

**Big Creek Research and Extension Team**  
University of Arkansas System Division of Agriculture  
Quarterly Report – January 1 to March 31, 2019

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

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**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 first Quarterly Report of 2019 for the Big Creek Research and Extension Team that details activities and progress made from January 1 through March 31, 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. This Report contains certified analyses of samples collected since those reported in the last quarterly report and results of the 2018 grid-soil sampling of Fields 1, 5a, and 12.
3. Sample collection and custody logs for samples collected and reported this quarter will be posted on the Project's website.

## Big Creek Science Team

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

**Andrew Bartlett, Ph.D.,** Clinical Assistant Professor, Agricultural Statistics Laboratory, Experimental regression, agricultural applications of statistics.

**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, PhD.,** 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 ably supported by several outstanding and dedicated 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

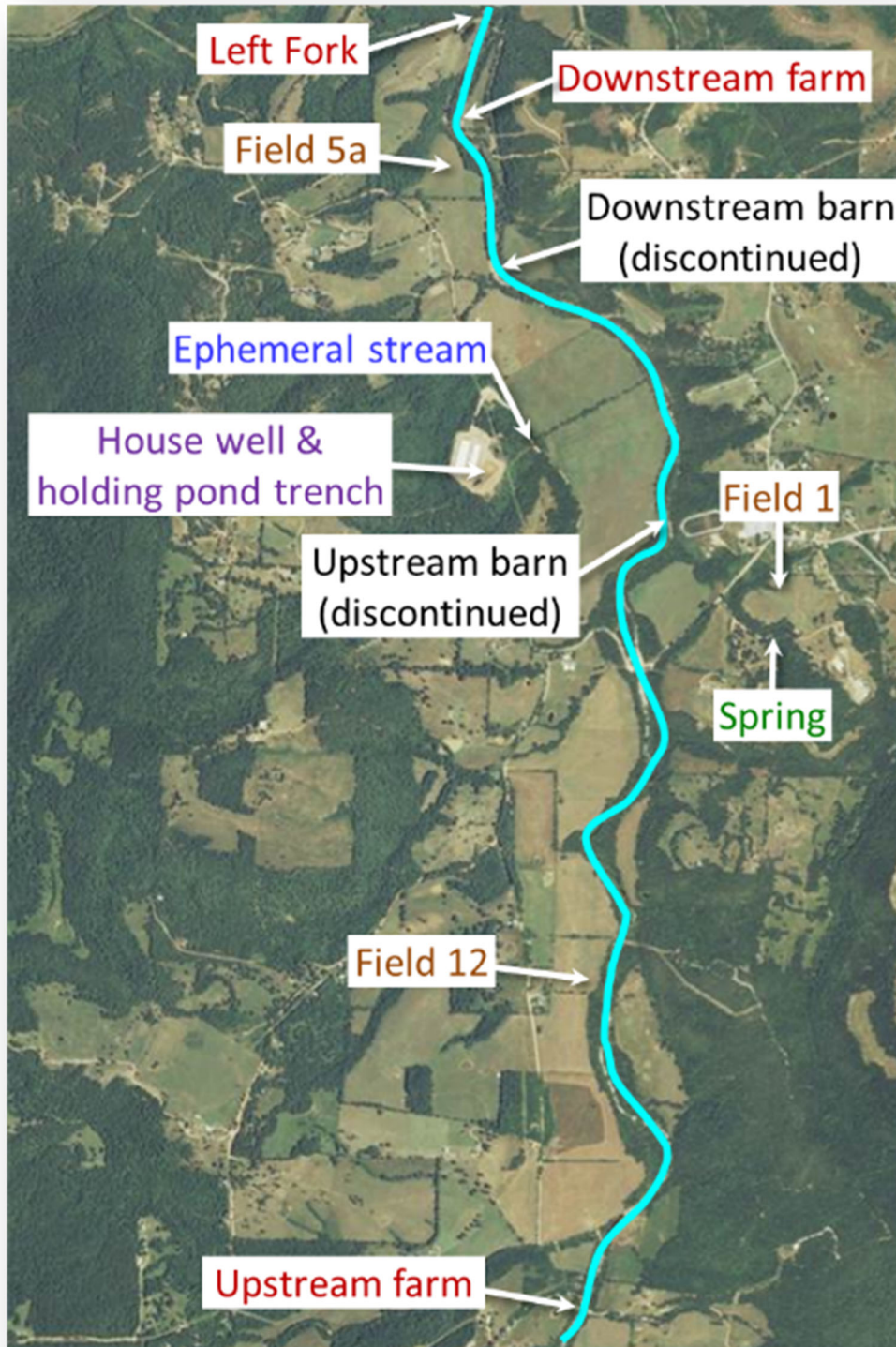


Figure 1. Location of sampling sites for the Big Creek Research and Extension Team project.



## 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](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](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](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 <sup>1</sup>
Alkalinity, mg/L as CaCO <sub>3</sub>	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

<sup>1</sup> 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](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 --		
<b>Samples analyzed since the last quarterly report</b>											
<b>1/3/2019</b>	<b>1/3/2019</b>	<b>Grab sample</b>									
<b>11:45</b>	14:30	Spring	0.007	0.013	<0.03	0.740	0.990	8.8	1.35	26.9	204.6
<b>12:16</b>	14:30	Upstream farm	0.006	0.006	0.01	0.182	0.240	2.3	0.46	47.9	816.4
<b>11:34</b>	14:30	Downstream farm	0.008	0.008	<0.03	0.323	0.400	2.1	0.47	50.4	980.4
<b>11:56</b>	14:30	Ephemeral stream	0.005	0.011	<0.03	1.091	1.220	1.5	0.24	10.9	1732.9
<b>11:25</b>	14:30	Left Fork	0.010	0.010	<0.03	0.358	0.450	2.3	0.58	32.7	1299.7
<b>12:03</b>	14:30	House well	0.007	0.007	<0.03	0.745	0.830	0.9	0.04	<1.0	<1.0
<b>1/16/2019</b>	<b>1/16/2019</b>	<b>Grab sample</b>									
<b>11:45</b>	15:30	Spring	0.009	0.014	<0.03	1.206	1.370	4.4	0.90	2.0	613.2
<b>12:56</b>	15:30	Upstream farm	0.005	0.010	0.01	0.147	0.200	1.1	0.39	155.3	727.0

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
11:32	15:30	Downstream farm	0.007	0.011	0.01	0.291	0.340	1.3	0.35	20.1	387.3
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
<b>1/31/2019</b>	<b>1/31/2019</b>	<b>Grab sample</b>									
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
<b>2/13/2019</b>	<b>2/13/2019</b>	<b>Storm grab sample</b>									
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
11:43	15:15	Ephemeral stream	0.008	0.019	<0.03	1.131	1.250	2.4	0.33	24.3	1732.9

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
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
<b>2/27/2019</b>	<b>2/27/2019</b>	<b>Grab sample</b>									
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
<b>3/14/2019</b>	<b>3/14/2019</b>	<b>Storm grab sample</b>									
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
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

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
12:15	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
<b>3/20/2019</b>	<b>3/20/2019</b>	<b>Grab sample</b>									
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

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

### 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 since January 2019.

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 ---		
<b>Samples analyzed since the last quarterly report</b>									
<b>1/3/2019</b>									
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
<b>1/16/2019</b>									
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
<b>1/31/2019</b>									
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
<b>2/13/2019</b>									
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
<b>2/27/2019</b>									



Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
<b>Upstream</b>	0.004	0.008	0.01	0.136	0.210	1.5	1.36	54.6	488.4
<b>Downstream</b>	0.006	0.010	0.02	0.273	0.370	1.5	0.89	62.0	410.6
<b>3/14/2019</b>									
<b>Upstream</b>	0.005	0.032	0.02	0.124	0.220	2.5	1.70	135.4	1553.1
<b>Downstream</b>	0.006	0.036	0.01	0.180	0.320	4.5	1.84	325.5	2419.2
<b>3/20/2019</b>									
<b>Upstream</b>	0.003	0.003	<0.03	0.098	0.160	2.1	0.45	344.8	1119.9
<b>Downstream</b>	0.004	0.004	<0.03	0.217	0.300	2.4	0.57	62.4	387.3

### 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 since January 2019.**

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 ---
<b>Ephemeral stream</b>									
<b>Samples analyzed since the last quarterly report</b>									
<b>1/3/2019</b>	0.005	0.011	<0.03	1.091	1.220	1.5	0.24	10.9	1732.9
<b>1/16/2019</b>	0.009	0.010	0.02	0.991	1.080	2.5	0.34	3.0	2419.2
<b>1/31/2019</b>	0.009	0.010	<0.03	1.015	1.140	1.9	0.28	6.3	2419.2
<b>2/13/2019</b>	0.008	0.019	<0.03	1.131	1.250	2.4	0.33	24.3	1732.9
<b>2/27/2019</b>	0.006	0.006	<0.03	0.967	1.120	1.3	1.87	18.5	1553.1
<b>3/14/2019</b>	0.006	0.028	<0.03	0.967	1.200	1.8	22.00	52.9	1986.3
<b>3/20/2019</b>	0.006	0.006	<0.03	0.983	1.160	3.3	0.33	5.2	1119.9
<b>House well</b>									
<b>Samples analyzed since the last quarterly report</b>									
<b>1/3/2019</b>	0.007	0.007	<0.03	0.745	0.830	0.9	0.04	<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
1/16/2019	0.008	0.008	0.01	0.703	0.790	0.5	0.35	<1.0	<1.0
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
<b>Interceptor Trench 1 (South)</b>									
<b>Samples analyzed since the last quarterly report</b>									
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
<b>Interceptor Trench 2 (North)</b>									
<b>Samples analyzed since the last quarterly report</b>									
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
<b>Spring</b>									
<b>Samples analyzed since the last quarterly report</b>									

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
<b>1/3/2019</b>	0.007	0.013	<0.03	0.740	0.990	8.8	1.35	26.9	204.6
<b>1/16/2019</b>	0.009	0.014	<0.03	1.206	1.370	4.4	0.90	2.0	613.2
<b>1/31/2019</b>	0.009	0.009	<0.03	1.142	1.300	2.5	0.63	3.1	488.4
<b>2/13/2019</b>	0.008	0.027	<0.03	0.692	0.940	8.0	1.26	15.8	1119.9
<b>2/27/2019</b>	0.007	0.014	<0.03	0.620	0.860	6.9	4.64	1.0	1732.9
<b>3/14/2019</b>	0.007	0.023	<0.03	0.518	0.760	2.0	4.73	22.8	816.4
<b>3/20/2019</b>	0.007	0.027	0.01	0.735	1.050	18.1	1.05	5.2	298.7
<b>Left Fork</b>									
<b>Samples analyzed since the last quarterly report</b>									
<b>1/3/2019</b>	0.010	0.010	<0.03	0.358	0.450	2.3	0.58	32.7	1299.7
<b>1/16/2019</b>	0.009	0.010	0.01	0.327	0.400	1.1	0.50	26.2	517.2
<b>1/31/2019</b>	0.008	0.008	<0.03	0.316	0.390	0.5	0.43	10.9	325.5
<b>2/13/2019</b>	0.010	0.025	0.02	0.428	0.550	1.7	1.63	49.5	1553.1
<b>3/14/2019</b>	0.006	0.032	0.01	0.161	0.240	3.0	2.89	186.0	2419.2
<b>3/20/2019</b>	0.002	0.002	<0.03	0.178	0.300	2.9	0.68	29.5	547.5

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
<b>Field 1</b>									
<b>No samples analyzed since the last quarterly report</b>									
<b>Field 5a</b>									
<b>No samples analyzed since the last quarterly report</b>									
<b>Field 12</b>									
<b>No samples analyzed since the last quarterly report</b>									

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

## 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 better define the major pathways of water sources at these sites. These values are given below in Table 8.

**Table 8. The pH, Chloride concentration, and electrical conducting of water samples collected at upstream, downstream, spring, ephemeral stream, house well and trench sites from the beginning of 2019.**

Date	pH	Chloride	Electrical conductivity
		mg/L	μS/cm
<b>Upstream</b>			
<b>Samples analyzed since the last quarterly report</b>			
<b>1/3/2019</b>	7.8	1.418	86.0
<b>1/16/2019</b>	7.9	1.472	94.0
<b>1/31/2019</b>	7.8	1.564	91.0
<b>2/13/2019</b>	7.7	1.181	74.0
<b>2/27/2019</b>	7.6	1.426	38.0
<b>3/14/2019</b>	7.6	1.531	67.0
<b>3/20/2019</b>	7.9	1.484	92.0
<b>Downstream</b>			
<b>Samples analyzed since the last quarterly report</b>			
<b>1/3/2019</b>	7.7	1.693	134.0
<b>1/16/2019</b>	8.0	1.797	196.0
<b>1/31/2019</b>	7.7	1.988	151.0
<b>2/13/2019</b>	7.7	1.473	117.0
<b>2/27/2019</b>	7.5	1.803	124.0
<b>3/14/2019</b>	7.5	1.665	105.0

Date	pH	Chloride	Electrical conductivity
3/20/2019	7.6	1.835	140.0
<b>Spring</b>			
<b>Samples analyzed since the last quarterly report</b>			
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
<b>Ephemeral Stream</b>			
<b>Samples analyzed since the last quarterly report</b>			
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
<b>House Well</b>			
<b>Samples analyzed since the last quarterly report</b>			
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
2/27/2019	8.2	4.737	508.0

Date	pH	Chloride	Electrical conductivity
3/14/2019	7.4	5.060	426.0
3/20/2019	7.5	4.680	439.0
<b>Trench 1</b>			
<b>Samples analyzed since the last quarterly report</b>			
2/13/2019	7.5	1.239	185.0
3/14/2019	7.2	1.151	147.0
<b>Trench 2</b>			
<b>Samples analyzed since the last quarterly report</b>			
2/13/2019	7.5	0.957	184.0
3/14/2019	6.6	0.706	117.0



## 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](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)

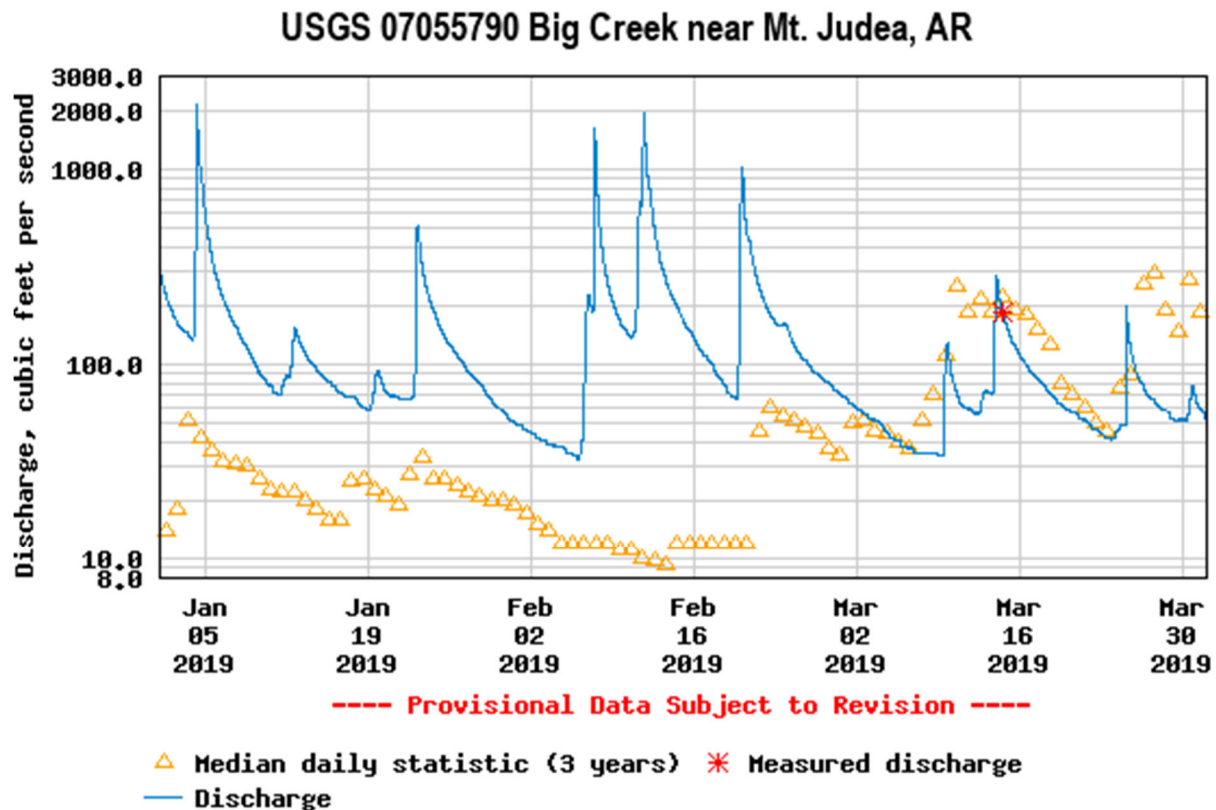


Figure 2. Discharge in Big Creek downstream of the C&H Farm for the period of monitoring; January 1 to March 31, 2019.

## 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 subsequent figures to show the season / temporal trends in measured concentrations (Figures 3, 4, 5, 6, 7, and 8).

The concentration of dissolved P, total P, nitrate-N, total N, bacteria and chloride with flow in Big Creek below the C&H Farm (Site BC7) for 2018 in Figures 9, 20, and 11.

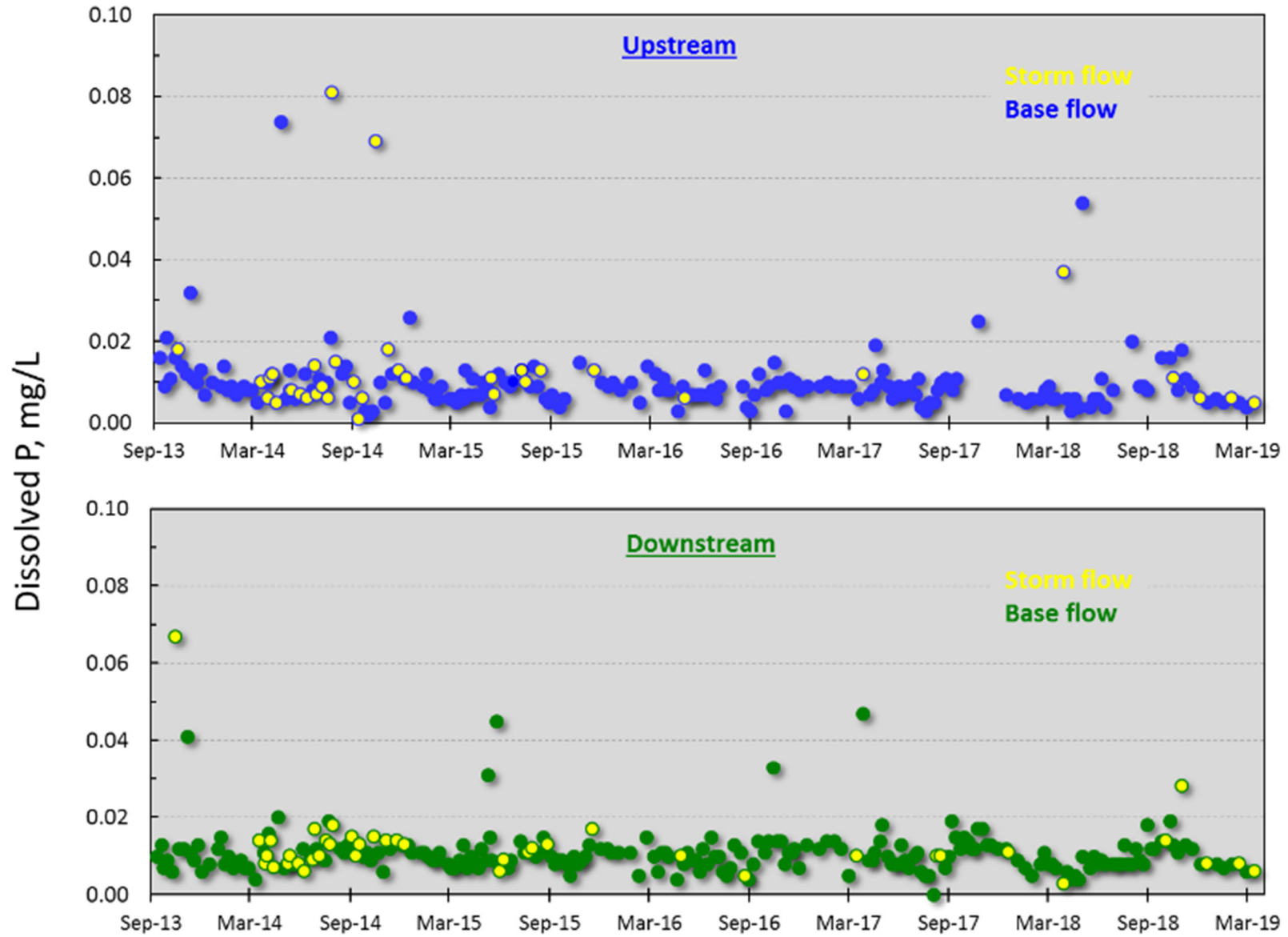


Figure 3. Dissolved P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

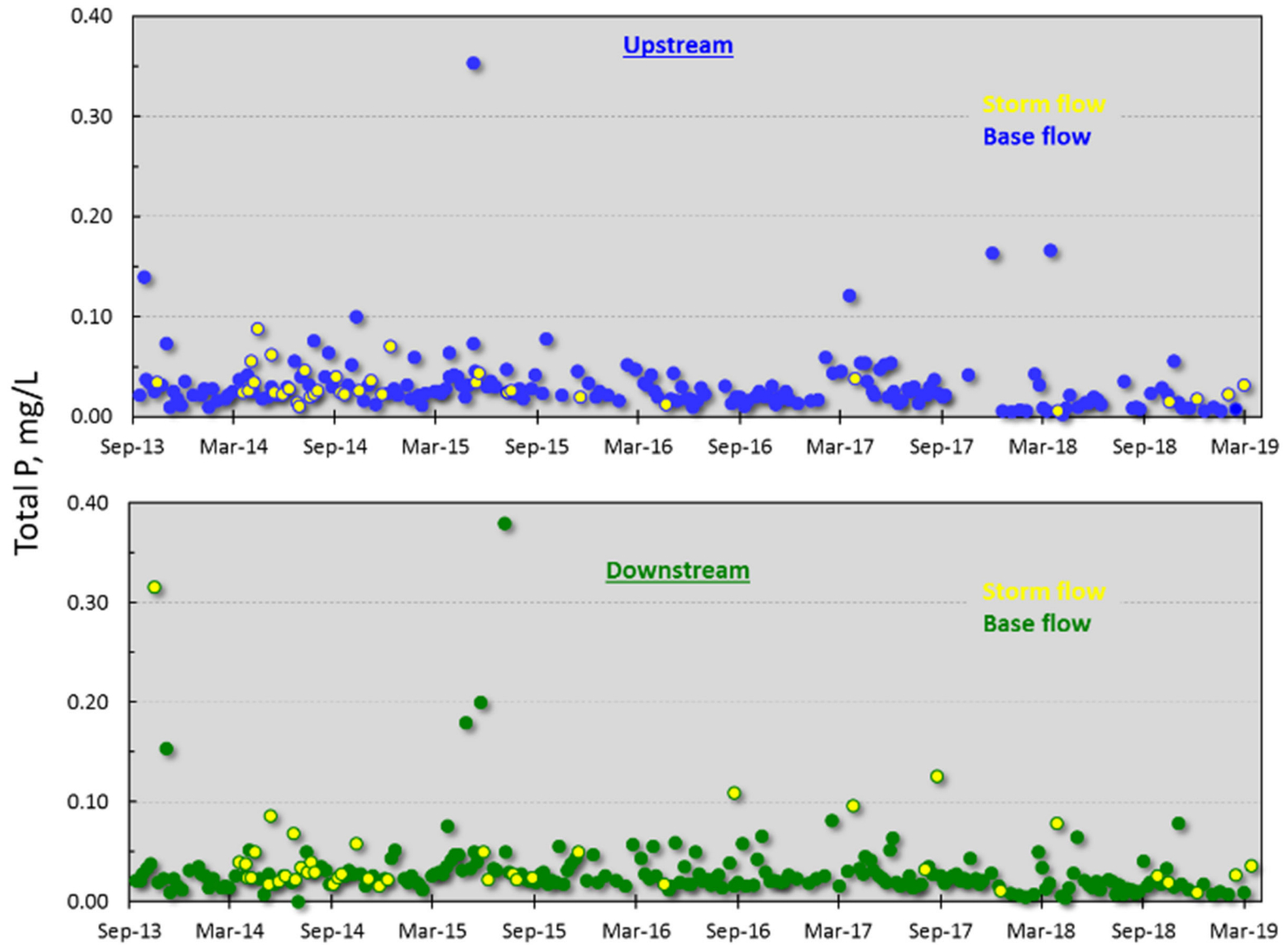


Figure 4. Total P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

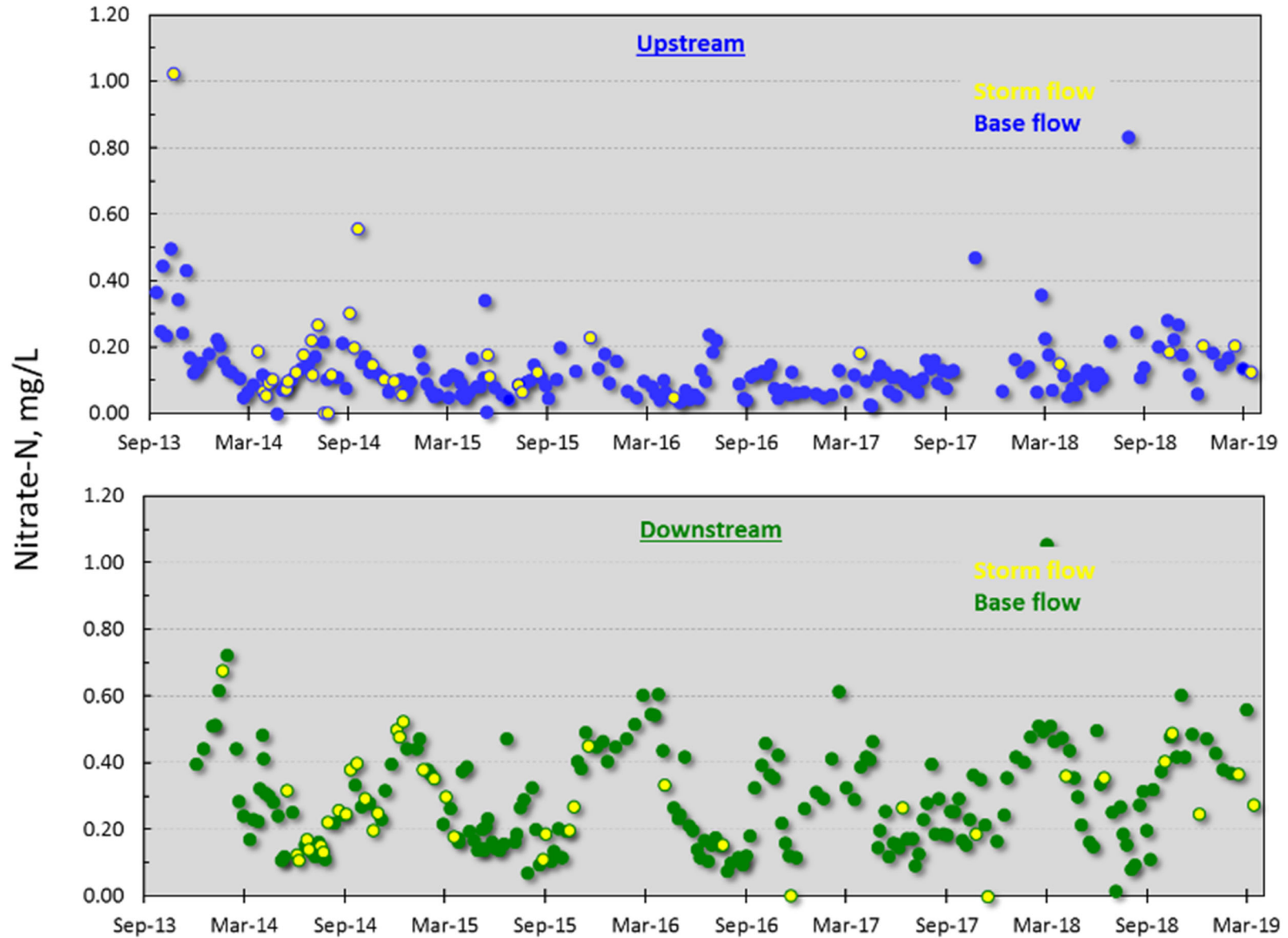


Figure 5. Nitrate-N concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

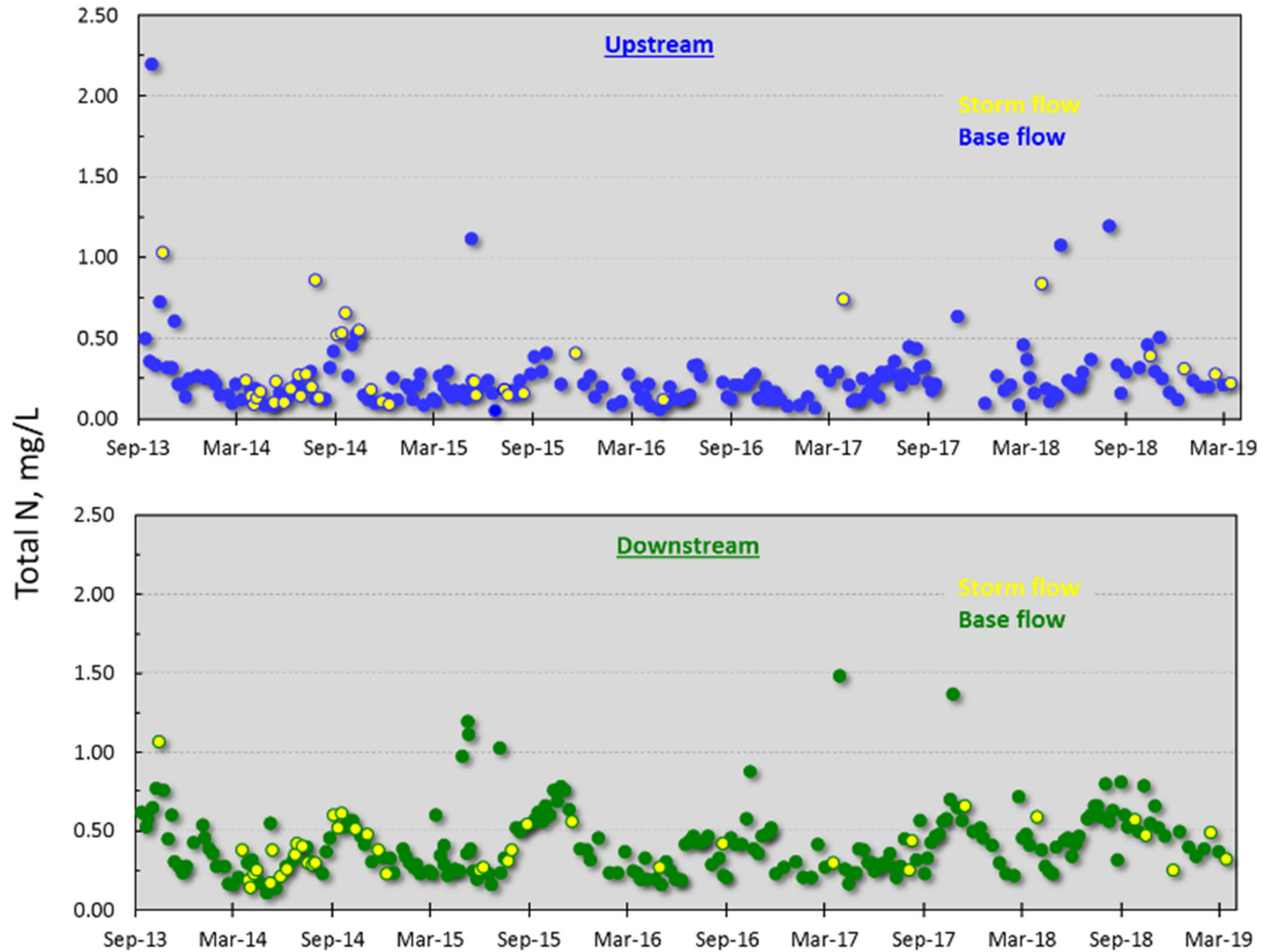


Figure 6. Total N concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

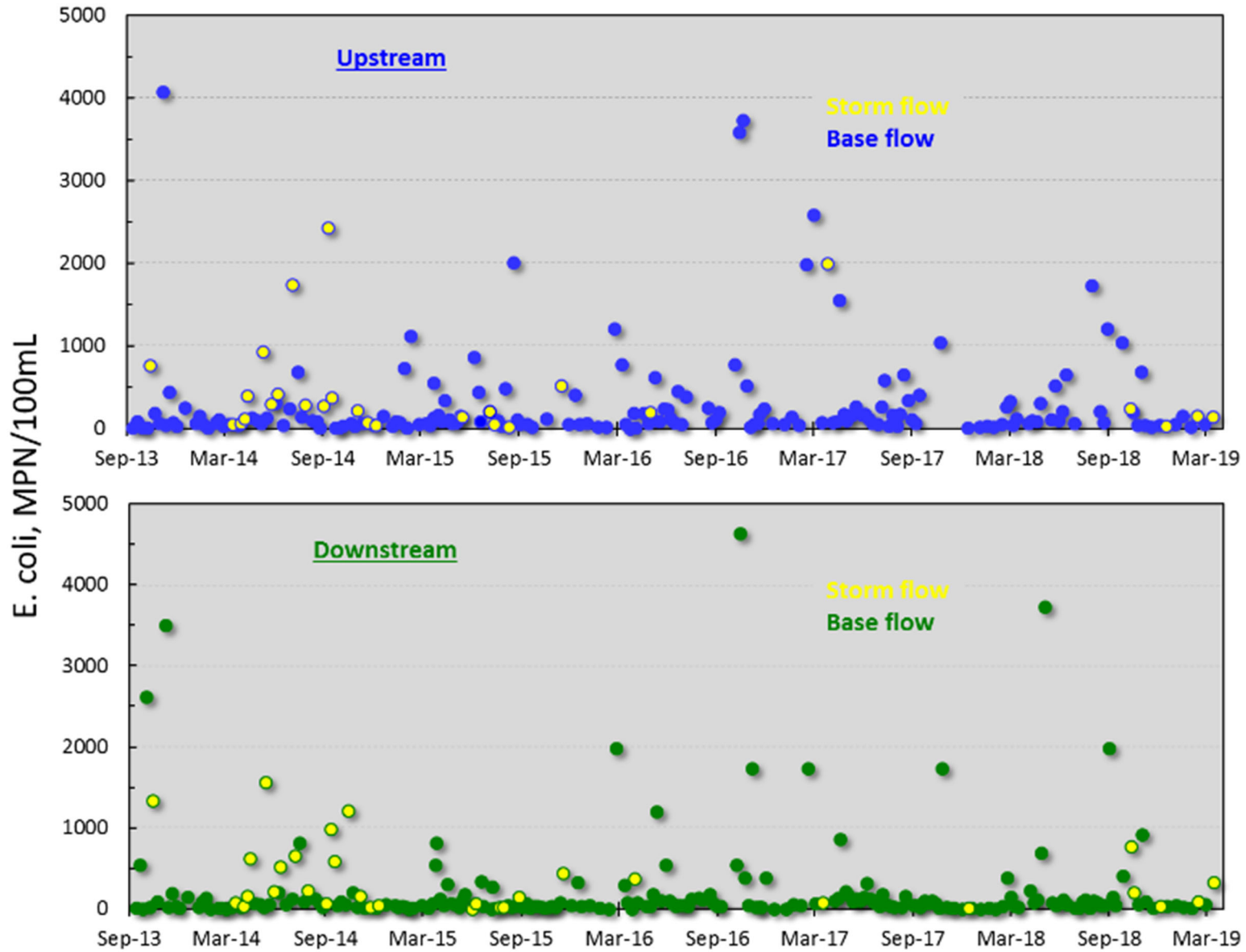


Figure 7. E. coli numbers at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

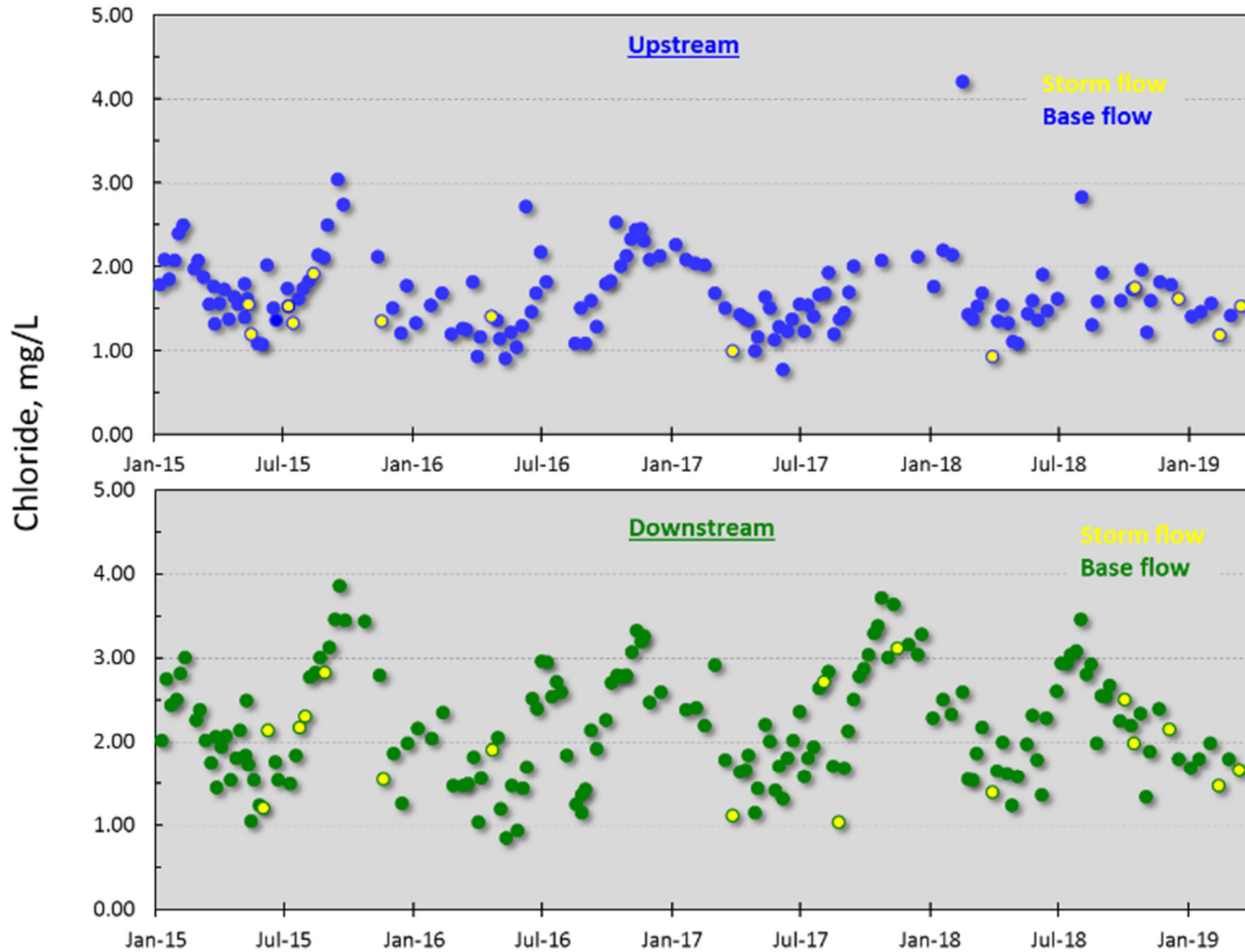


Figure 8. Chloride concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

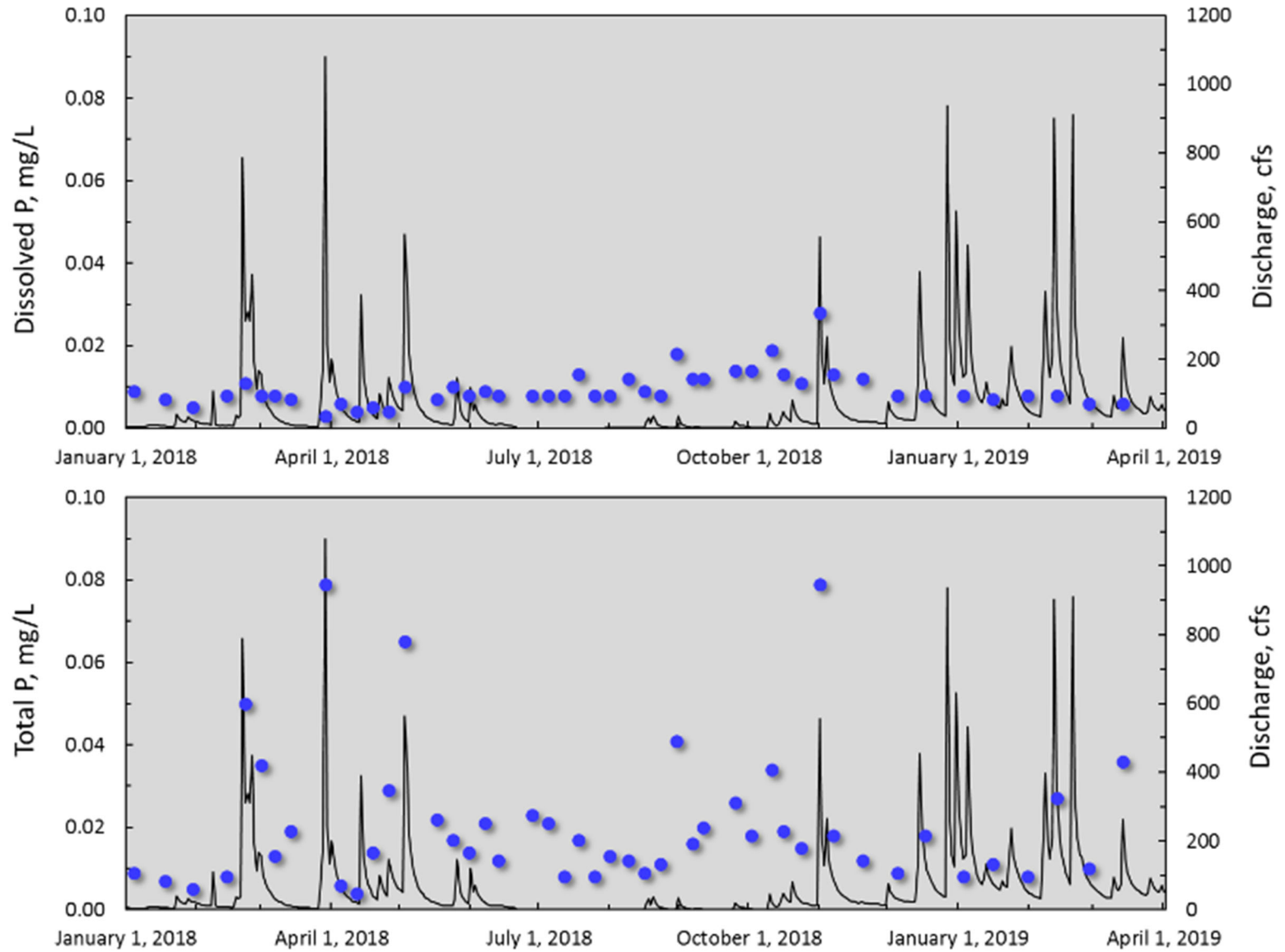


Figure 9. Dissolved and total P concentration and discharge at the Big Creek monitoring site downstream of the C&H Farm, Newton County, AR for 2018.



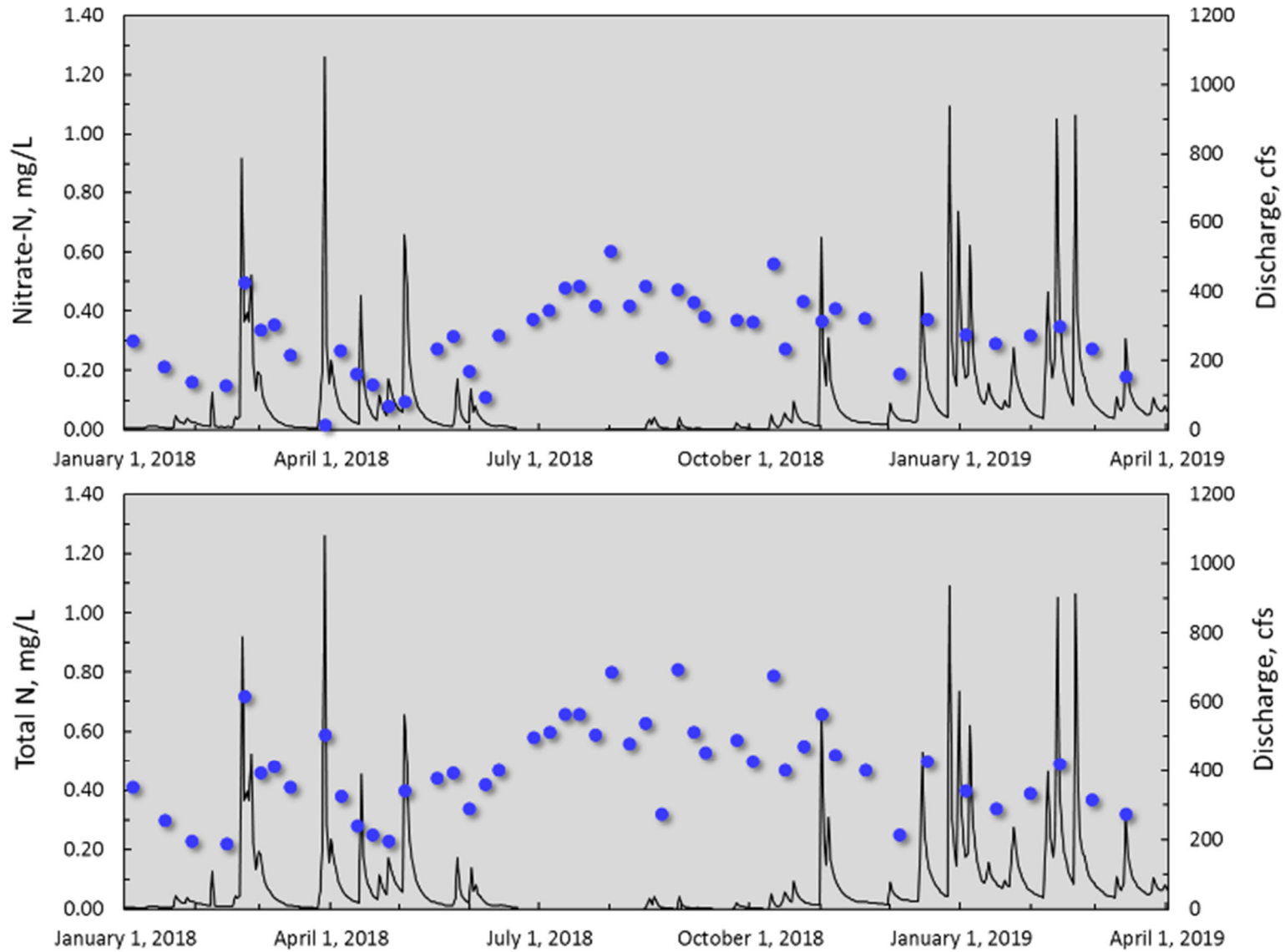


Figure 10. Nitrate-N and total N concentration and discharge at the Big Creek monitoring site downstream of the C&H Farm, Newton County, AR for 2018.

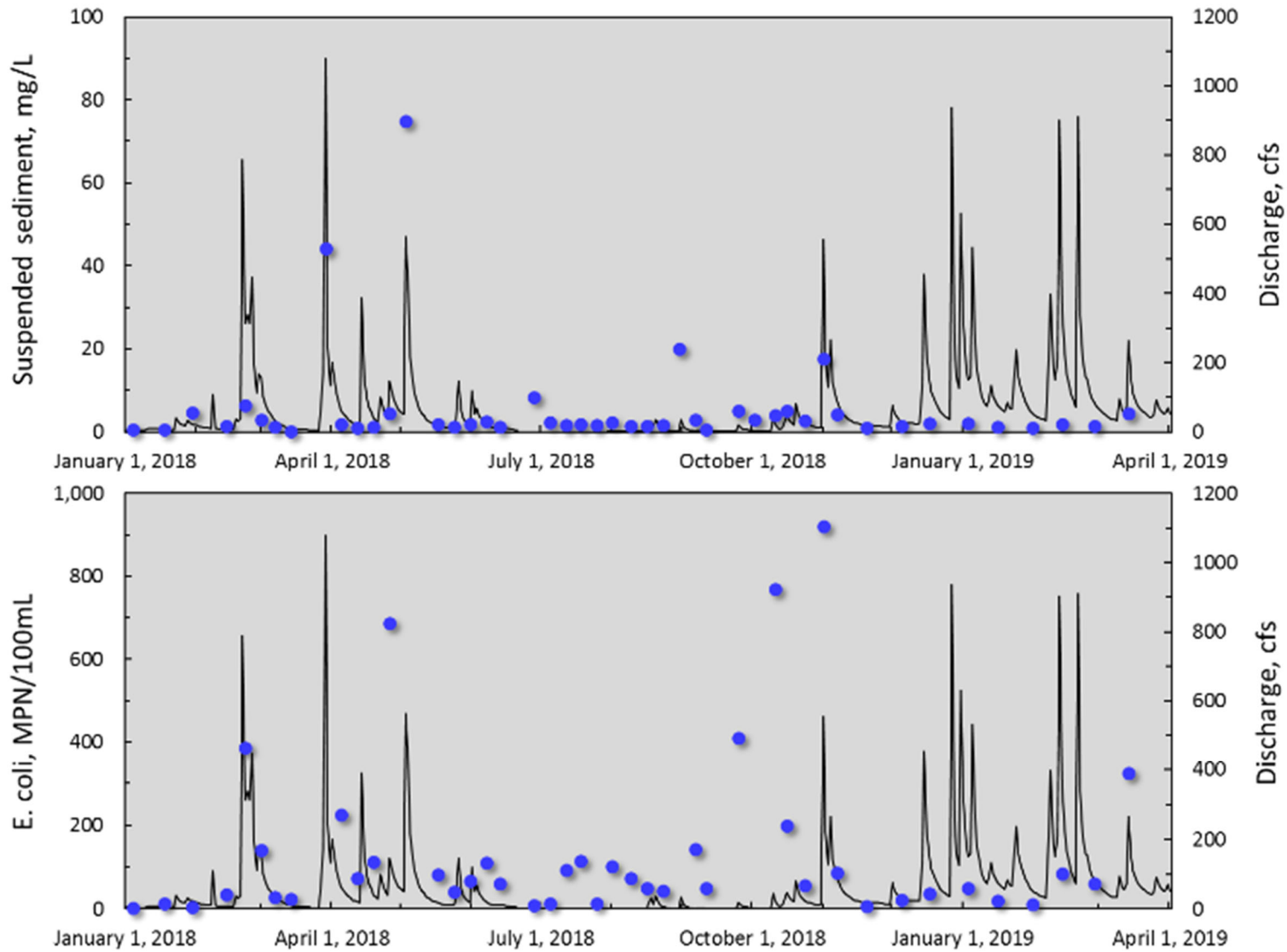


Figure 11. Suspended sediment and E. coli concentration and discharge at the Big Creek monitoring site downstream of the C&H Farm, Newton County, AR for 2018.

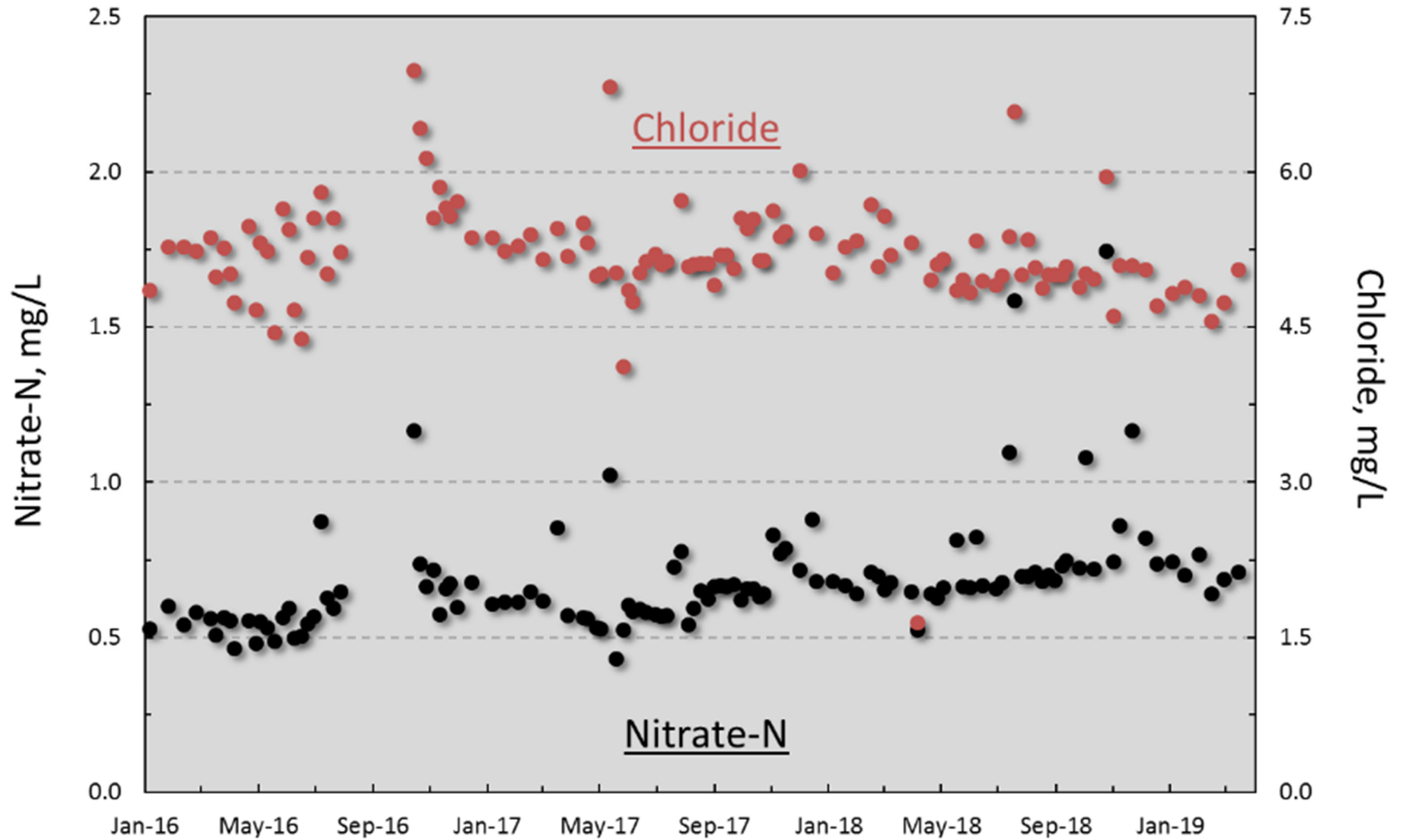


Figure 12. Nitrate-N and chloride concentration of well water at the C&H Farm, Newton County, AR.

## Grid-Soil Sampling

BCRET conducted grid-soil sampling of Fields 1, 5a, and 12 in March 2018. 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 is a repeat of the 2014 and 2016 sampling and was conducted within a 5-foot radius of the original geo-referenced point in order to document any changes in soil composition with time and land management.

The results of the 2016 sampling are presented in Tables 9 to 13. Samples were collected from the 0 – 4 and 4 – 8 inch depths for Fields 5a and 12. Due to rocks at or near the soil surface only 0 – 4 inch samples were collected from Field 1. Samples were sent to the University of Arkansas Soil Testing and Research Laboratory, Marianna, AR for analysis. Spatial analysis of 2014, 2016, and 2018 grid-soil sampling data will be conducted within the coming month and when complete will be reported.

**Table 9. Soil analyses of 0 to 4 inch samples collected from Field 1, collected March 2018.**

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
		cmol/kg	----- mg/kg -----									
<b>54506</b>	6.0	11.2	38	112	1318	95	17	77	298	1.6	3.6	0.3
<b>54507</b>	7.2	25.8	33	135	4477	116	12	35	209	1.8	3.4	0.4
<b>54508</b>	6.4	11.7	31	179	1463	101	15	60	373	1.8	3.4	0.2
<b>54509</b>	6.7	10.3	64	287	1124	169	17	101	174	1.5	4.1	0.4
<b>54510</b>	6.0	7.0	32	64	636	74	12	97	204	1.3	2.2	0.2
<b>54511</b>	5.9	7.0	58	82	632	71	14	113	133	1.4	2.8	0.2
<b>54512</b>	6.3	14.1	29	112	1941	62	17	68	274	1.7	3.4	0.4
<b>54513</b>	5.7	7.9	36	72	640	53	15	122	253	1.6	2.5	0.1

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54514	6.7	11.3	27	86	1599	61	14	77	218	1.5	2.3	0.2
54515	6.5	13.4	38	169	1796	109	14	76	211	1.7	4.1	0.3
54516	6.2	16.5	33	249	2236	136	19	63	281	2.0	4.4	0.4
54518	6.5	11.4	42	242	1496	93	16	78	284	1.1	3.8	0.3
54519	6.4	8.2	30	160	910	85	15	92	332	1.0	2.2	0.2
54520	6.4	11.3	18	66	1494	68	11	63	150	0.7	1.5	0.2
54521	6.2	8.7	47	53	1066	80	13	105	133	0.9	3.5	0.2
54522	5.9	6.9	55	52	668	41	13	97	94	0.5	1.3	0.1
54523	6.4	16.0	42	187	2182	126	20	64	355	1.1	4.9	0.4
54524	6.0	8.7	43	133	904	87	15	93	228	0.9	3.1	0.2
54525	6.3	12.2	52	330	1420	134	19	98	221	0.9	5.0	0.4
54526	6.9	27.3	105	557	4198	271	27	62	206	1.3	8.7	0.6
54527	6.9	14.3	98	211	1976	156	17	80	280	1.5	8.3	0.5
54528	6.8	12.1	105	297	1435	192	18	97	322	1.4	8.7	0.5
54530	6.8	9.0	27	102	1135	59	10	68	232	1.0	2.0	0.2
54531	5.9	6.5	41	105	522	62	15	96	225	0.7	1.7	0.2
54532	6.1	7.8	39	123	741	83	17	83	304	0.9	3.1	0.2
54533	5.7	8.4	57	89	696	79	16	120	170	1.1	3.2	0.2
54534	7.1	20.9	40	135	3487	128	20	49	309	1.3	6.6	0.7

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54535	6.3	12.0	87	218	1429	149	17	107	200	0.9	6.2	0.3
54536	6.1	11.3	52	154	1310	87	15	91	196	0.9	3.5	0.3
54537	5.9	11.7	121	315	1141	198	23	115	266	1.5	15.4	0.3
54538	6.3	13.1	120	457	1462	184	24	146	134	1.4	10.7	0.4
54539	6.1	18.3	141	442	2259	270	26	101	163	1.7	15.0	0.5
54540	6.5	11.9	128	556	1237	208	25	134	261	1.6	10.3	0.5
54542	6.4	11.5	152	392	1169	194	21	119	318	1.8	10.4	0.5
54543	6.2	9.5	120	447	851	176	24	108	310	1.6	8.1	0.4
54544	6.4	8.5	91	179	877	128	20	89	340	1.6	6.2	0.3
54545	6.3	10.3	81	214	1144	113	17	98	216	1.5	6.1	0.4
54546	5.9	9.7	86	123	1042	131	18	107	117	1.1	4.6	0.2
54547	6.4	12.9	94	235	1568	161	20	100	201	1.2	5.7	0.5
54548	5.8	14.3	186	402	1308	256	29	137	192	1.7	14.9	0.5
54549	6.2	15.0	233	289	1670	275	21	122	171	2.4	23.2	0.4
54550	6.3	15.0	178	451	1660	242	27	129	179	1.9	15.0	0.5
54551	6.5	16.0	196	660	1788	272	31	108	355	1.9	15.7	0.6
54552	6.5	11.8	136	338	1388	170	17	135	228	1.8	10.0	0.5
54554	6.5	11.0	114	398	1212	157	19	128	194	0.9	6.5	0.6
54555	6.2	8.8	76	258	933	107	16	109	153	0.7	3.9	0.4

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54556	6.1	11.3	92	313	1147	147	19	127	160	0.8	5.7	0.5
54557	6.7	13.0	135	330	1599	187	21	133	83	0.9	7.7	0.6
54558	6.0	14.1	247	325	1521	258	23	166	137	1.5	27.7	0.6
54559	6.6	14.5	189	557	1622	232	30	150	199	1.1	11.7	0.7
54560	6.3	14.4	147	528	1593	236	24	135	205	1.3	11.8	0.6
54561	6.2	9.8	104	396	970	162	23	154	225	0.9	7.2	0.5
54562	6.3	13.2	128	418	1499	189	27	219	125	0.9	7.0	0.6
54563	6.0	8.6	84	232	822	100	18	193	140	0.5	3.2	0.4
54564	6.2	9.0	79	196	1000	108	15	126	112	0.6	3.7	0.3
54566	6.1	10.9	60	199	1204	88	14	91	54	0.5	2.1	0.2
54567	5.3	10.3	71	141	948	70	16	154	91	0.5	2.3	0.3
54568	6.2	13.7	64	243	1698	117	18	117	209	1.1	6.7	0.5
54569	6.6	14.9	104	247	1929	191	17	103	343	1.2	10.5	0.5
54570	6.6	14.8	96	396	1902	140	26	130	314	0.9	6.0	0.5
54571	7.8	22.3	128	486	3584	128	25	106	296	1.1	6.2	0.8
54572	6.4	15.6	131	277	1972	178	25	135	228	1.3	12.2	0.7
54573	7.6	22.2	130	260	3646	154	19	91	196	1.2	8.2	0.5
54574	7.3	18.6	56	233	3021	104	19	82	270	0.9	3.5	0.4
54575	6.8	13.0	164	325	1600	200	27	159	191	1.2	13.1	0.5

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54576	6.6	13.5	127	252	1631	188	22	143	222	1.3	10.4	0.5
54578	6.6	21.3	173	295	3091	240	23	118	175	2.1	17.4	1.1
54579	7.6	36.5	63	144	6629	113	17	48	170	1.6	6.5	0.7
54580	6.8	17.0	145	291	2552	111	21	189	117	1.3	6.4	0.6
54581	7.8	60.7	43	104	11512	97	10	33	48	1.1	7.9	0.4
54582	7.7	49.7	31	220	9224	112	14	30	165	1.3	4.1	1.0
<b>Mean</b>	6.44	14.4	91	258	1909	143	19	106	213	1.3	7.1	0.4
<b>Median</b>	6.40	12.1	84	242	1463	128	18	105	206	1.3	6.1	0.4
<b>Minimum</b>	5.3	6.5	18	52	522	41	10	30	48	0.5	1.3	0.1
<b>Maximum</b>	7.8	60.7	247	660	11512	275	31	219	373	2.4	27.7	1.1
<b>Standard deviation</b>	0.50	8.7	54	143	1781	62	5	37	76	0.4	5.1	0.2
<b>Coefficient of variation, %</b>	7.76	60.6	59	55	93	44	26	34	36	33.2	71.9	45.5
<b>Count</b>	71											



**Table 10. Soil analyses of 0 to 4 inch samples collected from Field 5a, collected March 2018.**

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
		cmol/kg	----- mg/kg -----									
54458	5.3	10.93	28	79	1099	83	16	166	141	1.7	2.3	0.2
54459	6.6	13.15	26	62	1906	48	11	113	145	2.6	3.1	0.4
54460	5.6	10.16	39	96	1030	87	13	168	122	1.8	2.4	0.1
54461	5.3	7.24	78	32	432	55	13	148	118	2.1	2.9	0.1
54462	5.2	8.28	33	31	468	37	13	146	137	1.6	1.5	0.1
54463	5.3	8.32	40	60	595	77	13	129	131	1.7	1.9	0.1
54464	5.5	7.90	58	46	531	67	14	128	179	2.1	2.7	0.1
54465	5.2	8.18	62	33	421	52	12	165	96	1.8	2.4	0.1
54466	7.2	23.33	20	63	4139	49	11	96	103	2.5	3.9	0.5
54467	5.3	9.99	49	92	904	85	12	128	72	1.5	1.9	0.1
54468	5.5	8.45	43	55	621	74	13	128	210	2.4	2.9	0.2
54470	5.5	8.95	65	70	697	87	17	131	219	1.9	3	0.1
54471	5.4	7.87	55	42	524	70	13	148	192	1.7	2.9	0.1
54472	7	17.33	31	85	2903	63	13	104	120	2.1	3.1	0.5
54473	5.4	9.77	56	79	859	87	14	142	128	1.5	2.6	0.1
54474	5.8	9.47	51	60	919	80	11	147	193	2.6	3.9	0.2
54475	5.3	8.51	38	62	628	81	13	137	170	1.6	2	0.1

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54476	5.3	8.41	34	52	619	77	13	144	178	1.7	2.5	0.1
54477	6.5	18.13	35	77	2854	69	17	96	130	2.7	5.6	0.7
54478	6.2	11.27	25	41	1505	72	8	121	169	1.9	4.1	0.3
54479	6.1	14.31	20	51	1980	87	10	124	193	2.1	4	0.4
54480	5.8	11.39	77	68	1216	70	10	176	132	2.4	3.7	0.2
54482	5.7	9.38	64	66	907	74	11	157	206	3.2	4.6	0.2
54483	5.6	8.57	50	84	724	82	12	156	186	2.6	3.2	0.2
54484	6.9	18.77	44	125	3041	81	13	107	120	3.3	5.9	0.7
54485	5.2	9.14	101	75	572	64	24	111	276	2.2	3.2	0.1
54486	6.3	13.19	27	43	1789	71	10	124	167	2.3	4.4	0.4
54487	6	11.22	24	35	1409	65	8	125	153	2.2	3.7	0.3
54488	5.6	9.16	55	46	898	62	9	162	156	2.1	3.4	0.2
54489	5.6	9.46	59	69	919	77	10	153	192	2.6	2.8	0.2
54490	6.6	12.04	31	62	1664	60	10	111	197	2.7	3.6	0.3
54491	5.5	8.89	78	53	737	61	18	94	182	2.2	2.8	0.1
54492	6.6	15.80	26	70	2395	68	11	95	143	3	4.8	0.5
54494	6.3	11.31	46	92	1376	138	16	78	231	1.4	3	0.4
54495	5.2	9.11	150	64	587	54	28	127	286	2	3	0.1
54496	6	10.59	31	41	1250	84	8	141	163	1.8	3.8	0.3
54497	6	9.79	31	37	1119	67	7	139	143	1.7	3.5	0.2

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54498	5.6	10.10	35	47	1071	69	10	148	157	1.9	4.2	0.2
54499	5.9	12.60	44	58	1628	91	12	121	230	3.1	4.8	0.2
54500	6.9	16.53	25	92	2630	70	13	105	206	2.8	4	0.5
54501	6.9	19.90	28	89	3307	68	14	113	153	3	5.9	0.8
54502	6.8	18.86	29	79	3096	74	14	81	107	2.4	5.9	0.7
54503	5	9.64	65	62	640	88	22	95	197	0.9	1.6	0.1
54504	4.9	8.64	66	48	408	52	21	87	187	1.1	1.7	0.1
<b>Mean</b>	5.85	11.46	47	63	1341	72	13	128	166	2.1	3.4	0.3
<b>Median</b>	5.60	9.89	42	62	975	71	13	128	165	2.1	3.2	0.2
<b>Minimum</b>	4.90	7.24	20	31	408	37	7	78	72	0.9	1.5	0.1
<b>Maximum</b>	7.20	23.33	150	125	4139	138	28	176	286	3.3	5.9	0.8
<b>Standard deviation</b>	0.62	3.84	24	20	932	16	4	25	45	0.6	1.1	0.2
<b>Coefficient of variation, %</b>	10.59	33.5	51.8	32.5	69.5	22.3	32.1	19.8	27.1	25.8	33.8	74.6
<b>Count</b>	44											

**Table 11. Soil analyses of 4 to 8 inch samples collected from Field 5a, collected March 2018.**

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
		cmolc/kg	----- mg/kg -----									
76382	5.1	10.31	28	68	803	66	16	129	107	0.9	0.9	0.2
76383	6.1	11.06	16	46	1425	29	10	115	178	1.4	1.4	0.4
76384	5.5	10.01	23	75	935	72	10	149	135	0.8	0.8	0.2
76385	5.2	8.83	21	49	576	33	9	121	116	1.0	0.7	0.6
76386	5.0	7.89	28	31	415	23	13	144	150	0.8	0.8	0.6
76387	5.2	9.68	31	73	687	62	13	126	105	0.8	0.7	0.6
76388	5.4	6.77	29	31	380	29	11	126	167	1.1	1.0	0.5
76389	5.2	7.69	38	29	354	35	12	152	140	0.9	1.4	0.6
76390	6.5	14.20	11	50	2168	21	6	117	154	1.4	1.5	0.8
76391	5.0	9.78	49	83	716	52	12	135	71	0.9	0.5	0.7
76392	5.5	8.36	27	53	668	39	10	147	188	2.0	1.1	0.7
76394	5.5	8.44	26	59	665	49	14	132	190	1.4	1.1	0.2
76395	5.3	7.35	31	35	476	39	13	137	199	1.4	1.7	0.3
76396	5.1	8.85	38	44	551	52	13	131	120	1.0	1.0	0.3
76397	5.3	9.48	65	77	870	48	8	144	87	0.8	0.5	0.5
76398	5.7	8.95	40	53	895	36	9	146	193	2.1	2.1	0.6
76399	5.5	8.10	20	42	625	39	12	127	187	1.3	0.8	0.6

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
76400	5.3	6.84	24	36	373	42	11	133	165	1.0	1.1	0.5
76401	6.3	18.35	13	73	2868	31	11	107	181	2.3	3.2	1.0
76402	6.2	14.23	13	46	2044	42	8	117	168	1.6	2.4	0.8
76403	5.7	9.82	40	54	1070	36	6	155	143	0.9	1.1	0.6
76404	5.6	9.65	80	58	1018	43	9	175	225	2.8	3.2	0.6
76406	5.7	9.50	35	80	924	59	10	167	203	2.2	2.1	0.7
76407	6.4	20.77	14	105	3281	63	10	103	194	2.7	3.9	0.9
76408	5.0	8.12	40	31	463	21	25	106	264	1.2	1.1	0.2
76409	6.3	13.88	21	43	1972	42	10	144	165	1.9	3.1	0.5
76410	6.1	9.99	21	32	1213	34	8	145	129	1.2	2.1	0.3
76411	5.8	9.18	60	52	938	38	7	178	153	1.5	2.0	0.7
76412	5.6	11.08	53	67	1199	45	8	158	151	2.0	1.2	0.6
76413	6.6	12.45	19	57	1785	39	8	119	223	2.4	2.5	0.7
76414	6.6	19.10	17	84	3075	53	11	125	204	3.0	4.4	1.0
76415	5.3	7.82	55	40	589	25	27	117	279	1.2	1.7	0.6
76416	5.1	8.33	76	32	500	22	26	125	273	1.1	1.9	0.6
76418	5.8	7.31	64	31	588	30	19	111	300	1.1	1.8	0.2
76419	5.9	8.70	28	33	1037	45	8	167	141	1.1	2.1	0.3
76420	5.6	12.78	34	78	1490	55	12	142	179	2.9	3.2	0.6

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
76421	5.9	8.41	31	34	1002	32	7	170	133	1.1	2.1	0.2
76422	5.8	10.64	34	49	1122	43	9	149	157	1.4	2.2	0.2
76423	6.5	18.93	20	96	3004	74	13	115	179	2.7	4.1	1.1
76424	7.0	21.08	22	104	3648	61	16	138	189	3.1	5.6	1.2
76425	5.8	17.71	28	76	2405	52	17	122	102	2.3	3.0	0.8
76426	5.1	11.62	22	74	1015	98	17	90	107	0.4	0.4	0.7
76427	4.9	7.34	42	31	211	21	30	105	256	0.6	0.8	0.6
<b>Mean</b>	5.67	10.92	33	56	1210	43	12	134	171	1.5	1.9	0.6
<b>Median</b>	5.60	9.65	28	52	935	42	11	132	167	1.3	1.7	0.6
<b>Minimum</b>	4.90	6.77	11	29	211	21	6	90	71	0.4	0.4	0.2
<b>Maximum</b>	7.00	21.08	80	105	3648	98	30	178	300	3.1	5.6	1.2
<b>Standard deviation</b>	0.53	3.92	17	21	886	16	6	21	52	0.7	1.2	0.3
<b>Coefficient of variation, %</b>	9.29	35.90	50.9	38.5	73.2	37.4	45.3	15.4	30.5	47.6	63.1	44.5
<b>Count</b>	43											

**Table 12. Soil analyses of 0 to 4 inch samples collected from Field 12, collected March 2018.**

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
		cmol/kg	----- mg/kg -----									
54583	7.1	12.02	161	770	1332	158	24	165	283	1.6	10.7	0.6
54410	5.8	8.43	72	50	700	91	9	153	132	1.8	3.1	0.2
54411	6.1	11.02	119	73	1231	128	11	149	154	2.4	6.9	0.4
54412	5.9	12.51	170	199	1369	186	15	141	126	2.4	8.2	0.4
54413	6.1	12.97	119	162	1501	170	15	155	162	2.5	7.5	0.5
54414	6	13.63	159	257	1585	172	15	142	110	2.4	6.1	0.4
54415	5.9	13.92	124	231	1660	169	15	154	123	2.9	8.7	0.4
54416	6.4	17.92	91	86	2674	82	15	97	140	2.8	7.8	0.7
54417	5.9	11.48	52	50	1417	85	11	140	181	2.5	3.7	0.4
54418	5.9	8.85	93	72	944	103	11	161	130	2.2	5	0.3
54419	5.9	11.28	120	100	1227	149	12	151	163	2.6	7.3	0.4
54420	6.2	10.24	81	95	1195	104	12	136	159	2.6	5	0.4
54422	5.8	15.24	78	113	1710	151	14	131	178	2.2	6.1	0.5
54423	6	13.74	74	95	1723	147	14	121	143	2.1	5.2	0.4
54424	5.9	15.06	90	94	1968	162	15	113	116	2.2	6.3	0.5
54425	5.9	11.01	31	42	1351	72	10	134	198	1.9	3.5	0.4
54426	6.1	8.66	96	77	894	105	10	179	140	1.5	5.9	0.4

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54427	6.1	9.85	77	133	1073	122	13	149	179	1.5	5.3	0.4
54428	6.1	11.55	76	117	1303	133	13	146	183	1.8	5.4	0.4
54429	5.8	12.3	78	116	1268	126	14	133	170	1.8	4.4	0.4
54430	5.6	14.29	77	164	1593	151	16	135	128	2	5	0.4
54431	6	9.54	118	137	1027	114	14	126	194	2	7.1	0.4
54432	5.9	8.69	91	74	912	98	11	173	166	1.4	4.9	0.3
54434	6.1	11.59	100	111	1294	143	13	171	211	1.9	7.3	0.4
54435	6.2	11.28	99	111	1344	141	14	162	195	1.7	5.6	0.5
54436	5.8	13.76	150	165	1454	167	19	153	201	2.2	9	0.5
54437	5.7	11.84	137	166	1130	132	17	144	166	2	6.5	0.4
54438	5.9	8.11	143	125	767	99	14	122	133	1.4	5.1	0.3
54439	6.2	8.42	97	53	986	89	12	194	140	1.5	5.3	0.3
54440	6.1	10.86	108	122	1162	134	12	154	194	1.8	6.8	0.4
54441	6	11.27	101	110	1226	148	13	163	165	1.5	5.4	0.4
54442	5.9	8.4	176	156	766	126	13	176	144	1.6	7	0.4
54443	6.1	8.65	201	370	731	114	15	164	149	1.5	6.9	0.4
54444	5.8	8.69	119	182	678	83	14	141	199	1.3	4.3	0.3
54446	5.8	8.29	59	99	674	73	11	204	114	1.1	2.4	0.3
54447	6.2	10.87	91	96	1297	126	11	161	165	1.7	5.1	0.4



Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
54448	6	11.22	144	135	1212	146	13	165	131	2.1	6.4	0.4
54449	5.9	8.15	149	243	716	95	14	167	177	1.5	5	0.4
54450	6	8.28	198	249	713	116	15	164	187	1.5	6.5	0.4
54451	6.2	8.19	180	204	836	105	13	160	187	1.5	6	0.4
54452	6.3	14.66	125	126	1900	151	14	171	150	2.1	6.3	0.5
54453	6.2	8.49	198	304	850	105	13	175	140	1.7	5.3	0.4
54454	6.1	8.86	230	124	893	118	13	180	193	1.8	6.6	0.4
54455	6.2	9.38	256	238	986	151	15	172	204	1.8	9.2	0.4
54456	6.2	8.73	192	194	950	107	14	164	190	1.5	6.1	0.4
54583	7.1	12.02	161	770	1332	158	24	165	283	1.6	10.7	0.6
<b>Mean</b>	6.03	10.94	122	155	1205	125	14	154	164	1.9	6.1	0.4
<b>Median</b>	6.00	11.01	118	124	1212	126	14	154	165	1.8	6.1	0.4
<b>Minimum</b>	5.60	8.11	31	42	674	72	9	97	110	1.1	2.4	0.2
<b>Maximum</b>	7.10	17.92	256	770	2674	186	24	204	283	2.9	10.7	0.7
<b>Standard deviation</b>	0.24	2.41	50	117	407	29	2	21	33	0.4	1.6	0.1
<b>Coefficient of variation, %</b>	3.90	22.05	40.5	75.5	33.8	23.4	18.4	13.7	20.2	22.5	26.7	19.9
<b>Count</b>	45											

**Table 13. Soil analyses of 4 to 8 inch samples collected from Field 12, collected March 2018.**

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
		cmol/kg	----- mg/kg -----									
76346	5.9	7.63	60	48	801	54	9	146	120	1.4	1.5	0.5
76347	6.5	8.95	52	49	1126	72	8	133	124	1.7	2.9	0.6
76348	6.0	11.04	139	147	1192	136	13	171	134	1.9	6.3	0.7
76349	6.0	12.53	39	88	1563	105	12	123	107	1.9	2.1	0.6
76351	5.9	14.59	76	165	1895	130	15	163	78	2.3	4.3	0.8
76352	6.5	16.31	44	87	2508	51	12	108	134	1.9	4.3	1.0
76353	6.1	10.28	28	49	1249	43	8	129	116	2.0	1.6	0.6
76354	6.0	8.32	57	52	901	71	9	150	115	1.6	3.4	0.6
76355	6.1	13.10	54	95	1687	96	12	141	128	2.3	3.1	0.7
76356	6.3	11.32	32	57	1497	62	10	130	102	2.1	1.8	0.7
76358	6.2	15.75	25	70	2238	89	11	117	114	2.2	3.0	0.8
76359	6.2	14.80	27	65	2038	95	12	106	82	1.9	2.2	0.8
76361	6.0	9.91	25	47	1171	48	7	129	110	1.6	2.0	0.6
76362	6.0	7.65	32	54	802	50	7	126	97	0.8	1.4	0.5
76363	6.0	10.26	31	79	1173	70	8	124	141	1.4	1.5	0.3
76364	6.0	11.26	26	55	1381	73	9	114	111	1.4	1.7	0.3
76367	6.2	9.84	45	56	1229	53	12	107	163	1.5	2.2	0.3

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
76368	6.0	7.02	36	35	719	31	5	134	99	0.9	1.3	0.2
76370	6.1	12.18	30	68	1540	83	8	130	155	1.8	2.4	0.9
76372	5.8	15.22	53	72	1830	89	13	133	108	2.1	3.0	0.8
76373	5.5	12.43	80	82	1187	76	18	141	112	2.0	2.6	0.8
76374	5.7	8.63	50	50	809	39	14	101	82	1.0	1.2	0.7
76375	5.9	7.26	46	52	740	44	6	142	102	0.9	1.6	0.2
76376	6.0	11.23	31	55	1363	78	8	125	133	1.5	2.0	0.3
76377	6.0	12.28	24	65	1560	82	10	118	107	1.3	1.6	0.3
76378	5.8	9.34	79	73	914	58	11	138	122	1.2	2.4	0.3
76379	5.6	8.24	137	132	668	58	13	154	111	1.0	2.2	0.3
76380	5.9	7.91	52	64	840	50	11	109	126	1.0	1.2	0.3
76470	6.3	9.30	24	51	1153	43	12	111	87	0.9	0.8	0.2
86484	6.1	10.03	67	81	1113	79	13	186	236	1.8	3.5	0.6
86526	6.2	10.90	51	45	1371	103	11	133	143	1.6	3.1	0.8
86527	5.9	11.27	84	152	1267	116	13	175	143	1.9	5.9	0.7
86528	6.2	9.56	43	62	1123	86	8	151	146	1.5	2.8	0.8
86529	6.3	14.08	30	52	1903	104	10	141	152	1.8	3.6	1.0
86530	6.4	7.26	95	59	804	60	8	155	178	1.1	1.7	0.7
<b>Mean</b>	<b>6.05</b>	<b>10.79</b>	<b>52</b>	<b>72</b>	<b>1296</b>	<b>74</b>	<b>10</b>	<b>134</b>	<b>123</b>	<b>1.6</b>	<b>2.5</b>	<b>0.6</b>

Lab number	pH	ECEC	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn	B
<b>Median</b>	6.00	10.28	45	62	1192	72	11	133	116	1.6	2.2	0.6
<b>Minimum</b>	5.50	7.02	24	35	668	31	5	101	78	0.8	0.8	0.2
<b>Maximum</b>	6.50	16.31	139	165	2508	136	18	186	236	2.3	6.3	1.0
<b>Standard deviation</b>	0.23	2.59	29	32	454	26	3	20	30	0.4	1.2	0.2
<b>Coefficient of variation, %</b>	3.73	24.04	56.0	43.9	35.1	35.4	26.5	15.2	24.7	27.9	49.6	41.4
<b>Count</b>	35											



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**RESEARCH & EXTENSION**

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