Appendix D
Addison County River Watch Collaborative
Summary Report: 2015 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 2015 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 27 sites in these six watersheds during two Spring events (April and May) and 25 sites during four Summer events (June, July, August and September).

- April 8 (postponed from April 1 due to persistent ice cover)
- May 6
- June 3
- July 1
- August 5
- September 2

Sampling sites and parameters scheduled for the Spring and Summer months are presented in Table 1. Parameters included Total Phosphorus (TP), Dissolved Phosphorus (DP), Total Nitrogen (TN), Total Suspended Sediments (TSS), Turbidity, and *E. coli*. Alkalinity was also sampled at select sites in the Middlebury River watershed as part of a focused study.

II. Data Validation

The following sections discuss data quality objectives and 2015 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

Completeness – Primary Samples

ACRWC goals for completeness according to the Quality Assurance Project Plan are 80%**.** A summary of the completeness percentages achieved in the 2015 sampling season is presented in Table 2. As requested, a copy of completed QAPP Table 7c is also presented as an attachment to this Appendix, which summarizes the same information in a slightly different manner. Due to differences in scheduled sites and parameters, completeness has been calculated separately for the Spring and Summer events.

Table 1. 2015 Schedule of Sites / Parameters – Spring and Summer *Site Types: R = Rotational; S = Sentinel; O = Other (special project).*

Project Name: Addison County River Watch Collaborative														
Project Number: **137-01**				Spring Schedule (Apr, May)					Summer Schedule (Jun, Jul, Aug, Sep)					
Sample Year: **2015**									**PARAMETERS**					
Type	**River Name**	**Site ID**	**Site Location**	**TP**	**DP**	**TN**	**Turbidity**	**TSS**	***E.coli***	***ALK***	**TP**	**DP**	**TN**	**Turbidity**	**TSS**
S	Lewis Creek	LCR3.7	Old Route 7 Bridge	X			X		X		X			X	
S	Lewis Creek	LCR14	Tyler Bridge	X			X		X		X			X	
S	Lemon Fair River	LFR6.7	Route 125 bridge.	X	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	X
S	Little Otter Creek	LOC4.3	Route 7 Bridge	X	X		X	X	X		X	X		X	X
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)	X	X		X	X	X		X	X		X	X
R	Middlebury River	MIR0	Mouth of Middlebury River	X		X	X		X		X		X	X	
S	Middlebury River	MIR1.5	Shard Villa Road Bridge	X		X	X		X		X		X	X	
R	Middlebury River	MIR2	Blake Roy Road Bridge	X		X	X		X		X		X	X	
R	Middlebury River	MIR3	Route 7 Access	X		X	X		X		X		X	X	
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge	X		X	X		X		X		X	X	
R	North Branch MR	MRNB1.7	Dugway Road Bridge	X			X		X	X	X			X	
R	North Branch MR	MRNB3.5	Norton Farm Rd Bridge	X			X		X	X	X			X	
R	Middlebury River (Midd Br)	MIR10.6	Natural Turnpike Road	X			X		X	X	X			X	
R	Middlebury River (Midd Br)	MIR13	Wagon Wheel Rd Bridge	X			X		X	X	X			X	
R	South Branch MR	MRSB1	Goshen Road Bridge	X			X		X	X	X			X	
R	South Branch MR	MRSB4.2	Brook Road Bridge	X			X		X	X	X			X	
R	Halnon Brook MR	MRHT0.1	Upstream of Route 7 crossing	X			X		X	X	X			X	
S	New Haven River	NHR2	Muddy Branch confluence (just below)	X			X		X		X			X	
S	New Haven River	NHR6	Route 116 Bridge, Sycamore Park						X						
S	New Haven River	NHR9	South St. Bridge	X			X		X		X			X	
S	New Haven River	NHR11.5	Bartlett's Falls Pool						X						
S	Otter Creek	OTR7.3	Vergennes Falls / below outfall	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR13	Route 17 Bridge	X	X	X	X		X		X	X	X	X	
S	Otter Creek	OTR18	Twin Bridges Picnic Area	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR23	Frog Hollow	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR30	Swamp Road Bridge	X	X	X	X		X		X	X	X	X	
			Total # sites per event	25	9	10	25	4	27	7	25	9	10	25	4

Table 2. Summary of Project Completeness – 2015 Sampling Season

Season:	Spring	Summer	Totals
Total # Scheduled Samples:	146	428	574
Actual # Samples Achieved	144	428	572
Percent Completeness:	99%	100.0%	99.7%

Overall completeness (99.7%) meets the goal outlined in the QAPP (80%). Calculations of completeness take into account, not only whether the sample was achieved (successfully collected with a result reported by the lab), but also whether sample results may have been rejected for reasons of not meeting data quality objectives (as further detailed in Sections II.B and II.C). Percent completeness calculations presented above do not include the field QC samples (Field Blanks and Field Duplicates).

Completeness - Primary Samples

One primary sample was missed during the 2015 season:

- On April 8, a scheduled sample for analysis of TP and Turbidity at the Wagon Wheel Rd crossing of the North Branch of Middlebury River (station MIR13) was not collected. Access to this sample site along this unplowed road was prevented due to late snow cover.

Completeness - Field QC Samples

The ACRWC QAPP specifies collection of Field Blanks and Field Duplicates at a frequency of 1 / 10 primary samples for each scheduled analyte, per event.

One scheduled QC sample (a Field Duplicate) was missed for the Dissolved Phosphorus analysis at station OTR30 in the April 8 event, due to a sampling and labeling mixup. Therefore, these results were not available for comparison to the primary sample results and calculation of an RPD value.

Related to the above sampling and labeling mixup at station OTR30 on April, a Field Blank result for Total Phophorus was also missed.

Despite these omissions, Field Blank and Field Duplicate samples were collected and processed at a frequency of 10% or greater during each of the Spring and Summer sampling events – meeting the completeness goal for QC samples.

II.B Field Blank results

Field Blank results are summarized in Table 3. 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 the following Field Blank results, a value of the indicated constituent was detected slightly above the respective method detection limit. 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 LaRosa Laboratory. Since the reported value was only slightly above the detection limit, none of the corresponding results for these stations have been rejected or flagged as estimated values on account of these Field Blank results.

- April 8, Otter Creek station OTR30, TN
- May 6, Middlebury River station MIR1.5, TN
- May 6, Little Otter Creek station, LOC4.3, Turbidity
- July 1, Otter Creek station OTR7.3, Dissolved Phosphorus
- July 1, Little Otter Creek station LOC4.3, Dissolved Phosphorus
- July 1, Little Otter Creek station LOC4.3, Total Suspended Solids
- August 5, Lemon Fair River station, LFR6.7, Turbidity.

- On May 6, the Dissolved Phosphorus result for the Field Blank from Otter Creek station OTR18 was twice the detection limit, while results for analysis of other constituents were below the detection limit. It is unknown whether contamination of the DP Field Blank occurred in the field or in the lab. It is possible that the DP vial was mistakenly filled with river water; however, there is no suggestion of this in the field notes or lab runner log. The fact that Turbidity, TP, and TN results were non-detect would suggest that samplers followed protocol and filled all Field Blank vials with deionized water that had been provided by the LaRosa Laboratory. Detectable quantities of DP in the Otter Creek samples from this event have been flagged: "JB" for estimated due to detection in the field blank.

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Table 3. Field Blank Results

Sample Number	Location	Date	QA	Alklinity (mg CaCO3/L)	Final E. Coli (mpn/100ml)	TN (mg-N/l)	TP (ug P/L)	TDP (ug P/L)	TSS (mg/L)	Turbidity (NTU)
150974-34	MIR3 BLK	9/2/2015	B		< 1	< 0.1	< 5			< 0.2
150974-32	MRHT0.1 BLK	9/2/2015	B	< 1	< 1		< 5			< 0.2
150974-30	MDC1.2 BLK	9/2/2015	B		< 1		< 5	< 5	< 1	< 0.2
150974-28	NHR9 BLK	9/2/2015	B		< 1		< 5			< 0.2
150690-34	OTR18BLK	8/5/2015	B		< 1	< 0.1	< 5	< 5		< 0.2
150690-32	MRNB1.7BLK	8/5/2015	B	< 1	< 1		< 5			< 0.2
150690-30	LFR6.7BLK	8/5/2015	B		< 1		< 5	< 5	< 1	0.21
150690-28	LCR14BLK	8/5/2015	B		< 1		< 5			< 0.2
150487-32	MRNB3.5 BLK	7/1/2015	B	< 1	< 1		< 5			< 0.2
150487-30	OTR73. BLK	7/1/2015	B		< 1	< 0.1	< 5	6.74		< 0.2
150487-28	LOC4.3 BLK	7/1/2015	B		< 1		< 5	6.79	3	< 0.2
150319-32	MRSB1 BLK	6/3/2015	B	1.5	< 1		< 5			< 0.2
150319-30	MIR2 BLK	6/3/2015	B		< 1	< 0.1	< 5			< 0.2
150319-28	LFR12 BLK	6/3/2015	B		< 1		< 5	< 5	< 1	< 0.2
150092-32	OTR18 BLK	5/6/2015	B			< 0.1	< 5	10.6		< 0.2
150092-30	LCR14 BLK	5/6/2015	B				< 5			< 0.2
150092-28	MIR1.5 BLK	5/6/2015	B			0.13	< 5			< 0.2
150092-26	LOC4.3 BLK	5/6/2015	B				< 5	< 5	< 1	0.28
150047-32	OTR30 BLK	4/8/2015	B			0.55	NR	< 5		< 0.2
150047-30	NHR9 BLK	4/8/2015	B				< 5			< 0.2
150047-28	MIR3 BLK	4/8/2015	B			< 0.1	< 5			< 0.2
150047-26	LFR6.7 BLK	4/8/2015	B				< 5	< 5	< 1	< 0.2

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

II.C Field Duplicate results

Field Duplicate results are summarized in Table 4, 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:

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

and,

Mean RPD for "n" duplicate pairs = average ($RPD_{\text{pair 1}}$ + $RPD_{\text{pair 2}}$ + ... + $RPD_{\text{pair n}}$)

Mean RPD values for the season were within the precision goals specified for the project for all analytes except Total Suspended Solids.

Total Suspended Solids

The precision goal for TSS is a RPD value less than 15%. Each of the field duplicate pairs yielded RPD values at or less than 15% except for the results from the July 1 event from Little Otter Creek station LOC4.3 (100%). Various aspects of sampling and analysis procedures, as well as natural variability, may have contributed to this elevated RPD value. Flows on this date were Moderate to High, on the rising limb of a flow event in response to wide-spread storms. TSS results for the July event at Little Otter stations have been flagged: "JD" for estimated due to a field duplicate RPD value above the accepted goal. If the RPD for the July 1 event is eliminated, the overall RPD for 2015 (2 Spring and 3 Summer events, excluding July) is 6.7% which meets the precision goal (15%) for this analysis.

Dissolved Phosphorus

While the mean RPD value for Dissolved Phosphorus (15.8%) was within the precision goal (30%) for this analysis when calculated across the full season (6 duplicate pairs across 2 Spring and 4 Summer events), it should be noted that the RPD value for one duplicate pair exceeded this goal. Reported DP values from Little Otter Creek station LOC4.3 on May 6 yielded an RPD value of 90.7%, well above the goal. Flow conditions on the sample date were moderate, representing a baseflow condition during a dry spring.

Since the overall mean RPD for the 2015 sample year met the precision goal, none of the Dissolved Phosphorus results were rejected or flagged as estimated values on account of RPD results for Field Duplicate pairs.

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Table 4. Field Duplicate Results *(presented values are Relative Percent Difference of Field Duplicate pairs)*

Sample Number	Location	Date	QA	Alklinity (mg CaCO3/L)	Final E. Coli (mpn/100ml)	TN (mg-N/l)	TP (ug P/L)	TDP (ug P/L)	TSS (mg/L)	Turbidity (NTU)
150974-31	MDC1.2 DUP	9/2/2015	D		102.4 ‡		2.2	1.3	15.1	11.1
150974-35	MIR3 DUP	9/2/2015	D		3.8 †	4.1	5.2			6.9
150974-33	MRHT0.1 DUP	9/2/2015	D	1.8 †	6.4 †		1.6			4.0
150974-29	NHR9 DUP	9/2/2015	D				5.4			9.5
150690-31	LFR6.7DUP	8/5/2015	D		22.6 †		0.6	2.1	15.0	0.9
150690-29	LCR14DUP	8/5/2015	D		43.6 †		1.7			7.3
150690-33	MRNB1.7DUP	8/5/2015	D	3.6 †	36.1 †		5.4			5.3
150690-35	OTR18DUP	8/5/2015	D		44.9 †	10.5	4.4	19.7		8.1
150487-29	LOC 4.3 DUP	7/1/2015	D		4.3 †		1.9	5.8	100.0	1.0
150487-33	MRNB3.5 DUP	7/1/2015	D	2.5 †	7.1 †		3.5			15.1
150487-31	OTR7.3 DUP	7/1/2015	D		33.7 †	0.0	4.9	4.3		3.9
150319-29	LFR12 DUP	6/3/2015	D		4.6 †		0.0	0.6	0.0	11.5
150319-31	MIR2 DUP	6/3/2015	D		0.9 †	2.7	0.0			2.9
150319-33	MRSB1 DUP	6/3/2015	D	3.9 ‡	22.2 ‡		0.5			3.6
150092-31	LCR14 DUP	5/6/2015	D				15.0			0.4
150092-27	LOC4.3 DUP	5/6/2015	D				4.7	90.7	8.4	3.4
150092-29	MIR1.5 DUP	5/6/2015	D			0.0	4.9			19.8
150092-33	OTR 18 DUP	5/6/2015	D			4.1	7.6	16.8		11.8
150047-27	LFR6.7 DUP	4/8/2015	D				0.5	0.5	1.7	1.0
150047-29	MIR3 DUP	4/8/2015	D			0.0	21.2			11.3
150047-31	NHR9 DUP	4/8/2015	D				1.5			4.9
150047-33	OTR30 DUP	4/8/2015	D			3.7	3.7	NR		0.6
	# duplicate pairs			4	13	8	22	10	6	22
	Average RPD for Sample Year			2.6 †	18.9 †	3.1	4.4	15.8	23.4	6.6
				3.9 ‡	62.3 ‡					
	QAPP Acceptable RPD			≤5% (>20 mg/l) †	<50% (>25mpn) †	≤ 20%	≤ 30%	≤ 30%	≤ 15%	≤ 15%
				<15% (<20 mg/l) ‡	≤125% (<25mpn) ‡					

Note: Shaded cells indicate values exceeding the acceptable RPD values recorded in the Quality Assurance Project Plan.

III. Other QA/QC Issues

Prior to the April 8 event, insufficient labels were supplied by the laboratory, which resulted in some labels being filled out by hand. As a result, there was one suspected transcription error for this event concerning Middlebury River stations MIR2 and MIR3. Reported results have been corrected as follows:

Sample Number	Location	Date	QA	Alkalinity (mg/L)	E. Coli (mpn/100ml)	Total Nitrogen (mg/L)	Total Phosphorus (ug/L)	Total Dissolved Phosphorus (ug/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
150047-09	~~MIR3~~ MIR2	4/8/2015	A			0.4	12.5			1.77
150047-10	~~MIR2~~ MIR3	4/8/2015	A			0.5	27.4			4.95
150047-29	~~MIR3~~ MIR2 DUP	4/8/2015	D				0.0	21.2		11.3

IV. Corrective Actions

The following corrective actions are recommended to address issues encountered in 2015.

A. The few incidents of mis-labelling that occurred during the 2015 season were the result of miscommunications between sampling team members. ACRWC will continue with the annual refresher training that is mandatory for all volunteer samplers.

B. Spring training will particularly emphasize field collection methods for duplicate and field blank samples, as this is an area of recurring sampling errors. Sampling coordinators will make concerted effort to ensure the 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. Additional resources will be made available to samplers in the 2016 year, pending receipt of grant funding, to include a web-based “how-to” sampling video. QA personnel will also attend sampling as we rotate to a focus on the New Haven River and Little Otter Creek, which will involve new sampling volunteers.

D. Last year, the ACRWC Coordinator generated 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.

E. 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.

Attachment 1.

QAPP Table 7c – Project Completeness

Parameter	Number of Samples Anticipated (not including QC)	Number of Valid Samples Collected & Analyzed (not including QC samples	Percent Complete *
Chlorophyll-*a*			
Total and Dissolved Phosphorus Total: Dissolved: Total: Dissolved:	 Spring: 50 Spring: 18 Summer: 100 Summer: 36	 Spring: 49 Spring: 18 Summer: 100 Summer: 36	Spring: Total: 98% Diss: 100% Summer: Total: 100% Diss: 100%
E. coli	Summer only: 108	Summer only: 108	Summer:100%
Total Suspended Solids	Spring: 8 Summer: 16	Spring: 8 Summer: 16	Spring: 100% Summer: 100%
Transparency			
Alkalinity	Summer: 28	Summer: 28	Summer: 100%
pH			
Turbidity	Spring: 50 Summer: 100	Spring: 49 Summer: 100	Spring: 98% Summer: 100%
Total nitrogen (persulfate digestion)	Spring: 20 Summer: 40	Spring: 20 Summer: 40	Spring: 100% Summer: 100%
Total NOx			
Si, dissolved			
Dissolved Oxygen			
Conductivity			
Temperature	158 readings	158 readings	100%

* Percent Complete = (# of Valid Samples Collected and Analyzed) / (# of Samples Anticipated) * 100

See Section II.A in QA Summary report for discussion of Primary and QC Sample Completeness.