

Public Information Centre



SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA Municipal Class Environmental Assessment Update Phases 1 & 2

October 26, 2016

The City of
BARRIE

Welcome

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What is a Class Environmental Assessment?

- Planning and design process to identify, compare, and evaluate alternative solutions to an identified problem
- Applies to all municipal road, water, and wastewater projects and significant private projects as per the Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (EA) document, dated October 2000 (as amended in 2007, 2011 and 2015)
- Considers all aspects of the environment: physical, natural, social, cultural and economic

How Does a Class EA Work?

- Five Phases (see Municipal Class EA Process chart)
- This project is currently in Phase 2 and is following the Schedule 'B' process

This Public Information Centre will:

- Consult with the public and affected parties
- Assist in the selection of a preferred alternative

Public & Stakeholders should:

- Sign the registry
- Review the presentation material
- Ask questions of the City and/or Consultant
- Submit a comment sheet & indicate which design concept alternative you prefer and whether or not you want to be kept informed of the staff recommendations for the preferred alternative solution that will be presented to the General Committee as well as the publication of the Notice of Completion
- All comment sheets are to be returned to the City of Barrie by Thursday, November 10, 2016

Public Information Centre

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Comments and information regarding this project are being collected to assist the project team in meeting the requirement of the Municipal Class EA process. These comments will be maintained for reference throughout the project and, with the exception of personal information, may be used in the final documentation and will become a part of the public record.

The City of Barrie continues to enhance accessibility that is inclusive of all ages and abilities. The information presented at today's Public Information Centre can be provided in alternative formats upon request. Such a request should be submitted to:

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City of Barrie Engineering Dept.

70 Collier Street, P.O. Box 400

Barrie, ON L4M 4T5

t: (705) 739-4220 ext 4782

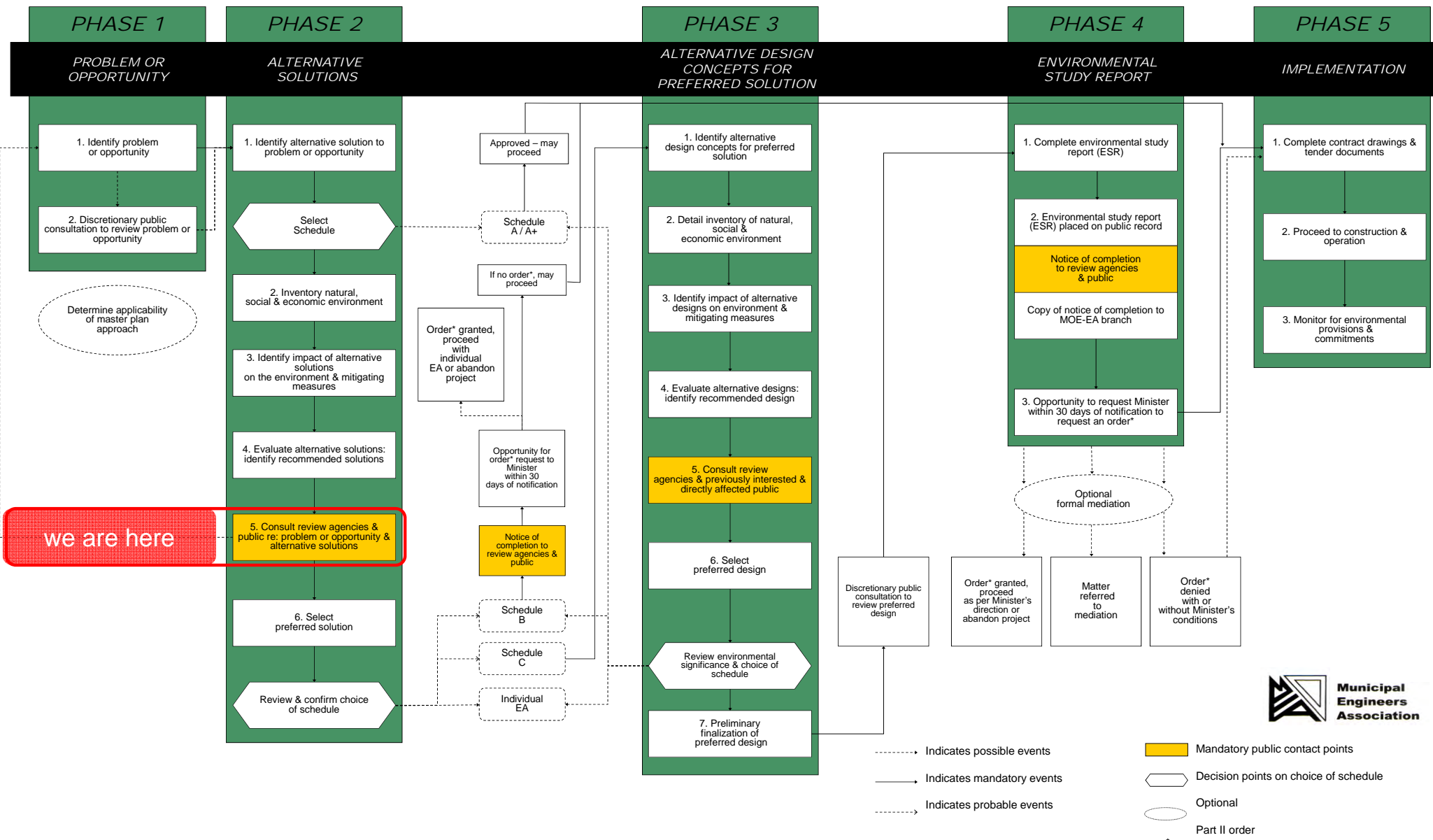
f: (705) 739-4247

e: lcooney@barrie.ca



Municipal Class EA Process

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Study Objective & Purpose

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The objective of the study is to update the Sophia Creek MDP completed in 2002 to ensure current standards and watershed objectives are met and to reduce flooding in the drainage systems within the Study Area.

This includes an assessment of the impact of stormwater runoff on drainage infrastructure in the watershed. It considers alternative solutions that include the following:

- Conveyance capacity improvements (road culvert crossings, channels improvements and trunk storm sewer) along Sophia Creek from Duckworth Street/Currie Street to Kempenfelt Bay
- Flow reduction/water quality improvements to minimize sedimentation and erosion in the watercourse
- Minimize building encroachments into the watercourse floodplain and reduce private property affected by flood waters

The purpose of Phases 1 & 2 of the study is to:

- Develop alternative design concepts to address the problem statement
- Identify the location, extent & sensitivity of affected environments
- Assess the design alternatives given potential impacts
- Identify the preferred design alternative(s)
- Establish measures to mitigate adverse impacts
- Satisfy the requirements for a Class EA study

Problem Statement

Currently, portions of the Sophia Creek watershed and Mulcaster drainage area experience flooding during both minor and major storm events. In addition, much of the existing storm infrastructure is reaching its service life expectancy and deteriorating and does not meet current City of Barrie Standards. The flooding has caused historic damage to both private and municipal property and causes concern for public safety.

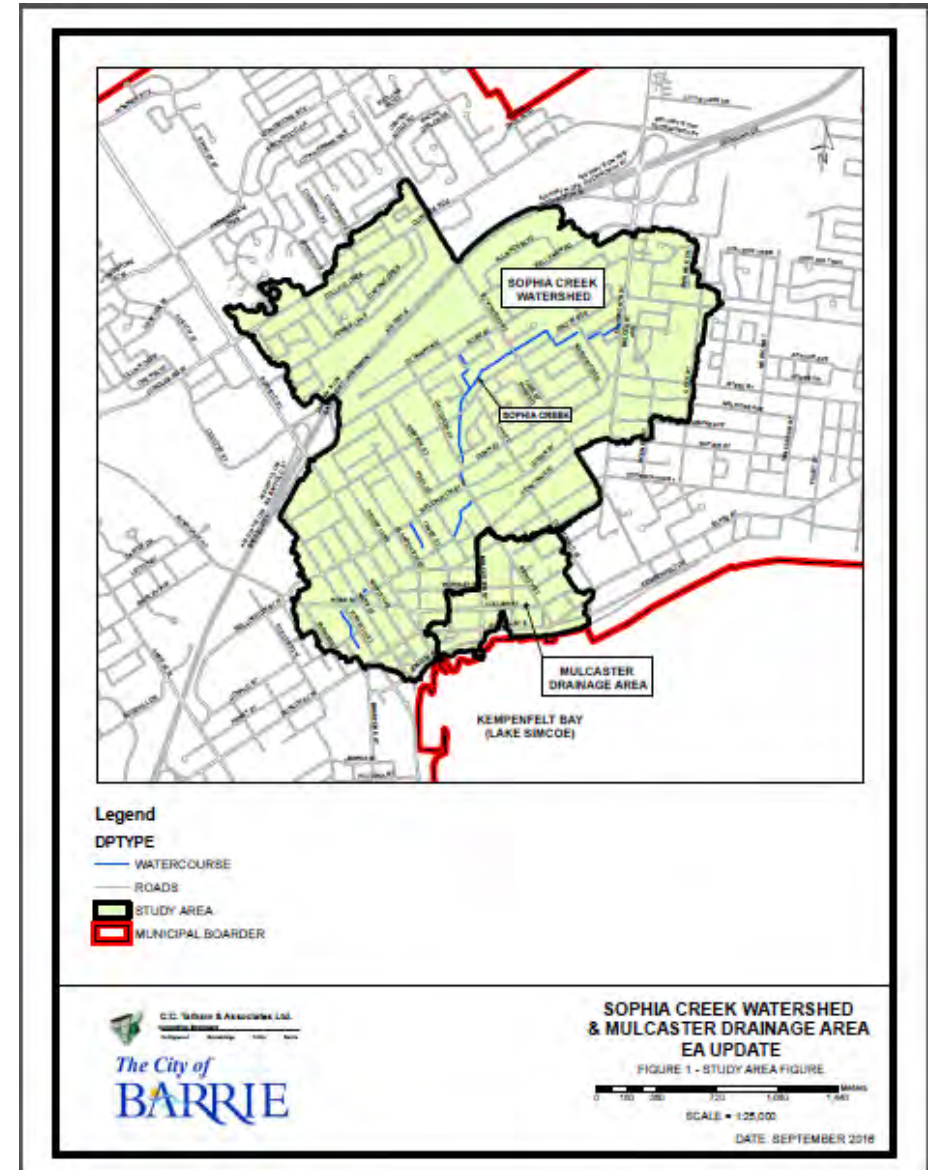
Specifically, culvert and storm sewer capacities along many streets in the Sophia Creek watershed and Mulcaster drainage area are inadequate resulting in the flooding of private properties.

The trunk storm sewer downstream of Peel Street to Kempenfelt Bay also has limited capacity and in some areas is located on private property. Deficient overland flow routes also exist that restrict the conveyance of overland flow.

Study Area

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- Sophia Creek watershed and Mulcaster drainage areas are in the north end of Barrie and flow south to Kempenfelt Bay
- Watershed is 95% developed
- Tributary area of +/- 470 hectares (Sophia) and 44 hectares (Mulcaster)
- Approximately 58% residential, 37% non-residential and 5% undeveloped
- 55% open channel, 45% storm sewer / enclosed pipe



Project Background

The City of Barrie completed the Sophia Creek Master Drainage Plan (MDP) Update Class EA in 2002 that included recommendations for improvements to the creek corridor such as:

- Increasing the capacity of specific road crossing culverts
- Construct two (2) stormwater management facilities (MacMorrison Park and 364 St. Vincent Street)
- Increase watercourse capacity in targeted areas to reduce flooding on private properties

Since 2002 a few specific projects have been implemented and City Design Standards have changed. The 2002 MDP also did not include recommendations specific to the trunk storm sewer function and drainage system downstream of Peel Street.

- The City subsequently, in 2015, developed minor and major storm models of the City's storm infrastructure in PCSWMM, Visual OTTHYMO and HEC RAS. The models were used to identify deficiencies to allow for evaluation of improvement alternatives. The following maps present the existing drainage infrastructure and summarize the noted deficiencies from the modelling completed.
- The intent of this PIC is to present those alternatives being considered.

To help identify all of the drainage issues in the Study Area, we would like you to consider the following:

- Are you a resident/landowner in the Sophia Creek watershed or Mulcaster drainage area?
- Is there a drainage problem you are aware of or have observed in the Study Area?
- If so, please take a moment to review the following maps and identify to a City representative and or Consultant of the location and extent of your observations.

Figure: Sophia Creek Watershed and Mulcaster Drainage Area – Existing Drainage Infrastructure

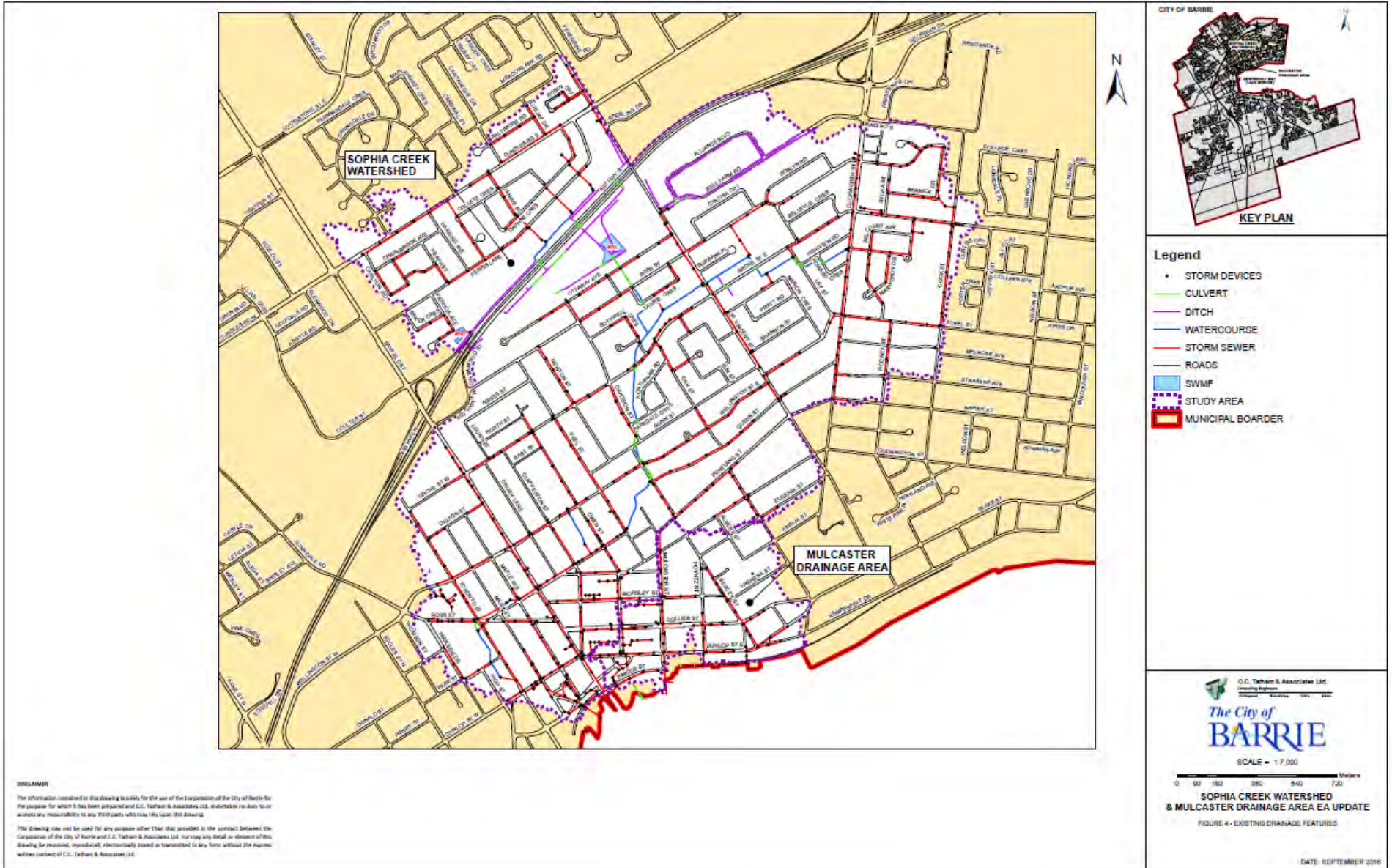


Figure: Sophia Creek Watershed and Mulcaster Drainage Area – Minor Drainage System Deficiencies

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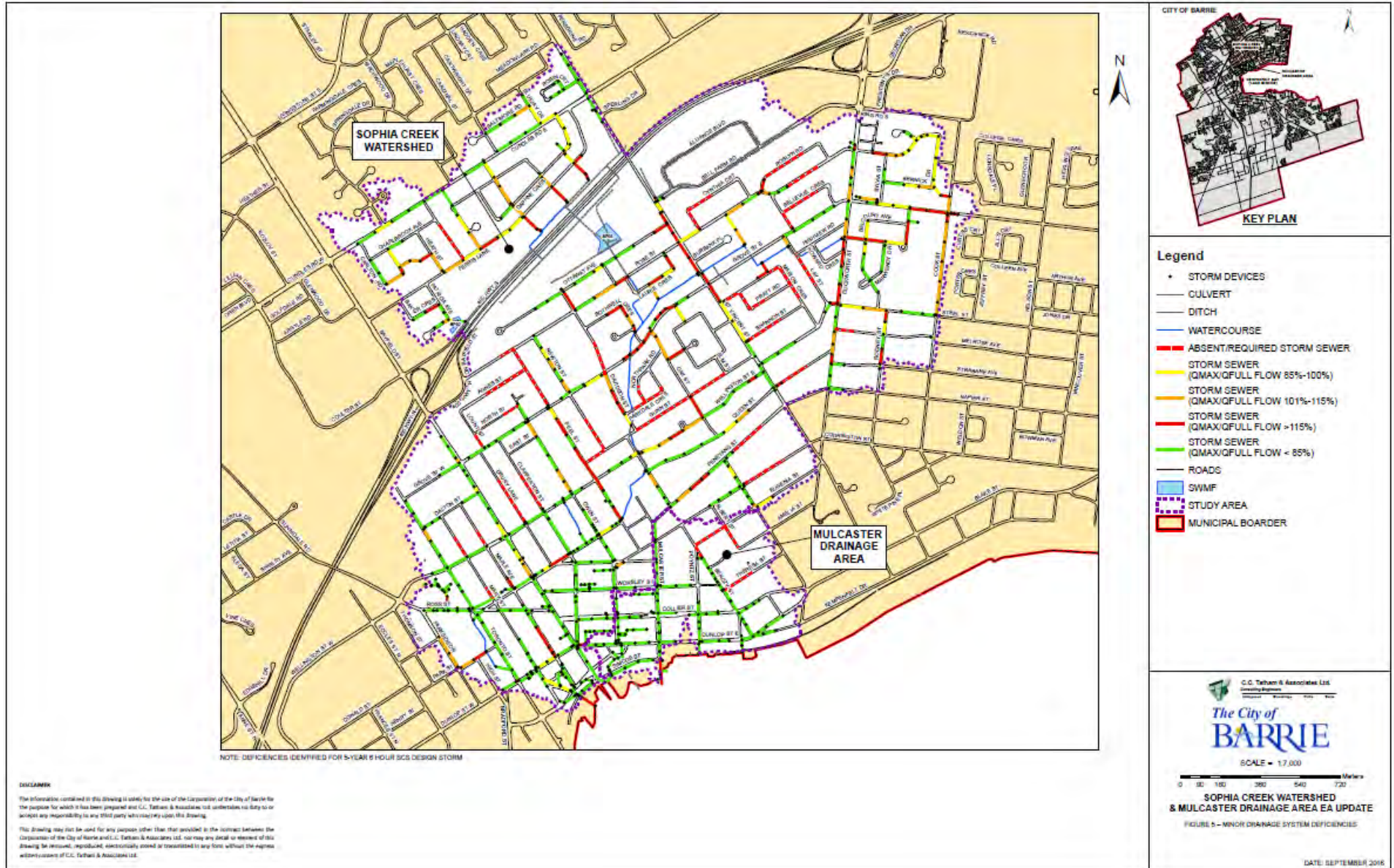


Figure: Sophia Creek Watershed and Mulcaster Drainage Area – Major Drainage System Deficiencies

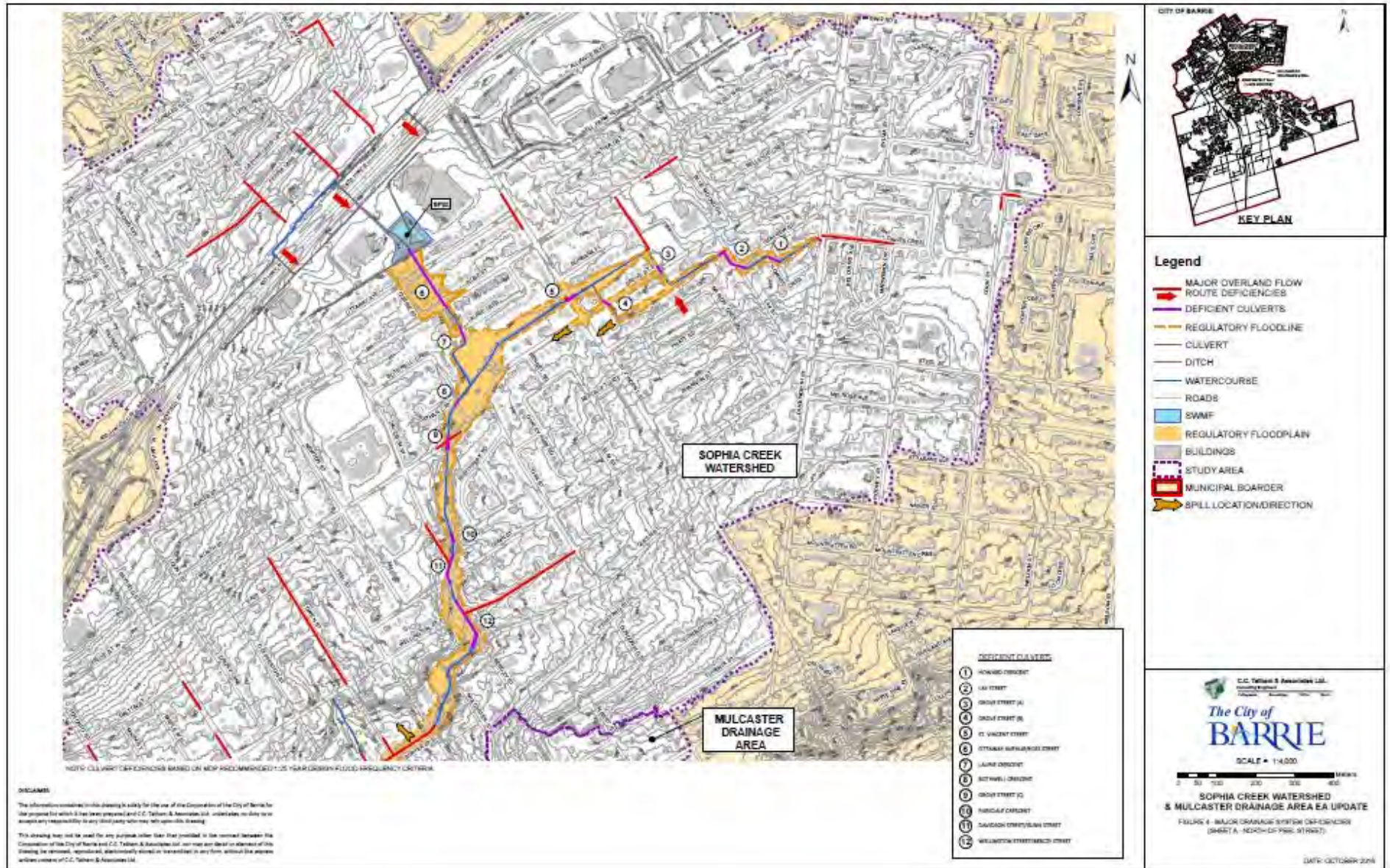
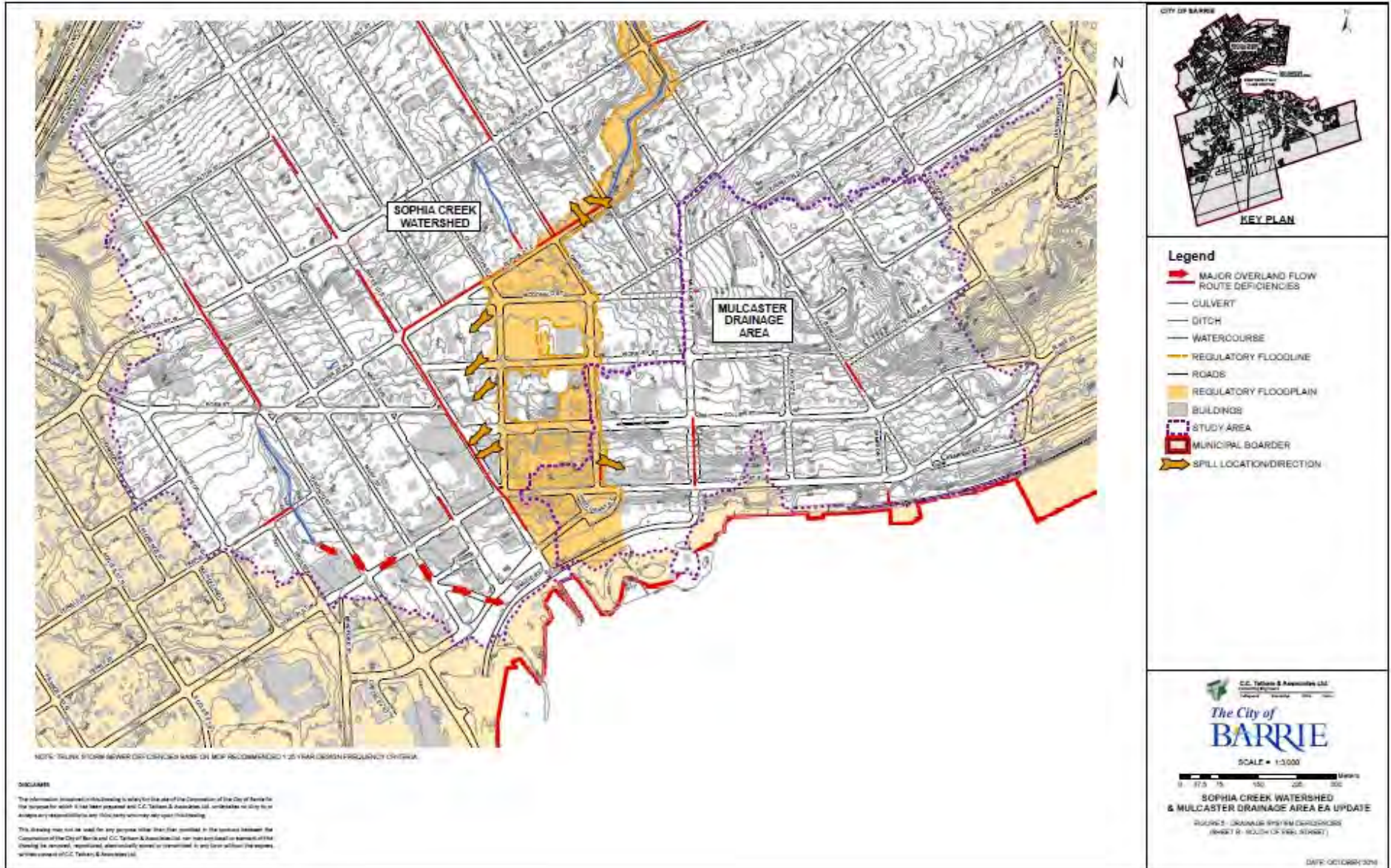


Figure: Sophia Creek Watershed and Mulcaster Drainage Area – Major Drainage System Deficiencies

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Alternative Screening

Utilizing the background modelling results and input from the other project disciplines (natural heritage, geotechnical, archaeological), a number of alternatives were pre-screened and categorized based on the following:

- 1) Area wide or location specific measures that can be implemented across the watershed that provide an overall benefit to water quality and quantity. These include SWM facility retrofits and/or the implementation of new SWM measures such as Low Impact Development (LID) techniques to reduce flows and improve water quality.
- 2) Conveyance improvements to the main channel and culverts upstream of Peel Street. These include improving road culvert crossings and the conveyance capacity of open channel sections on both public and private property.
- 3) Conveyance improvements to the trunk storm system downstream of Peel Street to Kempenfelt Bay. This includes evaluating alternative routes/alignments and options for improving trunk storm sewer capacity downstream of Peel Street.

A series of alternatives that passed the pre-screening criteria were then brought forward as described in the following.

Potential Alternatives

Alternative 1 – “Do Nothing” Existing Conditions

- Sophia Creek watershed and Mulcaster drainage area are to remain in existing condition with no further improvements proposed.
- Creek conveyance deficiencies including undersized culvert crossings and private dwellings in the floodplain will remain.
- There is potential for many properties to be affected during a major storm event.
- This alternative includes the City of Barrie continuing on its current schedule of performing routine maintenance including removal of sediment, correcting flood problems and remediation of erosion as they occur.
- If this alternative were selected, consideration should be given by the City to acquiring the private properties or interests therein (easements) that are impacted by flooding to comply with the City of Barrie Drainage Policies.

Sophia Creek – Potential Watershed Wide Alternatives

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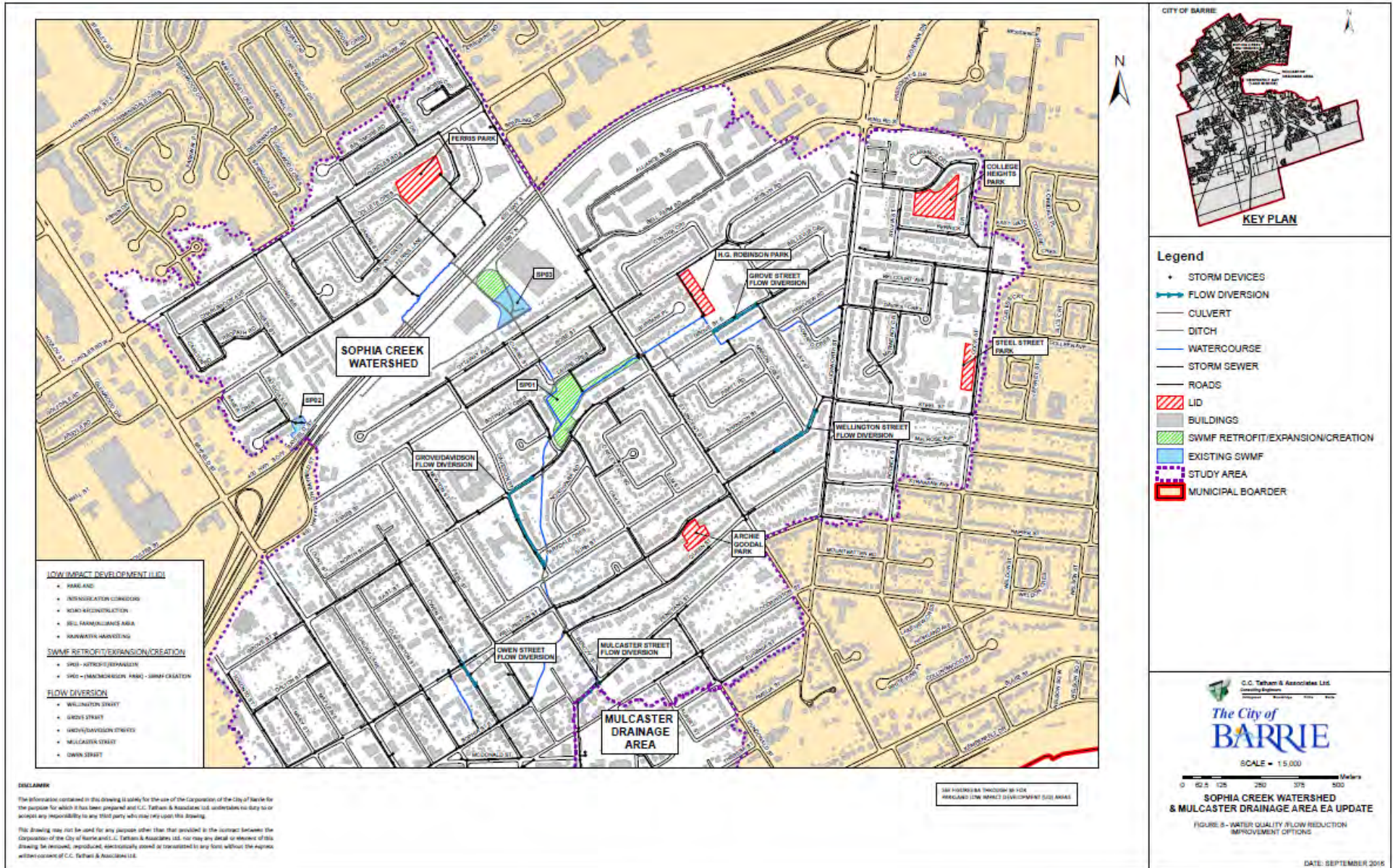
Alternative 2A – Retrofit Existing and/or Propose New Stormwater Management Facilities

- Two suitable sites have been identified for the construction of two online SWM facilities within Sophia Creek corridor
- Expand/retrofit the Ottaway Avenue/Currie Street SWMF (designated SP03). This will reduce downstream peak flows by 15-45%. This option will require land acquisition.
- Create new SWMF in MacMorrison Park (designated SP01). This will reduce downstream peak flows by 13-27%. This option will result in the loss of the existing use of much of park.
- Will reduce the frequency of flooding in areas, however it will not eliminate flooding of private property due to undersized infrastructure.

Alternative 2B – Implement Low Impact Development (LID's) Techniques

- LID techniques include at-source and conveyance SWM controls such as rain water harvesting, soakaway pits, infiltration trenches, bio-retention areas, permeable pavers, etc. (see examples)
- Implementation of LID's will provide important volume reduction, water quality and water balance benefits across the watershed.
- Analysis indicated existing conditions across the watershed are only partially suitable for the implementation of LID's with 35% of the area having suitable soil and groundwater conditions.
- Because of the limited ability to apply LID's across the watershed their implementation will not have an appreciable reduction in peak flows or flooding (estimated flow reduction of 2-6%). They will however, positively improve water quality and water balance in the Study Area.
- Potential sites have been identified on the following figure. Implementation can also occur across the watershed within the municipal road allowance on a best effort basis as City infrastructure renewal projects proceed.
- The implementation of LID's on private property should be encouraged throughout the study area.

Figure: Potential SWMF Retrofit/Creation and LID Options - Alternatives 2A and 2B



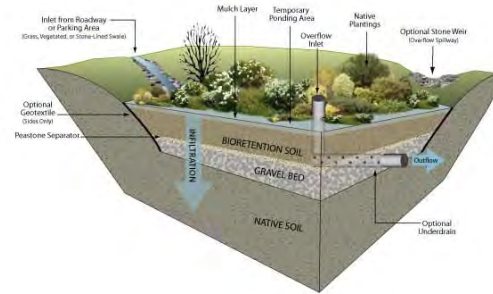
Sophia Creek – LID Examples

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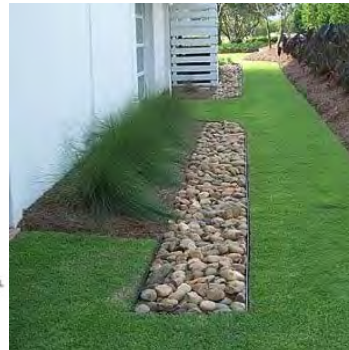
■ Rainwater Harvesting



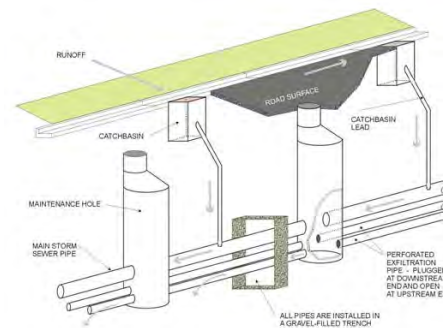
■ Bioretention



■ Soakaway Pits / Infiltration Trenches



■ Perforated Pipe Systems



Sophia Creek – Potential Conveyance Capacity Alternatives Upstream of Peel Street

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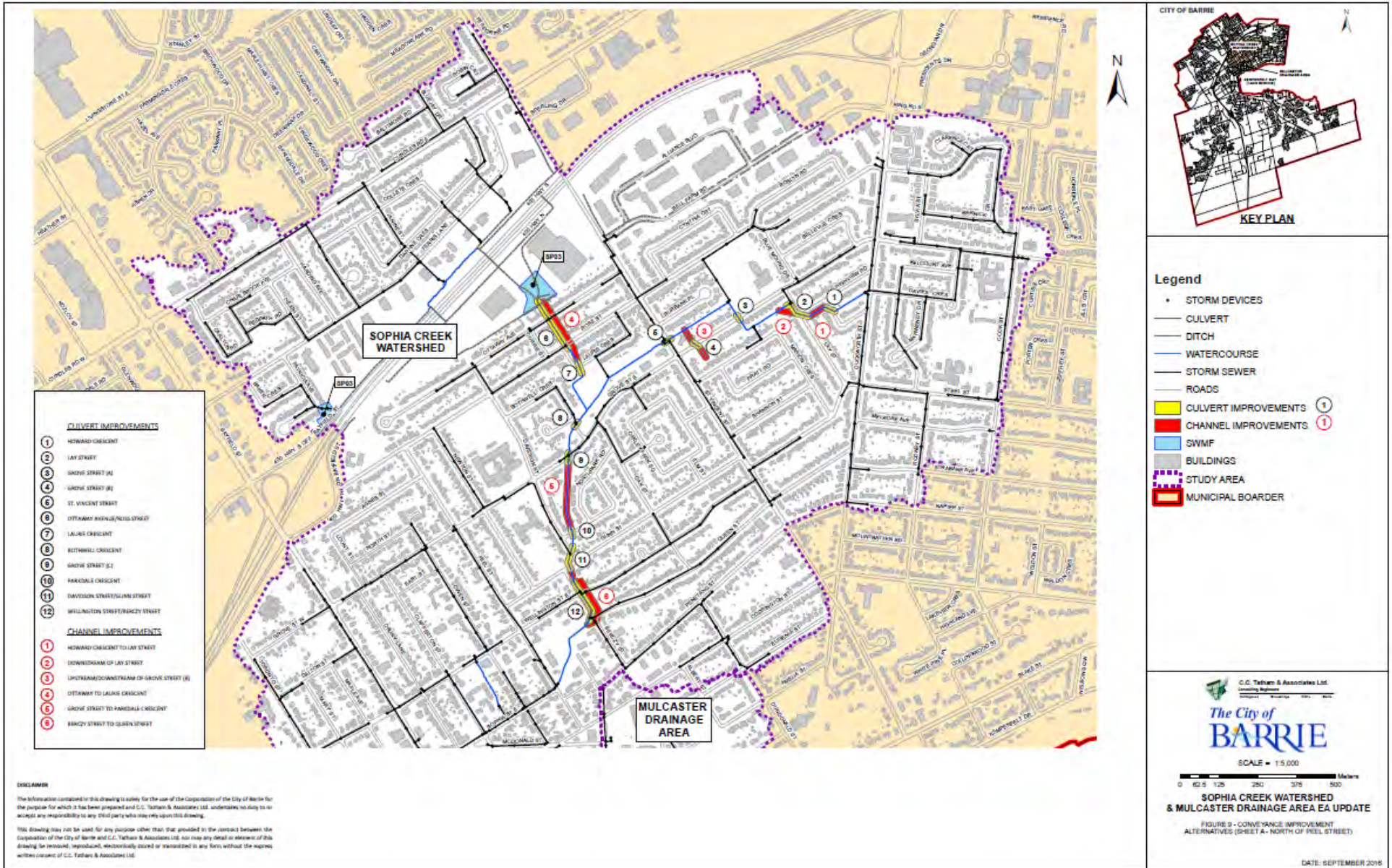
Alternative 3A – Culvert/Channel Conveyance Improvements (1:25 year) Upstream of Peel Street

- Replace culverts to meet 1:25 year design storm peak flow targets.
- 12 Identified culverts include: Howard Crescent, Lay Street, Grove Street (A), Grove Street (B), St. Vincent Street, Ottaway Avenue/Rose Street, Laurie Crescent, Bothwell Crescent, Grove Street (C), Parkdale Crescent, Davidson Street/Gunn Street, Wellington Street/Berczy Street
- Six (6) channel improvement locations: from Howard Crescent to downstream of Lay Street (2), from Bothwell Crescent to Parkdale Crescent (2), daylight watercourse from SWMF SP03 to Laurie Crescent, daylight watercourse along Berczy Street to Queen Street.
- 17 properties will need to be acquired to fully implement this alternative.
- Flood occurrences will be reduced to occur only following storm events greater than the 1:25 year storm.
- Culvert sizes and flooding issues can be further reduced if you implement Alternative 3A in combination with 2A and 2B.

Alternative 3B – Culvert/Channel Conveyance Improvements (to meet City design standard)

- Replace culverts to satisfy City design standards.
- Same 12 culverts as Alternative 3A have been identified for replacement.
- Same six (6) channel reaches as Alternative 3A have been identified for improvement.
- 17 properties will need to be acquired to fully implement this alternative.
- Flood occurrences would be reduced to meet City Standard; limited to greater than 1:50 year or 1:100 year storm events depending on the road classification.
- Culvert sizes and flooding issues can be reduced if you implement Alternative 3B in combination with 2A and 2B.

Figure: Potential Conveyance Improvements Upstream of Peel Street - Alternatives 3A and 3B



Sophia Creek – Potential Conveyance Improvements

Alternatives Downstream of Peel Street

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Alternative 4A – Owen Street Trunk Storm Sewer

- Trunk storm sewer downstream of Peel Street currently has a capacity <1:5 year storm. As a result, new trunk storm sewer alignments/routes were considered.
- A 1.8 m x 3.6 m box culvert on Sophia Street from Peel Street to Owen Street and on Owen Street from Sophia Street to Kempenfelt Bay would convey 1:100 year storm satisfying City design standards.
- If implemented in combination with Option 2A the trunk storm sewer could be reduced in size to a 1.5 m x 3.0 m box culvert.

Alternative 4B – Mulcaster Street Trunk Storm Sewer

- Trunk storm sewer downstream of Peel Street currently has a capacity <1:5 year storm. As a result, new trunk storm sewer alignments/routes were considered.
- A 3.0 m diameter trunk storm sewer from Sophia Creek down Mulcaster to Kempenfelt Bay would convey the 1:100 year storm and satisfying City design standards.
- Property acquisition would be required (71 McDonald, 92 Worsley) and other easements (13 Codrington Street, 76 and 88 Mulcaster Street) where sewer crosses private property.
- Deep sewer depths requiring non conventional construction techniques (micro tunneling) from Sophia Creek to Collier Street would be required.
- If implemented in combination with Option 2A the trunk storm sewer could be reduced in size to a 2.4 m diameter sewer.

Sophia Creek – Potential Conveyance Improvements

Alternatives Downstream of Peel Street

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Alternative 4C – Clapperton Street Trunk Storm Sewer

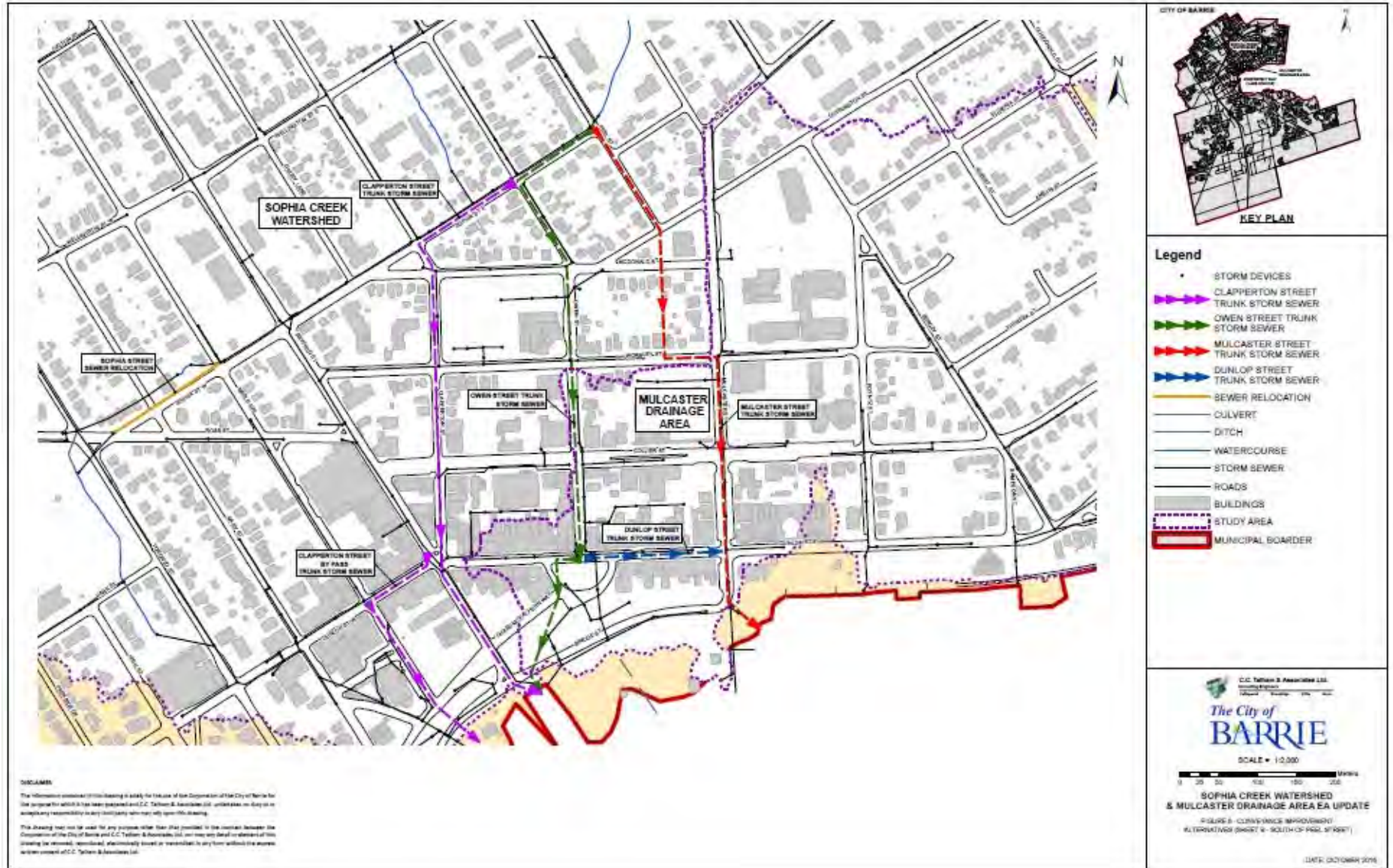
- Trunk storm sewer downstream of Peel Street currently has a capacity <1:5 year storm. As a result, new trunk storm sewer alignments/routes were considered.
- A 1.8 m x 3.6 m box culvert on Sophia Street from Peel Street to Clapperton Street, on Clapperton Street from Sophia Street to Bayfield Street, and on Bayfield Street from Clapperton Street to Kempenfelt Bay combined with a by-pass trunk storm sewer on Dunlop Street from Bayfield Street to Maple Street (2 m diameter storm sewer) and on Maple Street from Dunlop Street to Kempenfelt Bay (twin 1.25 m x 2.7 m box culvert) would convey 1:100 year storm satisfying City design standards.
- If implemented in combination with Option 2A the by-pass trunk storm sewer can be eliminated.

Alternative 4D – Dunlop Street Trunk Storm Sewer

- Trunk storm sewer downstream of Peel Street currently has a capacity <1:5 year storm. As a result, new trunk storm sewer alignments/routes were considered.
- A 1.8 m x 3.6 m box culvert on Sophia Street from Peel Street to Owen Street, on Owen Street from Sophia Street to Dunlop Street, on Dunlop Street from Owen Street to Mulcaster Street and on Mulcaster Street from Dunlop to Kempenfelt Bay would convey the 1:100 year storm satisfying City design standards.
- If implemented in combination with Option 2A the trunk storm sewer could be reduced in size to a 1.5 m x 3.0 m box culvert.

Figure: Potential Conveyance Improvements Downstream of Peel Street – Alternatives 4A and 4B

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Sophia Creek – Screening of Alternatives

Table 25: Assessment of Improvement Alternatives – Flow Reduction / Water Quality Improvement Alternatives

Evaluation Criteria	How the Criteria is Being Assessed	Design Alternative 1: "Do Nothing" (Existing Conditions)	Design Alternative 2A: Retrofit New Stormwater Management Facilities (SWMF)	Design Alternative 2B: Low Impact Development (LID's)
Physical Environment	Impact on Private Property	Increase/Decrease in the extent and frequency of private property flooding	Continued flooding of private property during minor and major design storms along Sophia Creek and through downstream core	Reduction of peak flows resulting in a decrease in the extent and frequency of flooding; flooding will still occur
	Impact on Existing Storm Sewer System	Increase/Decrease of flow to local and trunk storm sewer throughout the study area	Continued overcharging of existing storm sewers due to undetected pipes	Reduction of peak flows to Sophia Creek/Sayfield Street trunk storm sewer; no impact on flow to local storm sewers
	Impact on Existing Sanitary Sewer System	Severity/Number of conflicts with existing sanitary sewerlines Increase/Decrease in stormwater inflow to sanitary sewer system	No conflicts with the existing sanitary sewer system or services Continued inflow of stormwater runoff into sanitary sewer system during minor and major storm events	No conflict with the existing sanitary sewer system or services Reduction of stormwater inflow into the sanitary sewer system during minor and major storm events
	Impact on Existing Water Main	Severity/Number of conflicts with existing water mainlines	No conflicts with the existing water mainlines	No conflicts with the existing water mainlines
	Impact on Existing Utilities	Severity/Number of conflicts with existing underground utilities	No conflicts with existing utilities	No conflicts with existing utilities
	Impact on Existing Transportation System	Increase/Decrease in the extent and frequency of flooding within the road allowance Severity of the disturbance to the transit system during construction	Continued flooding of existing transportation system during minor and major storm events No disturbance to transit system as no construction is installed as part of "Do Nothing"	Decrease in flooding of existing transportation system along Sophia Creek and through downtown core Temporary disturbance to transit system (Snowfall Cease) during SWMF SPO1 construction
	Impact on Existing Floodplain	Increase/Decrease in flood level along Sophia Creek and through the downtown core	No impact on flood level in study area	Decrease in flood levels along Sophia Creek and through downtown core due to access to levees
Natural Environment	Impact on Parklands	Loss/Gain of parkland and/or green space Severity of the disturbance to parkland or use thereof	No impact on park level or green space	Loss of baseball diamond in Macklebrook Park for construction of SWMF SPO1; SWMF will remain passive parkland for public use
	Impact on Existing Vegetation	Loss/Gain of vegetation (trees, shrubs, etc.) designated endangered, threatened or special concern Enhancement/Diminishment of native species	No impact on existing vegetation	Minor loss of vegetation (grasses) through SWMF retrofit/construction Opportunity to enhance native plantings
	Impact on Fisheries within Creek	Alteration, disruption and/or destruction of fish habitat and aquatic features in Sophia Creek	No fisheries or fish habitat identified within Sophia Creek, as such no impact on fisheries within the Creek	No fisheries or fish habitat identified within Sophia Creek, as such no impact on fisheries within the Creek
	Impact on Terrestrial Wildlife	Loss/Gain of wildlife habitat throughout the study area	No impact on wildlife habitat in study area	Opportunity to enhance wildlife habitat in SWMF SPO1 and SPO1
	Impact on Existing Water Quality	Improvement/Diminishment of storm water runoff quality	Continued diminishment of the stormwater quality throughout the watershed	Improvement in water quality for SWMF SPO1 and SPO1 catchment areas No improvements in water quality downstream of SWMF SPO1 and SPO1
Social Environment	Impact on Property Value	Increase/Decrease in property values due to the extent and frequency of flooding Presence of municipal infrastructure on private property	Decrease in property values due to continued flooding during minor/major storms	Increase in property values downstream of SWMF SPO1 and SPO1 along Sophia Creek due to reduced frequent nuisance flooding during minor storms
	Impact on Public Safety	Increase/Decrease in potential public safety hazards due to flooding and erosion	Potential public safety concerns remain due to continued flooding during minor/major storms	Decrease in potential public safety hazards due to reduced flows, flooding and erosion during minor/major storm events
Cultural Heritage Environment	Archeological and Heritage Impacts	Potential contribution to the removal of archeological resources	No archeological or heritage impacts	Potential contribution to the removal of archeological resources in Macklebrook Park and 304 St. Vincent Street
Economic Environment	Impact on Drainage System Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance to municipal drainage systems Improvement/Diminishment of access to drainage infrastructure	Increase in drainage system maintenance costs due to aggrading/erosion of storm infrastructure and continued flooding/erosion No improvement in access to drainage infrastructure	Reduction in peak flows and flooding along with an improvement in water quality will reduce maintenance requirements No impact on access to existing drainage infrastructure
	Impact on Property Acquisition Costs	Property and easement acquisition costs	\$81,960,000	\$480,000
	Impact on Construction Costs	Preliminary estimated construction costs	\$0	\$4,239,668
	Impact on Private Property Maintenance Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance on private property	Increase in private property maintenance costs due to aggrading/erosion of storm infrastructure and continued flooding	Reduction in peak flows and flooding along with an improvement in water quality will decrease maintenance requirements

Legend

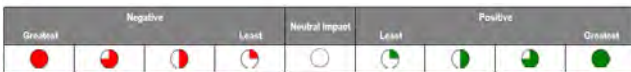


Table 26: Assessment of Improvement Alternatives – Conveyance Improvements (Upstream of Peel Street)

Evaluation Criteria	How the Criteria is Being Assessed	Design Alternative 3A: Culvert Channel/Major Drainage System Improvements (1:25 Year Conveyance Capacity)	Design Alternative 3B: Culvert/Channel/Major Drainage System Improvements (Design Flood Frequency Criteria)
Physical Environment	Impact on Private Property	Increase/Decrease in the extent and frequency of private property flooding	Reduction in the extent and frequency of flooding on private property during storms up to the 25 year storm event upstream of Peel Street
	Impact on Existing Storm Sewer System	Increase/Decrease of flow to local and trunk storm sewer throughout the study area	No impact on flow to local and trunk storm sewer
	Impact on Existing Sanitary Sewer System	Severity/Number of conflicts with existing sanitary sewerlines Increase/Decrease in stormwater inflow to sanitary sewer system	No conflicts with the existing sanitary sewer system Reduction of stormwater inflow into the sanitary sewer system during minor and major storm events (up to the 1:25 year storm)
	Impact on Existing Water Main	Severity/Number of conflicts with existing water mainlines	Conflict with existing watermain requiring the watermain to be lowered at multiple road crossings
	Impact on Existing Utilities	Severity/Number of conflicts with existing underground utilities	Conflict with existing utilities requiring the utilities to be relocated at multiple road crossings
	Impact on Existing Transportation System	Increase/Decrease in the extent and frequency of flooding within the road allowance Severity of the disturbance to the transit system during construction	Decrease in the extent and frequency of flooding within the road allowance during storms up to the 25 year storm event Temporary disturbance to transit system at each road crossing during construction
	Impact on Existing Floodplain	Increase/Decrease in flood level along Sophia Creek and through the downtown core	Decrease in flood levels along Sophia Creek (upstream of Peel Street) during minor and major storm events, up to the 25 year storm event
Natural Environment	Impact on Parklands	Loss/Gain of parkland and/or green space Severity of the disturbance to parkland or use thereof	No loss/gain of parkland and/or green space or use thereof
	Impact on Existing Vegetation	Loss/Gain of vegetation (trees, shrubs, etc.) designated endangered, threatened or special concern Enhancement/Diminishment of native species	Minor loss of vegetation along Sophia Creek Opportunity to enhance native species along improved channel sections
	Impact on Fisheries within Creek	Alteration, disruption and/or destruction of fish habitat and aquatic features in Sophia Creek	No fisheries or fish habitat identified within Sophia Creek, as such no impact on fisheries within the Creek
	Impact on Terrestrial Wildlife	Loss/Gain of wildlife habitat throughout the study area	Opportunity to enhance wildlife habitat along improved channel sections
	Impact on Existing Water Quality	Improvement/Diminishment of storm water runoff quality	Daylighting watercourse will provide minor improvement in storm water runoff quality
Social Environment	Impact on Property Value	Increase/Decrease in property values due to the extent and frequency of flooding Presence of municipal infrastructure on private property	Increase in property values along Sophia Creek (upstream of Peel Street) due to reduced flooding during minor and major storms, up to the 25 year storm event
	Impact on Public Safety	Increase/Decrease in potential public safety hazards due to flooding and erosion	Decrease in potential public safety hazards upstream of Peel Street due to reduced flooding and erosion during minor and major storms, up to the 25 year storm event
Cultural Heritage Environment	Archeological and Heritage Impacts	Potential contribution to the removal of archeological resources	No archeological or heritage impacts
Economic Environment	Impact on Drainage System Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance to municipal drainage systems Improvement/Diminishment of access to drainage infrastructure	Reduction in flooding will decrease drainage system maintenance requirements Improved access to existing storm infrastructure
	Impact on Property Acquisition Costs	Property and easement acquisition costs	\$4,175,000
	Impact on Construction Costs	Preliminary estimated construction costs	\$17,419,587
	Impact on Private Property Maintenance Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance on private property	Reduction in flooding will decrease private property maintenance requirements

Legend



Sophia Creek – Screening of Alternatives

Table 27: Assessment of Improvement Alternatives – Conveyance Improvements (Downstream of Peel Street)

Evaluation Criteria	How the Criteria is Being Assessed	Design Alternative 4A: Owen Street Trunk Storm Sewer and Major Drainage System Improvements	Design Alternative 4B: Mulcaster Street Trunk Storm and Major Drainage System Improvements
Physical Environment	Impact on Private Property	Increase/Decrease in the extent and frequency of private property flooding	Reduction in the extent and frequency of flooding of private property downstream of Peel Street through the downtown core
	Impact on Existing Storm Sewer System	Increase/Decrease of flow to local and trunk storm sewer throughout the study area	No impact on flow to local or trunk storm sewer throughout study area
	Impact on Existing Sanitary Sewer System	Severity/Number of conflicts with existing sanitary sewer services Increase/Decrease in stormwater inflow to sanitary sewer system	No conflicts with existing sanitary sewer system Reduction of stormwater inflow into the sanitary sewer system during minor and major storm events
	Impact on Existing Water Main	Severity/Number of conflicts with existing water main services	Conflict with existing watermain requiring the watermain to be lowered at multiple locations
	Impact on Existing Utilities	Severity/Number of conflicts with existing underground utilities	Conflict with existing utilities requiring the utilities to be relocated at multiple locations
	Impact on Existing Transportation System	Increase/Decrease in the extent and frequency of flooding within the road allowance Severity of the disturbance to the transit system during construction	Decrease in extent and frequency of flooding in road allowance through downtown core during minor and major storm events Significant temporary disturbance to transit system during construction (local collector and arterial roads)
	Impact on Existing Floodplain	Increase/Decrease in flood level along Sophia Creek and through the downtown core	Decrease in flood levels during minor and major storms through downtown core
Natural Environment	Impact on Parklands	Loss/Gain of parkland and/or green space Severity of the disturbance to parkland or use thereof	No loss/gain of parkland or green space Disturbance to memorial park during construction
	Impact on Existing Vegetation	Loss/Gain of vegetation (trees, shrubs, etc.) designated endangered, threatened or special concern Enhancement/Diminishment of native species	No impact on vegetation in the study area No opportunity to enhance native species
	Impact on Fishes within Creek	Alteration, disruption and/or destruction of fish habitat and aquatic features in Sophia Creek	No impact on fish habitat or aquatic features in Sophia Creek
	Impact on Terrestrial Wildlife	Loss/Gain of wildlife habitat throughout the study area	No impact on wildlife habitat downstream of Peel Street
	Impact on Existing Water Quality	Improvement/Diminishment of storm water runoff quality	No impact on the quality of storm water runoff
Social Environment	Impact on Property Value	Increase/Decrease in property values due to the extent and frequency of flooding Presence of municipal infrastructure on private property	Increase in property values through downtown core due to reduced flooding during minor and major storm events
	Impact on Public Safety	Increase/Decrease in potential public safety hazards due to flooding and erosion	Decrease in potential public safety hazards due to reduced flooding during minor and major storm events
Cultural Heritage Environment	Archaeological and Heritage Impacts	Potential contribution to the removal of archaeological resources	Potential contribution to the removal of deep archaeological resources through historic Town of Blaine
Economic Environment	Impact on Damage System Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance to municipal drainage systems Improvement/Diminishment of access to drainage infrastructure	Reduction in flooding will reduce drainage system maintenance requirements through downtown core
	Impact on Property Acquisition Costs	Property and easement acquisition costs	\$0
	Impact on Construction Costs	Preliminary estimated construction costs	\$12,816,164
	Impact on Private Property Maintenance Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance on private property Improvement/Diminishment of access to drainage infrastructure	Reduction in flooding will reduce private property maintenance requirements through downtown core

Legend

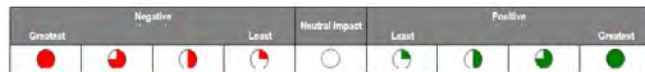
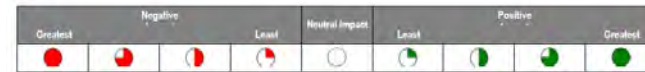


Table 28: Assessment of Improvement Alternatives – Conveyance Improvements (Downstream of Peel Street)

Evaluation Criteria	How the Criteria is Being Assessed	Design Alternative 4C: Clapperton Street Trunk Storm Sewer and Major Drainage System Improvements	Design Alternative 4D: Darling Street Trunk Storm and Major Drainage System Improvements
Physical Environment	Impact on Private Property	Increase/Decrease in the extent and frequency of private property flooding	Reduction in the extent and frequency of flooding of private property downstream of Peel Street through the downtown core
	Impact on Existing Storm Sewer System	Increase/Decrease of flow to local and trunk storm sewer throughout the study area	No impact on flow to local or trunk storm sewer throughout study area
	Impact on Existing Sanitary Sewer System	Severity/Number of conflicts with existing sanitary sewer services Increase/Decrease in stormwater inflow to sanitary sewer system	No conflicts with existing sanitary sewer system Reduction of stormwater inflow into the sanitary sewer system during minor and major storm events
	Impact on Existing Water Main	Severity/Number of conflicts with existing water main services	Conflict with existing watermain requiring the watermain to be lowered at multiple locations
	Impact on Existing Utilities	Severity/Number of conflicts with existing underground utilities	Conflict with existing utilities requiring the utilities to be relocated at multiple locations
	Impact on Existing Transportation System	Increase/Decrease in the extent and frequency of flooding within the road allowance Severity of the disturbance to the transit system during construction	Decrease in extent and frequency of flooding in road allowance through downtown core during minor and major storm events Significant temporary disturbance to transit system during construction (local collector and arterial roads)
	Impact on Existing Floodplain	Increase/Decrease in flood level along Sophia Creek and through the downtown core	Decrease in flood levels during minor and major storms through downtown core
Natural Environment	Impact on Parklands	Loss/Gain of parkland and/or green space Severity of the disturbance to parkland or use thereof	No loss/gain of parkland or green space Disturbance to memorial park during construction
	Impact on Existing Vegetation	Loss/Gain of vegetation (trees, shrubs, etc.) designated endangered, threatened or special concern Enhancement/Diminishment of native species	No impact on vegetation in the study area No opportunity to enhance native species
	Impact on Fishes within Creek	Alteration, disruption and/or destruction of fish habitat and aquatic features in Sophia Creek	No impact on fish habitat or aquatic features in Sophia Creek
	Impact on Terrestrial Wildlife	Loss/Gain of wildlife habitat throughout the study area	No impact on wildlife habitat downstream of Peel Street
	Impact on Existing Water Quality	Improvement/Diminishment of storm water runoff quality	No impact on the quality of storm water runoff
Social Environment	Impact on Property Value	Increase/Decrease in property values due to the extent and frequency of flooding Presence of municipal infrastructure on private property	Increase in property values through downtown core due to reduced flooding during minor and major storm events
	Impact on Public Safety	Increase/Decrease in potential public safety hazards due to flooding and erosion	Decrease in potential public safety hazards due to reduced flooding during minor and major storm events
Cultural Heritage Environment	Archaeological and Heritage Impacts	Potential contribution to the removal of archaeological resources	Potential contribution to the removal of deep archaeological resources through historic Town of Blaine
Economic Environment	Impact on Damage System Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance to municipal drainage systems Improvement/Diminishment of access to drainage infrastructure	Reduction in flooding will reduce drainage system maintenance requirements through downtown core
	Impact on Property Acquisition Costs	Property and easement acquisition costs	\$0
	Impact on Construction Costs	Preliminary estimated construction costs	\$21,373,512
	Impact on Private Property Maintenance Costs	Increase/Decrease in maintenance required to clear obstructions, repair erosion, remove accumulated sediment, and perform routine maintenance on private property Improvement/Diminishment of access to drainage infrastructure	Reduction in flooding will reduce private property maintenance requirements through downtown core

Legend



Next Steps

Remainder of Study to:

- Review/address public, agency & stakeholder comments
- Conduct assessment of alternative design concepts
- Identify preferred design alternative (may be a combination of alternatives)
- Prepare final report for Council review/endorsement
- Place final report on public record for 30-day review period

Before you leave:

- Have your questions been addressed?
- Have you signed the registry?
- Have you completed a comment sheet?

All comment sheets are to be returned to the City by Thursday, November 10, 2016

Please feel free to contact the City and/or their Consultant any time should you have any further questions or concerns

For Additional Information:

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Thank you for your interest in this project