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Science and Ecosystem Support Division
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Proctor Creek Watershed Monitoring
Third Quarterly Sampling Event
Final Report

Fulton County, GA
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SESD Project Identification Number: 16-0309

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Title & Approval Sheet

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1.0 Introduction

The Proctor Creek Watershed is located in Fulton County, Georgia, in the city of Atlanta (Figure 1). Nine miles of the main channel of Proctor Creek are currently on the Georgia Environmental Protection Division (EPD) 303(d) list for impairment due to fecal coliform bacteria. The current study is part of a multi-year water quality monitoring project to assess both baseflow and stormflow conditions in the watershed (USEPA 2015a). Multiple locations in the watershed are being sampled on a quarterly basis, while stormwater will be sampled periodically at up to three gauging stations during significant rain events. This report contains results from the third quarterly monitoring event.

2.0 Methods

2.1 Study Design and Methods

This study was conducted in accordance with the methods outlined in the Proctor Creek Watershed Monitoring Quality Assurance Project Plan (USEPA 2015a). Field sampling was performed on April 5-6, 2016. Sampling locations, which included stations in the mainstem of Proctor Creek as well as seven of its tributaries, are listed in Table 1 and shown in Figure 2. Discharge was estimated at most locations using an acoustic Doppler velocimeter and standard stream gauging techniques (USEPA 2012b). Discharge data for James Jackson (PC8) was obtained via the United States Geological Survey (USGS) real-time streamflow data for Station Number 02336526: Proctor Creek at Jackson Parkway, available online at http://waterdata.usgs.gov. *In situ* water quality measurements of temperature, pH, specific conductance, dissolved oxygen and turbidity were obtained using YSI multi-parameter sondes (USEPA 2013b).

Water samples for fecal bacteria indicators, nutrients, classical parameters, total recoverable metals, and pesticides were collected in accordance with the SESD standard operating procedure for surface water sampling (USEPA 2013c). All samples, except those for fecal bacteria indicators, were analyzed by the Analytical Support Branch (ASB) at SESD in accordance with the ASB Laboratory Operations and Quality Assurance Manual (USEPA 2015b). Water samples for fecal bacteria analysis were delivered to the EPA Office of Research and Development (ORD) laboratory in Athens, GA for immediate processing (within 6 hours of collection).

Water chemistry data were compared to Georgia Water Quality Standards (WQS), which include freshwater aquatic life criteria at both chronic and acute exposure levels, calculated using hardness concentrations at each station where applicable (Ga. Comp. R. & Regs. r. 391-3-6-.03). Although samples were not collected according to methods used to determine chronic exposure level violations, which require more than one sampling event, these levels were still used for comparison because they are the most protective of aquatic life. Since Proctor Creek is not used as a drinking water source, water chemistry data were not compared to state drinking water standards.

3.0 Results

3.1 *In situ* Water Quality

Dissolved oxygen (DO) was relatively low, at approximately 3 mg/L, downstream of the North Avenue CSO outfall (North CSO; PC4) where water flow was minimal. This DO level is potentially below the state water quality standard of 4.0 mg/L to support warm water species of fish, depending on stream classification and other factors. Specific conductance ranged from approximately 150-300 µS/cm throughout most of the watershed, but was higher in four tributaries: North CSO (PC4; 571 µS/cm), Lindsay Sreet (PC10; 421 µS/cm), AD Williams (PC13; 485 µS/cm) and West Highlands (PC15; 594 µS/cm). Other *in situ* parameters, temperature, pH and turbidity, were at normal levels and within acceptable limits according to Georgia water quality criteria (Ga. Comp. R. & Regs. r. 391-3-6-.03).

3.2 Precipitation and Discharge

There was no precipitation during the sampling period, although two rain events totaling approximately 1.4 inches occurred three days prior to sampling (http://waterdata.usgs.gov). The USGS Jackson Parkway gauge recorded discharge of 12 cubic feet per second (cfs) throughout the sampling period. Discharge measurements are shown in Table 2. Water velocity was too low to obtain acceptable measurements at North CSO (PC4).

3.3 *Escherichia coli*

Data for fecal coliform counts are provided in Table 2, reported as the most probable number (MPN) of *E. coli* per 100 mL. While the Georgia state water quality standard is written in terms of fecal coliform, not specifically *E. coli*, the *E. coli* data provide a conservative estimate of fecal coliform since they are a subset of this group. Therefore, exceedance of the standard by *E. coli* indicates a likely exceedance by fecal coliform bacteria as a whole. The applicable standard for this sampling period (between November and April) for fishing and/or recreational waters is a geometric mean of 1,000 per 100 mL, calculated using at least four samples during a 30-day period, not to exceed a maximum of 4,000 per 100 mL in any individual sample (Ga. Comp. R. & Regs. r. 391-3-6-.03(6).

Only one sample was collected at each station during this sampling event, which precludes the calculation of a geometric mean. However, four samples contained concentrations of *E. coli* higher than that standard, three of which also exceeded the maximum allowable concentration of 4,000 MPN/100 mL (Table 2). Counts were extremely high in the Greensferry tributary (PC2), at 23,155 MPN per 100 mL. Levels were also very high in Proctor Creek at the stations upstream (Burbank; PC1) and downstream (North Avenue; PC3) of that tributary.

3.4 Surface Water Chemistry

Inorganic chemistry data for surface water samples are shown in Tables 3-4. Total nitrogen (TN) was highest at Lindsay Street (PC10; Figure 3), where nitrate-nitrite accounted for more than 95% of the total, whereas ammonia was highest at Greensferry (PC2). Total phosphorus (TP) peaked

at Greensferry (0.72 mg/L) and was still elevated downstream of that station in Proctor Creek (PC3), then declined further down the main channel (Figure 4). Total organic carbon (TOC) ranged up to 2.5 mg/L throughout most of the watershed, but was higher in three tributaries: North CSO (PC4), AD Williams (PC13) and West Highlands (PC15).

Classical parameters and metals were somewhat uniform throughout the watershed, with some exceptions. Total suspended solids (TSS) were only above the reporting limit of 4 mg/L at one location, North CSO (PC4), where water depth and flow are both low and a silty, flocculent biofilm coats the substrate. Where total organic carbon (TOC) was elevated (North CSO, AD Williams and West Highlands), total alkalinity, chloride, calcium, magnesium, sodium, manganese and strontium were also generally higher. This was reflected in the specific conductance measurements at these three stations, as higher concentrations of ions increase water conductivity. However, no analytes were above state water quality criteria. Analytes not detected in any water chemistry samples are listed in Table 6.

Organic water chemistry data are presented in Table 5. Water samples were analyzed for a suite of organochlorine pesticides, most of which were below detection (Table 6). However, alpha- and gamma-chlordane, dieldrin, endrin ketone and heptachlor epoxide were all detected above the minimum reporting limit of 0.002 µg/L at multiple locations. Results for alpha- and gamma-chlordane were summed to provide a value for total chlordane for comparison with the WQS. Only heptachlor epoxide was above the WQS for 7-day, 10-year minimum or higher flow conditions, at Burbank (PC1), Greensferry (PC2) and North Avenue (PC3). Dieldrin and chlordane, as well as heptachlor epoxide at other stations, were above the WQS for annual average or higher flow conditions (Figure 5), which are not necessarily applicable to the sampling period. Discharge recorded at the USGS gauge at James Jackson was 12 cfs during this sampling event, which is less than the average of approximately 18 cfs calculated over 12 years of record (http://waterdata.usgs.gov). Discharge at Hortense (PC6) was measured at 3.6 cfs, versus the average of approximately 11.3 cfs calculated from historical data (2004-2006) at this location (USGS #02336517). While no average discharge data are available at the remaining stations, it is likely that flow throughout the watershed was below annual average conditions during sampling.

3.5 Quality Control

Quality control activities associated with field operations included a filter blank for dissolved phosphorus, temperature blanks for sample coolers and multi-meter instrument calibrations. Dissolved phosphorus in the filter blank sample was below detection. Temperature blank results indicate that water samples were below 4°C when received by the SESD Analytical Support Branch (ASB). All samples arrived at ASB in good condition and with a complete chain of custody. All YSI water quality instruments used during this study were maintained and calibrated according to requirements of the SESD Operating Procedure for Equipment Inventory and Management (USEPA 2013a). YSI instruments were operated within the ranges established by the manufacturer and therefore were within acceptable field measurement uncertainty guidelines (Table 6; USEPA 2012a). At the end of each sampling day, instruments were end-checked using the appropriate standard for each parameter measured. End check results indicate all instrument measurements were within acceptable limits.

4.0 Discussion

Results from this sampling event were very similar to the first two quarterly datasets collected in September 2015 (USEPA 2016a) and January 2016 (USEPA 2016b). Phosphorus and fecal bacteria were both highest in the tributary draining the decommissioned Greensferry CSO facility, and in the main channel of Proctor Creek downstream of that tributary. Nitrogen was generally elevated in the upper end of the watershed, at levels comparable to those measured in January. Total organic carbon, as well as several metals such as calcium, iron, manganese and sodium, were again higher in several tributaries: North Avenue CSO (PC4), AD Williams (PC13), and West Highlands (PC15). Overall patterns were relatively consistent among sampling dates, while minor fluctuations in the concentration of individual parameters can be attributed to seasonal variation (*e.g*., temperature, hydrology, biological activity).

In addition to the inorganic parameters being sampled quarterly, surface water samples collected during this event were also analyzed for organochlorine pesticides. Results of the September sampling event had indicated that levels of the pesticide chlordane may be above the WQS applicable during 7-day 10-year flow conditions (7Q10); however, the ASB routine-level reporting limit for this and several other pesticides is higher than the respective WQS. Samples collected during the April sampling event were therefore extracted and analyzed using modified methods in order to achieve lower detection and reporting limits. Pesticides data again revealed detections of both alpha- and gamma-chlordane. Concentrations of total chlordane (summing alpha- and gamma-chlordane) were above the annual average criterion at 9 stations, but none were above the 7Q10 criterion (Table 6). Dieldrin was above the annual average criterion at all stations sampled, and heptachlor epoxide was above the annual average criterion at most stations and above the 7Q10 criterion at three locations. Heptachlor epoxide is a breakdown product of heptachlor, both of which can also be breakdown products of chlordane. However, each of these have individual WQS and are therefore not included in the calculation of total chlordane. Given that flow conditions were most likely below the annual average, based on discharge data collected at the one long-term gauge in the watershed, it appears that only heptachlor epoxide may exceed the applicable 7Q10 WQS at three of the sampling locations.

Chlordane, dieldrin and heptachlor are all organochlorine pesticides that have been banned in the United States for approximately 30 years. These compounds were used historically for agricultural pest control as well as termite treatment in residential areas, and are extremely persistent in the environment (Kutz et al. 1991). It is therefore not surprising to find them throughout the Proctor Creek watershed, with the highest concentrations in dense urban neighborhoods close to downtown Atlanta and the lowest concentrations in more recently developed areas (*i.e.*, West Highlands). While these pesticides were detected at levels that may be harmful to aquatic life over time, there is low risk to human health through contact with surface water in Proctor Creek. However, since these compounds bioaccumulate up the food chain, there is a possibility of human exposure to these pesticides via consumption of fish caught in the watershed. A fish tissue screening was also conducted in April 2016 in the North Avenue area of Proctor Creek, within a sampling reach which extended upstream and downstream of station PC3, to determine whether pesticide concentrations are at levels of potential concern in resident fish populations. Results of that screening will dictate whether a fish consumption advisory is

recommended, which would require more extensive sampling in order to define limits and identify applicable stream reaches.

5.0 Conclusions

This was the third quarterly sampling event in a long-term monitoring study. Results of all sampling events will be compiled at the end of the study to provide a comprehensive summary. Two or more years of quarterly data will establish a baseline against which progress may be measured, as various improvement projects move forward in the Proctor Creek watershed.

6.0 References

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USEPA. 2015b. SESD Analytical Services Branch Laboratory Operations and Quality Assurance Manual (ASB LOQAM). Region 4, SESD, Athens, GA.

USEPA. 2016a. Proctor Creek Watershed Monitoring: First Quarterly Sampling Report. United States Environmental Protection Agency Region 4, SESD, Athens, GA.

USEPA. 2016b. Proctor Creek Watershed Monitoring: Second Quarterly Sampling Report. United States Environmental Protection Agency Region 4, SESD, Athens, GA.

Table 1: Sampling locations in the mainstem (MAIN) and tributaries (TRIB) of Proctor Creek.

Station ID	Station Name	Location Type	Location Description	Location (Decimal Degrees)	
				Latitude	Longitude
PC1	Burbank	MAIN	Proctor Creek at Burbank Drive	33.75710	-84.42892
PC2	Greensferry	TRIB	Tributary downstream of decommissioned Greensferry CSO	33.76075	-84.42691
PC3	North Avenue	MAIN	Proctor Creek at North Avenue	33.76800	-84.42769
PC4	North CSO	TRIB	Tributary downstream of North Avenue CSO outfall	33.76863	-84.42689
PC5	Hollowell	MAIN	Proctor Creek at Hollowell Parkway	33.77199	-84.42990
PC6	Hortense	MAIN	Proctor Creek at Hortense Place	33.77562	-84.44072
PC7	Kerry Circle	MAIN	Proctor Creek at Kerry Circle	33.79214	-84.45208
PC8	James Jackson	MAIN	Proctor Creek at James Jackson Parkway	33.79461	-84.47417
PC9	Northwest	MAIN	Proctor Creek at Northwest Drive	33.79931	-84.48682
PC10	Lindsay Street	TRIB	Tributary at Lindsay Street Park	33.76941	-84.41611
PC11	Grove Park	TRIB	Tributary at Grove Park	33.77406	-84.44029
PC12	Spring Street	TRIB	Tributary at Spring Street	33.78849	-84.46597
PC13	AD Williams	TRIB	Tributary at Northwest Drive	33.79633	-84.48602
PC14	Lillian Cooper	TRIB	Tributary at Lillian Cooper Shepherd Park	33.79799	-84.47842
PC15	West Highlands	TRIB	Tributary at Hollingsworth Boulevard	33.79076	-84.44724

Table 2: Data from *in situ* water quality measurements, discharge calculations, and fecal bacteria analysis.

Station ID	Station Name	Date	Time	Temp. (°C)	Sp. Cond. (µS/cm)	pH (S.U.)	Turbidity (NTU)	D.O. (mg/L)	Discharge (cfs)	*E. coli* (MPN/100mL)
PC1	Burbank	4/6/16	13:57	15.00	192	7.28	2.0	9.67	0.51	5,848
PC2	Greensferry	4/6/16	14:49	17.44	309	7.22	1.6	7.71	1.21	23,155
PC3	North Avenue	4/6/16	11:46	15.94	261	7.67	2.9	10.07	1.99	11,787
PC4	North CSO	4/6/16	12:17	14.40	571	7.03	1.1	3.08	NA	79
PC5	Hollowell	4/6/16	11:04	13.68	275	7.35	1.2	10.76	1.97	845
PC6	Hortense	4/6/16	9:20	12.32	257	7.30	2.0	9.43	3.61	643
PC7	Kerry Circle	4/5/16	18:05	19.08	320	7.66	2.3	9.82	5.74	1,028
PC8	James Jackson	4/5/16	16:29	18.47	277	8.30	2.1	11.31	12*	421
PC9	Northwest	4/5/16	13:57	16.64	271	7.79	2.9	10.88	11.81	316
PC10	Lindsay Street	4/6/16	13:04	16.55	421	6.93	0.6	8.91	0.05	242
PC11	Grove Park	4/6/16	10:23	11.85	210	7.64	1.7	10.60	0.98	572
PC12	Spring Street	4/5/16	17:08	16.00	154	7.42	3.1	9.58	2.80	529
PC13	AD Williams	4/5/16	15:08	14.92	485	7.67	2.4	9.17	0.47	59
PC14	Lillian Cooper	4/5/16	16:00	15.25	151	6.93	3.7	8.41	0.10	906
PC15	West Highlands	4/5/16	18:44	15.79	594	7.54	6.2	8.20	0.22	198

*Discharge at PC8 was obtained from USGS gauge data available online at http://waterdata.usgs.gov/ga/nwis for station number 02336526, Proctor Creek at Jackson Parkway. As of August 2 2016, flow data collected at this gauge in April 2016 were still considered provisional, and may be subject to revision by USGS.

Table 3: Surface water data for nutrient and classical analyses.

SURFACE WATER NUTRIENTS/CLASSICALS															
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
Analyte (mg/L)	Burbank	Greens-ferry	North Avenue	North CSO	Hollowell	Hortense	Kerry Circle	James Jackson	Northwest	Lindsay Street	Grove Park	Spring Street	AD Williams	Lillian Cooper	West Highlands
Total Suspended Solids	4.0 U	4.0 U	4.0 U	8.3	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Total Organic Carbon	1.1	2.5	2.4	6.4	1.3	1.3	1.7	1.4	2.0	1.0 U	1.3	1.7	4.5	1.9	5.9
Total Phosphorus	0.040 J,QR-1	0.72	0.54	0.13	0.32	0.15	0.051	0.034 J,QR-1	0.029 J,QR-1	0.041 J,QR-1	0.016 J,QR-1	0.065	0.012 J,QR-1	0.017 J,QR-1	0.010 U,J,QR-1
Total Dissolved Phosphorus	0.018 J,QR-1	0.68 J,QM-1	0.48	0.049 J,QR-1	0.29	0.10	0.011 J,QR-1	0.010 U,J,QR-1	0.012 J,QR-1	0.031 J,QR-1	0.010 U,J,QR-1	0.020 J,QR-1	0.010 U,J,QR-1	0.010 U,J,QR-1	0.010 U,J,QR-1
Total Nitrogen	2.27	4.20	2.54	0.38	2.30	1.85	1.20	1.01	1.08	4.46	0.94	1.15	2.00	0.42	1.59
Total Kjeldahl Nitrogen	0.67	1.8	0.64	0.33	0.40	0.35	0.36	0.23	0.24	0.16	0.15	0.35	0.50	0.20	0.39
Ammonia as N	0.17	0.79	0.30	0.14	0.14	0.10	0.063	0.050 U	0.050 U	0.050 U	0.050 U	0.087	0.083	0.068	0.26
Nitrate/Nitrite as N	1.6	2.4	1.9	0.054	1.9	1.5	0.84	0.78	0.84	4.3	0.79	0.80	1.5	0.22	1.2
Alkalinity, Total (as $CaCO_3$)	50	71	63	150	69	66	74	65	69	86	51	37	150	44	210
Bromide	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.62	0.10 U	0.10 U
Chloride	12	20	16	86	16	14	13	14	14	19	13	11	47	11	24
Fluoride	0.070	0.24	0.20	0.19	0.16	0.14	0.18	0.22	0.21	0.096	0.099	0.32	0.17	0.11	0.20
Sulfate as SO_4	17	40	32	17	33	32	58	44	39	77	28	16	21	11	66

U = The analyte was not detected at or above the reporting limit.
J = The identification of the analyte is acceptable; the reported value is an estimate.
QM-1 = Matrix Spike Recovery less than method control limits.
QR-1 = MRL verification recovery less than lower control limits.

Table 4: Surface water data for metals analyses. Detections are highlighted in grey for clarity. Acute and chronic exposure levels for aquatic life, calculated using hardness values for each station according to Ga. Comp. R. & Regs. r. 391-3-6-.03(5)(e)(ii), are provided for comparison.

SURFACE WATER METALS															
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
Analyte (µg/L)	Burbank	Greens-ferry	North Avenue	North CSO	Hollowell	Hortense	Kerry Circle	James Jackson	Northwest	Lindsay Street	Grove Park	Spring Street	AD Williams	Lillian Cooper	West Highlands
Aluminum	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100	100 U	100 U	100 U
Antimony	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Arsenic	1.0 U	1.0 U	1.0 U	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Barium	72	62	58	59	64	57	46	40	44	89	43	36	67	54	120
Calcium	20000	29000	26000	48000	30000	29000	37000	30000	29000	48000	23000	15000	41000	13000	69000
Iron	210	270	360	1600	370	460	350	350	380	120	290	480	340	810	650
Lead	1.0 U	1.0 U	1.0 U	1.9	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Magnesium	4000	6100	5300	4300	6000	5500	6100	5200	5300	7400	4400	2700	11000	2700	12000
Manganese	25	130	86	500	99	75	54	50	58	35	55	51	130	120	600
Potassium	2800	6200	5100	6300	5200	4100	5700	4700	4500	6000	2700	2600	6200	2400	6500
Sodium	9800	17000	13000	61000	14000	12000	15000	14000	14000	21000	12000	9300	41000	11000	36000
Strontium	97	110	110	200	130	110	110	100	110	240	94	67	200	96	330
Vanadium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.2
Zinc	11	10 U	10 U	17	10 U	11	10 U	10 U	10 U	71	10 U	10 U	10 U	10 U	20
Hardness* (mg/L)	66.0	96.0	86.0	140.0	99.0	94.0	120.0	96.0	94.0	150.0	75.0	50.0	150.0	44.0	220.0
Freshwater Aquatic Life: Acute Criteria															
Lead	40.97	61.77	54.78	92.97	63.88	60.37	78.72	61.77	60.37	100.13	47.15	30.14	100.13	26.14	150.61
Zinc	82.41	113.20	103.12	155.84	116.19	111.20	136.76	113.20	111.20	165.22	91.83	65.13	165.22	58.45	228.55
Freshwater Aquatic Life: Chronic Criteria															
Lead	1.60	2.41	2.13	3.62	2.49	2.35	3.07	2.41	2.35	3.90	1.84	1.17	3.90	1.02	5.87
Zinc	83.08	114.12	103.97	157.11	117.14	112.10	137.87	114.12	112.10	166.57	92.58	65.66	166.57	58.92	230.42

U = The analyte was not detected at or above the reporting limit.

Table 5: Surface water data for pesticide analyses. Detections are highlighted in grey, with concentrations above the annual average water quality standard (WQS) in yellow and above the 7Q10 WQS in orange.

SURFACE WATER PESTICIDES																	
	WQS		PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
Analyte (µg/L)	7Q10	annual average	Burbank	Greens-ferry	North Avenue	North CSO	Hollowell	Hortense	Kerry Circle	James Jackson	North-west	Lindsay Street	Grove Park	Spring Street	AD Williams	Lillian Cooper	West Highlands
Dieldrin	0.056	0.000054	0.012	0.0080	0.011	0.0010 J,Q-2	0.0083	0.0049	0.0025 J,Q-2	0.0018 J,Q-2	0.0016 J,Q-2	0.028	0.0038	0.0018 J,Q-2	0.0016 J,Q-2	0.0043	0.0011 J,Q-2
Endrin ketone	NA	NA	0.0052	0.00069 J,Q-2	0.0016 J,Q-2	0.0020 U	0.0014 J,Q-2	0.0011 J,Q-2	0.0021 U	0.0020 U	0.0020 U	0.0036 J,Q-2	0.0021 U	0.0021 U	0.0020 U	0.00059 J,Q-2	0.0021 U
Heptachlor epoxide	0.0038	0.000039	0.0052	0.0042	0.0045	0.0020 U	0.0036	0.0023	0.0013 J,Q-2	0.0012 J,Q-2	0.0011 J,Q-2	0.0034	0.0023	0.0013 J,Q-2	0.00061 J,Q-2	0.00079 J,Q-2	0.0021 U
alpha-Chlordane	0.0043	0.00081	0.0012 J,Q-2	0.0011 J,Q-2	0.00097 J,Q-2	0.00054 J,Q-2	0.00080 J,Q-2	0.00062 J,Q-2	0.0021 U	0.0020 U	0.0020 U	0.0011 J,Q-2	0.00059 J,Q-2	0.00056 J,Q-2	0.0020 U	0.0020 U	0.0021 U
gamma-Chlordane	0.0043	0.00081	0.00092 J,Q-2	0.0011 J,Q-2	0.00099 J,Q-2	0.00063 J,Q-2	0.00086 J,Q-2	0.00062 J,Q-2	0.00059 J,Q-2	0.00054 J,Q-2	0.00052 J,Q-2	0.00092 J,Q-2	0.00056 J,Q-2	0.00060 J,Q-2	0.00048 J,Q-2	0.00048 J,Q-2	0.00061 J,Q-2
Chlordane (total)	0.0043	0.00081	0.00212	0.00220	0.00196	0.00117	0.00166	0.00124	0.00059	0.00054	0.00052	0.00202	0.00115	0.00116	0.00048	0.00048	0.00061

U = The analyte was not detected at or above the reporting limit.

J = The identification of the analyte is acceptable; the reported value is an estimate.

Q-2 = Result greater than MDL but less than MRL.

Table 6: Total recoverable metals and pesticides not found in surface water samples at the minimum reporting limit (MRL) indicated. U = The analyte was not detected at or above the reporting limit.

TOTAL RECOVERABLE METALS	
Analyte	**MRL (µg/L)**
Beryllium	3.0 U
Cadmium	0.50 U
Chromium	5.0 U
Cobalt	5.0 U
Copper	10 U
Molybdenum	10 U
Nickel	10 U
Selenium	2.0 U
Silver	5.0 U
Thallium	1.0 U
Tin	15 U
Titanium	5.0 U
Yttrium	3.0 U

PESTICIDES	
Analyte	**MRL (µg/L)**
4,4'-DDD (p,p'-DDD)	0.0020 U
4,4'-DDE (p,p'-DDE)	0.0020 U
4,4'-DDT (p,p'-DDT)	0.0020 U
Aldrin	0.0020 U
Endosulfan I (alpha)	0.0020 U
Endosulfan II (beta)	0.0020 U
Endosulfan Sulfate	0.0020 U
Endrin	0.0020 U
Endrin aldehyde	0.0020 U
Heptachlor	0.0020 U
Methoxychlor	0.0020 U
Toxaphene	0.20 U
alpha-BHC	0.0020 U
beta-BHC	0.0020 U
delta-BHC	0.0020 U
gamma-BHC (Lindane)	0.0020 U

Table 7: Field measurement uncertainty ranges for YSI 6920 data sondes used to collect *in situ* water chemistry data.

Parameter	Units	Measurement Technology	Sensitivity of Primary Equipment
Dissolved Oxygen	mg/L	Luminescent dissolved oxygen probe	± 0.1 mg/L or ± 1% of reading
Temperature	°C	Thermistor	± 0.3 °C
pH	SU	Glass electrode	± 0.2 SU
Specific Conductivity	µS/cm	Nickel electrode cell	± 0.5% of reading
Turbidity	NTU	Optical probe	Greater of: ± 10% or 2 NTU

Figure 1: Study site location in Fulton County, GA. The Proctor Creek watershed drains to the Chattahoochee River, which flows across the Florida panhandle to the Gulf of Mexico.

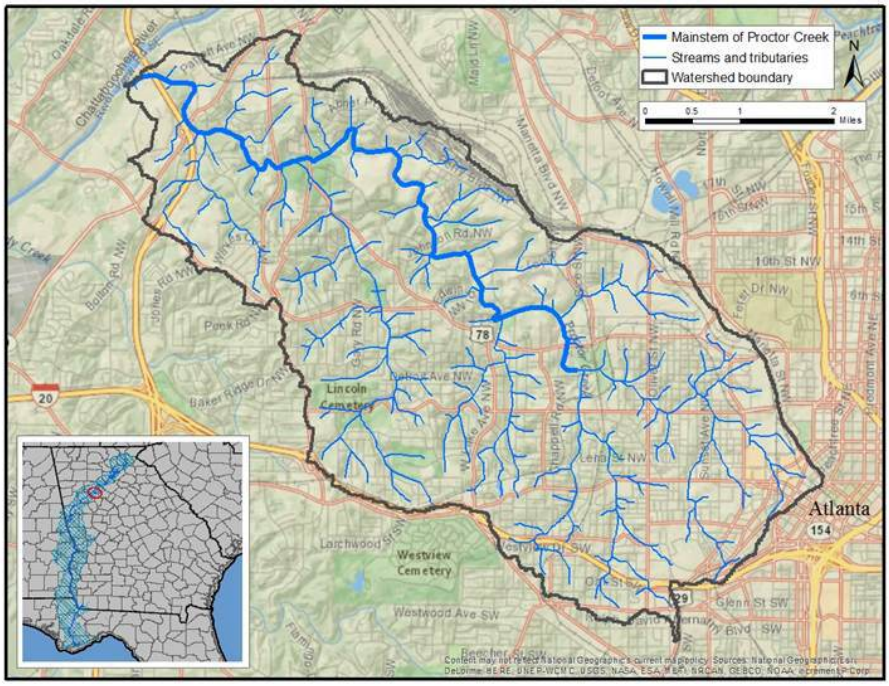


Figure 2: Map of sampling locations in the Proctor Creek watershed. The darker blue line indicates the mainstem of Proctor Creek, with tributaries shown in lighter blue. See Table 1 for station descriptions.

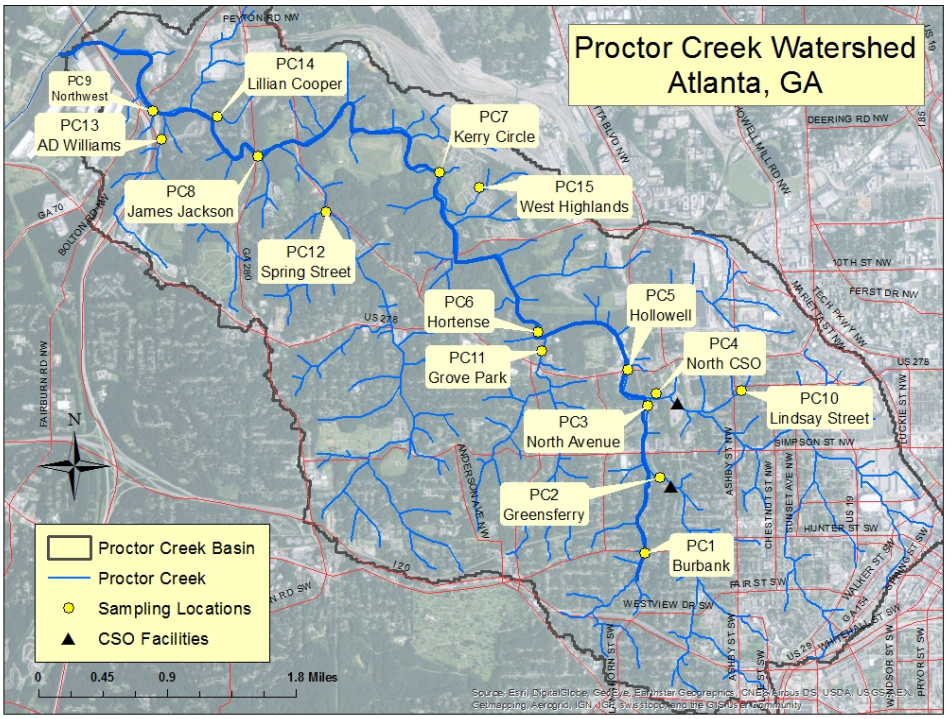


Figure 3: Total nitrogen (mg/L) in Proctor Creek and its tributaries. Locations are shown from upstream to downstream, in order from left to right.

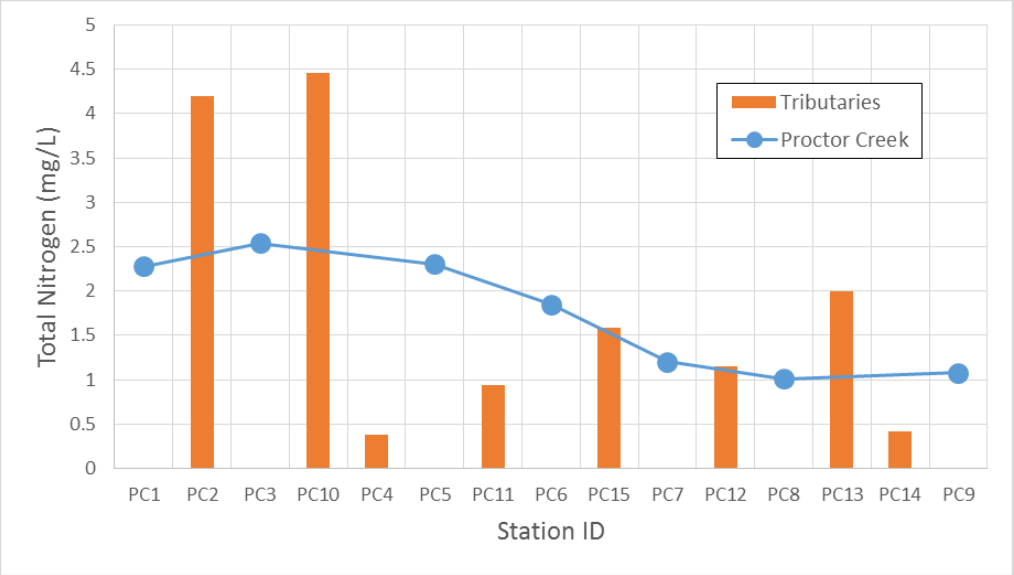


Figure 4: Total phosphorus (mg/L) in Proctor Creek and its tributaries. Locations are shown from upstream to downstream, in order from left to right.

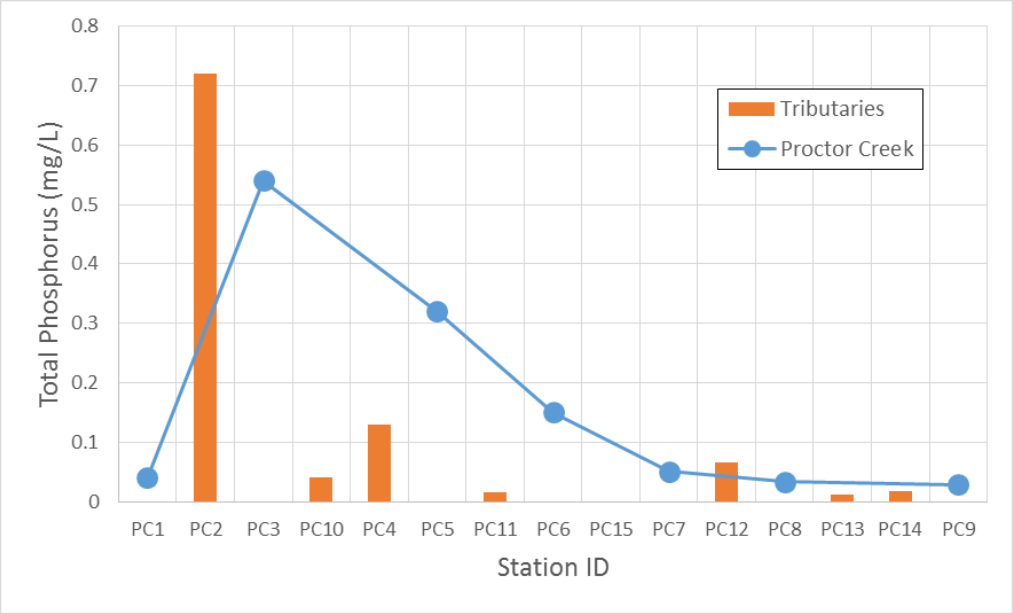
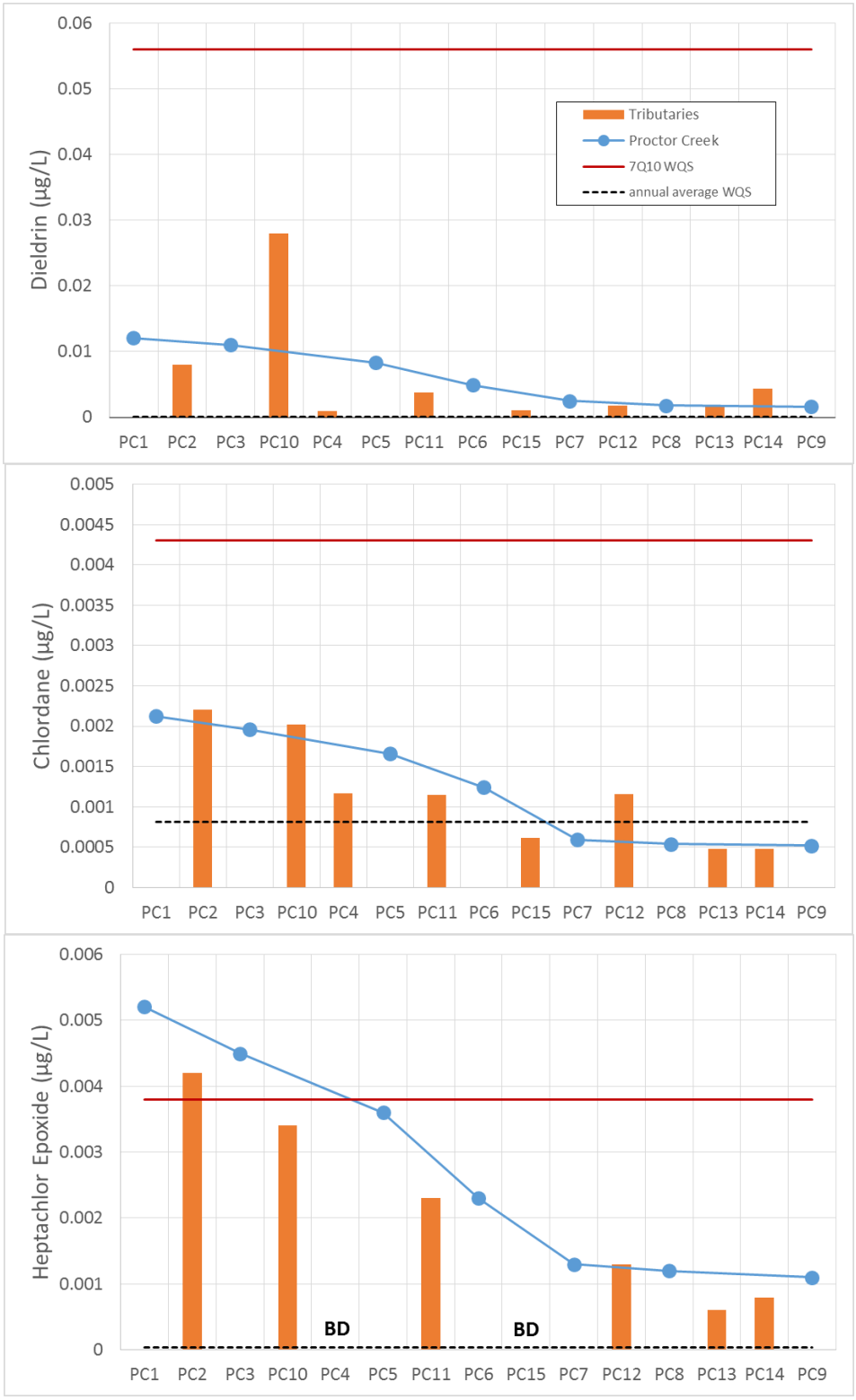


Figure 5: Data for organochlorine pesticides dieldrin, chlordane and heptachlor epoxide, compared to water quality standards (WQS). Annual average WQS are shown for reference, but likely do not apply to the sampling period due to lower than average flow conditions. BD = below detection.



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