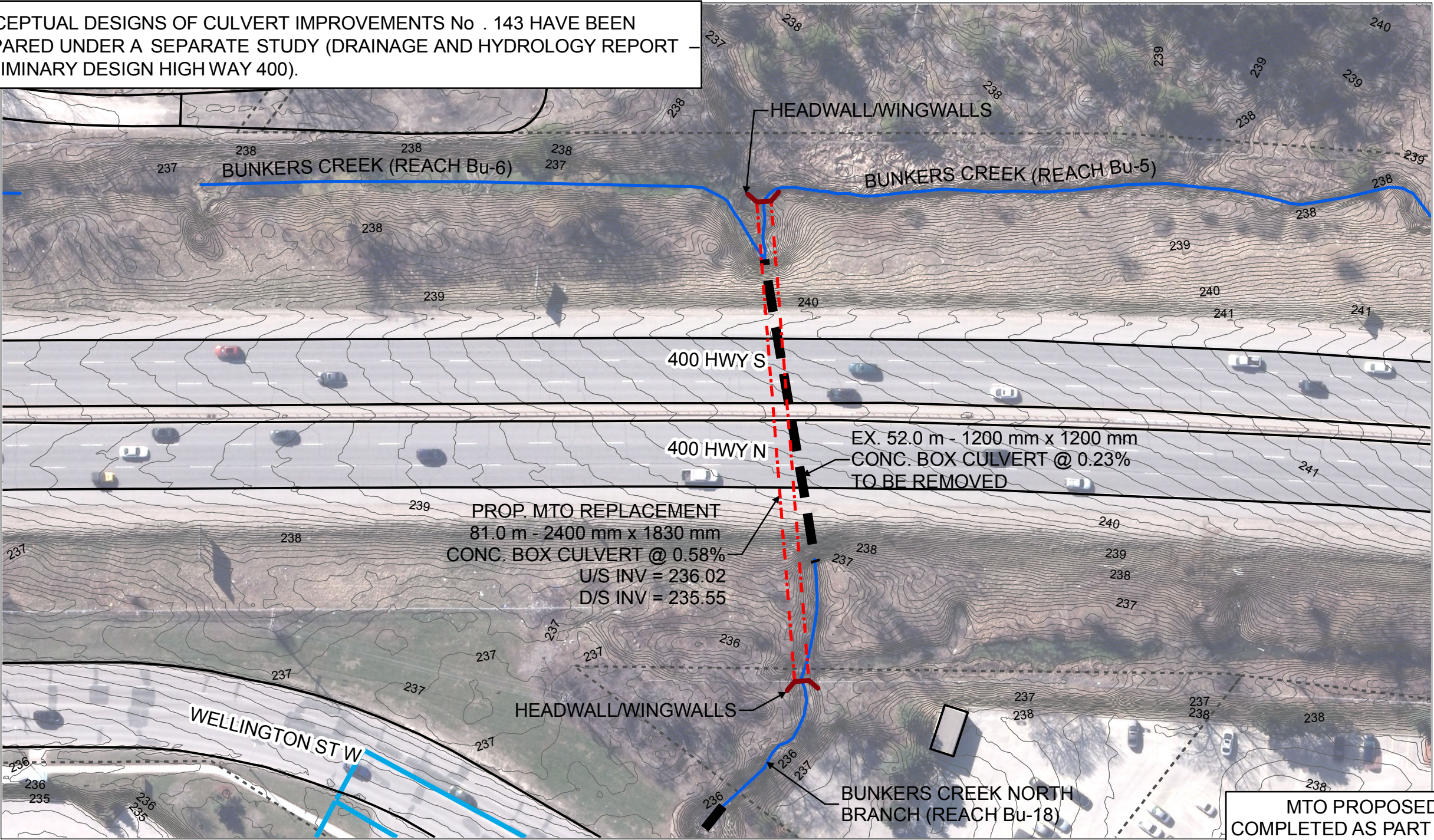


Appendix P: Third Party Drainage Solutions

CONCEPTUAL DESIGNS OF CULVERT IMPROVEMENTS No . 143 HAVE BEEN PREPARED UNDER A SEPARATE STUDY (DRAINAGE AND HYDROLOGY REPORT – PRELIMINARY DESIGN HIGH WAY 400).



PROPERTY ACQUISITION:
NONE

MTO PROPOSED CULVERT IMPROVEMENTS TO BE COMPLETED AS PART OF HIGHWAY 400 IMPROVEMENTS.



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LEGEND

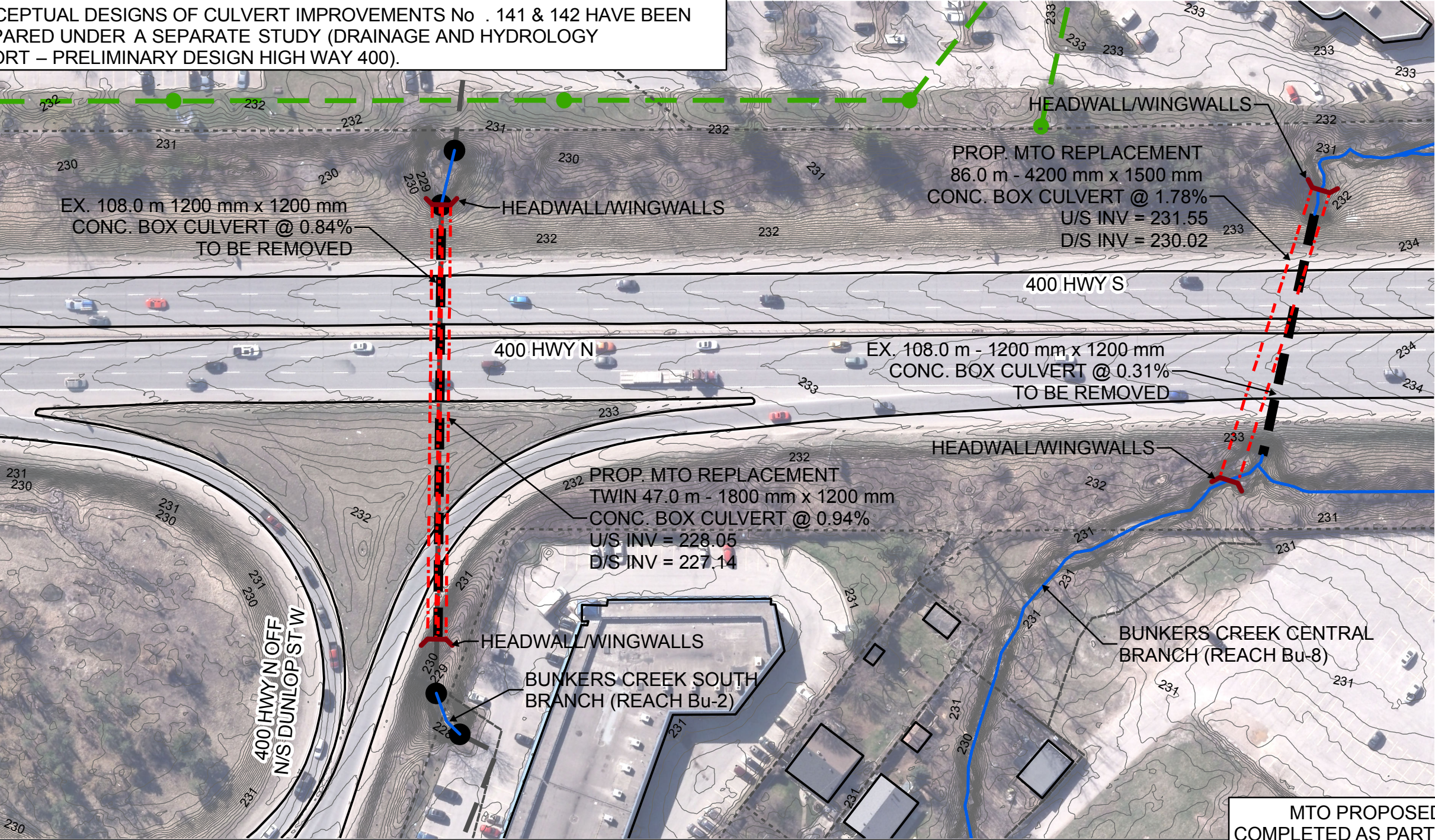
- PR. CULVERT
- PR. STORM SEWER
- PR STORM MAINTENANCE HOLE
- EX. STORM SEWER
- EX. STORM MAINTENANCE HOLE
- WATERCOURSE
- EX. SANITARY SEWER
- EX. SANITARY MAINTENANCE HOLE
- EX. WATERMAIN
- EX. CULVERT
- EX. PROPERTY LINE
- PROPERTY ACQUISITION

DRAINAGE MASTER PLAN
FINAL PREFERRED ALTERNATIVE SOLUTION

PROJECT No. 36
CULVERT IMPROVEMENT No. 143
(HIGHWAY 400)
BUNKERS CREEK WATERSHED
SCALE = 1:750

DATE: MARCH 2019

CONCEPTUAL DESIGNS OF CULVERT IMPROVEMENTS No . 141 & 142 HAVE BEEN PREPARED UNDER A SEPARATE STUDY (DRAINAGE AND HYDROLOGY REPORT – PRELIMINARY DESIGN HIGH WAY 400).



PROPERTY ACQUISITION:
NONE

MTO PROPOSED CULVERT IMPROVEMENTS TO BE COMPLETED AS PART OF HIGHWAY 400 IMPROVEMENTS.



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LEGEND

- PR. CULVERT
- PR. STORM SEWER
- PR STORM MAINTENANCE HOLE
- EX. STORM SEWER
- EX. STORM MAINTENANCE HOLE
- WATERCOURSE
- EX. SANITARY SEWER
- EX. SANITARY MAINTENANCE HOLE
- EX. WATERMAIN
- EX. CULVERT
- EX. PROPERTY LINE
- PROPERTY ACQUISITION

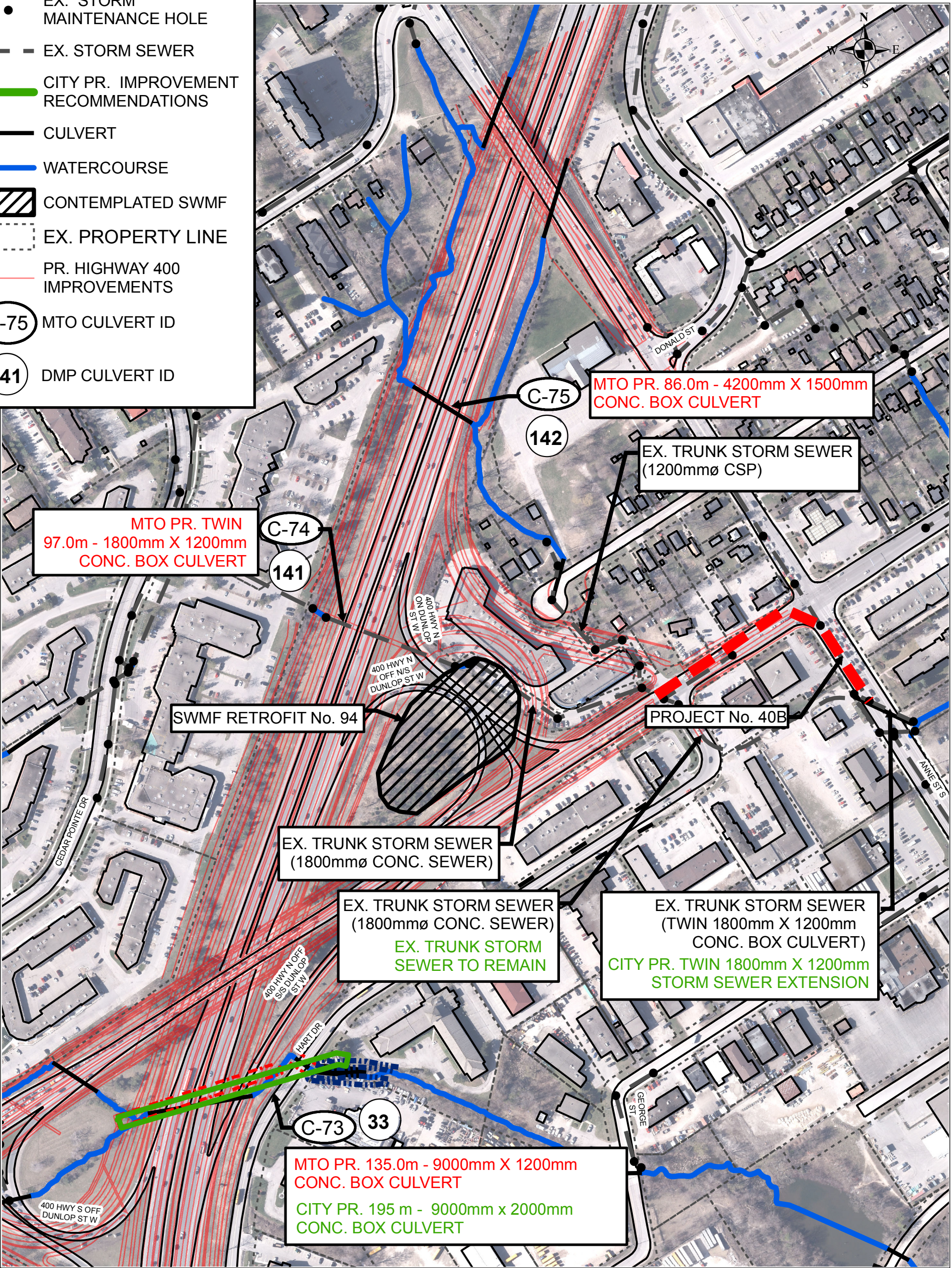
**DRAINAGE MASTER PLAN
FINAL PREFERRED ALTERNATIVE SOLUTION**

PROJECT No. 37 & 38
CULVERT IMPROVEMENT No. 141 & 142
(HIGHWAY 400)
BUNKERS CREEK WATERSHED
SCALE = 1:1,000

DATE: MARCH 2019

LEGEND

- EX. STORM MAINTENANCE HOLE
- EX. STORM SEWER
- CITY PR. IMPROVEMENT RECOMMENDATIONS
- CULVERT
- WATERCOURSE
- ▨ CONTEMPLATED SWMF
- EX. PROPERTY LINE
- PR. HIGHWAY 400 IMPROVEMENTS
- (C-75) MTO CULVERT ID
- (141) DMP CULVERT ID



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**DRAINAGE MASTER PLAN
FINAL PREFERRED ALTERNATIVE SOLUTION**

PROJECT No. 39
SWMF RETROFIT No. 94
BUNKERS CREEK WATERSHED

SCALE = 1:3,000

DATE: MARCH 2019

HART DRIVE:
ROAD CLASSIFICATION = MINOR COLLECTOR
DESIGN FLOOD FREQUENCY CRITERIA = 1:50 YEAR
MDP RECOMMENDED FLOOD
FREQUENCY CRITERIA = 1:100 YEAR

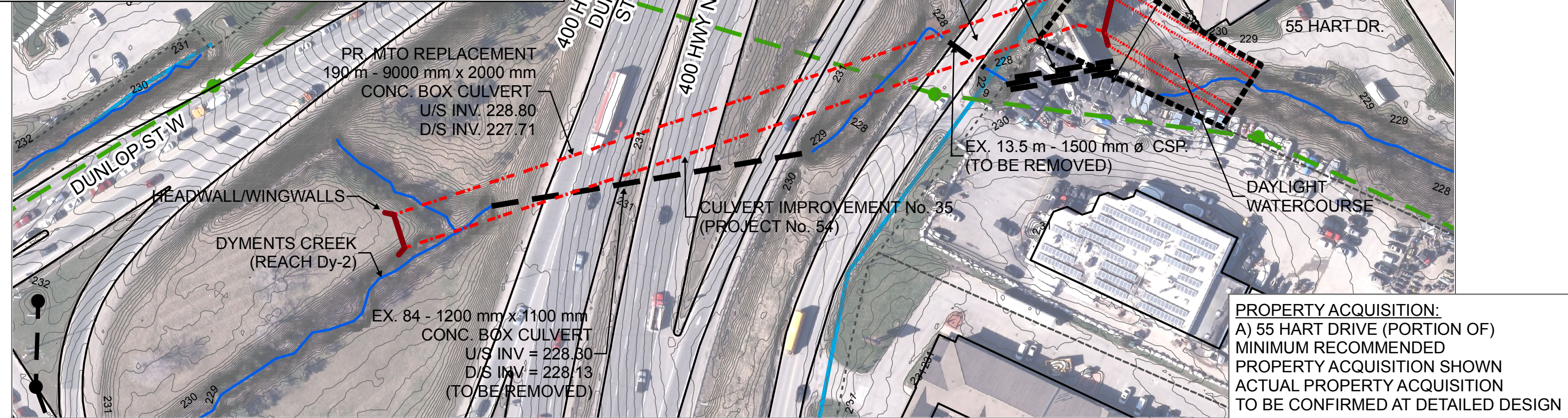
EXISTING: 1500 mm Ø CSP CULVERT
CONVEYANCE CAPACITY < 3.7 m³/s (EXISTING FLOWS)
DESIGN FLOOD FREQUENCY < 1:2 YEAR
DEPTH OF OVERTOPPING = 0.70 m (REGULATORY EVENT)

PROPOSED: 9000 mm X 2000 mm CONC. BOX CULVERT
CONVEYANCE CAPACITY = 54.0 m³/s (FUTURE FLOWS)
DESIGN FLOOD FREQUENCY REGIONAL (HURRICANE HAZEL) STORM
DEPTH OF OVERTOPPING = 0.00 m (REGULATORY EVENT)

CONCEPTUAL DESIGNS OF CULVERT IMPROVEMENT No. 33 HAVE BEEN PREPARED UNDER A SEPARATE STUDY (DRAWINGS AND HYDROLOGY REPORT – PRELIMINARY DESIGN HIGHWAY 400)

MTO PROPOSED CULVERT IMPROVEMENTS TO BE COMPLETED AS PART OF HIGHWAY 400 IMPROVEMENTS

THE CITY IS TO PROGRESSIVELY ACQUIRE LAND OR EASEMENTS FOR DRAINS, WATERCOURSES AND STORAGE AREAS CROSSING OR UPON PRIVATE PROPERTY WHERE IT IS CONSIDERED IN THE CITY'S INTEREST TO DO SO (BY-LAW 90-92: TO PROHIBIT OBSTRUCTION OF DRAINS & WATERCOURSES). PROPERTY ACQUISITION VIA EASEMENT, BLOCK, LOT OR PARCEL IS TO THE CITY'S DISCRETION.



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LEGEND

- | | |
|------------------------------|---------------------------------|
| --- PR. CULVERT | --- EX. SANITARY SEWER |
| --- PR. STORM SEWER | ● EX. SANITARY MAINTENANCE HOLE |
| ● PR STORM MAINTENANCE HOLE | --- EX. WATERMAIN |
| --- EX. STORM SEWER | --- EX. CULVERT |
| ● EX. STORM MAINTENANCE HOLE | --- EX. PROPERTY LINE |
| --- WATERCOURSE | --- PROPERTY ACQUISITION |

DRAINAGE MASTER PLAN
FINAL PREFERRED ALTERNATIVE SOLUTION

PROJECT No. 54, 55 & 56
CULVERT IMPROVEMENT No. 32 & 33
& WATERCOURSE IMPROVEMENT No. 11
DYMENTS CREEK WATERSHED

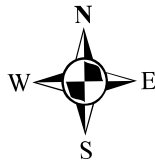
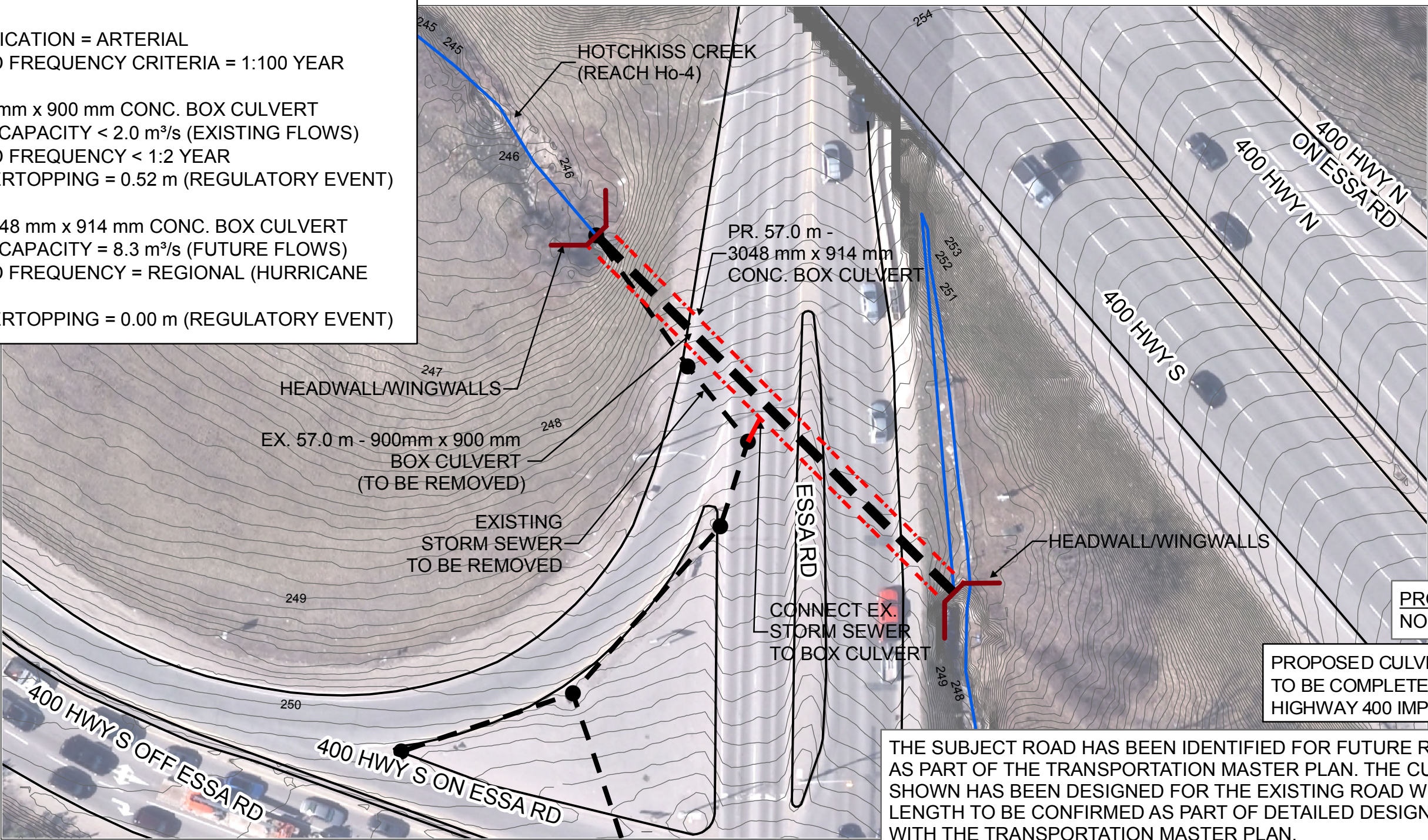
SCALE = 1:1,000

DATE: MARCH 2019

ESSA ROAD:
ROAD CLASSIFICATION = ARTERIAL
DESIGN FLOOD FREQUENCY CRITERIA = 1:100 YEAR

EXISTING: 900 mm x 900 mm CONC. BOX CULVERT
CONVEYANCE CAPACITY < 2.0 m³/s (EXISTING FLOWS)
DESIGN FLOOD FREQUENCY < 1:2 YEAR
DEPTH OF OVERTOPPING = 0.52 m (REGULATORY EVENT)

PROPOSED: 3048 mm x 914 mm CONC. BOX CULVERT
CONVEYANCE CAPACITY = 8.3 m³/s (FUTURE FLOWS)
DESIGN FLOOD FREQUENCY = REGIONAL (HURRICANE HAZEL) STORM
DEPTH OF OVERTOPPING = 0.00 m (REGULATORY EVENT)



PROPERTY ACQUISITION:
NONE

PROPOSED CULVERT IMPROVEMENTS
TO BE COMPLETED AS PART OF
HIGHWAY 400 IMPROVEMENTS

THE SUBJECT ROAD HAS BEEN IDENTIFIED FOR FUTURE ROAD WIDENING AS PART OF THE TRANSPORTATION MASTER PLAN. THE CULVERT IMPROVEMENT SHOWN HAS BEEN DESIGNED FOR THE EXISTING ROAD WIDTH. THE CULVERT LENGTH TO BE CONFIRMED AS PART OF DETAILED DESIGN IN COORDINATION WITH THE TRANSPORTATION MASTER PLAN.



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LEGEND

- | | |
|------------------------------|---------------------------------|
| --- PR. CULVERT | --- EX. SANITARY SEWER |
| --- PR. STORM SEWER | ● EX. SANITARY MAINTENANCE HOLE |
| ● PR STORM MAINTENANCE HOLE | --- EX. WATERMAIN |
| --- EX. STORM SEWER | --- EX. CULVERT |
| ● EX. STORM MAINTENANCE HOLE | --- EX. PROPERTY LINE |
| --- WATERCOURSE | --- PROPERTY ACQUISITION |

DRAINAGE MASTER PLAN
FINAL PREFERRED ALTERNATIVE SOLUTION

PROJECT No. 16
CULVERT IMPROVEMENT No. 44
(ESSA RD)
HOTCHKISS CREEK WATERSHED
SCALE = 1:500

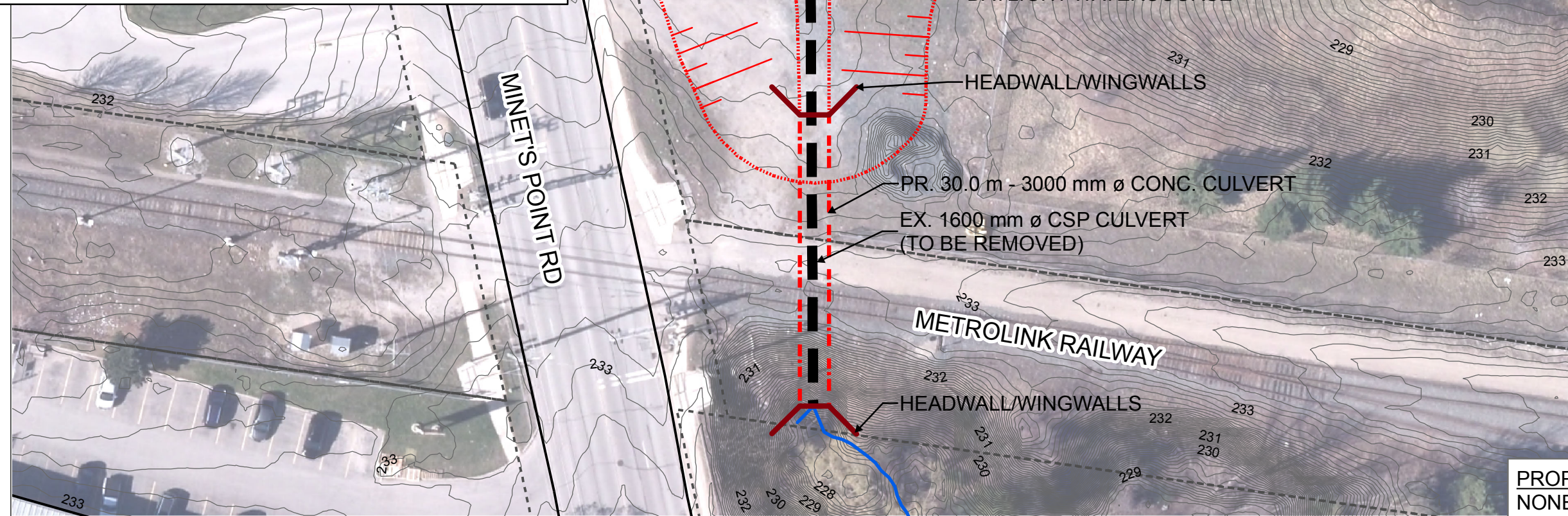
DATE: MARCH 2019

METROLINK RAILWAY:
MDP RECOMMENDED DESIGN FLOOD FREQUENCY CRITERIA = 1:100 YEAR

EXISTING: 1600 mm Ø CSP CULVERT
CONVEYANCE CAPACITY = 11.3 m³/s (EXISTING FLOWS)
DESIGN FLOOD FREQUENCY = 1:10 YEAR
DEPTH OF OVERTOPPING = 0.89 m (REGULATORY EVENT)

PROPOSED: 3000 mm Ø CONC. CULVERT
CONVEYANCE CAPACITY = 37.6 m³/s (FUTURE FLOWS)
DESIGN FLOOD FREQUENCY = 1:100 YEAR
DEPTH OF OVERTOPPING = 0.69 m (REGULATORY EVENT)

CULVERT DESIGNED TO MAXIMIZE FLOODPLAIN
STORAGE USED UPSTREAM OF CROSSING DURING
THE 1:100 YEAR STORM WITHOUT OVERTOPPING THE RAILWAY



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LEGEND

- | | |
|------------------------------|---------------------------------|
| --- PR. CULVERT | --- EX. SANITARY SEWER |
| --- PR. STORM SEWER | ● EX. SANITARY MAINTENANCE HOLE |
| ● PR STORM MAINTENANCE HOLE | --- EX. WATERMAIN |
| --- EX. STORM SEWER | --- EX. CULVERT |
| ● EX. STORM MAINTENANCE HOLE | --- EX. PROPERTY LINE |
| --- WATERCOURSE | --- PROPERTY ACQUISITION |

DRAINAGE MASTER PLAN **FINAL PREFERRED ALTERNATIVE SOLUTION**

PROJECT No. 86
CULVERT IMPROVEMENT No. 138
(METROLINK RAILWAY)
WHISKEY CREEK WATERSHED

SCALE = 1:500

DATE: MATCH 2019

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 36
Culvert Improvement No. 143 (Highway 400)
Bunkers Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	2400 x 1800 mm Conc. Box Culvert	m	81	\$5,785.00	\$468,585
	Subtotal: Culvert Improvement				\$468,585
	Construction Contingency:			30%	\$140,576
	Engineering Design Fee:			20%	\$93,717
	Contract Administration / Construction Inspection:			10%	\$46,859
	Utilities / Services Relocation Cost:			15%	\$70,288
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$820,024
	Construction Index:			5.2%	\$42,641
	HST:			1.76%	\$15,183
	Total Construction Cost (2019 Unit Prices):				\$877,848
	Total Estimated Project Cost				\$877,848

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 37
Culvert Improvement No. 142 (Highway 400)
Bunkers Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	4572 mm x 1219 mm Conc. Box Culvert	m	86	\$12,135.00	\$1,043,610
	Subtotal: Culvert Improvement				\$1,043,610
	Construction Contingency:			30%	\$313,083
	Engineering Design Fee:			20%	\$208,722
	Contract Administration / Construction Inspection:			10%	\$104,361
	Utilities / Services Relocation Cost:			15%	\$156,542
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$1,826,318
	Construction Index:			5.2%	\$94,969
	HST:			1.76%	\$33,815
	Total Construction Cost (2019 Unit Prices):				\$1,955,101
	Total Estimated Project Cost				\$1,955,101

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 38
Culvert Improvement No. 141 (Highway 400)
Bunkers Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	1800 x 1200 mm Conc. Box Culvert	m	94	\$3,970.00	\$373,180
	Subtotal: Culvert Improvement				\$373,180
	Construction Contingency:			30%	\$111,954
	Engineering Design Fee:			20%	\$74,636
	Contract Administration / Construction Inspection:			10%	\$37,318
	Utilities / Services Relocation Cost:			15%	\$55,977
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$653,065
	Construction Index:			5.2%	\$33,959
	HST:			1.76%	\$12,092
	Total Construction Cost (2019 Unit Prices):				\$699,116
	Total Estimated Project Cost				\$699,116

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 39
SWMF Retrofit No. 94
Bunkers Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	SWMF Retrofit				
1.01	Strip and Stockpile Topsoil	m ²	6,900	\$13.00	\$89,700
1.02	Excavation and Grading	m ³	17,626	\$24.00	\$423,024
1.03	Geotechnical Sampling for Off-site Disposal	m ³	17,626	\$1.00	\$17,626
1.04	Remove and Dispose of Excess Material	m ³	16,426	\$30.00	\$492,780
1.05	Construction Access Mud Mat	ea	2	\$6,000.00	\$12,000
1.06	Heavy Duty Silt Fence	m	620	\$23.00	\$14,260
1.07	1200 x 1200 mm Conc. Box Culvert	m	80	\$3,180.00	\$254,400
1.08	Place Topsoil and Hydroseed	m ²	400	\$10.00	\$4,000
1.09	Watercourse Improvements	m	100	\$2,000.00	\$200,000
1.10	Remove Asphalt	m ²	915	\$9.00	\$8,235
1.11	Remove Granular Road Base	m ²	915	\$7.00	\$6,405
1.12	Remove Existing Buildings	ea	6	\$25,000.00	\$150,000
1.13	Granular 'B' (450 mm)	m ²	700	\$20.00	\$14,000
1.14	Granular 'A' (150 mm)	m ²	700	\$11.00	\$7,700
1.15	100 mm HL8 Base Course Asphalt	m ²	700	\$39.50	\$27,650
1.16	40 mm HL3 Surface Course Asphalt	m ²	700	\$17.00	\$11,900
	Subtotal: SWMF Retrofit				\$1,733,680
	Construction Contingency:			30%	\$520,104
	Engineering Design Fee:			20%	\$346,736
	Contract Administration / Construction Inspection:			10%	\$173,368
	Utilities / Services Relocation Cost:			15%	\$260,052
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$3,033,940
	Construction Index:			5.2%	\$157,765
	HST:			1.76%	\$56,174
	Total Construction Cost (2019 Unit Prices):				\$3,247,879
2	Property Acquisition				\$955,000
2.01	132 Henry St.				\$258,000
2.02	134 Henry St.				\$311,000
2.03	129 Henry St.				\$185,000
2.04	127 Henry St.				\$201,000
	Adjusted Value:			165%	\$1,575,750
	Acquisition Contingency:			30%	472,725
	Property Acquisition:				\$2,048,475
	Total Estimated Project Cost:				\$5,296,354

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 53
Culvert Improvement No. 31 (Highway 400 and Dunlop St. E/W-S and N-E/W Ramps)
Dyments Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	9000 mm x 2000 mm Conc. Box Culvert	m	52	\$23,135.00	\$1,203,020
	Subtotal: Culvert Improvement				\$1,203,020
	Construction Contingency:			30%	\$360,906
	Engineering Design Fee:			20%	\$240,604
	Contract Administration / Construction Inspection:			10%	\$120,302
	Utilities / Services Relocation Cost:			15%	\$180,453
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$2,105,285
	Construction Index:			5.2%	\$109,475
	HST:			1.76%	\$38,980
	Total Construction Cost (2019 Unit Prices):				\$2,253,740
	Total Estimated Project Cost				\$2,253,740

Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019

Project No. 54
Culvert Improvement No. 33 (Highway 400)
Dyments Creek Watershed

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	9000 mm x 2000 mm Conc. Box Culvert	m	135	\$23,135.00	\$3,123,225
	Subtotal: Culvert Improvement				\$3,123,225
	Construction Contingency:			30%	\$936,968
	Engineering Design Fee:			20%	\$624,645
	Contract Administration / Construction Inspection:			10%	\$312,323
	Utilities / Services Relocation Cost:			15%	\$468,484
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$5,465,644
	Construction Index:			5.2%	\$284,213
	HST:			1.76%	\$101,197
	Total Construction Cost (2019 Unit Prices):				\$5,851,055
	Total Estimated Project Cost				\$5,851,055

**Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019**

**Project No. 16
(Transportation Master Plan Project ID 1217)
Culvert Improvement No. 44 (Essa Rd.)
Hotchkiss Creek Watershed**

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	Remove Existing Culvert	m	57	\$85.00	\$4,845
1.02	Remove Existing Headwalls	LS	1	\$2,500.00	\$2,500
1.03	3048 mm x 914 mm Conc. Box Culvert	m	81	\$7,010.00	\$567,810
1.04	Concrete Headwall / Wingwalls	ea	2	\$25,000.00	\$50,000
1.05	Flow Diversion	wks	4	\$20,000.00	\$80,000
	Subtotal: Culvert Improvement				\$705,155
	Construction Contingency:			30%	\$211,547
	Engineering Design Fee:			20%	\$141,031
	Contract Administration / Construction Inspection:			10%	\$70,516
	Utilities / Services Relocation Cost:			15%	\$105,773
	Environmental Assessment Costs:				\$0
	Construction Cost Estimate (2018 Unit Prices):				\$1,234,021
	Construction Index:			5.2%	\$64,169
	HST:			1.76%	\$22,848
	Total Construction Cost (2019 Unit Prices):				\$1,321,039
	Total Estimated Project Cost				\$1,321,039

Note: Construction cost estimate reflects cost of culvert installation as part of road renewal/reconstruction projects.

**Barrie Drainage Master Plan
Final Preferred Alternative Solution
Project Cost Estimate
February 2019**

**Project No. 86
Culvert Improvement No.138 (Metrolink Railway)
Whiskey Creek Watershed**

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Culvert Improvement				
1.01	Remove Existing Culvert	m	60	\$85.00	\$5,100
1.02	Excavation and Grading	m ³	800	\$24.00	\$19,200
1.03	Remove and Dispose of Excess Material	m ³	800	\$30.00	\$24,000
1.04	Geotechnical Sampling for Off-site Disposal	m ³	800	\$1.00	\$800
1.05	Strip and Stockpile Topsoil	m ²	1,600	\$13.00	\$20,800
1.06	Place Topsoil and Hydroseed	m ²	1,600	\$10.00	\$16,000
1.07	3000 mm Dia. Storm Sewer	m	30	\$5,545.00	\$166,350
1.08	Concrete Headwall / Wingwalls	ea	2	\$25,000.00	\$50,000
1.09	Watercourse Improvements	m	30	\$2,000.00	\$60,000
1.10	Flow Diversion	wks	10	\$20,000.00	\$200,000
1.11	Railway Reinstatement	m	20	\$1,500.00	\$30,000
Subtotal: Culvert Improvement					\$592,250
Construction Contingency:					30% \$177,675
Engineering Design Fee:					20% \$118,450
Contract Administration / Construction Inspection:					10% \$59,225
Utilities / Services Relocation Cost:					15% \$88,838
Environmental Assessment Costs:					\$0
Construction Cost Estimate (2018 Unit Prices):					\$1,036,438
Construction Index:					5.2% \$53,895
HST:					1.76% \$19,190
Total Construction Cost (2019 Unit Prices):					\$1,109,522
Total Estimated Project Cost					\$1,109,522