

Big Creek Research and Extension Team
University of Arkansas System Division of Agriculture
Quarterly Report – April 1 to June 30, 2019

**MONITORING THE
SUSTAINABLE
MANAGEMENT OF
NUTRIENTS ON C&H FARM
IN BIG CREEK WATERSHED**

Mission of the University of Arkansas System Division of Agriculture

The mission of the **Division of Agriculture** is to advance the stewardship of natural resources and the environment, cultivate the improvement of agriculture and agribusiness, develop leadership skills and productive citizenship among youth and adults, enhance economic security and financial responsibility among the citizens of the state, ensure a safe, nutritious food supply, improve the quality of life in communities across Arkansas, and strengthen Arkansas families.

Dr. Mark J. Cochran
Vice President for Agriculture

Executive Summary

This is the last Quarterly Report for the Big Creek Research and Extension Team and details activities and progress made from April 1 through June 30, 2019.

1. Collection of base flow and periodic stormflow water samples from Big Creek above and below the C&H Farm, along with water from a spring (reflecting shallow aquifer flow), ephemeral stream (reflecting landscape drainage from the area of the holding ponds and operation facilities), surface runoff sites on Fields 1, 5a, and 12, two interceptor trenches below the slurry holding ponds (reflecting subsurface flow below the holding ponds), and house well (reflecting deeper ground water) for chemical and bacterial analysis.
2. Sample collection and custody logs for samples collected and reported this quarter will be posted on the Project's website.
3. This is the final Quarterly Report for the Big Creek Research and Extension Teams' monitoring of Big Creek in compliance with our Memorandum of Understanding with the Arkansas Department of Environmental Quality. A Final Report will follow in mid-September.

Big Creek Science Team

Andrew Sharpley, Ph.D., TEAM LEADER – Distinguished Professor. Soil science, water quality, soil phosphorus chemistry, agricultural management.

Kris Brye, Ph.D., Professor. Effects of land application of poultry litter on in-situ nutrient leaching, effects of land use and management practices on soil physical, chemical, and biological properties related to soil quality and sustainability.

Mike Daniels, Ph.D., Professor – Extension. Water quality and nutrient management specialist.

Ed Gbur, Ph.D., Professor and Director, Agricultural Statistics Laboratory. Experimental design, linear and generalized linear mixed models, regression, agricultural applications of statistics.

Brian Haggard, Ph.D., Professor. Ecological engineering, environmental soil and water sciences, water quality chemistry, water quality monitoring and modeling, algal nutrient limitation, pollutant transport in aquatic systems.

Phil Hays, Ph.D., Ground Water Specialist, U.S. Geological Survey and Research Professor with Geosciences Dept., University of Arkansas. Application of stable isotopes and other geochemical indicators in delineating movement and behavior of contaminants in ground-water systems.

Mary Savin, Ph.D., Professor. Structure and function of microbial communities in natural and managed ecosystems, microorganisms in nutrient cycling, contaminant degradation.

Karl VanDevender, Ph.D. and P.E., Professor, Extension Engineer. Livestock and poultry manure and mortality management, nutrient management planning.

Jun Zhu, Ph.D., Professor - Biological and Agricultural Engineering. Agricultural sustainability, manure treatment technologies.

Adam Willis, M.Sc., Newton County Extension Agent – Agriculture.

Field Technicians, The Big Creek Research and Extension Team are supported by several Program Technicians based in Fayetteville and Little Rock.

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Water Sampling and Analytical Methods

Sampling Locations

Water-quality monitoring sites detailed in Table 1 and Figure 1 are:

- Site 1. Edge-of-field monitoring on Field 1 permitted to receive slurry.
- Site 2. Edge-of-field monitoring on Field 5a excluded from receiving slurry.
- Site 3. Edge-of-field monitoring on Field 12 permitted to receive slurry.
- Site 4. Ephemeral stream flow draining a subwatershed containing the production facilities.
- Site 5. Spring below Field 1.
- Site 6. Big Creek upstream of the C&H Farm operation.
- Site 7. Big Creek downstream of the C&H Farm operation.
- Site 9. Left Fork downstream of the C&H Farm operation.
- Site 10. North interceptor trench below the manure holding ponds.
- Site 11. South interceptor trench below the manure holding ponds.
- Site 12. House well at animal facility.

Table 1. Location of sampling sites on the Big Creek Research and Extension Team project.

Site description	Site	Latitude	Longitude	Elevation, ft
Field 1	BC1	35 55' 06.42"	93 03' 38.34"	984
Field 5a	BC2	35 56' 03.01"	93 04' 25.85"	778
Field 12	BC3	35 54' 13.57"	93 04' 04.76"	838
Ephemeral stream	BC4	35 55' 25.89"	93 04' 14.94"	824
Spring	BC5	35 54' 57.06"	93 03' 34.64"	977
Big Creek upstream of farm	BC6	35 53' 32.28"	93 04' 06.38"	857
Big Creek downstream of farm	BC7	35 56' 18.98"	93 04' 21.81"	769
Left Fork	BC9	35 56' 48.33"	93 04' 0.92"	760
Trench 1 (south)	T1	35 55' 19.24"	93 04' 23.04"	890
Trench 2 (north)	T2	35 55' 21.39"	93 04' 19.93"	882
House well	W1	35 55' 27.02"	93 04' 22.71"	915
Well water depth		35 55' 27.02"	93 04' 22.71"	590
Pond 1 base		35 55' 20.36"	93 04' 23.58"	900
Pond 2 base		35 55' 22.27"	93 04' 21.61"	892

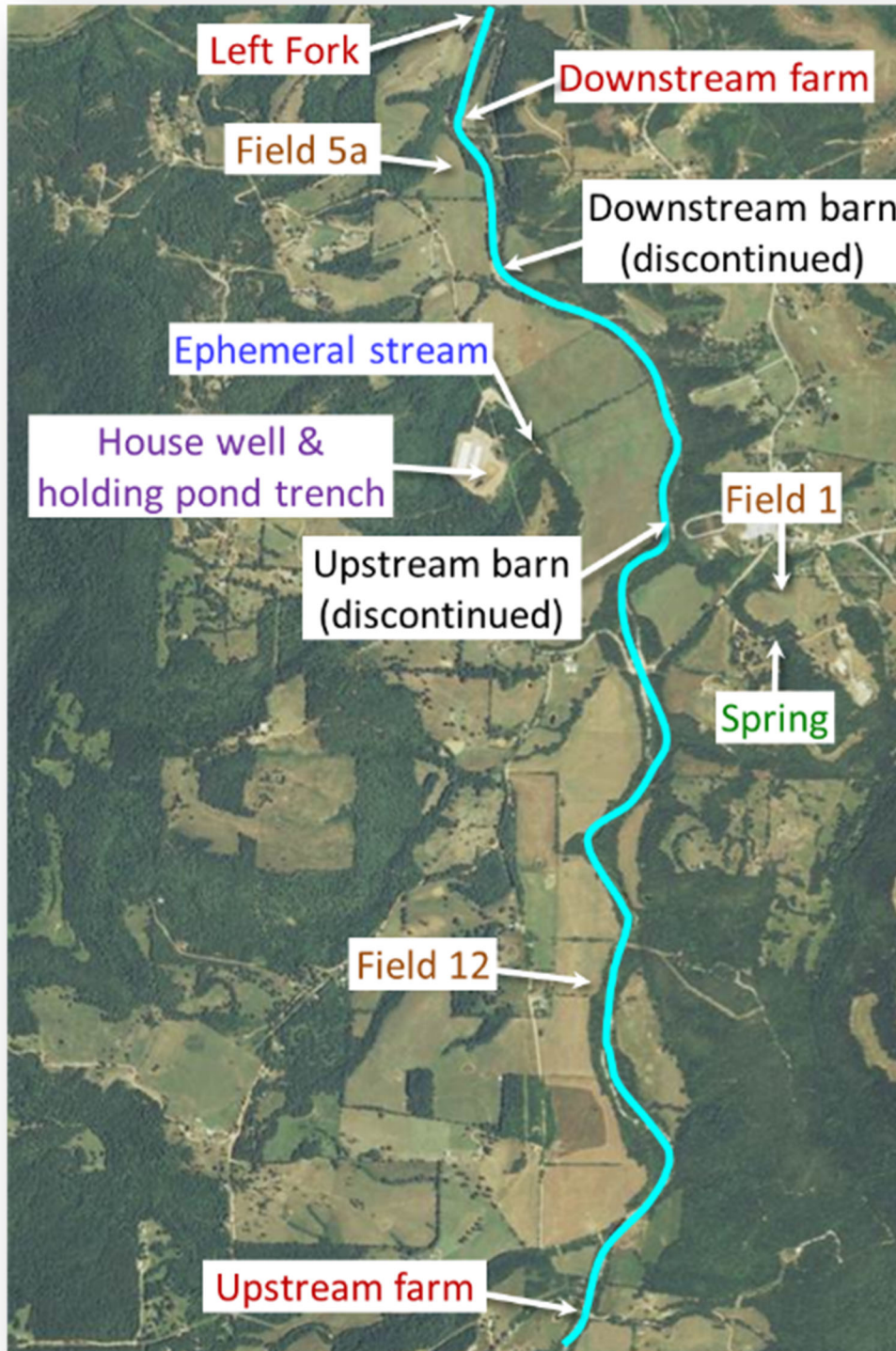


Figure 1. Location of sampling sites for the Big Creek Research and Extension Team project.

Sampling Protocols and Analyses

The following protocols were used to collect, prepare, and analyze all water samples:

1. One-liter acid-washed bottles were used to collect the stream samples for nutrient analyses.
2. Water was collected from just beneath the surface, where the stream was actively moving and well mixed.
3. The bottle was rinsed with stream water before collecting the sample.
4. Sterilized specimen cups were used to collect samples for bacterial evaluation.
5. Time of collection was noted, and samples placed in a cooler on ice to preserve them until processed and were submitted to the Arkansas Water Resources Center Water Quality Lab on the day of collection for analyses.
6. The ISCO autosamplers collect storm flow samples at sites edge-of-field sites on Fields 1, 5a, and 12, and at the ephemeral stream, upstream of the C&H Farm, and downstream of the C&H Farm sites (i.e., BC1, BC2, BC3, BC4, BC 6, and BC 7, respectively). Water-sample collection criteria for each site are detailed in Tables 2 and 3.
7. Analyses included Alkalinity (APHA 2320-B), Ammonia (EPA 351.2), Chloride (EPA 300.0), Dissolved Phosphorus (EPA 365.2), E. coli (APHA 9223-B), Electrical Conductivity (EPA 120.1), Nitrate (EPA 300.0), pH (EPA 150.1), Total Coliforms (APHA 9223-B), Total Dissolved Solids (EPA 160.1), Total Nitrogen (APHA 4500-P J), Total Phosphorus (APHA 4500-P J), and Total Suspended Solids (EPA 160.2). APHA is American Public Health Association from the Wadeable Streams Assessment, Water Chemistry Laboratory Manual http://www.epa.gov/owow/monitoring/wsa/WRS_lab_manual.pdf
8. Prior to collection of a house-well water sample, the well is purged and water temperature, pH, and electrical conductivity measured on-site every 30 seconds until all values stabilize. At that point, a sample of water is collected in a 1-L acid-washed bottle. This method is taken from USGS and EPA well water sampling protocols. See USGS methods for sampling at https://water.usgs.gov/owq/FieldManual/chapter4/pdf/Chap4_v2.pdf. Specific and detailed guidance on the collected of water quality data can be found in the USGS National Field Manual at <https://water.usgs.gov/owq/FieldManual/>.

The U.S. EPA also recommend that selected water quality parameters can be monitored during low-rate purging, with stabilization of these parameters indicating when the discharge water represents aquifer water or source well water. See:

http://www.csus.edu/indiv/h/hornert/Geol_210_Summer_2012/Week%20%20readings/Puls%20and%20Barcelona%201996%20Low%20flow%20sampling.pdf and <https://in-situ.com/wp-content/uploads/2015/01/Low-Flow-Groundwater-Sampling-Techniques-Improve-Sample-Quality-and-Reduce-Monitoring-Program-Costs-Case-Study.pdf>

9. Minimum detection limits (MDLs) for each chemical and biological constituent are listed in Table 4. Some constituent concentrations were reported by the laboratory as less than the MDL but greater than zero. Those values are given in subsequent tables but have less confidence in their accuracy than concentrations above the MDL.

10. Grid-soil sampling of Fields 1, 5a, and 12 was conducted using a grid network of approximately 0.25 acres was overlain on each field to determine the point of sampling, which were recorded with GPS. Each sample-hole remaining after the soil core was removed was carefully back-filled with commercial top soil. Where rock stopped the core penetrating below a specific layer, no sample was collected beyond that point. This sampling point was geo-referenced to collect sampling bi-annually at the same location in each field. Soil nutrients P, K, Ca, Mg, S, Na, Fe, Mn, Zn, Cu, and B, were determined by Mehlich-3 extraction; and soil pH and estimated cation exchange capacity (ECEC) in 1:2 soil:water mixture. Details of these methods are available at <https://aaes.uark.edu/research-locations/soil-testing-and-research-laboratory/lab-analytical-services-and-methods/>.

Table 2. Parameters used to enable ISCO auto-samplers at BCRET edge-of-field sites Field 1, 5a, and 12.

Site	Identifier	ISCO enabled when stage height (inches) above	Volume pacing, 100 mL water collected per gallon of water		
			Rainfall, inches		
			<2.5	2.5 to 4	>4
Field 1	BC1	> 0.75	500	1,000	5,000
Field 5a	BC2	> 0.75	5,000	10,000	50,000
Field 12	BC3	> 0.75	500	1,000	5,000

Table 3. Parameters used to enable ISCO auto-samplers at BCRET stream sites BC4, BC6, and BC7.

Site	Identifier	ISCO enabled when, over a 30-minute period, stage height (inches) increases by	Volume pacing, 100 mL water collected per gallon of water		
			Rainfall, inches		
			<2.5	2.5 to 4	>4
Ephemeral stream	BC4	> 2.0 *	25,000	50,000	100,000
Upstream Big Creek	BC6	1.2	40,000,000	50,000,000	70,000,000

Downstream Big Creek	BC7	1.8	60,000,000	80,000,000	100,000,000
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* For ephemeral stream stage height increases >2.0 inches over a 30-min period.

Table 4. Minimum detection limits (MDLs) for each chemical and biological constituent.

Constituent	Minimum detection limit ¹
Alkalinity, mg/L as CaCO ₃	2
Chloride, mg/L	0.093
Dissolved P, mg/L	0.002
Conductivity, uS/cm	1
Ammonia-N, mg/L	0.03
Dissolved organic carbon, mg/L	0.18
E. coli, MPN/100 mL	1
Nitrate-N, mg/L	0.004
pH	0.1
Total coliform, MPN/100 mL	1
Total dissolved solids, mg/L	15.22
Total N, mg/L	0.006
Total P, mg/L	0.012
Total suspended solids, mg/L	6.58

¹ MDL the Minimum Detection Limit of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Further information is available at http://water.usgs.gov/owq/OFR_99-193/detection.html

Big Creek Research and Extension Team Monitoring Data

Nutrients, Sediment, and Bacteria by Date of Sampling

Table 5. Water quality analyses at each sample site since January 2019. Coliform units are Most Probable Number (MPN) per 100 mL of water.

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
			----- mg/L -----						-- MPN/100 mL --		
1/3/2019	1/3/2019	Grab sample									
11:45	14:30	Spring	0.007	0.013	<0.03	0.740	0.990	8.8	1.35	26.9	204.6
12:16	14:30	Upstream farm	0.006	0.006	0.01	0.182	0.240	2.3	0.46	47.9	816.4
11:34	14:30	Downstream farm	0.008	0.008	<0.03	0.323	0.400	2.1	0.47	50.4	980.4
11:56	14:30	Ephemeral stream	0.005	0.011	<0.03	1.091	1.220	1.5	0.24	10.9	1732.9
11:25	14:30	Left Fork	0.010	0.010	<0.03	0.358	0.450	2.3	0.58	32.7	1299.7
12:03	14:30	House well	0.007	0.007	<0.03	0.745	0.830	0.9	0.04	<1.0	<1.0
1/16/2019	1/16/2019	Grab sample									
11:45	15:30	Spring	0.009	0.014	<0.03	1.206	1.370	4.4	0.90	2.0	613.2
12:56	15:30	Upstream farm	0.005	0.010	0.01	0.147	0.200	1.1	0.39	155.3	727.0
11:32	15:30	Downstream farm	0.007	0.011	0.01	0.291	0.340	1.3	0.35	20.1	387.3

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:18	15:30	Ephemeral stream	0.009	0.010	0.02	0.991	1.080	2.5	0.34	3.0	>2419.2
11:16	15:30	Left Fork	0.009	0.010	0.01	0.327	0.400	1.1	0.50	26.2	517.2
12:25	15:30	House well	0.008	0.008	0.01	0.703	0.790	0.5	0.35	<1.0	<1.0
1/31/2019	1/31/2019	Grab sample									
11:32	14:30	Spring	0.009	0.009	<0.03	1.142	1.300	2.5	0.63	3.1	488.4
12:15	14:30	Upstream farm	0.006	0.006	<0.03	0.168	0.200	1.6	0.27	17.3	387.3
11:16	14:30	Downstream farm	0.008	0.008	0.01	0.320	0.390	1.1	0.36	10.9	179.3
11:45	14:30	Ephemeral stream	0.009	0.010	<0.03	1.015	1.140	1.9	0.28	6.3	2419.2
11:06	14:30	Left Fork	0.008	0.008	<0.03	0.316	0.390	0.5	0.43	10.9	325.5
12:01	14:30	House well	0.010	0.010	0.01	0.768	0.820	0.6	0.19	<1.0	<1.0
2/13/2019	2/13/2019	Grab sample									
11:30	15:15	Spring	0.008	0.027	<0.03	0.692	0.940	8.0	1.26	15.8	1119.9
13:00	15:15	Upstream farm	0.005	0.022	0.02	0.204	0.280	1.0	0.77	148.3	1203.3
10:51	15:15	Downstream farm	0.008	0.027	0.02	0.349	0.490	1.9	0.82	86.0	1553.1

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:43	15:15	Ephemeral stream	0.008	0.019	<0.03	1.131	1.250	2.4	0.33	24.3	1732.9
10:38	15:15	Left Fork	0.010	0.025	0.02	0.428	0.550	1.7	1.63	49.5	1553.1
12:00	15:15	House well	0.008	0.010	0.02	0.642	0.760	0.1	0.66	<1.0	8.4
12:17	15:15	Trench 1	0.001	0.007	0.01	0.595	0.720	0.4	0.70	13.2	9330.0
12:40	15:15	Trench 2	0.004	0.012	0.02	0.899	1.110	0.7	1.30	1.0	980.4
2/27/2019	2/27/2019	Grab sample									
11:25	14:40	Spring	0.007	0.014	<0.03	0.620	0.860	6.9	4.64	1.0	1732.9
12:23	14:40	Upstream farm	0.004	0.008	0.01	0.136	0.210	1.5	1.36	54.6	488.4
11:07	14:40	Downstream farm	0.006	0.010	0.02	0.273	0.370	1.5	0.89	62.0	410.6
11:48	14:40	Ephemeral stream	0.006	0.006	<0.03	0.967	1.120	1.3	1.87	18.5	1553.1
11:55	14:40	House well	0.006	0.006	<0.03	0.690	0.810	0.5	1.26	<1.0	<1.0
3/14/2019	3/14/2019	Grab sample									
11:54	15:25	Spring	0.007	0.023	<0.03	0.518	0.760	2.0	4.73	22.8	816.4
12:58	15:25	Upstream farm	0.005	0.032	0.02	0.124	0.220	2.5	1.70	135.4	1553.1
11:37	15:25	Downstream farm	0.006	0.036	0.01	0.180	0.320	4.5	1.84	325.5	>2419.2

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:10	15:25	Ephemeral stream	0.006	0.028	<0.03	0.967	1.200	1.8	22.00	52.9	1986.3
11:30	15:25	Left Fork	0.006	0.032	0.01	0.161	0.240	3.0	2.89	186.0	>2419.2
12:15	15:25	House well	0.008	0.012	<0.03	0.711	0.870	0.0	2.73	<1.0	<1.0
12:25	15:25	Trench 1	0.002	0.016	0.01	0.616	0.820	120.1	1.73	<1.0	435.2
12:43	15:25	Trench 2	0.002	0.025	0.01	0.839	1.200	0.2	2.99	<1.0	435.2
3/20/2019	3/20/2019	Grab sample									
8:01	11:30	Spring	0.007	0.027	0.01	0.735	1.050	18.1	1.05	5.2	298.7
8:42	11:30	Upstream farm	0.003	0.003	<0.03	0.098	0.160	2.1	0.45	344.8	1119.9
7:44	11:30	Downstream farm	0.004	0.004	<0.03	0.217	0.300	2.4	0.57	62.4	387.3
8:11	11:30	Ephemeral stream	0.006	0.006	<0.03	0.983	1.160	3.3	0.33	5.2	1119.9
7:34	11:30	Left Fork	0.002	0.002	<0.03	0.178	0.300	2.9	0.68	29.5	547.5
8:17	11:30	House well	0.008	0.008	<0.03	0.726	0.880	0.0	0.16	<1.0	2.0
Samples analyzed since the last quarterly report											
3/28/2019	3/28/2019	Grab sample									
7:09	11:20	Spring	0.007	0.052	<0.03	0.703	1.040	35.1	3.39	1.0	365.4

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
7:55	11:20	Upstream farm	0.002	0.011	<0.03	0.069	0.130	2.0	2.22	123.6	866.4
6:51	11:20	Downstream farm	0.002	0.010	<0.03	0.136	0.210	2.5	1.01	93.3	666.7
7:21	11:20	Ephemeral stream	0.006	0.006	<0.03	0.966	1.130	1.6	7.37	7.4	>2419.2
6:35	11:20	Left Fork	0.001	0.007	<0.03	0.102	0.200	2.9	1.07	9.8	387.3
7:32	11:20	House well	0.006	0.009	<0.03	0.798	0.950	0.5	0.51	<1.0	<1.0
4/8/2019	4/8/2019	Grab sample									
12:00	15:00	Spring	0.006	0.011	<0.03	0.363	0.550	1.7	31.78	38.8	1046.2
12:40	15:00	Upstream farm	0.007	0.014	<0.03	0.060	0.130	3.6	4.39	193.5	1986.3
11:40	15:00	Downstream farm	0.004	0.022	<0.03	0.091	0.200	4.0	7.01	191.8	2419.2
12:10	15:00	Ephemeral stream	0.004	0.013	<0.03	0.792	0.920	1.7	18.32	37.3	1413.6
11:30	15:00	Left Fork	0.001	0.016	<0.03	0.064	0.200	5.1	10.61	178.9	>2419.2
12:25	15:00	House well	0.005	0.005	<0.03	0.678	0.770	0.9	23.13	<1.0	5.2
4/11/2019	4/11/2019	Grab sample									
11:20	14:10	Spring	0.007	0.012	0.01	0.639	0.800	1.8	1.01	16.1	613.1

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:47	14:10	Upstream farm	0.004	0.009	<0.03	0.048	0.110	2.9	0.47	146.7	1732.9
10:55	14:10	Downstream farm	0.007	0.019	<0.03	0.084	0.200	3.3	0.46	118.7	2419.2
11:28	14:10	Ephemeral stream	0.003	0.012	<0.03	0.823	1.010	5.6	0.34	19.9	>2419.2
10:45	14:10	Left Fork	0.004	0.010	<0.03	0.084	0.160	3.1	0.67	35.9	1203.2
11:33	14:10	House well	0.007	0.009	<0.03	0.671	0.800	0.2	1.58	<1.0	<1.0
4/18/2019	4/18/2019	Grab sample									
7:11	12:05	Spring	0.004	0.043	<0.03	0.399	0.700	12.7	2.01	866.4	16640.0
8:32	12:05	Upstream farm	0.018	0.104	<0.03	0.113	0.540	38.5	2.32	4130.0	23590.0
6:53	12:05	Downstream farm	0.006	0.046	<0.03	0.173	0.390	18.2	0.81	920.8	5630.0
7:24	12:05	Ephemeral stream	0.009	0.009	<0.03	0.920	1.080	2.8	0.35	31.7	>2419.2
6:35	12:05	Left Fork	0.006	0.020	<0.03	0.231	0.400	4.0	0.62	13960.0	>2419.2
8:01	12:05	Trench 1	0.001	0.062	<0.03	0.399	0.820	14.5	1.12	1046.2	241920
7:53	12:05	Trench 2	0.000	0.107	<0.03	0.120	0.910	20.9	0.14	6090.0	241920
4/25/2019	4/25/2019	Grab sample									
7:32	11:50	Spring	0.008	0.031	<0.03	0.641	1.080	8.7	3.19	1732.9	30760.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
8:47	11:50	Upstream farm	0.010	0.051	<0.03	0.109	0.360	18.8	1.73	2750.0	16640.0
7:11	11:50	Downstream farm	0.027	0.065	0.01	0.208	0.510	18.2	1.56	3270.0	34480.0
7:44	11:50	Ephemeral stream	0.009	0.010	<0.03	0.889	1.110	3.2	0.45	142.1	2490.0
6:49	11:50	Left Fork	0.016	0.043	<0.03	0.256	0.530	13.9	1.07	1986.3	22470.0
7:55	11:50	House well	0.009	0.009	0.01	0.670	0.840	0.3	0.14	1.0	6.3
8:05	11:50	Trench 2	0.002	0.031	0.02	0.155	0.470	4.2	1.47	204.6	48840.0
5/2/2019	5/2/2019	Grab sample									
12:59	15:35	Spring	0.013	0.027	0.05	0.465	0.720	6.0	1.94	325.5	3410.0
12:42	15:35	Upstream farm	0.009	0.047	0.04	0.103	0.270	11.3	1.77	727.0	9070.0
11:25	15:35	Downstream farm	0.010	0.056	0.04	0.145	0.750	14.9	1.66	613.1	9590.0
12:00	15:35	Ephemeral stream	0.007	0.024	0.03	0.957	1.120	2.7	0.55	159.7	1732.9
11:00	15:35	Left Fork	0.011	0.073	0.04	0.183	2.430	25.0	1.77	547.5	8160.0
12:05	15:35	House well	0.007	0.018	0.06	0.625	0.625	1.0	0.20	1.0	27.5
12:17	15:35	Trench 1	0.002	0.016	0.02	0.420	0.700	1.4	0.73	29.5	4960.0
12:23	15:35	Trench 2	0.003	0.034	0.05	0.150	0.660	3.2	2.03	77.1	19350.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
5/9/2019	5/9/2019	Grab sample									
6:45	11:25	Spring	0.010	0.017	0.01	0.459	0.660	12.1	1.64	93.3	2890.0
7:51	11:25	Upstream farm	0.006	0.020	0.01	0.158	0.260	5.7	0.91	435.1	2780.0
6:27	11:25	Downstream farm	0.009	0.024	0.02	0.262	0.390	6.9	1.17	275.5	5560.0
6:59	11:25	Ephemeral stream	0.006	0.014	0.01	0.944	1.100	1.2	0.73	167.0	2850.0
6:12	11:25	Left Fork	0.010	0.031	0.02	0.232	0.420	10.0	1.37	261.3	10140.0
7:11	11:25	House well	0.010	0.010	0.02	0.681	0.710	0.2	0.14	<1.0	13.4
7:21	11:25	Trench 1	0.001	0.003	0.01	0.489	0.600	0.9	0.45	115.3	7330.0
7:32	11:25	Trench 2	0.002	0.028	0.02	0.089	0.560	1.9	2.37	114.5	72700.0
5/16/2019	5/16/2019	Grab sample									
7:05	11:20	Spring	0.008	0.023	0.01	0.394	0.540	10.5	1.73	12.2	686.7
7:47	11:20	Upstream farm	0.005	0.014	0.01	0.136	0.210	3.9	0.73	104.3	2419.2
6:49	11:20	Downstream farm	0.007	0.012	0.05	0.303	0.380	2.3	0.73	81.3	2419.2
7:19	11:20	Ephemeral stream	0.008	0.008	0.04	0.996	1.120	1.1	0.53	23.3	2590.0
6:37	11:20	Left Fork	0.006	0.013	0.03	0.302	0.430	1.8	0.93	118.7	>2419.2

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
5/22/2019	5/22/2019	Grab sample									
6:49	11:50	Spring	0.010	0.028	0.01	0.572	0.760	6.9	3.64	547.5	5200.0
8:29	11:50	Upstream farm	0.007	0.068	0.01	0.166	0.380	11.9	2.49	980.4	20350.0
6:24	11:50	Downstream farm	0.010	0.045	0.01	0.254	0.450	10.7	2.29	1299.7	72700.0
7:05	11:50	Ephemeral stream	0.010	0.035	0.01	1.328	1.520	2.5	1.35	517.2	29090.0
6:01	11:50	Left Fork	0.011	0.059	0.02	0.238	0.480	17.3	3.18	1413.6	19350.0
7:16	11:50	House well	0.014	0.014	0.01	0.780	0.970	1.2	0.21	<1.0	5.2
7:29	11:50	Trench 2	0.005	0.006	0.01	0.127	0.200	1.0	1.18	30.9	23820.0
5/30/2019	5/30/2019	Grab sample									
6:33	11:40	Spring	0.010	0.045	0.02	0.409	0.700	8.9	2.17	1299.7	21870.0
7:46	11:40	Upstream farm	0.015	0.123	0.02	0.115	0.490	68.2	2.86	1553.1	30760.0
6:11	11:40	Downstream farm	0.031	0.179	0.02	0.138	0.700	90.7	3.67	3790.0	141360.0
7:01	11:40	Ephemeral stream	0.013	0.052	0.01	1.381	1.570	10.9	2.05	3800.0	77010.0
5:55	11:40	Left Fork	0.030	0.167	0.02	0.150	0.650	81.7	3.78	>2419.2	51720.0
7:15	11:40	Trench 1	0.004	0.056	0.01	0.366	0.860	5.8	2.49	1553.1	241920.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
7:24	11:40	Trench 2	0.005	0.079	0.02	0.183	1.040	11.4	4.55	17930.0	>241920
6/6/2019	6/6/2019	Grab sample									
6:51	11:10	Spring	0.014	0.025	0.02	0.426	0.620	8.4	1.07	41.3	1553.1
7:41	11:10	Upstream farm	0.007	0.015	0.01	0.115	0.190	2.9	0.62	307.8	2620.0
6:33	11:10	Downstream farm	0.009	0.017	0.02	0.279	0.370	3.3	0.68	204.6	3770.0
7:04	11:10	Ephemeral stream	0.011	0.019	0.02	1.138	1.260	1.2	0.41	2.0	3790.0
6:12	11:10	Left Fork	0.009	0.016	0.02	0.277	0.380	2.7	0.64	79.4	4350.0
7:15	11:10	House well	0.008	0.019	0.01	0.673	0.750	0.9	0.18	<1.0	5.2
6/12/2019	6/12/2019	Grab sample									
11:55	15:15	Spring	0.011	0.019	0.01	0.328	0.490	8.0	1.43	28.8	1299.7
12:56	15:15	Upstream farm	0.008	0.015	0.01	0.140	0.190	2.5	0.52	59.8	5980.0
11:41	15:15	Downstream farm	0.010	0.014	<0.03	0.356	0.420	2.6	0.51	86.2	5120.0
12:06	15:15	Ephemeral stream	0.012	0.013	0.01	1.244	1.310	1.0	0.31	101.7	3320.0
11:23	15:15	Left Fork	0.009	0.011	0.01	0.277	0.350	1.4	0.64	35.0	4350.0
12:24	15:15	House well	0.009	0.009	0.01	0.713	0.760	0.2	0.44	<1.0	3.1

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
6/20/2019	6/20/2019	Grab sample									
6:39	10:50	Spring	0.011	0.020	0.01	0.536	0.770	5.9	0.91	9.8	727.0
7:25	10:50	Upstream farm	0.007	0.008	0.02	0.123	0.240	1.7	0.50	49.5	2419.2
6:22	10:50	Downstream farm	0.008	0.008	0.02	0.296	0.450	1.3	0.51	75.4	3690.0
6:55	10:50	Ephemeral stream	0.011	0.015	0.01	1.073	1.290	11.5	0.23	1986.3	13540.0
6:03	10:50	Left Fork	0.005	0.005	0.02	0.228	0.400	1.3	0.62	63.8	4800.0
6/25/2019	6/25/2019	Grab sample									
7:54	12:30	Spring	0.012	0.017	0.01	0.335	0.550	5.1	1.46	101.4	5120.0
9:19	12:30	Upstream farm	0.008	0.023	0.01	0.144	0.230	4.3	0.73	127.4	5650.0
7:33	12:30	Downstream farm	0.012	0.032	<0.03	0.255	0.400	4.9	0.82	275.5	8130.0
8:19	12:30	Ephemeral stream	0.009	0.014	<0.03	1.088	1.260	1.7	0.24	114.5	5200.0
7:14	12:30	Left Fork	0.014	0.031	0.01	0.325	0.470	5.7	1.02	235.9	9850.0
8:29	12:30	House well	0.010	0.012	0.01	0.652	0.800	0.4	0.07	<1.0	54.5
8:55	12:30	Trench 1	0.004	0.004	<0.03	0.325	0.430	0.4	0.38	24.6	3130.0

¶ Values preceded by '<' were reported by the analytical laboratory as zero and the minimum detection limit is given.

§ ND is No Data, due to coliform not measured on water samples collected automatically by non-sterilized ISCO sampler.

Nutrients, Sediment, and Bacteria by Date Spring, Upstream, and Downstream Sites

Table 6. Water quality analyses in Big Creek upstream and downstream of the C&H Farm boundary of permitted land application.

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
-----				mg/L -----			--- MPN/100 mL ---		
1/3/2019									
Upstream	0.006	0.006	0.01	0.182	0.240	2.3	0.46	47.9	816.4
Downstream	0.008	0.008	<0.03	0.323	0.400	2.1	0.47	50.4	980.4
1/16/2019									
Upstream	0.005	0.010	0.01	0.147	0.200	1.1	0.39	155.3	727.0
Downstream	0.007	0.011	0.01	0.291	0.340	1.3	0.35	20.1	387.3
1/31/2019									
Upstream	0.006	0.006	<0.03	0.168	0.200	1.6	0.27	17.3	387.3
Downstream	0.008	0.008	0.01	0.320	0.390	1.1	0.36	10.9	179.3
2/13/2019									
Upstream	0.005	0.022	0.02	0.204	0.280	1.0	0.77	148.3	1203.3
Downstream	0.008	0.027	0.02	0.349	0.490	1.9	0.82	86.0	1553.1
2/27/2019									
Upstream	0.004	0.008	0.01	0.136	0.210	1.5	1.36	54.6	488.4
Downstream	0.006	0.010	0.02	0.273	0.370	1.5	0.89	62.0	410.6

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
3/14/2019									
Upstream	0.005	0.032	0.02	0.124	0.220	2.5	1.70	135.4	1553.1
Downstream	0.006	0.036	0.01	0.180	0.320	4.5	1.84	325.5	>2419.2
3/20/2019									
Upstream	0.003	0.003	<0.03	0.098	0.160	2.1	0.45	344.8	1119.9
Downstream	0.004	0.004	<0.03	0.217	0.300	2.4	0.57	62.4	387.3
Samples analyzed since the last quarterly report									
3/28/2019									
Upstream	0.002	0.011	<0.03	0.069	0.130	2.0	2.22	123.6	866.4
Downstream	0.002	0.010	<0.03	0.136	0.210	2.5	1.01	93.3	666.7
4/8/2019									
Upstream	0.007	0.014	<0.03	0.060	0.130	3.6	4.39	193.5	1986.3
Downstream	0.004	0.022	<0.03	0.091	0.200	4.0	7.01	191.8	2419.2
4/11/2019									
Upstream	0.004	0.009	<0.03	0.048	0.110	2.9	0.47	146.7	1732.9
Downstream	0.007	0.019	<0.03	0.084	0.200	3.3	0.46	118.7	2419.2
4/18/2019									
Upstream	0.018	0.104	<0.03	0.113	0.540	38.5	2.32	4130.0	23590.0

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.006	0.046	<0.03	0.173	0.390	18.2	0.81	920.8	5630.0
4/25/2019									
Upstream	0.010	0.051	<0.03	0.109	0.360	18.8	1.73	2750.0	16640.0
Downstream	0.027	0.065	0.01	0.208	0.510	18.2	1.56	3270.0	34480.0
5/2/2019									
Upstream	0.009	0.047	0.04	0.103	0.270	11.3	1.77	727.0	9070.0
Downstream	0.010	0.056	0.04	0.145	0.750	14.9	1.66	613.1	9590.0
5/9/2019									
Upstream	0.006	0.020	0.01	0.158	0.260	5.7	0.91	435.1	2780.0
Downstream	0.009	0.024	0.02	0.262	0.390	6.9	1.17	275.5	5560.0
5/16/2019									
Upstream	0.005	0.014	0.01	0.136	0.210	3.9	0.73	104.3	2419.2
Downstream	0.007	0.012	0.05	0.303	0.380	2.3	0.73	81.3	2419.2
5/22/2019									
Upstream	0.007	0.068	0.01	0.166	0.380	11.9	2.49	980.4	20350.0
Downstream	0.010	0.045	0.01	0.254	0.450	10.7	2.29	1299.7	72700.0
5/30/2019									
Upstream	0.015	0.123	0.02	0.115	0.490	68.2	2.86	1553.1	30760.0

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.031	0.179	0.02	0.138	0.700	90.7	3.67	3790.0	141360.0
6/6/2019									
Upstream	0.007	0.015	0.01	0.115	0.190	2.9	0.62	307.8	2620.0
Downstream	0.009	0.017	0.02	0.279	0.370	3.3	0.68	204.6	3770.0
6/12/2019									
Upstream	0.008	0.015	0.01	0.140	0.190	2.5	0.52	59.8	5980.0
Downstream	0.010	0.014	<0.03	0.356	0.420	2.6	0.51	86.2	5120.0
6/20/2019									
Upstream	0.007	0.008	0.02	0.123	0.240	1.7	0.50	49.5	2419.2
Downstream	0.008	0.008	0.02	0.296	0.450	1.3	0.51	75.4	3690.0
6/25/2019									
Upstream	0.008	0.023	0.01	0.144	0.230	4.3	0.73	127.4	5650.0
Downstream	0.012	0.032	<0.03	0.255	0.400	4.9	0.82	275.5	8130.0

¶ Values preceded by ‘<’ were reported by the analytical laboratory as zero and the Minimum detection limit is given.

§ ND is No Data, due to coliform not measured on water samples collected automatically by non-sterilized ISCO sampler.

Nutrients, Sediment, and Bacteria by Site for Ephemeral Stream, Trenches, Left Fork and Field Runoff

Table 7. Water quality analyses at the ephemeral stream draining the subwatershed containing the production houses and manure holding ponds, and surface runoff from Fields 1, 5a, and 12.

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
----- mg/L -----								--- MPN/100 mL ---	
Ephemeral stream									
1/3/2019	0.005	0.011	<0.03	1.091	1.220	1.5	0.24	10.9	1732.9
1/16/2019	0.009	0.010	0.02	0.991	1.080	2.5	0.34	3.0	>2419.2
1/31/2019	0.009	0.010	<0.03	1.015	1.140	1.9	0.28	6.3	2419.2
2/13/2019	0.008	0.019	<0.03	1.131	1.250	2.4	0.33	24.3	1732.9
2/27/2019	0.006	0.006	<0.03	0.967	1.120	1.3	1.87	18.5	1553.1
3/14/2019	0.006	0.028	<0.03	0.967	1.200	1.8	22.00	52.9	1986.3
3/20/2019	0.006	0.006	<0.03	0.983	1.160	3.3	0.33	5.2	1119.9
Samples analyzed since the last quarterly report									
3/28/2019	0.006	0.006	<0.03	0.966	1.130	1.6	7.37	7.4	>2419.2
4/8/2019	0.004	0.013	<0.03	0.792	0.920	1.7	18.32	37.3	1413.6

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/11/2019	0.003	0.012	<0.03	0.823	1.010	5.6	0.34	19.9	>2419.2
4/18/2019	0.009	0.009	<0.03	0.920	1.080	2.8	0.35	31.7	>2419.2
4/25/2019	0.009	0.010	<0.03	0.889	1.110	3.2	0.45	142.1	2490.0
5/2/2019	0.007	0.024	0.03	0.957	1.120	2.7	0.55	159.7	1732.9
5/9/2019	0.006	0.014	0.01	0.944	1.100	1.2	0.73	167.0	2850.0
5/16/2019	0.008	0.008	0.04	0.996	1.120	1.1	0.53	23.3	2590.0
5/22/2019	0.010	0.035	0.01	1.328	1.520	2.5	1.35	517.2	29090.0
5/30/2019	0.013	0.052	0.01	1.381	1.570	10.9	2.05	3800.0	77010.0
6/6/2019	0.011	0.019	0.02	1.138	1.260	1.2	0.41	2.0	3790.0
6/12/2019	0.012	0.013	0.01	1.244	1.310	1.0	0.31	101.7	3320.0
6/20/2019	0.011	0.015	0.01	1.073	1.290	11.5	0.23	1986.3	13540.0
6/25/2019	0.009	0.014	<0.03	1.088	1.260	1.7	0.24	114.5	5200.0
House well									
1/3/2019	0.007	0.007	<0.03	0.745	0.830	0.9	0.04	<1.0	<1.0
1/16/2019	0.008	0.008	0.01	0.703	0.790	0.5	0.35	<1.0	<1.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
1/31/2019	0.010	0.010	0.01	0.768	0.820	0.6	0.19	<1.0	<1.0
2/13/2019	0.008	0.010	0.02	0.642	0.760	0.1	0.66	<1.0	8.4
2/27/2019	0.006	0.006	<0.03	0.690	0.810	0.5	1.26	<1.0	<1.0
3/14/2019	0.008	0.012	<0.03	0.711	0.870	0.0	2.73	<1.0	<1.0
3/20/2019	0.008	0.008	<0.03	0.726	0.880	0.0	0.16	<1.0	2.0
Samples analyzed since the last quarterly report									
3/28/2019	0.006	0.009	<0.03	0.798	0.950	0.5	0.51	<1.0	<1.0
4/8/2019	0.005	0.005	<0.03	0.678	0.770	0.9	23.13	<1.0	5.2
4/11/2019	0.007	0.009	<0.03	0.671	0.800	0.2	1.58	<1.0	<1.0
4/25/2019	0.009	0.009	0.01	0.670	0.840	0.3	0.14	1.0	6.3
5/2/2019	0.007	0.018	0.06	0.625	0.625	1.0	0.20	1.0	27.5
5/9/2019	0.010	0.010	0.02	0.681	0.710	0.2	0.14	<1.0	13.4
5/22/2019	0.014	0.014	0.01	0.780	0.970	1.2	0.21	<1.0	5.2
6/6/2019	0.008	0.019	0.01	0.673	0.750	0.9	0.18	<1.0	5.2
6/12/2019	0.009	0.009	0.01	0.713	0.760	0.2	0.44	<1.0	3.1

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
6/25/2019	0.010	0.012	0.01	0.652	0.800	0.4	0.07	<1.0	54.5
Interceptor Trench 1 (South)									
2/13/2019	0.001	0.007	0.01	0.595	0.720	0.4	0.70	13.2	9330.0
3/14/2019	0.002	0.016	0.01	0.616	0.820	120.1	1.73	<1.0	435.2
Samples analyzed since the last quarterly report									
4/18/2019	0.001	0.062	<0.03	0.399	0.820	14.5	1.12	1046.2	241920
5/2/2019	0.002	0.016	0.02	0.420	0.700	1.4	0.73	29.5	4960.0
5/9/2019	0.001	0.003	0.01	0.489	0.600	0.9	0.45	115.3	7330.0
5/30/2019	0.004	0.056	0.01	0.366	0.860	5.8	2.49	1553.1	241920.0
6/25/2019	0.004	0.004	<0.03	0.325	0.430	0.4	0.38	24.6	3130.0
Interceptor Trench 2 (North)									
2/13/2019	0.004	0.012	0.02	0.899	1.110	0.7	1.30	1.0	980.4
3/14/2019	0.002	0.025	0.01	0.839	1.200	0.2	2.99	<1.0	435.2
Samples analyzed since the last quarterly report									
4/18/2019	0.000	0.107	<0.03	0.120	0.910	20.9	0.14	6090.0	241920

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/25/2019	0.002	0.031	0.02	0.155	0.470	4.2	1.47	204.6	48840.0
5/2/2019	0.003	0.034	0.05	0.150	0.660	3.2	2.03	77.1	19350.0
5/9/2019	0.002	0.028	0.02	0.089	0.560	1.9	2.37	114.5	72700.0
5/22/2019	0.005	0.006	0.01	0.127	0.200	1.0	1.18	30.9	23820.0
5/30/2019	0.005	0.079	0.02	0.183	1.040	11.4	4.55	17930.0	>241920
Left Fork									
1/3/2019	0.010	0.010	<0.03	0.358	0.450	2.3	0.58	32.7	1299.7
1/16/2019	0.009	0.010	0.01	0.327	0.400	1.1	0.50	26.2	517.2
1/31/2019	0.008	0.008	<0.03	0.316	0.390	0.5	0.43	10.9	325.5
2/13/2019	0.010	0.025	0.02	0.428	0.550	1.7	1.63	49.5	1553.1
3/14/2019	0.006	0.032	0.01	0.161	0.240	3.0	2.89	186.0	>2419.2
3/20/2019	0.002	0.002	<0.03	0.178	0.300	2.9	0.68	29.5	547.5
Samples analyzed since the last quarterly report									
3/28/2019	0.001	0.007	<0.03	0.102	0.200	2.9	1.07	9.8	387.3
4/8/2019	0.001	0.016	<0.03	0.064	0.200	5.1	10.61	178.9	>2419.2

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/11/2019	0.004	0.010	<0.03	0.084	0.160	3.1	0.67	35.9	1203.2
4/18/2019	0.006	0.020	<0.03	0.231	0.400	4.0	0.62	13960.0	>2419.2
4/25/2019	0.016	0.043	<0.03	0.256	0.530	13.9	1.07	1986.3	22470.0
5/2/2019	0.011	0.073	<0.03	0.183	2.430	25.0	1.77	547.5	8160.0
5/9/2019	0.010	0.031	0.02	0.232	0.420	10.0	1.37	261.3	10140.0
5/16/2019	0.006	0.013	0.03	0.302	0.430	1.8	0.93	118.7	>2419.2
5/22/2019	0.011	0.059	0.02	0.238	0.480	17.3	3.18	1413.6	19350.0
5/30/2019	0.030	0.167	0.02	0.150	0.650	81.7	3.78	>2419.2	51720.0
6/6/2019	0.009	0.016	0.02	0.277	0.380	2.7	0.64	79.4	4350.0
6/12/2019	0.009	0.011	0.01	0.277	0.350	1.4	0.64	35.0	4350.0
6/20/2019	0.005	0.005	0.02	0.228	0.400	1.3	0.62	63.8	4800.0
6/25/2019	0.014	0.031	0.01	0.325	0.470	5.7	1.02	235.9	9850.0
Field 1									
Samples analyzed since the last quarterly report									
Field 5a									

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
No samples analyzed since the last quarterly report									
Field 12									
No samples analyzed since the last quarterly report									

¶ Values preceded by '<' were reported by the analytical laboratory as zero and the minimum detection limit is given.
 § ND is No Sample. E. coli and total coliform were not measured on surface runoff samples collected by ISCO samplers when sample-holding time exceeded the required 8-hour threshold.

Water pH, Alkalinity, Chloride, Electrical Conductivity, and Total Dissolved Solids for Several Big Creek Sites

The pH, alkalinity, chloride concentration, electrical conductivity, and total dissolved solids were determined on water samples collected at the upstream and downstream sites, spring, house well, and trenches, to build a database that will enable to eventually source track the major water source pathways at these sites. These values are given below in Table 6.

Table 8. The pH, Chloride concentration, and electrical conducting of water samples collected at upstream, downstream, spring, ephemeral stream, house well and trench sites.

Date	pH	Chloride	Electrical conductivity
		mg/L	μS/cm
Upstream			
1/3/2019	7.8	1.418	86.0
1/16/2019	7.9	1.472	94.0
1/31/2019	7.8	1.564	91.0
2/13/2019	7.7	1.181	74.0
2/27/2019	7.6	1.426	38.0
3/14/2019	7.6	1.531	67.0
3/20/2019	7.9	1.484	92.0
Samples analyzed since the last quarterly report			
3/28/2019	7.7	1.365	82.0
4/8/2019	8.1	1.417	80.0
4/11/2019	8.5	1.415	91.0
4/18/2019	7.6	1.174	84.0
4/25/2019	7.8	1.116	88.0
5/2/2019	7.8	0.954	67.0
5/9/2019	7.6	1.341	82.0
5/16/2019	7.6	1.180	76.0
5/22/2019	7.6	1.232	84.0

Date	pH	Chloride	Electrical conductivity
5/30/2019	7.4	0.799	60.0
6/6/2019	7.6	1.231	115.0
6/12/2019	8.0	1.212	117.0
6/20/2019	7.6	1.345	139.0
6/25/2019	7.6	0.932	82.0
Downstream			
1/3/2019	7.7	1.693	134.0
1/16/2019	8.0	1.797	196.0
1/31/2019	7.7	1.988	151.0
2/13/2019	7.7	1.473	117.0
2/27/2019	7.5	1.803	124.0
3/14/2019	7.5	1.665	105.0
3/20/2019	7.6	1.835	140.0
Samples analyzed since the last quarterly report			
3/28/2019	7.5	1.700	125.0
4/8/2019	8.0	1.633	124.0
4/11/2019	8.0	1.684	140.0
4/18/2019	7.5	1.456	130.0
4/25/2019	7.5	1.454	143.0
5/2/2019	7.8	1.117	90.0
5/9/2019	7.4	1.557	128.0
5/16/2019	7.4	1.698	157.0
5/22/2019	7.4	1.380	134.0
5/30/2019	7.5	0.843	109.0
6/6/2019	7.4	1.679	175.0
6/12/2019	7.8	2.325	170.0

Date	pH	Chloride	Electrical conductivity
6/20/2019	7.5	2.035	198.0
6/25/2019	7.4	1.143	120.0
Spring			
1/3/2019	7.2	2.383	513.0
1/16/2019	7.2	3.648	534.0
1/31/2019	7.2	3.573	561.0
2/13/2019	7.1	2.087	492.0
2/27/2019	7.3	2.568	543.0
3/14/2019	7.1	1.983	469.0
3/20/2019	7.2	3.042	545.0
Samples analyzed since the last quarterly report			
3/28/2019	7.2	3.199	559.0
4/8/2019	7.3	2.084	552.0
4/11/2019	7.2	2.926	594.0
4/18/2019	7.0	1.832	498.0
4/25/2019	7.0	1.474	478.0
5/2/2019	7.2	1.459	488.0
5/9/2019	7.0	1.865	534.0
5/16/2019	7.0	2.145	569.0
5/22/2019	7.0	1.964	566.0
5/30/2019	6.9	0.940	476.0
6/6/2019	7.1	2.913	604.0
6/12/2019	7.1	2.211	582.0
6/20/2019	7.0	2.962	636.0
6/25/2019	7.0	1.917	483.0
Ephemeral Stream			

Date	pH	Chloride	Electrical conductivity
1/3/2019	7.4	2.764	331.0
1/16/2019	7.6	3.128	372.0
1/31/2019	7.9	3.190	374.0
2/13/2019	7.3	2.328	198.0
2/27/2019	7.7	2.842	395.0
3/14/2019	7.4	2.525	263.0
3/20/2019	7.7	2.878	375.0
Samples analyzed since the last quarterly report			
3/28/2019	8.0	3.189	407.0
4/8/2019	7.7	2.733	347.0
4/11/2019	8.0	2.777	387.0
4/18/2019	7.3	2.468	350.0
4/25/2019	7.2	2.851	374.0
5/2/2019	7.2	2.012	250.0
5/9/2019	7.1	2.551	252.0
5/16/2019	7.3	2.684	391.0
5/22/2019	7.4	2.820	359.0
5/30/2019	7.0	1.661	229.0
6/6/2019	7.5	2.914	439.0
6/12/2019	7.7	2.781	424.0
6/20/2019	7.8	3.064	460.0
6/25/2019	7.5	1.975	245.0
House Well			
1/3/2019	7.4	4.824	445.0
1/16/2019	7.3	4.885	446.0
1/31/2019	7.4	4.807	445.0
2/13/2019	7.4	4.561	450.0

Date	pH	Chloride	Electrical conductivity
2/27/2019	8.2	4.737	508.0
3/14/2019	7.4	5.060	426.0
3/20/2019	7.5	4.680	439.0
Samples analyzed since the last quarterly report			
3/28/2019	7.5	4.974	454.0
4/8/2019	7.6	5.031	450.0
4/11/2019	7.7	4.801	459.0
4/25/2019	7.4	4.661	479.0
5/2/2019	7.6	4.475	437.0
5/9/2019	7.3	4.766	458.0
5/22/2019	7.3	4.647	480.0
6/6/2019	7.3	4.611	478.0
6/12/2019	7.6	4.719	496.0
6/25/2019	7.3	4.587	404.0
Trench 1			
2/13/2019	7.5	1.239	185.0
3/14/2019	7.2	1.151	147.0
Samples analyzed since the last quarterly report			
4/18/2019	7.1	0.943	227.0
5/2/2019	6.7	0.846	179.0
5/9/2019	6.6	1.049	207.0
5/30/2019	6.3	1.405	193.0
6/25/2019	6.8	1.129	259.0
Trench 2			
2/13/2019	7.5	0.957	184.0
3/14/2019	6.6	0.706	117.0

Date	pH	Chloride	Electrical conductivity
Samples analyzed since the last quarterly report			
4/18/2019	6.8	0.292	158.0
4/25/2019	6.7	0.341	221.0
5/2/2019	6.4	0.319	154.0
5/9/2019	6.3	0.375	171.0
5/22/2019	8.1	0.482	273.0
5/30/2019	6.2	1.226	158.0

Discharge at USGS 07055790 Site Downstream of C&H Operation

Discharge downstream of the C&H Farm (USGS station 07055790 Big Creek near Mt. Judea, AR) is available at

https://nwis.waterdata.usgs.gov/ar/nwis/uv/?cb_00065=on&cb_00045=on&cb_00010=on&format=gif_default&period=&begin_date=2014-04-16&end_date=2014-04-23&site_no=07055790

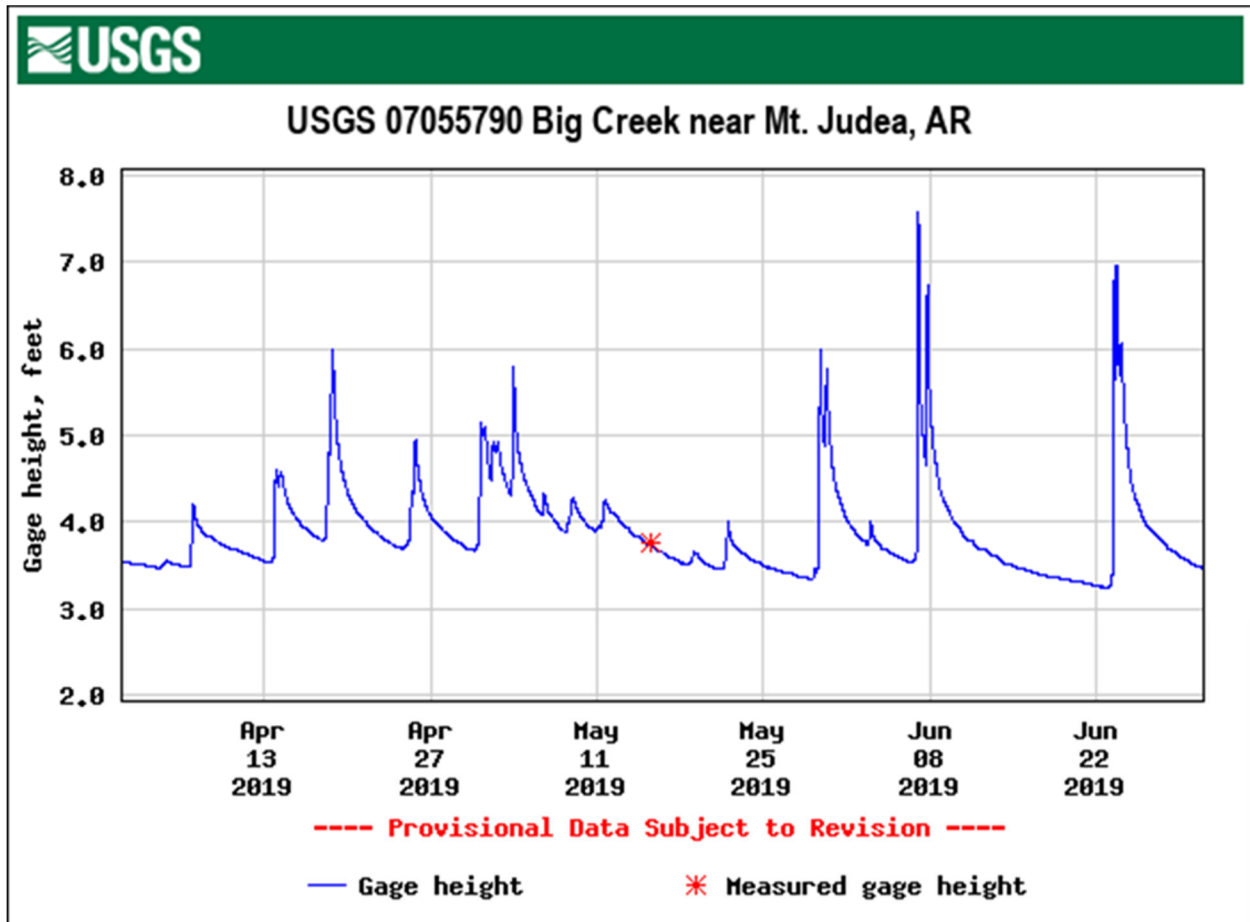


Figure 2. Discharge in Big Creek downstream of the C&H Farm for the period of monitoring; April 1 to June 30, 2019.

Temporal Trends in Phosphorus, Nitrogen, Bacteria, and Chloride in Big Creek above and below the C&H Farm

The concentration of dissolved P, total P, nitrate-N, total N, bacteria and chloride in Big Creek above and below the C&H Farm are presented in Figures 3, 4, 5, 6, 7, and 8, respectively, to show the season / temporal trends in measured concentrations. The concentration of nitrate-N and chloride in the house well water (site W1) is given in Figure 9 for water year 2018 (i.e., May 1, 2018 to April 30, 2019).

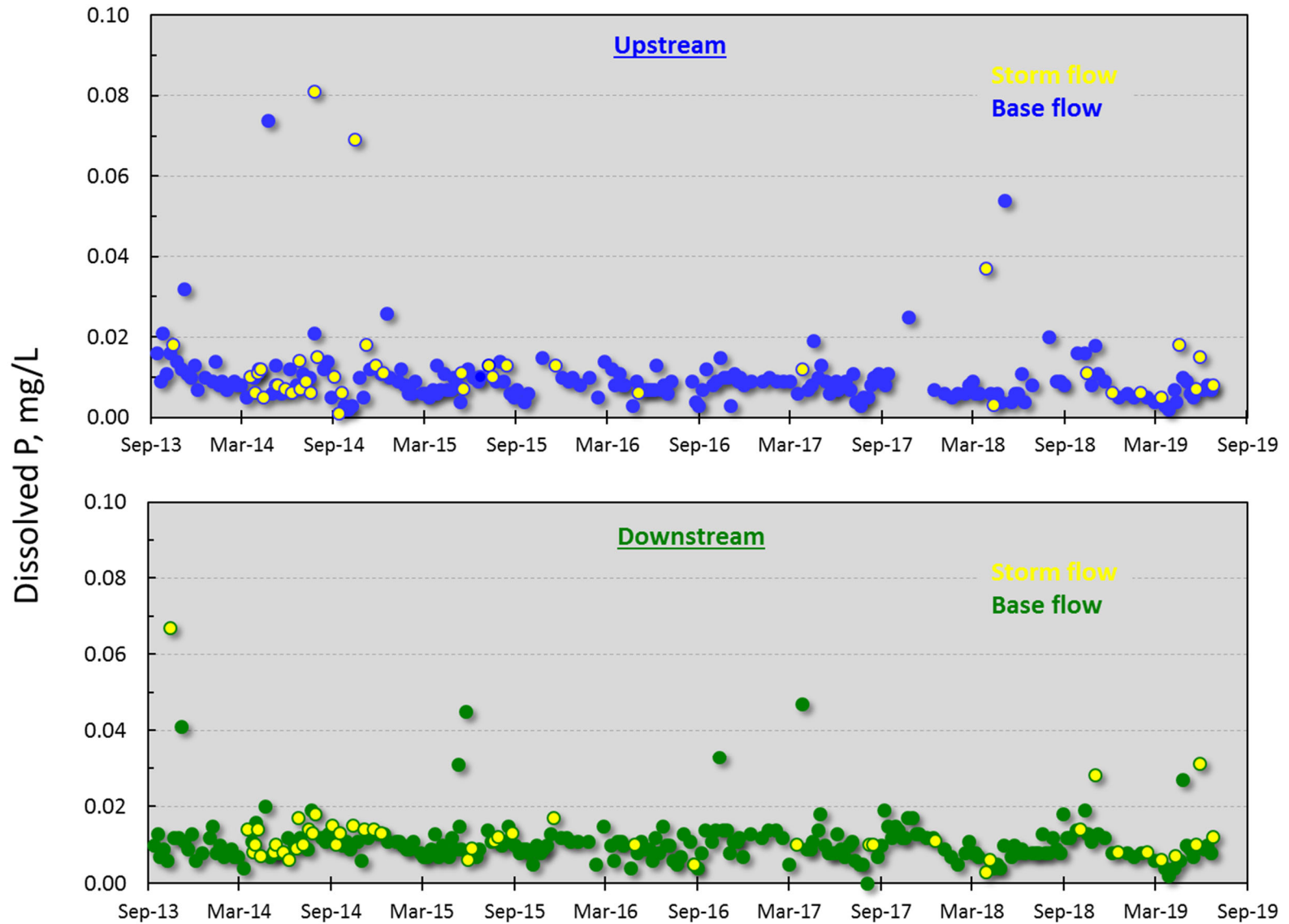


Figure 3. Dissolved P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

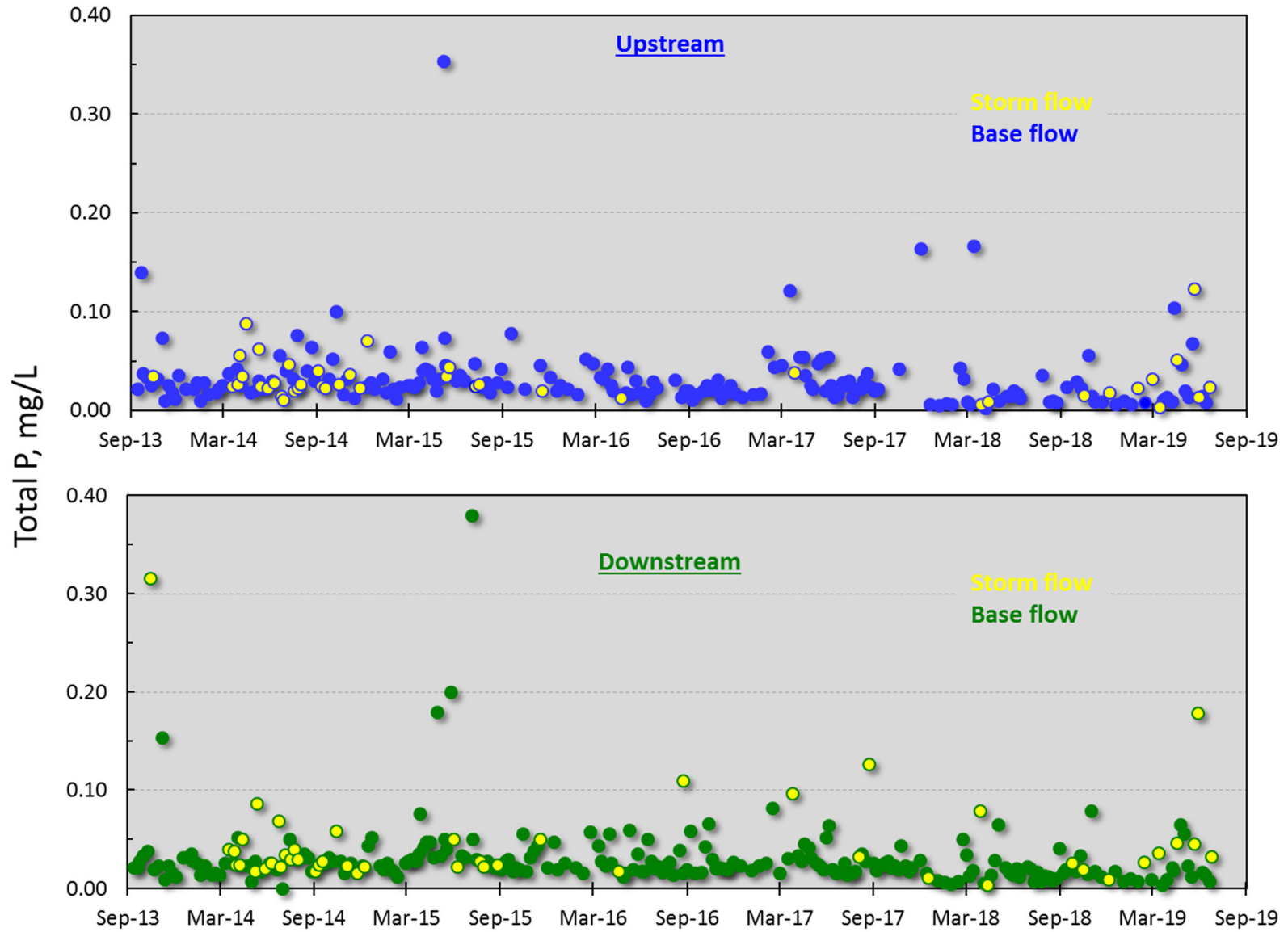


Figure 4. Total P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

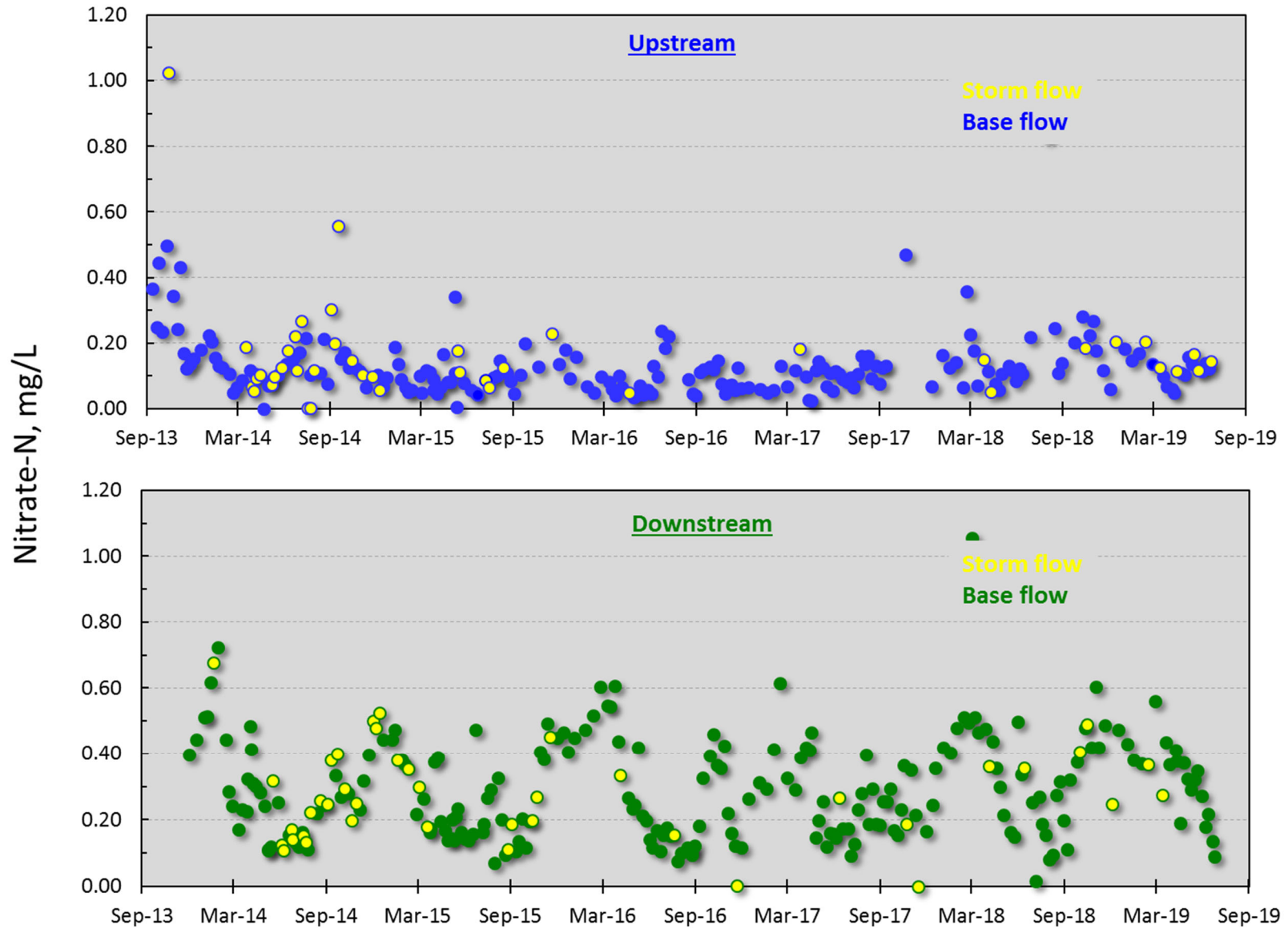


Figure 5. Nitrate-N concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

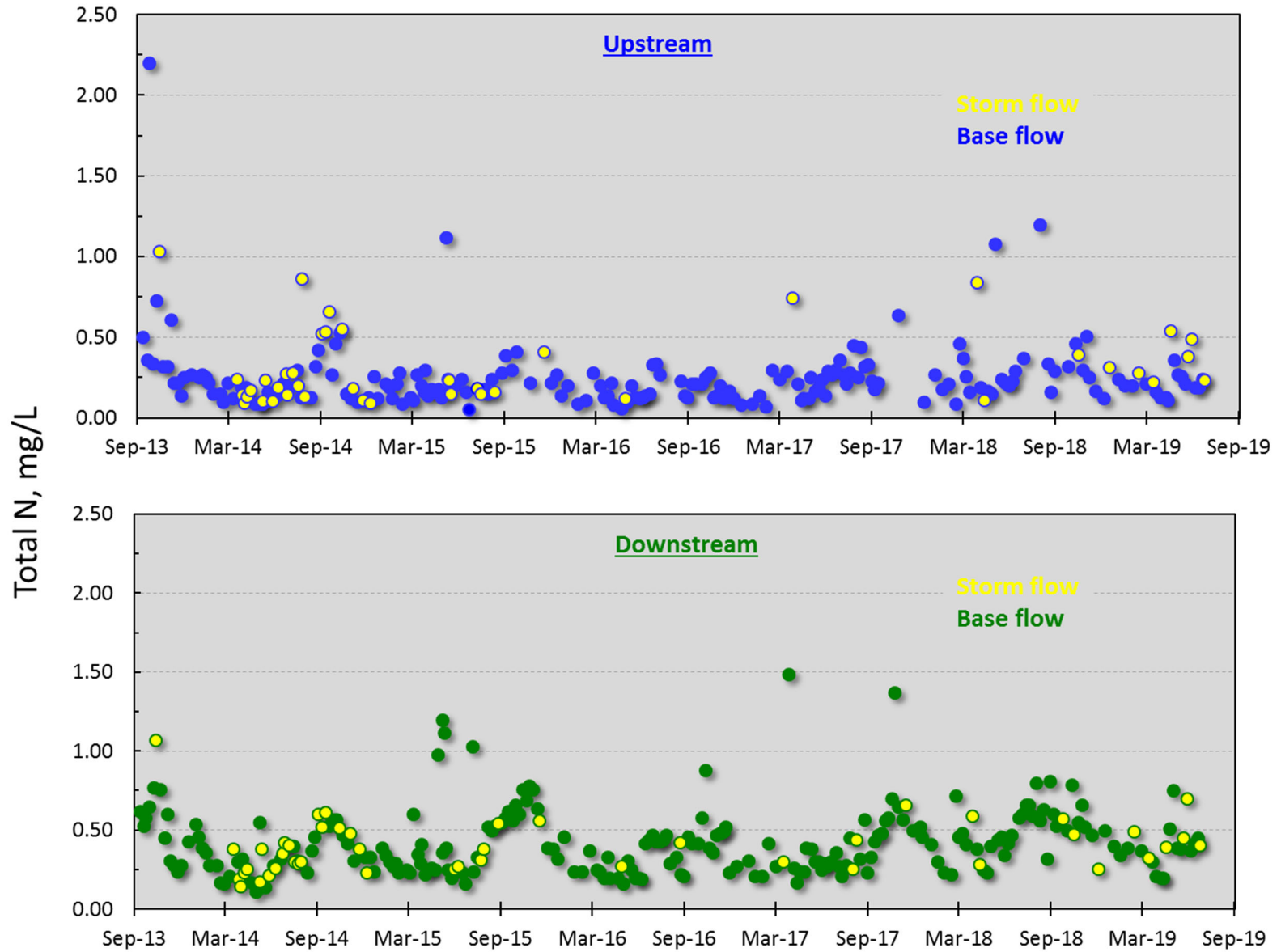


Figure 6. Total N concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

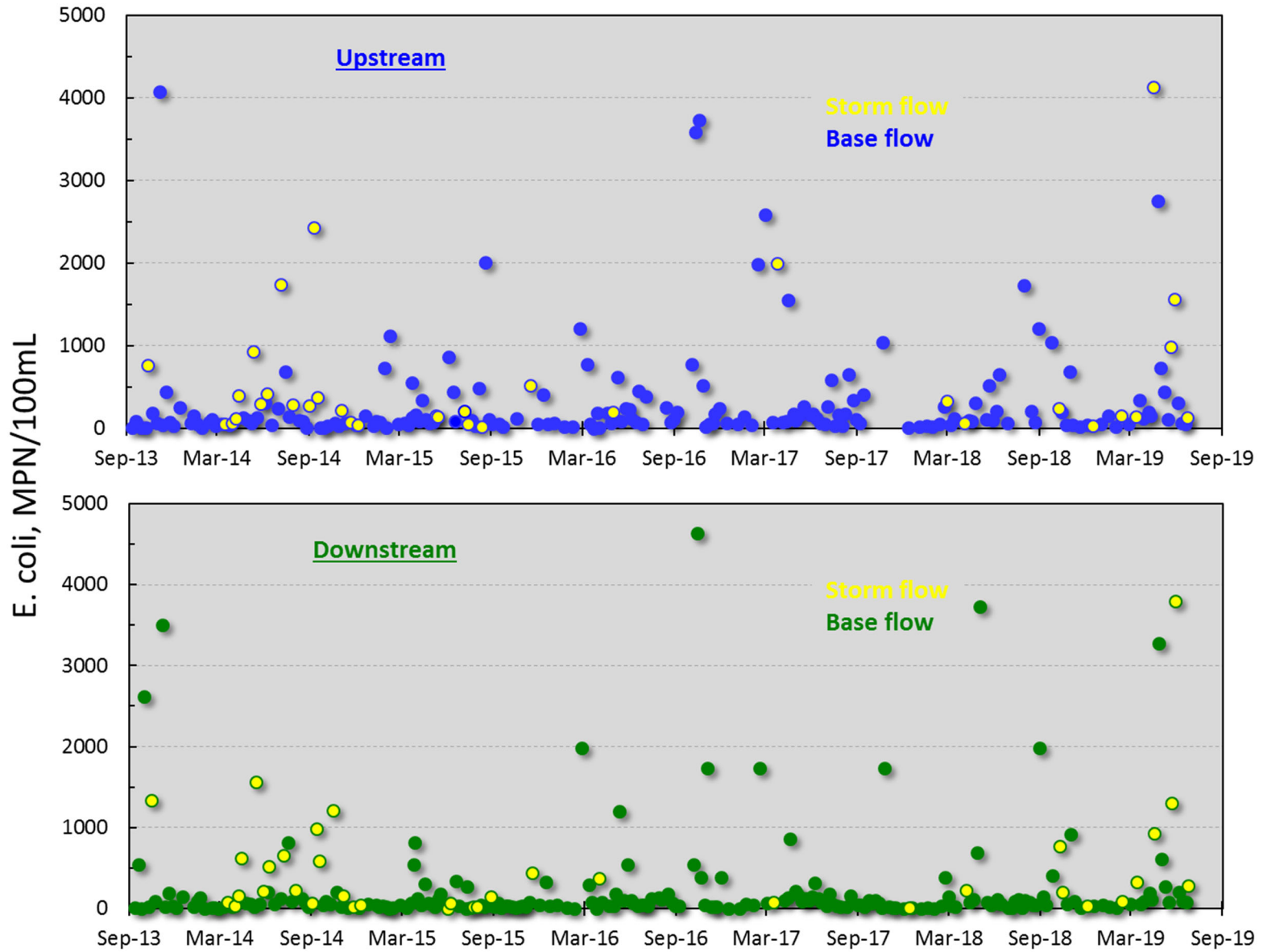


Figure 7. E. coli numbers at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

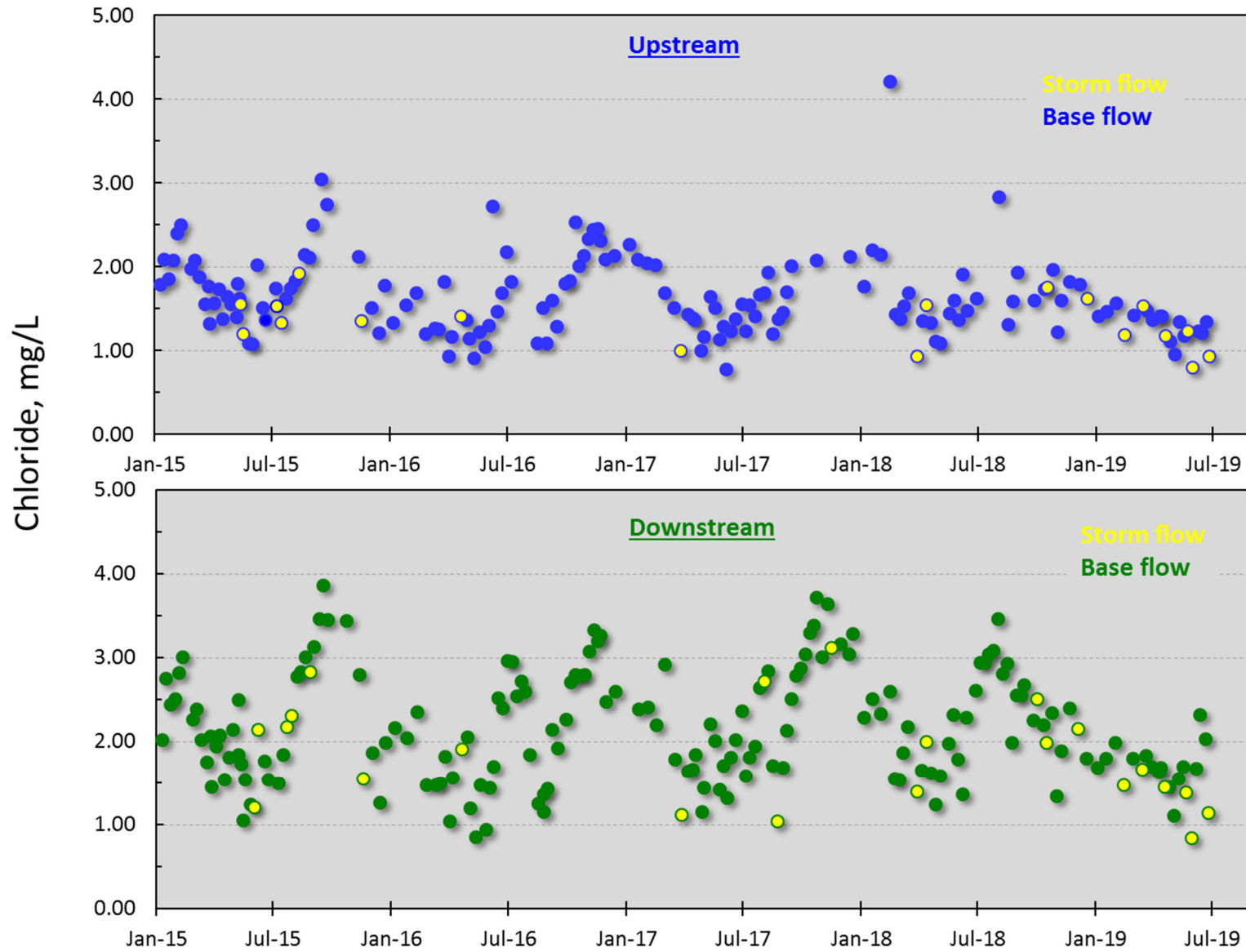


Figure 8. Chloride concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

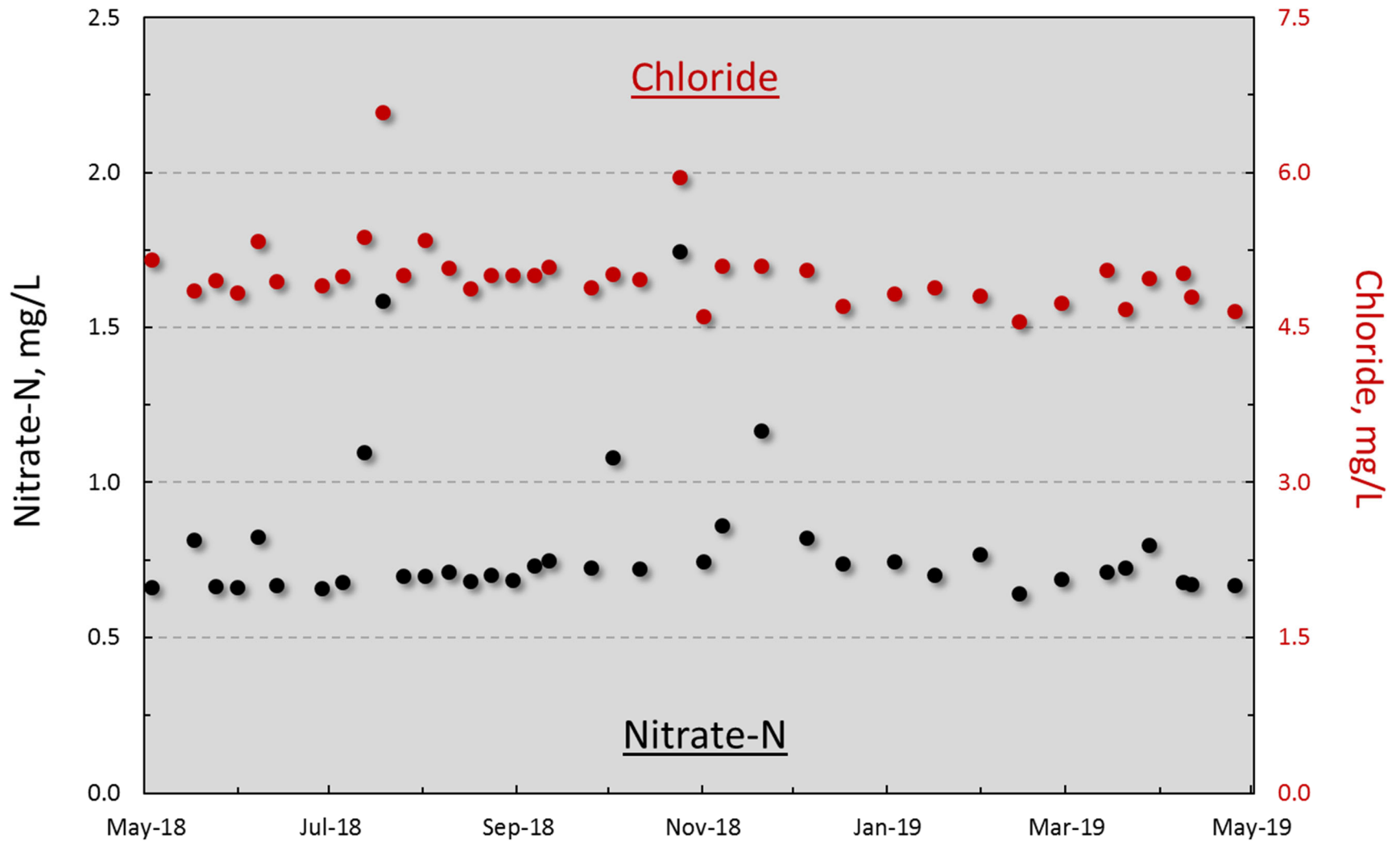


Figure 9. Nitrate-N and chloride concentration in well water adjacent to the animal barns and slurry holding ponds on &H Farm, Newton County, AR for water year 2018 (i.e., May 1, 2018 to April 30, 2019).



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