

WEST-END FLOODING INVESTIGATION 24 JULY 2009 RAINSTORM EVENT

CONSOLIDATED REPORT AND ACTION PLAN

MARCH 2011

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SUMMARY REPORT

1. Background

On July 24, 2009, parts of the City of Ottawa experienced a significant rainstorm (over 100 mm of rain in a 24-hour period in some areas) resulting in nearly 1,500 flooded basements. Sewer backups, overflows at two sewage pumping stations and seven culvert failures are some factors that contributed to the floodings. Most of the flooding occurred primarily in the City's west end, mainly in Ward 4 - Kanata North (Beaverbrook), Ward 5 - West Carleton-March (Carp Village), Ward 6 - Stittsville, and Ward 23 - Kanata South (Katimavik and Glen Cairn). An investigation, led by the Infrastructure Services Department (ISD) and supported by several City departments, was initiated to understand why flooding occurred, what can be done to reduce the risk of future occurrences and to implement solutions.

The investigation was carried out in five phases: Phase 1 - Background data collection, Phase 2 - Assessment and problem definition, Phase 3 - Identification and evaluation of alternative solutions, Phase 4 - Development and approval of action plan and Phase 5 - Implementation of approved action plan. The scope of the investigation included all west end locations that experienced flooding. The focus was on affected areas where flooding resulted in damage to private properties or to City infrastructure. While heavy rainfall and flooding also occurred in other parts of the City, flooding in other areas appears to be isolated and dispersed. These isolated cases are subject to a separate investigation on an individual basis.

2. Flood Investigation Process

This report presents the findings of Phases 1 to 4 of the investigation. This consolidated report and action plan represents the comprehensive investigation that was undertaken to confirm the cause of flooding and identify solutions to reduce the risk of future flooding occurrences. The investigation was undertaken using a combination of staff and engineering consultant resources. The investigation included Councillor and public input, field assessments, detailed topographical surveys, fog testing of sanitary sewer systems, targeted basement elevation surveys and camera inspections of the sewer system at selected locations. For all areas, the investigation focused on the evaluation of conceptual technical solutions using detailed hydraulic models (adjusted to recreate the 24 July 2009 conditions) that were developed for the affected areas. These models were used to confirm modes of flooding and assess various alternative solutions to select a preferred approach.

Flooding analyses were broken into four areas, namely Kanata North, Kanata South, Stittsville and Carp. Given the extent of flooding and complexities involved in the Glen Cairn area of Kanata South, the investigation followed the Class Environmental Assessment (EA) process. Through this comprehensive review, a number of alternative solutions were evaluated and preferred solutions identified. This information was presented at 2 public meetings. In addition, the evaluation was subject to a Value Engineering process, comprised of recognized experts in the field undertaking an independent assessment of the alternative solutions. This process has helped to reinforce the selection of the preferred technical solutions. A Public Advisory Committee (PAC) was also established at the outset by the Ward Councillor for Kanata South.

This PAC was engaged throughout the process and was instrumental in providing information related to the flooding event and ensured information presented to the public was communicated in a meaningful way. The EA study for the Glen Cairn Area is referenced in Appendix 4.

Detailed reports for the remaining flood clusters are also referenced in Appendices 1, 2, 3 and 5. Given the limited extent of flooding in Carp Village, a separate report was not produced but the remedial actions are referenced in this summary report.

3. Public Input

Extensive public consultation took place as part of the overall investigation process. The following is a summary of the Public Meetings that took place since the July 24, 2009 flooding event:

- July 30, 2009 – Stittsville
- September 12, 2009 – Glen Cairn (South of Carp River)
- September 12, 2009 – Glen Cairn (North of Carp River)
- September 12, 2009 – Katimavik
- October 1, 2009 – Kanata North
- February 17, 2010 – Stittsville
- April 14, 2010 – Glen Cairn Community Association meeting
- May 19, 2009 – Glen Cairn
- September 7, 2010 – Kanata North
- September 13, 2010 – Katimavik
- September 15, 2010 – Glen Cairn
- November 1, 2010 - Stittsville

Opportunities for public input were available at all public meetings. The Glen Cairn Flooding Investigation followed the Municipal Class Environmental Assessment (EA) process, providing further opportunities for public input via a Public Advisory Committee and the 30-day review period.

4. Level of Service Objective

The west-end communities that experienced flooding and sewer backups are serviced by separated storm and sanitary sewer systems, with a few locations serviced by roadside ditches. The City's sanitary and storm sewer systems convey flows generated from wastewater discharges and wet weather influences, respectively, and were designed and built in accordance with recognized standards that evolved over time. "Stormwater" means wet weather runoff that is collected from roads, parks, rooftops, private properties and building footing drains. "Sanitary sewage" means wastewater that comes from toilets, showers, floor drains, sinks and other plumbing fixtures.

Since the mid to late 1980's, there have been significant changes in the way communities in Ottawa are designed to handle stormwater by introducing the concept of minor and major storm drainage systems (also referred to as dual drainage). Minor systems refer to the storm sewers

that are sized and controlled to convey frequent storm events (i.e. rainfall events with a return frequency less than 5 years). Major systems refer to the grading of roads and the provision of stormwater retention facilities that are sized to handle larger less frequent storm events (i.e. rainfall events with a return frequency up to 100 years, including ability to handle historical major storm events). Communities built prior to the mid to late 1980's include provisions for the minor system (i.e. storm sewers) and provisions for the major system only gradually occurred on a more consistent basis after this date.

The provision of major system considerations in the design of new communities has resulted in a significant increase in the level of protection against property flooding from large and infrequent rainfall events. It has made these communities more resilient to these events and impacts associated with climate change. For example, this resiliency has been demonstrated with the limited property flooding that was experienced in new neighbourhoods of Orléans (significant rainfall events that occurred in 1998 and 2006) and Kanata (2009). The key is that even though rainfall levels were significant, flows in these newer communities were controlled and channeled away from private properties. The challenge is to emulate this level of resiliency in existing communities given the constraints associated with the existing conditions (i.e. topography, depressed driveways, road and lot layouts, etc).

For existing west-end communities, the current levels of service are based on the standards in place when they were built. When evaluating these existing communities as part of the investigation process, the objective was to achieve the same level of protection that is provided in new developments built to current standards.

5. Key Findings and Recommended Solutions

Several factors contributed to widespread occurrences of flooding and sewer backups in the City's west-end. The following is intended to highlight key findings and proposed solutions related to both the storm and sanitary sewer systems. Details that are more specific to each area (referred to as clusters) are provided in separate reports as referenced in the appendices.

Storm System

1. *Overtaxed storm sewers and deficient overland drainage system:*

The July 24, 2009 rainfall event exceeded the design capacity of the storm drainage system. This led to water entering basements through window wells, improperly sealed BWVs or cleanouts and floor joints around foundations. Water in basements evacuated through basement floor drains contributing high extraneous flows to the sanitary sewer system. This was a particular issue in Stittsville and Kanata South.

Recommended solution:

The solution includes two key elements.

The first is to limit the amount of water that enters the storm sewers to prevent the capacity of the pipes from being exceeded. This can be accomplished by installing inlet control devices (ICDs) in catch basins (Figure 1) and sealing maintenance hole covers, especially those that are likely to be submerged during a large rainfall event. The benefit of this approach is that by preventing sewer pipes from exceeding their design capacity there is less likelihood that water will backup in sewer laterals, which places less reliance on backwater valves (BWVs) on perimeter foundation drains as the only means of protection, and homes without any BWVs will be less vulnerable. Implementation of this solution means BWVs will serve as a line of last defense, not a first line of defense. Implementation of these measures was initiated in late 2010, as these provide significant benefit, and can be done in a cost effective manner and with little disruption to the existing community.

Figure 1 – Sample Inlet Control Device (ICD)



The second element of this solution is to channel the water that accumulates on the surface to a suitable outlet. Where possible, this can be accomplished by redirecting the water to a surface drainage ditch, a stormwater multi-use dry pond created in a park or open space, or allowing the water to accumulate on the road surface to a depth that does not pose a risk to property. The benefit of this approach is that the water would be managed or conveyed away from private properties. While there may be temporary inconveniences of water accumulation on the road surface, or in other areas, for short periods of time after a large infrequent rainfall event, this would have significantly less impact as compared to water accumulating in people's basements. This is the approach used for new communities.

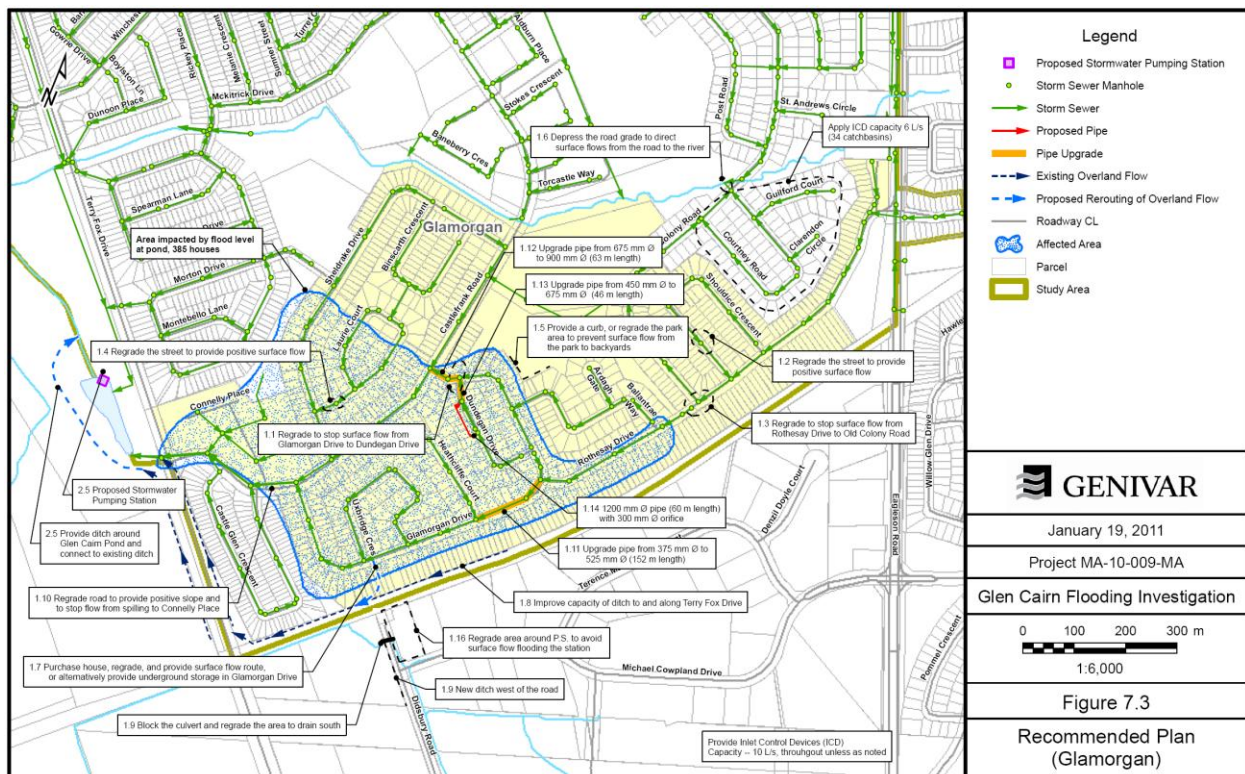
These two measures can be readily implemented in Stittsville with minor adjustments to overland drainage patterns. For Stittsville, overland flow solutions center mostly on increasing the amount of runoff that flows into the Westwood pond and the Cypress Gardens park. The solution includes modifying the orifice at the Westwood pond to improve the performance of the pond and modifications to the outlet structure of the Cypress Gardens Park in Westwood. The solutions also include regrading the pathways around the pond and park to allow more runoff to spill into them. Further technical details are provided in Appendix 2.

For Glen Cairn, more significant changes are required to address overland drainage. The Glen Cairn overland flow system was studied in great detail as part of the Glen Cairn EA (Appendix 4). Several overland flow modifications are recommended to alleviate ponding and flooding issues, including:

- modifying some parks to provide surface storage (i.e. Dog Bone Park),
- potentially acquiring a property in the Glamorgan area to improve an outlet for overland drainage,
- modifying roadway and pathway grading to improve drainage, and
- storing excess water in underground pipes.

Figure 2 provides an overview of the improvements identified for the Glamorgan cluster. Similar figures are provided in Appendix 4 for the other clusters in Glen Cairn.

Figure 2 – Summary of Improvements for the Glamorgan Cluster



2. High water level in Glen Cairn Stormwater Pond and Carp River:

Storm water in the Glen Cairn and Bridlewood North communities flows through the Glen Cairn Stormwater Pond (located on the west side of Terry Fox) before outletting into the Carp River. The pond provides both water quality and quantity control benefits.

The reach of the Carp River that flows through the Glen Cairn community also contributes flow to the pond. During large rainfall events, water accumulates in the pond, and this affects the water level in this part of the river. This section of the Carp River was the subject of previous channel improvements following the 2002 rainstorm. Based on the available observations, there are no indications to suggest that the Carp River overtopped its banks during the July 24, 2009 event. The channel improvements were effective in

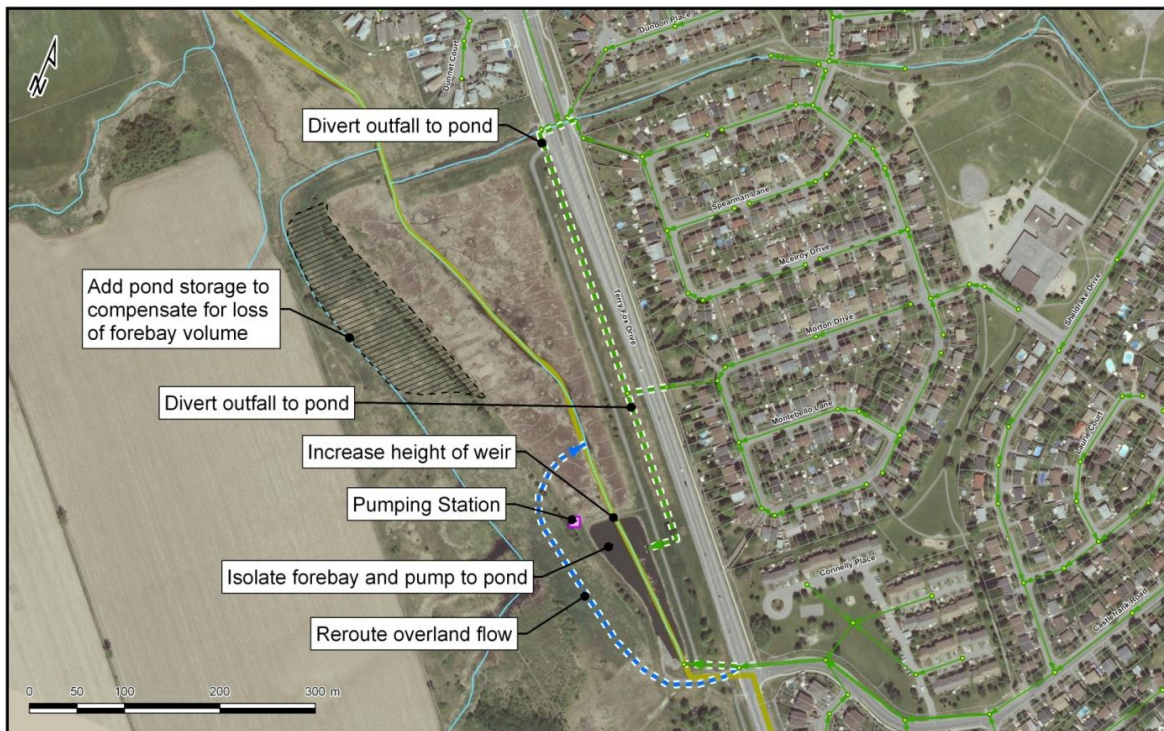
reducing the impact of surface flooding in the community. However, the high water levels in the pond and the river had an impact on the storm sewer system.

Since the pond and the Carp River serve as the outlet for the storm sewers, the capacity of the storm sewers are impacted by the outlet levels during large/infrequent rainfall events. This exacerbated the overtaxing of the storm sewers.

Recommended solution:

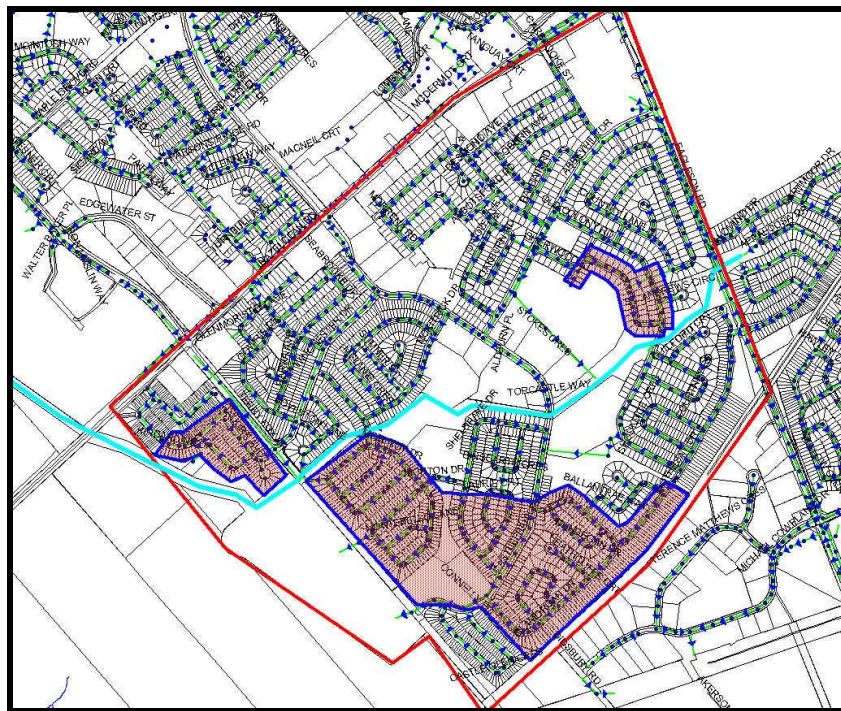
As part of the Glen Cairn EA, different alternative solutions were considered, such as channelizing the Carp River to improve the outlet, modifying the pond to increase its capacity and providing a storm water pumping station at the wet pond to lower the water level during significant rainfall events. The objective of these alternatives was to improve foundation drainage for homes in parts of the Glen Cairn community by providing a more efficient outlet for the storm sewer system. The preferred solution for the purpose of flood protection is the construction of a storm water pumping station in the water quality portion of the Glen Cairn pond. The water quality portion of the pond will then be isolated from the remainder of the pond so that during extreme events, the pumping station will maintain lower water levels in the water quality pond, thereby maintaining a free outlet for the storm system (a significant portion of the Glen Cairn storm sewer system outlets to the water quality pond). High levels in the river and remainder of the pond will therefore have no effect on the sewer system. Figure 3 shows the proposed conceptual solution. Further details are available in Appendix 4.

Figure 3 – Stormwater Pumping Station



The above solution addresses the storm sewer system that outlets to the pond. There are other storm sewers that outlet to the Carp River directly and some of the homes along these sewers are affected by high water levels in the river. Backwater valves with sump pumps will be installed in homes that are within the Carp River zone of influence, as homes within this zone may be impacted by storm sewer backups due to high water levels in the Carp River. Figure 4 shows the areas influenced by the high water levels in the Glen Cairn pond and the reach of the Carp River that flows through the Glen Cairn community. The smaller areas in Figure 4 (and a small part of the large area) will be protected with sump pumps and backwater valves, while most of the large area will be protected with the new storm pumping station.

Figure 4 – Zones of Influence



3. *Overwhelmed drainage along Monahan Drain at Terry Fox Drive:*

The TransCanada Trail (TCT), which intersects Terry Fox Drive, is the watershed boundary between the Carp and Monahan drainage systems. The area to the north of the TCT drains towards the Carp River and the area to the south drains towards the Monahan drain and on to the Jock River.

There is a culvert immediately south of the TCT where the Monahan Drain crosses Terry Fox Drive. This culvert is designed to convey flow from a relatively small area. During the July 24, 2009 rainfall event, a large pool of water accumulated on the west side of Terry Fox Drive. This was the result of the significant rainfall that overwhelmed the

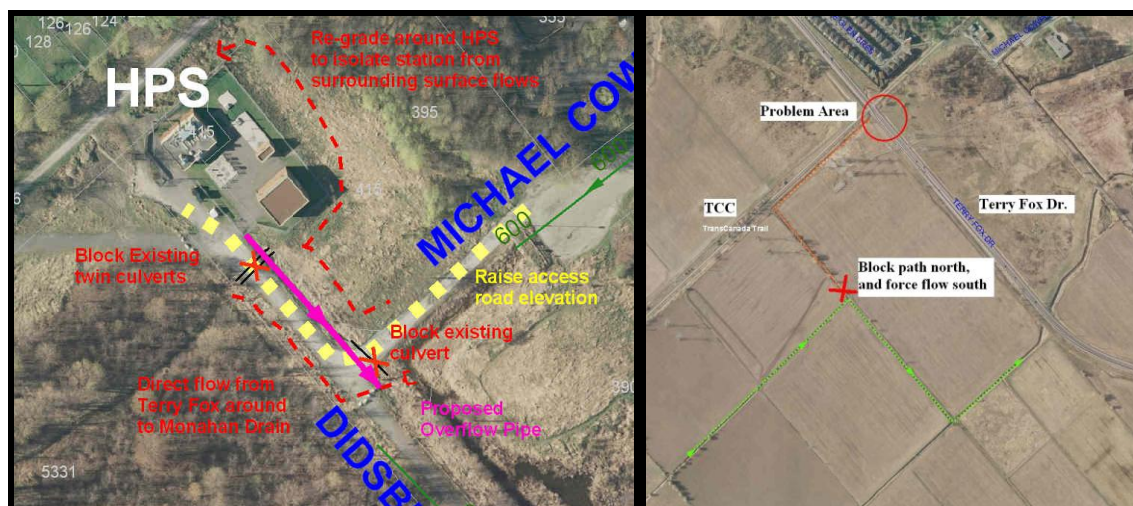
Monahan Municipal Drain system and some flows were directed north towards the TCT instead of outleting to the south as intended under normal conditions.

As noted, the TCT is the dividing boundary between the Carp and the Monahan systems, but there is a culvert located just east of the Hazeldean pumping station. This culvert is intended to drain rear yards from homes along Rothesay and the eastern portion of Glamorgan to the Monahan Drain. This culvert permitted flows from the Monahan Drain to reverse and move northward into the rear yards of the homes along Glamorgan and Castleglen and contributed flows to the Glen Cairn pond.

Recommended solution:

Grading and culvert modifications will be undertaken along the Monahan Drain, near the TCT and the Hazeldean Pumping Station to minimize the risk of this situation reoccurring in the future. Figure 5 shows the proposed modifications.

Figure 5 – Overland Flow Modifications Along Monahan Drain and TCT.



4. *High water level in Cattail Creek at Katimavik Road:*

On July 24 2009, high water levels were reported in Cattail Creek at Katimavik Drive. Debris, transported as a result of the storm, partially clogged the grate of the culvert crossing Katimavik Road causing water to back into the yards of properties along Peary Way and enter basements through window wells and joints around basement floors.

Recommended solution:

A hydraulic assessment was carried out to determine the capacity of the culverts and resulting water levels in Cattail Creek during large infrequent rainfall events. It was found that with the culverts entrance free of debris, the existing culverts have sufficient capacity, although water levels do approach backyards. Creating a berm in the backyards along

Cattail Creek, south of Katimavik, is recommended. During detailed design of the berm, the need for grating at the Katimavik culvert inlet will be reassessed. Figure 6 depicts the recommended solution and further information can be found in Appendix 3.

Figure 6 – Proposed Berm Behind Homes on Peary Way



5. *Failure of BWVs on perimeter foundation drains:*

Due to the significant rainfall, storm sewers were overtaxed causing water to backup in lateral connections, which created pressure on BWVs. Approximately 120 homes, mainly located in the Stittsville area, experienced failure of BWVs and this exacerbated extraneous flows to the sanitary sewer system (as flooded basements emptied through floor drains connected to the sanitary sewers).

Recommended solution:

In June 2010, Council approved report ACS2010-ISC-INF-0006 – Comprehensive Review of Storm and Sanitary Service Backwater Valves – Council Motion 71/11. This report included a comprehensive review to determine the mode of failure of BWVs during the July 24, 2009 event, a review of City standards with regard to current industry technology and practices, a comparison of the City's requirements relative to peer municipalities, and a recommended plan to reduce the potential for future occurrences of basement backups related to the failure of BWVs. The following is a summary of the 5-step plan that was approved:

i. Continue with Sewer System Improvements

The City's current Sewer Design Guidelines are based on preventing storm sewers from surcharging, therefore reducing the reliance on BWVs on perimeter foundation drains. When sewer system improvements are implemented, BWVs serve as a second line of defence instead of being the sole means of protection as is the case in communities built prior to the implementation of current standards.

ii. Expand Installation of BWVs

The review identified opportunities to increase the level of protection against sanitary sewer backups and recommended changes to the City's Sewer Design Guidelines to include the mandatory installation of a BWV on the sanitary service lateral for all new home construction.

iii. Increase Homeowner Awareness

Through various discussions with property owners, it is apparent that many are not aware of the maintenance requirements for BWVs and other measures needed to reduce the risk of basement flooding. Homeowners should be advised not to connect sump pump outlets to internal sanitary plumbing systems and to direct eaves trough outlets away from the home. A number of measures were approved to increase homeowner awareness.

iv. Maintain BWV Inspection Practices

The City already includes two BWV inspections at different stages of construction, which is considered a best practice when compared to peer municipalities. Through the building and plumbing permit application processes, there is an opportunity to increase awareness with contractors and homeowners of the benefits of BWVs and other measures to reduce the risk of basement flooding.

v. Consult with BWV Manufacturers

The review identified technical differences related to the test pressures for the caps of storm BWVs. Follow up discussions will take place with manufacturers to raise this issue along with including maintenance literature when BWVs are purchased.

6. *Alterations to roadside ditches:*

In the Old Stittsville and Vanstone areas, roadside ditches convey storm drainage. In Old Stittsville areas there appears to have been high levels of extraneous flows into the sanitary sewer, as witnessed by the high flows experienced at the Fringewood pumping station during the July 24 2009 event. Sump pumps directed away from the ditches and into internal plumbing systems may have contributed to the high amount of extraneous flows.

For the Vanstone area, there have been alterations to the roadside ditches that have reduced the ability for the drainage system to handle large events. These alterations have impacted overland drainage causing surface flooding and may have encouraged some residents to connect their sump pumps to the sanitary system (some homes at the end of Vanstone and Belleview flooded due to high flows in the sanitary system). There are also eaves troughs that outlet at or near building foundations and this can contribute to basement flooding and to extraneous flow into the sanitary system.

Recommended solution:

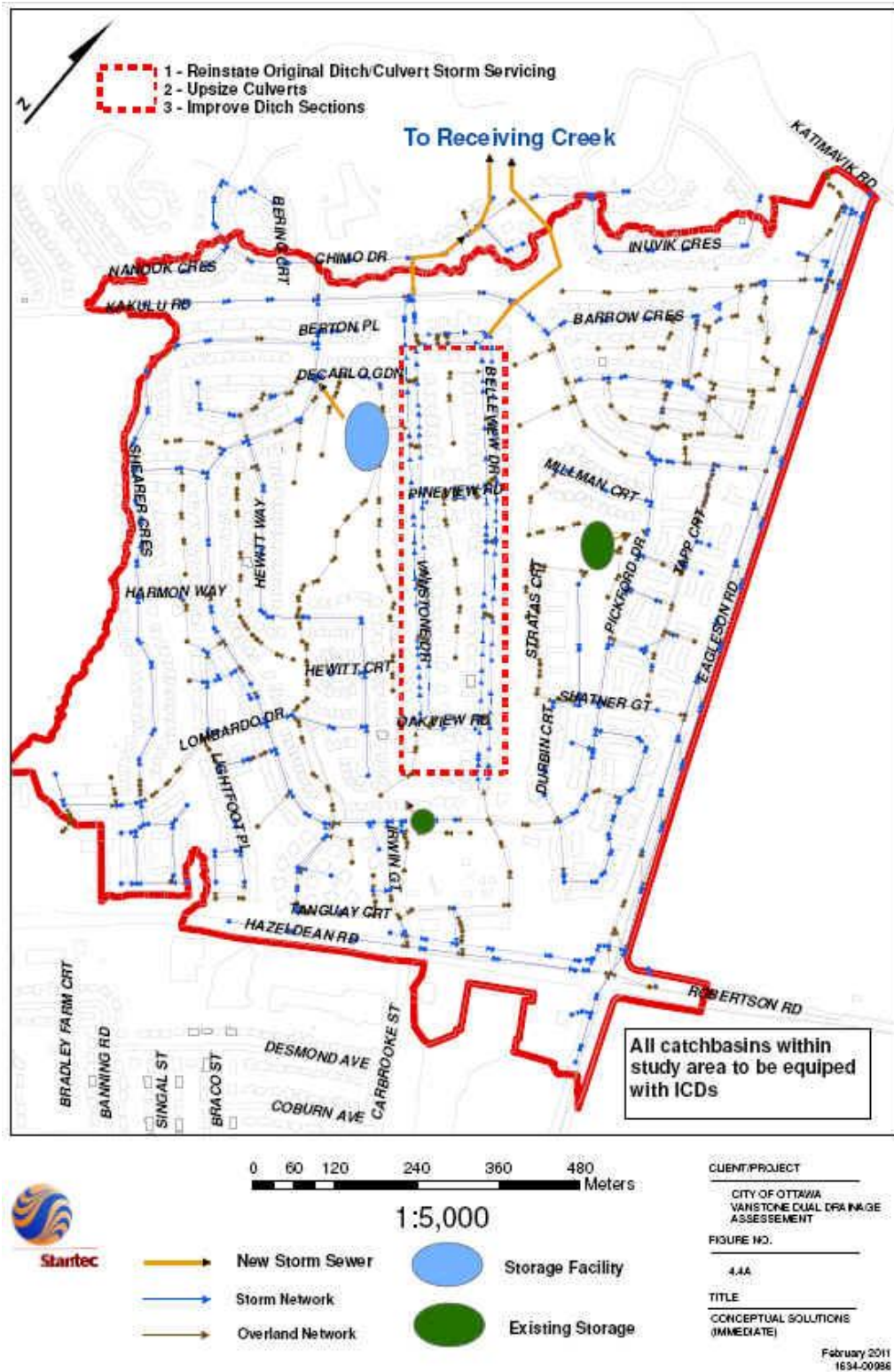
For the Old Stittsville area, the high extraneous flows into the sanitary sewer system can be managed within the capacity of the existing system and will be the subject of further investigation. There are no immediate modifications being proposed to the ditch systems as they were not directly related to flooding, but further investigation will look at opportunities to reduce extraneous flows.

For the Vanstone area, the intent is to reinstate roadside ditches along Vanstone Drive and Belleview Drive to improve the overall performance of the drainage system. New outlet sewers at the extremities of Vanstone and Belleview will also be constructed to convey the ditch flow to Cattail Creek. Stormwater storage is also proposed in Hewitt Park. Figure 7 shows the proposed improvements for the Vanstone area and further information is provided in Appendix 3.

Longer term solutions are also being recommended to help improve the storm drainage system in the areas adjacent to the Vanstone area. Although the adjacent areas did not report flooding during the event of July 24th, it does form part of the receiving system for the Vanstone area and can surcharge during rare events. Improvements in the form of a high level overflow and upgrading some sewer sections are recommended in the long term as is storage within Pickford and Irwin Gate Parks. The topography of these two parks lends itself to store water naturally making the storage simple, such that all that is required is a controlled outlet. These recommendations will form part of the longer term plan for the area as dual storm drainage provisions are implemented throughout Kanata.

Information will also continue to be communicated to the residents on measures they can take to reduce the risk of flooding, such as directing water from eaves troughs away from foundations and not outleting sump pumps to the internal plumbing system. This was presented at the public open houses.

Figure 7 – Vanstone Area Drainage Improvements



Sanitary System

1. High extraneous flows in sanitary sewers:

Sanitary sewers experienced a significant amount of extraneous flow, which lead to many occurrences of sewer backups in basements across all west-end areas affected by flooding. These high extraneous flows were caused mostly by basements that were flooded by storm water (these basements then drained into the sanitary system via floor drains) and by stormwater entering through holes in maintenance covers that would have been submerged during the large rainfall event.

Fog testing was undertaken in Glen Cairn, Katimavik and Beaverbrook to confirm the presence of cross-connections or other unwanted sources of storm water inflow into the sanitary sewer system. The fog testing identified one catch basin connected to the sanitary sewer system in the Beaverbrook area (this has already been corrected) and a number of other locations where storm water could enter the sanitary sewer system. It was also evident during the fog testing that there is potential for storm water to enter sanitary sewers through vent openings in the maintenance hole covers.

Excess extraneous flow into the sanitary system contributed to flooding in the Beaverbrook/Varly area, the Penfield area, the Naismith area and for a significant amount of the flooding in the Glen Cairn area.

Another source of extraneous flow is from sump pumps that are re-directed to the sanitary system instead of draining to a storm outlet or to the surface. It is believed that this factor contributed to some of the basement flooding in the Vanstone area as well as the flooding in the Rivington area in the Village of Carp.

Recommended solution:

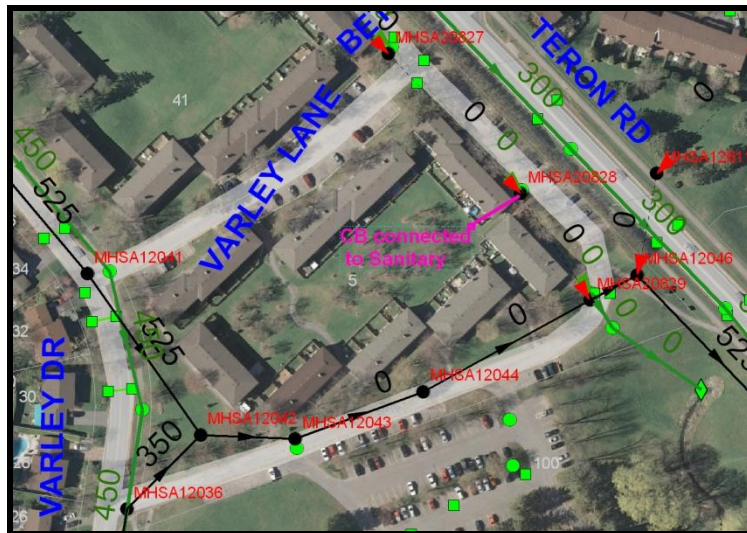
The solution includes the following key elements:

The first key element is to implement the storm system solutions mentioned previously to stop basements from flooding due to storm sewer backups. This will eliminate stormwater flooding in basements from draining back into the sanitary system via floor drains. This will be accomplished through the widespread installation of ICDs in storm catch basins in all areas impacted by flooding in the Stittsville and Kanata South areas.

The second element is the replacement of maintenance hole covers with solid covers. Approximately 1,400 covers are currently being replaced in all areas impacted in the Stittsville, Kanata South and Kanata North areas. Figure 8 depicts a new sanitary maintenance hole cover.

Figure 8 – Maintenance Hole Cover Replacement

The third element is to seal sanitary sewers and maintenance hole structures at locations identified by the fog testing to eliminate inflow sources. This was the case in the Beaverbrook/Varley area where a storm catch basin was connected to the sanitary system (See figure 9). This has since been corrected.

Figure 9 – Beaverbrook/Varley Cross Connection.

The fourth element is the disconnection of sump pumps from the sanitary sewer. It is believed that this source of inflow was responsible for some of the flooding in the Vanstone area in Katimavik as well as in Rivington Street area in Carp. Since it is difficult to police the internal connection of sump pumps in individual homes, homeowner education is the best approach to remedy this situation. Such a program would not only include information on proper sump pump connection, but would also include information on other ways homeowners can assist in protecting themselves from basement flooding such as proper lot grading, ensuring eaves troughs are not connected to the foundation drains and checking for the proper functioning of backwater valves.

A checklist has been developed to assist homeowners with ways of reducing the risk of basement flooding. Residents will also continue to be encouraged to participate in the

City's Residential Protective Plumbing Program. Information on these topics is available at Ottawa.ca and at Client Service Centers.

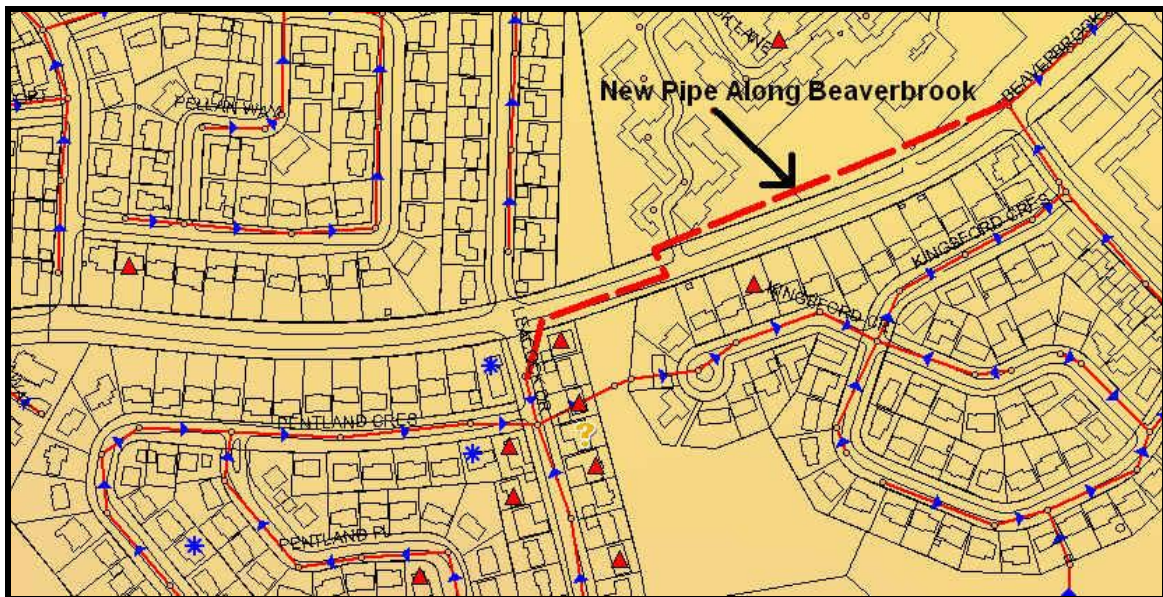
2. *Poor Sewer Hydraulics*

Some sections of the sanitary sewer system exhibit poor hydraulic conveyance due to the lack of adequate pipe slope. In most instances, frequent cleaning of these segments can resolve the problem, but in limited instances the frequent cleaning is not enough and sedimentation and grease accumulation become a chronic problem. This was the case in the Leacock area where a combination of extraneous flows and sediment accumulation contributed to the flooding.

Recommended solution

The extraneous flow portion of the problem will be addressed with the solution noted the previous item. A new sanitary pipe is proposed to bypass the existing pipe that experiences sedimentation problems. The existing pipe on Leacock will also be replaced to improve sewer hydraulics by increasing the slope and diameter of the pipe. Figure 10 shows the proposed sanitary sewer improvements for the Leacock area.

Figure 10 – Leacock Sanitary Sewer Improvement



3. *Overtaxed sewage pumping stations:*

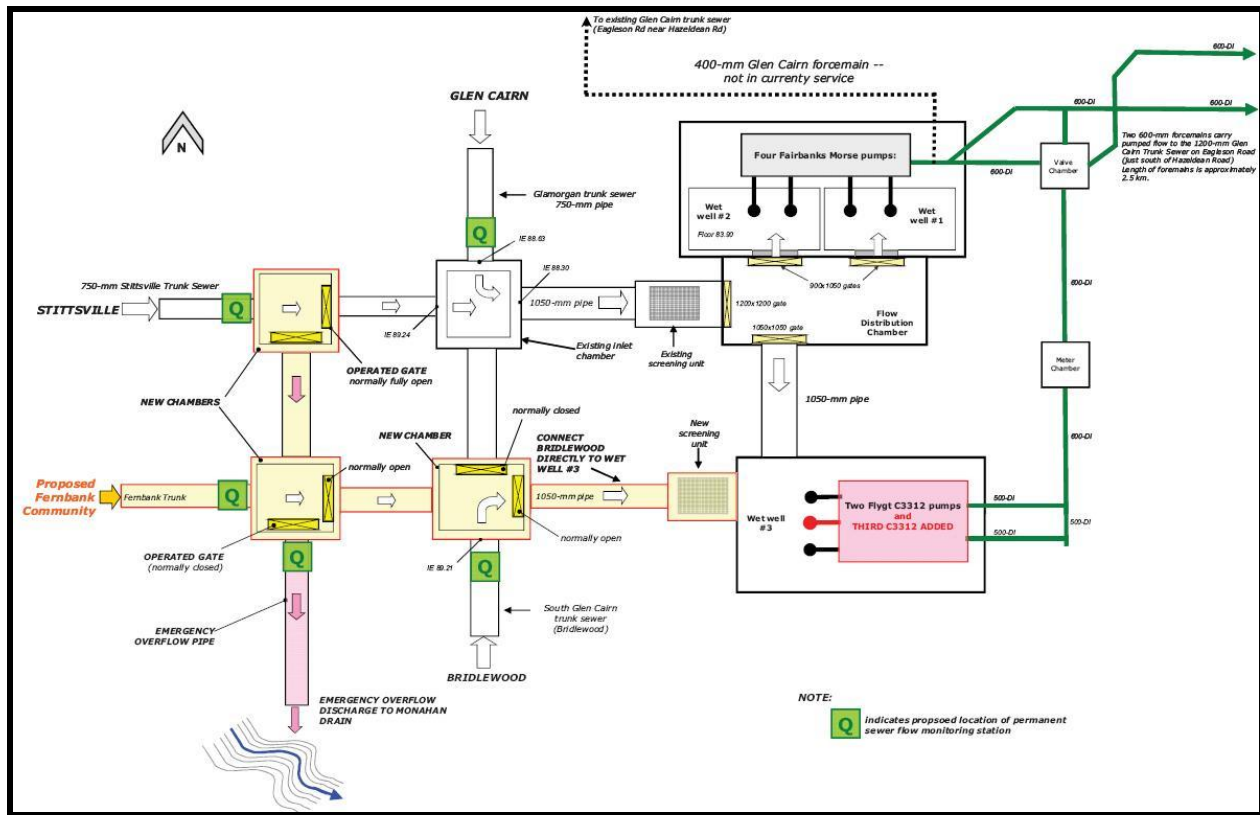
Under normal operating conditions, pumping stations have adequate capacity to handle sewage flows. High extraneous flows reaching pumping stations can cause them to operate at or above their design capacity, thereby creating elevated water levels in the stations themselves (overflows occurred at Fringewood and Acres Road pumping stations on July 24th, 2009).

Elevated wet well levels at the Hazeldean Pumping Station, caused by excessive extraneous flows in the incoming sanitary trunk sewers, contributed to basement flooding in the Glamorgan area.

Recommended solution:

Implementing the measures to remove the extraneous flows from the sanitary sewer system will reduce the risk of the Hazeldean Pumping Station being overwhelmed. Additional measures at the Hazeldean station include improving the station inlet configuration, providing a more effective emergency overflow, and increasing pumping capacity to provide a buffer between current demands and those expected from new developments as well as high extraneous flows experienced during severe rain storms. Figure 11 shows a schematic of the proposed solutions at the Hazeldean Pumping station and further technical details are provided in Appendix 4.

Figure 11 – Hazeldean Pumping Station Solutions



6. Other Findings (Culvert Failures)

The significant rainfall of July 24th, 2009 also contributed to the failure of seven road culverts (all less than 3 m in size) in rural areas. None of these seven culverts contributed to basement flooding and did not result in injuries or damage to private properties.

The extent of failure varied by location. Joint failures on corrugated steel pipe culverts caused most failures and deterioration contributed to others. Corrective action has been taken for all culverts.

7. Preliminary Cost Estimates

Table 1 provides a breakdown of the key remedial measures with their implementation status (as of 31 March 2011) and preliminary cost estimates. Costs presented in this table include the estimates presented in the Kanata North, Kanata South and Stittsville and Carp reports as well as those from the Glen Cairn EA (Appendices 1 to 5). An additional provision has also been included to reflect inflationary cost pressures and allowances for other unknowns.

Table 1 – Recommended Works, Schedule and Preliminary Cost Estimates

Recommended Measure	2010	2011	2012	Total	Status
Replace MH covers and install ICDs (Kanata, Stittsville and Carp)	\$1,300,000			\$1,300,000	Started late fall 2010, to be completed summer 2011
Correct fog testing deficiencies (Kanata and Stittsville)	\$650,000			\$650,000	Started late fall 2010, to be completed summer 2011
Glen Cairn Storm Pumping Station, incl pond cleaning and expansion as required		\$500,000	\$3,100,000	\$3,600,000	Subject to EA approval, design 2011 and construction 2012
Glen Cairn B/W valves and Sump pumps in zones of influence		\$1,000,000	\$1,675,000	\$2,675,000	Implementation to take place in 2011
Glen Cairn Storm drainage system improvements		\$400,000	\$8,400,000	\$8,800,000	Design in 2011/2012 with some construction starting in 2011 to be completed in 2012/2013
Hazeldean Sanitary Pumping Station improvements (surcharge control only)		\$400,000	\$4,200,000	\$4,600,000	Design 2011 and construction 2012 for the surcharge control components only. Provisions to increase capacity for growth not included and subject to discussion with PGM.
Leacock sanitary sewer	\$300,000	\$4,200,000		\$4,500,000	Design and construction in 2011
Cattail creek drainage improvements		\$25,000		\$25,000	Scope of project is being finalized.
Vanstone ditch and sewer upgrades		\$200,000	\$2,000,000	\$2,200,000	Design 2011 and construction in 2012/2013
Stittsville overland flow improvements		\$75,000	\$400,000	\$475,000	Design and construct 2011/2012
Misc and Contingency			\$3,300,000	\$3,300,000	
	\$2,250,000	\$6,800,000	\$23,075,000	\$32,125,000	The total amount does not include the approximately \$6M provisions to increase capacity for growth. This is beyond the scope of flood improvements and implementation is subject to discussions with PGM.

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