

QUALITY ASSURANCE PROJECT PLAN

GROUP A. PROJECT MANAGEMENT

A.1. Title and Approval Page

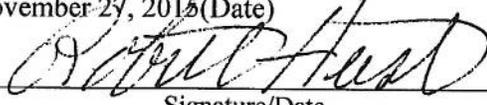
Riffle Bioassessment by Volunteers

(Project name)

Connecticut Department of Energy & Environmental Protection
Bureau of Water Protection & Land Reuse, Planning and Standards Division
(Responsible Agency)

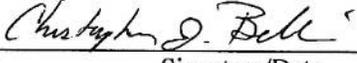
November 27, 2015 (Date)

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A.3. Distribution List

The following individuals will receive copies of the approved Quality Assurance Project Plan (QAPP) and subsequent revisions:

Name	Title/Organization	E-Mail
Steve DiMattei	Quality Assurance Officer, U.S. EPA ¹ Region 1	Dimattei.Steve@epa.gov
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Robert Hust	Assistant Director, Planning and Standards Division, CT DEEP WPLR ²	Robert.Hust@ct.gov
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Meghan Lally	Environmental Analyst, Monitoring & Assessment Program	Meghan.Lally@ct.gov
Tracy Lizotte	Environmental Analyst, Monitoring & Assessment Program	Tracy.Lizotte@ct.gov
Brian Jennes	Engineering Aide, Monitoring & Assessment Program	Brian.Jennes@ct.gov
Mary Becker*	Environmental Analyst, Monitoring & Assessment Program	Mary.Becker@ct.gov
Various Individuals ³	Program Coordinator, Local RBV Program	Various ³
Various Individuals ³	Certified Trainer, Local RBV Program	Various ³

¹ United States Environmental Protection Agency

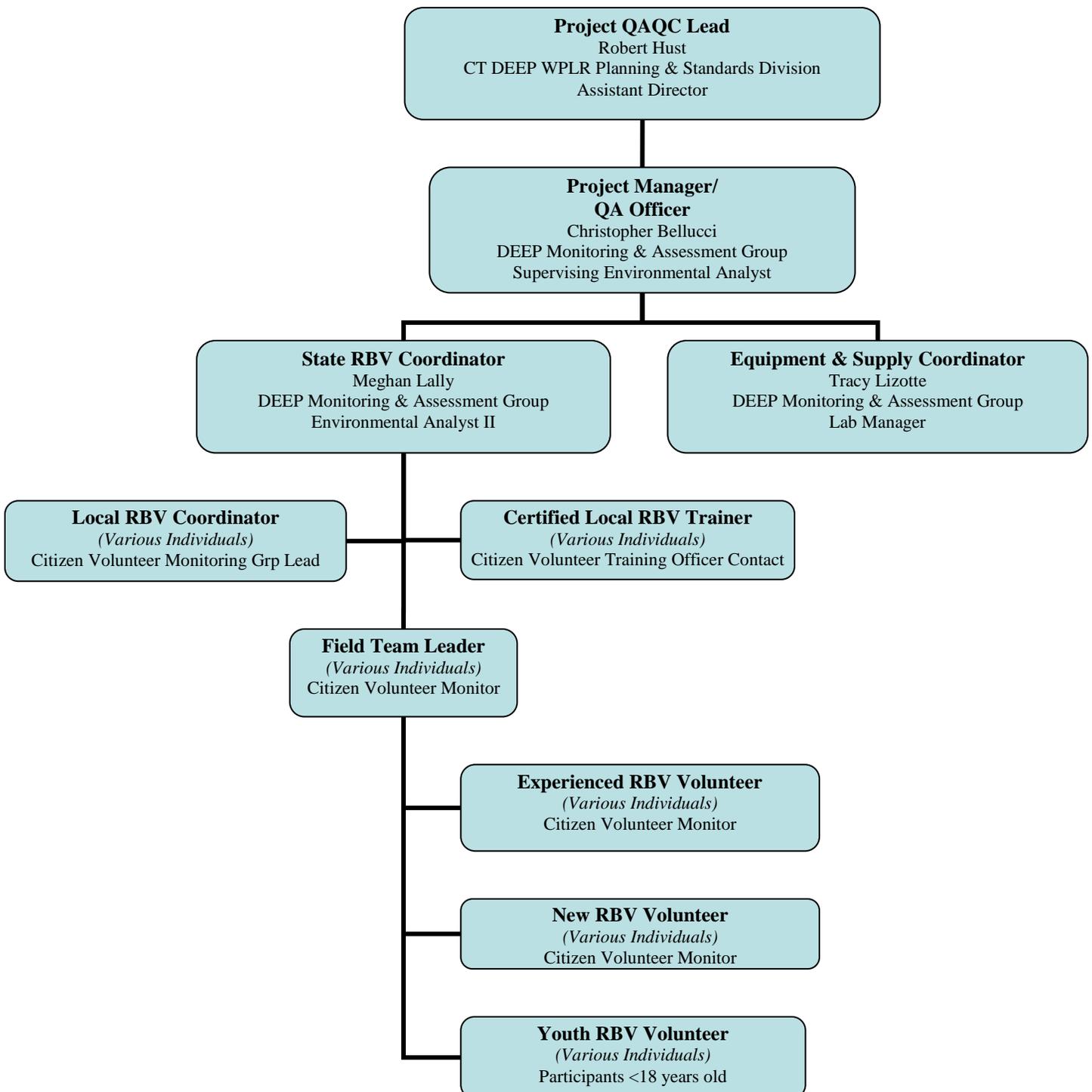
² Connecticut Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse

³ The list of Local RBV Program Coordinators and Certified Local RBV Trainers fluctuates on an annual basis. All current Local RBV Program Coordinators and active/certified Local RBV Trainers will receive via e-mail an electronic copy (.pdf format) of the approved program QAPP and any subsequent revisions.

The most current QAPP will be posted on the RBV Program webpage (www.ct.gov/deep/rbv) for viewing and download by program partners and interested members of the public.

A.4. Project/Task Organization

A.4.a Project Organization Chart



A.4.b Project Roles and Responsibilities

Project Quality Assurance and Quality Control (QAQC) Lead

The Project Quality Assurance and Quality Control (QAQC) Lead is responsible for review and approval of project QAPP and associated standard operating protocols (SOP) documents of the CT DEEP ambient water quality monitoring program. The Project QAQC Lead supervises the Project Manager.

Project Manager/ QA Officer

The Project Manager serves as the Senior QA Officer and is responsible for development and review of the project QA program. The Project Manager oversees program development, data assessment, and reporting activities. In addition, the Project Manager is experienced in aquatic macroinvertebrate identification and serves as the Taxonomy QA Officer. The Project Manager conducts an annual blind second review (i.e. taxonomic identification) of at least 10% of vouchers reviewed by the State RBV Coordinator. The Project Manager supervises the State RBV Coordinator and the Equipment & Supply Coordinator; the Project Manager reports to the Project QAQC Lead.

State RBV Coordinator

The State RBV Coordinator serves as the project data management officer, senior project training officer, project safety officer, and a project quality control officer. The State RBV Coordinator is responsible for the development of the project QAQC program, including maintenance and regular update of the QAPP. The State RBV Coordinator is also responsible for development and maintenance of program training materials; retention of program training records; maintenance and loan of project equipment; and data verification (i.e. voucher content review), compilation, quality control review, management, analysis and reporting. The State RBV Coordinator obtains any collection permits (i.e. CTDEEP Fisheries Scientific Collector Permit) necessary to execute the program. The State RBV Coordinator supervises the Local RBV Program Coordinators and Certified Local RBV Trainers; the State RBV Coordinator reports to the Project Manager.

Equipment and Supply Coordinator

The WPLR Lab Manager serves as the program Equipment and Supply Coordinator. The Equipment and Supply Coordinator oversees the purchase and maintenance of project-related equipment and supplies. The Equipment and Supply Coordinator reports to the Project Manager.

Local RBV Program Coordinator

The Local RBV Coordinator is the primary CT DEEP contact for each citizen volunteer monitoring group. The Local RBV Coordinator serves as a local volunteer coordinator and event organizer. The Local RBV Coordinator is responsible for volunteer recruitment, coordination, and associated record keeping; ensuring all volunteers have the equipment necessary to conduct RBV monitoring activities; and serving as the lead organizer for local RBV events. The Local RBV Coordinator is responsible for insuring that all volunteers complete annual training prior to monitoring, and compiles and submits corresponding program training records to CT DEEP annually. In addition, the Local RBV Coordinator serves as a local quality assurance agent and is responsible for reviewing new monitoring stations with the State RBV Coordinator prior to monitoring and ensuring all data submissions (i.e. vouchers, datasheets, and station documentation photographs) are complete and accurately labeled prior to submission to CT

DEEP. The Local RBV Coordinator works in partnership with one or more Certified Local RBV Trainers. The Local RBV Coordinator supervises all individuals serving as volunteers for their local RBV program; the Local RBV Coordinator reports to the State RBV Coordinator.

Certified Local RBV Trainer

The Certified Local RBV Trainer serves as a local quality assurance agent and is responsible for executing local RBV volunteer training sessions in accordance with the RBV Program QAPP. The Certified Local RBV Trainer is responsible for documenting all such trainings, and conducting field reviews of volunteer monitoring to ensure volunteers are conducting the program in accordance with program protocols. Local RBV Program Coordinators who complete the required training requirements may concurrently serve as their program's Certified Local RBV Trainer. The Certified Local RBV Trainer works in partnership with one or more Local RBV Coordinators. The Certified Local RBV Trainer supervises RBV volunteers during RBV training activities; the Certified Local RBV Trainer reports to the State RBV Coordinator.

Field Team Leader

The Field Team Leader is an Experienced RBV Volunteer assigned by the Local RBV Coordinator to supervise a volunteer monitoring team of 2 or more volunteers. The Field Team Leader is responsible for overseeing field data collection and documentation. At the conclusion of the monitoring activity the Field Team Leader is responsible for reviewing all field data and submitting the field data package to the Local RBV Program Coordinator. The Field Team Leader supervises other citizen volunteer monitors; the Field Team Leader reports to the Local RBV Coordinator.

Experienced RBV Volunteer

Experienced RBV Volunteers are adult citizen volunteer water quality monitors who have completed at least one prior RBV monitoring event within the past two years. Experienced RBV Volunteers are responsible for field data collection and documentation. Experienced RBV Volunteers report to the Local RBV Program Coordinator via their Field Team Leader.

New RBV Volunteer

New RBV Volunteers are adult citizen volunteer water quality monitors with no prior RBV training or monitoring experience, or who have not participated in the RBV Program within the past two years. New RBV Volunteers assist with field data collection and documentation. New RBV Volunteers report to the Local RBV Program Coordinator via their Field Team Leader.

Youth RBV Volunteer

All RBV volunteers under age 18 are considered Youth RBV Volunteers, regardless of prior program experience. Youth Volunteers assist with field data collection under the direct supervision of a Field Crew Leader. Youth volunteers must be accompanied by a parent/legal guardian or parent/guardian-approved designee (e.g. school teacher, community group leader). Youth RBV Volunteers report to the Local RBV Program Coordinator via their Field Team Leader.

A.4.c Personnel Qualifications

Table A.4.c1. Project Roles and Personnel Qualifications

Project Role	Name	Qualifications
Project QA/QC Lead	Robert Hust	5 ½ years as Assistant Director of Planning and Standards Division. Over 35 years involved with water quality management.
Project Manager/ QA Officer	Chris Bellucci	Over 28 years involved with surface water quality and biological monitoring. Supervising Environmental Analyst for the CT DEEP Ambient Water Quality Monitoring program.
Equipment & Supply Coordinator	Tracy Lizotte	Over 34 years involved with in water quality monitoring and laboratory analyses. Manager of the CT DEEP ambient water quality monitoring lab and Environmental Analyst III for the CT DEEP Ambient Water Quality Monitoring program.
State RBV Coordinator	Meghan Lally	Over 6 years involved with surface water quality and biological monitoring, and with volunteer water quality program management. State RBV Coordinator and Environmental Analyst II for the CT DEEP Ambient Water Quality Monitoring program.
Local RBV Program Coordinator	Various Individuals	Adult volunteer with an active interest in water quality monitoring and/or watershed management. Currently serving as the lead contact of an organized volunteer monitoring group.
Certified Local RBV Trainer	Various Individuals	Adult volunteer with an active interest in water quality monitoring and/or watershed management. Certified by State RBV Coordinator to conduct program trainings.
Field Team Leader	Various Individuals	Experienced RBV Volunteer (adult) who has been assigned by the Local RBV Coordinator to serve as the field crew supervisor for a team of 2 or more less experienced or new RBV volunteers.
Experienced RBV Volunteer	Various Individuals	Adult volunteer with an active interest in water quality monitoring. Has previously completed at least one RBV monitoring event within the past two years.
New RBV Volunteer	Various Individuals	Adult volunteer with an active interest in water quality monitoring. No prior RBV experience.
Youth RBV Volunteer	Various Individuals	Any RBV program participant under the age of 18. Active interest in water quality monitoring. May or may not have prior RBV program experience.

A.4.d Communication Pathways

The CT DEEP maintains an RBV Program web page (<http://www.ct.gov/deep/rbv>) which includes program overview information as well as downloadable electronic files of the program training and field materials, annual results summary reports, and the program QAPP.

The State RBV Coordinator maintains contact information and certification records for the current Local RBV Program Coordinators and Certified Local RBV Trainers. The State RBV Coordinator will electronically notify Coordinators and Trainers of any changes to program protocols or materials, and/or the release of any new program documents or reports. As necessary, the State RBV Coordinator will also communicate directly with Coordinators and/or Trainers to discuss concerns specific to a particular local RBV Program or event. The State RBV Coordinator will contact Certified Local RBV Trainers to notify them of certifications that are due to expire and to make subsequent arrangements for recertification. The State RBV Coordinator maintains an email listserv for Connecticut volunteer water quality monitors; volunteers will be notified by the State RBV Coordinator of any significant programmatic changes or upcoming program events via this listserv.

The Local RBV Coordinator maintains contact information for each adult RBV volunteer associated with his/her local RBV Program. Contact information records are to include the volunteer's full name (e.g. first and last), training date, and mailing address; if available, the volunteer's telephone number and email address will also be recorded. The Local RBV Coordinator is responsible for communicating any program changes or announcements delivered by the State RBV Coordinator to the individual volunteers in their program. In the event that the State RBV Coordinator has a question or concern regarding an RBV sample, the Local RBV Coordinator is responsible for contacting the individual collectors (i.e. volunteers) for clarification. Contact information for youth volunteers is maintained at the discretion of the Local RBV Coordinator in consultation with the youth volunteer's parent/legal guardian. The Local RBV Program Coordinator will discuss the participation of Youth RBV Volunteers with the State RBV Coordinator in advance of monitoring activities to develop a plan to insure that the quality of the monitoring activities is not compromised by the participation of such youth volunteers.

The Local RBV Coordinator is responsible for communicating directly with Field Team Leaders prior to monitoring activities to discuss monitoring location details, review safety, and insure the team has the necessary equipment to conduct monitoring. The Field Team Leader is also responsible for communicating (either verbally or by email) to the Local RBV Coordinator any quality control and/or safety concerns/challenges experienced by the team during monitoring, as soon as possible after the completion of monitoring to allow for prompt resolution. The Local RBV Coordinator is responsible for following up with the State RBV Coordinator at the conclusion of monitoring activities to discuss any variations from the RBV protocol and/or safety issues that may have arisen during the season.

The heart of the above communication pathway is between the State RBV Coordinator, the Local RBV Program Coordinator, the Certified Local RBV Trainer, and the Field Team Leaders. These individuals are collectively responsible for facilitating, organizing, and reporting all information related to volunteer training, station selection, data collection and submission, and data reporting. Communication flows up through the CT DEEP via the State RBV Coordinator and down to individual volunteer monitors via the Local RBV Coordinator, Certified Local RBV Trainer, and Field Team Leader.

A.5. Problem Definition/Background

A.5.a Problem Statement

Connecticut approximately 5,830 miles of rivers and streams throughout the State. The CT DEEP Bureau of Water Protection and Land Reuse (WPLR) Monitoring & Assessment Group is responsible for monitoring Connecticut's perennial streams and rivers. The Group's Ambient Biological Monitoring (ABM) Program collects chemical, physical and biological data to assess current surface water quality and long term trends. The ABM program characterizes water quality by evaluating the biological integrity of resident communities of aquatic organisms based upon community structure characteristics. Presently the ABM Program monitors three biological community types in freshwater, non-tidal wadeable stream segments: benthic macroinvertebrates, fish, and diatoms.

Despite a robust ambient surface water monitoring program, given the statewide stream mileage, it is not possible for DEEP to directly monitor all of Connecticut's rivers and streams in a given two-year assessment reporting cycle. DEEP therefore also considers external monitoring data, which, when collected with and according to established methods, can greatly increase the number of waterbodies and stream miles assessed by the State biennially.

The RBV protocol was first developed by CT DEEP in 1999. (This QAPP supersedes the CT DEEP program QAPP titled *Rapid Bioassessment in Wadeable Streams and Rivers by Citizen Volunteers*.) RBV was designed to provide volunteers with a relatively fast, low technology macroinvertebrate collection and identification method that can still concurrently generate data usable by CT DEEP for state and Federal water quality assessment purposes.

Since its introduction, the RBV program has been popular with volunteer water quality monitoring groups in Connecticut. An average of 20 groups, representing several hundred volunteers, participate annually. Collectively these volunteers monitor more than 100 RBV stations per year.

RBV is particularly well suited to address the shortage of water quality information available for smaller streams in Connecticut. Approximately 74% of all streams and rivers in Connecticut are small, headwater streams (i.e. 1st or 2nd order) (Figure A.5.a1). Evaluation of a recently developed macroinvertebrate-based CTDEEP-developed water quality model, the Connecticut Macroinvertebrate Multimetric Index model or CT MMI model (Bellucci et al 2013; Figure A.5.a2), predicts that the highest water quality in the State (green map area) is likely located in these relatively undeveloped, and, to-date, relatively unmonitored small watersheds.

Given the need for additional information on Connecticut's smaller stream segments and the ability of the RBV Program to identify high water quality, in 2012, the program was 're-branded' as CTDEEP's 'Treasure Hunt' for the State's healthiest streams and watersheds. Volunteers are directed to focus their monitoring efforts to small watersheds (i.e. catchment area is less than 15.0 square miles) and which are predicted by the CT MMI model to have high water quality; additional priority is given to waterbodies that have not previously been assessed by the State. It is anticipated that incorporating the mapping tool produced by the MMI model to identify smaller, high quality streams will not only lead to an increase in information regarding Connecticut's smaller streams and rivers, but that it will also lead to greater program efficiency by increasing the overall percent of program submissions that support a CTDEEP water quality assessment.

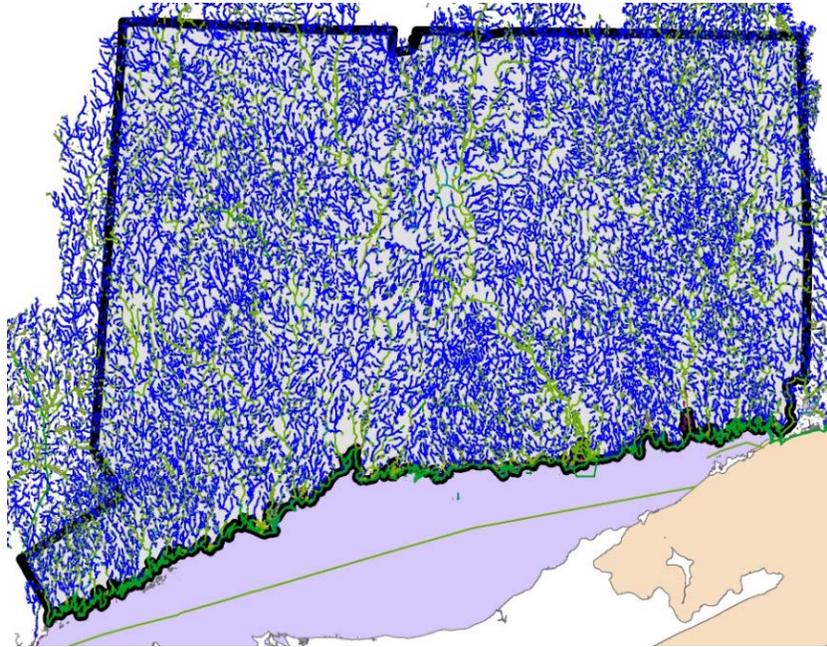


Figure A.5.a1. Connecticut has over 5,800 miles of streams and rivers. In the image above medium to large-sized rivers are shown in green; smaller headwater streams are depicted in blue.

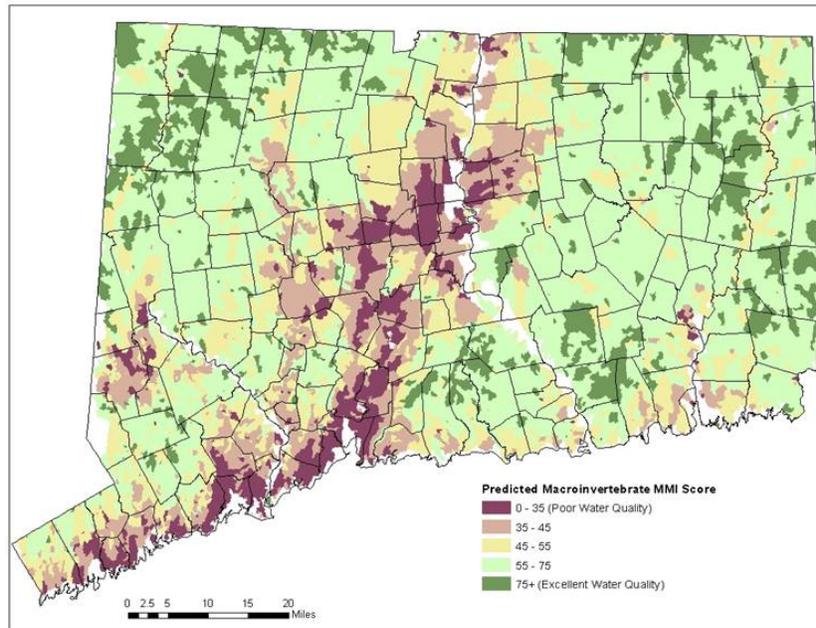


Figure A.5.a2. Predicted surface water quality in Connecticut. The highest water quality predictions (green) are often located in small, relatively undisturbed watersheds.

A.5.b Project Background Information

Benthic macroinvertebrates are macroscopic invertebrate animals inhabiting aquatic habitats. In freshwater, common forms include larval stages of aquatic insects (e.g. mayflies, stoneflies, caddisflies),

worms, snails, and crustaceans. Macroinvertebrates are found throughout the state’s streams and fulfill an important role in the aquatic food web. Macroinvertebrates have limited mobility and consequently cannot readily avoid exposure to pollutants. Therefore, changes in water quality conditions are reflected by commensurate changes in macroinvertebrate community structure. As a group, macroinvertebrates exhibit a relatively wide range of response to the effects of pollutants. Certain taxa in particular are extremely pollution intolerant, and can therefore serve as reliable biological indicators of good water quality conditions.

The primary objective of the RBV Program is to train volunteers to collect macroinvertebrate-based water quality information from freshwater, non-tidal wadeable stream segments in Connecticut to support water quality assessments. In particular, RBV seeks to train volunteers to collect macroinvertebrate data to document the presence of these pollution intolerant taxa and therefore confirm the presence of an excellent water quality (i.e. water quality conditions that are fully supporting aquatic life) in previously unassessed, small watersheds (<15.0 square miles). Secondary program objectives, include engaging citizen volunteers in the monitoring of their local water resources, and educating the public about water quality issues and CT DEEP’s role in monitoring and assessing Connecticut’s rivers and streams.

The RBV program was developed in 1999 by CT DEEP (then CT DEP). At that time DEEP assessed river and stream water quality conditions by comparing macroinvertebrate community monitoring results to one of ten high quality reference stations in Connecticut. Evaluation of the reference stations’ taxa lists resulted in the identification of 25 target groupings of macroinvertebrates (or RBV ‘types’; Table A.5.b1) that could be used to conduct a rapid screening of water quality in high gradient, riffle-based Connecticut streams. These 25 macroinvertebrate ‘types’ were further divided into the categories ‘most wanted,’ ‘moderately wanted,’ and ‘least wanted’ based upon their relative pollution tolerance.

Table A.5.b1. RBV Program Categories and Corresponding Taxa Groups or ‘Types’

Most Wanted (Most Pollution Intolerant)	Moderately Wanted (Moderately Intolerant)	Least Wanted (Least Intolerant)
Ephemerelellidae: <i>Drunella</i>	Heptageniidae: <i>Stenonema</i> *	Amphipoda (All families)
Isonychiidae; <i>Isonychia</i>	Philopotamidae; <i>Chimarra</i>	Asellidae
Heptageniidae: <i>Epeorus</i>	Psephenidae: <i>Psephenus</i>	Hirudinea (All families)
Peltoperlidae; <i>Peltoperla</i>	Corydalidae; <i>Nigronia</i> , <i>Corydalus</i>	Chironomidae
Perlidae	Odonata (All families)	Simuliidae
Pteronarcyidae: <i>Pteronarcys</i>	Hydropsychidae	Gastropoda (All families)
Misc. Stonefly**		Oligochaeta (All families)
Glossosomatidae: <i>Glossosoma</i>		
Apataniidae; <i>Apatania</i>		
Rhyacophilidae; <i>Ryacophila</i>		
Brachycentridae: <i>Brachycentrus</i>		
Lepidostomatidae; <i>Lepidostoma</i>		

*The genus *Stenonema* has been split into *Stenonema* and *Maccaffertium* since the program’s inception.

**The miscellaneous stonefly taxa grouping or RBV ‘type’ includes all other Plecoptera families not otherwise noted that occur in Connecticut, including *Capniidae*, *Leuctridae*, *Nemouridae*, *Taeniopterygidae*, *Chloroperlidae*, and *Perlodidae*.

RBV macroinvertebrate taxa groups or ‘types’, each have a distinct and well understood pollution tolerance, are easily recognizable by volunteers due to appearance or behavior, and have a statewide distribution. Typically volunteer identification to the family-level is required to place an organism into a taxa group. However, when a family is comprised of several genera of varying pollution sensitivity, the taxa category may be narrowed to represent only one genus, particularly to identify pollution intolerant taxa within the family. For example, the family Heptageniidae is represented under the ‘Most Wanted’

category by the genus *Epeorus* and under the ‘Moderately Wanted’ category by genus *Stenonema*. Certain taxa categories are represented at the order level, particularly in the “Least Wanted” category (e.g., Amphipoda), to reduce the RBV identification effort for these categories.

Further evaluation of data from the reference stations indicated that these stations, which were selected based on known excellent water quality conditions, all contained a minimum of four (4) ‘most wanted’ RBV taxa when sampled for macroinvertebrates (Table A.5.b2). The RBV ‘Four or More’ rule was therefore established; if volunteers could collect at least four RBV ‘most wanted’ taxa at a station, then the corresponding stream segment would be flagged for consideration as fully supporting aquatic life use attainment.

Table A.5.b2. Summary statistics for the 10 reference station community data collected from 1995-2000.

Statistic	Most Wanted	Moderately Wanted	Least Wanted
Maximum	9	7	4
75 th percentile	8	6	3
Median	7	6	2
Average	7	6	2
25 th percentile	5	5	1
Minimum	4	3	1

In 2008, CT DEEP transitioned to using a macroinvertebrate multi-metric index or MMI score (Gerritsen and Jessup, 2007) to help inform assessments of aquatic life support. To generate an MMI score for a monitoring station, a 200-organism subsample is collected from each station and identified to the lowest taxonomic levels possible. The subsample taxa list and corresponding organism counts are then used to compute a suite of macroinvertebrate-based water quality metrics. The MMI is a composite ‘final score’ index of these individual metrics. Stations with an MMI score of 48 or higher are eligible for listing as ‘fully supporting’ aquatic life use conditions (Gerritsen and Jessup, 2007; CT DEEP, 2014).

Analysis of Connecticut macroinvertebrate data collected by CTDEEP between 2000 and 2010 confirmed that the RBV ‘Four or More’ rule still holds true under the MMI assessment methodology (Figure A.5.b3) As shown in Figure A.5.b3, nearly all Monitoring and Assessment program benthic macroinvertebrate community samples collected between 2000-2010 that contained four or more ‘most wanted’ RBV types (99.4%; n=1145), had an MMI score above 48, and therefore would have been assessed as supporting aquatic life use based upon CTDEEP’s more extensive MMI assessment methodology.

It should be noted that, as seen in Figure A.5.b3, a small number of samples (n=7, <1%) analyzed from the 2000-2010 data set were likely assessed as not supporting aquatic life use due to an MMI score less than 48, despite containing four most wanted RBV types. These stations were large, urbanized, and/or impaired waterbodies, all of which would fail to meet the required RBV site criteria that RBV Coordinators must consider before selecting monitoring locations. Therefore, if volunteers follow the RBV protocols and attempt monitor only small high quality streams, there is a very minimal likelihood of them finding 4 ‘most wanted’ RBV types at a site that otherwise would not be considered fully supporting aquatic life use.

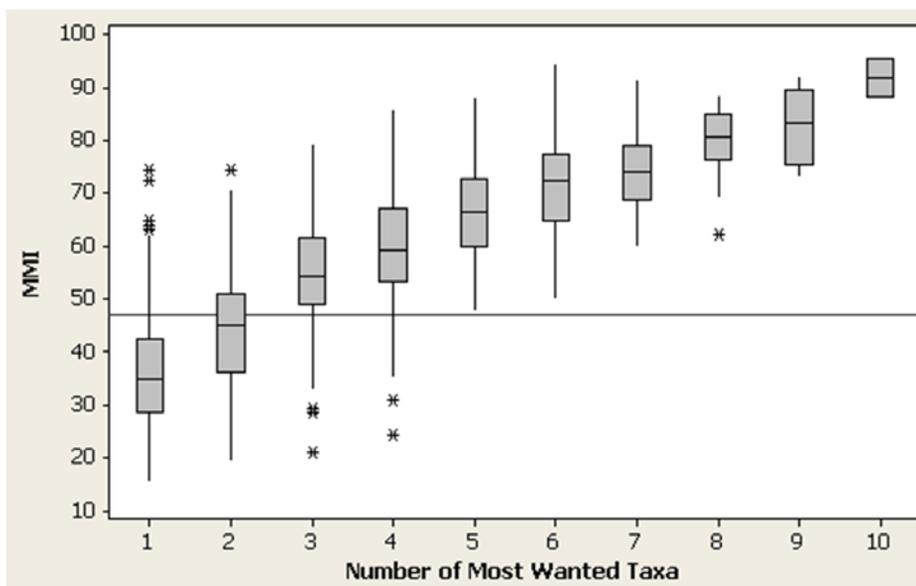


Figure A.5.b3. Comparison of MMI score and count of ‘most wanted’ RBV taxa present in Connecticut macroinvertebrate samples collected between 2000-2010 (n=1152). The horizontal line indicates an MMI score of 48, or a passing assessment for aquatic life use support.

Over the past fifteen years, RBV has developed into a reliable, easily accessible, volunteer-based water quality screening methodology for identification of Connecticut’s healthy waters (i.e. those waters with excellent water quality.) On average, the program helps to confirm aquatic life use support at 35 monitoring locations per IWQR reporting cycle, and this number continues to increase annually (Table A.5.b4). (Final listing in the Integrated Water Quality Report will be dependent upon review and evaluation of other available data for that monitoring station; stations will be listed as ‘fully supporting’ only when all lines of available evidence are in agreement with this assessment listing.)

Table A.5.b4. RBV data contribution to biennial water quality assessments published in the Connecticut Integrated Water Quality Report (IWQR).

	IWQR Reporting Cycle							
	2002	2004	2006	2008	2010	2012	2014	2016
<i>Data Collection Period</i>	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
# RBV Samples Submitted*	35	59	85	183	204	240	257	234
# Fall RBV Samples with 4+ ‘Most Wanted’ RBV Taxa	11	26	26	27	28	50	43	71
% Samples with 4+ ‘Most Wanted’ RBV Taxa	31.4%	44.1%	30.2%	14.8%	13.7%	20.8%	16.7%	30.3%

A.6. Project Description

A.6.a Summary of Work to be Performed and Products

The overall goal of the program is to collect volunteer-collected macroinvertebrate data in order to document the location of high quality, or ‘healthy’, stream segments in Connecticut.

Sampling will take place on high gradient, wadeable streams with an upstream catchment area smaller than 15.0 square miles. Monitoring stations must be characterized by sufficient riffle habitat to complete six kick-stops within a contiguous 100m stretch of stream. Stations are to be free from any obvious or known sources of impairment including but not limited to industrial discharges. Exceptions to these site requirements are made by the State RBV Coordinator to support large group training activities and participation of educational groups as needed; the data generated during these activities will be discussed with the Project Manager for usability at the conclusion of the season.

RBV sampling occurs each fall between September 1 and November 30, inclusive. Additional program training and reporting activities take place during August and December, respectively. Monitoring is conducted during periods of typical flow; periods of extreme low flow or extreme high flow are avoided due to data quality and safety concerns. Monitoring within 48 hours of heavy precipitation is avoided.

A.6.b Project Schedule

Table A.6.b1 provides a schedule of the project activities for a typical RBV year.

Table A.6.b1. Project Schedule

	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Local Program Planning Meetings												
Training Activities												
Sampling/Monitoring												
Training Records & Data Submission												
Data Entry & Validation												
Data Evaluation												
Data Reporting												

A.7. Project Quality Objectives and Criteria for Measurement Data

A.7.a Project Quality Objectives

The primary Project Quality Objective for this project is to collect sufficient and accurate macroinvertebrate data to document the locations of high quality stream segments in Connecticut. This information will be used to support biennial water quality assessments for Section 305(b) reporting in the Integrated Water Quality Report.

Following the standard procedures (Appendix A), trained RBV volunteers monitor assigned RBV stations in the fall (September 1-November 30, inclusive). The final product from each station monitored is a set of field/station condition photographs, a completed data sheet (Appendix B), and a representative voucher collection of organisms observed during monitoring. The entire monitoring procedure occurs at the stream station and can be completed by an RBV volunteer field team within 2-4 hours.

A.7.b Measurement Performance Criteria

A.7.b(i) Data Precision, Bias, and Accuracy

Accuracy is insured in the field by adequately training all RBV program participants, and by strict adherence to data and sample collection and documentation protocols.

Standard volunteer training (Appendix C) is conducted prior to each monitoring season to insure volunteer proficiency in and compliance with RBV protocols. Monitoring station requirements, ideal habitat selection, and collection technique are reviewed and practiced to insure collection from an adequate quantity and type of habitat. Individual macroinvertebrate variation is discussed to insure consistency of sorting and identification efforts. Reference collections and identification support materials (Appendix D, Appendix E) are provided to minimize bias towards selection of larger, more active, or more colorful organisms.

If an organism is present in the voucher it is considered evidence that that taxa was present at the RBV monitoring station on the date of monitoring. To account for misidentifications by volunteers, volunteers place 2-3 organisms of each macroinvertebrate type present at the monitoring station into the voucher container; this increases the likelihood of placing at least one correctly identified representative of each type present in the sample into the voucher container. All voucher contents and taxonomic identifications are verified by CT DEEP staff (Appendix F) at the conclusion of the monitoring season.

Ten percent of all vouchers submitted annually will be reviewed by a taxonomic quality control officer (Appendix F). The results will be compiled by the Project Manager and remedial action taken as necessary to insure the quality of program results.

Program collection and sorting equipment is thoroughly rinsed after each station, to prevent cross-contamination between stations. Precautions are also taken to prevent contamination of samples during collection and transport. Between monitoring events, equipment is washed, disinfected, and dried.

A.7.b(ii) Data Representativeness and Comparability

Standardization of sampling across stations is accomplished through pre-season program planning meetings and volunteer training. All data are collected between September 1 and November 30, inclusive. Volunteers avoid monitoring during extreme flows or within 48 hours of heavy precipitation.

RBV monitoring stations are limited to riffle habitat within high gradient, wadeable, small streams (i.e. <15.0 square mile catchment) in Connecticut that are believed to be characterized by high water quality. Local RBV Coordinators are required to discuss new monitoring stations with the State RBV Coordinator in advance of monitoring; field visits to review suitability of proposed sites are scheduled as needed. At each station, volunteers collect macroinvertebrates from a standard 1m² area within a 100m reach. Sample collection time is also standardized; rocks are first scrubbed by hand for a maximum of two minutes, and then the substrate is disturbed using the volunteer's foot (i.e. 'kicked') for one minute. The use of brushes, scrapers, or other equipment not otherwise described in the program protocols is prohibited to insure consistent collection methods between stations and participating organizations. Data collected in this fashion provide documentation of organisms present at a station at the date and time of collection, and allows for comparability between sites.

At the conclusion of the monitoring season, site photographs are reviewed to insure collection occurred at suitable locations and under suitable flow conditions. The results of the station are compared to the CT DEEP MMI model predictions, observed station conditions in the photograph and existing water quality information from that station, if available. The results of the review are shared with the Local RBV Coordinator and possible program improvements discussed.

A.7.b(iii) Data Completeness

The goal of the program is to have a vial of voucher organisms submitted for 100% of stations monitored. A site without a vial of voucher specimens is not used by CT DEEP since there is no record of taxa present and therefore no evaluation of the health of the site can be determined.

The State RBV Coordinator will track program progress by evaluating 1) the *total number* of ‘four or more’ RBV vouchers submitted annually to the State, and 2) the *percentage* of annual RBV vouchers that contain four or more ‘most wanted’ types. The annual target for samples containing four or more ‘Most Wanted’ types is 40% or greater.

A.8. Special Training Needs/Certification

A.8.a Training & Certification Requirements

A.8.a(i) State RBV Coordinator Training

To insure voucher review and organism identification quality control, the State RBV Coordinator will complete a pre-review taxonomic identification exam administered by the QA Officer. The exam shall consist of the identification of a randomly selected set of macroinvertebrates, which shall include, but will not be limited to, the ‘most wanted’ RBV taxa. In addition, the State RBV Coordinator will attend regional taxonomic identification workshops as such opportunities arise. The Project Manager will maintain the records for all such trainings.

A.8.a(ii) Certified Local RBV Trainer Training

Individuals interested in becoming a new Certified Local RBV Trainer must successfully complete a DEEP *RBV Train-the-Trainer Workshop* followed by successful completion of a mentorship period.

Workshops are held during the summer and led by the State RBV Coordinator. During the classroom portion of the workshop, participants are provided with an in-depth overview of the program and its development, a review of the program protocol with emphasis on data collection and documentation quality control, safety review, guidance on how to organize a training event, and training evaluation and documentation requirements. During the field-based portion of the workshop, participants will complete a full monitoring event. Successful completion of the workshop includes 100% participation in all classroom and field based activities. To obtain certification, participants must complete a subsequent probationary training and review period (i.e. mentorship period) during the following monitoring season.

During the mentorship period the participant will successfully organize and lead at least one complete training and monitoring event for volunteers. At the conclusion of the mentorship period, the probationary trainer will have successfully demonstrated proficiency with the RBV protocols, the ability to organize and carry out both the classroom and field-based portions of the RBV volunteer training, and successful participant evaluation and training documentation. The State RBV Coordinator will therefore certify the probationary trainer to serve as a Certified Local RBV Trainer, allowing the Trainer to carry out training events for an additional 4-year period. At the conclusion of 4-year period, the Trainer is responsible for completing a recertification review and field audit under the supervision of the State RBV Coordinator.

To retain certification, Certified Local RBV Trainers are required to participate in a recertification review and field audit at least once every five years after initial certification. During the review and audit the State RBV Coordinator will observe the Trainer lead at least one classroom-based training and one field-based training for volunteers. The State RBV Coordinator and the Certified Local RBV Trainer will discuss any quality control concerns that were documented during the review and develop an action plan to remedy any such concerns during future training events. Certified Local RBV Trainers that fail to adhere to multiple aspects of the program protocols during the audit will be required to attend an RBV Trainer refresher workshop at the discretion of the State RBV Coordinator.

The State RBV Coordinator will retain a list of all former and currently certified Local RBV Trainers, including a record of all previous training dates. The list of currently certified trainers will be posted on the RBV webpage (www.ct.gov/deep/rbv).

A.8.a(iii) Volunteer Training

All RBV volunteers (i.e. new, returning and youth) are required to attend annual training prior to participating in the current year's monitoring activities. Training is directed by State RBV Coordinator or a currently Certified Local RBV Trainer. Training is based upon the methodology outlined in the most current version of CT DEEP RBV training manual (and associated training materials) and the most current program QAPP.

New and youth volunteers must complete both classroom and field-based training activities. During classroom training volunteers are provided with program background and overview information, including a review of the program objectives, field safety, and monitoring protocols via standardized Microsoft PowerPoint presentations (Appendix C). During the field-based training, volunteers travel to a nearby RBV monitoring station to complete the RBV protocol under the supervision of the trainer. Successful completion of annual training for new and youth RBV volunteers is measured as 100% classroom attendance and demonstration in the field of the ability to implement the RBV protocol (i.e. sample collection, sorting, identification, voucher preparation, and documentation.)

All experienced volunteers must complete, at a minimum, annual field-based training under the supervision of a Certified Local RBV Trainer. Experienced RBV Volunteers may be allowed, at the discretion of the Local RBV Trainer, to review classroom presentation materials remotely (e.g. online/electronically) in lieu of classroom training. Successful completion of annual training for Experienced RBV Volunteers is measured as either 100% classroom attendance or remote review of classroom materials with electronic confirmation, along with field demonstration of the ability to implement the RBV protocol (i.e. sample collection, sorting, identification, voucher preparation, and documentation.)

A.8.b Training Scheduling and Documentation

Trainings described in Section A.8.a are scheduled and documented as described in Table A.8.b1.

All adult volunteers are required to sign-in to training events. The Certified Local RBV Trainer is responsible for maintaining a training record (Appendix G) for each training event. The training record includes the training date, training location, host organization, name of certified trainer conducting the training, and adult attendee/volunteer first and last name. Any experienced volunteers allowed an exception to the classroom portion of training must submit electronic confirmation of program material review to the Local RBV Trainer. The Trainer is responsible for submitting these volunteer training event records to the Local RBV Coordinator at the conclusion of each training event.

At the conclusion of the RBV season, the Local RBV Coordinator is responsible for compiling event training records, reviewing them for completeness and accuracy, and submitting to the State RBV Coordinator. The State RBV Coordinator will retain a list of all currently certified Local RBV Trainers, including a record of all training and recertification dates.

Table A.8.b1. RBV Program training frequency, function and documentation overview.

Trainee(s)	Course or Description	Trainer	Training Frequency	Training Date	Project Function	Records Maintenance
State RBV Coordinator	Taxonomic Identification Test	Senior QC Officer	Annually	Prior to Voucher Review	Voucher identification quality assurance	Project Manager maintains records
New Local RBV Trainers	‘Train the Trainer’ Certified RBV Trainer Workshop	State RBV Coordinator	One-time initial training followed by mentorship period	Summer Year 1 through Fall Year 2	Volunteer training quality assurance	State RBV Coordinator maintains records
Certified Local RBV Trainers	Recertification Review and Field Audit	State RBV Coordinator	3 years after initial certification; every 5 years thereafter	Fall	Volunteer training quality control	
All RBV Volunteers	RBV Volunteer Training	State RBV Coordinator OR Certified Local RBV Trainer	Annually	Summer/Fall ; Prior to sampling	Station documentation and data collection quality assurance	

A.9. Documentation and Records

A.9.a QAPP Distribution and Maintenance

The State RBV Coordinator is responsible for ensuring the distribution of this QAPP to all individuals identified on the distribution list. All distribution list members will receive an electronic version (i.e. PDF format) of the QAPP. In addition to the distribution list, the QAPP will be sent electronically to all Certified Local RBV Trainers and all Local RBV Program Coordinators.

The QAPP, as well program training and field materials (e.g. standard operating procedures), will be made publicly available in electronic PDF format on the RBV Program webpage (www.ct.gov/deep/rbv). Hard copy versions of the QAPP will be produced and distributed upon request.

The State RBV Coordinator is responsible for maintaining and updating the QAPP. QAPP changes can be requested by any participating project member; however any all changes to the QAPP must be approved by the Project QAQC Lead and the Project Manager. The State RBV Coordinator will discuss any QAPP deviations, and subsequent data usability concerns, with the Project Manager.

Decisions regarding real-time changes to volunteer training will be made at the time of training by the State RBV Coordinator or the Certified Local RBV Trainer. If such changes are necessary they are to be made in such a manner as to not jeopardize the quality or completeness of volunteer training. If a change is made, the change will be documented on the training record by the Certified Local RBV Trainer.

Any decisions regarding real-time changes to sampling effort or location (i.e. monitoring) will be made in the field by the Field Team Leader. If such changes are necessary they are to be made in such a manner as to not jeopardize the validity and comparability of the macroinvertebrate community data. If a change is made, the change will be documented by the Field Team Leader and communicated to the Local RBV Program Coordinator as soon as possible after sampling. Before the conclusion of the RBV season, the Local RBV Program Coordinator will submit documentation of any such deviations from the project QAPP, including the date of the deviation, the nature of the deviation, and any follow-up or corrective action(s) taken to the State RBV Program Coordinator.

A.9.b Field Data Report Package

Each Local RBV Program Coordinator will submit a field data report package to the State RBV Coordinator at the conclusion of the RBV season and no later than December 15th. The field data report package will include sampling collection records (e.g. RBV field data sheets, digital site condition photographs) and a preserved macroinvertebrate voucher for each site monitored by the local RBV Program.

All vouchers must be hand-delivered to the State RBV Coordinator as postal service regulations prohibit the routine mailing of flammables such as isopropyl and ethanol alcohol. Original hard copy datasheets are to be relinquished with vouchers. Photographs are to be labelled with date and monitoring location information and submitted in digital format either by e-mail or on a portable drive.

In addition, the package will include original hard copies of volunteer training records and documentation of any QAPP deviation(s) as described in Section A.8 and Section A.9.a.

A.9.c Laboratory Data Package

RBV vouchers submitted by volunteers are reviewed by the State RBV Coordinator using a compound dissecting microscope at the DEEP Water Lab in Windsor, CT. For each voucher reviewed, the State RBV Coordinator completes a Voucher Review Bench sheet (Appendix F). The bench sheet documents the contents of the voucher and serves as the final record of taxa observed at the RBV monitoring location on the given monitoring date. RBV voucher review bench sheet documentation includes the date of review, reviewer initials, official station information (i.e. assigned AWQ station description information), collection information (date and responsible organization), and the results of the review, including a list of taxa identified by the Coordinator in the voucher and a final tally of the number of 'Most Wanted' RBV organism types present in the voucher.

Upon completion of review, voucher contents are placed into a glass vial, preserved with 70% ethyl alcohol, labelled with a printed DEEP RBV voucher label (Appendix H) to include the name of the organization responsible for collection, the date of collection, assigned AWQ station ID, and corresponding AWQ station information (waterbody name, station location description, station municipality, latitude and longitude), and sealed with a rubber stopper. Original volunteer voucher labels and volunteer field datasheets are affixed to the corresponding voucher review bench sheet.

A.9.d Annual Report

Program results (i.e. stations and corresponding taxa lists) and a participation summary are compiled by the State RBV Coordinator into an annual program report. The annual program report is finalized and distributed electronically to all Local RBV Program Coordinators, Certified Local RBV Trainers, and CT DEEP WPLR Planning & Standards Division staff by March 31 annually. The report is posted online (www.ct.gov/deep/rbv) for public viewing and download as soon as possible thereafter.

If a station is characterized by four or more ‘most wanted’ RBV taxa, the corresponding stream segment will be flagged for consideration for a ‘fully supporting’ aquatic life use water quality assessment during the next Integrated Water Quality Reporting (IWQR) cycle. Assessment decisions made using RBV program data are reported in the IWQR to Congress, according to the following schedule:

RBV Data Collection Year:	IWQR Reporting Year
2016	2018
2017	2020
2018	2020
2019	2022
2020	2022

Upon approval by U.S. EPA, IWQRs are made publicly available online (www.ct.gov/deep/iwqr).

A.9.e Document and Record Storage and Retention

Training records are stored by the State RBV Coordinator at DEEP Headquarters in Hartford, CT.

Original hard copy volunteer field datasheets, along with any corresponding documentation of QAPP deviations, are stapled to the corresponding voucher review bench sheet and stored, organized by monitoring year, by the State RBV Coordinator at DEEP Headquarters in Hartford, CT for a period of at least 7 years.

Digital site condition photographs are renamed to include the collection date, collecting organization, and the Ambient Water Quality Exchange (AWQ) database station identification number to which the RBV monitoring station was assigned. These digital files are stored indefinitely in electronic .jpg format in the ‘RBV Program’ folder on the CT DEEP Monitoring and Assessment Group network drive (e.g. “M: Drive”).

Preserved and officially labelled RBV vouchers are maintained by the State RBV Coordinator and stored at the DEEP Water Lab in Windsor, CT or other appropriate long-term laboratory collection facility.

Electronic copies of annual program reports are stored indefinitely in the ‘RBV Program’ folder on the CT DEEP Monitoring and Assessment Group network drive (e.g. “M: Drive”).

GROUP B. DATA GENERATION AND ACQUISITION

B.1. Sampling Process Design

The RBV Program is intended to serve as a volunteer-based screening protocol to identify high quality or ‘healthy’ stream segments in Connecticut. The sample collection design is such that a representative macroinvertebrate voucher will be collected by trained volunteers at suitable stream and river locations and submitted to the CTDEEP for evaluation, in order to confirm the location of stream/river segments that are fully supporting the aquatic life use criteria as determined by the State’s listing methodology. The RBV program is used only to confirm the presence of high quality waters; RBV data is not used to establish evidence of impairment, to compare water quality between monitoring locations, nor to track incremental changes in water quality over time. Samples will not be collected from stream segments listed on the 303(d) list of impaired waters or from any water body otherwise known or believed to be

characterized by insufficient habitat or poor water quality conditions. The exact location of the sample will be determined in the field by the Field Team Leader.

Samples will be collected during the fall monitoring period to coincide with the index period for CT DEEP's ambient water quality monitoring program. To minimize the impacts of extreme flow events, volunteers will sample during periods of 'normal' flow (i.e. 25-75th percentile), avoid sampling within 48 hours of heavy precipitation, and collect samples from locations in the stream that are most likely to have remained wetted throughout the year (i.e. avoid edges, sand/gravel bars, etc.).

B.2. Sampling Methods

B.2.a Sample/Data Collection Procedures

Samples will be collected according to RBV field protocols (Appendix A).

Preliminary data collection activities involve documentation of the monitoring station, a GPS coordinates, taking station condition photographs, and completing the station description information on the RBV Field Datasheet (Appendix B). Datasheets should be complete and contain the following information: stream name, station location description and town, station latitude and longitude, collection date, full name (i.e. first and last) of all adult volunteers/collectors, and the organization responsible for the volunteers. Station photographs should be clear and include as much of the stream reach sampled and surrounding riparian conditions as possible. (Photographs document field conditions at the time of monitoring, provide evidence that monitoring occurred in suitable habitat conditions, and document the exact location of the monitoring station.)

In-stream sampling activities involve the use of a rectangular frame kick net to collect aquatic macroinvertebrates from six kick-stop riffle locations, totaling approximately 1 square meter of substrate from the monitoring reach. All kick nets must have an 18" x 9" net opening/frame, and an attached 10" deep net with 500 micron mesh size.

The start of the sampling reach is determined by the Field Team Leader based upon best available habitat and flow conditions within the intended monitoring station (i.e. stream reach). Working upstream, volunteers conduct a series of six kick stops. At each kick stop, the net is placed firmly against the substrate with the opening facing upstream and perpendicular to the current. Volunteers first identify all cobble size substrate (approximately tennis ball sized or larger) located within the 18 in x 14 in. 'sampling zone' in front of the net. This cobble sized substrate is placed inside the net and hand scrubbed to dislodge any attached organisms; once scrubbed cobble sized rocks are placed to the side outside of the sampling zone. Next, the volunteer stands adjacent to the net, so as not to block stream flow into the net, and uses the heel of their foot to vigorously 'kick' the sampling zone for 1 minute. Upon completion of the 'kick', the net is carefully removed from the stream so as not to lose any portion of the sample, and then the process is repeated at a second kick stop location. The contents of the two kick stops are carried to the stream bank and emptied into a sorting tray. This entire process is repeated two more times, with the contents of kicks three and four emptied into a second sorting tray, and the contents of kicks five and six emptied into a third sorting tray.

Each tray is sorted streamside by volunteers placing the net contents into sorting trays using forceps and plastic spoons. Sorting entails volunteers reviewing each tray, and removing any organisms observed. Removed organisms are grouped by similar appearance into an ice cube tray. Sorting is continued until volunteers are unable to identify any additional 'types' of organisms in the sub-sample. Once sorting is complete, volunteers use the RBV Sorting Guide (Appendix D), RBV Field Identification Cards (Appendix E), and the RBV reference collection to identify the organisms. (The identification level

required varies from genus to order level. Accurate volunteer identifications are not required however, as official taxa identifications are made by CT DEEP staff based upon the content of the voucher vial; see below.). Each macroinvertebrate ‘type’ found is marked off by the volunteer on the RBV datasheet (Appendix B).

After sorting and identification are complete, the Field Team Leader oversees the preservation of representative specimens of each macroinvertebrate type identified in the sample (i.e. a ‘voucher’) for taxonomic verification by DEEP staff. (The preserved voucher serves as evidence of the presence of a given RBV organism at the monitoring station at the time of volunteer monitoring.) Vouchers contain 2-3 representative organisms of each type of macroinvertebrate observed in the sample. Suitable voucher containers include smooth-sided, clear, plastic or glass containers with sealable lid. A label (Appendix H) containing the station identification number, stream name and location description, date, last name of sampler, information is completed in pencil and placed inside the voucher container. The container is then preserved by filling with isopropyl or ethyl alcohol, and sealed for storage and eventual transport (along with station photographs and field datasheet) to CTDEEP. (Volunteers are required to complete field data package materials, including the datasheet and voucher label, in pencil as the voucher preservative will dissolve the ink of most standard pens and markers.) Remaining organisms in the sample are returned to the stream. (If present, crayfish and freshwater mussels are not preserved but rather are photographed, noted on the field datasheet, and then released.)

B.2.b Sample/Data Collection Equipment

The equipment required to monitor one station using the RBV method is listed in Appendix I.

B.3. Sample Handling & Custody

At the conclusion of the monitoring event, the Field Team Leader is responsible for compiling and submitting the field data package to the Local RBV Coordinator. It is the responsibility of the Local RBV Coordinator to review these materials for completeness and accuracy, and to follow up with the Field Team Leader to resolve any inconsistencies or omissions prior to submitting these materials to the State RBV Coordinator as outlined in Section A.9.b.

The State RBV Coordinator logs each sample into the RBV Program Microsoft Access database upon receipt. During voucher logging, the monitoring station is assigned to an official station in the CT DEEP Ambient Water Quality database. Any station information discrepancies identified during voucher log entry are immediately discussed with the Local RBV Program Coordinator. Once assigned, the CT DEEP station ID number is recorded on the voucher container and the field datasheet. Station photographs are labeled with the CTDEEP station ID, stream name, and collection date, and stored electronically within an RBV Program folder on the CT DEEP network.

All vouchers and corresponding datasheets are stored at the CT DEEP Windsor laboratory until reviewed by CT DEEP staff. Upon review vouchers are preserved for indefinite long-term storage at the CT DEEP Windsor laboratory or other appropriate facility (e.g. Yale Peabody Museum). Datasheets and corresponding field bench sheets are stored at least 7 years at 79 Elm Street, Hartford, CT.

B.4. Analytical Methods

There are no field analytical tests performed, other than sample collection as described in Section B.2.

Laboratory analytical methods are limited to identification of voucher collection contents. The State RBV Coordinator reviews and identifies the contents of the RBV voucher collections submitted by Local

RBV Programs. Voucher contents are emptied into a Petri dish and examined using a dissecting microscope, light source, and taxonomic key to the lowest taxonomic level necessary to confirm the presence or absence of each of the 26 RBV organisms. Additional macroinvertebrate organisms present but not listed on the RBV datasheet (i.e. not one of the 26 RBV organisms) are identified to the family level. Upon completion of the voucher review, observed taxa are entered into the RBV database along with the corresponding station and collection information. Pupating macroinvertebrates are not identified but recorded as “unidentified pupa” in the database entry. Damaged organisms are identified to the lowest taxonomic level possible (e.g. if family-level identification is not possible).

A macroinvertebrate reference collection is maintained at the Water Lab and utilized by the State RBV Coordinator as needed to confirm identifications. Additional taxonomic identification support is provided by the QA Officer as needed/requested by the State RBV Coordinator. All identified organisms (e.g. vouchers) are preserved for long-term storage to allow for later re-identification as needed or requested.

B.5. Quality Control

The RBV Program is intended to serve as a screening program for high quality waters in Connecticut. Statistical analysis of CT DEEP ambient monitoring data has demonstrated that the presence of four or more pollution intolerant taxa (e.g. ‘Most Wanted’ RBV taxa) is reliable evidence that that stream segment support the aquatic life use criteria of Connecticut’s water quality standards based upon the health of the macroinvertebrate community at that location (Section A.5).

The possibility of a ‘false positive’ result, or a stream incorrectly being assessed as supporting aquatic life use based on RBV data, is minimal. False positive results are likely to occur only in the event of human error, in particularly if a volunteer were to incorrectly label a sample as being from a stream segment other than the one from which it was collected. Digital photographs help to verify site location within a stream. It is assumed that RBV volunteers have no incentive to intentionally mislabel or otherwise tamper with samples, therefore the quality assurance program is focused on protecting against accidental mislabeling of samples through volunteer training and oversight and quality controls are focused on the identification of any such mislabeling after samples have been submitted.

Misidentification of the voucher contents by the State RBV Coordinator could also result in a false positive result. Effort is made to minimize such error by requiring program staff to participate in annual training and through implementation of an internal voucher identification QC review.

Given the significant potential for volunteer taxa identification error that could result in a fewer from a monitoring location than actually were present at the station at the time of sampling, low numbers of ‘Most Wanted’ taxa in a voucher are not considered reliable evidence of water quality degradation or impairment. If a voucher contains fewer than four ‘Most Wanted’ taxa, no assessment is made regarding the water quality at the monitoring station; the potential for a ‘false negative’ result is therefore eliminated.

B.5.a Field Activity Quality Control

Quality assurance programs are directed towards protecting against accidental mislabeling of samples through volunteer training and field oversight of new volunteers. New volunteers are required to participate during their first monitoring season under the supervision of an experienced volunteer, Local RBV Program Coordinator or Certified Trainer, or the State RBV Coordinator. In addition, the most experienced member of the field crew, the Field Crew Lead, and is responsible for the completion of the field data sheet and voucher container, thereby maximizing the likelihood of complete and accurate documentation. Upon receipt of volunteer sample materials, quality controls focus on the identification of

potential mislabeling of samples by comparing volunteer's written station descriptions to station photographs and locational information provided. Any discrepancies in these three pieces of information (i.e. volunteer written location description, site photographs, GPS coordinates) are discussed and resolved with the assistance of the Local RBV Coordinator and Field Crew Lead prior to processing the voucher.

As noted above, volunteers are not expected to have the training or expertise of a trained, experienced professional, particularly with regard to macroinvertebrate taxonomy; volunteer error, particularly during sorting and identification, is expected and for this reason RBV data is used only as 'proof positive' of high water quality.

B.5.b Laboratory Activity Quality Control

The State RBV Coordinator is the primary staff person responsible for reviewing and identifying the contents of submitted RBV voucher collections. The State RBV Coordinator utilizes taxonomic keys to identify each organism present in the voucher collection. The laboratory reference collection is used to confirm identifications of rare organisms. Additional identification support is provided by the QA Officers upon request.

The State RBV Coordinator has completed training led by a certified taxonomist to become proficient in the identification of macroinvertebrates to the family level. Prior to the initiation of each RBV season's voucher collection review by the State RBV Coordinator, the State RBV Coordinator will complete a pre-review taxonomic identification exam administered by the QA Officer. The exam shall consist of the identification (to family level) of a randomly selected set of macroinvertebrates, which shall include, but will not be limited to, the 'most wanted' RBV taxa. Any misidentifications will be remediated through training by the QA Officer.

At the conclusion of the RBV season's voucher collection review by the State RBV Coordinator, ten percent (10%) of the voucher collections will be randomly selected by the QA Officer for a blind second review. The QA Officer will conduct a second review of the contents of each voucher without knowledge of the initial identification results by the State RBV Coordinator. (The result of this second review is compared to the State RBV Coordinator's identifications. Any inaccuracies identified will be corrected in the RBV database, and reviewed with the State RBV Coordinator; remedial training will be provided by the QA Officer as needed to prevent future misidentifications. If there is less than 80% agreement between the two reviews, an additional 10% of the annual vouchers will be selected for a second review. If there is less than 80% agreement between the second blind review and the initial State RBV Coordinator's identifications, the QA Officer will review all RBV vouchers submitted during that RBV season and remedial training to correct the State RBV Coordinator's taxonomic identifications will be implemented. The results of this internal voucher identification QC check are compiled by the Project Manager and stored with the RBV Field Data Sheets at CT DEEP's 79 Elm Street, Hartford, CT office.

B.6. Instrument/Equipment Testing, Inspection & Maintenance

The State RBV Coordinator is responsible for inspection, maintenance, cleaning and storage of all CTDEEP loan equipment. Local RBV Coordinators are responsible for the inspection, maintenance, cleaning and storage of equipment owned by their programs.

The only field equipment requiring testing, inspection, and maintenance are the GPS unit and the digital camera used to record station location and condition at the time of sampling. These equipment should be tested, inspected and maintained according to their individual manufacturer's specifications. Battery level should be checked in each prior to monitoring.

To avoid material loss during collection, the kick net must free of holes, rips, and tears. Voucher containers must be free of cracks, ill-fitting lids, and other obvious defects before use and will be discarded if defects are found to be present. Additional macroinvertebrate sampling equipment (e.g., sieve, sorting trays, forceps, spoons, identification materials) are checked for completeness and cleanliness prior to sampling by the equipment owner (CT DEEP or the Local RBV Program). All defective equipment must be repaired or replaced prior to monitoring.

All equipment is inspected and thoroughly rinsed with stream water following sampling. To avoid transfer of aquatic invasive organisms and pathogens, volunteers are instructed to return sample material to and rinse equipment in only the stream segment from which the sample was collected. Thorough equipment cleaning occurs with a scrub brush and hot soapy water between sampling events and prior to storing the gear.

Table B.6.1. Maintenance of Sampling Equipment

Equipment	Maintenance Activity	Maintenance Frequency	Person Responsible
Kick Nets	Repair holes/tears; replace irreparable net heads and handles	At the conclusion of each monitoring season; recheck prior to each monitoring season	<p>State RBV Program Coordinator w/ assistance from Equipment and Supply Coordinator*</p> <p>(*If equipment is owned by volunteer group, Local RBV Program Coordinator is responsible)</p>
Digital Camera	Remove and replace batteries	Battery removal at conclusion of monitoring season; Battery replacement prior to start of monitoring season	
GPS Unit	Remove and replace batteries	Battery removal at conclusion of monitoring season; Battery replacement prior to start of monitoring season	
Stop Watch	Check battery level and operation	Prior to each monitoring event	
RBV Reference Collections	Refill preservative; replace missing/damaged specimens	At the conclusion of each monitoring season; recheck prior to each monitoring season	
Sorting Trays	Clean and decontaminate for storage; replace missing/broken units	At the conclusion of each monitoring season; recheck prior to each monitoring season	<p>State RBV Program Coordinator w/ assistance from Equipment and Supply Coordinator*</p> <p>(*If equipment is owned by volunteer group, Local RBV Program Coordinator is responsible)</p>
Ice Cube Trays	Clean and decontaminate for storage; replace missing/broken units	At the conclusion of each monitoring season; recheck prior to each monitoring season	
Sorting Tools (forceps, spoons)	Clean and decontaminate for storage; replace missing/broken units	At the conclusion of each monitoring season; recheck prior to each monitoring season	
Hand Lens	Clean and decontaminate for storage; replace missing/broken units	At the conclusion of each monitoring season; recheck prior to each monitoring season	
Sieve - Size #30	Clean and decontaminate for storage; replace missing/broken units	At the conclusion of each monitoring season; recheck prior to each monitoring season	
RBV Kit Bag	Repair tears; wash and dry for storage	At the conclusion of each monitoring season; recheck prior to each monitoring season	
Laminated Field ID Cards	Replace damaged/missing materials	Prior to start of monitoring season	
Laminated Sorting Guide	Replace damaged/missing materials	Prior to start of monitoring season	

Laminated Field Instructions	Update with SOP changes; Replace damaged/missing materials	Upon announcement of SOP change; Prior to start of monitoring season	
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B.7. Instrument/Equipment Calibration & Frequency

There is no equipment in need of calibration for macroinvertebrate collection.

B.8. Inspection/Acceptance of Supplies and Consumables

Program supplies and consumables include pencils, field datasheets, voucher containers, voucher labels, and voucher preservative. It is the responsibility of the Local RBV Program Coordinator to obtain all program supplies and consumables prior to monitoring activities. (Field datasheets and voucher labels can be downloaded from the RBV webpage for printing.) At least one pencil, datasheet, voucher container and voucher label must be present and in usable condition prior to the start of the sampling event. Voucher containers must be clean and undamaged; lids must be able to be securely attached at the conclusion of the monitoring event. Adequate preservation material (isopropyl or ethyl alcohol) to completely fill the voucher container must be present at the monitoring station.

The Local RBV Program Coordinator will inspect all supplies and consumables prior to distribution to monitoring field teams; any missing or damaged supplies and consumables will be replaced by the Local RBV Coordinator. Field Team Leaders will inspect all supplies and consumables prior to monitoring; any missing or damaged supplies and consumables will be reported to the Local RBV Program Coordinator and monitoring ceased until a replacement or approved substitute can be obtained.

B.9. Non-direct Measurements

No data are obtained from existing data sources nor are data otherwise not directly measured or generated in this project.

B.10. Data Management

Upon completion of each macroinvertebrate voucher review, the State RBV Coordinator enters the data (e.g. the identified voucher contents) into the RBV Database along with the corresponding station and collection information. The CT DEEP RBV Program Database is an Access database stored on the CT DEEP computer network. The data are neither transformed nor reduced. Raw data can be retrieved upon request by the State RBV Coordinator. These program data are compiled into an annual program report, which are posted electronically to the RBV webpage (www.ct.gov/deep/rbv) for a period of three years. Electronic copies of the reports are stored indefinitely in the ‘RBV Program’ folder on the CT DEEP Monitoring and Assessment Group network drive (i.e. “M Drive”) and can be retrieved upon request by the State RBV Coordinator. Preserved RBV vouchers are maintained by the State RBV Coordinator and stored indefinitely at the DEEP Water Lab in Windsor, CT until they can be transferred to an approved long-term storage facility (e.g. Yale Peabody Museum); these RBV vouchers can be retrieved and reevaluated as necessary if there are concerns or questions relating to the data in the RBV Database.

Digital site condition photographs are renamed by the State RBV Coordinator to include the collection date, collecting organization, and the Ambient Water Quality Exchange (AWQ) database station identification number to which the RBV monitoring station was assigned. These digital files are stored

indefinitely in electronic .jpg format in the 'RBV Program' folder on the CT DEEP Monitoring and Assessment Group network drive (e.g. "M: Drive").

RBV Database and the CT DEEP Monitoring and Assessment Group network drive are located on the CT DEEP computer network. The CT DEEP Information and Technology Department maintain this network. The network is backed up regularly in order to allow for restoration following catastrophic loss or the corruption.

GROUP C. ASSESSMENT AND OVERSIGHT

C.1. Assessment and Response Actions

During Train-the-Trainer workshops and Trainer recertification audits, trainers will be required to successfully demonstrate proper field collection, data documentation, and data submission protocols as well as proper volunteer training, review and documentation protocols to the Certified Local RBV Trainer. During annual volunteer training, all volunteers will be required to successfully demonstrate proper collection and data documentation protocols to the Certified Local RBV Trainer in the field setting. Whenever possible, QAPP nonconformance issues encountered during training and/or field monitoring are handled in a timely manner so as not to jeopardize the sample results. Any deficiencies or unusual conditions/circumstances are documented and communicated as described in Section A.4.d *Communication Pathways* and Section C.2. *Reports to Management*. Issues that cannot be immediately resolved are reported by the State RBV Coordinator to the Project Manager.

C.2. Reports to Management

General project communication pathways are outlined in Section A.4.d, *Communication Pathways*. The Certified Local RBV Trainer is responsible for communicating any training challenges or deviations from approved protocol to the State RBV Coordinator within one week of the training event. The Field Team Leader is responsible for communicating (either verbally or by email) to the Local RBV Coordinator any quality control and/or safety concerns/challenges experienced by the team during monitoring, as soon as possible, and no more than one week, after the completion of monitoring to allow for prompt resolution. The Local RBV Coordinator is responsible for following up with the State RBV Coordinator at the conclusion of monitoring activities to discuss any variations from the RBV protocol and/or safety issues that arose during the season.

Training reports will be compiled and submitted at the conclusion of the RBV monitoring season. The Local RBV Program Coordinator, with support from the Certified Local RBV Trainer, is responsible for submitting proof of volunteer training as well as a report of any QA issues or concerns that arose over the monitoring season to the State RBV Coordinator by December 15 of that monitoring year. The State RBV Coordinator will compile all QA issues or concerns reported by Local RBV Coordinators and submit a summary report to the Project Manager for review and follow-up action by March 1 of the following year. Three years after initial certification, and every five years thereafter, Certified Local RBV Trainers are responsible for completing a recertification review to be administered by the State RBV Coordinator. The results of the review will be communicated to the Trainer as soon as it is practical thereafter. Current trainer certification status and recertification due dates will be summarized by the State RBV Coordinator and reported to project staff, including Certified Local RBV Trainers and Local RBV Program Coordinators, by March 1 of the following year.

The State RBV Coordinator will compile an annual summary report containing the list of sites monitored and the corresponding results by March 1 of the following year. The report will be distributed immediately thereafter by the State RBV Coordinator to all project participants and posted online (<http://www.ct.gov/deep/rbv>) for viewing by individual project volunteers, project partners and the general public. The State RBV Coordinator will e-mail a program-specific report to each Local RBV Coordinator to document and discuss recommended remedial action(s) related to any reported or observed deviations from the project QAPP during the prior monitoring season.

Upon completion of initial voucher review by the State RBV Coordinator, the Project Manager will randomly select ten percent (10%) of the vouchers for a second review by one of the taxonomic QA officers. The Project Manager will summarize the results of the initial and second QA review in a memo as soon as it is practical thereafter and distribute to the project staff for discussion and identification of corrective or remedial follow-up actions as necessary.

Special project QAQC reports, such as assessments comparing RBV data to DEEP macroinvertebrate data collected at the same sites during the same monitoring season, will be prepared as such opportunities arise by the State RBV Coordinator and submitted to the Project Manager.

GROUP D. DATA VALIDATION AND USABILITY

D.1. Data Review, Verification and Validation

The State RBV Coordinator will document the receipt of all program materials (e.g. training records, site photographs, datasheets, and vouchers) in an annual electronic voucher log as they are received. The voucher log is stored on the WPLR network drive.

The station location information (i.e. stream name, location description and town, latitude and longitude, and station photographs) provided on the datasheet is evaluated and compared to determine the exact location of the monitoring station. The information on the voucher label is compared to that on the datasheet to insure consistency. Any apparent discrepancies will be resolved with the Local RBV Coordinator responsible for that monitoring station. Data from flagged stations will be discussed with the Project Manager to determine suitability for consideration during the next IWQR reporting cycle. If a location conflict is unable to be resolved and/or the station cannot be determined with complete confidence, the voucher will be discarded and the Local RBV Coordinator instructed to follow up with the collector(s) to provide remedial training.

Once the station location has been determined, the station is assigned to the nearest monitoring station that resides on the same stream segment in the CTDEEP WPLR Ambient Water Quality (AWQ) database; new stations will be created in the database at the discretion of the State RBV Coordinator.

Station photographs are labeled with the AWQ station number assigned to that RBV monitoring location along with the name of the responsible organization and photograph date. Photographs are reviewed to insure volunteers sampled appropriate habitat (i.e. riffle habitat) and under appropriate flow conditions (i.e. normal flow conditions). Any apparent discrepancies from the RBV protocol will be flagged, discussed with the Local RBV Coordinator responsible for the volunteers that collected the sample. Data from flagged stations will be discussed with the Project Manager to determine suitability for consideration during the next IWQR reporting cycle.

After assignment to an AWQ station and resolution of any documentation discrepancies, volunteer field data (i.e. organisms observed at the monitoring site as noted on the Field Data Sheet) are verified and validated by evaluating the contents of the voucher collection. RBV voucher contents are evaluated by

the State RBV Coordinator, or other trained CT DEEP WPLR Monitoring & Assessment staff person. The voucher contents are emptied into a Petri dish and the label is cross-referenced against the datasheet. Organisms are then individually examined using a dissecting microscope, light source, and taxonomic key to the taxonomic level necessary to confirm the presence of one of the twenty-six RBV organisms.

The reviewer checks off each organism present on the original volunteer data sheet, including those not initially noted by the volunteer as present. "NIV", which stands for 'not in voucher,' is recorded beneath any organism that was marked present by the volunteer but not found by the reviewer in the voucher.' At the conclusion of the review, the reviewer tallies and records the final number of 'Most Wanted' types in the upper corner of the data sheet, and then dates and initials the sheet. In addition, any organisms not included in the RBV taxa list are noted at the top of the datasheet.

Voucher information including the station location information (i.e. AWQ station), collector information (i.e. organization, volunteer names, collection date), and the list of taxa present in the voucher are then entered into an electronic RBV Access database.

D.2. Verification and Validation Methods

During sampling, volunteers check off all organism types that they believe they have identified in their sample on the RBV Field Data Sheet. At least one of each of the organism checked off on the RBV Field Data Sheet are placed in the voucher collection container at the conclusion of the sampling event. In addition, at least one of each type of organism either not on the datasheet or that was not able to be definitively identified by volunteers in the field are placed in the voucher collection. If more than one representative organism of a given organism type is present in the sample, volunteers are instructed to place 2-3 representative organisms into the voucher container; this is intended to decrease the likelihood of not placing a representative organism of a present type into the voucher due to misidentification as another type already represented in the voucher.

At the conclusion of the monitoring season, after ensuring the accuracy and completeness of the station and collection information, the State RBV Coordinator reviews each organism in the voucher collection. Organisms are identified using a dissecting microscope and taxonomic key, and confirmed against a reference specimen. Because the RBV methodology does not provide volunteers with a comprehensive list of all potential riffle-dwelling benthic macroinvertebrates found in Connecticut streams, it is expected that organisms not listed as part of the protocol will be present in the voucher vial. All organisms in the vial are identified by the State RBV Coordinator to the family level and recorded on the corresponding voucher review bench sheet. (Organisms on the RBV organism list are identified to the genus or species level if necessary to confirm the presence of the target RBV type.) Identifications of rare or unusual organisms are confirmed with a Taxonomy QA Officer.

As described in Section B.5.b *Laboratory Activity Quality Control*, at least 10% of the vouchers submitted during each RBV monitoring season are randomly selected by the Project Manager for a second taxonomic review by one of the Taxonomy QA Officers.

D.3. Reconciliation with User Requirements

If correct sampling methods were used, the data packages are complete and the data meet DQO's for precision, accuracy/bias, completeness, representativeness, and comparability as described in Section A.7 *Quality Objectives and Criteria for Measurement Data*, the data are considered usable for the stated purpose of this project. If DQO's are not met, the State RBV Coordinator will work with the Local RBV Coordinator and Certified Local RBV Trainer (if applicable) to determine the source of errors or

discrepancies. The State RBV Coordinator, in consultation with the Project Manager, will make a decision whether to qualify or discard data, or resample if possible.

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Title: Riffle Bioassessment by Volunteers
Revision Number: 1
Revision Date: 11/27/2015
Appendix A

Appendix A - RBV Field Instructions

Click the link below to access an online PDF of Appendix A - RBV Field Instructions:

http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbv_vol_abbrev_fieldinstr2014.pdf

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Appendix B

Appendix B - RBV Field Data Sheet

Click the link below to access an online PDF of Appendix B - RBV Field Data Sheet:

http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbvdatasht.pdf

Appendix C - RBV Training Presentations

Click the links below to access online PDFs of Appendix C - RBV Training Presentations:

- RBV Overview & Field Methods Training Presentation
http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbv_training_methodspresentation.pdf
- RBV Macroinvertebrate Review Training Presentation
http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/intro_rbv_critters_presentation.pdf
- RBV Site Photograph Instructions
http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbv_photoinstructions.pdf

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Appendix D

Appendix D - RBV Field Macroinvertebrate Sorting Guide

Click the link below to access an online PDF of Appendix D - RBV Field Macroinvertebrate Sorting Guide:

http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbpkey.pdf

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Appendix E

Appendix E - Field Macroinvertebrate Identification Cards

Click the link below to access an online PDF of Appendix E - RBV Field Macroinvertebrate Identification Cards:

http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbvcards.pdf

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Appendix E

Appendix F - Voucher Review Bench sheets

RBV Voucher QAQC Review Bench Sheet

AWQ#: _____
 Waterbody: _____
 Municipality: _____
 Location: _____

Collection Date: _____ ID#: _____
 Organization: _____
 Collector(s): _____

Panel #	Taxa Name	Alternate ID	Present	Comments
1	<i>Drunella</i>			
2	<i>Isonychia</i>			
3	<i>Epeorus</i>			
4	Peltoperlidae			
5A	Perlidae			
5B	<i>Pteronarcys</i>			
5C	Capniidae			
5C	Perlodidae			
5C	Leuctridae			
5C	Chloroperlidae			
5C	Nemouridae			
5C	Taeniopterygidae			
6A	<i>Glossosoma</i>			
6B	<i>Apatania</i>			
7	<i>Rhyacophila</i>			
8A	<i>Brachycentrus</i>			
8B	<i>Lepidostoma</i>			
9	Hydropsychidae			
10	Philopotamidae			
11	<i>Stenonema</i>			
12	<i>Psephenus</i>			
13A	<i>Corydalus</i>			
13B	<i>Nigronia</i>			
14A	Odonata (Dragonfly)			
14B	Odonata (Damselfly)			
15A	Amphipoda			
15B	Isopoda			
15C	Leech			
15D	Midge			
15E	Simuliidae			
15F	Snail			
15G	Worm			
Other	Crayfish			
Other	Tipulidae			
Other	<i>Hexatoma</i>			
Other	Elmidae			
Other	Baetidae			
Other	<i>Atherix</i>			
Other	Planaria			
Other	Bivalves			
Other				

QAQC REVIEW RESULTS	
QAQC Reviewer:	_____
QAQC Review Date:	_____
Sample #:	_____
AWQ Station #:	_____
#Most Wanted:	_____
# Total Taxa:	_____
COMPARISON TO INITIAL REVIEW:	
Initial Review:	_____
Reviewer Name:	_____
Review Date:	_____
# Total Taxa	_____
# Most Wanted	_____
Taxa Discrepancies:	_____
Additional Comments:	_____

Review Comments: _____

RBV Voucher Review Bench Sheet

AWQ#: _____
 Waterbody: _____
 Municipality: _____
 Location: _____

Collection Date: _____ ID#: _____
 Organization: _____
 Collector(s): _____

Panel #	Taxa Name	Alternate ID	Present	Comments
1	<i>Drunella</i>			
2	<i>Isonychia</i>			
3	<i>Epeorus</i>			
4	Peltoperlidae			
5A	Perlidae			
5B	<i>Pteronarcys</i>			
5C	Capniidae			
5C	Perlodidae			
5C	Leuctridae			
5C	Chloroperlidae			
5C	Nemouridae			
5C	Taeniopterygidae			
6A	<i>Glossosoma</i>			
6B	<i>Apatania</i>			
7	<i>Rhyacophila</i>			
8A	<i>Brachycentrus</i>			
8B	<i>Lepidostoma</i>			
9	Hydropsychidae			
10	Philopotamidae			
11	<i>Stenonema</i>			
12	<i>Psephenus</i>			
13A	<i>Corydalus</i>			
13B	<i>Nigronia</i>			
14A	Odonata (Dragonfly)			
14B	Odonata (Damselfly)			
15A	Amphipoda			
15B	Isopoda			
15C	Leech			
15D	Midge			
15E	Simuliidae			
15F	Snail			
15G	Worm			
Other	Crayfish			
Other	Tipulidae			
Other	Elmidae			
Other	Baetidae			
Other	<i>Atherix</i>			
Other	Planaria			
Other	Bivalves			
Other				

VOUCHER REVIEW RESULTS	
Reviewer:	_____
Review Date:	_____
Sample #:	_____
AWQ Station #:	_____
#Most Wanted:	_____
# Total Taxa:	_____

Review Comments: _____

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Appendix G

Appendix G - Event Training Record

Click the link below to access an online PDF of Appendix G - RBV Event Training Record:
http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbvtrainingsignsheet.xls

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Appendix H

Appendix H - Voucher Labels

Click the link below to access an online PDF of Appendix H - RBV Event Training Record:
http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbvtrainingsignsheet.xls

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Appendix I

Appendix I: Equipment List

Click the link below to access an online PDF of Appendix I - RBV Equipment List:

http://www.ct.gov/deep/lib/deep/water/volunteer_monitoring/rbv_equipment.pdf