Virginia Department of Environmental Quality

Water Monitoring Quality Assurance Project Plan (QAPP) Template

**Remove this page before submitting**

**Purpose and Background:** This template has been developed by the Virginia Department of Environmental Quality (DEQ) to aid in the development of QAPPs as part of the volunteer water monitoring program.

This template is based on [EPA QA/G-5](https://www.epa.gov/sites/default/files/2015-06/documents/g5-final.pdf) and [QA/R-5](https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans) guidance for the development of QAPPs. The language provided is generalized and based on common features of monitoring projects. The specificity and information required in a QAPP is highly project dependent, and as such, this document should be tailored to meet the needs of the individual user/monitoring project.

**Use:** The text highlighted in yellow and in italics are for the purpose of guiding the user and provide context and examples of the requirements for each section. This text should be removed and replaced with text specific to the user’s monitoring project. Examples throughout the QAPP template do not reflect an actual project and are used for general information only.

Before submitting this document for review, please be sure to remove and/or replace all highlighted and italicized text, update the table of contents, and ensure the header information is correct.



**Insert Project Name**

**Quality Assurance Project Plan**

Date

**Insert Organization Information**

Insert contact information for project manager

# PROJECT MANAGEMENT

## Title of Plan and Approval

**Quality Assurance Project Plan**

**Enter Title of Project**

This Quality Assurance Project Plan (QAPP) documents the procedures, roles, and responsibilities associated with this project or special study.

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| --- | --- | --- | --- |
| Title | Name | Approval Signature | Date |
| Insert QAPP applicant project manager title |  |  |  |
| Insert QAPP applicant quality assurance officer title |  |  |  |
| Additional QAPP applicant signatory title remove if not used |  |  |  |
| Insert DEQ project manager title |  |  |  |
| Additional DEQ signatory title remove if not used |  |  |  |
| DEQ Quality Assurance Officer |  |  |  |

Insert Name of Organization

Log of changes

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| Revised by: | Date: | Revision number: | Summary of changes: |
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Updates made to references, typos, and adding clarifications to the language can be described as ‘No major changes’.

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## Distribution List

This section is used to list the major data users, significant staff such as the project manager and QA officer, and major project partners covered by this QAPP.

|  |  |  |  |
| --- | --- | --- | --- |
| **Position Title** | **Name** | **Address** | **Phone/E-mail** |
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## Project/Task Organization

This section is used to identify major participants of the study including the signatories found on page 1. Add additional lines as necessary.

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| --- | --- | --- |
| **Name** | **Project Job Title** | **Responsibility/Duties** |
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## Problem Definition/Background

### Problem Statement

In this section, describe the reason why the group is doing this project. This includes stating the issue of concern, where it is located, and potential sources or areas the study will address.

For example:

*Previous monitoring in Bob’s Creek in Nelson County has shown high levels of E. coli bacteria. Based on looking at aerial photography maps, we suspect the bacteria is entering the water from nearby farm runoff and failing septic systems. By setting up additional sampling stations along the creek, we will be able to identify significant E. coli bacteria sources.*

### Intended Usage of Data

This section covers how the results from the study will be used as well as who will receive the results.

For example:

*We intend to use the data to identify possible pollution sources in Bobs Creek. We will share our findings with the local government, soil and water conservation district, DEQ, and local residents. This data will be useful to target areas for cost share implementation for local farms and provide justification to implement a regular septic pump out and maintenance program.*

## Problem/Task Description and Schedule

### General Overview of Project

This section helps give a brief overview of the project. It is important to include such items as the water quality parameters the group is testing for and the methods to collect samples. In addition, it is good to identify which tests are the most critical and which are of secondary importance.

For example:

*The project will focus on collecting E. coli bacteria grab samples starting in January 2016. Sampling will consist of monthly sampling at 3 locations with sampling ending by December 2016. Monitoring will include secondary field observations such as the appearance and odor of the water being sampled and the amount of rainfall during the previous 48 hours before sampling. These secondary sampling parameters will be used with the bacteria results to gauge when conditions are likely to generate high bacteria levels in the water. Sites are located at bridge crossings or areas where stream access is provided by landowner permission.*

### Project Timeline/Work Schedule

This template uses a table to define specific tasks and division of work for the project. It is highly recommended this is supported with a narrative explanation to define these tasks for each key position.

For example:

*Task 1- The project manager develops the QAPP. The QAPP must describe the whole project in detail and have it approved before the project begins. See page 1 for approval initials.*

*Task 2- The project manager establishes stations and determines sample collection logistics including shipping samples to the laboratory and receiving results.*

*Task 3- The quality assurance officer conducts and oversees new or refresher training of field team members and reviews monthly data.*

*Task 4- Field team leader oversees the field collection staff on collecting field data, and shipping samples to the laboratory for analysis. The sampling procedures are presented in section 2.2.*

*Task 5- The laboratory QA officer will oversee the laboratory analysis of water samples. The laboratory method and laboratory requirements are described in section 2.4.*

*Task 6- The quality assurance officer will validate the laboratory analytical results by assessing for bias, completeness, representativeness, and acceptable levels of precision and accuracy as outlined in section 2.5.*

*Task 7- The project manager will submit the final report when the data have all been collected, validated, approved, analyzed, to the distribution contacts listed in section 1.3.*

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| --- | --- | --- | --- |
| **Task** | **Activity** | **Projected Start Date** | **Anticipated Date of Completion** |
| *1* | *Develop QAPP* | *November 2024* | *December 2024* |
| *2* | *Review and approval of sample sites* | *November 2024* | *December 2024* |
| *3* | *Provide monitor training/certification* | *December 2024* | *January 2025* |
| *4* | *Collect samples* | *January 2025* | *December 2025* |
| *5* | *Oversee analysis* | *January 2025* | *December 2025* |
| *6* | *Review results* | *January 2025* | *December 2025* |
| *7* | *Generate report and submit data* | *February 2026* | *February 2026* |

## Quality Objectives and Criteria for Measurement Data

This section is to summarize how the study will collect quality data that will be used to address the study goals stated in section 1.5.2.

For example:

*Data produced by this survey are used for evaluating the environmental condition of State waters or identifying other water quality problems. Data generated in this survey may be used to make decisions on the sources of the contaminants in the sampled water. Both field and laboratory personnel will work to achieve the highest possible level of confidence in the quality of study results by using established procedures to ensure the accuracy, precision, representativeness, comparability, and completeness of the data.*

### Data Precision, Accuracy, Measurement Range

For DEQ to approve a QAPP the group must use EPA and/or DEQ recognized methods. The website [www.nemi.gov](http://www.nemi.gov) offers free downloads of EPA approved methods and list other recognized methods. Groups can also contact local laboratories, college science departments, or the DEQ QA officer for more information.

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| **Matrix** | **Parameter/Method** | **Measurement Range** | **Accuracy** |
| *Water* | *E. coli: EPA 1103.1*  | *<1 to >2,000 CFU/100 ml*  | *<0.6 Log transformed difference in duplicate samples* |
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### Data Representativeness

It is important that this study produces data representative to actual conditions. In this section, the group should note such items as:

* number of sample sites
* how sites were selected
* specific timeframe samples are collected
* and any reasons why samples are collected under specific conditions.

For example:

*Due to the heavily wooded nature of the watershed, sample sites were selected based on accessibility and safety considerations. Sites will include road crossings and sites adjacent to fields where landowner permission was obtained. Sampling will occur between 10 am to 2 pm to ensure samples arrive in time for analysis by the laboratory. During the study, two targeted samples will occur within 1 hour of the start of a significant rainfall event (estimated >0.1 inches). These samples will compare bacteria levels due to runoff sources and will be marked as targeted samples in the data results so they can be separated from the routine baseline testing results.*

### Data Comparability

In this section, state the methods for testing samples. Include a brief summary of how samples are collected, transported (if going to a laboratory or another location for analysis), methods are used to analyze samples, and significant differences to cited protocols. It is recommended groups include an attachment of their sampling and test methods (known as Standard Operating Procedures or SOP).

For example:

*The bacteria sampling will use standard collection and analytical methods as outlined in EPA method 1103.1. Samples are kept on ice during transport and storage. Due to the delay in shipping samples to a laboratory for processing, samples are processed within 24 hours of collection which is longer than the standard 6 hour holding time stated for the method. Based on a bacteria survivability study done by Virginia DEQ, the delay in processing will have insignificant impact on recovery of E. coli results compared to the method listed six hour holding time.*

*Appendix 1 of this document contains the sampling and testing procedure for E. coli bacteria. Sampling consists of collecting water using standard bacteria sampling techniques and sterile sample bottles. Samples are processed using standard sterile technique. An overview of the method is available at the National Environmental methods Index (NEMI) at* [*https://www.nemi.gov/methods/method\_summary/5581*](https://www.nemi.gov/methods/method_summary/5581)*.*

### Data Completeness

This section is used to determine how much data is needed to represent actual conditions. For most sampling programs, samples should cover a full range of flow conditions. For bacteria and general water column testing (nutrients, dissolved oxygen, pH, etc.), the minimum recommended frequency of sampling is usually monthly. Benthic macroinvertebrate, sediment sampling, or advanced water chemistry (PCB, dissolved metals, etc.) is usually once or twice a year at a site but can be more frequent depending on the study.

Groups should plan to collect extra samples or have enough time set aside during the collection season to reschedule sampling in the event of bad weather or a sample is lost before analysis. Therefore, groups should develop a sample completeness percentage goal. Depending on the sample size, most groups set a goal of 80 to 95% completeness. The monitoring group QA officer and the DEQ QA officer can help set this goal based on the needs of the project. If the sample completeness goal is not met, the final report should note this to inform data users that the study was not complete so results may not represent actual conditions.

Use the table below to define this section.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Number of Samples Planned** | **Minimum Percent Goal**  |
| *E. coli* | *3 stations x 14 samples = 42* | *>90%* |
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## Special Training Requirements/Certification

### Training Logical Arrangements

List the training activities of the group and related staff (e.g. laboratory staff)

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| --- | --- |
| **Type of Training** | **Frequency of Training/Certification** |
| *New/refresher water quality sampler training* | *January of every year during the project phase.* |
| *Laboratory technician proficiency testing* | *June of every year or when a new technician is hired.* |
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### Description of Training and Trainer Qualifications

Field samplers and laboratory staff should receive regular training or recertification to ensure they follow EPA or DEQ recognized methods. Normally, this is accomplished by an annual training or recertification event or individual training of new monitoring or lab staff. Include a summary of what is involved in the training event and who will conduct/oversee the event. This section can refer to a more complete version of training and certification as an appendix but should be summarized in this section.

For example:

*Every year, monitors meet to receive training and recertification. The quality assurance officer verifies sample team collection bottles and equipment distributed to monitors are clean and in good condition. Training is done by sample team members performing a sample collection for the QA officer to review. If necessary, monitors are retrained and scheduled for a follow up field audit to ensure they are performing correct sampling procedures as outlined in field sampling SOP manual found in Appendix 1.*

*Laboratory personnel performing E. coli testing, have their methods evaluated on an annual basis by the laboratory QA officer. This review consists of performing 10 replicate samples to verify E. coli results are within an acceptable range of difference.*

## Documentation and Records

This section deals with how the group will record and store data. This section is broken up into four subsections based on the type of data or forms. Groups can delete any subsections which do not apply with their study.

Please note the amount of time that the group will hold onto the data (usually 3 or more years) and who is responsible for maintaining the data. In addition, include a blank copy of any calibration, field sheets, and related data forms as an attachment to the QAPP.

For example:

*Field and laboratory results are to be submitted to DEQ via the Virginia Data Explorer. In addition, the QAPP and any final reports or conclusions will be provided to each organization representative listed in section 1.3. The below subsections identify the documents and reports to be generated throughout the survey and the information to be included in these documents and reports.*

### Field Documentation

Required subsection for nearly every project as samples are collected in a field setting.

For example:

*The QA officer will receive and enter all the data collected in the field into the database once laboratory results are received. Usually this is within three days of sample submission. In summary, the QA Officer will be responsible for maintaining the following documents:*

1. *Field Data Sheet*
2. *Quality Control Checks for pre- and post-calibration checks of field equipment.*
3. *Sample container labels*
4. *Any other paperwork necessary for shipping or delivering to the laboratory*

### Laboratory Documentation

Applies for projects using a laboratory to perform analysis.

For example:

*Laboratory documentation will include producing and submitting the following information:*

1. *Electronic data submittal of final certified data to project manager*
2. *Printed copies of Certificates of Analysis when specifically requested to do so*
3. *Any other data associated with the measurement process when specifically requested to do so.*

### Audit Reports

The group or laboratory QA officer, or when needed, the DEQ QA officer, will conduct an audit of field collection and/or laboratory audit to ensure samples are being collected and analyzed based on the protocols outlined in the QAPP.

For example:

*Technical system audits will be conducted as needed by the QA officer during field activities by auditing a random field sampler every six months or a specific sampler if problems are suspected. The laboratory QA officer will audit technician performance if problems are identified in the laboratory quality control tests. The auditing procedures are outlined in more detail in Section 3 of this QAPP. The auditors will prepare a report that summarizes the observations and findings of each of these audits. As needed, the audit reports will be supplemented by a corrective action plan, to be implemented as soon as feasible, to correct each observation or finding of erroneous procedures.*

### Data Validation Reports

This subsection is very important when working with parameters that require laboratory analysis or involve complex field sampling protocols such as using field probes. This section summarizes how potentially faulty data is identified and segregated from the rest of the dataset.

For example:

*Only valid and certified data will be transferred to the monitoring group from the laboratory. Data validation flags will be applied to those sample results that fall outside of specific limits and include a description of why the data was flagged. Field data that was collected due to using faulty equipment such as equipment that failed calibration checks will be flagged with a description of why the data was flagged.*

*Periodically, the laboratory QA officer, at the request of monitoring group, will identify biases inherent in the data, including assessment of laboratory performance, and overall precision, accuracy, representativeness and completeness. The data validation report will address whether the quality of the flagged data affects the ability to use the data as intended. As needed, the data validation reports will be supplemented by a corrective action plan, to be implemented as soon as feasible, to correct each observation or finding of erroneous procedures.*

*Section 4 of this QAPP provides more detail on how the data validation process is conducted.*

# DATA GENERATION AND ACQUISITION

A Standard Operating Procedure for each parameter/method that will be collected must be included as an attachment in the appendix unless this QAPP provides thorough step by step procedures for each parameter/method in the following sub-sections.

## Sampling Design

### Rational for Selection of Sampling Sites

The group uses this subsection to identify sampling locations and explain why the sites were selected. The group should summarize any safety or other considerations for selecting the sample site and refer to the sample collection SOP manual which should be included as an attachment to this QAPP.

For example:

*Water quality monitoring to identify bacteria sources will be conducted at 3 stations on Bob’s Creek. The goal of this study is to collect monthly E. coli water quality samples for the year. Sampling sites are located at bridges or areas where landowner permission was obtained and are above confluences with nearby major tributaries. All samples will be analyzed by a contacted laboratory. Stations are listed in section 2.1.2.*

### Sample Design Logistics

The table below is an example and groups can modify or develop a similar table and include it as an attachment to the QAPP. The table must provide a clear description of sample sites using terms that anyone not familiar with the project can locate using Google Maps or similar applications. Good examples use names or route numbers of road crossings or approximate distance from a major tributary or dominant landmark/feature. Latitude and longitude must be in decimal degrees to at least five decimal places using NAD 1983 geographic coordinate system.

Citizen Monitoring Grant recipients can use the monitoring plan developed for their proposal to satisfy the requirements of this section (please attach as an appendix). Coordination grantees must ensure that station lists include the collecting organization, and that those sub-organizations are consistent with the list in section 1.3.

The Environmental Data Mapper is a useful online map application that provide coordinates for sites is available at <https://apps.deq.virginia.gov/EDM/> .

| **Waterbody Name** | **Station ID** | **Description** | **Latitude** | **Longitude** | **Parameter and Frequency** |
| --- | --- | --- | --- | --- | --- |
| *Bobs Creek* | *BC1* | *At Wilson Road bridge* | *37.68142* | *-78.86203* | *E. coli 1/month* |
| *Bobs Creek* | *BC2* | *50 feet above outfall of Nelson Lake* | *37.69391* | *-78.88147* | *E. coli 1/month* |
| *Bobs Creek* | *BC3* | *At private farm access road ~2800 stream feet upstream of railroad crossing* | *37.69907* | *-78.89150* | *E. coli 1/month* |

## Sampling Methods

In the table below, list all water quality parameters, equipment, and sampling methods used. Such equipment may be as simple as collecting a sample using a sample bottle dipped directly in the water to the complex such as an automated sampler collecting samples at specific times at the site. Sampling methods are usually either grab (sampled directly at the stream at a specific time), or composite (multiple samples obtained during the day at the site and combined into one large container for analysis. Include holding times and sample preservation as specified in the parameter method.

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| --- | --- | --- | --- | --- |
| **Parameter** | **Sampling Equipment** | **Sampling Method** | **Preservation** | **Holding Time** |
| *E. coli* | *Sample bottle* | *Grab sample* | *Ice- < 4 oC* | *< 24 hours* |
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## Sampling Handling and Custody

This section applies to projects where samples are taken to another location for testing such as a laboratory. Projects where samples are tested at the sample site will have very little if any sample handling or custody requirements.

For projects where samples are shipped to another location for testing, this section lists what the group will do to ensure the samples arrive to the location that have not been contaminated due to improper handling or storage during transport. NOTE: laboratories which process samples for a group usually have a Chain of Custody (COC) form that should be included as an attachment to the QAPP (see section 1.9.1). At the end of this document is a generic COC form in the event one is needed and not provided by the laboratory. Users can modify this to best suit their needs.

For example:

*Sample bottles are labeled with the station id, date/time of collection, and sampler initials after collection using provided tags. Samples are preserved on ice and transported as described in the SOP manual found in Appendix 1 of this QAPP. Samples are shipped in a sealed cooler to the laboratory using UPS. As samples are shipped in a sealed container, the COC form lists the person who packed the samples in the cooler with the COC form attached to the inner lid of the cooler in a Ziploc bag. Upon reaching the laboratory, the laboratory staff who received the cooler signs the COC form and the sample is handled in accordance with the laboratory sample handling procedures.*

## Analytical Methods

This section goes into more detail than what was provided in subsection 1.7.3. This section provides information on the methods used to analyze the samples. This should include the test methods (EPA 1600 for example) and the equipment used to conduct the study (membrane filter apparatus for example). Organizations can go to [www.nemi.gov](http://www.nemi.gov) to find approved methods for most environmental sampling methods. Laboratories performing analysis should be able to provide the methods and equipment used for samples they process. NOTE that some laboratories may not wish to share their actual methods/procedures due to fear of reveling proprietary information. In such cases, have the laboratory provide a contact if there are questions on procedures.

For example:

*E. coli sample analyses will be conducted using EPA method 1103.1, membrane filtration of E. coli using modified mTEC agar. The analytical procedures and standard test methods used by the laboratory are included in Appendix 2 of this document. Questions on specific laboratory procedures can be directed to the laboratory QA officer using the contact information found in section 1.3.*

## Quality Control

This section is very important to any QAPP as it defines the steps project staff will follow to ensure data generated in the study is scientifically valid. Refer to <https://www.epa.gov/quality/volunteer-monitors-guide-quality-assurance-project-plans> for a basic overview of various quality assurance and quality control terminology and methods to ensure proper sampling technique and performance.

### Field Measurement/Analysis Quality Control Checks

Under this subsection, the group must describe the methods used to test and/or collect field samples. This can refer to an SOP submitted as an appendix with the QAPP. This subsection should include what type and frequency quality control checks are done on field samples such as: taking multiple measurements at the site to check equipment performance, field blanks to check for contamination of equipment, and split samples to check the variability due to sampling methods. A good quality control frequency is 10% for small studies (<100 sample events) or 5% for large studies (>100 sample events).

For example:

*All field and field quality control sampling will be collected in accordance with the SOP manual found in Appendix 1. Equipment blanks and field splits are collected at frequency of at least 10 percent. All quality control samples will be entered into the database and flagged as quality control samples. Any deficiencies observed and corrective action taken will be reported is covered in Section 3 of this document.*

### Laboratory Analysis Quality Control Checks

This subsection applies for any laboratory testing performed during the study. Usually, the laboratory will provide a summary of their checks such as laboratory duplicate, matrix spike, laboratory blank, and related quality control samples as part of the laboratory report.

For example:

*All laboratory samples will be analyzed in accordance with established standard laboratory methods, procedures and QA procedures outlined in Appendix 2 of this document. Periodically the laboratory QA officer will generate a report evaluating the accuracy, precision, representativeness and comparability to identify deficiencies in analysis. Any deficiencies observed will be reported and corrective action taken is covered in section 3 of this document.*

### Data Analysis Quality Control Checks

This section mainly applies for projects where data is provided from multiple sources or from other organizations to ensure that the data was checked. Usually this is done by the group’s project manager or QA officer and may involve simple procedures such as looking for discrepancies in results such as high blank readings coupled with very low or non-detect sample readings (usually due to a field staff member mislabeling the bottles).

For example:

*The group QA officer reviews the submitted laboratory data to verify sample results reflect suspected conditions such as high bacteria levels usually associated with recent rain events. The officer also verifies simple errors in results such as if a blank sample shows very high E. coli levels while the accompanying sample showed no E. coli which likely indicates the sample bottles were mislabeled in the field. Any deficiencies observed and corrective action taken is covered in section 3 of this document.*

## Instrument/Equipment Testing, Inspection, and Maintenance

This section details the steps the group and laboratory staff undertake to ensure equipment used is properly cleaned and maintained to avoid faulty data. These checks can include something as simple as a visual inspection of sample equipment to make sure it is free of dirt to more complex steps such as calibrating laboratory equipment.

For example:

*The field staff will be responsible for the maintenance of equipment used to collect and transport samples following procedures outlined in the sample collection SOP found in Appendix 1 of this document. Checks include ensuring sample bottles appear clean and sterile seals are intact. Coolers are routinely inspected and cleaned to prevent mold or other contaminates interfering with samples.*

*Laboratory staff performs regular inspections of equipment and growth media to confirm no contamination occurs in the analyzed samples. Details are found in the table below, and Appendix 2 of this document.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Equipment Type** | **Inspection Frequency** | **Type of Inspection** | **Maintenance Procedure** |
| *Sample bottles* | *Before use* | *Visual check to ensure bottles are clean and sterile seals are intact* | *Replace broken/unsealed bottles*  |
| *Incubator* | *Before use* | *Visual check to confirm temperature is properly set* | *Adjust temperature setting as needed* |
| *Filtering equipment and glassware* | *Monthly* | *Confirm equipment is sterile and not interfering with analysis by performing a positive and negative bacteria control check* | *Clean and sterilize equipment as outlined in laboratory SOP. Replace equipment with deep scratches or chips.*  |
| *Autoclave*  | *Monthly* | *Perform pressure and temperature check and visually check for deposits.*  | *Adjust valves and settings as necessary flush out debris.*  |

## Instrument/Equipment Calibration and Frequency

This section covers the need to calibrate field, laboratory, or other equipment used to obtain readings. This can include morning and end of day calibration checks using known standards or checking thermometers against an certified reference thermometer. The table below is a good example that can address this section. A narrative description can also be used.

For example:

*The field staff is responsible for the maintenance of equipment used to measure all the requested water quality parameters in accordance with the SOP manual listed in Appendix 1. As there is no monitoring equipment except using the sample collection bottles, no calibration is necessary.*

*Laboratory staff performs an annual verification of incubator thermometers using a NIST certified thermometer in a water bath heated to 35.0 oC which reflects the incubation temperature for the bacteria test. Incubator thermometers that are within +/-0.1 oC of this NIST reference is accepted and used in the incubators. The autoclave max temp thermometer is verified at 121.0 oC using a NIST reference and must be within +/- 0.5 oC of the NIST value. Thermometers failing this validation are disposed and replacement certified thermometers are used. Additional details are available in Appendix 2.*

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| --- | --- | --- | --- | --- |
| **Equipment Type** | **Calibration Frequency** | **Standard or Calibration Instrument Used** | **Acceptance Criteria** | **Corrective Action** |
| *Incubator thermometer* | *Annually* | *NIST validation at 35.0 oC* | *+/- 0.1 oC* | *Replace thermometer with NIST certified thermometer* |
| *Autoclave check thermometer* | *Annually* | *NIST validation at 121.0 oC* | *+/- 0.5 oC* | *Replace thermometer with NIST certified thermometer* |
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## Inspection/Acceptance Requirements for Supplies and Consumables

This section covers procedures used to check all equipment, regents, and related consumable supplies are of good quality.

For example:

*The field staff and QA officer are responsible for inspecting incoming equipment and supplies to be used in the special study before placing them in service. Any defective equipment such as sample bottles with broken or missing sterile seals are discarded as outlined in section 2.6 of this document.*

*Laboratory staff inspect all reagents and consumables to ensure they are sterile and within expiration dates. In addition, a positive and negative bacteria control test is performed monthly or whenever a new batch of growth media, membrane filters, and new de-ionized (DI) water cartridges are used.*

## Non-direct Measurements

This section outlines all sources of data not associated with actual monitoring by the project team members. Some examples include obtaining rainfall or stream flow data from a weather service or USGS stream gauge website. In addition, this section is used to reference any sources of information used or included on this project and how it is managed. Note that items referred to in this section should be referenced in section 5 of this QAPP template.

For example.

*Part of the study is to determine the amount of fecal bacteria is present due to runoff from nearby fields, septic drain fields, and wildlife sources. As fecal bacteria is usually the highest at the beginning phase of a heavy rain event, the study will use weather forecasts and local weather station data to determine the ideal time to sample and record actual rainfall totals. This will be obtained through the National Weather Service Weather Prediction Center (*[*https://www.wpc.ncep.noaa.gov/*](https://www.wpc.ncep.noaa.gov/) *). Actual rainfall totals at time of sample collection will be obtained from the meteorological website Weather Underground (*[*www.wunderground.com*](http://www.wunderground.com)*).*

*Stream flow data from the nearest and most representative USGS stream gauge located at Piney River at gauge 02027500 (*[*http://waterdata.usgs.gov/va/nwis/nwisman/?site\_no=02027500*](http://waterdata.usgs.gov/va/nwis/nwisman/?site_no=02027500)*). The Piney River station was selected due to relatively close proximity to the study area so that rain events are reasonably assumed to be the same. However, the Piney River discharges nearly 10 times the area of Bobs Creek (49 mi2 vs. 4.85 mi2). Extrapolating a direct discharge rating curve will be limited to a best estimate due to the significant differences in size. However, the resulting rating curve should provide a reasonable estimate of hydrological conditions required for bacteria levels to exceed state recreational standards.*

## Data Management

In this section, applicants will describe how data from the project are handled and kept for future reference. section 4 will cover this in greater detail.

For example:

*Project data will include computer and handwritten entries. Field observations, measurements, and records such as sample collection and shipping information will be recorded on hardcopy forms, and in a Microsoft 2010 Access database. Hardcopy records are kept for a minimum of six years. Electronic data is stored indefinitely and includes data backup to a secure offsite database.*

*Data analyzed in the laboratory is entered into the Laboratory Information Management System (LIMS) by the responsible laboratory personnel. Following validation and approval, data is shipped electronically to the group project manager where it is uploaded into the access database.*

# ASSESSMENT AND OVERSIGHT

## Technical System Audits (TSAs)

In any well-developed study, it is important to do regular Technical System Audits (TSA) of staff and procedures to ensure results are not influenced due to poor technique. This usually involves the QA officer or senior field team leader performing random audits of field or laboratory staff or checking performance using a standard reference (proficiency sample) unknown to the testing group. Results of this audit are then reported to the project manager and any corrective actions implemented.

For example:

*Field personnel are audited annually. Audits can occur sooner if an issue is suspected with how a staff member is collecting a sample. This audit is performed by the field team leader or QA officer due to their extensive experience and knowledge of the sampling method. Field TSAs focus on availability and proper use of field equipment; ability to follow and document sample collection, identification, handling, and transport of samples and proper collection and handling of field blank and duplicate samples. If problems are discovered during the field TSA, the field staff is retrained and noted deficiencies are recorded in a field audit form for future reference. If the error is severe enough to question the validity of previously collected data, the suspected data will be flagged based on a review by the QA officer and communicated to the project manager.*

*TSAs of laboratory operations will be performed by the laboratory QA officer on an ongoing basis. Laboratory TSAs include reviews of sample handling procedures, internal sample tracking, following SOPs, analytical data documentation, QA/QC protocols, and data reporting. If errors or deficiencies are discovered, appropriate laboratory staff undergoes retraining. If the error is severe that may affect the quality of previously submitted data, this is communicated to the project manager and QA officer along with recommendations using a corrective action form found in Appendix 2.*

## Reports and Management

This section covers all reports made to the project manager to inform of corrective actions or modifications that need to be made. In addition, this section covers reports provided by a contracted laboratory as the project manager usually handles or oversees laboratory data being entered along with any field data collected by the group.

For example:

*The QA officer and laboratory QA officer will provide all correction action reports related to the project and corrective actions taken to the project manager. Laboratory data is submitted electronically to the data manager who oversees the results are correctly entered with data collected by field staff.*

# DATA VALIDATION AND USABILITY

## Data Review, Verification, and Validation

The purpose of this section is to describe the process for documenting the degree to which the project objectives were met, individually and collectively, and to estimate the effect of any QA/QC procedural deviations on the ability to use the data.

Each of following areas will be reviewed:

* Sample collection procedures
* Sample handling
* Analytical procedures
* Quality control verification of equipment blanks (EB) and field splits (S1 & S2).

For example:

*Each month, the QA officer will review the data collected by the field staff is correct and keyed in values match field sheet entries. If questions arise, the QA officer will speak with the field sampler and/or laboratory manager. Sample runs where an equipment blank or spilt sample was collected and failed to meet quality control requirements outlined in subsection 1.7.1 of this document will be flagged as suspect due to contaminated equipment or improper collection technique.*

*If data is in need of correction or is suspect, the QA officer will flag and document the data for additional review. Decisions to reject data not meeting quality assurance will be done through agreement of the QA officer, project manager, and sample team leader. Rejected data will be notated in the database as to the reason why it were flagged and rejected.*

## Verification and Validation Methods

The previous step of the QAPP dealt with who will be responsible for reviewing the data. This step covers the methods that the person will review and validate the data. Such examples include:

* Use of sample spikes and other QC steps
* Confirming computer-entered data with actual field sheets
* Ensuring proper filling out of chain of custody forms
* Equipment calibration frequency

Also, include a section discussing if the person finds errors in the data, how they plan to correct the errors.

For example:

*The QA officer will verify all equipment blank and sample duplicate samples are within tolerances as outlined in section 1.7.1.*

*The QA officer will review laboratory submitted data to ensure the laboratory performed the necessary quality assurance checks and the results are within acceptable margins. This includes checking that laboratory based blanks, matrix spikes, and duplicates are complete and of good quality.*

*If issues are found or biases in analysis is suspected, the QA officer will confer with the laboratory QA officer and project manager to identify if a problem exists and if so, if the problem is severe enough to affect*

 *reported results. If a result is identified as being likely biased, it is rejected and noted in the database as to the reason why the results were flagged and rejected.*

## Reconciliation with User Requirements

The group should describe how to determine if the data generated by the project will meet the objectives of the project (section 1.7). To determine this, the project manager should compare and analyze the project data for completeness, accuracy, precision, representativeness, and comparability.

In the event the data does not meet with the planned goals, describe how the group would approach to address and correct the problem. Discarding of some data, revising the project scope, or setting limits on how unusable data is acceptable in these situations. Please also state who will receive any data corrections.

For example:

*At the completion of the monitoring phase and all data has been received and entered, the project manager and QA officer will review the results to ensure it meet the goals outlined in section 1.7.*

*If the project failed to meet the minimal sample goal or if deficiencies in sampling or analysis are discovered during this review, limits will be placed on the dataset. Such limits can include not using the results to identify bacteria sources or use the results as a baseline dataset for Total Maximum Daily Load modeling. Such limitations will be predominately highlighted and explained in the final report to ensure readers of the report do not use the data or report improperly.*

# REFERENCES

This section is to cite all reference material used or in this document. When available, include website addresses for material available online. The below format is an acceptable scientific bibliographic format.

1. US EPA (March 2000). *Method 1103.1- Improved Enumeration Methods for the Recreational Water Quality Indicators: Enterococci and Escherichia coli*, EPA/821/R-97/004 [www.nemi.gov/methods/method\_pdf/5575/](http://www.nemi.gov/methods/method_pdf/5575/)
2. USGS (March 2014) How Streamflow is Measured <http://water.usgs.gov/edu/measureflow.html>
3. USGS Piney River Stream Gauge 02027500 <http://waterdata.usgs.gov/va/nwis/nwisman/?site_no=02027500>
4. NOAA Weather Prediction Center <http://www.hpc.ncep.noaa.gov/qpf/qpf2.shtml>
5. Weather Underground Arrington Weather Station https://www.wunderground.com/?cm\_ven=cgi

# APPENDIX

An appendix should be added for each supporting document affiliated with the QAPP. This includes field and laboratory data sheets, SOPs, and any other documents referenced within the QAPP.