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Quality Assurance Project Plan

Water Turbidity in Hangman Creek and the Spokane River

January 2022

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Cover photo: Mouth of Hangman Creek 1/10/2019 by Jule Schultz

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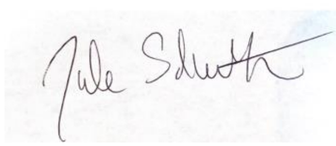
January 2022

Reviewed by: (If not an Ecology publication, modify as needed)

Signature: 	Date: 1/5/2022
Jerry White Jr., Spokane Riverkeeper Signature: 	Date:1/5/2022
Jule Schultz., Spokane Riverkeeper Technical Lead Signature:	Date:
Ecology Program Representative	

1.0 Table of Contents

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2.0 Abstract

Hangman Creek frequently discharges water with high turbidity into the Spokane River. Little is known about the effect of this sediment on the Spokane River, which holds vital redband trout spawning, rearing, and migration habitat. This study aims to engage citizen scientists to measure the water transparency in Hangman Creek and its effect on water transparency on the Spokane River. Volunteers will use Secchi (transparency or turbidity) tubes and a turbidimeter to measure water transparency in Hangman Creek and in the Spokane River above and below the confluence with Hangman Creek. Monitoring will take place between December and June each year.

3.0 Background

3.1 Introduction and problem statement

Sediment pollution in Hangman Creek, also known as Latah Creek, is a well-known and studied occurrence (Joy, 2009). Monitoring throughout the basin shows high levels of sediment and turbidity (See River and Stream Flow Monitoring, WRIA 56), with almost 200,000 tons of sediment exiting the system in a high water year (SCCD, 2002). The Washington State Department of Ecology (Ecology) lists the creek "impaired" for sediment (Joy, 2009), citing sediment loads that violate the designated use of "salmon spawning, rearing, and migration" and increased by land use practices in WRIA 56 (Hangman Creek).

Sediment pollution and the resulting turbidity negatively impacts fish and macroinvertebrates, with the effect compounding with both time and intensity of the event (Berry et al., 2003). Impacts of sediment pollution in Hangman Creek in Idaho show lethal and sub-lethal effects to trout (Peters, Kinkead, and Stanger, 2003). Not surprisingly, most of the Hangman Creek watershed does not contain native redband trout, although records suggest they once thrived there (Joy, 2009). The Spokane River still contains a "fishable" population of native, wild redband trout, although populations of these fish are lower than that of similar rivers in Idaho and Montana (Lee, 2017).

Little is known about the effect of sediment loading from Hangman Creek on the Spokane River. Washington State Department of Ecology currently samples at the mouth of Hangman Creek and downstream of the Hangman mouth at the Spokane River at Riverside State Park and at the Nine Mile Bridge. These data, from monthly sampling events, suggest that turbidity from Hangman Creek influences the Spokane River. Hangman Creek is notoriously flashy watershed, sometimes rising and falling thousands of cubic feet per second in a day, bringing with it the associated sediment. Monthly sampling is not sufficient to capture these flashy events. More frequent sampling will record the intensity and duration of Hangman Creek's sediment plume in the Spokane River. Hangman Creek flows into the Spokane River at Peoples Park, downstream from downtown Spokane. At the confluence during periods of high, turbid flow, the contrast between the muddy waters of Hangman Creek and clear water of the Spokane River is stark. The unmixed turbid waters of Hangman Creek flow over prime spawning habitat for redband trout in the Spokane River (Addley and Peterson, 2011).

The duration and intensity of sediment and the resulting turbidity pollution in the Spokane River may cause adverse impacts to native redband trout, but little is known about these pollution events. High concentrations of sediment coupled with high flows of Hangman Creek can cause high turbidity levels in the Spokane River. These events typically occur during the spring snowmelt season, which coincides with redband trout spawning and rearing. Hangman Creek may also display high sediment concentrations during low flow seasons in late spring due to thunderstorms or heavy precipitation. These events may not pollute the entirety of the Spokane River with sediment due to the high flow of the Spokane River and low flow of Hangman Creek, but will produce measurable turbidity immediately downstream in the Spokane River.

3.2 Study area and surroundings

From *Hangman (Latah) Creek Fecal Coliform, Temperature, and Turbidity TMDL: Water Quality Implementation Plan (In quotations):*
The Hangman Creek watershed "encompasses over 689 square miles (approximately 441,000 acres). Hangman Creek is a tributary to the Spokane River. Past and current land uses within the watershed are varied and contribute to the water quality problems. Water quality issues such as stormwater runoff; sedimentation; streambank erosion; urban development; wetland destruction; and agricultural and forestry practices are all major concerns for the area.

Agriculture has been the dominant land use in the Hangman Creek watershed since the early 1900s. By the early 1920s, a significant portion of the farmable land had been cleared and cultivated for the production of wheat, barley, peas, and lentils. Thousands of acres of forest and riparian areas were cut and cleared (see "Historic Hangman Creek Vegetation" section). Miles of stream channel were straightened, and new ditches were dug to drain wetlands and quickly move water off the farm fields.

These modifications, along with stream meander cutoff by roads, changed the watershed's hydrological response. The system became stressed with heavy sediment loading, poor water quality, and accelerated streambank erosion. The altered hydrology produces flashy, and sometimes damaging stream flows during the winter and spring months. Peak winter and spring flows are generally 4,000 to 10,000 cubic feet per second (cfs), with flows up to 20,000 cfs. During the summer months, the baseflow decreases significantly throughout a majority of the watershed (daily average flows of less than one cfs have been recorded)."

The Hangman Creek watershed contains steep, highly erodible soils that produce a flashy hydrograph, especially during rain on snow events. This combined with the lack of ground cover causes highly turbid water in the creek and to enter the Spokane River.

Figure 1. Map of larger study area

3.2.1 History of study area

See section 3.2

3.2.2 Summary of previous studies and existing data

From section 3.1: Sediment pollution in Hangman Creek, also known as Latah Creek, is a well-known and studied occurrence (Joy, 2009). Monitoring throughout the basin shows high levels of sediment and turbidity (See River and Stream Flow Monitoring, WRIA 56), with almost 200,000 tons of sediment exiting the system in a high water year (SCCD, 2002). The Washington State Department of Ecology (Ecology) lists the creek "impaired" for sediment (Joy, 2009), citing sediment loads that violate the designated use of "salmon spawning, rearing, and migration" and increased by land use practices in WRIA 56 (Hangman Creek).

3.2.3 Parameters of interest and potential sources

From Hangman (Latah) Creek FC, Temperature, and Turbidity TMDL: WQ Improvement Report: "Turbidity and suspended solids have been longstanding problems in Hangman Creek. In 1980 and 1988, Hangman Creek Water Quality Index scores were among the worst in the state for turbidity and suspended solids (Singleton and Joy, 1981; Hallock, 1988). Naturally eroding streambanks and upland soils in various parts of the watershed have been further destabilized by poor road building and agricultural practices (Figure 3 and Figure 25). The sediment that reaches the streams and its associated turbidity degrade aquatic habitats and transport excessive amounts of nutrients in Hangman Creek and the Spokane River."

3.2.4 Regulatory criteria or standards

Hangman Creek and the Spokane River's aquatic designated use are "salmonid spawning and rearing", imparting protections described below. . From McCarthy, S. and N. Mathieu, 2017:

"The state established turbidity criteria in the State Water Quality Standards primarily to protect aquatic life. Two different turbidity criteria are established to protect six different categories of aquatic communities [WAC 173-201A-200; 2003 edition].

> • To protect the designated aquatic life uses of "Char Spawning/Rearing," "Core Summer Salmonid Habitat," "Salmonid Rearing and Migration" and "Non-anadromous Interior Redband Trout," turbidity must not exceed: (A) 5 NTU over background when the background is 50 NTU or less; or (B) a 10% increase in turbidity when the background turbidity is more than 50 NTU.
>
> • To protect the designated aquatic life uses of "Salmonid Rearing and Migration Only" and "Indigenous Warm Water Species" turbidity must not exceed: (A) 10 NTU over background when the background is 50 NTU or less; or (B) a 20% increase in turbidity when the background turbidity is more than 50 NTU.

The effects of suspended solids (a correlate of turbidity) on fish and other aquatic life can be divided into four categories:

- Acting directly on the fish swimming in the water and either killing them or reducing their growth rate, resistance to disease, or other normal functions.
- Preventing the successful development of fish eggs and larvae.
- Modifying natural movements and migrations.
- Reducing available food."

Suspended solids may also serve to transmit attached chemical and biological contaminants to water bodies where they can be taken up in the tissue of fish. This can affect the health of humans or wildlife that eat the fish. Turbid waters also interfere with the treatment and use of water as potable water supplies and can interfere with the recreational use and aesthetic enjoyment of the water.

4.0 Project Description

Little is known about the effect of sediment loading from Hangman Creek on the Spokane River. Citizen scientists will collect water transparency readings and samples to determine the impact of sediment from Hangman Creek on water clarity in the Spokane River.

The goals of this project are:

- Involve and educate citizen scientists on the impact of Hangman Creek to the Spokane River.
- Collect water turbidity and transparency data in the Spokane River to build support for a complete evaluation (e.g. in situ turbidity loggers) of the impact of Hangman Creek on the Spokane River.
- Collect data for a report to distribute to the public and regulatory personnel.
- Enter data into Ecology's Environmental Information Monitoring (EIM) database.

Volunteers will collect samples for turbidity reading and use a transparency tube at three locations in Hangman Creek and the Spokane River from December 2018 to June 2019 to collect data. For information on how to use a transparency tube, see Appendix A. For information on use of the Hach 2100P Turbidimeter, see the online manual located at: https://www.hach.com/2100p-portable-turbidimeter/product-downloads?id=7640450099 Volunteers will also photograph the mouth of Hangman Creek to record visual evidence of sediment pollution. Volunteers will collect data on flow and weather conditions as well. Data will be collected as many times as possible, with volunteers signing up before hand to avoid targeting events and multiple samples per day. Data will be entered into a database at https://spokanefallstu.org/spokane-river-sediment-study/.

Samples will be taken in Hangman at the 11th Street Bridge and in the Spokane River at Sandifur Bridge and below the TJ Meenach Bridge. Turbidity will be determined using both a transparency tube (recorded in centimeters) and a handheld turbidimeter.

The transparency tube functions as a modified secchi disk, with a black and white disk located at the bottom of clear tube. The volunteer will fill the 60 cm tube with water, look into the opening of the tube from above, let out water by releasing the stopcock until the disk is visible, and record the height of water remaining in the tube (photo at right).

Samples for lab turbidity readings will be taken alongside the transparency tube readings. Volunteers will label and fill Whirl-Pak bags with sample water and drop them off at for analysis when the turbidity tubes are returned. Spokane Riverkeeper staff and trained volunteerswill pick up the samples and run them on the turbidimeter. Samples will be run within 48 hours of sampling.

Readings from Sandifur Bridge samples will be compared to readings from the TJ Meenach samples to determine the effect of Hangman Creek on the Spokane River.

In locations where the river/creek is not accessible from land, a jar/bucket will be lowered into the water with a rope off of a bridge. Water will be hauled up in the container and analyzed for turbidity.

To complete a sampling run:

1. Pick up and return transparency tube, four Whirl-Paks and sample bottle from 1004 N Summit inside gate to house off driveway (will be in grey tub near or strapped to fence inside the gate).
2. Drive to photo point at corner of Summit and College and take photo of mouth of Hangman Creek.
3. Drive to TJ Meenach and take water sample and transparency reading of Spokane River (see below for instructions), record data.
4. Drive to Peoples Park and take water sample and transparency reading of Spokane River below Sandifur Bridge (upstream of Hangman Creek), record data.
5. Drive to 11th Street Bridge in High Bridge Park and take water sample and transparency reading of Hangman Creek, record data.
6. Drive to Riverside Memorial Park (cemetery) and take water sample and transparency reading of Spokane River below Sandifur Bridge (upstream of Hangman Creek), record data.
7. Enter transparency data at https://spokanefallstu.org/spokane-river-sediment-study/
8. Fill out data sheet. This data sheet serves as a “chain of custody” form, certifying you took the samples and dropped them in the locked cooler.
9. Return sampler to 1004 N SummitPlace samples in cooler. Use combination to unlock cooler.

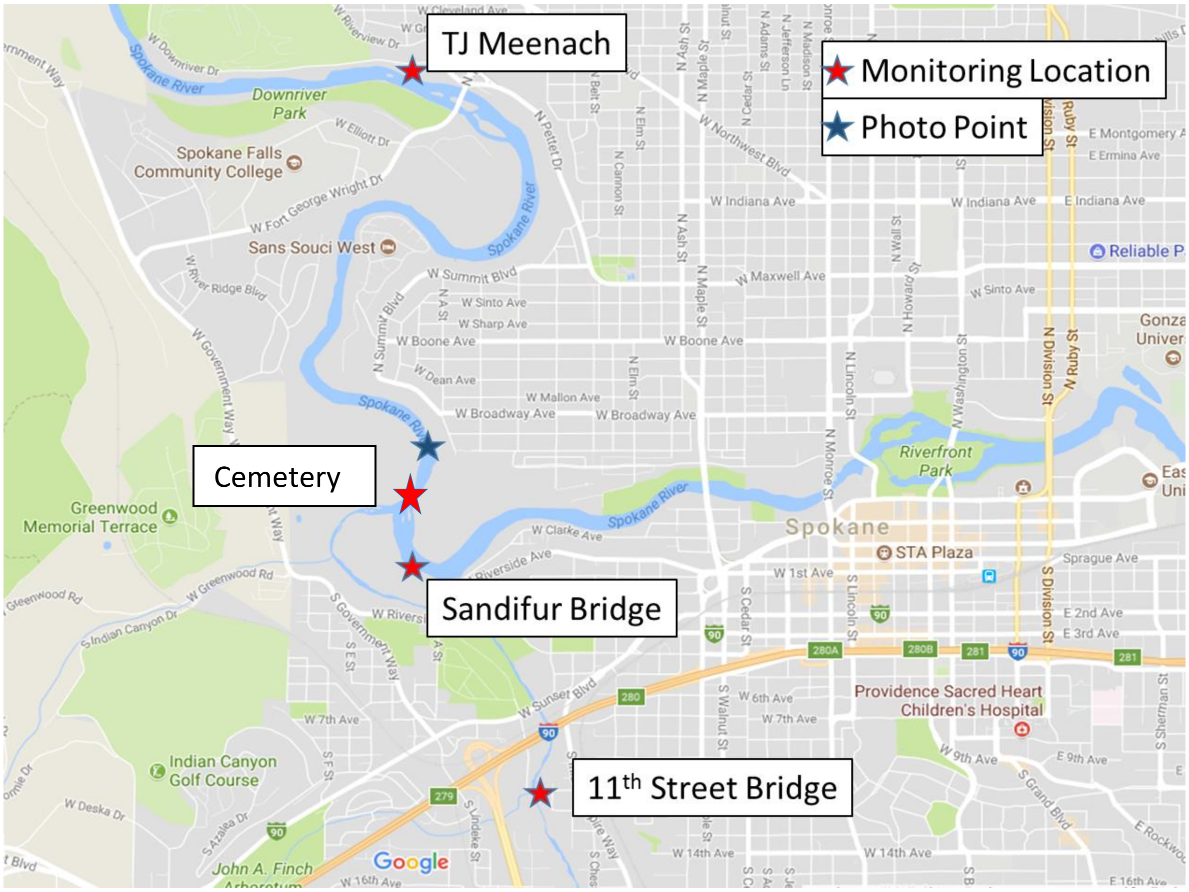


Figure 2. Map of Sampling locations

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 1. Organization of project staff and responsibilities.

Staff	Title	Responsibilities
Jule Schultz Spokane Riverkeeper 509-464-7632	Technical Lead	Study Lead, report writer, organizer, data entry into EIM, sample analysis
Josh Abel Spokane Fall Trout Unlimited	SFTU Board	Web Layout and database management

Staff	Title	Responsibilities
Riverkeeper Science intern or volunteer	RK Intern	Data management, error checking, data verification, sample analysis

5.2 Special training and certifications

All volunteers will participate in a training session with Jule Schultz prior to data collection.

5.3 Organization chart

Not applicable, see Table 1.

5.4 Proposed project schedule

- December-January: Volunteer Training
- December-June: Data Collection
- Fall: Data analysis and final report

5.5 Budget and funding

The Spokane Riverkeeper received funding from the Charlotte Y. Martin Foundation to perform this study. The budget consists primarily of staff time for organizing, training, and report writing. A small equipment and travel budget is included in the grant. The grant can be available if requested. No funding is available for volunteer samplers or citizen scientists for time or travel. Sampling requires no lab fees. Turbidimeters were donated by the Coeur d'Alene Tribe of Indians and Spokane Falls Trout Unlimited.

6.0 Quality Objectives

6.1 Data quality objectives

The overall data quality objectives of this study are to take water samples in Hangman Creek and the Spokane River and measure the turbidity (water clarity) of these samples. These samples will be taken at least twice/week, which is the estimated minimum frequency estimated to measure sediment pollution in this flashy watershed. Measurement quality objectives (MQOs) describe acceptable levels of error and variability in measurement processes and measured results. Indicators of data quality include precision, sensitivity, bias, representativeness, comparability, and completeness.

6.2 Measurement quality objectives

The use of a transparency tube is a reliable method for estimating turbidity (Dahlgren et al., 2004). Dahlgren et al. shows that transparency significantly correlates with turbidity. Furthermore, transparency shows reliable measurements between samples and samplers, with a 3-5% error for both. As stated in the SOP (Appendix A), all samplers will be trained and measurements will be taken in the shade to reduce glare off the sample.

6.2.1 Targets for precision, bias, and sensitivity

Table 2. Measurement Quality Objectives

Parameter	Method	Field Duplicates	Sensitivity	Max
Transparency	Transparency Tube	10% samples or 10 replicates 90% samples within 5%	0.2 cm	60 cm
Turbidity	SM 2130	10% samples or 10 replicates 90% samples within 5%	0.01 NTU	1000 NTU

6.2.1.1 Precision

Precision refers to the degree of variability in replicate measurements. In this study 10% or at least 10 samples will be field duplicated. In the field, two separate samples will be taken, measured, and recorded by the same person. Variability of 3-5% are assumed, but if the duplicate numbers exceed this, it will be noted in the final report.

6.2.1.2 Bias

No calibration of the transparency tube is possible, although certain procedures are used to reduce error in measurements. All samplers will be trained to reduce bias. In general, bias will be held to the same standard as precision, with a 3-5% error acceptable.

The turbidimeter will be calibrated once following to manual instructions at the beginning of the sampling period using premixed calibration solutions. The unit has a stated accuracy of +/- 2%.

6.2.1.3 Sensitivity

The turbidity tube is has 0.2 cm increments marked on it from 0 to 60 cm. The stated resolution of the turbidimeter is 0.01 NTU.

6.2.2 Targets for comparability, representativeness, and completeness

6.2.2.1 Comparability

Standard operating procedures are listed in Appendix A and at https://www.hach.com/2100p-portable-turbidimeter/product-downloads?id=7640450099

6.2.2.2 Representativeness

The samples will be pulled directly from the river. The sediment in Hangman Creek tends not to settle out due to the fine nature of the particles, so pulling samples from the shoreline is representative of the entire river. The sample site downstream from Hangman Creek in the Spokane River at TJ Meenach Bridge is located sufficiently downstream to ensure complete mixing. The sample location 1000 feet downstream of the mouth of Hangman Creek, on the west bank of the Spokane River, does not contained well mixed water. However, because it is outside of the mixing zone required by WAC 173-201A-200 (1)(e)(i) A-C), turbidity standards should apply.

The sampling strategy requires volunteers to sign up in advance, assuring that no storm events are targeted. The target is to sample twice/week, although in many cases volunteers sample more frequently. Hangman Creek is a flashy system, however, due to the long travel time of sediment down the creek (up to 5 days), time of day and other factors will not make a difference in results.

6.2.2.3 Completeness

No process exists for accepting or rejecting sample data based on data quality, due to the nature of the sampling. However, the project will be viewed as a success if we collect over 2 samples/week. This number is what we view as the minimum resolution to determine the true water clarity of Hangman Creek.

6.3 Acceptance criteria for quality of existing data

This project will collect new environmental data for determining water clarity in the Spokane River and Hangman Creek. Currently, turbidity data exists from ambient monthly sampling at Hangman Creek and the Spokane River below Hangman Creek (https://fortress.wa.gov/ecy/eap/riverwq/station.asp?theyear=&tab=notes&scrolly=0&wria=54&sta=first)

6.4 Model quality objectives

N/A

7.0 Study Design

7.1 Study boundaries

The study will be conducted in Hangman Creek and the Spokane River (see Figure 1).

7.2 Field data collection

See Figure 1.

7.2.1 Sampling locations and frequency

Samples will be scheduled randomly, with volunteers signing up as their schedule allows, weeks in advance. See Figure 2 for sampling locations.

7.2.2 Field parameters and laboratory analytes to be measured

Volunteers will monitor water transparency using a turbidity tube and collect samples for analysis of turbidity by the Riverkeeper. Data will be recorded in centimeters to the nearest 0.2 cm and turbidity to the nearest 0.01 NTU.

7.3 Modeling and analysis design

N/A

7.4 Assumptions in relation to objectives and study area

We assume that water clarity taken from the shore is similar to that taken mid river at the TJ Meenach sample site. The “cemetery” sample site does not contain well mixed water, but according to WAC 173-201A-200 (1)(e)(i) A-C) is outside of the mixing zone.

7.5 Possible challenges and contingencies

Safety of volunteers is the primary concern in the study. Walking on snowy or icy river banks could prove hazardous. Volunteers have been advised not to sample if dangerous conditions exist.

7.5.1 Logistical problems

Coordinating volunteers will be the biggest logistical concern. We’ve developed a sign up calendar (https://www.signupgenius.com/go/5080d49a5a62fabf58-signup) to coordinate volunteers so that resources can be used appropriately and samples aren’t duplicated.

7.5.2 Practical constraints

The main constraint will be recruiting volunteers for the study. However, social media, email, and word of mouth are effective tools for recruiting volunteers.

7.5.3 Schedule limitations

The issues described above may reduce the number of samples taken. A reporting process is in place to record each sample and communicate the results with the project lead.

8.0 Field Procedures

8.1 Invasive species evaluation

The study exists within a connected, small portion of the watershed.

8.2 Measurement and sampling procedures

See Appendix A.

8.3 Containers, preservation methods, holding times

N/A

8.4 Equipment decontamination

N/A

8.5 Sample ID

N/A Samples will be analyzed and read in field.

8.6 Chain-of-custody

Samples will be taken in Whirl-Pak bags labeled with location, date and time. Samplers will record the location, time, date, and any weather conditions of the sample on the sample form with permanent ink (Appendix A). The bags will be dropped in a locked cooler kept at under 4C with ice.

8.7 Field log requirements

A field data sheet is provided to samplers that will be used to record data and observations.

8.8 Other activities

All volunteers will be trained in all aspects of the study, including sampling, sample location and safety.

9.0 Laboratory Procedures

We will be analyzing turbidity samples with our a Hach 2100P and 2100Q mobile turbidimeters, allowing readings both in the field or in the office. Within 48 hours of sampling, the filled Whirl-Paks will be analyzed with our turbidimeters. Instructions for use are located at https://www.hach.com/2100p-portable-turbidimeter/product-downloads?id=7640450099.

10.0 Quality Control Procedures

Quality control of data will be addressed through duplicate measurements, field staff training and observing samplers, and weekly review of data.

10.1 Table of field and laboratory quality control

Samples measurements will be duplicated in the field to analyze variability in reading the turbidity tube. Samples will be duplicated in the field (samples taken from same location twice during event) to analyze environmental variability. Approximately 10% or 10 samples will be duplicated.

Secondary calibration standards (Hach Gelex standards) will be used to calibrate the instrument and check for instrument drift prior to each set of sample measurements.

10.2 Corrective action processes

If a sampler or group of samplers have been incorrectly collecting water transparency data their data will be discarded and not used in the analysis.

Samples analyzed after the 48 hour holding period will be entered into EIM, but noted with a

11.0 Data Management Procedures

11.1 Data recording and reporting requirements

Electronic data will be cross checked in the database with field data sheets by the project manager. Raw turbidity data will be entered into EIM.

11.2 Laboratory data package requirements

N/A

11.3 Electronic transfer requirements

N/A

11.4 EIM/STORET data upload procedures

All water quality data will be entered into EIM, following all existing Ecology business rules and the EIM User's Manual for loading, data quality checks, and editing.

11.5 Model information management

N/A

12.0 Audits and Reports

12.1 Field, laboratory, and other audits

The Spokane Riverkeeper will accompany field samplers when requested to double check their readings.

12.2 Responsible personnel

See above.

12.3 Frequency and distribution of reports

The report summarizing the study will be written after the study ends in June of each year. .

12.4 Responsibility for reports

The Spokane Riverkeeper will author the report.

13.0 Data Verification

EPA defines data verification as "the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements."

Data verification and review is conducted by the project lead at the Spokane Riverkeeper by examining all field and laboratory-generated data to ensure:
- Specified methods and protocols were followed.
- Data are consistent, correct, and complete, with no errors or omissions.
- Data specified in the Sampling Process Design section were obtained.
- Results for QC samples, as specified in the Measurement Quality Objectives and Quality Control, accompany the sample results.
- Established criteria for QC results were met.
- Data qualifiers (QC codes) are properly assigned.

13.1 Field data verification, requirements, and responsibilities

The Spokane Riverkeeper staff will examine field data to ensure that MQOs have been met.

13.2 Laboratory data verification

N/A

13.3 Validation requirements, if necessary

N/A

13.4 Model quality assessment

N/A

14.0 Data Quality (Usability) Assessment

14.1 Process for determining project objectives were met

The project objective will be met if approximately two samples per week are taken over the course of the study that meet data quality objectives. Data will be rejected if they are out of the measurement range (0-60 cm).

14.2 Treatment of non-detects

Turbidity samples read on the turbidimeter as zero will be entered as such.

Transparency data over 60 cm will be recorded as >60 and analyzed as 60 cm. In the analysis this will be recorded as a non-detect and summarized as such (e.g. turbidity was detected in xx% of samples).

Data Entry Qualifiers:

REJ: If samples are read on the turbidimeter 48 hours after sampling, they will be entered in EIM with the "REJ" qualifier and a "48 hr. holding period exceeded" will be entered into the "Result_comment" field.
FI: Ice impacted sample when a sample has ice in it

14.3 Data analysis and presentation methods

Transparency data will be graphed over time, flow, and compared to turbidity in NTUs measured from the duplicate samples. Percent of samples with measured turbidity will be calculated.

14.4 Sampling design evaluation

The study is designed to collect data at a frequency to look at the effect of Hangman Creek on water clarity in the Spokane River. No statistical tests will be used.

14.5 Documentation of assessment

N/A

15.0 References

Snouwaert, E. and Noll R., 2011. Hangman (Latah) Creek Watershed Fecal Coliform Bacteria, Temperature, and Turbidity Total Maximum Daily Load Water Quality Implementation Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 11-10-012.

Joy, J., Noll, R., Snouwaert, E., 2009. Hangman (Latah) Creek Watershed Fecal Coliform, Temperature, and Turbidity Total Maximum Daily Load: Water Quality Improvement Report. Washington State Department of Ecology, Olympia, WA. Publication No. 09-10-030. www.ecy.wa.gov/biblio/0910030.html

McCarthy, S. and N. Mathieu, 2017. Programmatic Quality Assurance Project Plan Water Quality Impairment Studies. Washington State Department of Ecology, Olympia, WA. Publication No. 17-03-107

Dahlgren, R., Van Nieuwenhuyse, E., and Litton G, 2004. Transparency tube provides reliable water-quality measurements. CALIFORNIA AGRICULTURE, VOLUME 58, NUMBER 3.

16.0 Appendix A

Turbidity sampling: from https://extension.usu.edu/utahwaterwatch/monitoring/field-instructions/turbidity/turbiditytube/index

Turbidity Sampling Instructions

Step 1 - Collect your sample

1. Dip the tube into the water at your sampling site and fill to the top. Be careful to sample flowing water and not the stream bottom. Do not stand upstream from the area you are sampling.

Time – 2 minutes
Persons – 1
Materials – Turbidity Tube

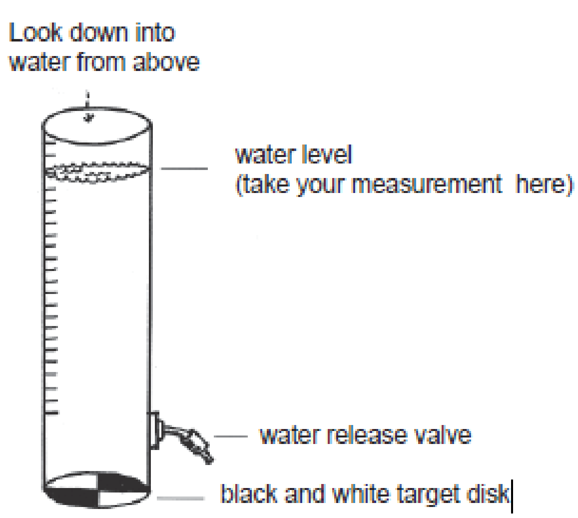
Step 2 - Take your measurement

(see figure below for help)

1. Take your filled turbidity tube to a shaded spot. If there is no shade, use your body to block the sun from shining on the tube.
2. With your hand over the opening, shake the tube vigorously. This will help to re-suspend any sediment that has settled to the bottom.
3. Look down through the tube toward the target disk on the bottom.
   • If the disk is visible, record the water level in centimeters (cm).
   • If the disk is not visible, slowly release water from the release valve until the disk becomes visible. Note the water level in centimeters (cm) on the student worksheet.

Step 3 - Convert from centimeters (cm) to turbidity units (NTUs)

1. Match your turbidity measurement in centimeters to the corresponding NTU using the conversion chart on the back of this page. Record on the student worksheet.



Location	Name	Date	Time	Transparency reading (CM)	Turbidity reading-lab only (NTU) (Riverkeeper use only)	Flow Hangman Creek	Flow Spokane River	Notes (Note Ice in sample or other weather conditions, if sample was not taken due to safety concerns, or if sample was not taken due to frozen creek)
Hangman-11th St.								
Sandifur-Spokane River								
TJ Meenach-Spokane River								
Time and Date placed in cooler:			**Time and Date Sample received (Riverkeeper use only):**					
Hangman-11th St.								
Sandifur-Spokane River								
TJ Meenach-Spokane River								
Time and Date placed in cooler:			**Time and Date Sample received (Riverkeeper use only):**					

Appendix B: Sample data sheet and chain of custody form