Quality Assurance Project Plan
River Source Programs &
New Mexico Watershed Watch

January 2019

PROJECT MANAGEMENT

Title and Approval Sheet (A1)

January 14, 2019

Richard Schrader/ Program Director and Monitoring Project Manager Date
River Source
2300 W. Alameda, A6
Santa Fe, NM 87507
505-660-7928
rich@riversource.net

Table of Contents

Project Management

Title and Approval Sheet..... 1
Distribution List 3
Key Personnel and Responsibilities.....3
Program Definition/Background.....4
Project Task..... 4
Measurement Quality Objectives.....7
Training Requirements and Certification..... 10
Documentation and Records.....11

Data Generation and Acquisition

Sampling Process Design.....11
Sampling Method Requirements.....12
Sample Handling and Custody Procedures.....14
Sampling Schedule.....15
Analytical Methods Requirements.....15
Quality Control Requirements..... 17
Instrument/Equipment Testing, Inspection, and Maintenance Requirements..... 17
Data Acquisition Requirements..... 18
Data Management..... 19

Assessment and Oversight

Assessment and Response Actions..... 19
Reports to Management..... 20

Data Validation and Usability

Data Review and Validation..... 22
Validation and Verification Methods.....22
Reconciliation with Data Quality Objectives..... 22

Tables:

Table 1: Key Personnel and Responsibilities..... 3
Table 2: Quality Assurance: Accuracy and Precision Targets.....8
Table 3: Sample container, holding times and preservation.....14
Table 4: Sampling Schedule..... 15
Table 5: Analytical Methods and Equipment.....16
Table 6: Equipment Calibration and Inspection.....17

Distribution List

This Quality Assurance Project Plan (QAPP) for River Source 1) describes the framework for how data will be collected to achieve specific project objectives; and 2) outlines the procedures necessary to ensure data of known quality are collected. This QAPP applies to River Source volunteer monitoring programs, primarily Watershed Watch and fisheries monitoring for the New Mexico Department of Game and Fish, and includes River Source's work with other groups.

This QAPP shall be posted on the River Source website for download at http://riversource.net/downloads-data under the Watershed Watch resources heading. River Source shall replace posted files on the website as the plan is revised.

Participants in River Source monitoring work will receive email notification of the document and subsequent revisions. The official signed document shall be filed at the River Source office. The Monitoring Project Manager may make revisions to this plan which shall be approved by signature on page A1. River Source is not responsible for the control of reprinted copies from the website or photo copies of the original plan. It is the responsibility of the reader to ensure that they are using the most current QAPP. An acknowledgement statement of receipt of this document, including a responsibility to be familiar with its contents and to follow the guidelines contained within the QAPP, will be signed by River Source volunteers.

Key Personnel and Responsibilities

Table 1: Key Personnel and Responsibilities

Key Personnel **Name**	**Project Title/Responsibility**	**Telephone Number**
Richard Schrader	River Source, Director Project Manager, QA Manager, overall program coordination	505-660-7928
Carlos Herrera	Program Associate, Data Manager, QA technician	505-231-4860
Kevin Holladay & Aquatic Habitat staff representative	New Mexico Department of Game & Fish Agency sponsor	505-476-8095
Local field monitoring team leader & trained field samplers	School teachers, watershed group staff, or government agency staff who collect, manage, and summarize data	Various numbers, please see attachment 1
Monitoring staff (River Source) and Advisory Group members	Sample collection, training of field samplers and data managers, sample analysis, data interpretation	505-660-7928 plus staff & trained volunteers of River Source programs

Program Definition/Background

River Source engages New Mexico residents in conducting studies to learn about the ecological health of rivers and fisheries, to share that information with local residents and government agencies. The educational objective of River Source programs is to increase awareness about threats, or needed actions, to preserve, protect, and restore the qualities of a healthy ecosystem in the watersheds of New Mexico.

The purpose of the New Mexico Watershed Watch program is to increase the understanding of fisheries and watershed health, as well as water quality indicators, and to cultivate a stewardship ethic amongst young adults who may be interested in fishing. School teachers and adult volunteers play an essential role in educating students about the condition of river ecology and fisheries health and increasing the involvement of local adult mentors in collecting and using data. The local adults may be the staff of a watershed group, government agency, or private ranch.

The New Mexico Department of Game and Fish (NMDGF) is one of several funders for fisheries monitoring and the Watershed Watch program, using Sports Fish Restoration Program funds. River Source provides written guidance, teacher training, equipment calibration, quality assurance and data management training, and guidance in the field for data collection for up to 24 schools per year around New Mexico. Teachers sponsoring the Watershed Watch program and watershed groups (hereafter called volunteers) are eligible to receive monitoring equipment on loan, training, and technical assistance in fisheries and watershed monitoring.

River Source monitoring programs provide education which lead to watershed residents becoming more engaged in activities like protection of riparian areas, changing land use behaviors to decrease non-point source pollution, and enhancing fish habitat.

The purpose of this document is to detail the quality assurance objectives, quality control, and quality assurance methods of River Source volunteer monitoring programs including data collectors and users of the WATERSHED WATCH program. The document provides guidance for teachers and students to learn and apply quality assurance requirements. In addition, other non-profit and watershed groups working with River Source use this guidance to conduct data collection, analysis, and reporting with quality assurance and control measures in place.

Project Task

River Source coordinates citizen volunteers conducting watershed monitoring at over 100 sites in New Mexico. River Source began running the Watershed Watch program for the NMDGF in 1998 with approximately 20 schools participating annually. Today, more than 24 schools participate in the program in nearly all the major basins of New Mexico, including the Rio Grande, Chama, Gila, Pecos, Red River, and Canadian basins.

River Source requires participants to:

- Use standardized sampling protocols and create a study design
- Document the details of their sampling process

- Participate with local experts who can provide technical advice and recruit volunteers
- Report data to River Source and/or to a local or regional and/or statewide audience

For most projects, River Source requires schools and watershed groups to prepare a sampling and analysis plan, also known as a monitoring plan, which will guide sampling and analysis and align monitoring efforts with quality assured methods for volunteer monitoring programs. Such a plan will include the locations for monitoring sites, frequency of monitoring, and descriptions of how data will be shared locally.

River Source monitoring activities are designed to achieve a number of outcomes, including:

- Building a long-term dataset of credible fisheries monitoring and water quality information that can be used to track watershed health trends and conditions over time
- Providing watershed education and awareness to participating students, teachers, and volunteers, which will lead to informed decisions in land management and resource use and enhance watershed health and productivity
- Providing a hands-on, real-world science opportunity for students
- Meeting watershed group or local data user needs
- Providing data to NMDGF to guide management decisions

Teachers are required to complete a simple monitoring plan which details the study purpose, site selection, and how they will report the data at the end of the school year. Students and teachers in the Watershed Watch program visit selected monitoring sites from August to May, with some schools additionally monitoring in the summer. Some Watershed Watch teams monitor water quality conditions at multiple sites while others only go to one site periodically over an extended period of time.

Watershed Watch teams normally consist of 6 to 30 students. The number of student participants is determined by the lead teacher. Schools sponsor the program after signing a memorandum of understanding, which describes the requirements for receiving annual training and equipment in exchange for following monitoring protocols, maintaining and calibrating instruments, and reporting data. Teachers are required to come to an annual teacher training where they learn sample collection, analysis, and data reporting methods.

Data collected by the Watershed Watch program includes water temperature, discharge, total dissolved solids, pH, and turbidity. Additional observations include benthic macroinvertebrate sampling and sorting to major groups. Nitrate, total reactive phosphorus, and dissolved oxygen are collected at most sites. Additional measurements collected at some sites include riparian and fisheries habitat data including pebble counts, vegetation cover, and channel cross-sections. Copper and aluminum are also collected at some sites. Students present their data to local watershed groups, school boards, federal and state agencies, and other groups.

Data generated by field samplers in River Source programs ***will be used for educational purposes*** to inform government agencies and local watershed residents of the trends and changes of resource conditions. The data will be provided to state governmental agencies to be used for screening for potential water quality problems and ***conducting trend analysis or screening***, particularly where data is very limited or not available.

In addition, the data may be used by program participants and government agencies to evaluate the effectiveness of best management practices for watershed restoration or stewardship. For instance, local watershed groups and their partners may use the data to document improvements in water resource conditions following the implementation of a watershed restoration project.

Measurement Quality Objectives

Water quality monitoring conducted by River Source focuses on the evaluation of baseline watershed conditions and trend assessment. Analysis of data generated from River Source programs helps identify areas of concern, evaluate the efficacy of on-the-ground and education projects towards restoration goals, and identify sites with good water quality. Collection methods used in River Source monitoring will be consistent with standard methods used by other monitoring programs supported by state and local government agencies. Data quality objectives include:

- accuracy
- precision
- representativeness
- completeness

Proper training, oversight, and coordination are necessary to ensure reliable, quality data is being generated that can be used for resource management and awareness/educational purposes.

Precision and Accuracy: Table 1 lists the precision, accuracy, and associated criteria for stream column chemistry, benthic macroinvertebrate indices, biological habitat (such as flow, temperature, and rapid bioassessment data), geomorphology, photopoints, and vegetation monitoring parameters. Any data collected which do not meet the accuracy and precision limits defined below will be rejected or accepted with qualifications.

Accuracy quality control audits will be made by River Source staff during regular visits to school sites during which school calibration of pH, TDS, and turbidimeters will be assessed prior to data collection. Precision of field sampling will be assessed by replicate sampling of water chemistry and streamflow and analysis of variance such as strange outliers. Voucher collections of benthic macroinvertebrate samples will be verified by professional taxonomists on a selected basis. The accuracy of geomorphology measurements will be assessed by establishing and checking the height of two rebars set in pairs for measuring channel cross-sections to see if they are still at nearly the same elevation over time (+/- 0.2 feet).

Table 2: Quality Assurance: Accuracy and Precision Targets

Medium	Parameter	Precision	Accuracy	Measurement Range
Water	Temperature	±2.0 °C	± 0.5 °C	-5 to 35 °C
Water	pH	± 0.5 SU	± 0.2 SU	0 to 14 SU
Water	Conductivity/ estimated TDS	± 10% of Std. Value	± 10% of Std. Value	0 to 4000 µS/cm or 0 to 1999 ppm
Water	Turbidity	± 5% of Std. Value	± 5% of Std. Value	0 to 1000 NTU
Water	Stream Discharge	± 20 %	± 10 %	NA
Water	Dissolved oxygen	± 20 % mg/L	n/a	0-10 mg/L
Aquatic insect community	Benthic macro-invertebrates to order and family levels	1 duplicate gathered and professionally sorted to major group 10% RPD	Selected schools will have samples validated plus professional assistance at lab sessions	n/a
Photopoints	Repeat landscape photos from fixed positions	n/a	n/a	n/a
Geomorph-ology	Channel Cross-section	± 0.1 feet (1.44 inches)	Rebar height ± 0.2 feet	0 – 40 feet
Geomorph-ology	Longitudinal profile with laser level	n/a	Annual accuracy check of laser level	0 ft – 1,000 feet per reach
Vegetation Canopy Gap	Bare soil estimate expressed as percent cover	± 30% RPD /1 on bare soil percentage for transect line-point data /1	n/a	0 – 100% vegetation cover
Vegetation Cover & functional group composition	Vegetation cover expressed as percent bare soil & functional groups (trees, shrubs, grasses, forbs)	± 10% RPD on bare soil percentage for transect line-point data	n/a	0 – 100% vegetation cover

$$\%\,RPD = \left(\frac{|X1 - X2|}{\bar{X}}\right) \times 100\%$$

/1 RPD stands for Relative Percent Difference is calculated by formula to left where X1 = value of the first measurement, X2= value of the second measurement, X = Average of X1 and X2

Representativeness: Data representativeness is a function of the sampling locations and the number of samples collected over a variety of flow conditions. Monitoring locations should represent different and distinct reaches of rivers, springs, and upland tributaries and exhibit variation in land use, slope, soil types, vegetation cover, and stream morphology. Monthly sampling (for some parameters) and annual sampling events (for geomorphology and vegetation) will increase the likelihood that data gathering will occur over a representative range of conditions.

Water samples will be gathered from a well-mixed portion of the stream by rinsing sample containers a minimum of three times and taking a sample approximately halfway down the column (if safely possible). Samples will be gathered upstream of any other person standing in the stream to avoid sample contamination by someone stirring up sediment in the stream bottom.

Benthic samples will be gathered in two ways to ensure a sample is obtained that is representative of the community in question.

- Riffle sample consisting of three 0.33 m^2 samples which are composited into one sample as per EPA RPB level II protocols
- Microhabitat samples of pools, stagnant backwater areas, undercut banks, and stream bottom sediments

Geomorphology measurements will be taken at riffle and point bar segments of streams which will be clearly marked with rebar monuments. Cross-sections may be sampled at the top and bottom of the project. A minimum of two locations may be sampled with cross-section transects between the top and bottom of the project. A longitudinal profile may be sampled between the top and bottom of the project.

Photopoints will be set at a minimum of one location per monitoring site. In 2019 the program is beginning a shift to using the PicturePost methodology from the University of New Hampshire. Vegetation monitoring transects may be set in locations that are most representative of where change is expected due to the treatment. A minimum of 180 vegetation sampling points will be sampled per project site if vegetation change is expected to occur based on land management and/or restoration goals.

Comparability: The methods for the New Mexico Watershed Watch Program are based on several well-established methods and protocols. The references include:

- USEPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries
- Rio Puerco Management Committee's QAPP for the Rio Puerco Watershed Initiative
- Colorado River Watch, a cooperative effort between the Colorado Watershed Network and Colorado Division of Wildlife
- New Mexico Dept. Of Game and Fish Lotic and Lentic Habitat Assessment Protocol
- Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems by Jeff Herrick and many others at Jornada Experimental Range of the United States Department of Agriculture

Monitoring participants will refer to the New Mexico Watershed Watch Workbook (2002) and the latest guidance documents shown on www.riversource.net. Rio Puerco Monitoring

Workbook (version 1.4) is the last version of that guidebook. Teacher trainings are also essential to ensure comparability with similar projects by following standardized sampling procedures outlined in this plan.

Completeness: This objective refers to the percentage of measurements made that are judged to be valid according to specific criteria. When data are judged valid they are entered into the data management system. Every effort is made to obtain all sample measurements to optimize completeness. Errors in equipment calibration, misuse of equipment, improper sampling techniques, and mistakes made in recording of sample results all result in loss of valid sample results, which will reduce the ability to perform analysis, integrate results, and prepare reports.

Schools in the Watershed Watch Program submit a monitoring plan or revisions to the plan each year to document their sampling schedule and the variables that will be measured and reporting audience. Completeness of this dataset is expected to range from 60% - 100%. Each school will choose an appropriate number of sites so that each site can be monitored on or near the sample date whenever possible. Measurements will be taken at 90% of the sites unless conditions (i.e., bad weather, impassable roads, no flow, etc.) prevent sampling. The integrity of the project will not be compromised if 90% of planned data collection efforts are determined to be valid.

Training Requirements and Certification

River Source program participants will receive training on proper equipment maintenance, collection of field samples, and data management (recording, analysis, and reporting). Field methods and data management training sessions are held annually for monitoring staff and volunteers, typically in August or September each year. Additional training session will be held, as needed, for new start-up schools or if there is a large transition of team members during the year. Data management training is on-going, with a special emphasis on data analysis at the conclusion of the monitoring year as reports and displays are prepared. Direct field assistance by River Source staff will also be provided to acquaint newly trained participants with procedures and perform quality assurance audits of proper sampling and analysis procedures.

Each school sponsor of River Source programs must sign a memorandum of understanding which articulates training, reporting, and equipment maintenance requirements. The MOUs for the Watershed Watch Program can be found on the River Source website. A condition of the equipment loan agreement (see attachment 2), signed by participants when they receive equipment, is to follow procedures outlined by River Source guidance and other monitoring guidance. All participants should be trained by River Source staff or by long-standing participants who have extensive training and practice in monitoring.

Documentation and Records

A downloadable version (with current version and date shown) of this QAPP is located on the River Source website at (http://riversource.net/downloads-data/) under the Watershed Watch resources section. Additional documentation for the River Source monitoring program can also be found on the website including:

- Watershed Watch Quality Assurance Audit Checklist (click here to view)
- New Mexico Watershed Watch Workbook – the basic SOP for Watershed Watch program (2002)
- Templates for preparing sampling and analysis plans (monitoring plans)
- Data reporting templates

Thorough documentation of all calibration, equipment maintenance, field sampling, and handling activities is necessary for proper field analysis, data reduction, and ultimately for the interpretation of study results. For each River Source sampling event, a field data sheet must be completed on-site at the time sampling occurs. Documentation must include recording of measurements taken in the field, results from the meters used, and any observations that the participants notice at the site which may an influence on water quality results, including deviation from any prescribed sampling procedures.

River Source program participants are asked to maintain a hard copy (original or copy) of results from each sample outing with their records. A hard copy may be provided to River Source and a local monitoring partner such as watershed group. The River Source monitoring team may also enter their data into an Excel electronic spreadsheet or onto an on-line database for watershed health trend assessment, which is being developed by River Source and several partners. Calibration and equipment maintenance records will also be reviewed at the end of each sampling season to verify that all equipment is in proper working order**.**

DATA GENERATION AND ACQUISITION

Sampling Process Design

Each group that generates data must prepare a sampling and analysis plan or a basic monitoring plan that documents the logic for selecting sampling locations, sampling time and frequency, and reporting audiences. Their monitoring plan should also describe the study purpose, the total number of monitoring locations, what parameters will be measured at each site, and when samples will be collected. Parameters collected may include any parameter described in the New Mexico Watershed Watch Workbook (2002) or in this QAPP.

The number of sites sampled per school or watershed group depends on the proximity of sites to the school, safe and legal access, and school scheduling flexibility. Local watershed groups should take the lead in selecting sites that contribute to a better understanding of watershed

conditions, complement existing monitoring efforts, or address trends in resource conditions related to restoration projects or TMDL implementation.

Sampling Method Requirements

The goal of meeting watershed group data needs is one reason why River Source places a strong emphasis on data quality and the collection of scientifically sound data. Parameters are collected that complement and supplement outside sources of data. Field measurements for the Watershed Watch Program minimally include pH, water temperature, total dissolved solids, turbidity, and river stage or estimated discharge. Sampling by watershed groups may include these parameters plus others such as cross-sections and vegetation transect measurement of cover and species composition. The Rio Puerco Monitoring Workbook and New Mexico Watershed Watch Workbook establish the protocols for data gathering for all parameters except the longitudinal profile which is documented in Harrelson (1994).

These protocols are summarized below.

Water quality measurements including turbidity, total dissolved solids, pH, temperature, and dissolved oxygen will be collected at 50% of the depth below the surface of the deepest section of the stream at each sampling site or in specifically identified microhabitats to obtain a representative sample. Turbidity will be measured via a Hach 2100P turbidimeter. Oakton and HACH handheld meters with temperature compensation and two-point calibration will be used for pH and total dissolved solids measurements. Dissolved oxygen data will be measured with Winkler titration (using the LaMotte kit or by a calibrated meter). An alcohol-filled thermometer will be used for temperature measurements.

Water depth or discharge will be collected using a measuring tape and yard stick. The float method will be used as described in the New Mexico Watershed Watch Workbook (2002) or in current revisions of field sheets and guidance. Discharge data will also be collected via web-based access from the USGS gaging stations where available. Rating curves to estimate flow will be developed by River Source or its partners as schedules and budgets allow.

Benthic macroinvertebrate samples will be collected following the protocols from the New Mexico Watershed Watch Workbook (2002) except for the selection and number of riffle kicks used for collecting bugs. Most rivers with habitat dominated with riffles will have four samples collected in two slow and two fast areas and then composited into one sample. Microhabitat samples will also be collected from places such as pools and underneath overhanging banks with school groups monitoring larger rivers or if schools looking at riffle-dominated streams have extra time. 500 micron (µm) mesh is used for all sampling nets and or sieve buckets. Samples will be stored in wide mouth mason jars and ethyl alcohol for up to 2 years. All sampler nets and sieve buckets need to be thoroughly rinsed and examined for clinging organisms between sampling events. All boot waders, sampling nets, gloves and brushers should also be decontaminated with chlorine bleach in between uses to prevent the spread of whirling disease.

Photopoints and general observations will be recorded once per year at a minimum to document changing conditions through the years. A Picture Post, either permanent or temporary, will be set up at each site to aid in repeat photos. The guidance for setting up, taking, repeating and

managing photopoint data can be found in Photopoint guidance v 1.2 at http://riversource.net/wp-content/uploads/2013/01/Photopoint-Setup-Data-Mgm.pdf. Digital photopoints are strongly recommended instead of photopoints on print media. In 2019 River Source is moving towards using the PicturePost methodology when permission is given for installing a fixed location.

Channel cross-section samples will be collected using nylon construction string pulled tightly between two rebars that have been leveled using a line level, steel carpenter's level with a built-in laser, or a laser level and stadia rod. The string will be tied 0.1 feet from the top of each rebar. Measurements will be taken from the left rebar to right rebar. The elevation of the soil to the string will be recorded at the rebar on left bank then proceed to the right bank pin. Each major break in channel shape will be measured, including the depth of the thalweg and the estimated height of the floods that occur frequently enough to shape the lowest terrace.

Sinuosity samples will be collected using a measuring tape laid along the thalweg between rebar monuments set at the top of the project and the bottom of the project. The top and bottom of the project will be identified with rebars set on right and left banks, a paired set of two rebars at the top and another set at the bottom of the project. A line will be pulled between the paired rebars at both the top and bottom, creating two lines run perpendicular to the channel direction and intersecting the thalweg at two locations. Then a measuring tape will be placed in the thalweg and laid in the thalweg to measure the length of the channel between the thalweg positions at the top and bottom of the project. The valley length will also be measured. Sinuosity will be calculated by dividing the channel length by the valley length.

Longitudinal profiles will be collected using a measuring tape, laser level, and stadia rod with the top and bottom of the reach identified with rebar monuments set in the same way as with sinuosity sampling. A benchmark monument set deep with a 3-foot rebar or an existing feature such as large rocks will be used to establish a reference point to link data gathered at different survey dates. The longitudinal profile will be started from a fixed point at the top of the project using a paired set of rebars. Measurements of elevation will be taken at stations of importance such as the location of restoration structures and the tops and bottoms of pools and riffles. River Source or BLM staff will always take the measurements or directly supervise project implementers in taking this data.

Vegetation canopy gaps will be collected using measuring tapes laid on the ground between points fixed by rebars. Observers will use a pin flags and start from the zero end of the transect and measure all soil gaps greater or equal to 0.5 feet or 6 inches.

Vegetation cover & functional group composition will be collected using measuring tapes laid on the ground between points fixed by rebars. Observers will walk from the zero end of the transect and take measurements every 2.5 feet or at smaller intervals depending on the project implementer's monitoring plan. The pin flags are dropped at each designated point and all plants, litter and soil touching the pin flag get identified to the functional group level starting with the topmost level. River Source staff will sample at least one site each year to the species level with a professional botanist.

Sample Handling and Custody Procedures

Macroinvertebrate samples will be preserved in the field and returned to the lab for identification and storage except where teachers choose to return an unpreserved sample back to the waterbody. Benthic macroinvertebrate samples that are not preserved and analyzed in the lab will not be reported. Field preservative should be decanted off and replaced with fresh preservative within a week of collecting the sample. The bottles should be marked according to the protocols described in the Watershed Watch Workbook. Macroinvertebrate sample jars will be labeled with a permanent pen on the outside with site name, date and time of collection, collectors, and sample jar number. The same information should be written on a piece of paper, in pencil and inserted into the jar. Transport of the samples to a laboratory conducting taxonomic work should be pre-arranged if this level of analysis is funded in the future.

Vegetation samples taken by monitoring participants will be kept flat and placed in a plastic ziplock bag along with an identification sheet, and handled carefully to prevent bending or breaking. Samples with field notes will be taken to the offices of River Source or monitoring technical advisors for identification. An identification sheet will be completed after positive identification by a professional botanist. The sample will be kept at the school, watershed group office, or at the office of the professional botanist.

Table 3: Sample container, holding times, and preservation

Parameter	Container	Volume	Preservation	Holding Time
Benthic macroinvertebrates	wide mouthed bottle	1 L	Ethanol	6 weeks
Temperature	in-stream or in sample container	NA	None	immediately
Total dissolved solids	in-stream or in sample container	250 mL	None	immediately
Dissolved Oxygen	BOD bottle, P	300 ml	None	immediately
Photopoints	Camera, digital or 35 mm	n/a	n/a	n/a
Vegetation functional group composition	Ziplock bag	1 gallon	n/a	n/a

Sampling Schedule

Schedules are determined by volunteers in conjunction with River Source and Watershed Watch staff, and are documented in the sample plan in accordance with these guidelines.

Table 4: Sampling Schedule

Parameter	Sampling Dates	Special timing or weather conditions
pH, total dissolved solids, turbidity, dissolved oxygen	Monthly	Avoid sampling in high water situations or where ice covers the stream
Photos	Once a year at a minimum	Repeat photography is most effective when the date and time of day is approximately the same each year.
Stream depth or discharge estimates with float method	Monthly	Avoid sampling in high water situations or where ice covers the stream
Stream morphology: Channel Cross-section, sinuosity, and longitudinal profile with laser level	Immediately after BMP implementation within 2 weeks, if possible, for pre-treatment data. Then after monsoons, in September through November, in subsequent years	Monsoons often create the most disturbance in arroyo and river channels. Monitoring in the fall after monsoons typically provides the best timing for seeing BMP effectiveness
Vegetation: Bare soil estimate expressed as percent cover and vegetation cover expressed as percent bare soil & functional groups (trees, shrubs, grasses, forbs)	During the fall (late August through November) or prior to treatment with BMP if necessary for pre-treatment data. Post-treatment monitoring will be done annually in the fall in subsequent years.	Vegetation indicators are best measured after a full growing season.

Analytical Methods Requirements

Standard protocols from the New Mexico Watershed Watch Workbook or Rio Puerco Monitoring Workbook will be used for all parameters except longitudinal profile. Longitudinal profile will be gathered using methods established in Harrelson (1994). Stream temperature, total dissolved solids, turbidity, pH, and dissolved oxygen will be measured streamside. Under some conditions, preserved dissolved oxygen samples may be transported to the lab for titration. Waste generated that contains any of the chemicals from the above tests should be collected in a container clearly marked as hazardous waste and disposed of at appropriate hazardous waste facilities.

Table 5: Analytical Methods and Equipment

Parameter	Method	Units	Equipment
Field temperature	Defined by manufacturer	Celsius	Non-mercury thermometer
Conductivity/total dissolved solids	Wheatstone Bridge	µSiemens /cm converted to mg/L	Oakton TDS Testr
pH	Electrometric	S.U.	Oakton TDS Testr
Stream discharge or stream depth	Velocity – Area	Cubic feet/sec	Yard stick, measuring tape, orange or other appropriate float device
Turbidity	Nephlometric[1]	NTU	HACH 2100P
Benthic Macroinvertebrates	EPA Rapid Bioassess. Protocol	Various	500 µm Mesh rectangular frame or D-frame kick net
Photos	Picture Post	n/a	35 mm camera or digital camera, compass, field form. Picture Post method also used
Channel Cross-section	Rio Puerco Monitoring Workbook, Harrelson (1994)	Decimal feet	Measuring tape, rebar, nylon string, stadia rod, field form, line level or laser level, total station
Longitudinal profile with laser level	Harrelson (1994)	Decimal feet	Measuring tape, laser level, stadia rod, rebar, field form
Bare soil estimate expressed as percent cover	Rio Puerco Monitoring Workbook, Herrick etal (2005)	Decimal feet	Measuring tape, pin flag, rebar, field form
Vegetation cover expressed as percent bare soil & functional groups (trees, shrubs, grasses, forbs)	Rio Puerco Monitoring Workbook, Herrick etal (2005)	Decimal feet	Measuring tape, pin flag, rebar, field form, plant identification keys

Quality Control Requirements

Quality control procedures should follow the recommended list below:

- Duplicate samples (a minimum of two samples per parameter) will be gathered for water quality parameters such as pH, temperature, total dissolved solids, and turbidity on each sample run.
- The height of rebars set for channel cross-sections will be checked by River Source staff at 50% of cross-section transects to assess accuracy of geomorphology measurements.
- River Source will conduct a minimum of one quality assurance audit per year for each school sponsoring the Watershed Watch program.
- Accuracy checks for pH and total dissolved solids will be conducted at the beginning of the day of the sampling event or a day before to confirm accuracy is within guidelines.
- Accuracy checks for turbidimeters and thermometers will be conducted annually in the fall and periodically through the school year to confirm accuracy.

Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Monitoring participants and River Source will follow the maintenance and inspection recommendations below.

Table 6: Equipment Calibration and Inspection

Equipment Type	Inspection /Calibration Frequency	Type of Inspection
pH Meter	Each monitoring day or 1 day prior	Accuracy/calibration, reference solution and storage solution
Conductivity/TDS Meter	Each monitoring day or 1 day prior	Accuracy, cables and batteries
Dissolved Oxygen Kit	Each monitoring day	Glassware & titrator, quantity and expiration of chemicals
Thermometer	Each monitoring day and annual accuracy check	Breaks in fluid continuity and cracks
Turbidity Meter	Once per year calibration with formazin solution plus periodic checks against secondary Gelex standards	Accuracy, batteries and look for scratches on vials
Elevation of cross-section rebars	Once per year prior to taking measurements	SOP for project implementers is to tie string and line level and evaluate if bubble in line level shows that one of the rebars is no longer level with its pair. River Source will check with laser level to see if elevation has changed at 50% of cross-sections at 2 sites per year.
Measuring tapes	Inspect twice per year in	Assess if part of tape is broken or unreadable

Equipment Type	Inspection /Calibration Frequency	Type of Inspection
	first year, once per year in second. No calibration needed	
Stadia Rod	Inspect prior to each site visit	Check base for breaks resulting in loss of rod height.
Laser level	Inspect prior to each field visit. Calibrate minimum of once per year with two peg test	Check for damage. Make sure extra batteries are present. Recalibrate instrument if ± 0.1 feet on a 2-peg test.

Calibration of the instruments will follow manufacturer instructions. Calibration results will be recorded on sampling event field sheets and entered into an Excel spreadsheet template that will be reviewed by River Source immediately if problems are detected or minimally at the end of each sampling season (typically June of each year).

Data Acquisition Requirements

To assist in analysis and decision-making, outside sources of data will be accessed to obtain historical or supplemental information. These data may include information regarding land use, precipitation, flow volume, soil characteristics, ecoregion values, and water quality designated use standards. Supplemental data sources may include:

- U.S. Geological Survey
- New Mexico Environment Department
- Watershed Groups
- Natural Heritage New Mexico of the University of New Mexico

Latitude and longitude for each site can be determined using, in order of preference: a GPS set to a known datum (preferably UTM, NAD 27), USGS 7.5 minute topographic maps, or Google Earth. Whichever method is used at a site, it is critical that the method be reported with the latitude and longitude values with decimal degrees in order to have accurate coordinates.

For macroinvertebrate sample analysis and assessment, pollution tolerance values assigned to organisms and metric calculation formulas can be obtained from documentation provided by state water quality agencies or Dr. Gerald Jacobi.

Streamflow and weather data will be retrieved online or by contacting directly the USGS at http://waterdata.usgs.gov/nm/nwis/rt. The quality of all data collected will be assessed and referenced in any reports or presentations.

Data Management

River Source monitoring forms and data management spreadsheets can be found on the River Source website (http://riversource.net/downloads-data/). Watershed Watch data generators and River Source staff upload data to http://watershedwiser.org/projects/nm-watershed-watch. Data generators are asked to do a 10% check on all values entered to ensure the reliability of the data.

Data will receive final review and verification by the participating schools, watershed group monitoring staff, and local cooperators at the end of the sampling season. A final report will be prepared starting in August of each year, quality checked and given to data users by the following January. River Source will maintain a master dataset of all project datasets. Quality assured data will be posted on www.WatershedWiser.org to allow for wider access. The website will include interactive maps of the sampling sites and background information on each monitoring plan.

River Source monitoring participants are responsible for reporting their data to local watershed groups and other interested parties to encourage the development of a learning community on watershed health. Reporting templates for organizing and presenting data can be found via the downloads page on the River Source website (www.riversource.net).

ASSESSMENT AND OVERSIGHT

Assessment and Response Actions

Watershed Watch teachers, watershed group monitoring staff, and students who generate data will be responsible for all field activities. If problems arise, the local field team leader should contact River Source and/or the local cooperators immediately to inform them of the nature of the problem and take actions necessary to address the problems. River Source will verify if appropriate corrective actions were taken or provide further assist in troubleshooting and correcting the situation. The monitoring participant will document the situation and the corrective actions taken.

River Source will oversee and monitor the quality of field sampling and data collection activities at each of the monitoring participants' sample runs a minimum of once a year to ensure that the procedures specified in the QAPP and monitoring procedures in the Watershed Watch workbook and training materials are being followed.

Monitoring participants will determine *accuracy* for pH, turbidity, and total dissolved solids by measuring standards before each sampling event. Deviation from the standard will be compared to defined accuracy ranges to assign an accuracy classification for samples collected on that day for each parameter.

Duplicate sample results will be used by monitoring participants to determine the *precision* of water quality measurements for each sampling event. Participants will compare differences between duplicate values against defined precision requirements shown on the back of field data

sheets and make a determination in the field to assign data precision classifications. Data precision levels will be assigned on the field data sheets by the lead teacher.

Comparison between macroinvertebrate field and lab duplicates will be used to assess sampling and sub-sampling variability, respectively. Re-identification of macroinvertebrates by an experienced student of taxonomy or a taxonomist will assess variability between taxonomists.

River Source and the local sponsor of the monitoring work will be responsible for reviewing the entire monitoring project on a regular basis. They may also receive guidance and advice from state agencies and local experts. River Source or the local watershed group and/or lead teacher will coordinate the training of all volunteers before any monitoring activities are done, and schedule refresher training sessions as needed.

Quality assurance audits will be performed by River Source annually and any/all identified procedural problems will be corrected based on the recommendations by the local watershed group or lead teacher.

Reports to Management

Each sampling and analysis plan (monitoring plan) prepared by the school or watershed group should identify how the results of quality control tests and other project assessments will be reported including to whom the information will be reported and when. Reporting should include the following:

- Local monitoring participants will conduct accuracy and precision tests before sampling and report the results on the field sheet unless noted otherwise in their monitoring plan.
- Performance assessment results conducted by the River Source staff will always be communicated immediately to field staff and the project manager.

River Source will prepare an annual report sharing data that has been collected and quality assured by January of each year. This report will be made as an Excel spreadsheet and a summary table with web links to fisheries staff and outreach/education staff of the New Mexico Department of Game and Fish and staff of the Surface Water Quality Bureau of the New Mexico Environment Department.

DATA VALIDATION AND USABILITY

Data Review and Validation

Data quality will be assessed by comparing entered data to original data with any errors being corrected as they are found. An assessment of field duplicates (when students take multiple measurements of the same parameter) will also be performed by the Watershed Watch school teams with data found outside of the quality control limits identified in the Measurement Quality Objectives flagged for further review. River Source and its advisors will perform a final data review and validation with outliers, inconsistencies, and decisions made regarding their use documented.

Validation and Verification Methods

The methods for validating and verifying data quality should include:

- Review of field data forms at the end of each day for completeness and reasonableness (field samplers and team leaders).
- Review of database values before conducting analysis and presentation.
- Compare raw field data values and rebar elevation data to past data in-field or upon returning to office.
- Compare summary values of data with past summaries.
- Data input from cross-section and longitudinal profile data will be verified by first evaluating the reasonableness of the graphed data. If the graphed data appears incorrectly entered, data entry from the field sheet will be validated. If consistent data entry problems are found the validity of a minimum of 10% of the data will be verified.

Reconciliation with Data Quality Objectives

As soon as possible after sampling events, calculations and determinations for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet the project's specifications, data should be flagged on field sheets. Re-sampling may occur. The cause of the failure should be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling personnel error, the project implementers will be identified for retraining at future trainings. If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, then this QAPP will be revised.

REFERENCES

Harrelson, C.C., Rawlins, C.L., and Potyondy, J.P., 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. U.S.D.A. Forest Service, General Technical Report RM-245.

Herrick, Jeffrey E., Justin W. Van Zee, Kris M. Havstad, Laura M. Burkett, and Walter G. Whitford. 2005. Jornada Experimental Range, USDA. Summary can be found online at http://Watershed Watchw.uapress.arizona.edu/books/bid1612.htm

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. USDA Forest Service, R1-75-002. Washington, D.C.

Rosgen, D. and Silvey, L. 1996. Applied River Morphology. Wildland Hydrology.

ATTACHMENTS

Attachment 1: List of current local field sampling sponsors and partners (Watershed Watch teachers, watershed groups, and government agency staff).

2018-2019 River Source Sponsoring Schools, Teacher, and Monitoring Location		
January 14, 2019		
School	**Contacts**	**Monitoring Locations**
Bosque School	Jim Daly	East Fork Jemez, San Antonio, Las Huertas
Reserve High	Katie Skaggs	Tularosa
Cottonwood Valley Charter School	Carly Hume	Rio Grande at Socorro
SF Girl's School	Olivia Messinger	Santa fe River at project preserve
SF School for the Arts and Sciences	Nate Moore	Santa Fe River at BLM
Ruidoso High School	Kala Scarafiotti	Bogs Springs in Ruidoso
Santo Domingo School	Velma Coriz	Rio Grande at SD and Cochiti lake
Cochiti School	Vania Meetze	Santa Fe river at Cochiti
Cien Aguas International	Stephen Phillips	Rio Grande at NHCC
Camino de Paz School & Farm	Patricia Pantano	Santa Cruz
Los Alamos Middle School	Megan Rains	East fork Jemez and Jaramillo at Valles Caldera
Aldo Leopold Charter School	Peter Hurley	Gilla River at Iron Bridge
Rio Rancho High	Scotia Kurowski	Rio Grande at Willow Creek
Mesa Vista High	Victor Jaramillo	Ojo Caliente , Rio Vallecitos
Escalante High	Claudia Reynoso	Chama River
Taos High School	David Gilroy	Red River
Santa Fe Indian School	Mark Ericson. Kai-t Bluesky	Santa Fe River above Calle Debra
May School for Learning	Kathy Hillock	Santa fe River at Calle Debra and Cerro Gordo
Eldorado Middle School	Marion Markham	Galisteo Creek and Pecos River
Questa High School	Santana Santistevan	Red River
Penasco High	Mercela Cordova	Sant Barbara, Rio Pueblo
Capital High	Kelly Phillips	Santa Fe River
Camino Real Academy	Katherine Bueler	Little Tesque at Hyde Park
Milagro Middle School	Aaron Abeyta, Megan Auer	Santa fe River at Patrick Smith and BLM
Monte del Sol	Ty McCormick	Santa fe River
Next Gen Academy	Laura White, Michael Steele	Rio Grande at Valle del Oro
Anansi School and/or Taos Charter	Betsie Kinney	Red River
Desert Academy	Erica Penzer	Arroyo Hondo , Santa Fe River at Patrick Smith
Walatowa Charter School	Kristina Kommander	Jemez River at Jemez Pueblo
Santa Fe Watershed Association/SFPublic Schools	Various	SF River above Nichols Reservoir