



COLORADO RIVER WATCH

Water Quality Sampling Plan

Version 4.23

<https://coloradoriverwatch.org/>

Sponsored By: *Colorado Parks and Wildlife*
<https://cpw.state.co.us/>



River Science
<https://river.science>



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River Watch Water Quality Sampling Manual
Introduction



Introduction to River Watch

The “Colorado River Watch” program (River Watch) is a statewide volunteer water quality-monitoring program co-sponsored by Colorado Parks and Wildlife (CPW) and River Science (RS). River Watch brings together education and environmental protection in a meaningful, hands-on program for Colorado students and volunteers.

River Watch’s two equally weighted goals are 1) to provide an educational opportunity for students, adults, and all individuals to understand the value and function of Colorado rivers, lakes and wetland ecosystems and 2) to generate high quality spatial and temporal water ecosystem data for CPW, Water Quality Control Commission, water resource managers and all interested entities.

River Watch accomplishes this by partnering with voluntary stewards who collect water quality data (including macroinvertebrates samples) and assess physical habitat as indicators of biodiversity watershed health. Our primary monitoring question and data objective is the same question the Clean Water Act asks: are our waters swimmable and fishable? The type of study design and monitoring program that would generate data to answer that question is monitoring baseline conditions. The entity that makes the most decisions about what is allowed into our waterways is whomever administers the Clean Water Act. Thus, that is the primary River Watch targeted decision-maker. Data generated by River Watch volunteers must meet the data quality and information needs of these decision-makers.

The River Watch Study Design (available on www.coloradoriverwatch.org) describes how River Watch does just that; providing that design, equipment and training to volunteers, who in turn generate data that CPW delivers to various decision processes. The data is available for anyone and more information about what is available where and how to get it is on our data FAQ ([here](#) on our website). River Watch is unique in its statewide coverage and frequency of data collection. The River Watch program is a top provider of volunteer data to the National Water Quality Portal.

River Watch volunteers are primarily Middle and High School students, but also informal education groups, citizen and stakeholder groups, individuals, colleges, municipalities, special districts, industries and non-profit organizations. Each volunteer group is required to attend a training, receives equipment and support needed to monitor their respective water bodies with the goal of providing consistent and accurate data. A Quality Assurance and Quality Control plan (QA/QC plan) is in place to ensure high quality data generated. This includes a visit from a River Watch staff member once a year in order to provide quality control, one-on-one support and technical assistance.

Each volunteer group signs an annual agreement committing to sample a minimum of one station monthly for one year. Volunteers collect monthly field samples and analyze for hardness, alkalinity, temperature, dissolved oxygen, and pH. Additional laboratory samples are collected monthly for analysis of total and dissolved metals, including Al, As, Ca, Cd, Cu, Fe, Mg, Mn, Pb, Na, K, Se and Zn. Twice a year, volunteers collect nutrient samples for analysis of total phosphorous, total nitrogen, nitrate+nitrite, ammonia, chloride, sulfate and total suspended solids. In addition to the chemical samples, a macroinvertebrate sample is collected on an annual basis and sent to a certified taxonomist for identification to species/genus. These macroinvertebrate collections are accompanied by an annual instream (micro) and reach (macro) physical habitat assessment.

New volunteers must attend a River Watch sponsored training prior to participating in the program. Additionally, existing groups with a new volunteer team leader are encouraged to attend, while others can attend as a refresher course if space and funding allows. The training consists of an introduction to stream ecology, basic watershed management, and the chemical, physical and biological metrics used in studying rivers. Each volunteer is instructed on how to collect water and macroinvertebrate samples, conduct physical habitat assessment, record field data, and how to analyze hardness, alkalinity, dissolved oxygen, pH, and temperature. Volunteers also receive training on QA/QC sample processing, data management and interpretation. Participants are tested and certified as River Watchers. Each group receives the supplies and equipment necessary to be a River Watch volunteer organization and keeps the equipment as long as a signed agreement is on file.

An essential part River Watch's success and ability to generate useful data is the rigorous Quality Assurance and Quality Control Program. All field and laboratory methods are used by the Colorado Water Quality Control Division (CWQCD) and are either Environmental Protection Agency (EPA) method or Standard Methods 2012. River Watch is a one size fits all approach which means all volunteers receive the same training and standardized equipment, chemicals and protocols. River Watch conducts 20% QA samples versus the industry standard of 10% and validates every field and laboratory result versus a random set and all data entries. Some QA/QC components include volunteers must collect a metal field blank and duplicate sample every fifth outing (20%), and analyze unknown samples for pH, alkalinity and hardness tests twice a year. In the laboratory, analysis is validated through a series of special samples including laboratory blanks, duplicates, known standards and spikes, use of outside labs and documentation and reporting of QA/QC results. All data is validated by CPW staff before release. River Watch has a Master Standards Operation Procedures (SOP) Document, 20 plus process tracking tools, over 200 SOPs that include datasheets, forms and subdocuments like our Quality Assurance Project Plan, Data and Volunteer Management Plans and numerous tutorials. Documentation is updated annually and the program is evaluated each year and adjustments made annually. The ecological foundation of River Watch is based on the River Continuum Concept (RCC). RCC illustrates that a river is a predictable continuum of chemical, physical and biological attributes. Station locations are determined each year based on data gaps, priorities, active volunteer groups and resources.

Federal, state, and local agencies make land use management, regulatory and non-regulatory decisions about Colorado's rivers and streams using data from the River Watch program. Many other local, private and public entities also use the data. This includes use of the River Watch data to help establish water-quality standards for Colorado waters in the Colorado Water Quality Control Commissions (WQCC) Hearings. (The CWQCC is a politically appointed nine member commission that represents a diverse geographic and water use spectrum. This commission decides what uses will be protected and what level of protection will be afforded via Colorado's Clean Water Act.) River Watch data is available on our website, the Colorado Data Sharing Network and the National Water Quality Portal (an EPA, USGS, other federal and state agencies and third party national database).

The ambitious and successful River Watch program is funded primarily through CPW with funding and implementation assistance from River Science. The program began in 1990 with 19 schools along the Arkansas, Eagle and Yampa rivers, and is still going strong with a 140 annual group capacity. River Watch has worked with hundreds of volunteer groups to collect tens of thousands of water quality samples. We have directly trained over 2500 individuals who in turn reach another 8000. River Watch has data on about 1000 stations on 500 plus rivers in Colorado.

While this manual is a subdocument to the larger River Watch SOP Document, it is organized specifically for volunteers to implement River Watch. River Watch is an effective data acquisition program.

CPW's Vision: Colorado Parks and Wildlife is a national leader in wildlife management, conservation, and sustainable outdoor recreation for current and future generations.

CPW's Mission: To perpetuate the wildlife resources of the state, to provide a quality state park system, and to provide enjoyable and sustainable outdoor recreation opportunities that educate and inspire current and future generations to serve as active stewards of Colorado's natural resources. (C.R.S. 33-9-101)

River Science Mission: Our mission is to use education, technology, and information to improve river management and project impacts.



Benefits

- For CPW, water resource managers and other interested entities: accurate high quality, useable data on all rivers in the network. Data meets the industry FAIR standards (findable, accessible, interoperable and reproducible). This data aids in making reliable, consistent, and holistic, watershed management decisions regarding the rivers of Colorado. All data is carefully collected and analyzed according to standard methods driven by state water quality standards information needs. Data is available to CPW staff, Water Quality Control Commissioners and Division Staff, EPA and other water resource managers. CPW also gains public relations, social capital and stewardship that help recruitment, get individual outdoors, create potential non consumptive wildlife users, park and state wildlife area users as a well as anglers and hunters. This creates support for CPW. River Watch reaches an untraditional and CPW audience and an underserved educational audience.
- For participating citizens, watershed groups and students: a hands-on real science real purpose opportunity to understand and value our river ecosystems and make a difference. Citizens and students contribute to something larger than themselves, many groups use the network and resources for funding match to achieve protection or restoration goals, teachers teach relevant real science, students have earned credit, awards, career paths, jobs and other benefits.
- For local communities and the state of Colorado: accurate, consistent and abundant data led to more informed decisions and effective resource prioritization and allocation. That in turn keeps healthy rivers healthy; helps restore more impaired rivers and perhaps sooner; supports biodiversity, ecosystem resiliency and retains the quality of life Coloradans desire.

Data Objectives

River Watch's primary data objective is to collect long term baseline aquatic ecosystem data. Aquatic ecosystem data includes chemical, physical and biological components. River Watch's secondary data objective is to collect site or study specific aquatic ecosystem data for a short term purpose. The program is designed as a data acquisition program. Data analyses, interpretation, creating information and delivery to users is not part of the program. Instead, CPW plays that role so the data is always used and River Watch invests resources and time to train volunteers to conduct these tasks and take their own action with the data.

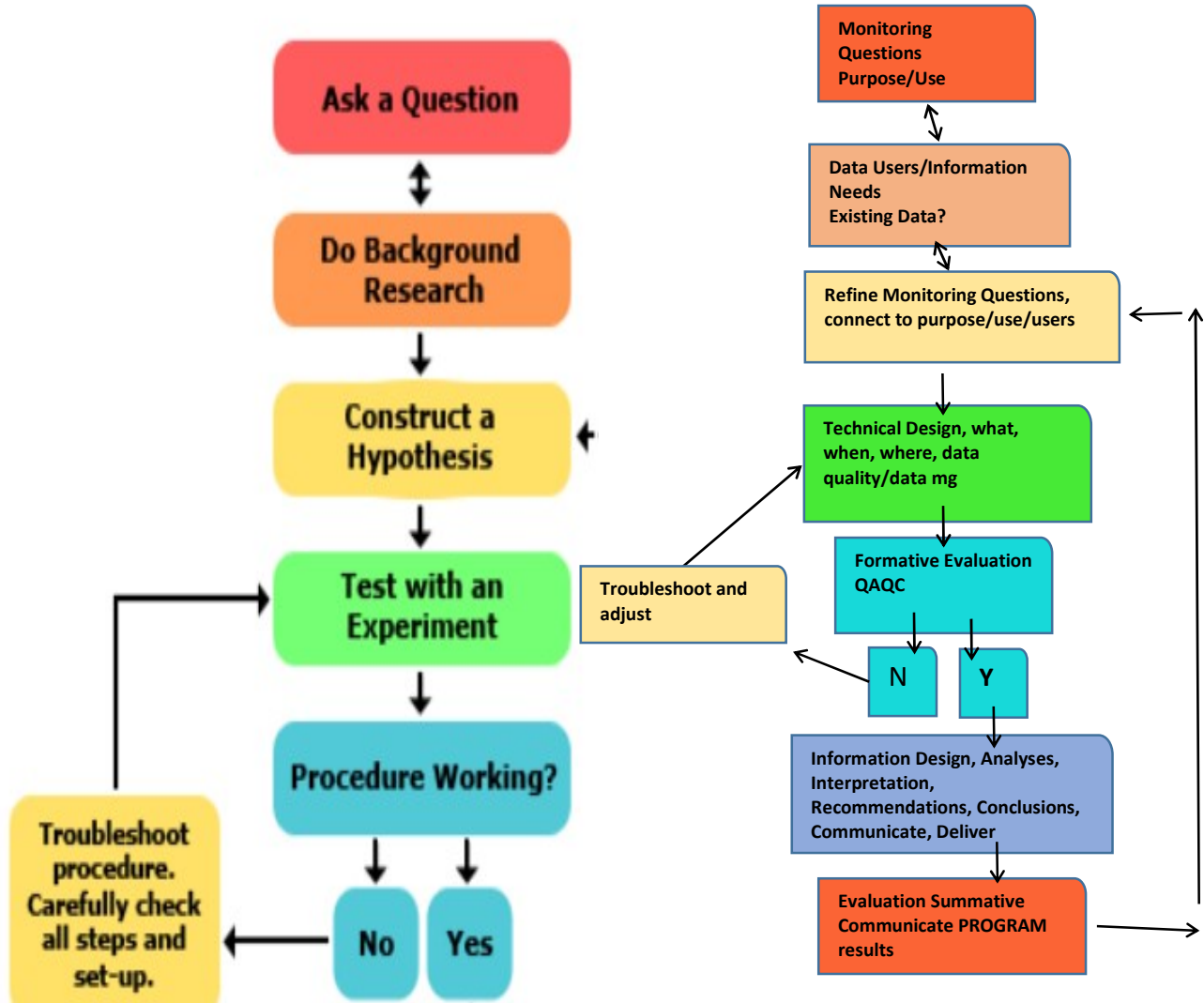
River Watch Study Design

Data is just numbers or facts. Data is not information of value without context, purpose and a path that connects purpose and a technical design that collects the right data at the right time and place with the right method to answer posed questions. Often you have a question you are trying to answer, maybe something like, is my water safe to drink? How do you know what to collect where? What do you want to do what with the data and what information do you need where, when, with what methods and quality? Collecting data is hardly the end, all that data has to be managed in a way it can be verified, secured and available. Data remains data until it is translated into information through analyses, simple or robust and available (read delivered or communicated) to those who take action on that

information. Then evaluation needs to occur to understand if monitoring questions were answered, if not why not, what should be adjusted? Were desired results, outcomes or impacts achieved or was progress made? This is how success stories are collected, curated and create a sustainable program.

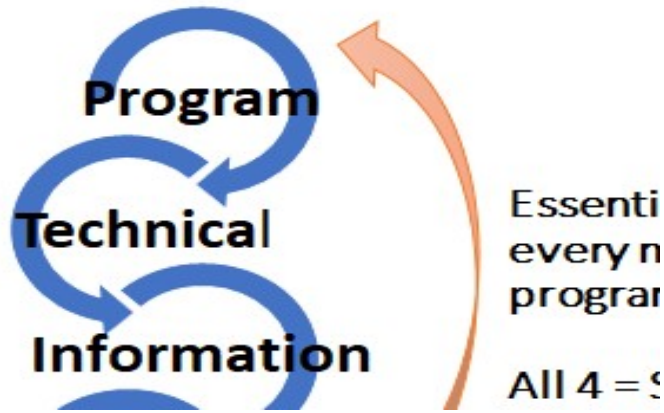
A Study Design or Monitoring Plan is the blue print or strategy put in place to generate the quality of data needed to answer the questions being asked to achieve desired results, impacts or outcomes. Without a Study Design or Monitoring Plan that integrates four key elements 1) who and why? 2) technical 3) information and 4) evaluation plans to the degree of formality and rigor for desired results, outcomes or impacts. Monitoring for monitoring sake is not sustainable nor does it generate measurable results beyond outputs such as number of stations, results or people trained to sample. A Study Design or Monitoring Plan tells the data user what you are doing, why and how, level of quality and what you are not doing, your niche. It tells them everything they need to know to evaluate if the data and information can be used for their purposes or not. It provides a program credibility, transparency and a way to measure results. It is a best management practice or an industry standard to help communicate and share data effectively and widely. A Study Design can be formal or informal, simple or complex and there is no one way. However, addressing all elements, even if a particular element is not needed in a design, tells the user that you thought about it, which makes your Study Design credible.

A Study Design in essence follows the scientific method used to explore observations and answer questions. In this method you ask a question, do background research around the question, construct a hypothesis, design an experiment to test the hypothesis, and evaluate the results. Did you answer your question? If yes, you conclude your hypothesis is correct or partially correct, communicate and deliver results and form or adjust original questions and future experiments or technical designs and repeat. If no, you evaluate and determine what needs to be adjusted for another round, is it the question, the design, etc. Below is a comparison of the scientific method and creating a study design or monitoring plan.



River Watch volunteers should understand the River Watch Study Design and should provide it to others interested in the data. Every monitoring program has a design to communicate basically four buckets of information, independent of program rigor, formality or purpose.

You can access River Watch’s study design at, www.coloradoriverwatch.org, and a high level outline in Chapter 8. The Clean Water Act provides agencies their program design, data quality objectives for technical design, requirements for information design (305b Report, 303d list, etc.) standardized so they can evaluate the nation’s waters as a whole. Many citizen science projects must follow others designs (even if for their purposes) or develop their own study design.



Program Drives all other designs	Technical	Information	Evaluation
Why Monitor?	What to monitor?	Analyses	Formative
Purpose/Data Uses (different)	When?	Interpretation	Summative
Data Users/Information Needs	Where?	Recommendations	Did you answer Monitoring Questions, yes, no, adjustments
Data Quality Needed (QAQC)	Methods lab and field to meet data quality	Conclusions	Documentation
Monitoring Questions/data objectives	Data management and validation of data	Information Products (warnings, reports, story boards, etc.)	Communication of results, outcomes and impacts along with monitoring results
Desired Results, Outcomes Impacts from monitoring		Communication and Delivery of data, information, results	Capture adjustments, changes, success stories, modify design, repeat or end
Who is monitoring?		Data Management of information products	
Scope			
Existing data, budget			

River Watch Resources Overview

River Watch provides numerous resources and reports for the volunteer, this Sample Plan is one. We list them here as an overview. You will find information in other chapters or resources.

Sample Plan	Webpage	Database/Training Platform
Instructions, datasheets, tips	RW Study Design , Sample Plan, datasheets, forms	Chemical, physical, biological data exports
Volunteer safety and quality assurance plans	Watershed Reports & access to database, data entry	Meta-data reports, rivers, stations, etc.
Stream ecology; Why's for all parameters	Group profiles, activities and success stories, Stewardship	Your organization performance report, quality assurance data

	awards	
Support information to implement the program	Resource library, Macroinvertebrate library, tips and tools, RW Webinars	Data FAQ. How to get data, information about the data
People to contact to support the program	Curriculums, Tutorials like Clean Water Act	Training Platform provides self-paced videos, tests, modules for RW training, brush up and CDIP Certification*
	Annual Program Performance, Quality Assurance Plan,	Stewardship Recognition*

*see Chapter 9 for more information

River Watch Staff Code of Ethics

Take only Positive Positions

When faced with an issue position with which you disagree, or don't like, search out and support a positive alternative. If you're against something, you must be for something else as the solution, look for it. Be able to clearly communicate your alternative solution.

Do Your Homework

Be prepared. Complete your research. Question what you read, investigate the source. Know that what you are saying is based on evidence and fact.

Probe the Force Field

Be aware of all the people and their positions on the same problem and issue. Know who's for, neutral, or against an issue and what basis they have used to adopt their positions and when and how you could be accommodating.

Keep a Balanced View, Empathize

See all sides of the issue. Walk in the other person's shoes. Know what values and principles your position is based upon. Try to understand and accept the validity of other viewpoints. Look underneath what is being said to what the needs are and the values behind the needs. Seek first to understand, then to be understood, learn to listen. Understanding is not the same as agreement.

Individualize, Eliminate Stereotyping

Treat everyone as an individual with value to contribute. Recognize that each person holds his or her own identity within a group. Stereotyping can be limited and misleading, often blocking solutions rather than building bridges among people or groups. Be aware of your biases and their impact on others.

Remain Flexible

Be willing to adjust or change your own stand in the light of new information. Remain flexible, yet decisive, based on your carefully conceived value position. Never forget the values and principles that are the basis for your position on the issue. Compromise on the implementation but not the values unless you find from new experience a new value position makes good sense.

Accept Responsibility, Eliminate Scapegoating

Never blame anyone or anything else for your lack of success. Rather than place blame beyond yourself to others when things don't go as planned, look to what you could have done more effectively in carrying out your plan. Focus on what is in your control. Most importantly decide, based your analysis, what actions you could take next to move toward attaining your goal.

Be Persistent, Recycle

Persistence is an absolute key to success in environmental matters. Do, do, and do again until you are successful. There are no mistakes, all efforts contribute to progress, zero is a valid result. When you encounter a block, back off, reconsider perspective, options and directions, begin again, and try another route.

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You can reach us at riverwatch@coloradowatershed.org or visit our website at www.coloradoriverwatch.org.

For all River Watch related business, (samples, equipment, contract, data sheets, other paper work, etc.) please use this mailing address:

**River Watch
C/o Colorado Parks and Wildlife
6060 Broadway
Denver CO 80216**

For **River Science** related business, mailing address is:

River Science
430 Main Street
Canon City CO 81212

Visit <https://river.science> for more information regarding River Science and their programs.

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River Watch Intern

River Watch Intern (6-9 months during a year)

River Watch Website:

Home Page: coloradoriverwatch.org



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Volunteer Group Profiles:

Send us information on your organization/school group and we'll post it on our website.

Help River Watch and others see you who are and the difference you make. Share where you monitor (photo of your stations), who you are as an organization and how you implement River Watch.

You Matter! Share your wisdom with others just starting the program.

Testimonials are greatly appreciated as well. Please send your group profiles and testimonials to riverwatch@coloradowatershed.org.

Data Tab

- Data entry on the Data Tab: you will have the ability to access the database to enter your field data and unknown results. The password is by organization not individual, tied to your kit number. We can help you find it.
- Download results, view and download River Watch data under the Data Tab which includes station information, field, metal, nutrient data, and bug data.



ABOUT RIVER WATCH

[Our Mission](#)

[Our Partnerships](#)

[Our Data](#)

[Get Involved!](#)

Our Data

If you are a River Watch volunteer, please log in and enter your data here in our [database](#).

If you are a volunteer logging in or entering data for the first time, please watch this short [five-minute video](#) on field data entry.

Data FAQ

Click [here](#) to learn how to retrieve data, see what data is available, and learn more information about River Watch data.

Instructional Video Tab on how to enter field/unknowns, access data and performance reports:



Database Instructional Videos

These short instructional videos will assist you in utilizing the River Watch database.

- [River Watch data overview](#)
- [How to log into the River Watch database](#)
- [How to enter field data into the River Watch database](#)

How to access specific datasets:

[Chemical data](#)

FIND US ON SOCIAL MEDIA!



ABOUT RIVER WATCH

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Resources Tab

Under the Resources tab, there is a page for forms. This is where you will find the MOUs, Chain of Custody forms, datasheets, etc. that you might need to manage your RW program.



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ABOUT RIVER WATCH

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Data Sheets, Forms & Documents

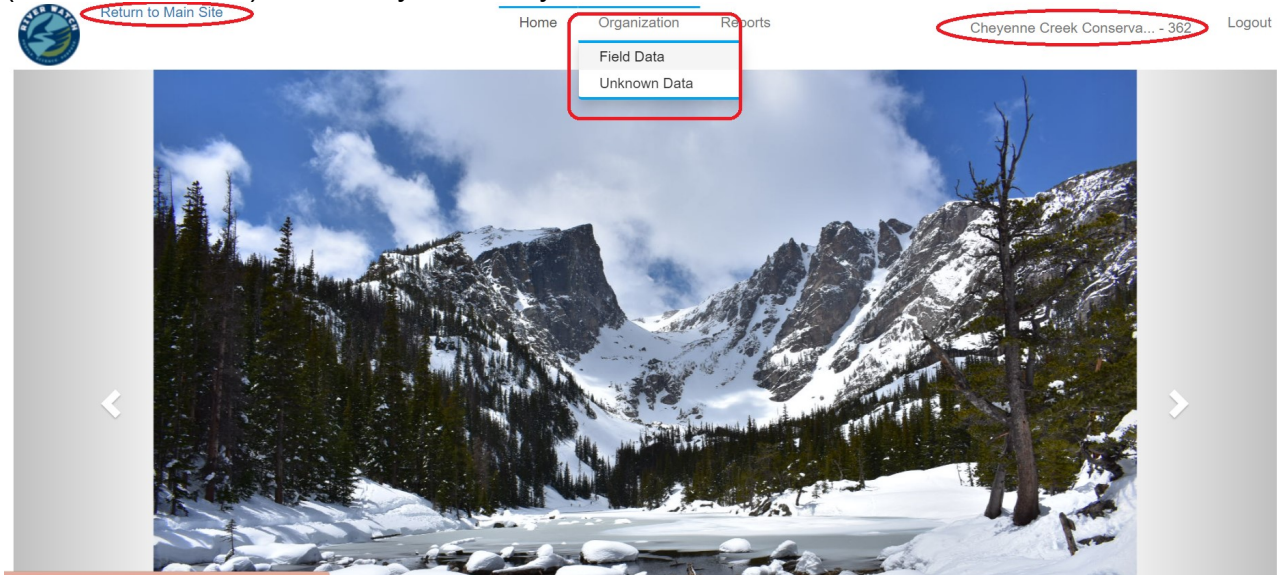
A variety of useful River Watch forms are found below. Simply click on a link to open the document in a new tab where it can be easily downloaded as a PDF.

General Information

- [River Watch Volunteer MOU 2022-2023](#)
- [Chain of Custody Form](#)
- [Participant Contact Information](#)

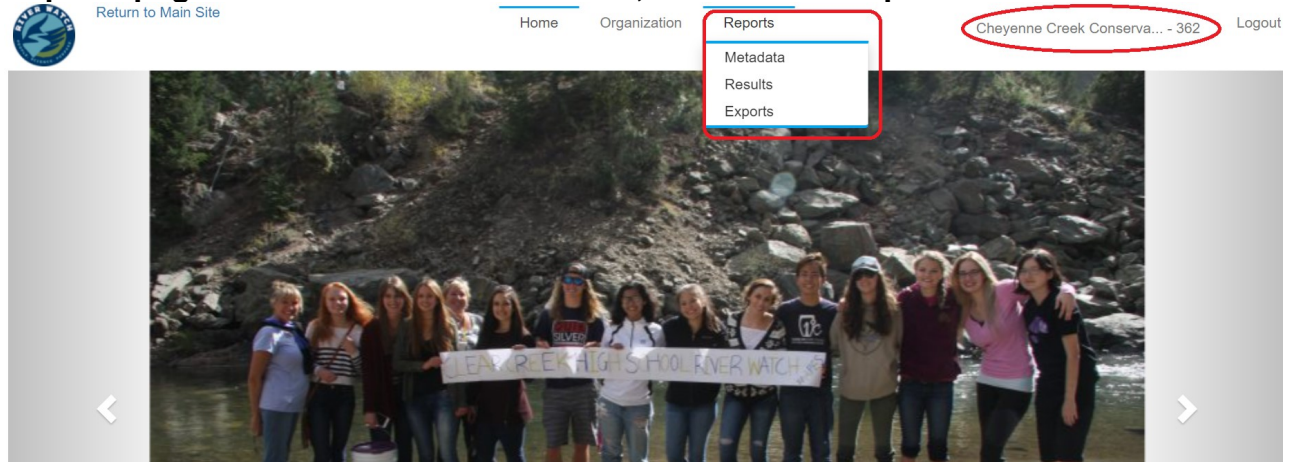
River Watch Database Application:

Once you log into the River Watch Database Application (use organization name/kit # and password) from the home page/Data Tab you will see the screen below: Take notice how to: Return to Home Site (left side of screen) and Logout (right side of screen). You should see your group name and kit number just left of the "Logout". Under the Organization tab (middle of screen) is where you enter your Field and Unknown Data.

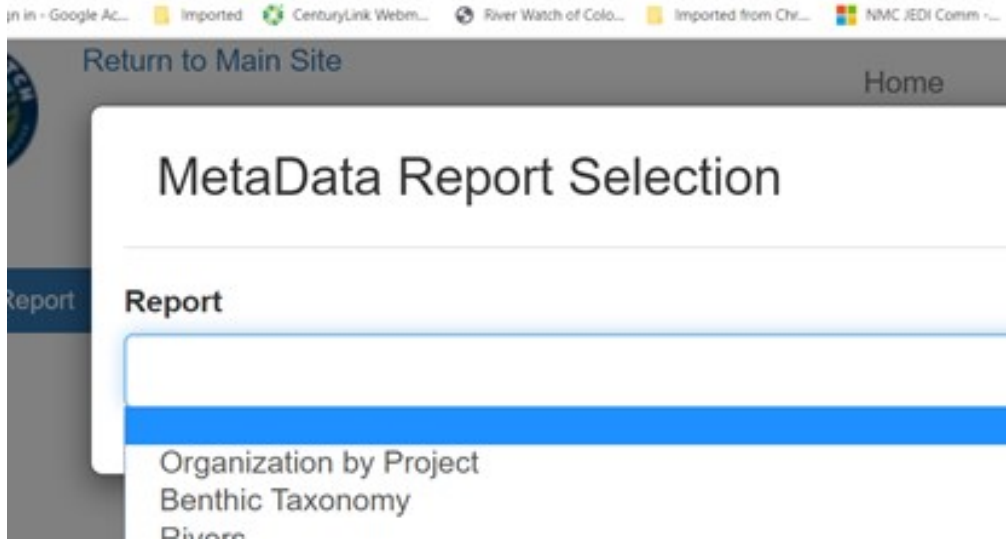


Tutorial videos on how to enter field and unknown data are on the main site.

Reports page has selections for Metadata, Results and Exports:



Metadata:



- Organization by Project - projects lump River Watch stations into a project and then can download data by that “project”.
- Benthic Taxonomy - a taxonomic list of all bugs in the database AND information on functional feeding group (how they eat) and habitat strategies.
- Rivers - a list of all rivers monitored by volunteers in the database.
- Stations - see what River Watch stations are out there or information about each station.
- Stations with Gauges - provides a list of River Watch stations by USGS/State Engineer gauges.
- Station Samples by Type - allows the user to see what data is available for each station: field, metals, nutrients, macroinvertebrates and/or physical habitat and data ranges available for data.
- Organization Performance - is how we track each group every year. We based your performance on the back of the Memorandum of Agreement (MOU) you sign every year. Agreements on the back of your MOU include items like sampling 12 times a year, collecting blanks and duplicates and completing 2 unknowns. In the event we have to cut participants, we use these to retain high performing groups.
- Quarterly Performance by Organization - provides a performance report for all active groups by quarter collectively versus individually.
- Station Event Milestone - provides event milestones per station for River Watch Stewardship awards.

Metadata is data or information about results. Station name, number, river name, date, time, parameter units, analytical methods and associated detection and reporting limits are all considered meta data. In addition, Study Design information such as monitoring purposes, data users, data objectives and monitoring questions are also meta data.

Documenting metadata along with data or results provides a context for data users to understand why the data was collected and the quality of the data. Providing data of a known quality is a best management practice so that other users can determine if they can use the data for their purposes. This makes data an asset, providing value long after the original use. Metadata allows **FAIR** data standards to be used, making data findable, accessible, interoperable (usable in many platforms) and reusable.

Results – select All Samples Results

return to Main Site

Export PDF

Results Report Selection

Report

All Sample Results

Please open and read the attached FAQ PDF document to understand how these reports have read the document, please acknowledge reading it by clicking the checkbox below

FAQ I have read the FAQ

Select Result Type Chemicals Bugs Physical Habi

Organization ALL

Project ALL

Watershed ALL

County ALL

WQCC Sub Watershed ALL

Watershed Gathering ALL

This report is designed to have you select various items and narrow your query of the database. It is not designed to perform an entire database dump, which is very large. It asks you to download a FAQ about the data which explains how to get the data you want, what data exists when, what the output looks like and means and the data quality. These are important items to communicate to data users so they can determine if the data is sufficient quality for their uses. Those instructions will not be repeated in this document.

- First tier selection is chemical, bug or physical habitat data
- Second tier selection is one of the categories that follows, narrowing either the geographic scope or narrow by project, station or year. Then select run report.

User guides and videos are located at www.coloradoriverwatch.org (data tab/database instructional videos sub tab).

A Chemical export will have two tabs in excel. The first tab has meta-data for the user to have contact about the results. The second tab being a pivot table that provides quality control and assurance information for data users. This helps data users know the quality of the data, meet FAIR data standards and makes the data more valuable, credible and usable.

The terms and information on the first tab, Chemical Results include the following, most items are self-explanatory.

Station #	Driving directions
Station Name	RW Watershed, WQCC Watershed
Longitude / Latitude	Watercode, Waterbody ID ¹
Event ID, Sample #, Date, Time, Type	Watershed Report ²
Watershed	County
River	Watershed Gathering ³
Organization, Kit #	Project Name

¹Watercode is CPW administrative unit assigned to all waterbodies that correlate to how the fishery is managed. Waterbody ID is the equivalent administrative unit (but different sizes and definitions) for the Water Quality Control Commission to administer discharge permits, assign uses and protect those uses. Providing this information helps those data user easily find data they need within those units.

² Reports completed by River Watch to find data outliers and Volunteers data analyses that mirrors the assessment completed by the Water Quality Control Commission but with River Watch data only.

³A geographic grouping of River Watch Volunteers to conduct gatherings around sharing data.

The terms and information on the second tab, Chemical Qualifiers include the following for every parameter analyzed starting July 2017.

Item	Definition	
Method Detection Limit (MDetLimit)	The analytical methods ability to detect the presence of the substance it is measuring; to “detect” the substance or not with a degree of confidence	
Lower Reporting Limit (LRepLimit)	The lowest level reported associated with an analytical methods ability to detect a substance. This is usually one or two standard deviations from the detection limit to provide a reliable, reproducible, precise, accurate and consistent result.	
Data Qualifier (Qual)	This tells the user how River Watch treats results that are below detection limit, in between detection limit and reporting limit. For example, you could report a 0, a null, a <detection limit, a <DL for results below the detection limit. These have implications for data analyses when you need a number not a character or 0’s can bias statistical analyses. This is often a code, like A, U or J.	
Detection Condition (DetCond)	Compliments the Qualifier field giving a text definition of how detection is reported	
Result Value	Qualifier Legacy / New	Result Detection Condition* Legacy / New
Result is null or blank	A / A	Not Reported/Not Reported
Result is <Method Detection Limit (MDL) Legacy data result = 0, new = # (the respective DL)	U / DL	blank or null/blank or null
Result is >=MDL and <Lower Reporting Limit (LRL) Legacy data result = 0, new = # (result)	U / J	blank or null / >=MDL and <LRL result
Result is >= LRL (#=result)	Blank/D	Blank/Detected

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