FALCON CREEK EROSION CONTROL
CN RAILROAD TO WILLOWBROOK ROAD

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

PUBLIC INFORMATION CENTRE (PIC)

Wednesday 08 March 2023
6:00 pm to 7:30 pm

VIRTUAL MEETING (MS TEAMS)

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Consultant Team

The Consultant Team retained by the City of Burlington to complete the *Falcon Creek Erosion Control Study* includes the following firms:

Valdor Engineering – Lead consultant, water resources and municipal engineers
North-South Environmental – Ecologists
Water's Edge – Fluvial Geomorphologists
Soil Engineers – Geotechnical engineers
Amick - Archaeologists













FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Problem Statement and Background Information

The City of Burlington is undertaking the preparation of erosion control and detailed design for a section of Falcon Creek extending from the CN Railroad to Willowbrook Road following the Municipal Class Environmental Assessment (EA).

As reported in the City Creeks Inventory and Erosion Assessment Report completed in 2020, sections of this reach have been significantly eroded and remediation measures are required as private properties and public infrastructure are at risk. The City retained Valdor Engineering to complete the *Falcon Creek Hydrology and Hydraulics Study* (Dec 2012) and additional investigations on Falcon Creek were completed as part of the Aldershot Go Major Transit Station Area (MTSA) Study.

The length of the study area is approximately 320 meters within City easements on private property and the public road allowance along Willowbrook Road. Falcon Creek outlets to Hamilton Harbour and Lake Ontario and includes a drainage area of approximately 380 ha. Land uses within the watershed consist of rural and residential/industrial developed areas and includes the Burlington Golf and Country Club near the downstream limit of the watershed at North Shore Boulevard.

The project purpose is to complete an erosion control study to identify the preferable alternative(s) to stabilize the existing creek erosion, including bank sections that have fallen into the creek which has resulted in creek instability and ongoing erosion. The project will include the completion of the erosion control study and proposed design while following the Class EA process. This will include the completion of surveys and field investigations to analyze available alternatives and present the preferred solution for detailed design and construction, while considering hydraulic impacts and revising existing modelling. Detailed design and construction supervision will also be included as a part of the project, pending successful completion of the preceding project components.

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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

2020 Creeks Inventory and Erosion Assessment

Aquafor Beech Limited

City of Burlington
Mr. Arif Shahzad, M.Eng., P.Eng
Senior Project Manager
Stormwater Engineering
Capital Works Department
City of Burlington
426 Brant Street
Burlington, Ontario L7R 3Z6

City of Burlington
2020 Creeks Inventory and Erosion Assessment



Submitted by:
Aquafor Beech Ltd.

May 26th, 2021

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F. 905.629.0089

Aquafor Beech Ltd. Reference: 66698

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Site ID: 76 | **FALCON CREEK** | **Priority Rank: 20**

Overview

Priority Rank: 20 (of 94)
Erosion Hazard Score: 80 /100
Risk Type: Critical Infrastructure (Willowbrook Rd)
City of Burlington
5 m

Description of Problem

- Willowbrook Rd is at risk on an outside meander bend of Falcon Creek (F05), downstream of Enfield Rd.
- The creek passes through a circular concrete culvert at Enfield Rd after which the channel meanders towards Willowbrook Rd.
- The top of bank is approximately 2 m from the guardrail and 3 m from the pavement.
- The bank slope is 2.5 m and comprised of unconsolidated soils and is highly erodible.
- Several large trees are located along the slope between the road and the watercourse.



Recommended Solution

- Utilize City land holding to realign channel approximately 6 m to the southwest away from Willowbrook Rd to accommodate 2.5:1 (H:V) regrading of east slope.
- Construct vegetated buttress slope protection on both banks (approximately 15 m in length) with boulders at the toe for long-term stability.
- Revegetate upper slopes above buttress.

Constraints & Comments:

- Warm water stream classification (specific construction timing window to be determined at the detailed design stage).
- Retain large trees at top of slope where possible to maintain established tree canopy on residential street.

Construction Cost Estimate: $300,000
Recommended Timeframe: 0 - 5 Years (2020 - 2025)

Representative Photographs



Looking east towards Willowbrook Rd at exposed tree roots

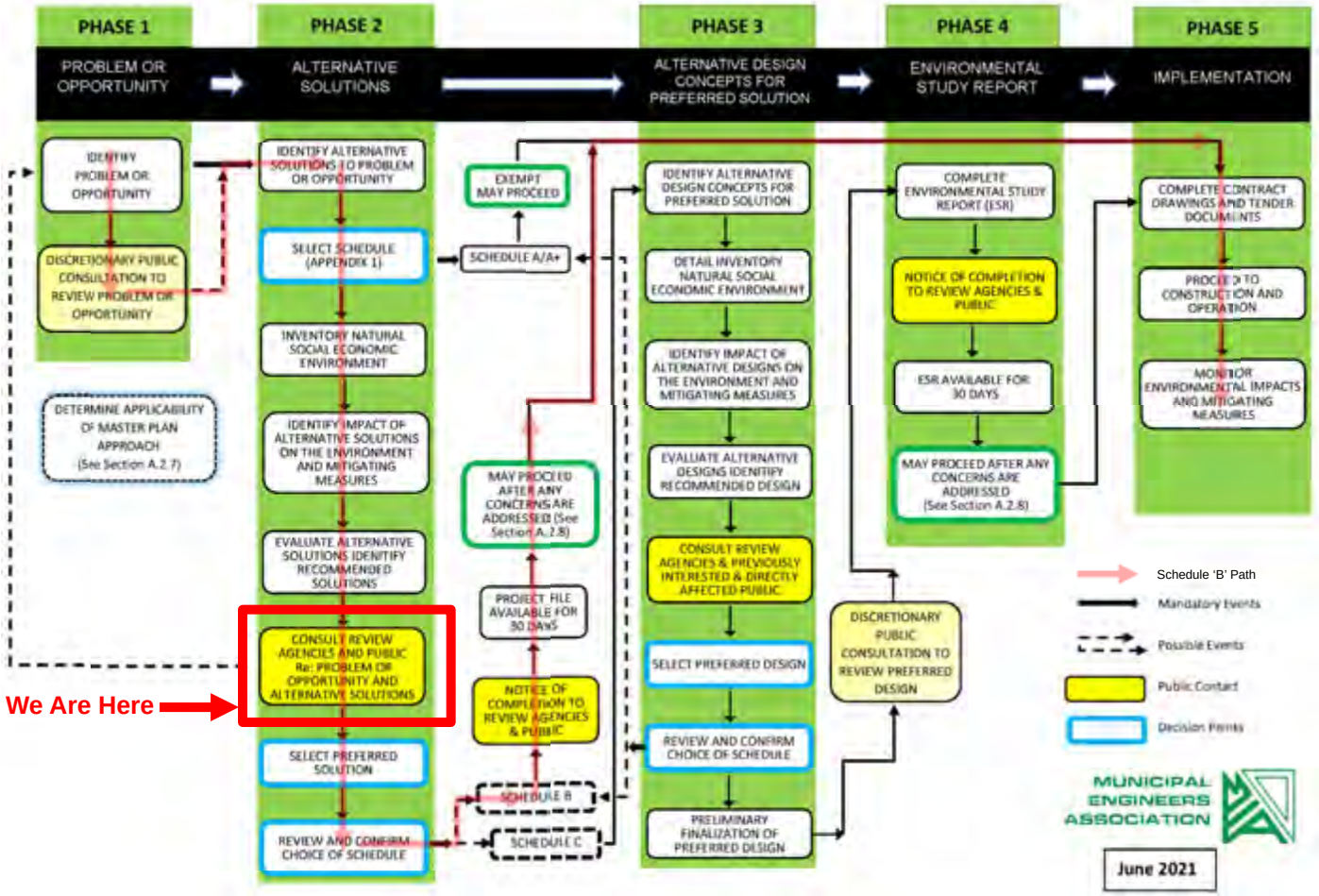


Looking upstream at active erosion along toe of slope

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Municipal Class Environmental Assessment (EA) Process

The Municipal Class EA applies to municipal infrastructure projects including roads, water and wastewater projects. Depending on the potential environmental impact of projects undertaken by the municipality, the project is classified according to the following schedules that must be adhered to as part of the Municipal Class EA process:



Municipal Class EA Process

Schedule A

Generally includes normal or emergency operational and maintenance activities. The environmental effects of these activities are usually minimal and, therefore, these projects are pre-approved.

Schedule A+

These projects are pre-approved, however, the public is to be advised prior to project implementation. The manner in which the public is advised is to be determined by the proponent.

Schedule B

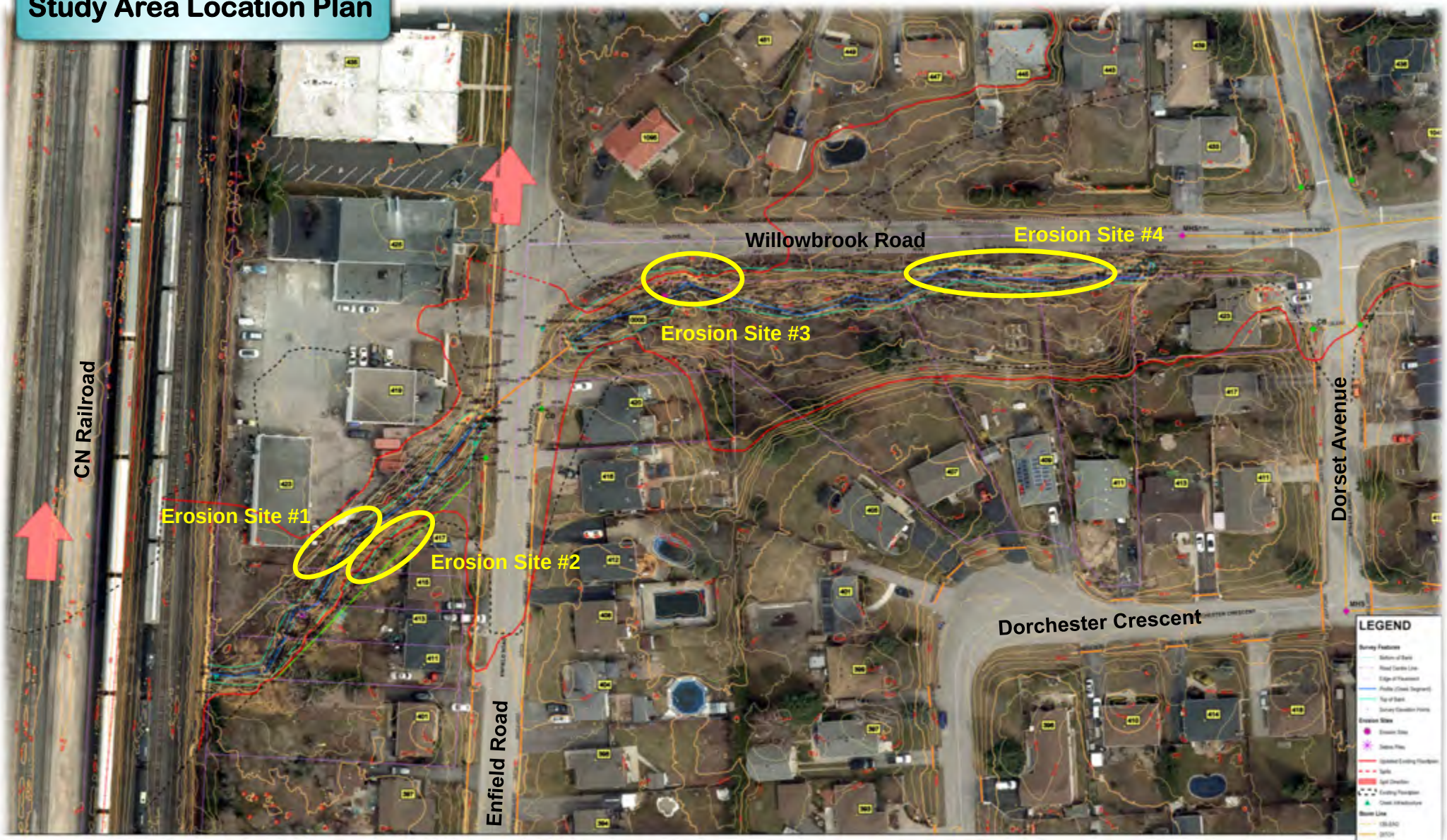
Generally includes improvements and minor expansions to existing facilities. There is the potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process including consultation with those who may be affected.

Schedule C

Generally includes the construction of new facilities and major expansions to existing facilities. These projects proceed through the environmental assessment planning process outlined in the Municipal Class EA document (MEA, 2011).

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

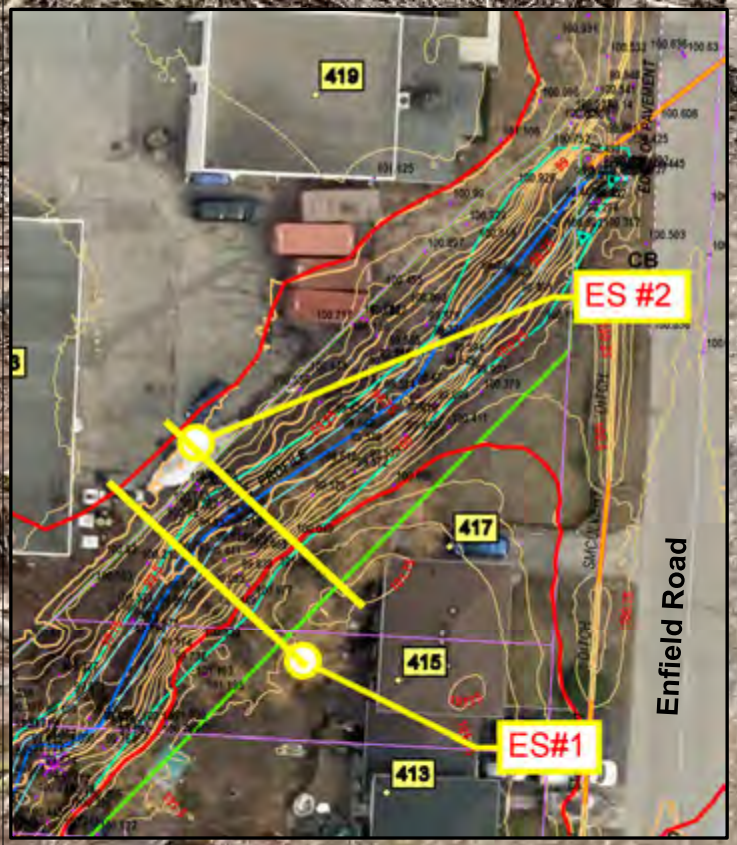
Study Area Location Plan



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

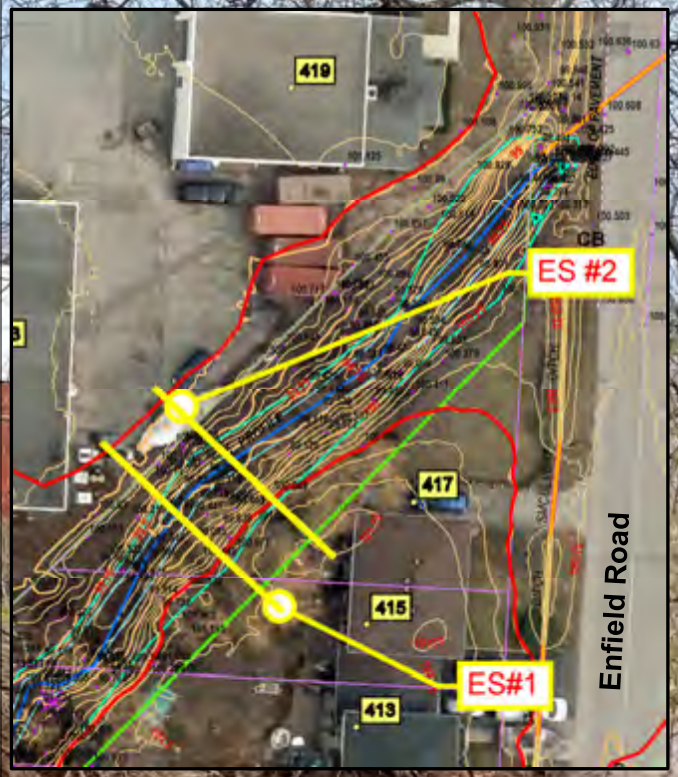
Erosion Site #1



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #2



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

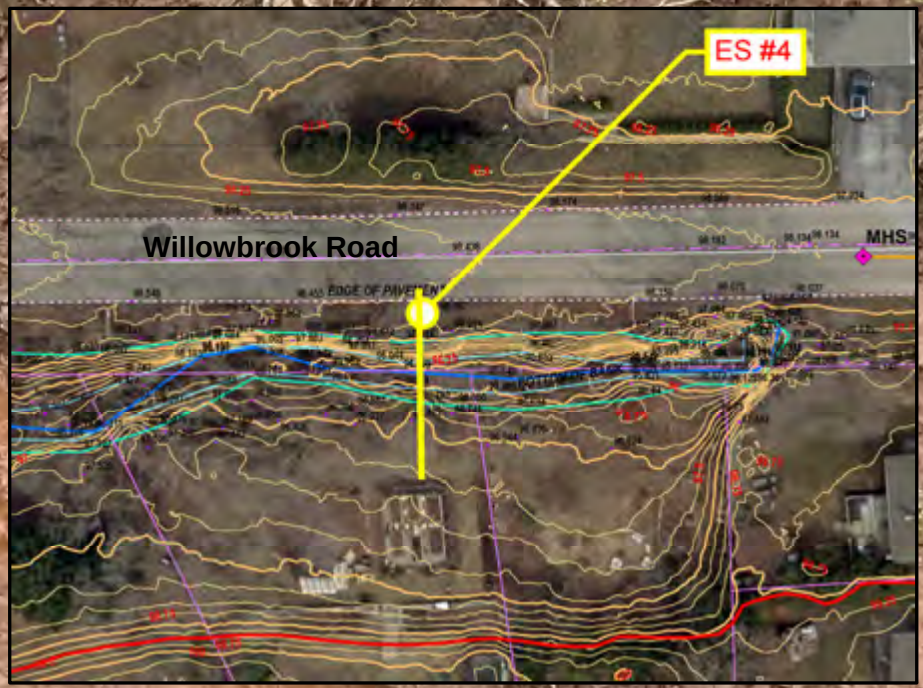
Erosion Site #3



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4



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INVENTORY OF THE SOCIAL/CULTURAL & ECONOMIC ENVIRONMENT

Economic Environment

The existing economic environment within the study area is summarized as follows:

- There is some economic activity based on the commercial and industrial businesses.
- Economic growth is limited.

Social Environment

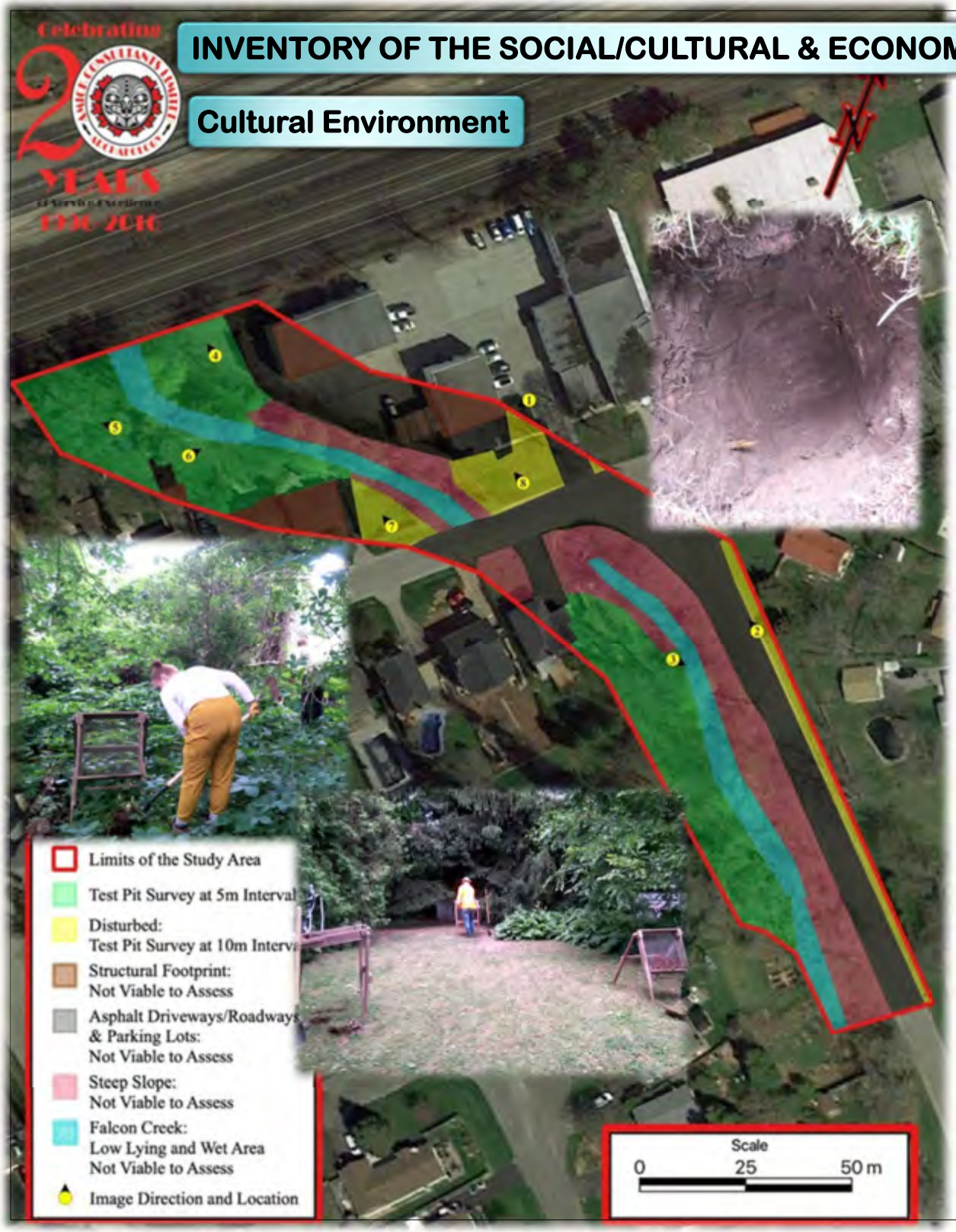
The existing social environment within the study area is described as follows:

- The current land use consists of primarily of residential lands with a small amount of commercial/industrial lands.
- Some persons are employed within the study area.
- Residential and employment densities have been relatively constant for many years.
- Development expansion is restricted by the current floodplain and railroad corridor.



INVENTORY OF THE SOCIAL/CULTURAL & ECONOMIC ENVIRONMENT

Cultural Environment



The entirety of the study area was subject to Stage 1/Stage 2 archaeological investigations consisting of high intensity test pit methodology at a five-metre interval between individual test pits and test pit survey at a ten-metre interval to confirm disturbance on 29 June 2022. All records, documentation, field notes, photographs, and artifacts (as applicable) related to the conduct and findings of these investigations are held at the Lakelands District corporate offices of AMICK Consultants Limited until such time that they can be transferred to an agency or institution approved by the MTCS on behalf of the government and citizens of Ontario.

As a result of the Stage 2 Property Assessment of the study area, no archaeological resources were encountered.

Based on the archaeological investigations completed, the following recommendations are made:

- No further archaeological assessment of the study area is warranted.
- The Provincial interest in archaeological resources with respect to the proposed undertaking has been addressed.
- The proposed undertaking is clear of any archaeological concern.

INVENTORY OF THE NATURAL ENVIRONMENT

Aquatic and Terrestrial Investigations

An inventory of the natural environment (aquatic and terrestrial investigations) was completed by the project ecologist (North-South Environmental) in 2022.

It was determined that erosion control measures along this reach of Falcon Creek would improve terrestrial and aquatic habitat by eliminating or reducing the erosion of land into the watercourse which not only results in a loss of terrestrial habitat but also introduces sediment pollution which can detrimentally impact fish and other aquatic species.

During erosion control works to stabilize the banks, there is an opportunity to enhance/restore the natural environment by channel design, removing invasive species, restoring habitat with native plants, and cleaning up garbage.

Table 4. Summary of Natural Heritage Constraints

Constraint	Assessment
Fish and Fish Habitat	Falcon Creek is fish habitat. Depending on the preferred alternative selected, there may be potential for impact to fish and fish habitat. A DFO Request for Review may be required once the preferred design alternative has been selected.
Species at Risk	Present (Barn Swallow and Chimney Swift). Further, seven of the screened SAR assessed in **Appendix 6** have moderate or high potential to be present (Little Brown Myotis, Northern Myotis, Tri-coloured Bat, Monarch, Yellow-banded Bumblebee, Midland Painted Turtle, Snapping Turtle).
Significant Wildlife Habitat	No confirmed SWH is present (see **Appendix 7**). There are six types of candidate (i.e., 'potential') SWH: Bat Maternity Colonies, Turtle Wintering Areas, Reptile Hibernacula,
	Migratory Butterfly Stopover Areas, Turtle Nesting Areas, Habitat for Special Concern and Rare Wildlife Species.
Significant Woodland	None present.
Significant Valleyland	None present.
Life Science Area of Natural and Scientific Interest (ANSI)	None present.
Natural Heritage System	None present.
Savannah, Tallgrass Prairie, Alvar	None present.
Provincially Significant Wetlands or Other Wetlands	None present.
Migratory Bird Nesting Habitat	The study area supports migratory birds that could be disturbed during erosion control works.
Conservation Halton Regulated Area	The study area is within Conservation Halton's regulated limit. A permit from Conservation Halton is required.
Conservation Halton Hazard Lands	Conservation Halton has hazard lands mapped within the study area (floodplain hazard, stable top of slope hazard, and meander belt hazard). A permit from Conservation Halton is required.

















INVENTORY OF THE NATURAL ENVIRONMENT

Fluvial Geomorphology Investigations

An inventory of the natural environment (fluvial geomorphology - or the study of river behaviour) was completed by the project geomorphologist (Water's Edge) in 2022 and the following is a summary of the investigations:

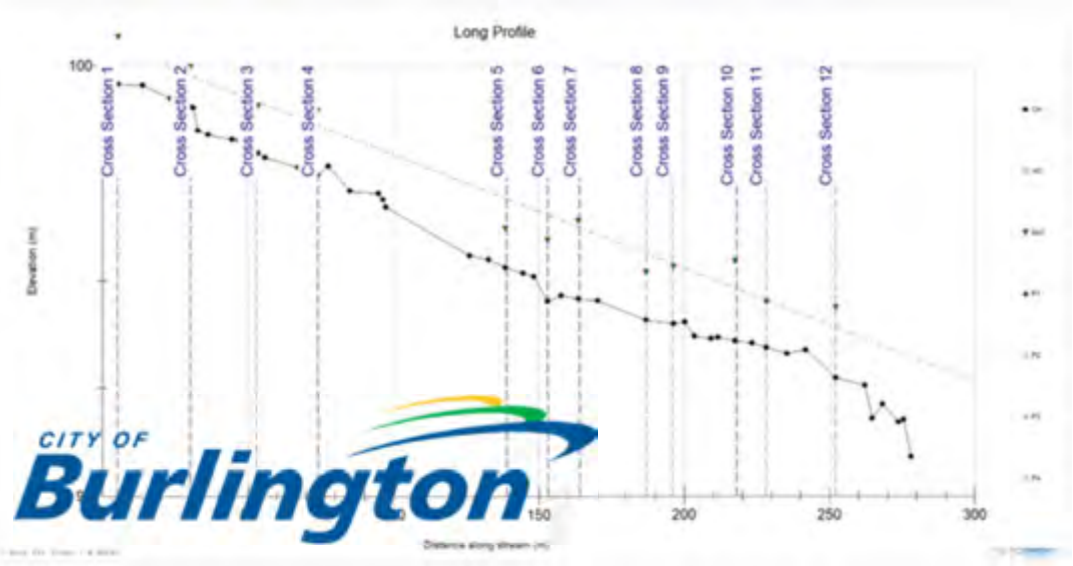
- In order to carry out a fluvial geomorphic and erosion assessment, a geomorphic survey of approximately 270 m of the stream reach in the area of interest was carried out. The sediment substrate in the riffles of the studied reach was dominated by gravels and cobbles.
- Bank erosion is occurring within the reach. The channel has been classified as 'In Adjustment' and 'Fair' conditions for river stability. There are signs of significant erosion. ES#1 and 2 do not, however, require immediate responses, but it is recommended to implement monitoring programs. It is recommended to complete immediate mitigative action at ES#3 and ES#4 which is threatening public property (Willowbrook Road).
- Continued maintenance is recommended for all sites.

Stability Index (SI) Value	Classification	Interpretation
SI ≤ 0.20	In Regime	The channel morphology is within a range of variance for rivers of similar hydrographic characteristics and evidence of instability is isolated or associated with normal river meander processes.
0.21 ≤ SI ≤0.40	Transitional/Stressed	Channel morphology is within a range of variance for rivers of similar hydrographic characteristics, but the evidence of instability is frequent.
SI ≥ 0.40	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is widespread.

Creek	Score	Verbal Ranking
Falcon Creek	0.43	In Adjustment

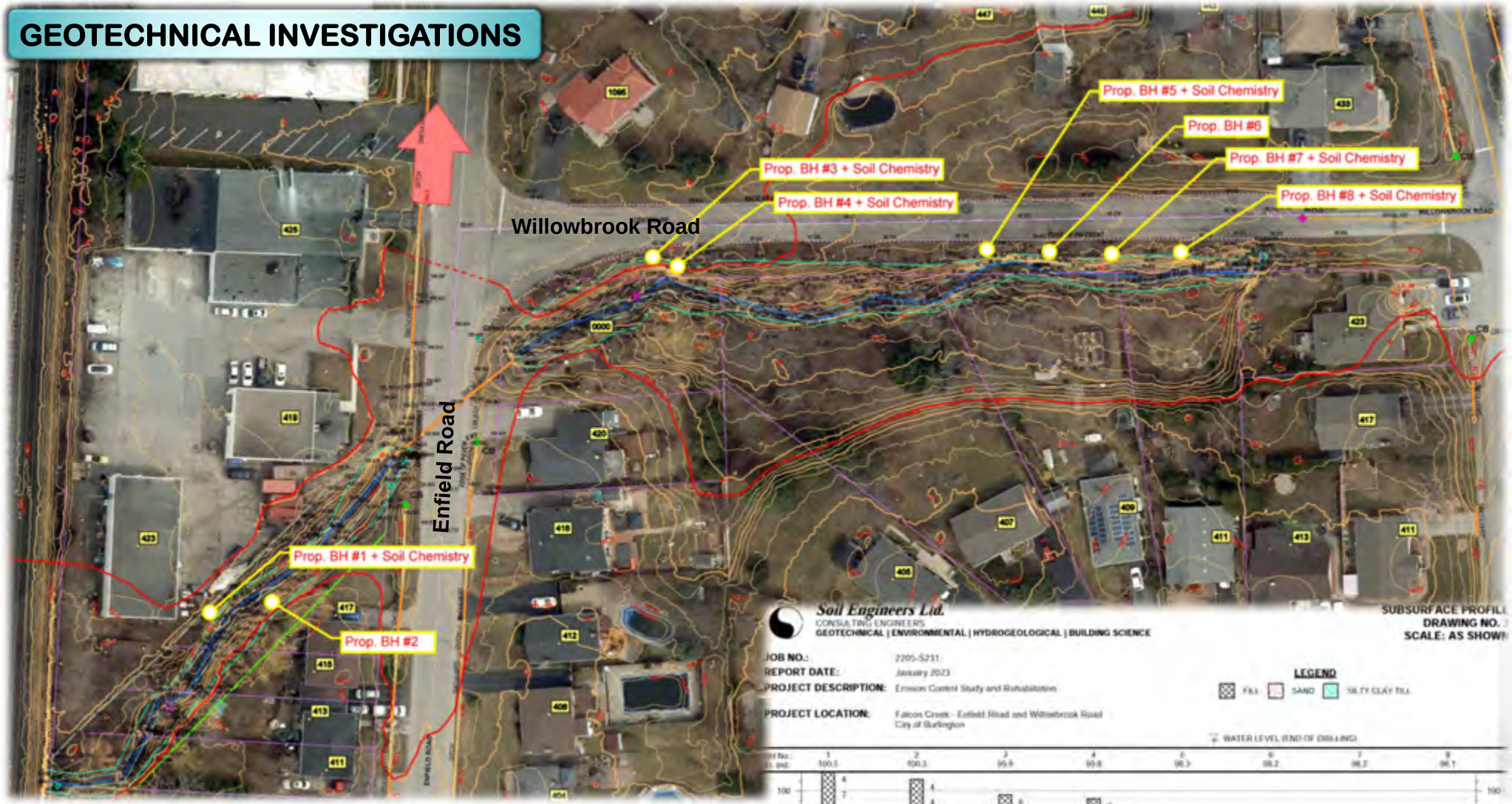
RSAT Score	Ranking
41-50	Excellent
31-40	Good
21-30	Fair
11-20	Poor
0-10	Degraded

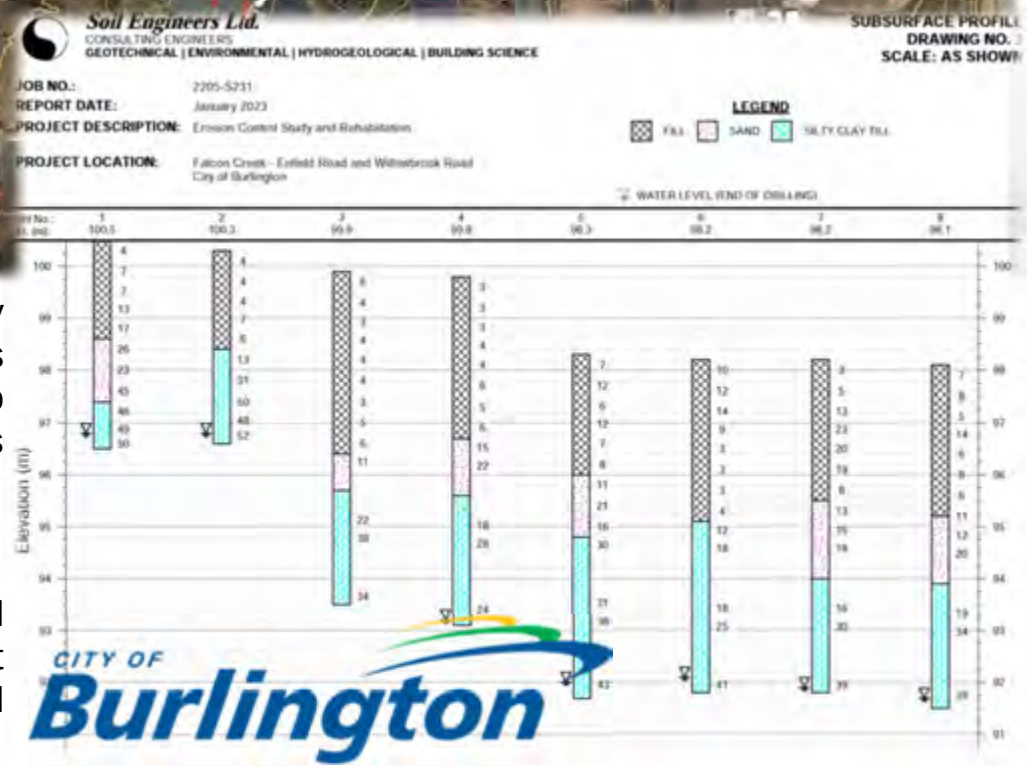
River	Score	Verbal Ranking
Falcon Creek	26	Fair



Parameter	Mean	Min	Max
Bankfull Width (m)	5.3	3.20	6.93
Bankfull Mean Depth (m)	0.53	0.25	0.73
Bankfull Max Depth (m)	0.86	0.55	1.12
Bankfull Area (m^2)	3.04	1.09	4.78
Bankfull Flow (m^3/s)	5.16	1.19	12.26
Wetted Perimeter (m)	5.7	3.48	7.43
Hydraulic Radius (m)	0.49	0.23	0.68
Width-Depth Ratio	10.78	8.68	17.64
Entrenchment Ratio	2.62	1.4	3.27
Bankfull Slope (m/m)	0.016	0.016	0.016
Channel Substrate D50 (mm)*	165	75	255
Channel Substrate D84 (mm)*	277	126	510
Channel Sinuosity	1.08	-	-
Rosgen Classification	C3/C4		

GEOTECHNICAL INVESTIGATIONS





Geotechnical investigations were completed within the study area by Soil Engineers Ltd. to assess the current conditions and to collect soils data for slope stability calculations and to confirm disposal options during construction. The following is a brief summary of the findings:

- Underlying soils consisted of earth fill, clay and sand
- The results of the chemical analysis indicate general conformance with Table 1 Standards with a slight exceedance for Barium (which is believed to be an isolated occurrence) and exceedances regarding sodium.

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HYDROTECHNICAL INVENTORY

Hydrologic/Hydraulic Investigations

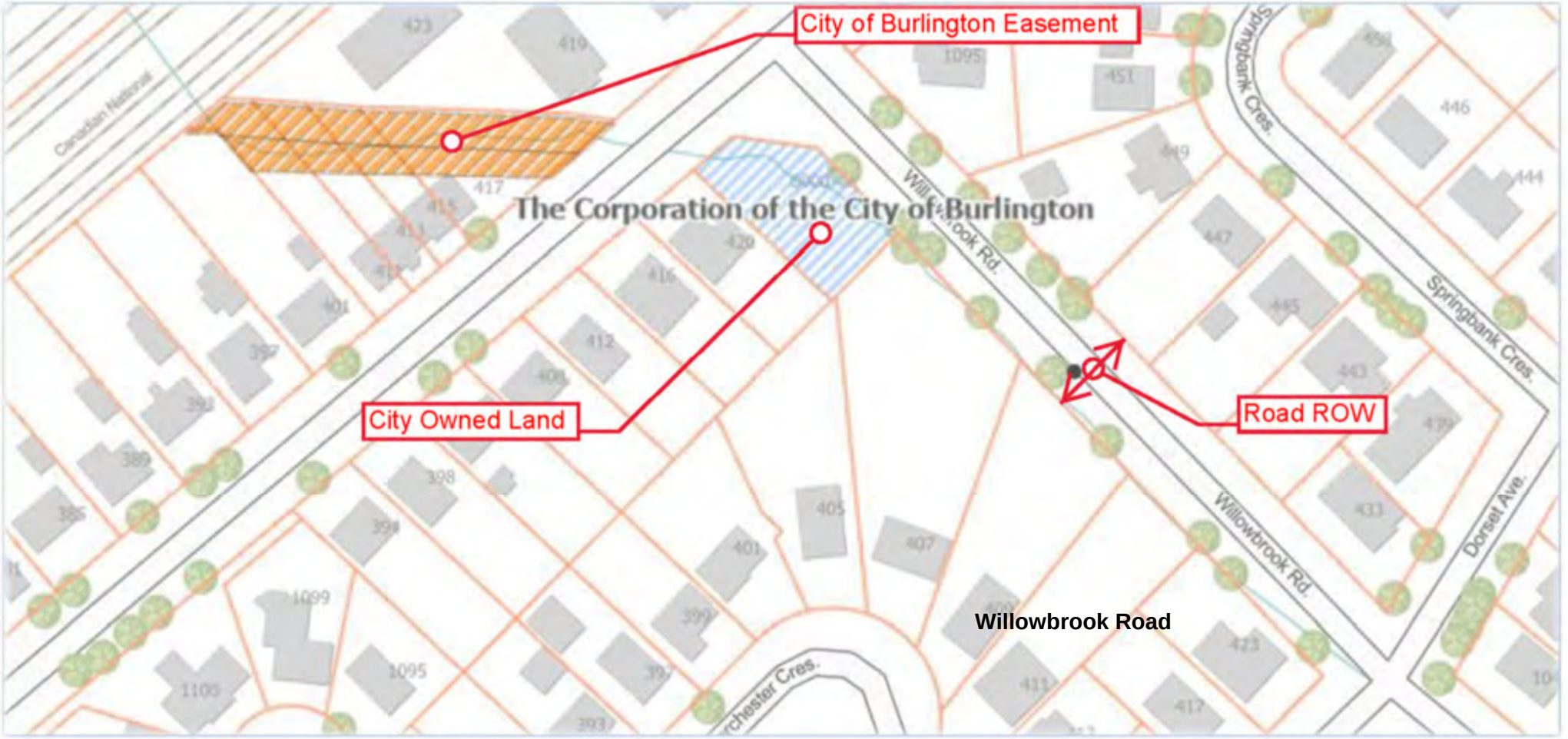
The regulatory peak flow was obtained from Conservation Halton for the current approved hydraulic model. The current approved hydraulic model was updated based on the detailed survey and LiDAR data. The updated regulatory floodline was delineated on the base plan.



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

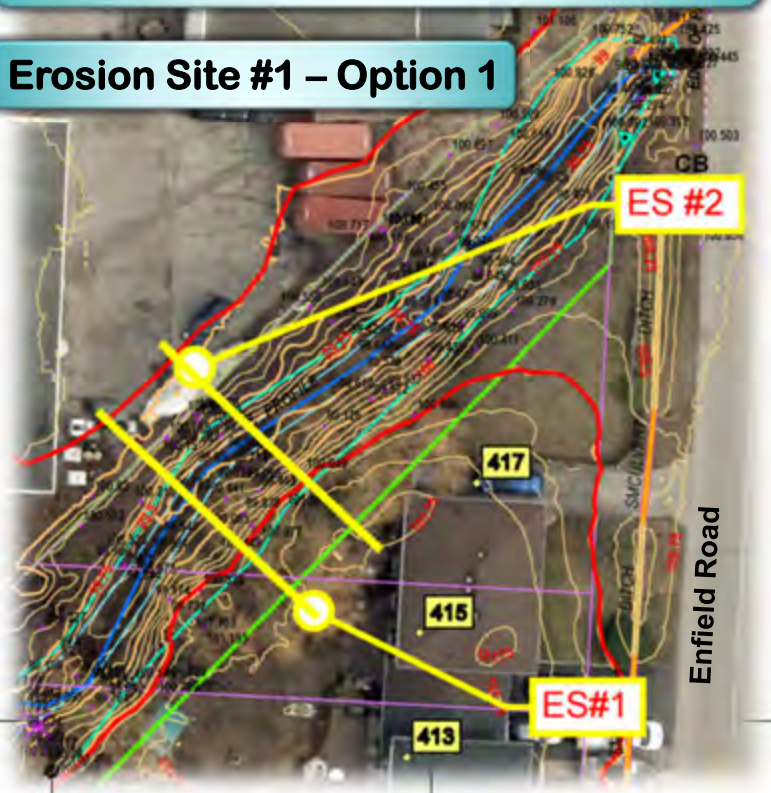
Property Ownership



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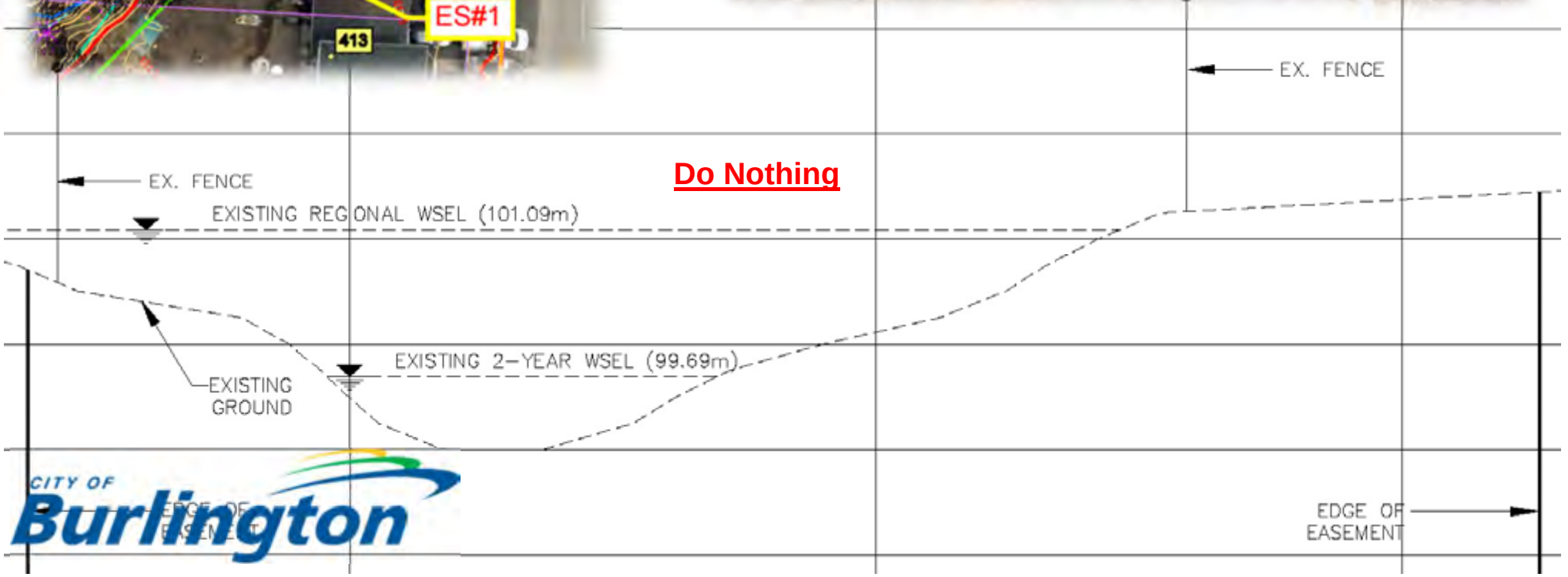
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #1 – Option 1





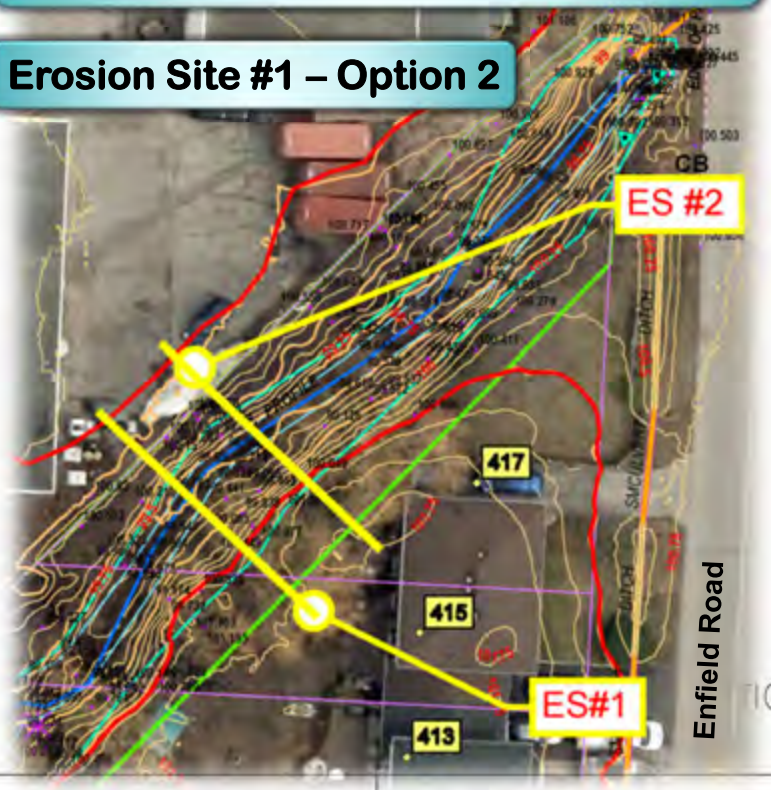
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

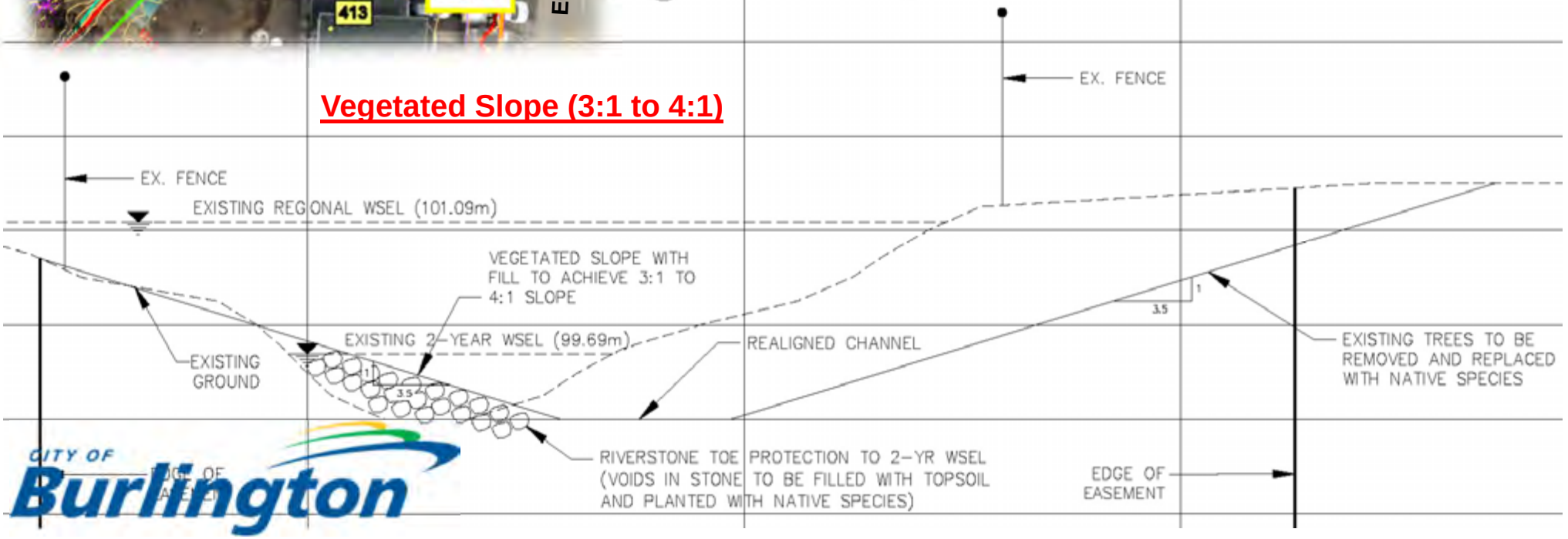
Erosion Site #1 – Option 2





TION (2) EROSION SITE #1

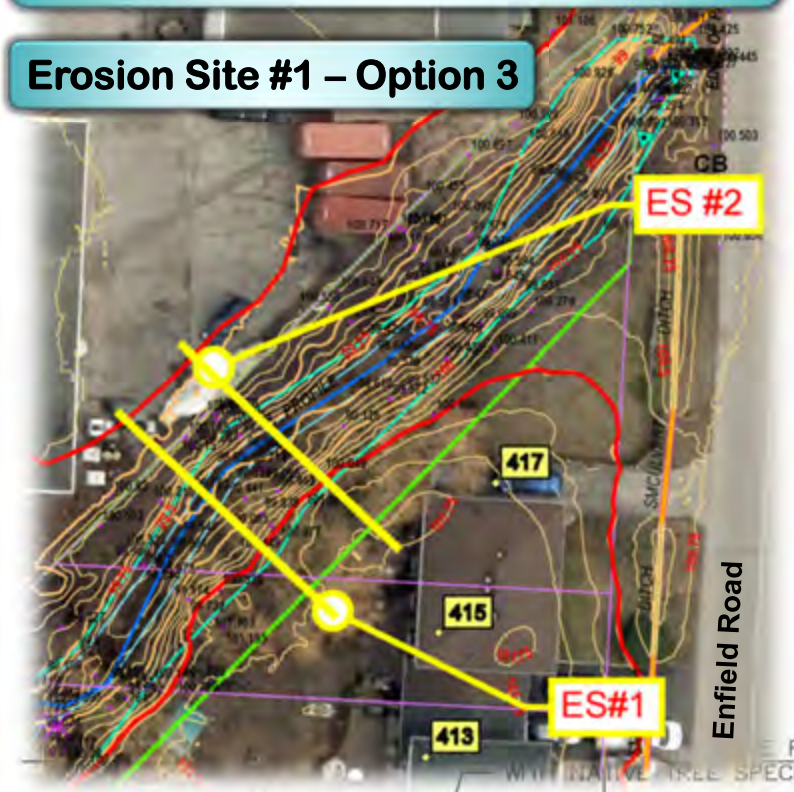
Vegetated Slope (3:1 to 4:1)



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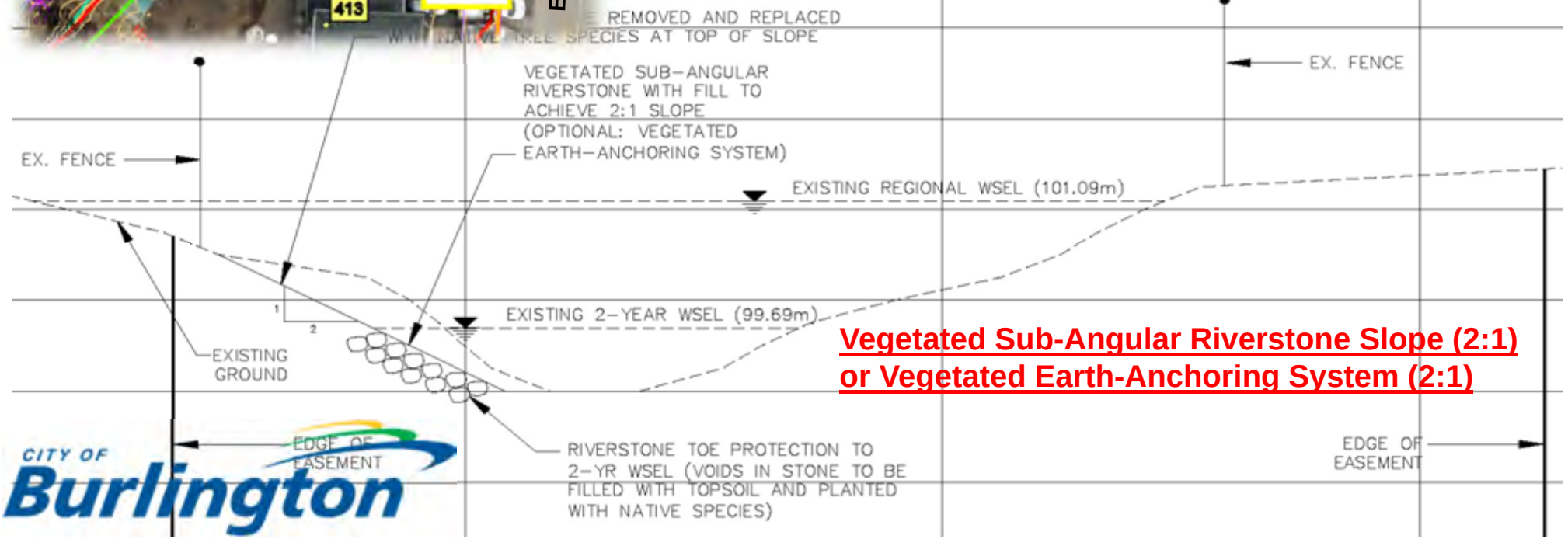
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #1 – Option 3





OPTION (3) EROSION SITE #1

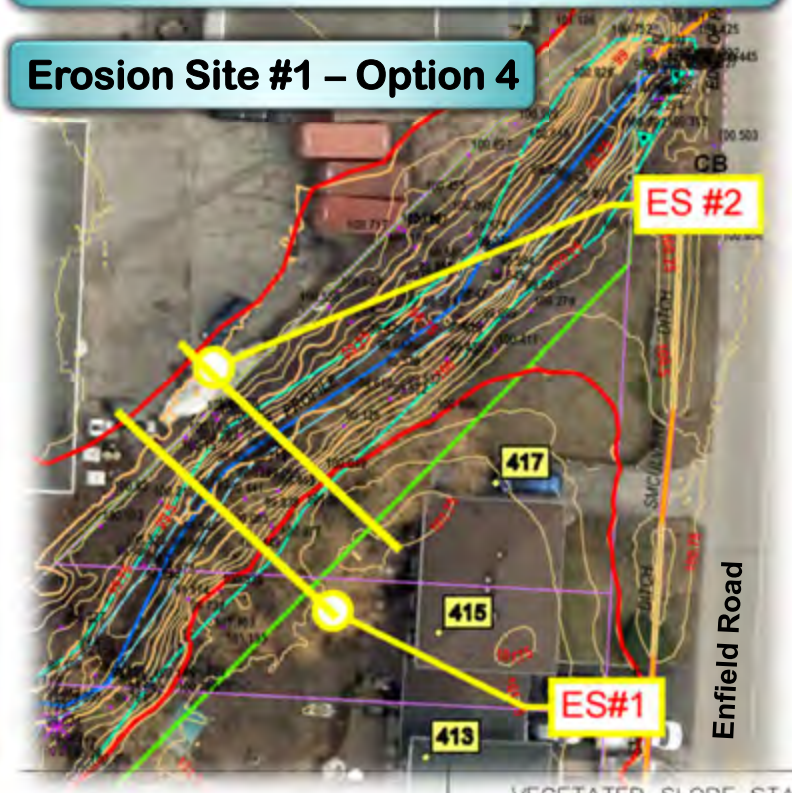


Vegetated Sub-Angular Riverstone Slope (2:1)
or Vegetated Earth-Anchoring System (2:1)

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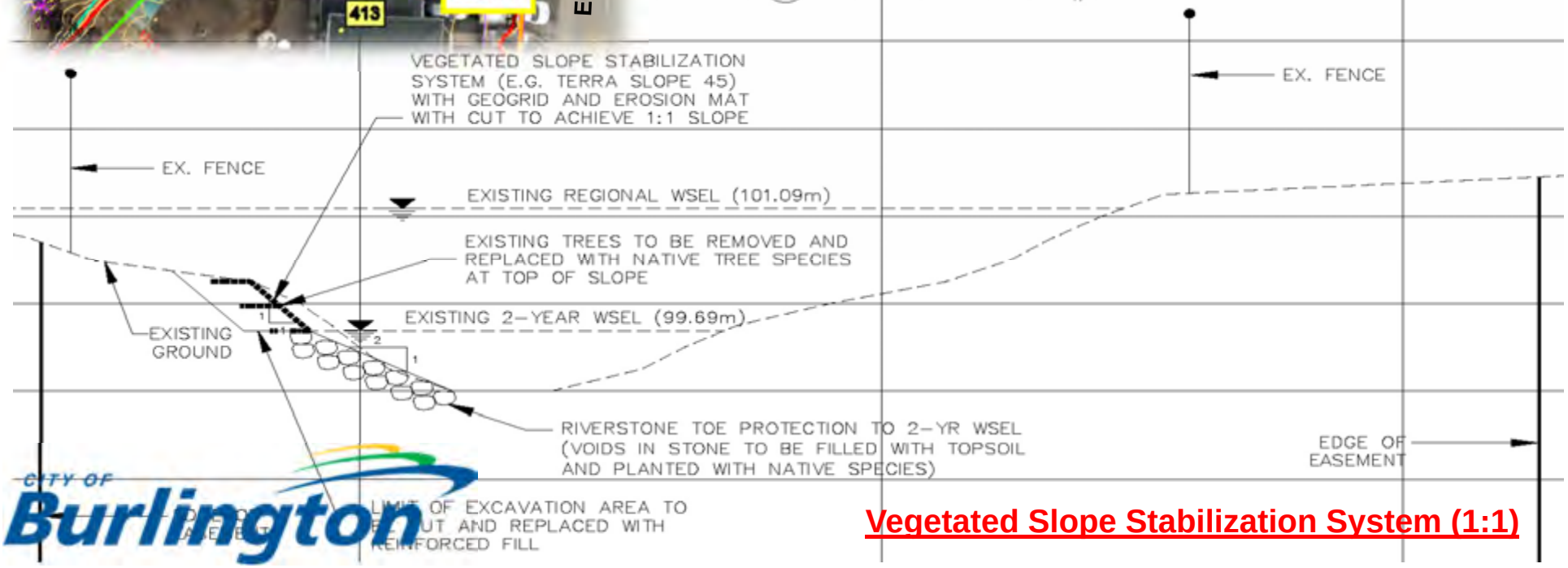
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #1 – Option 4





OPTION (4) EROSION SITE #1

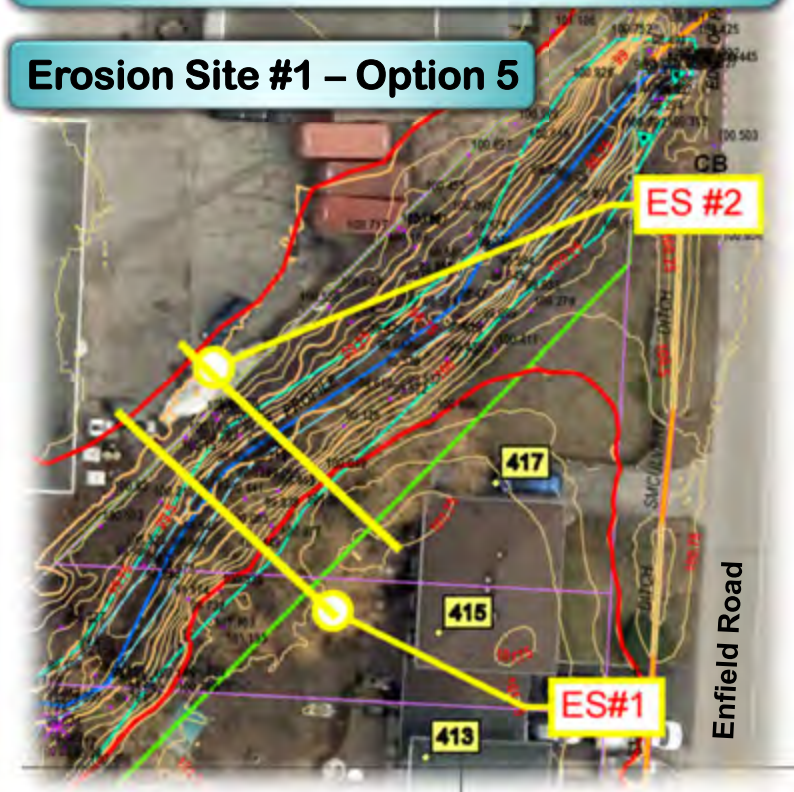


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Vegetated Slope Stabilization System (1:1)

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

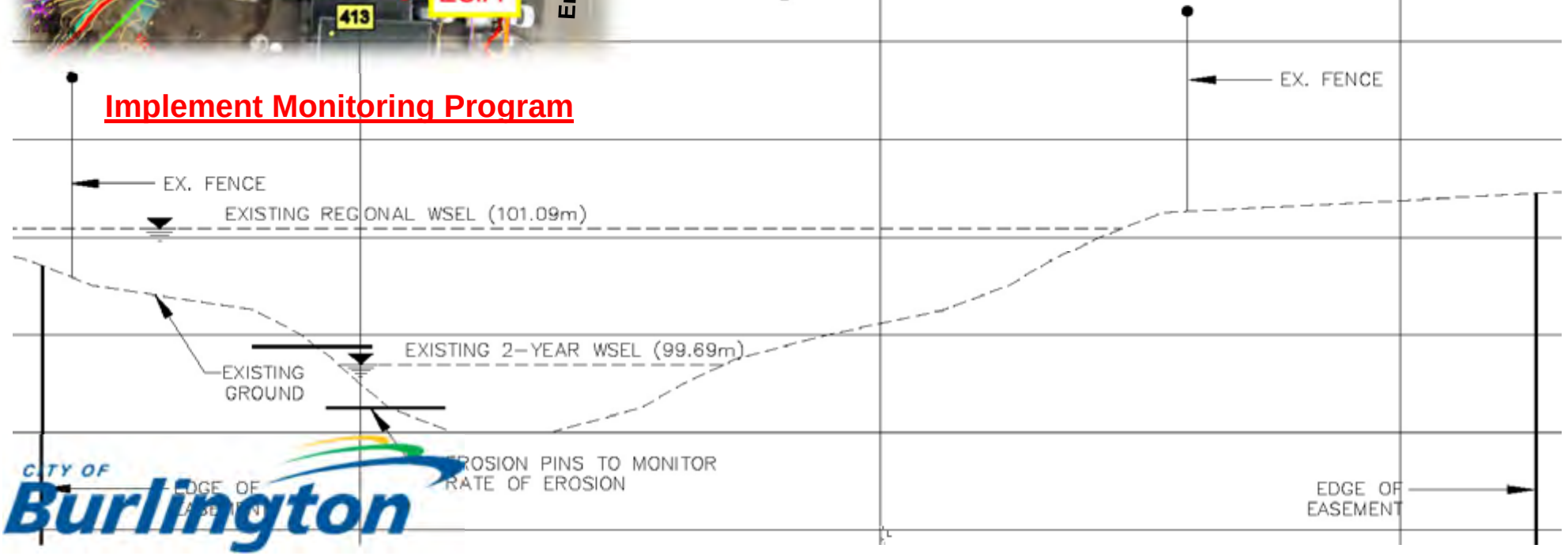
Erosion Site #1 – Option 5





OPTION (5) EROSION SITE #1

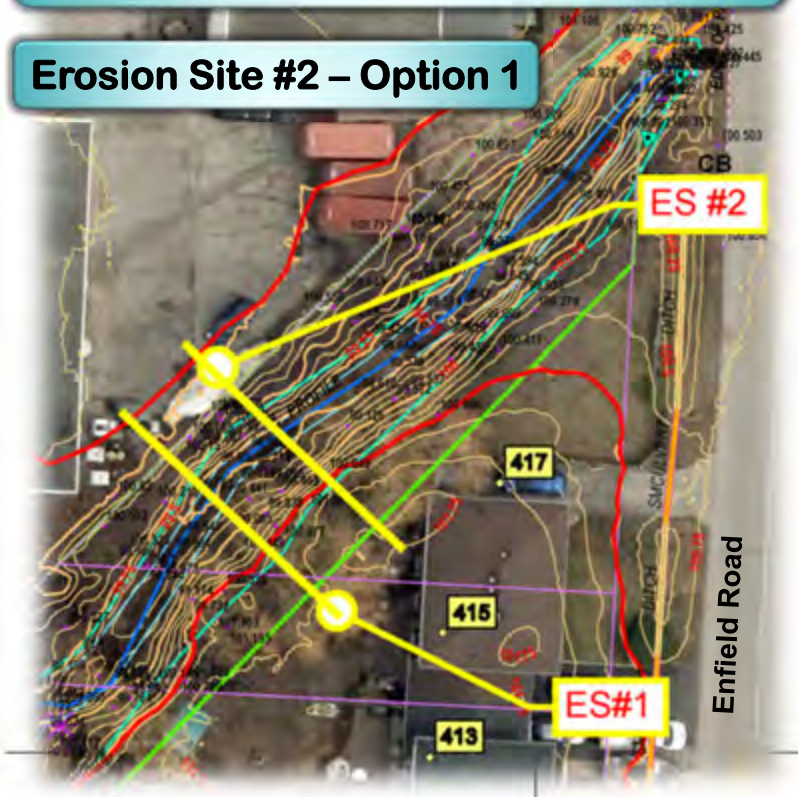
Implement Monitoring Program



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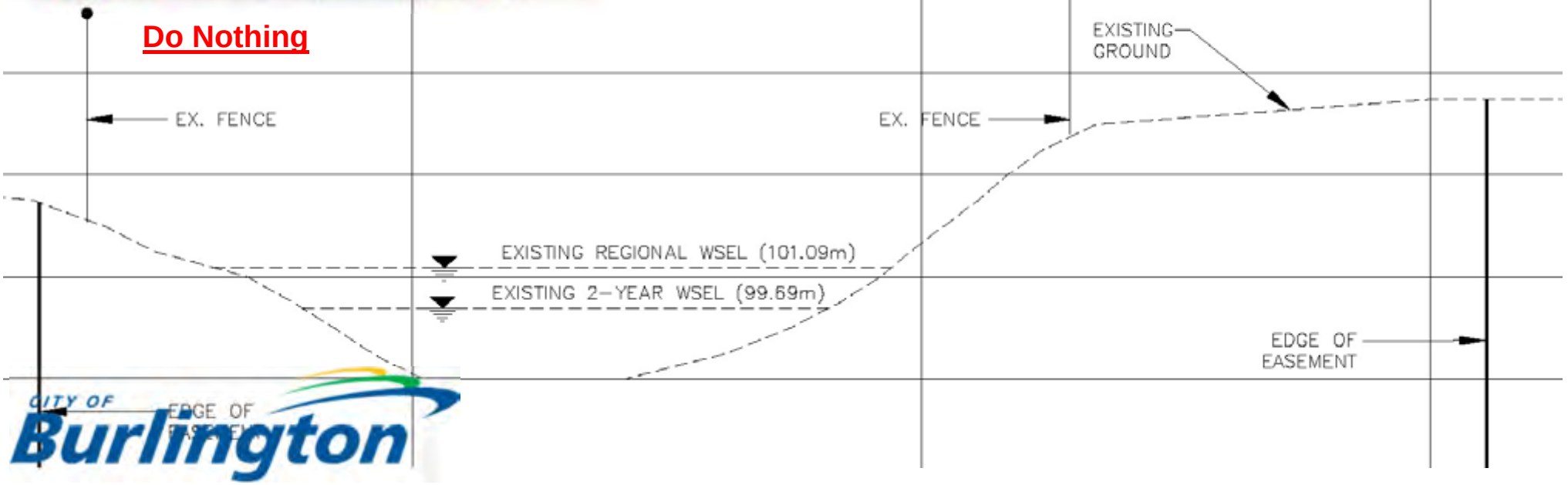
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #2 – Option 1





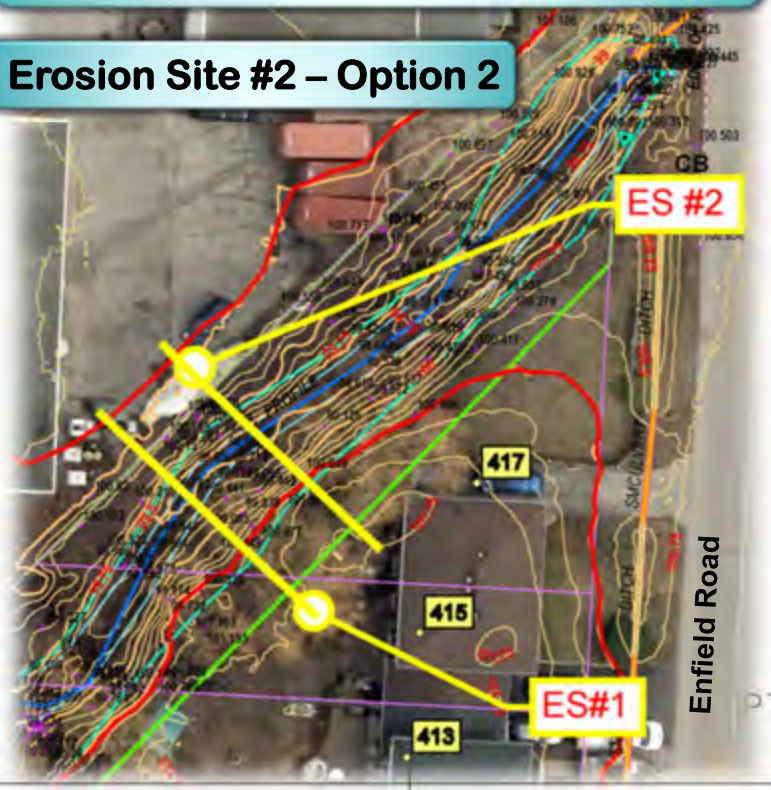
Do Nothing



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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

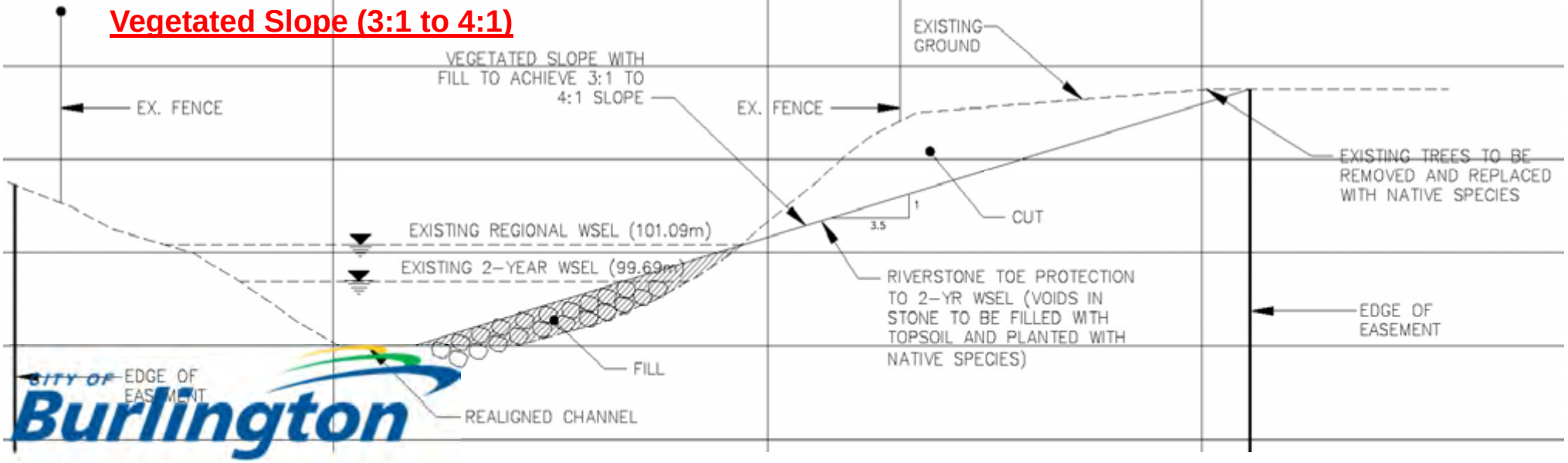
Erosion Site #2 – Option 2





PTION (2) EROSION SITE #2

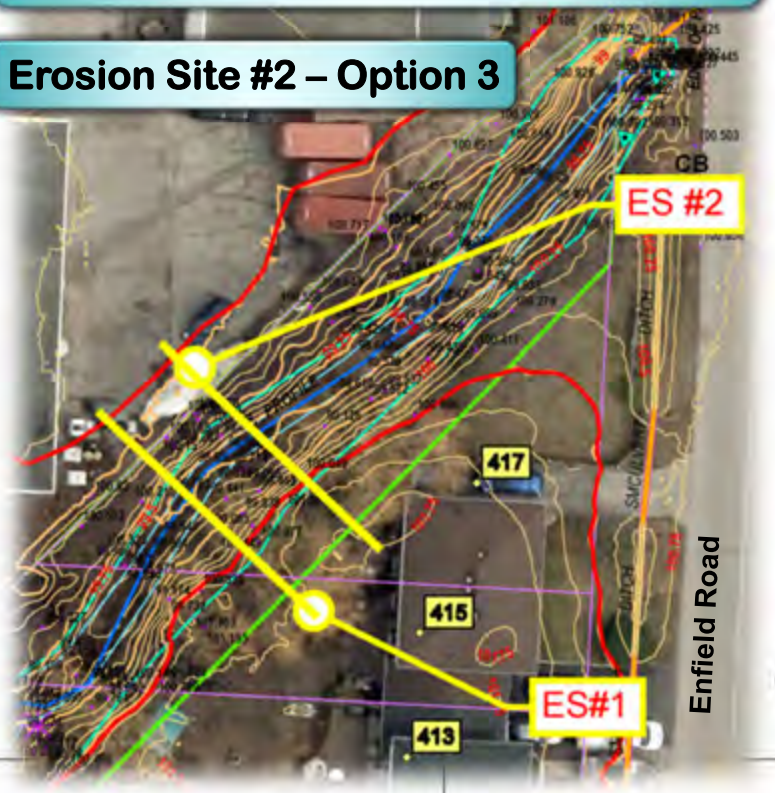
Vegetated Slope (3:1 to 4:1)



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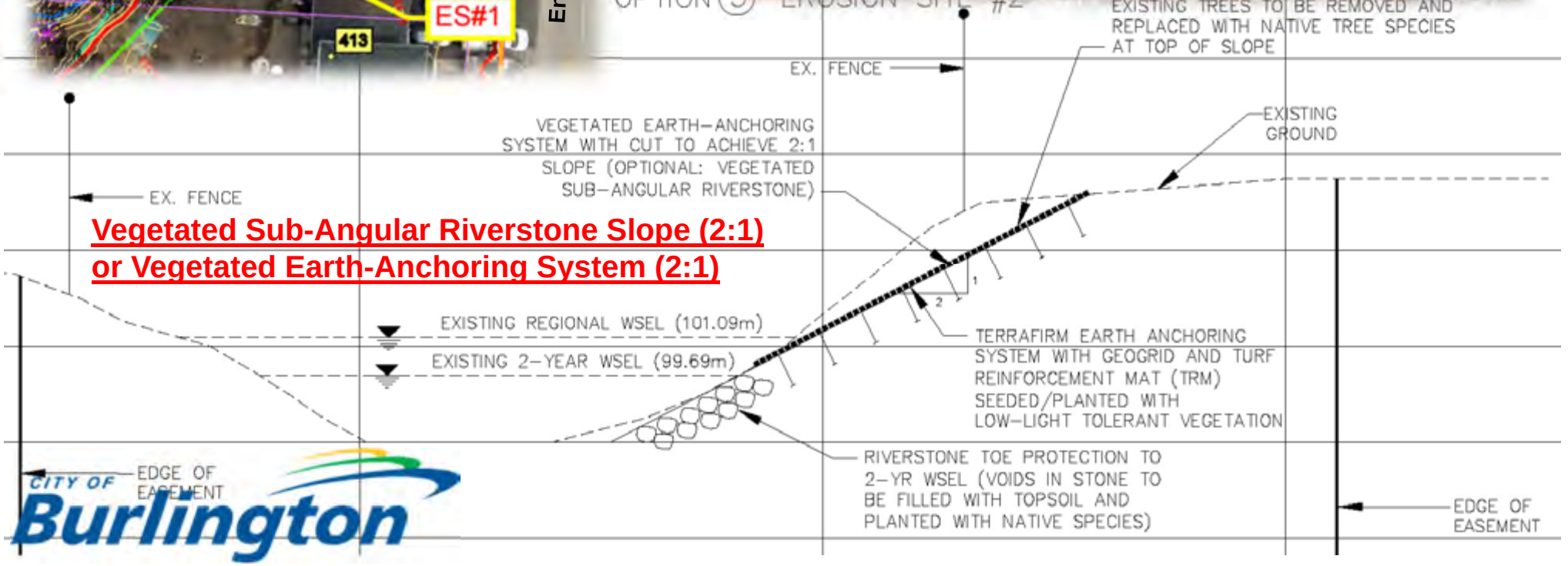
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #2 – Option 3





OPTION (3) EROSION SITE #2

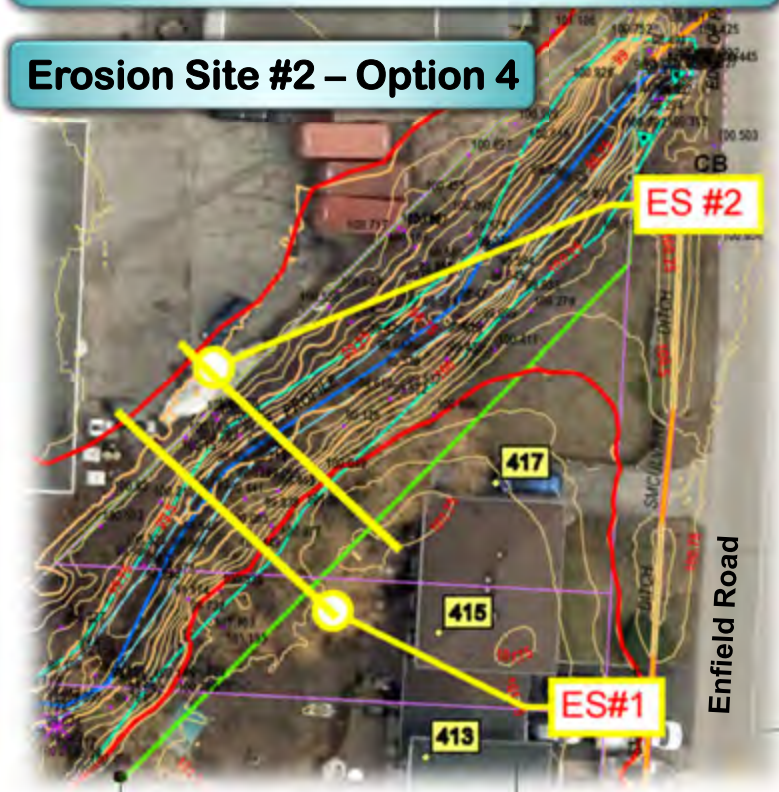


Vegetated Sub-Angular Riverstone Slope (2:1)
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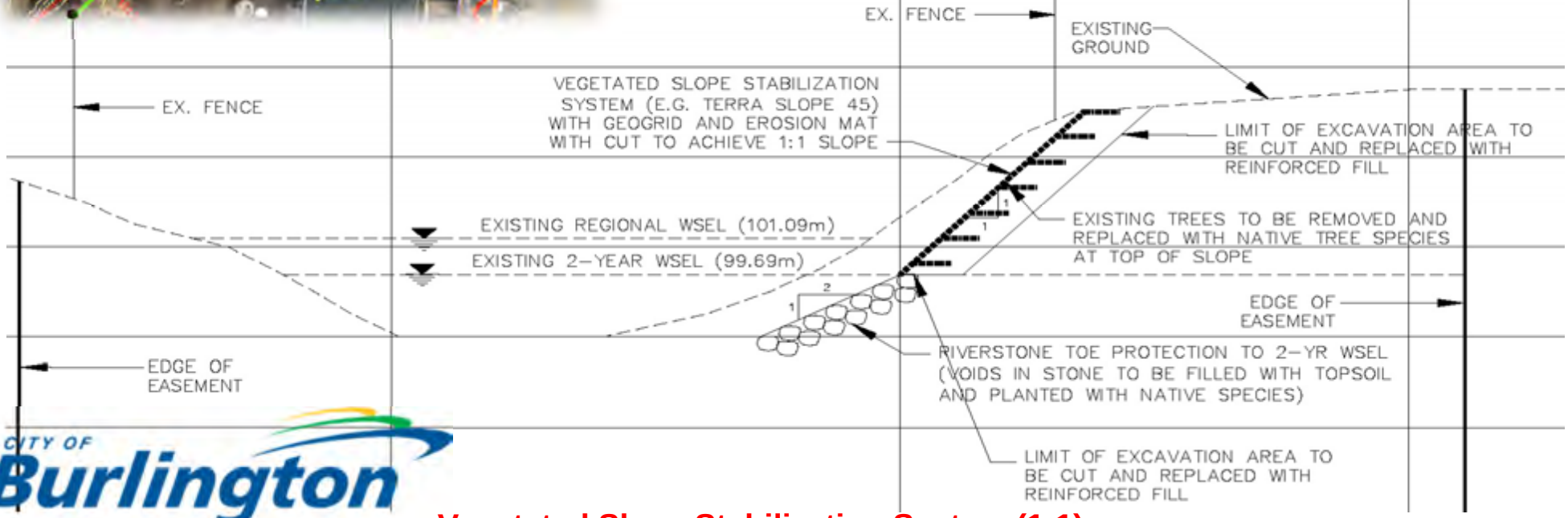
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #2 – Option 4





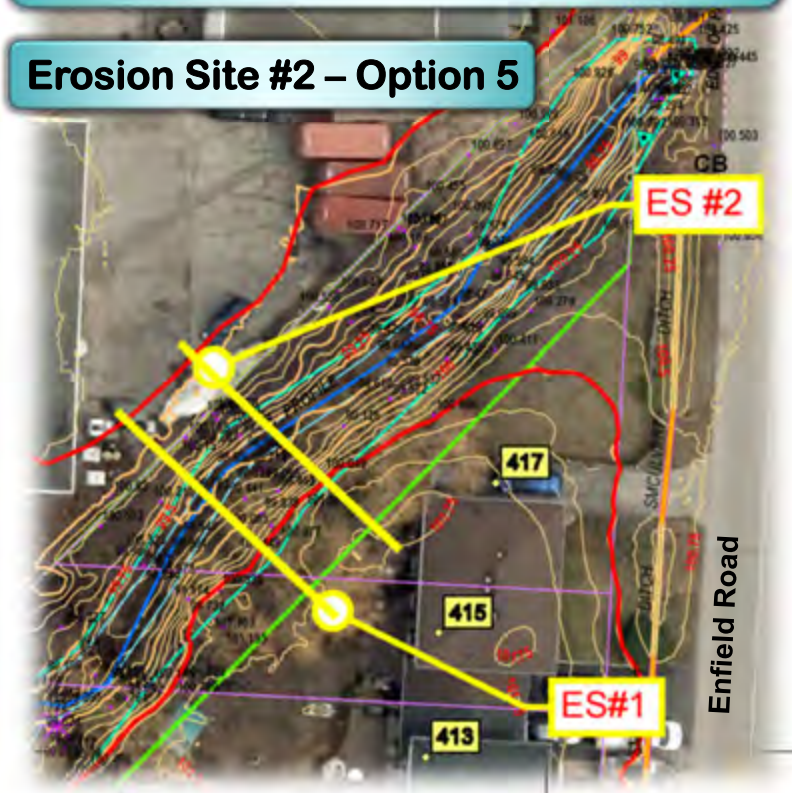


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Vegetated Slope Stabilization System (1:1)

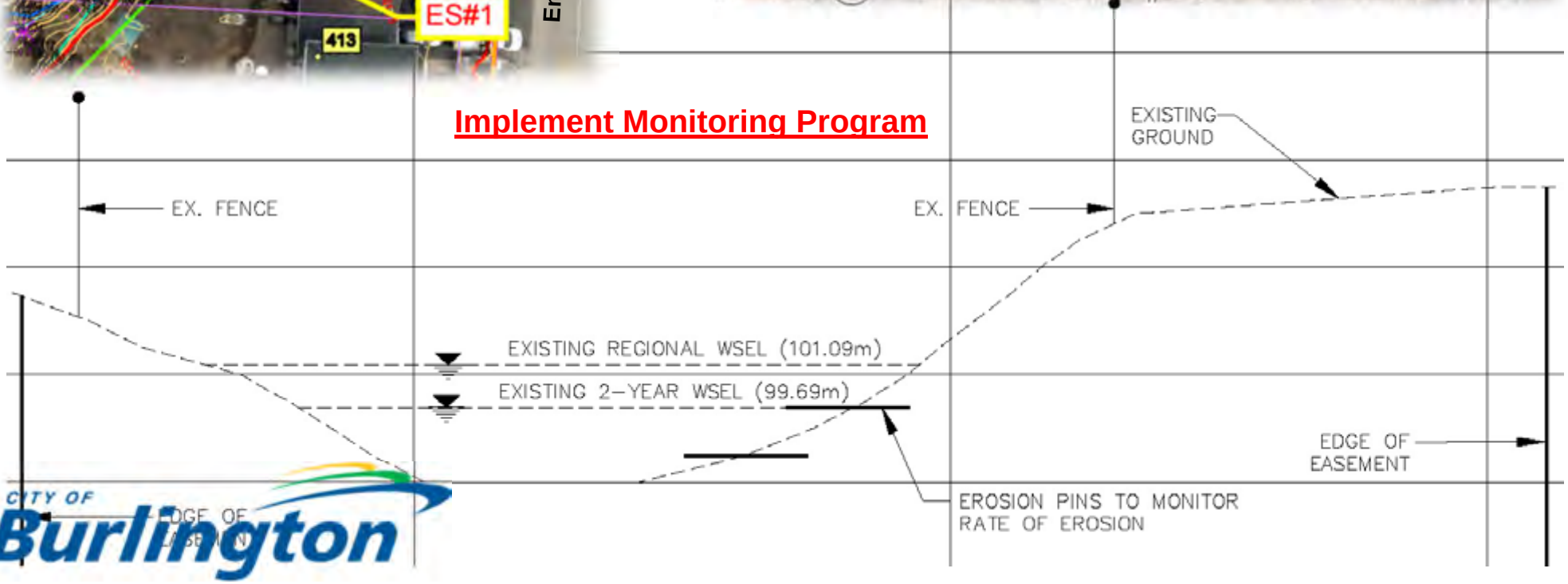
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #2 – Option 5





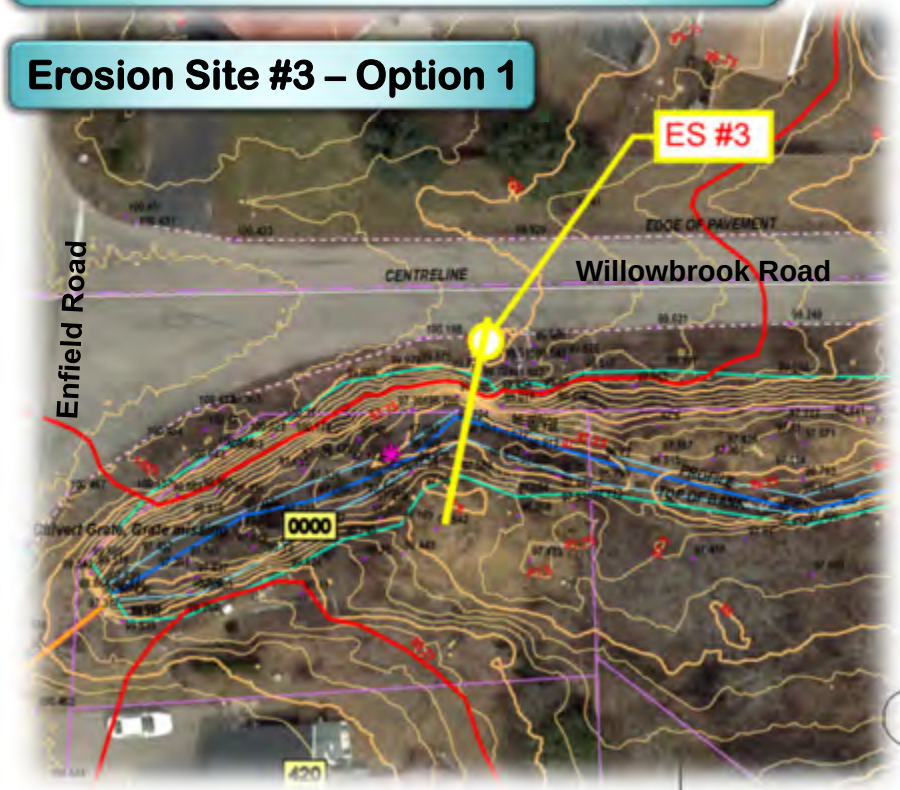
Implement Monitoring Program



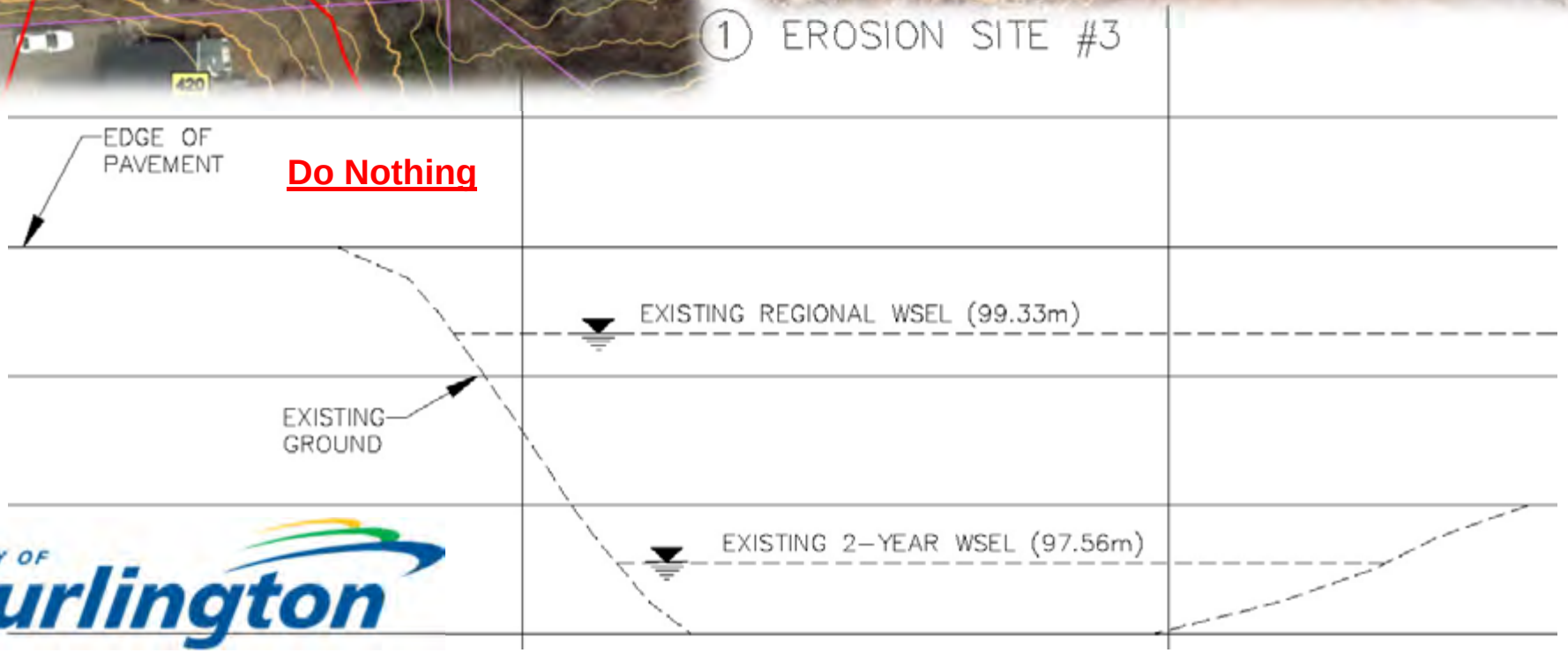
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 1







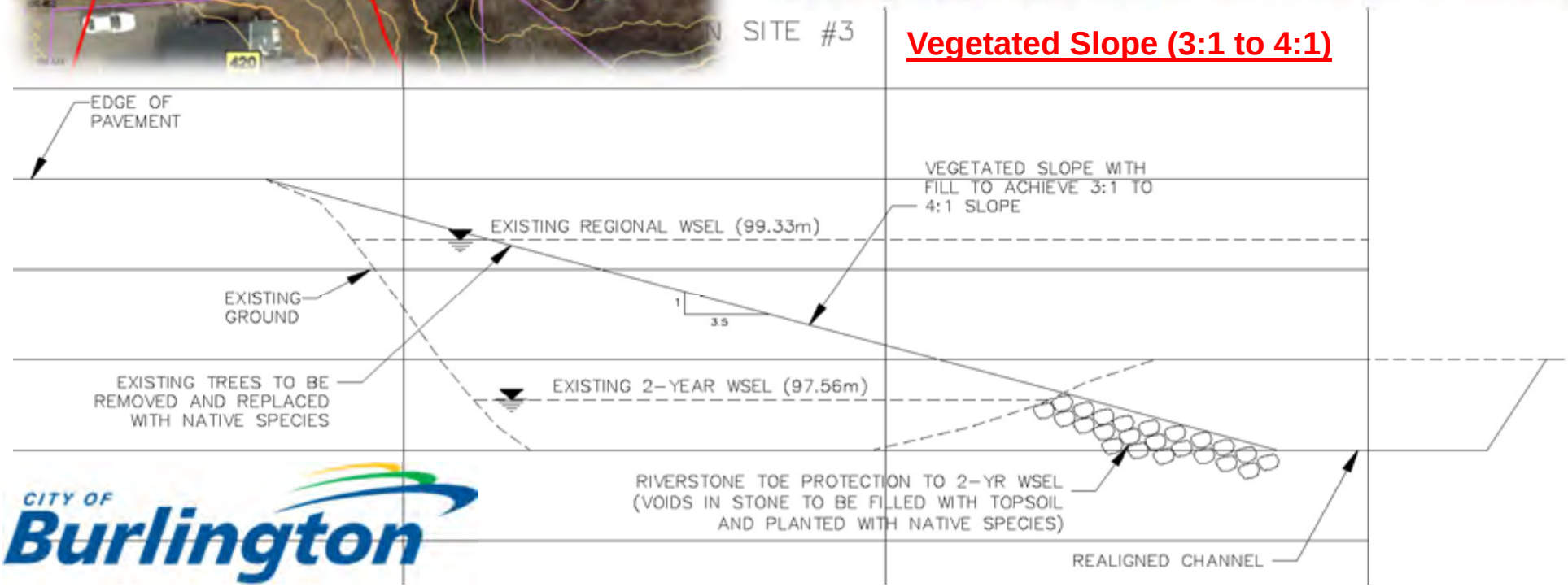
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 2



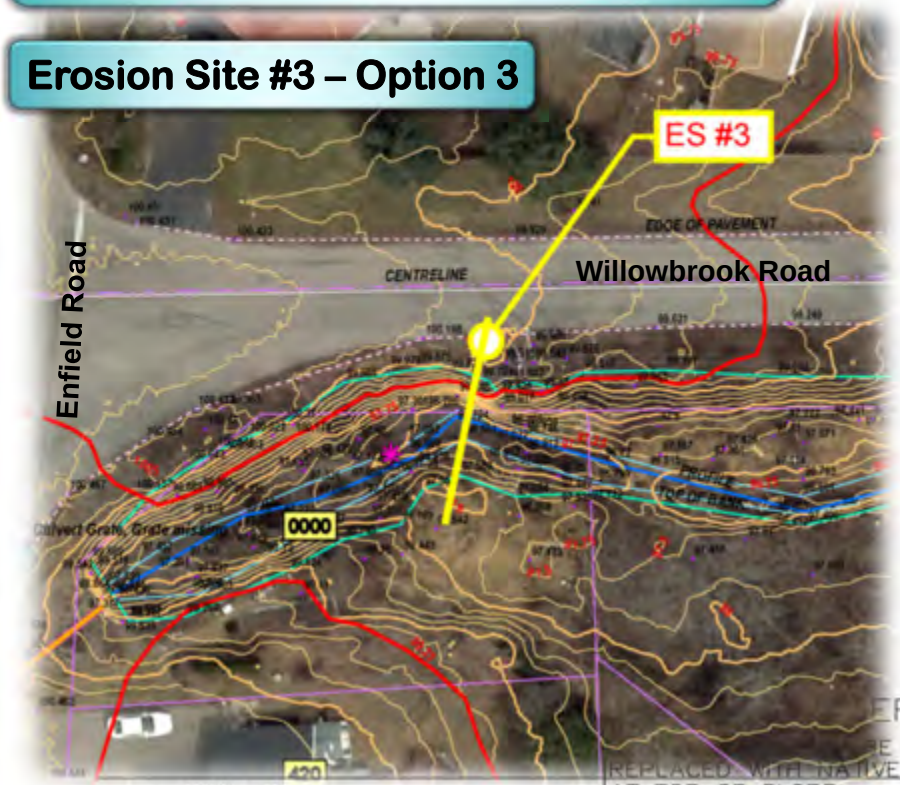




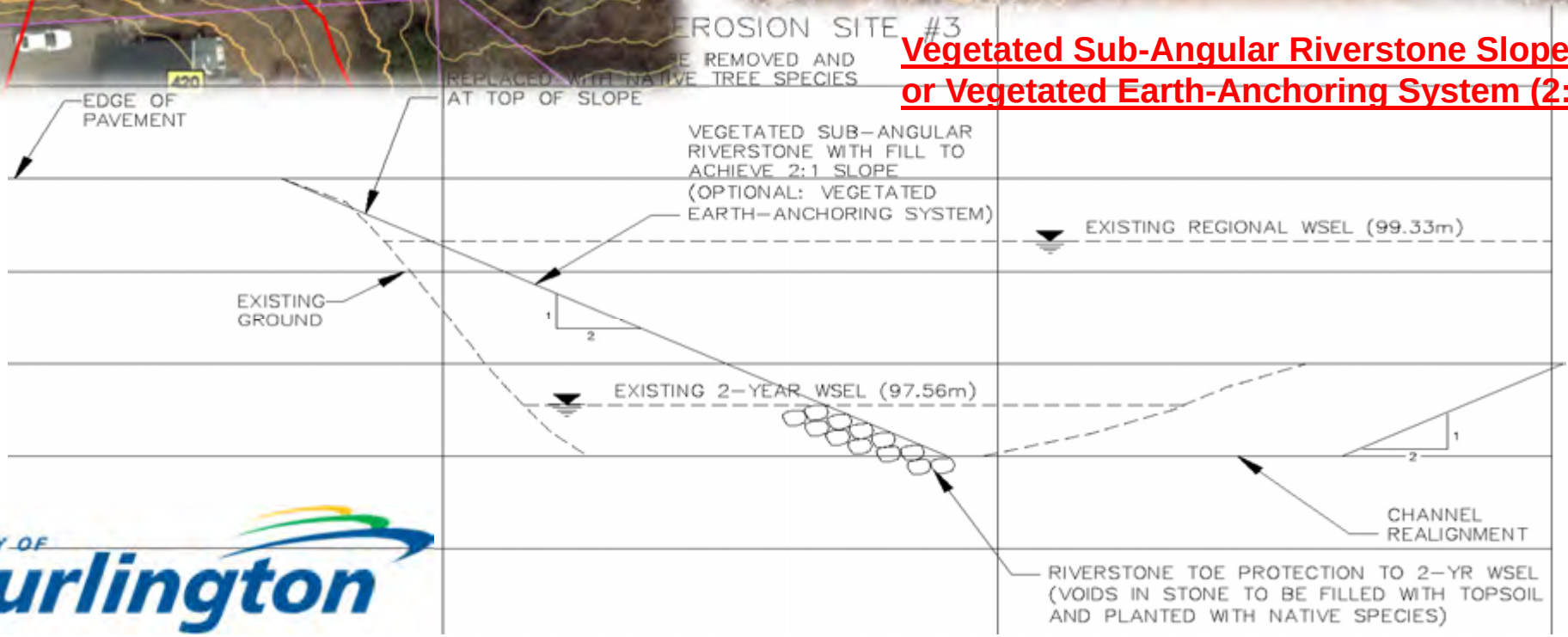
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 3







Vegetated Sub-Angular Riverstone Slope (2:1)
or Vegetated Earth-Anchoring System (2:1)

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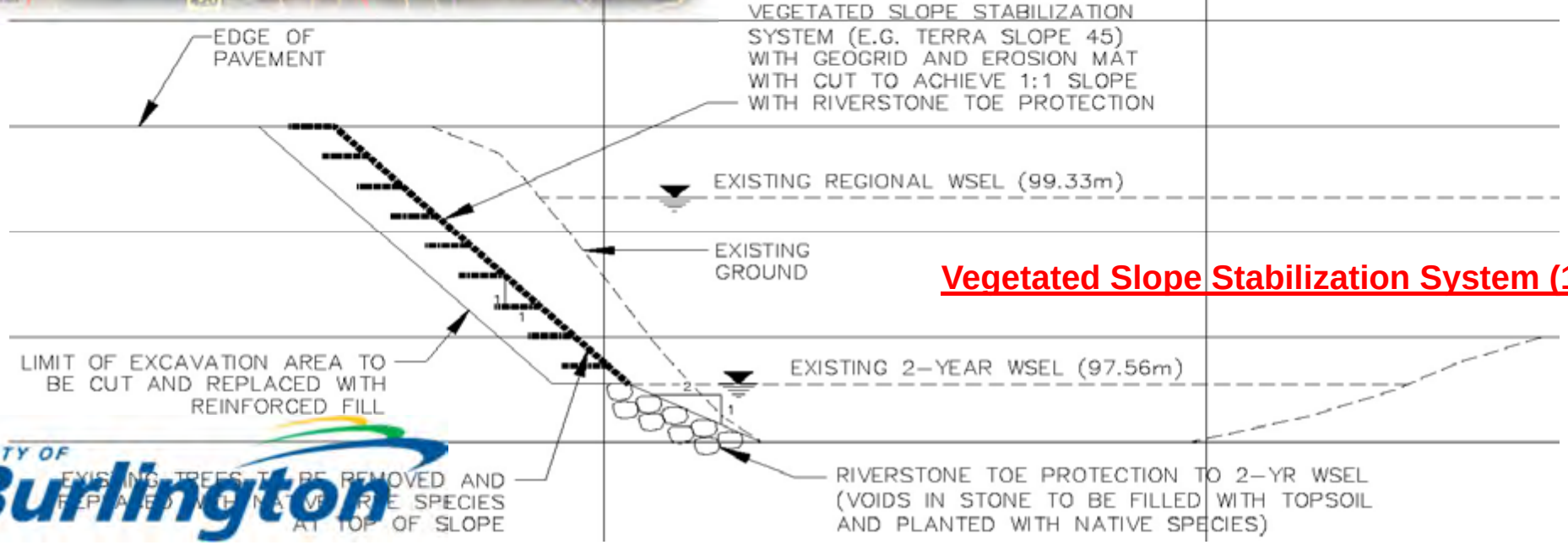
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 4





TION (4) EROSION SITE #3

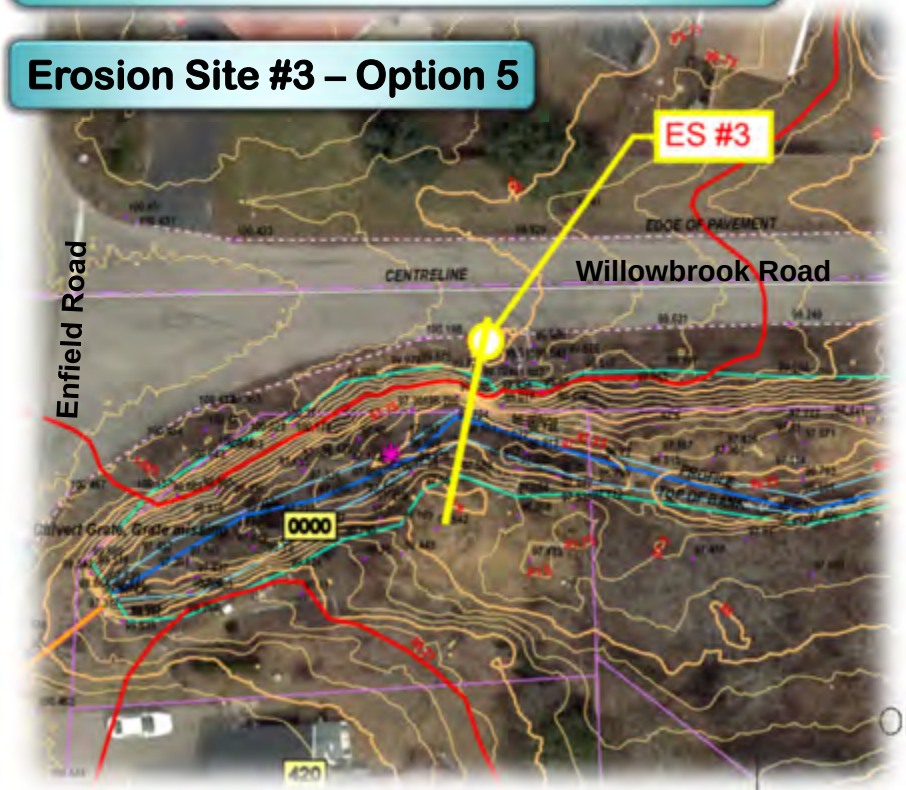


Vegetated Slope Stabilization System (1:1)

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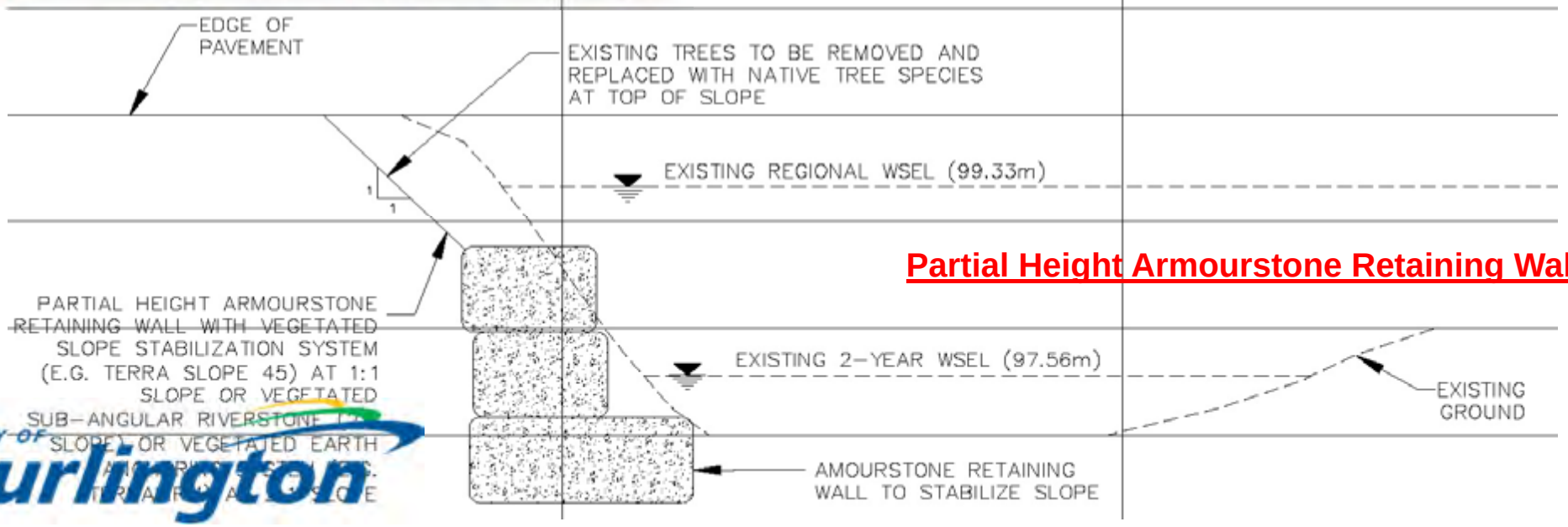
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 5





ON (5) EROSION SITE #3



Partial Height Armourstone Retaining Wall

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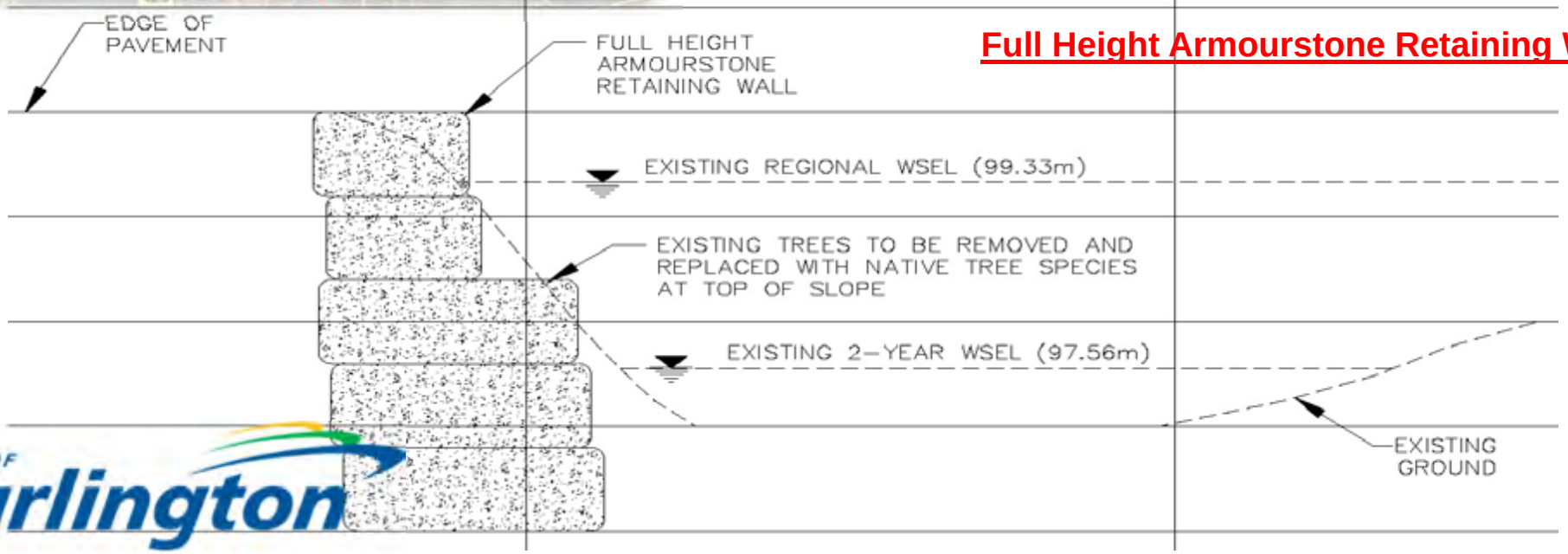
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #3 – Option 6





ON (6) EROSION SITE #3

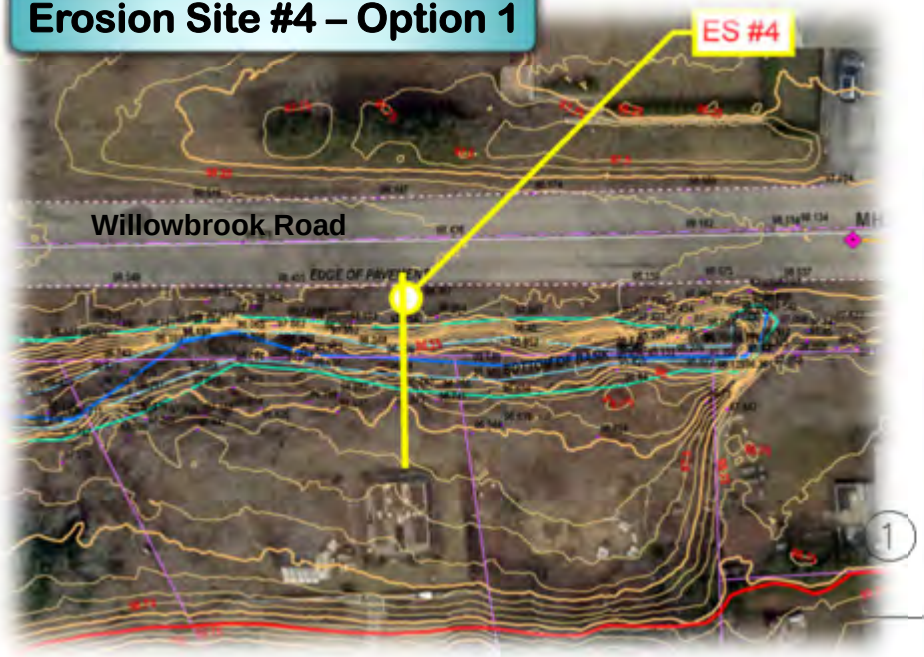


Full Height Armourstone Retaining Wall

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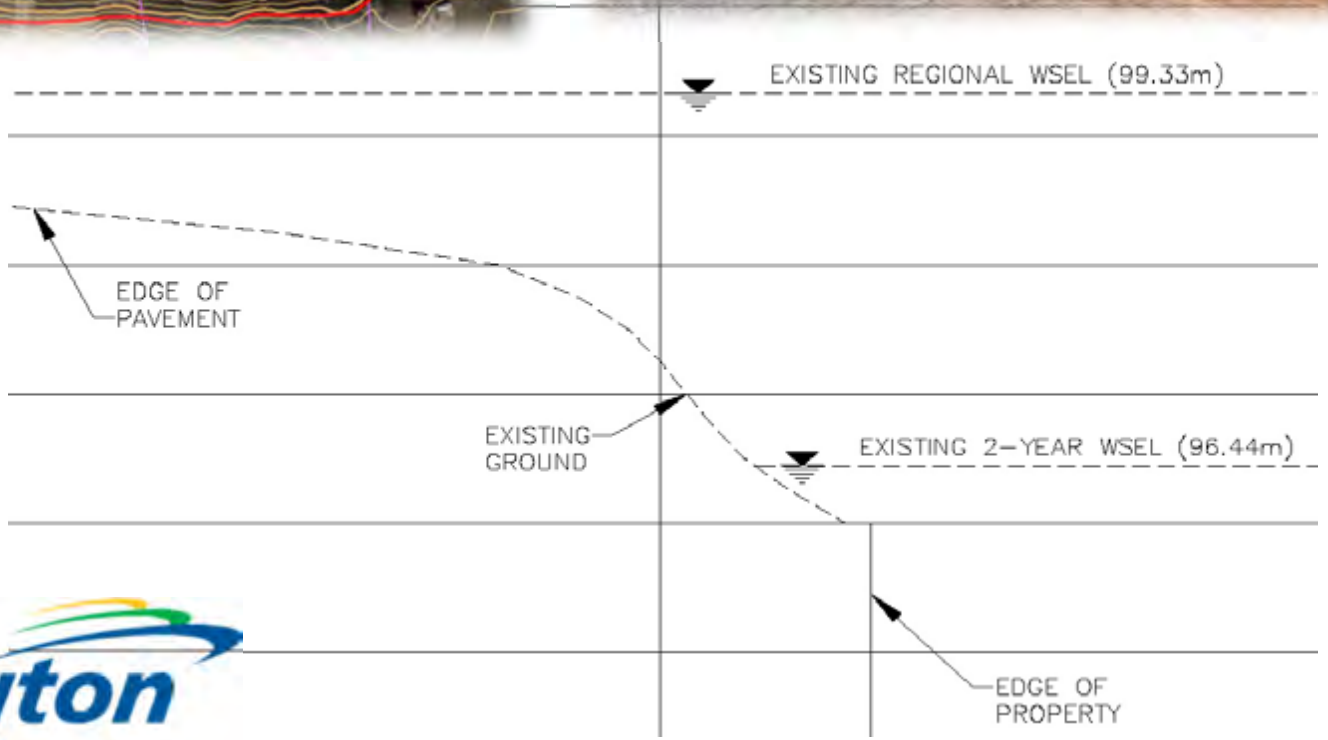
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 1





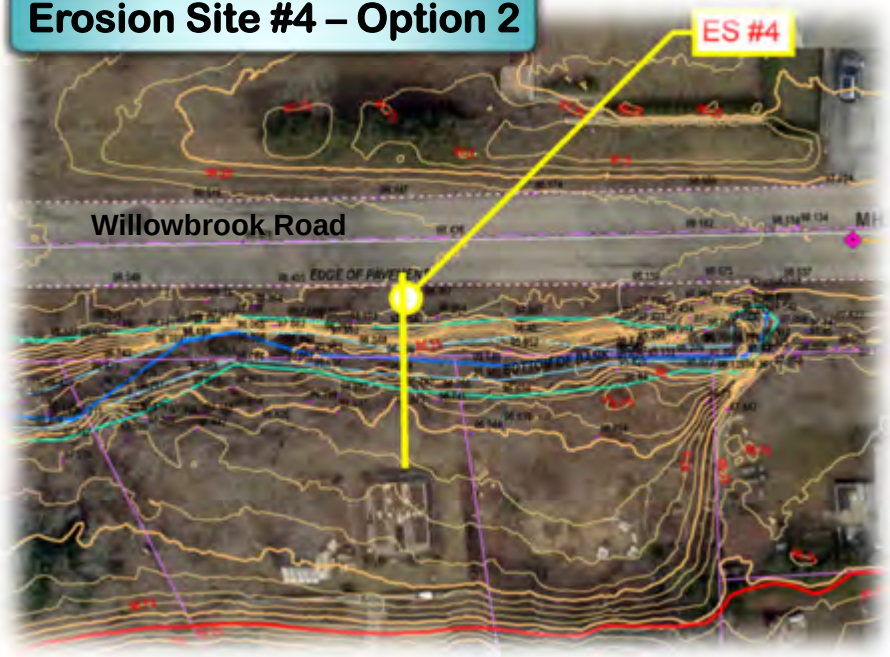
Do Nothing



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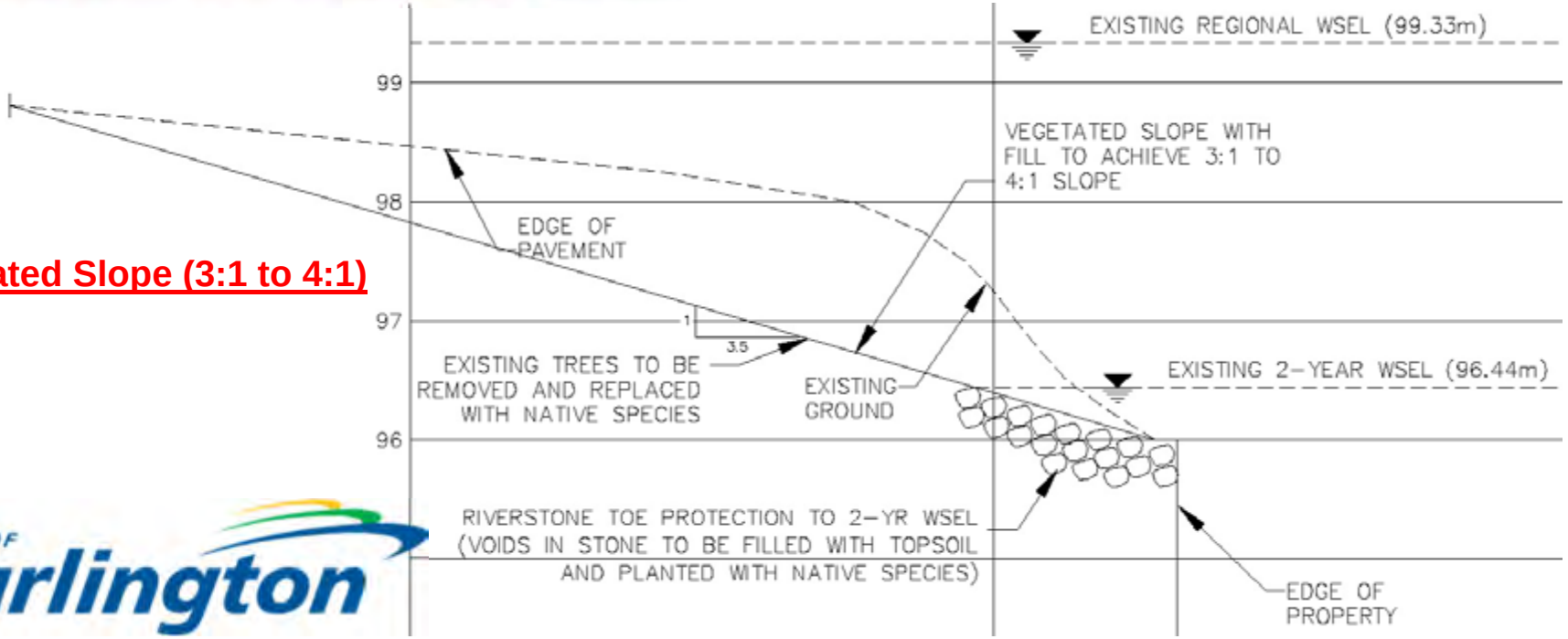
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 2





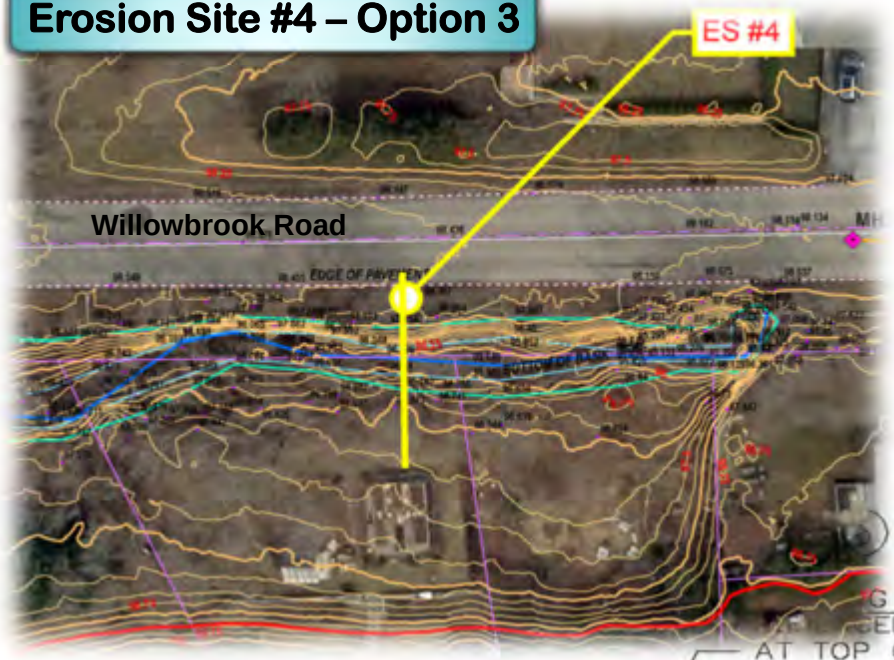
Vegetated Slope (3:1 to 4:1)



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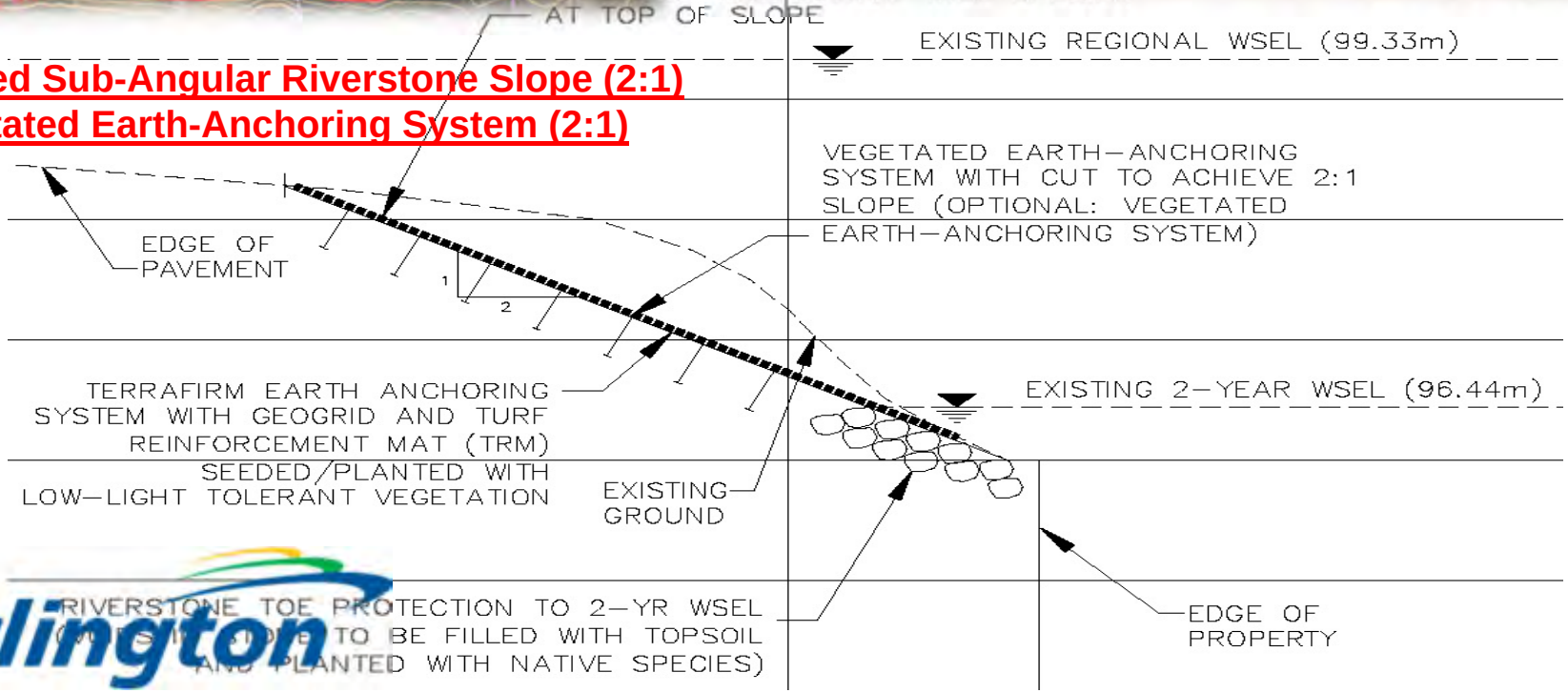
FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 3





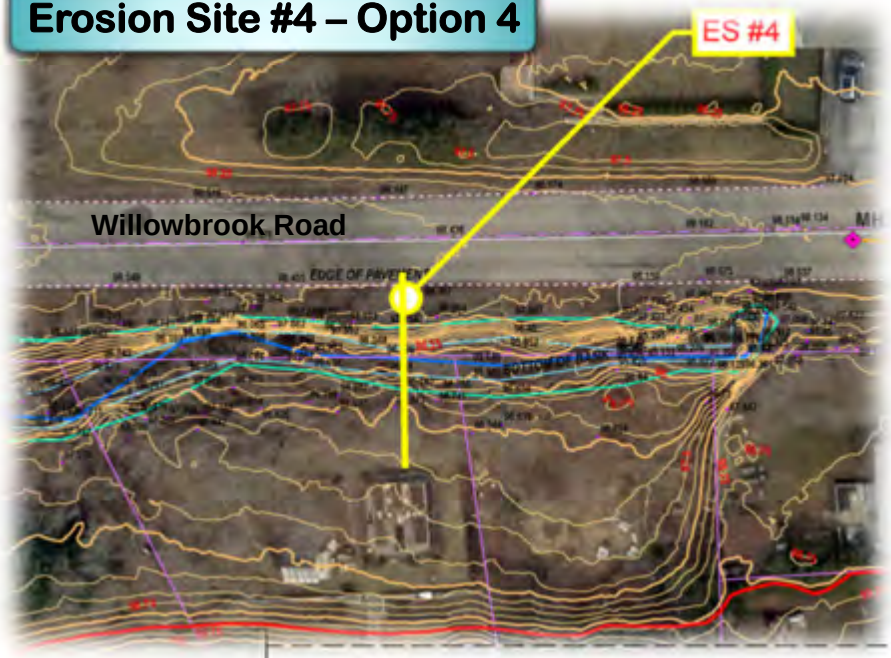
Vegetated Sub-Angular Riverstone Slope (2:1)
or Vegetated Earth-Anchoring System (2:1)



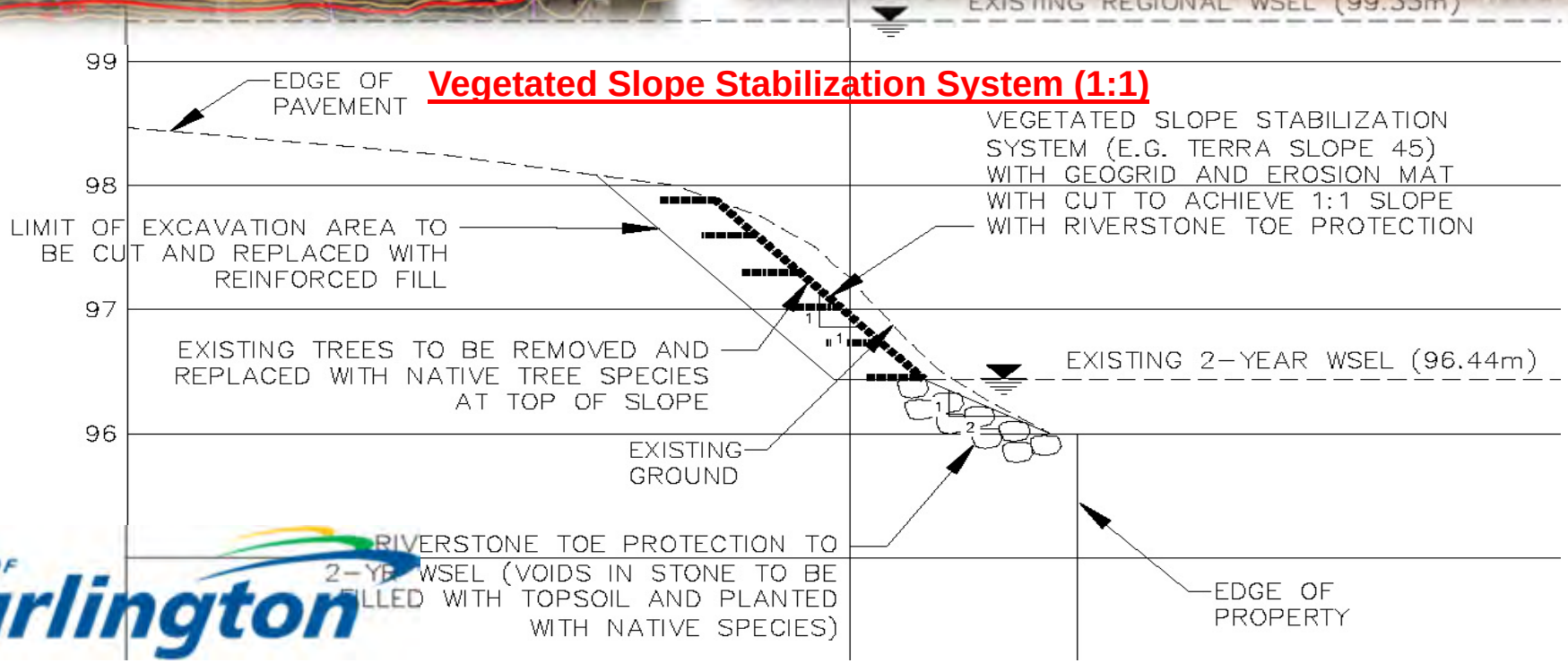
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 4



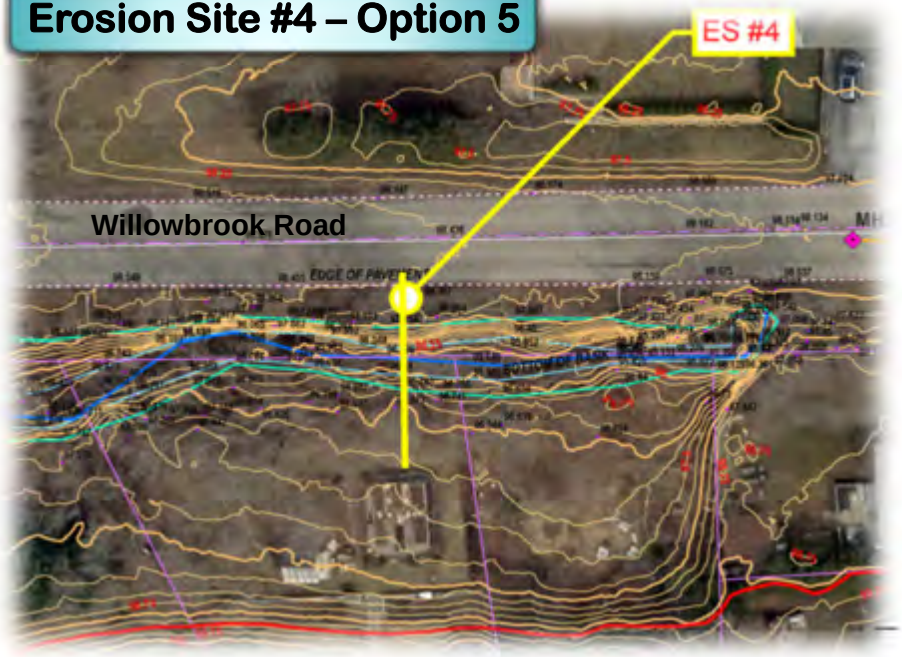




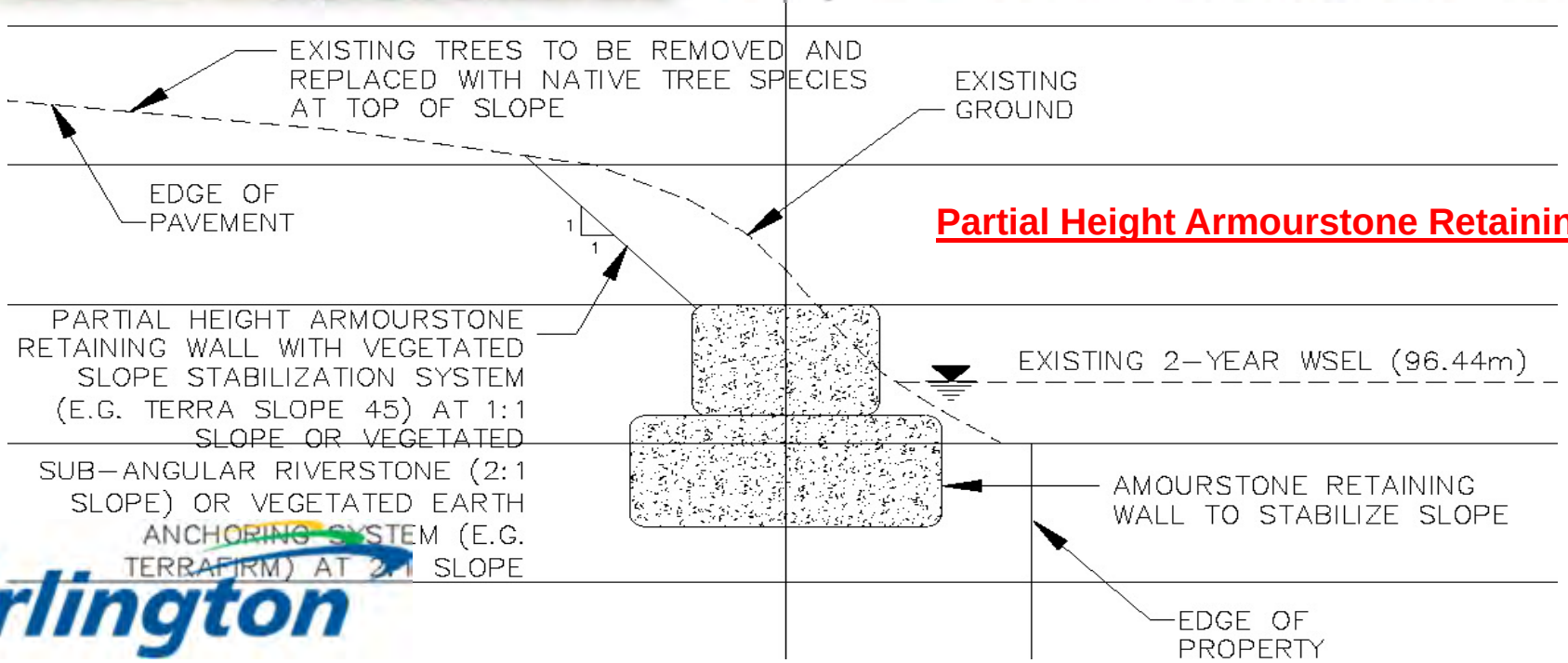
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 5





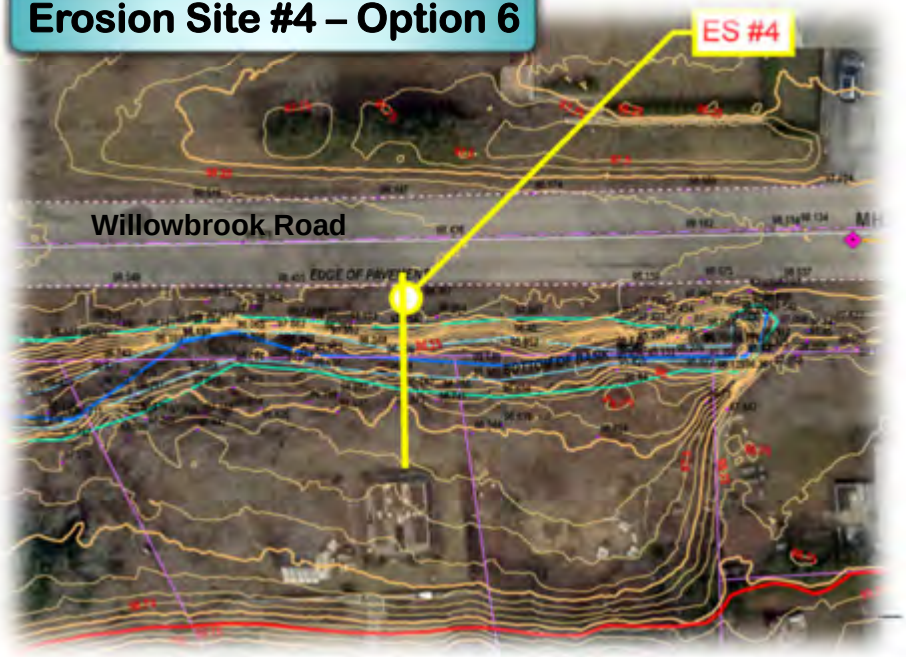


Partial Height Armourstone Retaining Wall

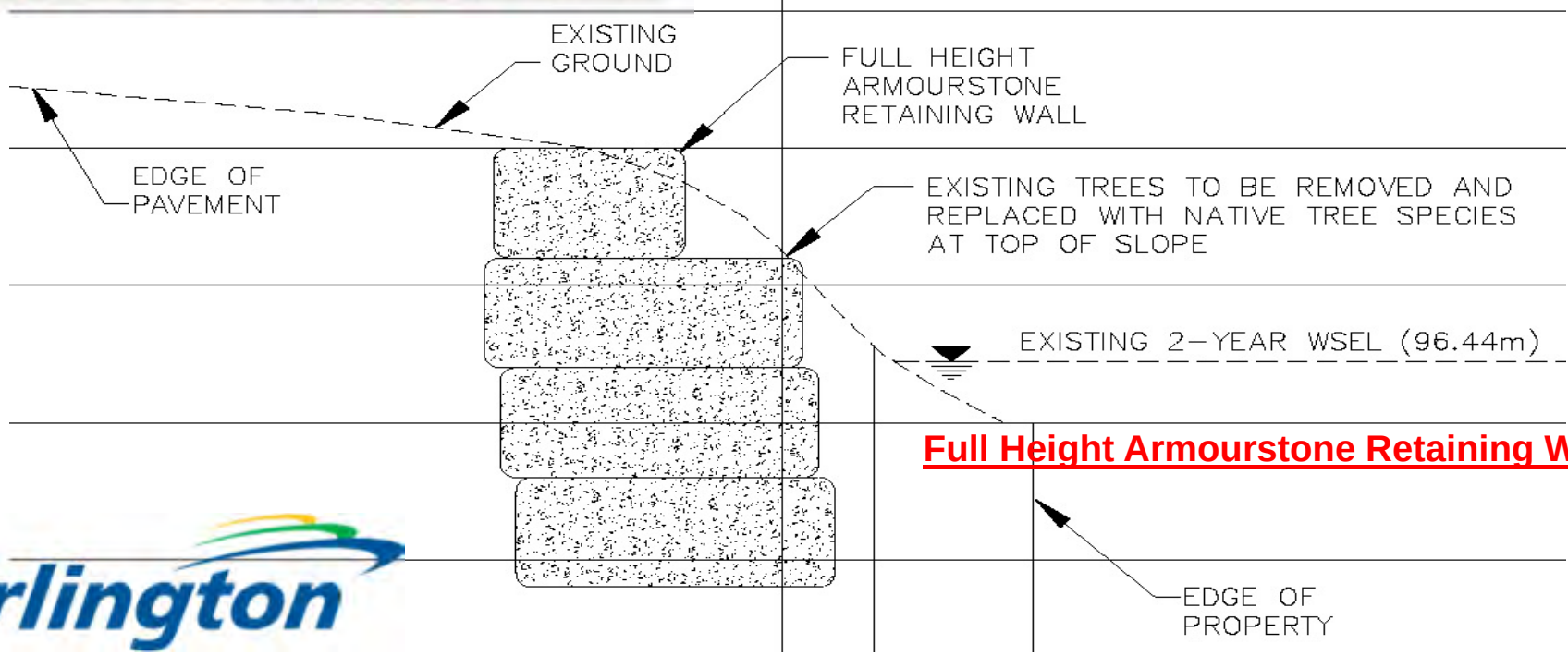
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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Erosion Site #4 – Option 6







Full Height Armourstone Retaining Wall

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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Summary of Mitigation Options – Falcon Creek - Erosion Site #1

Mitigation Option	Description	Advantages	Disadvantages
1	Do Nothing (Existing Conditions) – No mitigation work to be completed	• Cost savings (if erosion risk is low and if mitigation is not required) • No tree removal required	• Erosion issues may become worse, including sedimentation downstream • Ultimate repair costs will be higher (if mitigation is required) • Potential liability issues (private property) (if erosion risk is high)
2	Vegetated slope (3:1 to 4:1) with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• Very naturalized long-term solution • Low maintenance costs • No reduction in floodplain storage (if slope is achieved by cut) • May improve natural channel sinuosity • Will improve bank stabilization and reduce sedimentation downstream	• Potential reduction in floodplain storage (if slope is achieved by fill) and channel realignment will be required • Tree removal required • Significant addition/removal of material required • Potential to shift long term stable slope west • Disturbance to private infrastructure (e.g. parking area, fencing) may occur (if slope is achieved by cut and maybe also with fill)
3	Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• No reduction in floodplain storage (if slope is achieved by cut) • Will improve bank stabilization and reduce sedimentation downstream • Tree removal requirements may be reduced compared to Options 2 or 4	• Potential long term maintenance costs • Potential to shift long term stable slope to east • Potential reduction in floodplain storage (if slope is achieved by fill) and not feasible without channel realignment
4	Vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	• No reduction in floodplain storage • Will improve bank stabilization and reduce sedimentation downstream	• Significant excavation and engineered fill required • Tree removal required
5	Implement monitoring program (e.g. using erosion pins) to track and assess erosion risk and the requirement for mitigation	• Cost savings (if erosion risk is low and if mitigation is not required) • Provides more certainty whether mitigation is required	• Ultimate repair costs will be higher (if mitigation is required) at a later time

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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Summary of Mitigation Options – Falcon Creek - Erosion Site #2

Mitigation Option	Description	Advantages	Disadvantages
1	Do Nothing (Existing Conditions) – No mitigation work to be completed	• Cost savings (if erosion risk is low and if mitigation is not required) • No tree removal required	• Erosion issues may become worse including sedimentation downstream • Ultimate repair costs will be higher (if mitigation is required) • Potential liability issues (private property) (if erosion risk is high)
2	Vegetated slope (3:1 to 4:1) with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• Very naturalized long-term solution • Low maintenance costs • Will improve bank stabilization and reduce sedimentation downstream • May improve natural channel sinuosity	• Potential reduction in floodplain storage (if slope is achieved by cut/fill) • Tree removal required
3	Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• No reduction in floodplain storage (if slope is achieved by cut) • Tree removal may be avoided if slope achieved with fill • Will improve bank stabilization and reduce sedimentation downstream	• Potential long term maintenance costs • Potential reduction in floodplain storage (if slope is achieved by fill) and may not be feasible without channel realignment • Disturbance to private infrastructure (e.g. fencing) (if slope achieved by cut) • Tree removal required if slope achieved by cut
4	Vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	• No reduction in floodplain storage • Will improve bank stabilization and reduce sedimentation downstream	• Significant excavation and engineered fill required • Disturbance to private infrastructure may occur (e.g. fencing) • Tree removal required
5	Implement monitoring program (e.g. using erosion pins) to track and assess erosion risk and the requirement for mitigation	• Cost savings (if erosion risk is low and if mitigation is not required) • Provides more certainty whether mitigation is required	• Ultimate repair costs will be higher (if mitigation is required) at a later time

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FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Summary of Mitigation Options – Falcon Creek - Erosion Site #3

Mitigation Option	Description	Advantages	Disadvantages
1	Do Nothing (Existing Conditions) – No mitigation work to be completed	• Short term cost savings • No tree removal required	• Erosion issues will become worse including sedimentation downstream • Ultimate repair costs will be higher • High risk of damages to public infrastructure
2	Vegetated slope (3:1 to 4:1) with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• Very naturalized long-term solution • Low maintenance costs • No reduction in floodplain storage (if slope is achieved by cut) • Will improve bank stabilization and reduce sedimentation downstream • May improve natural channel sinuosity	• Potential reduction in floodplain storage (if slope is achieved by fill) and channel realignment is required • Trees will require removal and replacement on slope and at location of realigned channel • Potential to shift long term stable slope to west • Disturbance to public infrastructure (e.g. Willowbrook Rd) will occur (if slope is achieved by cut)
3	Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• Tree removal requirements may be reduced compared to Option 2 • No reduction in floodplain storage (if slope achieved by cut) • Provides more naturalized solution than armourstone (Options 5 or 6) • Will improve bank stabilization and reduce sedimentation downstream • May improve natural channel sinuosity	• Potential long term maintenance costs • Potential reduction in floodplain storage and channel realignment required (if slope is achieved by fill) • Disturbance to public infrastructure (e.g. Willowbrook Rd) will occur (if slope is achieved by cut) • Potential to shift long term stable slope to west • Tree removal required
4	Vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	• Disturbance to public infrastructure (e.g. Willowbrook Rd) may be avoided • No reduction in floodplain storage • Tree removal requirements may be reduced compared to Options 2 and 3 • No channel realignment required • Provides more naturalized solution than armourstone (Options 5 or 6) • Will improve bank stabilization and reduce sedimentation downstream	• Significant excavation and engineered fill required • Tree removal required

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5	Partial height armourstone retaining wall for bottom portion of the slope including riverstone toe protection with the top portion of the slope either with vegetated sub-angular riverstone (2:1 slope) or vegetated earth anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat or vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope	• Less armourstone required than Mitigation Option 6 • No reduction in floodplain storage • Will improve bank stabilization and reduce sedimentation downstream • Disturbance to public infrastructure (e.g. Willowbrook Rd) may be avoided	• Less 'hard' armouring than Option 6 but still not well supported by Conservation Authority or First Nations (not naturalized) • Costly to build and maintain • Tree removal required • Significant excavation required but less than for Option 6
6	Full height armourstone retaining wall with riverstone toe protection	• No reduction in floodplain storage • Will improve bank stabilization and reduce sedimentation downstream	• Not well supported by Conservation Authority or First Nations (not naturalized) • Costly to build and maintain • Tree removal required • May not be feasible without disturbance to public infrastructure (e.g. Willowbrook Rd) • Significant excavation required

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

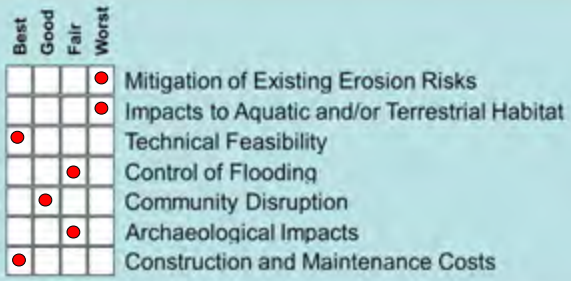
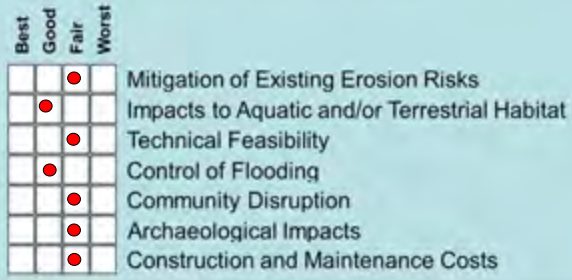
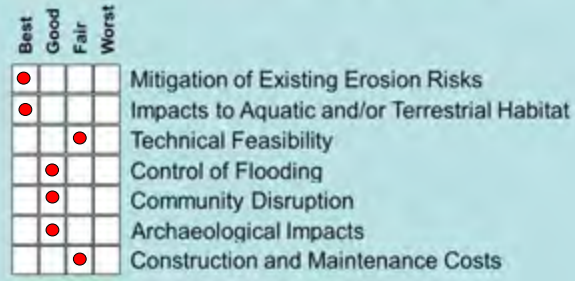
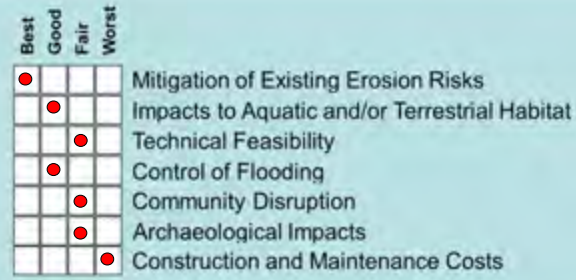
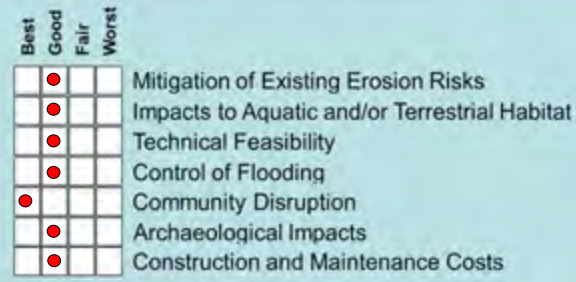
Summary of Mitigation Options – Falcon Creek - Erosion Site #4

Mitigation Option	Description	Advantages	Disadvantages
1	Do Nothing (Existing Conditions) – No mitigation work to be completed	• Short term cost savings • No tree removal required	• Erosion issues will become worse including sedimentation downstream • Ultimate repair costs will be higher • High risk of damages to public infrastructure
2	Vegetated slope (3:1 to 4:1) with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	• Very naturalized long-term solution • Low maintenance costs • No reduction in floodplain storage (if slope achieved by cut) • Will improve bank stabilization and reduce sedimentation downstream	• Potential reduction in floodplain storage (if slope is achieved by fill) • Trees will require removal and replacement on slope and at location of realigned channel • Disturbance to public infrastructure (e.g. Willowbrook Rd) will occur (if slope is achieved by cut) • Works will encroach on private property (if slope achieved by fill) and channel realignment will be required
3	Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation	• Tree removal requirements may be reduced compared to Option 2 • No reduction in floodplain storage (if slope achieved by cut) • Provides more naturalized solution than armourstone (Options 5 or 6) • Will improve bank stabilization and reduce sedimentation downstream	• Potential long term maintenance costs • Potential reduction in floodplain storage (if slope is achieved by fill) • Disturbance to public infrastructure may occur (if slope is achieved by cut) • Tree removal required
4	Vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	• No reduction in floodplain storage • Provides more naturalized solution than armourstone (Options 5 or 6) • May avoid works encroaching on private property • Will improve bank stabilization and reduce sedimentation downstream • May avoid works encroaching on private property	• Significant excavation and engineered fill required • Disturbance to public infrastructure (e.g. Willowbrook Rd) may occur (if slope achieved by cut) • Tree removal required

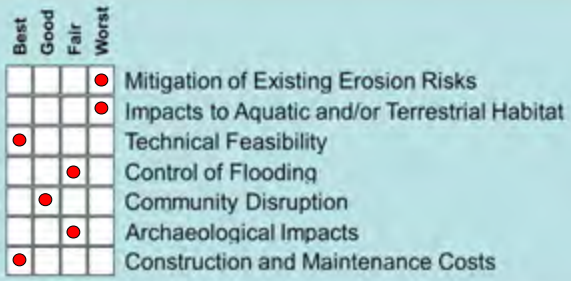
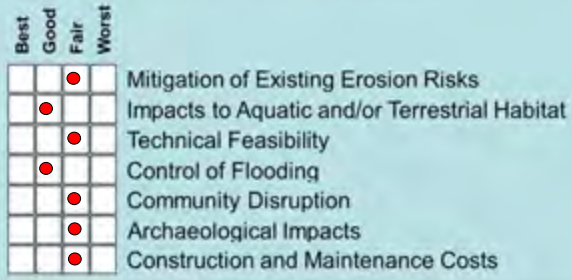
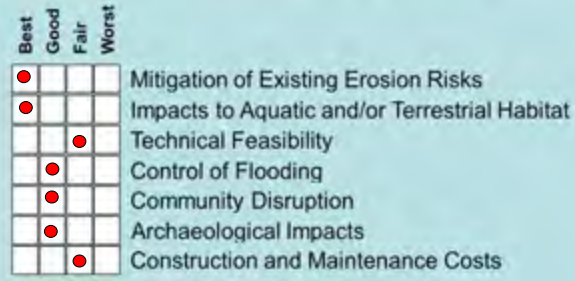
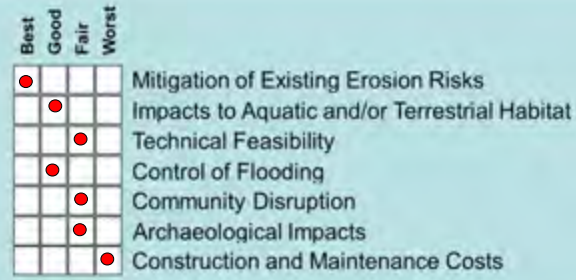
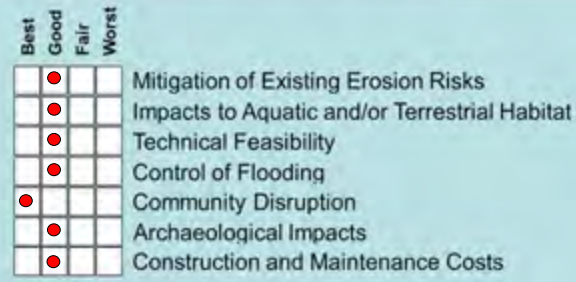
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5	Partial height armourstone retaining wall for bottom portion of the slope including riverstone toe protection with the top portion of the slope either with vegetated sub-angular riverstone (2:1 slope) or vegetated earth anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat or vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope	• Less armourstone required than option 6 • No reduction in floodplain storage • May avoid works encroaching on private property • Will improve bank stabilization and reduce sedimentation downstream	• Less 'hard' armouring than Option 6 but still not well supported by Conservation Authority or First Nations (not naturalized) • Costly to build and maintain • Significant excavation required but less than Option 6 • Tree removal required
6	Full height armourstone retaining wall with riverstone toe protection	• No reduction in floodplain storage • May avoid works encroaching on private property • Will improve bank stabilization and reduce sedimentation downstream	• Not well supported by Conservation Authority or First Nations (not naturalized) • Costly to build and maintain • Potential to shift long term stable slope to east (to be checked at detailed design) • Significant excavation required • Tree removal required

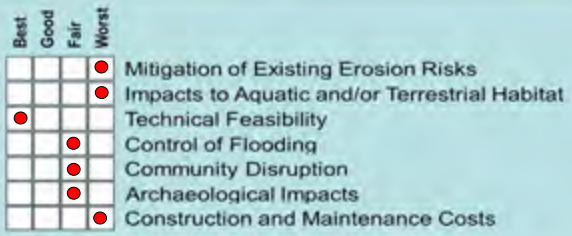
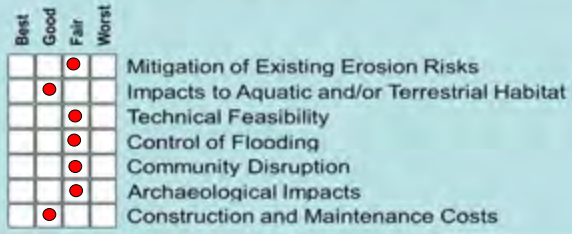
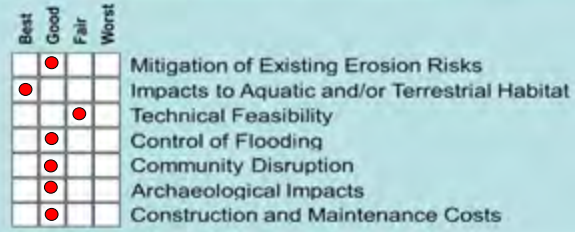
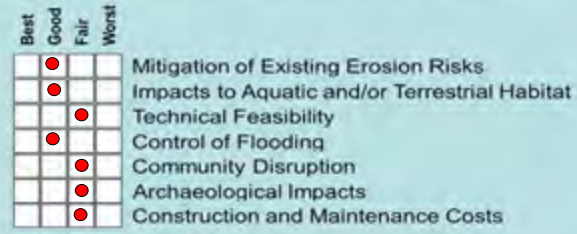
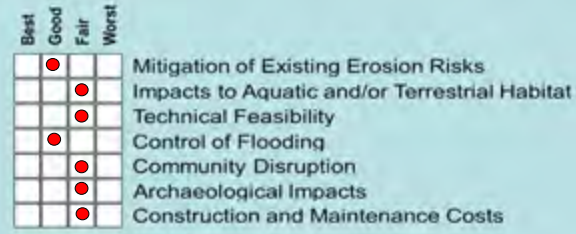
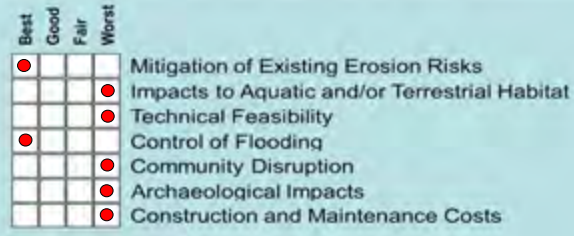
Erosion Site #1 – Relative Comparison of Options

Flood Mitigation Option	Description	Relative Comparison to Other Options
1	**Do Nothing** (Existing Conditions) – No mitigation work to be completed	
2	**Vegetated slope (3:1 to 4:1)** with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
3	**Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system** (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
4	**Vegetated slope stabilization system** (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	
5	**Implement monitoring program** (e.g. using erosion pins) to track and assess erosion risk and the requirement for mitigation	

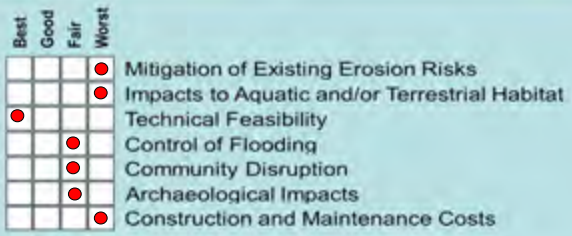
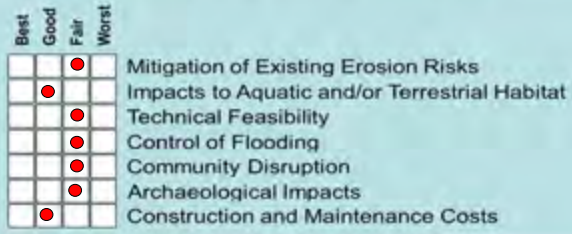
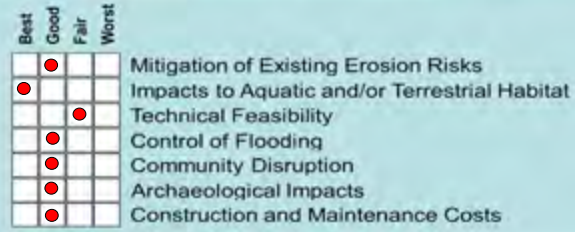
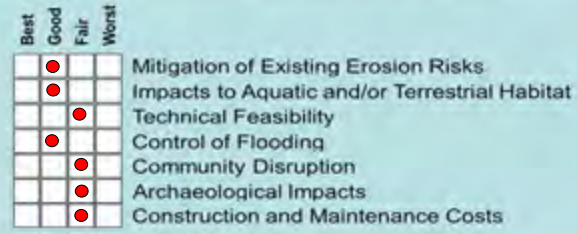
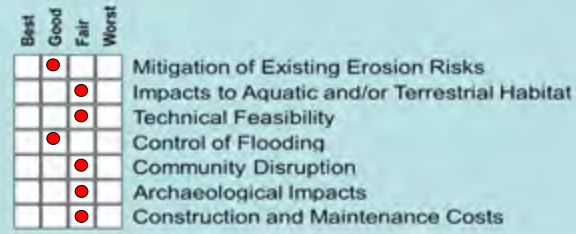
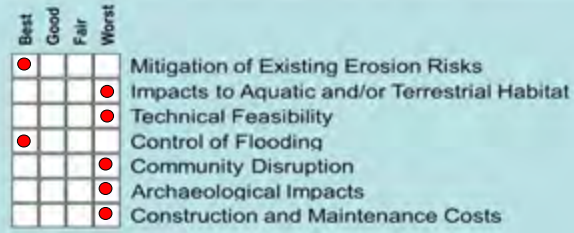
Erosion Site #2 – Relative Comparison of Options

Flood Mitigation Option	Description	Relative Comparison to Other Options
1	**Do Nothing** (Existing Conditions) – No mitigation work to be completed	
2	**Vegetated slope (3:1 to 4:1)** with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
3	**Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system** (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
4	**Vegetated slope stabilization system** (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	
5	**Implement monitoring program** (e.g. using erosion pins) to track and assess erosion risk and the requirement for mitigation	

Erosion Site #3 – Relative Comparison of Options

Flood Mitigation Option	Description	Relative Comparison to Other Options
1	**Do Nothing** (Existing Conditions) – No mitigation work to be completed	
2	**Vegetated slope (3:1 to 4:1)** with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
3	**Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system** (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
4	**Vegetated slope stabilization system** (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	
5	**Partial height armourstone retaining wall** for bottom portion of the slope including riverstone toe protection with the top portion of the slope either with vegetated sub-angular riverstone (2:1 slope) or vegetated earth anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat or vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope	
6	**Full height armourstone retaining wall** with riverstone toe protection	

Erosion Site #4 – Relative Comparison of Options

Flood Mitigation Option	Description	Relative Comparison to Other Options
1	**Do Nothing** (Existing Conditions) – No mitigation work to be completed	
2	**Vegetated slope (3:1 to 4:1)** with riverstone toe protection to the 2-yr water surface elevation with or without channel realignment and cut or fill to achieve the requisite slope	
3	**Vegetated sub-angular riverstone slope (2:1) or vegetated earth-anchoring system** (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat and including riverstone toe protection to the 2-yr water surface elevation	
4	**Vegetated slope stabilization system** (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope and including riverstone toe protection to the 2-yr water surface elevation	
5	**Partial height armourstone retaining wall** for bottom portion of the slope including riverstone toe protection with the top portion of the slope either with vegetated sub-angular riverstone (2:1 slope) or vegetated earth anchoring system (e.g. Terrafirm) at 2:1 slope with geogrid and turf reinforcement mat or vegetated slope stabilization system (e.g. Terra Slope 45) with geogrid and erosion mat at 1:1 slope	
6	**Full height armourstone retaining wall** with riverstone toe protection	

FALCON CREEK EROSION CONTROL MUNICIPAL CLASS EA STUDY

Next Steps

1. Review comments received from the Public.
2. Finalize the EA Report.
3. Select the preferred solution(s).
4. Prepare and post the Notice of Study Completion for 30-day review period.
5. Complete the detailed design for the preferred solution(s).
6. Public Meeting #2 (Pre-Construction).
7. Prepare the construction tender.
8. Complete the construction of the preferred solution(s).



Burlington

Comment Sheet
Public Information Meeting – 08 March 2023
Falcon Creek Erosion Control (between CNR and Willowbrook Road)
Please provide us with your comments by March 31st, 2023

Name:
Address:

Postal Code:
Telephone Number:
Email:

Comments:

Thank you for your comments
Your contributions are valuable to us

Please drop off, mail or fax to:
City of Burlington
Engineering Department
426 Brant Street
P.O. Box 5013
Burlington, Ontario
L7R 3Z6
Attention: Mr. Arif Shahzad, M.Eng., P.Eng.
(905) 335-7600 (fax) (905) 335-7861

CITY OF Burlington







Comments from the Public

Please take a moment to complete the comment sheet provided and return via fax, mail, e-mail or by hand to either of the following individuals:

Mr. Arif Shahzad, M.Eng., P.Eng.
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426 Brant Street, P.O. Box 5013
Burlington, Ontario
L7R 3Z6
Telephone: 905-335-7600 Ext. 7486
E-mail: arif.shahzad@burlington.ca

Mr. Bill Coffey, M.Sc., P. Eng.
Head of Water Resources
Project Manager
Valdor Engineering Inc.
571 Chrislea Road, Suite 4
Woodbridge, Ontario
L4L 8A2
Telephone: (905) 264-0054 Ext. 232
Fax: (905) 264-0069
e-mail: bcoffey@valdor-engineering.com

****A copy of the PIC posters and Comment Sheet will be available on the City's website for further reference****

Your feedback is important! **Thank you for attending the PIC**.