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TO:	**CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON MAY 5, 2015**
FROM:	**JOHN BRAAM, P. ENG. MANAGING DIRECTOR, ENVIRONMENTAL & ENGINEERING SERVICES & CITY ENGINEER**
SUBJECT:	**UPDATE ON RESULTS OF SHERWOOD FOREST WEEPING TILE DISCONNECT PILOT PROJECT**

RECOMMENDATION

That, on the recommendation of the Managing Director, Environmental & Engineering Services & City Engineer, with respect to the Sherwood Forest Weeping Tile Disconnect Pilot Project, this report **BE RECEIVED** for information.

PREVIOUS REPORTS PERTINENT TO THIS MATTER

“Contract Award: Tender No. 13-49 & 13-22 Sherwood Forest Weeping Tile Disconnect Internal & External Works (ES2680) (Irregular Result), CWC, May 6, 2013.

"Foundation Drain Disconnection to Mitigate Basement Flooding", CWC, August 21, 2012.

"Foundation Drain Disconnection to Mitigate Basement Flooding", BNEC, November 14, 2011.

“Measures to Reduce Inflow and Infiltration into Sanitary Sewers”, ETC, June 21, 2010.

“Voluntary Downspout Extension Pilot Study: Sherwood Forest”, ETC, June 7, 2010.

“Sherwood Forest Flooding Assessment and Mitigation Works Study – Scope Change – ES2680”, ETC, December 7, 2009.

“Basement Flooding Report: Follow-up to Flooding Events in February 2009 and May 2009”, ETC, November 16, 2009.

“Appointment of Consultant for Sherwood Forest Flooding Assessment and Mitigation Works Study”, ETC, August 24, 2009.

“Grants for Sump Pump, Sewer Ejector and Storm Private Drain Connection By-law”, ETC, August 24, 2009.

“Smoke Testing Sanitary Sewers”, ETC, July 20, 2009.

BACKGROUND

Purpose:

The purpose of this report is to provide Council with the results of the Sherwood Forest weeping tile disconnection pilot project on Blanchard Crescent to mitigate basement flooding.

Additionally, to report back on item b) from the November 11, 2013 Civic Works Committee meeting. See ‘Future Considerations’ below for the report back.

Recommendation: That the following actions be taken with respect to the communication dated November 3, 2013, from P. Machuk, 124 Blanchard Crescent, with respect to a request for

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compassionate compensation regarding the Sump Pump Program Pilot Project on Blanchard Crescent:

a) a one-time $1,000.00 grant BE APPROVED for the following municipal addresses, without prejudice, to assist with future costs to maintain the sump pumps installed under previous sump pump assistance programs, that would otherwise have been paid, had the City installed the sump pumps at those addresses under the Pilot Project:

i) 55 Blanchard Crescent;
ii) 59 Blanchard Crescent;
iii) 63 Blanchard Crescent;
iv) 92 Blanchard Crescent;
v) 120 Blanchard Crescent;
vi) 124 Blanchard Crescent;
vii) 128 Blanchard Crescent; and,

b) the Civic Administration BE DIRECTED to report back with a proposed course of action for the handling of this type of situation should it arise in the future. (2013-F11)

Context:

Basement flooding is a very serious concern for many homeowners in London and throughout North America. For many homeowners, basements are becoming an important living space and can add significant value to the home. The climate is changing and correspondingly the insurance industry has seen a dramatic increase in the frequency and severity of sewer backup damage and claims in municipalities across the country.

The term "Inflow and Infiltration" (I&I) refers to storm water runoff, snow melt and/or ground water that enters the sanitary sewer through a variety of means. Although some volume of I&I is accounted for in the design of sanitary sewers, some areas of the City experience much higher levels of I&I for a number of reasons. See Appendix A for a more in-depth description of I&I.

In the City of London, a major source of excessive volumes of I&I during severe wet weather events originates from pre 1985 vintage residential home private weeping tile (also known as foundation drains), which are connected to the sanitary sewer.

High volumes of I&I in sanitary sewers often results in:

- Higher operating costs at sanitary pumping stations and sewage treatment plants, from pumping and processing this extra flow volume;
- Sewer overflows from the conveyance system and bypasses at the plants, from too great a flow volume for the conveyance and treatment systems to manage; and,
- Basement flooding, from too great a flow volume for the conveyance system to manage causing sewer backups.

The City of London offers a Basement Flooding Grant program which provides up to 75% funding to assist homeowners with the cost of protecting their basement from flooding through disconnection of weeping tile, installation of a sump pump, and installation of a backwater valve. An incentive to use this program by a homeowner that has been subjected to basement flooding clearly exists, but not so for homes that could be contributing to I&I, but not experiencing a flooded basement.

Overview of Blanchard Crescent:

Blanchard Crescent has historically been prone to basement flooding. Prior to this pilot, homes on Blanchard Crescent had their weeping tile directly connected to the sanitary sewer, which was common practice in homes built prior to 1985. Water collected in the weeping tile drainage pipe is considered to be the primary source of Blanchard Crescent's flooding issues. In heavy rain events, excess water would enter the sanitary sewer from weeping tile connections from each house, and in some cases would overload the sanitary sewer, causing some basement backups through the floor drain.

Overview of the Pilot Project:

Historically, municipalities have undertaken infrastructure upsizing and storage in an attempt to mitigate basement flooding. This approach, however, only accommodates the I&I. Additionally, there are challenges associated with sizing infrastructure in these circumstances as there is a risk that a large storm or back to back storms could once again overwhelm the system. Infrastructure upsizing and storage is also very costly.

In the case of Blanchard Crescent, the Environmental and Engineering Service Area (EES) chose to look at a source control solution to disconnect the weeping tile from the sanitary sewer in order to remove the excess I&I and mitigate basement flooding at a sustainable cost. To compare and contrast the cost of source control versus infrastructure upsizing/storage, EES hired AECOM to undertake a pipe upsizing/storage solution for Sherwood Forest neighbourhood. The result included approximately 2.3km of pipe upsizing and 1,400m^3 of storage at a total cost of approximately $10 Million. Alternatively, EES estimated a cost of only $2 Million to provide a source control solution, which, in addition to the cost advantage, was considered a more reliable and robust solution as the challenge of sizing pipes/storage to accommodate I&I for a particular sized storm event was eliminated.

EES subsequently initiated, as a pilot, a voluntary weeping tile disconnection program, which was offered to residents on Blanchard Crescent in addition to 3 other areas in the Sherwood Forest neighbourhood. The pilot tested a 100% funded City program, and was unique in that EES hired a contractor to undertake work on private property and within each participating homeowner's basements. Residents who participated in the project were also provided a $1,000, one time allotment, intended to offset future maintenance and electrical costs associated with sump pump operation.

Pilot program information was clear, at least in the opinion of EES staff, that this allotment was only for those homeowners taking part in this pilot and was not available to those homeowners that had already had a sump pump and backwater valve installed.

A significant percentage of homeowner participation was necessary, in order that a sufficient volume of I&I would be removed to prevent the likelihood of future basement flooding, requiring a threshold of 50% participation for Blanchard Crescent and 75% participation for the other 3 areas. These thresholds were determined through calibrated sanitary sewer system hydraulic modelling. Only Blanchard Crescent received enough voluntary homeowner support to meet the threshold.

Work Undertaken:

Overall, 33 homes, from 50 eligible on Blanchard Crescent, participated in the pilot project. The extent of the work was as follows:

- Install sump pit and sump pump;
- Disconnect weeping tile from sanitary and reconnect to sump pit;
- Install backwater valve on sanitary lateral; and,
- Construct storm sewer private drain connection (PDC) from storm main to house and connect sump pump discharge to storm PDC pipe.

This work was undertaken in summer of 2013.

Cost:

The project was separated into two contracts, one for internal works, which included weeping tile disconnection, installation of sump pit and sump pump, installation of backwater valve, and any necessary restoration. Additionally, an external works contract was issued to install storm sewer PDCs, connect to sump pump discharge pipe exiting the house, and restoration, including road resurfacing. This was undertaken to eliminate the possibility of surface icing issues in the winter due to active sump pump discharge. As noted above, a one time $1,000 allotment to each participating house was also provided. The overall cost to complete the work was $460,175 ($164,533 Internal; $262,642 External; $33,000 allotment). All Season Excavating was awarded both contracts.

Pilot performance:

Cost performance:
The cost to undertake this work was in line with pre construction estimates. Utilizing source control remains approximately 20% of the cost of comparable pipe upsizing/storage which makes source control very cost beneficial. Therefore, the City was able to provide a basement flooding solution at a substantially reduced cost when compared to the alternative of pipe upsizing/storage.

Technical performance:
Overall, this program has been considered to be a technical success. EES staff have been monitoring the flow in the sanitary sewer downstream of Blanchard Crescent, and have seen a dramatic decrease in I&I induced flow since the project was completed. Pipe flows on Blanchard Crescent have been reduced in half. See Appendix B for pre and post flow monitoring results.

Public satisfaction performance:
A post project survey was distributed to all homeowners within the project limits to obtain feedback for this project. Based on this, and other feedback received from these homeowners, it can be concluded that there was an overall appreciation that the City was proactive in initiating the project in an attempt to alleviate the basement flooding issues that historically affected this area. The homeowners were generally pleased with the outcome of the construction phase of the project, understanding that with any construction project, challenges can arise that can alter the original work plan. Communication from the start of the project through to completion was important in order provide the homeowners as much information as possible so they understood the scope of the project, and the potential impacts of construction.

Future Considerations:
EES believe that source control through weeping tile disconnection from the sanitary continues to be an effective means of reducing I&I and basement flooding risk and is less expensive than infrastructure upsizing and storage. The challenge lies with the logistics of undertaking this disconnection since it is located on private property, within homeowner's basements and with receiving interest from homeowners who have historically had dry basements. It is important to educate homeowners so they understand the benefits of weeping tile disconnection, making them more willing to participate in projects of this nature.

As for the $1,000 allotment, a number of homes had, in the past, previously retrofitted a sump pump and backwater valve. In some cases, a previous homeowner undertook the work. When EES informed these homeowners that the $1,000 allotment was only offered through participation in the pilot program and that they were not eligible for it, they in turn lobbied Municipal Council to receive the allotment as well. As can be seen from the *Recommendation* included above, they were successful. Going forward, it is recommended that homes within the project area who used the individual program previously to remove their weeping tile flows from the City sanitary sewer, now be recognized, with the $1,000 allotment, as being part of the neighbourhood solution, saving all ratepayers the higher cost of system based solutions.

Summary:

Blanchard Crescent has historically had basement flooding resulting from overloaded sanitary sewers during heavy rainfall/snowmelt events, due to private side weeping tile connections to the sanitary sewer system. EES undertook a pilot project in 2013 to test an alternative method of source control through disconnection of weeping tile from the sanitary sewer, which involved the City undertaking remedial work on private property and within homeowner's basements. This approach was undertaken to remove excess I&I water flows at the source rather than try to accommodate excess flows by building a storage facility and/or upsizing sewer pipes, which were deemed to be more expensive and potentially less effective options.

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Following the project completion, EES staff has continued to monitor the downstream sanitary sewer and have seen a dramatic decrease in sanitary flows due to excessive I&I during wet weather events.

This pilot project is considered a technical, financial and public satisfaction success. Homeowner education and understanding of the source of basement flooding and the benefit of weeping tile disconnection for I&I removal remain critical to the success of projects of this nature. EES is investigating other suitable target areas to continue this method of reducing I&I to mitigate potential basement flooding.

Acknowledgements:

This report was prepared within the Wastewater and Drainage Engineering Division by Kyle Chambers, P.Eng., Environmental Service Engineer.

PREPARED BY:	**REVIEWED AND CONCURRED BY:**
TOM COPELAND, P. ENG. **DIVISION MANAGER, WASTEWATER AND DRAINAGE ENGINEERING**	**JOHN LUCAS, P. ENG.** **DIRECTOR, WATER AND WASTEWATER**
RECOMMENDED BY:	
JOHN BRAAM, P.ENG. **MANAGING DIRECTOR, ENVIRONMENTAL & ENGINEERING SERVICES & CITY ENGINEER**	

April 28, 2015
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APPENDIX "A" Inflow and Infiltration Description

What is Inflow and Infiltration (I&I) and why is it a problem?

For the past 50-70 years, most North American cities, including London, have constructed two sewers to service developments: one sewer, a storm sewer, is constructed to collect rain and melt water runoff (through catchbasins on the road), and one sewer, a sanitary sewer, is constructed to collect sanitary flow (for discharge of all internal plumbing fixtures including showers, laundry, toilet, sinks, etc.). Sanitary sewers are not sized for collecting or conveying storm water. The occurrence of storm water or groundwater entering into sanitary sewers is called Inflow and Infiltration (I&I); Inflow is the direct flow of storm water into a sanitary sewer through a direct connection, and Infiltration is the seepage of groundwater into a sanitary sewer through leaks or cracks in the sewer. Infiltration is a function of the condition of the sewers and can be addressed through long term management and rehabilitation/replacement of sewers. Inflow, however, must be addressed in a different manner and should be minimized as much as possible, since it has the potential to contribute very large volumes of extraneous flow.

Where does Inflow come from?

Inflow comes from direct storm water source connections into the sanitary sewer. This can include catchbasins, roof downspouts, and foundation drains. Catchbasins, if found to be mistakenly connected to a sanitary sewer, are redirected to storm sewers at the earliest opportunity. It is illegal, under London's by-law to connect a roof downspout directly to a sanitary sewer, therefore, there is a means to rectify and remove that inflow source if one is found. However, foundation drains connected to the sanitary sewer remain as a major source of inflow which the City currently has no means of controlling. The following provides a brief history of foundation drains, as they apply to the City of London.

When a home is constructed foundation drains, or weeping tiles, are placed around the perimeter of the house at the bottom of the foundation. The purpose of these foundation drains is to collect groundwater (and groundwater only) to take it away from the base of the home before it has a chance to get into the basement through the concrete walls or through the joint between the basement floor and the basement wall (which is not generally water tight). The traditional view was that these foundation drains conveyed only small amounts of water, and so they were connected to the home's sanitary connection pipe. This practice was continued in London until 1985. In 1985, London's by-law was changed and foundation drains were no longer allowed to be connected to the sanitary sewer. Instead, foundation drains were directed to a sump pit and discharged to the outside surface via a sump pump. This change was made as it was found that increasingly higher volumes of inflow were being directed into the sanitary sewers from the foundation drains, and in some cases, causing sanitary sewer surcharging, leading to basement flooding. Various icing and surface water issues associated with sump pump discharges led to another by-law change in 1995. All homes constructed after 1995 are required to discharge all sump pump flow directly into a storm private drain connection (PDC) which is connected directly to the storm sewer.

The following table simplifies the timeline:

Year	Foundation Drains Connected To:
Up to 1985	Sanitary Sewer
1985 – 1995	Sump Pit Discharging to Surface
1995 - Present	Sump Pit Discharging to Storm Sewer

The problem of inflow from foundation drains is increased by the following conditions:

- Lot grading: lots around homes are originally graded so that water flows away from the house. However, over time, settlement can occur, which can direct water towards homes, down the foundation wall, and into the foundation drain
- Clay Soils: Clay type soils do no absorb water; therefore, water travels along the ground, rather than being absorbed.
- Roof Downspouts: Roofs on homes can collect a tremendous amount of water. Roof downspouts are supposed to be extended at least two meters away from the base of

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the home. If downspouts are outletting too close to the home, the water simply infiltrates down to the foundation drains.
- Smaller Lots: Some subdivisions have very close lot spacing. This reduces the amount of green space and increases the amount of hard surfaces (roofs, driveways), which reduces the ability for the land to absorb water. Instead, water gets directed along the surface.

Some areas in London have all of the above characteristics: small lots; clay soil, poor lot grading, downspouts exiting too close to the home, and foundation drains connected to the sanitary sewer. During extreme rain events, there is simply too much water being directed to the sanitary sewer from foundation drains.

Other Issues Associated with I&I:

Basement flooding can be considered the worst case outcome associated with too much I&I in the sanitary sewers. However, I&I can pose other problems as well, which are outlined below:
- Overflows/Bypasses – London has overflows, or bypass pipes within the sewer system and at every pumping station and treatment plant. If wet weather flows in the sanitary sewer become too great to handle, the excess flow is bypassed directly to a watercourse to prevent basement flooding. These flows are not treated, and therefore may have an environmental impact on the watercourses.
- Treatment Cost – All sanitary flow is treated at one of London's six sewage treatment plants. Storm sewers discharge directly to a watercourse. When I&I get into the sanitary sewer, we are forced to treat the additional volumes, which results in an additional unnecessary operational cost. Reduction in I&I equals less flow, which results in lower treatment costs.
- Lower Sewer Capacity – I&I takes up space, or capacity, inside the sanitary sewer. Lack of capacity limits the amount of development growth which can be accommodated by the sewer system. Reduction in I&I frees up sewer capacity, which can allow further growth to develop without requiring costly sewer, pumping station, and plant upsizing.

How do we reduce I&I?

The City has a comprehensive capital sewer replacement and lining program to replace or rehabilitate aging sewers. This goes a long way toward addressing the infiltration side of I&I but does not adequately address the inflow side of the equation. Foundation drains remain a very large contributor to inflow. Currently, London has a voluntary sump pump grant program which is offered to homeowners in flood prone areas. This program disconnects foundation drains from the sanitary sewer, installs a sump pit and sump pump, and install a backflow preventer (valve in sewer connection which closes if flow direction reverses) to protect the homeowner from future sewer surcharges. This program is 75% funded by the City. However, to date, the City has had very low uptake on the program. The other large drawback is that it receives no interest from 'dry' basement owners, even though their foundation drains are contributing equally to the inflow problem.

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The following table (circa 2011) outlines what some other municipalities are doing to disconnect foundation drains. Note that Fort Erie is the only municipality in Ontario which has implemented a mandatory disconnect program. Duluth, Minnesota has also implemented a similar program, although Duluth has different federal regulatory requirements to comply with.

Municipality	Type	Eligible Items	Amount of Subsidy	Upset Funding
London	Voluntary	Sump Pump, Backwater Valve, Storm PDC	75%	
Toronto	Voluntary	weeping tile disconnect, sump pump, backwater valve	80% of the cost of eligible works (to an upset cost limit)	
Hamilton	Voluntary	backwater valve, sump pump, sewer lateral inspection / repair, downspout disconnect		combined maximum of $2,000 per property
Ottawa	Voluntary	installation of protective plumbing devices, sump pumps, downspout disconnect / flat roof work.	50% - 100% of the cost of eligible works to a maximum	maximum of $2,500 to $7,500, depending on scenario
Region of Halton	Voluntary	weeping tile disconnect, sump pump, backwater valve	50% of the cost of eligible works (to an upset cost limit)	
Sudbury	Voluntary	weeping tile disconnect, sump pump, backwater valve	50% of the cost of eligible works (to an upset cost limit)	
Fort Erie	Mandatory	weeping tile disconnect, sump pump, backwater valve , downspout disconnect, sewer later repair	100% of the cost of eligible works (to an upset cost limit)	

Other Means of Addressing I&I, Wet Weather Flow:

While it is recognized that the most effective way of managing I&I is to remove it at the source, there are other, albeit costly, methods of dealing with excessive wet weather flow into the sanitary sewer system. They include:

- Sewer Separation – this applies to older areas of the City which were originally constructed with only one sewer. Catchbasins, a major source of inflow, are connected to the sanitary sewer in these areas. A storm sewer must be constructed in these areas

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to provide an alternate outlet for the catchbasins. This is very costly, and typically only occurs when the combined sewer reaches the end if its life.

- Storage – When wet weather flows in the sanitary sewer exceed the capacity of the conveyance system or the pumping station/plant capacity, an alternative to bypassing is to store the additional flows, which are released back into the system at a slower rate after the storm has ended. This solution is also very costly, and still requires the City to treat all of the inflow, as none of the flow is removed, it is simply stored and treated at a later time. Examples of storage solutions in London include twin in line storage pipes which were constructed in White Oaks, and a large overflow pond which was constructed next to the Dingman Pumping Station. However, these very costly solutions have their limitations; a storm (or back to back storms) exceeding the capacity of the storage results in basement flooding or overflows to the adjacent watercourse.
- Rapid Treatment at the Plant – Advances in technology has allowed for more rapid treatment processes at the plant to allow the plant to handle more flow. However, there are still two obvious drawbacks: 1) we must still pay to treat the additional flow since it has not been removed, and 2) the conveyance system must be big enough to carry the flow; if inflow overwhelms the sewers or the pumping station, basement flooding or bypasses can still occur, no matter how rapid the plant can treat the flows.

There is no better solution than to remove the flow at the source. By removing the flow, one does not have to be concerned about pipe upsizing, storage, pumping station upgrades, rapid treatment processes, or additional costs associated with treatment of inflow. Foundation drains remain a major contributor to inflow, and it is anticipated that a foundation drain disconnection program in basement flooding prone areas will provide a solution to basement flooding that is much more cost effective in both the short and long term.

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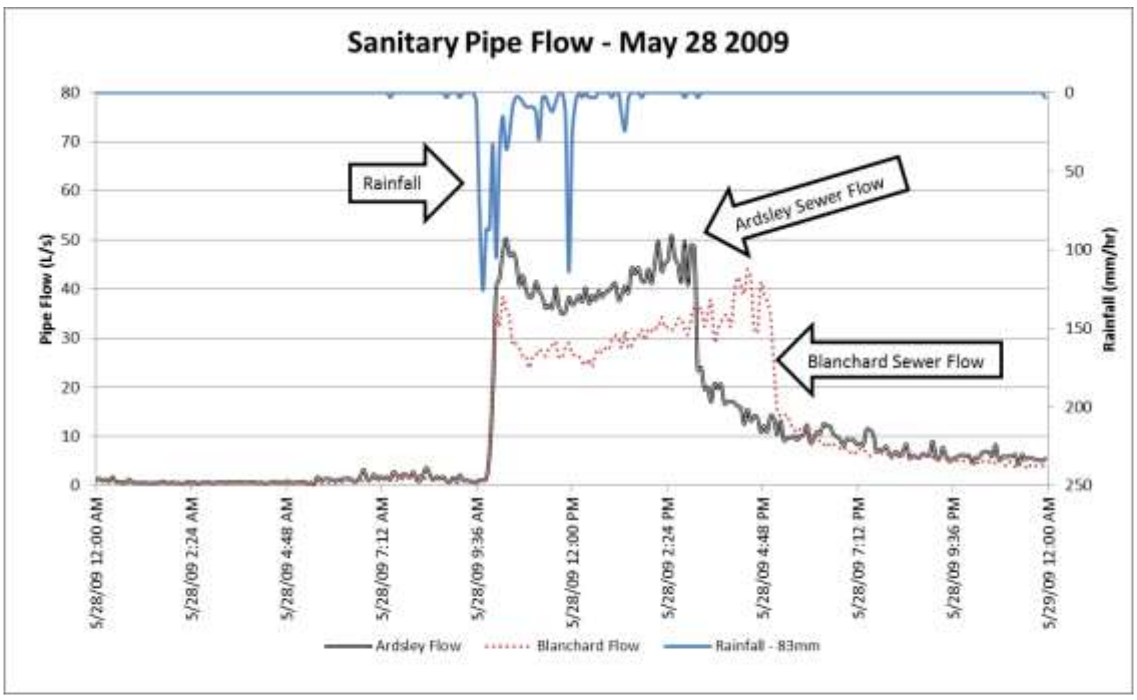
Appendix B

Flow Monitoring Results:
Blanchard Crescent and Ardsley Crescent are located within the same neighbourhood and have very similar characteristics. To measure the effectiveness of the pilot project, the City utilized sanitary sewer flow monitors to compare "before and after" sanitary flows. Prior to the pilot project being undertaken, Blanchard and Ardsley experienced significant sanitary flows during wet weather. This is shown in the May 28, 2009 chart which shows Ardsley peaking at 50 litres per second (L/s) while Blanchard peaked at 45 L/s. This flow is approximately double the capacity of the sewers.



Immediately following construction in 2013, this area experienced significant rainfall on both September 11th, and on September 20th-21st. The chart below shows sanitary sewer response on September 20th-21st. It is noted that September 11th flows showed the same pattern. The chart below indicates virtually no wet weather response in the Blanchard Cr. sewer which is surprising since approximately half of the homes still have weeping tile connected to the sanitary sewer. Staff have continued to monitor and have undertaken maintenance of flow monitor sensors and equipment at the site.

On September 10th, 2014 a heavy rainfall event did result in wet weather response in Blanchard. It is noted that peak flow was approximately half of Ardsley sewer. This 2014 flow data is in line with staff expectations. Staff have not definitively determined why Fall 2013 flows are so low, but currently it is considered an anomaly.

It does appear that the Blanchard sanitary sewer now receives half the flow of what would be expected had weeping tile not been disconnected. Staff therefore consider this project to be a technical success because it maintained peak flows within the capacity of the sewer serving the street.

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