



Appendix F

Stream Morphology

APPENDIX A
Field Data Summaries

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS: HT-1 Detailed Site

Site Location: HT-1 Premier Gateway

Length surveyed: 150m

Number of cross-sections: 7

Date of Survey: 17-Sep-15

Modifying Factors

Surrounding Land Use: meadow

General Riparian Vegetation: tall herbs and grasses

Existing Channel Disturbances: road crossing

Woody Debris: none

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	2.62 - 3.65	3.14
Bankfull Depth (m)	0.44 - 0.62	0.50
Width / Depth	5.42 - 10.37	6.49
Wetted Width (m)	1.41 - 2.51	1.99
Water Depth (m)	0.06 - 15.88	2.39
Wetted Width / Depth	0.15 - 22.95	12.86

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS: HT-1 Detailed Site

Bank Characteristics

	Range	Average
Bank Height (m)	1 - 2	1.32
Bank Angle (degrees)	70 - 90	85
Root Depth (cm)	5.0 - 20	10.6
Root Density (1=Low - 5=High)	1 - 5	3.0
Protected by vegetation (%)	70 - 95	83.9
Amount of undercut (cm)	30.0 - 30	30.00000
Banks with undercuts (%)	1 / 14	7%

Bank Materials: si/fs/cl

Planform Characteristics

Long Profile (avg)

Bankfull Gradient:	0.26 %
Bed Gradient:	0.22 %

Substrate Characteristics

Particle Shape (cm):		Range	Average
	X	4 - 15	10.3
	Y	3 - 12	7.4
	Z	0.5 - 6	2.5

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS: HT-1 Detailed Site

Hydraulic Roughness (cm):

	Range	Average
Maximum	0 - 12	7.7
Median	0 - 1	0.9
Minimum	0 - 0.001	0.0

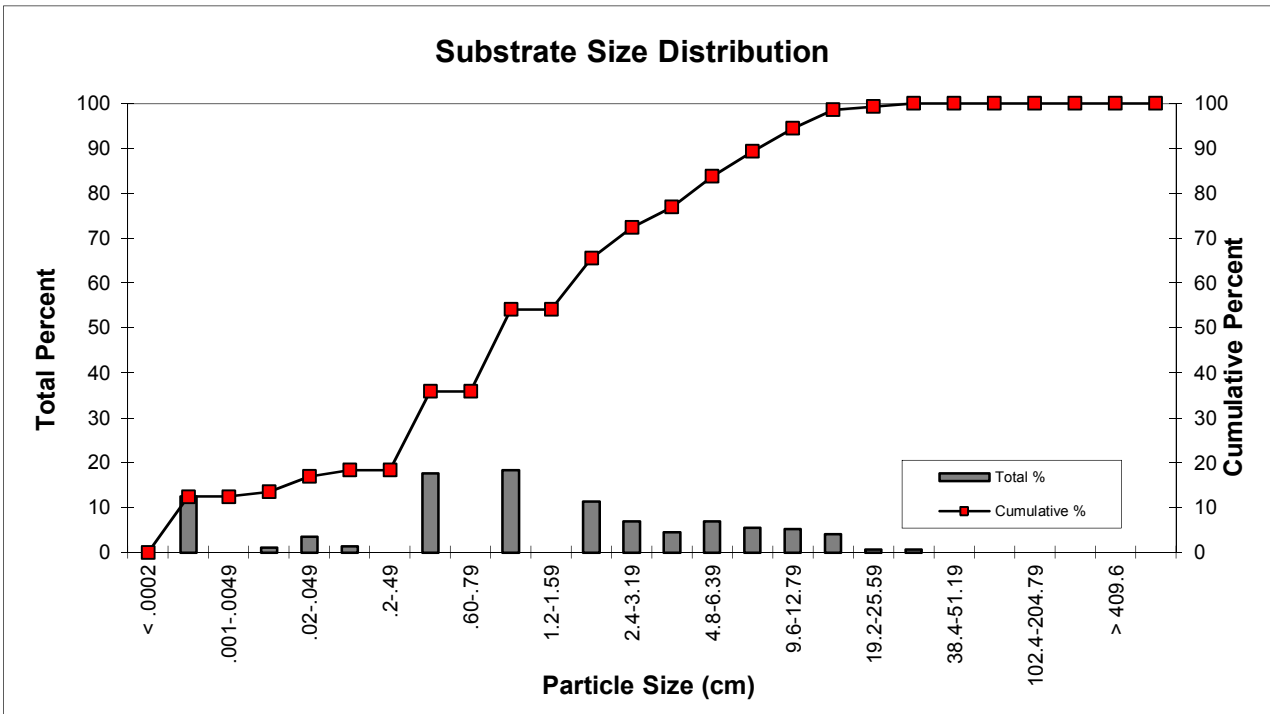
Embeddedness (%):

0 - 80 60.0

Particle Sizes (cm):

Pebble Counts

D10	0.0007639	cm
D50	1.10	cm
D90	10.02	cm



DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS: HT-1 Detailed Site

Field Observations

XS1

RB is 30cm undercut

large cobble with silt overlay

xs is 10m US of bend/tree on RB

Xs2

A lot of silt deposition with larger cobbles

Aquatic vegetation in channel

banks are slumping

Xs3

plate-like particles

banks are slumping

banks are heavily vegetated

Xs4

left bank is terraced

xs is in apex of meander bend

heavily vegetated banks

Xs5

vertical banks

small pebbles in riffle

Xs6

LB is slumped 30cm U/S

substrate is unconsolidated

xs is in apex of meander bend

Xs7

LB is slumped

substrate has coarser gravel, cobbles with silt overlay

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Site Location: W-T1-2 Premier gateway Site #2
Length surveyed: 160m
Number of cross-sections: 7
Date of Survey: 23-Sep-15

Modifying Factors

Surrounding Land Use: forest/ agricultural field/ residential
General Riparian Vegetation: deciduous trees, grasses, herbs
Existing Channel Disturbances:

Woody Debris: minor

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	3.90 - 5.50	4.79
Bankfull Depth (m)	0.29 - 0.37	0.32
Bankfull Width / Depth	10.67 - 17.97	14.97
Wetted Width (m)	1.55 - 2.45	2.05
Water Depth (m)	0.05 - 0.15	0.08
Wetted Width / Depth	16.80 - 35.20	26.79

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Bank Characteristics

	Range	Average
Bank Height (m)	0.8 - 1.7	1.35
Bank Angle (degrees)	30 - 90	67.857143
Root Depth (cm)	5.0 - 20	11.4
Root Density (1=Low - 5=High)	1 - 5	3.1
Protected by vegetation (%)	40 - 90	67.1
Amount of undercut (cm)	0.0 - 0	0.00
Banks with undercuts (%)	0 / 14	0%

Planform Characteristics

Long Profile (avg)

Bankfull Gradient:	0.12 %
Bed Gradient:	0.18 %

Substrate Characteristics

Particle Shape (cm):		Range	Average
	X	4 - 19	8.5
	Y	2 - 13	6.2
	Z	0.5 - 4	2.0

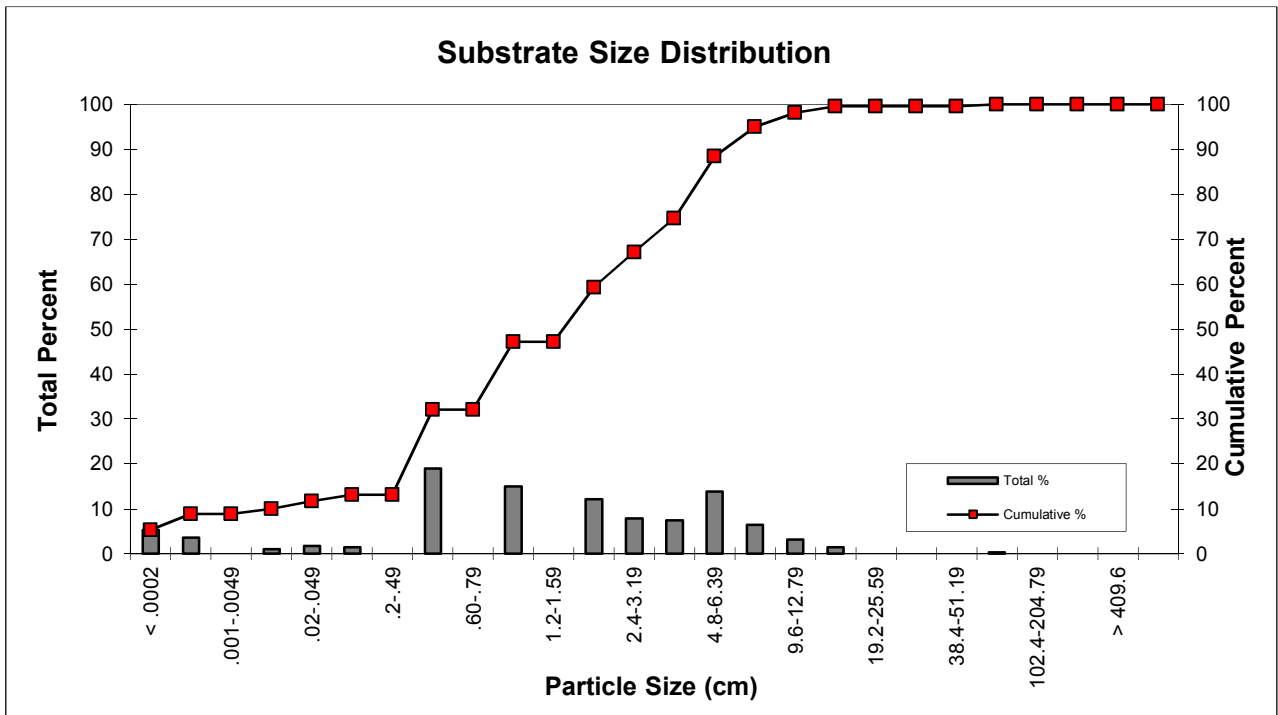
DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Hydraulic Roughness (cm):	Maximum	Range	Average
	Median	5 - 11	7.6
	Minimum	1 - 4	2.7
		0.001 - 0.001	0.0
 Embeddedness (%):		0 - 30	15.7

Particle Sizes (cm):

Pebble Counts	
D10	0.019 cm
D50	1.78 cm
D90	7.10 cm



DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Field Observations

Xs1

LB is eroded with vertical banks
RB is low angled bank
xs is in end of meander bend
exposed clay along LB

xs2

exposed clay along LB
LB is eroded and vertical
RB is eroded at toe with lower bank angle
xs at apex of meander

xs3

LB has exposed clay
Lb vertical and overhanging veg
RB has low bank angle

Xs4

LB has exposed clay along toe and bed
LB is vertical an slumped
RB has low bank angle

Xs5

RB is eroded with vertical banks and exposed clay
LB has low bank angle with a piont bar
channel widens into large pool 1m U/S

Xs6

RB has low bank angle
LB is eroded with vertical banks near the top of bank.
LB has exposed clay

Xs7

LB overhanging and eroded bank with exposed clay
RB has low angle with small gravel piont bar

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Site Location: Halton Hills - Hornby Tributary - Reach E-T1-2

Length surveyed: 230.00 m

Number of cross-sections: 7

Date of Survey: May 9 2016

Modifying Factors

Surrounding Land Use: Agricultural - Cow Pasture

General Riparian Vegetation: Manicured Lawn

Existing Channel Disturbances: Cows

Woody Debris: NA

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	3.20 - 6.34	4.33
Bankfull Depth (m)	0.30 - 0.45	0.37
Bankfull Width / Depth	8.77 - 20.90	12.06
Wetted Width (m)	1.03 - 1.91	1.35
Average Water Depth (m)	0.07 - 0.14	0.10
Wetted Width / Depth	9.32 - 15.36	13.33

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Bank Characteristics

	Range	Average
Bank Height (m)	0.4 - 1.5	0.7821429
Bank Angle (degrees)	20 - 90	36.071429
Root Depth (cm)	3.0 - 15	8.6
Root Density (1=Low - 5=High)	2 - 4	2.9
Protected by vegetation (%)	10 - 40	37.1
Amount of undercut (cm)	20.0 - 20	20.00000
Banks with undercuts (%)	1 / 14	7%

Planform Characteristics

Long Profile (avg)

Bankfull Gradient:	0.55 %
Bed Gradient:	0.70 %

Substrate Characteristics

Particle Shape (cm):		Range	Average
	X	3 - 15	7.1
	Y	3 - 24	10.9
	Z	1 - 5	2.5

DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

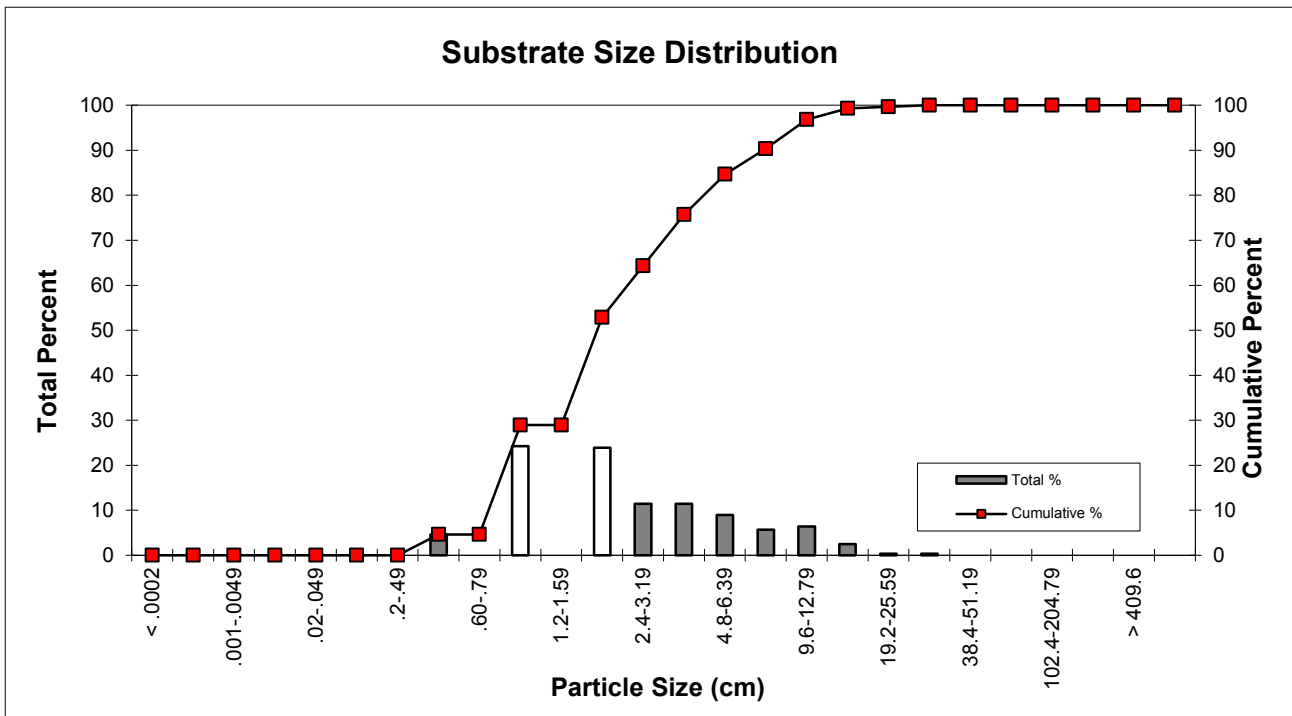
Project: Premier Gateway SWS

Hydraulic Roughness (cm):		Range	Average
	Maximum	2 - 15	8.9
	Median	1 - 5	2.1
	Minimum	0.01 - 0.1	0.1

Embeddedness (%): 10 - 60 22.1

Particle Sizes (cm):

Pebble Counts	
D10	0.878235 cm
D50	2.29 cm
D90	9.39 cm



DETAILED GEOMORPHOLOGICAL FIELD DATA SUMMARY

Project: Premier Gateway SWS

Field Observations

- XS1: XS is 20m downstream of large eroding bend at upstream end of the reach. Left bank is vertical and eroding, clumps of grass located at the base of the bank. Right bank is flat, floodplain/vegetated bar. Wetted width is very narrow. Flow is fast at the cross-section resulting in well-exposed gravels with minimal embeddedness. Fine material has been flushed into downstream pool. Riffle.
- XS2: Right bank is slumping, grass material at toe of bank. Aquatic vegetation dense along the base of the right bank as well. Very coarse material at cross-section, cluster of cobbles located in middle of the cross-section. High velocities. Some overbank deposition of sands noted upstream of the cross-section. Left bank is lower, also slumping. Immediately downstream of cross-section, elevated eroding bank with exposed gravel layer. Riffle
- XS3: High velocity at the cross-section, coarse armoured material. Upstream there is siltation and fines accumulation in the pool. Cross-section located at steep riffle. Some slumping on left bank. Minimal erosion at the cross-section, erosion in bend located downstream. Narrow wetted width at the cross-section under low flow conditions.
- XS4: Cross-section is located 10m upstream of the small tree-d area where cows spend most of their time. Slower velocity at this cross-section, located in more of a transitional area. Increased silt/fine material resulting in more embeddedness of gravels. Right bank is slightly higher than left bank. Sand depositional bar in bend located approx. 10m upstream. Small log located approximately 5m upstream of cross-section in channel.
- XS5: Cross-section located downstream of small treed area where cows spend their time. Right bank has large trees and is quite flat due to trampling. Left bank is higher and steeper. Narrow wetted width, relatively shallow transition area. Bend located downstream.
- XS6: Wetted width is very narrow. Bed is armoured with very coarse material. High velocity at cross-section (riffle). Undercut on left bank, valley along right bank. Cross-section is located downstream of small treed area and a small bend.
- XS7: Wetted width is narrow. Gravel at this cross-section is noticeably smaller than that seen at the other cross-sections. Gravel is consistently sized. Severe erosion along right bank at cross-section. Cross-section located in relatively straight stretch of channel. Channel widens into a pool downstream of cross-section. Aquatic vegetation located mid-channel upstream of cross-section.

APPENDIX B
Field Photograph Summary

*Matrix Supplied
November 13, 2015*



1. W-T1-3 Riffle and lateral bar formation along right bank

*Matrix Supplied
November 13, 2015*



2. W-T1-3 erosion on bank causing leaning trees

*Matrix Supplied
November 13, 2015*



3. W-T1-3 Exposed clay on bed

*Matrix Supplied
November 13, 2015*



4. W-T1-3 Major woody debris jam at upstream end of reach



*Matrix Supplied
June 1, 2015*

5. W-T1-2b CSP under driveway at far upstream end of reach.



*Matrix Supplied
June 1, 2015*

6. W-T1-2b width of channel (approximately 24cm) at far upstream end of reach.

*Matrix Supplied
November 13, 2015*



7. W-T1-2b facing downstream. Flow path through tall grasses at downstream end of reach.

*Matrix Supplied
November 13, 2015*



8. W-T1-2b facing downstream. Flow into CSP located under farm lane.

*Matrix Supplied
November 13, 2015*



9. W-T1-2a Channel flowing out of phragmites patch which widens downstream.

*Matrix Supplied
November 13, 2015*



10. W-T1-2a facing downstream through treed section. Shallow wetted width and low banks.

*Matrix Supplied
November 13, 2015*



11. W-T1-2a facing downstream. Channel more narrow and less defined as it travels through grasses.

*Matrix Supplied
November 13, 2015*



12. W-T1-2a facing downstream. Channel is very narrow at the confluence with the main channel.

*Matrix Supplied
September 23, 2015*



13. W-T1-2 Cross-section 1 facing upstream

*Matrix Supplied
September 23, 2015*



14. W-T1-2 Cross-section 1 facing downstream

*Matrix Supplied
September 23, 2015*



15. W-T1-2 Cross-section 2 facing upstream

*Matrix Supplied
September 23, 2015*



16. W-T1-2 Cross-section 2 facing downstream

*Matrix Supplied
September 23, 2015*



17. W-T1-2 Cross-section 3 facing upstream

*Matrix Supplied
September 23, 2015*



18. W-T1-2 Cross-section 3 facing downstream

*Matrix Supplied
September 23, 2015*



19. W-T1-2 Cross-section 4 facing upstream

*Matrix Supplied
September 23, 2015*



20. W-T1-2 Cross-section 4 facing downstream

*Matrix Supplied
September 23, 2015*



21. W-T1-2 Cross-section 5 facing upstream

*Matrix Supplied
September 23, 2015*



22. W-T1-2 Cross-section 5 facing downstream

*Matrix Supplied
September 23, 2015*



23. W-T1-2 Cross-section 6 facing upstream

*Matrix Supplied
September 23, 2015*



24. W-T1-2 Cross-section 6 facing downstream

*Matrix Supplied
September 23, 2015*



25. W-T1-2 Cross-section 7 facing upstream

*Matrix Supplied
September 23, 2015*



26. W-T1-2 Cross-section 7 facing downstream

*Matrix Supplied
November 13, 2015*



27. W-T1-3 facing downstream. Large vegetated lateral bars inducing sinuosity.

*Matrix Supplied
November 13, 2015*



28. W-T1-3 Banks experiencing erosion opposite of bars producing bank slumping and undercutting which exposes roots.

*Matrix Supplied
November 13, 2015*



29. W-T1-2 typical conditions.

*Matrix Supplied
November 13, 2015*



30. W-T1-2 Large woody debris jam at upstream end

*Matrix Supplied
July 3, 2015*



31. W-T1-2 gravel bar accumulation along inner bank.

*Matrix Supplied
July 3, 2015*



32. W-T1-1 calving of bank material.

*Matrix Supplied
July 3, 2015*



33. W-T1-1 Channel flows through dense meadow vegetation.

*Matrix Supplied
July 3, 2015*



34. W-T1-1 Narrowing of wetted width due to dense grass vegetation.



*Matrix Supplied
June 1, 2015*

35. HDF-3 channel with cattails in channel and manicured lawn banks.



*Matrix Supplied
June 1, 2015*

36. HDF-3- channel confluence into pond.



*Matrix Supplied
June 1, 2015*

37. HDF-4 culvert under golf course trail.



*Matrix Supplied
June 1, 2015*

38. HDF-4 dry channel dry at time of photo.

*Matrix Supplied
July 3, 2015*



39. HDF-1- ponded area at farm lane.

*Matrix Supplied
July 3, 2015*



40. HDF-1- Stagnant water located in grass channel undefined.

*Matrix Supplied
July 3, 2015*



41. HDF-1 Channel flows as drainage ditch along fenceline (right side of photograph)



*Matrix Supplied
June 1, 2015*

42. E-T1-4 Standing water in trapezoidal shaped channel at downstream extent of RGA/RSAT analysis



*Matrix Supplied
June 1, 2015*

43. E-T1-4 Channel is dry and armouring placed along left bank placed to prevent erosion along fairway boundary.



*Matrix Supplied
June 1, 2015*

44. E-T1-4 Channel alternates between being piped under golf course fairways (as seen in this photograph) and being a grassed trapezoidal channel.



*Matrix Supplied
June 1, 2015*

45. E-T1-4 Channel alternates between being piped under golf course fairways and being an intermittent grassed trapezoidal channel (as seen in this photograph).



*Matrix Supplied
May 28, 2015*

46. E-T1-3 Small pebbles and gravel through thalweg and silt accumulation (10-15cm) in other areas.



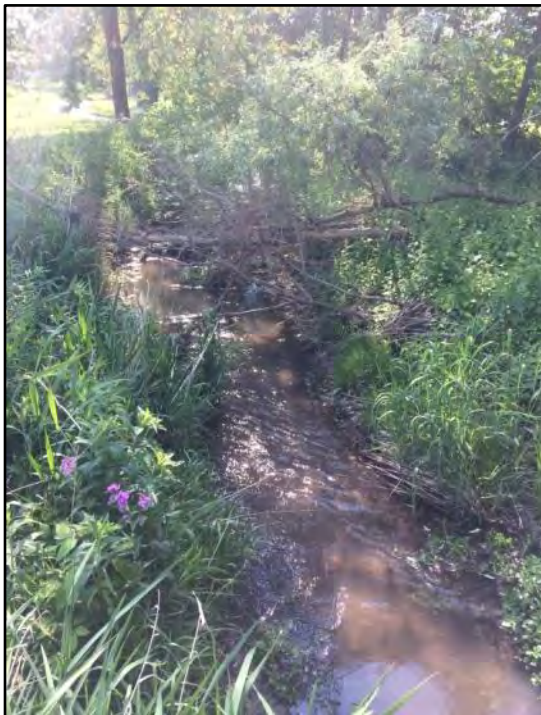
*Matrix Supplied
May 28, 2015*

47. E-T1-3 Good grass riparian buffer between the channel and golf course.



*Matrix Supplied
May 28, 2015*

48. E-T1-3 CSP's damaged by weight of crossing, did not convey water efficiently.



*Matrix Supplied
May 28, 2015*

49. E-T1-3 Channel runs through woodlot as it approaches clubhouse.



*Matrix Supplied
May 28, 2015*

50. E-T1-3 Manicured lawn next to putting green is slumping.



*Matrix Supplied
May 28, 2015*

51. E-T1-3 riparian zone decreases in width.



*Matrix Supplied
May 28, 2015*

52. E-T1-3 Silt accumulation in multiple areas of the channel.



*Matrix Supplied
May 28, 2015*

53. E-T1-3 Area of active erosion in areas lacking riparian buffer.

*Matrix Supplied
November 13, 2015*



54. E-T1-2 Dense emergent aquatic vegetation, including algae (not seen in photograph).

*Matrix Supplied
November 13, 2015*



55. E-T1-2 Bank failure and other areas of erosion due to surrounding landuse.

*Matrix Supplied
November 13, 2015*



56. E-T1-2 Flow splits due to large island formation in center of channel.

*Matrix Supplied
November 13, 2015*



57. E-T1-2 Channel wetted width varies throughout reach.

*Matrix Supplied
November 13, 2015*



58. E-T1-2 Substrate upstream is more firm consisting of sands and gravel, as opposed to silt downstream.

*Matrix Supplied
November 13, 2015*



59. E-T1-2 Long eroding exposed bank face at upstream extent of reach walk. Bank height approximately 1.5-2m in height.



*Matrix Supplied
May 9, 2016*

60. E-T1-2 Cross-section 1 facing upstream



*Matrix Supplied
May 9, 2016*

61. E-T1-2 Cross-section 1 facing downstream



*Matrix Supplied
May 9, 2016*

62. E-T1-2 Cross-section 2 facing upstream



*Matrix Supplied
May 9, 2016*

63. E-T1-2 Cross-section 2 facing downstream

*Matrix Supplied
May 9, 2016*



64. E-T1-2 Cross-section 3 facing upstream

*Matrix Supplied
May 9, 2016*



65. E-T1-2 Cross-section 3 facing downstream

*Matrix Supplied
May 9, 2016*



66. E-T1-2 Cross-section 4 facing upstream

*Matrix Supplied
May 9, 2016*



67. E-T1-2 Cross-section 4 facing downstream



*Matrix Supplied
May 9, 2016*

68. E-T1-2 Cross-section 5 facing upstream



*Matrix Supplied
May 9, 2016*

69. E-T1-2 Cross-section 5 facing downstream



*Matrix Supplied
May 9, 2016*

70. E-T1-2 Cross-section 6 facing upstream



*Matrix Supplied
May 9, 2016*

71. E-T1-2 Cross-section 6 facing downstream



*Matrix Supplied
May 9, 2016*

72. E-T1-2 Cross-section 7 facing upstream



*Matrix Supplied
May 9, 2016*

73. E-T1-2 Cross-section 7 facing downstream

*Matrix Supplied
July 3, 2015*



74. E-T1-1 Channel crossing farm lane with no CSP.

*Matrix Supplied
July 3, 2015*



75. E-T1-1 Active erosion and undercutting on outside bend of reach downstream of farm lane.

*Matrix Supplied
July 8, 2015*



76. T1 Low gradient and slow moving flow with slight erosion on banks hidden by overhanging vegetation.

*Matrix Supplied
July 8, 2015*



77. T1 Bridge crossing is quite low with major siltation underneath the structure.



*Matrix Supplied
July 8, 2015*

78. T1 Woody debris jam.



*Matrix Supplied
July 8, 2015*

79. T1 Erosion being experienced on embankment that meets road. Some places embankment has become concave (not shown in photograph).



*Matrix Supplied
May 28, 2015*

80. HT-2a-2 Erosion and undercutting along right bank. Two small riffle in channel just upstream of double box culvert at Trafalger Rd.



*Matrix Supplied
May 28, 2015*

81. HT-2a-2 Erosion along both banks with leaning trees over channel (elevated). Large angular riffle material.



*Matrix Supplied
May 28, 2015*

82. HT-2a-2 Rip rap placed along toe of right bank protecting private property.



*Matrix Supplied
May 28, 2015*

83. HT-2a-2 Woody debris jam consisting of large vegetation causing siltation upstream of it. WDJ found at downstream end of reach.

*Matrix Supplied
November 13, 2015*



84. HT-2a-1 Flow splits around vegetated bar in center of channel. Channel does this multiple times within reach.

*Matrix Supplied
November 13, 2015*



85. HT-2a-1 Boulders placed to make weir structure.

*Matrix Supplied
November 13, 2015*



86. HT-2a-1 Exposed clay along bed at toe of bank.

*Matrix Supplied
November 13, 2015*



87. HT-2a-1 Severe undercutting on bank with overhanging vegetation.



*Matrix Supplied
June 1, 2015*

88. HT-2b-3 Dry at time of visit, localized depression on an agricultural property.



*Matrix Supplied
June 1, 2015*

89. HT-2b-3 Depression is approximately 0.5m in width and 0.15m in depth.



*Matrix Supplied
May 28, 2015*

90. HT-2b-2 Feature dry but well defined with signs of riffle features.



*Matrix Supplied
May 28, 2015*

91. HT-2b-2 Feature disperses into cattail marsh.

*Matrix Supplied
November 13, 2015*



92. HT-2b-1 Narrow channel with dense overhanging grasses.

*Matrix Supplied
November 13, 2015*



93. HT-2b-1 Lateral bar formation on right bank. Primarily consisting of 1cm particles, pebbles and fine.

*Matrix Supplied
November 18, 2015*



94. HT-2b-1 Channel becomes undefined through cattail patch.

*Matrix Supplied
November 18, 2015*



95. HT-2b-1 Farm crossing of channel with no CSP to convey flow.

*Matrix Supplied
November 18, 2015*



96. HT-2b-1 Severe undercutting found at parts of the reach. Up to 0.30m of undercutting observed.

*Matrix Supplied
November 18, 2015*



97. HT-2b-1 Parts of channel are quite sinuous.

*Matrix Supplied
September 17, 2015*



98. HT-1 Cross-section 1 facing upstream

*Matrix Supplied
September 17, 2015*



99. HT-1 Cross-section 1 facing downstream

*Matrix Supplied
September 17, 2015*



100. HT-1 Cross-section 2 facing upstream

*Matrix Supplied
September 17, 2015*



101. HT-1 Cross-section 2 facing downstream

*Matrix Supplied
September 17, 2015*



102. HT-1 Cross-section 3 facing upstream

*Matrix Supplied
September 17, 2015*



103. HT-1 Cross-section 3 facing downstream

*Matrix Supplied
September 17, 2015*



104. HT-1 Cross-section 4 facing upstream

*Matrix Supplied
September 17, 2015*



105. HT-1 Cross-section 4 facing downstream

*Matrix Supplied
September 17, 2015*



106. HT-1 Cross-section 4 facing upstream

*Matrix Supplied
September 17, 2015*



107. HT-1 Cross-section 5 facing downstream

*Matrix Supplied
September 17, 2015*



108. HT-1 Cross-section 6 facing upstream

*Matrix Supplied
September 17, 2015*



109. HT-1 Cross-section 6 facing downstream

*Matrix Supplied
September 17, 2015*



110. HT-1 Cross-section 7 facing upstream

*Matrix Supplied
September 17, 2015*



111. HT-1 Cross-section facing downstream

*Matrix Supplied
July 8, 2015*



112. HT-1 Material that has slumped off bank has created island causing the flow to split.

*Matrix Supplied
July 8, 2015*



113. HT-1 Channel narrows in multiple areas to a wetted width of approximately 1m.

*Matrix Supplied
July 8, 2015*



114. HT-1 Woody debris causing obstacles for regular flow patterns.

*Matrix Supplied
July 8, 2015*



115. HT-1 downstream extent of reach is more sinuous than further upstream. Bends become over widened with evidence of planform adjustment.

APPENDIX C
Historic Aerial Photographs



Eighth Line

Hornby Road

Steeles Avenue

Sixth Line

54-4326
25-94

1954 Historic Photos
Scale 1:12,500
Source: Archives of Ontario



[Redacted]



Trafalgar Road

Hornby Road

Steeles Avenue

Sixth Line

1978 Historic Photos
Scale 1:11,179
Source: Archives of Ontario



[Redacted]



2002 Historic Photos
Scale 1:11,179
Provided by Conservation Halton



Trafalgar Road

Hornby Road

Steeles Avenue

Sixth Line

2007 Historic Photos
Scale 1:11,179
Provided by Conservation Halton

APPENDIX D
Headwater Drainage Feature Assessment Memo
(Matrix Solutions Inc., June 2016)



A Division of Matrix Solutions Inc.

June 3, 2016

Matrix 21510-522

Mr. Ron Scheckenberger
AMEC FOSTER WHEELER
3215 North Service Rd
Burlington, ON L7N 3G2

Subject: Results of Headwater Drainage Feature Assessment for Premier Gateway Scoped Subwatershed Study

Dear Mr. Scheckenberger

A headwater drainage feature (HDF) assessment was undertaken as part of the Premier Gateway Scoped Subwatershed Study. The assessment was initiated in 2015, however due to timing of project initiation and permission to enter information, only the 'second visit' as outlined in the TRCA/CVC (2014) protocol was completed. To establish complete characterization of the HDFs, the 'first visit' was completed during the appropriate timing window in March 2016. Due to the delay in completion of the assessment, from 2015 to 2016, results were not included in the Phase 1: Study Area Characterization which was issued February 2016. The results and documentation from the assessment are presented in the following memorandum and appendices.

Following the guidance of the TRCA/CVC protocol, the HDFs were visited on two separate occasions (no feature required three visits). As outlined in the Phase 1 report, the timing of the visits was based on the three visit recommendation set out in the TRCA/CVC protocol. The visits were completed as outlined below.

1. May 28, 2015 - initial visits were conducted during the Site Visit #2 timing window in 2015. All features were visited during this visit with the exception of HDF-1, HT-2b-4 (a and b), and W-T1-2b.
2. July 3, 2015 - visit conducted during the Site Visit #3 timing window in 2015. Only HDF-1 and W-T1-2b were visited on this date, based on conditions during the assessment it was determined that a Site Visit #2 would be superfluous for these features and was not needed in 2016.
3. March 8, 2016 - all features were visited on this date to serve as Site Visit #1. Due to unseasonably warm winter conditions, this is somewhat earlier than the normal freshet visit (late March-April). A melt event occurred on this date as a result of snowfall accumulation occurred over the previous week followed by warming temperatures (high of 11.6° Celsius on March 8, 2016). Typically, Site Visit #1 is conducted a few days after the freshet to allow for melt of the snow pack

and runoff. To compensate for a smaller snowpack in 2016, the Site Visit #1 was conducted closer to the melt event. However, this may have resulted in somewhat higher flows than would normally be anticipated for a typical Site Visit #1.

4. May 25, 2016 - this served as the Site Visit #2 for HT-2b-4 (a and b) because access was not available in 2015 during the proper timing window.

The goal of the TRCA/CVC protocol is to objectively classify those features on the landscape which are not considered permanent watercourses but appear to serve some hydrologic, terrestrial, riparian, or aquatic function. Due to the subjective, ill-defined nature of these features, the protocol at times does not appear to adequately capture their function and importance. It is understood that a protocol can never address or anticipate all possible scenarios that may arise in the field. Therefore, to address this two management recommendations have been provided for the features: one based on strict adherence to the TRCA/CVC protocol (protocol management recommendation), and a second based on the protocol results and interpretation of overall function and importance of the feature to the system (final management recommendation). This helps to address features that are particularly complex or difficult to interpret. Both recommendations have been shown in the summary table (Appendix A), along with specific notes and rationale, and in separate mapping (Appendix B).

There were a few features which were particularly complex that warrant additional discussion within this section. Original mapping for HT-2b-4 (shown as a dashed blue line in Appendix B) is located in a low-lying area adjacent to an active agricultural field. During Site Visit #1, drainage that would be directed to the original drainage line was pooling along the edge of the agricultural fields as a result of furrowing and altered drainage. An additional line therefore was added to indicate where the water is primarily draining due to modification of the landscape (this is labelled HT-2b-4 in Appendix B). Additionally, at Steeles Avenue there is a culvert which appears to outlet drainage from the roadway (Photo 42 and 49, Appendix C). Based on Site Visit #1, this outlet does not appear to connect to the drainage along the agricultural fields and was primarily ponded within 100 m of the outlet.

Drainage mapping for W-T1-2b indicates that it should flow straight in a north-south direction. During Site Visit #1 it was noted that within Segment 1 (S1), the feature made a 90 degree turn at the property line and then drained toward Sixth Line as opposed to continuing southward (Photo 136, Appendix C). The drainage line has been modified to show this in the mapping (Appendix B). The connection between S1 and Segment 3 (S3) is unclear due to a lack of access to the properties on which Segment 2 is located. At the upstream end of S3, minimal surface flow was noted during Site Visit #1 (Photo 139, Appendix C). Modified drainage made it difficult to determine connectivity and drainage within this feature. Based on upstream (S1) and downstream (S3) conditions and review of aerial photography, the majority of S2 can be given a preliminary management recommendation of 'Mitigation' (Appendix A). Currently, the break between S2 and S3 coincides with the property boundary to indicate where the segment of W-T1-2b which could not be accessed (shown in Figure 3, Appendix B). The downstream end of S2 should be considered part of S3 due to consistent riparian vegetation (scrubland) and would therefore receive the recommendation of 'Conservation' (shown in Figure 4, Appendix B).

The management recommendations from the protocol listed in order of importance (high to low) are Protection, Conservation, Mitigation, Recharge, Protection, Maintain or Replicate Terrestrial Linkage, and No Management Required. A brief description, taken directly from the protocol, of each recommendation is provided below to aid in interpretation.

Protection - Important Functions: e.g. swamps with amphibian breeding habitat; perennial HDFs; seeps and springs; Species at Risk habitat; permanent fish habitat with woody riparian cover

- Protect and/or enhance the existing feature and its riparian zone corridor, and groundwater discharge or wetland in-situ.
- Maintain hydroperiod.
- Incorporate shallow groundwater and baseflow protection techniques such as infiltration treatment.
- Use natural channel design techniques or wetland design to restore and enhance existing habitat features, if necessary; realignment not generally permitted.
- Design and locate the stormwater management system (e.g. Extended detention outfalls) are to be designed and located to avoid impacts (i.e. Sediment, temperature) to the feature.

Conservation - Valued Functions: e.g. seasonal fish habitat with woody riparian cover; marshes with amphibian breeding habitat; or general amphibian habitat with woody riparian cover.

- Maintain, relocate, and/or enhance drainage feature and its riparian zone corridor.
- If catchment drainage has been previously removed or will be removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. Restore original catchment using clean roof drainage), as feasible.
- Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary.
- Maintain or replace external flows.
- Use natural channel design techniques to maintain or enhance overall productivity of the reach.
- Drainage feature must connect to downstream.

Mitigation - Contributing Functions: e.g. contributing fish habitat with meadow vegetation or limited cover

- Replicate or enhance functions through enhanced lot level conveyance measures, such as well-vegetated swales (herbaceous, shrub and tree material) to mimic online wet vegetation pockets, or replicate through constructed wetland features connected to downstream.
- Replicate on-site flow and outlet flows at the top end of system to maintain feature functions with vegetated swales, bioswales, etc. If catchment drainage has been previously removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage).
- Replicate functions by lot level conveyance measures (e.g. vegetated swales) connected to the natural heritage system, as feasible and/or Low Impact Development stormwater options (refer to Conservation Authority Water Management Guidelines for details).

Recharge Protection - Recharge Functions: e.g. features with no flow with sandy or gravelly soils

- Maintain overall water balance by providing mitigation measures to infiltrate clean stormwater, unless the area qualifies as an Area of High Aquifer Vulnerability under the Oak Ridges Moraine Conservation Plan or Significant Recharge Areas under the Source Water Protection Act. These areas will be subject to specific policies under their respective legislation.
- Terrestrial features may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with them.

Maintain or Replicate Terrestrial Linkage - Terrestrial Functions: e.g. features with no flow with woody riparian vegetation and connects two other natural features identified for protection

- Maintain the corridor between the other features through in-situ protection or if the other features require protection, replicate and enhance the corridor elsewhere
- If the feature is wider than 20 m, it may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with it.

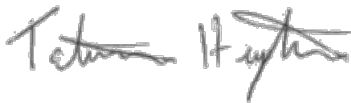
No Management Required - Limited Functions: e.g. features with no or minimal flow; cropped land or no riparian vegetation; no fish or fish habitat; and no amphibian habitat.

- The feature that was identified during desktop pre-screening has been field verified to confirm that no feature and/or functions associated with HDFs are present on the ground and/or there is no connection downstream. These features are generally characterized by lack of flow, evidence of cultivation, furrowing, presence of a seasonal crop, and lack of natural vegetation. No management recommendations required.

We trust that this memorandum suits your present requirements. If you have any questions or comments, please feel free to contact us.

Yours truly,

PARISH AQUATIC SERVICES



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Reviewed by



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TH/ap

REFERENCES

Toronto and Region Conservation Authority and Credit Valley Conservation. 2014. Evaluation, Classification, and management of headwater drainage features guideline. TRCA Approval July 2013 (Finalized January 2014).

DISCLAIMER

We certify that this letter report is accurate and complete and accords with the information available during the site investigation. Information obtained during the site investigation or provided by third parties is believed to be accurate but is not guaranteed. We have exercised reasonable skill, care and diligence in assessing the information obtained during the preparation of this letter report.

This letter report was prepared for AMEC Foster Wheeler. The letter report may not be relied upon by any other person or entity without our written consent and that of AMEC Foster Wheeler. Any uses of this letter report by a third party, or any reliance on decisions made based on it, are the responsibility of that party. We are not responsible for damages or injuries incurred by any third party, as a result of decisions made or actions taken based on this letter report.

APPENDIX A
Headwater Drainage Feature
Summary Table

Drainage Feature Segment	Segment Code	Step 1 Hydrology	Modifiers	Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
HT-2b-3b	S1	Contributing	Ag	Limited (code 3)	Contributing	Limited	Mitigation	No Management	Higher flow than normally anticipated due to timing of first visit. Modified through agricultural usage. Feature could not be located on second visit.
HT-2b-3a	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Higher flow than normally anticipated due to timing of first visit. Modified through agricultural usage. Feature could not be located on second visit.
HT-2b-3	S1	Contributing	Ag	Valued (code 4)	Contributing	Limited	Mitigation	Mitigation	Larger feature. Presence of healthy vegetation on second visit indicative of wetter conditions later into the dry season.
HT-2b-2	S1	Contributing		Important (code 7)	Contributing	Limited	Conservation	Conservation	Management recommendation is "Conservation" due to "important" riparian vegetation consisting of wetland and scrubland.
	S2	Contributing		Valued (code 4)	Contributing	Limited	Mitigation	Conservation	Mitigation recommendation based on hydrology. Recommendation is increased to "Conservation" as a result of higher classification in upstream segment.
	S3	Contributing		Valued (code 4)	Contributing	Limited	Mitigation	No HDF recommendation, segment has been upgraded to 'watercourse'	Receives a "Mitigation" classification based on hydrology. Standing water at downstream end of segment (Site Visit #2), defined bed/banks through length of segment, and gravel substrates on the bed suggest that this is a permanent feature of higher importance. Segment is classified as a 'watercourse' consistent with segment downstream of Trafalgar Road.
HT-2b-4	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	No management based on standing water at the first visit as a result of water pooling at the downstream end of the agricultural field.
	S2	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	Conservation	No management based on hydrology. This segment had defined bed/banks approaching the Trafalgar Road culvert and gravel substrate suggesting higher importance. Management recommendation was increased to "Conservation".
HT-2b-4b	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Based on hydrology, standing water at the first visit. Feature appears to be cut through furrowing to help drain the fields in the spring.
HT-2b-4a	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Based on hydrology, standing water at the first visit. Feature appears to be cut through furrowing to help drain the fields in the spring.

Drainage Feature Segment	Segment Code	Step 1 Hydrology	Modifiers	Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
E-T1-4	S1	Contributing		Limited (code 3)	Contributing	Limited	Mitigation	Conservation	Management recommendation is "Mitigation" based on hydrology. Based on the amount of flow noted at Site Visit #1, historic aerial photos, and conditions upstream of the study area, the management recommendation has been increased to "Conservation". It is noted that upstream of the golf course the feature appears to be a defined watercourse based on a review of aerial photography. Modification by the golf course has made this feature difficult to assess fully. It is thought that with removal of the golf course this could potentially be a more significant feature than it currently appears to be, based on upstream conditions.
	S2	Valued		Important (code 5)	Contributing	Limited	Conservation	Protection	Management recommendation is "Conservation" due to surrounding riparian vegetation dominated by scrubland. Management recommendation is increased to "Protection" as a result of both defined bed and banks and standing water at Site Visit #2, suggesting more permanence and importance hydrologically.
HDF-1	S1	Important	Golf course ponds outlet at upstream end	Valued (code 4)	Contributing	Valued	Protection	Conservation	Management recommendation is "Protection" based on "important" hydrology classification as a result of water during Site Visit #3. Terrestrial habitat is "valued" due to presence of tadpoles in isolated pool during Site Visit #3. Management recommendation is reduced to "Conservation" as the golf course ponds outlet to the feature and it is unclear how this impacts the natural hydrology of the feature.
	S2	Important		Valued (code 4)	Contributing	Valued	Protection	Conservation	Management recommendation is "Protection" based on "important" hydrology classification as a result of water during Site Visit #3. Terrestrial habitat is "valued" due to presence of tadpoles in isolated pool during Site Visit #3. Management recommendation is reduced to "Conservation" as the golf course ponds outlet to the feature and it is unclear how this impacts the natural hydrology of the feature.
HDF-2	S1	Contributing	Outlet from west to east pond	Limited (code 3)	Contributing	Limited	Mitigation	No Management	Management recommendation is based on hydrology. This feature is a small swale that connects the west golf course pond to the east golf course pond; therefore, hydrology is a result of the pond water levels. Suggest reducing recommendation to "No Management".

Drainage Feature Segment	Segment Code	Step 1 Hydrology	Modifiers	Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
HDF-3	S1	Limited or recharge		Limited (code 3)	Contributing	Limited	No Management	No Management	Standing water at Site Visit #1, no management required.
HDF-4	S1	Contributing		Limited (code 3)	Contributing	Limited	Mitigation	No Management	Management recommendation of "Mitigation" is based on hydrology. Difficult to determine management due to potentially altered drainage on golf course, suggested that "No Management" recommendation.
HDF-4a	S1	Limited or recharge		Limited (code 3)	Contributing	Limited	No Management	No Management	Standing water at site visit 1, no management required.
W-T1-2b	S1	Contributing	Ag	Limited (code 3)	Contributing	Limited	Mitigation	Mitigation	Management recommendation of "Mitigation" based on hydrology.
	S2	Contributing*		Contributing* (code 2)	Contributing*	Limited*		Mitigation*	Management recommendation of "Mitigation" based on hydrology.
	S3	Contributing		Important (code 5)	Contributing	Contributing	Conservation	Conservation	Management recommendation of "Conservation" based on "important" riparian vegetation classification due to scrubland.

*Hydrology and fish habitat for W-T1-2b (S2) were based on the up- and down- stream classification, while riparian and terrestrial were based on a review of aerial photographs. Final management recommendation is preliminary based on a lack of field confirmation.

APPENDIX B
Headwater Drainage Feature
Management Recommendation Maps

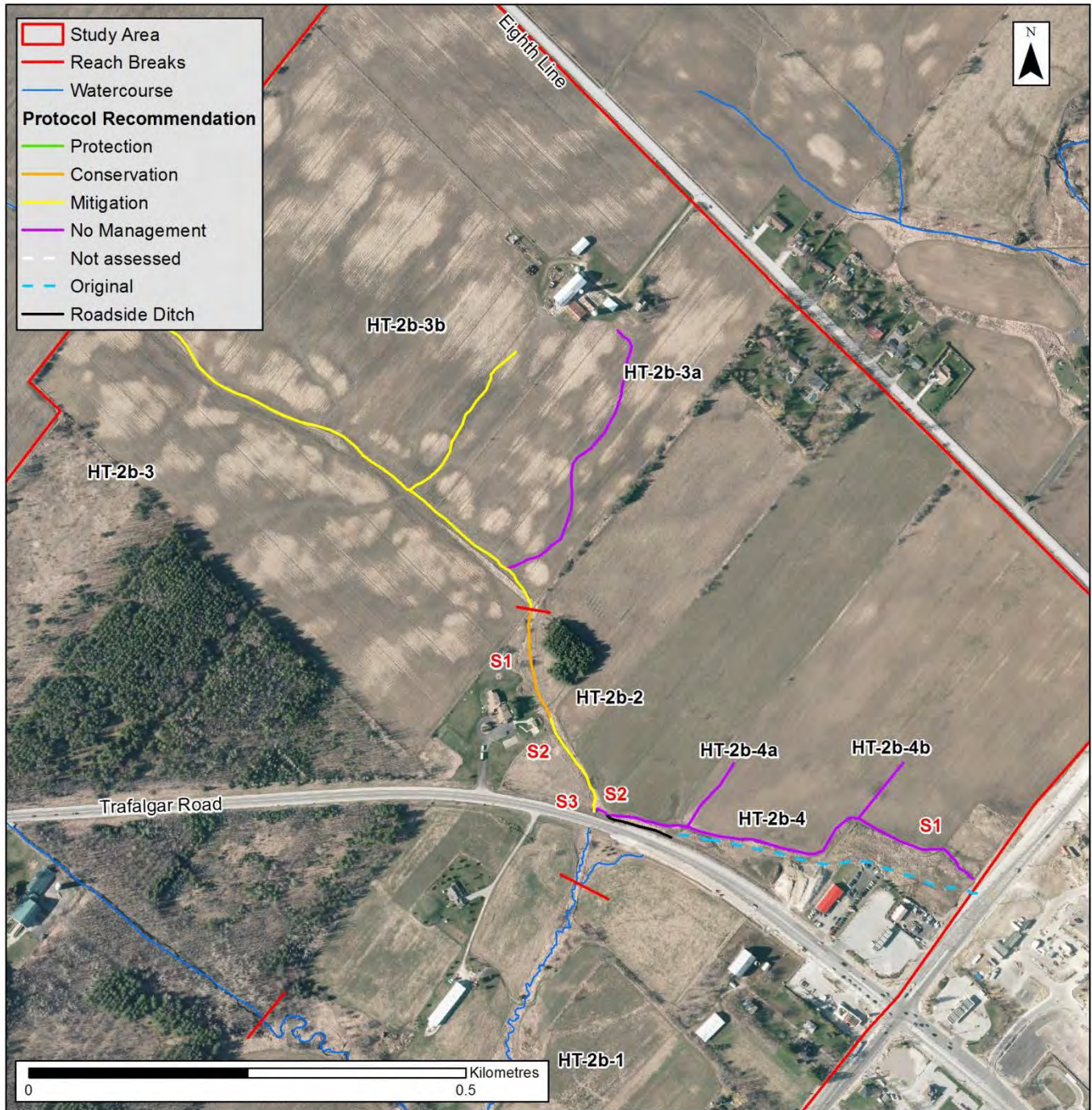


Figure 1 – Protocol Management Recommendations for HDFs in Eastern Portion of Study Area.

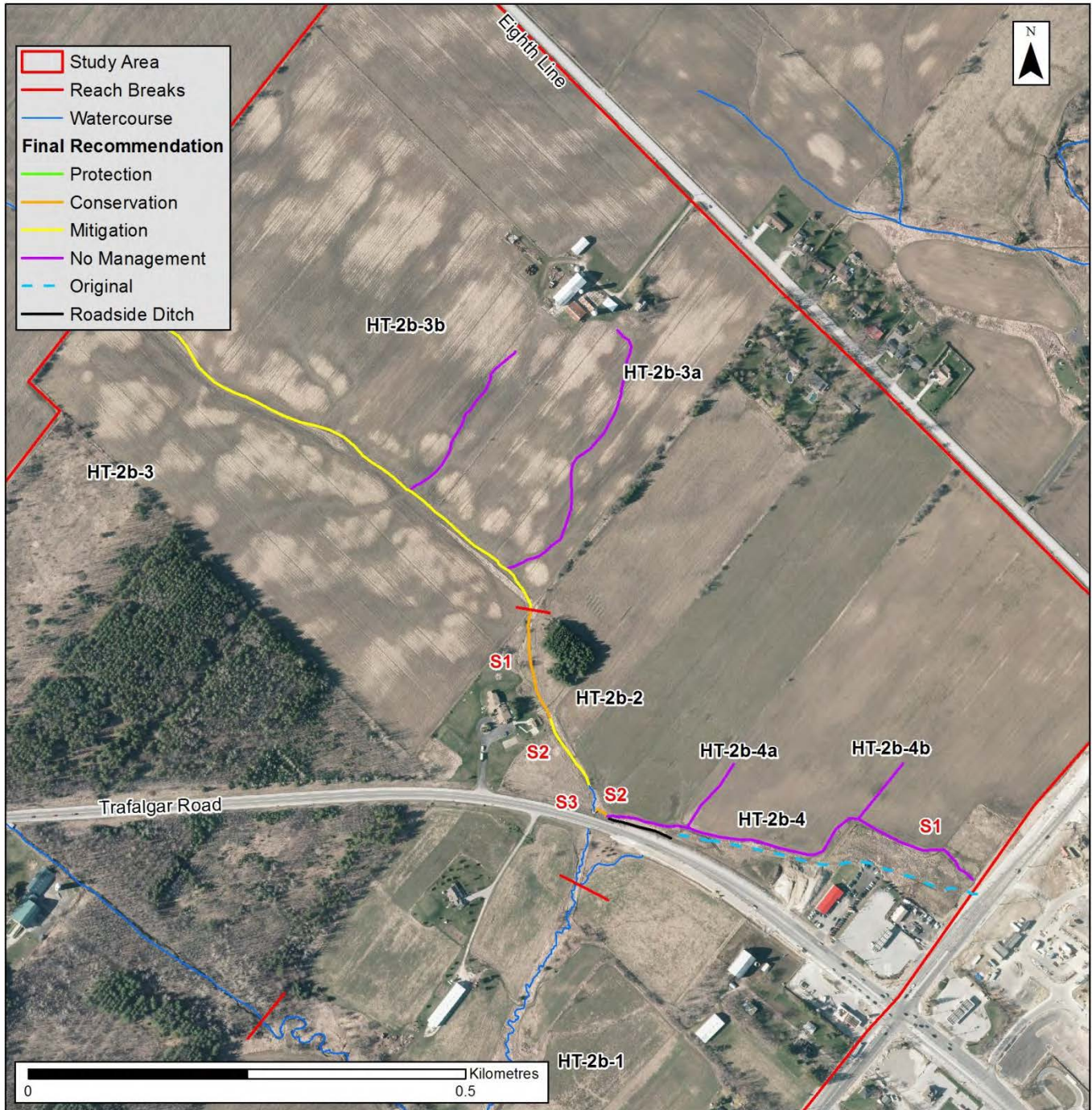


Figure 2 – Final Management Recommendations for HDFs in Eastern Portion of Study Area

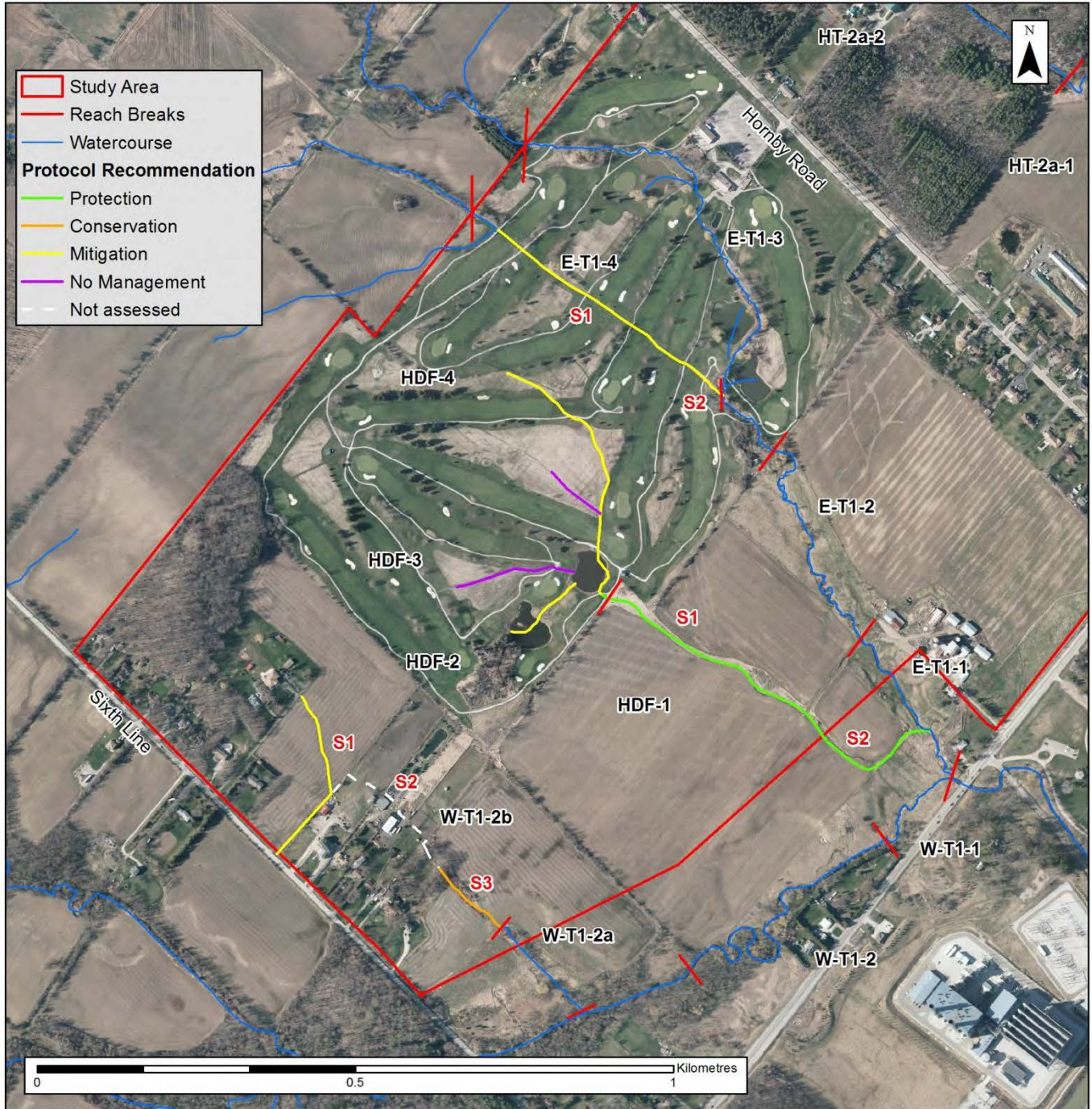


Figure 3 - Protocol Management Recommendations for HDFs in Western Portion of Study Area

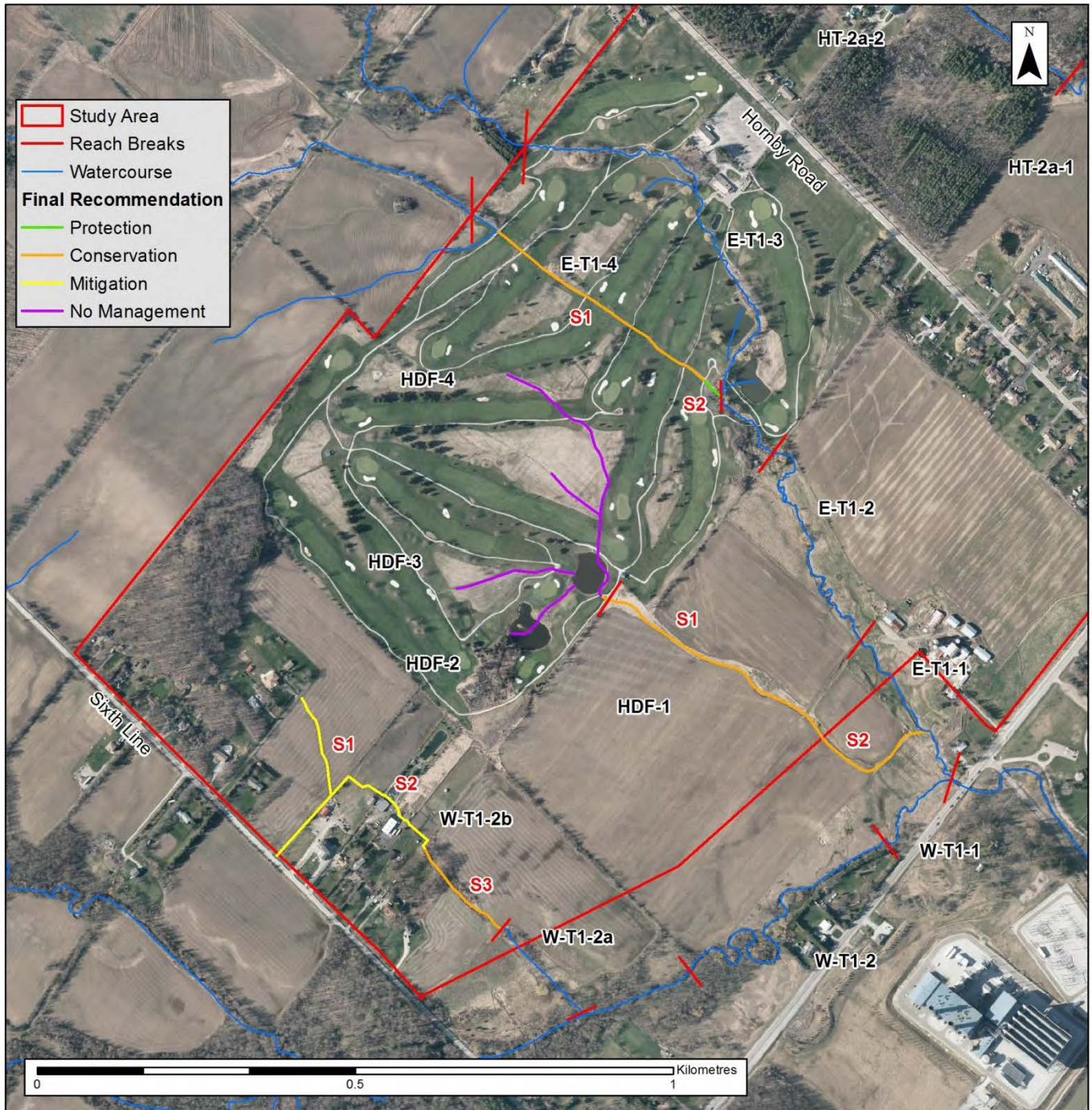


Figure 4 - Final Management Recommendations for HDFs in Western Portion of Study Area

APPENDIX C
Headwater Drainage Feature
Assessment Photographs



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

1. **HT -2b -3b.** At upstream end of feature where flow begins to follow defined flow path. Facing upstream. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

2. **HT -2b -3b.** Mid -feature, facing upstream. Note defined flow path and some development of sinuosity. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

3. **HT -2b -3b.** Near downstream end of feature, facing upstream. Feature type is swale and flow condition is surface flow minimal. Feature had sinuosity development and transport of fine sediments.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

4. **HT -2b -3b.** Downstream end of feature where it meets HT -2b -3, flow disperses. Feature type is swale and flow condition is surface flow minimal. Yellow arrow indicates direction of flow.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

5. **HT -2b -3b.** Area where feature would be located facing upstream. Feature type is swale, flow condition is dry. **Management recommendation: No Management**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

6. **HT -2b -3a.** Upstream end of feature, facing upstream. Feature type is swale and flow condition is standing water.



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March 8, 2016 (Site Visit 1)*

7. **HT -2b -3a.** Mid -feature, facing upstream. Water is primarily standing and does not have a well-defined flow path. Feature type is swale and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

8. **HT -2b -3a.** Approaching downstream end, facing upstream. Flow becomes more defined as it approaches confluence with HT -2b -3. Feature type is swale and flow condition is standing water.



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March 8, 2016 (Site Visit 1)*

9. **HT -2b -3a.** Downstream end where feature meets HT -2b -3. Feature type is swale and flow condition is standing water. Yellow arrow indicates direction of flow.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

10. **HT -2b -3a.** Facing upstream in vicinity of feature. No depression was visible. Flow condition was no surface water and feature type was swale. **Management Recommendation: No management required.**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

11. HT -2b -3. Standing water adjacent to vegetation and cropland at upstream end of feature.
Feature type is no defined feature (overland flow only) and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

12. HT -2b -3. Standing water adjacent to vegetated area and cropland, near upstream end. Feature type is no defined feature (overland flow only) and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

13. HT -2b -3. Water on either side of vegetated area between two crop fields. Facing upstream. Feature type is no defined feature (overland flow only) and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

14. HT -2b -3. Near downstream end of feature, facing upstream. Flow is more spread out over flatter area. Feature type is no defined feature (overland flow only) and flow condition is surface flow minimal.



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March 8, 2016 (Site Visit 1)*

15. HT -2b -3. Downstream end of feature, ponded water on either side of vegetation area, facing upstream. Feature type is no defined feature (overland flow only) and flow condition is surface flow minimal.



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May 28, 2015 (Site Visit 2)*

16. HT -2b -3. Near upstream end of feature, facing upstream. Vegetated buffer area between two crop fields. Feature type is no defined feature (overland flow only) and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

17. HT -2b -3. Facing upstream, within vegetated area. Note narrow depression in center of photo. Feature type is no defined feature (overland flow only) and flow condition is no surface water.



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18. HT -2b -3. Facing upstream, near downstream end of feature. Feature type is no defined feature (overland flow only) and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

19. **HT -2b -3.** Facing upstream and downstream extent of feature. Feature type is no defined feature (overland flow only) and flow condition is no surface water. **Management Recommendation:**
Mitigation



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March 8, 2016 (Site Visit 1)*

20. **HT -2b -2 (Segment 1).** At upstream end of feature where water flows off agricultural fields upstream. Maximum water depth was at upstream end where water was pooling in several locations (max depth approx. 20cm). Feature type is multi -thread and flow condition is surface flow substantial.



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21. HT -2b -2 (Segment 1). Facing downstream, multiple poorly defined flow paths. Feature type is multi -thread and flow condition is surface flow substantial.



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March 8, 2016 (Site Visit 1)*

22. HT -2b -2 (Segment 1). Facing upstream at downstream end of Segment. Multiple poorly defined flow paths upstream of small pedestrian boardwalk on property. Feature type is multi -thread and flow condition is surface flow substantial.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

23. HT -2b -2 (Segment 1). Upstream end of feature, facing downstream from property boundary. No defined depression or flow path, no water present. Feature type is multi -thread and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

24. HT -2b -2 (Segment 1). Facing upstream within feature. Note dead grass patches indicating previous flow paths. Feature type is multi -thread and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

- 25. HT -2b -2 (Segment 1).** Facing upstream from downstream end of Segment towards area of wetland vegetation (cattails). Numerous depressions indicative of multi -thread flow during spring freshet. Feature type is multi -thread and flow condition is no surface water. **Management Recommendation: Conservation (based on riparian vegetation)**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

- 26. HT -2b -2 (Segment 2).** Upstream end of Segment, facing downstream. Downstream of boardwalk crossing flow is more focused into single channel. Feature type is swale and flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

27. HT -2b -2 (Segment 2). Facing upstream, mid -Segment. Feature type is swale and flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

28. HT -2b -2 (Segment 2). Facing downstream at end of Segment. Feature type is swale and flow condition is surface flow substantial.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

29. HT -2b -2 (Segment 2). Upstream end of Segment located at small boardwalk. Visible depression through this Segment. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

30. HT -2b -2 (Segment 2). Within Segment, facing upstream. Note dead grass indicative of swale depression. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

31. HT -2b -2 (Segment 2). Downstream end of Segment, facing downstream. Tree indicates transition to Segment 3. Feature type is swale and flow condition is no surface water. **Management Recommendation: Conservation**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

32. HT -2b -2 (Segment 3). Upstream end of Segment where feature transitions into feature type defined natural channel (visible banks). Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

33. HT -2b -2 (Segment 3). Facing downstream to culvert at Trafalgar Road, note overhanging grasses. Feature type is defined natural channel (visible banks); flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

34. HT -2b -2 (Segment 3). Facing downstream to culvert at Trafalgar Road, note well -defined channel banks. Feature type is defined natural channel (visible banks); flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

35. HT -2b -2 (Segment 3). Downstream end of Segment where feature enters Trafalgar Road culvert. Feature type is defined natural channel (visible banks); flow condition is surface flow substantial.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

36. HT -2b -2 (Segment 3). Upstream end of feature at tree where channel bed becomes defined. The feature is primarily dry through the length of the Segment with some very isolated standing water. Feature type is defined natural channel (visible banks); flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

37. HT -2b -2 (Segment 3). Facing downstream towards culvert at Trafalgar Road. Feature type is defined natural channel (visible banks); flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

38. HT -2b -2 (Segment 3). Gravel bed substrates within Segment 3. Feature type is defined natural channel (visible banks); flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

39. HT -2b -2 (Segment 3). Facing upstream at downstream end of Segment. Note channel is dry within this section. Feature type is defined natural channel (visible banks); flow condition is no surface water



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

40. HT -2b -2 (Segment 3). Standing water was only noted at downstream end of Segment immediately upstream of culvert. Feature type is defined natural channel (visible banks); flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

41. HT -2b -2 (Segment 3). Standing water in culvert, downstream end of Segment. Feature type is defined natural channel (visible banks); flow condition is no surface. **Management Recommendation: None. Feature is classified as a Watercourse**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

42. HT -2b -4 (Segment 1). Culvert at Steeles Avenue upstream end of feature. Feature type is no defined feature (overland flow only); flow condition was standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

43. HT -2b -4 (Segment 1). Facing upstream towards Steeles Avenue. Lack of flow or well -defined single flow path. Feature type is no defined feature (overland flow only) and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

44. HT -2b -4 (Segment 1). Standing at base of agricultural field where water had ponded facing Steeles Avenue. Feature type is no defined feature (overland flow only) and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

45. HT -2b -4 (Segment 1). Facing upstream towards Steeles Avenue. Water is more concentrated into modified channel. Feature type is no defined feature (overland flow only); flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

46. HT -2b -4 (Segment 1). Facing downstream to large ponded area where water runs off the fields. Feature type is no defined feature (overland flow only); flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

47. HT -2b -4 (Segment 1). Facing upstream, ponded water draining off the fields toward roadside ditch. Feature type is no defined feature (overland flow only); flow condition standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

48. Roadside ditch along Trafalgar adjacent HT -2b -4 (Segment 1). Standing water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

49. HT -2b -4 (Segment 1). Upstream end of feature at Steeles Avenue culvert. Standing water was noted at the culvert only, and not within feature. Feature type is no defined feature (overland flow only); flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

50. HT -2b -4 (Segment 1). Facing downstream towards agricultural fields. Several depressions no singular flow path. Feature type is no defined feature (overland flow only); flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

51. HT -2b -4 (Segment 1). Facing upstream towards Steeles Avenue from agricultural field. Feature type is no defined feature (overland flow only); flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

52. HT -2b -4 (Segment 1). Facing upstream towards Steeles Avenue in agricultural field. Feature type is no defined feature (overland flow only); flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

53. HT -2b -4 (Segment 1). Facing downstream towards Trafalgar Road where water was ponded during first visit. Feature type is no defined feature (overland flow only), flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

54. HT -2b -4 (Segment 1). Facing downstream towards Trafalgar Road where water drains off agricultural field towards roadside ditch. Feature type is no defined feature (overland flow only), flow condition is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

55. HT -2b -4 (Segment 1). Facing downstream towards Trafalgar Road, feature drains toward roadside ditch. During this visit no defined depression noted through this area. Feature type is no defined feature (overland flow only) and flow type is no surface water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

56. Roadside ditch adjacent to **HT -2b -4**, facing downstream towards Trafalgar Road culvert. Feature was dry.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

57. Area where **HT -2b -4 (Segment 1)** and roadside ditch converge upstream of Trafalgar Road culvert. **HT -2b -4 (Segment 1)** is on the left, roadside ditch is on the right. **Management recommendation:**
No Management



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

58. **HT -2b -4 (Segment 2)**. Downstream of confluence with roadside ditch, features combine to establish defined bed and banks approaching culvert.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

59. HT -2b -4 (Segment 2). Defined bed and banks directly upstream of Trafalgar road culvert, flow condition is dry. **Management Recommendation: Conservation**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

60. HT -2b -4a. Feature added after observation in field on first visit. Facing upstream from downstream end. Feature looks to be cut as a furrow by farmer. Feature type is channelized (modified agricultural) and flow condition is standing water.



*Matrix Solutions Inc.
May 25, 2016 (Site Visit 2)*

61. HT -2b -4a. Looking eastward across field where feature was previously located. Feature is no longer visible as field appears to have been reworked. Flow condition is dry, feature type is channelization (modified agricultural). **Management Recommendation: No management required.**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

62. HT -2b -4b. Feature added after identification in the field at time of first visit. Facing upstream from downstream end. Feature appears to be cut as a furrow by farmer. Feature type is channelization (modified agricultural) and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

63. HT -2b -4b. Feature drains to large ponded area of HT -2b -4, photo facing upstream. Feature appears to be cut as a furrow by farmer. Feature type is channelization (modified agricultural) and flow condition is standing water.



*Matrix Solutions Inc.
May 25, 2016*

64. HT -2b -4b. Facing east across field where feature was located at Site Visit #1. Feature is no longer visible as field appears to have been reworked. Flow condition is dry, feature type is channelization (modified agricultural). **Management Recommendation: No management required.**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

65. E -T1 -4 (Segment 1). At upstream end of golf course facing upstream. Water is standing and pooled, approximately depth of 20 cm. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

66. E -T1 -4 (Segment 1). At upstream end of golf course, facing downstream towards first cart crossing bridge. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

67. E -T1 -4 (Segment 1). At first cart path crossing, facing downstream. Water flows beneath bridge and drains into small pipe across the fairway. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



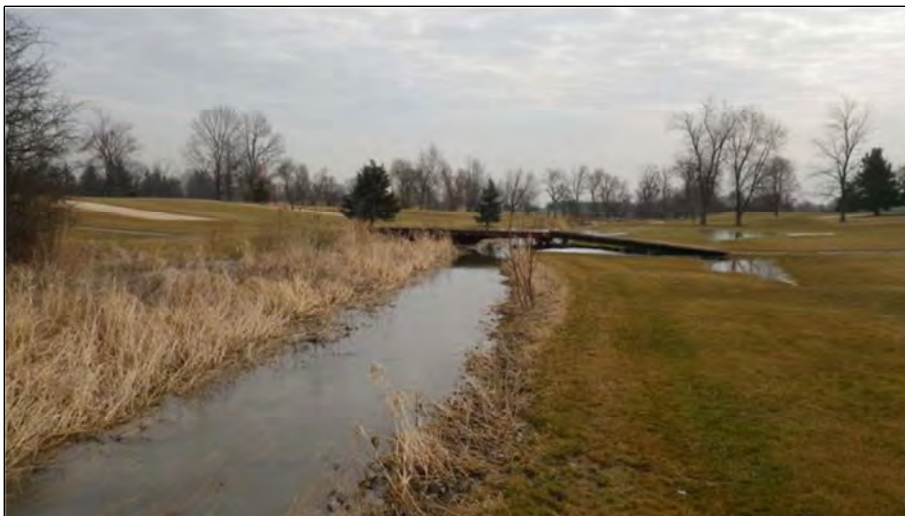
*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

68. E -T1 -4 (Segment 1). Downstream side of second cart path crossing. Water flows out of pipe upstream of cart path crossing and then again drains into pipe to traverse another fairway. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

69. E -T1 -4 (Segment 1). Facing downstream of second cart path crossing, no surface water due to piping along fairway, water outlets into grassed area. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

70. E -T1 -4 (Segment 1). Facing downstream towards third cart path crossing. Feature is not piped through this section. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

71. E -T1 -4 (Segment 1). Facing upstream towards third cart path crossing. In background of photo water is pooling at surface where it has overwhelmed the pipe. In foreground, pipe outlets into grasses area, where flow is relatively fast and erosion has occurred around the outlet. Wetted depth is 14cm. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

72. E -T1 -4 (Segment 1). Facing downstream towards fourth cart path crossing. Water flows at surface after outletting from pipe. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

73. E -T1 -4 (Segment 1). Facing downstream towards fifth cart path crossing. Overland flow through piped section downstream of fourth cart path crossing. Hole in pipe as indicated by bubbling water in photo. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

74. E -T1 -4 (Segment 1). Facing upstream from fifth cart path crossing, wide area of water pooling due to broken pipe. Two pipe outlets upstream of cart path crossing. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
March 8, 2015 (Site Visit 1)*

75. E -T1 -4 (Segment 1). Facing upstream towards fifth cart path crossing where feature appears to be open to surface, wetted width approximately 3.5m. Feature type is classified as tiled drainage (buried stream/pipe) because the feature is primarily piped through the extent of the golf course. Flow condition is surface flow substantial.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

76. E -T1 -4 (Segment 1). Facing upstream at upstream end of golf course. No water or standing water only noted. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

77. E -T1 -4 (Segment 1). Facing upstream towards first cart path crossing, feature is piped, no surface flow. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

78. E -T1 -4 (Segment 1). Pipe outlet at second cart path crossing, facing downstream. No water noted. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

79. E -T1 -4 (Segment 1). Facing upstream towards second cart path crossing, within area where pipe outlets to surface. Standing water noted at the outlet only. A depression bare of grass was noted indicating previous flows. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

80. E -T1 -4 (Segment 1). Facing downstream towards third cart path crossing, where feature is at surface. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

81. E -T1 -4 (Segment 1). Facing upstream to third cart path crossing, feature is piped beneath fairway. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

82. E -T1 -4 (Segment 1). Evidence of erosion by flows downstream of pipe outlet in section between third and fourth cart path crossing. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

83. E -T1 -4 (Segment 1). Facing downstream towards fourth cart path crossing. Dry defined depression, evidence of previous flows from pipe outlet. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

84. E -T1 -4 (Segment 1). Facing upstream towards fourth cart path crossing. Feature piped beneath fairways. Feature type is classified as tiled drainage; flow condition is no surface water.



*Matrix Solutions Inc.
June 1, 2015 (Site Visit 1)*

85. E -T1 -4 (Segment 1). Facing downstream from fifth cart path crossing where feature is at surface. Feature type is classified as tiled drainage; flow condition is no surface water. **Management Recommendation: Conservation**



*Matrix Solutions Inc.
March 8, 2015 (Site Visit 1)*

86. E -T1 -4 (Segment 2). Natural conditions downstream of last cart path crossing, until confluence with E -T1 -3 (approx. 40m). Feature type is classified as defined natural channel (visible banks) and flow condition is surface flow substantial.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

87. E -T1 -4 (Segment 2). At upstream end of Segment, facing upstream towards to sixth cart path crossing. Feature type is defined natural channel (visible banks) and flow condition is standing water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

88. E -T1 -4 (Segment 2). Channel bed within Segment. Feature type is defined natural channel (visible banks) and flow condition is standing water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

89. E -T1 -4 (Segment 2). Facing downstream to confluence with E -T1 -3. Feature type is defined natural channel (visible banks) and flow condition is standing water. **Management Recommendation: Protection.**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

90. HDF -4. At upstream end of feature where flow initiates. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

91. HDF -4. Facing upstream to upstream end of feature, cattail growth in wetted area was frequent. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

92. HDF -4. Facing upstream where feature drains into small pipe beneath fairways. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

93. HDF -4. Facing upstream, feature is piped beneath fairway and outlets again downstream of a cart path. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

94. HDF -4. Facing upstream, frequent cattail growth is seen in feature. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

95. HDF -4. Facing upstream. Progressing further downstream, feature dimensions were relatively consistent throughout. Wetted width varied between 7cm to 15cm. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

96. HDF -4. Facing upstream, feature enters pipe again. Note additional smaller feature joining in left side of photo (HDF -4a). Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

97. HDF -4. Facing upstream from downstream end of feature. Feature is piped to the downstream outlet at a pond. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

98. HDF -4. Outlet at golf course pond downstream end. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

99. HDF -4. Facing upstream at upstream end of feature. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

100. HDF -4. Facing upstream, area where feature is densely vegetated with cattails and grasses before entering a pipe. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

101. HDF -4. Facing downstream, defined depression with evidence of previous flows. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

102. HDF -4. Facing downstream, feature runs along edge of manicured golf course green. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

- 103. HDF -4.** Facing downstream towards golf course pond at downstream end. Feature is piped through last Segment. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

- 104. HDF -4.** Downstream end of feature outletting to pond. Feature is piped through last Segment. Feature type is swale and flow condition is no surface water. **Management recommendation: No management required**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

105. HDF -4a. Facing upstream from confluence with HDF -4. Feature type is swale and flow condition is standing water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

106. HDF -4a. Feature at downstream end joining HDF -4. Feature type is swale and flow condition is no surface water. **Management Recommendation: No management required**



*Matrix Solutions Inc.
March 8, 2016(Site Visit 1)*

107. HDF -3. Upstream end of feature, facing upstream. Feature type is swale, flow condition is standing water



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

108. HDF -3. Facing upstream, mid -feature. Cattail growth noted within feature. Feature type is swale, flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016(Site Visit 1)*

109. HDF -3. Facing downstream at downstream end of feature. Feature flows through two small pipes for path crossings before entering the golf course pond. Feature type is swale, flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

110. HDF -3. Downstream end of feature at golf course pond. Feature type is swale, flow condition is standing water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

111. HDF -3. Facing upstream, near downstream end of feature. Feature heavily vegetated with cattails. Feature type is swale; flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

112. HDF -3. Downstream end of feature at golf course pond. Feature type is swale; flow condition is no surface water. **Management Recommendation: No management required.**



*Matrix Solutions Inc.
March 8, 2015 (Site Visit 1)*

113. HDF -2. Facing western golf course pond. Feature is a surface connection between the two golf course ponds. Feature type is pond outlet; flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2015 (Site Visit 1)*

114. HDF -2. Facing eastern golf course pond. Feature is a surface connection between the two golf course ponds. Feature type is pond outlet; flow condition is surface flow minimal.

No Photo documentation from May 28, 2015 (Site Visit 2)

115. HDF -2. Feature is a surface connection between the two golf course ponds. Feature was dry at time of assessment. Feature type is pond outlet; flow condition is no surface flow. **Management Recommendation: No management required**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

116. HDF -1 (Segment 1). At upstream end of feature, facing downstream. Upstream end has more water due to outlet from golf course ponds. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

117. HDF -1 (Segment 1). Within feature, flow is distributed in pockets, lacks a continuous flow path. Wetted depth 5 cm to 10 cm. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

118. HDF -1 (Segment 1). Facing upstream towards golf course within Segment. Typical conditions, tall grasses with areas of pockets water. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

119. HDF -1 (Segment 1). Upstream end of feature at pond outlet from golf course. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

120. HDF -1 (Segment 1). Facing downstream from upstream end of Segment, dense vegetation through feature, including some cattails. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

121. HDF -1 (Segment 1). Standing water throughout feature up to 20cm. Feature type is multi -thread and flow condition is standing water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

- 122. HDF -1 (Segment 1).** Facing upstream from downstream end of Segment. Note dense vegetation. Water beginning to focus along boundary between cropland and vegetation. Feature type is multi -thread and flow condition is standing water. **Management Recommendation: Conservation**



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

- 123. HDF -1.** Transition point between Segment 1 and 2, facing upstream. Large area of ponded water as a result of farm lane depression.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

124. HDF -1. Tadpoles noted in farm lane crossing ponded water area.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

125. HDF -1 (Segment 2). Facing downstream within Segment. Water becomes more concentrated between crops and grasses. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

126. HDF -1 (Segment 2). Facing downstream, flow path is more defined. Feature type is swale and flow condition is surface flow minimal. Wetted depth is 18 cm.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

127. HDF -1 (Segment 2). Facing downstream towards E -T1 -2. Definition is lost approaching E -T1 -2. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

128. HDF -1 (Segment 2). Looking towards confluence location with E -T1 -2. Flow discontinues in this area, a confluence could not be identified in the field based on presence of flow or topography. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

129. HDF -1 (Segment 2). Upstream end of Segment, facing downstream. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

130. HDF -1 (Segment 2). Facing downstream, flow concentrated along boundary between cropland and vegetated area. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

131. HDF -1 (Segment 2). Facing downstream. Dense vegetation, some wetland species (cattails). Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

132. HDF -1 (Segment 2). Facing downstream towards E -T1 -2. Flow is reduced through this section. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

133. HDF -1 (Segment 2). At downstream end of feature, feature goes dry and is not able to be identified through tall grass section to confluence with E -T1 -2. Confluence could not be located. Feature type is swale and flow condition is surface flow minimal. **Management Recommendation: Conservation**



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

134. W -T1 -2b (Segment 1). Upstream end of Segment 1 facing downstream. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

135. W -T1 -2b (Segment 1). Facing downstream within Segment. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

136. W -T1 -2b (Segment 1). Downstream end of feature. Feature makes a turn westward and drains towards Sixth line. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

137. W -T1 -2b (Segment 1). Upstream end of feature, some erosion due to CSP outlet. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
May 28, 2015 (Site Visit 2)*

138. W -T1 -2b (Segment 1). Facing downstream, feature has been cut as a furrow through field. Feature type is swale and flow condition is no surface water. **Management Recommendation:**
Mitigation



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

139. W -T1 -2b (Segment 3). Upstream end of Segment, facing upstream. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

140. W -T1 -2b (Segment 3). Within Segment, dense vegetation. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

141. W -T1 -2b (Segment 3). Within Segment, dense vegetation including some wetland species (cattails). Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
March 8, 2016 (Site Visit 1)*

142. W -T1 -2b (Segment 3). Downstream end of Segment where water drains to CSP beneath farm lane crossing, facing downstream. Feature type is swale and flow condition is surface flow minimal.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

143. W -T1 -2b (Segment 3). Downstream end of Segment facing upstream. Feature is densely vegetated with wetland vegetation (cattails), tall grasses, and deciduous trees. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

144. W -T1 -2b (Segment 3). Small depression noted within vegetation, no water noted. Feature type is swale and flow condition is no surface water.



*Matrix Solutions Inc.
July 3, 2015 (Site Visit 3)*

145. W -T1 -2b (Segment 3). Dense wetland vegetation within feature. Feature type is swale and flow condition is no surface water. **Management Recommendation: Conservation (based on important riparian habitat)**

APPENDIX E

Updated Headwater Drainage Feature Summary Table
(Matrix Solutions Inc., April 2018)

Drainage Feature Segment	Segment Code	Step 1		Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
		Hydrology	Modifiers						
HT-2b-3c	S1	Contributing	Ag	Limited (code 3)	Contributing	Limited	Mitigation	Mitigation	Channel definition noted during HDF site visit on Jan 19 2017
HT-2b-3b	S1	Contributing	Ag	Limited (code 3)	Contributing	Limited	Mitigation	No Management	Higher flow than normally anticipated due to timing of first visit. Modified through agricultural usage. Feature could not be located on second visit.
HT-2b-3a	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Higher flow than normally anticipated due to timing of first visit. Modified through agricultural usage. Feature could not be located on second visit.
HT-2b-3	S1	Contributing	Ag	Valued (code 4)	Contributing	Limited	Mitigation	Mitigation	Larger feature. Presence of healthy vegetation on second visit indicative of wetter conditions later into the dry season.
HT-2b-2	S1	Contributing		Important (code 7)	Contributing	Valued	Conservation	Conservation	Management recommendation is "Conservation" due to "important" riparian vegetation consisting of wetland and scrubland.
	S2	Contributing		Valued (code 4)	Contributing	Limited	Mitigation	Conservation	Mitigation recommendation based on hydrology. Recommendation is increased to "Conservation" as a result of higher classification in upstream segment.
	S3	Contributing		Valued (code 4)	Contributing	Limited	Mitigation	No HDF recommendation, segment has been upgraded to 'watercourse'	Receives a "Mitigation" classification based on hydrology. Standing water at downstream end of segment (Site Visit #2), defined bed/banks through length of segment, and gravel substrates on the bed suggest that this is a permanent feature of higher importance. Segment is classified as a 'watercourse' consistent with segment downstream of Trafalgar Road.
HT-2b-4	S1	Limited or recharge	Ag	Important (code 7)	Contributing	Contributing	Conservation	Conservation	Management recommendation is "Conservation" due to "important" riparian vegetation consisting of wetland.
	S2	Limited or recharge	Ag	Valued (code 4)	Contributing	Contributing	Conservation	Conservation	Scored as Conservation due to upstream and section considered as Conservation
	S3	Limited or recharge	Ag	Limited (code 3)	Contributing	Contributing	Conservation	Conservation	Scored as Conservation due to upstream section considered as Conservation. The segment also has defined bed and banks approaching the Trafalgar Road culvert and gravel substrate suggesting higher value.
HT-2b-4b	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Based on hydrology, standing water at the first visit. Feature was appears to be cut through furrowing to help drain the fields in the spring.
HT-2b-4a	S1	Limited or recharge	Ag	Limited (code 3)	Contributing	Limited	No Management	No Management	Based on hydrology, standing water at the first visit. Feature was appears to be cut through furrowing to help drain the fields in the spring.

Drainage Feature Segment	Segment Code	Step 1 Hydrology	Modifiers	Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
E-T1-4	S1	Contributing		Limited (code 3)	Contributing	Limited	Mitigation	No HDF recommendation, segment has been upgraded to 'watercourse'	Management recommendation is "Mitigation" based on hydrology. Based on the amount of flow noted at Site Visit #1, historic aerial photos, and conditions upstream of the study area, the management recommendation has been increased to "Conservation". It is noted that upstream of the golf course the feature appears to be a defined watercourse based on a review of aerial photography. Modification by the golf course has made this feature difficult to assess fully. It is thought that with removal of the golf course this could potentially be a more significant feature than it currently appears to be, based on upstream conditions.
	S2	Valued		Important (code 5)	Valued	Contributing	Conservation	No HDF recommendation, segment has been upgraded to 'watercourse'	Management recommendation is "Conservation" due to surrounding riparian vegetation dominated by scrubland. Management recommendation is increased to "Protection" as a result of both defined bed and banks and standing water at Site Visit #2, suggesting more permanence and importance hydrologically.
HDF-1	S1	Important	Golf course ponds outlet at upstream end	Limited (Code 3)	Contributing	Valued	Protection	Conservation	Management recommendation is "Protection" based on "important" hydrology classification as a result of water during Site Visit #3. Terrestrial habitat is "valued" due to presence of tadpoles in isolated pool during Site Visit #3. Management recommendation is reduced to "Conservation" as the golf course ponds outlet to the feature and it is unclear how this impacts the natural hydrology of the feature.
	S2	Important		Limited (Code 3)	Contributing	Limited	Protection	Conservation	Management recommendation is "Protection" based on "important" hydrology classification as a result of water during Site Visit #3. Management recommendation is reduced to "Conservation" as the golf course ponds outlet to the feature and it is unclear how this impacts the natural hydrology of the feature.
HDF-2	S1	Important		Important (code 7)	Contributing	Valued	Protection	Protection	Management recommendation is "Protection" based on "important hydrology classification as a result of water noted during Jan 19 2017 site visit. Additionally ELC classification as SWM1-1 (White Cedar-Hardwood Mineral Mixed Swamp) can be considered wetland, resulting in important riparian and terrestrial.

Drainage Feature Segment	Segment Code	Step 1 Hydrology	Modifiers	Step 2 Riparian	Step 3 Fish Habitat	Step 4 Terrestrial Habitat	Protocol Management Recommendation	Final Management Recommendation	Notes/ Rationale
	S2	Contributing	Outlet from west to east pond	Limited (code 3)	Contributing	Contributing	Protection	Protection	Management recommendation is based on hydrology. This feature is a small swale that connects the west golf course pond to the east golf course pond; therefore, hydrology is a result of the pond water levels. Suggest reducing recommendation to "No Management". Increased to Protection due to protection in upstream segment
HDF-3	S1	Limited or recharge		Limited (code 3)	Contributing	Limited	No Management	No Management	Standing water at Site Visit #1, no management required.
HDF-4	S1	Contributing		Limited (code 3)	Contributing	Limited	Mitigation	No Management	Management recommendation of "Mitigation" is based on hydrology. Difficult to determine management due to potentially altered drainage on golf course, suggested that "No Management" recommendation.
HDF-4a	S1	Limited or recharge		Limited (code 3)	Contributing	Limited	No Management	No Management	Standing water at site visit 1, no management required.
W-T1-2b	S1	Contributing	Ag	Limited (code 3)	Contributing	Limited	Mitigation	Mitigation	Management recommendation of "Mitigation" based on hydrology.
	S2	Contributing*		Contributing* (code 2)	Contributing*	Limited*		Mitigation*	Management recommendation of "Mitigation" based on hydrology.
	S3	Contributing		Important (code 5)	Contributing	Contributing	Conservation	Conservation	Management recommendation of "Conservation" based on "important" riparian vegetation classification due to scrubland.

*Hydrology and fish habitat for W-T1-2b (S2) were based on the up- and down- stream classification, while riparian and terrestrial were based on a review of aerial photographs. Final management recommendation is preliminary based on a lack of field confirmation.