

**Washington University Stable Isotope Laboratory**  
**Two Mile Creek Watershed**  
**Chemical and Bacterial Analyses**

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This report summarizes the results of samples collected from the Two Mile Creek watershed, including commercial discharge near a Two Mile Creek tributary (sample 121116A) and three samples along the south branch of Two Mile Creek (samples TMC-1, 121116B; TMC-2, 121116C; and TMC-3, 121116D). Available results from field and laboratory analyses are summarized below and pictures are attached as an appendix. Additionally, the implications of the data have been assessed.

**Data Precision, Accuracy, and Methods:**

Table 1 describes the precision and accuracy of each in situ water quality measurement.

**Table 1. Field parameters listed with the precision and accuracy of the measurement.**

Parameter	Precision	Accuracy
Temperature	+/- 0.2°C	+/- 0.2°C
Specific Conductivity	+/- 0.05 mS/cm	+/- 10%
pH	+/- 0.2 pH units	+/- 0.2 pH units
Dissolved Oxygen	+/- 0.3 mg/L	+/- 10%
Turbidity	+/- 5% (NTU)	+/- 10%

Table 2 describes the precision, accuracy, method, and whether the method is approved by the EPA for each of the laboratory water quality parameters.

**Table 2. Laboratory analyses listed with the precision, accuracy, method, and EPA approval status of the measurement.**

Parameter	Precision	Accuracy	Method	EPA Approval
Ammonia as nitrogen	+/- 0.01 mg/L	+/- 20%	Spectrophotometry, Chromotropic Acid Method: Hach Method 10020 (Hach, 2005a)	Yes
Chloride	+/- 1.0 mg/L	+/- 20%	Digital titration: Hach Method 8206 (Hach, 2005b)	Yes
Nitrate as nitrogen	+/- 0.01 mg/L	+/- 20%	Spectrophotometry, Nessler Method: Hach Method 8038 (Hach, 2005c)	Yes
Total Phosphorus	+/- 0.01 mg/L	+/- 20%	Spectrophotometry, Acid Persulfate Digestion: Hach Method 8190 (Hach, 2005d) and Ascorbic Acid: Hach Method 8048 (Hach, 2005e)	Yes
<i>E. Coli</i>	N/A – Most probable # (MPN)	N/A IDEXX claims 95% confidence level	IDEXX Colilert System (97 well tray)	Yes
Total Coliform	N/A (MPN)	N/A	IDEXX Colilert System (97 well tray)	Yes
<i>E. Coli</i>	N/A (MPN)	N/A	Coliscan® Easygel®	No
Total Coliform	N/A (MPN)	N/A	Coliscan® Easygel®	No

### Quality Control:

Accurate, reliable field measurements and analytical results depend upon consistent methods, careful execution of procedures, quality supplies, and properly maintained instrumentation. A laboratory blank was analyzed during the wet chemical analyses and results are shown in Table 3. The laboratory blank results were below the detection limit for all tested parameters, confirming that the laboratory procedures have not contaminated the samples.

### Field Measurements, Wet Chemistry, and Biological Analyses:

The methods below were used to assess the impairment of the various sites for compliance with EPA water quality standards. They regard EPA quantitative standards that apply to the "Protection of Aquatic Life" (AQL or for category B recreational waters) for dissolved oxygen (DO), ammonia-N, chloride, total phosphorus, and *E. coli* (taken from MoDNR, 2009) or EPA Drinking Water Contaminants for nitrate (taken from EPA, 2010a). Specifically:

<b>Low DO:</b>	No more than 10% of all samples below criterion (5 mg/L for AQL).
<b>Ammonia-N:</b>	Freshwater criteria are pH, temperature, and life-stage dependent.
<b>Chloride:</b>	No more than one chronic (> 230 mg/L) or acute (> 860 mg/L) toxic event in 3 years.
<b>Nitrate-N:</b>	No more than 10 mg/L.
<b>Total Phosphorus:</b>	No more than 0.58 mg/L for lakes, no set criterion for streams.
<b><i>E. coli</i>:</b>	Water quality standards not exceeded as a geometric mean (206 cfu/dL for <i>E. coli</i> ) in any of the last three years, for samples collected during April 1 to October 31.

Application of these standards is strictly academic because Two Mile Creek is not classified for any beneficial use. Nevertheless, the EPA guidelines provide a valuable way to summarize water quality and water quality trends at these sites.

## Results:

All analyses obtained for the sites are shown in Table 3 and discussed below.

**Table 3. Field and laboratory data for all samples.**

Sample ID		121116A	121116B	121116C	121116D	QA/QC
		Commercial Discharge	TMC-1	TMC-2	TMC-3	Laboratory Blank
Date and Time	Date	11/16/2012	11/16/2012	11/16/2012	11/16/2012	-
	Time	12:41	13:08	13:24	13:33	-
Coordinates	Easting	0724003	0723987	0723863	0723856	-
	Northing	4275844	4275770	4275996	4276122	-
Conductivity Meter	SpC ( $\mu\text{S}/\text{cm}$ )	1017	1134	1003	1022	-
	T ( $^{\circ}\text{C}$ )	10.5	9.3	7.8	6.7	-
DO Meter	DO (mg/L)	2.67	3.85	11.55	11.12	-
	DO (% sat)	24.3	33.3	97.4	90.7	-
	T ( $^{\circ}\text{C}$ )	10.9	9.4	7.8	6.7	-
pH Meter	pH	8.32	8.11	8.31	8.36	-
Turbidity Meter	Turbidity (NTU)	44	10	2	3	0
Lab Analyses	Ammonia-N (mg/L)	2.37	0.45	0.14	0.22	0.00
	Chloride (mg/L)	65	70	93	95	<0.1
	Nitrate-N (mg/L)	0.5	0.9	0.5	0.7	0.0
	Phosphorus (mg/L)	3.98	1.36	0.81	0.67	0.00
IDEXX	<i>E. coli</i> (1:1)	>2419.6	>2419.6	>2419.6	>2419.6	<1
	Total Coliform (1:1)	>2419.6	>2419.6	>2419.6	>2419.6	<1
	<i>E. coli</i> (1:4)	>9678.4	>9678.4	3465.6	3683.2	<4
	Total Coliform (1:4)	>9678.4	>9678.4	>9678.4	>9678.4	<4
Coliscan® Easygel®	<i>E. coli</i>	40200	8800	1800	2800	0
	Total Coliform	-	-	49000	43600	0

### *Turbidity*

The commercial discharge sample (121116A) had a gray appearance in the field, indicating low water clarity, and this was confirmed by a relatively high turbidity of 44 NTU. The turbidity for the southwest branch of Two Mile Creek generally decreased downstream of the commercial discharge site.

### *DO*

The DO concentrations of the commercial discharge and the most proximal stream sample, TMC-1 (121116B), were below the 5 mg/L EPA regulatory limits. This is likely the result of high rates of decomposition of organic materials in the commercial discharge and TMC-1. The two other stream samples, TMC-2 (121116C) and TMC-3 (121116D), were above 5 mg/L. The higher values are likely the result of dilution, aeration, and algal growth between TMC-1 and the downstream sites.

## *pH*

The pH was slightly alkaline ( $> 7.5$ ) for all sites, and the pH values were relatively similar at between sites. The pH values for these sites are slightly higher than typical St. Louis County streams.

## *Conductivity and Chloride*

Conductivity and chloride concentrations for all samples were elevated relative to pristine streams in east-central Missouri, but typical of the most urbanized sub-basins in the Deer Creek watershed (Hasenmueller, 2011). The differences in conductivity between the sites were minor and varied less than 12% and chloride concentrations did not exceed EPA regulatory limits.

## *Nutrients*

Nitrate-N levels remained well below regulatory levels for all the sampling sites ( $< 1.0$  mg/L). Ammonia-N levels were high for the commercial discharge sample (2.37 mg/L) and the proximal TMC-1 site (0.45 mg/L). Ammonia-N at the downstream sites (TMC-2 and TMC-3) were half that of TMC-1 due to dilution below TMC-1. Like ammonia-N, total phosphorus levels were highest for the commercial discharge sample (3.98 mg/L) and TMC-1 (1.36 mg/L), and subsequently decreased downstream, likely due to dilution.

## *Bacterial Analyses*

Bacteria levels were analyzed with a 1:1 dilution (i.e., no dilution) and a 1:4 dilution using the EPA-approved IDEXX system. However, because of high bacteria levels, the 1:1 dilutions for both *E. coli* and total coliforms for all samples were off-scale ( $> 2419.6$  colonies/100 mL), and the 1:4 dilutions were off-scale for the commercial discharge (both *E. coli* and total coliforms), TMC-1 (both *E. coli* and total coliforms), TMC-2 (total coliforms only), and TMC-3 (total coliforms only). The Coliscan® Easygel® system was used in attempt to further quantify *E. coli* levels. The *E. coli* level in the commercial discharge sample was more than three orders of magnitude greater than regulatory limits, but it should be noted that the sample was not collected during the regulation period (i.e., the April 1 to October 31 interval). Bacteria levels tended to decrease downstream of the commercial discharge site.

## Summary:

The commercial discharge site and the proximal TMC-1 sample have highly elevated *E. coli* and total coliform contents and abnormally low DO. No other measurements are of regulatory concern, but in most cases the values for the commercial discharge and TMC-1 indicate some water quality impact compared to pristine streams, especially in the case of ammonia-N and total phosphorus.



### **References:**

- EPA (2010a) Drinking Water Contaminants. Environmental Protection Agency, <http://www.epa.gov/safewater/contaminants/index.html>.
- EPA (2010b) National Recommended Water Quality Criteria. Environmental Protection Agency, <http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm>.
- Hach (2005a) Method 10020: Nitrate: Chromotropic acid method: Hach Company, 4 p.
- Hach (2005b) Method 8206: Chloride, mercuric nitrate, *in* Digital titrator model 16900 manual: Hach Company, p. 67-68.
- Hach (2005c) Method 8038: Nitrogen, ammonia: Nessler Method: Hach Company, 6 p.
- Hach (2005d) Method 8190, Phosphorus: Total digestion: Hach Company, 4 p.
- Hach (2005e) Method 8048: Phosphorus: Reactive (orthophosphate) method: Hach Company, 6 p.
- Hasenmueller, E.A., 2011. The hydrology and geochemistry of urban and rural watersheds in east-central Missouri [Ph.D. thesis]. Washington University in St. Louis, St. Louis, Missouri.
- MoDNR (2009) Methodology for the development of the 2010 Section 303(d) List in Missouri. Missouri Department of Natural Resources, Division of Environmental Quality Water Protection Program. <http://www.dnr.mo.gov/ENV/wpp/docs/final2010-lmd.pdf>

### **Appendices:**

Appendix A: Field and laboratory pictures

**Site 121116A:**



**Site 121116A:**





**Site 121116A:**



**Site 121116B:**





**Site 121116C:**



**Site 121116D:**



**Laboratory Analyses:**

**Nitrate-N Analysis:**



**Phosphorus Analysis:**





## Figures



**Figure 1: Drainage Ditch; Tomášovic Property.**



**Figure 2: Outfall to Two Mile Creek.**



**Figure 3: Outfall to Two Mile Creek.**





Figure 4: Harwood Park.



Figure 5: Pet Waste Station.



An aerial photograph of a residential neighborhood with various houses and trees. Overlaid on the image are red and blue lines, possibly representing utility lines or property boundaries. Numerous numbers are scattered across the map, some in red and some in blue, likely indicating addresses or specific data points. The map is oriented horizontally, with the top of the image showing a row of houses and the bottom showing a street with more houses.

