TORONTO

REPORT FOR ACTION

Rockcliffe Riverine Flood Mitigation Project Municipal Class Environmental Assessment

Date: May 11, 2022
To: Infrastructure and Environment Committee
From: General Manager, Transportation Services, and General Manager, Toronto Water
Wards: Ward 5, York South-Weston

SUMMARY

The Rockcliffe-Smythe area is located in Ward 5 (York South—Weston) and is the most flood vulnerable area in the Toronto and Region Conservation Authority's jurisdiction. There are hundreds of buildings within the regulatory floodplain of Black Creek and Lavender Creek; many of these properties experience frequent surface and basement flooding during severe storms. This is a result of riverine flooding and the overloading of the City of Toronto's urban drainage system.

The City of Toronto, together with Toronto and Region Conservation Authority (TRCA), initiated a Municipal Class Environmental Assessment (MCEA) to determine a preferred riverine flood mitigation strategy for the Rockcliffe-Smythe neighbourhood, and satisfy all four phases of the MCEA process. This study built upon recent advancements in the understanding of the causes of flooding within the community. Completion of the MCEA is the next step necessary to meet regulatory requirements prior to construction of flood mitigation measures.

This report recommends the Preferred Solution and Design for providing riverine flood protection to the Rockcliffe-Smythe area for endorsement by City Council. This report also reviews the opportunities explored to naturalize the Black Creek Channel as a part of establishing the alternative designs as directed by City Council.

The Preferred Solution involves significant infrastructure investment to modify the Black Creek and Lavender Creek Channels, construct a new flood protection wall, road realignment, as well as several bridge and culvert replacements. The entire project would be constructed in phases over an anticipated 10-year timeframe, and would flood protect 195 homes located in approximately 80 hectares (198 acres) of flood prone land from the 350-year flood area, and remove 222 buildings from the regulatory floodplain during a regional storm event, at an estimated cost of approximately $371 million.

RECOMMENDATIONS

The General Manager, Transportation Services and the General Manager, Toronto Water recommend that:

1. City Council endorse the recommended Preferred Solution and Design for flood protecting the Rockcliffe-Smythe area as generally shown in Attachment 1.

2. City Council request the Toronto and Region Conservation Authority (TRCA), General Manager, Transportation Services and General Manager, Toronto Water to prepare the Environmental Study Report (ESR), issue the Notice of Completion, and put the ESR in the public record in accordance with the requirements of the Municipal Class Environmental Assessment.

FINANCIAL IMPACT

The Preferred Solution and Design involves significant infrastructure investment to modify the Black Creek and Lavender Creek Channels, construct a new flood protection wall, road realignment as well as several bridge and culvert replacements. If approved, the entire project would be constructed in phases over an anticipated 10-year timeframe with an estimated cost of approximately $371 million, including sewer upgrades within the area to mitigate basement flooding.

Of the infrastructure upgrades proposed, the Jane Street Bridge Replacement and Symes Road Culvert Replacement projects are funded in the 2022-2031 capital budget and plan ($56 million), with approved funding contributions committed for the Jane Street Bridge Replacement under the Federal Disaster Mitigation Adaptation Fund (DMAF). Basement Flooding Protection Program project 45-48 is funded in Toronto Water's 2022-2031 capital budget and plan ($163.4 million), scheduled for a targeted construction start of 2027.

The remaining infrastructure upgrades proposed are currently not funded. An application requesting funding contributions for the remaining projects from DMAF has been submitted and is pending approval from the Federal government, with status and response anticipated by fall 2022.

The City will continue to explore other funding opportunities to support the proposed infrastructure upgrades identified in the Rockcliffe Riverine Flood Mitigation EA.As the EA continues to be developed and upon receipt of DMAF grant, funding required for the remaining projects would be submitted for consideration at the appropriate time through the future budget process.

The Chief Financial Officer and Treasurer has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

At its meeting on April 6, 2022, City Council adopted a motion "Seeking Provincial Funding for the Construction of Riverine Flood Mitigation for the Rockcliffe-Smythe Area" directing the City Manager to review opportunities and initiate a request for funding from the Province along with funding from the Federal government, to support the recommendations identified in the Rockcliffe Riverine Flood Mitigation Environmental Assessment Project. City Council also requested the General Manager, Transportation Services and the General Manager, Toronto Water to work with the Chief Executive Officer, Toronto and Region Conservation Authority to finalize an implementation phasing plan to optimize the order of the final solution http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2022.MM42.6

At its meeting on July 14, 2021, City Council adopted a motion "Reviewing suggested solutions to reduce the impact of flooding in the Rockcliffe-Smythe area" requesting the General Manager, Transportation Services and the General Manager, Toronto Water to work with the Toronto and Region Conservation Authority to explore opportunities to naturalize the Black Creek Channel as a part of establishing the alternative design options. http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2021.MM35.27

At its meeting on June 18, 2019 City Council adopted the Federal Disaster Mitigation and Adaptation Fund - Update to request the City Manager, with appropriate City staff, to prepare a submission for funding for the recommended flood protection measures for the Jane Street crossing for the next round of funding through the Federal National Disaster Mitigation Program
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2019.EX6.4

COMMENTS

The purpose of the Rockcliffe Riverine Flood Mitigation Municipal Class Environmental Assessment is to identify a riverine flood mitigation strategy for the Rockcliffe-Smythe area that:

- Mitigates project impacts on the built and natural environments;
- Flood protects up to the 350-year storm event;
- Provides a robust and low-maintenance solution;
- Is capable of adapting to more intense storm events and a changing climate;
- Reduces riverine flooding to help alleviate urban flooding;
- Capitalizes on opportunities to upgrade and future proof infrastructure and to provide benefits to basement flooding mitigation; and
- Facilitates the development of an infrastructure implementation sequencing plan.

The study incorporates and expands on previous flood mitigation and basement flooding studies undertaken in this area.

Study Area and Background

The study area, shown in Figure 1, consists of residential properties, employment lands, and parks and open spaces with a combination of floodplain, tableland, and ponds. This area falls roughly between Eglinton Avenue West, to the north, St. Clair Avenue West to the south, Weston Road to the east and the Humber River to the west. Natural cover within the area is generally located within Smythe Park, Black Creek Park West, and Black Creek Park East areas, and is dominated by several types of forest and smaller areas of wetland and aquatic zones. Lavender Creek and Black Creek both flow through the study area and are largely channelized throughout. Black Creek, and portions of Lavender Creek, are concrete lined.

Figure 1. Study Area

Factors that contribute to the flooding of Black Creek in the Rockcliffe area relate to alterations to the Black Creek channel and residential development over the past 70 years. Residential urban development in this area and the corresponding alterations to Black Creek occurred primarily during and after the 1940s. Channelization of Black

Creek occurred as early as 1942 along Humber Boulevard, parallel to Cordella Avenue. These early alterations to Black Creek predate Hurricane Hazel in 1954, and were not intended to be flood control measures.

Following the substantial flooding caused by Hurricane Hazel, several remediation measures were proposed in a 1959 Plan for Flood Control by the Metropolitan Toronto and Region Conservation Authority. Two key riverine flood control measures were implemented from this Plan: the expansion of the Black Creek channel (constructed in 1959), and the Black Creek flow attenuation dam (completed in the 1960s). These flood control measures were designed based on the available methods and information at that time, and without the availability of streamflow records. In addition, land use assumptions at the time were different from how the upstream areas developed in subsequent years.

These flood protection measures on Black Creek provide some riverine flood remediation benefits, but do not fully protect the area from riverine flooding. Riverine flooding occurs when the water levels of rivers rise, overflowing their banks.

Black Creek is an extremely flashy watercourse, with floodwaters that quickly accumulate into and pass through the system given the highly urbanized and altered drainage area, together with multiple engineered channel sections. With the historic development in the most low-lying areas of the floodplain, many of the 366 properties in the regulatory floodplain are at high risk of riverine flooding during more frequent events.

Water levels in Black Creek can also impact the performance of City of Toronto's sewer systems and combine with other factors to contribute to the basement flooding of homes within and outside of the regulatory floodplain limits of the Rockcliffe area. During storm events, high water levels in Black Creek, in combination with excess rain runoff from local roads and other hard surfaces, restricts the ability of sewers to discharge adequate storm water downstream into the creek. This situation contributes to the surcharge of sewers.

Since 2008, the Rockcliffe area has been ranked among the top five priority areas for riverine flood risk within TRCA's jurisdictional area. It is currently ranked the highest priority area for riverine flood risk within Toronto.

Previous Studies

The Rockcliffe Riverine Flood mitigation study is building off of a number of findings from previous studies as follows.

Black Creek (Rockcliffe Area) Riverine Flood Management Class Environmental Assessment (2014) and the Basement Flooding Study Area 4 and Combined Sewer Overflow Control Environmental Assessment

In 2014, TRCA and the City of Toronto completed separate Environmental Assessment (EA) studies that investigated options and recommended measures to reduce riverine and urban (sewer system) related flooding, respectively. Toronto Water and TRCA consulted with each other during the above EA studies. The 2014 EAs

completed by TRCA followed the Class Environmental Assessment process for Remedial Flood and Erosion Control Projects outlined by Conservation Ontario, and focused on developing solutions that would mitigate riverine flooding during the most extreme flood events and identified the benefit of improving conveyance capacity.

Since the 2014 EAs were completed, Toronto Water and TRCA have continued consulting with each other on next steps and implementation considerations for the recommended measures from both EA studies to reduce flooding risks in the Rockcliffe area.

Actions were taken by TRCA to support remediation of riverine flood risk in the Rockcliffe area. This included identifying the Rockcliffe area as a priority area for risk communications and flood education programs. A dedicated real-time monitoring water level gauge was installed at Black Creek, downstream of Alliance Avenue in 2016, and a real time precipitation gauge was also installed within the watershed, which assists in flood forecasting and warning, as well as emergency preparedness.

Additionally, continued investments for the operation and maintenance of flood infrastructure within the Black Creek watershed occurred, namely:

- Black Creek Channel Restoration (2013-2016)
- Black Creek Channel Guardrail Installation (2016)
- Black Creek Dam Safety Review (2017)
- Black Creek Reservoir Dredging and Maintenance Project (2017)

City of Toronto Basement Flooding Investigation Environmental Assessment Studies - Basement Flooding Study Area 45 (Black Creek)
Study Area 45 location in the Black Creek and Highway 401 (north and south) area has experienced recurring basement and surface flooding during extreme storms. This area consisted of several underground sewer systems in the area roughly bounded by Steeles Avenue West, St. Clair Avenue West, Highway 400, and Keele Street.

Black Creek at Rockcliffe Special Policy Area Flood Remediation and Transportation Feasibility Study (2020)
In 2018, TRCA initiated and completed a new 2-Dimensional hydraulic model for the Rockcliffe-Smythe area, due to the level of flood risk within the Rockcliffe-Smythe area, and the advancement of modelling and mapping technology as well as new data collected during the July 2013 and August 2018 flood events. The modelled results indicate that flood remediation solutions proposed in the 2014 EA would not protect the most vulnerable properties from the more frequently occurring flooding.

This new information and modelling led Transportation Services, Toronto Water, and TRCA to collaboratively undertake a Flood Remediation and Transportation Feasibility Study in 2020 with funding from the National Disaster Mitigation Program. The objectives of this study were:

- to assess and expand riverine flood protection options, placing greater focus on remediating the areas of greatest riverine flood risk;
- assess those flood remediation options against traffic and transportation needs; and
- to develop a roadmap for implementation.

Coordination with Other Area Initiatives

The EA has established a coordinated approach to evaluate and implement flood protection in the Rockcliffe area, in the context of other major infrastructure projects, proposed or underway. Attachment 2 identifies major infrastructure projects that are being considered as part of this coordination.

Process and Consultation

Public involvement was an integral and ongoing part of the study process for the Rockcliffe Riverine Flood Mitigation MCEA Study. Throughout the completion of the study, the public consultation requirements of the MCEA were met and exceeded.

Notice of Commencement for the Rockcliffe EA study was issued on January 21, 2021 which introduced the EA study. The Rockcliffe EA Study included two Community Liaison Committee (CLC) Meetings, two Public Information Centres (PICs), and meetings with key stakeholders and residents. In addition, there is a project webpage that includes all pertinent information related to the Study. A mailing list was created based on interaction with interested parties during the course of the study. The consultation meetings and when they were held included:

- Community Liaison Committee #1 - May 19, 2021
- Community Liaison Committee #2 - February 1, 2022
- Channel Design Workshop - November 15, 2021
- Public Information Centre #1 - June 16, 2021
- Public Information Centre #2 - March 1, 2022
- Site Meeting - Friends of Smythe Park - November 2, 2021
- Site Meeting - Lavender Creek Walk - March 30, 2022

Future consultation will take place through the Notice of Completion stage (which is required to complete this EA study) when the Environmental Study Report (ESR) is made available for 30 days for public review.

What We Heard

Though ongoing Councillor engagement and support for this project as well as consultation and feedback from stakeholders and members of the public, the following key insights and priorities have been provided:

- Take action and make progress to address flood risks in Rockcliffe area – both riverine and basement flooding;
- Communicate the process, cost, and timelines of the project with the community;
- Minimize impacts on:
  - Transportation, transit and traffic,
  - Green space, trees, wildlife habitat and biodiversity, and
  - Recreational amenities, particularly Smythe Park;
- Interest in naturalization efforts and restoring the natural river area;
- Interest in adding new trails/connections throughout the study area; and

- Interest in how the City is addressing other flood mitigation measures for urban flooding (other studies and City work);
- Screening to be considered to improve privacy at private properties and improve aesthetics by blocking the view of industrial properties;
- Interest about interim flood risk during construction and between the different construction phases (Scarlett Road Bridge replacement vs Jane Street Bridge; and
- Mitigate risk due to temporary conditions during construction.

The feedback from the consultation informed the identification of recommended solutions, the development of alternative designs, and the evaluation of alternatives. In particular, the project team:

- Reviewed and minimized impacts to Smythe Park;
- Considered opportunities for enhancing public amenities/trails;
- Preserved and provided opportunities to enhance public greenspace;
- Sought to improve the ecological value of the environment; and
- Identified approaches to fast track the EA and project timelines.

Alternative Solutions

Following the identification of problems and opportunities to be addressed by this project in the initial phase of the EA process, a long list of potential solutions was developed and screened based on which solutions could address the problem and meet the objectives and opportunities identified. This short list of feasible alternative solutions were then further developed along with evaluation criteria to assess the alternatives. The alternative solutions focused on addressing flooding that is caused by the river flows (not sanitary sewer backups, nor flooding due to storm sewer capacity). However, each alternative allowed urban runoff to reach the river as a prerequisite.

At the June 16, 2021 Public Information Centre #1, three alternative solutions to improve the study area riverine flood condition were presented to the public. Each alternative included differing levels of improvements along Black Creek from Jane Street to Weston Road and on Lavender Creek from Symes Road to Black Creek. The alternative solutions are shown in Attachment 3.

Alternative 1 - Black Creek Channel Widening - Jane St to Alliance Ave

Alternative 1 proposed Black Creek channel modifications between Jane Street to Alliance Avenue, Lavender Creek channel modifications between Black Creek and upstream of Symes Road, bridge replacements at Jane Street, Rockcliffe Boulevard and Symes Road culvert. Two bridge structures off of Symes Road over Lavender Creek were identified, (Symes Road south driveway for removal and Symes Road north driveway for removal or replacement). Additionally, a new floodwall structure was proposed at Weston Road.

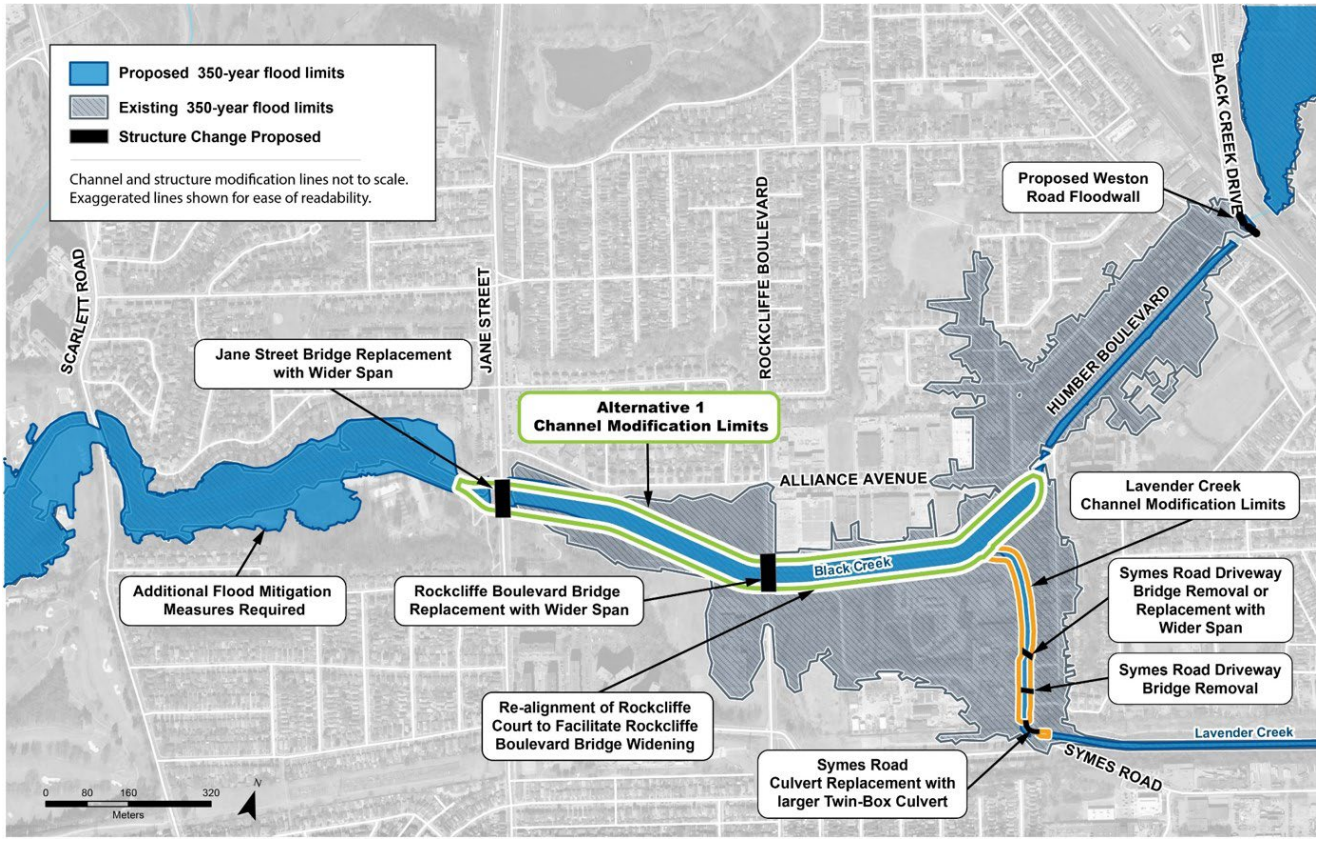

Figure 2. Alternative 1 - Black Creek Channel Widening - Jane Street to Alliance Avenue

Alternative 2 - Black Creek Channel Widening –Scarlett Rd to Alliance Ave

Alternative 2 builds on Alternative 1 and also included additional Black Creek channel modifications between Scarlett Road to Jane Street.

Alternative 3 - Black Creek Channel Widening –Scarlett Rd to Weston Rd

Alternative 3 incorporated the improvements in both Alternative 1 and 2 and also included additional Black Creek channel modifications between Alliance Avenue to Weston Road and additional bridge replacements at Alliance Avenue and Humber Boulevard.

Evaluation Criteria

The evaluation criteria used to identify the preferred alternative was based on the following:

Natural Environment

- Potential impacts to existing terrestrial and aquatic environment
- Potential effects to Species at Risk
- Potential effects to air quality
- Potential effects to ground water during construction

Social Environment

- Impacts to planned infrastructure capital works projects
- Impacts to private property and uses
- Effects on archaeological resources
- Impacts to cultural heritage features
- Conformity with approved local and provincial plans and policies
- Potential to provide safe pedestrian and vehicular ingress and egress
- Impacts to traffic conditions and level of service for motor vehicles
- Impacts to traffic conditions and level of service for alternate modes of transportation
- Disruption to adjacent property owners and businesses
- Effects to natural aesthetics
- Effects to parks and recreational amenities

Technical
- Construction constraints, complexities and timeline
- Impacts to existing and proposed municipal servicing and utility infrastructure
- Flood risk reduction during Regulatory Flood
- Reduction in flooded area during a 350-year storm
- Effects on erosion potential downstream of the proposed works
- Effects on flood levels upstream and downstream of proposed works
- Climate change resiliency
- Effect of riverine flood impact to urban drainage system

Cost
- Operations and maintenance costs
- Potential reduction of costs associated with flood damages
- Costs associated with contaminated soil removal and site remediation
- Capital costs

Preferred Solution

Following the evaluation of alternative solutions, Alternative 1 was identified as the recommended solution that was presented to the public in March 2022. Attachment 4 summarizes the evaluation of the alternative solutions.

Alternative 1 is preferred because it has the least property impacts and lowest cost while providing a similar level of flood mitigation as the other alternatives. It avoids significant impacts to Smythe Park. Alternative 1 includes flood mitigation measures west of Jane Street. Additional modifications include bridge replacements at Jane Street, Rockcliffe Boulevard, and the Symes Road culvert. A new floodwall structure has been identified on Weston Road for additional flood protection.

There was strong preference from the public from the June 2021 meeting for Alternative 1. Additionally, at the PIC, the need for improvements downstream of Jane Street were identified. Following this feedback, the study team identified an opportunity to provide greater flood relief through Scarlett Road bridge replacement works as part of the preferred solution.

Naturalization

In July 2021, City Council adopted a Members Motion that requested the project team to explore opportunities to naturalize the Black Creek Channel as a part of establishing the alternative designs. The consultant team developed and evaluated an alternative for naturalization as part of refining the alternative solutions and advancing alternative designs.

The naturalization alternative was screened out through the analysis as the impacts greatly outweighed the benefits, particularly due to high costs and impacts to the community, private properties, and infrastructure in the area.

A natural channel requires at least three times more land than an engineered channel to flood protect the required 350-year storm event. The plants and rocks in a natural channel slows the flow of water through the channel requiring more space to pass the same water in comparison to a smooth concrete channel. At a minimum a 120 metre valley is required to accommodate the 350-year storm event. This wider naturalized channel would be entirely flooded during extreme storm events.

The increased valley width that would be needed for naturalization would have significant property impacts and require the acquisition of many single residential properties, multiple high-rise residential properties, an employment land parcel and the Rockcliffe Middle School. There would be greater impacts to Smythe Park and the City's Parks Operations yard at Rockcliffe Court would have to be relocated. To span the wider creek profile, larger engineered bridge structures would also be required at Jane Street, Rockcliffe Boulevard, and Rockcliffe Court. There would be significant municipal servicing impacts requiring extensive relocation of combined sewer infrastructure along Black Creek valley precluding the ability to implement Black Creek Sanitary Trunk Sewer and Basement Flooding Improvement Works.

All of these impacts combined would create significantly higher costs, greater impacts, and would increase the time to implement flood protection to the Rockcliffe Smythe area.

Alternative Designs

The second Public Information Center was held on March 1, 2022 and built off the PIC 1 preferred alternative solution. The preferred solution was presented, as well as alternative designs for both Black Creek and Lavender Creek, including identifying the trade-offs and benefits of the concept variations. Both the Black Creek and Lavender Creek alternative designs focussed on different designs for the respective channels. Additionally, each alternative design included the balance of improvements (e.g. bridge replacements) from the preferred solution. Diagrams depicting the alternative designs are included in Attachment 5. The details of the naturalization alternative assessment as well as project and implementation next steps were also presented at PIC 2.

Black Creek Alternative Designs

In addition to the naturalization concept, two alternative designs for the Black Creek Channel Modifications from Jane Street to where Alliance Avenue meets Humber Boulevard were developed and presented to the public. Rendered axonometric views of the two alternative designs are included in Attachment 5. The two designs include:

- BC1 – Engineered Channel
  - Uniform channel shape and bank slopes
  - Channel bank slope same as existing
  - Channel approximately 3 times wider and 1.3 times deeper than existing
  - Entire channel surface hard and relatively smooth to maximize flood protection benefit and protect against erosion
  - Opportunity for green space and public amenity space outside of channel
- BC3 – Hybrid Engineered Channel
  - Variable channel shape and bank slopes within property constraints
  - Channel bank slope same as existing or flatter
  - Channel approximately 3-5 times wider and 1.3 times deeper than existing
  - Channel surface can be a mix of hard surface and vegetation treatments.
  - Upper 25-50% of channel banks may be covered with armourstones, boulders, grasses/meadow plants or small shrubs
  - Lower 50-75% of channel banks must be hard, relatively smooth surface to provide the maximum benefit to basement flooding mitigation
  - Less opportunity for green space and public amenity space outside of channel

Lavender Creek Alternative Designs

Four alternative designs were developed and presented to the public for the Lavender Creek Channel Modifications proposed between Black Creek and just upstream of Symes Rd. Similar to the Black Creek Alternative Designs, the key difference between alternatives consisted of different approaches to the channel treatments with an engineered channel for two alternatives (LC1 and LC2) and a combination of an engineered channel and smooth concrete channel for the remaining two alternatives (LC3 and LC4). Alternatives LC1 and LC3 included the removal of the existing driveway bridge structures that cross Lavender Creek connecting Symes Road to private property. Alternatives LC2 and LC4 includes the removal of the south bridge and the replacement of the north bridge connecting to private property.

Preferred Design*s*

The project team evaluated, presented the evaluation of the alternative designs and the recommended designs - BC1 and LC3 - at the March 2022 public meeting. The evaluation summary is included in Attachment 6. These designs best meet the evaluation criteria as well as public input and feedback received from local residents.

This report recommends the Black Creek Engineered Channel BC1 and Lavender Creek Smooth Concrete Channel - with north bridge removal LC 3 alternative. Benefits of the preferred design include:

- The greatest reduction of riverine flood risk;
- A coordinated approach with other City infrastructure improvement projects;

- Increased resiliency of the community to climate change by establishing more space in the channel to contain flood waters;
- Minimal impacts to Smythe Park to only what is needed to rebuild the Jane Street bridge and the channel beneath it;
- Consideration for opportunities to enhance public amenities such as future trails;
- Least impact to private properties;
- Smallest footprint needed for Black Creek; and
- Flexibility to reduce Lavender Creek footprint north of Orman Avenue allowing for more public greenspace and habitat restoration.

Property Acquisition

Some property acquisition will be necessary to support the EA recommendations. An initial property assessment was conducted to identify potential property needs to enable the implementation of the EA improvements. The initial property needs are required for:

- The realignment of Rockcliffe Court;
- The Lavender Creek channel widening and Symes Road culvert replacement, including permanent easements; and
- The Scarlett Road Bridge replacement (permanent easements from the Lambton Golf and Country Club).

Where possible, the Rockcliffe Court property impacts related to the realignment would be pursued through the development review process.

Potentially affected property owners were notified of potential impacts via targeted letters that were mailed in 2021 and 2022. Final property requirements will be confirmed during the detailed design activities that will follow this study.

Implementation Schedule, Related Projects and Next Steps

This report recommends that City Council authorize City staff to complete the ESR and EA process in accordance with the MCEA process. Subject to direction from Council and available funding, the implementation schedule is generally to begin detailed design in 2023, starting with the Jane Street bridge widening, for which funding is currently allocated.

Through detailed design, the location, width, and alignment of Black Creek and Lavender Creek would be determined, along with opportunities for restoration plantings and new or enhanced pathways and trails. Through detailed design for bridge replacements at Scarlett Road, Jane Street, and Rockcliffe Boulevard, the design of other elements, such as municipal servicing, utility relocations, streetscape, light poles, traffic signals, lane markings, would be confirmed. Further public consultation would be undertaken during the detailed design process.

Construction would be coordinated with planned Basement Flooding Protection Program construction and the implementation of the Keele Relief Trunk Sewer, which are funded in the rate-based budget.

Preliminary Construction Phasing Strategy

The driving factors for implementation and phasing include:

- Mitigation of flooding for existing highest risk properties first (e.g., opening Jane Street up first for additional conveyance capacity);
- Mitigation of flooding for properties exposed to higher flood risk due to interim conditions of construction phasing (e.g., working from downstream to upstream);
- Interrelationship with the Basement Flooding Program;
- Traffic management during construction; and
- Funding availability. DMAF has been submitted and is pending approval from the Federal government, with status and response anticipated by fall 2022. In addition, at its meeting on April 6, 2022, City Council adopted a motion to direct the City Manager to seek opportunities for funding from the Province to support implementation.

These factors have been taken into account by modeling the changes to provide the greatest riverine flood relief while reducing system impacts.

- Phase 1 - Jane Street Bridge (2024-2027)
- Phase 2 - Black Creek - from Jane Street to Rockcliffe Boulevard (2026-2028)
- Phase 3a - Rockcliffe Boulevard bridge replacement (2026-2028)
- Phase 3b - Black Creek - from Rockcliffe Boulevard to Alliance Ave (2027-2028)
- Phase 4 - Scarlett Road Bridge (2028-2029)
- Phase 5 - Lavender Creek and Symes Road culvert replacement (2028-2030)

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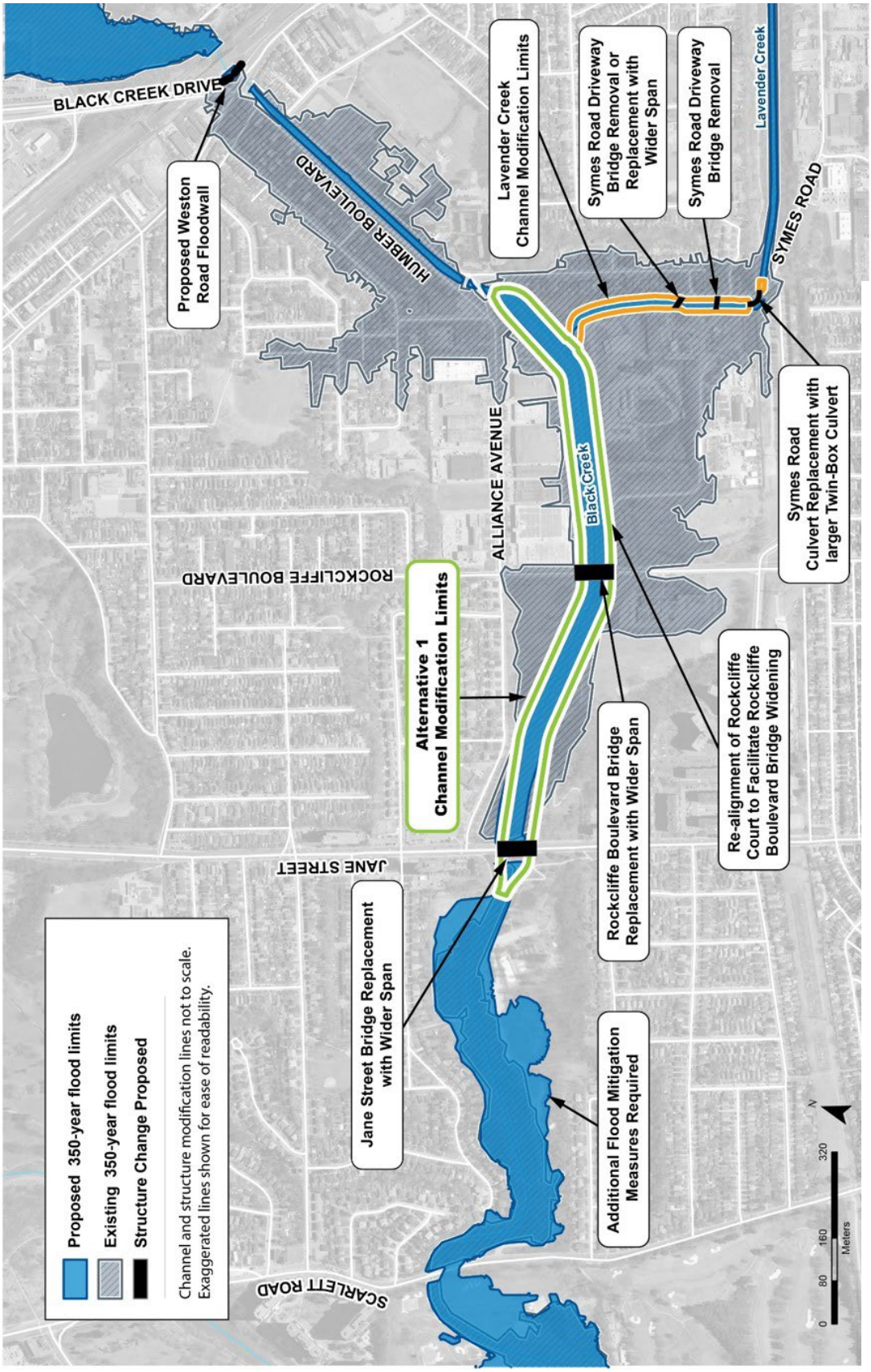
ATTACHMENTS

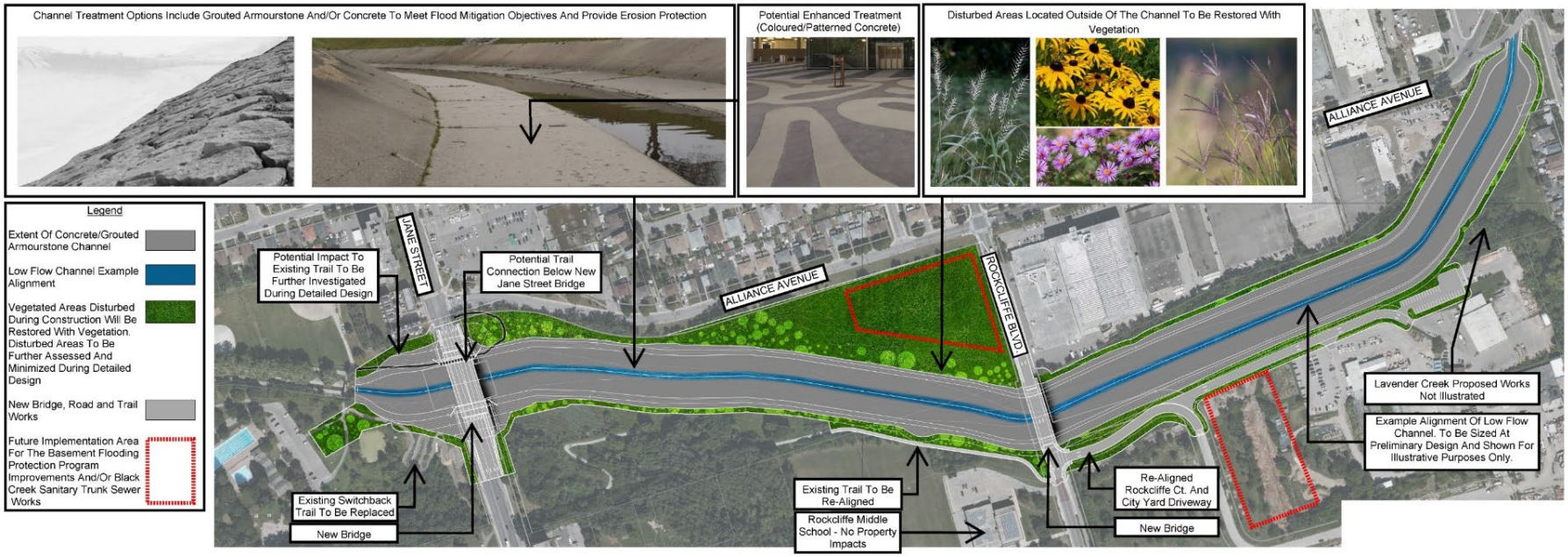
Attachment 1 - Preferred Solution and Designs
Attachment 2 - Proposed Infrastructure in the Study Area
Attachment 3 - Alternative Solutions
Attachment 4 - Evaluation of Alternative Solutions
Attachment 5 - Black Creek Channel Alternative Designs Axonometric Views
Attachment 6 - Evaluation of Alternative Designs

Attachment 1: Preferred Solution and Designs

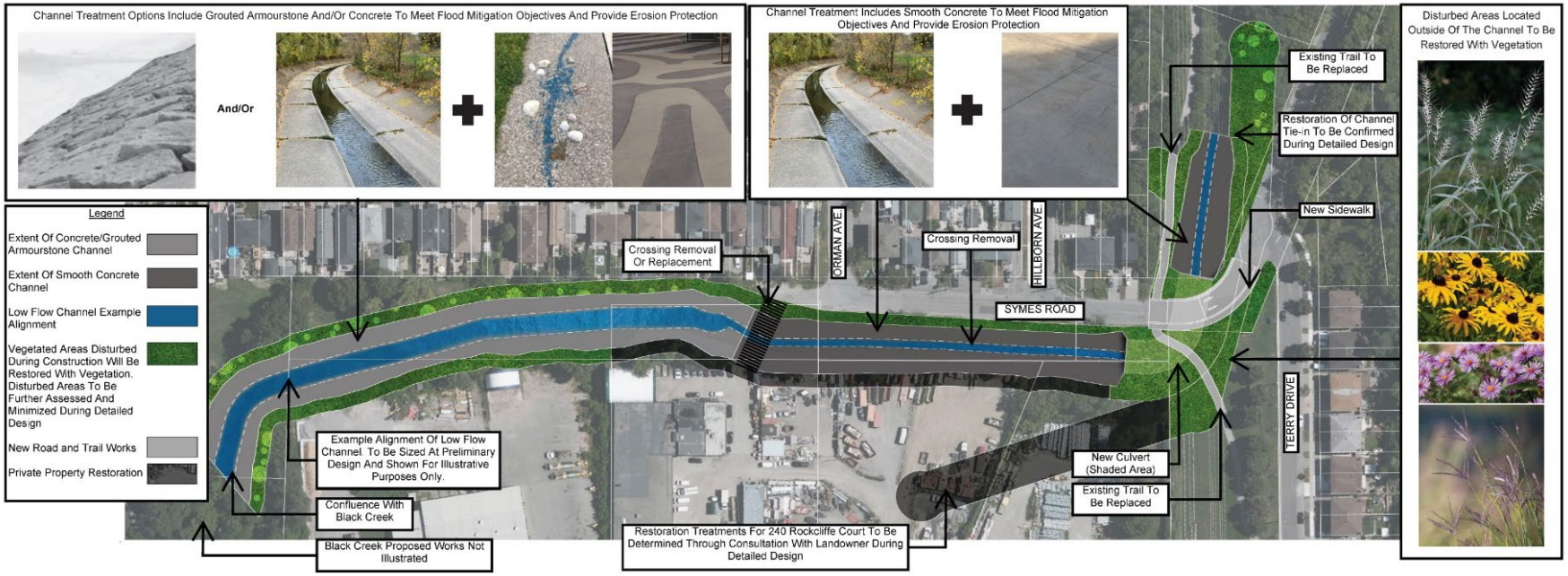


Alternative 1

Note: Scarlett Road Bridge replacement and associated flood reduction benefit not shown

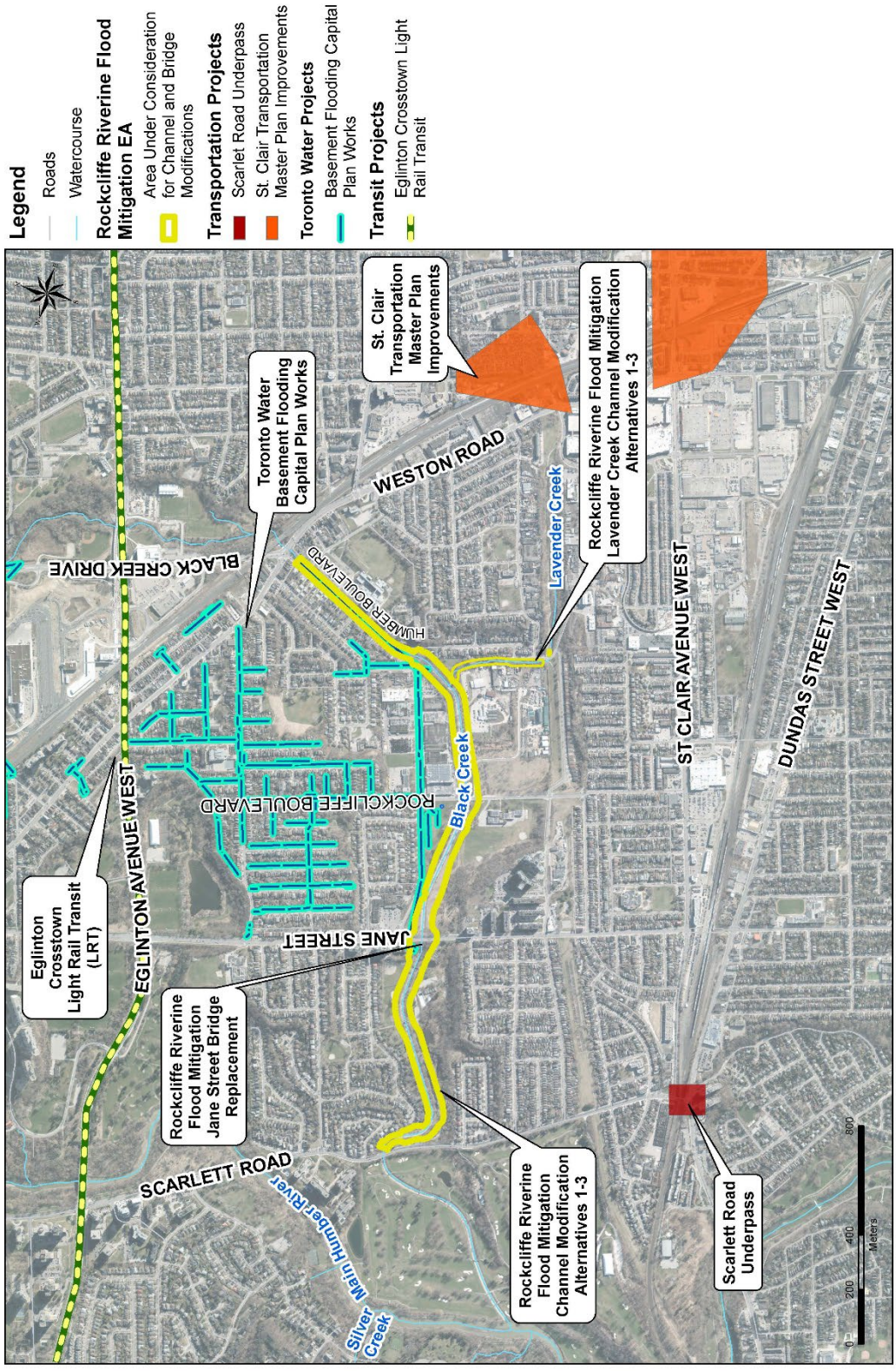


BC1 - Black Creek Area Preferred Design (Engineered Channel)

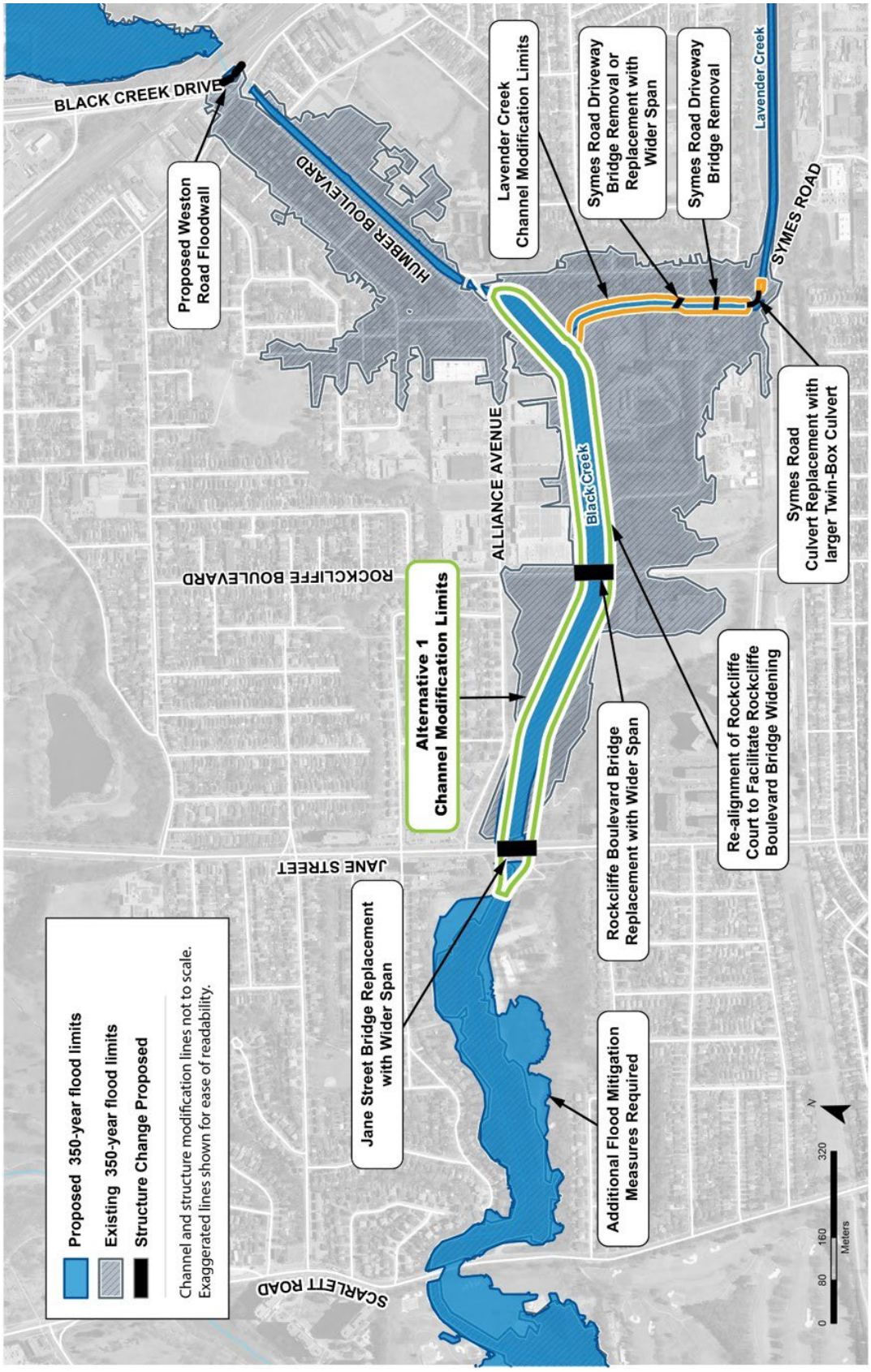


LC3 - Lavender Creek Area Preferred Design (Combination of Smooth Concrete Channel and Engineered Channel segments with both Driveway Bridges removed)

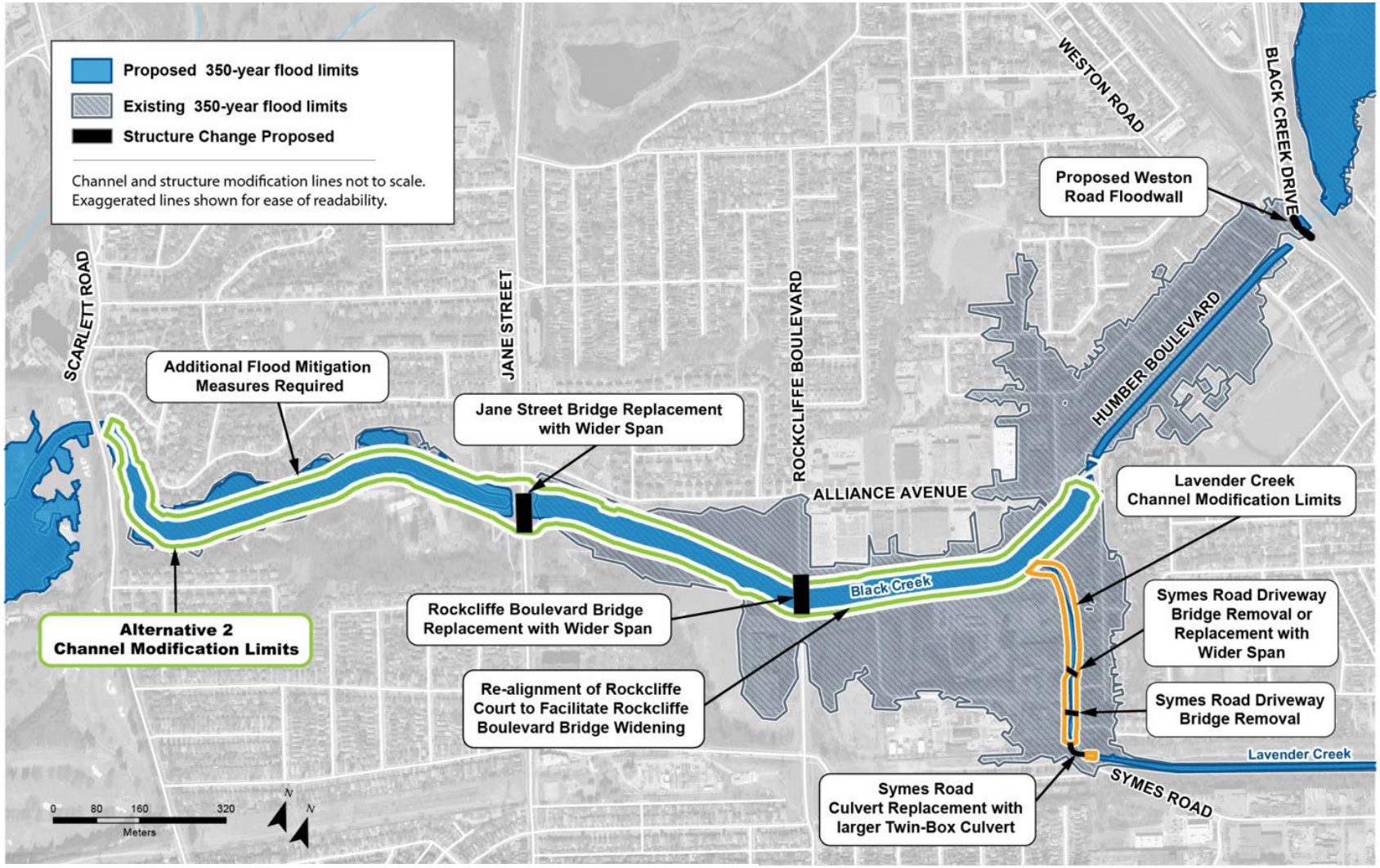
Attachment 2 - Proposed Infrastructure in the Study Area



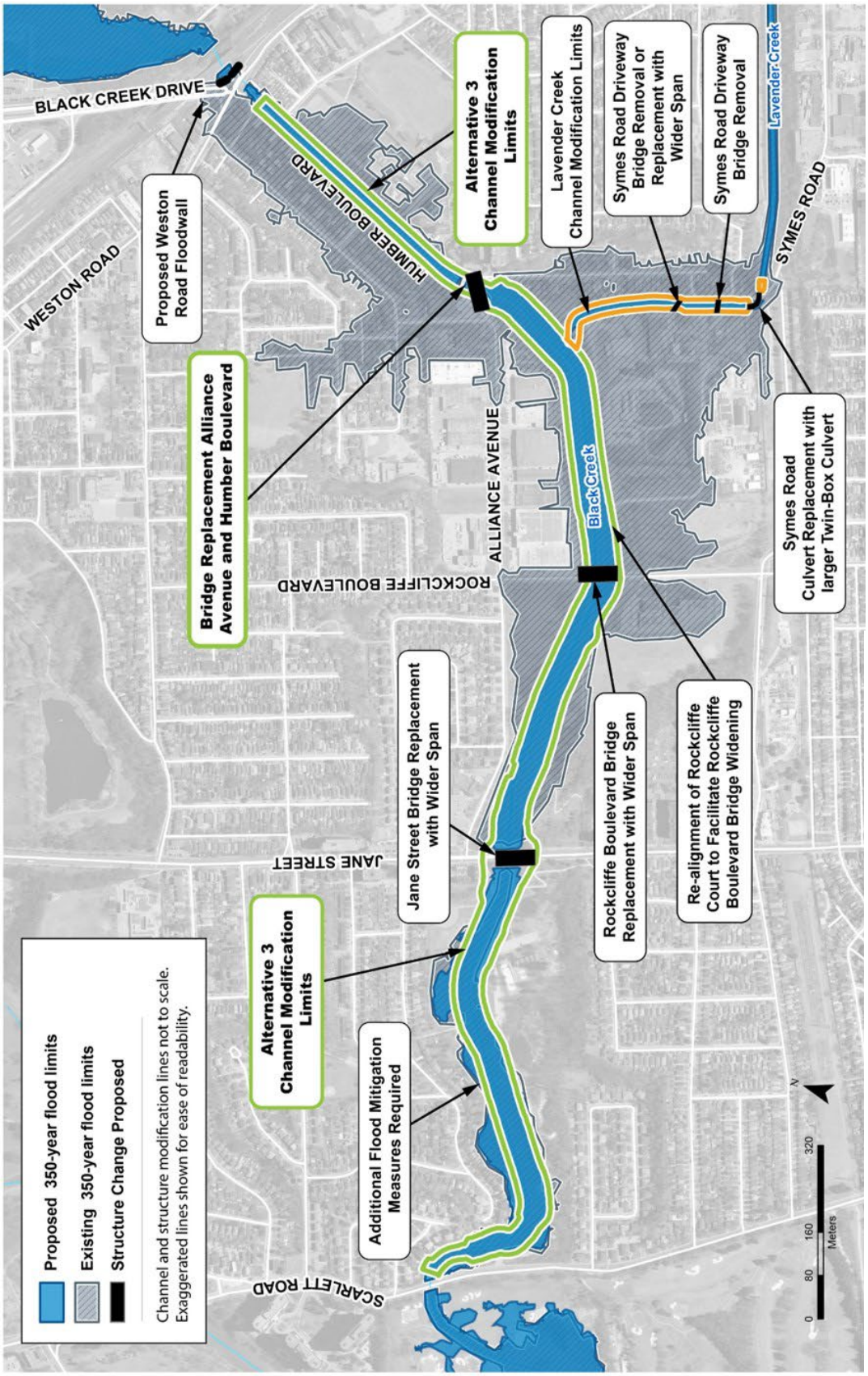
Attachment 3 - Alternative Solutions



Alternative 1



Alternative 2



Alternative 3

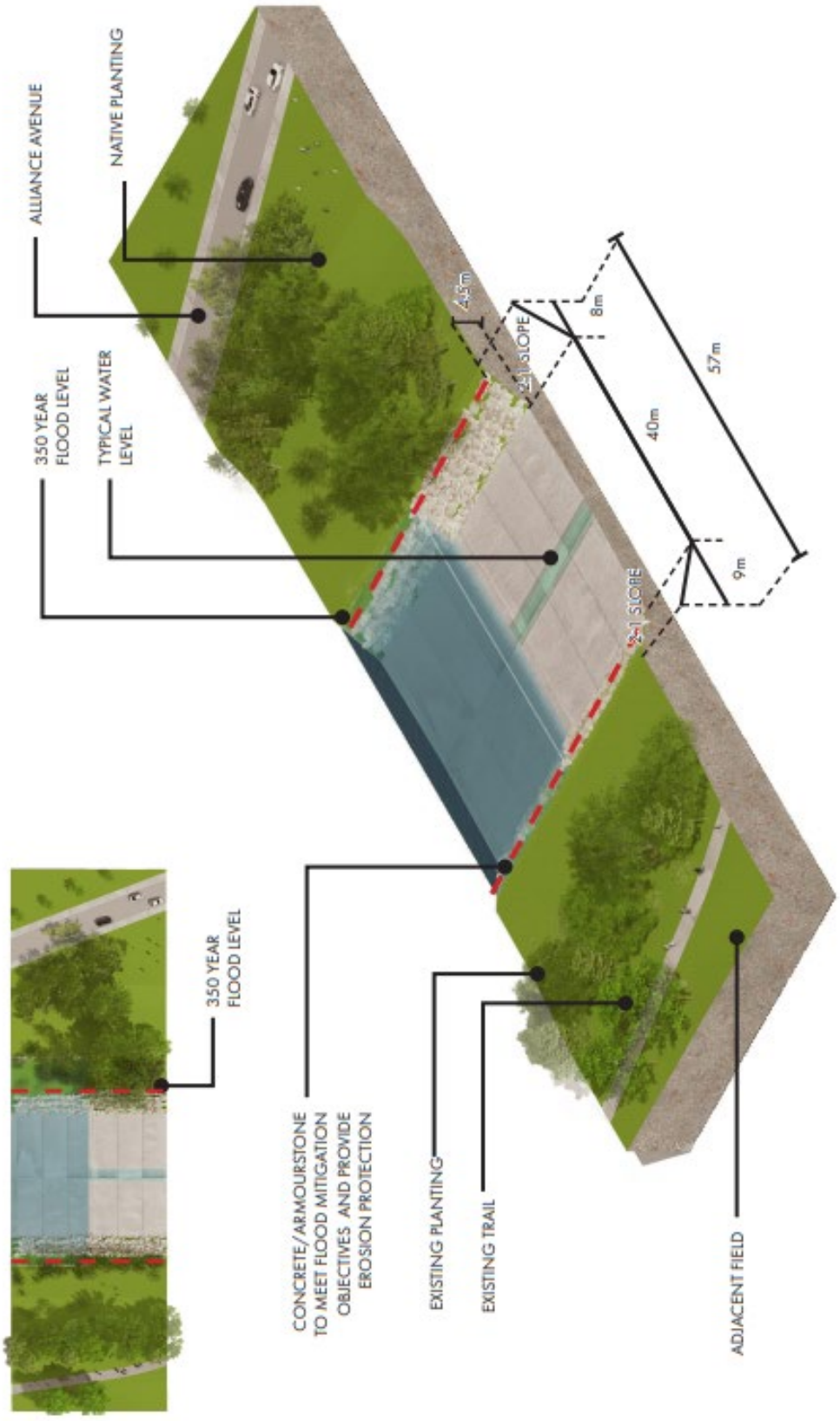
Attachment 4: Evaluation of Alternative Solutions

EVALUATION CATEGORIES	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
NATURAL ENVIRONMENT	●	◑	◑
SOCIAL AND CULTURAL ENVIRONMENT	●	◑	○
TECHNICAL CONSIDERATIONS	●	◑	◔
COST CONSIDERATIONS	●	◑	◔

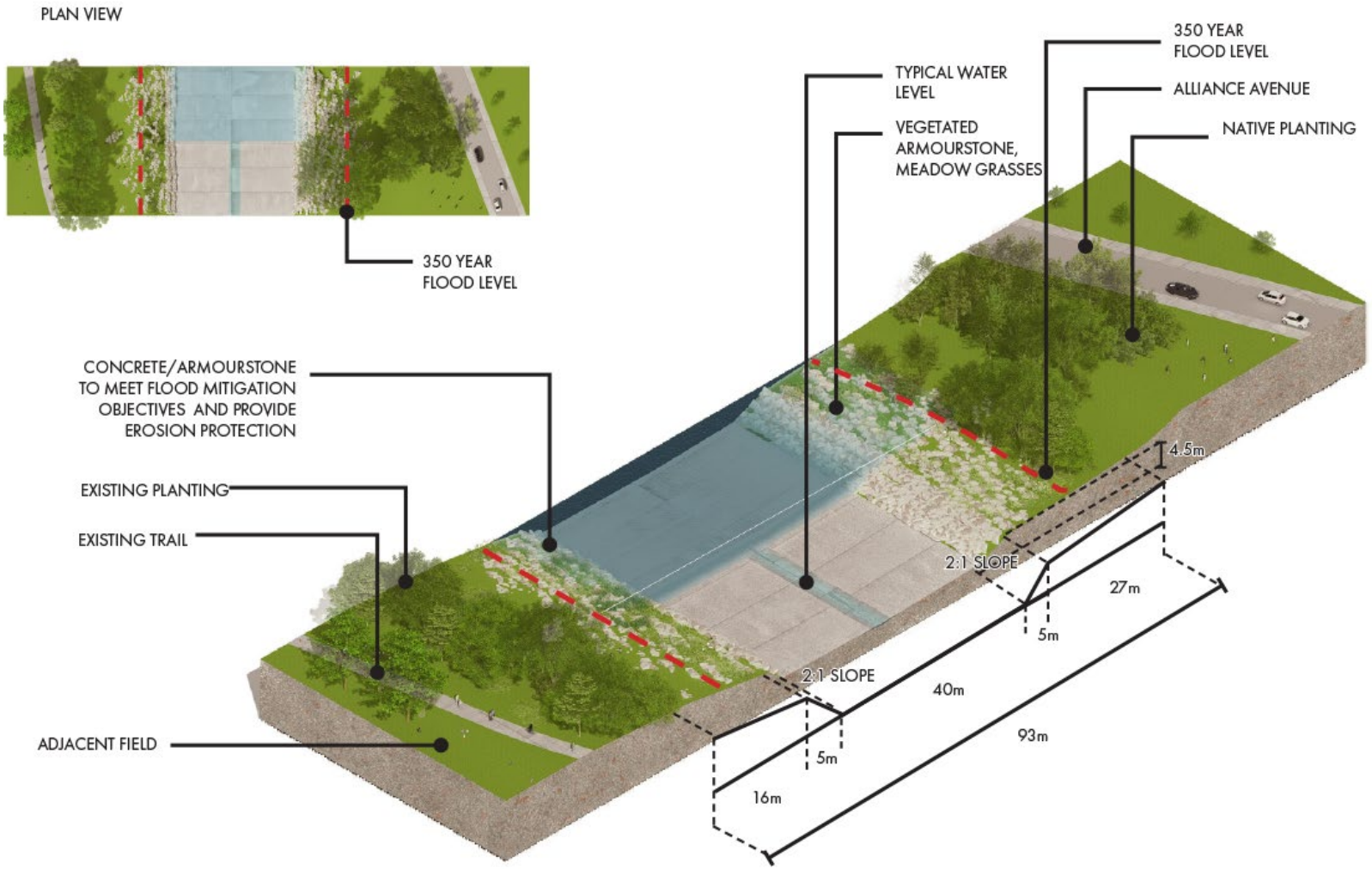
Legend

- ● Most Preferred
- ○ Least Preferred
- Preliminary Preferred Design Concept

Attachment 5: Black Creek Channel Alternative Designs Axonometric Views



BC1 - Black Creek Engineered Channel



BC3 - Black Creek Hybrid Engineered Channel

Attachment 6 - Evaluation of Alternative Designs

Black Creek Alternative Designs Evaluation

EVALUATION CATEGORIES	BC1 Engineered Channel	BC3 Hybrid Engineered Channel
NATURAL ENVIRONMENT		
SOCIAL AND CULTURAL ENVIRONMENT		
TECHNICAL CONSIDERATIONS		
COST CONSIDERATIONS		

Legend

- Most Preferred
- Least Preferred
- Preliminary Preferred Design Concept

Lavender Creek Alternative Designs Evaluation

EVALUATION CATEGORIES	LC1 Engineered Channel (No Driveway Bridge)	LC2 Engineered Channel (North Driveway Bridge Replaced)	LC3 Smooth Concrete Channel (No Driveway Bridge)	LC4 Smooth Concrete Channel (North Driveway Bridge Replaced)
NATURAL ENVIRONMENT				
SOCIAL AND CULTURAL ENVIRONMENT				
TECHNICAL CONSIDERATIONS				
COST CONSIDERATIONS				

Legend

- Most Preferred
- Least Preferred
- Preliminary Preferred Design Concept