

**Addison County River Watch Collaborative
Summary Report: 2019 Sampling Results**

Quality Assurance / Quality Control Summary Report

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I. Introduction

This appendix provides a summary of the Quality Assurance review of sampling results for the 2019 season in six watersheds monitored by the Addison County River Watch Collaborative:

- Lemon Fair River
- Lewis Creek
- Little Otter Creek (including Mud Creek)
- Middlebury River
- New Haven River
- Otter Creek

The Addison County River Watch Collaborative sampled 34 sites in these six watersheds during two Spring events (April and May) four Summer events (June, July, August and September) in 2019.

Table 1. Sampling Dates in 2019

Stations	Sampling Dates	
34 sentinel and rotational stations	April 10	July 10
	May 1	Aug 7
	June 5	Sept 4

Sampling sites and parameters monitored during Spring and Summer months are presented in Table 2. Parameters included Total Phosphorus (TP), Dissolved Phosphorus (DP), Total Nitrogen (TN), Total Suspended Sediments (TSS), Turbidity, and *E. coli*. Originally-scheduled *E. coli* and Turbidity analyses for highlighted (yellow) sites in Table 2 were eliminated for the Summer sampling events to comply with a mid-season request from the LaRosa Volunteer Monitoring Program to reduce requested services.

II. Data Validation

The following sections discuss data quality objectives and 2019 season results with respect to completeness, accuracy (Field Blank results) and precision (Field Duplicate results). Recommended corrective actions for identified issues are addressed in Section IV.

II.A Completeness

Overall completeness (**96.1%**) exceeded the goal outlined in the ACRWC Quality Assurance Project Plan (80%) as detailed in Table 3. Due to differences in scheduled parameters, completeness has been calculated separately for the Spring versus Summer events.

Table 2. 2019 Schedule of Sites / Parameters – Spring, Summer

Site Types: R = Rotational; S = Sentinel; O = Other (special project).

Project Number: 137-01				Spring Schedule (Apr, May)						Summer Schedule (Jun, Jul, Aug, Sep)						
Sample Year: 2019 - Revised				PARAMETERS												
Type	River Name	Site ID	Site Location	TP	DP	TN	NOX	Turbidity	TSS	E.coli	TP	DP	TN	NOX	Turbidity	TSS
R	Lewis Creek	LCR0.3	Boat Access upstream of Hawkins Bay	X				X			X					
S	Lewis Creek	LCR3.7	Old Route 7 Bridge	X				X			X					
R	Lewis Creek	LCR9.9	Upper Covered Bridge, Roscoe Rd.	X				X			X					
R	Pond Brook	LCT3D.5	Silver Street culvert	X				X			X					
S	Lewis Creek	LCR14	Tyler Bridge	X	X	X		X		X	X	X	X		X	
O	Hollow Bk (Lewis Ck)	LCHLW1.0	Tyler Bridge Rd X'g of Hollow Bk	X	X	X		X		X	X	X	X		X	
O	Hollow Bk (Lewis Ck)	LCHLW0.1	Hollow Brook at Confl w/ Lewis	X	X	X		X		X	X	X	X		X	
O	Lewis Creek	LCR14.3	Just above confluence of Hollow Bk	X	X	X		X		X	X	X	X		X	
O	Lewis Creek	LCR15	Just above Clifford stabilized crossing	X	X	X		X		X	X	X	X		X	
O	Lewis Creek	LCR16	LaRue bridge crossing	X	X	X		X		X	X	X	X		X	
R	Lemon Fair River	LFR1.2	Prunier Road bridge	X	X	X		X	X		X	X	X			
R	Lemon Fair River	LFR4	Lemon Fair Rd bridge	X	X	X		X	X		X	X	X			
S	Lemon Fair River	LFR6.7	Route 125 bridge.	X	X	X		X	X		X	X	X			
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge	X	X	X		X	X		X	X	X			
R	Lemon Fair River	LFR15.8	Shacksboro Road bridge	X	X	X		X	X		X	X	X			
R	Lemon Fair River	LFR23.9	Murray Road Bridge	X	X	X		X	X		X	X	X			
R	Lemon Fair River	LFR26.6	Old Sawmill Rd bridge	X	X	X		X	X		X	X	X			
R	Beaver Branch (LFR)	LFB0.5	Route 125 crossing	X	X	X		X			X	X	X			
R	Beaver Branch (LFR)	LFB2.5	Sperry Road crossing, Beaver Branch	X	X	X		X			X	X	X			
R	Beaver Branch (LFR)	LFB5	Clark Rd bridge	X	X	X		X			X	X	X			
R	Trib to Beaver Br (LFR)	LFBS1-0.9	Route 74 crossing	X	X	X		X			X	X	X			
R	Bascom Brook (LFR)	LFBasc 0.3	Buttolph Rd crossing	X	X	X		X			X	X	X			
R	Perry Brook (LFR)	LFPerr 0.5	Buttolph Rd crossing	X	X	X		X			X	X	X			
S	Little Otter Creek	LOC4.3	Route 7 Bridge	X							X					
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)	X							X					
S	Middlebury River	MIR1.5	Shard Villa Road Bridge	X						X	X					
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge	X						X	X					
S	Middlebury River (Midd Br)	MIR10.6	Natural Turnpike Road	X							X					
S	New Haven River	NHR2	Muddy Branch confluence (just below)	X							X					
S	New Haven River	NHR6	Route 116 Bridge, Sycamore Park							X						
S	New Haven River	NHR9	South St. Bridge	X							X					
S	New Haven River	NHR11.5	Bartlett's Falls Pool							X						
S	Otter Creek	OTR7.3	Vergennes Falls / below outfall	X							X					
S	Otter Creek	OTR18	Twin Bridges Picnic Area	X							X					

Table 3. Project Completeness

Table 7c - Project Completeness

* Anticipated totals were revised after the April 2019 event to comply with LaRosa Program request to reduce analytical expenses. Therefore these anticipated totals do not match those in the approved QAPP for the 2019 season.

Parameter			Number of Samples Anticipated			Number of Valid Samples Collected & Analyzed			Percent Complete
			Primary	QC	Total	Primary	QC	Total	
Chlorophyll- <i>a</i>			-	-	-				
Phosphorus	Total	Spring	64	16	80	63	20	83	100.0
		Summer	128	32	160	126	32	158	98.8
	Dissolved	Spring	38	8	46	38	12	50	100.0
		Summer	76	16	92	74	24	98	100.0
<i>E. coli</i>		Summer	40	8	48	30	4	34	70.8
Total Suspended Solids		Spring	7	2	9	7	2	9	100.0
		Summer	0	0	0	0	0	0	
Transparency					-				
Alkalinity		Summer	-	-	-				
pH					-				
Turbidity		Spring	23	6	29	23	6	29	100.0
		Summer	24	8	32	24	4	28	87.5
Total Nitrogen		Spring	38	8	46	38	12	50	100.0
		Summer	76	16	92	74	19	93	100.0
Total Nox		Spring							
		Summer							
Si, dissolved			-	-	-				
Dissolved Oxygen			-	-	-				
Conductivity			-	-	-				
Temperature		Spring/Summer	160		160	160		160	100.0

Completeness - Primary Samples

Select constituent analyses for several primary samples were missed during the 2019 season:

- On **May 1**, a mix-up of collection materials resulted in a missing sample from the Lewis Creek station LCT3D.5. This accounts for one sample of total phosphorus.
- For the **July 10** event, an abundance of poison parsnip at Lemon Fair River sites LFB0.5 and LFB2.5 prevented volunteers from approaching the river at these locations. Samples were not taken. This included total nitrogen, total phosphorus, and dissolved phosphorus samples for each of the two sites.
- For the **August 7** event, an unanticipated sample of dissolved phosphorus was collected at Otter Creek site OTR7.3. This was due to a mix-up during the bottle ordering process. This can be attributed to two factors: the state was transitioning into a new ordering system that everyone was still learning, and ACRWC was transitioning to a new person completing the ordering process.
- For the **September 4** event, VAEL reported a lab error that prevented all *E. coli* samples from being analyzed after they were delivered to the lab. This included 10 primary and 2 QC samples.

Completeness - Field QC Samples

The ACRWC QAPP specifies collection of Field Blanks and Field Duplicates at a frequency of 1 per 10 primary samples for each scheduled analyte, per event. Field blank and duplicate samples were collected and processed at a frequency of 10% or greater during each of the spring and summer sampling events, except in these instances:

- At the **August 7** sampling event at the Lewis Creek LCR14 site, four anticipated QC samples were not taken. This included a field blank and duplicate for *E. coli* and a field blank and duplicate for turbidity. ACRWC believes this was due to the transition to the new ordering system in the state. This transition caused some confusion, and the proper bottles were not ordered.
- During the **September 4** sampling event, two QC turbidity samples went missing from the Lewis Creek LCR16 site. Volunteer samplers wrote on the data form that they collected the samples, but they were not checked in and sent to the lab. It is unclear exactly how this occurred.
- Also for the **September 4** sampling event, VAEL reported a lab error that prevented all *E. coli* samples from being analyzed after they were delivered to the lab. This included 10 primary and 2 QC samples.

II.B Field Blank results

Field Blank results are summarized in Table 4. Field Blanks collected for each constituent in the Spring and Summer events were within field accuracy goals (no constituents detected above the respective method detection limits in the blanks) – except for the following cases.

- In some Field Blank results for various events and various constituents, a value of the indicated constituent was detected slightly above the respective method detection limit (see light orange-shaded values in Table 4). It is unknown whether contamination of the Field Blank occurred in the field or in the lab. ACRWC utilized deionized water that had been provided by the VAEL. Since the reported value was only slightly above the detection limit, and It is not uncommon for Turbidity and TP to be detected in Field Blanks at very low levels, but somewhat above the method detection limit (Jim Kellogg, email communication with Kristen Underwood, 1/15/2018), none of the corresponding results for these stations have been rejected or flagged as estimated values on account of these Field Blank results.

Sample Number	Location	Date	Final E. Coli. (mpn/100ml)	Turbidity (NTU)	TN (mg-N/L)	TP (ug P/L)	DP (ug P/L)	TSS
1900141-035	LCHLW1.0 BLK	4/10/19		<0.2	<0.1	<5	<5	
1900141-039	LFB5 BLK	4/10/19		<0.2	<0.1	6.00	7.00	
1900141-037	LFR15.8 BLK	4/10/19		<0.2	<0.1	<5	<5	<2.0
1900338-033	LCHLW1.0 BLK	5/1/19			<0.1	<5	<5	
1900338-037	LFB5 BLK	5/1/19			<0.1	<5	<5	
1900338-035	LFR15.8 BLK	5/1/19			0.10	<5	<5	
1900338-040	MIR1.5 BLK	5/1/19				6.00		
1900338-041	OTR7.3 BLK	5/1/19				6.00		
1900363-035	LCR15 BLK	6/5/19		<0.2	<0.1	<5	<5	
1900363-035	LCR15 BLK	6/5/19	<1.00					
1900363-039	LFBasc 0.3 BLK	6/5/19			<0.1	<5	<5	
1900363-037	LFR6.7 BLK	6/5/19			<0.1	<5	<5	
1900363-041	NHR2 BLK	6/5/19				<5		
1900569-035	LCR14 BLK	7/10/19		<0.2	<0.1	<5	<5	
1900569-035	LCR14 BLK	7/10/19	<1.00					
1900569-039	LFPerr 0.5 BLK	7/10/19			<0.1	<5	<5	
1900569-037	LFR12 BLK	7/10/19			<0.1	<5	<5	
1900569-041	OTR7.3 BLK	7/10/19				<5		
1900812-035	LCR14 BLK	8/7/19			<0.1	<5	<5	
1900812-039	LFPerr 0.5 BLK	8/7/19			<0.1	<5	<5	
1900812-037	LFR12 BLK	8/7/19			<0.1	<5	<5	
1900812-041	OTR7.3 BLK	8/7/19				<5	<5	
1900981-035	LCR16 BLK	9/4/19			<0.1	<5	<5	
1900981-039	LFB0.5 BLK	9/4/19			<0.1	<5	<5	
1900981-037	LFR15.8 BLK	9/4/19			<0.1	<5	<5	
1900981-041	LOC4.3 BLK	9/4/19				<5		

Shaded cells indicate values detected at or above the method detection limit.

Table 4. Field Blank Results

II.C Field Duplicate results

Field Duplicate results are summarized in Table 5, which presents the Relative Percent Difference (RPD) values for each analyte for each Field Duplicate pair. As per the QAPP, Mean Relative Percent Difference was calculated as follows:

$$\text{RPD}_{\text{field duplicate pair 1}} = \frac{\text{absolute value (sample}_1 - \text{sample}_2)}{\text{average (sample}_1 \text{ and sample}_2)}$$

$$\text{and, mean RPD for "n" duplicate pairs} = \text{average (RPD}_{\text{pair 1}} + \text{RPD}_{\text{pair 2}} + \dots + \text{RPD}_{\text{pair n}})$$

Mean RPD values for the season were within the precision goals specified for the project for all analytes.

While the mean values met precision goals, RPD values in one instance exceeded this goal (shaded in orange in Table 5). This was the dissolved phosphorus sample and duplicate pair from the Lewis Creek site LCR16 on September 4. It is unclear what caused this elevated RPD value, but various aspects of sampling and analysis procedures, as well as natural variability, may have contributed. The detected concentration in the duplicate pair was quite low – a condition which can contribute to elevated RPD. Since the overall mean RPD for the 2019 sample year met the precision goal, none of the results were rejected or flagged as estimated values on account of RPD results for Field Duplicate pairs.

Table 5. Field Duplicate Results (presented values are Relative Percent Difference of Field Duplicate pairs)

Location	Date	E. Coli. (mpn/100ml)	Total Nitrogen (mg/L)	Total Phosphorus (ug/L)	Dissolved Phosphorus (ug/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
LCHLW1.0	4/10/19		2.35	9.52	0.00		0.58
LFB5	4/10/19		1.16	9.23	11.76		1.07
LFR15.8	4/10/19		1.50	1.40	12.50	0.88	0.31
MIR1.5	4/10/19			2.41			
OTR7.3	4/10/19			13.33			
LCHLW1.0	5/1/19		5.41	15.38	0.00		
LFB5	5/1/19		1.74	0.00	12.50		
LFR15.8	5/1/19		1.31	2.79	3.57		
MIR1.5	5/1/19			6.90			
OTR7.3	5/1/19			3.28			
LCR15	6/5/19	3.31	3.39	25.00	9.52		0.27
LFBasc 0.3	6/5/19		1.77	1.83	0.00		
LFR6.7	6/5/19		10.53	3.10	4.26		
NHR2	6/5/19			16.22			
LCR14	7/10/19	5.88	1.48	9.52	0.00		10.53
LFPerr 0.5	7/10/19		14.81	1.60	0.00		
LFR12	7/10/19		5.88	3.51	1.38		
OTR7.3	7/10/19			0.00			
LCR14	8/7/19			0.00	25.00		
LFPerr 0.5	8/7/19			0.88	2.35		
LFR12	8/7/19			2.06	0.00		
OTR7.3	8/7/19			2.74			
OTR7.4	8/7/19			0.00			
LCR16	9/4/19		7.41	18.18	131.71		
LFB0.5	9/4/19			1.20			
LFR15.8	9/4/19		3.33	1.94	3.64		
LOC4.3	9/4/19			3.11			
Number of Duplicate Pairs		2	14	27	17	1	5
Average RPD for Sample Year		4.59	4.43	5.75	12.83	0.88	2.55
QAPP Acceptable RPD		≤50% (>25mpn) ≤125% (<25mpn)	≤20%	≤30%	≤30%	≤15%	≤15%

KEY	
	Missing a Duplicate Sample
	Samples have been flagged due to unusual values

III. Other QA/QC Issues

1. Results for one sample was reported by the lab with an incorrect sample ID:

Lab_ID	Order	Site	DateTime
1900141-018		LFB0.5	4/10/2019 7:05
1900338-018		LFB0.5	5/1/2019 8:15
1900363-018		LFB0.5	6/5/2019 8:25
1900569-018		LFB0.5	7/10/2019 8:05
1900812-018		LFB0.5	8/7/2019 8:03
1900981-018		LFB0.5	9/4/2019 8:00

2. In one Lewis Creek duplicate sample (LCR16), collected during the June 5 event, subtraction of the reported DP concentration from the TP concentration resulted in a negative value. ACRWC is not certain what happened. As a duplicate sample, however, it is notable that the value of DP is very similar to the sample value for TP, and vice versa. It is probable that TP and DP vials were reversed in the field.

IV. Corrective Actions

The following corrective actions are recommended to address issues encountered in 2019.

- A. ACRWC will continue with the annual refresher training that is mandatory for all volunteer samplers. A new sampling instruction video was prepared by ACRWC in 2017 that will be used at training, and available to samplers throughout the season, to emphasize proper sampling techniques. <http://acrpc.org/programs-services/natural-resources/acrwc/whatsnew/>.
- B. Spring training has been emphasizing field collection methods for duplicate and field blank samples, as this is an area of recurring sampling errors. Sampling coordinators have been making concerted efforts to ensure that field blank vials are filled with DI water prior to sampling so that there is no opportunity to fill a blank vial (erroneously) with river water.
- C. The ACRWC Coordinator will continue to generate a Lab Runner Log. This form was used to document any QA issues relevant to sample transport and delivery and record them as they happened, which proved useful to the generation of this QA/QC summary report.
- D. ACRWC was able to avoid many QC issues this year, as a result of a series of checks and data reviews throughout the sampling season (detailed in the 2010 season QA Summary Report). Far fewer omissions and incidents have occurred in recent years as a result of instituting these checks and balances. ACRWC will continue with these procedures in future years.

- E. ACRWC staff and volunteers will continue the learning process of the new VAEI ordering system. With time and experience, ACRWC believes that there will be fewer errors with the bottle ordering and labeling process, resulting in an even better completeness score.
- F. ACRWC is undergoing a transition from one QC Coordinator to another. ACRWC will make every effort to make this transition smooth by writing down methods, maintaining open communication between both individuals, and providing appropriate training.