BUFFALO – RED RIVER WATERSHED DISTRICT

2023 Buffalo-Red River Watershed District Water Quality Report

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PROTECTING • MANAGING • EDUCATING

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Introduction

The Buffalo-Red River Watershed District (BRRWD) is a political subdivision of the State of Minnesota operating under Chapter 103D of Minnesota Statutes. BRRWD encompasses 1,786 square miles including portions of Clay, Becker, Otter Tail, and Wilkin Counties. Clay County makes up the largest portion of BRRWD at 45% land area, followed by Wilkin County at 31% land area, Becker County accounts for 16 % land area, and Otter Tail County accounts for 8 % land area. The Mission Statement of BRRWD is to alleviate flooding and to manage water resources of the District in a manner that best protects this valuable resource. BRRWD goals include reducing and alleviating damage caused by floodwaters, protecting and/or improving water quality of the surface and groundwater resources, and endeavoring to inform and educate residents about water and soil resource issues and the importance of protecting these crucial resources.

BRRWD supports the Red River Basin River Watch Program. The program provides direct, field-based experiential water quality opportunities for students and citizens to enhance watershed understanding and awareness. BRRWD partners with the International Water Institute (IWI), Barnesville High School, and RMB Environmental Laboratories to conduct water quality work and sampling. IWI is a nonprofit organization working to facilitate research, education, training, and information dissemination centered on the Red River of the North Basin (Red River). Barnesville High School has partnered with BRRWD since 2011, offering opportunities that intend to help students interact with hands-on water quality work in the field and to inform them about the importance of water within the District. BRRWD also partners with RMB Environmental Laboratories, an analytical laboratory whose mission is to improve our water resources and increase the community's health. RMB Labs helps collect these samples and test them at their Detroit Lakes, MN, office.

In 2023, water quality samples were taken at 33 separate sites from 15 tributaries within BRRWD boundaries. Tributaries and number of sites along those tributaries are shown in Exhibit No. 1 and are listed out as follows; Buffalo River (9), South Branch Buffalo River (5), Otter Tail River (3), Whisky Creek (3), Hay Creek (2), Stony Creek (2), Becker County Ditch No. 15 (1), Blue Eagle Lake (1), Deerhorn Creek (1), Unnamed Creek (1), Whiskey Creek (1), Wilkin-Otter Tail Judicial Ditch No. 2 (1), Wilkin County Ditch No. 3 (1), Wilkin County Ditch No. 31 (1), and Wolverton Creek (1). All data collected can be searched for and found at (MPCA Surface Water Monitoring Stations).

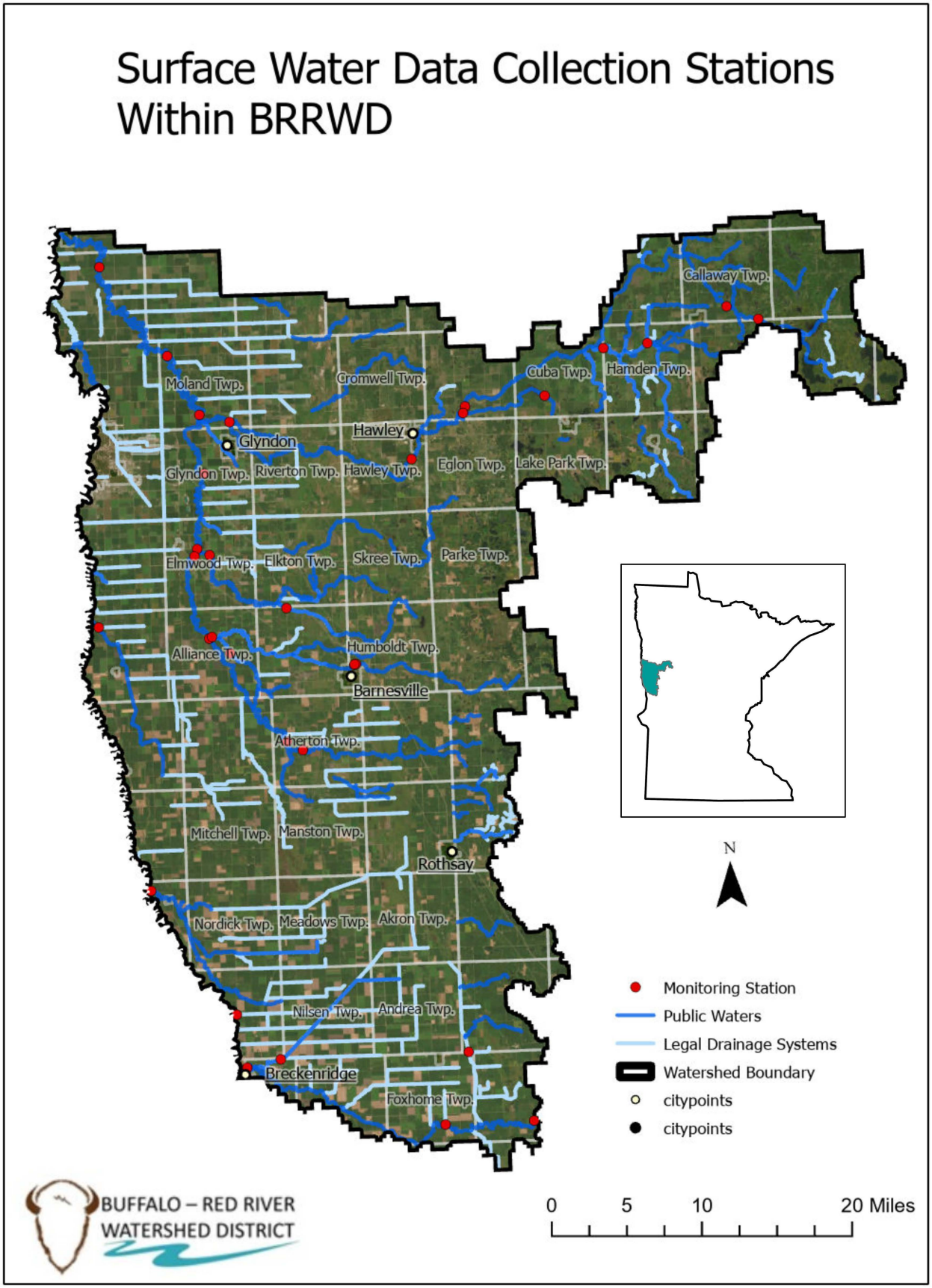

Exhibit No. 1. BRRWD boundary, rivers, ditches, and monitoring stations.

Sample Collection and Analytes Measured

Sample dates and number of samples collected varied from site to site. Samples were generally collected between April and October by IWI, Barnesville High School, and RMB Environmental Laboratories. All samples were tested for Ammonia Nitrogen, Total Phosphorous, Nitrate/Nitrite, Total Kjeldahl Nitrogen, Total Suspended Solids, and Escherichia Coli Bacteria. Several sites were also tested for Chlorophyll-a, Pheophytin Corrected. Samples were graphed and compared to water quality standards set by either the Minnesota Pollution Control Agency (MPCA) or the Environmental Protection Agency (EPA).

1. *Ammonia Nitrogen*

Ammonia Nitrogen (NH4+NH3) is the combination of Ionized Ammonium (NH4) and unionized Ammonium (NH3). Ammonia Nitrogen is important pollutant to monitor because the unionized form is highly toxic to fish and other aquatic creatures. Ammonia is commonly produced from wastes, fertilizers, and other natural processes. Maintaining the pH levels of water is important when monitoring Ammonia since the increase in pH favors an increase for the unionized toxic form. Agricultural runoff, manure application, septic seepage, and overflow from water impoundments are common ways Ammonia can enter a water body (EPA).

2. *Total Phosphorous*

Total Phosphorous (TP) is the measure of all dissolved and particulate forms of phosphorous. Phosphorous is commonly found in manure, organic debris such as branches, fallen leaves, and yard trimmings, and fertilizers used to boost the productivity of agricultural crops (IWI, 2021). Bank erosion during overland flooding also commonly contributes phosphorous into water bodies (USGS).

3. *Nitrate/Nitrite*

Nitrate/Nitrite as N (N+N) is the combination of Nitrate (NO3) and Nitrite (NO2). Nitrate is essential for plant growth and is commonly used in fertilizer in the agricultural industry. Nitrate is more commonly found than Nitrite, which means most of the N+N value consists of Nitrate. N+N finds its way into water bodies by runoff from agricultural fields treated with nitrogen fertilizer and manure (EPA).

4. *Total Kjeldahl Nitrogen*

Total Kjeldahl Nitrogen (TKN) is the sum of total organic nitrogen and total ammonia. Manure and sewer discharges can lead to increased levels of TKN (IWI, 2021).

5. *Total Suspended Solids*

Total Suspended Solids (TSS) are suspended particles that are not dissolved in water, including inorganic and organic materials larger than two microns in size that can be measured. In our region, common TSS comes from agricultural erosion, bank erosion and growth of algae (IWI, 2023).

6. *Escherichia Coli Bacteria*

While some strains of Escherichia Coli Bacteria (E. Coli) are harmless, other forms can cause adverse health effects to humans. E. Coli is prevalent within our rivers and streams and it is difficult to manage because it originates from the digestive tracts of animals using the water source (USGS). There are also naturally occurring forms of E. Coli in our watershed.

7. *Chlorophyll-a, Pheophytin Corrected*

Chlorophyll-a, Pheophytin Corrected (Chl-a) is the measure of amount of algae growing in a waterbody. Algae is a naturally occurring organism, however, waters containing large quantities of nutrients from fertilizers can have high concentrations of Chl-a, which can lead to excess amounts of algae (EPA). Large algae blooms can create dead zones in water, it can produce deadly toxins that are poisonous to humans and animals, and it can raise costs for drinking water (EPA).

Ammonia Nitrogen, Total Phosphorous, Nitrate/Nitrite, Total Kjeldahl Nitrogen, and Total Suspended Solids were measured in milligrams per liter (mg/L). E. Coli was measured in most probable number per 100 milliliters (MPN/100mL) and Chorophyll-a was measured in micrograms per liter (ug/L). Some of the above listed analytes had concentrations that were very low, which makes an accurate reading difficult. In those cases, a less than symbol (<) was used when an exact value was not determined. Analytes and their respective concentrations that had this occur include E. Coli (<1 MPN/100mL), Ammonia (<.02 mg/L), Nitrate/Nitrite (<.03 mg/L), and some Total Suspended Solids had a value of (<2 mg/L). It is important to note that while the graphs use lines of best fit, continuous recording is not present at any of our sites. That is, the lines between the collection dates may not be 100% accurate because samples were only taken roughly once a month.

Planning Regions

The Buffalo-Red River Watershed Comprehensive Watershed Management Plan (CWMP), splits BRRWD into nine Planning Regions. Planning regions are based on three distinguishing characteristics: ecoregions, hydrology, and land use. The planning regions include Central, Lakes, Mainstem, Moorhead, Northern, Otter Tail, Southern, Upper Red, and Western. Planning regions can be found on the interactive map on the BRRWD website. Once the map is opened, a layer labeled "planning regions" should be available for viewing under the layer list.

1. *Central*

The Central planning region is the largest planning region with 326 square miles (18% of the District). The communities of Barnesville, Rollag, and Downer are located in this region. The Central planning region is located along a beach ridge of the historical Glacial Lake Agassiz. Topography of this landscape varies from undulating in the east to flat in the west. The South Branch Buffalo River, Stony Creek, and Whisky Creek are the main watercourses in the Central planning region. Agriculture is the predominant land use at 68.5%. The Central planning region also had the most sampling stations (11).

2. *Lakes*

The Lakes planning region covers the farthest northeastern part of the District spanning 106 square miles (6% of the District). The topography of the land is undulating with many small lakes and wetlands located throughout. The headwaters of the Buffalo River are located within this region. The only region where the primary land use is not agriculture is the Lakes planning region, with deciduous forest being the predominant use (40.1%). Only two (2) out of the 34 sampling stations were within the Lakes planning region.

3. *Mainstem*

The Mainstem planning region is the second largest region with an area of 304 square miles (17% of the District). The communities of Callaway, Audubon, Lake Park, Hawley, and Glyndon are located in this region. Topography is undulating to the east, becoming flatter to the west. Becker County Ditch No. 15, Hay Creek and a large portion of the Buffalo River are the main watercourses of this region. The predominant land use is agriculture at 67.3%. There are seven (7) sampling stations in the Mainstem planning region.

4. *Moorhead*

The Moorhead planning region is the smallest of the nine planning regions at only 63 square miles (3% of the District). Topography of the land is flat, with the Red River making the western border of this region. While the cities of Moorhead and Dilworth are within the planning region, agriculture is the most common land use at 65.4% of the land area is in agricultural production. There are no sampling stations within the Moorhead planning region.

5. *Northern*

The Northern planning region is located in the northwestern part of the District encompassing 225 square miles (13% of the District). The communities of Georgetown, Kragnes, and Hitterdahl are located in this planning region. Topography of the land is flat. The Buffalo River is the main watercourse in this planning region. This main land use is agriculture with 85% of the land being farmed. The Northern planning region has three (3) monitoring stations.

6. *Otter Tail*

The Otter Tail planning region is the farthest south planning region in the District, with an area of 178 square miles (10% of the District). The communities of Foxhome and a portion of Breckenridge are located in this planning region. Topography of this region is undulating in the east, gradually becoming flatter towards the west. Orwell Dam and the lower reaches of the Otter Tail River, to the confluence of the Red River, are located within this region. Land use is predominantly agriculture at 86.6% of the land area. There are five (5) monitoring stations in this region.

7. *Southern*

The Southern Planning regions is located between the Central and Upper Red planning regions. The Southern planning region is 175 square miles in size (10% of the District). This planning region includes Manston Slough and Rothsay Wildlife Management Area. Topography is undulating to the east, and flat to the west. Headwaters of the South Branch Buffalo River are within this planning region, along with Deerhorn Creek. The predominant land use in the Southern planning region is agricultural land at 77.4% of the land area. There are two (2) monitoring stations in the Southern planning region.

8. *Upper Red*

The Upper Red planning region is 244 square miles in size (14% of the District). Topography is undulating to the east, and flat to the west. The communities of Kent and Rothsay are located within this planning region. The Red River forms the western border of this planning region and includes Whiskey Creek and Wilkin County Ditch No. 31. Agriculture is the predominant land use, with 87% of the lands in agricultural production. There are two monitoring stations in the Upper Red planning region.

9. *Western*

The Western planning region has an area of 165 square miles (9% of the District) including the communities of Wolverton, Comstock, and Sabin. The Red River forms the western border of this region with topography of the land being flat with very few wetlands. Agriculture makes up most of the land use with 92.8% in agricultural production. There is only one monitoring station within this region, located on Wolverton Creek.

Sites and Stations

1. *Buffalo River*

The Buffalo River is the longest stream within BRRWD. BRRWD has nine (9) sampling stations along the Buffalo River: three in Becker County and six in Clay County. The Buffalo River meanders generally west, starting north of Rochert and running through 16 townships before depositing into the Red River northwest of Georgetown. The Buffalo River runs through Lakes, Mainstem, and Northern planning regions. Stations listed below will start with an S, followed by a six-digit code.

a) S007-457: Located north of Richwood where the Buffalo River crosses underneath Somdahl Road, S007-457 is the farthest upstream sampling station along the Buffalo River and is located within the Lakes planning region.

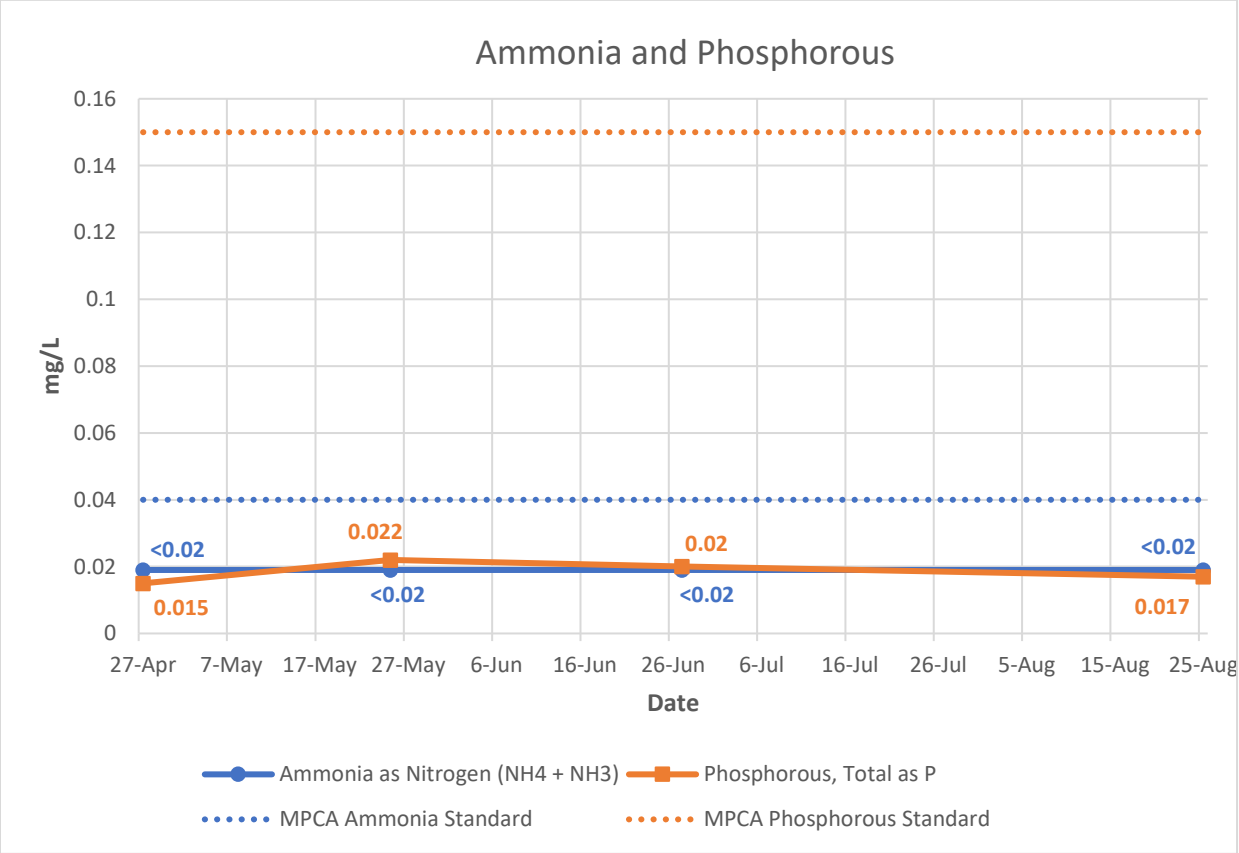

Figure 1. Ammonia and Phosphorous samples collected at S007-457.

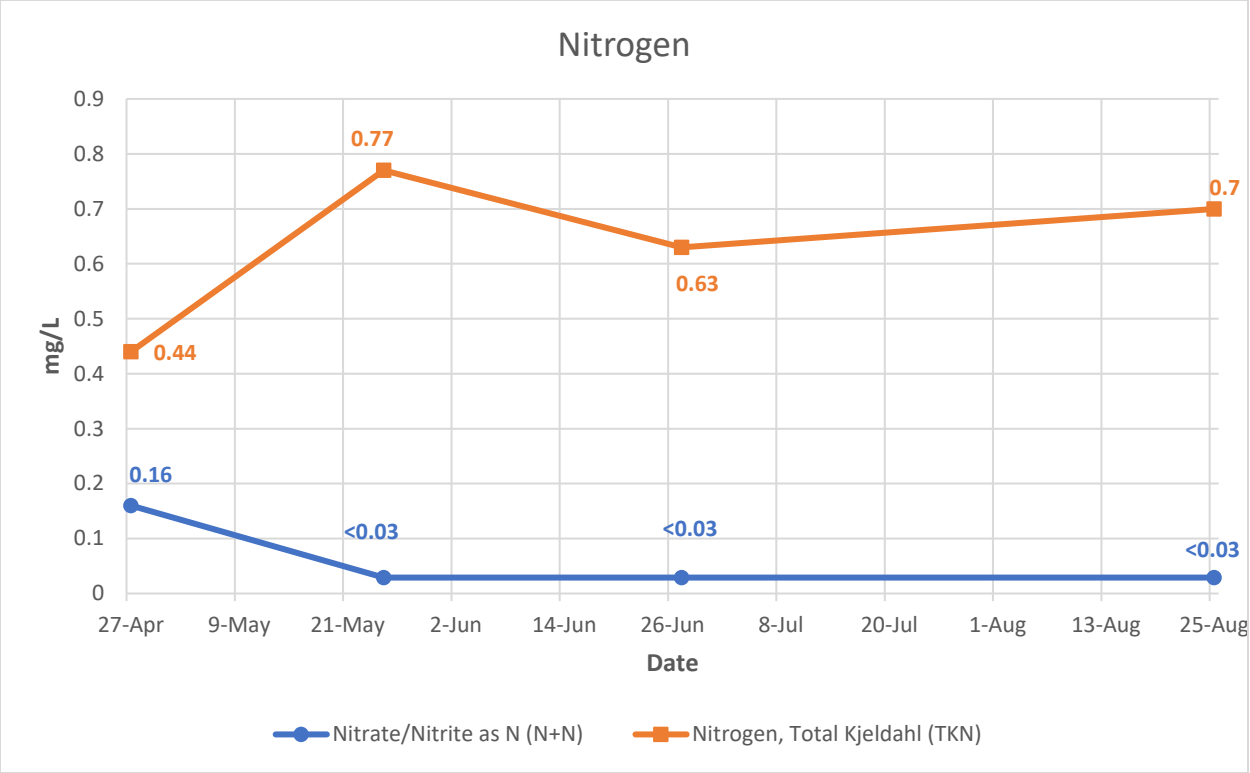

Figure 2. Nitrogen samples collected at S007-457 (MPCA and EPA standards are 10 mg/L)

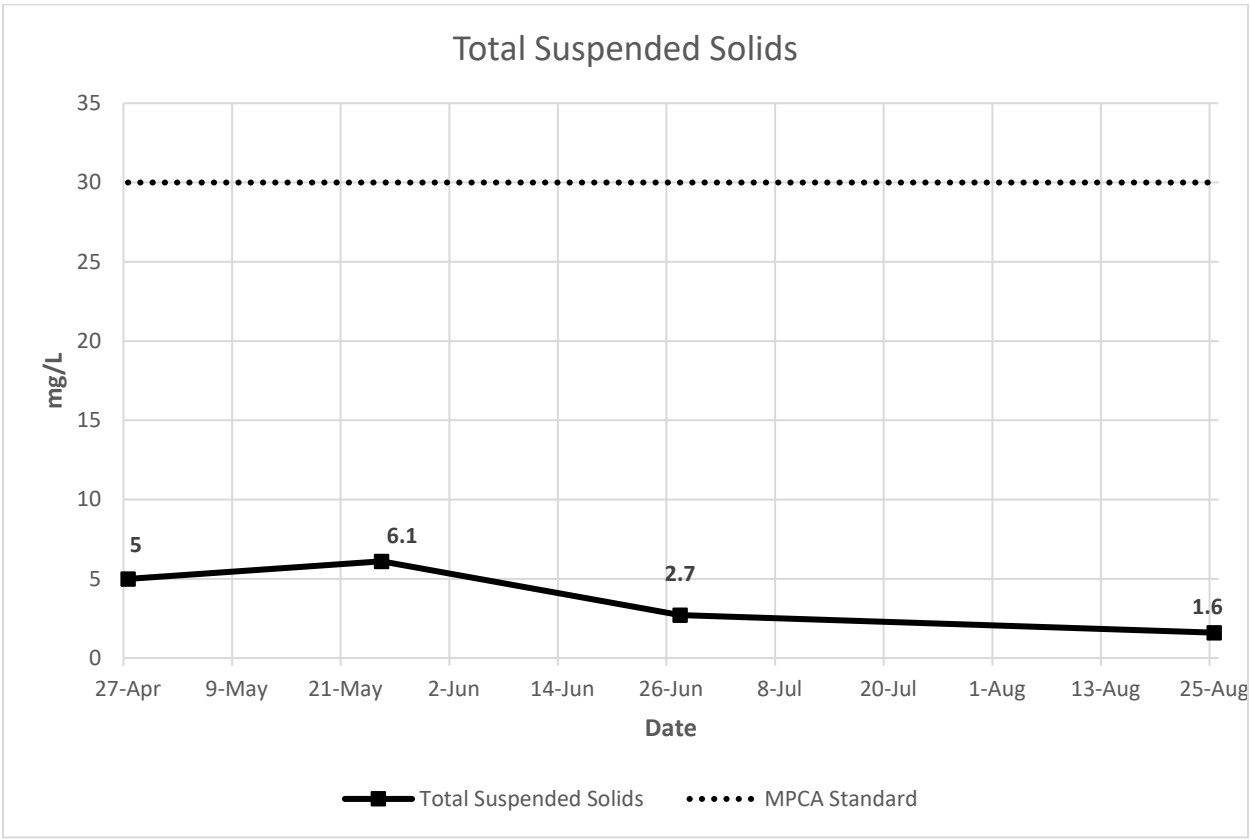

Figure 3. Total Suspended Solids samples collected at S007-457.

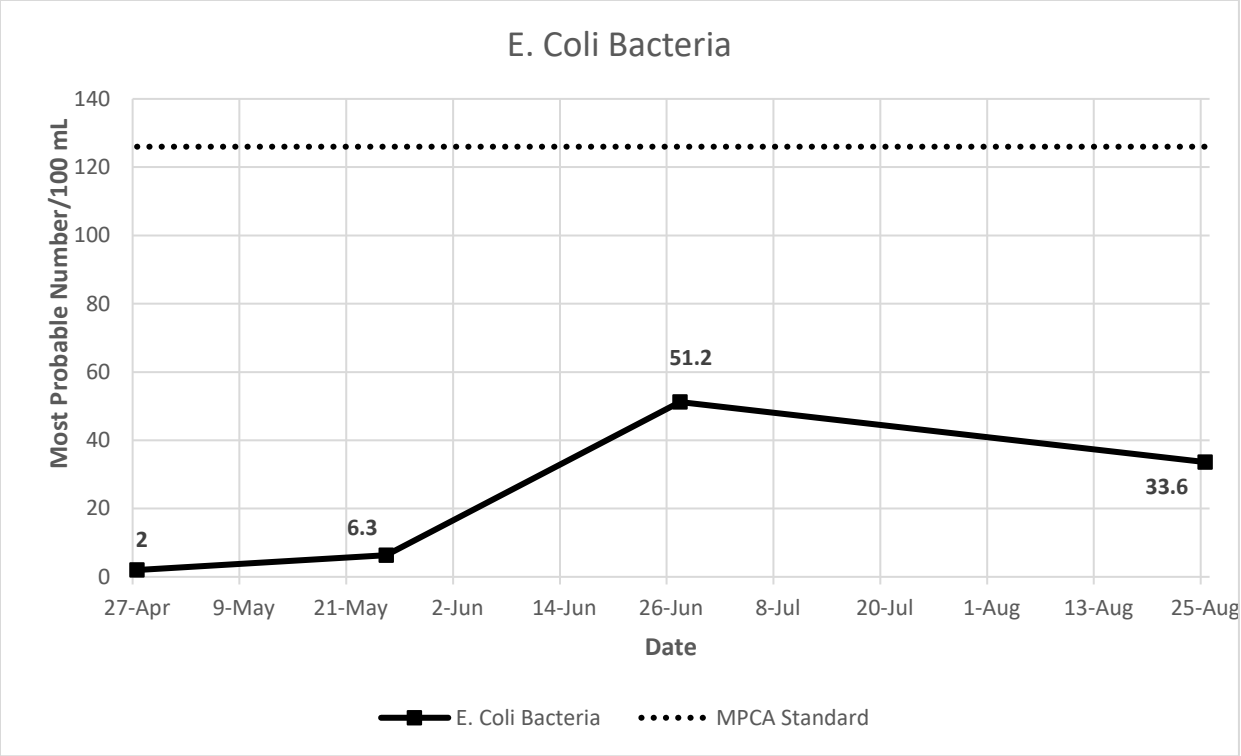

Figure 4. E. Coli Bacteria samples collected at S007-457.

b) <u>S004-105:</u> Located east of Callaway within the Lakes planning region, S004-105 is sampled as the Buffalo River crosses underneath Becker County Highway 14.

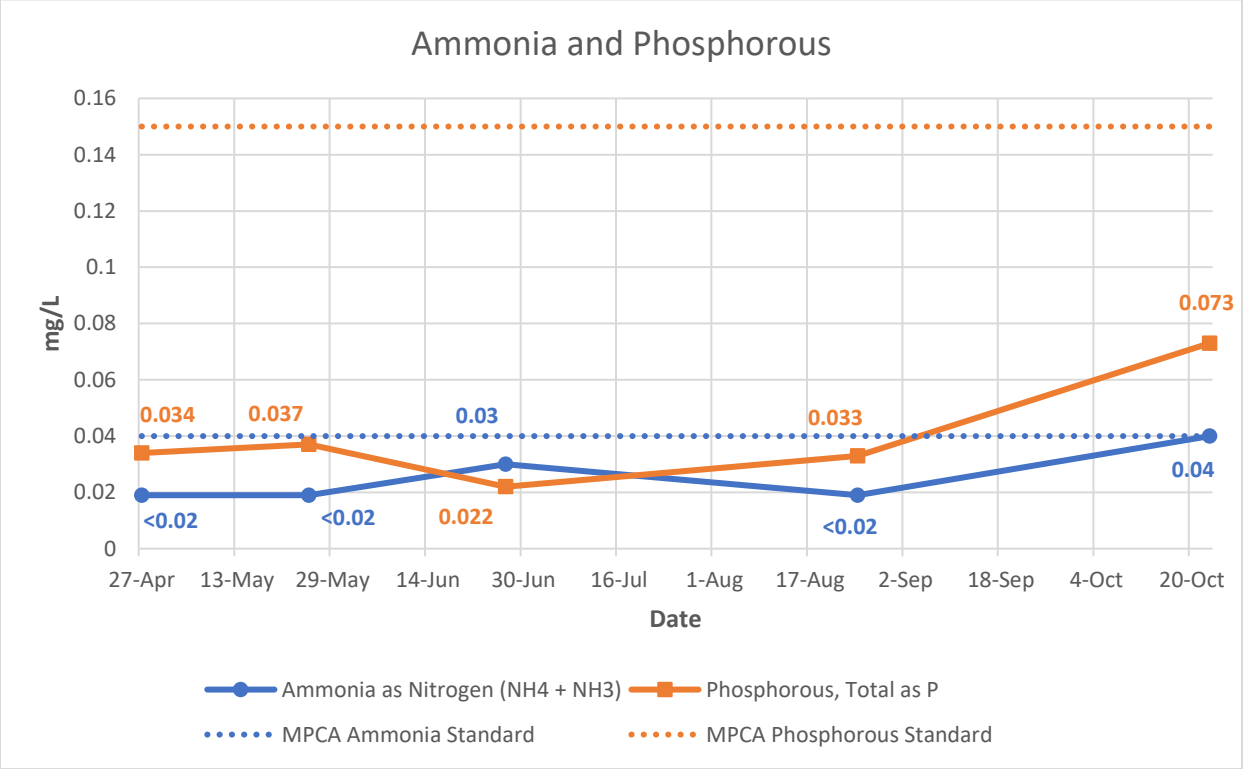

Figure 5. Ammonia and Phosphorous samples collected at S004-105.

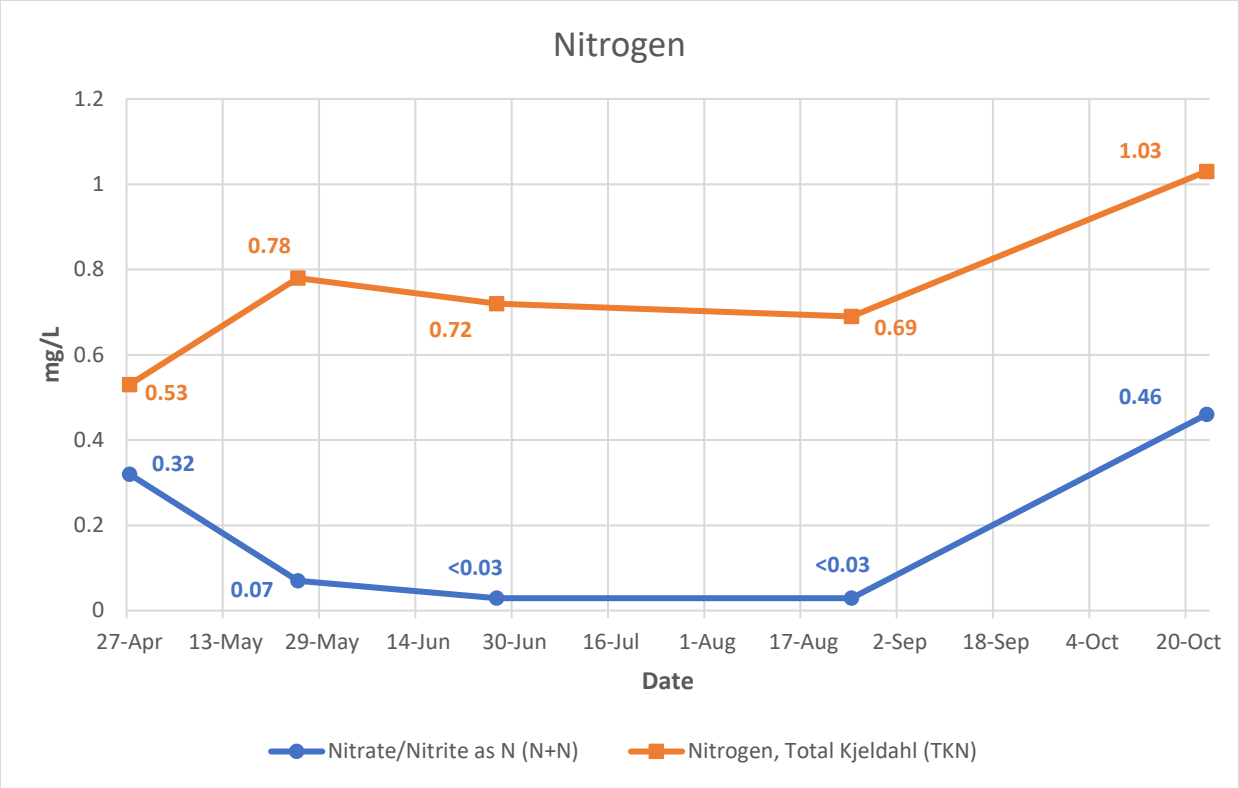

Figure 6. Nitrogen samples collected at S004-105 (MPCA and EPA standards are (10 mg/L).

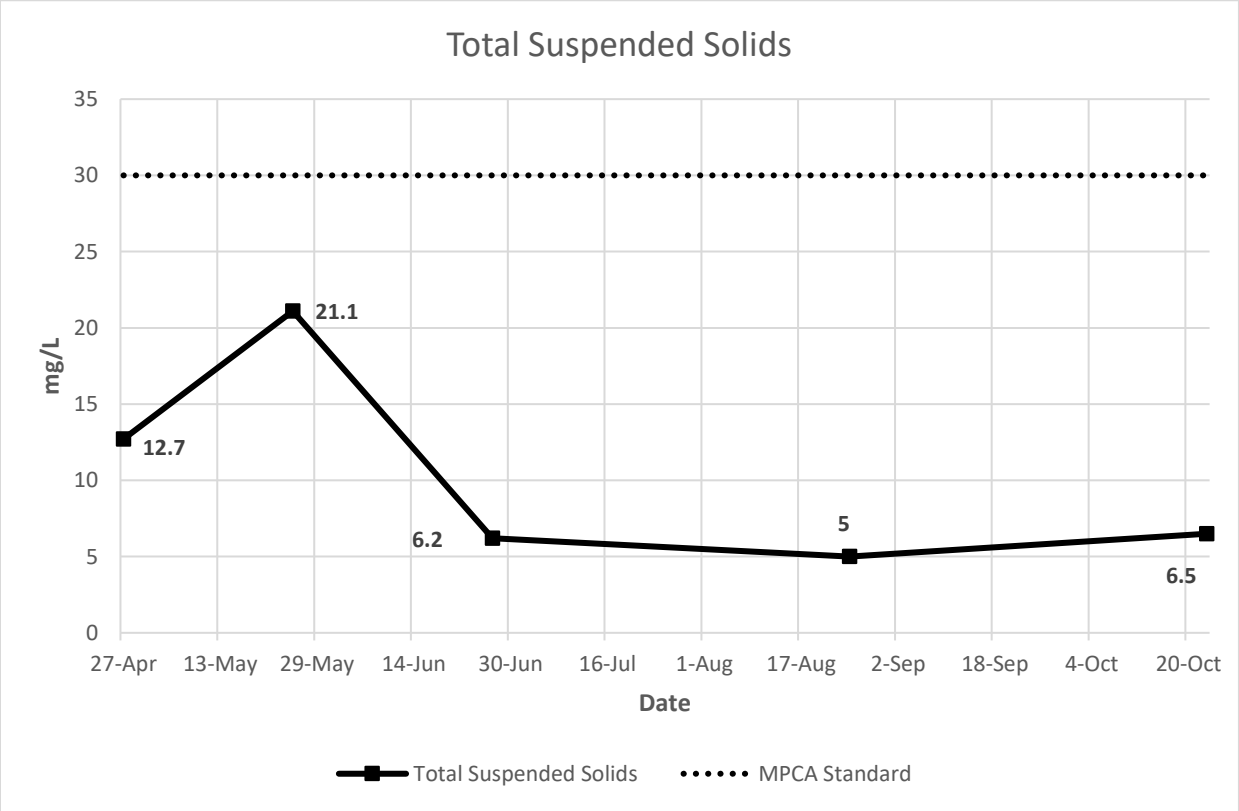

Figure 7. Total Suspended Solids collected at S004-105.

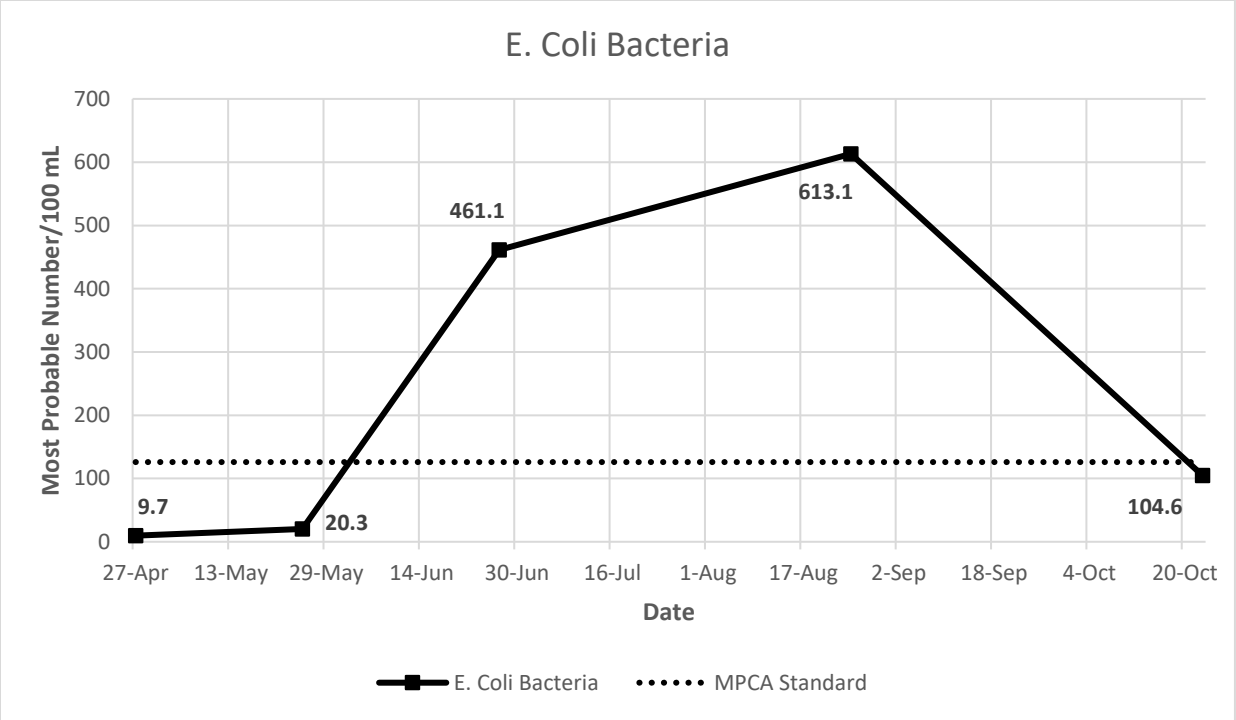

Figure 8. E. Coli Bacteria samples collected at S004-105.

c) <u>S004-145:</u> Located between Sections 11 and 12 of Cuba Township in the Mainstem planning region, S004-145 is located where the Buffalo River crosses underneath Becker County Highway 9.

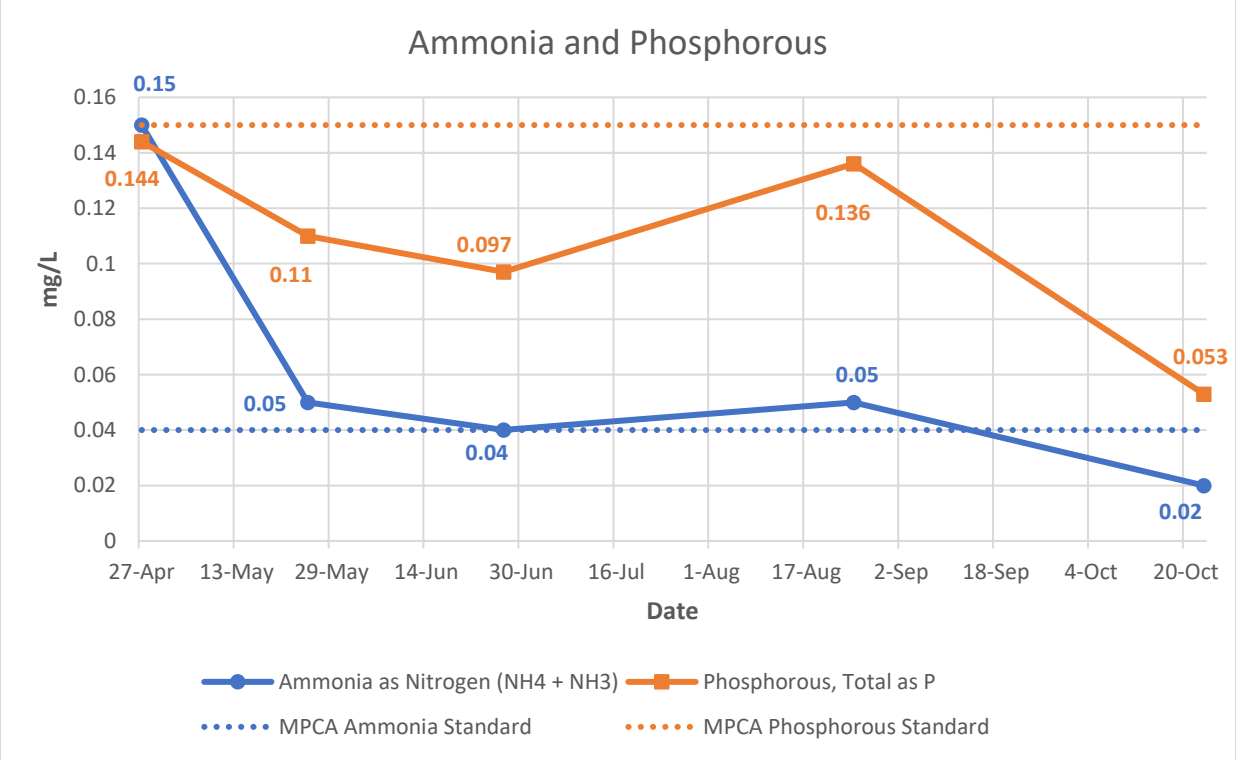

Figure 9. Ammonia and Phosphorous samples collected at S004-145.

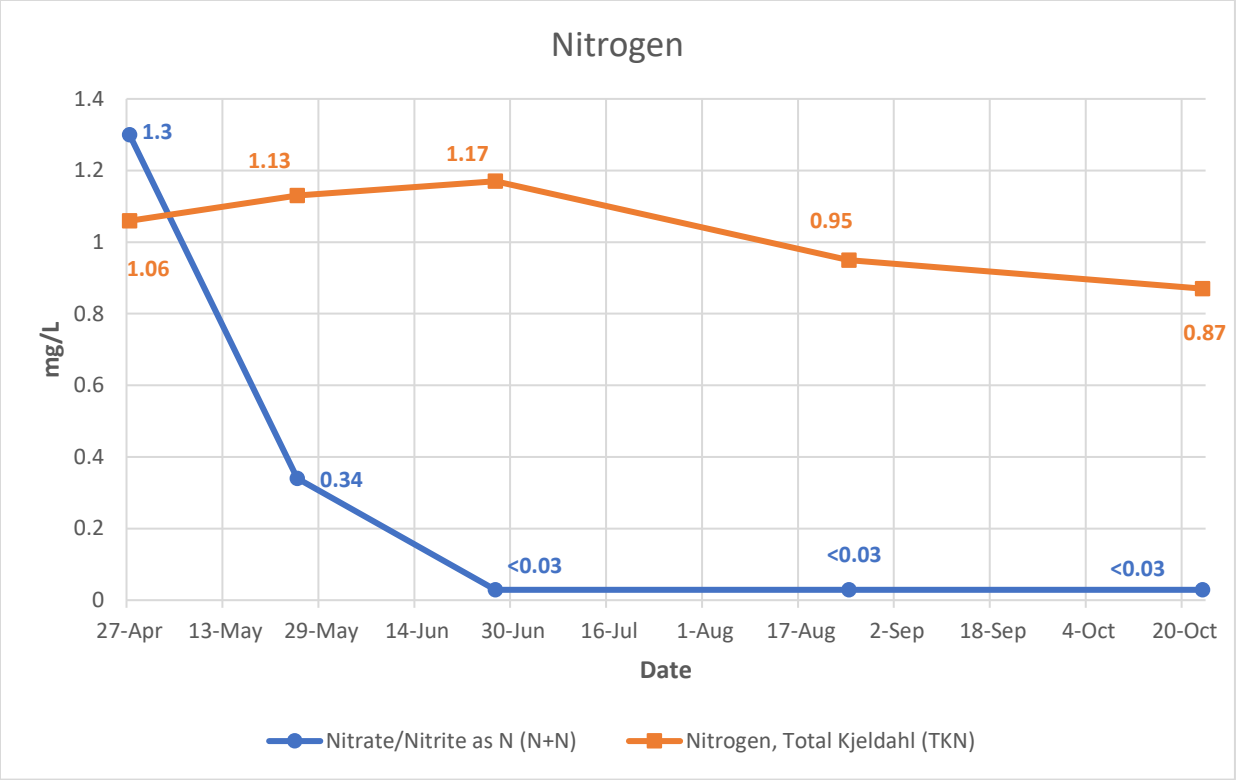

Figure 10. Nitrogen samples collected at S004-145 (MPCA and EPA standards are 10 mg/L)

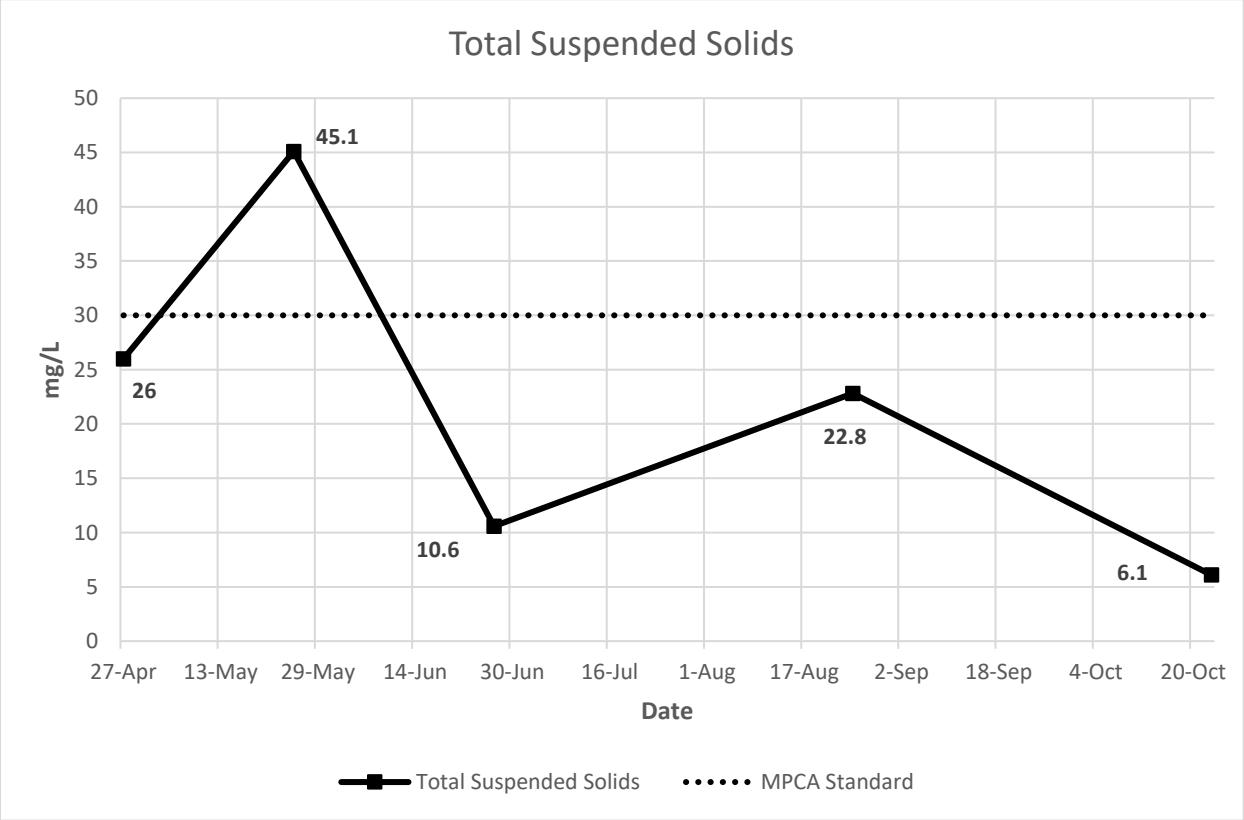

Figure 11. Total Suspended Solids samples collected at S004-145.

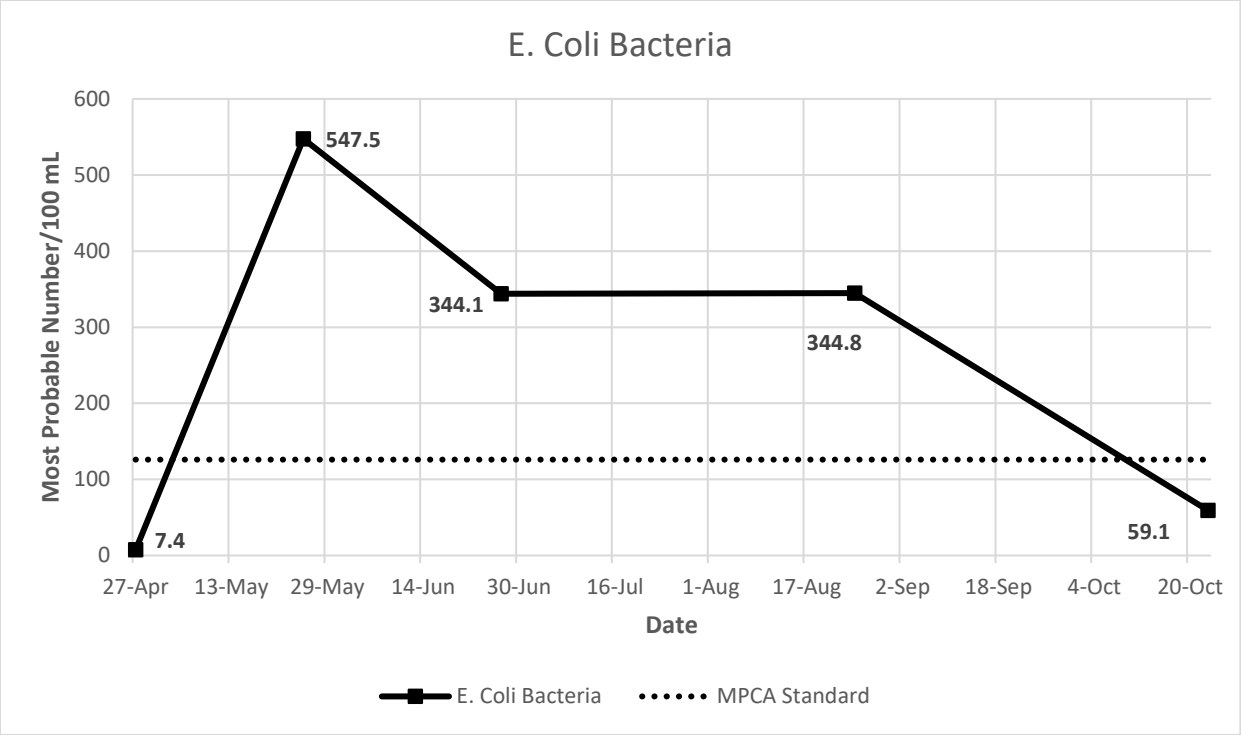

Figure 12. E. Coli Bacteria samples collected at S004-145.

d) <u>S003-155:</u> Located within the Mainstem planning region, S003-155 is located north of Winnipeg Junction, before the Buffalo River goes underneath 28th Ave N in Highland Grove Township.

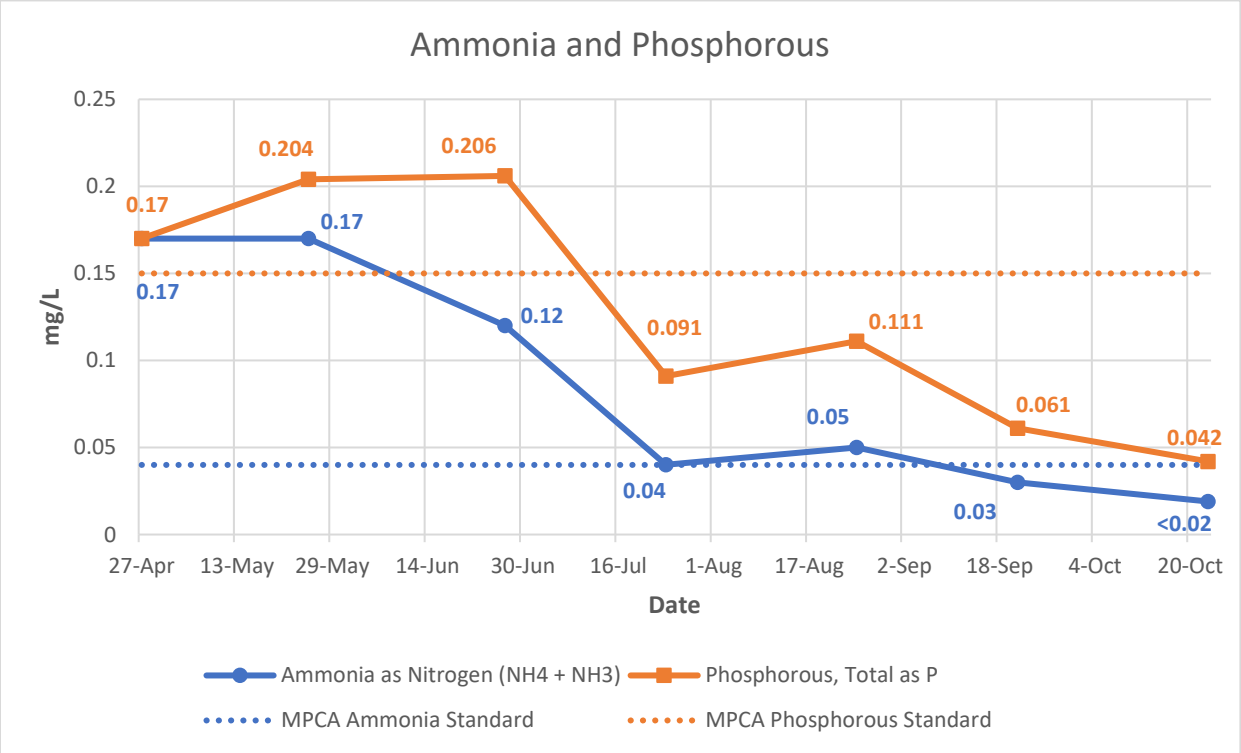

Figure 13. Ammonia and Phosphorous samples collected at S003-155.

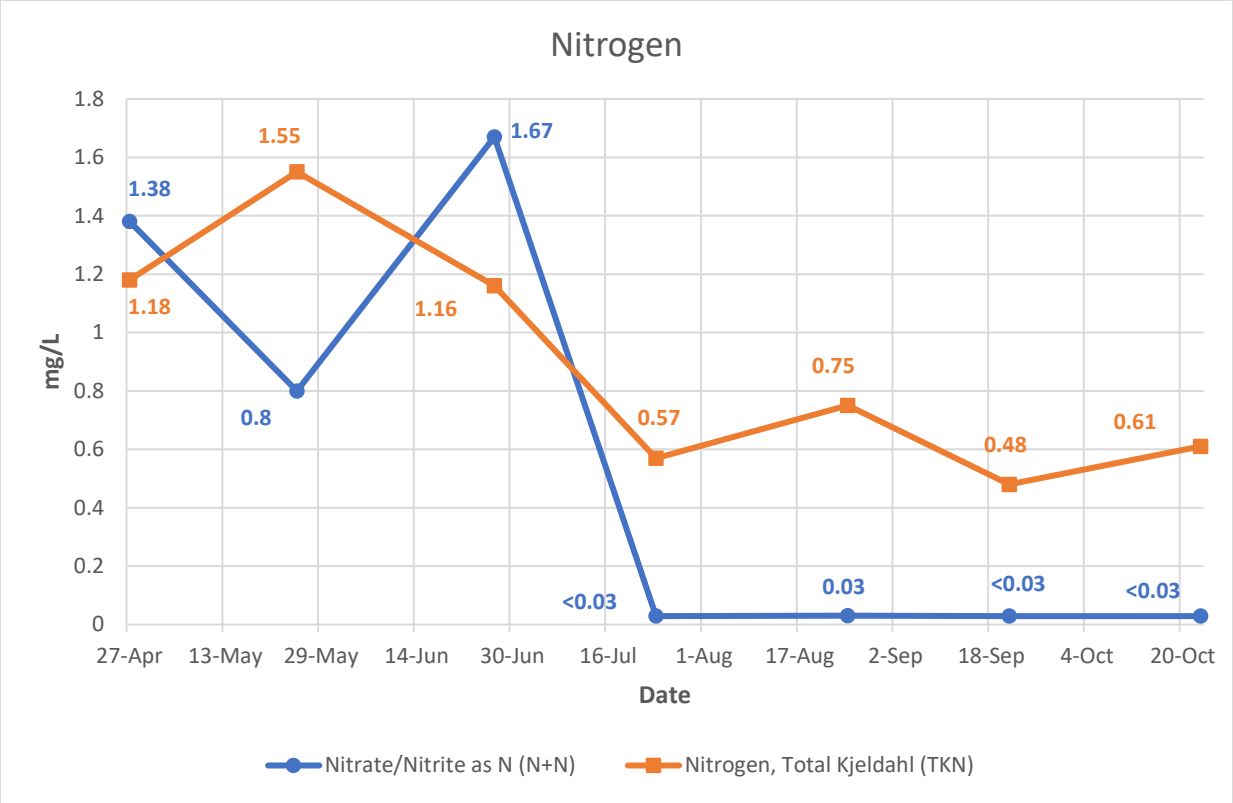

Figure 14. Nitrogen samples collected at S003-155 (MPCA and EPA standards are 10 mg/L)

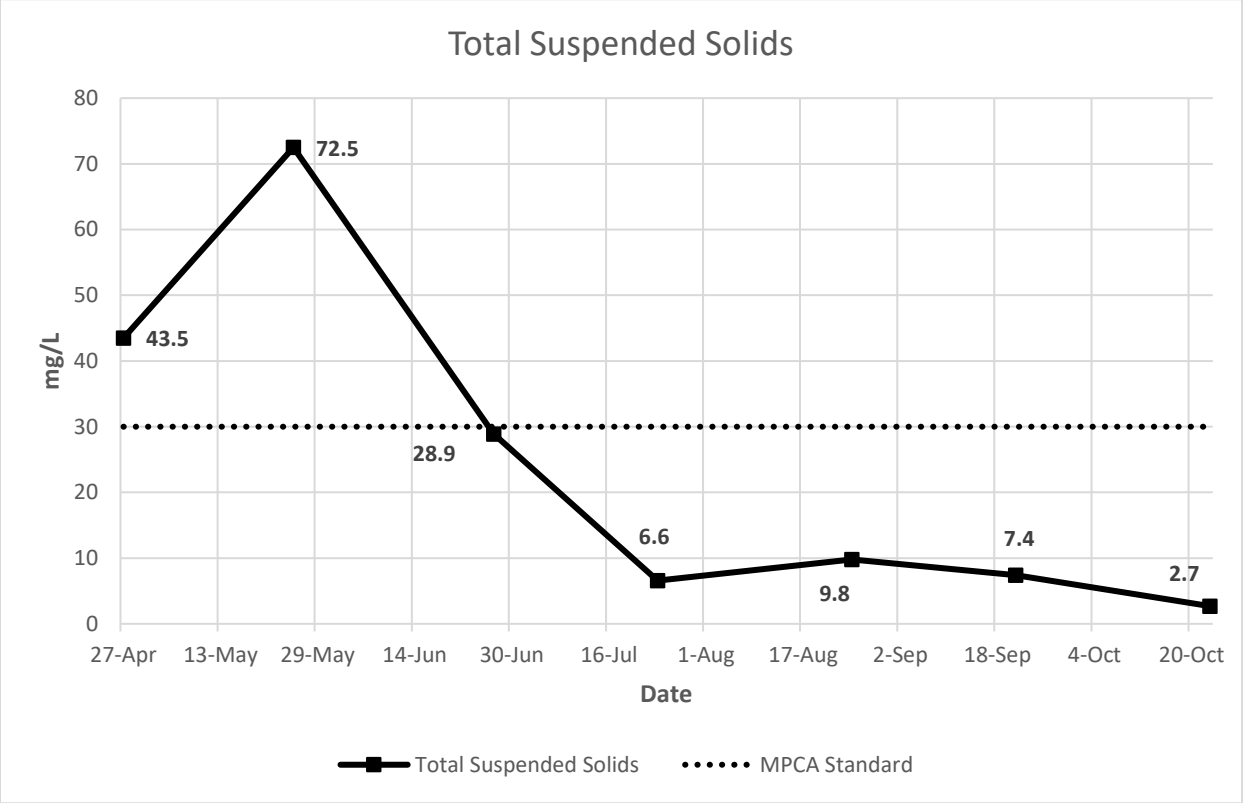

Figure 15. Total Suspended Solids collected at S003-155.

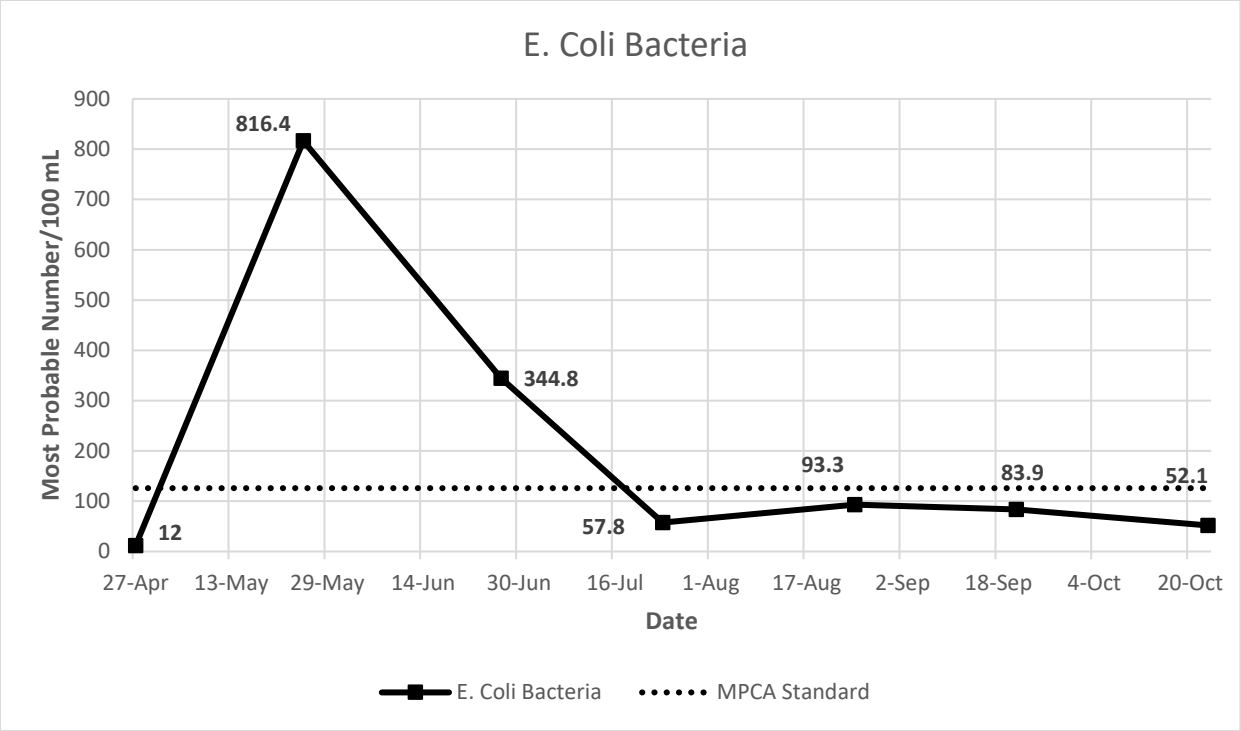

Figure 16. E. Coli Bacteria samples collected at S003-155.

e) <u>S003-152:</u> Located south of Hawley, S003-152 in the Mainstem planning region along the east side of Clay County Highway 31.

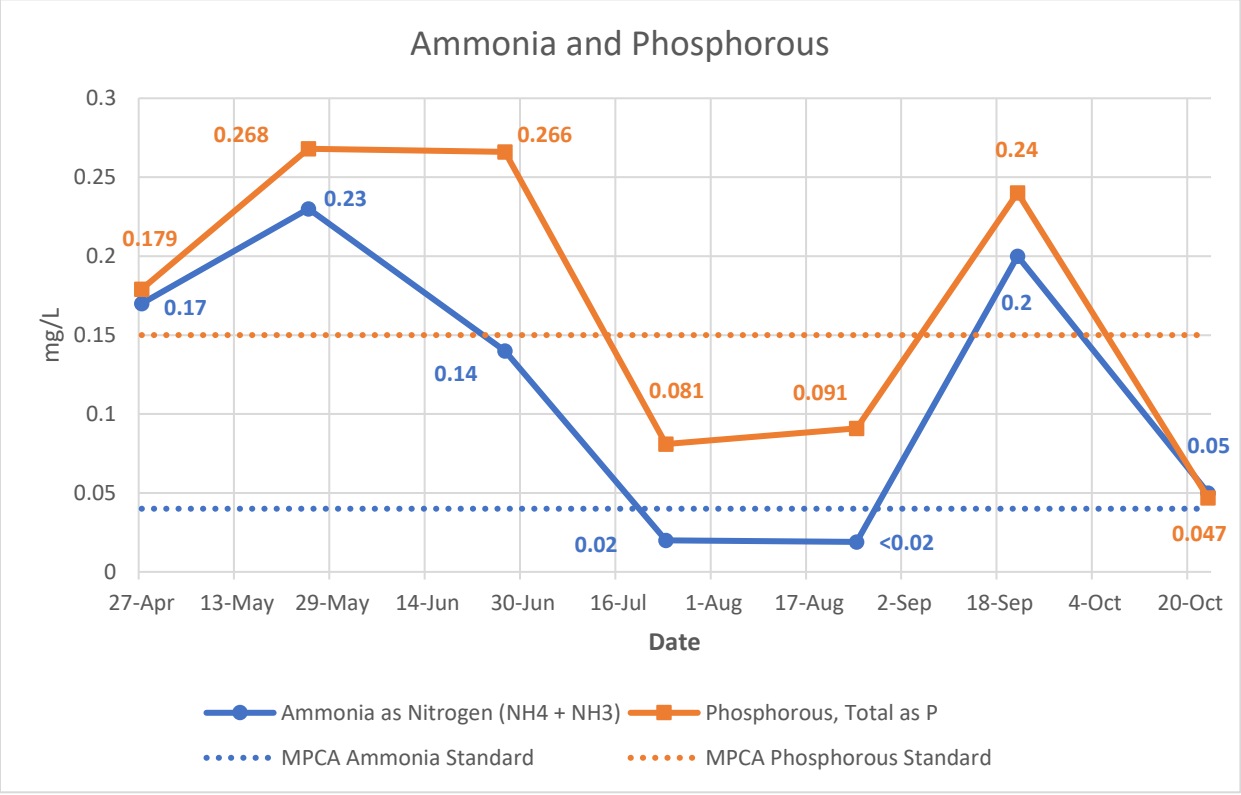

Figure 17. Ammonia and Phosphorous samples collected at S003-152.

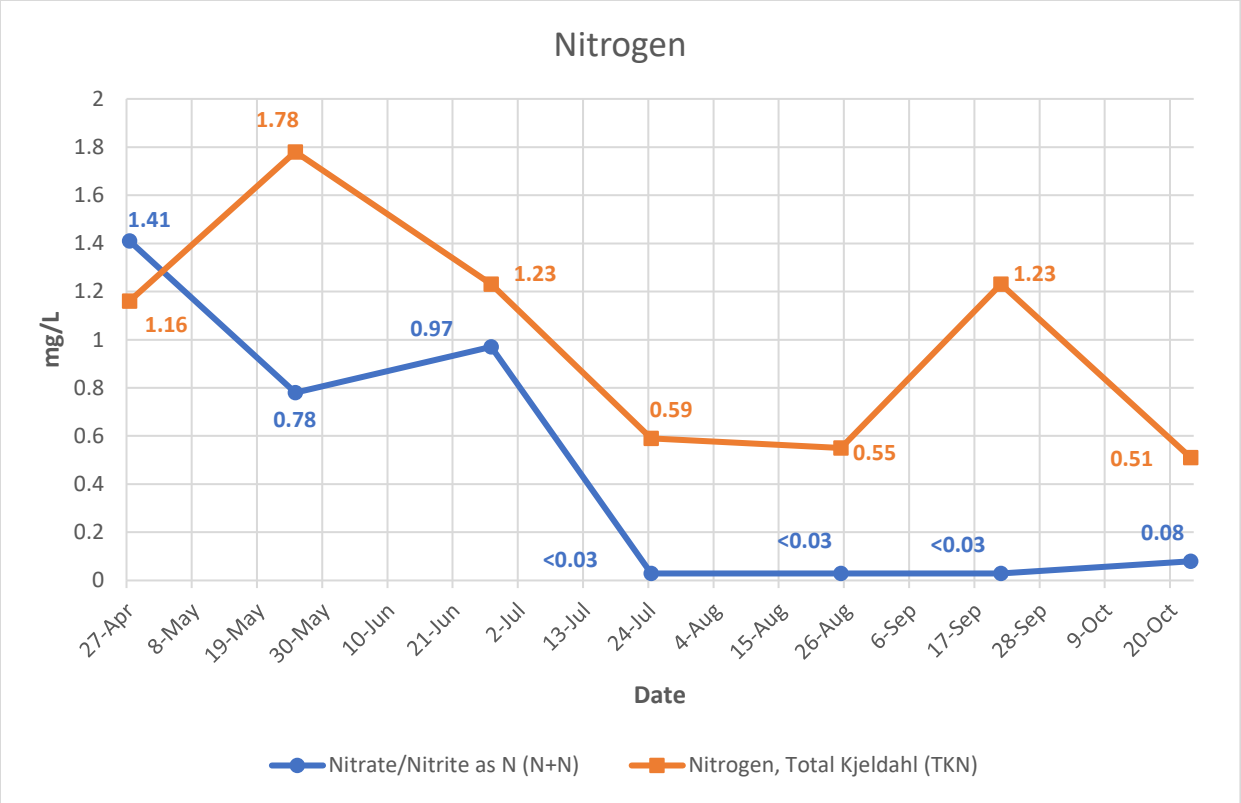

Figure 18. Nitrogen samples collected at S003-152 (MPCA and EPA standards are 10 mg/L).

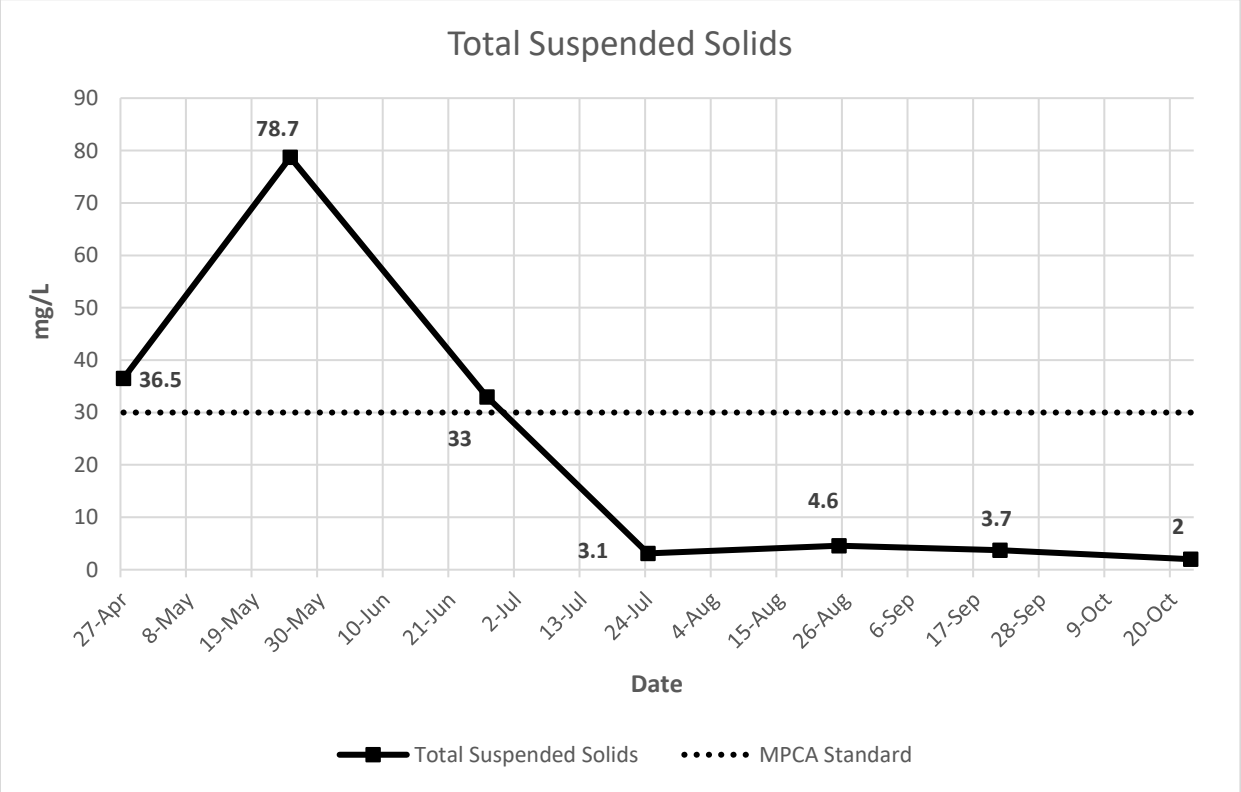

Figure 19. Total Suspended Solids collected at S003-152.

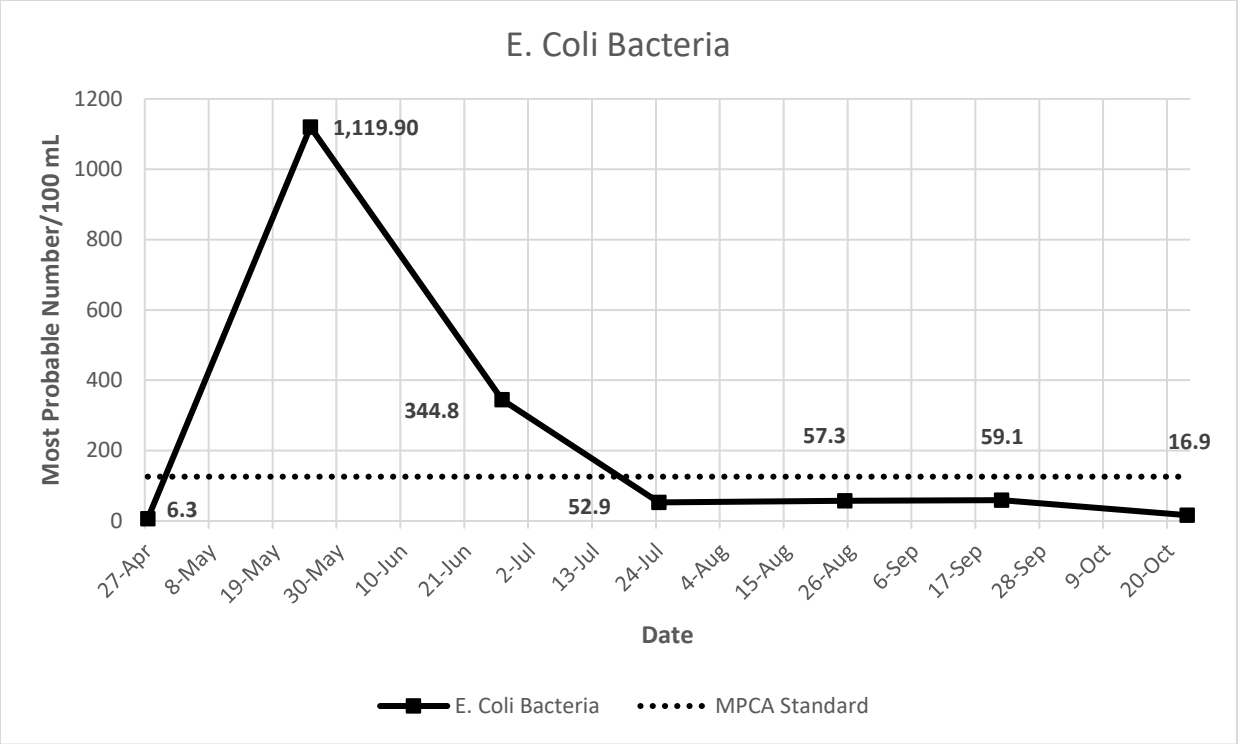

Figure 20. E. Coli Bacteria samples collected at S003-152.

f) <u>S007-586:</u> Located north of Glyndon along the east side of Clay County Highway 19, S007-586 is within the Mainstem planning region and is the farthest downstream sampling station along the Buffalo River.

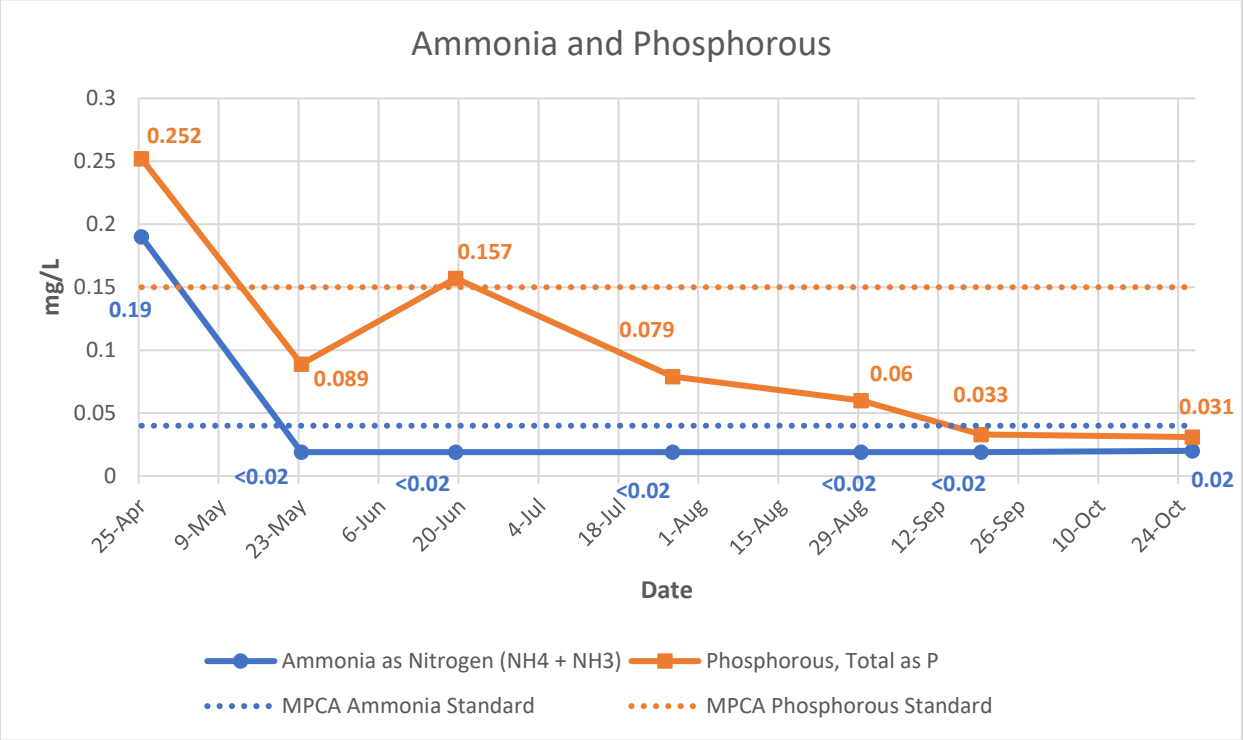

Figure 21. Ammonia and Phosphorous samples collected at S007-586.

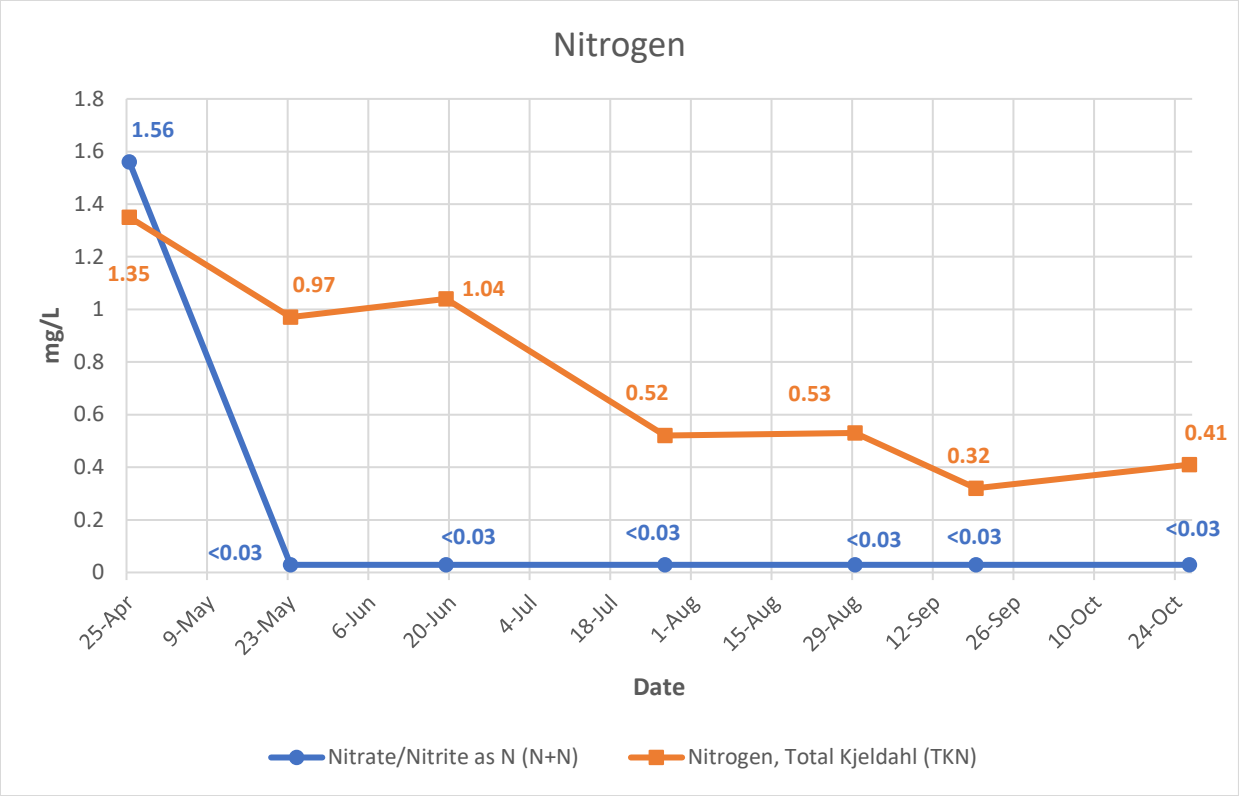

Figure 22. Nitrogen samples collected at S007-586 (MPCA and EPA standards are 10 mg/L).

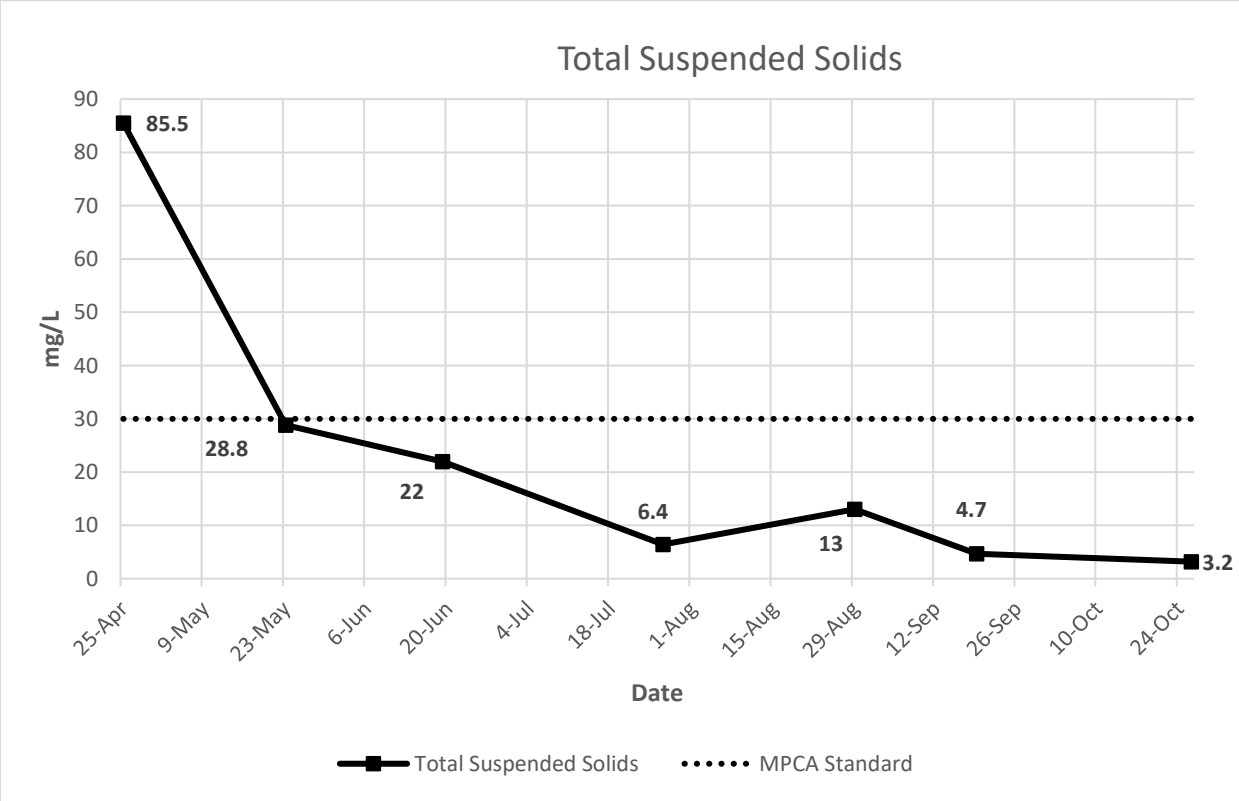

Figure 23. Total Suspended Solids samples collected at S007-586.

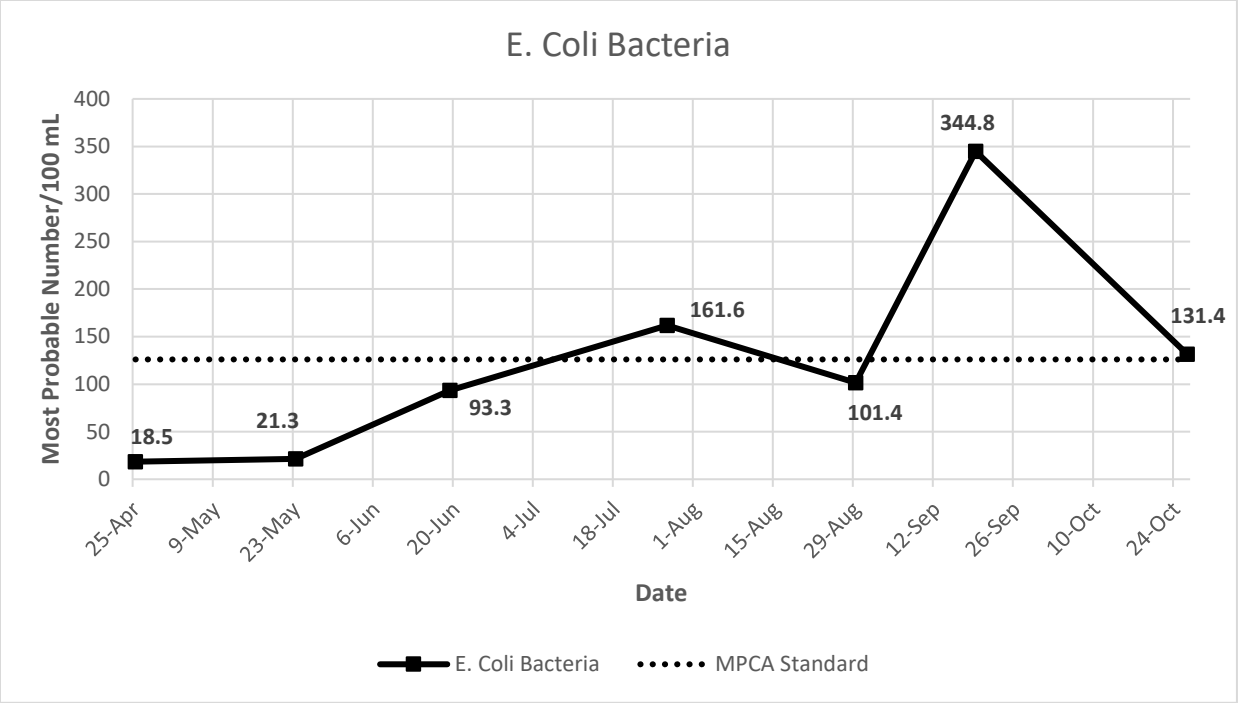

Figure 24. E. Coli Bacteria samples collected at S007-586.

g) <u>S003-693:</u> Located 2 miles north between Glyndon and Dilworth along 28th Ave N, S003-693 is in the Northern planning region and is the furthest upstream station along the Buffalo River.

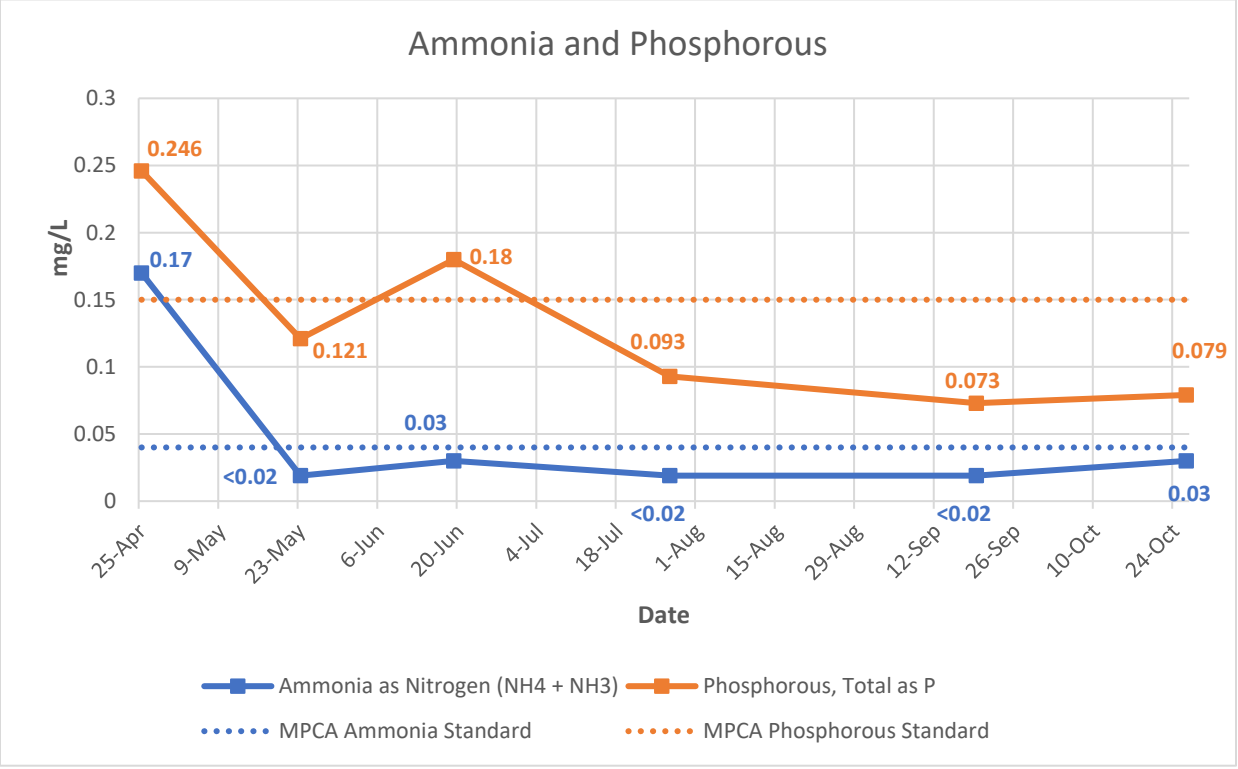

Figure 25. Ammonia and Phosphorous samples collected at S003-693.

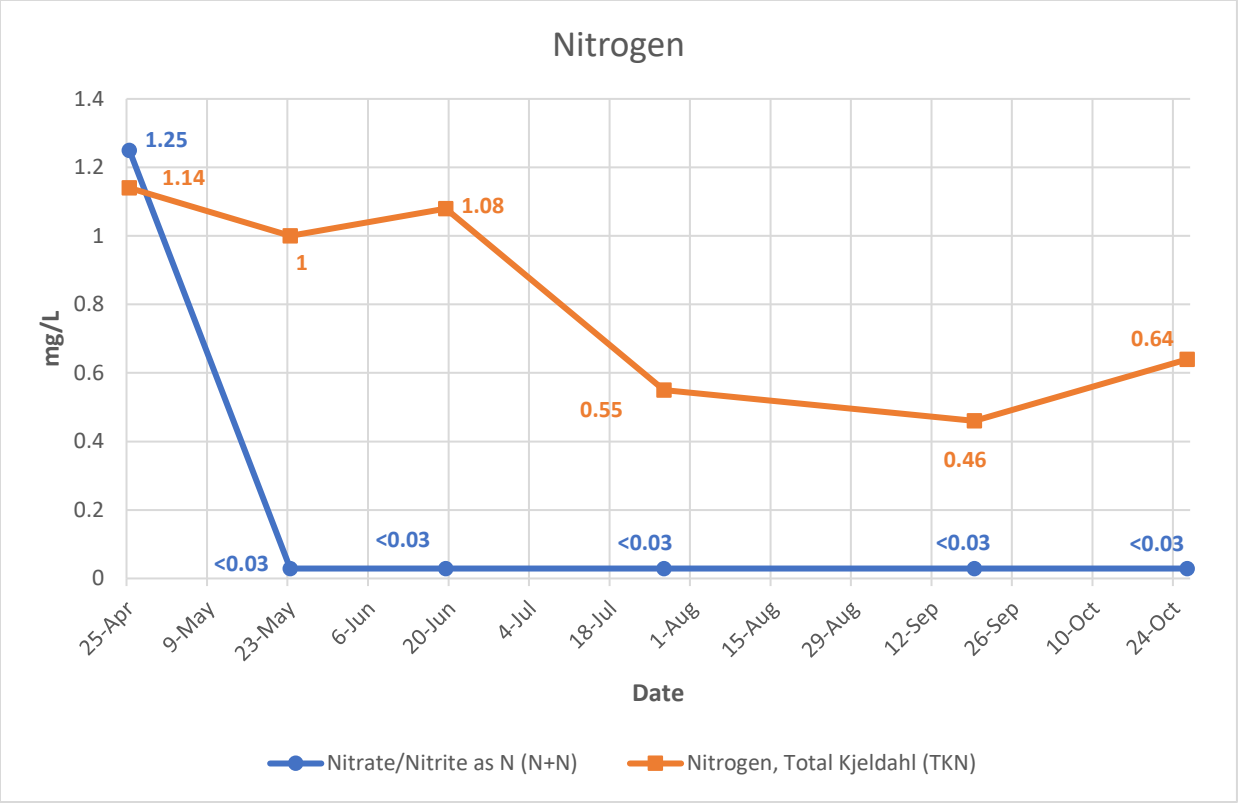

Figure 26. Nitrogen samples collected at S003-693 (MPCA and EPA standards are 10 mg/L)

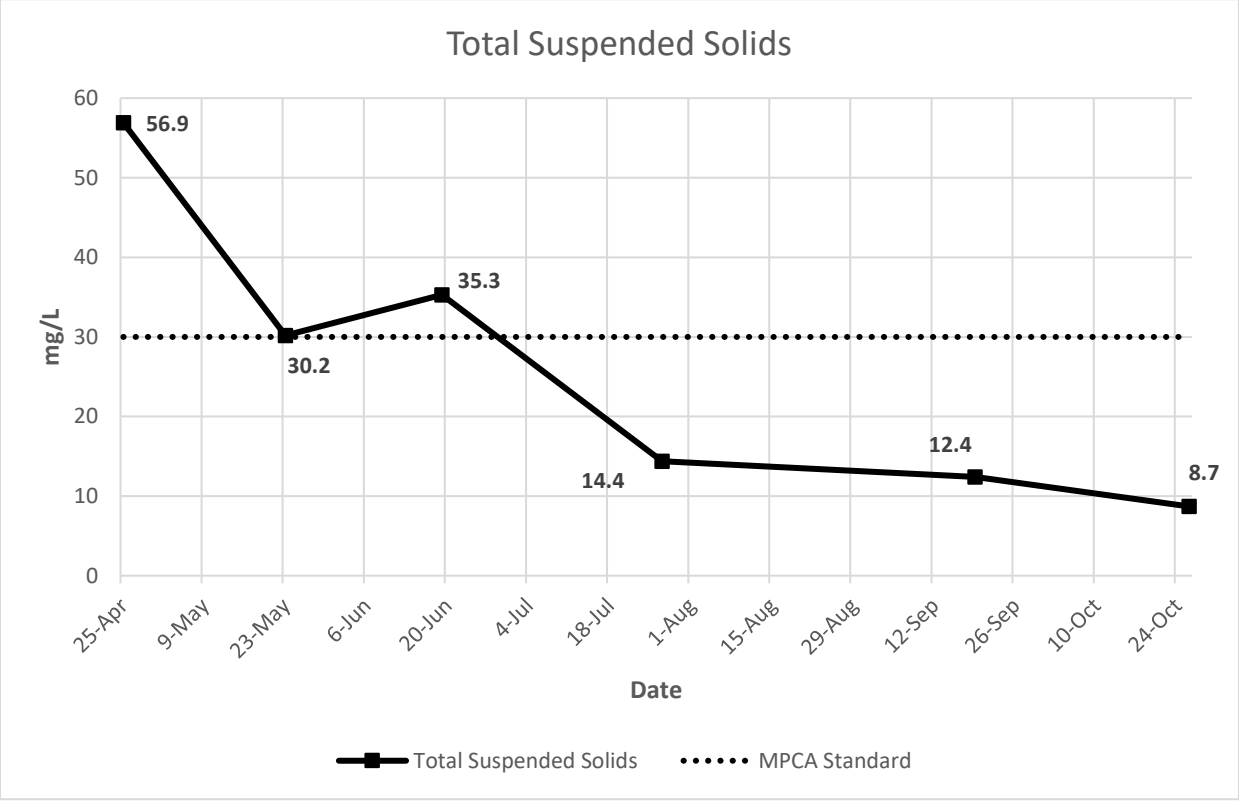

Figure 27. Total Suspended Solids collected at S003-693.

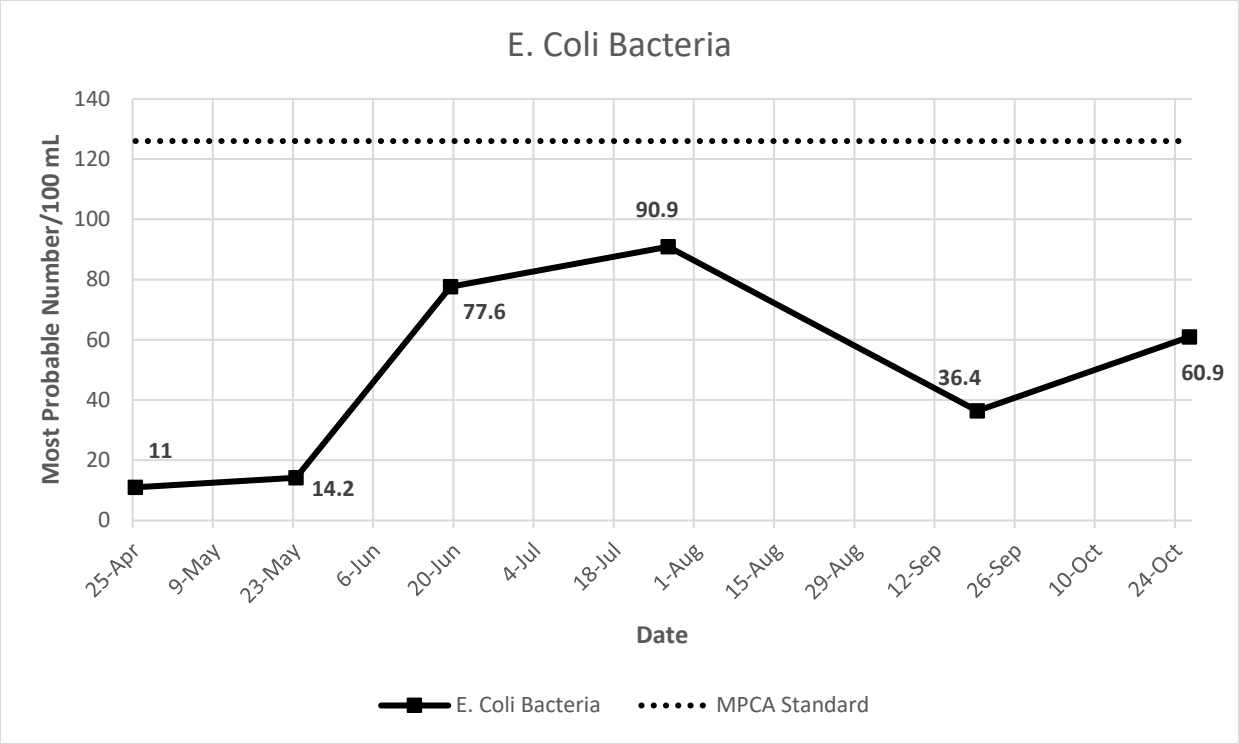

Figure 28. E. Coli Bacteria samples collected at S003-693.

h) <u>S002-708:</u> Located in Section 7, Moland Township before the Buffalo River runs underneath 80th Ave N in the Northern planning region.

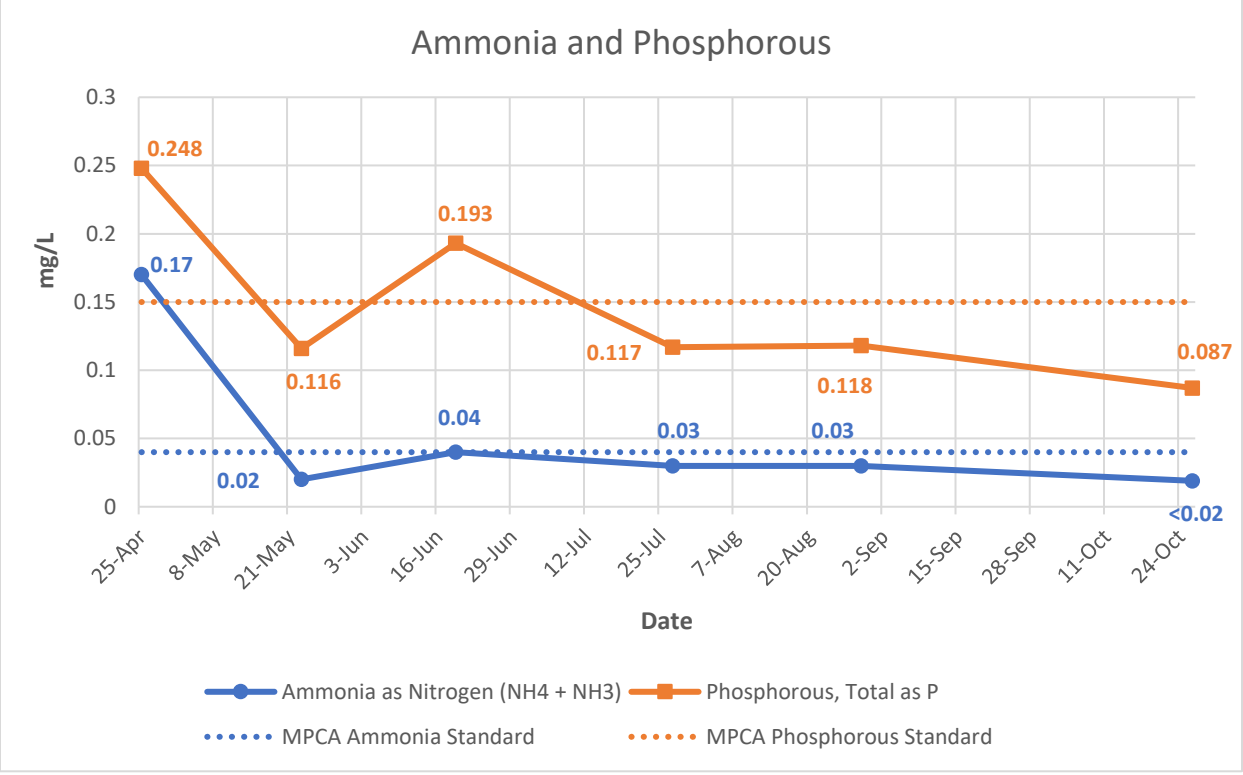

Figure 29. Ammonia and Phosphorous samples collected at S002-708.

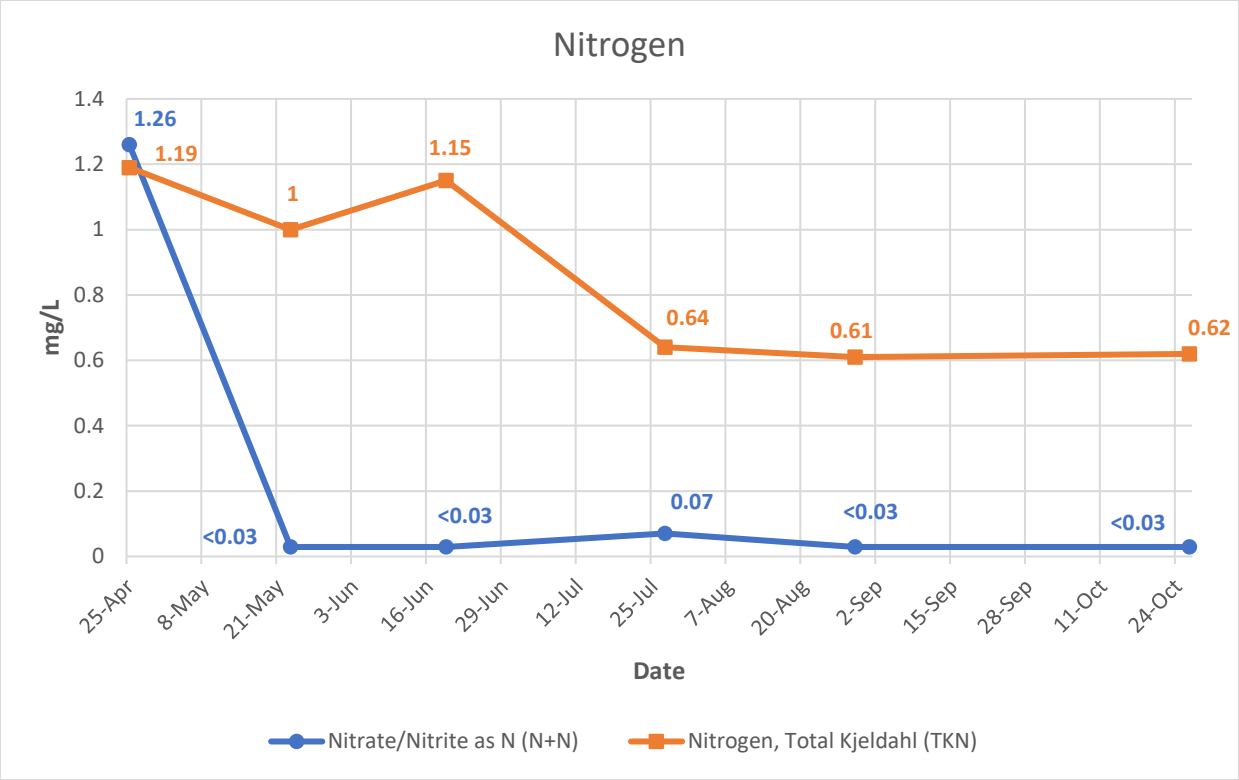

Figure 30. Nitrogen samples collected at S002-708 (MPCA and EPA standards are 10 mg/L).

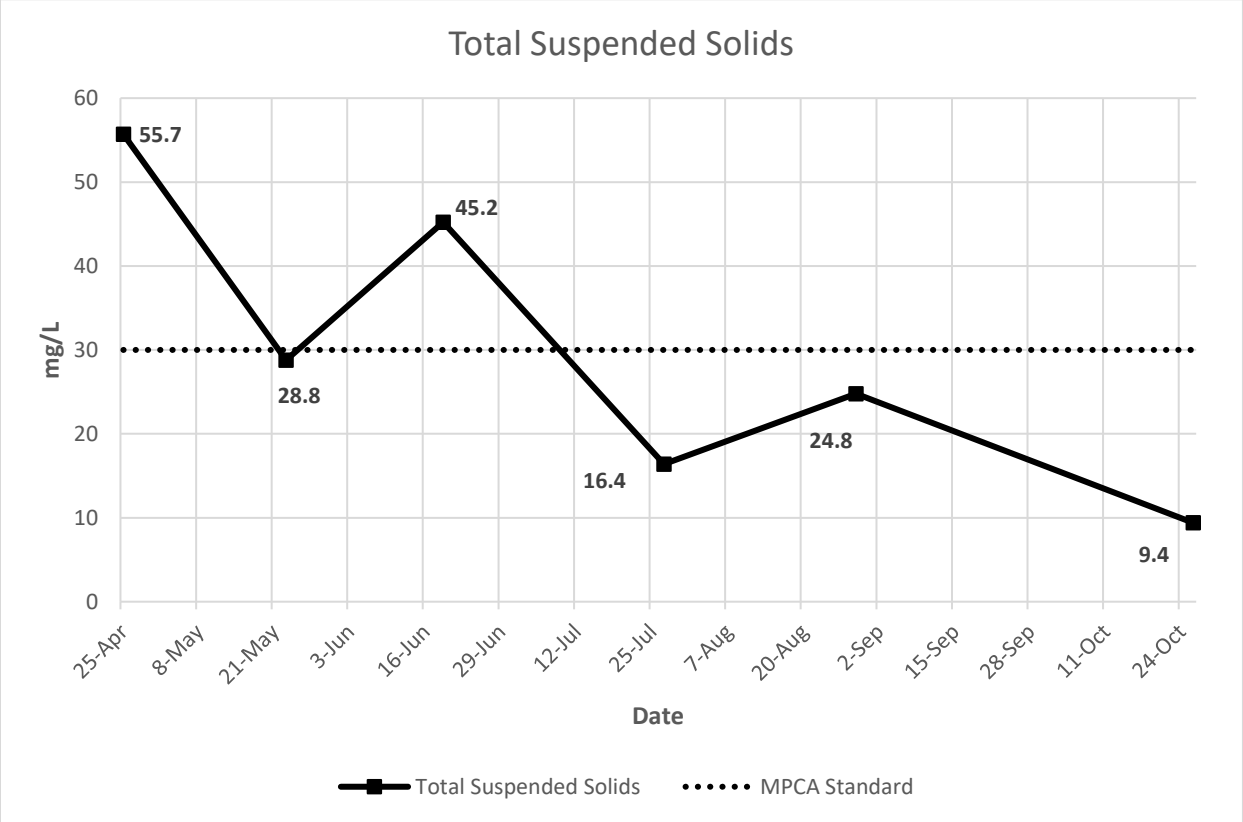

Figure 31. Total Suspended Solids sampled at S002-708.

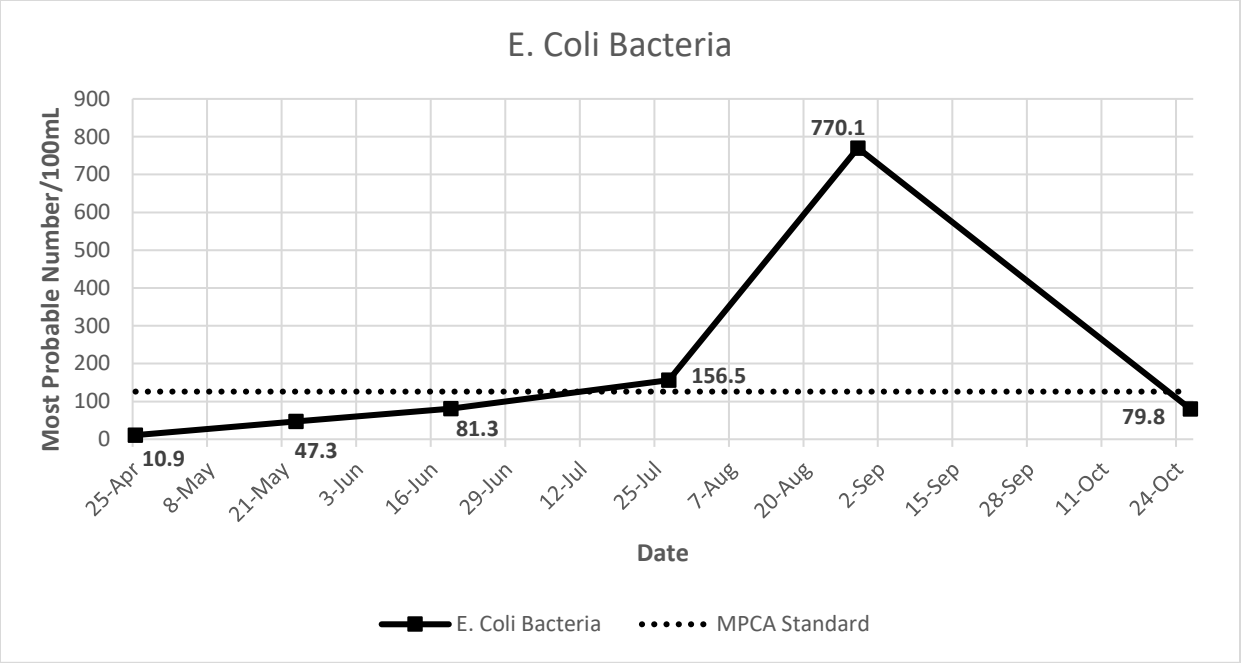

Figure 32. E. Coli Bacteria sampled at S002-708.

i) <u>S002-125:</u> Located along the south side of 140th Ave N, S002-125 is located approximately 10 river miles upstream of where the Buffalo River outlets into the Red River. This station is in the Northern planning region and is the last monitoring station along the Buffalo River.

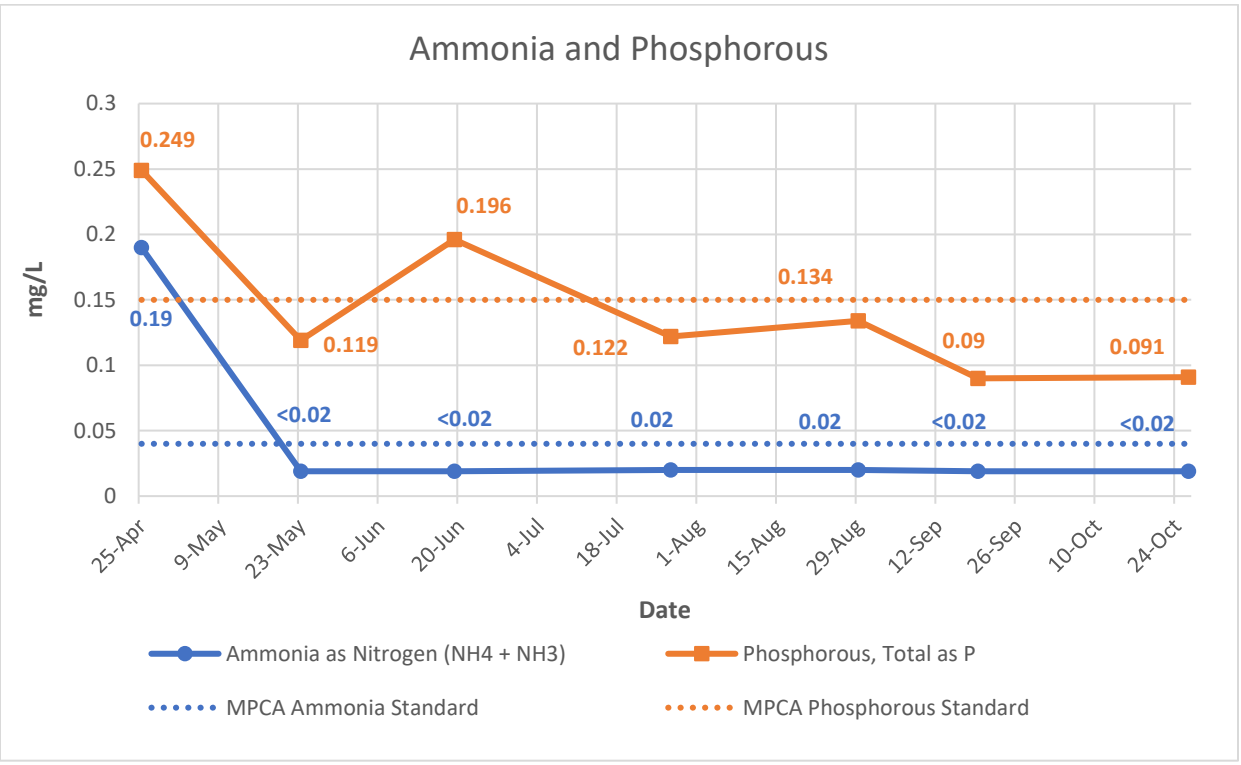

Figure 33. Ammonia and Phosphorous samples collected at S002-125.

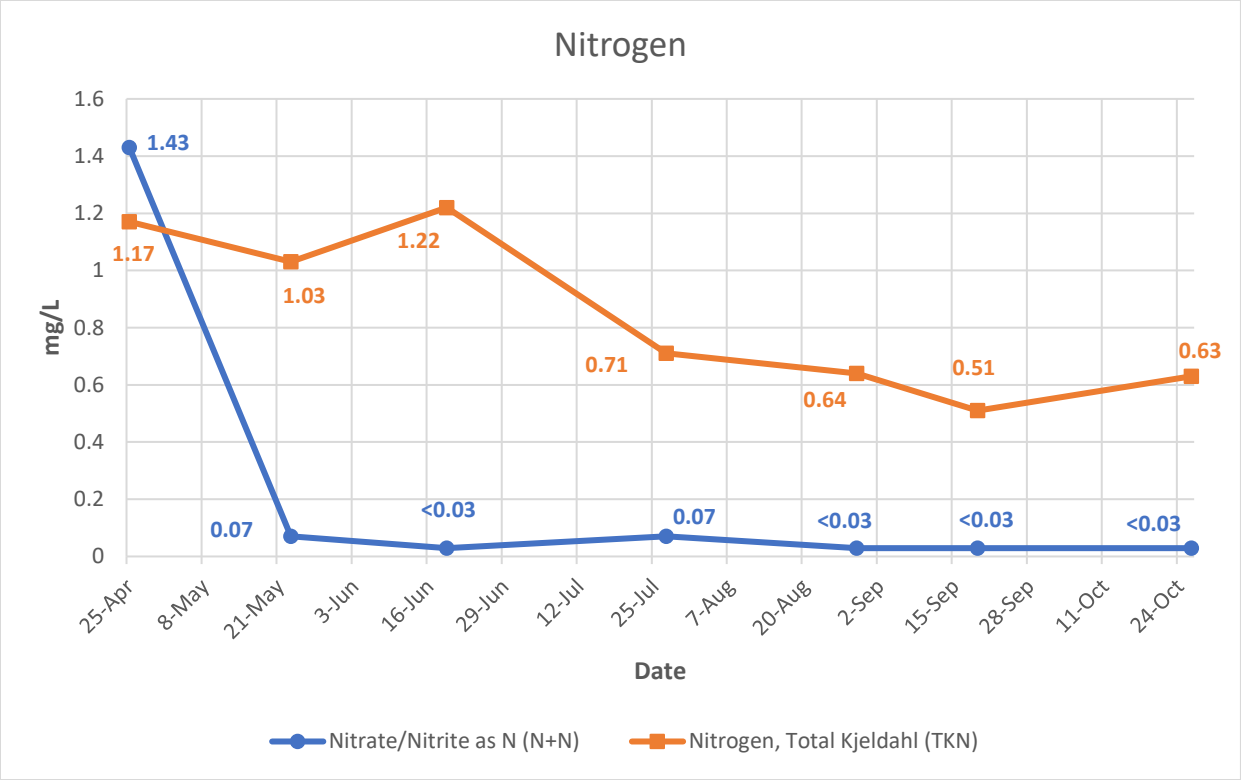

Figure 34. Nitrogen samples collected at S002-125 (MPCA and EPA standards are 10 mg/L).

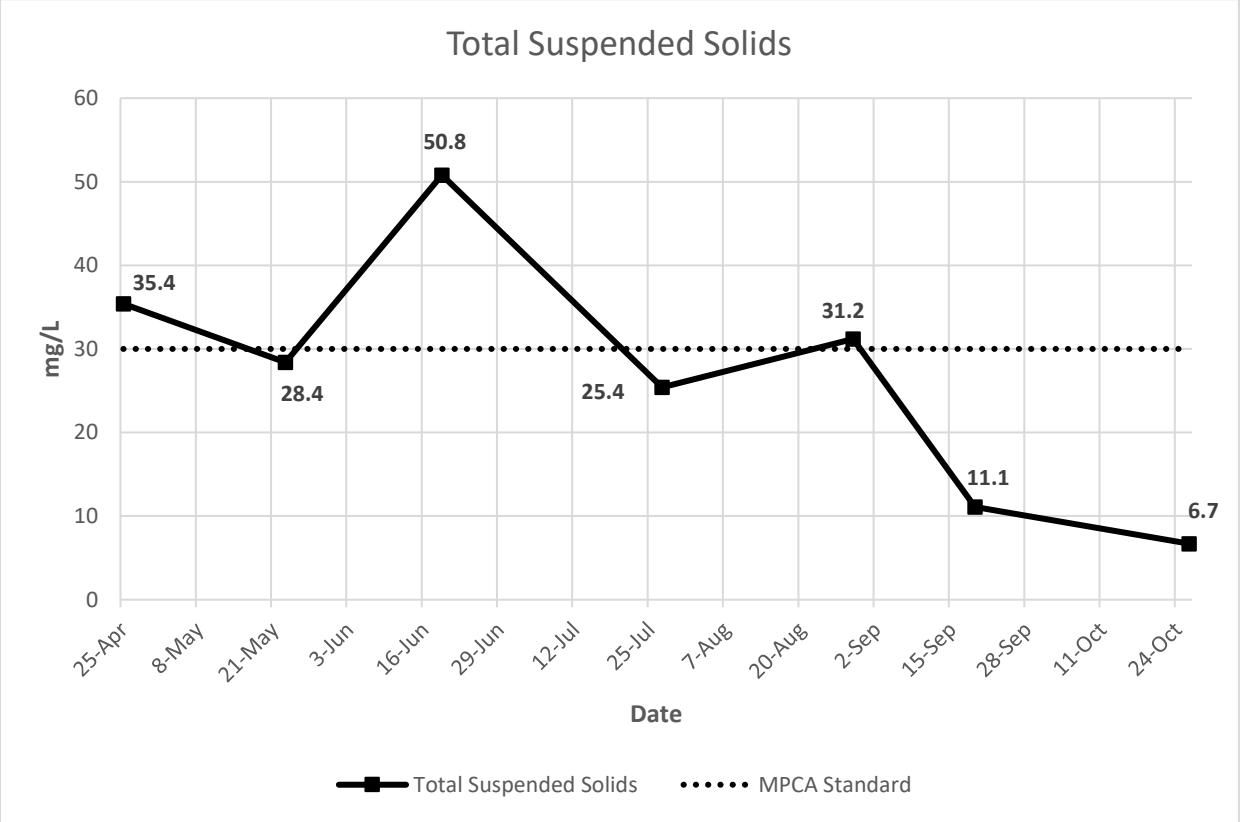

Figure 35. Total Suspended Solids samples collected at S002-125.

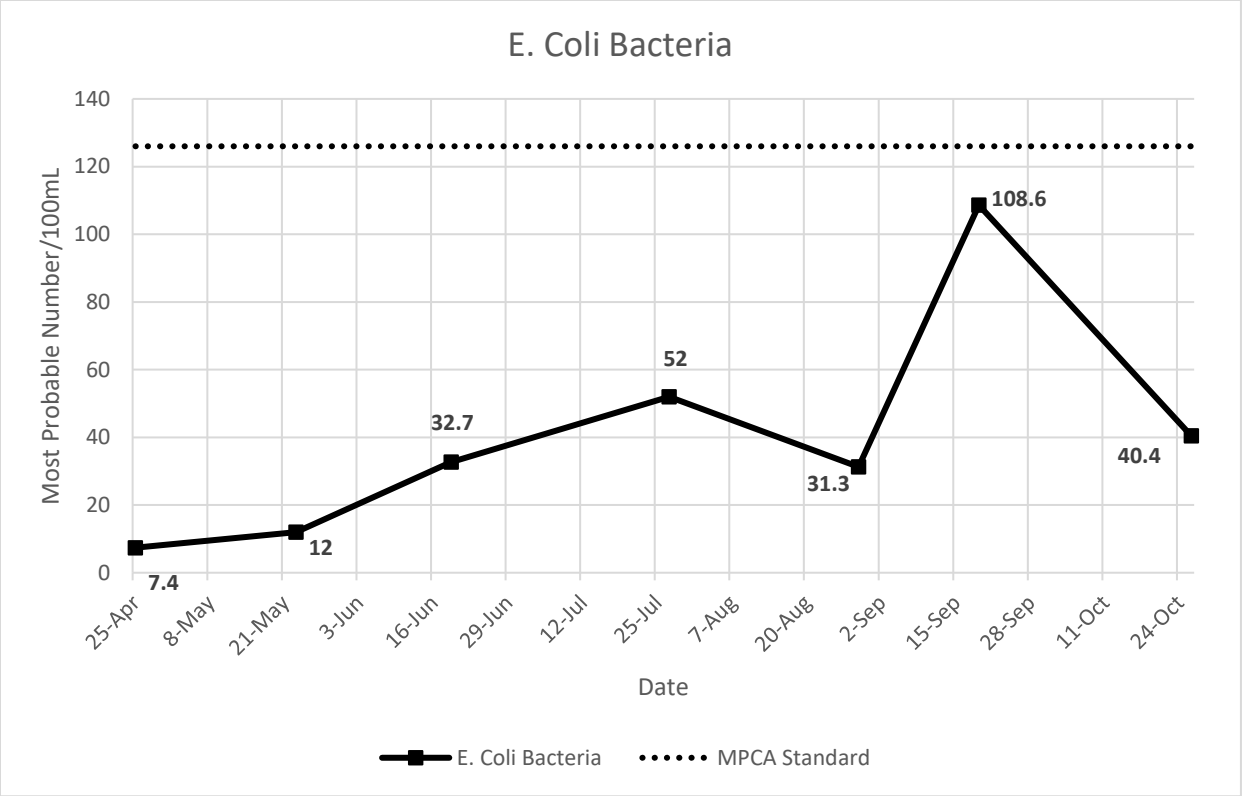

Figure 36. E. Coli Bacteria samples collected at S002-125.

2. <u>South Branch Buffalo River</u>

The headwaters of the South Branch Buffalo River are approximately five miles northwest of Rothsay in Wilkin County, moving north/northwest for over 60 river miles before connecting with the Buffalo River two miles northwest of Glyndon within Clay County. The South Branch Buffalo River runs through eight townships, four in Wilkin County (Tanberg, Manston, Atherton, and Deerhorn) and four in Clay County (Alliance, Elmwood, Glyndon, and Moland). There are five sampling stations along the South Branch Buffalo River: one station in the Southern planning region and four stations are in the Central planning region.

a) <u>S015-046:</u> Located in Section 18, Atherton Township within the Southern planning region, this station is the farthest upstream sampling station along the South Branch Buffalo River.

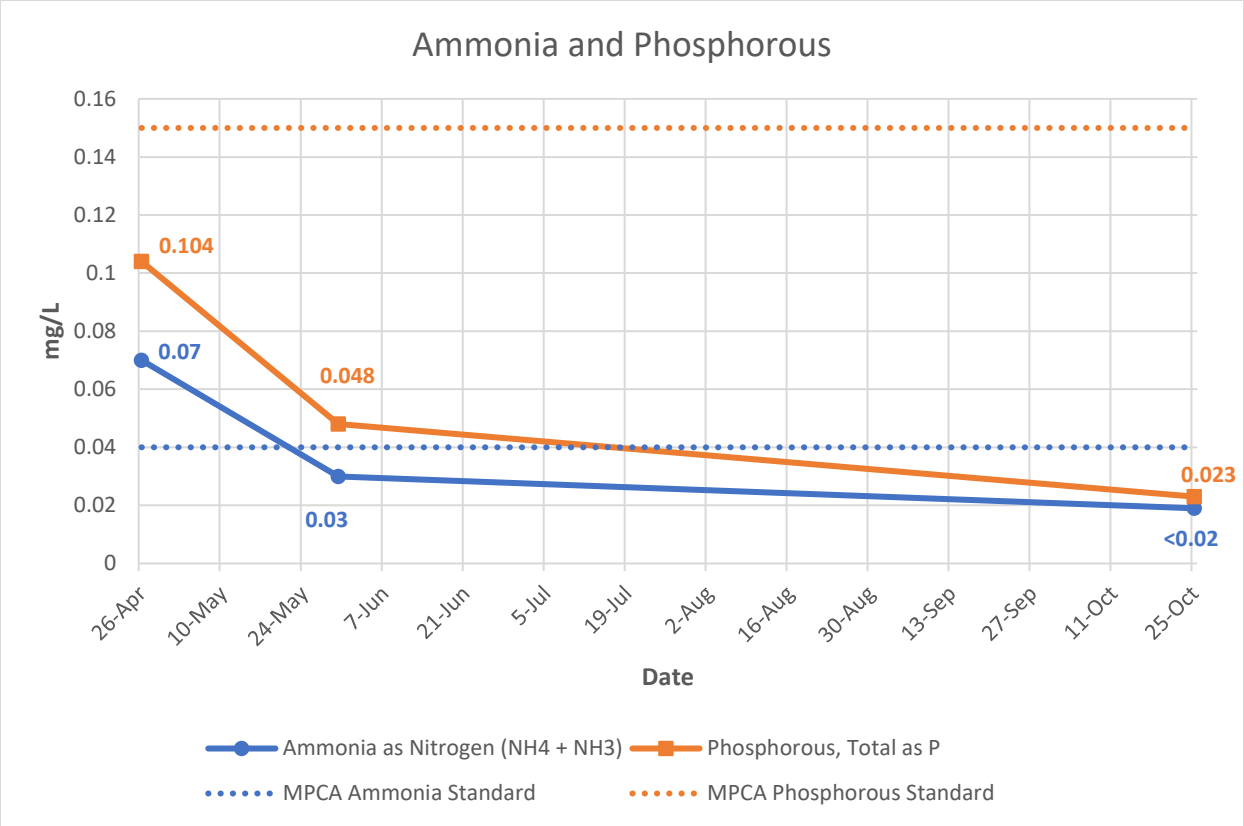

Figure 37. Ammonia and Phosphorous samples collected at S015-046.

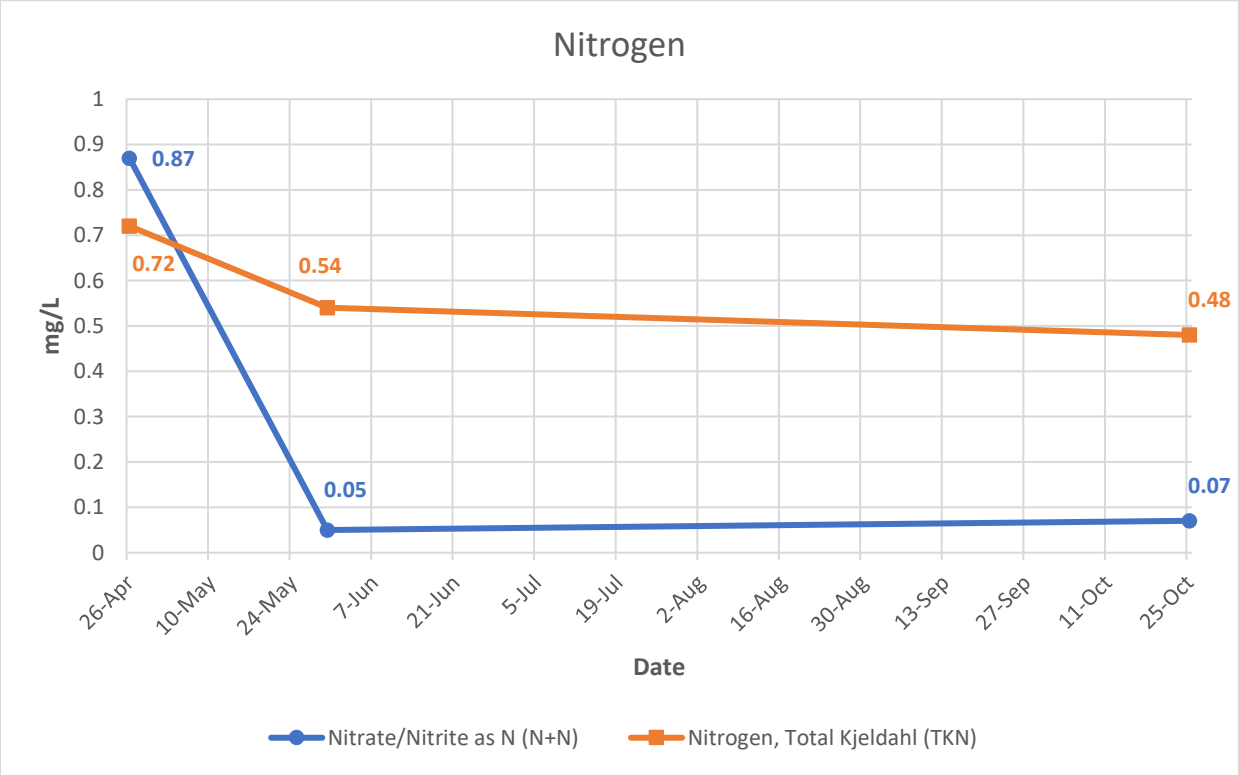

Figure 38. Nitrogen samples collected at S015-046 (MPCA and EPA standards are 10 mg/L)

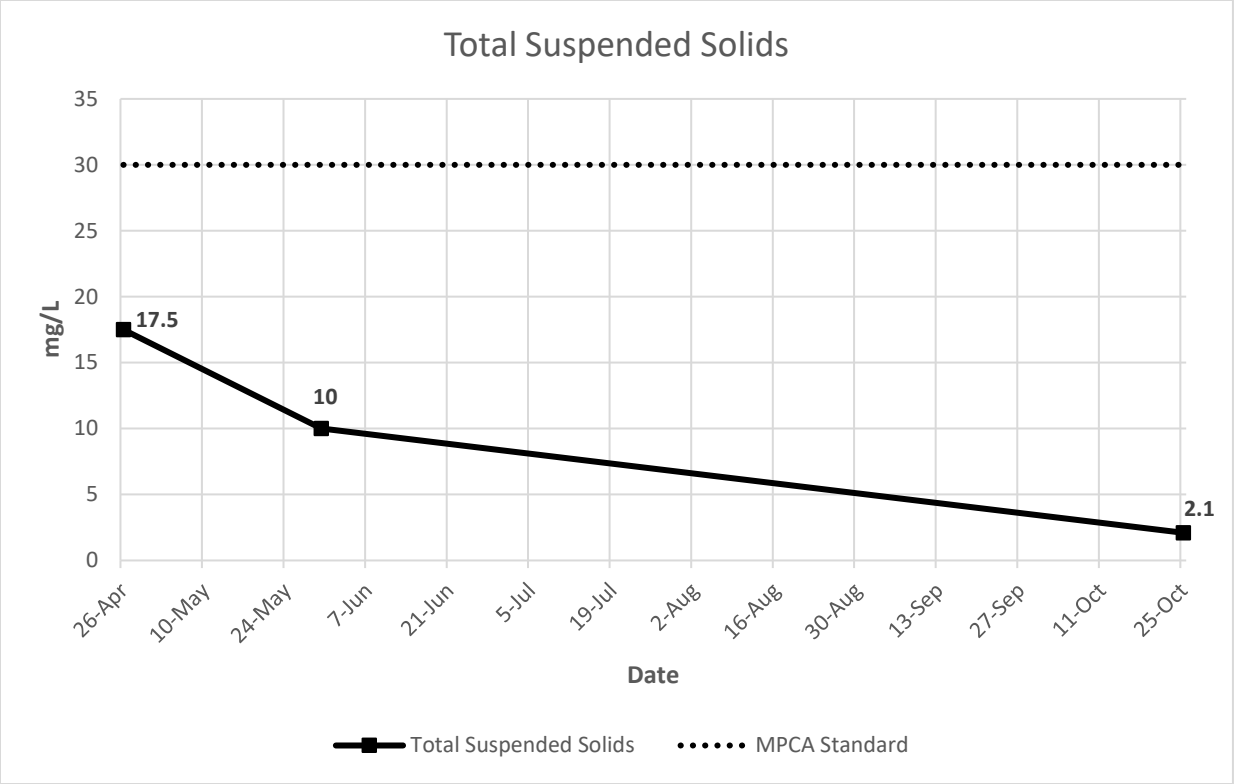

Figure 39. Total Suspended Solids samples collected at S015-046.

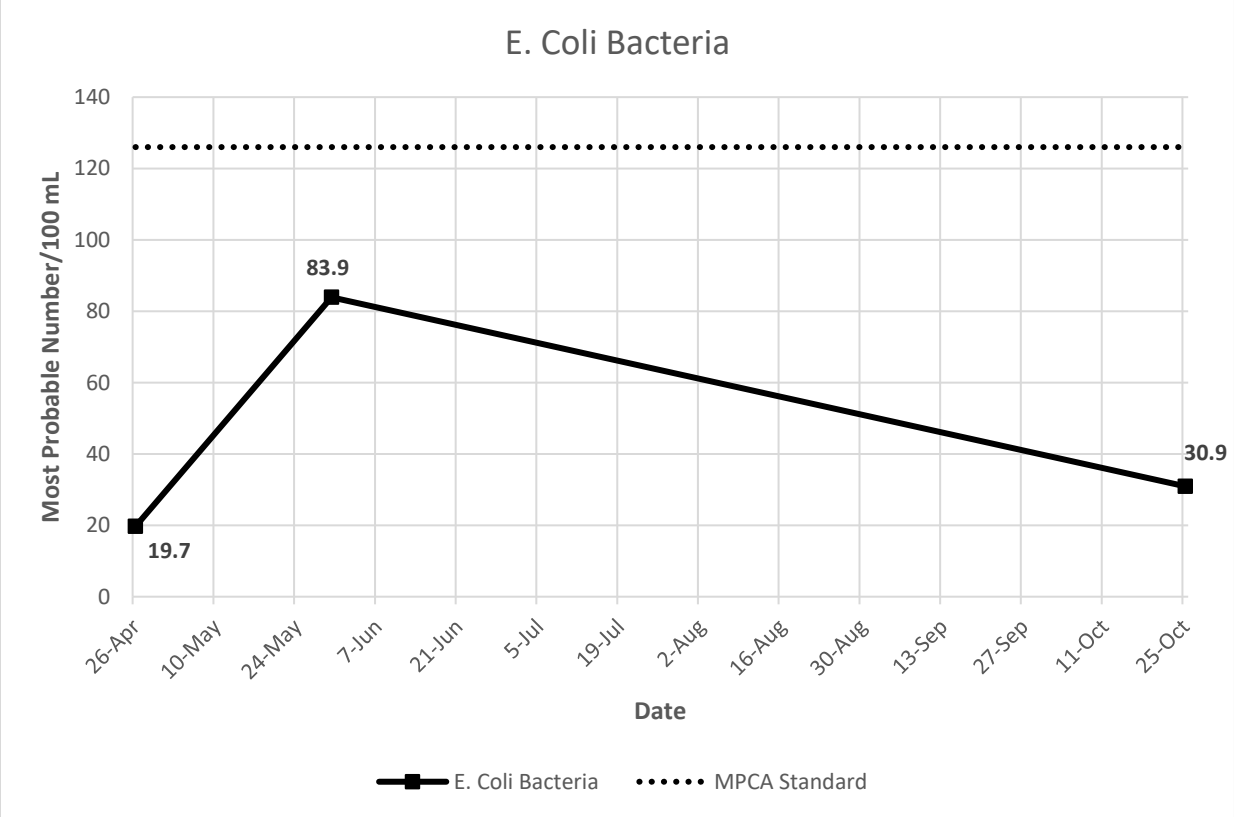

Figure 40. E. Coli Bacteria samples collected at S015-046.

b) S006-563: Located approximately 20 river miles downstream from station S015-046, this station is in the Central planning region in Section 9, Alliance Township.

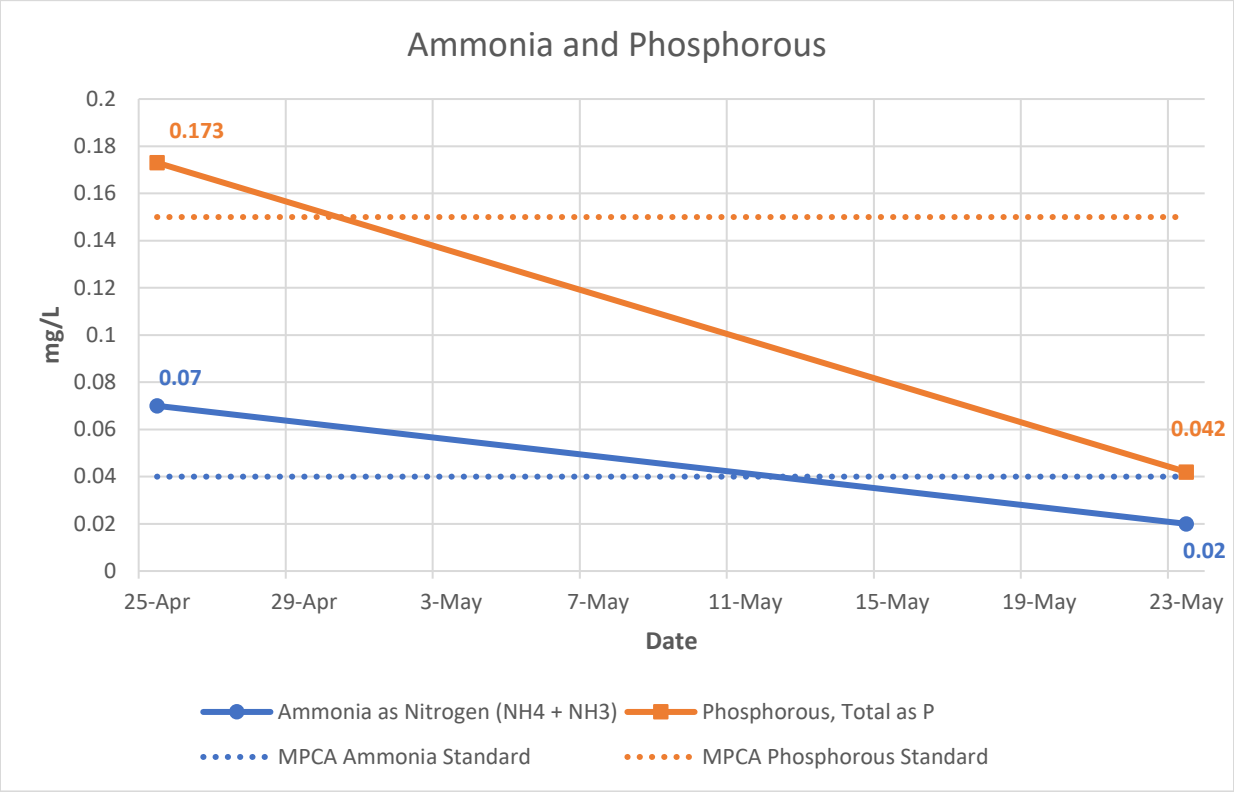

Figure 41. Ammonia and Phosphorous samples collected at S006-563.

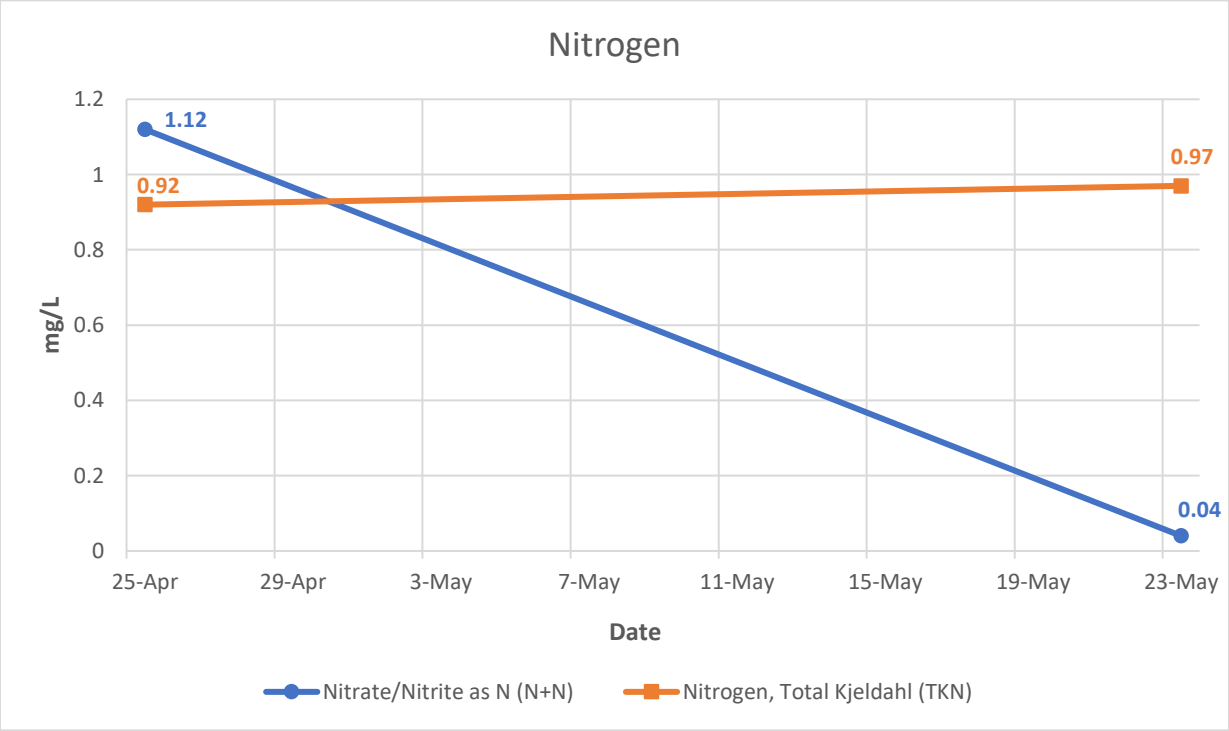

Figure 42. Nitrogen samples collected at S006-563 (MPCA and EPA standards are 10 mg/L).

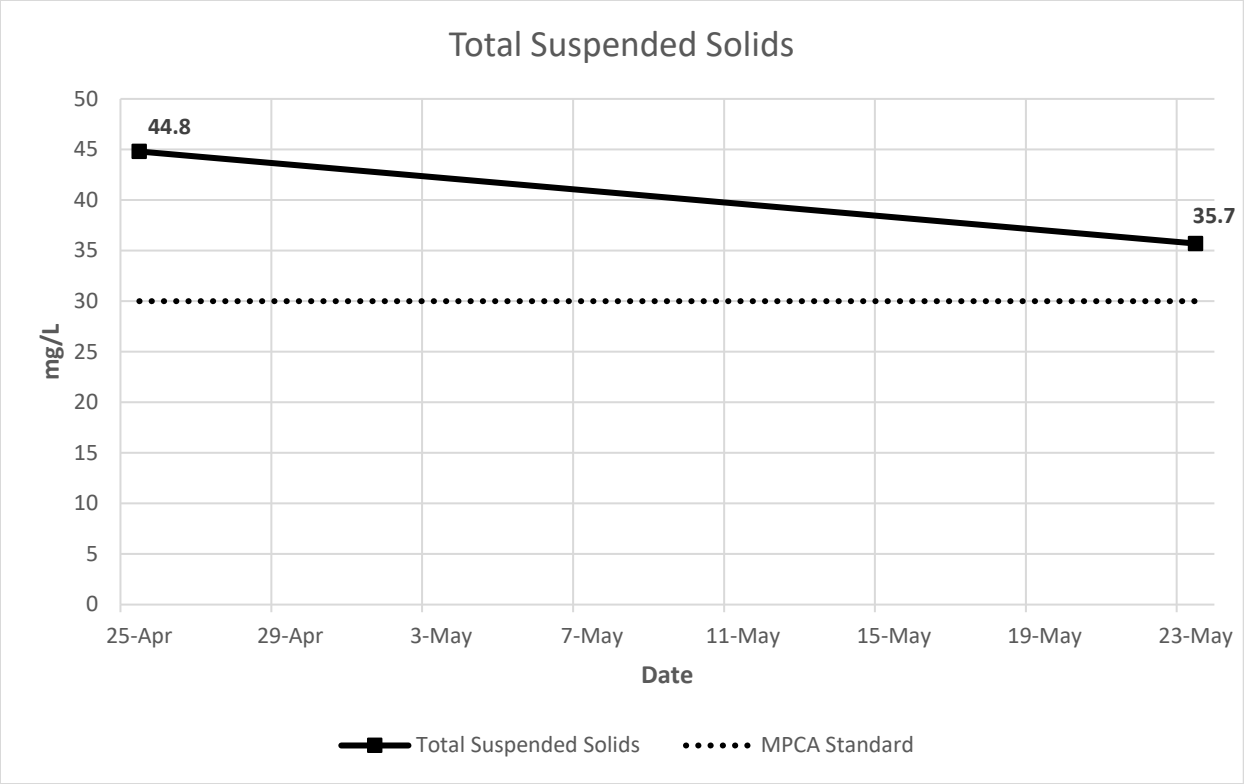

Figure 43. Total Suspended Solids samples collected at S006-563.

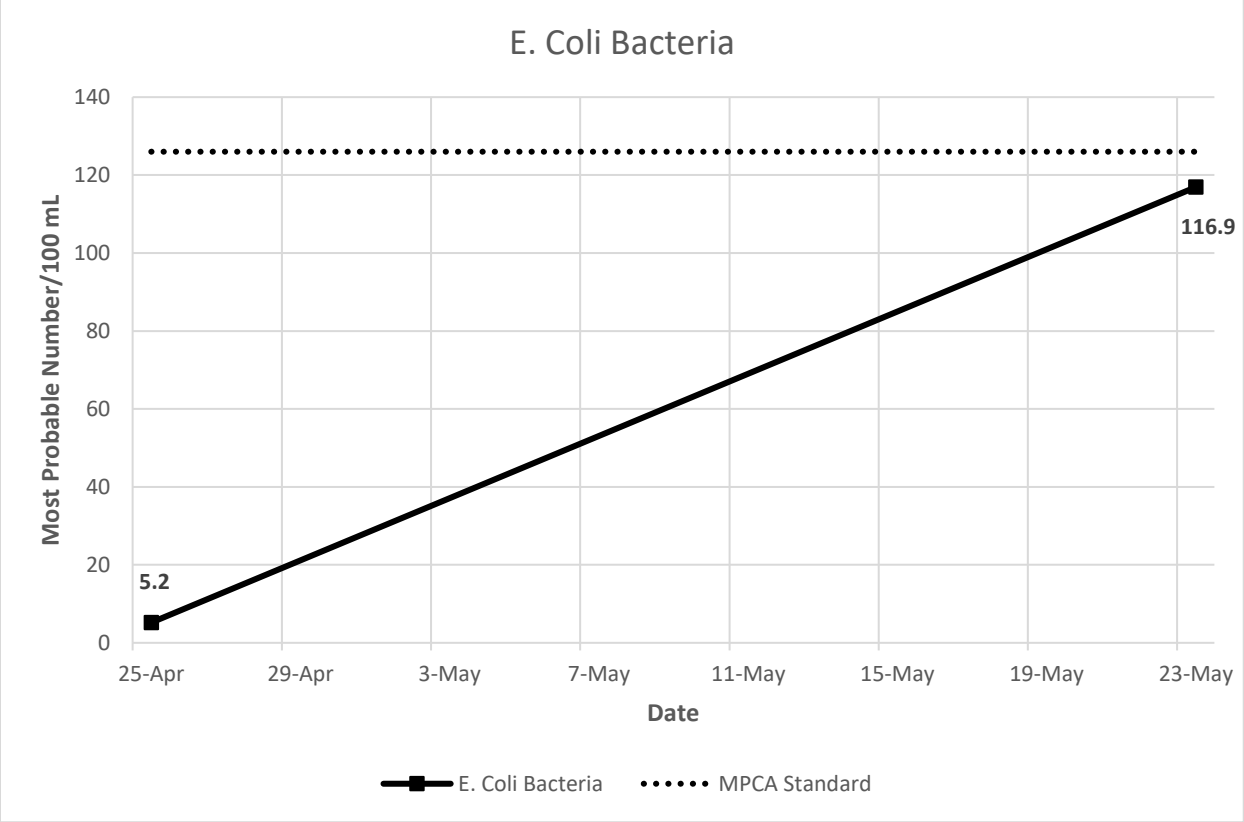

Figure 44. E. Coli Bacteria samples collected at S006-563.

c) <u>S004-147:</u> Located between Sections 16 and 17, Elmwood Township, S004-147 is located in the Central planning region along 80th St S southeast of Sabin.

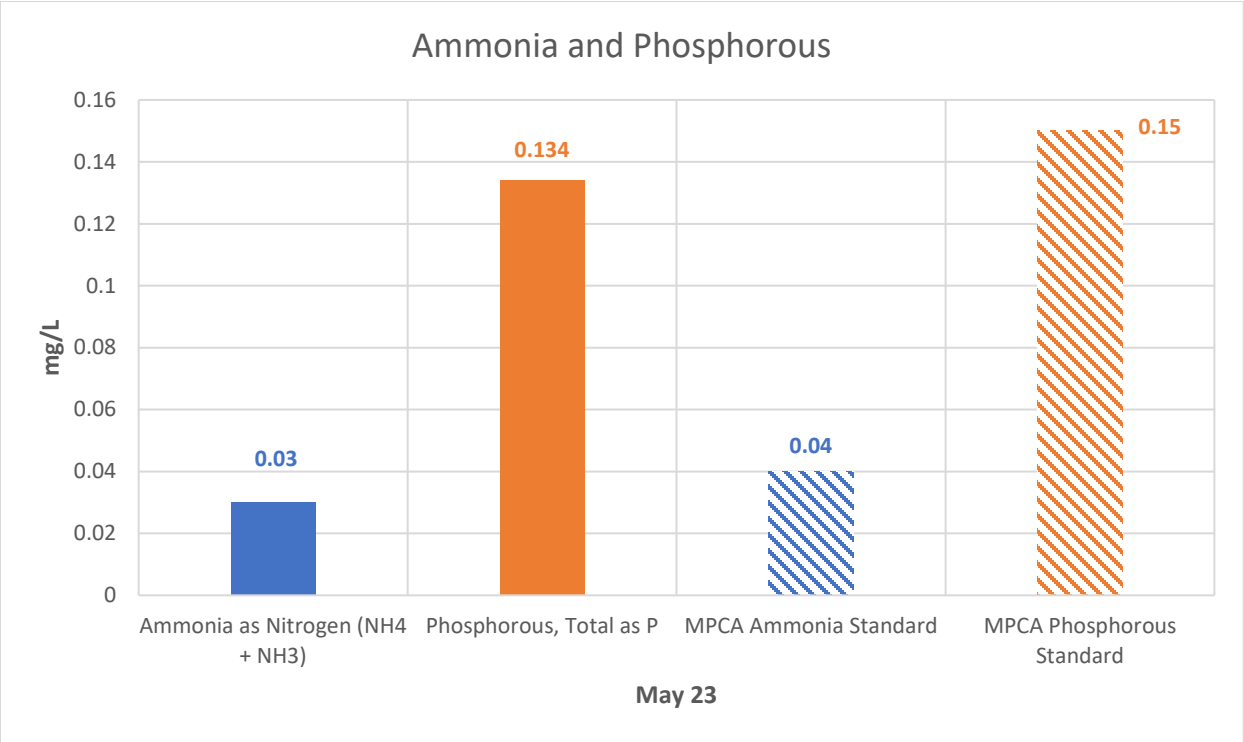

Figure 45. Ammonia and Phosphorous samples collected at S004-147.

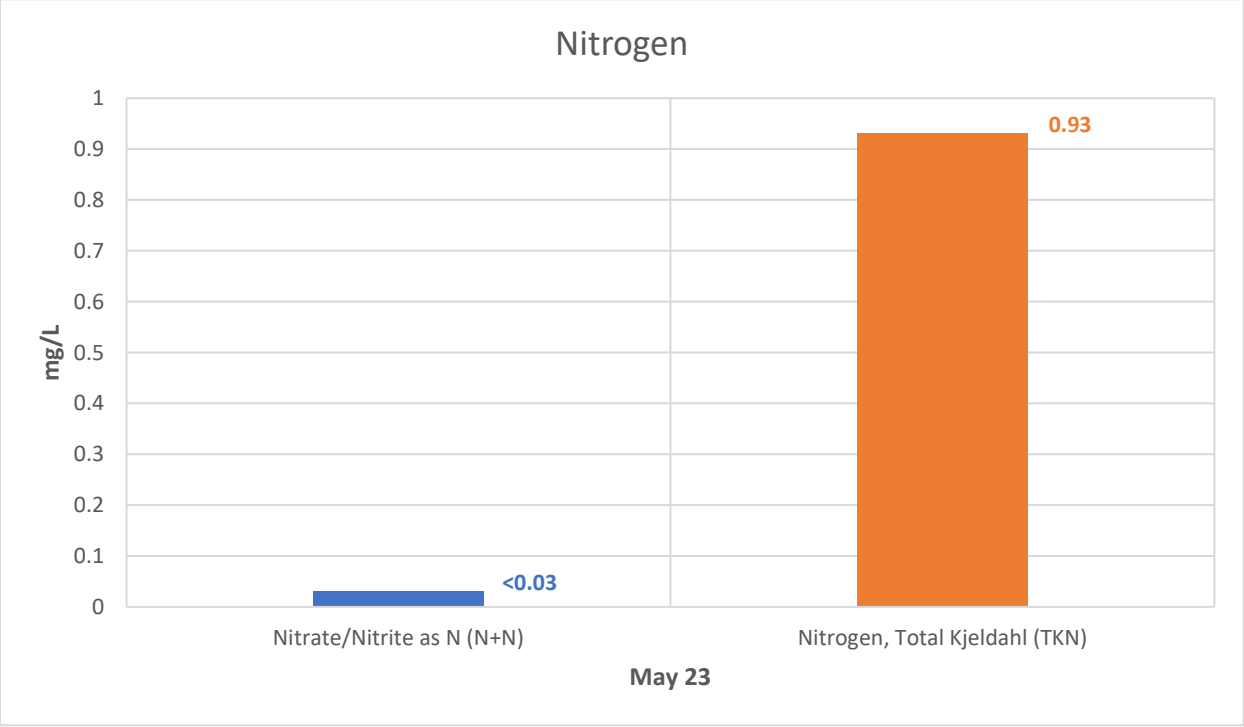

Figure 46. Nitrogen samples collected at S004-147 (MPCA and EPA standards are 10 mg/L)

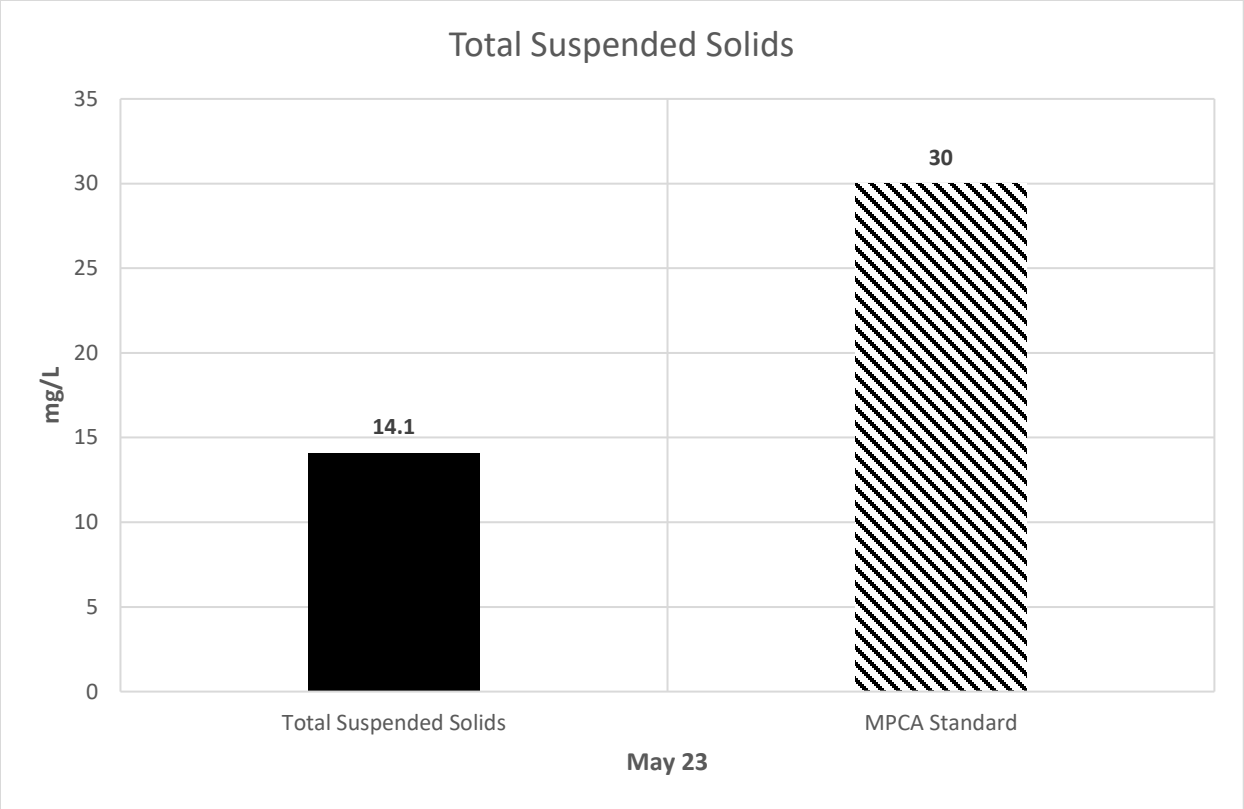

Figure 47. Total Suspended Solids samples collected at S004-147.

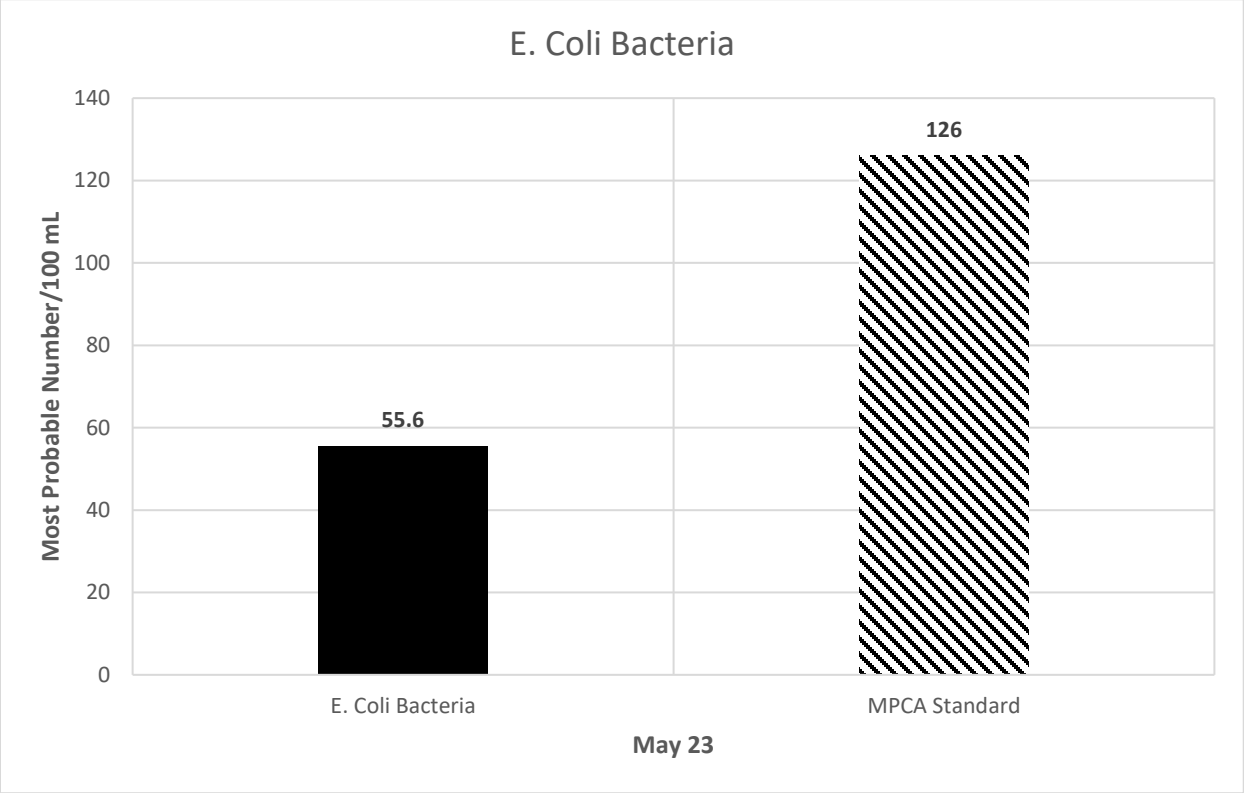

Figure 48. E. Coli Bacteria samples collected at S004-147.

d) S002-709: Located approximately one river mile downstream from station S004-147, this station is in the Central planning region located east of Sabin where the South Branch runs underneath 80th Ave S.

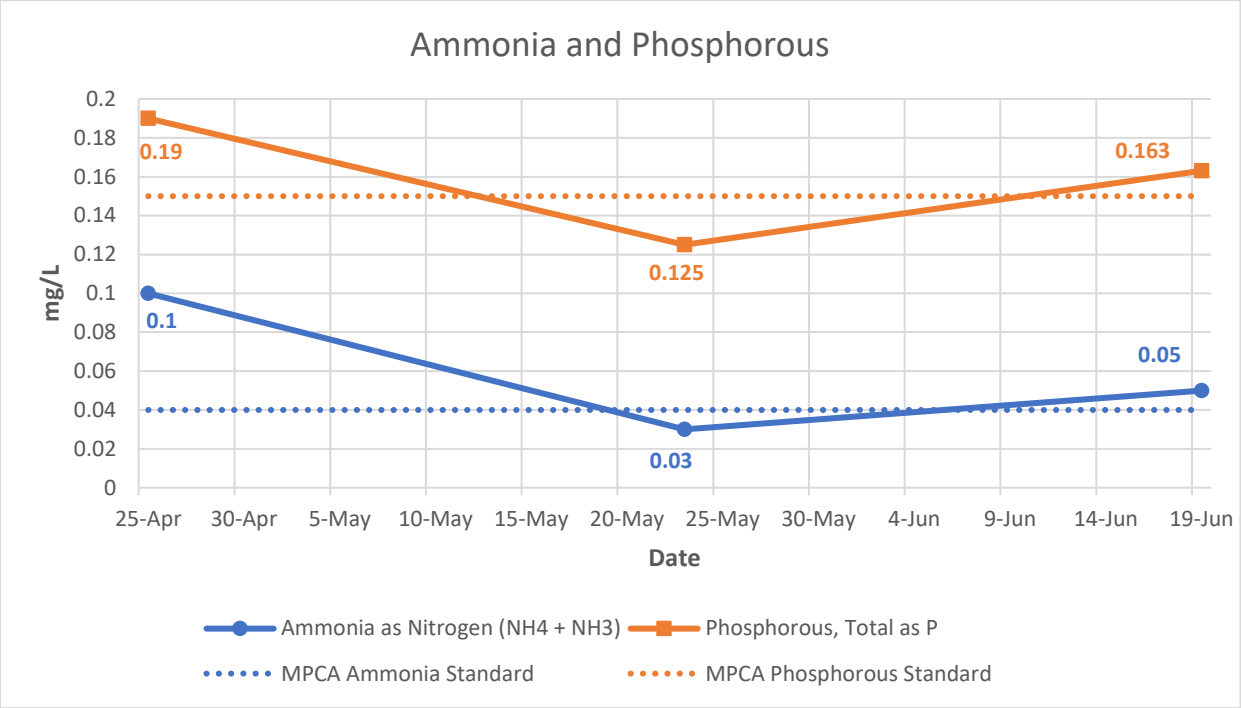

Figure 49. Ammonia and Phosphorous samples collected at S002-709.

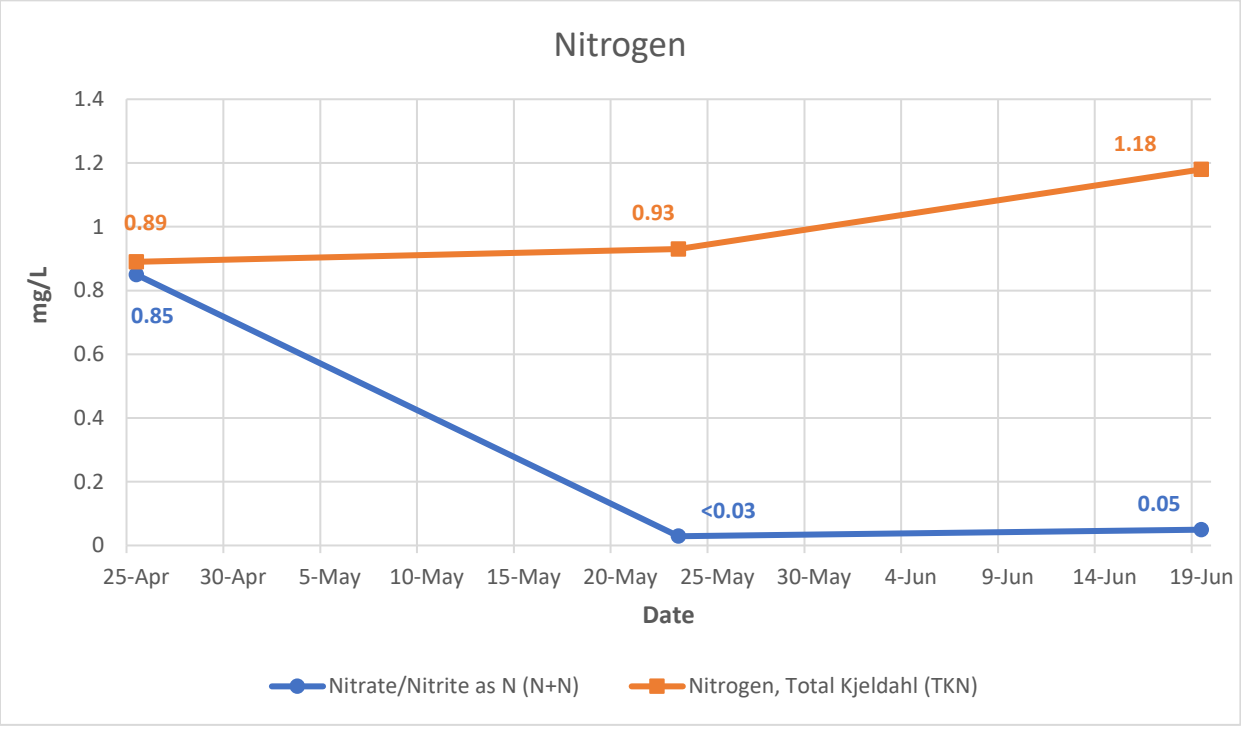

Figure 50. Nitrogen samples collected at S002-709 (MPCA and EPA standards are 10 mg/L)

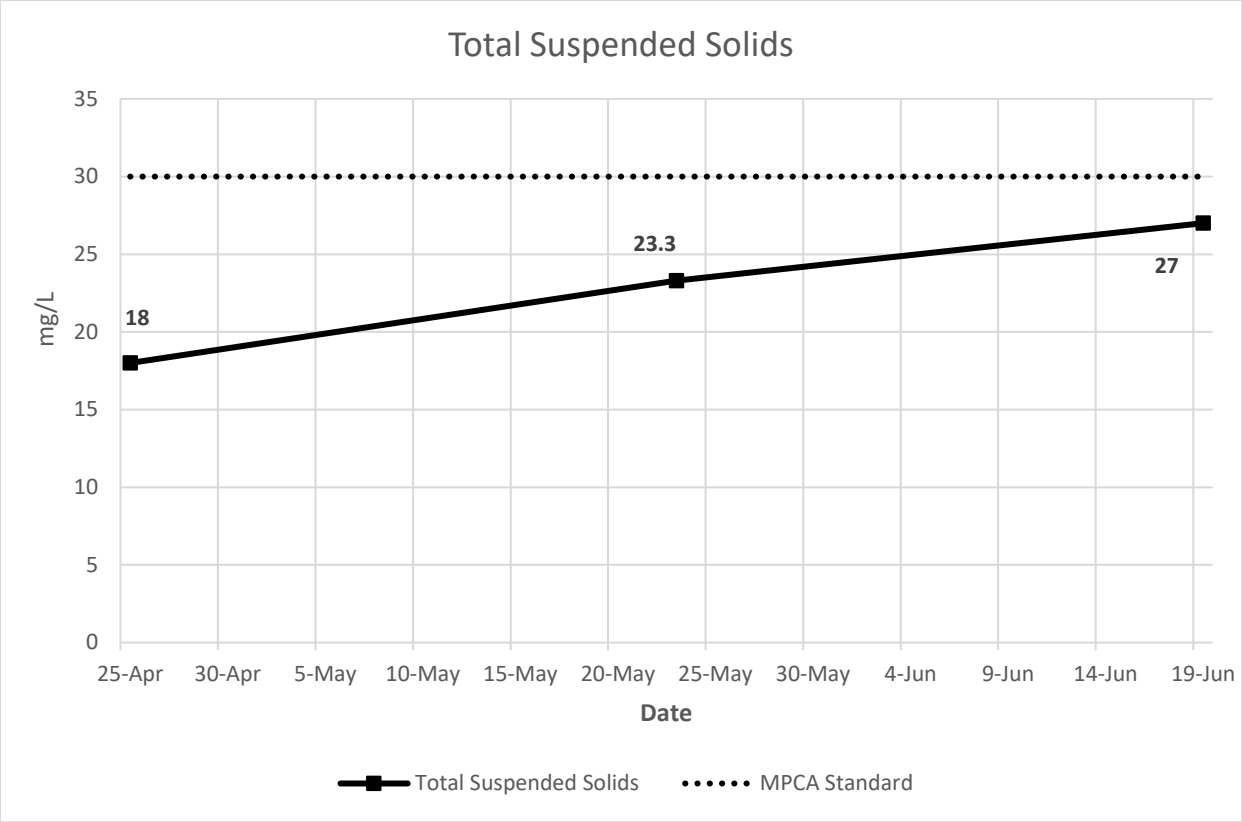

Figure 51. Total Suspended Solids samples collected at S002-709.

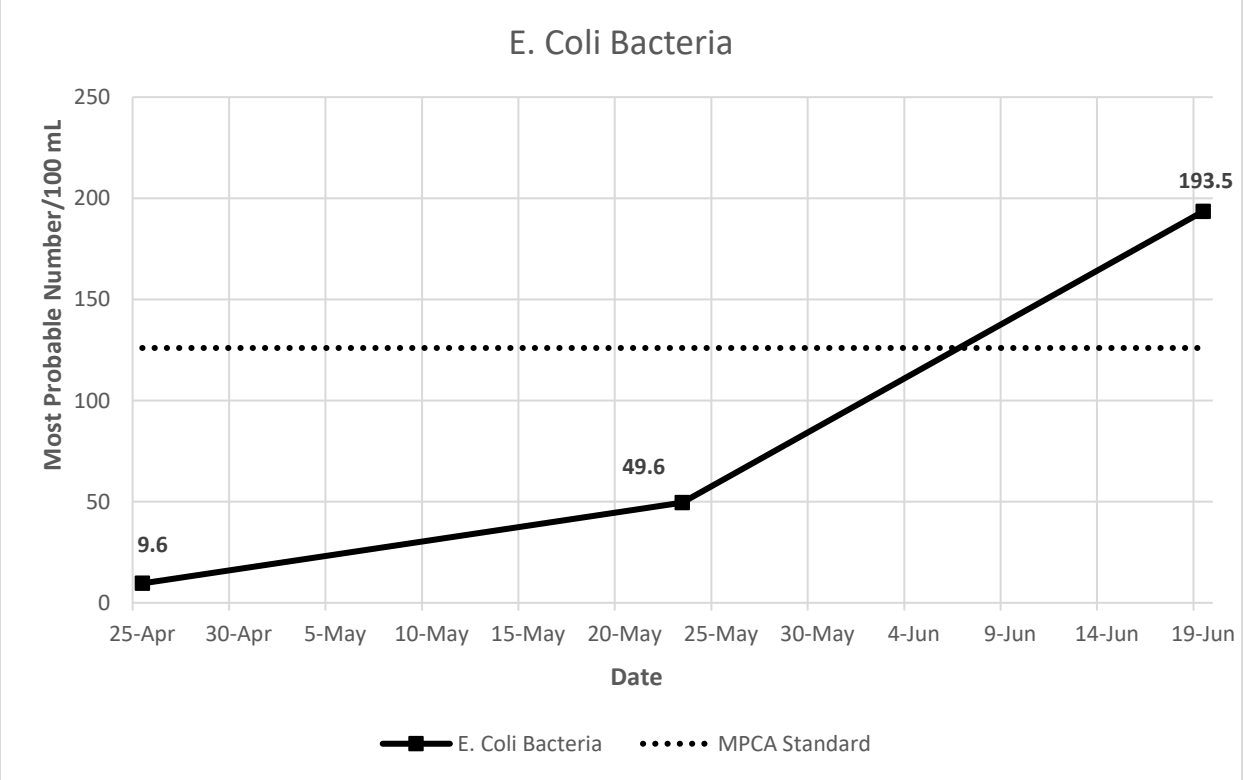

Figure 52. E. Coli Bacteria samples collected at S002-709.

e) <u>S004-148:</u> Located approximately seven miles before the South Branch Buffalo River outlets into the Buffalo River between Sections 16 and 21, Glyndon Township within the Central planning region.

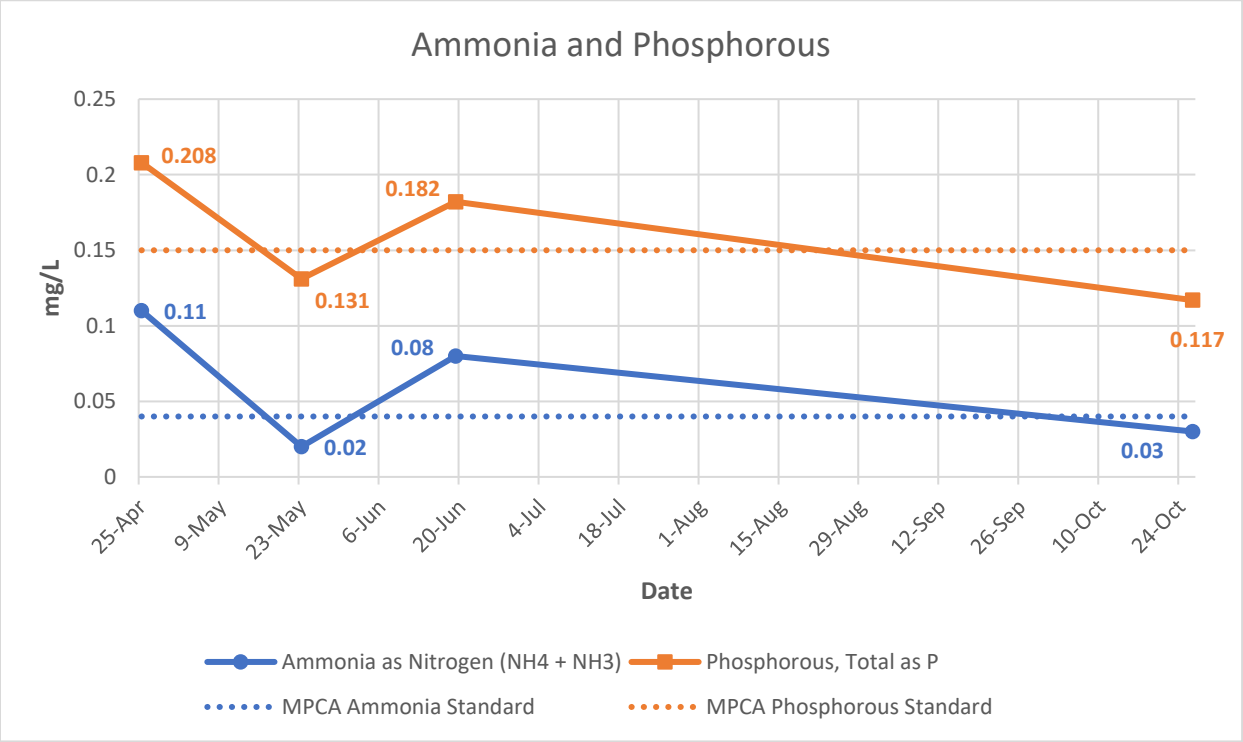

Figure 53. Ammonia and Phosphorous samples collected at S004-148.

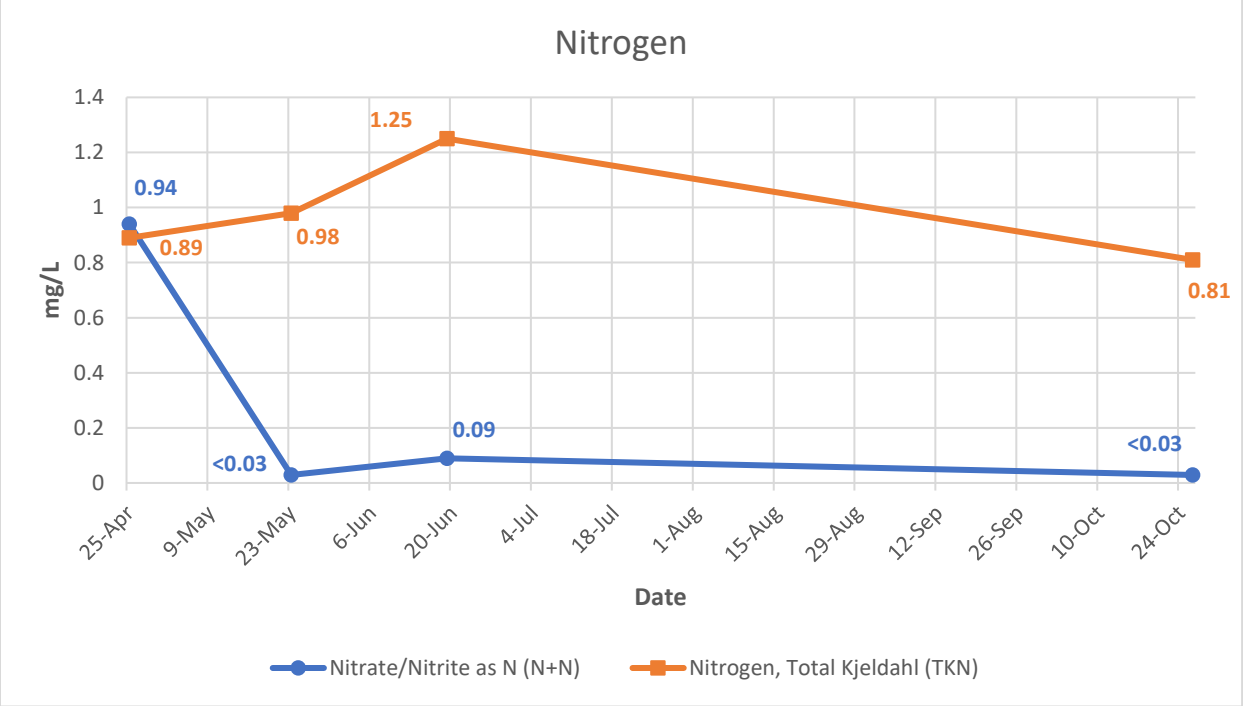

Figure 54. Nitrogen samples collected at S004-148 (MPCA and EPA standards are 10 mg/L).

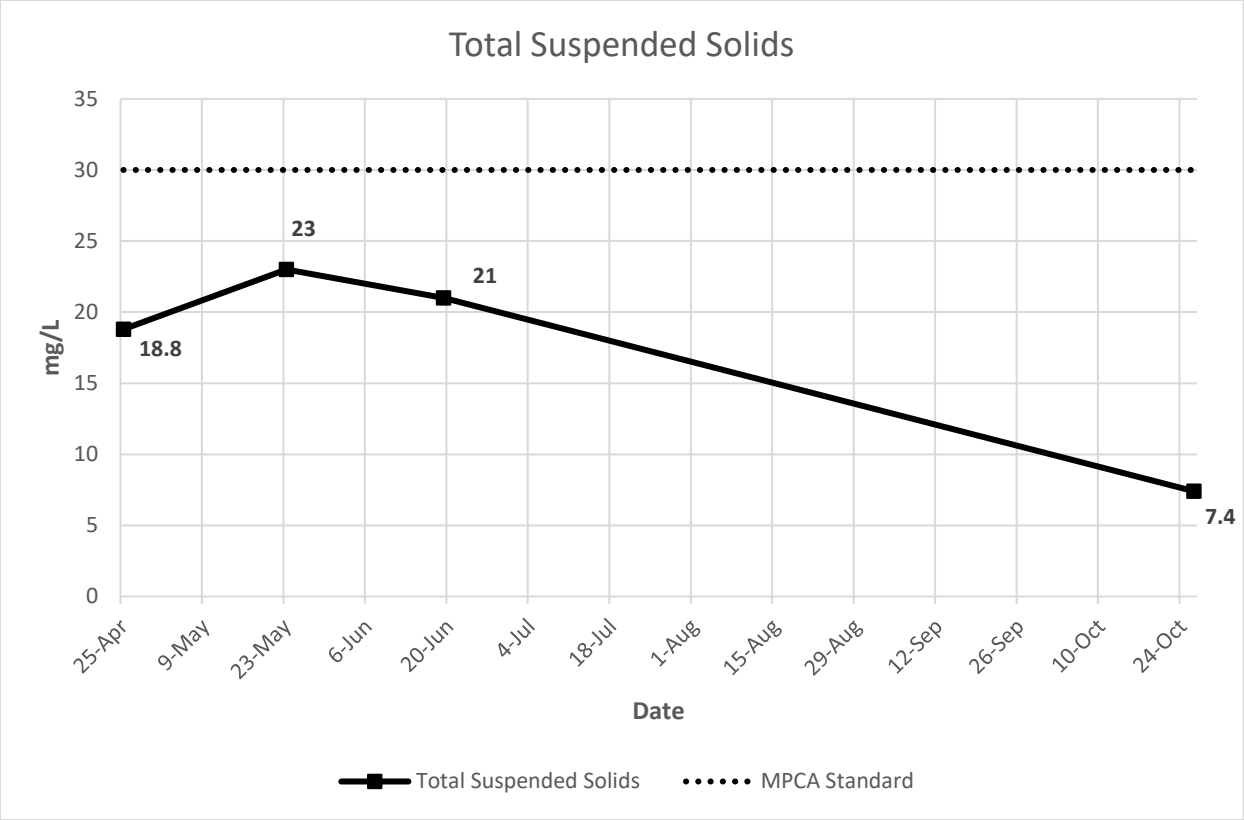

Figure 55. Total Suspended Solids samples collected at S004-148.

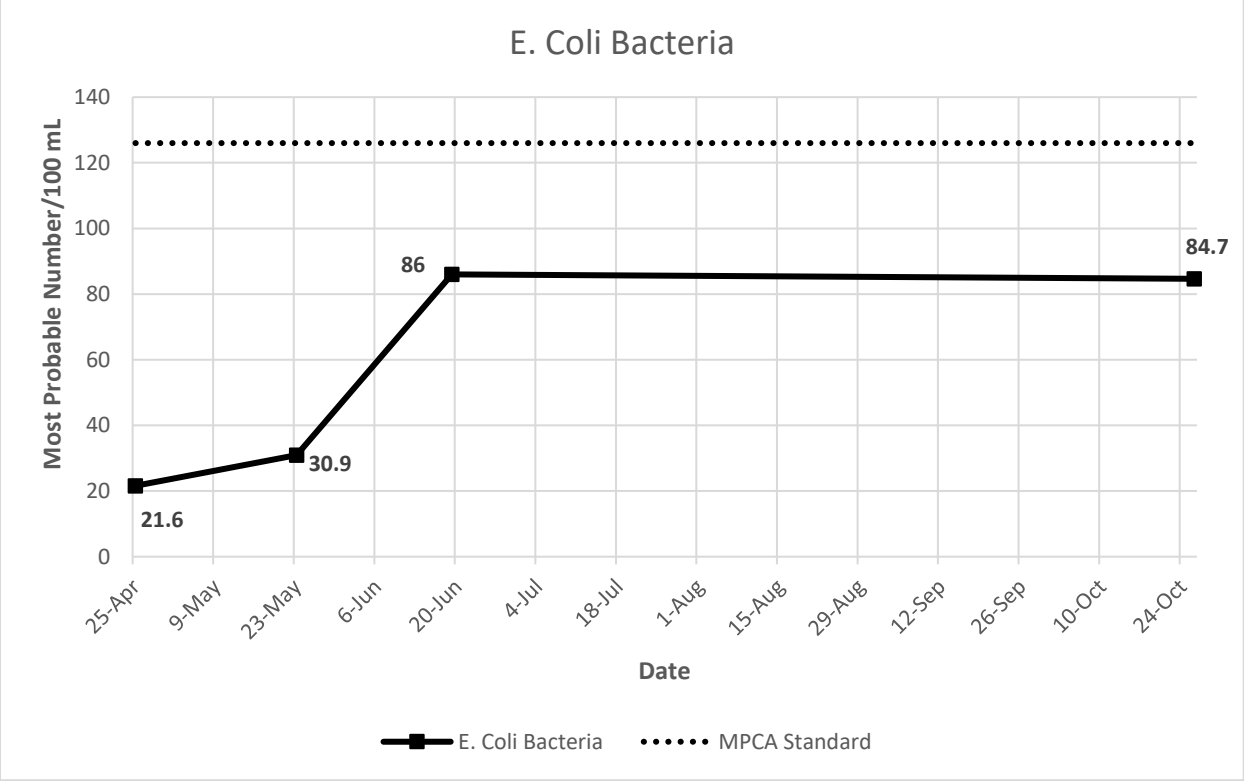

Figure 56. E. Coli Bacteria samples collected at S004-148.

3. *Otter Tail River*

The lower portion of the Otter Tail River consists of approximately 35 river miles within BRRWD boundaries starting on the downstream end of Orwell Dam. The Otter Tail River runs west through Orwell, Foxhome, Sunnyside, and Breckenridge Townships until it connects with the Bois de Sioux River at the confluence of the Red River. There are three sampling stations along the Otter Tail River, all located within the Otter Tail planning region.

a) S002-003: Located downstream of Orwell Dam where the Otter Tail River crosses under Otter Tail County Road 15, this station is the farthest upstream sampling station on the Otter Tail River.

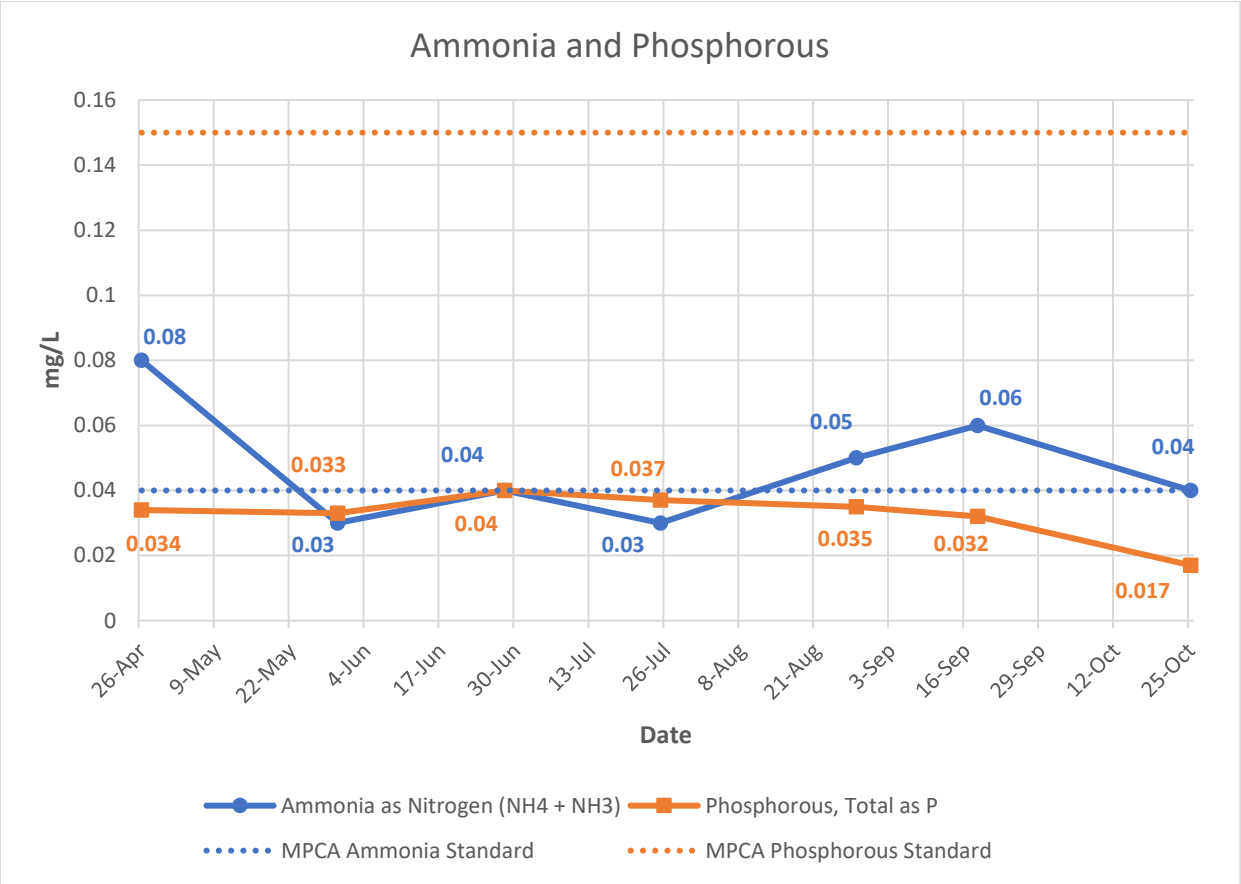

Figure 57. Ammonia and Phosphorous samples collected at S002-003.

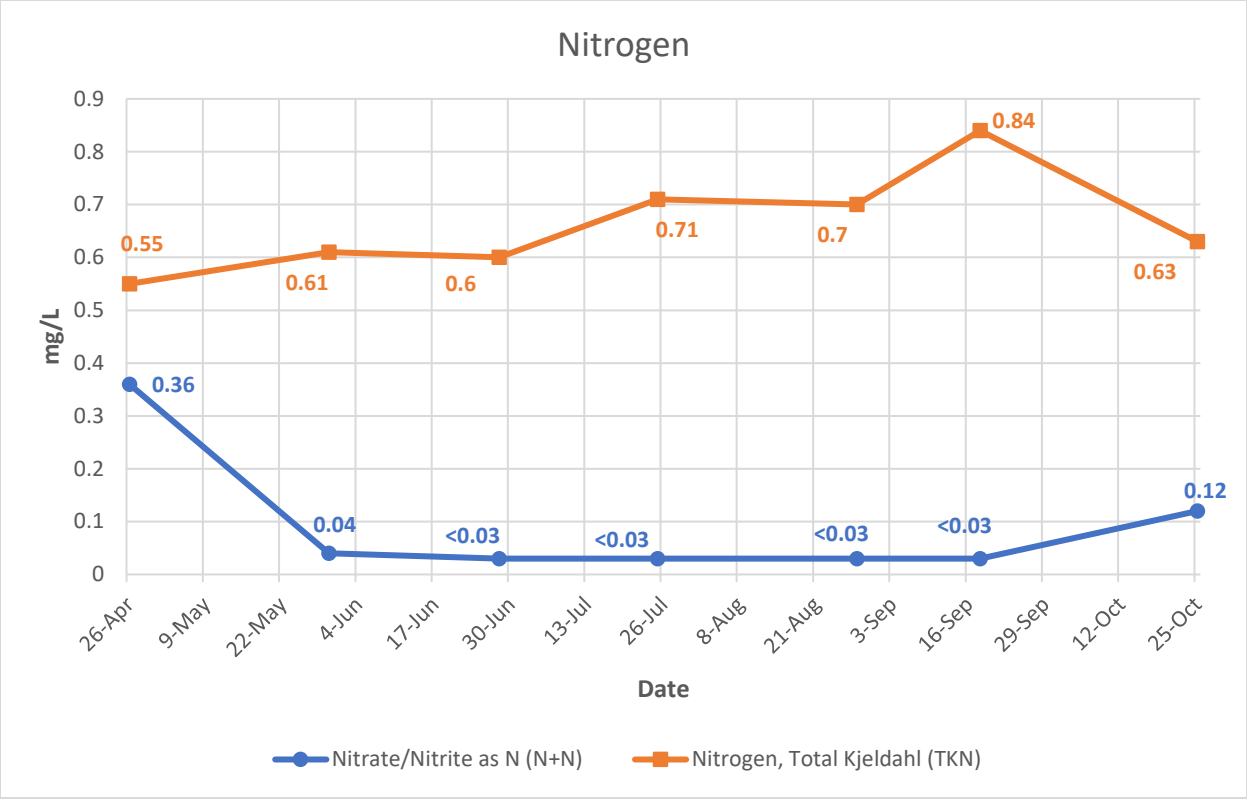

Figure 58. Nitrogen samples collected at S002-003 (MPCA and EPA standards are 10 mg/L).

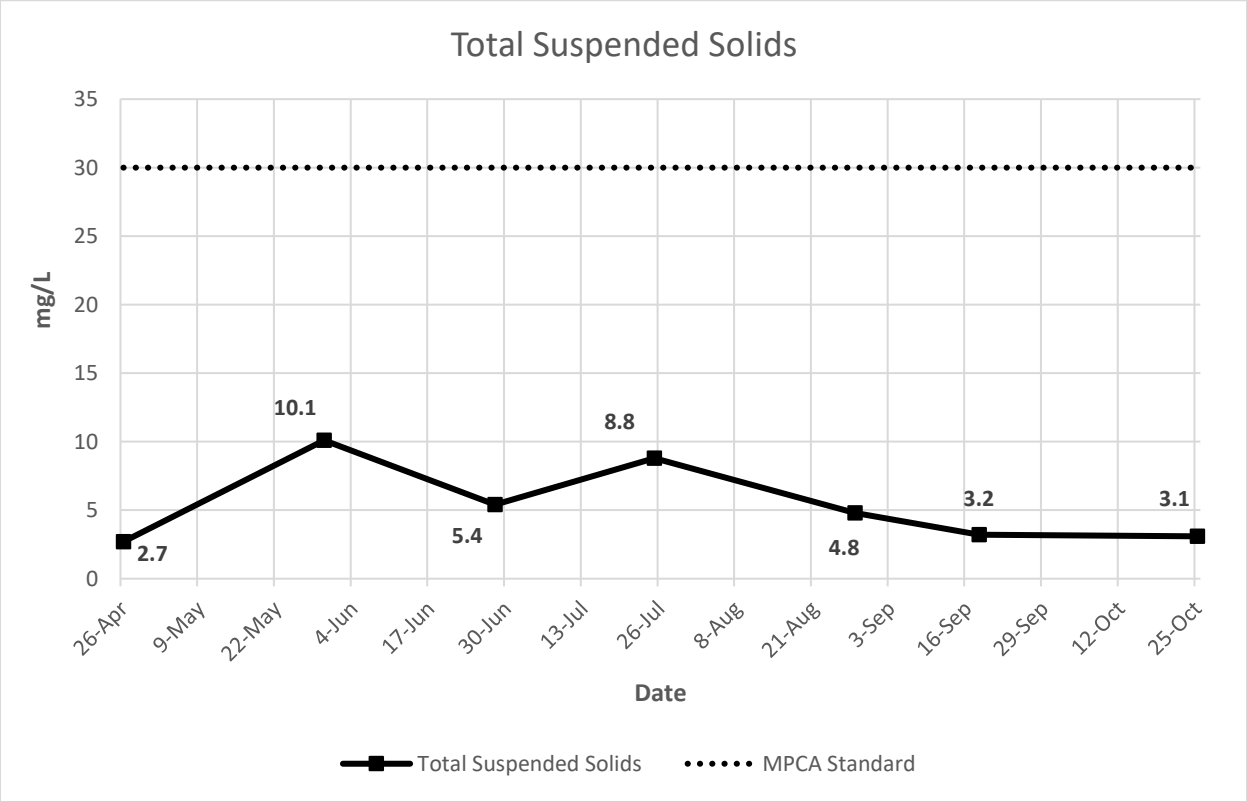

Figure 59. Total Suspended Solids samples collected at S002-003.

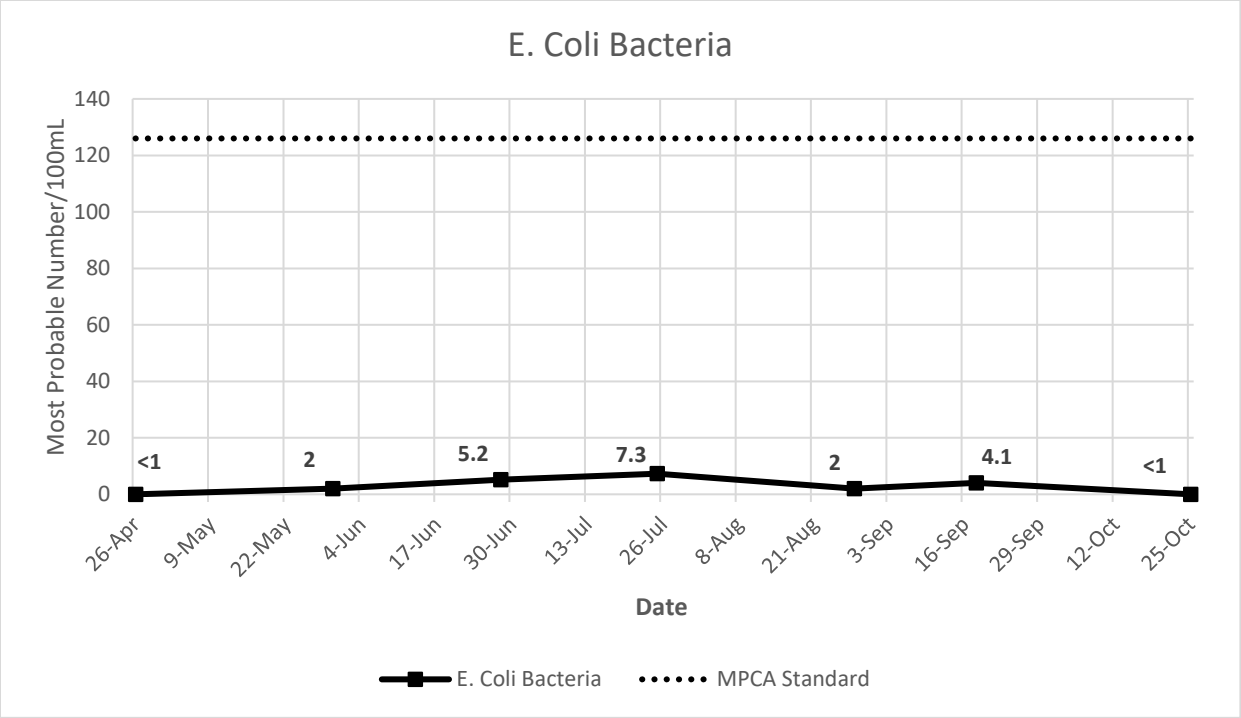

Figure 60. E. Coli Bacteria samples collected at S002-003.

b) <u>S003-166:</u> Located approximately 10 miles downstream of Orwell Dam, this station is located between Sections 26 and 27, Foxhome Township.

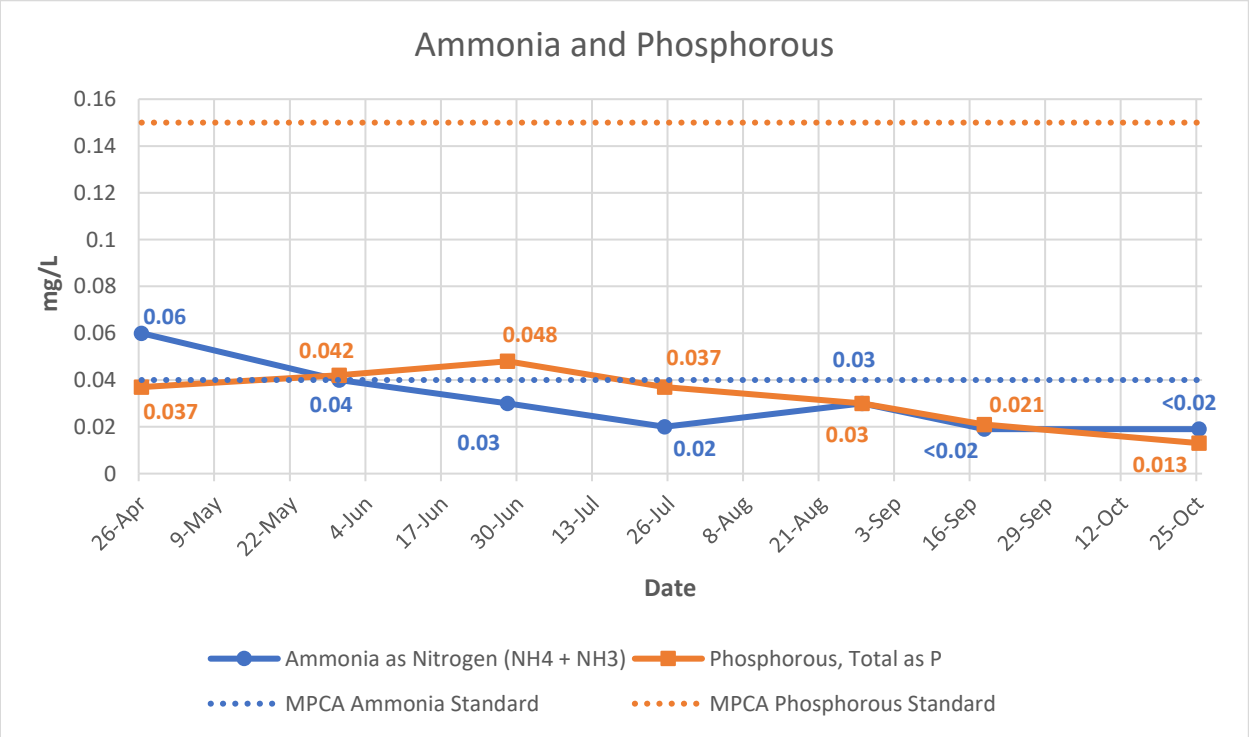

Figure 61. Ammonia and Phosphorous samples collected at S003-166.

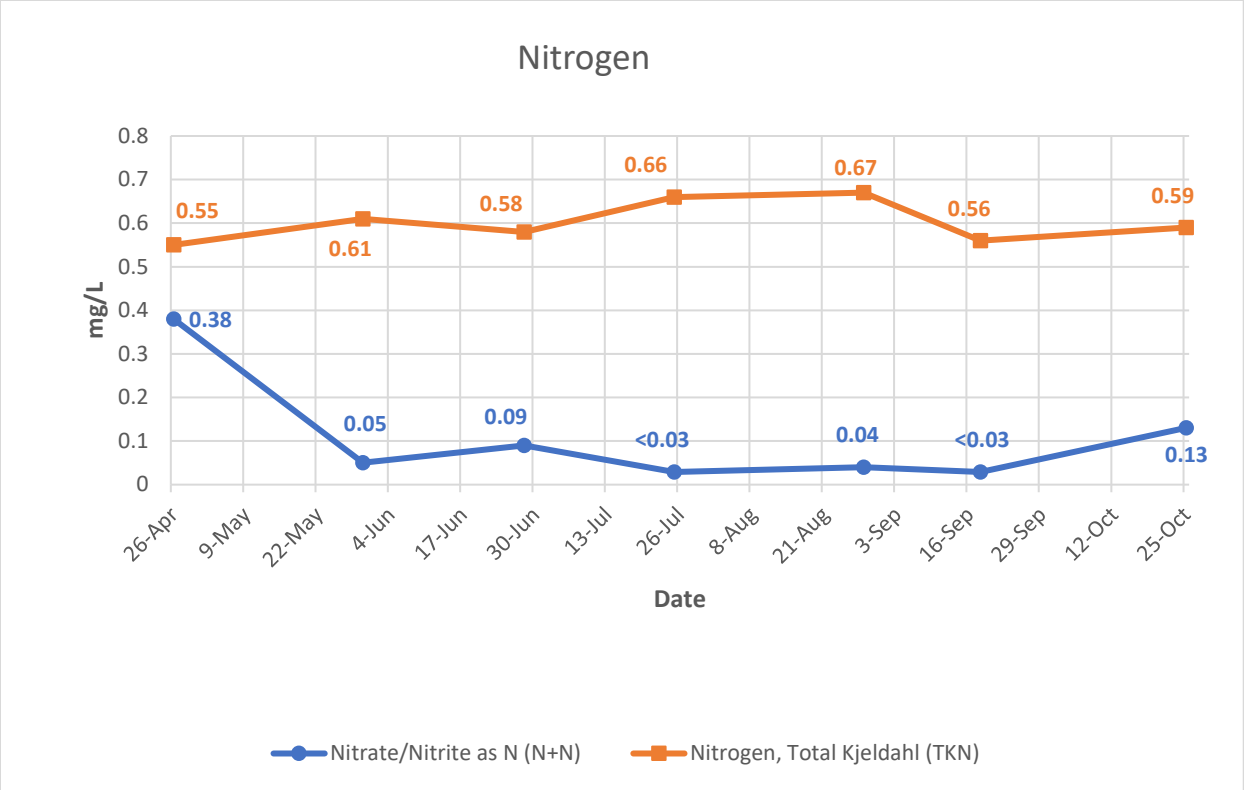

Figure 62. Nitrogen samples collected at S003-166 (MPCA and EPA standards are 10 mg/L).

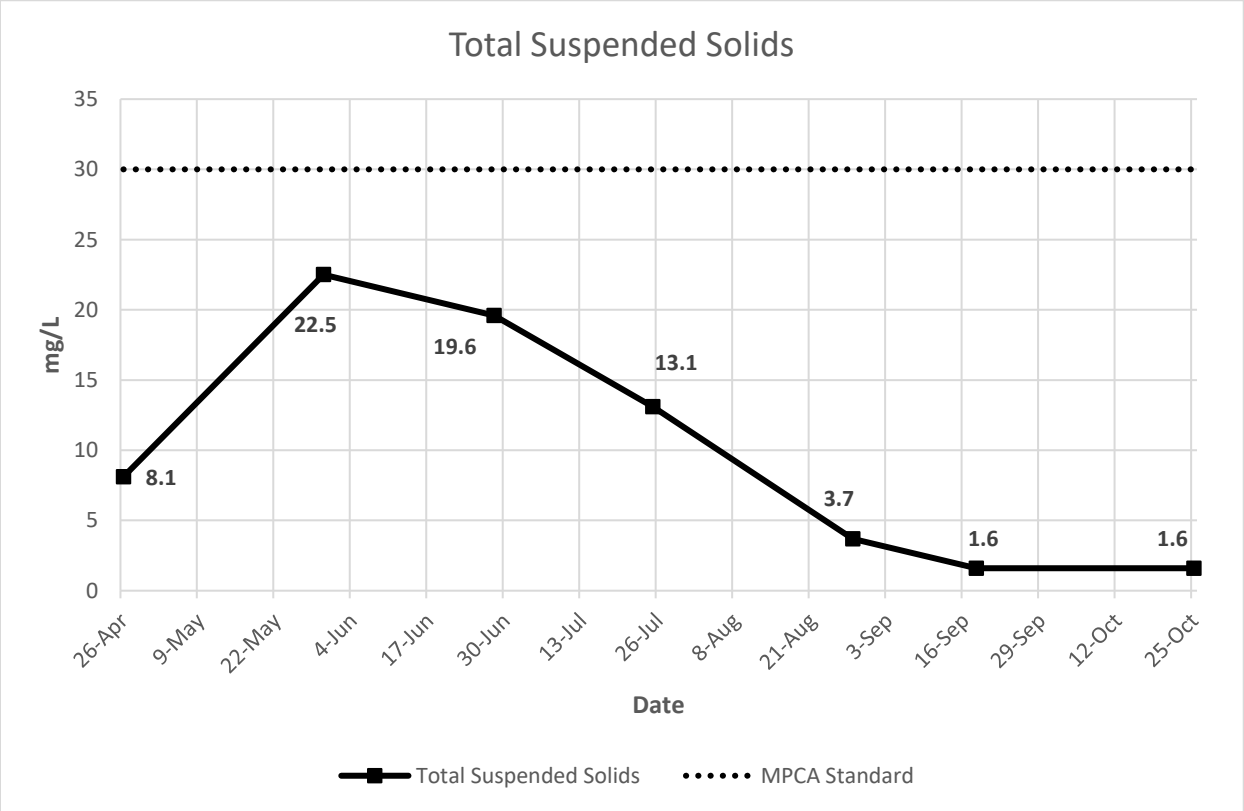

Figure 63. Total Suspended Solids samples collected at S003-166.

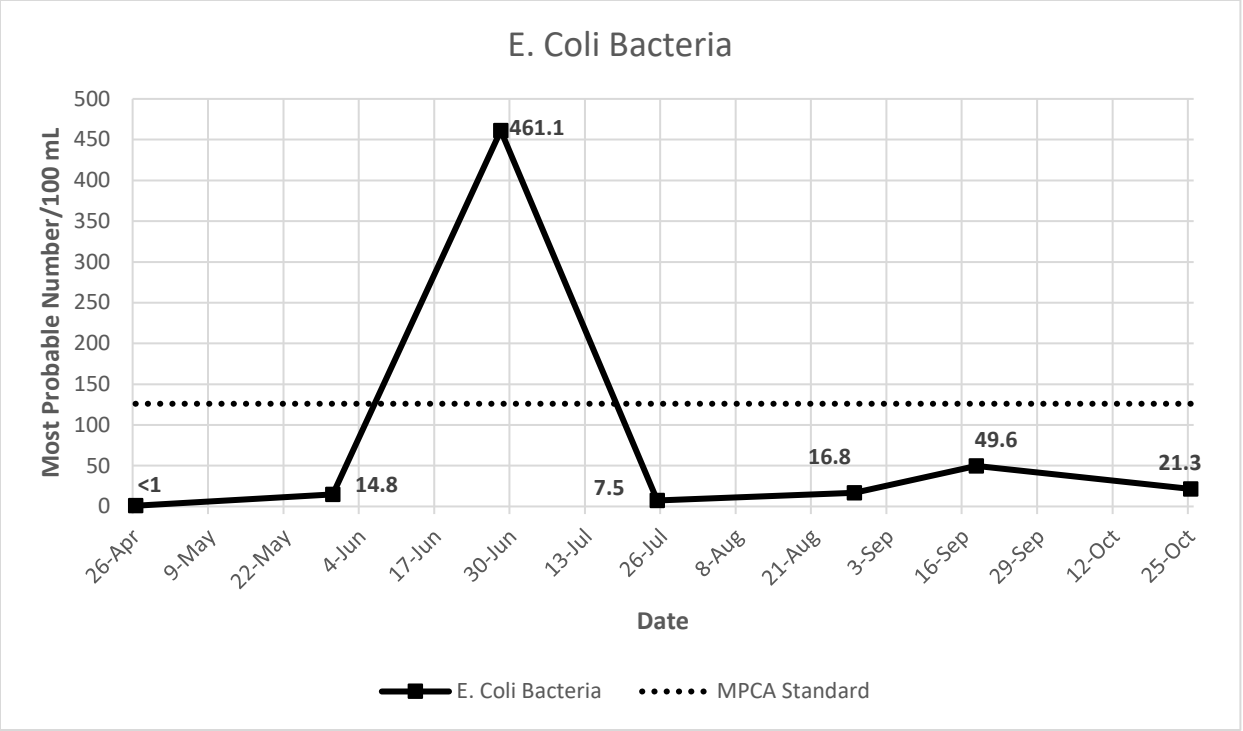

Figure 64. E. Coli Bacteria samples collected at S003-166.

c) <u>S002-000:</u> Located along Wilkin County Road 16 approximately three miles upstream of the confluence of the Red River, S002-000 is the most downstream monitoring station along the Otter Tail River.

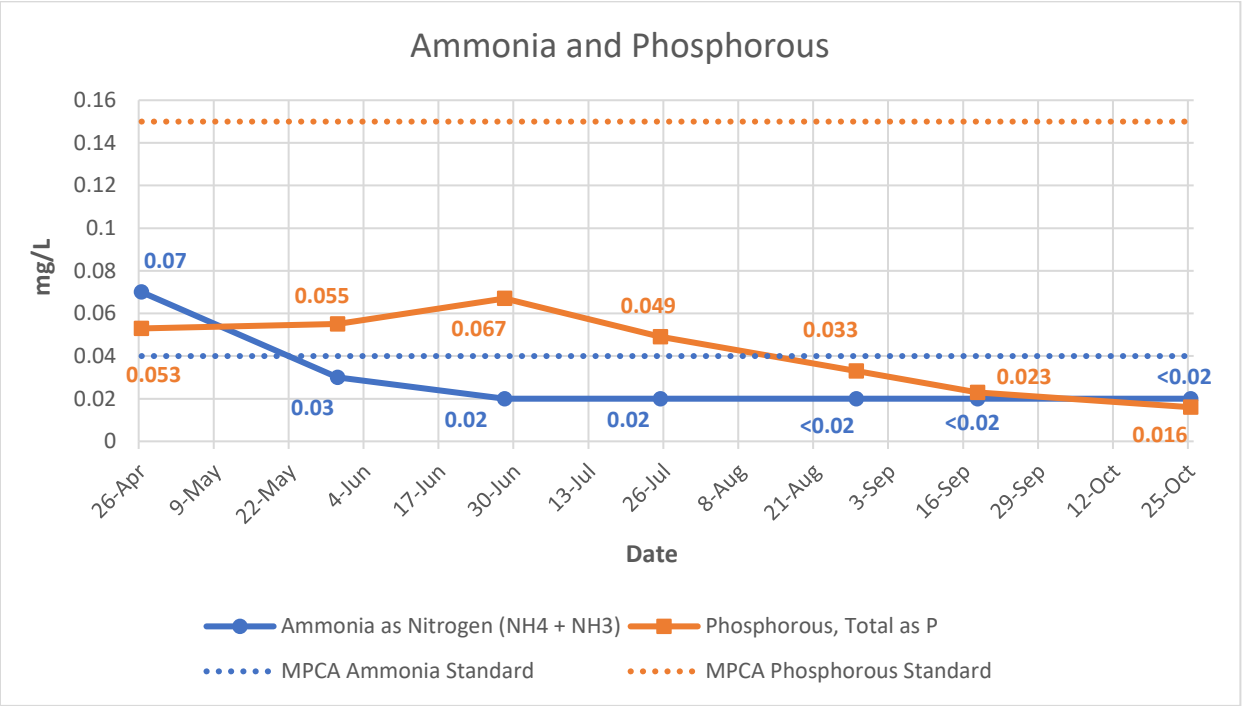

Figure 65. Ammonia and Phosphorous samples collected at S002-000.

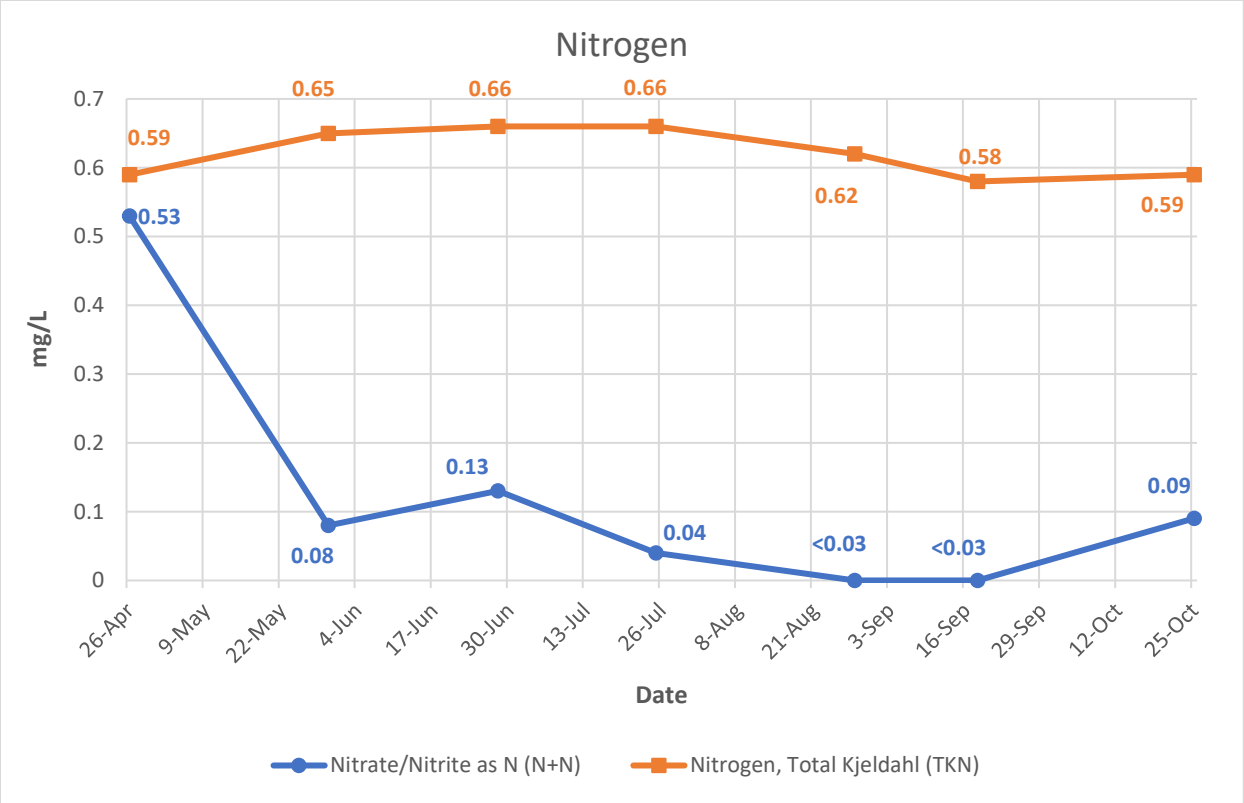

Figure 66. Nitrogen samples collected at S002-000.

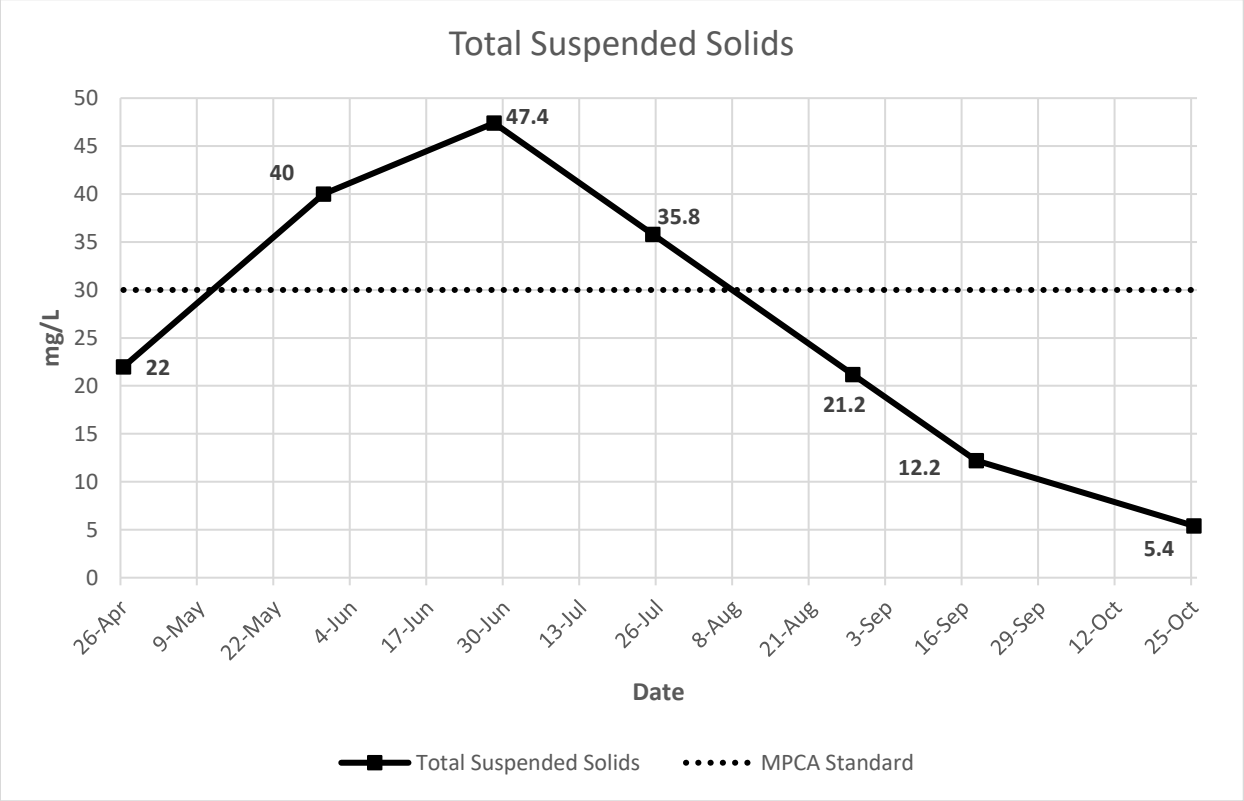

Figure 67. Total Suspended Solids samples collected at S002-000.

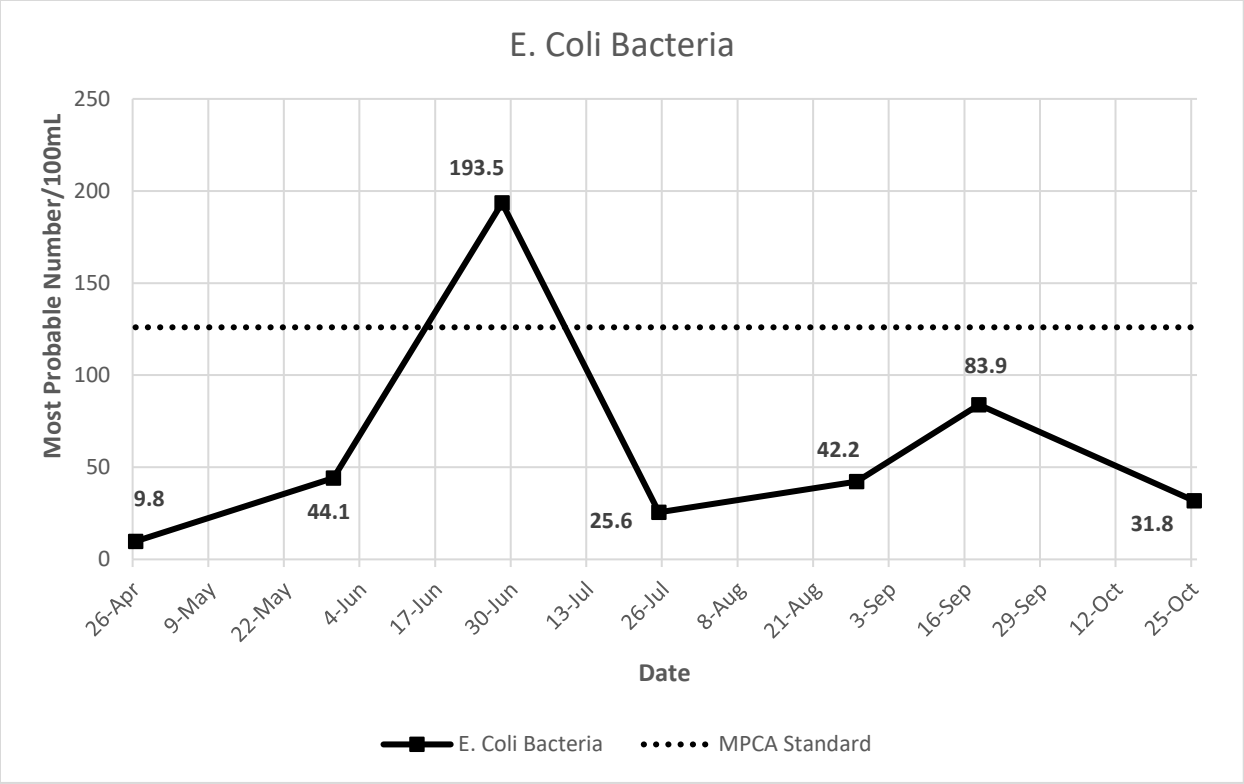

Figure 68. E. Coli Bacteria samples collected at S002-000.

4. Whisky Creek

Whisky Creek is a tributary to the South Branch Buffalo River, beginning at Whisky Lake between Sections 25 and 36, Tansem Township, Clay County. The first sampling station on Whisky Creek is located near Barnesville, approximately 20 miles downstream from the headwaters. In Barnesville, Whisky Creek runs underneath State Highway 34 and outlets into a pond that catches sediment from entering Blue Eagle Lake. Rock riffles were installed on the west side of this pond, where Whisky Creek continues westward until it connects with the South Branch Buffalo River in Section 9, Alliance Township. The portion of Whisky Creek downstream of Clay County Highway 2 west of Barnesville is also known as Clay County Ditch No. 34.

a) S004-998: Located in Section 19, Barnesville Township along the north side of State Highway 34 before Whisky Creek connects with the sediment catchment pond in the Central planning region.

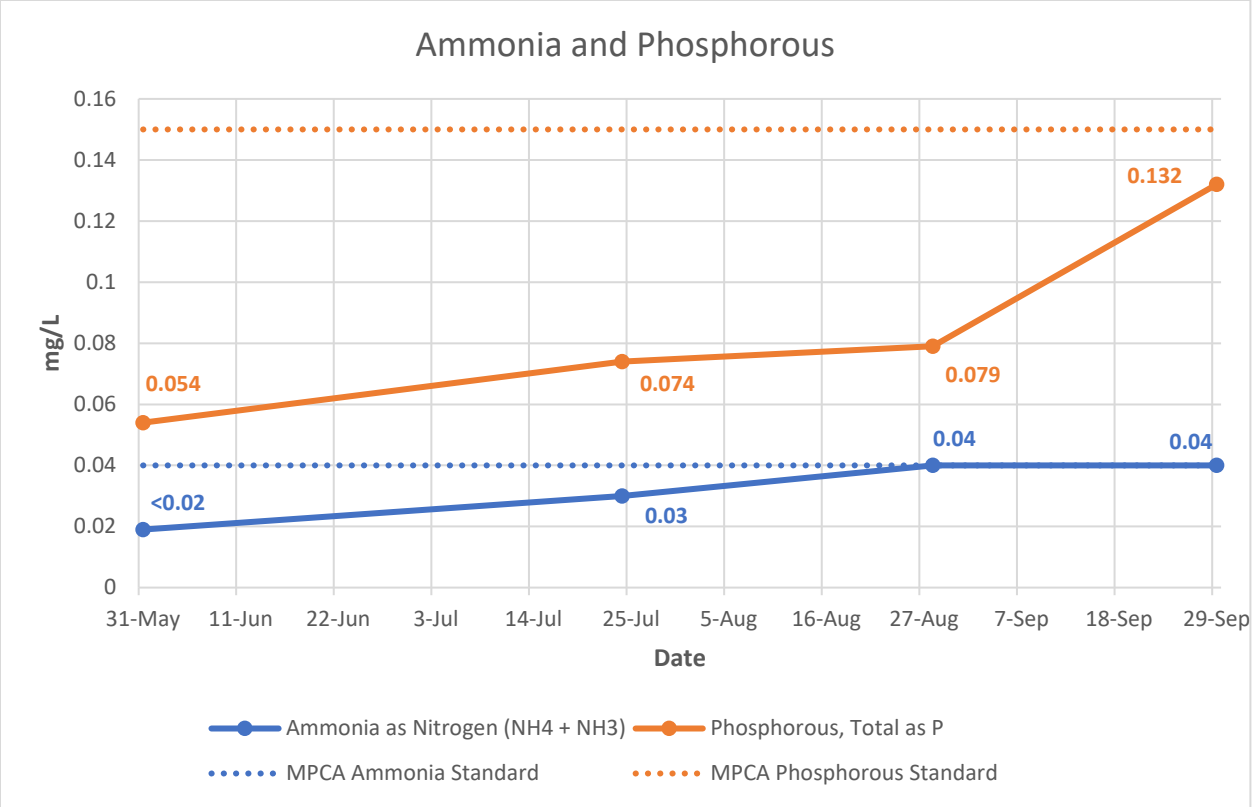

Figure 69. Ammonia and Phosphorous samples collected at S004-998.

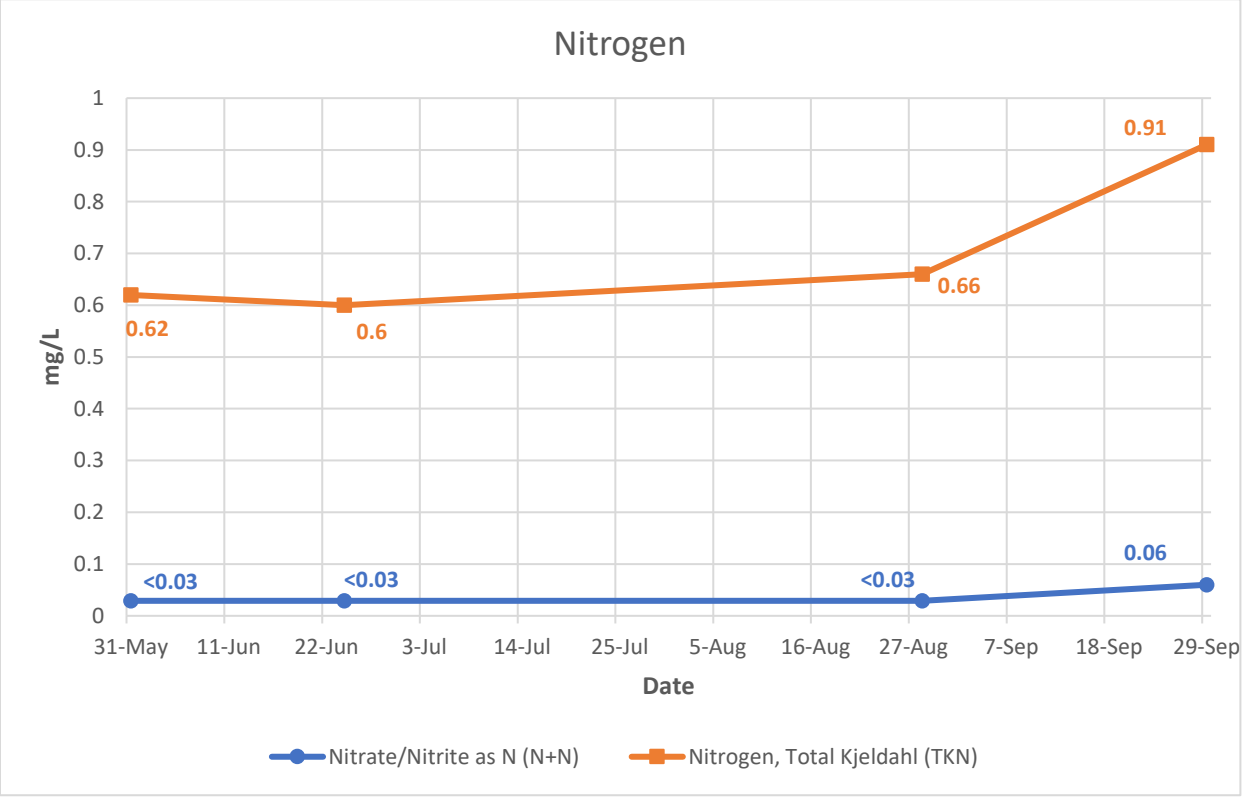

Figure 70. Nitrogen samples collected at S004-998 (MPCA and EPA standards are 10 mg/L).

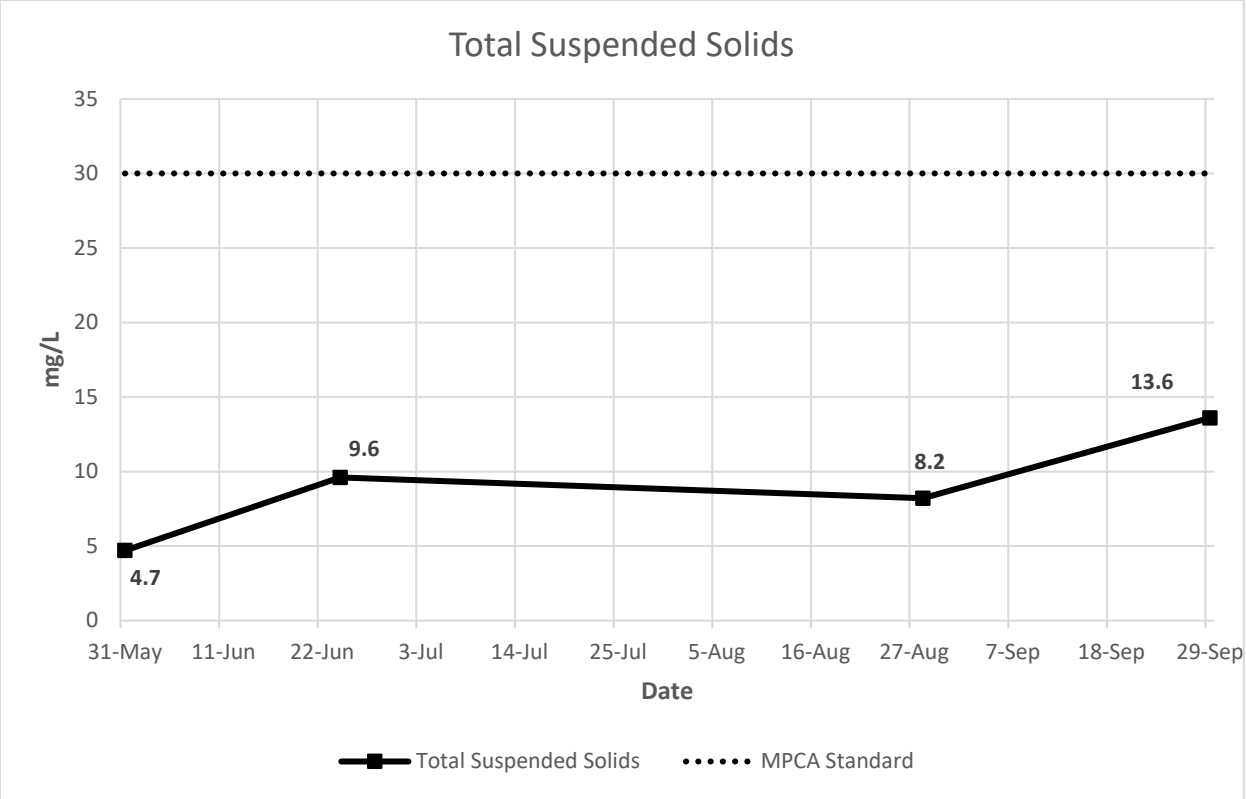

Figure 71. Total Suspended Solids samples collected at S004-998.

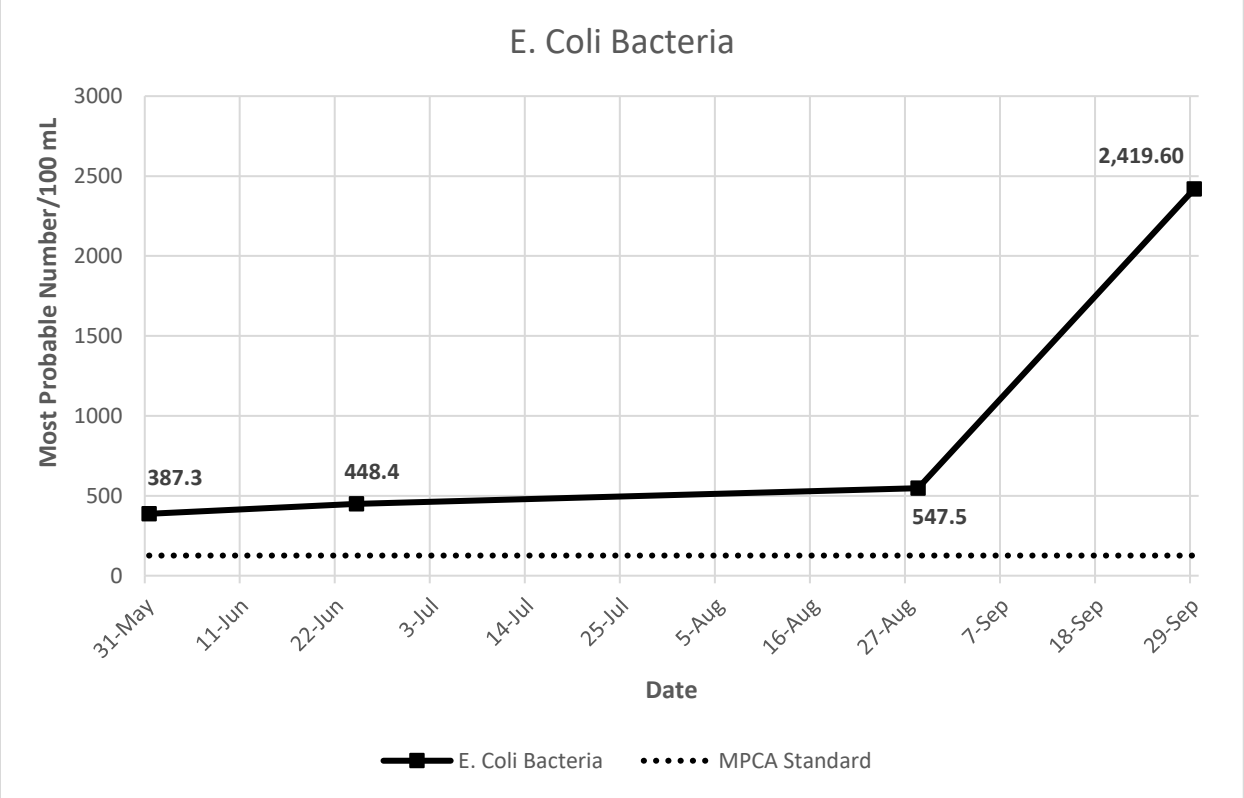

Figure 72. E. Coli Bacteria samples collected at S004-998.

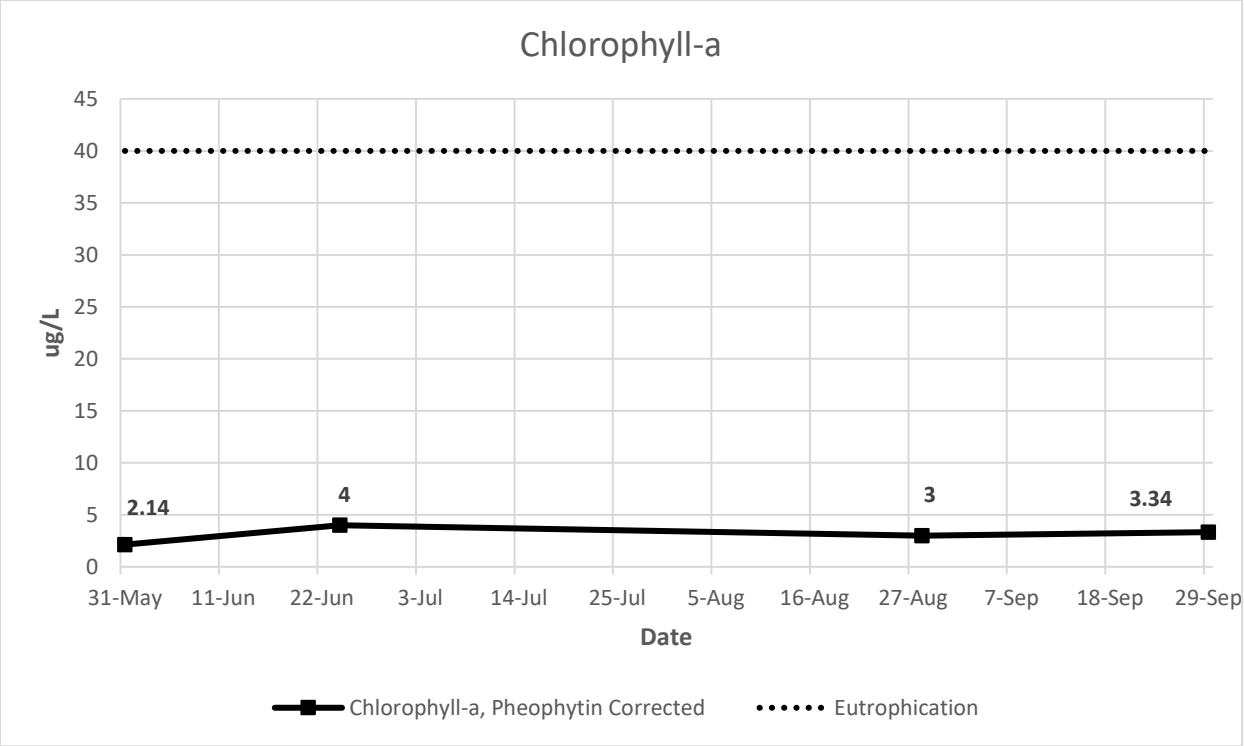

Figure 73. Chlorophyll samples collected at S004-998.

b) <u>S007-455:</u> Located along the rock riffles at the outlet of the sediment catchment pond near Blue Eagle Lake in Barnesville in the Central planning region.

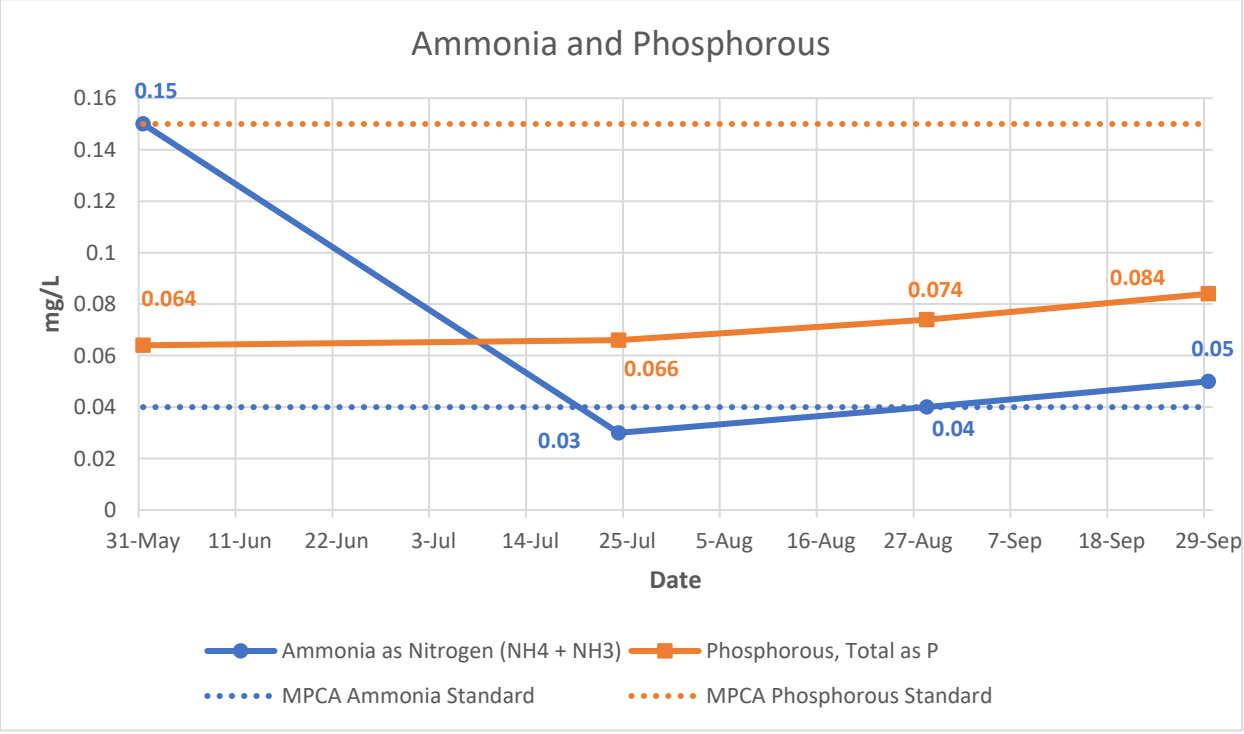

Figure 74. Ammonia and Phosphorous samples collected at S007-455.

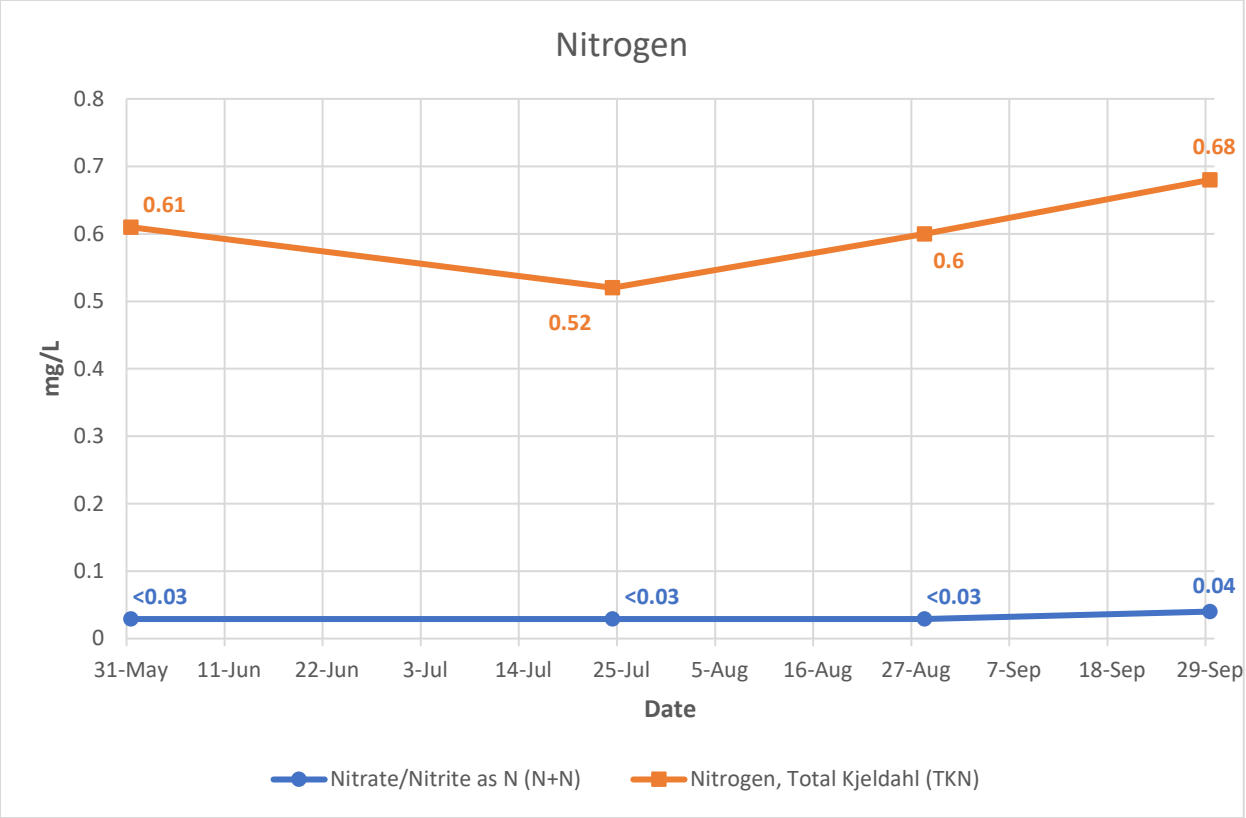

Figure 75. Nitrogen samples collected at S007-455 (MPCA and EPA standards are 10 mg/L).

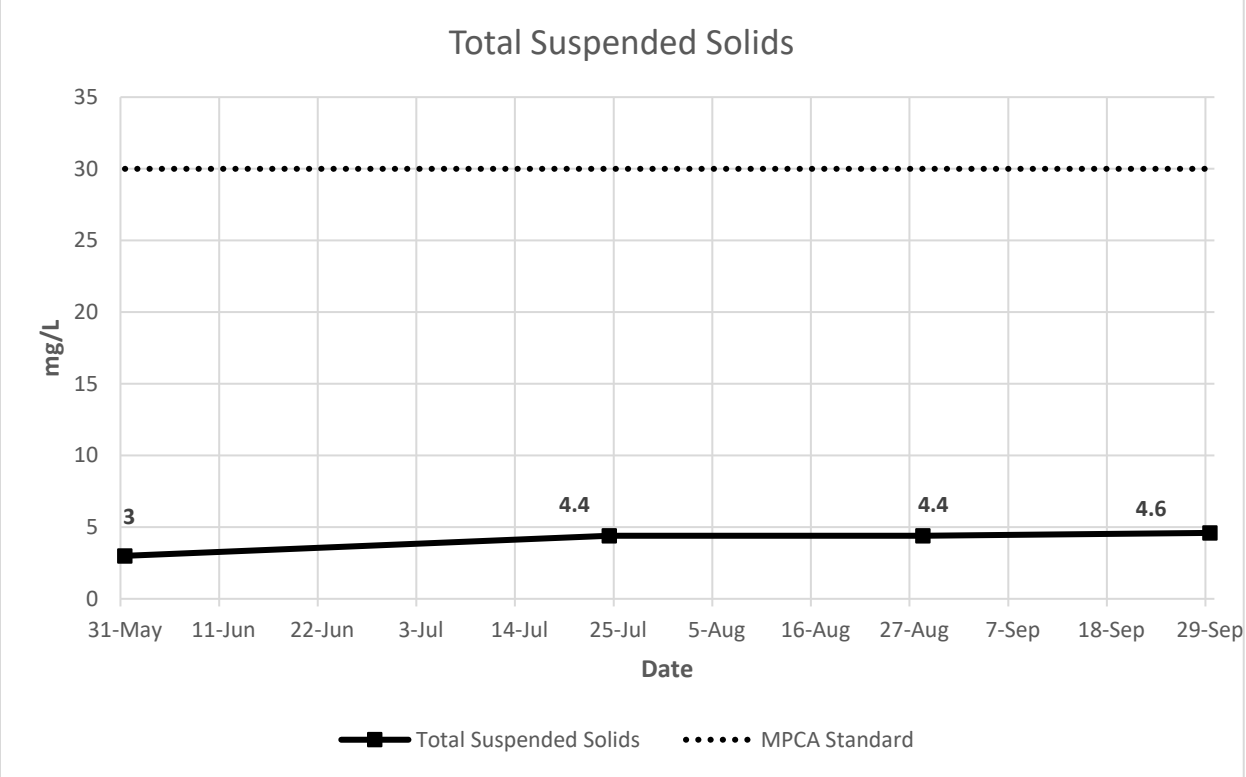

Figure 76. Total Suspended Solids samples collected at S007-455.

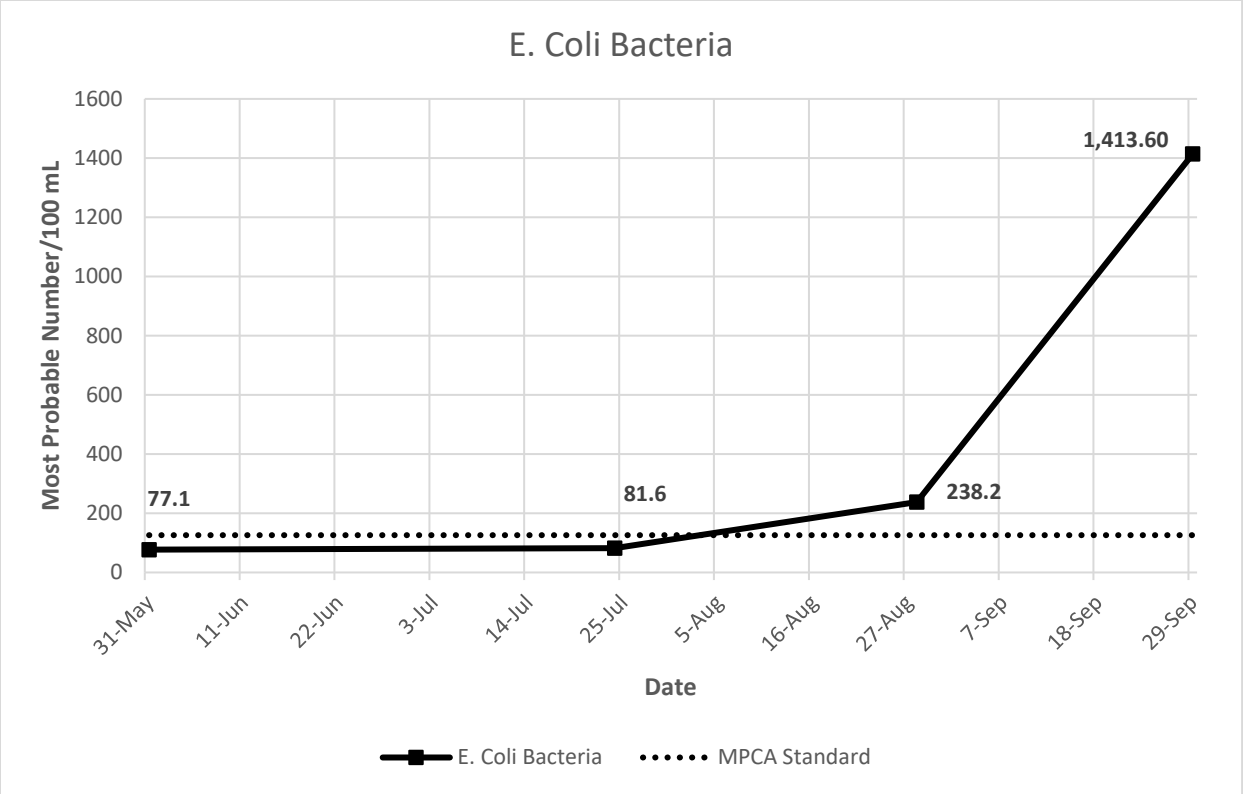

Figure 77. E. Coli Bacteria samples collected at S007-455.

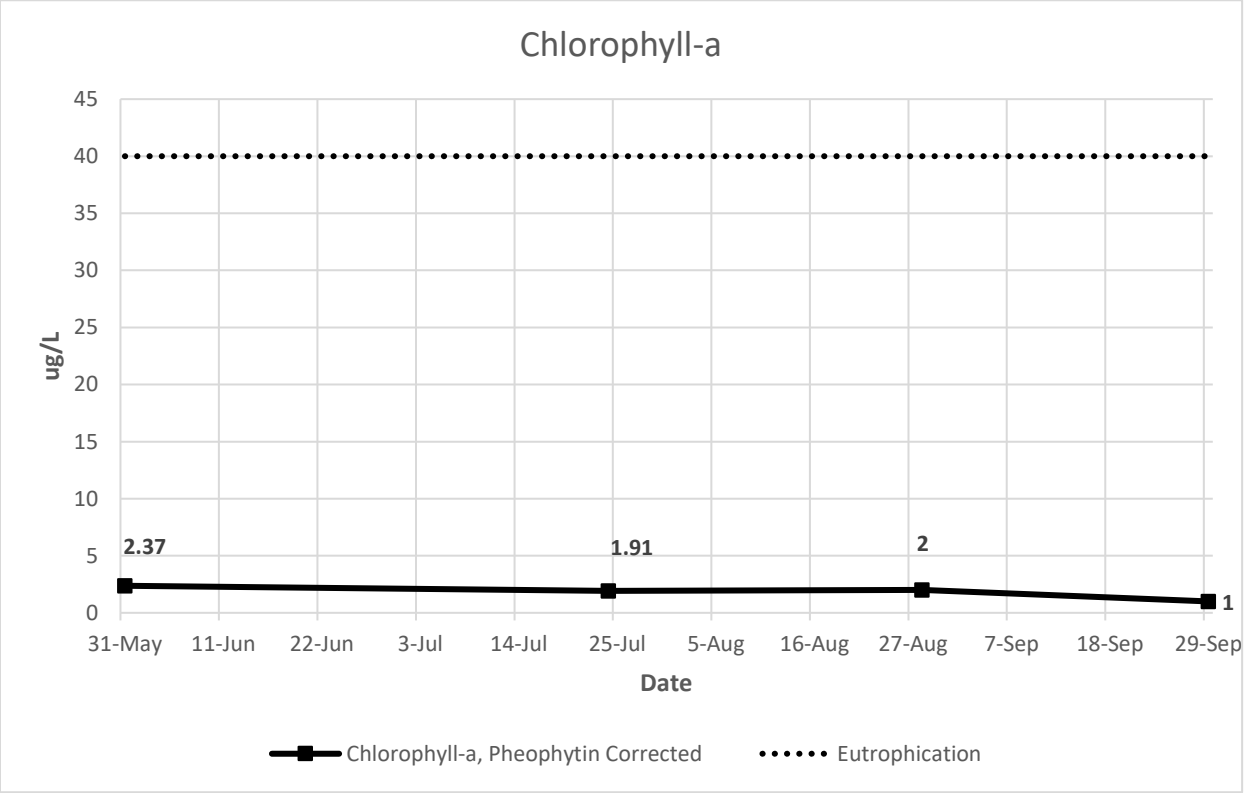

Figure 78. Chlorophyll samples collected at S007-455.

c) <u>S005-607:</u> Located approximately 15 river miles downstream of S007-455, this station is located upstream of where Whisky Creek outlets into the South Branch Buffalo River in Section 9, Alliance Township in the Central planning region.

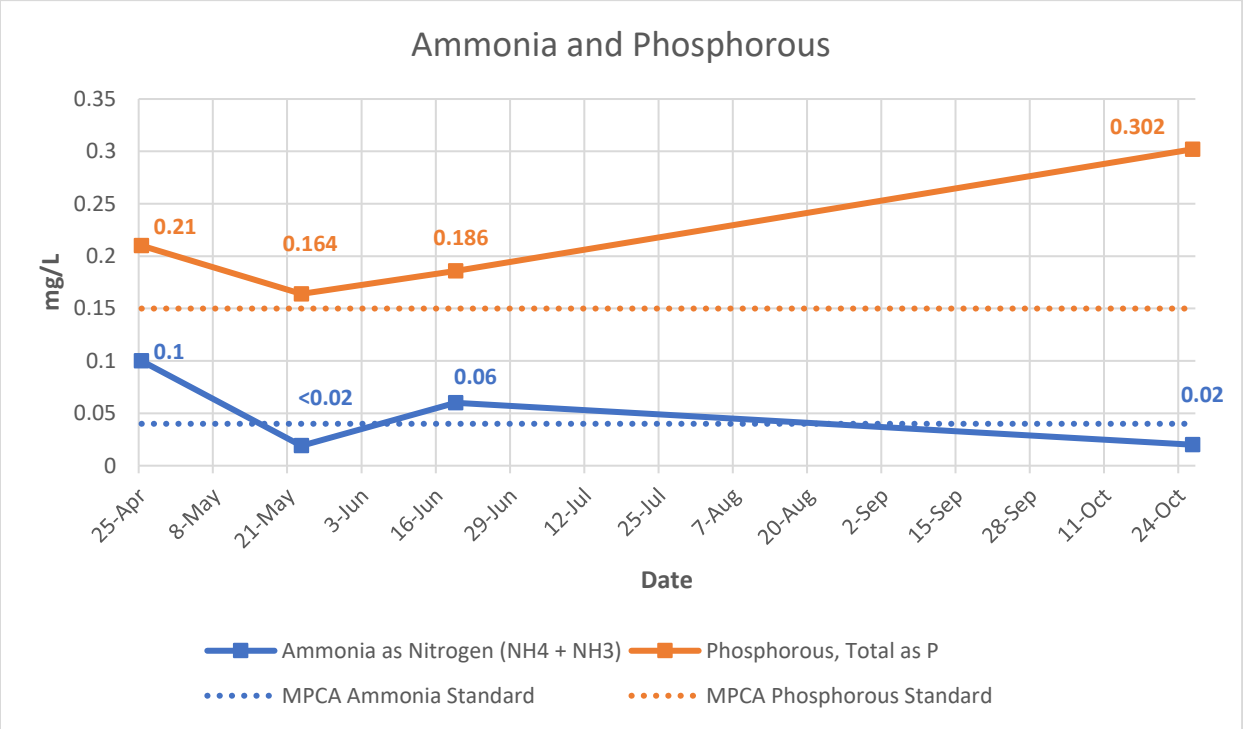

Figure 79. Ammonia and Phosphorous samples collected at S005-607.

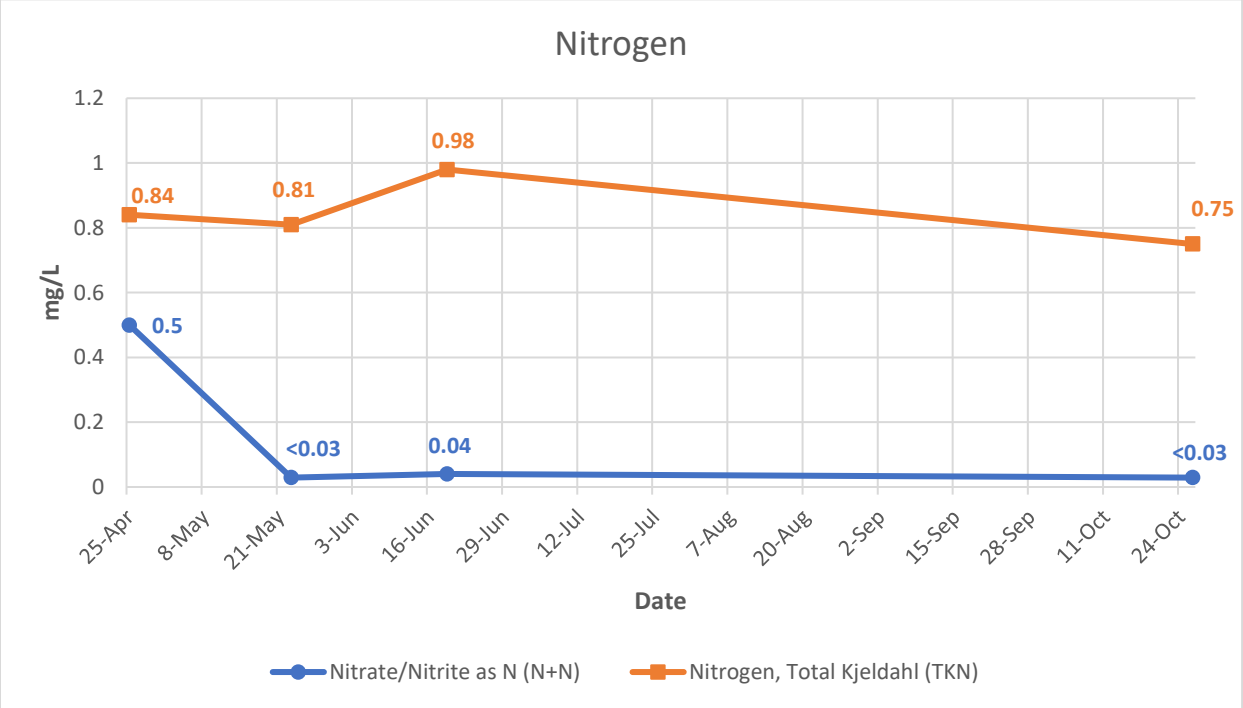

Figure 80. Nitrogen samples collected at S005-607 (MPCA and EPA standards are 10 mg/L).

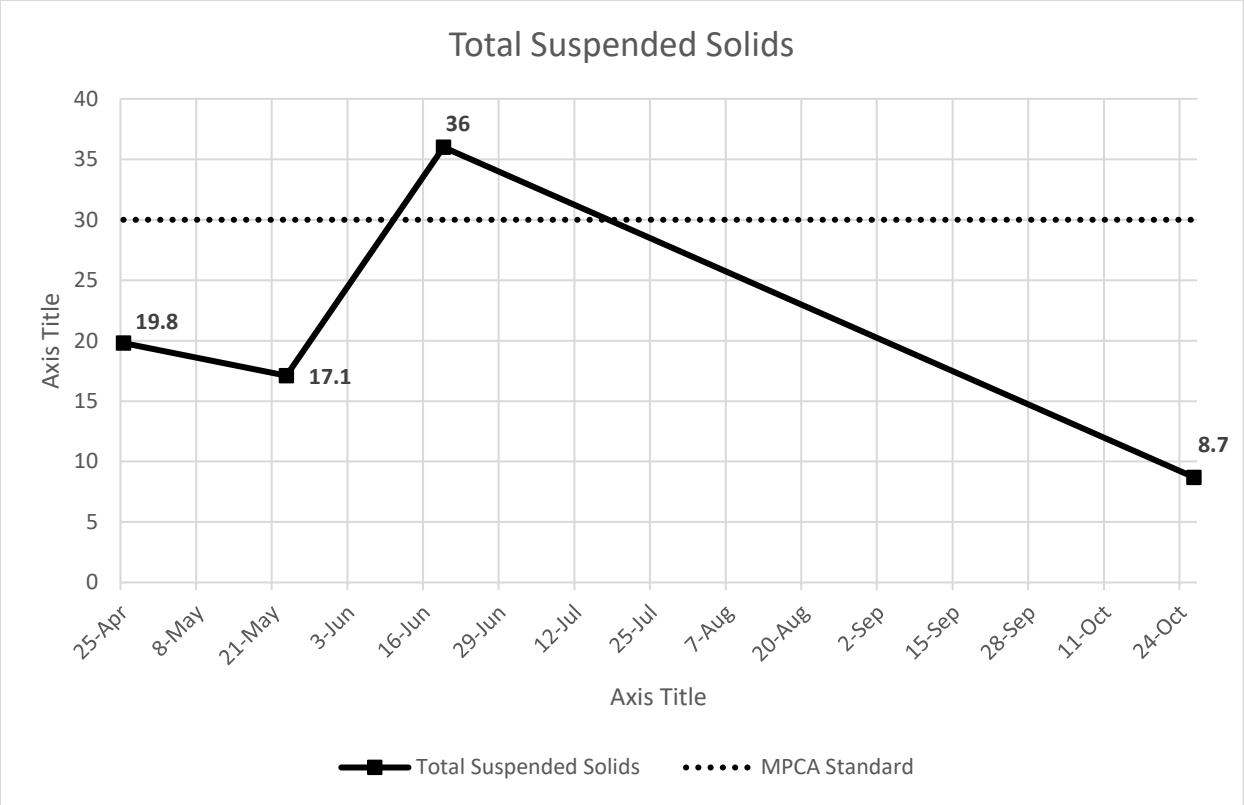

Figure 81. Total Suspended Solids samples collected at S005-607.

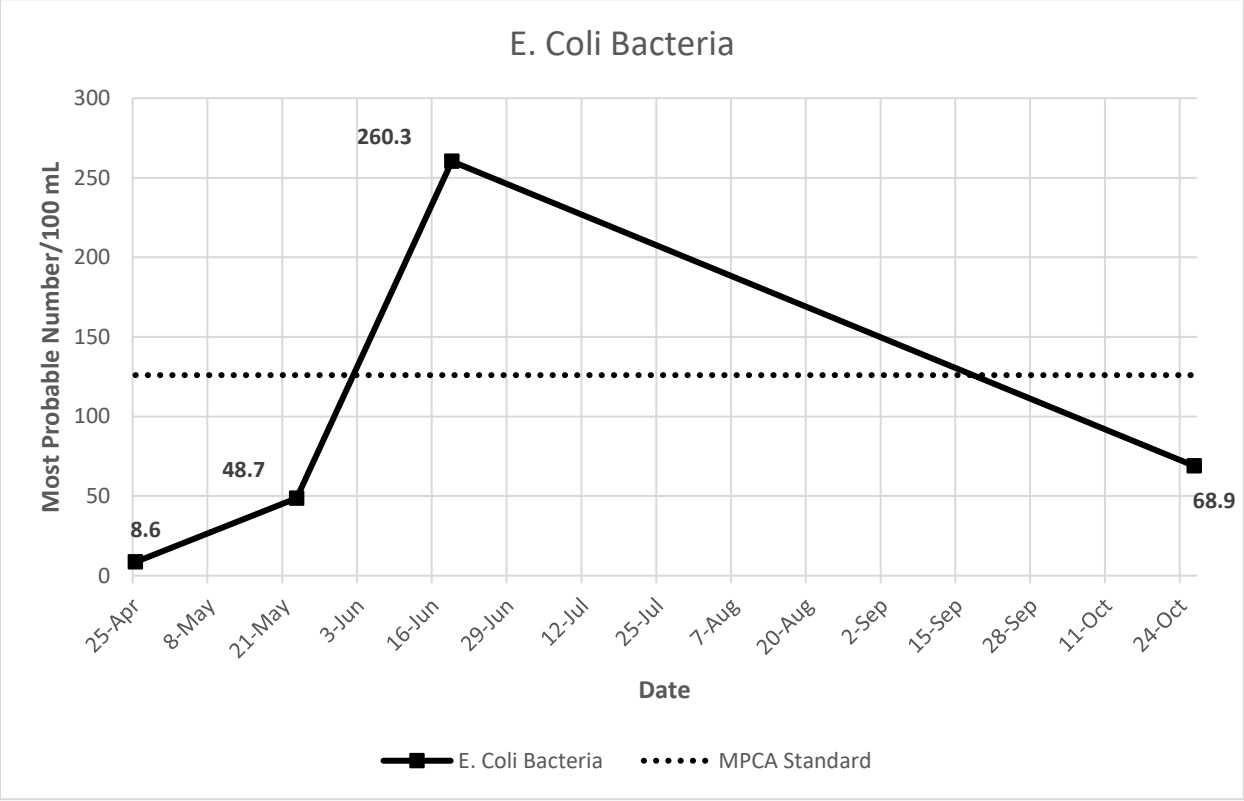

Figure 82. E. Coli Bacteria samples collected at S005-607.

5. *Hay Creek*

Hay Creek is a small tributary starting three miles south of Lake Park. This tributary is the outlet of Stakke Lake, flowing north and west for approximately 15 miles, running through Roberg Lake, Stinking Lake, and several wetlands prior to connecting with the Buffalo River at Winnipeg Junction. There are two sampling stations along Hay Creek, both are located within the Mainstem planning region.

a) S005-133: Located where Hay Creek crosses under 130th Ave to the east of Stinking Lake.

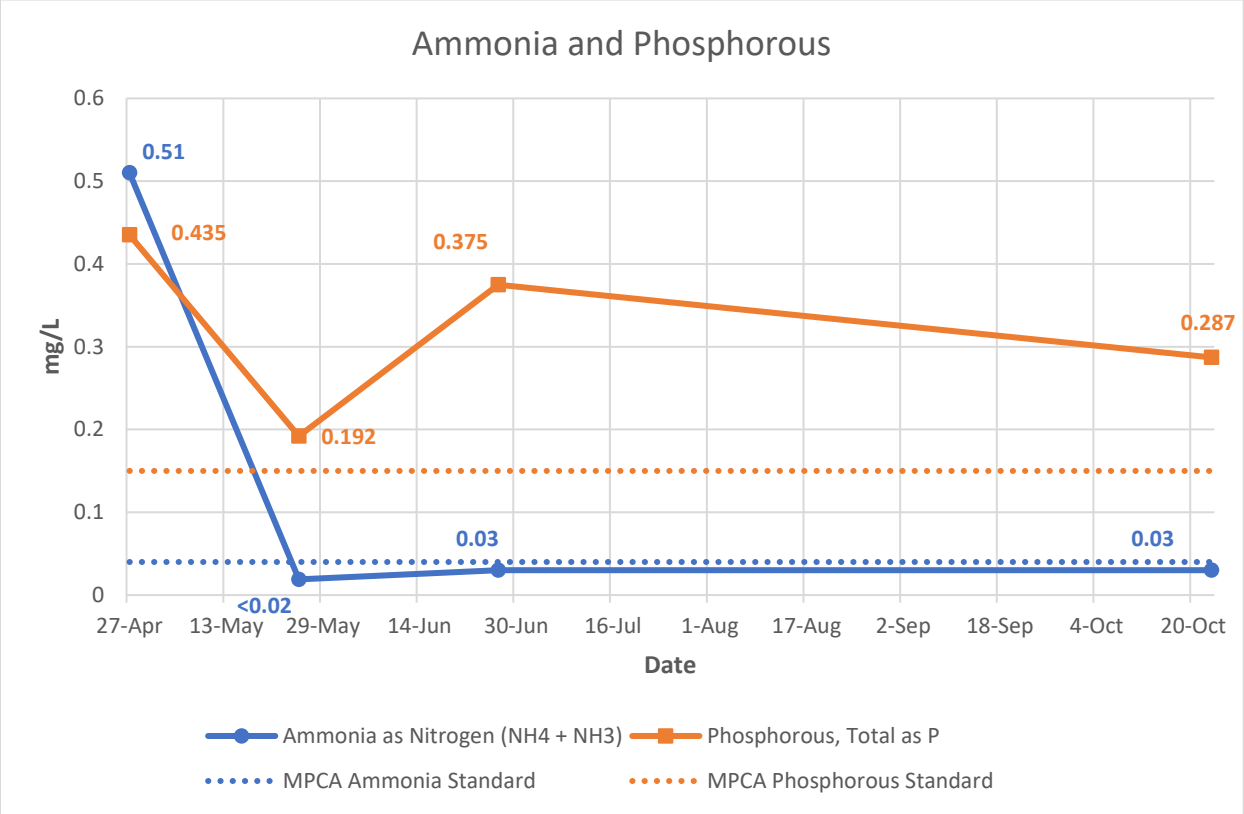

Figure 83. Ammonia and Phosphorous samples collected at S005-133.

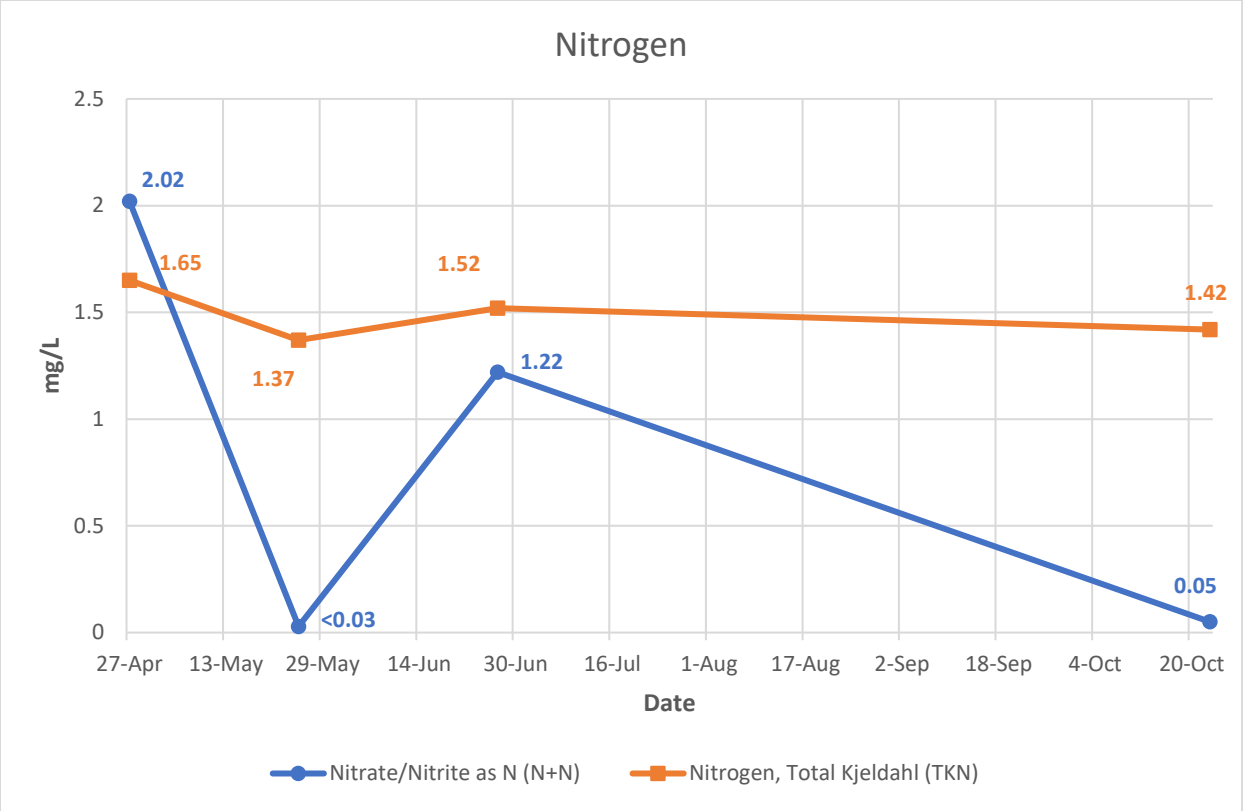

Figure 84. Nitrogen samples collected at S005-133 (MPCA and EPA standards are 10 mg/L).

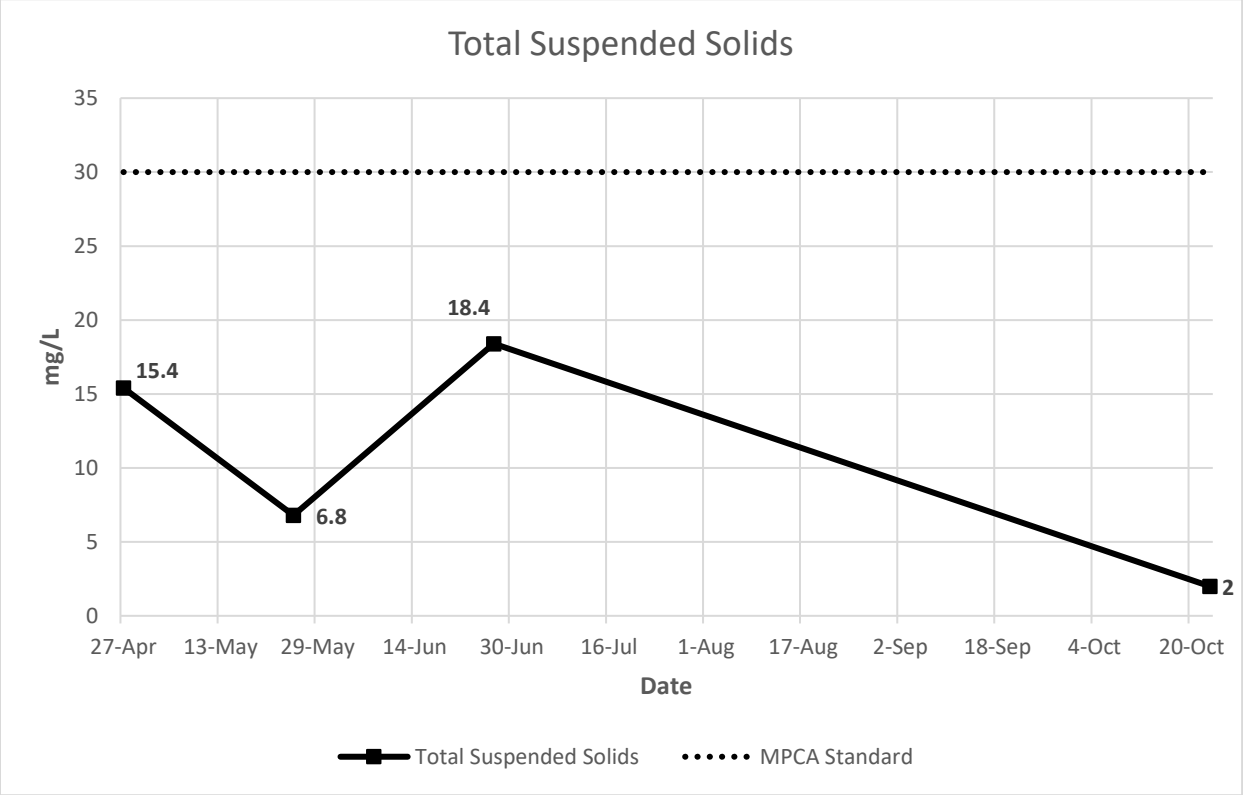

Figure 85. Total Suspended Solids samples at S005-133.

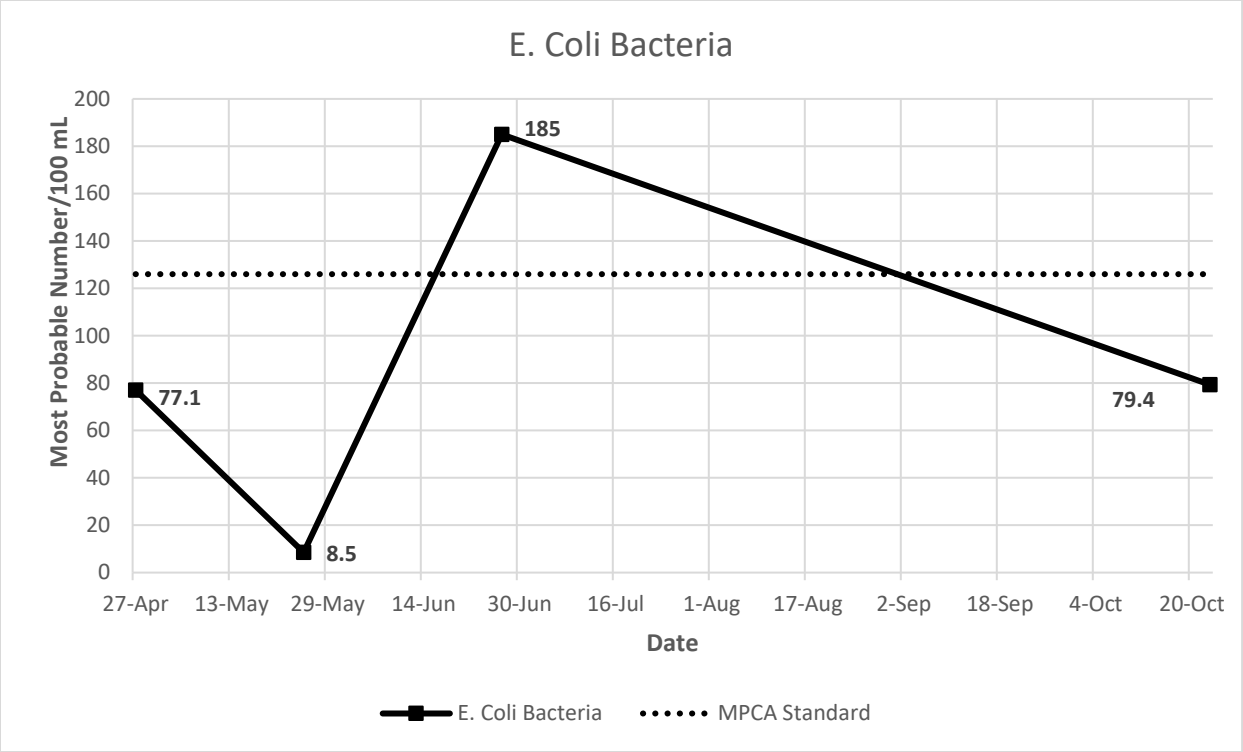

Figure 86. E. Coli Bacteria samples collected at S005-133.

b) <u>S005-606:</u> Located along 265th St N, approximately 0.25 miles before Hay Creek connects with the Red River.

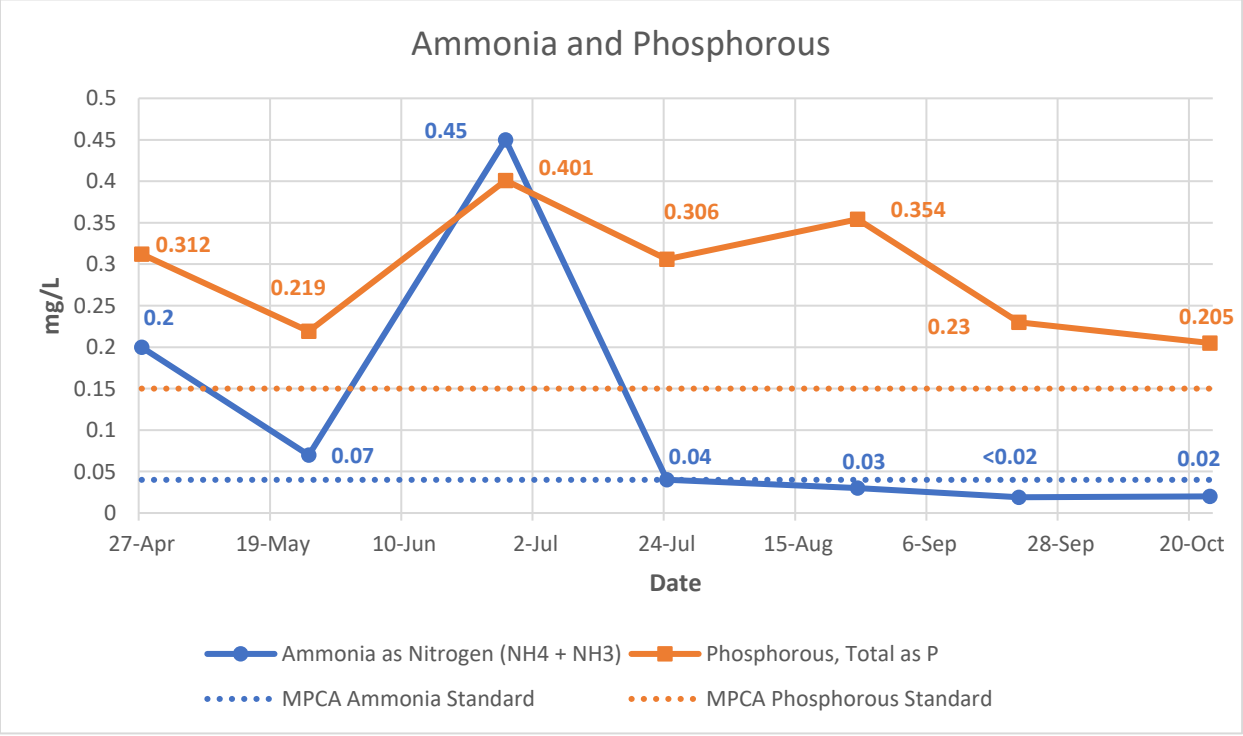

Figure 87. Ammonia and Phosphorous samples collected at S005-606.

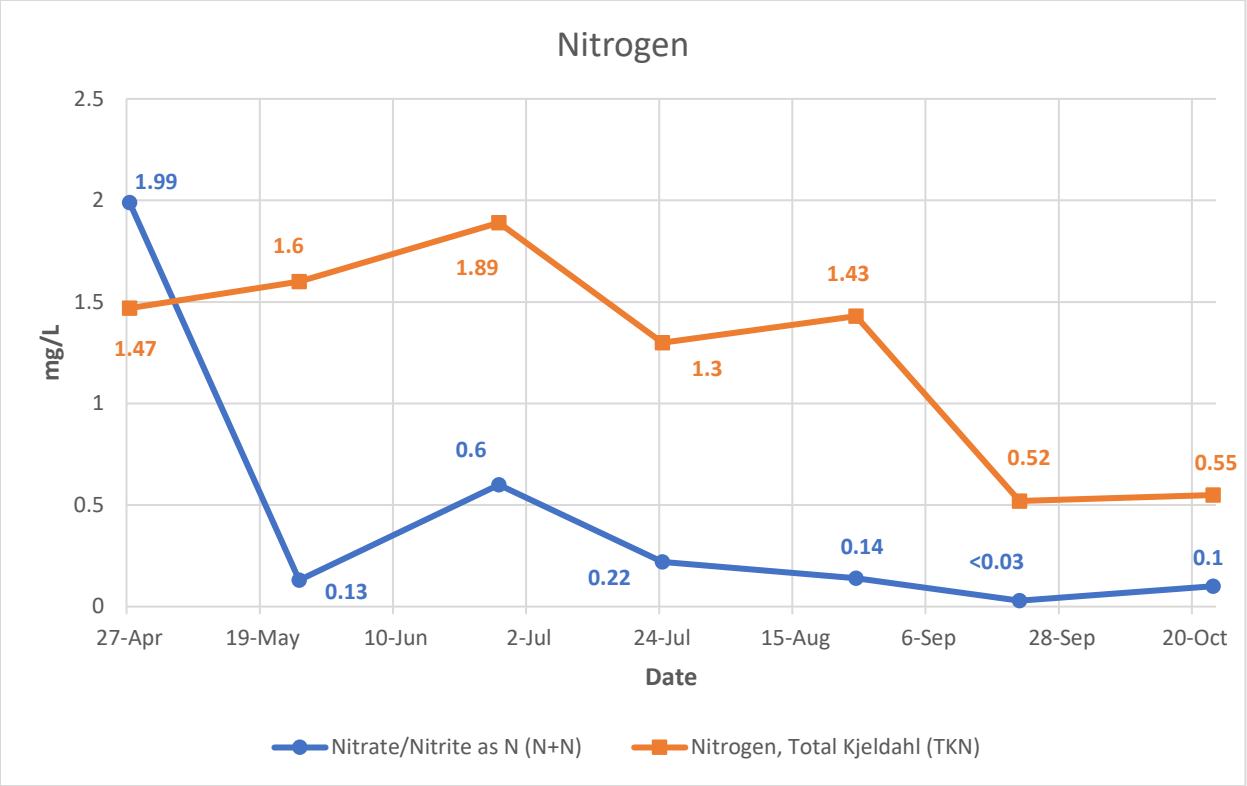

Figure 88. Nitrogen samples collected at S005-606 (MPCA and EPA standards are 10 mg/L).

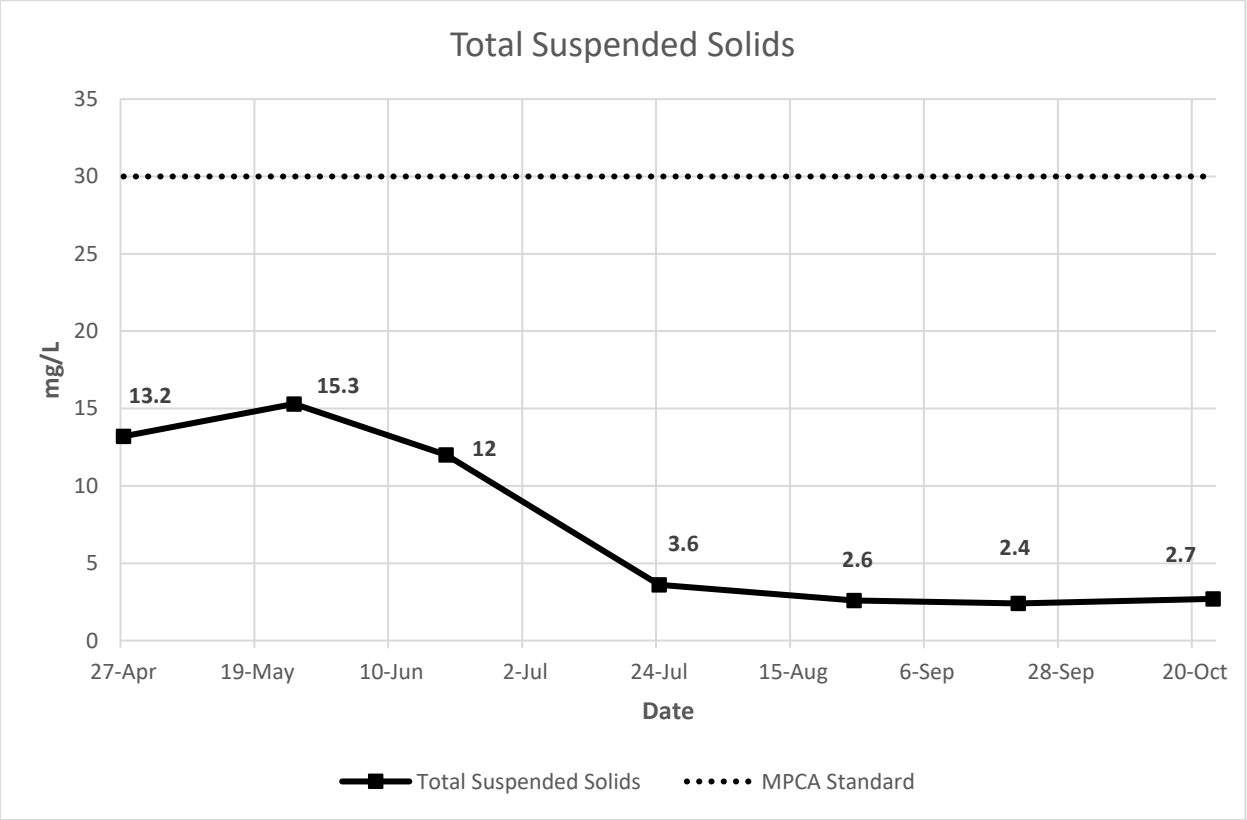

Figure 89. Total Suspended Solids samples collected at S005-606.

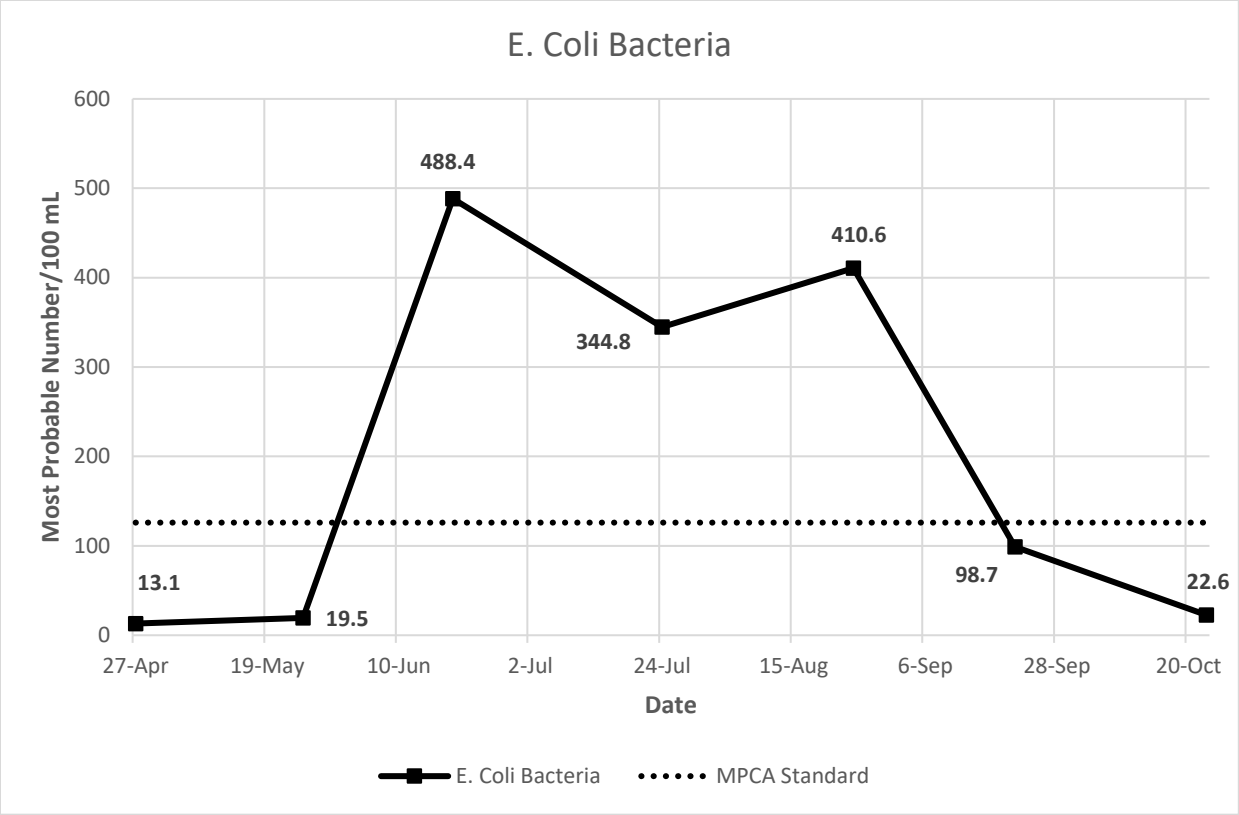

Figure 90. E. Coli Bacteria samples collected at S005-606.

6. *Stony Creek*

Stony Creek is a mid-sized tributary that outlets into the South Branch Buffalo River near Sabin. Stony Creek starts from the body of water on the west side of Barnesville Management Area in Section 12, Elkton township, flowing mostly westward for nearly 40 miles through Humboldt, Barnesville, and Elmwood Townships until connecting with the South Branch in Section 16, Elmwood Township. There are two monitoring stations along Stony Creek, both within the Central planning region.

a) S003-312: Located along 140th St S between Sections 4 and 5, Barnesville Township.

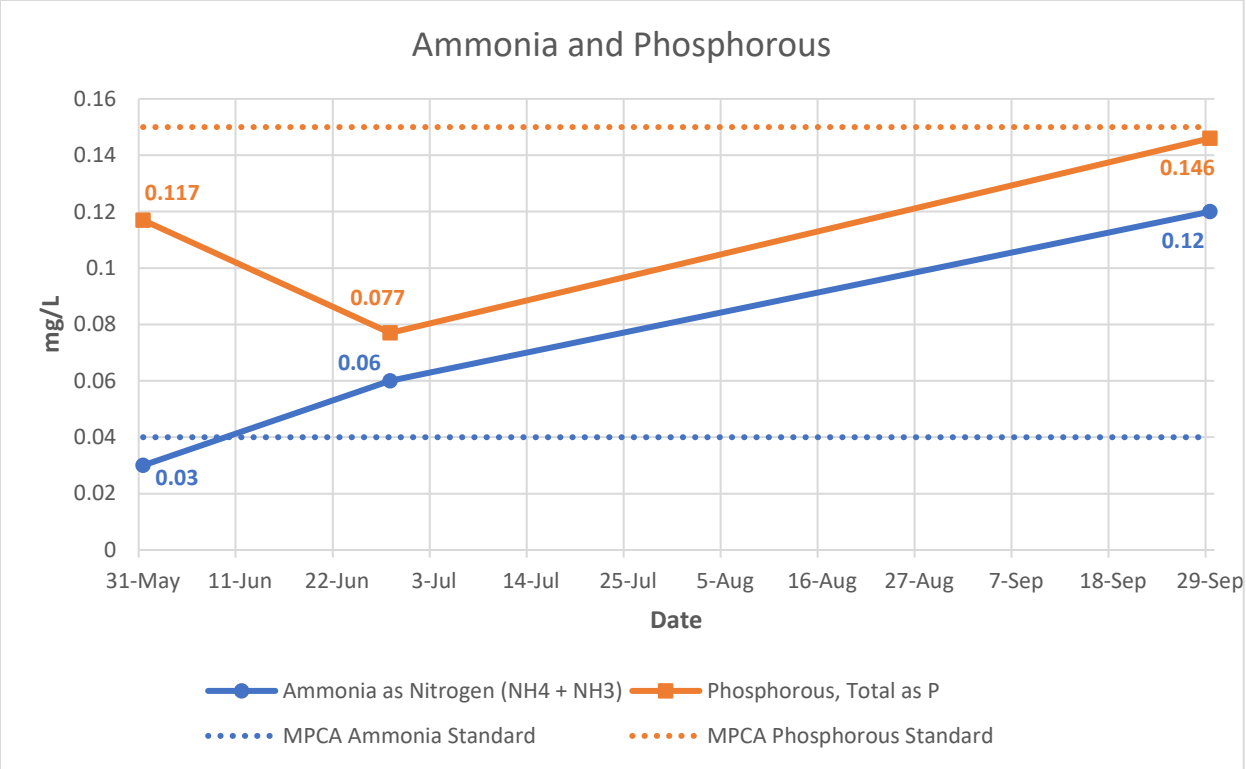

Figure 91. Ammonia and Phosphorous samples collected at S003-312.

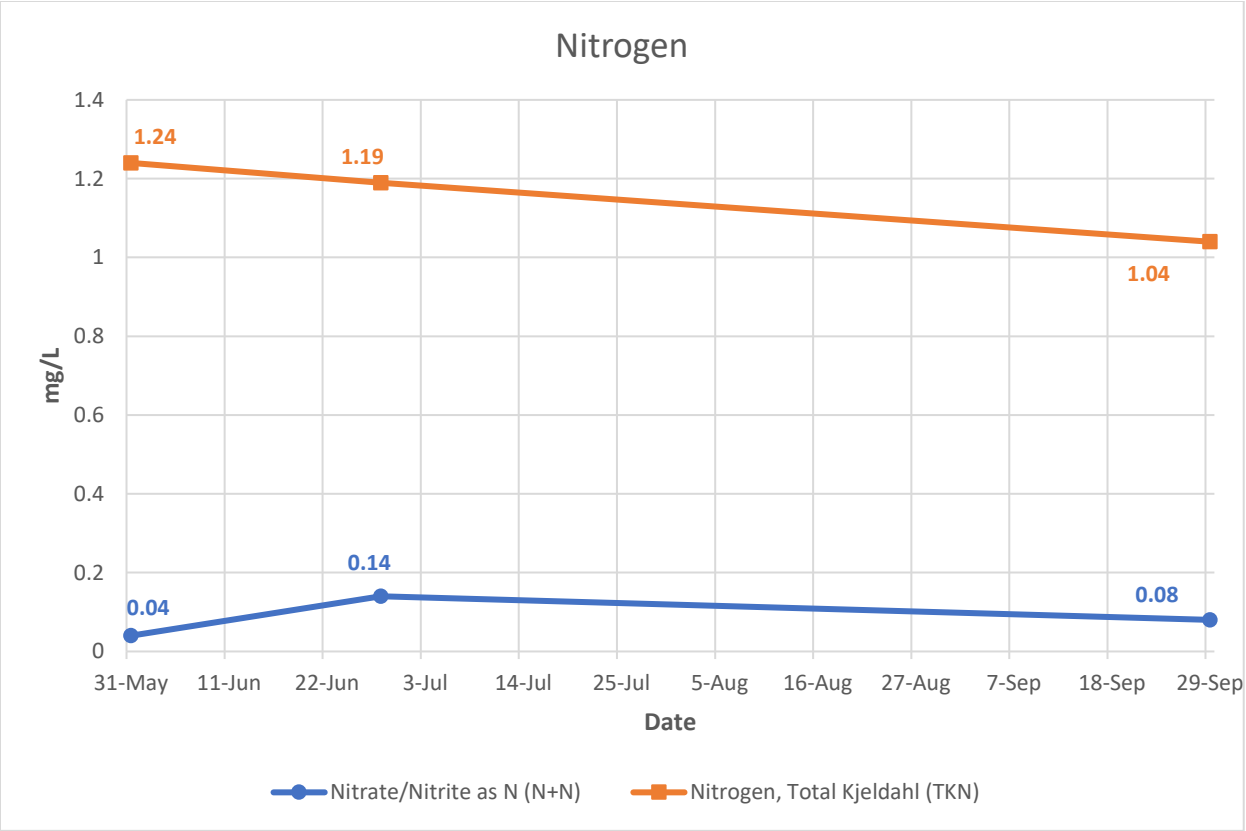

Figure 92. Nitrogen samples collected at S003-312.

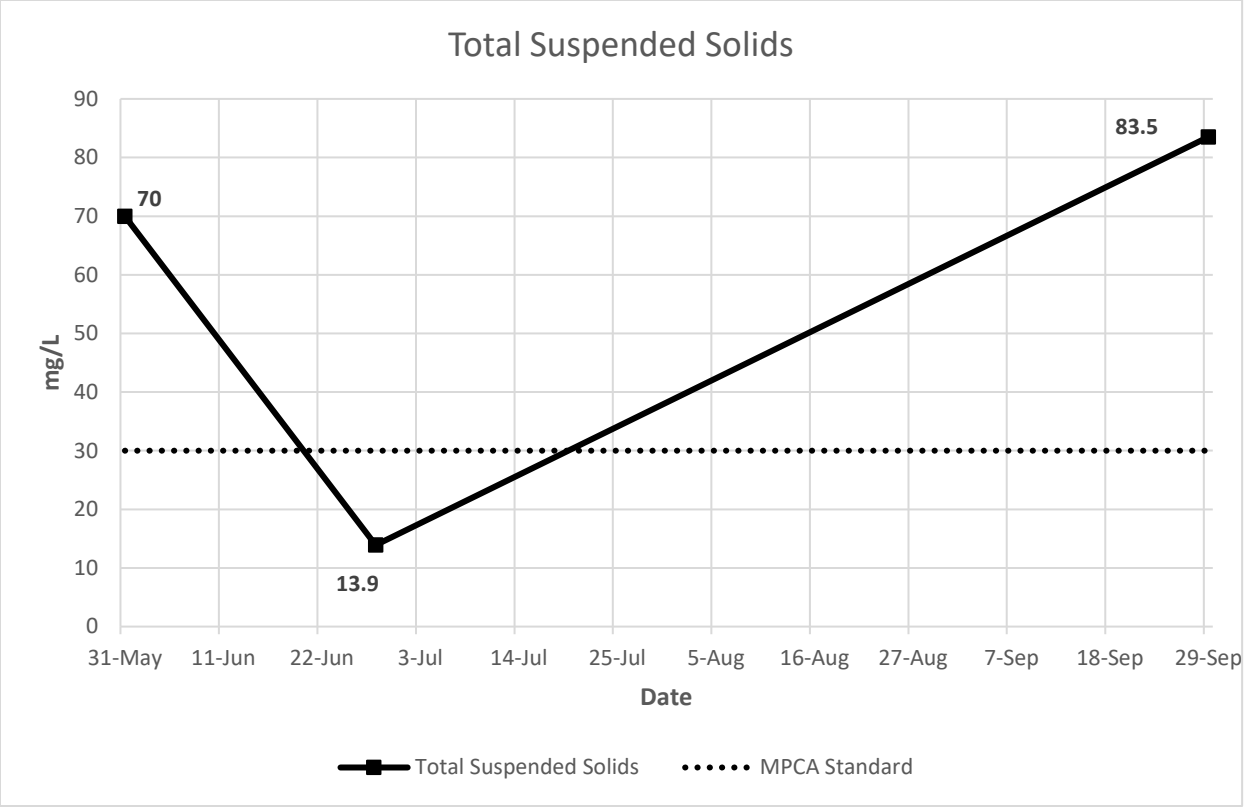

Figure 93. Total Suspended Solids samples collected at S003-312.

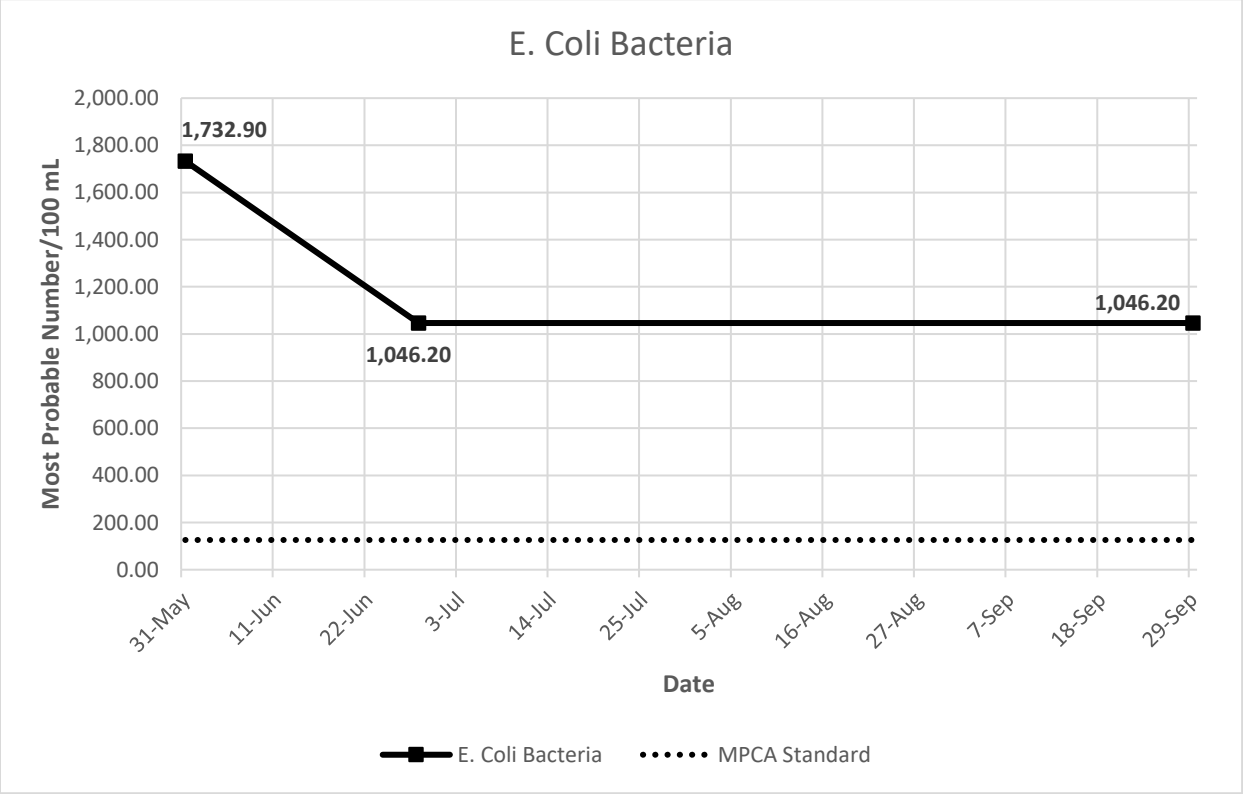

Figure 94. E. Coli Bacteria samples collected at S003-312.

b) <u>S002-711:</u> Located approximately 1.5 miles upstream of where Stony Creek outlets into the South Branch Buffalo River in Section 16, Elmwood Township.

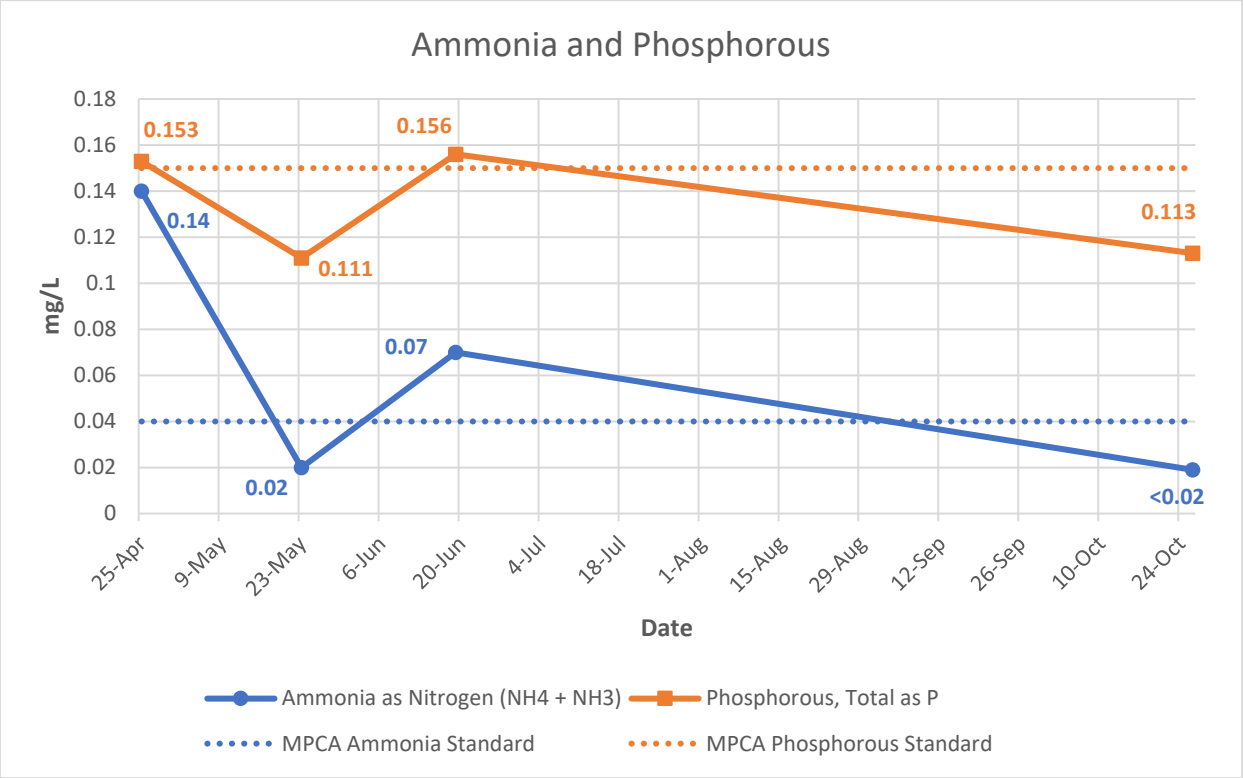

Figure 95. Ammonia and Phosphorous samples collected at S002-711.

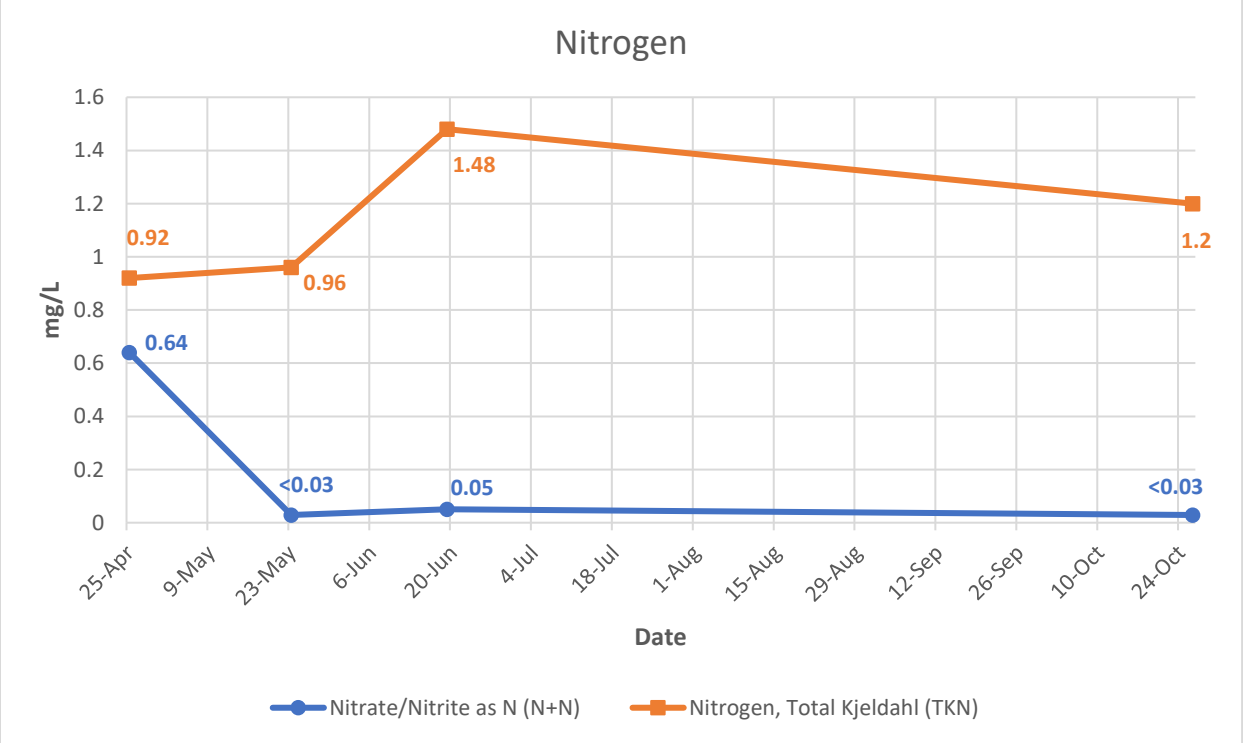

Figure 96. Nitrogen samples collected at S002-711 (MPCA and EPA standards are 10 mg/L).

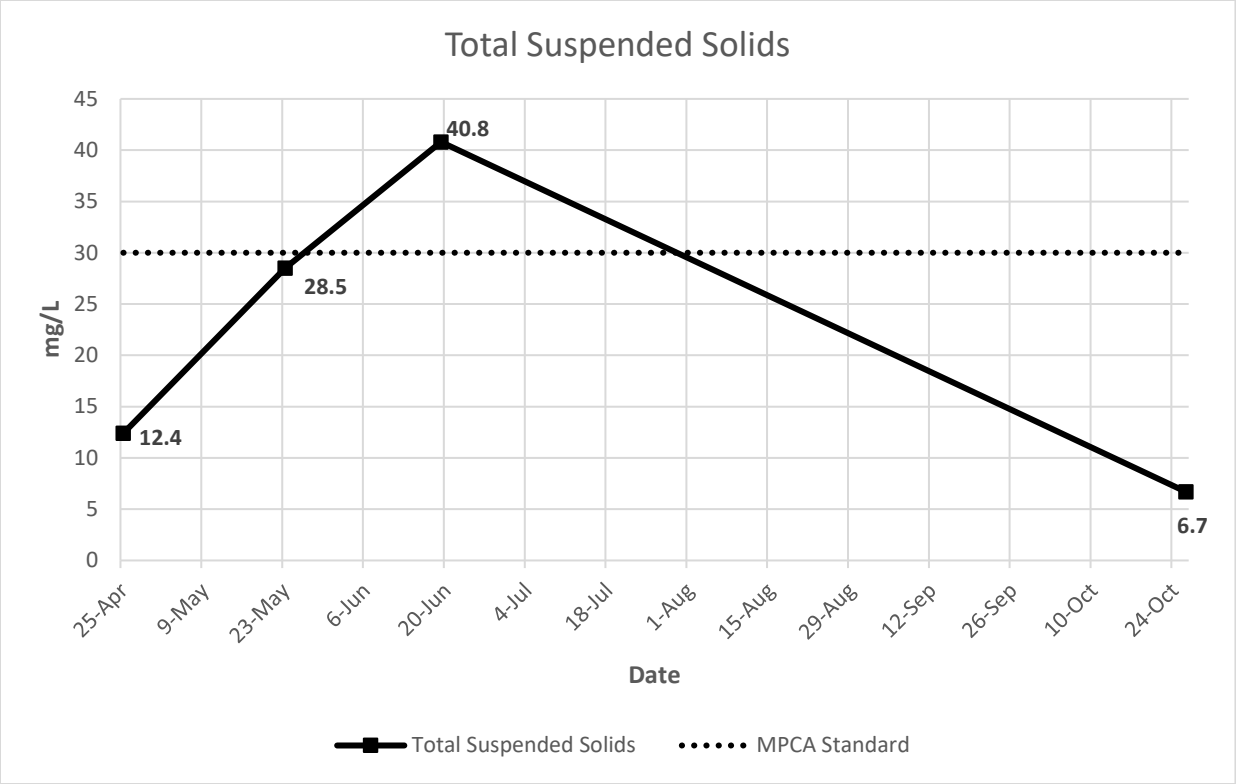

Figure 97. Total Suspended Solids samples collected at S002-711.

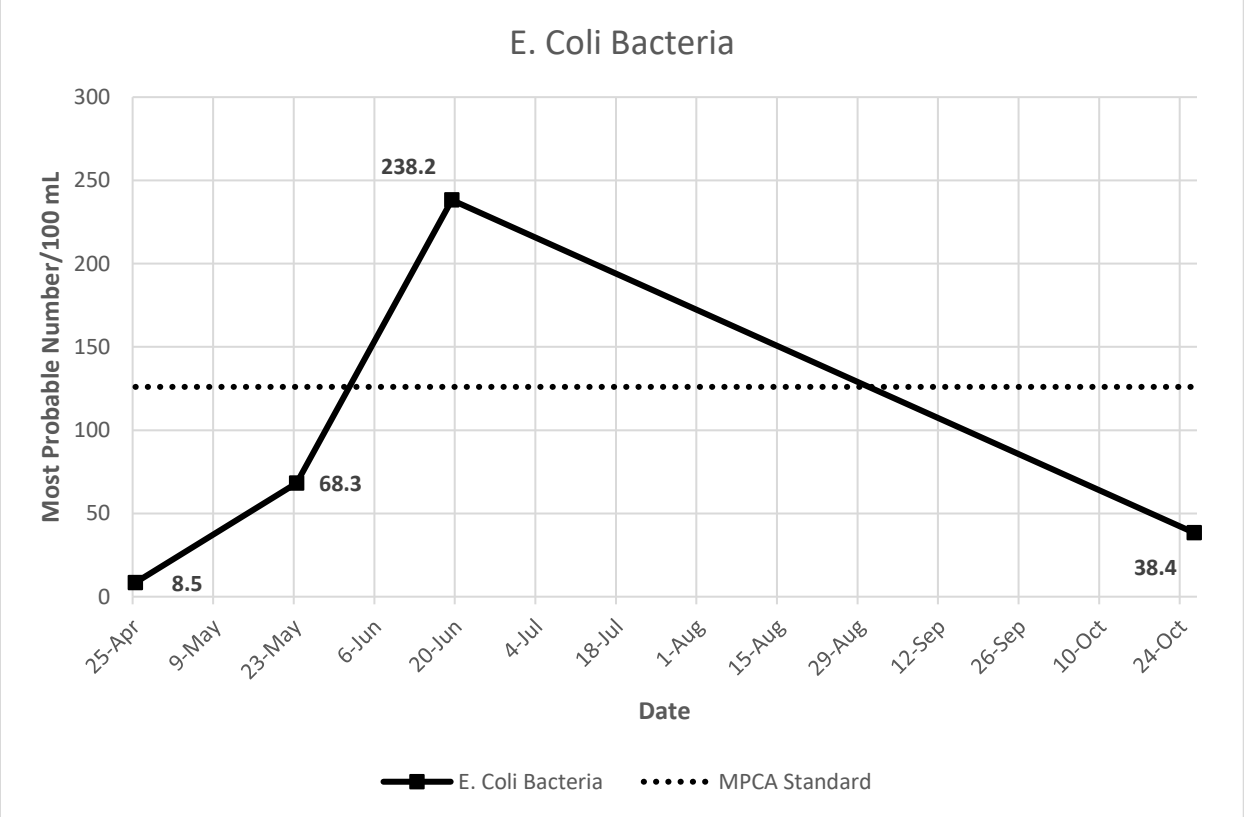

Figure 98. E. Coli Bacteria samples collected at S002-711.

7. *Becker County Ditch No. 15*

Becker County Ditch No. 15 spans nearly 10 miles north to south and 5.5 miles east to west between Lake Park, Audubon, and Callaway. There is only one sampling station located on Becker County Ditch No. 15, which is in the Mainstem planning region.

a) S005-135: Located where the ditch runs underneath 170th Ave, just over one mile before outletting into the Buffalo River.

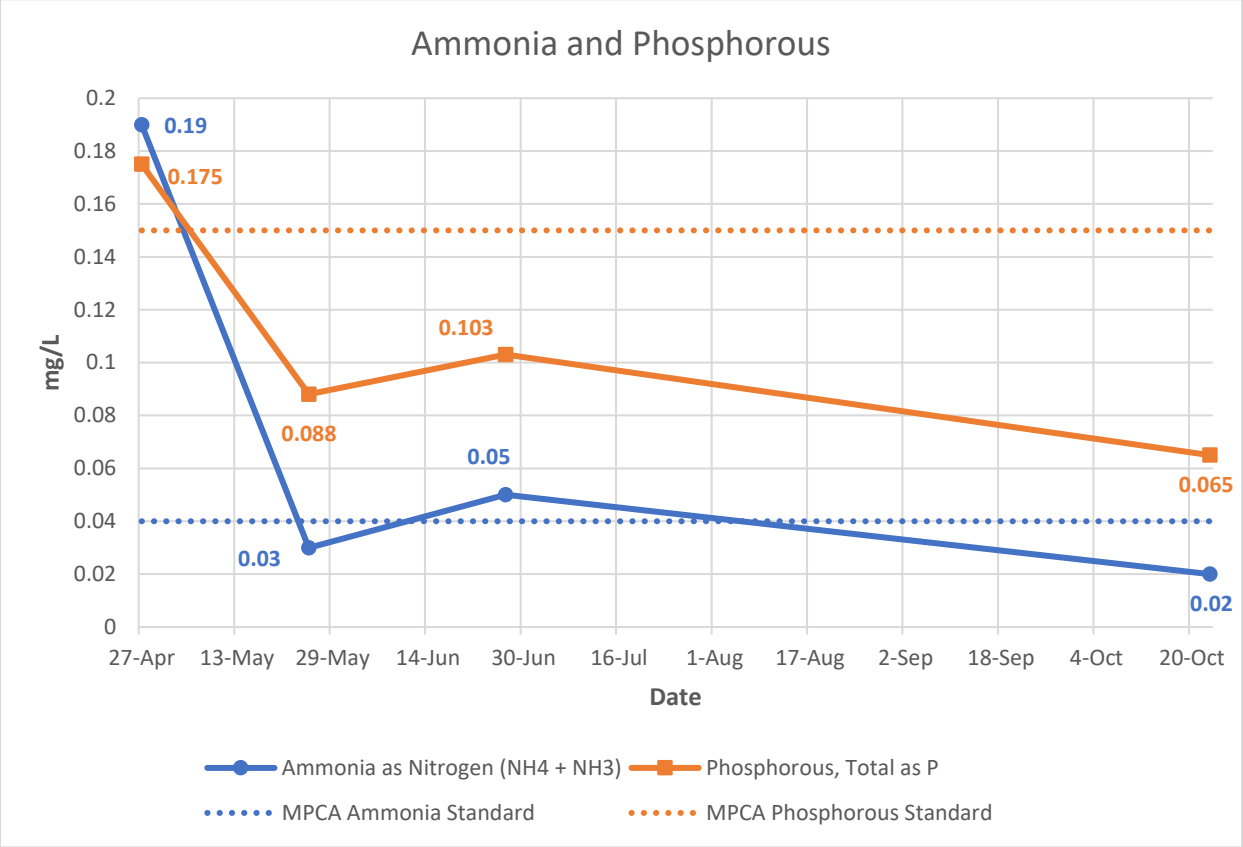

Figure 99. Ammonia and Phosphorous samples collected at S005-135.

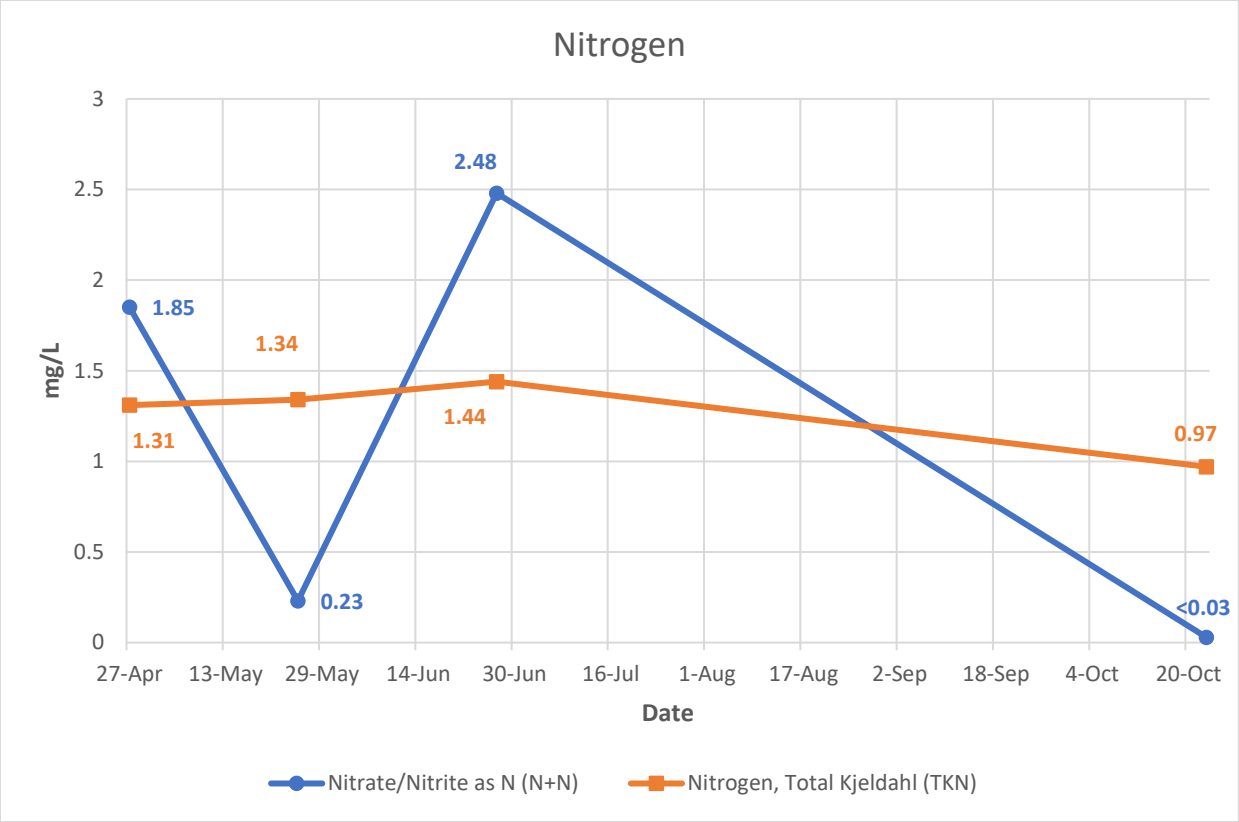

Figure 100. Nitrogen samples collected at S005-135 (MPCA and EPA standards are 10 mg/L).

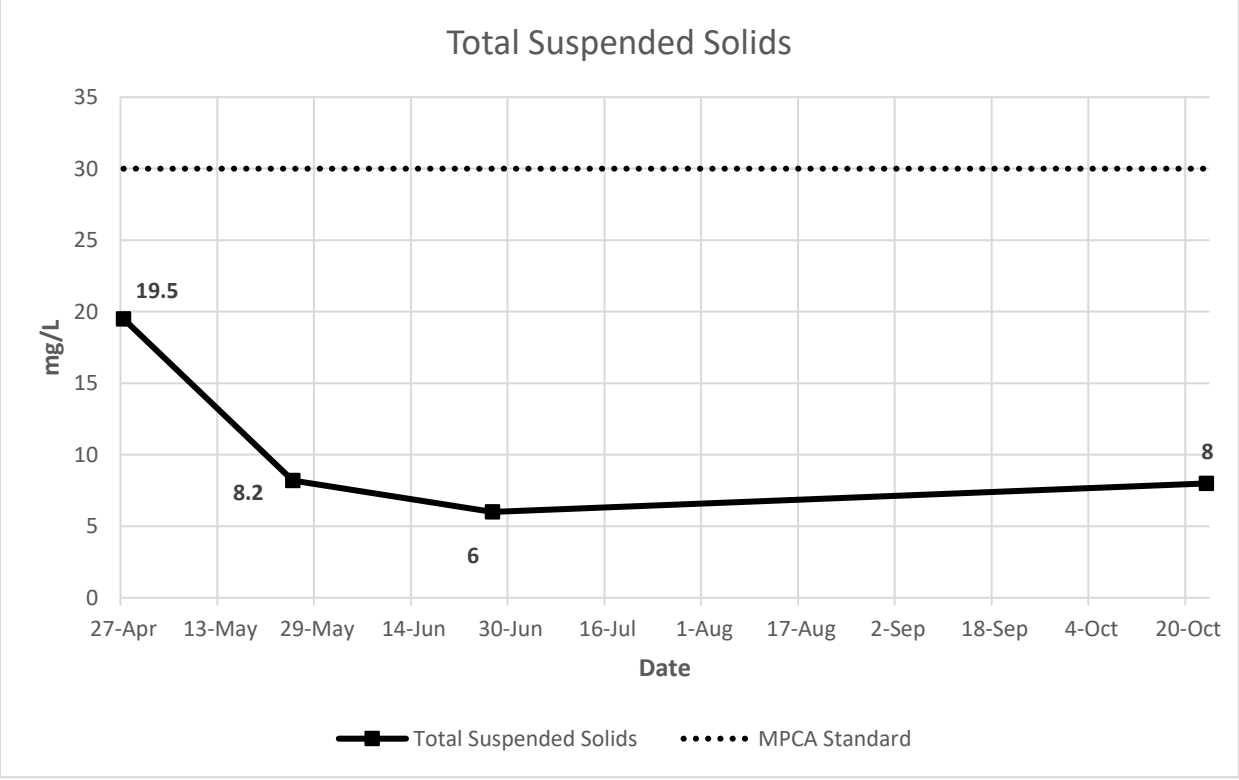

Figure 101. Total Suspended Solids samples collected at S005-135.

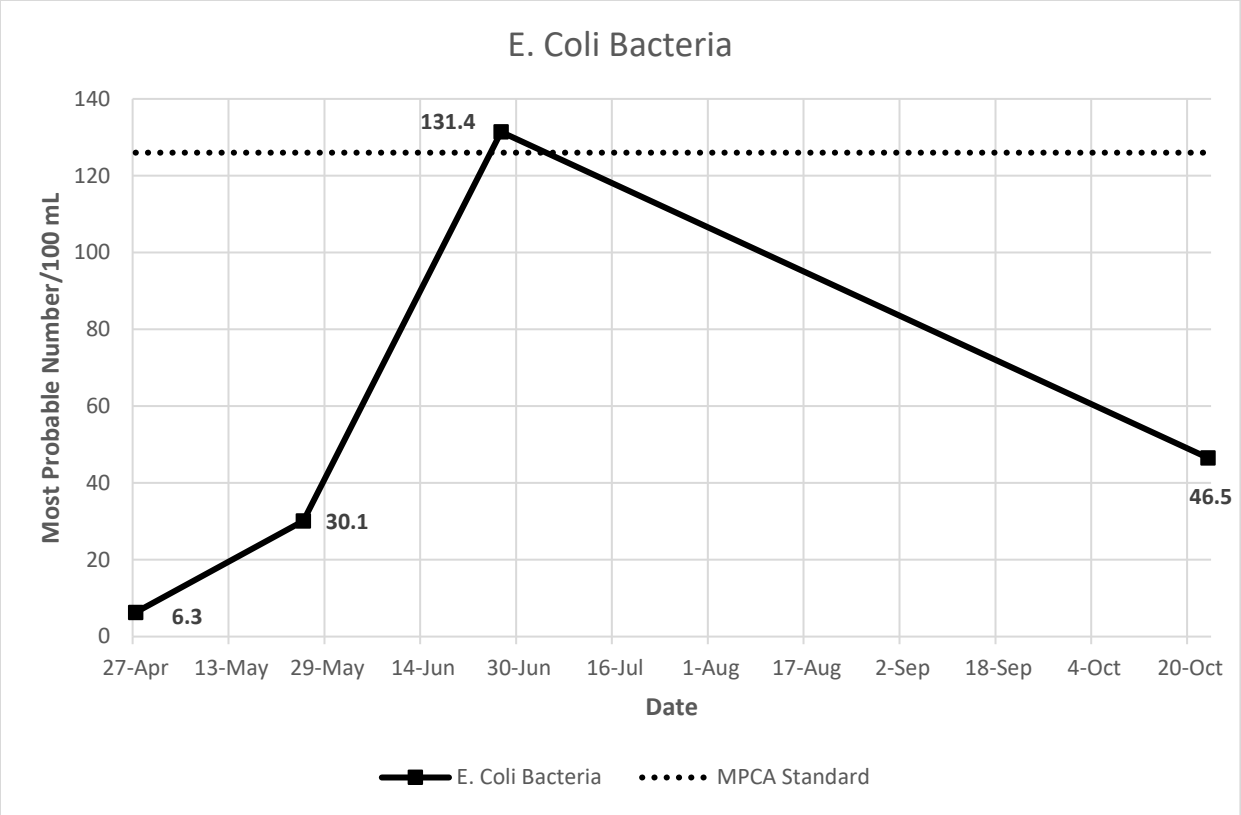

Figure 102. E. Coli Bacteria samples collected at S005-135.

8. <u>Blue Eagle Lake</u>

Blue Eagle Lake is a small man-made lake in Barnesville. The lake is approximately 9 acres and receives flow from Whisky Creek through a sediment pond that separates the two bodies of water. Blue Eagle Lake is in the Central planning region.

a) <u>14-0093-00-201:</u> Samples were taken from Blue Eagle Lake four times between the end of May and the end of September.

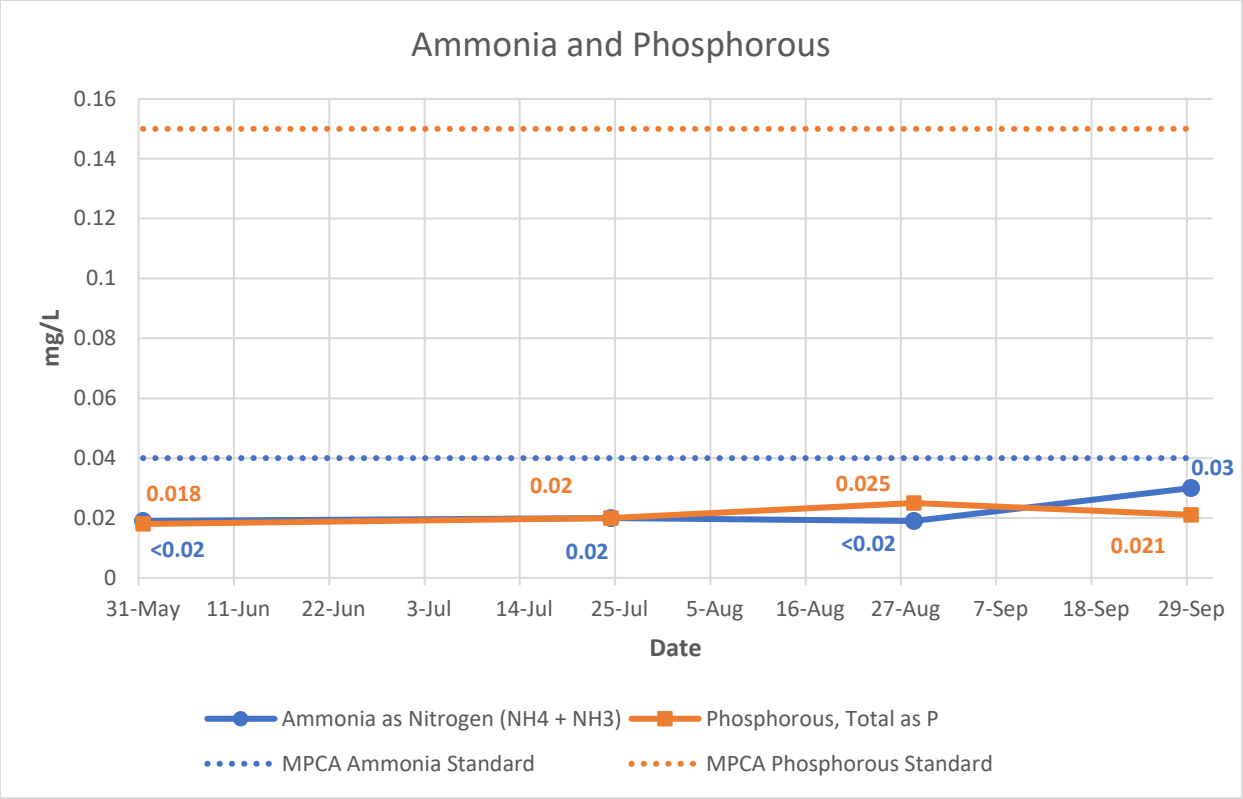

Figure 103. Ammonia and Phosphorous samples collected at 14-0093-00-201.

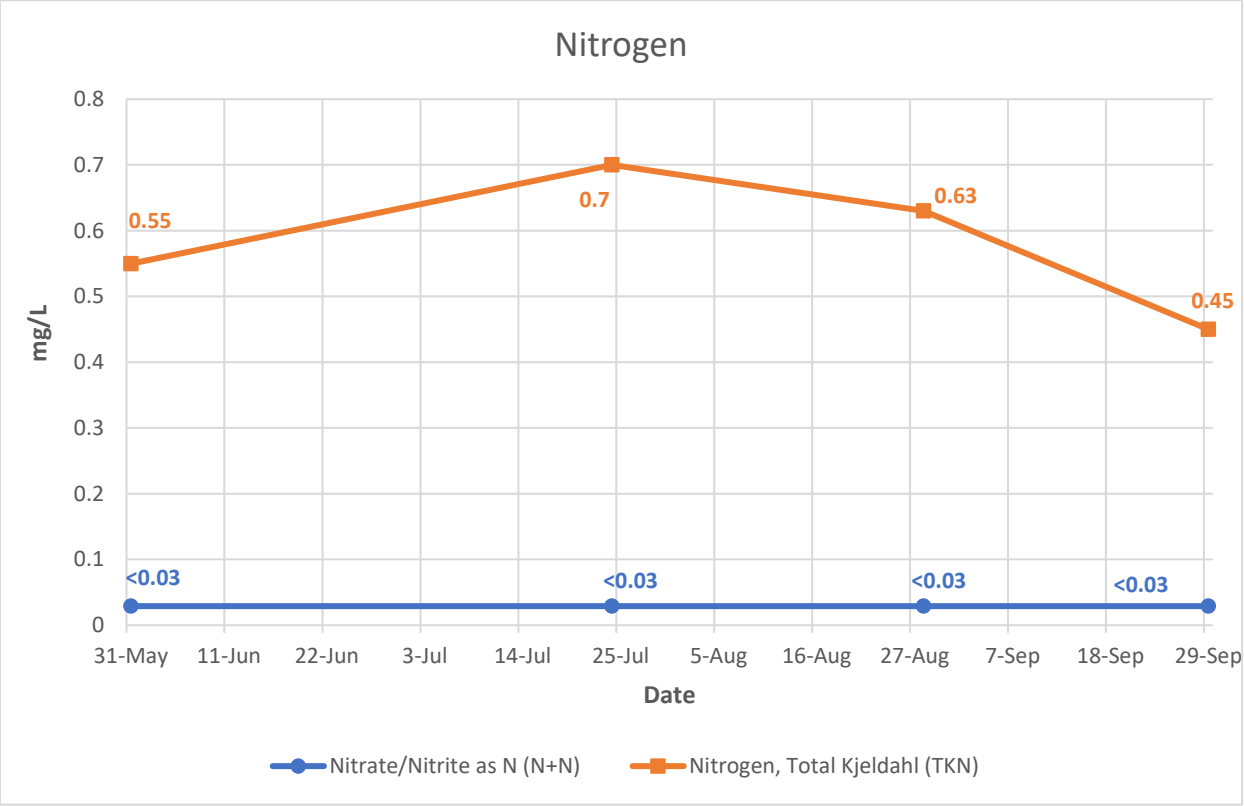

Figure 104. Nitrogen samples collected at 14-0093-00-201 (MPCA and EPA standards are 10 mg/L).

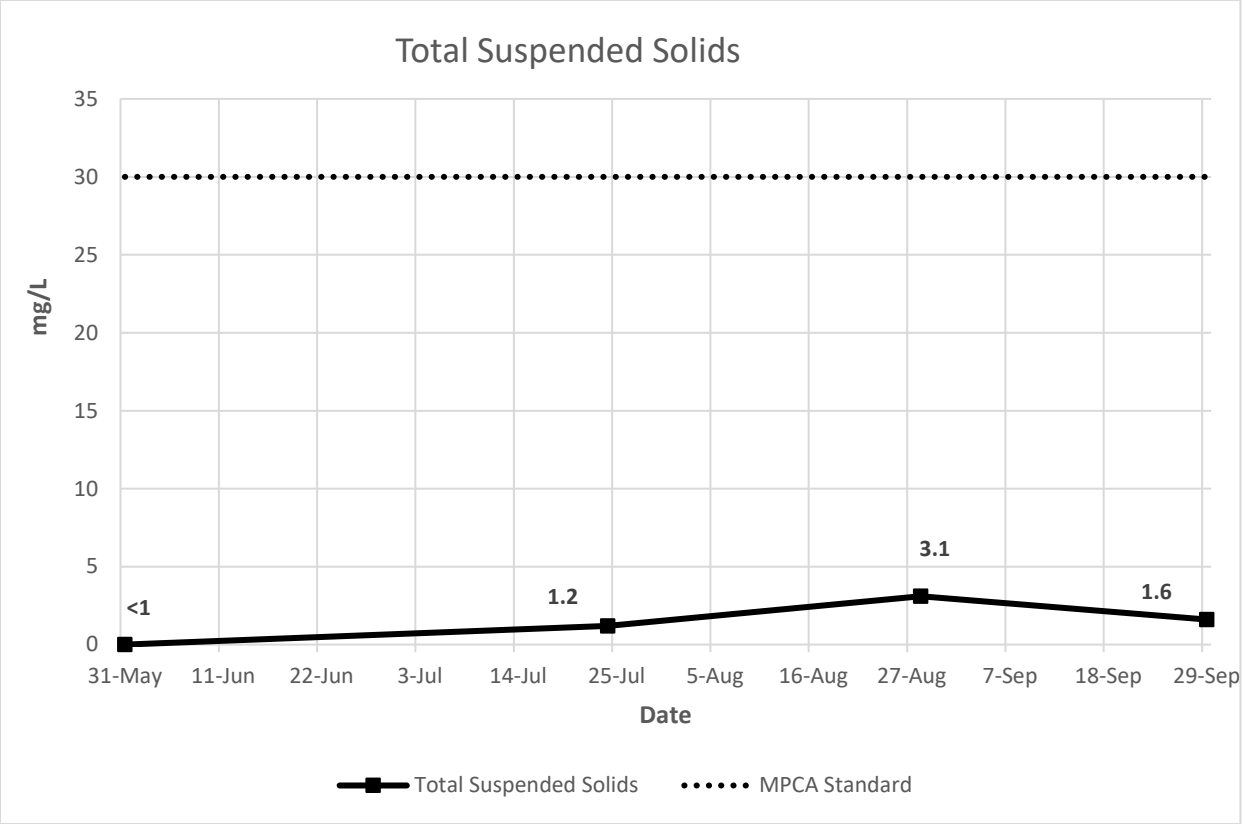

Figure 105. Total Suspended Solids samples collected at 14-0093-00-201.

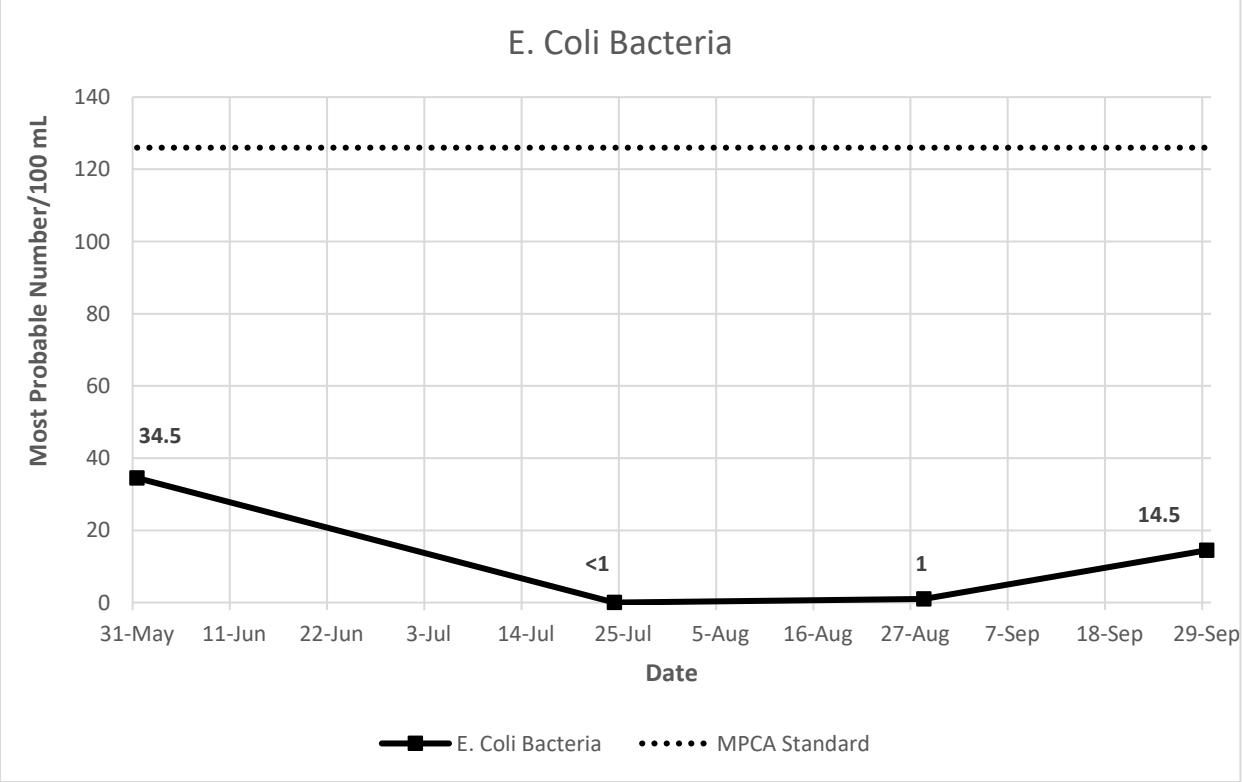

Figure 106. E. Coli Bacteria samples collected at 14-0093-00-201.

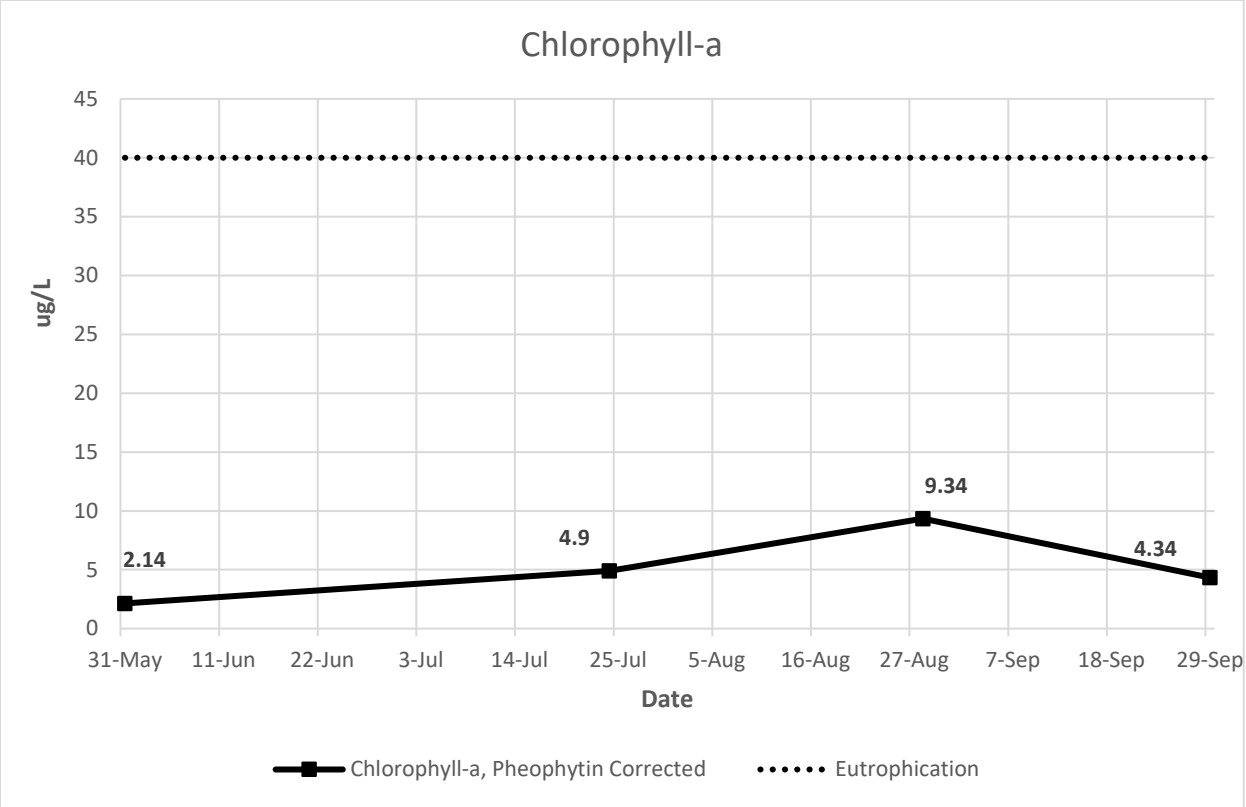

Figure 107: Chlorophyll samples collected at 14-0093-00-201.

9. <u>Deerhorn Creek</u>

Starting in Section 21, Norwegian Grove Township, Deerhorn Creek meanders mostly west through Prairie View and Atherton Townships and outlets into the South Branch Buffalo River in Section 20, Atherton Township.

a) <u>S003-151:</u> Located near the outlet of the Deerhorn Creek between Sections 20 and 21, Atherton Township in the Southern planning region. This is the only station along Deerhorn Creek.

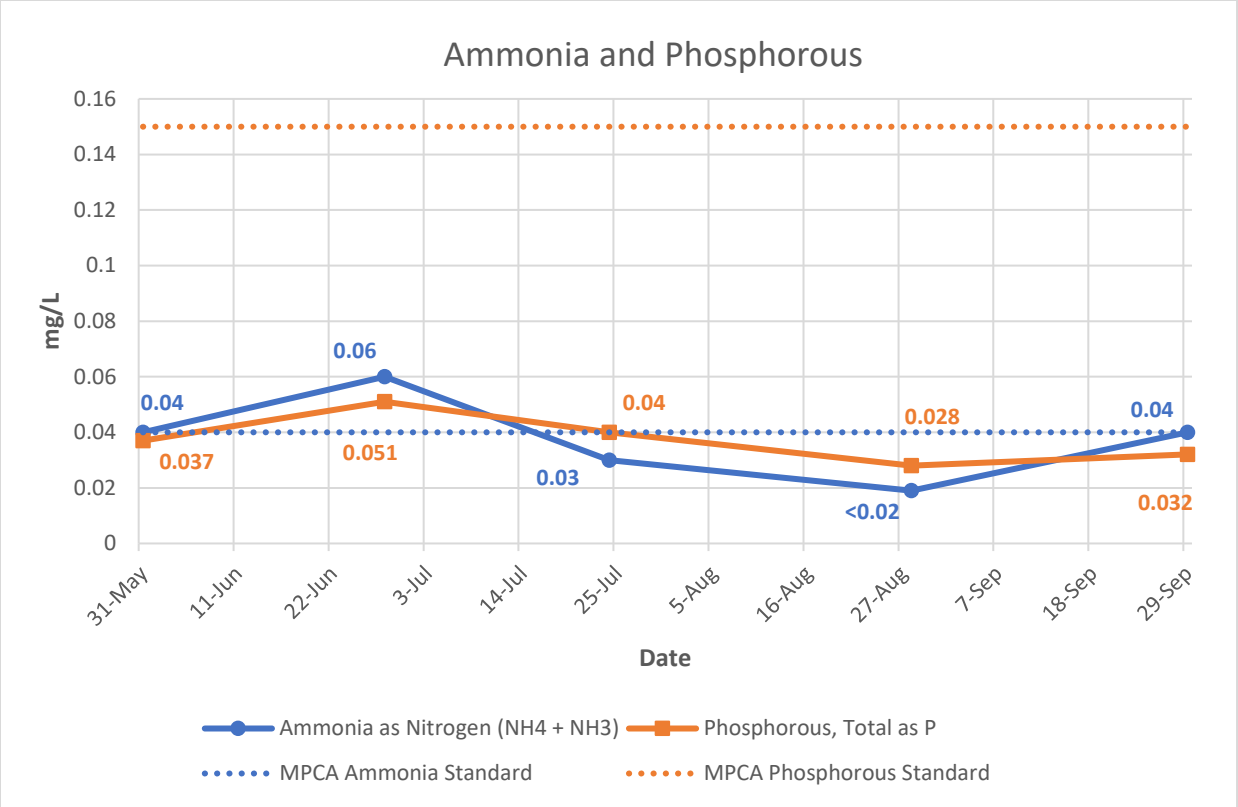

Figure 108. Ammonia and Phosphorous samples collected at S003-151.

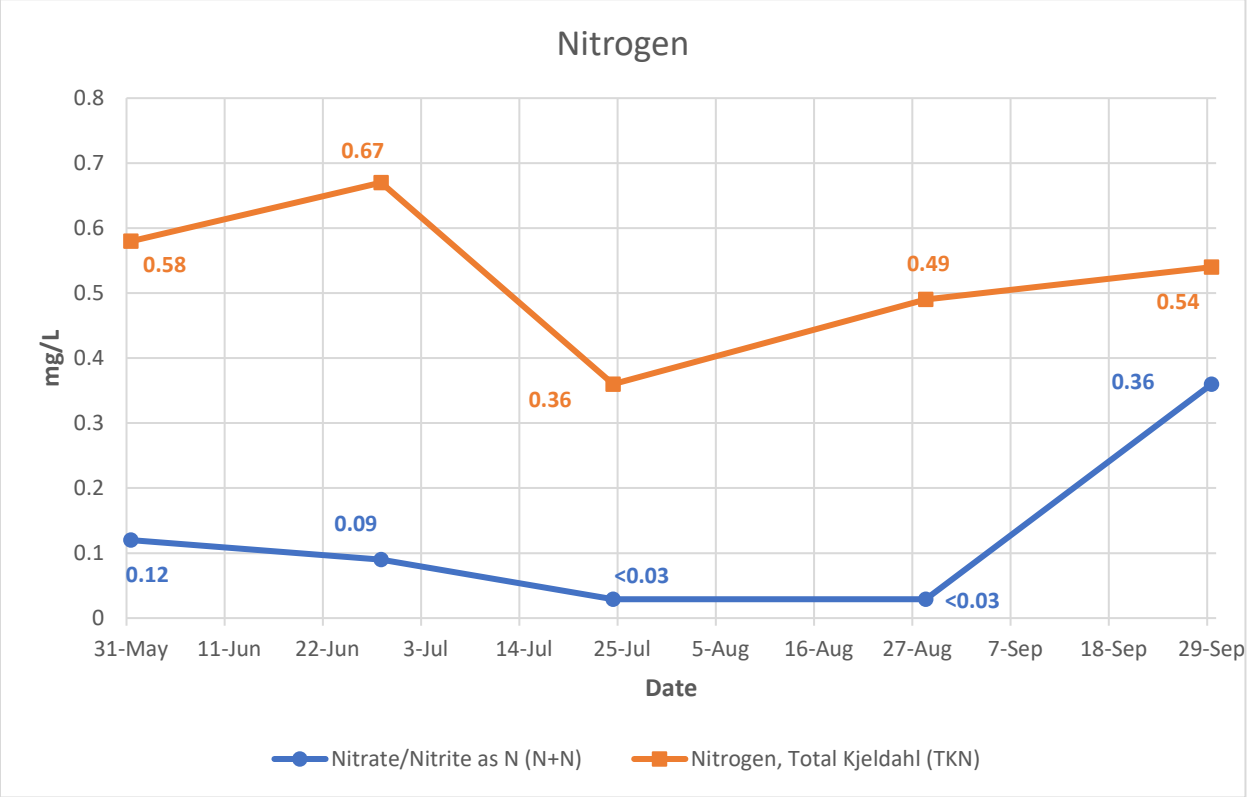

Figure 109. Nitrogen samples collected at S003-151 (MPCA and EPA standards are 10 mg/L).

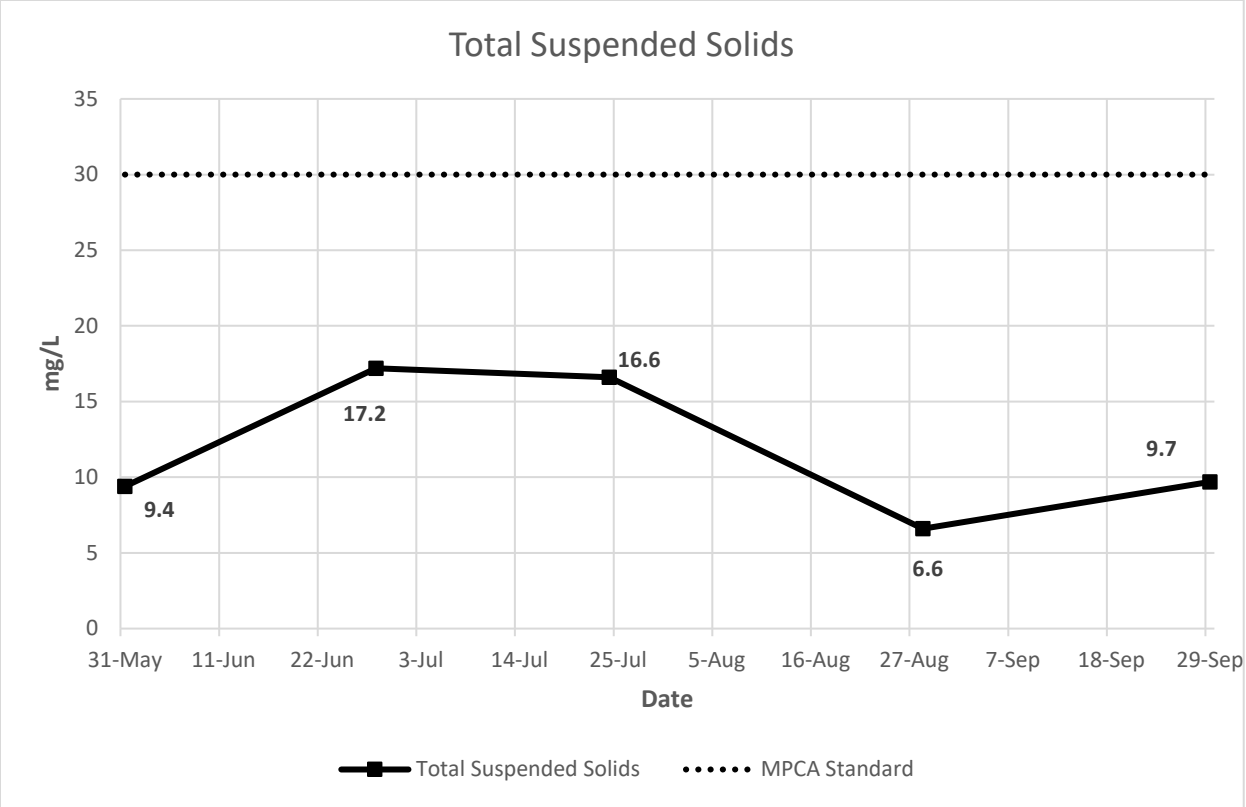

Figure 110. Total Suspended Solids samples collected at S003-151.

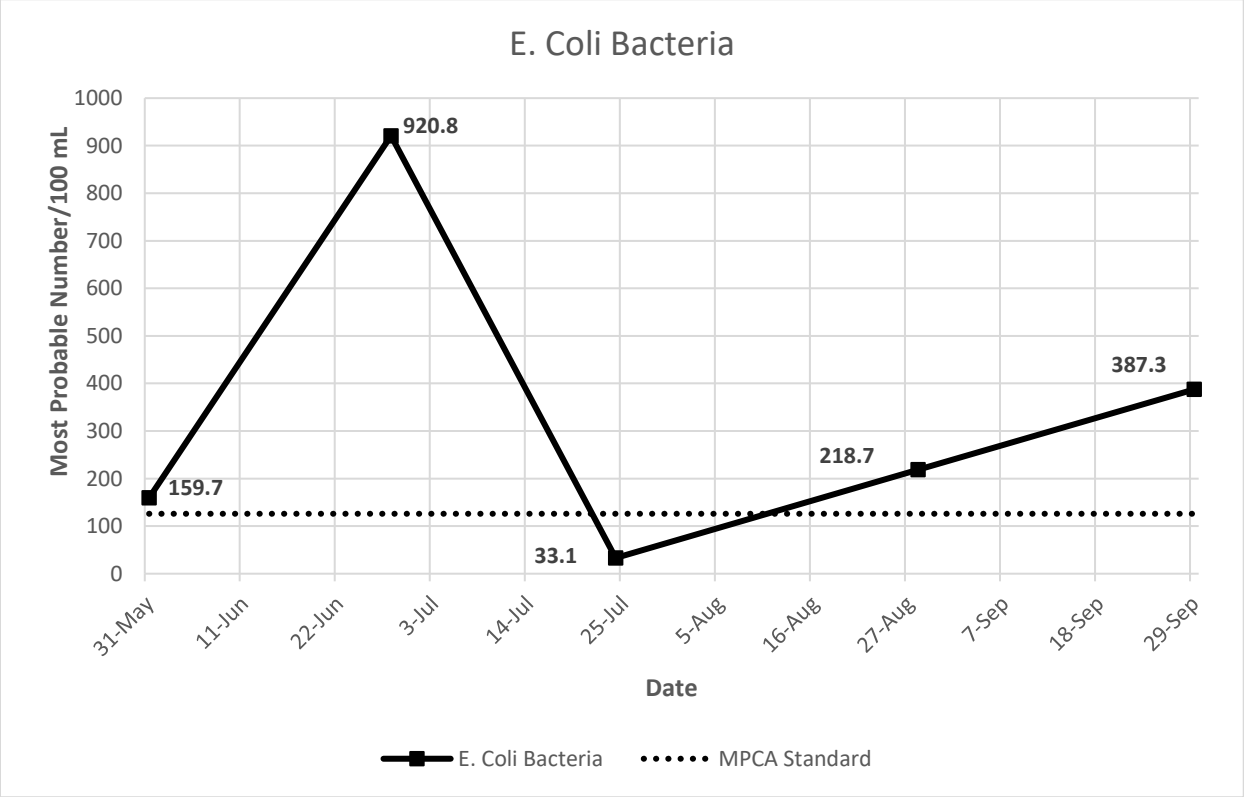

Figure 111. E. Coli Bacteria samples collected at S003-151.

10. <u>Unnamed Creek</u>

This unnamed creek starts in Atherton Township and runs northwest until it connects with Whisky Creek/Clay County Ditch No. 34. This small creek has several arms and receives drainage from Clay County Ditch No. 54.

a) <u>S005-592:</u> Located between Sections 14 and 23, Alliance Township, this station is located just under two miles before it connects with Whisky Creek in the Central planning region.

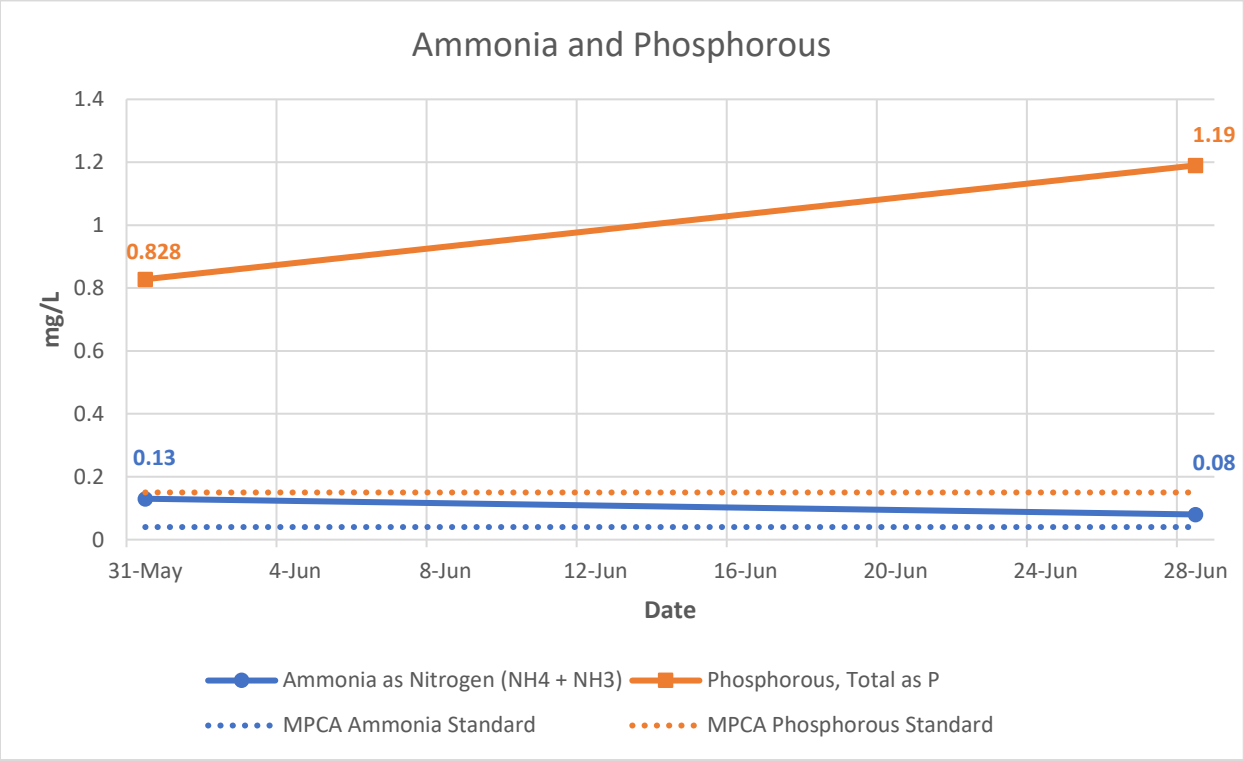

Figure 112. Ammonia and Phosphorous samples collected at S005-592.

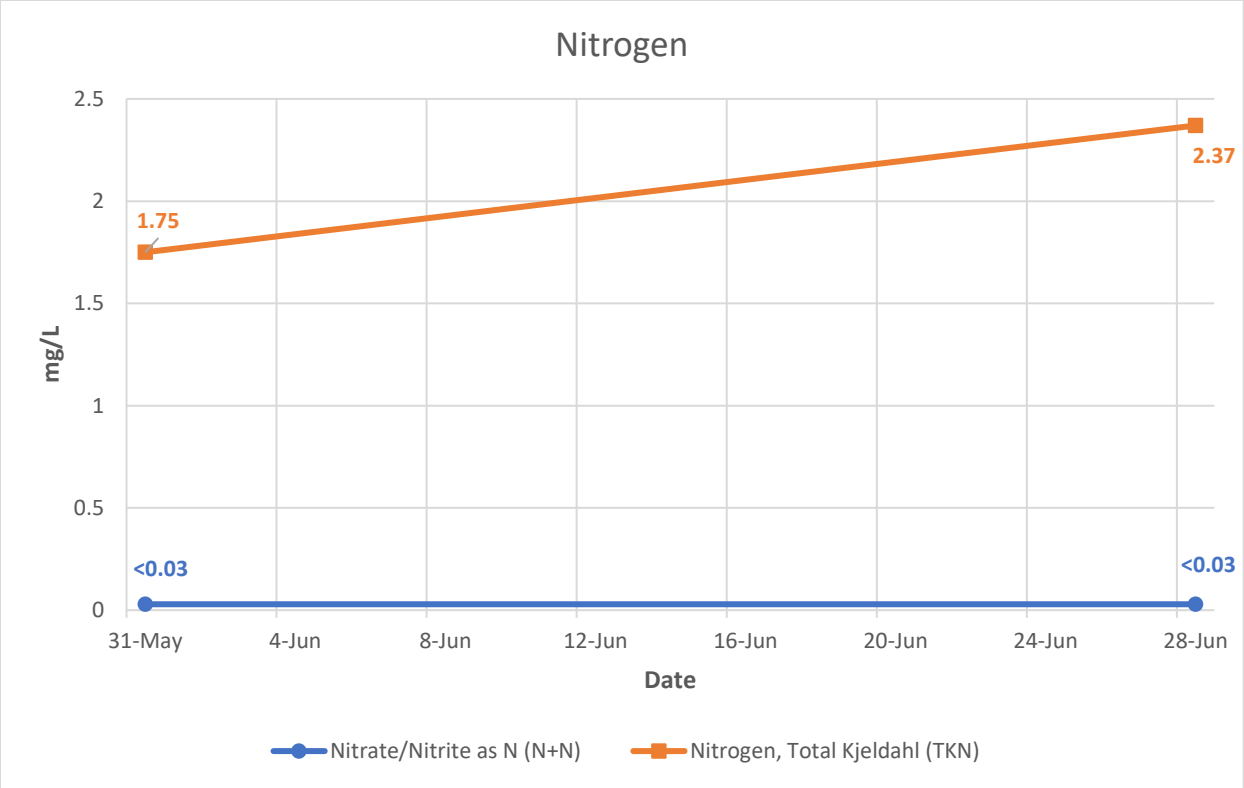

Figure 113. Nitrogen samples collected at S005-592 (MPCA and EPA standards are 10 mg/L).

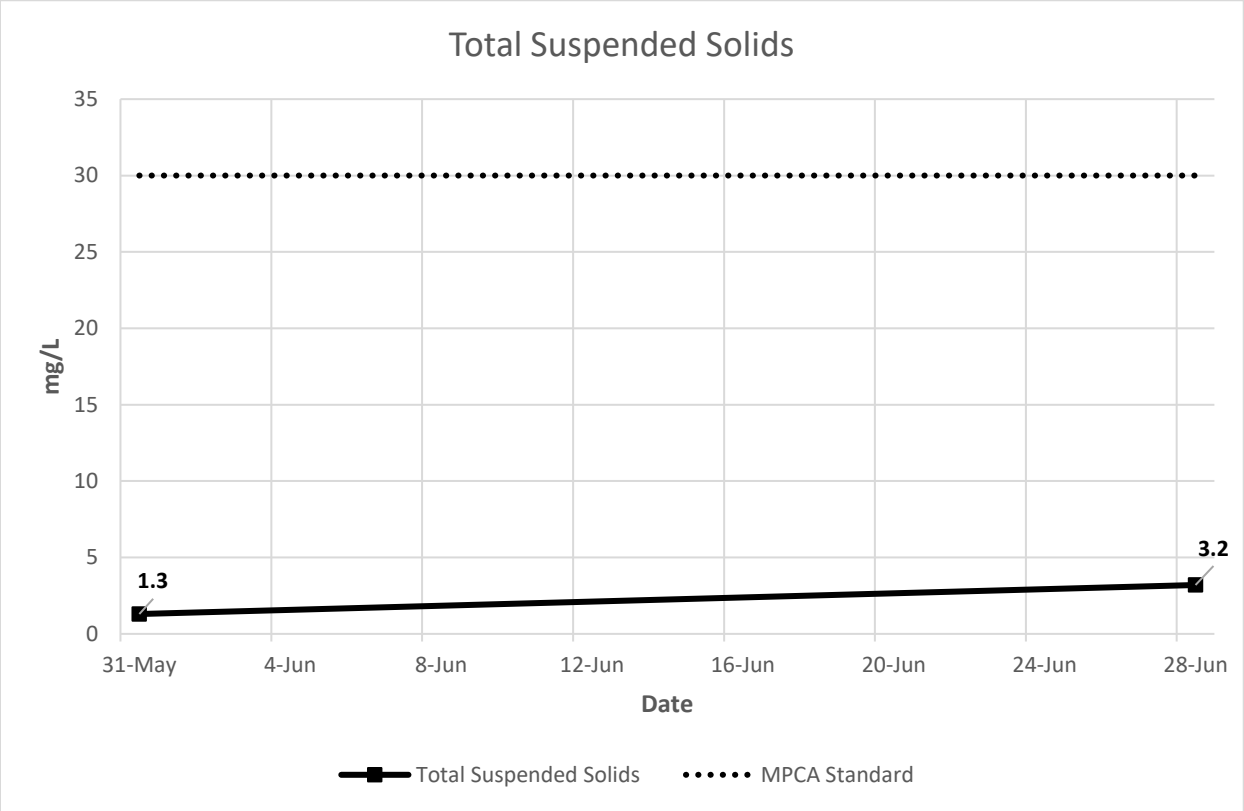

Figure 114. Total Suspended Solids samples collected at S005-592.

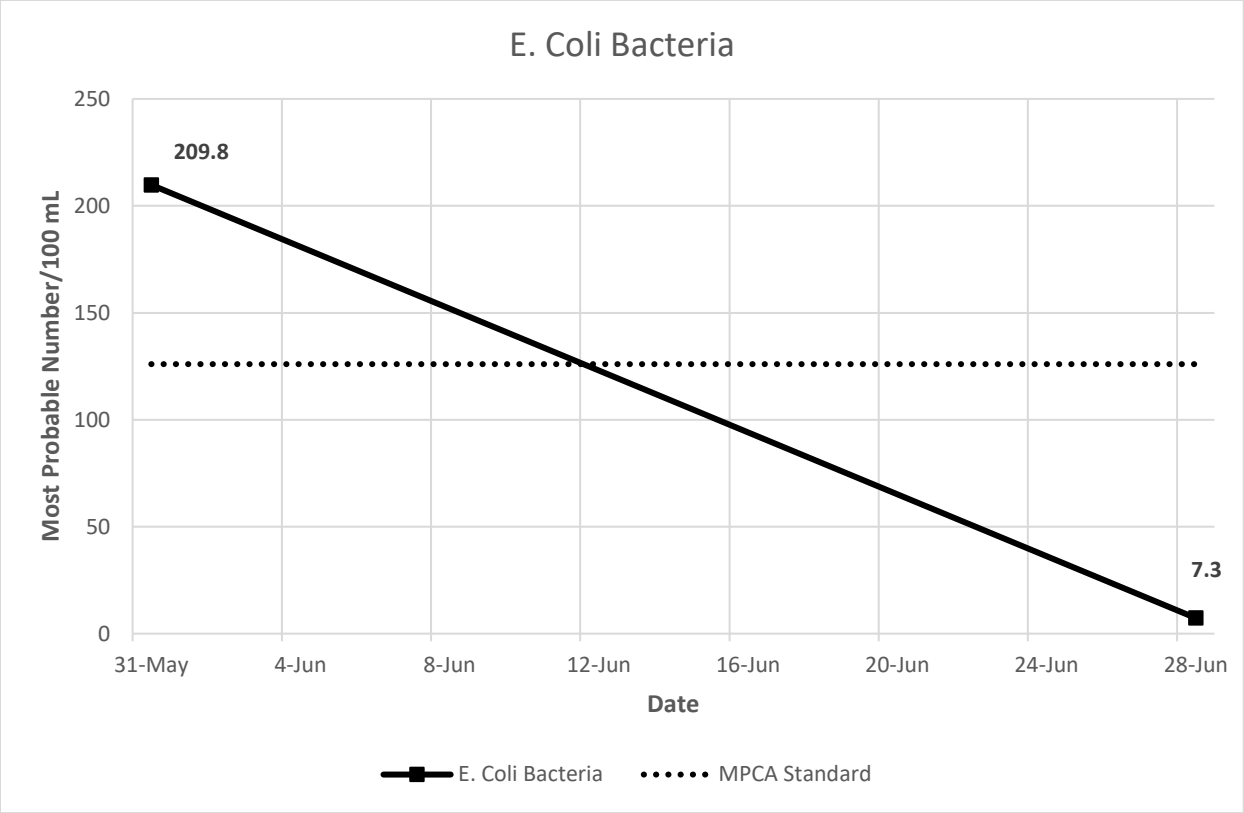

Figure 115. E. Coli Bacteria samples collected at S005-592.

11. <u>Whiskey Creek</u>

Whiskey Creek is a medium-sized tributary that starts in Section 18, Nilsen Township, running mostly north and west for a little over 20 miles through Nilsen, Connelly, Nordick, and McCauleyville Townships before it outlets into the Red River.

a) <u>S001-060:</u> Located north of McCauleyville along Wilkin County Highway 1, approximately 1.5 miles upstream of the outlet of Whiskey Creek.

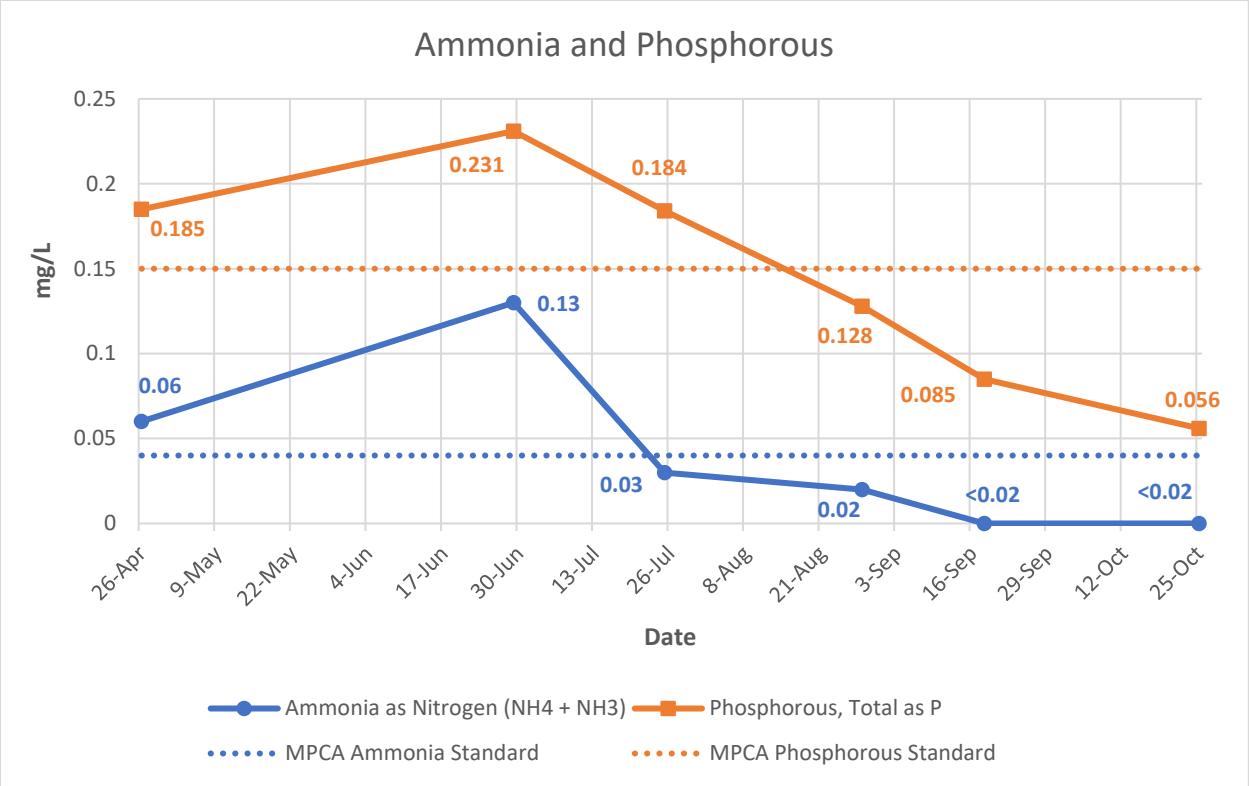

Figure 116. Ammonia and Phosphorous samples collected at S001-060.

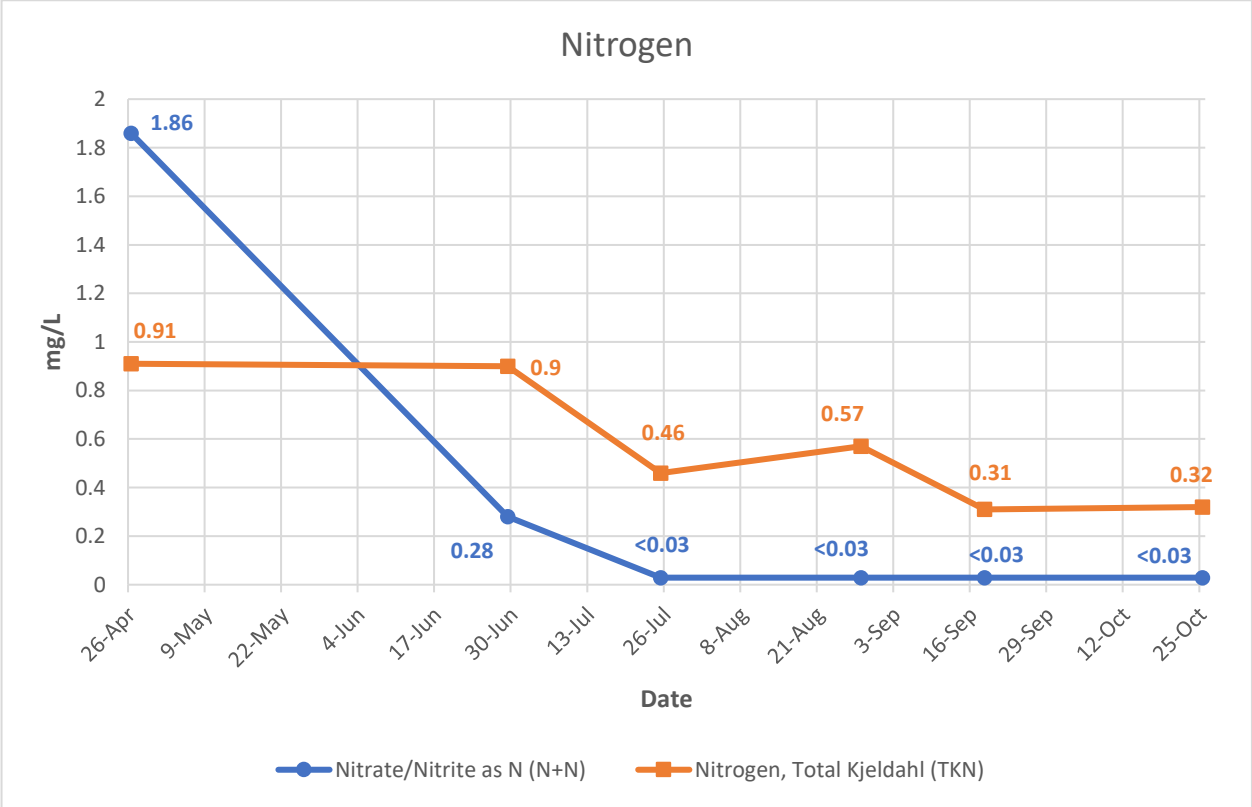

Figure 117. Nitrogen samples collected at S001-060 (MPCA and EPA standards are 10 mg/L).

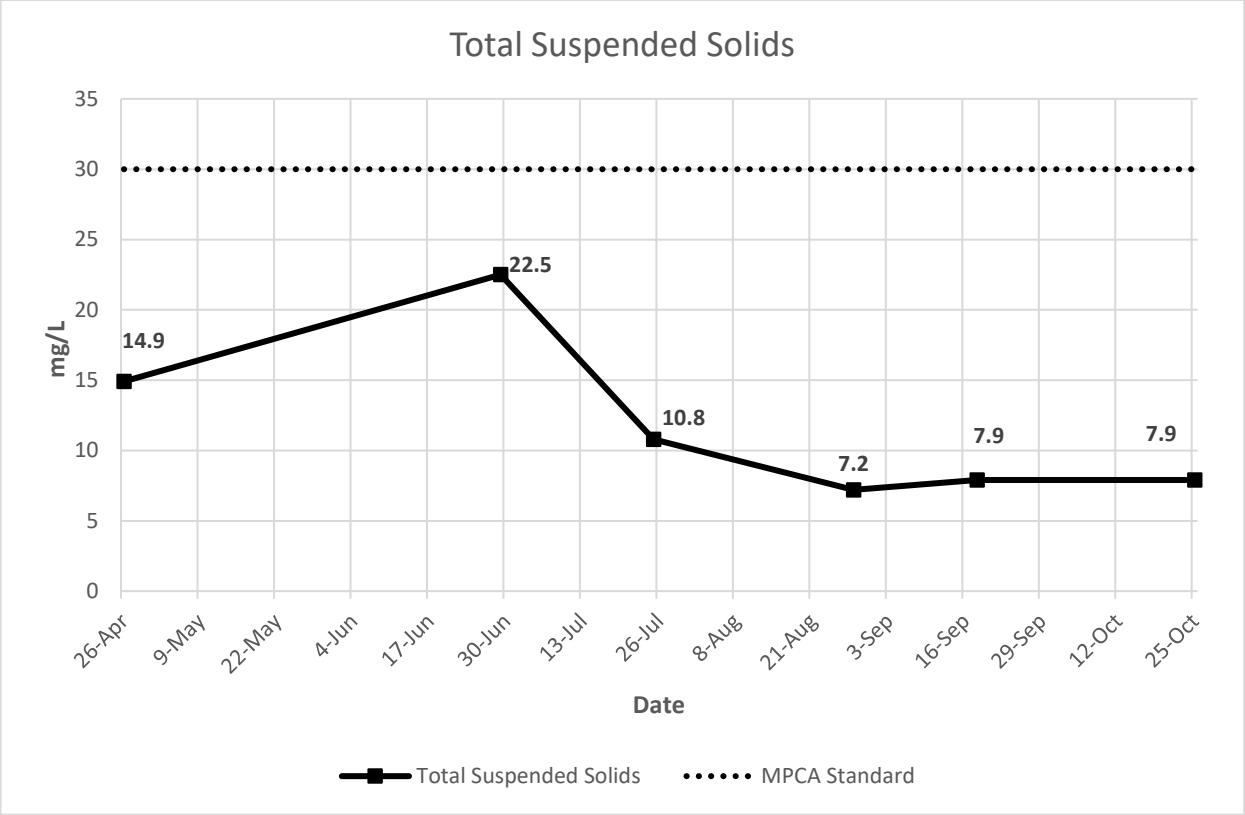

Figure 118. Total Suspended Solids samples collected at S001-060.

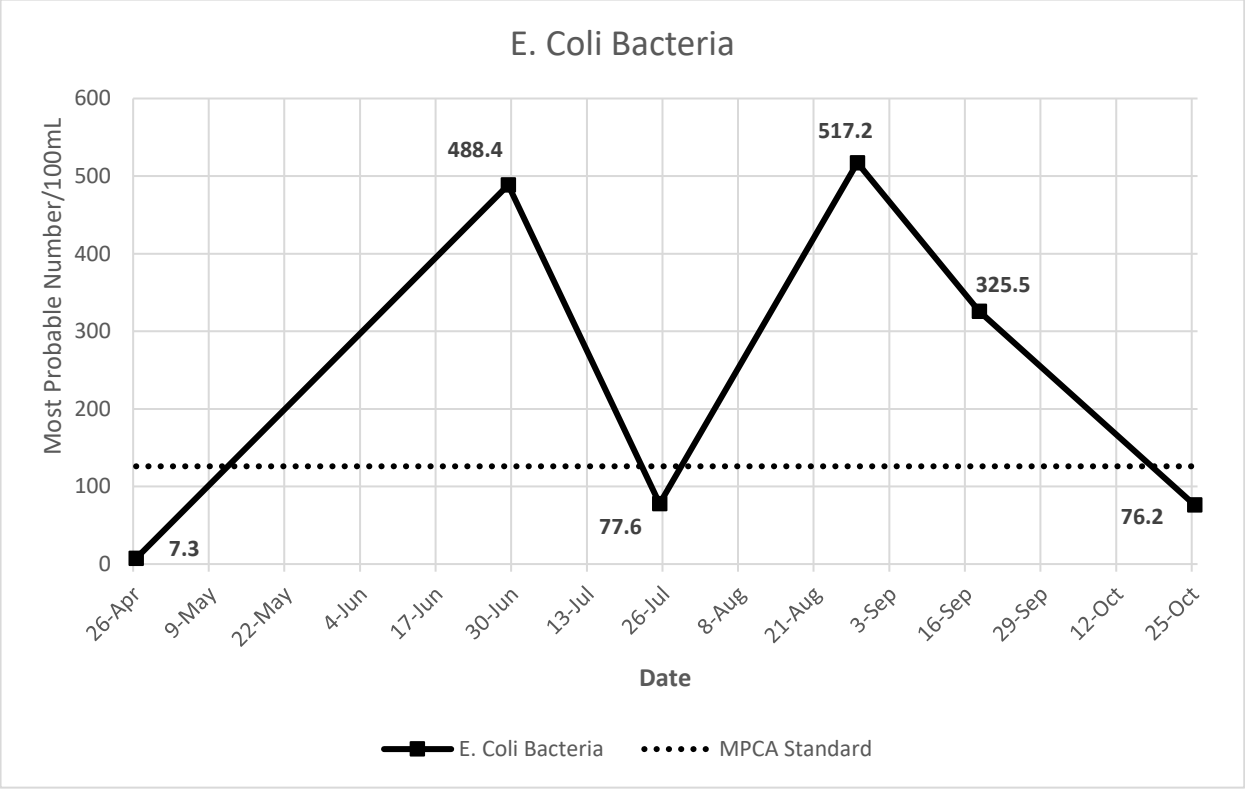

Figure 119. E. Coli Bacteria samples collected at S001-060.

12. <u>Wilkin County Ditch No. 3</u>

Wilkin County Ditch No. 3 is another multi-armed ditch that runs through three Townships in Wilkin County. Starting between Sections 15 and 16, Akron Township, water in the ditch flows mostly west/southwest through Akron, Nilsen, and Breckenridge Townships before it outlets into the Otter Tail River east of Breckenridge.

a) <u>S007-459:</u> Located on the south side of State Highway 210 between Sections 1 and 2, Breckenridge Township in the Otter Tail planning region.

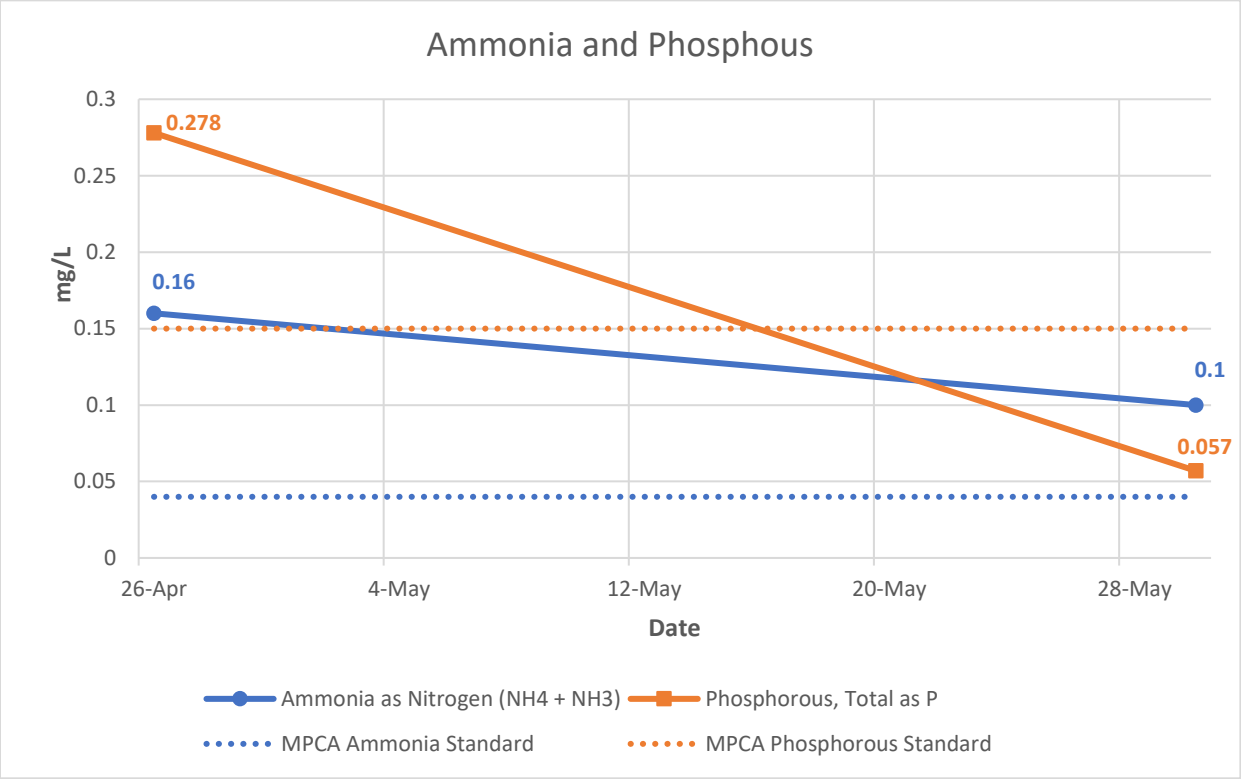

Figure 120. Ammonia and Phosphorous samples collected at S007-459.

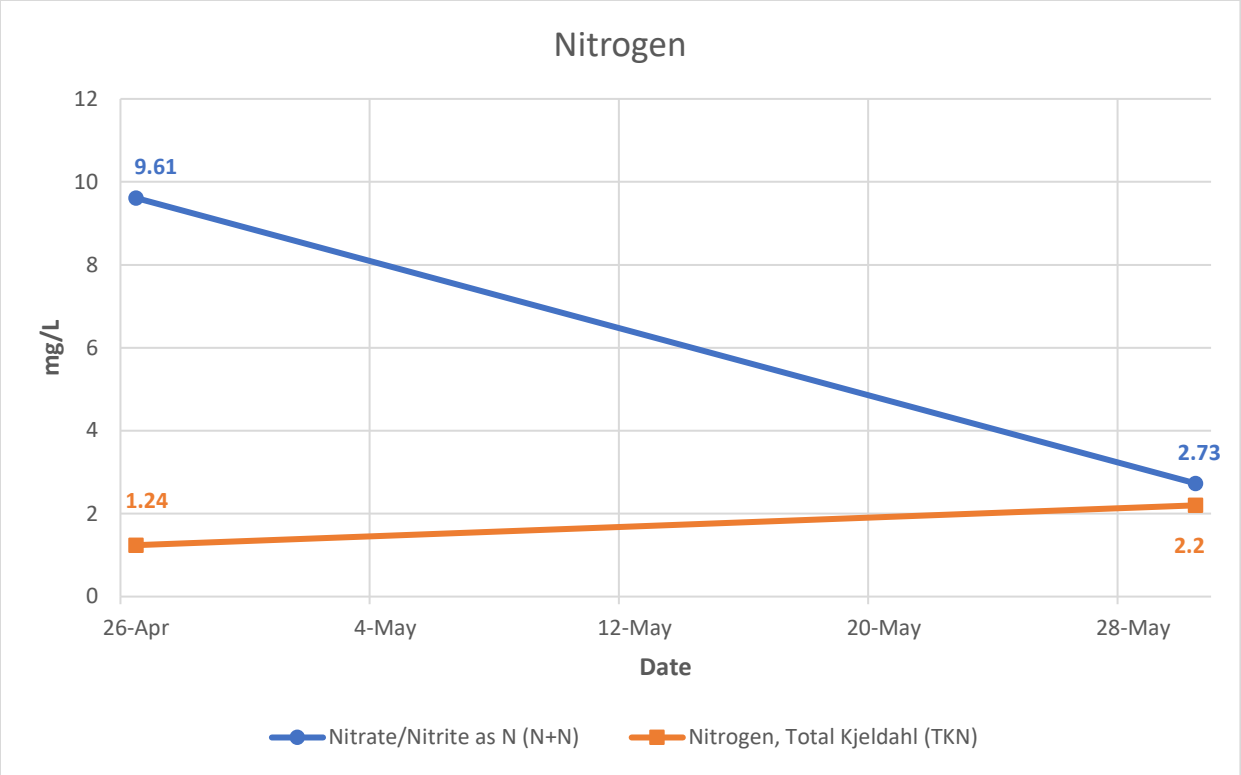

Figure 121. Nitrogen samples collected at S007-459 (MPCA and EPA standards are 10 mg/L).

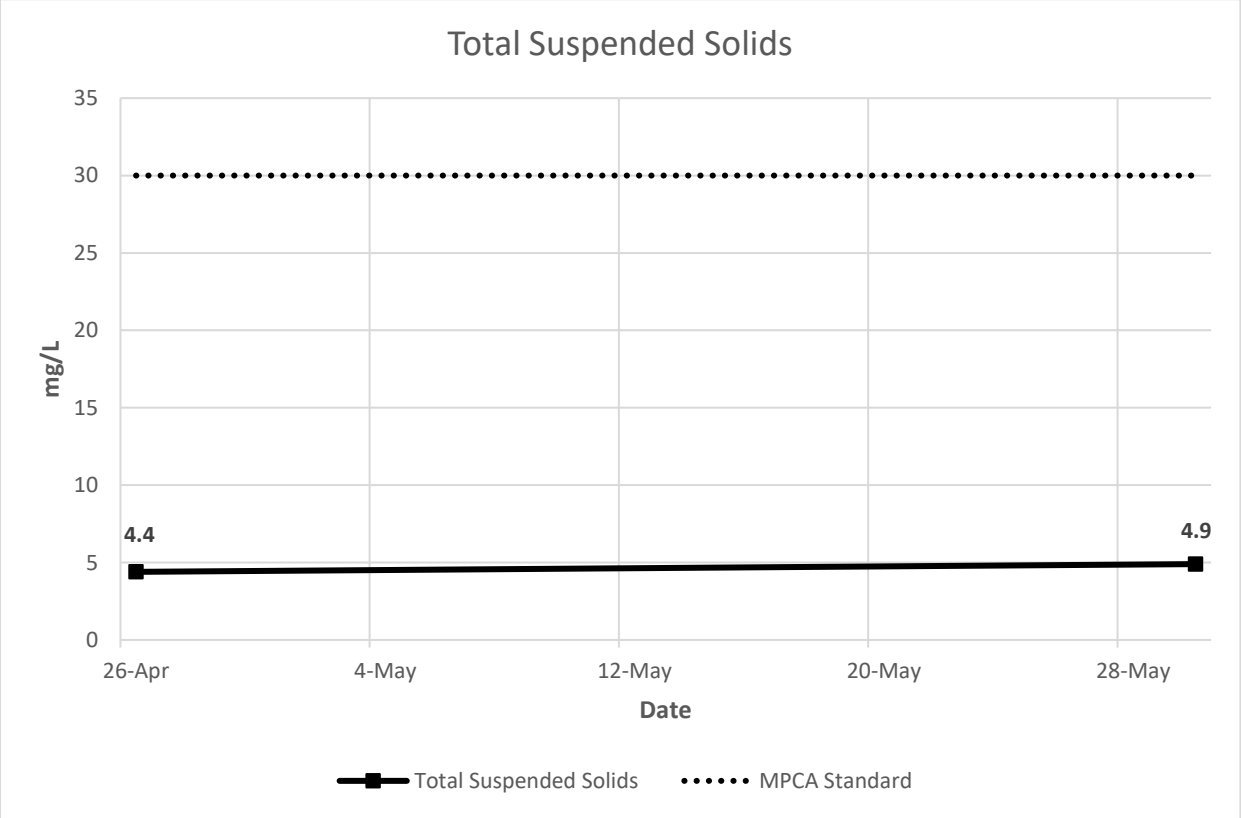

Figure 122. Total Suspended Solids samples collected at S007-459.

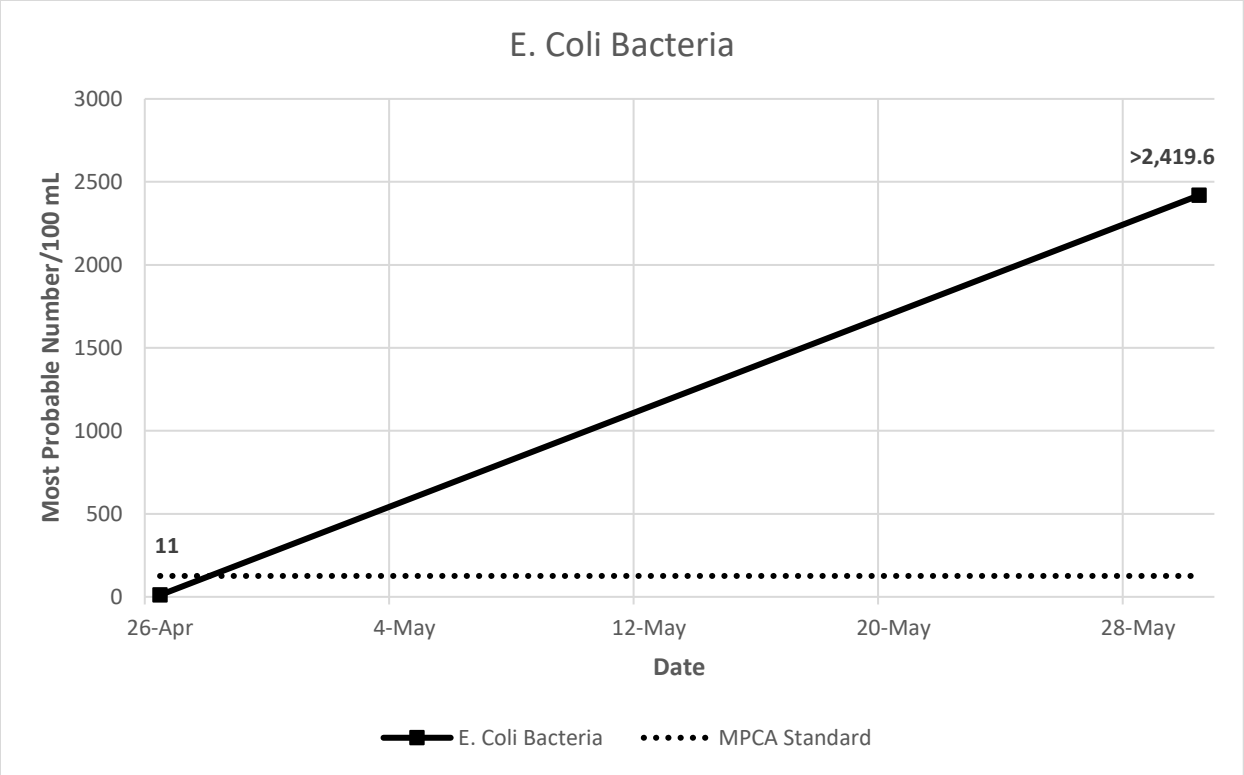

Figure 123. E. Coli Bacteria samples collected at S007-459.

13. Wilkin-Otter Tail Judicial Ditch No. 2

Wilkin-Otter Tail Judicial Ditch No. 2 is a south flowing ditch, starting in Section 1, Andrea Township, Wilkin County and outlets into the Otter Tail River in Section 30, Orwell Township.

a) S007-460: Located at approximately the halfway point of the ditch, as Judicial Ditch No. 2 runs underneath State Highway 210, east of Foxhome. This station is within the Otter Tail planning region.

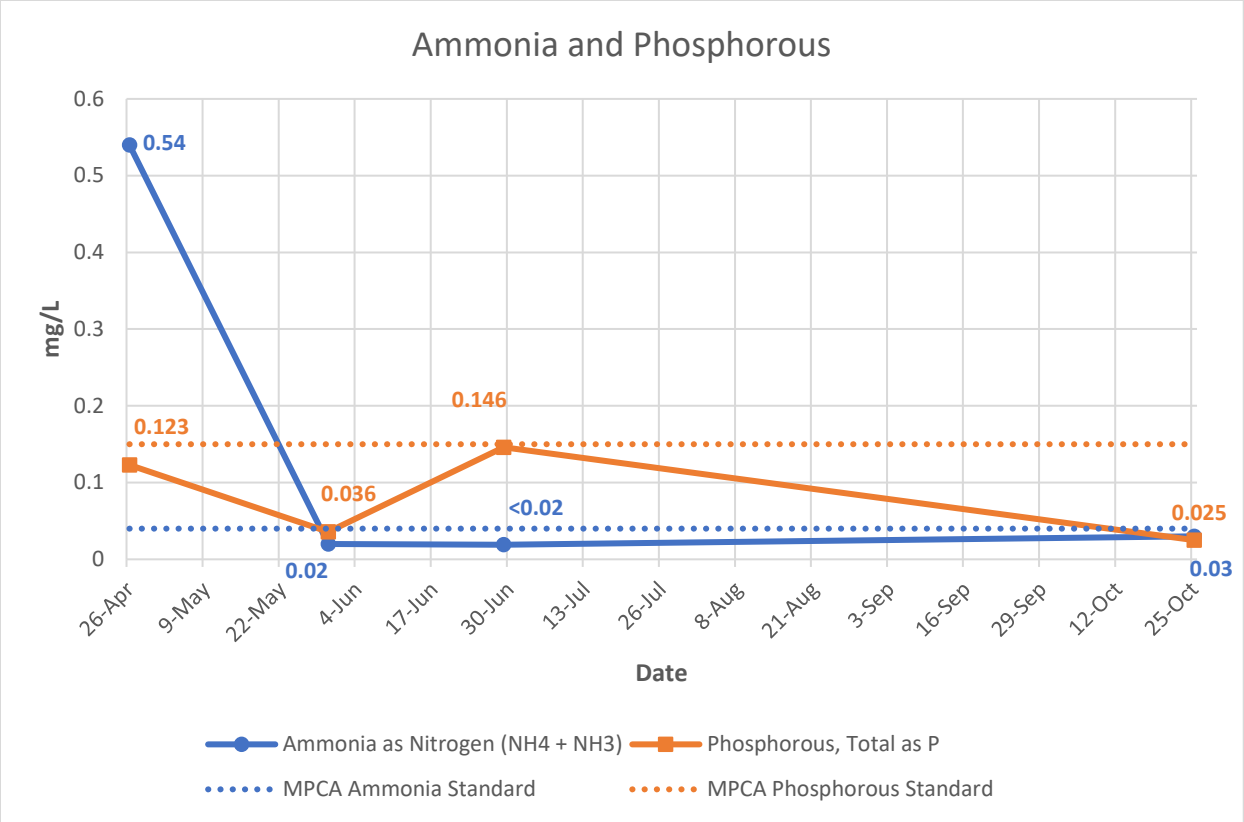

Figure 124. Ammonia and Phosphorous samples collected at S007-460.

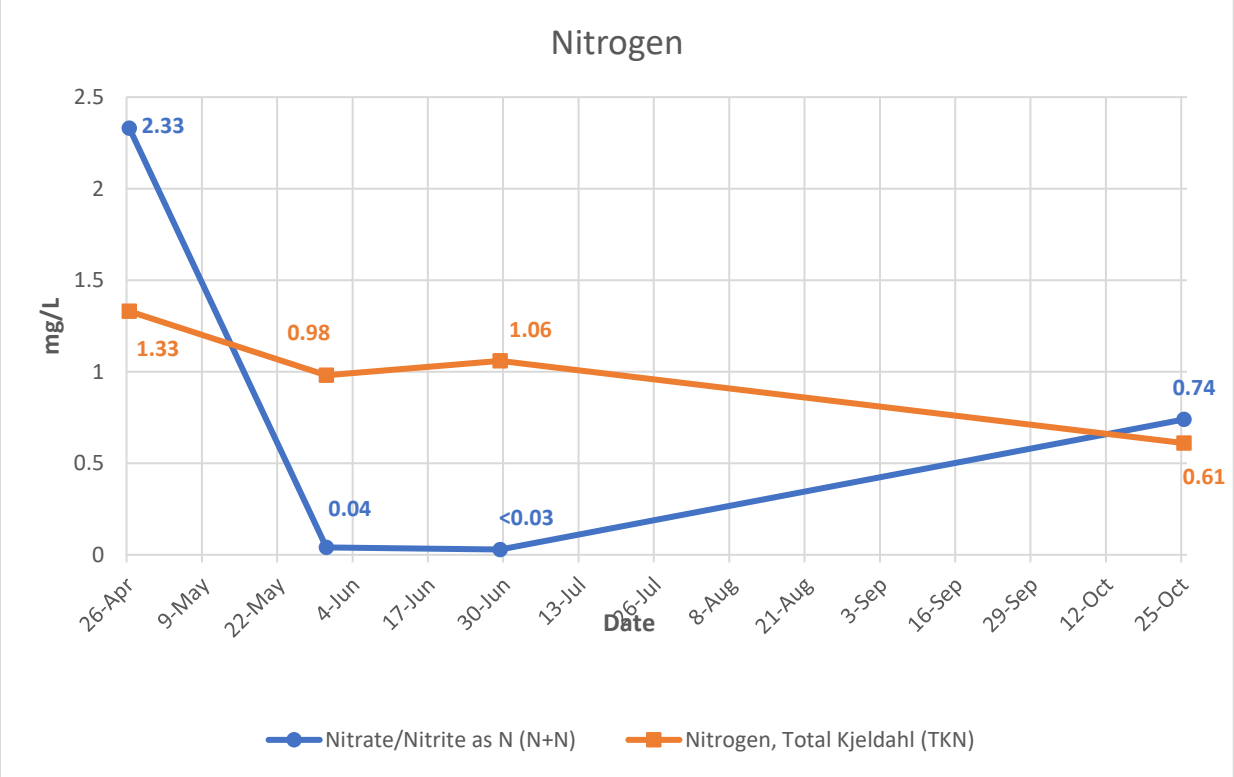

Figure 125. Nitrogen samples collected at S007-460 (MPCA and EPA standards are 10 mg/L).

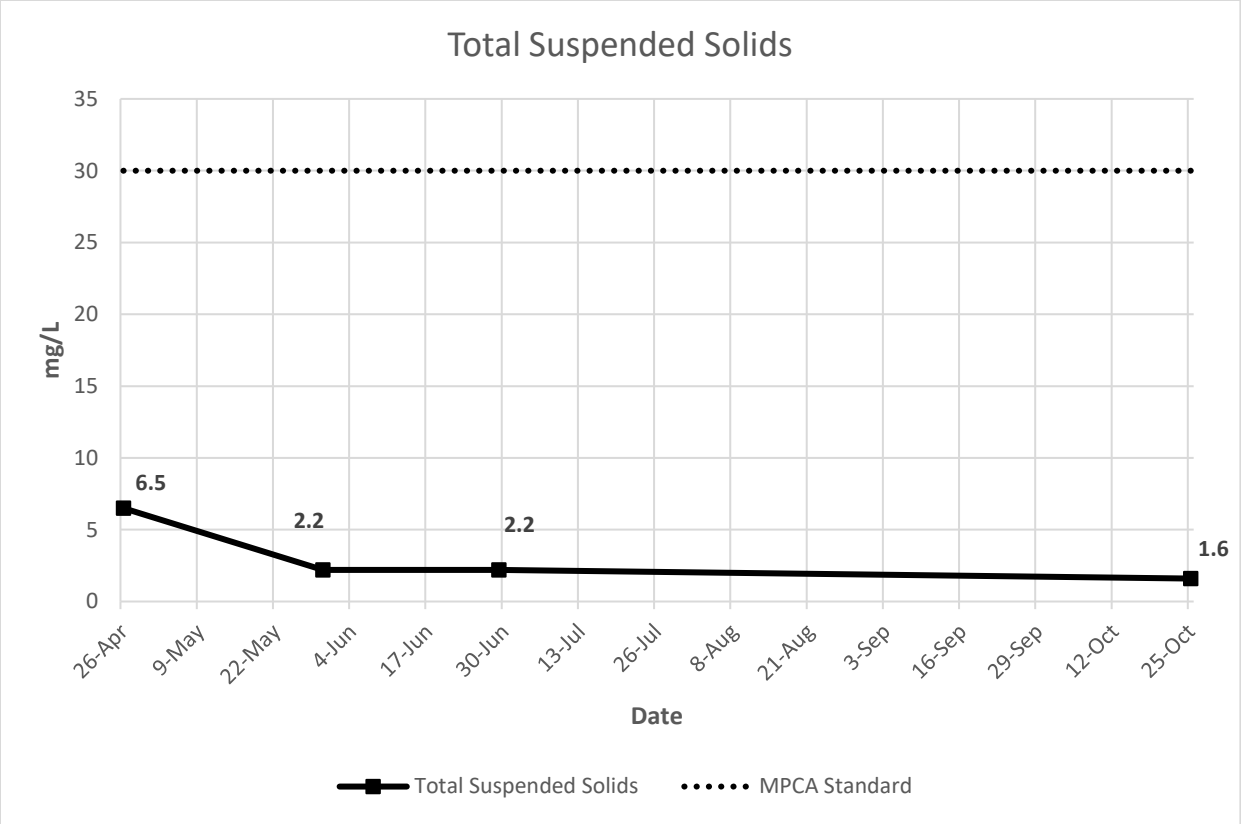

Figure 126. Total Suspended Solids samples collected at S007-460.

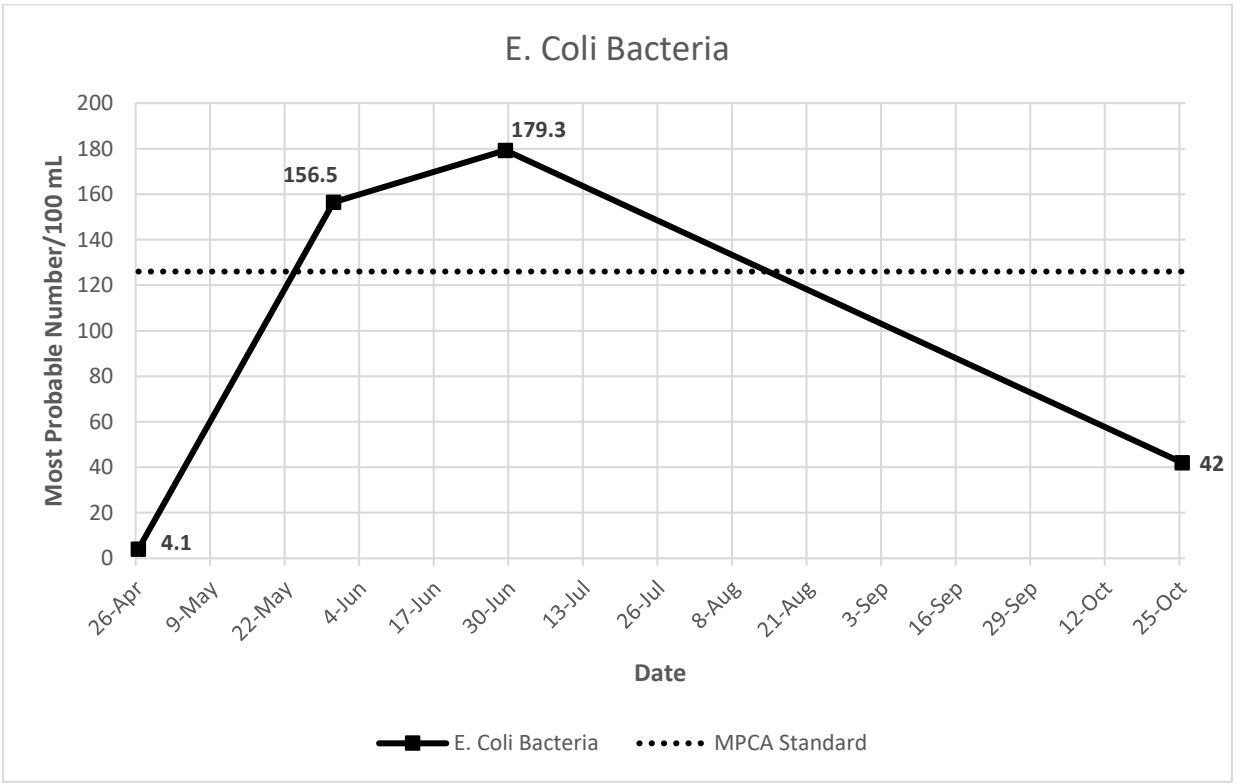

Figure 127. E. Coli Bacteria samples collected at S007-460.

14. Wilkin County Ditch No. 31

Wilkin County Ditch No. 31 is a mostly straight ditch starting in Andrea Township, moving west through Nilsen and Connelly Townships before outletting into the Red River.

a) S007-461: Located along State Highway 75 in Section 21, Connelly township in the Upper Red planning region.

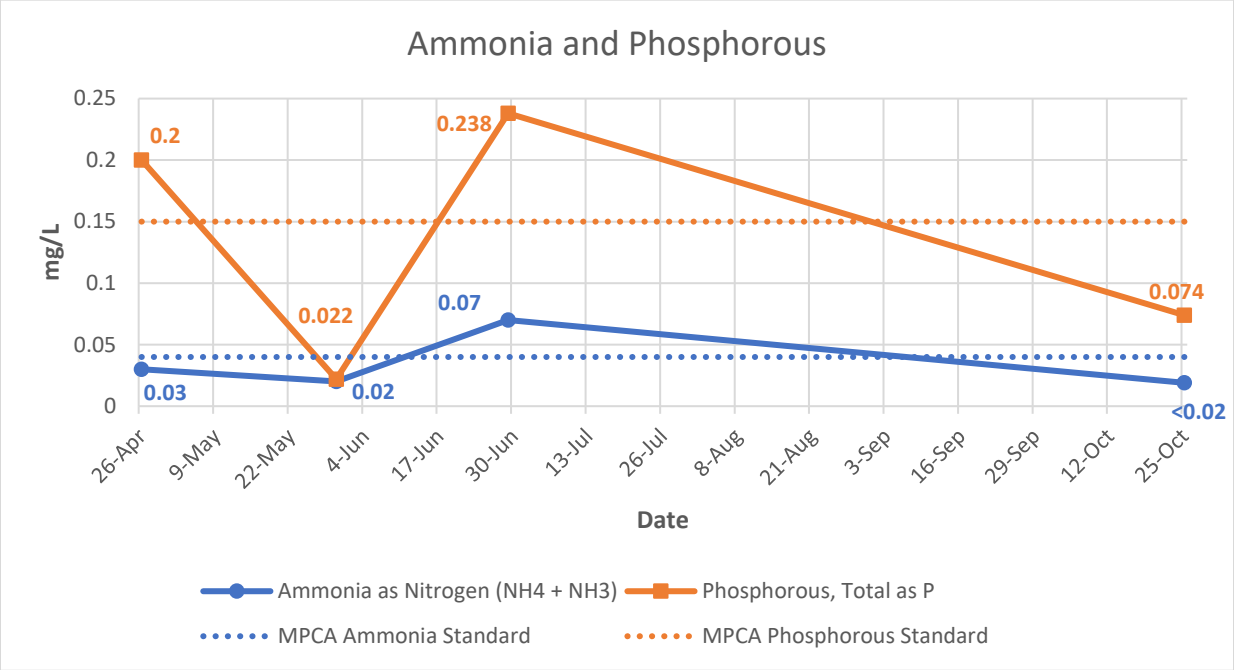

Figure 128. Ammonia and Phosphorous samples collected at S007-461.

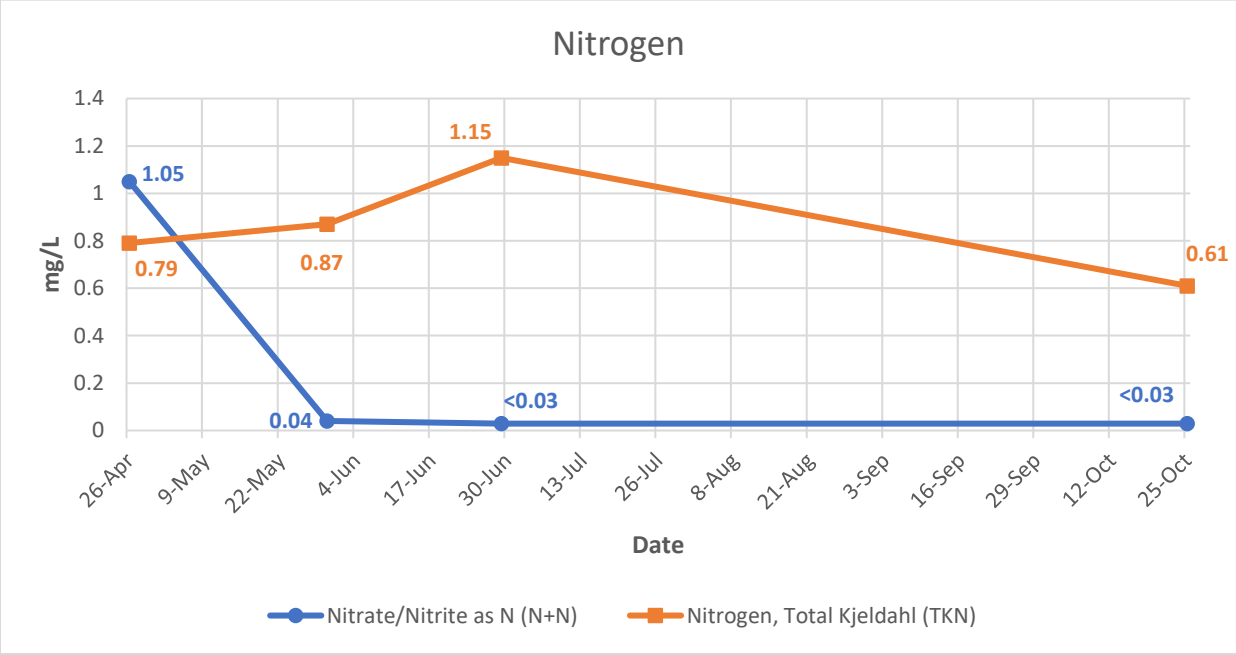

Figure 129. Nitrogen samples collected at S007-461 (MPCA and EPA samples collected at S007-461).

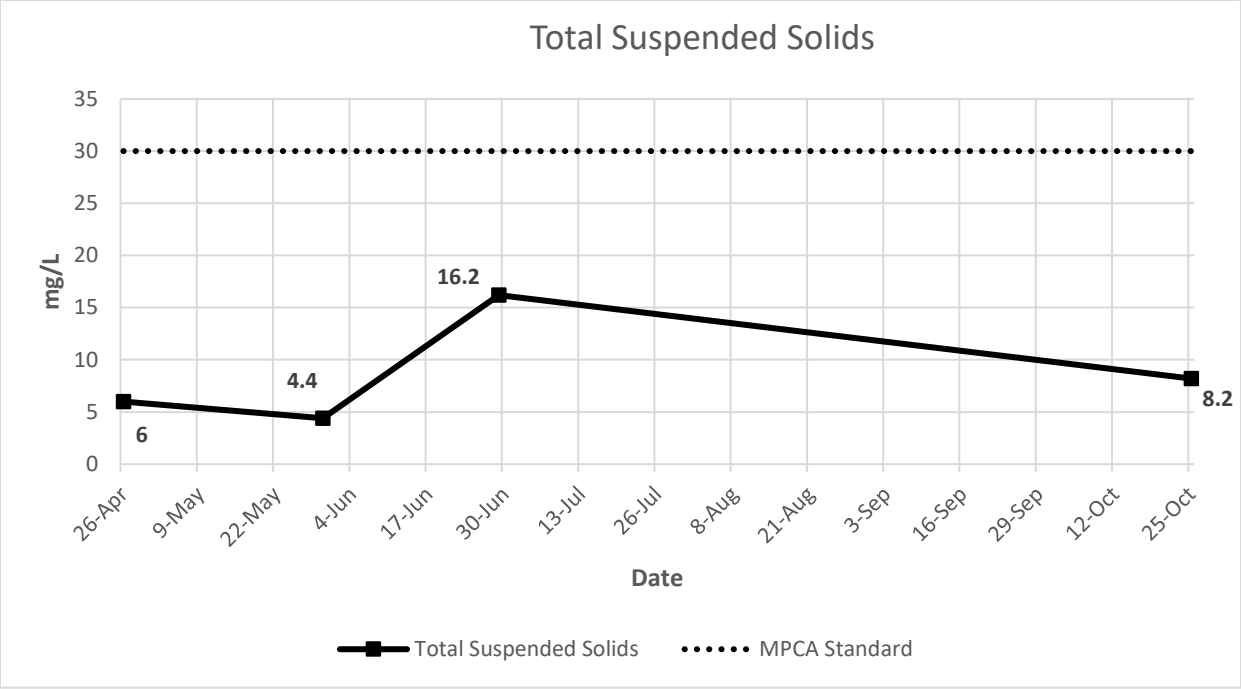

Figure 130. Total Suspended Solids samples collected at S007-461.

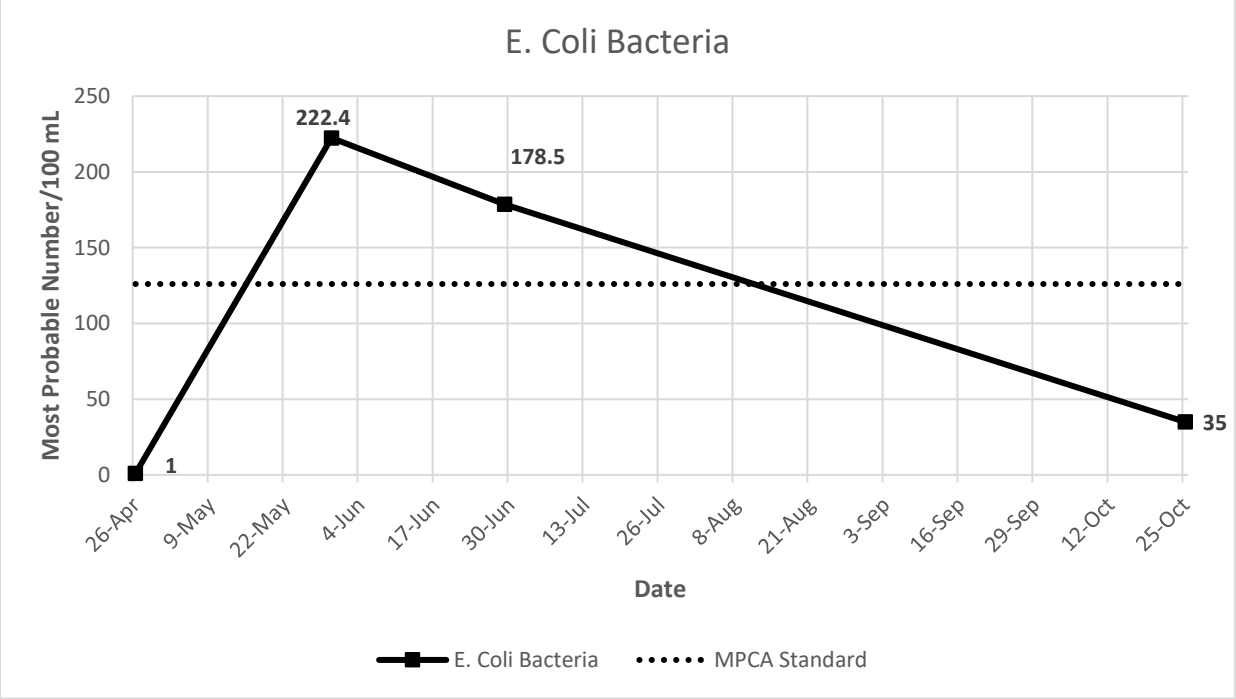

Figure 131. E. Coli Bacteria samples collected at S007-461.

15. <u>Wolverton Creek</u>

Wolverton Creek flows northwest starting in Wolverton Township, Wilkin County and outlets into the Red River in Holy Cross Township, Clay County. Wolverton Creek is a 23.5-mile-long

stream that was highly sediment laden prior to the Wolverton Creek Restoration Project by BRRWD.

a) S005-322: Located just downstream of where Clay County Ditch No. 36 outlets into Wolverton Creek. This station is within Section 5, Holy Cross Township in the Western planning region.

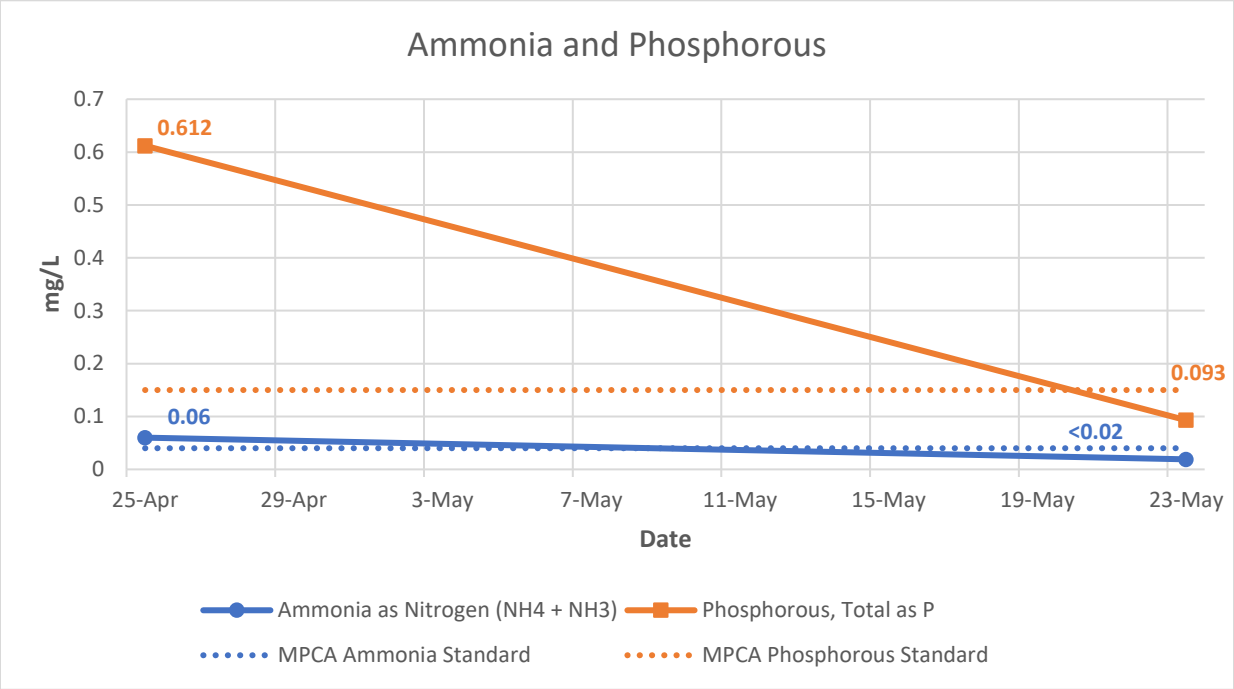

Figure 132. Ammonia and Phosphorous samples collected at S005-322.

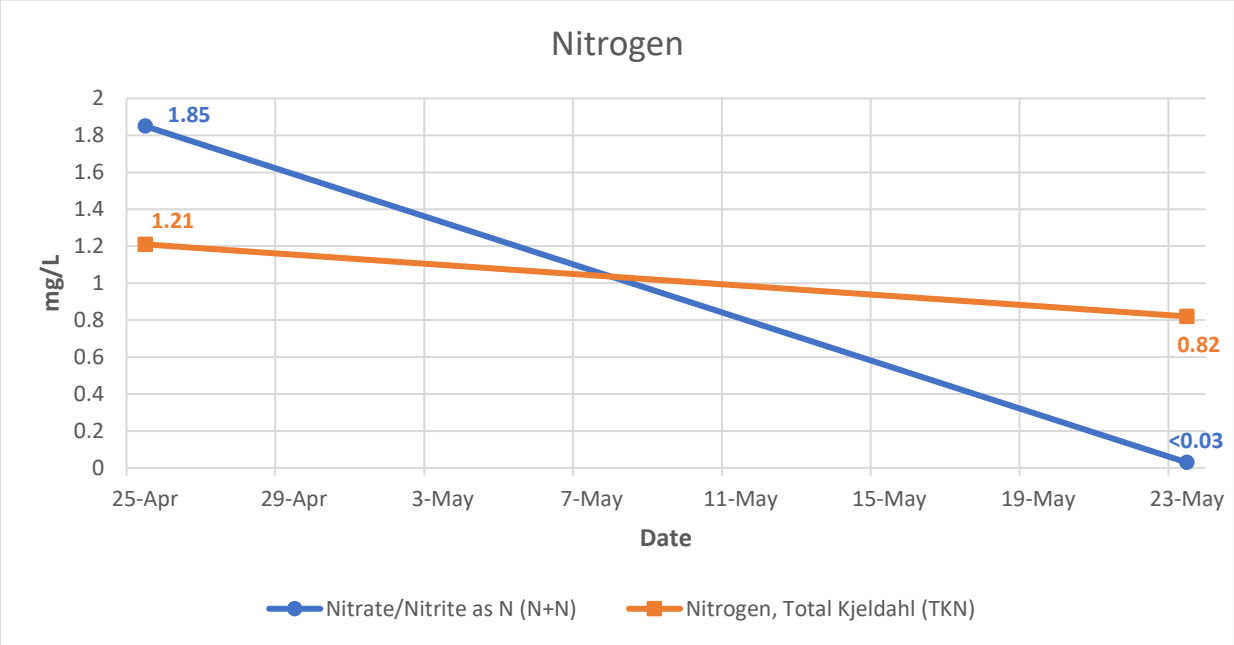

Figure 133. Nitrogen samples collected at S005-322 (MPCA and EPA standards are 10 mg/L).

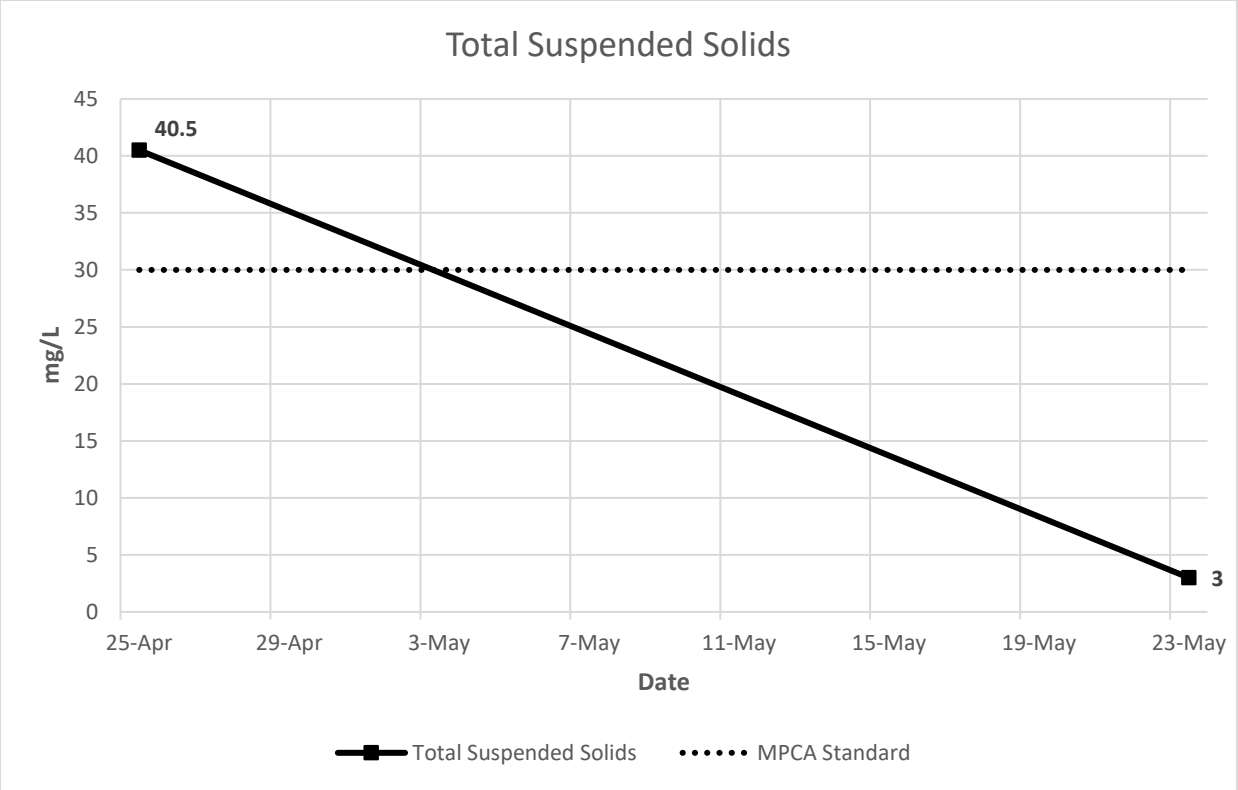

Figure 134. Total Suspended Solids samples collected at S005-322.

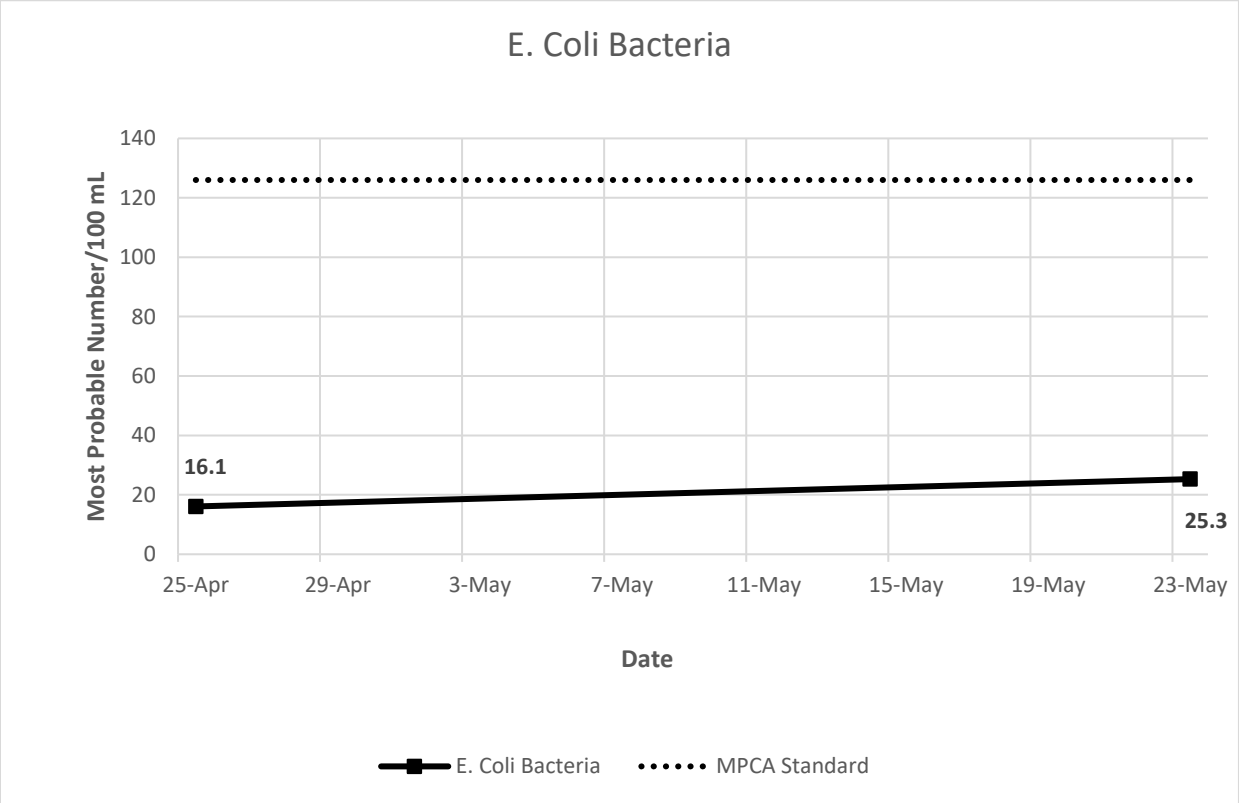

Figure 135. E. Coli Bacteria samples collected at S005-322.

Conclusions and Discussion

Overall, results in 2023 were comparable to 2022 results. Ammonia had 51 samples of 151 (33.8%) exceeding MPCA standards. Phosphorous had 48 samples of 151 samples (31.7%) exceeding MPCA standards. Nitrate/Nitrite and Total Kjeldahl Nitrogen did not have any samples that exceeded MPCA or EPA standards. Total Suspended Solids had 25 samples of 151 (16.5%) that exceeded MPCA standards. E. Coli Bacteria had 15 samples of 151 (9.9%) that exceeded the MPCA standards. All Chlorophyll-a samples were in compliance with state standards.

Other than the spring melt, 2023 was a dry year with minimal large rain events. Large rain events, especially when farmers are planting, spraying, and harvesting their crop can lead to sharp increases in analytes, which was not seen often with our samples. With the rapid warmup and brief spring flooding in 2023, coupled with drought, fields were dry shortly after spring flooding which allowed farmers to plant. Also, presumably, most rain received in 2023 soaked directly into the soil rather than running overland and carrying analytes with it.

BRRWD plans to continue monitoring these stations in the years to come. Continued monitoring of these stations can help us get a better understanding of the long-term health of our ecosystem, it can help determine locations of point source pollution, and it can be a great resource for landowners in the watershed. It also may help individuals along these bodies of water implement different land use practices in an attempt to decrease levels of specific analytes.

Resources

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- United States Geological Service. (June 5, 2018). Phosphorus and Water. Retrieved from https://www.usgs.gov/special-topics/water-science-school/science/phosphorus-and-water.