras Assoc. Inc. "Post-construction evaluation of stormwater exfiltration and filtration systems." Project No. 9321 for City of Etobicoke, October 1997 (A. M. Candaras Assoc. Inc., 8400 Jane St., Suite 203, Concord, Ontario, L4K 4L8) CIRIA Construction Industry Research and Information Association. "Infiltration Drainage – Manual of good practice". Report 156 by Roger Bettess, Ph.D. 1996. German Association for Water Pollution Control. German ATV Standards, Wastewater – Waste. Standard ATV – A 138E, "Construction and Dimensioning of Facilities for Decentralized Percolation of Non-Harmful Polluted Surface Water". January 1990 MIDUSS 98 User Manual (320 pp). Download available at http://www.miduss.com .	
2011 Apr 14	*OMB Westwood Decision* [E-Status has title Westwood Phase 2] http://www.omb.gov.on.ca/e-decisions/pl011151-apr-14-2011.pdf Pg 2 The matter before the Board arises from a Decision and Order issued on January 14, 2004, (Decision No. 0075). The Board approved a draft plan of subdivision and delegated final approval of the plan to the City pursuant to Subsection 51(56.1) of the Planning Act. Since that time, two of three phases of the plan of subdivision have been registered. A **dispute has arisen with respect to the City's concerns about sanitary and storm sewer capacity for the final phase**. The Board issued an Order from a prehearing conference held on March 4, 2011 that set a hearing date for April 6-8, 2011. The City has brought a motion to adjourn the hearing to give it sufficient time to review and obtain supporting documentation relating to the MIDUSS Model Summary Report submitted by the Appellants. A supporting Affidavit provided by the City indicates that a minimum of two weeks, after receipt of the required supporting documentation, is needed to complete a review of the MIDUSS Report. The Board Orders: 1. The City will provide the Appellants with a draft copy of Mr. Rampersad's (a City employee) report on the MIDUSS Report by April 27, 2011.	
2011 May 11	*OMB Westwood Decision* [E-Status has title Westwood Phase 2] http://www.omb.gov.on.ca/e-decisions/pl011151-may-11-2011.pdf On April 27, 2011, the Board held a second Prehearing Conference by telephone conference call for an appeal arising from a Decision and Order issued on January 14, Pg 2 2004, (Decision No. 0075). The Board approved a draft plan of subdivision and delegated final approval of the plan to the City pursuant to Subsection 51(56.1) of the Planning Act. Since that time, two of three phases of the plan of subdivision have been registered. A **dispute has arisen with respect to the City's concerns about sanitary and storm sewer capacity for the final phase**.	The OMB E-Status website has this case as Open as at 20130820 with no further hearings scheduled

	Mr. Kelly, counsel for the Appellants, advised the Board that they have received a draft copy of Mr. Rampersad's report and are working on providing the additional information requested. All of this information is expected to help to narrow the issues for the hearing. Mr. Kelly requested the possibility of another prehearing telephone conference call if needed. Ms Turner, counsel for the City, confirms that the Parties are working cooperatively in the exchange of information. The Board Orders: 1. **A 3-day hearing has been scheduled for July 11, 12, and 13, 2011** beginning at 11:00 a.m. in the Keefer Room, Heritage Building, Ottawa City Hall, 110 Laurier Avenue, Ottawa, Ontario.	
2011 Dec	*The Impacts of Urbanization on the Hydrology of Wetlands: A Literature Review* by Toronto and Region Conservation Authority, December 2011 68 pages http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/04/Wetlands-Literature-Review.pdf	
2011 Dec 8	*OMB Decision PL110298 240 West Ridge Drive Proposed Plan of Subdivision and Site Plan* 3 pages http://www.omb.gov.on.ca/e-decisions/pl110298-dec-08-2011.pdf Approved DP/SD and SP at 67 singles and semis for former school site	
2012 Aug	*Stormwater Management Criteria ▪ Appendix D: Water Balance for Protection of Natural Features* http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/05/SWM-Criteria-2012_Appendix-D.pdf	
2013 Aug 7	*Photo taken at Fernbank Road near wetlands (looking north)* 	Does Fernbank Road flood in extreme events? Will increased water levels in the wetlands impact the Fernbank Road and ditch drainage? Is there a culvert under Fernbank? If there is not a culvert, is there a hydraulic connection underground which needs to be considered?
2013	*Mississippi-Rideau Source Protection Plan 2013* D11 City of Ottawa Significant Threat Areas 1 page http://www.mrsourcewater.ca/plan/Mississippi%20Rideau%20Source%20Protection%20Plan/Appendices/Appendix%20D11-OttawaThreatAreas.pdf [extract for Stittsville]	This map and other maps in the Characterization of Ottawa's watersheds show the Fernbank Creek tributary The 6279 Fernbank development area appears on these maps as being in 2 subwatersheds - Upper Poole Creek (UPC) in the Carp River watershed and Flowing Creek subwatershed in the Jock River watershed

		
2013 June 18	*Wet Weather Infrastructure Management Plan Final Report* by Stantec 31 July 2012 [tabled to Environment Committee 18 June 2013 as Item 6 *Wet Weather Infrastructure Management Plan – Ottawa River Action Plan Project*] http://app05.ottawa.ca/sirepub/cache/2/w3do0ucoeuaw21ehv055btqw/6803408192013061014767.PDF Pg 24 DRAFT - January 2009 Storm Sewer Catchments [yellow dot = storm sewer outfall; purple dot = dry pond; blue = wetlands] 	This map omits the Cypress Gardens Dry SWMP It is not clear where the 1650mm Cypress Gardens Storm Sewer – it is shown above Elm, but also should be shown closer to the Westwood North SWMP The 2d Westwood South SWMP is missing The tributary is shown on the 6279 Fernbank site and the Fernbank Wetlands north and south of Fernbank Road with a buffer This map is incomplete and has errors. After amalgamation, the City lost much of the knowledge concerning SWMPs and stormwater infrastructure.

2013 July	*Evaluation, Classification and Management of Headwater Drainage Features Guidelines - Revised* http://trca.on.ca/dotAsset/163576.pdf 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.	