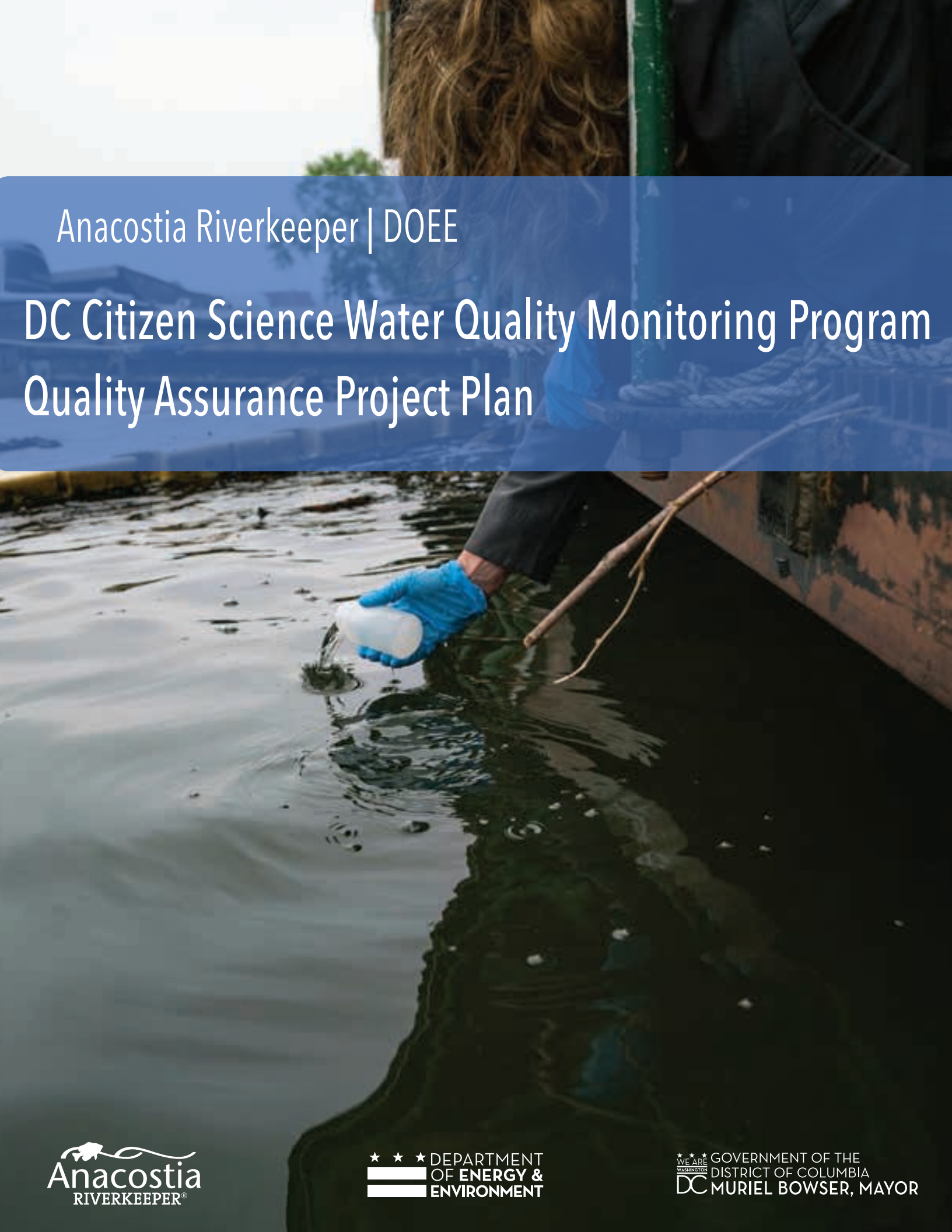

Anacostia Riverkeeper | DOEE

DC Citizen Science Water Quality Monitoring Program Quality Assurance Project Plan

Anacostia RIVERKEEPER®

DEPARTMENT OF ENERGY & ENVIRONMENT

GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

QUALITY ASSURANCE PROJECT PLAN

Volunteer Water Quality Monitoring in District of Columbia Waters

Prepared for:

Department of Energy and Environment, Water Quality Division
Grant#: RFA 2018-1805-WQD-VWQM Project #1

Prepared by:

Anacostia Riverkeeper

Alliance for the Chesapeake Bay

Potomac Riverkeeper Network

Rock Creek Conservancy

Audubon Naturalist Society

May 1, 2019

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Section A – Program Management Elements

A1. Title and Approval Page

Project Name: Volunteer Water Quality Monitoring in District of Columbia Waters
Responsible Agency: Anacostia Riverkeeper
Date: May 1, 2019
Revision No.: 3
Updated: April 21, 2021

Name: Suzy Kelly

Title and Organization: Acting President, Anacostia Riverkeeper

Signature and Date: 4/16/2021

Name: Jeanne Braha

Title and Organization: Executive Director, Rock Creek Conservancy

Signature and Date: 4/16/2021

Name: Liz Chudoba

Title and Organization: Water Quality Program Manager, Alliance for the Chesapeake Bay

Signature and Date: 4/16/2021

Name: Eliza Cava

Title and Organization: Director of Conservation, Audubon Naturalist Society

Signature and Date: 4/21/2021

Name: Efeturi Oghenekaro

Title and Organization: Environmental Protection Specialist, DOEE

Signature and Date: 05-03-2021

This document has been prepared according to the United States Environmental Protection Agency publications – *Th Volunteer Monitor's Guide to Quality Assurance Project Plans,* EPA 841-B-96-003, 1996*,* available at http://water.epa.gov/type/rsl/monitoring/qappcovr.cfm and *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, 2001, available at http://www.epa.gov/quality/qs-docs/r5-final.pdf

A2. Table of Contents

A3. Distribution List

Table 1. Distribution List for Quality Assurance Project Plan.

Name	Organization	E-mail	Phone
Suzy Kelly Trey Sherard Robert O'Donnell Christine Burns	Anacostia Riverkeeper	suzykelly@anacostiariverkeeper.org Trey@anacostiariverkeeper.org robbie@anacostiariverkeeper.org christine@anacostiariverkeeper.org	202-863-0158 910-200-0788 540-454-0731 215-435-3757
Jeanne Braha John Boland	Rock Creek Conservancy	jbraha@rockcreekconservancy.org jboland@rockcreekconservancy.org	301-579-3105
Liz Chuboda	Alliance for the Chesapeake Bay	lchudoba@allianceforthebay.org	804-793-8785
Eliza Cava Ari Eisenstadt Gregg Trilling	Audubon Naturalist Society	eliza.cava@anshome.org ari.eisenstadt@anshome.org gregg.trilling@anshome.org	301-652-9188 ex22 347-743-1546

A4. Project/Task Organization

A4.1 Project Organization

Anacostia Riverkeeper (ARK) is the lead project manager in this volunteer-based monitoring program that will implement a bacteria monitoring program in the surface waters of the District of Columbia utilizing volunteers. Volunteers and lead personnel from partner organizations will be trained through a citizen-science based training program. Anacostia Riverkeeper has partnered with Rock Creek Conservancy (RCC), Alliance for the Chesapeake Bay (AFB), the Audubon Naturalist Society (ANS), and other organizations or local stakeholder groups, further referred to as "Project Team", to recruit and train volunteers to collect samples and other water quality data during the recreational season (April-September).

Alliance for the Chesapeake Bay, Rock Creek Conservancy and Audubon Naturalist Society will be the lead partners in volunteer training. Anacostia Riverkeeper, Rock Creek Conservancy, and Audubon Naturalist Society will take the lead in and providing support for volunteers to collect water quality samples and proper maintenance of sampling equipment. Rock Creek Conservancy, Audubon Naturalist Society, and ARK will recruit and motivate volunteers for this monitoring program. Anacostia Riverkeeper is the primary partner that tests the collected water quality samples.

Table 2. Roles and Responsibilities in this project.

Team Member	Organization	Responsibilities
Suzy Kelly Acting President	Anacostia Riverkeeper	Schedule and attend planning meetings, prepare and submit quarterly reports and the final report.
Trey Sherard Outreach Coordinator	Anacostia Riverkeeper	Attend planning meetings and training sessions, recruit and manage volunteers, monitor and oversee volunteers' monitoring, manage IDEXX lab-work and other sample processing, receive volunteer samples delivered to ARK offices.
Robbie O'Donnell Program Manager	Anacostia Riverkeeper	Attend planning meetings, project management and logistics, process samples when necessary, monitoring management for Anacostia River sites, upload data to online platforms for dissemination, perform data quality assurance and validation, data management.
Christine Burns Project Coordinator	Anacostia Riverkeeper	Attend planning meetings, process samples, work with ARK personnel on data upload to online platforms for dissemination, receive volunteer samples delivered to ARK offices and/or other designated location, data entry.
Water Quality Associate	Anacostia Riverkeeper	Receive volunteer samples at "satellite office" or ARK offices, process samples, data entry, assist with data upload to online platforms for dissemination, maintain lab space.
Jeanne Braha John Boland	Rock Creek Conservancy	Planning Team, volunteer recruitment and management for selected sites in Rock Creek, ensure weekly monitoring of Rock Creek, assist in sample delivery to ARK offices.
Liz Chudoba	Alliance for the Chesapeake Bay	Planning Team to develop training manual and plan volunteer training, assist with upload to CMC.

Eliza Cava Ari Eisenstadt Gregg Trilling	Audubon Naturalist Society	Planning Team, Volunteer recruitment and management for the Potomac River, conduct volunteer training, ensure weekly monitoring of Potomac sites. Plan and coordinate public outreach activities to educate and engage students and community members in learning about bacteria in DC's waterways.

A4.2 Roles and Responsibilities

Project Manager: Anacostia Riverkeeper

- Manages the Project Team to ensure the Quality Management Plan (QMP), QAPPs, and Quality Assurance (QA) policies are implemented;
- Develops the QMP and annual reviews, and updates the documents as needed. Small changes will be reported to the DOEE in bi-annual reports. When substantial changes that impact the quality system are made to this QAPP, the Project Manager will re-submit the QAPP to DOEE for review and approval;
- Oversees the effective implementation of the QAPPs;
- Ensures that the quality program has adequate resources to accomplish all of the requirements established in the QAPP;
- Schedule and coordinate on-site assessments of ARK volunteer monitors;
- Schedule regular Project Team meetings;
- Coordinate with Project Team the scheduling and carrying out of training sessions; and
- Is responsible for all items listed under Project Team.

QA Management: Anacostia Riverkeeper and Alliance for the Chesapeake Bay, Rock Creek Conservancy, and Audubon Naturalist Society

- Reviews the project QAPPs and provides guidance to the Project Team for effective implementation of the QAPPs;
- Reviews the QA/QC programs, practices, systems, training materials, and performance annually to ensure practices are in accordance with the QMP. Subsequently documents and responds to QA/QC needs and issues;
- Acts as a liaison between the Project Team and the volunteers;
- Assists with QA dispute resolutions (if/when needed); and
- Assesses data management procedures for the monitoring programs and the project database to ensure they meet data quality objectives outlined in the QAPP.

Project Team: Anacostia Riverkeeper, Alliance for the Chesapeake Bay, Rock Creek Conservancy, Audubon Naturalist Society

- Ensures that all monitoring groups adhere to the QMP and approved QAPPs;
- Ensures that all monitoring operations are covered by the appropriate documentation (i.e., SOPs, QAPPs, project plans);
- Develops, reviews, updates, and approves SOPs for monitoring activities;
- Conducts trainings and certifies monitors;

- Continually assesses collected data and monitors performance through data QC, trainings, and re-certifications to identify QA compliance or deficiencies. All QA deficiencies will be properly documented and attempted to be resolved;
- Provide training and guidance to volunteer monitors;
- Attends regular Project Team meetings;
- Complies with findings and recommendations from QA reviews and audits; and
- Resolves disputes regarding quality system requirements, QA/QC procedures, certifications, or corrective actions.

Volunteer Trainers: Anacostia Riverkeeper, Alliance for the Chesapeake Bay, Audubon Naturalist Society

- Conducts trainings and certifies monitors;
- Adheres to the Certified Trainer requirements;
- Adheres to SOP guidelines;
- Maintains annual certification;
- Reports QA issues to Project Team leaders; and
- Complies with QA reviews or audits.

Monitoring Volunteers

- Adheres to SOPs and complies with QAPP guidelines;
- Evaluates and reports QA issues to designated Project Team leaders, regional liaison, or QA Manager as they occur; and
- Maintains certification as outlined in the project's QAPP.
- Maintained and monitored by Anacostia Riverkeeper, Audubon Naturalist Society, and Rock Creek Conservancy.

Data Management: Anacostia Riverkeeper and Alliance for the Chesapeake Bay

- Submit water quality data reports to DOEE weekly;
- Share water quality data with Chesapeake Monitoring Cooperative (CMC);
- Weekly upload of water quality data to Water Reporter; and
- Make water quality data publicly available through Project Team connections.

A5. Problem Definition/Background

As a result of concerted efforts to clean up the Anacostia and Potomac Rivers, our waterways have become visually more appealing primarily due to reductions in floating debris. However, contamination from fecal bacteria released into the water after a heavy rain (including raw sewage and pet and wildlife waste) still poses a significant human health risk. The District of Columbia and its Department of Energy and Environment (DOEE) have demonstrated a commitment to increasing recreational access to District waterways. Thus, timely public notification of the presence of *E. Coli* during the primary recreation season from April through September, via easily downloadable

applications (e.g., Water Reporter) and accessible websites (www.anacostiariverkeeper.org) will support District wide recreational use goals, and public health and safety for citizens who recreate on and in our local waters.

A5.1 Goals and Objectives

The purpose of this monitoring project is to increase understanding of water quality health in areas with large amounts of water recreational activities and to make *E. coli* data directly accessible to the public as well as to produce scientifically defensible datasets that may be used for development of swim advisories in the future. Data collected through this monitoring project may be used to assess the effectiveness of capital investments to reduce bacteria loading into select District tributaries, streams and rivers. Results from weekly sample collections will be reported within 48 hours to DOEE identified staff, and to the public via upload to the Chesapeake Monitoring Cooperative (CMC), distribution on Water Reporter, and ARK website and social media.

A5.2 Data Use

The primary target audiences are: residents and visitors to Washington DC who may recreate in and on its waters; on-water recreational outfitters; marinas; local high school and adult rowing and sailing clubs; canoers and boaters; recreational fishers; park goers whose children and dogs may enter streams and come in direct contact with river water; school age children and volunteers who are interested in participating in training; District government decision makers who may use this data to establish swim advisories; anyone else seeking open-source data on *E. coli* presence in District waterways (through the CMC).

A6. Project Description

A6.1 Project Timeline

Table 3. Sample Work Plan

DATE	Activity	Who Responsible
August	1.Schedule Planning meetings 2.Hold Planning meetings	ARK ARK, ANS, RCC, AFB
Sept	Sample once at each site	ARK, RCC, ANS
Oct	Submit Quarterly Report	ARK

Sept - Jan	Planning Meetings: 1. Develop Training Program 2. Begin Volunteer Recruitment 3. QAPP 4. One sample run in September (2018 only) 5. Share results with DOEE	 1. ANS, Alliance for Bay, ARK 2. ARK, RCC, ANS 3. ARK 4. ARK, ANS, RCC, AFB 5. ARK
Jan	Submit Quarterly Report	ARK
Aug - Jan	1. Develop parameters of Recreational Use Survey (RUS)	ALL
Jan - Apr	Recruit Volunteers Volunteer training sessions: 1. Promote Training Events 2. Lead 2 – 3 Training Events	ALL ALL RCC, ANS, Alliance for Bay
Apr	Submit Quarterly Report	ARK
May - Sept	1. Conduct RUS	Volunteers overseen by ARK, ANS, RCC
July	Submit Quarterly Report	ARK

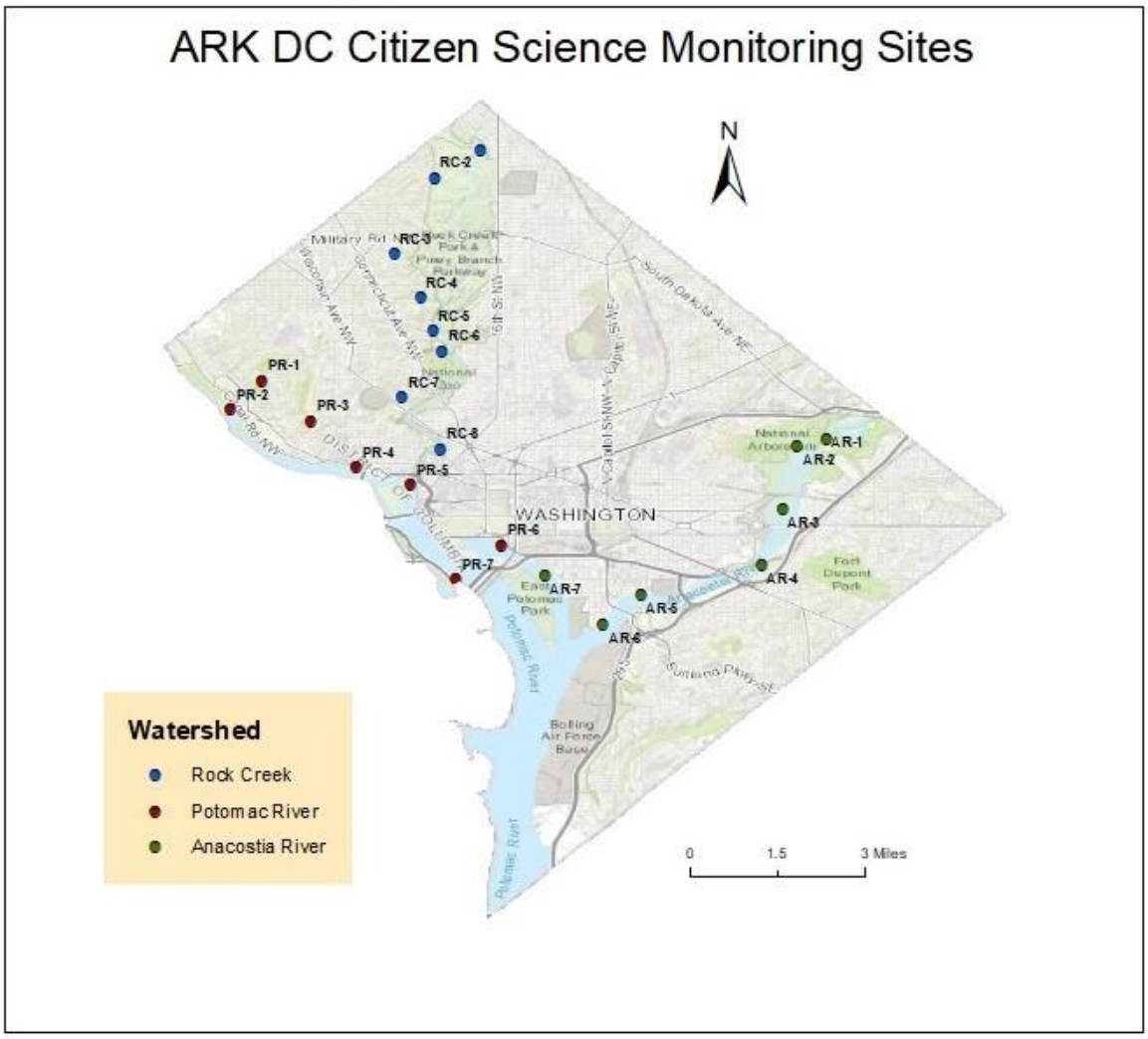
Weekly May - Sept	1. Collect Samples 2. Upload to CMC 3. Report out on Water Reporter 3. Share with DOEE 4. Conduct Recreational Use Survey	Volunteers Alliance for Bay ARK ARK Volunteers
Sept	Report Results of RUS	ARK
Oct	Submit Final Report	ARK

A6.2 Site Selection

Sites will be selected based on several criteria including: ease of public access to the waterway (not only for recreants, but also for volunteers collecting water samples), what is upstream, and areas of high public recreation. Considerations to take into account are tributaries, commercial industries of interest, dog parks, parking lots, recent development, installation of stormwater controls, or other factors that will influence the sample. Also sites already being sampled by the local stormwater divisions will be considered as to not duplicate testing efforts. All sites selected will be tagged with latitude and longitude coordinates to ensure samples are collected from the same location each time, eliminating the possibility of sampling site errors when several volunteers rotate through the same location. In addition, special consideration will be made to sites that have been designated as impaired by DOEE in its 2015 Annual Report to EPA (ie. DOEE reported that Pinehurst Branch, Broad Branch, Soapstone Creek, Melvin Hazen Valley Branch, Normanstone Creek, and other tributaries of Rock Creek are impaired for *E.Coli*.).

A final list of sample locations and their descriptions along with GPS coordinates can be found in Appendix A. A map is included in Figure 1.

Figure 1. Sampling location Map



A6.3 Water Quality Parameters

The primary water quality parameter for this monitoring project is a type of bacteria known as *E. coli*. This type of bacteria is a common representative water quality parameter for human health in waters that have been designated recreational. The EPA along with State water regulatory agencies have set water quality standards for this parameter to ensure a safe environment for recreation through water contact. The level of *E. coli* bacteria is also used to assess the safety of a beach or other water access points. Other water quality parameters (pH, temperature, turbidity) will also be assessed. Temperature and pH will be measured in-situ while bacteria and turbidity will be measured in-lab by Anacostia Riverkeeper.

The techniques used to measure these parameters are performed with accessible and affordable equipment, making the process feasible for citizen and nontraditional monitoring groups. The parameters to be analyzed and the equipment to be used are found in Appendix B.

A6.4 Data Management

Results will be reported within 24 hours of analysis to: DOEE; uploaded on the CMC; and reported to the public on Water Reporter, and Anacostia Riverkeeper's website.

A7. Data Quality Objectives for Measurement Data

A7.1 Data Precision, Accuracy and Measurement Range

The Project Team will train the volunteer monitors how to properly collect a water sample, collect basic water quality information at the site and the use of "chain-of-custody" for transport of samples to the lab. Each volunteer monitor will be provided with a copy of the *Volunteer Training Manual* and a simplified version of the sample collection Standard Operating Procedures (SOPs). Routine field checks will be conducted by the Project Team leads to verify the SOPs are being followed by each volunteer monitor. ARK staff will additionally maintain all lab records and results (e.g., bench sheets, log books, lab notes) and conduct monthly audits of lab procedures to ensure data quality and representativeness.

A7.2 Representativeness

A7.2.1 Selection of Sampling Sites

The volunteer monitors will be grouped into three different sample regions in the DC area – Potomac River, Anacostia River and Rock Creek. The list of samples sites can be found in Appendix A and a map is included in Figure 1. Based on the geographical position of the sample sites, the three different regions may help in a greater efficiency of delivering water samples in a timely manner to the lab for testing. The goal is to produce a quick turnaround of water samples to bacteria results.

A7.2.2 Sample Collection

Sample data shall be representative of the actual conditions or concentrations present in the stream at that point in time. Sample collection, preservation, and handling methods are factors that directly affect field sample representativeness. Monitors will collect water samples from the bank-side portion of the selected waterbody with an attempt to get as close to mid-stream as is possible while ensuring safe monitoring is practiced. Water samples will be collected using bottles appropriate for the parameter being measured. Sample bottles for turbidity will be rinsed three times, and swiped vertically through the water column, in order to collect a single sample that is representative of the conditions in the stream at that particular location and time. Bacterial samples will be collected by simple methodology but without any rinsing of sample bottles due to the presence of preservatives in designated bacterial sample bottles. During sample collection and analysis, monitors will follow prescribed methods and QA procedures to ensure representative data are collected. These techniques will ensure that the minimum standards of field representativeness are met.

A7.2.3 Volunteer Sample Site(s)

The number of sites each volunteer or group of volunteers will collect samples from, will be based on the number of volunteers available. Collectively, the Team organizations bring hundreds of already engaged citizen volunteers to the project. Additionally, each Team group has established relationships with established water sport clubs, outfitters, and marinas, whose members are out on the water almost daily during the season and who are very interested in learning about water quality and how to recreate safely on the water. Groups already interested in volunteer training include Friends of Kingman Island, Friends of Pope Branch, Capital Yacht Club, DC Sail, Community Boat House, Historic Anacostia Boating Association, Capital SUP, Washington Canoe Club, Thompson's Boat House, Audubon Naturalist Society, Rock Creek Conservancy, Friends of Dumbarton Oaks, Whitman Crew Boosters, and Friends of Kenilworth Aquatic Gardens. It is the goal of the Project Team and DOEE to ensure that volunteers from all DC wards are included in sampling efforts to include the widest and most diverse pool of volunteers possible.

A7.2.4 Sampling Timelines

All routine sampling will be collected on a Wednesday morning (Thursday alternate) collection schedule, excluding holidays, to allow for the most flexibility in sampling and to account for potential week-to-week weather conflicts (i.e., rain events). Volunteers will collect and deliver the sample from their respective station every week, either on a designated Wednesday or Thursday. Samples will be delivered to the Anacostia Riverkeeper Lab between the hours of 8:00AM – 12:00PM. In the case that a volunteer and the volunteer substitute are both unavailable for collection and delivery, the volunteer will inform the Team member covering that jurisdiction who will then be responsible for collecting the sample and delivering to the lab for testing and reporting. Samples must be turned into the lab within 6 hours of collection.

A "satellite" office will be made available to monitors in the Rock Creek and Potomac watersheds from 9:00 to 11:00AM each morning of sampling in order to facilitate sample drop-off and travel delays due to distance. ARK will organize and manage this satellite office with Team partners to ensure that it is staffed at all times.

The Team will add additional protocols into the plan accounting for transportation issues and other potential complications as part of the program development process.

A7.3 Comparability

It is important to analyze water samples with commonly accepted methods by Federal, State and Local officials. The water quality data collected will be analyzed using DOEE approved methods or other common methods for analyzing basic water quality data. The primary water quality parameter to be analyzed is *E. coli*; in which, the IDEXX Colilert Test kit will be used. The Colilert procedural manual can be found in Appendix B.

A7.4 Completeness

To provide a complete and accurate picture for citizens to assess if water contact in the three regions is safe, each volunteer monitor scheduled for the specified date must be able to collect a water sample weekly and deliver samples to the lab within the prescribed time frame. This allows for residents and visitors to DC to have consistent, up-to-date information on the quality of water in the regions, as well as provides DOEE with a full data set of water quality parameters related to bacteria for the entirety of the sampling period.

A8. Training Requirements

Sample collection volunteers will be provided with training and procedures for collecting water samples from tributaries, streams and rivers identified in the Site Selection Process as informed by the Recreational Use Survey. All training will be provided by the Training Team leaders (ARK, Rock Creek Conservancy, Alliance for the Bay, ANS) to ensure that efforts are in accordance with quality control measures and procedures formalized in the *Volunteer Training Manual*. All Training Team members will be provided with training materials to review at the beginning of each new project year.

The training manual will train each new volunteer and provide them with specific instructions on proper sampling techniques, sanitary handling practices, and chain of custody. Volunteers will work with Team staff onsite after training to ensure proper execution of sampling protocols. The *Volunteer Training Manual* will provide the volunteers with a map of their test location in relation to the larger watershed, an information sheet about the program, directions to the lab, written sample collection instructions, custody forms, links to the databases, and a prepared sample collection kit consisting of all items needed to successfully collect and deliver samples to the Anacostia Riverkeeper lab.

A8.1 Volunteer Water Quality Monitoring Training

Monitors will be required to attend a Water Quality Monitoring Training before they begin collecting water quality data for this project. ARK will provide the trainings on an as-needed basis during the project timeframe (April - September). At the Water Quality Monitoring training participants will learn how to:

- Clean, use, store, and maintain monitoring equipment
- Collect, store, and transport water samples for water quality analysis
- Analyze water samples
- Fill out and complete field data sheets and chain of custody forms accurately
- Follow quality assurance and quality control procedures
- Enter monitoring results into the project database

Participant performance will be evaluated at the training during the training activities. ARK/AFB/RCC/ANS will work closely with the participants during the hands-on training exercises to be sure that they achieve the goals of the exercises. It is expected that each participant will be able to collect and analyze water samples and enter the results into the project database after attending the Water Quality Monitoring Training.

Monitors will be given the equipment and supplies needed to begin monitoring at the conclusion of the Water Quality Monitoring Training. They will also receive copies of the training materials, which contain the information they learned at the training, *Volunteer Training Manual* and SOPs for collecting, recording, and entering their data, field data sheets, external QC forms, and references of how and where to access regional resources to supplement and reinforce what they learned at the training.

A9. Documentation and Records

A9.1 Field Data Sheets

Monitors will fill out and complete their field data sheet for every sampling event, as detailed in the Volunteer SOP Manual, Appendix C, and included in Appendix D. On the data sheet, monitors will record their name, date, time, and sample site location/name. They will also record weather conditions, their monitoring results, and the amount of time spent monitoring. If daily calibration of equipment is required for field parameter testing, this information will be recorded on the data sheet. The original data sheets will be submitted to Anacostia Riverkeeper and archived for at least seven years after the sampling date. The project will also maintain electronic (digital) records of the data within a project specific database.

A9.2 Lab QA/QC Forms

Anacostia Riverkeeper is the primary lab manager for this project and will maintain consistent records of lab checks, equipment calibration/maintenance, and data results. In-lab bench sheets will act to confirm and ensure proper incubator temperature and sample handling; log books will allow for a hard copy backup to all lab procedures and equipment handling; and equipment calibration and maintenance records will be kept to ensure all sampling equipment is in proper working order.

Anacostia Riverkeeper lab bench and lab sample sheets are included in Appendix D.

A9.3 Other Documentation and Records

As the Project Manager for this QAPP and recipient of the associated grant, Anacostia Riverkeeper, will submit quarterly reports to the DOEE. ARK will also be the primary holder of documents associated with this project. These may include lab log books, field notebooks, chain of custody forms and any other material that DOEE may need to assess this project.

Upon receiving all field sheets, chain of custodies, recreational use surveys, and other pertinent physical volunteers forms ARK will organize forms and keep on hand in ARK offices. Forms will be organized by month and watershed. Additionally, all volunteer forms from training (i.e., certification tests, surveys, etc) will be kept on hand at ARK offices. Finally, physical copies of the most up-to-date QAPP and *Volunteer Training Manual* will be kept on hand at the ARK lab.

Each member of the Project Team will also have access to the data and records for their use, with the approval of Anacostia Riverkeeper. Since the data will be used to educate the public on the safety of their local water access points, each member of the Project Team will be encouraged to share the data on their social media and with their members and partners, ensuring proper accreditation to DOEE as the funding agency for the project and ARK as the project manager. Reports will be submitted from each member organization of the Project Team as to where the data was shared and what reactions (if any) there are from the public. This information will be reported to the Project Manager on an informal basis through regular Project Team meetings.

Section B – Data Generation and Acquisition

B1. Volunteer Training Process

Volunteer trainings are necessary to provide consistent water collection, testing and handling techniques to have reliable data. The process for training volunteers under this QAPP is divided into two types of trainings, new volunteer training and annual re-certification training.

B1.1. New Volunteer Trainings

New volunteer trainings will be held at the beginning of the year's program and will be managed by the Project Team. Once volunteers are recruited, they will be invited to participate in a training class. Training will occur two to three times throughout the sampling period, however, if there is sufficient size of volunteers for additional trainings, then more may be conducted.

Process of New Volunteer Trainings:

- All volunteers will meet with the team leaders conducting the training at a convenient site;
- All volunteers will be given a copy of the *Volunteer Training Manual* and other necessary paperwork;
- Volunteers will be instructed based on the training plan of the team leader; which will include,
  a) Introduction to the project,
  b) Introduction of the team leaders and points of contact,
  c) Review of the project QAPP and the Volunteers SOP Manual,
  d) Introduction to the field test kits and how they are used,
  e) Demonstration of sample collection, testing and completing field worksheets and chain of custody forms,
  f) Volunteers will perform practice sampling,
  g) Team Leaders will discuss sample sites with volunteer(s),
  h) Volunteers will be provided with scheduling links in order to sign-up and schedule themselves for monitoring.
- Volunteers will be introduced to the Lab if interested

B1.2. Annual Certification Training

All returning volunteers are required to complete an annual re-certification training class online. This annual training class allows the Project Team to assess the adherence to the QAPP and Volunteer SOPs. Annual trainings also allow for opportunities to inspect and calibrate the field equipment. These annual trainings may also serve as a reporting mechanism on the progress of the project to the volunteers.

Process of Annual Recertification Trainings:

- All existing volunteers that have collected samples during the previous field season must complete the annual online training;
- Volunteers will review the project QAPP and Volunteer SOPs;
- Each Volunteer will be required to take a simple test for verification of knowledge on sampling practices and procedures.

B2. Sampling Standard Operating Procedures

A detailed outline of SOPs for water quality sampling in DC waters is summarized in the below sections and included in Appendices B and C.

B3. Sample Handling and Chain-of-Custody

Each volunteer will be trained in how to properly collect and handle water samples and data information sheets. It is important to have consistency with each volunteer or group of volunteers so that the measured data has the reliability for accurate information that will be portrayed to the public. Equally important, is the ability to compare sample results that will be used in addressing additional research questions.

Chain of custody forms along with field data sheets are necessary elements in validating the measured results to be as accurate as can be. Field data sheets will be filled out during each sampling event by the monitoring volunteer(s). The data sheets will include information such as date, time, site observations, and field water quality data from handheld monitoring equipment. The use of Chain-of-custody forms is necessary to show proper handling of the sample as it travels from collection point to the lab. When a sample is passed from one person to another, each individual will sign, date and note the time.

Samples will be collected each week on Wednesday morning (Thursday will be an alternate bad weather sampling day) by volunteers and delivered to the lab at Anacostia Riverkeeper. Delivery may either be in person by the volunteer or a member of the Project Team that collects the water samples from the volunteer locations. Samples will be delivered within a 6-hour time frame from collection to properly analyze the sample. Because bacterium is the primary water quality parameter, all samples must be kept on ice during transport. Detailed instructions on collecting and handling water samples can be found in the Volunteers SOPs (Appendix C).

B4. Lab Analytical Methodology

Anacostia Riverkeeper has an in-house lab with analytical equipment specific for the intent of this project. ARK will be using the IDEXX Colilert system to measure *E. coli* in each water sample. The Colilert system can return results within 24 hrs. The quick turnaround timeframe for results is necessary to allow the public to have water quality data as accurate as possible for the water access

locations and general conditions of the river. Detailed information on the IDEXX Colilert system can be found in Appendix B, Lab and Field Equipment Manuals/SOPs.

A nephelometric method will be used to measure in-lab turbidity for samples collected in the field. The LaMotte 2020we/wi uses light attenuation passing through a sample compared to lab standards to determine the turbidity of a sample in nephelometric units (NTUs). Lab turbidity samples will be run concurrently with bacterial samples so both results are available in a 24-hr time period. Detailed information on the LaMotte 2020we/wi system, sample preparation, and quality control can be found in Appendix B, Lab and Field Equipment Manuals/SOPs.

Temperature and pH parameters will be measured in-situ in the field so do not require lab analysis.

B5. Quality Control

The goal of this project is to produce timely and accurate water quality data that allows the public to assess the health and safety of the waters in the Anacostia River, Rock Creek and the Potomac River in the downtown DC area. It is important to have a high level of quality control so that the data presented to the public is not misrepresenting the “as close to” the true conditions of the rivers in the downtown DC area. The following sections of this QAPP outline the procedures that will be followed by the volunteers and lab to produce accurate and quality assured data. Detailed information for each section can be found in the Volunteers SOPs (Appendix C) and/or the Lab and Field Equipment Manuals/SOPs (Appendix B).

B5.1 Field QC Checks

B5.1.1 Equipment Calibration

All equipment used in sampling analysis throughout the project period will be calibrated per instrument SOPs and manufacturer recommendations. Field sampling equipment will be calibrated once at the beginning of each sampling season. Thermometers will be calibrated with a certified thermometer and pH strips arrive to ARK lab pre-certified from the supplier via their own QA/QC checks.

B5.1.2 Field Duplicates and Blanks

Field duplicates ensure that sampling procedures don’t contribute any contamination to samples during collection, maintaining sample integrity and fidelity. Field duplicates will be collected each week within each watershed and sampled concurrently or in-line with standard samples. One field duplicate will be collected from each watershed each week to ensure that duplicates are being collected for more than 10% of samples. An empty and sealed sample bottle will be provided randomly to volunteers when duplicate samples are required, and all volunteers will be trained on the use and sampling methodology behind field duplicates.

Blank samples will be collected during sampling to ensure sample preservation and quality. A field blank will be collected 10% of the time to ensure field sampling procedures and to assess potential sources of field contamination. Blanks will be randomly assigned to volunteers in each watershed each week. Volunteers will carry bacteria bottles into the field, unseal each bottle and expose it to air, and then recap and place in the cooler. Once delivered back to the lab, lab personnel will fill field blanks with DI water and run in-line with other bacterial samples. Blanks will be provided randomly to volunteers 10% of the time to carry into the field and then back to the lab, assessing any possible field or transportation sources of contamination.

B5.2 Laboratory QC Checks

All lab equipment and instrumentation used in the testing for this QAPP will follow all the manufacturer's requirements for Quality Control. There are two main lab equipment used in for this project, the IDEXX Colilert System and the LaMotte 2020we/wi turbidity meter.

Laboratory QC Checks for the IDEXX Colilert System involve a QA/QC check when a new batch of reagent is received in the lab and concurrently every week that samples are collected. IDEXX quality control protocols use a positive bacterial strain of *E. coli* (*Escherichia coli*), a positive coliform (*Klebsiella pneumoniae*), and a negative coliform (*Pseudomonas aeruginosa*) to ensure all sampling and lab procedures are not introducing any contamination into analysis as well as the reliability of the reagent.

The LaMotte 2020we/wi turbidity meter requires the use of blanks for each sample analysis and standards for development of the calibration curve when new reagent solution is used.

B5.2.1 Laboratory Equipment Calibration Procedures

Bacterial lab equipment does not require a dedicated calibration schedule as the test is visual and does not involve any electrical sensors. QC checks are performed on each shipment of bacterial reagents to the lab, as well as concurrently each week of sampling, to ensure quality and comparison between samples. Additionally, lab bench sheets are kept in-lab to ensure proper function and record of all lab equipment and procedures. IDEXX Colilert system QC checks can be found in Appendix B, Lab and Field Equipment Manuals/SOPs and Lab Bench sheets can be found in Appendix D, QA/QC Forms.

A certified thermometer will be kept inside the Binder Incubator to track the accuracy of the digital thermometer on the outside of the machine. The Incubation temperature must be kept consistent at 35°C for proper propagation of sample bacteria. A temperature fluctuation under/over 0.5°C is acceptable, any fluctuations above/below 0.5°C will be noted by the lab QA/QC manager. The incubator will be serviced by Anacostia Riverkeeper once each year before the start of sampling.

The in-lab turbidimeter will be calibrated according to the LaMotte 2020we/wi User’s Manual once a week, per each bulk sampling run, and tested every 10 samples to ensure accuracy. When samples

are collected and run over a two-day period the instrument will be calibrated each day before sample analysis and documented in a log book. Calibration standard vials are included with the instrument and first calibrated using a blank and then with standards of known NTU values to establish a calibration curve. This curve is then tested on a 0 NTU and 10 NTU sample once every 10 samples run to ensure the calibrations accuracy and address any drift that may have occurred. If lab personnel notice a difference >0.2 NTU in the 0 NTU calibration standard, or 10% of the 10 NTU standard, then the machine will be recalibrated and tested before any project samples are run. Full LaMotte 2020we/wi calibration procedures can be found in the Lab and Field Equipment Manuals/SOPs Appendix B.

All lab equipment maintenance, calibration, and operation will be recorded in daily lab bench sheets and the dedicated project lab logbook.

B5.3 Data Entry QC Checks

The data collected both in the field and the lab will be managed by ARK. Chain of Custody forms will be scanned digitally and hard copies kept in a designated file in ARK offices to keep consistent records and for project audits. Field data sheets will be turned into ARK each week after sampling is conducted. Field data sheets and recorded lab results will be reviewed by a supervisor at ARK and stored appropriately. Sheets will be scanned digitally and held in a database while hard copies will be kept in designated files in ARK offices. Each week the recorded data will also be uploaded to Water Reporter and the ARK website. The data collected will also be shared with Project Team members, DOEE, and CMC, allowing for three separate checks on data quality.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

Monitors will inspect their equipment prior to each sampling event to ensure that all materials are clean and working properly as outlined in the Volunteers SOPs Appendix C. After testing, monitors will clean all equipment following the procedures also listed in the SOPs.

ARK will maintain lab equipment per manufacturer’s instructions and ensure all instruments are in proper working order going into the sampling period (April-September).

B6.1 Equipment Maintenance

Monitoring equipment and supplies are stored according to the manufacturer’s directions when not in use. Unless chemicals and reagents are discolored, fail standardization, or show other obvious signs of degradation or damage, they are considered valid until the printed date of expiration. Expired chemicals are to be disposed of properly in accordance with federal, state and local environmental control regulations. All monitoring equipment will be maintained according to the manufacturer's instructions.

B7. Instrument/Equipment Calibration and Frequency

All lab equipment and instrumentation used in the testing for this QAPP will follow all the manufacturer's requirements for calibration. There are two main lab equipment used in for this project, the IDEXX Colilert System and the LaMotte 2020we/wi turbidity meter.

The IDEXX Colilert System only requires a blank calibration when new reagent solution is used. No other calibration is required.

The LaMotte 2020we/wi turbidity meter requires a calibration curve to provide the most accurate reading. The Meter comes with a factory calibration curve. However, it is recommended to use approved calibration solutions when the suspected range of the sample will differ from previous sample analyses. Calibration must also be conducted if a dilution of the sample is required. The frequency calibration is variable and determined based on environmental conditions; however, at a minimum, calibration should be conducted 1 time/week.

Field equipment will be calibrated on a routine schedule according to the Volunteer SOP guidelines. Field testing has been limited to pH test trips and thermometers. Only the thermometers will have to be calibrated on a frequency that matches the training schedule or as indicated in the manufacturer's manual.

B8. Inspection and Acceptance Requirements for Supplies

Project Team Leads will obtain monitoring equipment and materials from reputable laboratory supply companies such as LaMotte, Micrology, HACH, Forestry Suppliers, Hanna, AquaPhoenix Scientific, VA Laboratory Supply, and Fisher Scientific. Monitoring equipment for this project will be chosen based on accuracy, precision, ease of use, cost, experience using, and/or recommendations from other monitoring program coordinators.

Project Team Leads will inspect purchased equipment and broken, or defective items will be sent back to the supplier. Equipment will be distributed to monitors at the Water Quality Monitoring Training or afterwards as needed. Monitors will check their supplies, including calibration solutions and reagents each month to be sure they have not expired and will return expired chemicals and defective equipment to designated Project Team Leader.

B9. Data Management

All project data will be recorded and managed by ARK and distributed weekly to the Project Team, DOEE, CMC, and Water Reporter. ARK is the designated organization for data management. Hard copies of project materials like chain of custody forms, field collection sheets, lab QC records, etc. will be kept in ARK offices and available for view per request from DOEE or the Project Team. Digital scans of project forms and data sheets will be kept in a database as backups by ARK. The Program

Manager of Anacostia Riverkeeper will act as data custodian for the sampling period and ensure that digital and hard copies of the following are kept secure and backed up separately: sampling sheets, chain of custody forms, lab bench sheets, lab log book, and data Excel sheets.

Field sampling data will first be recorded by volunteers on the date and time of their monitoring on designated field collection sheets. All field and lab data will then be added to a shareable data table, separated by watershed, accessible to the Project Team upon ARK approval and DOEE to ensure the most up-to-date data is available to all parties. ARK team members will update this data table weekly with that week's results and additionally upload the results from that week to Water Reporter, and CMC.

C1. Assessment and Response Actions

The Project Team will use four categories of assessment to ensure the integrity of the data:

- Laboratory
- Training Program participation
- Field Sampling
- Validation and Reporting

C1.1 Laboratory Assessments

The internal audits used to evaluate the laboratory will examine:

- Sample blank
- Procedures
- Quality assurance
- Data reduction and reporting

The specific makeup of the audit team and procedures to conduct laboratory audits are contained in the individual laboratory project plans.

C1.2 Training Program Assessments

Training program assessments will be included in quarterly and annual reports to DOEE where relevant. Alliance for the Bay, Rock Creek Conservancy, and ANS will provide all training materials and notes to the project team and ARK will synthesize these into assessments that assess volunteer turnout, turnover, geography, and demographics. Assessments are important to assure the project team and DOEE that the project has a volunteer sampling roster of at least 45 participants and that volunteers accurately represent District communities in all areas of the city.

C1.3 Field Sampling Assessments

Field sampling assessments will be conducted throughout the project period to ensure volunteer collection methodology and quality of field data. Project Team members will conduct field audits quarterly on a random basis once per watershed (Anacostia, Potomac, Rock Creek). Team members will observe volunteer sample collection to ensure that volunteer samplers are following methods outlined in this QAPP and the SOPs (Appendix B). If any breach of methodology is observed during field audits the project team member conducting the audit will correct volunteers, ensure standard collection practices moving forward, and make note of any mistakes on that day's field sheet for data validation. ARK will review any field corrections made by project auditors weekly to determine whether the data is acceptable. Any corrections will be included in quarterly progress reports to DOEE.

C1.4 Validation and Reporting Assessments

Validation and reporting assessments will be conducted by the Project Leader (ARK) and the Grant Manager (DOEE) throughout the performance period.

All field and laboratory data are subject to verification and validation by ARK QC personnel (Program Manager and Project Coordinator). Data verification includes: weekly spot checks of incoming sampling and chain of custody forms, laboratory procedures, and data input. QC checks will be documented and initialed on established internal ARK QC forms to ensure the data for that week has been assessed and approved by qualified personnel.

QC checks and forms will be included in the quarterly and annual reports to DOEE as well as available upon request to the Project Team.

C2. Reports

The following documents will be provided to DOEE through quarterly reports and a final report submitted by ARK.

- Logbooks
- Field sheets and forms upon request
- Results from Quanti-Tray tests
- Photos of Quanti-Trays,
- Copies of data spreadsheets
- Mileage and travel record
- Supply receipts
- Staff time logs
- Chain of custody forms,
- Data/Progress Reports
- Project photographs

Section D – Data Validation and Usability

D1. Data Review, Validation, and Verification

Data review, validation, and verification will be completed on a weekly, quarterly, an annual basis by ARK, the Project Team, and DOEE. This promotes transparency throughout the period of performance and ensures the highest quality of data is available weekly to DC residents and visitors.

Weekly data review will be completed by the Project Team along the whole of the sampling chain from field to laboratory analysis. ARK, having control over data input, will have final review and verification of all data before it's submitted to DOEE, CMC, and Water Reporter.

Quarterly field spot checks will be conducted once in each watershed (Anacostia, Potomac, Rock Creek) by the project partners and included in quarterly reports to DOEE. Quarterly data validation documents submitted to DOEE will include: field spot check reports, ARK QC forms, and chain-of-custody or field collection sheets upon request.

Annual data review and validation will come in the form of an office audit by DOEE to ARK's office. Laboratory procedures and methods will be observed as well as data management and input.

Appendix A:

Final Sample Site List

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List of Monitoring Locations

Rock Creek

RC-1. Rock Creek at Juniper St NW Trailhead - Northernmost testing site sits close to the Rock Creek border with Montgomery County in one of the widest sections of Rock Creek. Hikers, dog-walkers, and even horse-riders routinely use the area to recreate and enjoy the Park.

RC-2. Pinehurst Branch (Rock Creek Tributary) - The 680-acre Pinehurst watershed encompasses residential neighborhoods in Chevy Chase, Maryland, and Chevy Chase, DC, as well as forested parkland. The stream can be accessed from Western Avenue; Beech Street; Aberfoyle Street; Oregon Avenue; trails in Rock Creek Park; and Beach Drive. Recreational activity includes walking, jogging, hiking, horseback riding, and dog walking along trails, which cross the stream in several places.

RC-3. Broad Branch (Rock Creek Tributary) - Broad Branch flows through the Chevy Chase and Forest Hills neighborhoods in Northwest DC. It can be accessed from Broad Branch Road. DOEE day-lighted and restored part of the stream and the site now has picnic tables. Nearby residents take pride in the day-lighting, and several are engaged in documenting amphibians at the newly restored stream for Frogwatch USA. This site is accessible from Van Ness-UDC and Tenleytown-AU metro stations.

RC-4. Soapstone Creek (Rock Creek Tributary) - The Soapstone Creek watershed encompasses neighborhoods in Northwest DC from Wisconsin Avenue to east of Connecticut Avenue. Trails through Soapstone Valley Park draw walkers, hikers, joggers, and dog walkers from the nearby apartment buildings, businesses, and UDC along Connecticut Avenue, as well as from the Forest Hills neighborhood. The park can be accessed from Windom Place, Albemarle Street, Audubon Terrace, and Broad Branch Road. It is a short walk from the Van Ness-UDC metro station. Foot trails in the park cross the stream on stepping-stones in several places. The Potomac Appalachian Trail Club routinely restores these stream crossings to keep the trails open. Five stormwater outfalls empty into Soapstone Creek, the largest of which is just south of Albemarle and 32nd Streets, NW. Dry weather flow from this outfall is frequently sudsy and has a foul sewage smell, indicating possible illegal sanitary connections to storm drains, perhaps from apartment buildings along Connecticut Avenue. Century-old sanitary sewers underlie Soapstone Creek. DC Water is working on plans to restore them.

RC-5. Melvin Hazen Run (Rock Creek Tributary) - The Melvin Hazen Run originates in springs in and around Hearst Recreational Park west of Reno Road, NW, then flows east through Melvin C. Hazen Park, and enters Rock Creek downstream of Tilden Street, NW. The watershed includes several large apartment buildings and single-family homes, as well as some embassies. Foot trails running along the stream and crossing it in twice are frequented by hikers and dog walkers. At the lower end, near the stream's confluence with Rock Creek, is a parking lot for Peirce Mill, a large picnic shelter, and an open space where games are played. It is a 14-minute walk to the Cleveland Park metro station. Although no sanitary sewers underlie Melvin Hazen Run, a few storm sewers empty into it. ANS has a benthic macroinvertebrate monitoring station 100 meters upstream of the confluence with Rock Creek. Since 2008, the ANS monitoring team has reported finding long thick filamentous green algae covering the streambed, a possible indication of excess nutrients from sanitary sewer leaks or illicit discharges.

RC-6. Rock Creek Just Below Piney Branch Confluence - This Mid-Creek testing site sits just below the confluence of Rock Creek and the Piney Branch tributary downstream from the largest Combined Sewer Overflow discharge into Rock Creek. The area is routinely used recreationally for hiking and biking and features dog-walkers at all times of the year.

RC-7. Normanstone Run (Rock Creek Tributary) - Normanstone Run meanders alongside Normanstone Drive, NW, and enters Rock Creek Park south of Edgevale Terrace. People and their dogs walk along the road and on trails in the

park. ANS has a benthic macroinvertebrate monitoring station at Normanstone Drive and 30th Street. Storm sewers convey runoff from the nearby Woodland-Normanstone neighborhood, as well as parts of Cleveland Park, Embassy Row, and Massachusetts Avenue Heights. During a dry spell in 2012, the team observed gray soapy water flowing from the culvert just upstream of their monitoring reach and smelled sewage. They reported their observations to the National Park Service and DC Water. It was determined that an overflow pipe at a sewage lift station at the Naval Observatory had been improperly connected to the storm sewer. There is the potential for *E. coli* impairment from other illegal sanitary connections to storm sewers and leaky sanitary sewers underlying the stream. There is residential street parking, and the site is a 12-minute walk from the Woodley Park-Zoo metro station.

RC-8. P Street Beach - The southernmost Rock Creek site sits directly adjacent to the Rock Creek hiker-biker trail and includes the only area of Rock Creek that is fishable per District of Columbia fishing regulations.

Potomac River

PR-1. Battery Kemble Creek/Fletcher's Run (Direct Potomac Tributary) - Battery Kemble Creek, also known as Maddox Branch, flows through Battery Kemble Park in the Palisades neighborhood of Northwest Washington. It enters the Potomac not far from Fletcher's Boathouse. Battery Kemble was a fortification defending Washington during the Civil War. It is now a feature of Fort Circle National Park. Not only is the park visited by historians, it is a very busy gathering spot for dogs and their owners. It is also popular for running, sledding, picnicking, and nature walks along the creek. Hikers take the streamside trail to connect to a trail in Wesley Heights and the C & O Canal Towpath.

PR-2. Fletchers Cove - Fletcher's Cove is a park and recreation area owned and managed by National Park Service, located at 4940 Canal Road, Washington, D.C. 20007, between Chain and Key Bridges, part of Chesapeake and Ohio Canal National Historical Park. It is situated along the C&O Canal Tow Path and attracts thousands of visitors annually by car, bicycle, and on foot. It is a popular destination for picnicking, angling and paddling. This site hosts a Tackle Shack, snack bar, and a concession that rents paddle boats, rowboats and canoes, kayaks and bicycles. Fletcher's Cove also receives upstream discharge from Battery Kemble Park, a popular dog walking area that may convey pet waste to the area.

PR-3. Foundry Branch (Direct Potomac Tributary) - Foundry Branch originates in the Tenleytown neighborhood of Northwest DC and flows through several Glover Archbold Park before entering the Potomac River in Georgetown. Adjoining neighborhoods include McLean Gardens, Cathedral Heights, Glover Park, Burleith, and Foxhall Village. Several side trails lead from neighborhood streets to the main trail that parallels the stream. The upper reaches of the stream are accessible from the Tenleytown-AU metro station. At any time of day, one encounters dog walkers, office workers on break, and neighborhood residents enjoying the trails. Their footprints can be seen at water's edge. Although some bridges cross the stream, in places crossings must be made on stepping-stones. The stream has exposed century-old sanitary sewer infrastructure in the streambed and adjacent to it. Asphalt and concrete patches show that sewer joints have been repaired more than once. DC Water is developing plans to rehabilitate these sewers. **Note:** Original site was moved ~50-100ft upstream to accommodate for dry drought conditions during summer and to ensure enough flow to sample each week.

PR-4. Washington Canoe Club - First opened in 1904, WCC's boathouse, is over a century old and is an iconic historic landmark serving as a base for its members to train for competition, paddle for recreation, and host community, educational and charitable groups. WCC is located just north of Key Bridge. With over 200 members, Washington Canoe Club is a community of volunteers dedicated to preserving, promoting, and engaging in paddlesports on the Potomac River in Washington, D.C. They will recruit volunteers for sampling and surveying.

PR-5. Thompson Boat Center - Thompson Boat Center is home to several high school and adult rowing clubs, and regularly hosts regattas for visiting clubs from other cities. It also offers rentals and lessons of kayaks, canoes, sculls,

stand up paddleboards. It is located at the mouth of Rock Creek and accesses waters directly affected by combined sewer overflows.

PR-6. Washington Tidal Basin - The Tidal Basin is a partially man-made reservoir between the Potomac River and the Washington Channel in Washington, D.C. It is part of West Potomac Park and is a focal point of the National Cherry Blossom Festival held each spring. Historically, it was actually a favored swimming hole up until the late 1940s when it was permanently closed due to chronic sewage contamination. Thousands of visitors and residents are able to rent paddleboats and recreate on the river and walk around the shoreline annually.

PR-7. Columbia Island – Columbia island is a natural formation on the west bank of the Potomac River spanning the distance between the Theodore Roosevelt bridge and the 14th Street bridge. It's been reworked and developed by humans since the creation of DC and is administered by the National Park Service. The island contains several pedestrian trails, parks, memorials, and one marina, so is a heavily trafficked and utilized riverside site along the Potomac that experiences a high frequency of boat and watersport traffic on a daily basis.

Anacostia River

AR-1. Floating Dock by National Arboretum - This floating dock is a documented swimming location and a frequent access point for paddle-craft who pull out and put back in here after resting or visiting the Arboretum. Its proximity to Kenilworth Park lends further merit to the site as that stretch of the seawall across from this dock is a favorite fishing site of the local community as well as a common put in site for paddle craft.

AR-2. Hickey Run (Anacostia Tributary) - Hickey Run flows through the grounds of the National Arboretum in Northeast Washington, DC, where it empties into the Anacostia River. Its upper reaches are now encased in storm sewers that serve residential, commercial, and industrial areas of Langdon, Arboretum, South Woodridge, West Fort Lincoln, South Brookland, Mt. Olivet, Brentwood, and Gateway. The watershed is outside the area of combined sewer overflow, yet 36% imperviousness in the watershed brings heavy stormwater runoff. The DOEE website states that "although the stream is cleaner than it has been in the past, Hickey Run is still very polluted by trash, bacteria, low oxygen levels, excess sediments, toxic chemicals and metals, making the stream harmful to humans and wildlife." DOEE is working to reduce stormwater runoff by educating homeowners and engaging them to participate in the RiverSmart Homes program. DOEE has also been working with the community to restore the Springhouse Run Tributary of Hickey Run. Residents engaged by DOEE's efforts, and members of the Friends of National Arboretum, could be a good source of volunteers for this site.

AR-3. Kingman Lake at Floating Dock - The floating dock on the south side of the boardwalk bridge between Heritage and Kingman Islands is a known swimming location and frequent put in and pull out point of paddle craft access.

AR-4. Anacostia Park Boat Ramp Dock - The boat ramp and dock here are a frequent fishing, paddle craft, and motor craft access point, including for Anacostia River Explorer tours and, most recently, the Family and Youth Casting Call.

AR-5. Yards Marina - The marina piers are a known swimming site, as well as a frequent fishing, motor craft, sail craft, and paddle craft access point, including for stand-up paddle boards. This site is also within several hundred yards of a common anchorage where frequent swimming is known to occur, and a current DOEE water quality monitoring station.

AR-6. Buzzard Point at the Henson Center – The Henson Center is a known swimming area, frequent motor craft and sail craft access point, with some paddle craft access.

AR-7. Washington Channel - Washington Channel is a huge point of access for motor craft, sail craft, and paddle craft, and a known swimming site. With the recent opening of The Wharf, significantly more frequent water contact is expected here.

Sample Site Identification Number and GPS Coordinates

Station ID	Site Name	Latitude	Longitude
RC-1	Rock Creek at Juniper St	38.98315	-77.04068
RC-2	Pinehurst Branch	38.97634	-77.05221
RC-3	Broad Branch	38.95748	-77.06218
RC-4	Soapstone Creek	38.9466	-77.05575
RC-5	Melvin Hazen Run	38.93831	-77.05258
RC-6	Rock Creek below Piney Branch	38.93337	-77.05024
RC-7	Normanstone Run	38.92176	-77.06027
RC-8	P Street Branch	38.90885	-77.05065
PR-1	Battery Kemble Creek	38.92586	-77.09509
PR-2	Fletcher's Boat House	38.91868	-77.10311
PR-3	Foundry Branch	38.91583	-77.08306
PR-4	Washington Canoe Club	38.90431	-77.07193
PR-5	Thompson Boat Center	38.90008	-77.05842
PR-6	Tidal Basin	38.88495	-77.0355

PR-7	Columbia Island	38.87637	-77.04671
AR-1	National Arboretum	38.91162	-76.95459
AR-2	Hickey Run	38.90975	-76.96182
AR-3	Kingman Lake	38.89394	-76.96554
AR-4	Anacostia Park	38.87994	-76.97087
AR-5	Yards Marina	38.87278	-77.00064
AR-6	Buzzard Point	38.86535	-77.01015
AR-7	Washington Channel	38.87738	-77.02462

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Appendix B:

Lab and Field
Equipment Manuals/SOPs

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Water Quality Parameters

- Parameters Tested in the Field
  a) pH testing will be conducted by using test strips
  b) Air and water temperature will be measured by pocket thermometers
- Parameters Tested in the Lab
  a) Turbidity will be tested by LaMotte 2020WE EPA Portable Turbidity Meter
  b) *E. coli* will be tested by the IDEXX Colilert system

Field Test Equipment SOPs

Procedures for testing field parameters are found in Appendix C

Lab Test Equipment Manuals: Following pages

LaMotte

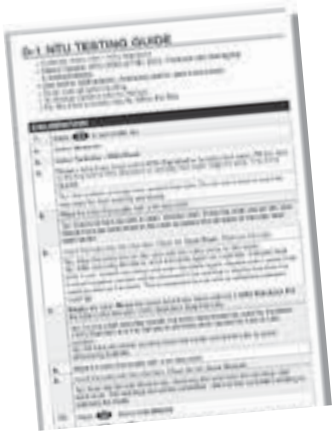
2020we/wi TURBIDIMETER

1970-EPA
1970-ISO

GENERAL INFORMATION


2020we/wi QUICK START GUIDE

Refer to the Quick Start Guide for simplified Calibration and Analysis procedures.


0-1 NTU TESTING GUIDE

Refer to the Testing Guide for detailed Calibration and Analysis procedures for improving the accuracy of low range turbidity measurements.

INTRODUCTION

■ TURBIDITY

What is Turbidity?

Turbidity is an aggregate property of the solution, which is water in most cases. Turbidity is not specific to the types of particles in the water. The particles could be suspended or colloidal matter, and they can be inorganic, organic or biological. At high concentrations, turbidity is perceived as cloudiness, haze or an absence of clarity in the water. Turbidity is an optical property that results when light passing through a liquid sample is scattered. The scattering of light results in a change in the direction of the light passing through the liquid. This is most often caused when the light strikes particles in solution and is scattered backward, sideways and forward. If the turbidity is low, much of the light will continue in the original direction. Light scattered by the particles allows the particle to be ”seen” or detected in solution just as sunlight allows dust particles in the air to be seen.

In the past 10 years, turbidity has become more than just a measure of water clarity. Because of the emergence of pathogens such as Cryptosporidium and Giardia, turbidity now holds the key to assuring proper water filtration. In 1998, the EPA published the IESWTR (interim enhanced surface water treatment rule) mandating turbidities in combined filter effluent to read at or below 0.3 NTU. By doing so, the EPA hoped to achieve a 2 log (99%) removal of Cryptosporidium. There is presently consideration to lower this to 0.1 NTU. The trend has been to check the calibration of on-line turbidimeters with hand-held field units. The optical design and low detection limit of the 2020we/wi allows very accurate readings for such calibrations.

The meter also allows the user to choose the units of measure for expressing turbidity. While nephelometric turbidity unit (NTU) has been the standard for years, FNU (formazin nephelometric unit) and FAU (formazin attenuation unit) are now being used in ISO 7027 units. American Society of Brewing Chemists (ASBC) units and European Brewery Convention (EBC) units allow the brewing industry to check process waters.

How is Turbidity Measured?

Turbidity is measured by detecting and quantifying the scattering of light in water (solution). Turbidity can be measured in many ways. There are visual methods and instrumental methods. Visual methods are more suitable for samples with high turbidity. Instrumental methods can be used on samples with both high and low levels of turbidity.

Two visual methods are the Secchi Disk method and the Jackson Candle method. The Secchi Disk method is often used in natural waters. A black and white Secchi Disk is lowered into the water until it can no longer be seen. It is then raised until it can be seen again. The average of these two distances is known as the “Secchi Depth”. The Jackson Candle method uses a long glass tube over a standard candle. Water is added or removed from the tube until the candle flame becomes

indistinct. The depth of the water measured with a calibrated scale is reported as Jackson Turbidity Units (JTU). The lowest turbidity that can be determined with this method is about 25 NTU. There are two common methods for instruments to measure turbidity. Instruments can measure the attenuation of a light beam passing through a sample and they can measure the scattered light from a light beam passing through a sample. In the attenuation method, the intensity of a light beam passing through a turbid sample is compared with the intensity passing through a turbidity-free sample at 180° from the light source. This method is good for highly turbid samples. The most common instrument for measuring scattered light in a water sample is a nephelometer. A nephelometer measures light scattered at 90° to the light beam. Light scattered at other angles may also be measured, but the 90° angle defines a nephelometric measurement. The light source for nephelometric measurements can be one of two types to meet EPA or ISO specifications. The EPA specifies a tungsten lamp with a color temperature of 2,200–3,000 K. The units of measurement for the EPA method are nephelometric turbidity units (NTU). The ISO specifies a light emitting diode (LED) with a wavelength of 860 ± 30 nm and a spectral bandwidth less than or equal to 60 nm. The units of measurement for the ISO method are formazin nephelometric units (FNU). The 2020we meets the EPA specification and the 2020wi meets the ISO specification. The nephelometric method is most useful for low turbidity.

The 2020we/wi is a nephelometer that is capable of measuring turbidity by both the attenuation method and the nephelometric method. It uses a detector placed at 180° to the light source for high turbidity samples. It uses a detector placed at 90° to the light source for the nephelometric method for low turbidity samples. The 2020we/wi has a signal averaging option to improve the stability of readings on low turbidity samples.

The 2020we/wi has two different turbidity calibrations, formazin and Japan Standard. The formazin calibration is the EPA and ISO approved method of calibrating nephelometers. This calibration can be used with user prepared formazin standards or commercially purchased formazin standards. LaMotte Company approved AMCO™ standards labeled for use with the 2020we/wi can also be used with the formazin calibration. Stablcal® standards below 50 NTU should not be used to calibrate the 2020we/wi.

The Japan Standard calibration is a calibration for a Japanese Water Works standard. It is based on Japanese formulated polystyrene turbidity standards. This calibration should only be used to meet Japanese Water Works requirements. The Japanese polystyrene standards can only be purchased in Japan. Formazin, AMCO and Stablcal® standards cannot be used with this calibration.

Taking Turbidity Water Samples

Clean plastic or glass containers may be used for turbidity samples. Ideally, samples should be tested soon after collection and at the same temperature as when collected.

■ SAMPLE DILUTION TECHNIQUES

If a test result is out of the range of the meter, it must be diluted. The test should then be repeated on the diluted sample. The following table gives quick reference guidelines for dilutions of various proportions.

Amount of Sample	Deionized Water to Bring Final Volume to 10 mL	Multiplication Factor
10 mL	0 mL	1
5 mL	5 mL	2
2.5 mL	7.5 mL	4
1 mL	9 mL	10
0.5 mL	9.5 mL	20

All dilutions are based on a final volume of 10 mL, so several dilutions will require small volumes of the water sample. Graduated pipets should be used for all dilutions. If volumetric glassware is not available, dilutions can be made with the colorimeter tube. Fill the tube to the 10 mL line with the sample and then transfer it to another container. Add 10 mL volumes of deionized water to the container and mix. Transfer 10 mL of the diluted sample to the colorimeter tube and follow the test procedure. Repeat the dilution and testing procedures until the result falls within the range of the calibration. Multiply the test result by the dilution factor. For example, if 10 mL of the sample water is diluted with three 10 mL volumes of deionized water, the dilution factor is four. The test result of the diluted sample should be multiplied by four.

OPTIONS & SET UP

■ FACTORY DEFAULT SETTINGS

Settings that have user options have been set at the factory to default settings.

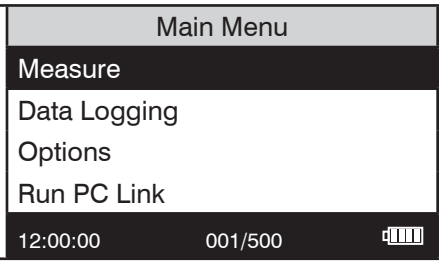
The factory default settings are:

Averaging	Disabled
Turbidity Units	NTU
Turbidity Calibration	Formazin
Date Format	MM-DD-YYYY
Power Save	5 minutes
Backlight	10 seconds
Language	English

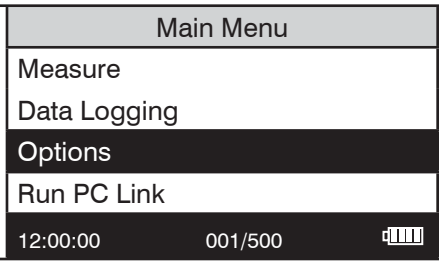
■ AVERAGING

The averaging option allows the user to average multiple readings. This option will improve the accuracy of samples with readings that may tend to drift with time. When the two, five or ten measurement option has been selected the final average is displayed. The averaging option is available only for turbidity. The default setting is disabled. To change the setting:

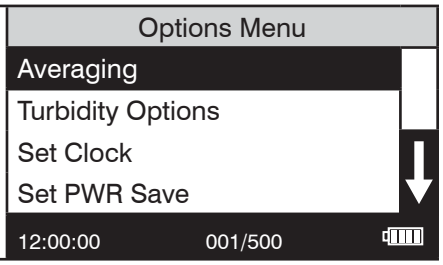
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



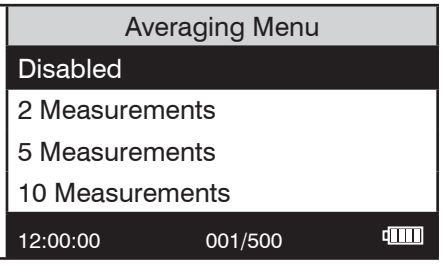
2. Press ▼ to scroll to **Options**.



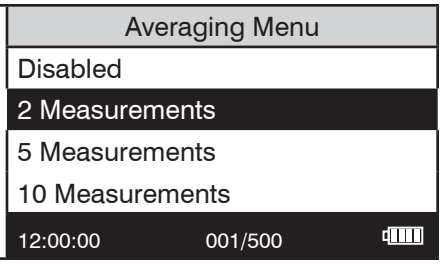
3. Press ENTER to select **Options**.



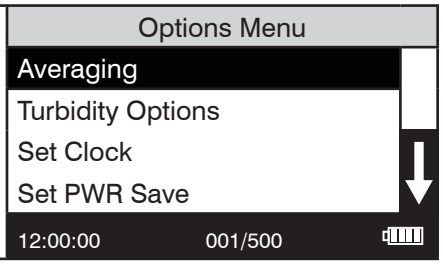
4. Press ENTER to select **Averaging**.



5. Press ▲ or ▼ to scroll to the desired option.



6. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.



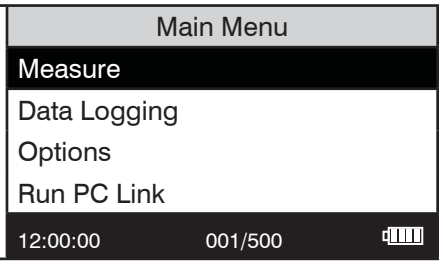
NOTE: When the **Averaging** option is enabled, more time will be required to display a reading and more power will be used.

■ TURBIDITY OPTIONS

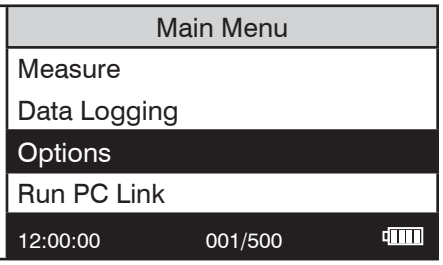
The default units are NTU and the default calibration curve is formazin. To change the settings:

Selecting Turbidity Units

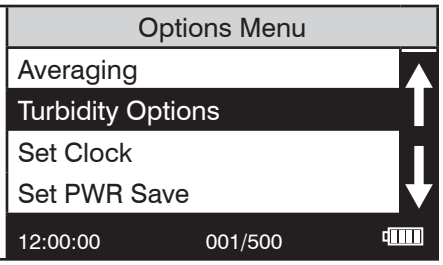
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



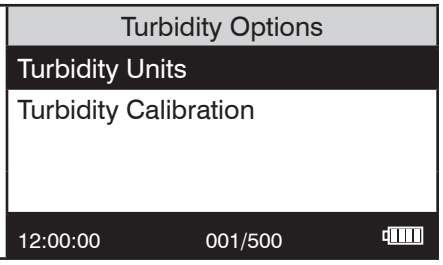
2. Press ▼ to scroll to **Options**.

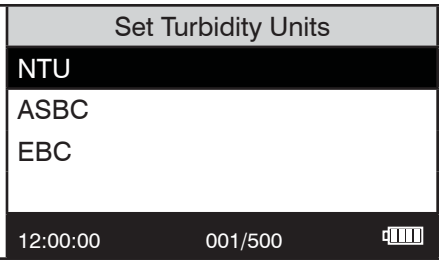


3. Press ENTER to select **Options**. Press ▼ to scroll to **Turbidity Options**.

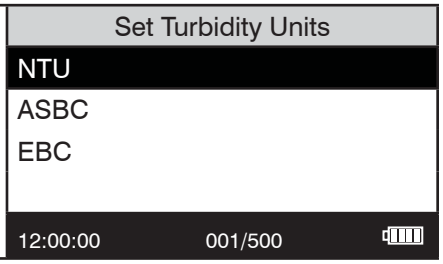


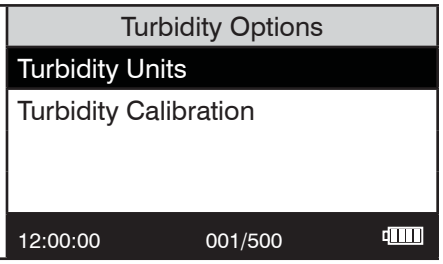
4. Press ENTER to select **Turbidity Options**.



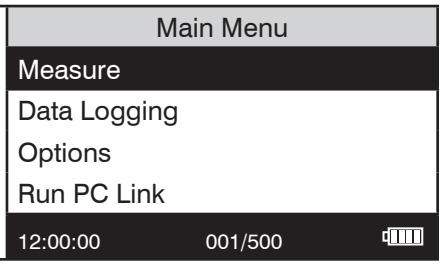
5. Press ENTER to select **Turbidity Units**.	

Available units are:
NTU (Nephelometric Turbidity Units)(2020we only)
FNU (Formazin Nephelometric Units) (2020wi only)
ASBC (American Society of Brewing Chemists)
EBC (European Brewery Convention)
NOTE: The meter will automatically switch to the attenuation mode above approximately 600 NTU or FNU. Measurements will be made with the 180° detector as indicated by AU or FAU on the display.

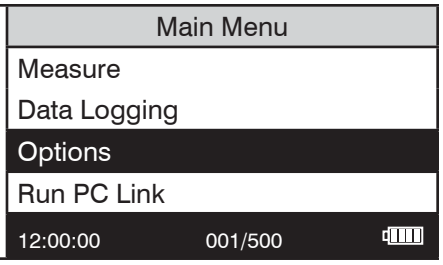
6. Press ^ or v to scroll to the desired units.	

7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Turbidity Options** menu. Press EXIT to return to a previous menu.	

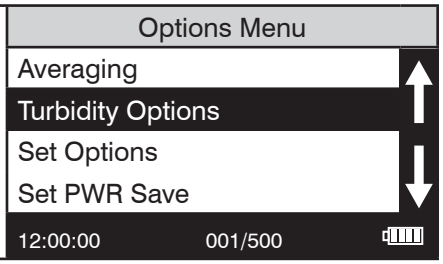
Selecting a Turbidity Calibration Curve

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	

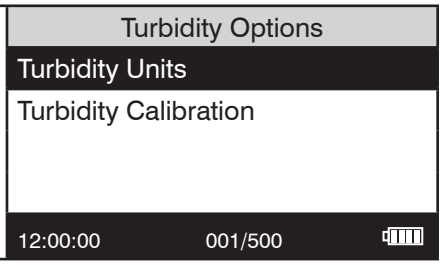
2. Press ▼ to scroll to **Options**.



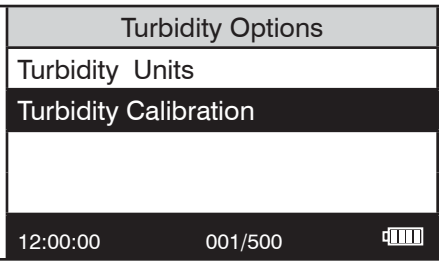
3. Press ENTER to select **Options**. Press ▼ to scroll to **Turbidity Options**.



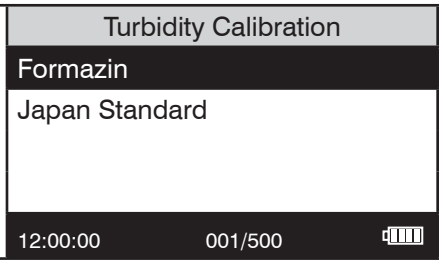
4. Press ENTER to select **Turbidity Options**.



5. Press ▼ to scroll to **Turbidity Calibration**.



6. Press ENTER to select **Turbidity Calibration**.



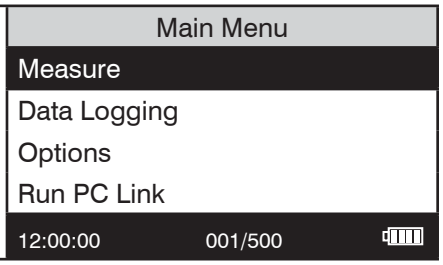
7. Scroll to the desired calibration option. Select a calibration option based on the composition of the standards that will be used to calibrate the meter.	Turbidity Calibration Formazin Japan Standard 12:00:00 001/500

NOTE: Stablcal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent has a different refractive index than traditional formazin standards and will affect the results.

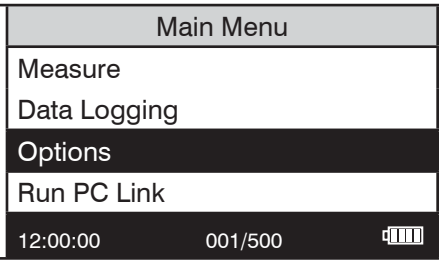
8. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Turbidity Options** menu. Press EXIT to return to a previous menu.	Turbidity Options Turbidity Units Turbidity Calibration 12:00:00 001/500

■ SETTING THE CLOCK

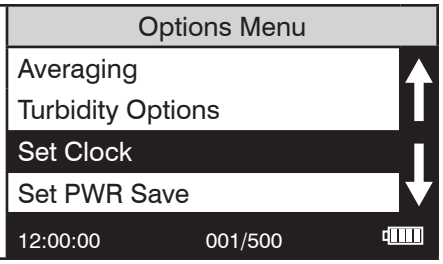
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



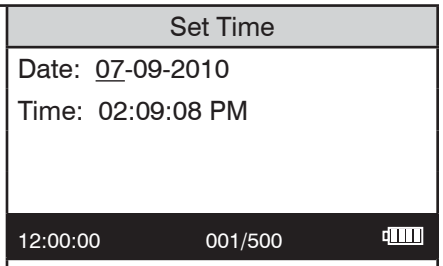
2. Press ▼ to scroll to **Options**.



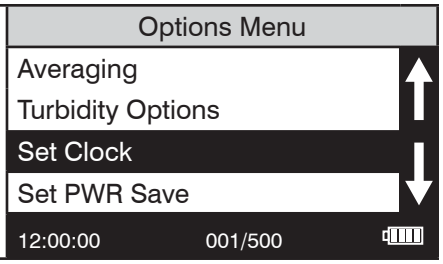
3. Press ENTER to select **Options**. Press ▼ to scroll to **Set Clock**.



4. Press ENTER to select **Set Clock**. The date is displayed as month-day-year. The time is displayed as hours:minutes:seconds AM/PM. Press ▲ or ▼ to the appropriate character and press ENTER to select. The cursor will move to the next character. Set all characters in the same manner. This is a scrolling menu.



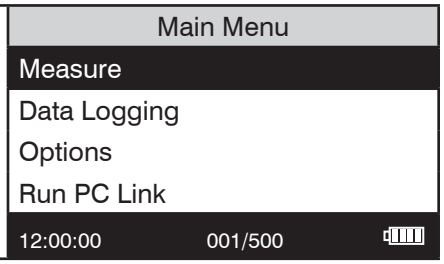
5. Press ENTER to select the final character. The time and date will be saved and the screen will return to the **Options Menu**.



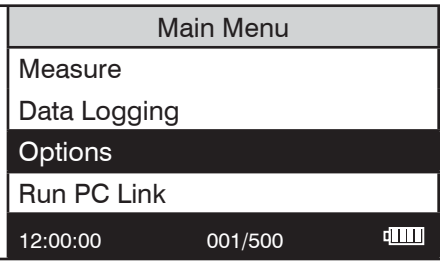
■ SETTING POWER SAVE

The power saving Auto Shutoff feature will turn the meter off when a button has not been pushed for a set amount of time. The default setting is disabled. To change the setting:

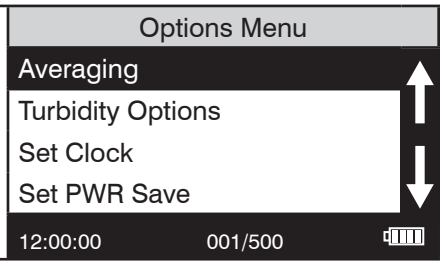
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



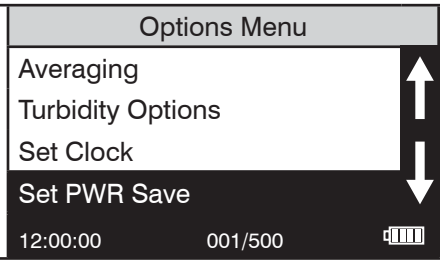
2. Press ▼ to scroll to **Options**.



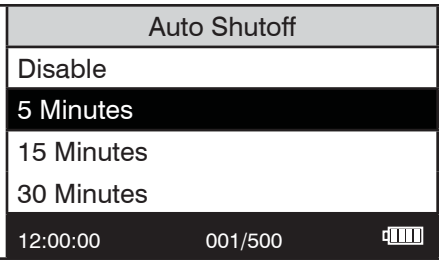
3. Press ENTER to select **Options**.



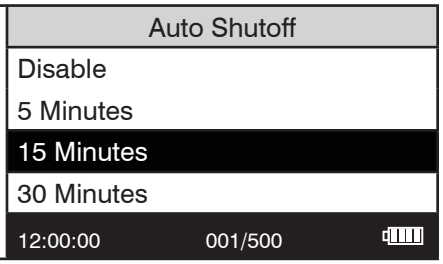
4. Press ▼ to scroll to **Set PWR Save.**



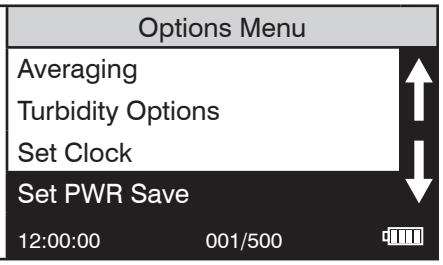
5. Press ENTER to select **PWR Save**.



6. Press ▼ ▼ to scroll to desired setting.



7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.



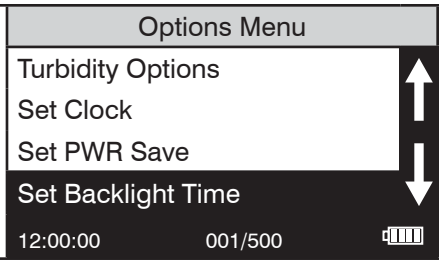
■ SETTING THE BACKLIGHT TIME

The backlight illuminates the display for enhanced viewing. If Button Control is chosen the backlight button on the key pad will act as an on/off switch and the backlight will remain on or off when the meter is being used. When one of the other settings – 10, 20 or 30 seconds – is chosen, the display will be illuminated for the specified amount of time after any button is pressed. As a precaution, the backlight will not illuminate during turbidity measurements to avoid interference from stray light.

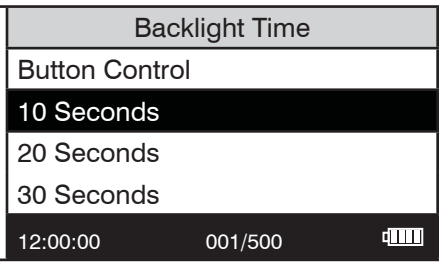
NOTE: The backlight feature uses a significant amount of power. The longer the backlight is on, the more frequently the battery will have to be charged if the USB/Wall Charger is not being used.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ▼ to scroll to **Options**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Options**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500

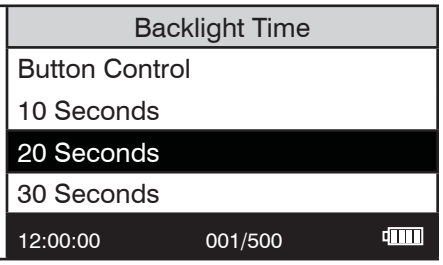
4. Press ▼ to scroll to **Set Backlight Time.**



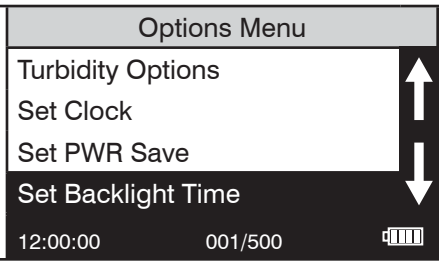
5. Press ENTER to select **Set Backlight Time.**



6. Press ▼ ▼ to scroll to desired setting.



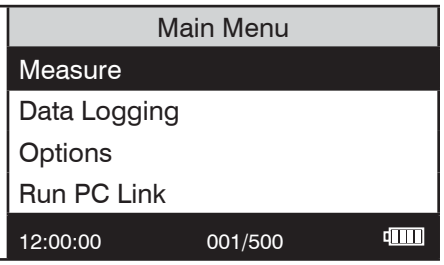
7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.



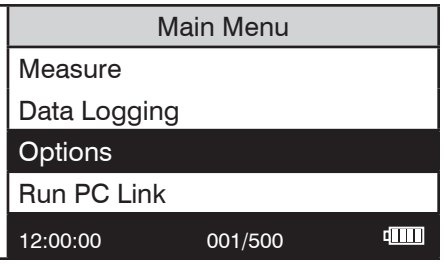
■ FACTORY RESET

Performing a Factory Reset will restore the factory default settings. All user-level calibrated settings will be lost.

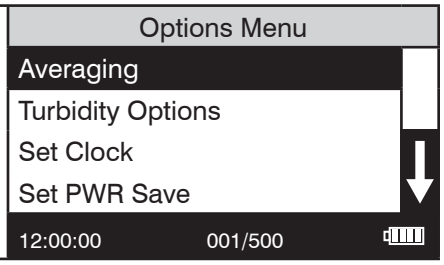
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



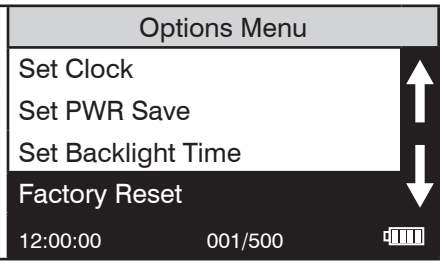
2. Press ▼ to scroll to **Options**.



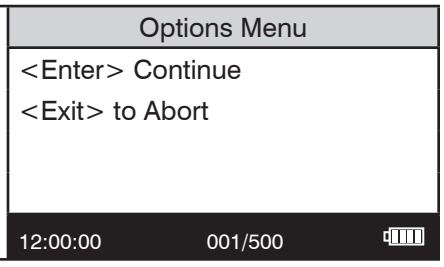
3. Press ENTER to select **Options**.



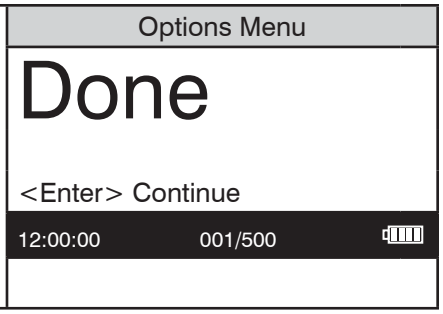
4. Press ▼ to scroll to **Factory Reset.**



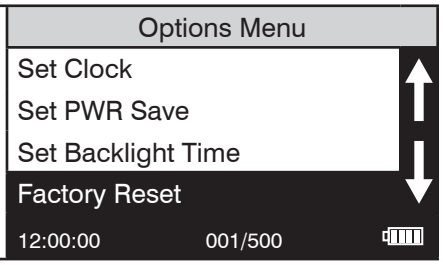
5. Press ENTER to select to **Factory Reset.**



6. Press ENTER to complete the Factory Reset. The screen will momentarily display **Writing**. The screen will display **Done** and return to the **Options Menu.** To retain the current user level calibration settings, press EXIT to abort the Factory Reset.



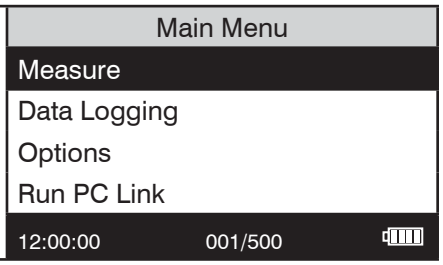
7. Press ENTER to return to the **Options Menu.**



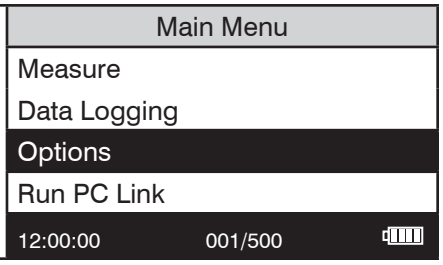
■ SELECTING A LANGUAGE

There are seven languages available in the 2020we/wi: English, Spanish, French, Portuguese, Italian, Chinese, and Japanese (Kana).

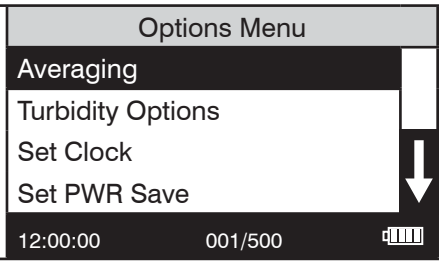
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



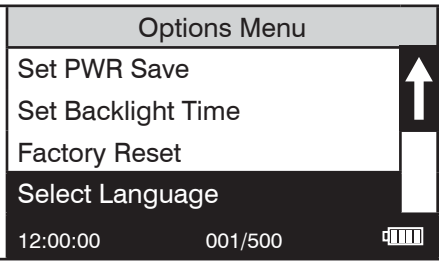
2. Press ▼ to scroll to **Options**.



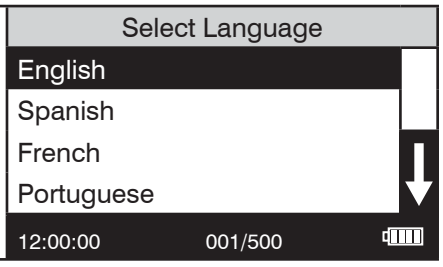
3. Press ENTER to select **Options**.



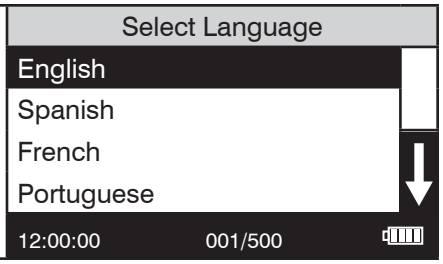
4. Press ▼ to scroll to **Select Language.**



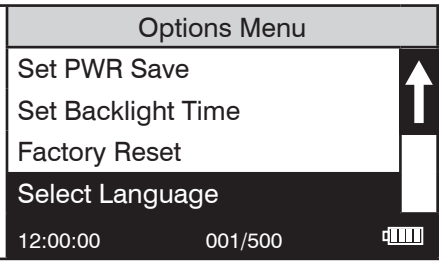
5. Press ENTER to select to **Select Language**.



6. Press ▲ or ▼ to scroll to desired language.



7. Press ENTER to select desired language. The screen will momentarily display, **Storing...**for about 1 second and return tot the **Options Menu**.



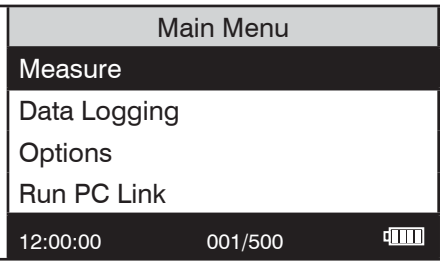
NOTE: If the meter unintentionally switches to another language, use the procedure above to reset the meter to the desired language. For example, to reset the meter to English:

1. Turn the meter on.
2. Press down arrow twice. Press ENTER.
3. Press down arrow seven times. Press ENTER.
4. Press ENTER.

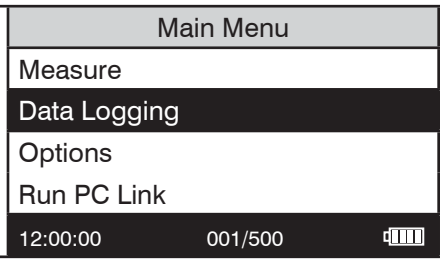
DATA LOGGING

The default setting for the data logger is enabled. The meter will log the last 500 data points. The counter in the center bottom of the display will show how many data points have been logged.

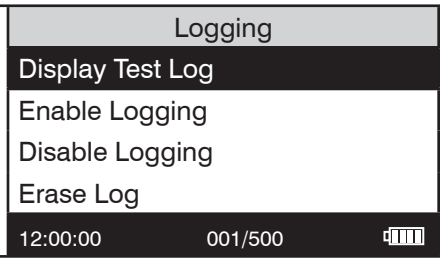
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



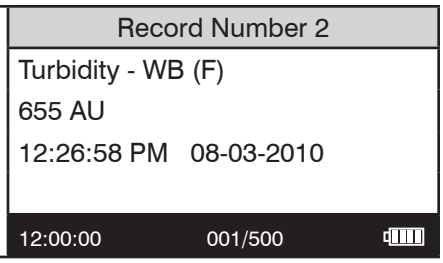
2. Press ▼ to scroll to **Data Logging**.



3. Press ENTER to select **Data Logging**.



4. Press ENTER to display the last data point and the time that it was logged.



5. Press ^ or v to scroll through the data points in the log.	Record Number 1 Turbidity - WB (F) 95.4 NTU 12:26:44 PM 08-03-2010 12:00:00 001/500

6. Press EXIT to return to the **Logging** menu. Press ^ or v to scroll to disable the logging options or erase the log. Press ENTER to select the option. The screen will display **Storing...** for about 1 second and return to the **Logging Menu**.	Logging Display Test Log Enable Logging Disable Logging Erase Log 12:00:00 001/500

CALIBRATION & ANALYSIS

■ CALIBRATION

Turbidity Standards

Only use AMCO or formazin standards with the 2020we/wi. StablCal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent used in the StablCal® standards has a different refractive index than traditional formazin standards and will affect the results. The concentration of the calibration standard should be similar to the expected concentration of sample that will be tested. The following standards are available from LaMotte Company:

1480 0 NTU Standard, 60 mL (EPA or ISO)

1450 1 NTU Standard, 60 mL (EPA)

1453 1 NTU Standard, 60 mL (ISO)

1451 10 NTU Standard, 60 mL (EPA)

1454 10 NTU Standard, 60 mL (ISO)

1452 100 NTU Standard, 60 mL (EPA)

1455 100 NTU Standard, 60 mL (ISO)

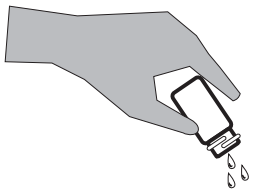
Turbidity Calibration Procedure

The default units are NTU and the default calibration curve is formazin as indicated by (F) in the Menu bar. For the most accurate results, a user calibration should be performed. The Japan Standard calibration mode, as indicated by (J) in the Menu bar, should be used only with Japanese Polystyrene Standards (0-100 NTU). To change the settings see the Set Up Instructions on page 9.

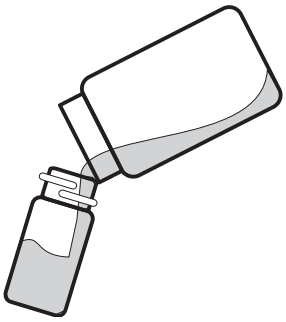
For the most accurate results, perform a calibration over the smallest range possible. Use a calibration standard that, along with the blank, brackets the range of samples that will be tested. For example, if the samples that are to be tested are expected to be below 1 NTU, more accurate results will be obtained by calibration with a blank and a 1 NTU standard as opposed to a blank and a 100 NTU standard.

It is recommended that the meter be calibrated daily.

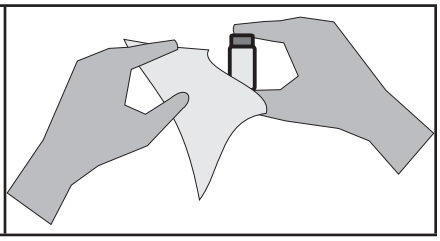
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500

2. Press ENTER to select **Measure**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
3. Press ▼ to scroll to **Turbidity - With Blank**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
4. Press ENTER to select **Turbidity - With Blank.**	Turbidity WB (F) Scan Blank Scan Sample 12:00:00 001/500
5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.	

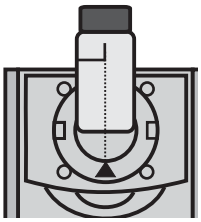
6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.



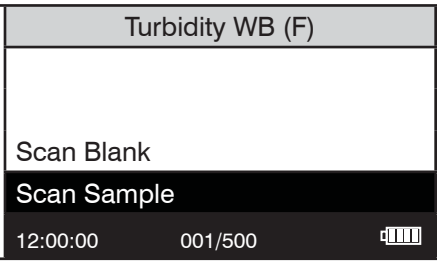
7. Wipe the tube thoroughly with a lint-free cloth.



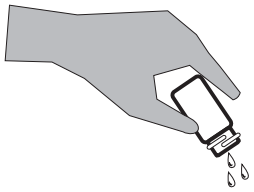
8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



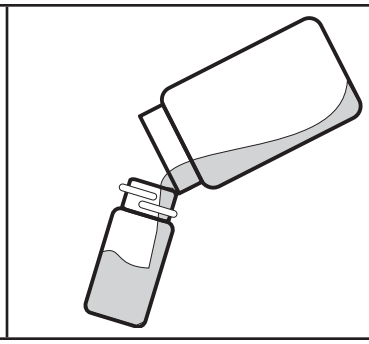
9. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Turbidity - With Blank Menu**.



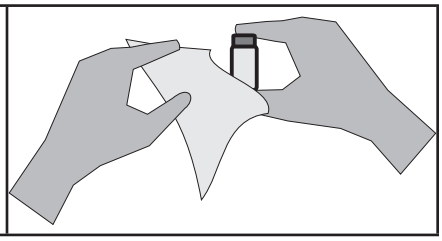
10. Rinse a clean tube (0290), or the same tube, three times with the standard.



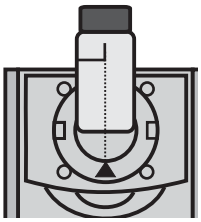
11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.



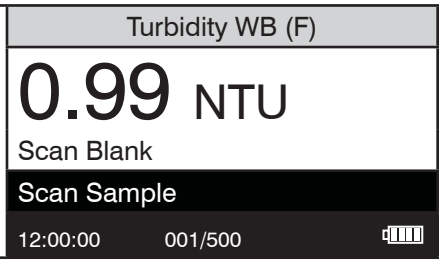
12. Wipe the tube thoroughly with a lint-free cloth.



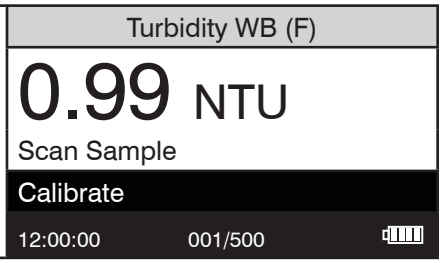
13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



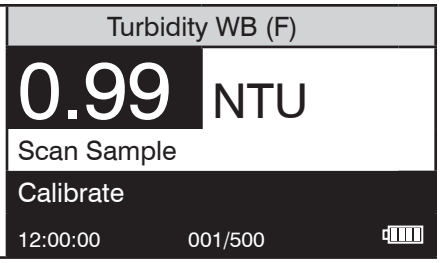
14. Press ENTER to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.



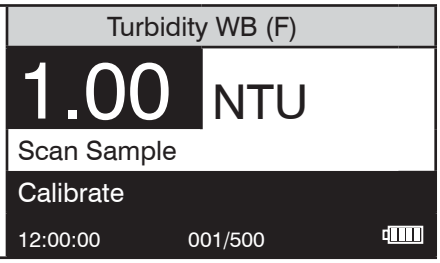
15. Press ▼ to scroll to **Calibrate**.



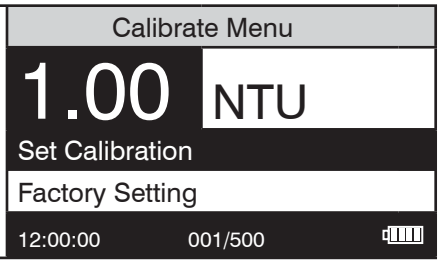
16. Press ENTER to select **Calibrate**. A reverse font (dark background with light characters) will appear to indicate that the reading can be adjusted.



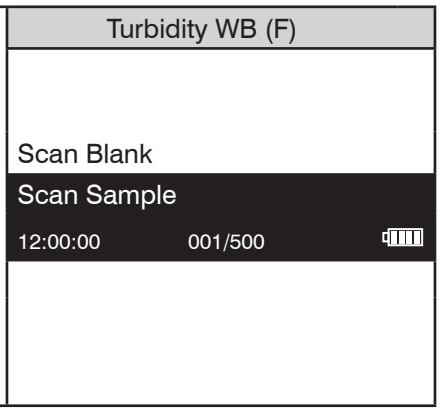
17. Press ^ or v to scroll to the concentration of the standard, 1.00 in the example. Note: The allowable adjustment is ±10%.



18. Press ENTER to select **Caibrate**. Two menu choices will be offered, **Set Calibration** and **Factory Setting**.



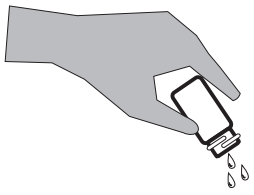
19. Press ENTER to select **Set Calibration** and save the calibration. Press ^ or v to scroll and select **Factory Setting** to revert to the factory calibration. The meter will momentarily display **Storing...** and return to the **Turbidity -Without Blank** menu. The calibration has now been saved and the meter can be used for testing.



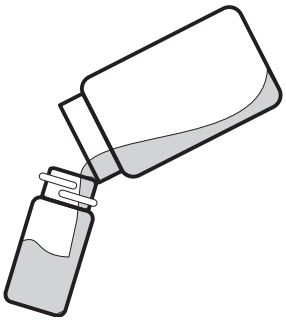
NOTE: For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.

■ ANALYSIS WITHOUT BLANKING PROCEDURE

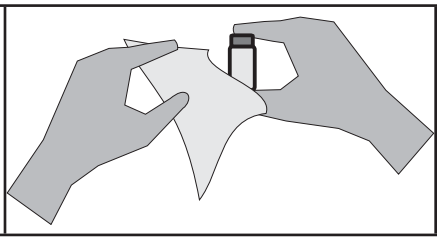
To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ENTER to select **Measure**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
3. Press ENTER to select **Turbidity - No Blank**.	Turbidity NB (F) Scan Blank Scan Sample 12:00:00 001/500
4. Rinse a clean tube (0290) three times with the sample.	

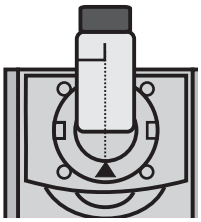
5. Fill the tube to the fill line with the sample. Pour the sample down the inside of the tube to avoid creating bubbles. Cap the tube.



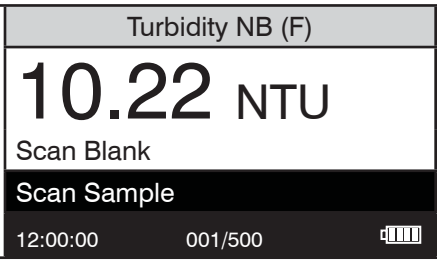
6. Wipe the tube thoroughly with a lint-free cloth.



7. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



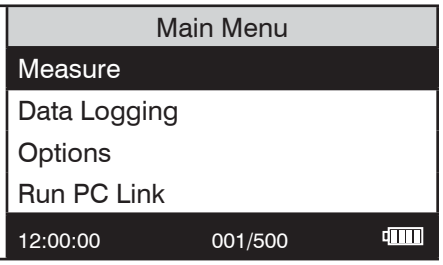
8. Press ENTER to select **Scan Sample**. The screen will display **Reading** for about 1 second. The result will appear on the screen.



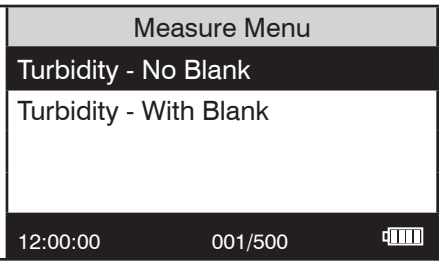
■ ANALYSIS WITH BLANKING PROCEDURE

To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

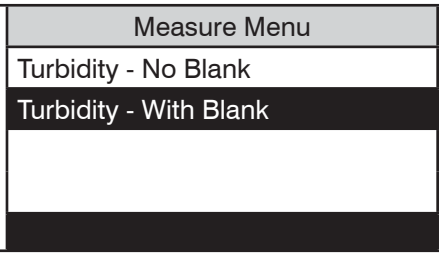
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



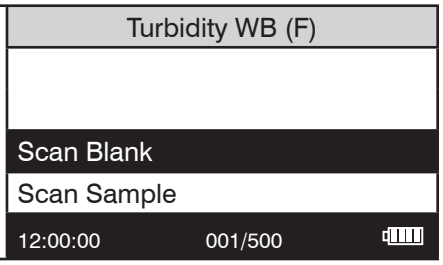
2. Press ENTER to select **Measure**.

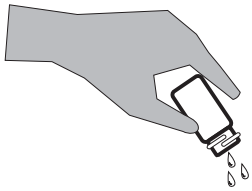
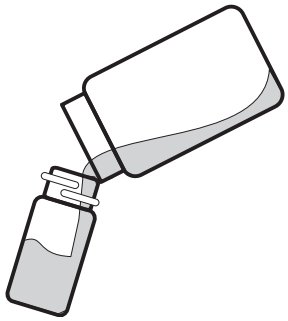
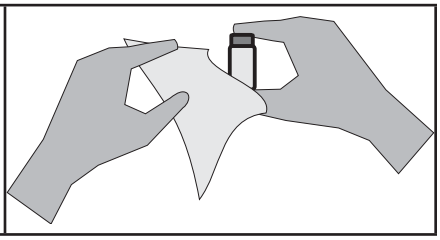
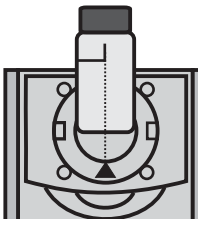


3. Press ⌄ to scroll to **Turbidity - With Blank**.

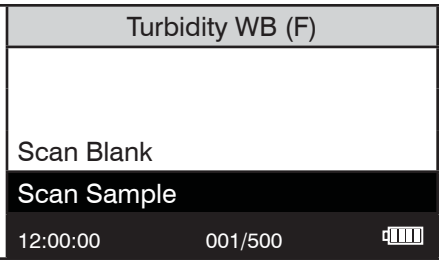


4. Press ENTER to select **Turbidity - With Blank**.

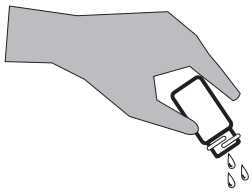


5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.	
6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.	
7. Wipe the tube thoroughly with a lint-free cloth.	
8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.	

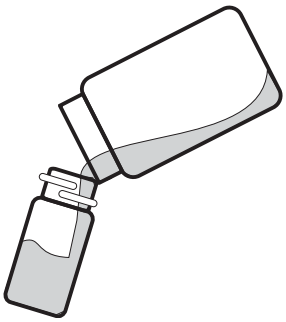
9. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Turbidity - With Blank** menu.



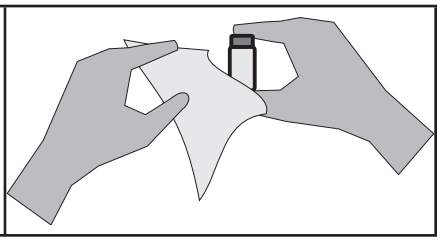
10. Rinse a clean tube (0290), or the same tube, three times with the sample.



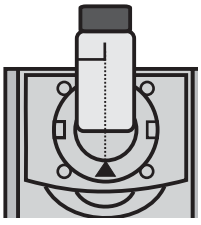
11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.



12. Wipe the tube thoroughly with a lint-free cloth.



13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



14. Press ENTER to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.	Turbidity WB (F) 0.99 NTU Scan Blank Scan Sample 12:00:00 001/500

NOTE: The meter will remember the last scanned blank reading. It is not necessary to scan a blank each time the test is performed. To use the previous blank reading, instead of scanning a new one, scroll to Scan Sample and proceed. For the most accurate results, the meter should be blanked before each test and the same tube should be used for the blank and the reacted sample.

■ DILUTION PROCEDURES

If a sample is encountered that is more than 4000 NTU, a careful dilution with 0 NTU or very low turbidity water will bring the sample into an acceptable range. However, there is no guarantee that halving the concentration will exactly halve the NTU value. Particulates often react in an unpredictable manner when diluted.

Turbidity-Free Water

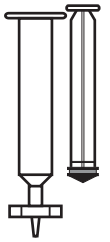
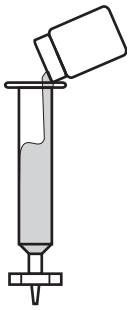
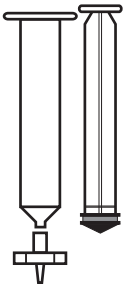
The definition of low turbidity and turbidity-free water has changed as filter technology has changed and nephelometric instruments have become more sensitive. At one time turbidity-free water was defined as water that had passed through a 0.6 micron filter. Now 0.1 micron filters are available and higher purity water is possible. Water that has been passed through a 0.1 micron filter could be considered particle free and therefore turbidity free, 0 NTU water. Turbidity is caused by scattered light. Therefore, low turbidity water is water without any particles that scatter a measurable amount of light. But water that passed through a 0.1 micron filter may still have detectable light scatter with modern instruments. This light scattering can be the result of dissolved molecules or sub-micron sized particles that can not be filtered out of the water. Because there may still be a small amount of scattered light from dissolved molecules, high purity water is often called low turbidity water and assigned a value of 0.01 or 0.02 NTU. However, because this water is used as a baseline to compare to sample water, the difference between the sample and the low turbidity or turbidity-free water will be the same whether it is called 0.00 NTU or 0.02 NTU. For design simplicity the 2020we/wi uses the term turbidity-free water and the value of 0.00 NTU.

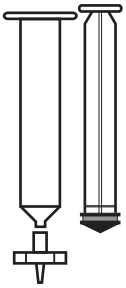
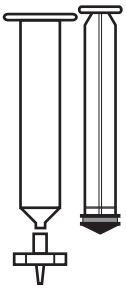
■ PREPARATION OF TURBIDITY-FREE WATER

A 0 NTU Standard (Code 1480) is included with the meter. An accessory package (Code 4185) is available for preparing turbidity-free water for blanking the meter and dilution of high turbidity samples.

The preparation of turbidity-free water requires careful technique.

Introduction of foreign matter will affect the turbidity reading. A filtering device with a special membrane filter is used to prepare turbidity-free water. The filter, filter holder and syringe must be conditioned by forcing at least two syringes full of deionized water through the filtering apparatus to remove foreign matter. The first and second rinses should be discarded. Turbidity-free water as prepared with the following procedure may be stored in the dark at room temperature in a clean glass bottle with a screw cap and used as required. The storage container should be rinsed thoroughly with filtered deionized water before filling. The water should be periodically inspected for foreign matter in bright light.

1. Remove the plunger from the syringe (0943). Attach the filter to the bottom of the syringe.	
2. Pour approximately 50 mL of deionized water into the barrel of the syringe. Insert the plunger. Exert pressure on the plunger to slowly force the water through the filter. Collect water in the clean storage container. Rinse walls of the container then discard this rinse water.	
3. Remove the filter from the syringe. Remove the plunger from the barrel. (This step is required to prevent rupturing the filter by the vacuum that would be created when the plunger is removed.)	

4. Replace the filter and repeat step 2 for a second rinse of the syringe and storage container.	
5. Remove the filter from the syringe. Remove the plunger from the barrel. Replace the filter and fill the syringe with approximately 50 mL of deionized water. Filter the water into the storage container and save this turbidity-free water.	
6. Repeat Step 5 until the desired amount of turbidity-free water has been collected.	

TESTING TIPS

1. Samples should be collected in a clean glass or polyethylene container.
2. Samples should be analyzed as soon as possible after collection.
3. Gently mix sample by inverting before taking a reading but avoid introducing air bubbles.
4. For the most precise results, follow the recommended procedure for wiping a filled tube before placing it in the meter chamber. Invert tube very slowly and gently three times to mix the sample. Surround the tube with a clean, lint-free cloth. Press the cloth around the tube. Rotate the tube in the cloth three times to assure that all areas of the tube have been wiped.
5. Discard tubes that have significant scratches and imperfections in the light pass zones. (Central zone between bottom and fill line).
6. When reading very low turbidity samples, do not use tubes or caps that have been used previously with high turbidity samples.
7. Use the averaging option for low level measurements of turbidity.

8. The meter should be placed on a surface that is free from vibrations. Vibrations can cause high readings.
9. Turbidity readings will be affected by electric fields around motors.
10. Carbon in the sample will absorb light and cause low readings.
11. Excessive color in a sample will absorb light and cause low readings. The user should verify if a certain level of color will cause a significant error at the level of turbidity being tested.
12. Observe shelf life recommendations for turbidity standards.
13. Do not use silicone oil on tubes when testing turbidity with the 2020we/wi.
14. When testing at low concentrations use the same tube for the blank and the sample.
15. Always insert tube into the meter chamber with the same amount of pressure and to the same depth.
16. Occasionally clean the chamber with a damp lint-free wipe, followed by a Windex® dampened wipe. A clean chamber and tubes are essential for reliable results.
17. For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.
18. Calibrate the meter daily.
19. Calibrate the meter with a 1.0 NTU Standard if samples are expected to be 1.0 NTU or less. Calibrate the meter with a 10.0 NTU Standard if samples are expected to be 1.0 NTU or greater.

TROUBLESHOOTING GUIDE

■ TROUBLESHOOTING

PROBLEM	*REASON*	*SOLUTION*
“Blank?”	Sample is reading lower than the blank.	With samples of very low concentration reblank or record as zero. On samples of higher concentration reblank and read again.
Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/computer charger.
“Low Battery”	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/computer charger.
“Shut Down Low Batt” Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/computer charger.
“Over range”	Sample is outside of acceptable range.	Dilute sample and test again.
“Error1”	High readings with 90° and 180° detectors.	Dilute sample by at least 50% and retest.
Lost in meter menus	Reset to factory default settings.	Follow Procedure on page 9 or page 26.
Unusually large negative or positive readings when performing calibration	Incorrect standards used to calibrate meter.	Use fresh 0.0 standard in clean tube. Reset meter to factory default settings. Recalibrate meter.

■ STRAY LIGHT

The accuracy of readings on the 2020we/wi should not be affected by stray light. Make sure that the sample compartment lid is always fully closed when taking readings. The backlight will interfere with turbidity readings. The meter will temporarily disable the backlight while turbidity measurements are being taken.

GENERAL OPERATING INFORMATION

■ OVERVIEW

The 2020we/wi is a portable, microprocessor controlled, direct reading nephelometer. Turbidity is measured directly by either EPA Method 180.1 or ISO Method 7027. It has a graphical liquid crystal display and 6 button keypad. These allow the user to select options from the menu driven software, to directly read test results or to review stored results of previous tests in the data logger. The menus can be displayed in seven different languages.

The 2020we/wi uses a state of the art, multi-detector optical configuration that assures long term stability of calibrations, high precision and accuracy and low detection limits. All readings are determined by sophisticated digital signal processing algorithms, minimizing fluctuations in readings and enabling rapid, repeatable measurements. The microprocessor and optics enable a dynamic range and auto-ranging over several ranges. Energy efficient LED light sources are used for ISO turbidity. EPA turbidity uses a tungsten filament light source that meets or exceeds EPA specifications and is designed for a uniform light spot image and stable output.

A USB computer/wall charger or Lithium battery powers the 2020we/wi.

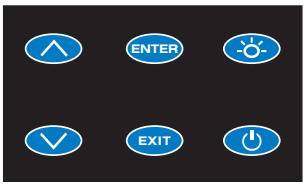
A USB port on the back of the meter allows an interface of the meter with a Windows-based computer for real-time data acquisition and data storage using a PC. The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program.

GENERAL OPERATING INFORMATION

The operation of the 2020we/wi is controlled by the menu driven software and user interface. A menu is a list of choices. This allows a selection of various tasks for the 2020we/wi to perform, such as, scan blank and scan sample. The keypad is used to make menu selections that are viewed on the display.

■ The Keypad

	This button will scroll up through a list of menu selections.
	The button is used to select choices in a menu viewed in the display.
	This button controls the backlight on the display.
	This button will scroll down through a list of menu selections.
	This button exits to the previous menu.
	This button turns the meter on or off.

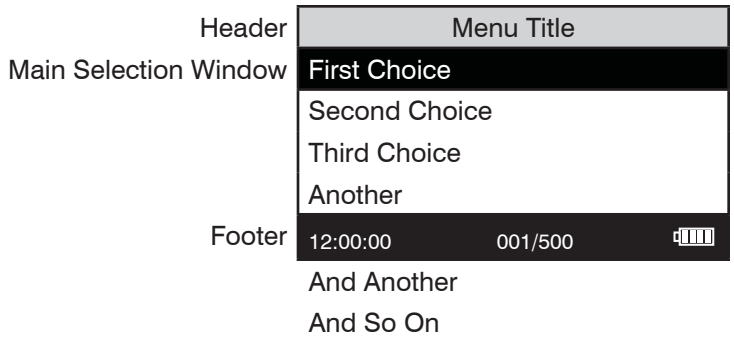


■ THE DISPLAY & MENUS

The display allows menu selections to be viewed and selected. These selections instruct the 2020we/wi to perform specific tasks. The menus are viewed in the display using two general formats that are followed from one menu to the next. Each menu is a list of choices or selections.

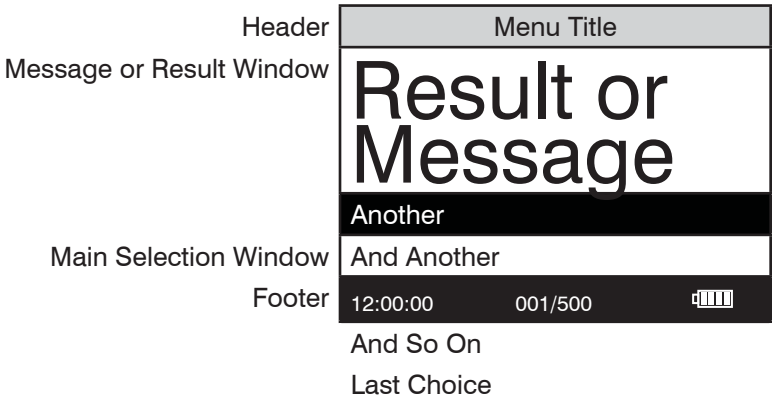
The display has a header line at the top and a footer line at the bottom. The header displays the title of the current menu. The footer line displays the time and the date, the data logger status and the battery status. The menu selection window is in the middle of the display between the header and the footer.

The menu selection window displays information in two general formats. In the first format only menu selections are displayed. Up to 4 lines of menu selections may be displayed. If more selections are available they can be viewed by pressing the arrow buttons to scroll the other menu selections into the menu selection window. Think of the menu selections as a vertical list in the display that moves up or down each time an arrow button  is pressed. Some menus in the 2020we/wi are looping menus. The top and bottom menu choices are connected in a loop. Scrolling down past the bottom of the menu will lead to the top of the menu. Scrolling up past the top of the menu will lead to the bottom of the menu.



A black bar will indicate the menu choice. As the menu is scrolled through, the black bar will highlight different menu choices. Pressing the ENTER button will select the menu choice that is indicated by the black bar.

In the second format the menu choice window takes advantage of the graphical capabilities of the display. Large format graphic information, such as test results or error messages or the LaMotte logo is displayed. The top two lines of the display are used to display information in a large, easy to read format. The menus work in the same way as previously described but two lines of the menu are visible at the bottom of the display.



As described previously, the EXIT button allows an exit or escape from the current menu and a return to the previous menu. This allows a rapid exit from an inner menu to the main menu by repeatedly pushing the EXIT button. Pushing ⏻ at any time will turn the 2020we/wi off.

The display may show the following messages:

	Battery Status
	More choices are available and can be viewed by scrolling up and/or down through the display.
Header	Identifies the current menu and information on units and reagent systems if applicable.
Footer	In the data logging mode the number of the data point is displayed and the total number of data points in the memory will be shown. The footer also shows current time and battery status

■ NEGATIVE RESULTS

There are always small variations in readings with analytical instruments. Often these variations can be observed by taking multiple readings of the same sample. These variations will fall above and below an average reading. Repeated readings on a 0.00 sample might give readings above and below 0.00. Therefore, negative readings are possible and expected on samples with concentrations at or near zero. This does not mean there is a negative concentration in the sample. It means the sample reading was less than the blank reading. Small negative readings can indicate that the sample was at or near the detection limit. This is a normal variation that results in a negative reading. A large negative reading, however, is not normal and indicates a problem. Some instruments are designed to display negative readings as zero. In this type of instrument, if the meter displayed zero when the result was actually a large negative number there would be no indication that a problem existed. For this reason, the 2020we/wi displays negative numbers for turbidity.

■ TUBES

The 2020we/wi uses one type of tube (Code 0290). There is no need for a special turbidity tube.

The handling of the tubes is of utmost importance. Tubes must be clean and free from lint, fingerprints, dried spills and significant scratches, especially the central zone between the bottom and the sample line.

Scratches, fingerprints and water droplets on the tube can cause stray light interference leading to inaccurate results when measuring turbidity. Scratches and abrasions will affect the accuracy of the readings. Tubes that have been scratched in the light zone through excessive use should be discarded and replaced with new ones.

Tubes should always be washed on the inside and outside with mild detergent prior to use to remove dirt or fingerprints. The tubes should be

allowed to air-dry in an inverted position to prevent dust from entering the tubes. Dry tubes should be stored with the caps on to prevent contamination.

After a tube has been filled and capped, it should be held by the cap and the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry and smudge-free. Handling the tube only by the cap will avoid problems from fingerprints. Always set the clean tube aside on a clean surface that will not contaminate the tube. It is imperative that the tubes and light chamber be clean and dry. The outside of the tubes should be dried with a clean, lint-free cloth or disposable wipe before they are placed in the meter chamber.

Tubes should be emptied and cleaned as soon as possible after reading a sample to prevent deposition of particulates on the inside of the tubes. When highly accurate results are required, reduce error by designating tubes to be used only for very low turbidity and very high turbidity testing.

Variability in the geometry of the glassware and technique is the predominate cause of variability in results. Slight variations in wall thickness and the diameter of the tubes may lead to slight variations in the test results. To eliminate this error the tubes should be placed in the chamber with the same orientation each time.

COMPUTER CONNECTION

■ PC LINK

The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program and USB Cable. The program will store test information and results in a database.

■ OUTPUT

USB

■ COMPUTER CONNECTION

USB Type A, USB mini B, Order Cable Code 1720.

BATTERY OPERATION

The 2020we/wi may be operated on battery power or using a computer/AC wall adapter. If using the meter as a bench top unit, use the AC wall adapter if possible to extend the battery life. The meter will remain on when the USB adapter is used.

The battery icon will show no bars and flash when the unit first turns on. Then the indicator will indicate the battery status by showing 0, 1, 2, 3 or 4 bars.

It will take 5 hours to fully change a low battery. The battery icon will flash when the battery is charging. The battery icon will show four bars and stop flashing when it is fully charged. The charging circuit will automatically switch to a float charge when the battery is fully charged. The charger may remain connected. Some computers will NOT supply

power to their USB ports during standby operation. The wall charger will charge the unit continuously.

The battery icon will show no bars and continuously flash if the battery is getting low but the unit will still operate normally. A “Low Battery” message on the status bar of the display will replace the time when the battery voltage is too low for proper operation and accuracy may be degraded. A “Shutdown Low Batt” message on the display will appear for a few seconds before the power is switched off when the battery is too low to operate the unit.

To extend the battery life:

- Shut down the unit with the power switch when not taking measurements or use the power save option to have the unit automatically turn off after 5 minutes.
- Store the unit in a cool dry place.
- Fully charge the battery before storing the unit for extended periods of time.
- Limit backlight use. The unit consumes 3X normal power with the backlight on. Set the backlight time option to 10 seconds, or select “Button Control” and keep the backlight off.

MAINTENANCE

■ CLEANING

Clean the exterior housing with a damp, lint-free cloth. Do not allow water to enter the light chamber or any other parts of the meter. To clean the light chamber and optics area, point a can of compressed air into the light chamber and blow the pressurized air into the light chamber. Use a cotton swab dampened with Windex® window cleaner to gently swab the interior of the chamber. Do not use alcohol; it will leave a thin residue over the optics when dry.

■ REPAIRS

Should it be necessary to return the meter for repair or servicing, pack the meter carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 800-344-3100 (US only) or 410-778-3100, faxing 410-778-6394, or emailing tech@lamotte.com. Often a problem can be resolved over the phone or by email. If a return of the meter is necessary, attach a letter with the return authorization number, meter serial number, a brief description of problem and contact information including phone and FAX numbers to the shipping carton. This information will enable the service department to make the required repairs more efficiently.

■ METER DISPOSAL

Waste Electrical and Electronic Equipment (WEEE)

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment. To avoid harm to the environment and natural resources, the use of appropriate take-back systems is recommended. The crossed out wheeled bin symbol on the meter encourages the use of these systems when disposing of this equipment.

Take-back systems will allow the materials to be reused or recycled in a way that will not harm the environment. For more information on approved collection, reuse, and recycling systems contact local or regional waste administration or recycling services.

GENERAL INFORMATION

■ PACKAGING AND DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments.

After the product leaves LaMotte Company, all responsibility for safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

■ GENERAL PRECAUTIONS

READ THE INSTRUCTION MANUAL BEFORE ATTEMPTING TO SET UP OR OPERATE THE METER. Failure to do so could result in personal injury or damage to the meter. The meter should not be used or stored in a wet or corrosive environment. Care should be taken to prevent water from wet tubes from entering the meter chamber.

NEVER PUT WET TUBES IN THE METER.

■ SAFETY PRECAUTIONS

Read the label on all reagent containers. Some labels include precautionary notices and first aid information. Certain reagents are considered potential health hazards and are designated with a * in the instruction manual. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or FAX. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four-digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

■ LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

■ SPECIFICATIONS - 2020we/wi

Instrument Type:	Nephelometer
Standard:	EPA 180.1, 2020we; ISO7027, 2020wi
Units of Measure:	NTU (Nephelometric Turbidity Units) (2020we only) FNU (Formazin Nephelometric Units) (2020wi only) ASBC (American Society of Brewing Chemists) EBC (European Brewery Convention)
Range:	0-4000 NTU, 0-4000 FNU, 0-10,500 ASBC, 0-150 EBC
Range Selection:	Automatic
Resolution: (display)	0.01 NTU, 0–10.99 NTU Range 0.1 NTU, 11.0–109.9 NTU Range 1 NTU, 110–4000 NTU Range
Accuracy:	From 0-2.5 NTU the accuracy is ±0.05 NTU. From 2.5-100 NTU the accuracy is ±2%. Above 100 NTU the accuracy is ±3%.
Detection Limit:	0.05 NTU
Light Source:	Tungsten lamp 2300°C ±50 °C, 2020we; IR LED 850 nm ±10 nm, spectral bandwidth 50 nm, 2020wi
Detector	Photodiode, centered at 90°, maximum peak 400-600 nm, TC-3000we Photodiode, centered at 90°, TC-3000wi
Response Time:	<2 seconds
Signal Averaging:	Yes
Sample Chamber:	Accepts 25 mm flat-bottomed test tubes
Sample:	10 mL in capped tube
Display:	Graphic Liquid Crystal Display
Software:	*Auto Shut-off:* 5, 10, 30 min, disabled *Calibration:* Field adjustable, 2-points *Data Logging:* 500 points
Languages:	English, Spanish, French, Portuguese, Italian, Chinese, Janpanese (Kana)
Temperature:	Operation: 0–50 °C; Storage: -40–60 °C

Operation Humidity Range:	0–90 % RH, non-condensing
Auto Shut-off:	5, 10, 30 min, disabled
Waterproof:	IP67
Power Source†:	USB computer/wall charger or Lithiun ion rechargeable battery 2200 mAH, 3.7V
Battery Life:	~380 tests (backlight on) to 1000 tests (backlight off) (with signal averaging disabled)
Dimensions:	(W x L x H) 8.84 x 19.05 x 6.35 cm; 3.5 x 7.5 x 2.2 inches
Weight:	362 g, 13 oz (meter only)
USB Interface	mini B

†CE Mark: The device complies to the product specifications for the Low Voltage Directive.

■ STATISTICAL & TECHNICAL DEFINITIONS RELATED TO PRODUCT SPECIFICATIONS

Method Detection Limit (MDL): "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte."[1] Note that, "As Dr. William Horwitz once stated, 'In almost all cases when dealing with a limit of detection or limit of determination, the primary purpose of determining that limit is to stay away from it.'"[2]

Accuracy: Accuracy is the nearness of a measurement to the accepted or true value.[3] The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e. ±0.5 ppm). It can also be expressed as the % recovery of a known amount of analyte in a determination of the analyte (i.e. 103.5 %).

Resolution: Resolution is the smallest discernible difference between any two measurements that can be made.[4] For meters this is usually how many decimal places are displayed. (i.e. 0.01). Note that the resolution many change with concentration or range. In some cases the resolution may be less than the smallest interval, if it is possible to make a reading that falls between calibration marks. A word of caution, that resolution has very little relationship to accuracy or precision. The resolution will always be less than the accuracy or precision but it is not a statistical measure of how well a method of analysis works. The resolution can be very, very good and the accuracy and precision can be very bad! This is not a useful measure of the performance of a test method.

Repeatability: Repeatability is the within-run precision.[5] A run is a

single data set, from set up to clean up. Generally, one run occurs on one day. However, for meter calibrations, a single calibration is considered a single run or data set, even though it may take 2 or 3 days.

Reproducibility: Reproducibility is the between-run precision.[6]

Detection Limit (DL): The detection limit (DL) for the 2020we/wi is defined as the minimum value or concentration that can be determined by the meter, which is greater than zero, independent of matrix, glassware, and other sample handling sources of error. It is the detection limit for the optical system of the meter.

[1] CFR 40, part 136, appendix B

[2] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 31.

[3] Skoog, D.A., West, D. M., *Fundamental of Analytical Chemistry*, 2nd ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

[4] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 34.

[5] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130.

[6] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130

■ CONTENTS & ACCESSORIES

	2020we Kit EPA Version Code 1970-EPA	2020wi Kit ISO Version Code 1970-ISO
Contents	*Code*	*Code*
0 NTU Standard, 60 mL	1480	1480
1 NTU Standard, 60 mL	1450	1453
10 NTU Standard, 60 mL	1451	1454
Water Sample Bottle, 60 mL	0688	0688
Tubes, 4	—	—
Cable, USB, 3 ft.	1720	1720
USB Wall Plug	1721	1721

Accessories	
Code	*Description*
1452	100 NTU Standard, 60 mL (EPA)
1455	100 NTU Standard, 60 mL (ISO)
0290-6	Tubes, Code 0290, Set of 6
4185	Turbidity-Free Water Kit
2-2097	Filters, 0.1 micron, Pack of 50
1901-CD	SMARTLink 3 Software

■ EPA COMPLIANCE

The 2020we meter meets or exceeds EPA design specifications for NPDWR and NPDES turbidity monitoring programs as specified by the USEPA method 180.1.

■ ISO Compliance

This 2020wi meter meets or exceeds ISO design criteria for quantitative methods of turbidity using optical turbidimeters as specified by ISO 7027.

■ CE COMPLIANCE

The 2020we and 2020wi meters have been independently tested and have earned the European CE Mark of compliance for electromagnetic compatibility and safety. To view certificates of compliance, go to the LaMotte website at www.lamotte.com.

NOTE: The device complies to the product specifications for the Low Voltage Directive.

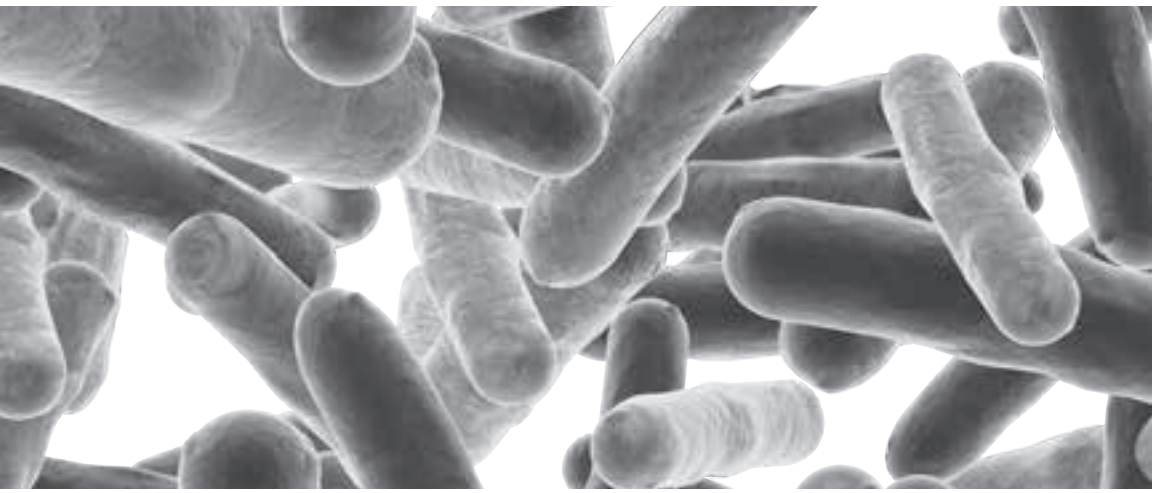
■ WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 2 years from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 for a return authorization number or visit www.lamotte.com for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

802 Washington Ave • Chestertown • Maryland • 21620 • USA
410-778-3100 • 800-344-3100
www.lamotte.com

1970-MN • 9.9.10

Colilert*



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For Technical Support, please call:

North/South America: 1 207 556 4496/1 800 321 0207

Europe: 00800 4339 9111

UK: +44 (0) 1638 676800

China: +86 21 61279528

Japan: 03 5301 6800

Australia: 1300 443 399

IDEXX Laboratories, Inc., One IDEXX Drive, Westbrook, Maine 04092 USA

idexx.com/water

Colilert* Test Kit

Introduction

Colilert* simultaneously detects total coliforms and *E. coli* in water. It is based on IDEXX's proprietary Defined Substrate Technology*. When total coliforms metabolize Colilert's DST* nutrient-indicator, ONPG, the sample turns yellow. When *E. coli* metabolize Colilert's DST* nutrient-indicator, MUG, the sample also fluoresces. Colilert can simultaneously detect these bacteria at 1 cfu/100 mL within 24 hours even with as many as 2 million heterotrophic bacteria per 100 mL present.

Storage

Store at 2–30°C away from light.

Presence/Absence (P/A) Procedure

1. Add contents of one pack to a 100 mL sample in a sterile, transparent, nonfluorescing vessel.
2. Cap vessel and shake.
3. Incubate at 35±0.5°C for 24 hours.
4. Read results according to Result Interpretation table below.

Quanti-Tray* Enumeration Procedure

1. Add contents of one pack to a 100 mL water sample in a sterile vessel.
2. Cap vessel and shake until dissolved.
3. Pour sample/reagent mixture into a Quanti-Tray* or Quanti-Tray*/2000 and seal in an IDEXX Quanti-Tray* Sealer.
4. Place the sealed tray in a 35±0.5°C incubator for 24 hours.
5. Read results according to the Result Interpretation table below. Count the number of positive wells and refer to the MPN table provided with the trays to obtain a Most Probable Number.

Result Interpretation

Appearance	Result
Less yellow than the comparator[1]	Negative for total coliforms and *E. coli*
Yellow equal to or greater than the comparator	Positive for total coliforms
Yellow and fluorescence equal to or greater than the comparator	Positive for *E. coli*

- Look for fluorescence with a 6-watt, 365-nm UV light within 5 inches of the sample in a dark environment. Face light away from your eyes and towards the sample.
- Colilert results are to be read after 24 hours of incubation.
- However, if the results are ambiguous to the analyst based on the initial reading, incubate up to an additional four hours (but not to exceed 28 hours total) to allow the color and/or fluorescence to intensify.
- Positives for both total coliforms and *E. coli* observed before 24 hours and negatives observed after 28 hours are also valid.
- In addition, laboratories may incubate samples for additional time (up to 28 hours total) for their convenience.

Procedural Notes

- This insert may not reflect your local regulations. For compliance testing, be sure to follow appropriate regulatory procedures. For example, samples run in other countries are incubated at 36±2°C for 24–28 hours.
- Colilert can be run in any multiple tube format. *Standard Methods for the Examination of Water and Wastewater*[2] MPN tables should be used to find Most Probable Numbers (MPNs).
- If a water sample has some background color, compare inoculated Colilert sample to a control blank of the same water sample.
- If sample dilutions are made, multiply the MPN value by the dilution factor to obtain the proper quantitative result.
- Use only sterile, nonbuffered, oxidant-free water for dilutions.
- Colilert is a primary water test. Colilert performance characteristics do not apply to samples altered by any pre-enrichment or concentration.
- In samples with excessive chlorine, a blue flash may be seen when adding Colilert. If this is seen, consider sample invalid and discontinue testing.
- Aseptic technique should always be followed when using Colilert. Dispose of in accordance with Good Laboratory Practices.

Quality Control Procedures

1. One of the following quality control procedures is recommended for each lot of Colilert:
   A. IDEXX-QC Coliform and *E.coli* [3]: *Escherichia coli*, *Klebsiella variicola*‡, and *Pseudomonas aeruginosa*
   B. Quanti-Cult*[4]: *Escherichia coli, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*.
   C. Fill three sterile vessels with 100 mL of sterile nonbuffered oxidant-free water and inoculate with a sterile loop of ATCC[5] strains, *Escherichia coli* ATCC 25922/WDCM 00013 or ATCC 11775/WDCM 00090, *Klebsiella variicola*‡ ATCC 31488/ WDCM 00206 and *Pseudomonas aeruginosa* ATCC 10145/WDCM 00024 or ATCC 27853.
2. Follow the P/A Procedure or Quanti-Tray Enumeration Procedure above.
3. Results should match the Result Interpretation table above.

NOTE: IDEXX internal quality control testing is performed in accordance with ISO 11133:2014. Quality Control Certificates are available at idexx.com/water.

1. IDEXX P/A Comparator, catalog #WP104; Quanti-Tray Comparator #WQTC, or Quanti-Tray/2000 Comparator #WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, 2005. Washington, DC.
3. IDEXX-QC Coliform and *E. coli*—IDEXX Catalog #UN3373-WQC-TCEC
4. Quanti-Cult cultures—IDEXX catalog # WKIT-1001
5. American Type Culture Collection 1-800-638-6597 atcc.org

‡. *Klebsiella pneumoniae* (ATCC 31488/WDCM 00206) has been renamed to *Klebsiella variicola*.

Kit d'analyse Colilert*

Introduction

Colilert* permet la détection simultanée des coliformes totaux et *E. coli* dans l'eau. Ce test est basé sur la technologie propriétaire Defined Substrate Technology* (DST*) d'IDEXX. Lorsque les coliformes totaux métabolisent ONPG, le substrat chromogène-indicateur de Colilert, le prélèvement vire au jaune. Lorsque l'échantillon est positif, le réactif MUG contenu dans Colilert est métabolisé par les *E. coli* et génère une fluorescence. Colilert peut détecter simultanément ces bactéries à 1 cfu/100 ml en 24 heures, même en présence de bactéries hétérotrophes d'une concentration de 2 millions par 100 ml.

Conditions de Conservation

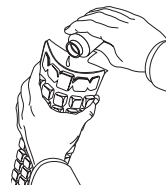
Conserver entre 2–30°C à l'abri de la lumière.

Procédure de Présence/Absence (P/A)

1. Ajouter le contenu d'un sachet dans un prélèvement de 100 ml placé dans un récipient stérile, transparent et non fluorescent.
2. Fermer le récipient et agiter.
3. Incuber à 35±0,5°C pendant les 24 heures qui suivent.
4. Interpréter les résultats en se référant au tableau d'interprétation des résultats ci-dessous.

Quanti-Tray* Procédure de numération

1. Ajouter le contenu d'un sachet dans un prélèvement de 100 ml d'eau placé dans un récipient stérile.
2. Fermer le récipient et agiter jusqu'à dissolution.
3. Verser le mélange prélèvement/réactif dans un Quanti-Tray* ou un Quanti-Tray*/2000 et fermer hermétiquement dans un IDEXX Quanti-Tray* Sealer.
4. Placer le plateau hermétiquement fermé dans un incubateur à 35±0,5°C pendant 24 heures.
5. Interpréter les résultats en se référant au tableau d'interprétation des résultats ci-dessous. Compter le nombre de puits positifs et se référer au tableau MPN fourni avec les plateaux pour obtenir le Chiffre le plus probable (MPN).



Interprétation des Résultats

Aspect	Résultat
Moins jaune que le comparateur[1]	Négatif pour les coliformes totaux et *E. coli*
Aussi jaune ou plus jaune que le comparateur	Positif pour les coliformes totaux
Couleur jaune et fluorescence égales ou supérieures au comparateur	Positif pour *E. coli*

- Évaluer la fluorescence avec une ampoule UV de 6 watts et 365 nm placée à 13 cm du prélèvement dans l'obscurité. Orienter la lumière vers le prélèvement, dans la direction opposée à celle des yeux de l'opérateur.
- Les résultats du test Colilert doivent être lus après 24 heures d'incubation.
- Toutefois, si les résultats de la première lecture sont ambigus pour l'analyste, incuber jusqu'à quatre heures supplémentaires (sans dépasser 28 heures au total) pour laisser la couleur et/ou la fluorescence s'intensifier.
- Les résultats positifs en coliformes et *E. coli* observés avant 24 heures et les résultats négatifs observés après 28 heures sont également valables.
- En outre, les laboratoires peuvent incuber des échantillons pendant une durée plus longue (jusqu'à 28 heures en tout) par souci de commodité.

Remarques Concernant la Procédure

- Cette notice peut différer des réglementations en vigueur dans votre pays. Pour tout test de conformité, suivre les procédures réglementaires appropriées. Par exemple, l'incubation des échantillons dans certains pays est réalisée à 36±2°C pendant 24 à 28 heures.
- Colilert peut être effectué en format de tubes multiples. Utiliser des méthodes standards et les tableaux MPN pour le contrôle des eaux et eaux usées[2] afin de déterminer les Chiffres les Plus Probables (MPN).
- Si un prélèvement d'eau présente une couleur de fond, comparer le prélèvement inoculé avec Colilert à un contrôle neutre du même prélèvement d'eau.
- Si les prélèvements sont dilués, multiplier la valeur MPN par le facteur de dilution pour obtenir le résultat quantitatif correct.
- Utiliser uniquement de l'eau stérile, non tamponnée et sans oxydant pour les dilutions.
- Colilert est avant tout un test pour eau. Les caractéristiques de performance de Colilert ne s'appliquent pas aux prélèvements altérés par tout enrichissement préalable ou toute concentration.
- Avec les prélèvements présentant un excédent de chlore, il peut se produire une rapide lueur bleuâtre lors de l'ajout de Colilert. Si tel est le cas, le prélèvement n'est pas valide et il faut cesser le test.
- Utiliser systématiquement des techniques aseptiques dans l'emploi de Colilert. Mettre au rebut conformément aux Bonnes pratiques de laboratoire.

Procédures de contrôle de qualité

1. L'une des procédures de contrôle qualité suivantes est recommandée pour chaque lot de Colilert:
   A. IDEXX-QC[3] pour les Coliformes et *E.coli*: *Escherichia coli*, *Klebsiella variicola*‡ et *Pseudomonas aeruginosa*.
   B. Quanti-Cult*[4] *Escherichia coli*, *Klebsiella pneumoniae* et *Pseudomonas aeruginosa*.
   C. Remplir trois récipients stériles avec 100 ml d'eau stérile, non tamponnée et sans oxydant puis inoculer les récipients avec une anse stérile avec des souches ATCC[5], *Escherichia coli* ATCC 25922/ WDCM 00013 ou ATCC 11775/ WDCM 00090, *Klebsiella variicola*‡ ATCC 31488/ WDCM 00206 et *Pseudomonas aeruginosa* ATCC 10145/ WDCM 00024 ou ATCC 27853.
2. Suivre la procédure P/A ou la procédure de numération Quanti-Tray ci-dessus.
3. Les résultats doivent correspondre aux résultats du tableau d'interprétation ci-dessus.

REMARQUE: les tests de contrôle qualité internes d'IDEXX sont effectués conformément à la norme ISO 11133:2014. Les certificats de contrôle qualité sont disponible à l'adresse idexx.fr/water.

1. Comparateur P/A IDEXX, réf. n° WP104 ; Comparateur Quanti-Tray n° WQTC ou Quanti-Tray/2000 Comparateur n° WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water and Wastewater* (Méthodes traditionnelles d'analyses de l'eau et des eaux usées), American Public Health Association, 2005. Washington, DC.
3. Coliforme et *E. coli* d'IDEXX-QC - Catalogue IDEXX n° UN3373-WQC-TCEC
4. Cultures Quanti-Cult - IDEXX réf. n° WKIT-1001
5. American Type Culture Collection 1-800-638-6597 atcc.org

‡. *Klebsiella pneumoniae* (ATCC 31488 / WDCM 00206) a été renommé *Klebsiella variicola*.

Kit di analisi Colilert*

Introduzione

Colilert* rileva simultaneamente i coliformi totali e l'*E. coli* nell'acqua. Si basa su una tecnologia di substrato definito (DST* o Defined Substrate Technology) di cui IDEXX* e' proprietaria del brevetto. Quando i coliformi totali metabolizzano l'indicatore di nutrienti del Colilert, ONPG, il campione diventa giallo. Quando l'*E.coli* metabolizza il nutriente-indicatore MUG, il campione presenta anche fluorescenza. Il Colilert è in grado di rilevare simultaneamente questi batteri in concentrazioni di 1 cfu/100 ml entro 24 ore anche se sono presenti addirittura 2 milioni di batteri eterotrofici per 100 ml.

Conservazione

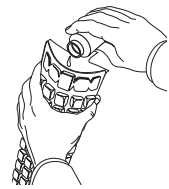
Conservare a 2–30°C lontano dalla luce.

Procedura Relativa a Presenza/Assenza (P/A)

1. Unire il contenuto di un pacchetto ad un campione da 100 ml in un a provetta sterile, trasparente e non fluorescente.
2. Incappucciare la provetta ed agitarla.
3. Incubare a 35±0,5°C per 24 ore.
4. Leggere i risultati secondo la tabella di Interpretazione dei risultati qui sotto.

Procedura di Enumerazione Quanti-Tray*

1. Unire il contenuto di un pacchetto ad un campione di acqua da 100 ml in una provetta sterile.
2. Chiudere la provetta e agitarla fino a dissoluzione.
3. Versare la miscela campione/reagente in un vassoietto Quanti-Tray* o Quanti-Tray*/2000 e sigillarlo in un IDEXX Quanti-Tray* Sealer.
4. Mettere il vassoietto sigillato in un'incubatrice a 35°C±0,5°C per 24 ore.
5. Leggere i risultati secondo la tabella di Interpretazione dei risultati qui sotto. Contare il numero di pozzetti positivi e consultare la tabella MPN fornita insieme ai vassoietti per ottenere il numero più probabile.



Interpretazione dei Risultati

Aspetto	Risultato
Meno giallo rispetto al colore di confronto[1]	Negativo per coliformi totali ed *E. coli*
Giallo uguale o più intenso rispetto al colore di confronto	Positivo per coliformi totali
Giallo e fluorescenza uguali o più intensi rispetto al colore di confronto	Positivo per *E. coli*

- Individuare la fluorescenza con una luce a raggi ultravioletti da 6 watt, 365 nm, entro circa 13 cm dal campione, in ambiente buio. Dirigere la luce verso il campione, in direzione opposta ai propri occhi.
- I risultati di Colilert devono essere letti dopo 24 ore di incubazione.
- Tuttavia, se i risultati sono ambigui per l'analista sulla base della lettura iniziale, incubare fino a quattro ore in più (non superando tuttavia 28 ore in totale) in modo da consentire l'intensificarsi del colore e/o della fluorescenza.
- Sono validi anche i positivi sia per i coliformi totali sia per *E. coli* osservati prima di 24 ore e i negativi osservati dopo 28 ore.
- Inoltre, i laboratori possono incubare i campioni per un periodo aggiuntivo (fino a 28 ore in totale) per loro comodità.

Note Sulla Procedura

- Questo inserto informativo potrebbe non riflettere le normative locali. Per i test sulla conformità, assicurarsi di seguire le procedure normative corrispondenti. Ad esempio, i campioni trattati in altri Paesi vengono incubati a 36±2°C per 24–28 ore.
- Il Colilert si può eseguire in qualsiasi formato a provetta multipla. I metodi standard per l'esame delle tabelle MPN dell'acqua e delle acque di scarico[2] vanno usati per ottenere i Numeri Più Probabili (MPN).
- Se un campione di acqua dovesse presentare della colorazione di sfondo, confrontare il campione Colilert inoculato con controllo vuoto dello stesso campione di acqua.
- Se il prodotto viene diluito, moltiplicare il valore MPN per il fattore di diluizione per ottenere la quantità giusta.
- Per le diluizioni usare solo acqua sterile, non tamponata, priva di ossidanti.
- Il Colilert è un test primario per l'acqua. Le caratteristiche di prestazione del Colilert non sono applicabili a campioni alterati da qualsiasi pre-arricchimento o da concentrazione.
- In campioni con cloro eccessivo, quando si aggiunge il Colilert si potrebbe vedere un lampo azzurro. In questo caso, considerare il campione non valido e interrompere l'analisi.
- Quando si usa il Colilert va sempre seguita la tecnica asettica. Eliminare secondo le buone pratiche di laboratorio.

Procedure di Controllo della Qualità

1. Per ciascun lotto di Colilert si consiglia una delle seguenti procedure di controllo della qualità:
   A. Coliformi ed *E.coli*[3] IDEXX-QC: *Escherichia coli*, *Klebsiella variicola*‡ e *Pseudomonas aeruginosa*.
   B. Quanti-Cult*[4] *Escherichia coli*, *Klebsiella pneumoniae* e *Pseudomonas aeruginosa*.
   C. Riempire tre contenitori sterili con 100 ml di acqua sterile non tamponata e senza ossidanti e inoculare con un'ansa sterile di ceppi ATCC[5], *Escherichia coli* ATCC 25922/ WDCM 00013 o ATCC 11775/ WDCM 00090, *Klebsiella variicola*‡ ATCC 31488/ WDCM 00206 e *Pseudomonas aeruginosa* ATCC 10145/ WDCM 00024 o ATCC 27853.
2. Seguire la procedura P/A o la procedura di enumerazione Quanti-Tray descritte sopra.
3. I risultati devono corrispondere a quelli della tabella di Interpretazione dei risultati indicata sopra.

NOTA: i test di controllo di qualità interni IDEXX sono condotti in conformità con ISO 11133:2014. I certificati di controllo qualità sono disponibili sul sito idexx.it/water.

1. Comparatore P/A IDEXX, codice di catalogo WP104; Comparatore Quanti-Tray N. WQTC o Quanti-Tray/2000 Comparatore N. WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, 2005. Washington, DC.
3. Coliformi ed *E.coli* IDEXX-QC - Catalogo IDEXX N. UN3373-WQC-TCEC
4. Colture Quanti-Cult N. di catalogo IDEXX WKIT-1001
5. American Type Culture Collection 1-800-638-6597

‡. *Klebsiella pneumoniae* (ATCC 31488 / WDCM 00206) è stato rinominato in *Klebsiella variicola*

Colilert* Testkit

Einführung

Colilert* ist zum gleichzeitigen Nachweis von Gesamtcoliformen und *E. coli* im Wasser bestimmt. Es basiert auf der gesetzlich geschützten Defined Substrate Technology* (DST*) von IDEXX. Wenn die Gesamtcoliformen den Nährstoff-Indikator ONPG von Colilert metabolisieren, verfärbt sich die Probe gelb. Wenn *E. coli* den Nährstoffindikator MUG verstoffwechselt, fluoresziert die Probe. Colilert kann diese Bakterien gleichzeitig im Bereich von 1 CFU/100 ml innerhalb von 24 Stunden nachweisen, selbst wenn 2 Mio. heterotrophe Bakterien pro 100 ml vorhanden sind.

Lagerung

Bei 2–30°C und nicht im Licht lagern.

Presence/Absence (P/A) Test

1. Den Inhalt einer Packung zu einer 100 ml Probe in einem sterilen, transparenten, nicht fluoreszierenden Gefäß hinzugeben.
2. Das Gefäß verschließen und schütteln.
3. Für den verbleibenden 24-Stunden-Zeitraum bei 35±0,5°C inkubieren.
4. Die Ergebnisse gemäß der nachstehenden Ergebnisauswerte-Tabelle ablesen.

Quanti-Tray* Auszähl-Methode

1. Den Inhalt einer Packung zu einer 100 ml Wasserprobe in einem sterilen Gefäß hinzugeben.
2. Das Gefäß verschließen und so lange schütteln, bis der Inhalt aufgelöst ist.
3. Die aus Probe und Reagenz bestehende Mischung in ein Quanti-Tray oder Quanti-Tray/2000 gießen und in einem IDEXX Quanti-Tray Sealer fest verschließen.
4. Das verschlossene Tray 24 Stunden in einen Inkubator im Temperaturbereich von 35±0,5°C inkubieren.
5. Die Ergebnisse anhand der nachstehenden Ergebnisauswerte-Tabelle ablesen. Die Anzahl der positiven Vertiefungen zählen und die wahrscheinlichste Zahl (MPN; Most Probable Number) anhand der MPN-Tabelle, die den Trays beiliegt, ermitteln.

Ergebnisauswertung

Aussehen der Probe	Mögliche Ergebnisse
Geringere Gelbfärbung als der Comparator[1]	Negativ für Gesamtcoliforme und *E. coli*
Gleiche oder stärkere Gelbfärbung als der Comparator	Positiv für Gesamtcoliforme
Gelbfärbung und Fluoreszenz gleich oder stärker als die des Comparators	Positiv für *E. coli*

- Prüfung auf Fluoreszenz mit einer 6-Watt, 365 nm UV-Lampe aus einem Abstand von 13 cm in einer dunklen Umgebung. Dabei die Lampe nur auf die Probe, nicht auf die Augen, richten.
- Colilert-Ergebnisse sollten nach einer Inkubationszeit von 24 Stunden abgelesen werden.
- Wenn die Ergebnisse jedoch nach der ersten Ablesung nicht eindeutig sind, nochmals bis zu vier Stunden (insgesamt jedoch nicht länger als 28 Stunden) inkubieren, um die Intensivierung der Farbe und/oder Fluoreszenz zu ermöglichen.
- Positive Ergebnisse für Gesamtcoliforme und *E. coli*, die vor Ablauf von 24 Stunden und negative Ergebnisse, die nach Ablauf von 28 Stunden beobachtet werden, sind ebenfalls gültig.
- Darüber hinaus können Labors die Proben aus praktischen Gründen auch länger (insgesamt bis zu 28 Stunden) inkubieren.

Verfahrenshinweise

- Diese Packungsbeilage entspricht unter Umständen nicht Ihren örtlichen Bestimmungen. Bei Konformitätsprüfungen unbedingt die entsprechenden aufsichtsbehördlichen Verfahren anwenden. In anderen Ländern werden zum Beispiel zu untersuchende Proben 24–28 Stunden bei 36±2°C inkubiert.
- Das Colilert Verfahren kann in jedem Multiple-Tube-Format durchgeführt werden. Zur Ermittlung der MPNs (wahrscheinlichste Zahlen) sollten MPN-Tabellen für Standardverfahren zur Untersuchung von Wasser und Abwasser[2] verwendet werden.
- Wenn eine Wasserprobe etwas Hintergrundfarbe aufweist, ist die inokulierte Colilert Probe mit einer Kontrollprobe derselben Wasserprobe zu vergleichen.
- Bei Probenverdünnungen den MPN-Wert mit dem Verdünnungsfaktor multiplizieren, um das korrekte quantitative Ergebnis zu erhalten.
- Nur steriles, nicht gepuffertes, keine Oxidantien enthaltendes Wasser zur Verdünnung verwenden.
- Colilert ist ein primärer Wassertest. Die Leistungsmerkmale von Colilert gelten nicht für Proben, die durch Voranreicherung oder Konzentration modifiziert wurden.
- In Proben mit übermäßigem Chlorgehalt wird bei der Zugabe von Colilert u.U. ein blaues Aufleuchten beobachtet. In diesem Fall ist die Probe als ungültig zu betrachten und der Test abzubrechen.
- Bei der Verwendung von Colilert ist ein aseptisches Vorgehen vorgeschrieben. Entsorgung gemäß Standard-Laborpraktiken.

Qualitätskontrollverfahren

1. Eines der folgenden Qualitätskontrollverfahren wird für jede Colilert-Charge empfohlen:
   A. IDEXX-QC Coliforme okund *E.coli* [3]: *Escherichia coli*, *Klebsiella variicola*‡ und *Pseudomonas aeruginosa*.
   B. Quanti-Cult*[4] *Escherichia coli*, *Klebsiella pneumoniae* und *Pseudomonas aeruginosa*.
   C. Drei sterile Gefäße mit 100 ml sterilem, ungepuffertem, oxidansfreiem Wasser füllen und mit einer sterilen Öse ATCC[5]-Stämme, *Escherichia coli* ATCC 25922/ WDCM 00013 oder ATCC 11775/ WDCM 00090, *Klebsiella variicola*‡ ATCC 31488/ WDCM 00206 und *Pseudomonas aeruginosa* ATCC 10145/ WDCM 00024 oder ATCC 27853 inokulieren.
2. Das oben beschriebene P/A-Verfahren oder das Quanti-Tray Auszählverfahren befolgen.
3. Die Ergebnisse sollten mit der Ergebnisauswerte-Tabelle oben übereinstimmen.

HINWEIS: Die internen Qualitätskontrollprüfungen von IDEXX werden im Einklang mit ISO 11133:2014 durchgeführt. Qualitätskontrollzertifikate sind unter idexx.de/water erhältlich.

1. IDEXX P/A Comparator, Best.-Nr. WP104; Quanti-Tray Comparator WQTC oder Quanti-Tray/2000 Comparator WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water and Wastewater* (Standardverfahren für die Wasser- und Abwasseruntersuchung). American Public Health Association, 2005. Washington, DC, USA.
3. IDEXX-QC Coliform und *E.-coli* - IDEXX Bestellnr. UN3373-WQC-TCEC
4. Quanti-Cult Kulturen - IDEXX Best.-Nr. WKIT-1001
5. American Type Culture Collection 1-800-638-6597

‡. *Klebsiella pneumoniae* (ATCC 31488 / WDCM 00206) wurde *Klebsiella variicola* umbenannt

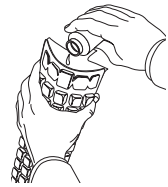
Kit de análisis Colilert*

Introducción
Colilert* detecta simultáneamente los coliformes totales y *E. coli* en el agua. Se basa en Defined Substrate Technology* (Tecnología de substrato definido [DST*]), patentada por IDEXX. Cuando los coliformes totales metabolizan el indicador ONPG de nutrientes de Colilert, la muestra toma una coloración amarilla. Cuando *E. coli* metaboliza el indicador MUG de nutrientes de Colilert, la muestra además fluoresce. Colilert puede detectar simultáneamente estas bacterias a una concentración de 1 ufc/100 ml dentro de las 24 horas, hasta en presencia de 2 millones de bacterias heterotróficas por cada 100 ml.

Almacenamiento
Almacenar a temperatura de 2–30°C, alejado de la luz.

Procedimiento de Presencia/Ausencia (P/A)
1. Añadir el contenido de una dosis a una muestra de 100 ml en un recipiente estéril transparente, no fluorescente.
2. Tapar y agitar el recipiente.
3. Incubar a 35±0,5°C durante 24 horas.
4. Leer los resultados de acuerdo con el cuadro de interpretación de resultados, más abajo.

Procedimiento de Enumeración Quanti-Tray*
1. Añadir el contenido de un paquete a una muestra de 100 ml de agua, en un recipiente estéril.
2. Tapar y agitar el recipiente hasta disolver.
3. Verter la mezcla de muestra/reactivo en una Quanti-Tray* o una Quanti-Tray*/2000 y sellar en un IDEXX Quanti-Tray* Sealer.
4. Colocar la bandeja sellada en una incubadora a 35±0,5°C durante 24 horas.
5. Leer los resultados de acuerdo con el cuadro de interpretación de resultados, más abajo. Contar el número de pocillos positivos y referirse al cuadro NMP proporcionado con las bandejas para obtener el número más probable.



Interpretación de resultados

Aspecto	Resultado
Menos amarillo que el comparador[1]	Negativo para coliformes totales y *E. coli*
Amarillo igual o mayor que el del comparador	Positivo para coliformes totales
Amarillo y fluorescencia iguales o mayores que los del comparador	Positivo para *E. coli*

- Buscar fluorescencia usando una luz UV de 6 vatios, 365 nm a distancia de unas 5 pulgadas (13 cm) de la muestra, en un entorno oscuro. Apuntar el haz de luz en dirección contraria a los ojos y hacia la muestra.
- Los resultados de Colilert se deben leer a las 24 horas de incubación.
- Es possible prolonger el tiempo de lectura 4 horas mas, hasta las 28 horas, para que en raro pero posible caso de duda el color o la fluorescencia se intensifiquen.
- Los resultados positivos para coliformes totales y *E. coli* antes de las 24 horas y negativos tras 28 horas también son válidos.
- Asimismo, los laboratorios pueden incubar muestras (hasta 28 horas en total) si lo desean, para mayor comodidad.

Notas sobre el procedimiento
- Este prospecto tal vez no refleje sus reglamentaciones locales. Para probar el cumplimiento, asegurarse de seguir los procedimientos reglamentarios apropiados. Por ejemplo, las muestras realizadas en otros países se incuban a 36±2°C durante 24 a 28 horas.
- Colilert puede procesarse en cualquier formato de múltiples tubos. Deben usarse los Standard Methods for Examination of Water y las tablas NMP de aguas residuales[2] para encontrar los números más probables (NMP).
- Si la muestra de agua tiene un cierto color de fondo, comparar la muestra inoculada de Colilert con un blanco testigo de la misma muestra de agua.
- Si se hacen diluciones de muestra, multiplicar el valor NMP por el factor de dilución para obtener el resultado cuantitativo apropiado.
- Usar solamente agua estéril, no tamponada, libre de oxidantes, para efectuar las diluciones.
- Colilert es una prueba primordialmente del agua. Las características de rendimiento de Colilert no se aplican a muestras alteradas por enriquecimiento o concentración previos.
- En el caso de muestras con un exceso de cloro, tal vez se observe un destello azul al añadir Colilert. Si se observa, considerar que la muestra no es válida y suspender la prueba.
- Siempre debe utilizarse una técnica aséptica cuando se use Colilert. Desechar en cumplimiento con las Buenas Prácticas de Laboratorio.

Procedimientos de control de calidad
1. Se recomienda uno de los siguientes procedimientos de control de calidad para cada lote de Colilert:
   A. IDEXX-QC Coliform and *E.coli*[3]: *Escherichia coli*, *Klebsiella variicola*‡ y *Pseudomonas aeruginosa*.
   B. Quanti-Cult*[4] *Escherichia coli*, *Klebsiella pneumoniae* y *Pseudomonas aeruginosa*.
   C. Llene tres recipientes estériles con 100 ml de agua estéril, libre de oxidantes, no tamponada e inocule con un asa estéril de cepas ATCC[5], *Escherichia coli* ATCC 25922/ WDCM 00013 o ATCC 11775/ WDCM 00090, *Klebsiella variicola*‡ ATCC 31488/ WDCM 00206 y *Pseudomonas aeruginosa* ATCC 10145/ WDCM 00024 o ATCC 27853.
2. Seguir el procedimiento P/A o el procedimiento de enumeración Quanti-Tray mencionado anteriormente.
3. Los resultados deben corresponder a los del Cuadro de Interpretación de resultados, más arriba.

NOTA: Las pruebas de control de calidad interna de IDEXX se realizan según ISO 11133:2014. Los certificados de control de calidad se encuentran disponibles en idexx.es/water.

1. IDEXX, Comparador P/A, Nº de catálogo WP104; Comparador Quanti-Tray Nº WQTC o Quanti-Tray/2000 Comparador Nº WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water & Wastewater*, (Métodos estándares para el análisis del agua y las aguas residuales). American Public Health Association, (Asociación Americana de Salud Pública), 2005. Washington, D. C.
3. IDEXX-QC Coliform and *E.coli* — IDEXX Catalog #UN3373-WQC-TCEC
4. Cultivos Quanti-Cult— Nº de catálogo IDEXX WKIT-1001
5. American Type Culture Collection 1-800-638-6597

‡. *Klebsiella pneumoniae* (ATCC 31488 / 00206 WDCM) se ha renombrado como *Klebsiella variicola*

Colilert* (コリラート) 検査キット

はじめに

Colilert*はIDEXXが知的財産権を持つDefined Substrate Technology* (DST*) (特定酵素基質法)を用いて、水中の大腸菌群と大腸菌を同時に検出します。大腸菌群が、コリラートに含まれる栄養指標のONPGを代謝することにより、検水は黄色に変色します。さらに、大腸菌がもう1つの栄養指標であるMUGを代謝すると、検水は蛍光を呈します。コリラートは、100mL当たり最大200万個の従属栄養細菌の存在下においても、24時間以内に1cfu/100mLの感度で対象細菌を検出する ことができます。

保管

直射日光を避け、2～30℃で保管してください。

定性検査手順手順

1. スナップパック1つの中身を、滅菌済みの透明な蛍光を発しない容器に入った100mLの検水に加えてください。
2. 容器の蓋を締め、振ってください。
3. 36±1℃で、24時間培養してください。
4. 以下の結果判定表に従って、結果判定してください。

Quanti-Tray*定量検査手順

1. スナップパック1つの中身を、滅菌済み容器に入った100mLの検水に加えてください。
2. 容器の蓋を閉め溶けるまで静かに振ってください。
3. Quanti-Tray/2000に検水/コリラート混合液を注ぎ、シーラーで密封してください。
4. 密封されたトレイを36±1℃で24時間培養してください。
5. 以下の結果判定表に従って、結果を判定してください。陽性ウェルの数を数え、専用MPN表を参照して、最確数を求めてください。

結果判定

培養液の状態	結果
比色管*より薄い黄色[1]	大腸菌群および大腸菌陰性
比色管*と同等か、またはそれより濃い黄色	大腸菌群陽性
比色管*と同等か、またはそれより濃い黄色および蛍光	大腸菌陽性

- 暗所で6W・365nmのUVランプから13cm以内に検水を置き、判定してください。光は目に向けないようにし、検水に向けてください。
- コリラートの結果は培養開始から24時間後に判定してください。
- 但し、初回の判定において結果があいまいな場合には、さらに最長4時間（総時間数が28時間を超えないように）培養を継続し、再判定を行ってください。
- 24 時間以内で大腸菌群および大腸菌が共に陽性となった場合、または 28 時間以降も共に陰性であった場合、これらの判定は有効です。
- また、検査の便宜上、検水の培養時間を延長 (総培養時間28時間まで) することも可能です。

操作上の注意

- 本説明書の内容は該当する地域の法律・条例に適合していない場合があります。法律・条例に準拠した検査を行うために、必ず適切な規制手順に従ってください。例えば、他の国で検査を行う際は、36±2°Cで24～28時間培養する必要があります。
- コリラートは、5本法などの最確数法でも実施できます。最確数は最確数表(MPN表)を使用して求めてください。
- 検水に何らかの着色がある場合、同じ検水を用いたブランクと比較してください。
- 検水を希釈した場合、MPN値に希釈倍数を掛けて、適切な定量結果を求めてください。
- 希釈には、緩衝液や酸化物質の入っていない、滅菌された水だけを使用してください。
- コリラートは、水の一次検査です。コリラートの性能特性として、増菌培地で培養または濃縮によって変質した検水に使用できません。
- 塩素を過剰に含む検水では、コリラートを加えると、青色を呈することがあります。この場合、検査は無効ですので検査を中止してください。
- コリラートを使用する際は、常に無菌操作を行ってください。結果判定後の検水と容器は GLPに従って、廃棄してください。

品質管理手順

1. コリラートを使用する場合、ロット毎に次の品質管理手順のいずれかを行うことをお薦めします。
   A. IDEXX-QC大腸菌群および大腸菌[3]：大腸菌、*Klebsiella variicola*‡、*Pseudomonas aeruginosa*（緑膿菌）
   B. Quanti-Cult*[4]: *Escherichia coli*（大腸菌）、*Klebsiella pneumoniae*（肺炎桿菌）、*Pseudomonas aeruginosa*（緑膿菌）
   C. 滅菌容器3本に、それぞれ緩衝剤や酸化剤の入っていない滅菌水100 mLを入れ、大腸菌ATCC 25922/WDCM 00013またはATCC 11775/WDCM 00090、*Klebsiella variicola*‡ ATCC 31488/WDCM 00206、および *Pseudomonas aeruginosa* ATCC 10145/ WDCM 00024または27853 ATCC[5]菌株を、滅菌ループを用いて接種してください 。
2. 上記の定性検査手順またはQuanti-Tray定量検査手順に従ってください。
3. 結果が上の結果判定表と一致することを確認してください。

注: IDEXXの社内品質管理検査は、ISO 11133:2014に準拠して行われます。成績証明証 (品質管理認証) は idexx.co.jp/waterにて利用可能です。

1. IDEXX P/A 比色管, カタログ # WP104、または Quanti-Tray/2000比色トレイ#WQT2KC
2. Eaton, AD, Clesceri, LS, Greenberg, AE, Rice, EN. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, 2005. Washington, DC.
3. IDEXX-QC大腸菌群および大腸菌- IDEXX カタログ番号UN3373-WQC-TCEC
4. Quanti-Cult—IDEXX カタログ # WKIT-1001
5. American Type Culture Collection 1-800-638-6597

‡. *Klebsiella pneumoniae* (ATCC 31488/WDCM 00206) は*Klebsiella variicola*へと菌種名の変更が行われました。

IDEXX Water Quality Control Laboratory is accredited to ISO/IEC 17025:2005

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Appendix C:

Volunteer SOPs

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Volunteer
Standard Operating Procedures

Table of Contents

1 Before You Begin

1.1 Safety, Equipment List, and Volunteer Responsibilities

1.1.1 Safety – General Precautions

a) Always perform water-monitoring activities under the guidance of an adult or with a partner when possible.

b) Read all instructions to familiarize yourself with the test procedure before you begin. Note any precautions in the instructions.

c) Use caution when collecting water samples from the shoreline to prevent slips, fall, or extended contact with water.

1.1.2 Field Equipment Maintenance and Cleanliness

a) Keep your thermometer clean after each use and store in a protective case/location when not in use.

b) Keep the pH test strip container as clean as possible. If test strips are discolored, DO NOT use.

c) Keep turbidity bottles free of dirt or contamination which can alter results of testing.

1.1.3 Lab Equipment Maintenance and Cleanliness

d) Keep the incubator on a steady and level base with easy access and clearance for both the door to open and the back fan to vent with more than 6” of space.

e) Keep bacterial sample bottle in a dry location with consistent temperature before use and discard in designated lab disposal receptacle after use.

f) All lab equipment, standards, and reagents will be kept and maintained according to manufacturer instructions to ensure quality.

g) All bacterial lab equipment will be cleaned and disinfected with ethanol before and after each analysis.

1.2 Monitor Responsibilities

Ensure that you have attended a yearly volunteer training session if you are a new volunteer. Training sessions are provided annually by Anacostia Riverkeeper staff and project partners to certify all volunteers for the project and the collection of environmental data.

Maintain the monitoring schedule for your site(s) each week. Sample collection must be performed every Wednesday or Thursday morning. If you are unable to collect a water sample from your site, find an alternate person and/or contact one of the Watershed Coordinators. Samples must be transported to the lab within 6 hours of collection.

Properly mark your sample bottles before the site visit and update each bottle with the appropriate information and label.

Maintain a clean cooler that will be used to transport water samples stored on ice from the field to the lab.

Record your test results: Record data on a data collection form provided. Always record the test results as you go along. Keep a copy of the data collected for your records and to provide a backup copy should the original be lost, whether that be a picture or results written in a notebook.

Provide comments as necessary: The "Comments/Notes" section can be used to record general observations about the site especially changes due to erosion, recent notable weather, and any problems you had with the sampling procedures.

Provide data sheets and chain of custody forms to Team Supervisors when you deliver your sampling cooler weekly. Ensure that upon delivery of your samples the sampling cooler contains necessary samples (duplicates and field blanks if necessary), chain of custody sheet, and sampling sheet.

Stay certified: Complete the project recertification process each year if you are a returning volunteer. You can also attend any training session to refresh yourself of the concepts and procedures between re-certifications.

2 QA/QC Procedures

2.1 Certification and Re-certification

2.1.1 Certification

Monitors can become certified at their initial training session by demonstrating a mastery of the sampling procedures and complete understanding of the quality assurance protocols used during data collection to be assessed by a Project Team member or Certified Trainer. Monitors must also pass a test that assesses the monitor's understanding of QA/QC procedures outlined in this SOP and the project QAPP with a score of 80%.

Monitors that attend an initial training and are unable to pass the requirements to become certified at the end of the training will be encouraged to continue practicing their monitoring procedures. Un-certified monitors are encouraged to assist certified monitors in the field until they have become comfortable with the procedures and QA/QC protocols. Un-certified monitors are allowed to retake the certification test and demonstrate proper sampling and analysis technique up to three times in order to become a certified monitor.

When a monitor achieves certification, they may be assigned a site and begin to collect Tier II data and submit it to the project database.

2.1.2 Re-certification

The Project Team and Certified Monitors will host online recertification sessions annually for monitors that have passed the initial training and wish to maintain their certification. Recertification sessions are conducted in a fashion that is similar to an online module. Monitors are checked to assure that: they remain proficient in methodology and understanding of basic water quality parameters; their equipment is operational and properly calibrated/verified; and they have an adequate supply of viable chemicals, procedures, equipment verification/check, and updated information about monitoring. Monitors will be provided will all pertinent information online and take a final recertification test to officially be recertified. Materials will include an informational video, program materials, and small quizzes.

2.2 Pre-monitoring checks

2.2.1 Equipment Check

Prior to going out into the field, monitors should check their equipment for cleanliness, breakage, discoloring or any other expiration. If a monitor finds that their equipment is damaged and will affect the quality of the data they collect, they will not collect data that day and mark the reason on their data sheet and then inform their Project Team Leader as soon as possible. The monitor should contact their Project Team member to get the equipment repaired or replaced prior to the next scheduled sample.

2.2.2 Calibration

Thermometers that are verified should be re-verified every year. Thermometers will be verified each year before the start of the sampling season (May-September).

Lab turbidimeter will be calibrated before each sampling run by trained ARK staff. Should full sampling occur over two days then the turbidimeter will be calibrated by lab personnel each day before sampling. The turbidimeter calibration will be tested every 10 samples to ensure no drift has occurred in calibration. If measured 0NTU and 10NTU standards show a drift >0.2 NTU then the machine will be recalibrated and tested again.

IDEXX bacterial methodology requires minimal calibration. The Binder incubator will be serviced once each year to ensure proper function. Each new batch of IDEXX reagent will be tested before use to check its viability. A dedicated certified thermometer will be placed in the Binder incubator to ensure consistent temperature with the external digital readout.

2.3 Field QC

2.3.1 Duplicates

Monitors collecting samples for Tier II laboratory analysis will perform duplicate samples at least 10% of the time. Duplicates consist of immersing sample containers side by side in the water at the same time. This ensures that the samples are representative of the current water conditions and taken from identical locations.

3 Field Monitoring Procedures

3.1 Field Sampling Procedures

3.1.1 Best Practices

a) Use of protective gloves. Gloves serve a dual purpose: 1) protecting the sample collector from potential exposure to sample constituents and 2) minimizing accidental contamination of samples by the collector. Wearing protective gloves at all times while sampling is recommended. Latex or nitrile gloves may be used for common sampling conditions.

b) Safety always comes first. All sampling should be conducted with the proper equipment and least amount of danger to field personnel.

c) Permission must be obtained from landowners before entering private property.

d) Care should be taken not to disturb the bottom when sampling. When nearing a stream, always sample in an upstream direction on the bank.

e) Surface water should always be collected facing upstream and from a safe location on the bank to ensure volunteer safety.

f) Samples should be collected in the main flow representative of the stream you are monitoring (for small streams, this is usually mid-channel) just below the water surface, about 0.3 meters (0.5 to 1 foot) deep.

g) Whenever possible, collect field measurements directly from the sample site, not from bucket. If the field parameters need to be measured in the bucket, collect water quality samples (bacteria and turbidity) first before measuring water temperature and testing for pH.

h) In situations where the sample site is a boat ramp or other hard surface access, it is best to avoid collecting a sample in waters above the hard surface. These are usually warmer waters and may provide inaccurate bacteria data.

i) When there are obvious standing pools of water during low or no flow conditions, do not collect samples or field measurements. Make a note of this on the data sheet.

j) When collecting bacterial samples:

   i. DO NOT rinse the bacteria sample bottle before collecting the sample (decanting to 100mL line is acceptable).
   ii. Be careful not to insert fingers into the mouth of the container or on the interior of the cap.

3.1.2 Streambank and Instream Sampling

All water samples will be collected from a streambank as to limit the amount of sediment disturbance and for volunteer safety.

When sampling from the streambank, care should be taken to sample from an area that will most closely represent the entire stream. Typically, this will be the area of the greatest flow in the stream and away from stagnant pools or eddies.

Step	Bacteria Samples
1.	Walk upstream to the sample location. Be sure any sediment or debris disturbed from your movement in the streambed is not present where you will collect the sample.
2.	Submerge the container; neck first into the water. The mouth of the bottle should be completely below the water surface approximately 6-12 inches.
3.	Invert the bottle so the neck is upright and pointing into the water flow.
4.	Move the bottle forward away from the body for at least six inches.
5.	Return the filled container quickly to the surface. Pour any excess water and cap.

3.1.3 Dock or Bridge Sampling

1. Sample in the center of main flow from or as close as you can get on the dock or bridge. If sampling from a bridge sample from the safest side of the bridge and where contamination is least likely to occur. Typically, sampling on the upstream side of the bridge or dock is less likely to be contaminated.

2. During rainy periods, avoid sampling where storm water runoff from the bridge can affect sample.

3. Obtain field parameters (pH, temperature) first before lowering a sample bucket.

4. When lowering the sample bucket, allow it to fill ¼ the way full and retrieve. Swirl the contents and dump the rinse away from the sample location to avoid kicking up sediment.

5. Repeat step 4 two more times and on the final time fill ½ to ¾ the way full.

6. Retrieve the bucket and collect the samples in the following order.

    1. Bacteria
        - Open the bottle without touching the inner wall of the bottle or lid.
        - Invert the bottle by holding to the main body of the bottle and lower into the bucket 3-6 inches.
        - Fill the bottle in a ‘U’ from the side of the bucket closest to you to the opposite end.
        - At the end, bottle opening should be facing up and remove from the bucket.
        - Pour off any excess water and cap with the lid.

7. In situations where field parameters must be obtained from the bucket, all water samples must be collected prior to testing for water temperature and pH in the bucket.

3.2 Air Temperature Measurement

Equipment: armored, digital thermistor

Temperature is reported in degrees Celsius (ºC). Always measure air temperature before water temperature.

Method:

1. Standing on the streambank hold the thermometer over the water to obtain the best measurement.

2. Wait 3-5 minutes to allow the thermometer to equilibrate.

3. Record air temperature to the nearest 0.5 ºC for the armored thermometer on the Field Sampling Sheet in the designated location.

3.3 Recording General Observations

Record weather and general observations on the datasheet.

3.4 Water Temperature Measurement

Equipment: armored, digital thermistor, or probe

Temperature is reported in degrees Celsius (ºC). Always measure air temperature before water temperature.

Method:

Surface Sampling:

1. Place your probe or thermometer 0.3 m beneath the surface of the water
2. Wait for the probe or thermometer to stabilize
3. Record your reading

Sample with bucket:

1. Hang thermometer in the bucket
2. Wait for the probe or thermometer to stabilize
3. Record your reading

3.5 pH Test Strips

Method:

1. Remove one test strip from the container (close cap) and insert into the water at your sampling spot and allow water to react with the color strip (may take a few minutes)

2. Let color develop.

3. Compare color of test strip to the color chart on the pH test strip container.

4. Record measurement on field sheet. Repeat if collecting a replicate.

3.6 Turbidity Sample

1. Label the top of the turbidity container and unscrew the cap

2. Collect the sample as close to midstream as possible, however if sampling from the bank be sure not to disturb any bottom sediments

3. Be sure to sample upstream of any disturbed sediments

4. Collect another water sample using the methods identified in this document, additionally rinsing the bottle three times before collecting the sample on the fourth time.

5. Cap and label the sample bottle. (Site name/#, date, time, initials)

4 Lab sample collection preparation and handling

4.1 Bacteria Samples

Collecting on stream bank:

1. Get as close to the stream bank as possible with minimal disturbance of bottom sediments;

2. Take a few steps upstream with care not to disturb the sediment;

3. Un-cap the pre-labeled bottle

4. Using a U motion dip the bottle into the water down and away from yourself allowing the bottle to fill to the shoulder

5. After samples are taken, immediately place the sample on ice up to the shoulders of the bottle. The lid should not be immersed under the ice, in case ice water leaks into the sample bottle, diluting the concentration of the sample.

4.2 Sample container handling and preservation

Proper sample containers and sample preservation are essential to sample integrity. Samples not preserved properly may be rejected by the laboratory.

a) Sample containers should be inspected and any torn, punctured or cracked sample containers discarded.

b) After collecting the sample, make sure the lids are secured tightly to prevent contamination from water seepage in or out of the container.

c) Sample containers and coolers should be stored with the tops securely fastened. Containers with loose fasteners should be replaced or taped to prevent loss of sample containers during transport.

d) In the field, unless specified otherwise, all samples should be placed in an ice filled cooler immediately after collection. To ensure samples do not exceed the 4°C holding temperature, sample containers shall be placed upright and if possible, covered with ice in such a manner that the container openings are above the level of ice.

e) Glass sample containers should be packed in bubble wrap or other waterproof protective materials to minimize accidental breakage.

4.3 Sample Bottle Identification

Each sample container must include a label with the following information.

a) Station ID or description

b) Date and time of sample collection

c) Analyte sampled for

d) Collector's initials

Samples will not be analyzed if this information is missing. If more than one container is needed for a parameter (such as a duplicate sample), each container collected for that parameter must have a label with identical information in addition to an indication of 1 of 3, 2 of 3, 3 of 3, etc., as required. Duplicate samples should be designated as "Station ID – Dup".

Please remember to fill out the labels on the bottle with a waterproof pen before taking the samples.

It is essential that the actual sampling site match the labeling information. Always check the labeling information against the actual site. Samples not labeled properly may be rejected by the laboratory.

4.4 Transport of Samples

After collecting the samples at the site:

1. Place the bottles in the cooler filled with ice. Coolers should have enough ice to come up to the necks of the sample bottles.

2. Place any chain of custody forms in the Ziploc bag taped to the inner lid of the cooler.

3. Transport the cooler with samples to the designated drop off point or laboratory within 6 hours of collection.

5 Cleanup and Storage of Water Monitoring Equipment

a) Rinse the thermometer in tap water and store upright.

a) Ensure pH test strips are secure in the container and are kept in a clean, dry place between sampling event

Appendix D:

QA/QC Forms

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Volunteer Monitors Field Sheet

Volunteer Water Quality Monitoring in District of Columbia Waters

SITE NAME:	
SITE ID:	**RECORDER:**
DATE (mm/dd/yyyy)**:**	**TIME** (hhmm)**:**
MONITOR:	**MONITOR:**
MONITOR:	**MONITOR:**

OBSERVATIONS / WEATHER

Water Surface (circle one): Calm / Ripple / Waves / White Caps / N/A

Stream Flow Rate (circle one): High / Normal / Low / Stagnant

Weather Type (circle one): Sunny / Overcast / Partly Cloudy / Fog/Haze / Drizzle / Rain / Intermittent Rain

Water Color (circle one): Normal / Abnormal _____(color description)

Other observations (circle): Oil slick / SAV / Dead fish / Erosion / Foam / Odor / Debris

Field Parameter Measurements

Parameter	Measurement 1	Measurement 2
Air Temperature (°C)		**N/A**
Water Temperature (°C)		**N/A**
pH test strip		

Field Samples for Lab

Action	Yes	No
Bacteria sample collected?		
Bacteria sample bottle labeled? (site name, date, time)		
Turbidity sample collected?		
Turbidity sample labeled? (site name, date, time)		
Sample bottles placed in cooler?		
Fill out Chain of Custody form?		
Duplicate Collected?		

Notes:

ARK Internal Use Only		
Tide/Stream height (m):	**Rainfall (24hrs): inches**	**Duplicate (Y/N):**
UV Index:	**Rainfall (48hrs): inches**	**QC Check:**

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DEPARTMENT OF ENERGY & ENVIRONMENT

GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

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Anacostia RIVERKEEPER®

DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA

WE ARE WASHINGTON DC
GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

District Rivers' Recreational Use Survey

Site ID:_____ Date:_____ Start time:_____ End time:_____

Observers:_____

Activity	Description (if needed)	# of participants total
Swimming - indicate if seen from: Dock, boat, or shore		
Swim event (20+ people)		
Wading (waist deep or higher)		
Water play by children		
SCUBA/Snorkeling		
Power boat		
Tubing		
Water skiing		
Wake boarding		
Jet skiing		
Kayaking		
Stand up paddle boarding		
Pedal boarding		
Canoeing		
Rowing/sculling		
Paddle boating/swan boat		
Sailing		
Fishing		
Contact with wet dogs after playing in water		
Contact with water while hiking/crossing streams		
Other water contact activity (include a description)		

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Incubator Recording Sheet:

Incubator Turn On		**Place in Incubator**				**Remove from Incubator**			
Time and Date	Initials	Time and Date	Sample ID	Temp (°C)	Initials	Time and Date	Sample ID	Temp (°C)	Initials

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Colilert E. Coli Analysis Lab Sheet

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Lab Name: **Date:**

Lab Analysis: **QA/QC Supervisor:**

Sample	Analysis Start Time	Dilution	Incubation Start Time & Temp (C)	Incubation End Time & Temp (C)	UV Reader	# of large fluorescent wells	# of small fluorescent wells	E. Coli MPN

FD = field duplicate; LD = Lab duplicate

Quality Assurance Project Plan

District Stream Trash Monitoring
Grant # RFA 2016-1605-SWMD

Prepared for:
District Department of Energy & Environment
Stormwater Management Division

Approved _____ Date 8/12/16

Project Manager: Matt Gallagher
Quality Assurance Project Plan Prepared by: Matt Gallagher

Approved Phong T. _____ Date 7/24/16

Department of Environmental Programs
Metropolitan Washington Council of Governments

July 2016

Table of Contents

Distribution List:

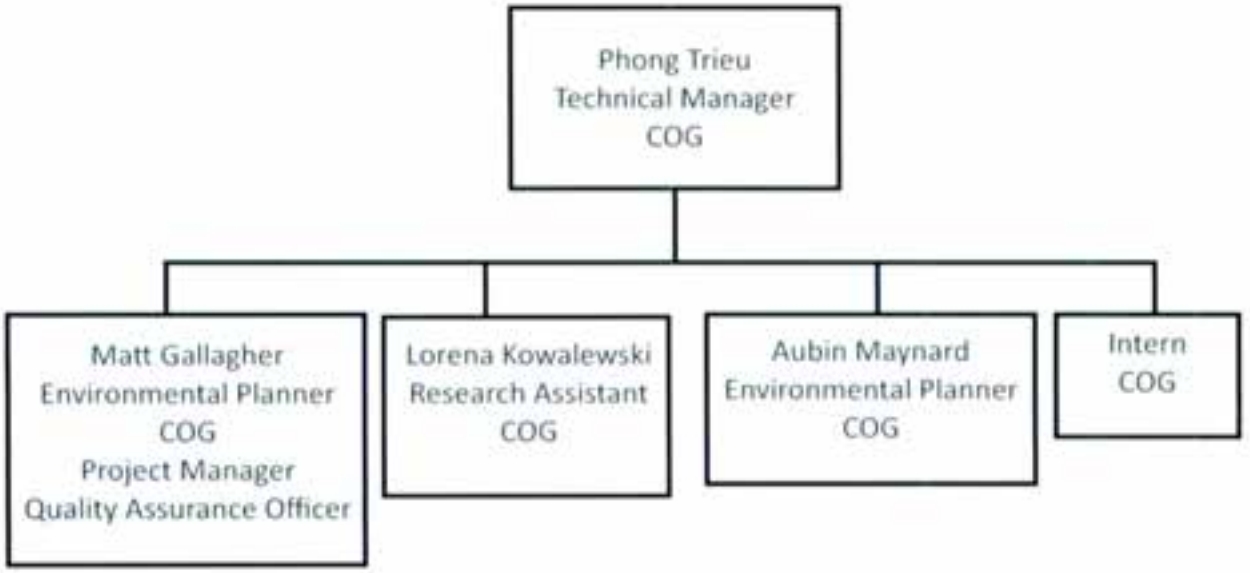
Matt Gallagher - 1 copy
Phong Trieu - 1 copy
Aubin Maynard - 1 copy
Lorena Kowalewski - 1 copy

Matthew Robinson - 3 copies + electronic

1.0 Project Management

1.1 Project Task/Organization

The District of Columbia Department of Energy & Environment (DOEE) has awarded a grant to the Metropolitan Washington Council of Governments (COG) to monitor District streams for trash levels. Mr. Phong Trieu is the COG Technical Manager in the Department of Environmental Programs and will ensure staff has met all project obligations. Mr. Trieu will be consulted and involved with all major project decisions. Mr. Matt Gallagher is the COG Environmental Planner in the Department of Environmental Programs and the Project Manager for this grant. Mr. Gallagher will also serve as the official Quality Assurance Officer. Ms. Lorena Kowalewski will assist Mr. Gallagher with field work, data entry, data quality assurance, and the preparation of reports. Mr. Aubin Maynard will assist with field work. A COG intern will assist with field work and data entry.



1.2 Problem Assessment and Purpose

Per the approved September 2010 Anacostia Watershed Trash Total Maximum Daily Load (TMDL), the District is required to remove or prevent 103,188 pounds of trash from entering its tributaries to the Anacostia River each year by 2017. In 2011, the U.S. Environmental Protection Agency (EPA) listed trash as a priority pollutant in the District's MS4 permit, and it is expected to be included in the new 2016 permit; the permit requires the District to conduct trash monitoring and to report results in its annual MS4 report.

In September 2015, COG reconvened the Anacostia Trash Reduction Workgroup (ATRW) in order to address concerns raised by the Natural Resources Defense Council and other stakeholder groups regarding the trash TMDL and how the jurisdictions were implementing, tracking and reporting on their trash reduction programs. COG has been conducting the Anacostia trash TMDL-driven stream monitoring for Prince George's and Montgomery Counties since 2011, and COG is expecting to continue that monitoring for at least the next 5 years. Implementing the same monitoring methodology in the District would complement the ATRW's goal of achieving consistency within the Anacostia watershed jurisdictions in their trash TMDL programs.

The proposed District monitoring is critical for assessing the effectiveness of both trash removal and pollution prevention measures and for documenting trends in specific trash items of interest (e.g., plastic bags, polystyrene, etc.). More specifically, the project will provide a quantification of trash loads in 12 stream and one river shoreline areas. In addition, the approximate trash loading rates in 6 of those streams within the District will be determined.

1.3 Project/Task Description

Trash is listed as a priority pollutant in the District's MS4 permit; the permit requires the District to conduct monitoring and report results in the annual MS4 report. In order to fulfill the obligations of this grant, COG will conduct instream trash monitoring in 12 stream and one river shoreline areas that follows the similar protocol that COG has been conducting in Prince George's and Montgomery Counties' portions of the Anacostia Watershed since 2011. The data collected for this grant will be provided to DOEE to be reported in the District's annual MS4 reports to EPA.

1.4 Quality Objectives and Criteria

In conjunction with DOEE staff, 12 stream and one river shoreline areas were identified for biannual trash monitoring (Figures 1 and 2; Appendix Table 1 and Figures 3-14). The proposed protocol includes walking in the wetted perimeter to count and collect trash items, so only wadeable sites that can be physically traversed on foot were selected. Each site was given a unique identifying site ID. The proposed protocols are consistent with the stream trash monitoring surveys that COG has been employing in Montgomery and Prince George's Counties since 2011, and are discussed in more detail in section 2.1. Briefly, each monitoring site is 500 feet long and will undergo a *count survey*, where every trash item within the bankfull width will be identified and recorded on the data sheet into one of the categories of trash approved by DOEE. In addition, 6 of those sites (all of the Anacostia watershed sites) will undergo an additional level of observation known as *pick surveys*, where every item in the upstream 250 foot portion of the 500 foot length will be collected, sorted into the categories of trash approved by DOEE, and each category will be weighed in aggregate. Note: the monitoring transects may not overlap exactly with the stream channels in the maps due to inaccuracies in current stream channel layers.

The instream baseline surveys will occur twice per year (i.e., late spring/summer and late fall prior to leaf-off conditions). Monitoring will occur only on days that have not had significant (greater than 0.2 inches) precipitation within the previous 48 hours, as clear, baseflow conditions are crucial for allowing surveyors to see and identify all trash items in the stream. Photographic documentation of representative conditions (e.g. general stream channel condition, number of trash "strainers", storm drain outfalls present, etc.) will occur at every survey.

The downstream end (0 feet), mid-point (250 feet), and upstream end (500 feet) will be recorded using a hand-held GPS unit. In addition, each of those points will be flagged to aid in finding the sites for each of the surveys.

1.5 Special Training/Certification

There is no specialized training necessary for surveying the streams for trash. Currently, all COG staff that will be involved in these surveys have already conducted these protocols in Montgomery and Prince George's counties. Current staff assisted in the development and refinement of the Anacostia stream trash survey. If new staff are brought on to assist with the project, at least one COG staff member identified in Section 1.1 (pg. 1) will be present to make sure proper sampling protocols are followed.

1.6 Documents and Records

This QAPP was developed by Environmental Planner (and the Project Manager for this grant) Matt Gallagher and reviewed by Technical Manager Phong Trieu. Upon review and when necessary revisions are completed, it will be submitted to DOEE for review. Amendments to the original QAPP will be completed by Mr. Gallagher and reviewed by Mr. Trieu, who will sign the amended version.

A sample data sheet is included in the Appendix (Figure 1). The data will be transferred from the paper data sheets into an electronic database. Paper sheets will be cataloged in a binder and held at COG's office. Typically, data entry is completed by an intern and Quality Assurance and Quality Control (QA/QC) measures are administered by Research Assistant I, Lorena Kowalewski. In the event that either of these staff are unavailable, the Project Manager, Matt Gallagher, will conduct the QA/QC for data entry. Tables and Figures to

be used in progress, annual and final reports will be reviewed for accuracy by Matt Gallagher prior to use in the reports.

Electronic copies of all reports to DOEE will be retained by COG under the terms of the Grant Award Notice. DOEE will be provided electronic copies of all reports; hard copies will be provided upon special request. Quarterly progress reports will include the general grant award information, a brief summary of progress, a brief summary of any barriers the project has faced, and the current status of the project's budget. Annual reports will include, at a minimum, a summary of data collected during the previous year, statistical analyses of data, a written summary of findings, and an Excel database that includes all data collected to date. The final technical memorandum will include data analyses and written summaries that follow the annual report template but for all 3 years of sampling (6 complete surveys over 3 years). In addition, the final report will include recommendations for future monitoring and/or trash reduction strategies and will also be accompanied by the complete Excel database of all data collected over the 3 year period. COG and DOEE will retain all data reports in perpetuity.

The Pesola scales used to weigh samples will be calibrated with a known Ohaus precision weights prior to each survey. Precipitation data will be collected from the Washington/Reagan National Airport rain gauge.

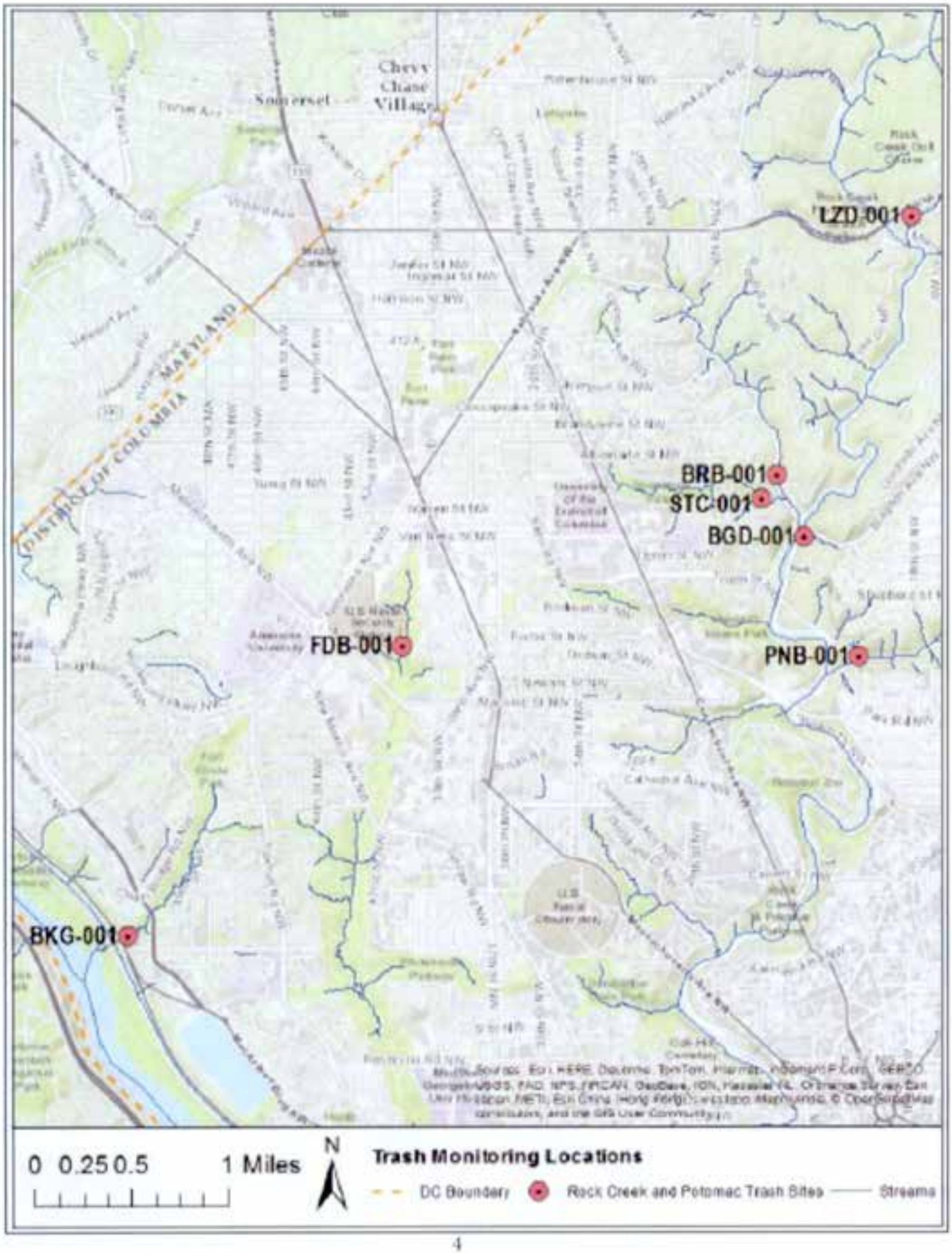


Figure 1. Potomac and Rock Creek Watershed Stream Trash Monitoring Sites (7, Total)

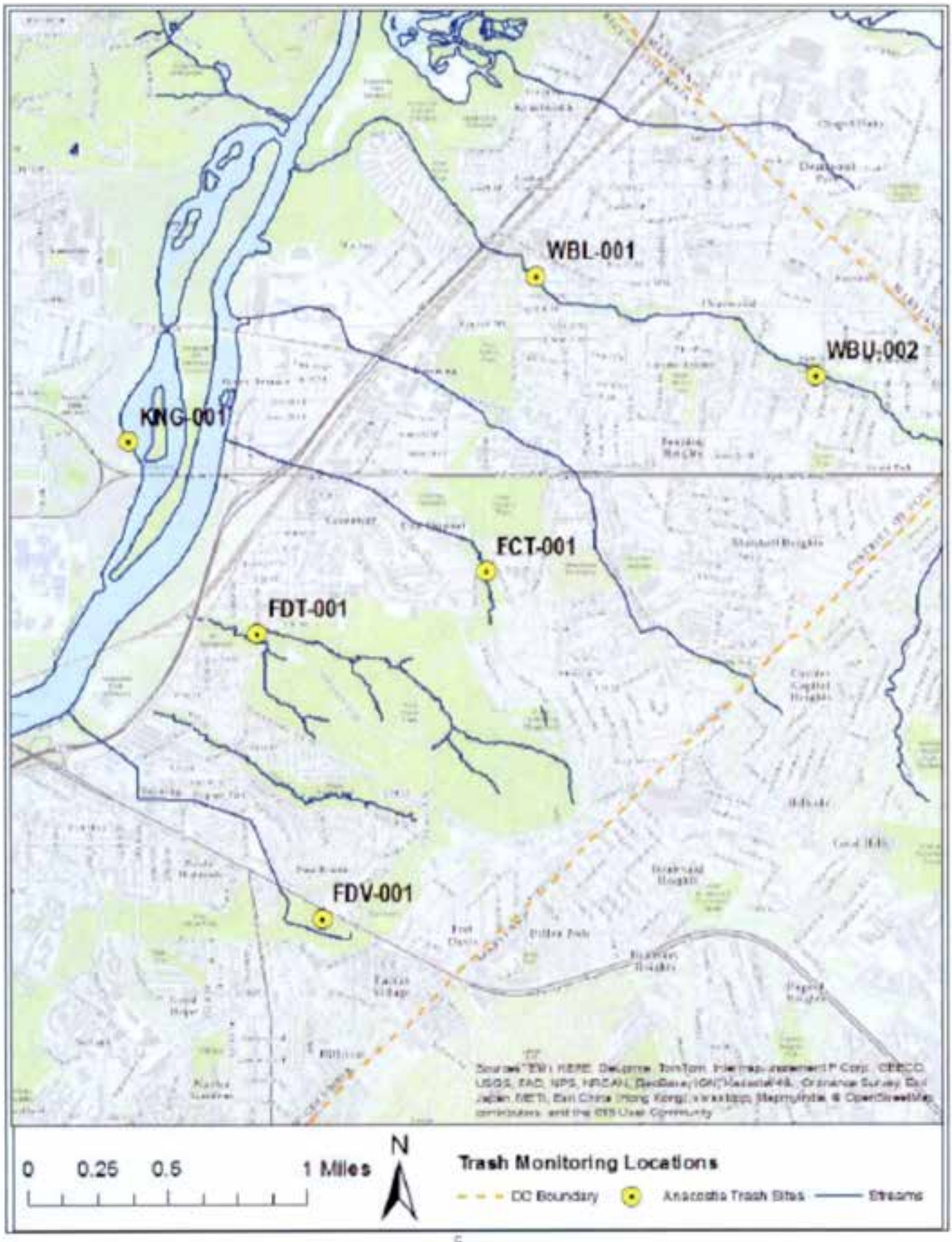


Figure 2. Anacostia Watershed Monitoring Sites (6, Total)

2.0 Data Generation and Acquisition Elements

2.1. Sampling Process Design (Experimental Design)

The purpose of the project is to conduct trash monitoring for compliance with the District's MS4 permit. COG's survey methodology has been approved by the Maryland Department of the Environment for trash monitoring in the Anacostia watershed portion of Montgomery and Prince George's Counties. DOEE has received approval from EPA Region III to use this monitoring approach to meet MS4 permit requirements.

The instream baseline trash surveys for all 13 sites will be performed twice per year. Each complete biannual monitoring round will consist of both *count surveys* and *pick surveys*. All monitoring sites were chosen in collaboration with DOEE. See Section 1.4 for the information on all 13 monitoring sites.

Count surveys will occur at all 13 sites. For safety concerns, there will always be at least 2 surveyors present, with a minimum of 1 surveyor for every 10 feet of stream channel width. Each count survey will begin at the downstream end. Surveyors will walk upstream, and every trash item within the bankfull width for the entire 500 foor length will be identified and recorded on the data sheet into one of the 22 trash categories. (The original TMDL sorted trash into 20 categories, but due to recent legislation in the Anacostia jurisdictions, COG now separates out "carry out bags" and "expanded polystyrene".)

Pick surveys will occur at the 6 Anacostia watershed sites and will occur after the count survey has been conducted for that site. Beginning at the midway point of the site's designated 500 foot length, COG staff will walk upstream and pick up every visible trash item within the bankfull width for that upstream 250 foot length. Upon completion, every item will be sorted into the 22 categories and a total weight and total number of items for each category will be calculated and recorded on a second data sheet. No large or heavy items (i.e., tires, bricks, concrete, appliances etc.) are collected for the pick surveys (they are recorded for the *count surveys*, however). The focus is on "floatables" and other items that can freely travel through the MS4 pipes. After enumeration, all collected trash items will be removed and properly disposed. The protocol will enable COG to develop a reasonable estimate of general instream trash accumulation/loading rates at these pick sites.

2.2 Analytical methods

The trash that is found in streams is often laden with water and/or sediment. As part of the *pick surveys*, bottles and cans will be emptied of water and sediment when possible. COG staff do not empty containers that appear to contain questionable or hazardous materials; these "full" containers are included in the weight calculations. In addition, organic material such as leaf litter, twigs, and grass are removed from items prior to weighing. Once the items are sorted into the 22 categories, an aggregate weight for each category is determined using Pesola 20kg, 1000g, and 100g scales. There is no "drying period" prior to weighing items; all aggregate weights are wet weights that are determined on site.

2.3 Quality Control

The sampling methodology requires that at least two surveyors are present for each survey. For the *count surveys*, one person is responsible for recording trash items on the data sheet while the other surveyor(s) calls out each item he or she sees. When more than one person is calling out items, the surveyors will establish their particular areas of the stream channel (i.e., left or right half) to

ensure no items are counted twice. For the *pick surveys*, it is less important to define areas, as all items will be collected within the bankfull width of that 250 foot length. One surveyor is responsible for walking the 250 foot length to ensure all items have been collected.

Field quality control checks are performed by rotating the roles of the personnel.

2.4 Sample Handling and Custody

The sampling methodology does not require processing any samples off-site. No custody procedures are needed.

2.5 Instrument/Equipment Testing, Inspection, and Maintenance

A hand-held GPS will be used to define the start point, midpoint, and endpoints of the 500 foot surveys. The GPS is a Trimble GeoXH. The scales are Pesola 20 kg, 1000 g, and 100 g, and they are calibrated with known weights before each monitoring season. In order to weigh heavier/larger items, a 5 gallon bucket's weight is tared on the 20 kg scale, so any additional weights added to the bucket (trash items) start at a zero. COG always has 2 sets of scales available, should there be any malfunctions.

2.5 Inspection/Acceptance of Supplies and Consumables

The project does not require any laboratory consumables.

2.6 Data Management

For *count surveys*, the number of trash items will be compiled on paper data sheets during the sampling events. For *pick surveys*, a separate data sheet will be filled out. The information on the data sheets will be transferred to a Microsoft Access database, and the paper sheets will be catalogued in a binder that will be kept at COG's office. Copies of the data sheets and/or the electronic database will be provided to DOEE upon request. A sample data sheet is included in the Appendix.

2.7 Non-direct Measurements

Weather observation data, including precipitation, will be taken from the Reagan National Airport online database. Prior to each stream survey, COG staff will consult the precipitation record to ensure there has not been more than 0.2 inches of rainfall in the previous 48 hours.

3.0 Assessment and Oversight

3.1 Assessments and Response Actions

Data collection will always be collected a minimum of 48 hours after a rain event. The data will be reviewed and inspected by Matt Gallagher, the grant's Project Manager. Mr. Gallagher will also arrange for meetings with DOEE, should any changes in procedures or site locations be required to fulfill the deliverables of the grant.

3.2 Report Preparation and Submission

Mr. Gallagher or another approved COG staff will review all data entry, analysis, and preparation of associated tables and figures. COG will submit progress reports to DOEE on a quarterly basis. In addition, more comprehensive annual reports will be prepared and submitted to DOEE. A final technical memorandum will be completed and submitted to DOEE at the end of the grant period, summarizing all results from the grant project. COG staff will consult with DOEE on any significant modifications that may affect the grant's deliverables and/or schedule.

4.0 Data Validation and Usability

4.1 Data Review, Verification and Validation

Data collection on trash levels is a new field and questions still remain regarding the most accurate ways to capture trash levels in streams. The protocols described here have been approved by MDE for monitoring in Montgomery and Prince George's Counties and have been helpful in determining trash hot spots and estimating trash accumulation over time at *pick sites*. Significant outliers in data points are unlikely, but COG staff will investigate potential reasons (e.g. major strainers) prior to incorporation in reports.

4.2 Verification and Validation Methods

A data collection sheet is attached. No samples will be transported to any laboratory; therefore no chain of custody form is needed.

4.3 Reconciliation with User Requirements

All data that has undergone QA/QC measures will be sent to DOEE on an annual basis. Impacts of precipitation and strainers blocking stream flow will be discussed. Results of stream trash surveys and possible methodology modifications to improve the quality of the data will be reviewed.

Appendix

Figure 1. Stream Trash Monitoring data sheet.

ANACOSTIA WATERSHED TRASH SURVEY – MDE 8 Digit Watershed Code - 02140205

DATE: _____ START TIME: _____

CREW: _____ END TIME: _____

SUBWATERSHED:			
STATION NUMBER:			
STATION NAME:			
STARTING COORD. (DDMMSS):	Lat:	Long:	
END COORD. (DDMMSS):	Lat:	Long:	
SURVEY TYPE (check applicable)			
1. **Stream**	☐	Length (ft):	
		No. of Trash "Strainers":	
		Riparian Buffer Conditions:	
2. **Trash Netting System**	☐	Net Number and Total Weight (lbs)	
Total Number of Nets/ Nets Surveyed		1 2 3 4 5 6 7 8	
3. **Road Right of Way**	☐	300' long and 5' wide on either side of curb gutter per side	
4. **Stormwater Management Pond**	☐		
5. **Storm Drain Outfall (Trash Fence)**	☐	DA (Acres/mi^2)=	
GENERAL LAND USES (check all applicable)	☐		
• Low Density Residential (large lot, single family)	☐		
• Medium Density Residential (small lot, single family, and/or townhouses)	☐		
• High Density Residential (apartments)	☐		
• Commercial	☐		
• Industrial	☐		
• Institutional (libraries, schools, religious)	☐		
• Recreational Area (developed)	☐		
• Forest	☐		
• Agriculture	☐		
GENERAL STATION DESCRIPTION:			
PHOTO NUMBERS:			
TOTAL NO. OF OBSERVED ITEMS:			
TOP THREE ITEMS AND ASSOCIATED SUB-TOTALS:			
TOTAL WEIGHT (OPTIONAL):		(lbs)	

1

Figure 2. Stream trash monitoring data sheet (continued).

ANACOSTIA WATERSHED TRASH SURVEY (Cont'd)

STATION NO.: _____ Total Weight: _____ (Wet weight)

DATE: _____ Less Container Weight: _____ (Dry weight)

	Trash Item	Field Count		Number of Items (Sub-total)	Optional Weight ( )
1	Plastic Bags	Carry Out	Other		
2	Plastic Bottles				
3	Glass Bottles				
4	Aluminum Cans				
5	Styrofoam (cups, packaging, etc.) 10 peanuts = 1	Expanded Polystyrene	Other		
6	Paper (newspapers, magazines, etc.)				
7	Cardboard				
8	Cloth/Clothing/Carpeting				
9	Food Packaging				
10	Auto :				
	Oil Quart Containers				
	Oil Filters				
	Antifreeze Containers				
	Body Parts: Large >1 ft^2				
	Small <1 ft^2				
11	Car Batteries				
12	Tires (cars, trucks)				
13	Construction Debris :				
	Bricks (>1/2 brick)				
	Concrete				
	Lumber				
	Misc. (e.g. drywall, etc.)				
14	Appliance(s)				
15	Wooden Pallets				
16	Metal (Drums, Cans, Pipes)				
17	Shopping Carts				
18	Toiletries/Drug Containers				
19	Sports Equipment/Toys				
20	Miscellaneous				
TRASH TOTAL					
DEBRIS SUBTOTAL				Total	
TOTAL WEIGHT					

Container Weight = # of Strainers =

2

Table 1. Coordinates of each stream trash monitoring site. A middle coordinate is provided for the Anacostia watershed sites, as those 6 sites are "pick sites", where the middle coordinate delineates where the pick survey begins.

Watershed	Site	Location	Longitude	Latitude
Potomac	BKG-001	Lower	-77.10039	38.91993
		Upper	-77.09908	38.92066
	FDB-001	Lower	-77.07967	38.93689
		Upper	-77.07946	38.93809
Rock Creek	BGD-001	Lower	-77.04942	38.94320
		Upper	-77.04794	38.94282
	PNB-001	Lower	-77.04704	38.93542
		Upper	-77.04532	38.93626
	LZD-001	Lower	-77.04198	38.96094
		Upper	-77.04138	38.96190
	STC-001	Lower	-77.05132	38.94549
		Upper	-77.05264	38.94540
	BRB-001	Lower	-77.05103	38.94541
		Upper	-77.05150	38.94677
Anacostia	FDV-001	Lower	-76.95676	38.86736
		Middle	-76.95619	38.86704
		Upper	-76.95545	38.86677
	FDT-001	Lower	-76.96119	38.88162
		Middle	-76.96035	38.88161
		Upper	-76.95974	38.88157
	FCT-001	Lower	-76.94504	38.88598
		Middle	-76.94479	38.88546
		Upper	-76.94444	38.88483
	WBL-001	Lower	-76.94203	38.90067
		Middle	-76.94155	38.90036
		Upper	-76.94109	38.90009
	WBU-002	Lower	-76.92447	38.89572
		Middle	-76.92337	38.89552
		Upper	-76.92248	38.89496
	KNG-001	Lower	-76.92447	38.89572
		Middle	-76.96784	38.89118
		Upper	-76.96754	38.89053

Figure 3. Battery Kemble (BKG-001) stream trash monitoring site.

Figure 4. Foundry Branch (FDB-001) stream trash monitoring site.

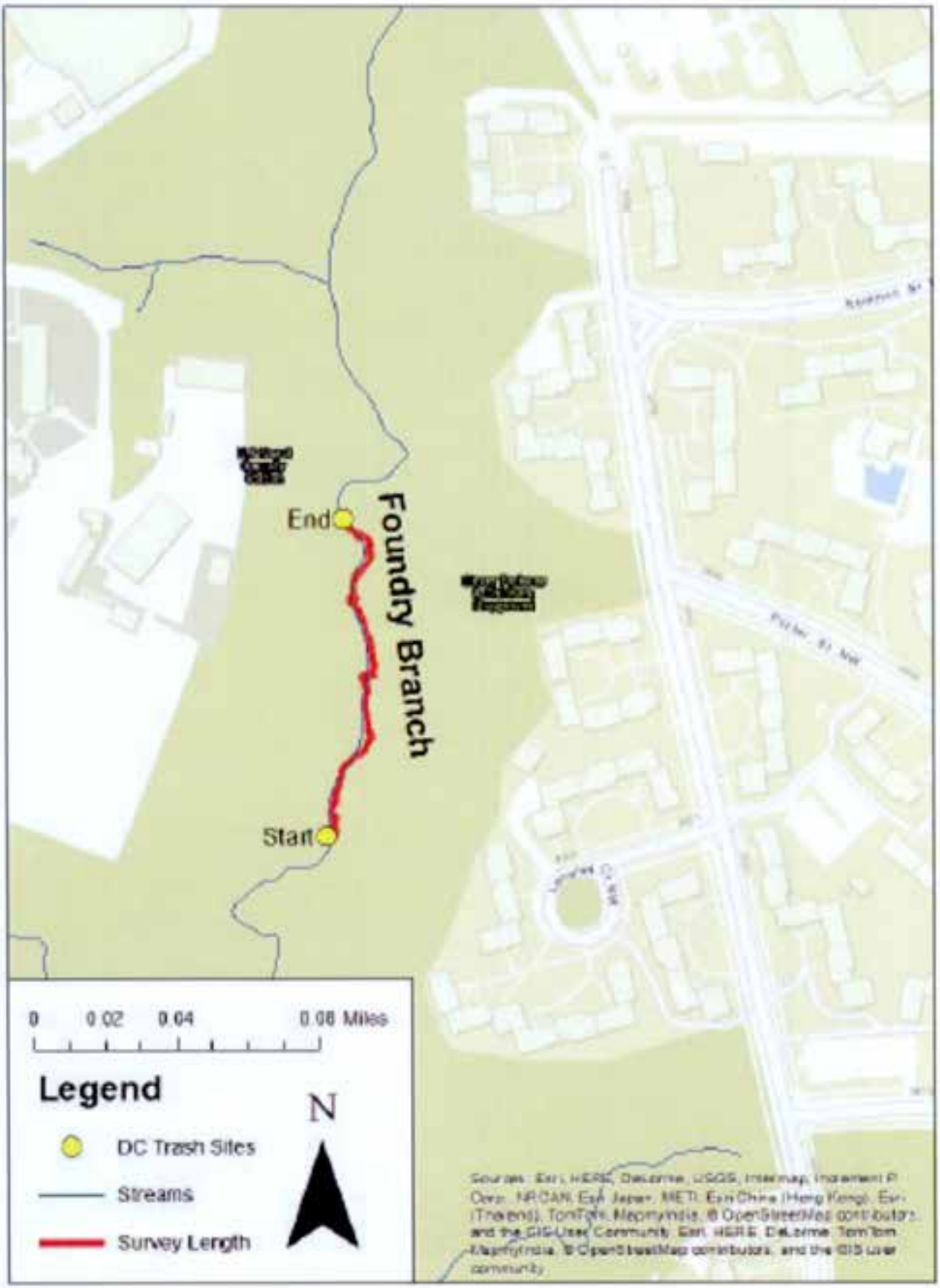


Figure 5. Blagden Run (BGD-001) stream trash monitoring site.

Figure 6. Piney Branch (PNB-001) stream trash monitoring site.

Figure 7. Luzon Branch (LZD-001) stream trash monitoring site.

Figure 8. Soapstone Creek (STC-001) and Broad Branch (BRB-001) stream trash monitoring sites.

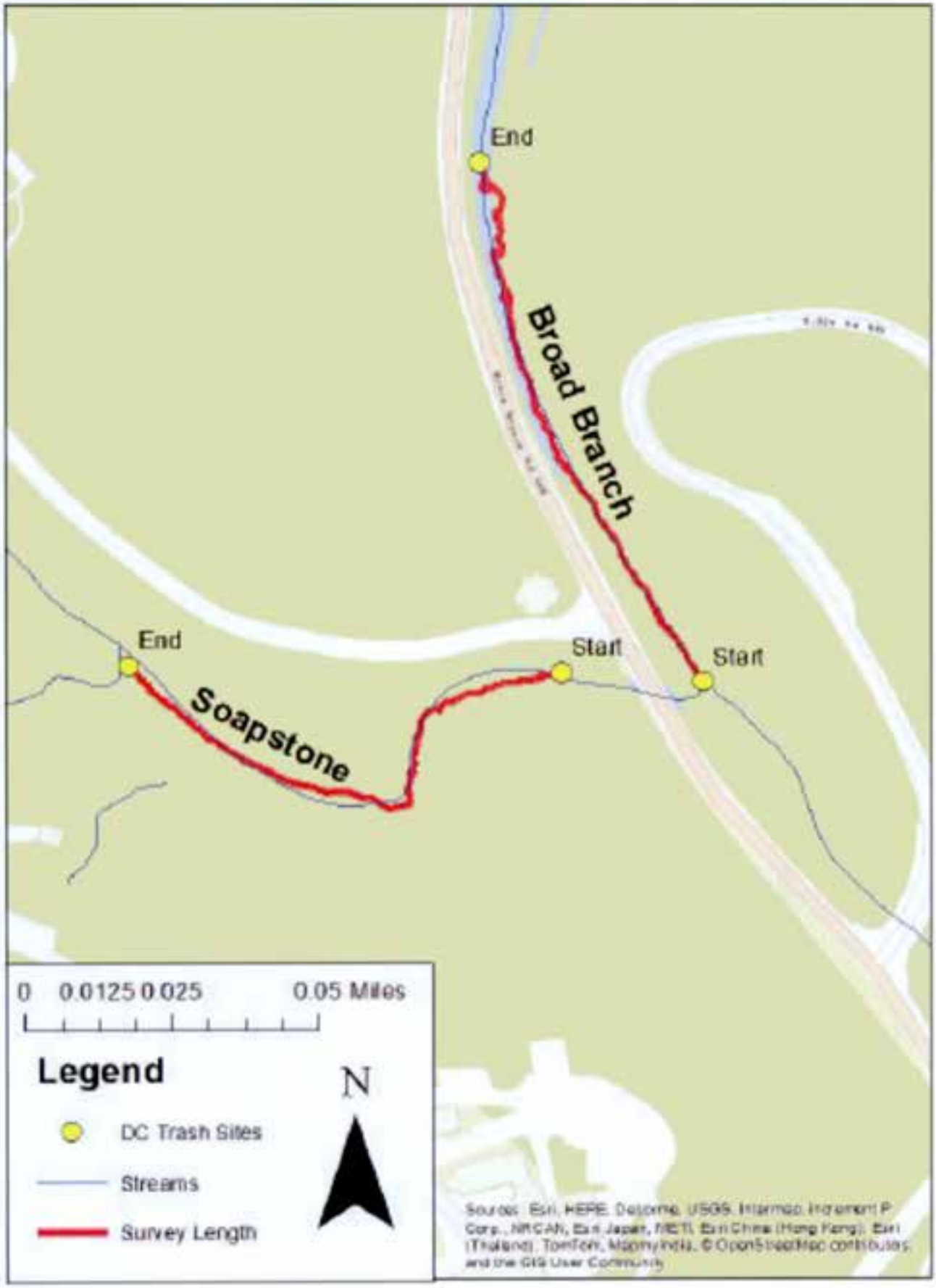


Figure 9. Fort Davis Tributary (FDV-001) stream trash monitoring site.

Figure 10. Fort Dupont Tributary (FDT-001) stream trash monitoring site.

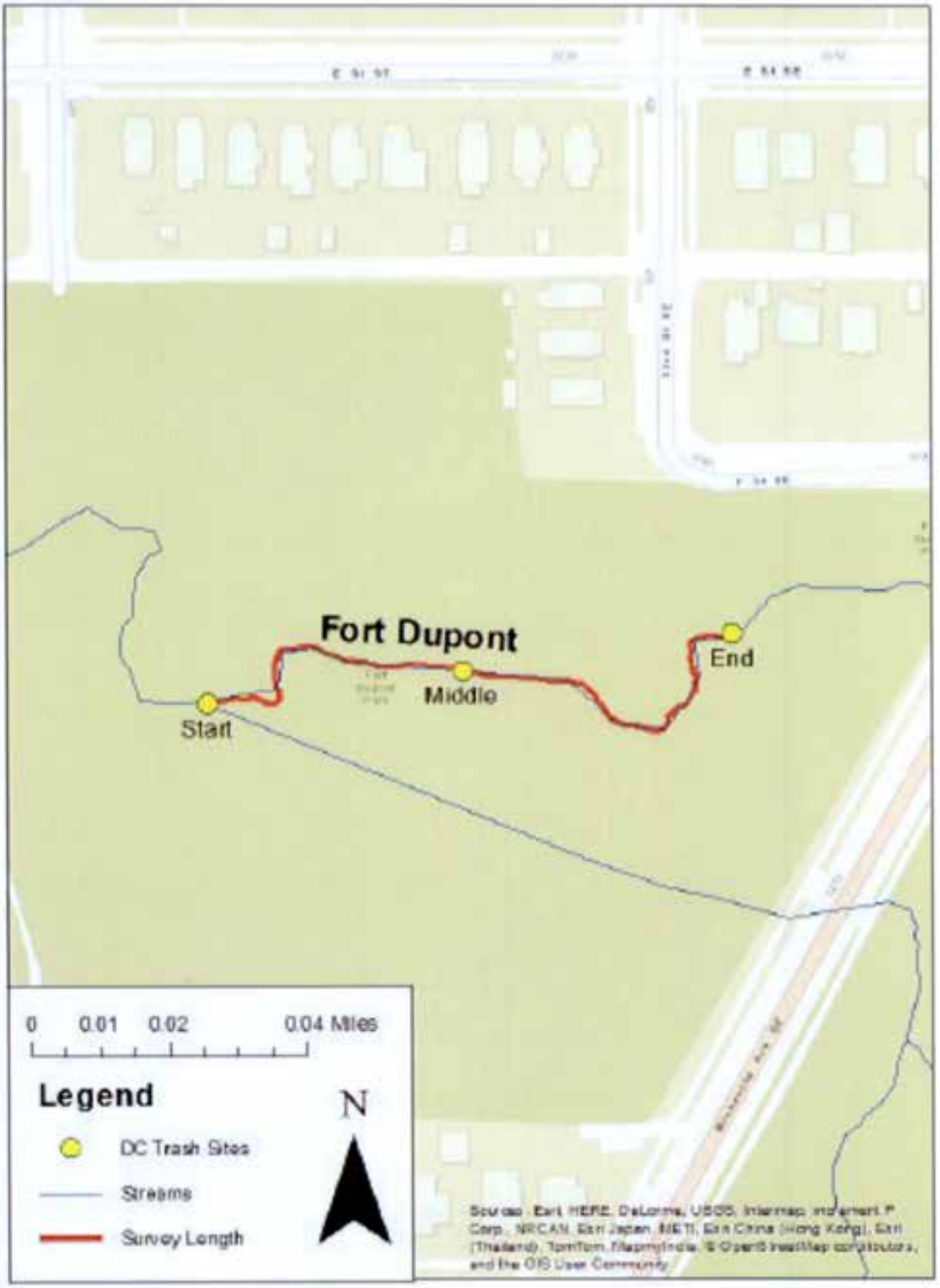


Figure 11. Fort Chaplain Tributary (FCT-001) stream trash monitoring site.

Figure 12. Watts Branch Upper (WBU-001) stream trash monitoring site.

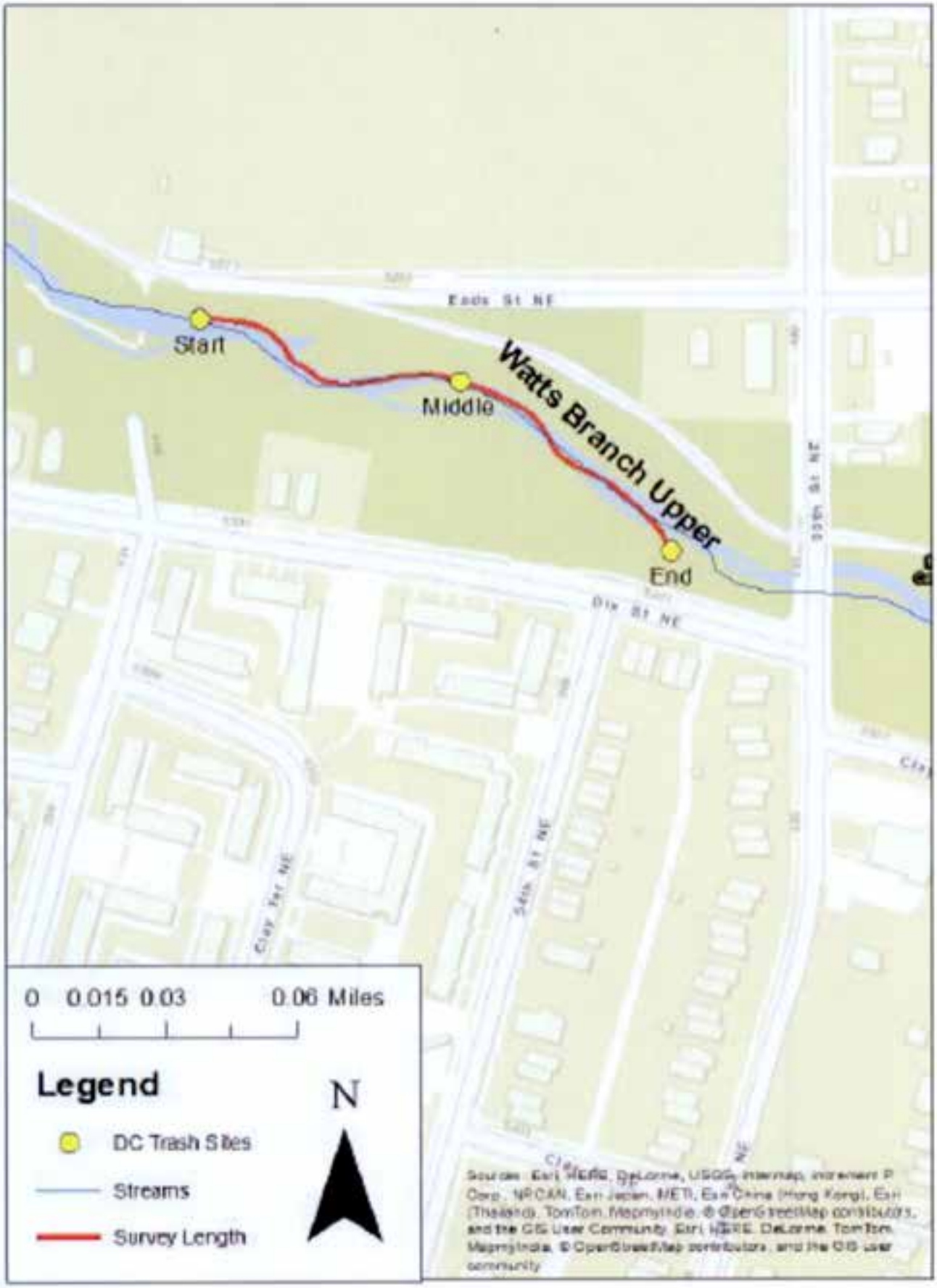


Figure 13. Watts Branch Lower (WBL-001) stream trash monitoring site.

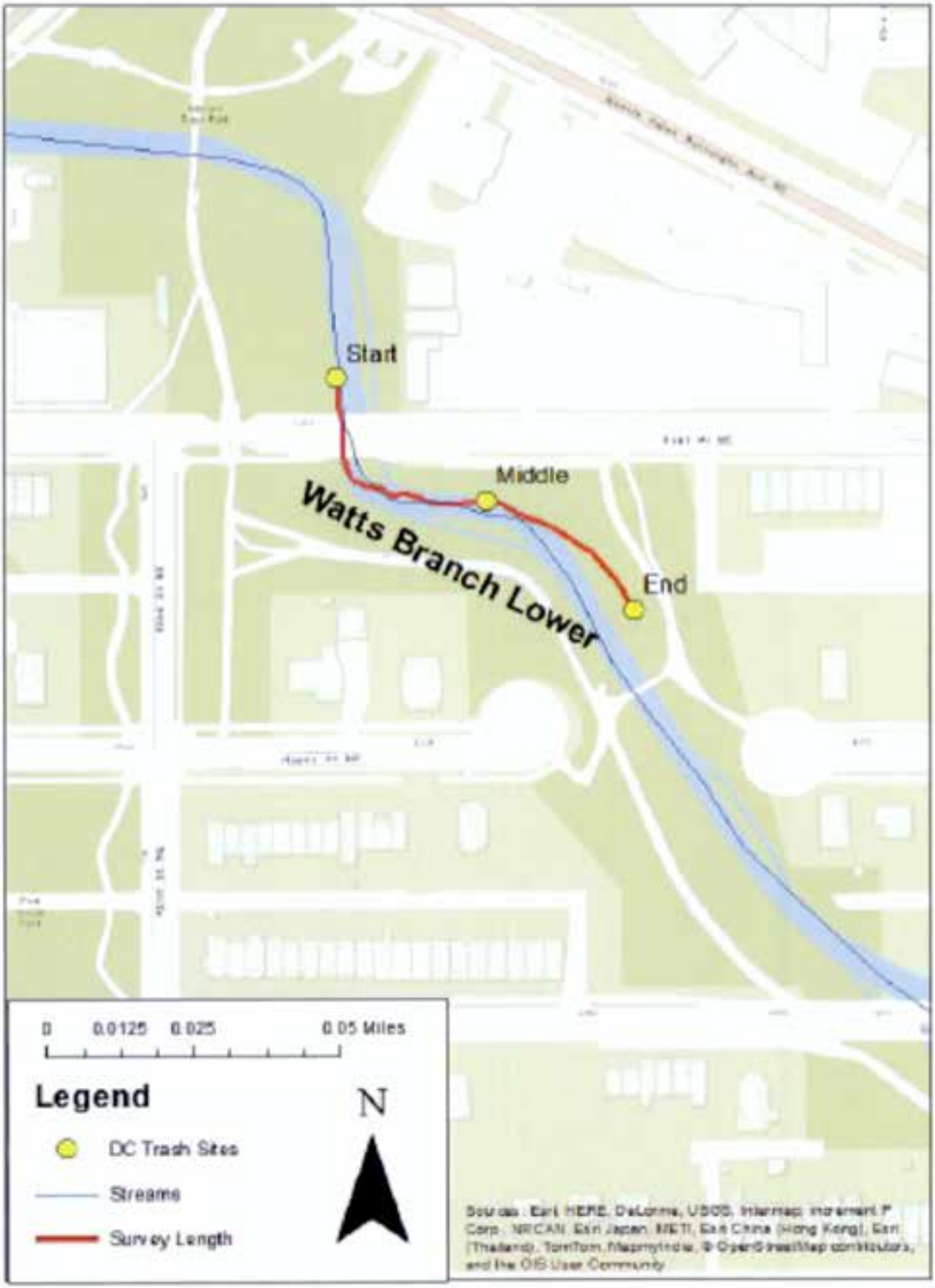


Figure 14. Kingman Lake (KNG-001) stream trash monitoring site.

QUALITY ASSURANCE PROJECT PLAN

FOR

THE DISTRICT OF COLUMBIA STORMWATER

COLLECTION & ANALYSIS PROJECT

Contract No. CW58584

29 June 2018

Prepared by
Apex Companies, LLC
9700 Capital Court Suite #100
Manassas, VA 20110

Prepared for
District Department of Energy and Environment
1200 First Street NE, 5th Floor
Washington, DC 20002

6/29/2018

_____ Date: _____
Project Manager

_____ Date: _____
QA Officer

_____ Date: _____
DOEE Representative

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Tables

Appendix

A. PROJECT MANAGEMENT

A3. Distribution List

Name: Jerusalem Bekele
Title: Contract Administrator- Environmental Protection Specialist
Organization: District of Columbia Department of Energy and Environment
Contact Information:
Address: 1200 First Street NE, 5th Floor
Washington, DC 20002
Telephone: (202) 535-1903
Email: jerusalem@bekele@dc.gov

Name: Andrea Heller
Title: Project Manager
Organization: Apex Companies, LLC
Contact Information:
Address: 9700 Capital Court #100
Manassas, VA 20110
Telephone: (703) 396-6730
Email: aheller@apexcos.com

Name: Ignatius Mutoti
Title: Quality Assurance/Quality Control Manager
Organization: Retaw Engineering
Contact Information:
Address: 2903 Sagecreek Circle
Midlothian, VA 23112
Telephone: (804) 245-2979
Email: Ignatius.Mutoti@retaweng.com

Name: Melanie Duszynski
Title: Data Quality Reviewer
Organization: Microbac Laboratories, Inc
Contact Information:
Address: 2101 Van Deman Street
Baltimore, MD 21224
Telephone: (410) 633-1800
Email: melanie.duszynski@microbac.com

A4. Project/Task Organization

Key Corporate Quality Assurance (QA) /Quality Control (QC) personnel for each specific task are as follows:

- Project Manager, Andrea Heller; Apex Companies, LLC
- QA/QC Manager, Ignatius Mutoti; Retaw Engineering
- Health and Safety Manager, Gavin Kitchens; Apex Companies, LLC
- Task Manager/Key Personnel, Amanda Hren and Toni Sanders; Apex Companies, LLC
- Field Sampling Team, Apex and Microbac Team (Multiple Individuals)
- Data Quality Reviewer, Melanie Duszynski; Microbac Laboratories, Inc.

Project Manager (PM). The Project Manager is accountable for the organization, coordination, and implementation throughout the duration of the project and utilizes the Task Leaders/Key Personnel for any technical assistance. The Project Manager may delegate authority to expedite and facilitate the implementation of the project plan. The Project Manager is responsible for:

- Coordination with client
- Budget control
- Subcontractor performance
- Project coordination to implement work plan
- Allocation of resources and staffing to implement the QA/QC program
- Allocation of resources and staffing to implement the Health and Safety Plan (HASP)
- Review of engineering and interim reports

QA/QC Manager. The QA/QC Manager is accountable to the Project Manager throughout the duration of the project and is responsible for validation of analytical data reports on all sampling and analysis data conducted under the storm water sampling project. The QA/QC Manager is also responsible for project-specific supervision and monitoring of the QA/QC Program.

- Will ensure that field personnel use proper sample procedures, field measurement techniques, sample identification, and chain-of-custody procedures
- Coordinate with the analytical laboratory for the receipt of samples, the reporting of analytical results, and recommending corrective actions to correct deficiencies in the analytical or sampling protocol
- Will audit field activities
- Provide QA/QC reports to management
- Will provide QA/QC technical assistance to the field sampling team

Health and Safety Manager. The Health and Safety Manager serves as the administrator of the Apex Team's Corporate Health and Safety Program. He is accountable directly to the Project Manager for project health and safety concerns and is responsible for:

- Proper training for the Apex Team field personnel
- Medical clearance of the Apex Team field personnel
- Field personnel having adequate experience with personal protective equipment
- Providing guidance on Health and Safety Plan (HASP) data interpretation

- Determining levels of worker protection
- Evaluating compliance with the HASP through regular audits of field activities

Task Managers/Key Personnel. Task Managers/Key Personnel provide technical support to the Project Manager for implementation of the Work Plan relative to their respective tasks and have the following responsibilities:

- Prepare task reports and outlining field investigation requirements
- Review daily reports and field notebooks
- Task scheduling
- Task budget management
- Task work plan coordination
- Review of field and laboratory analysis data
- Coordinate field activities
- Schedule sampling and other field activities

Field Sampling Team. Project personnel are drawn from the Apex Team irrespective of group or geographic assignment. The project personnel are selected based on appropriate skills, experience, and availability. Tasks and subtasks are assigned to Task Managers. Personnel working on specific tasks report daily to their respective Task Managers. Task Managers, in turn, work under the daily direction of the Project Manager. Personnel follow the procedures described in the following sections to assure consistency in sample collection and handling. Other duties may include:

- Inspect and replace equipment
- Prepare daily and interim reports
- Prepare samples for shipment

Data Quality Reviewer. A qualified laboratory, which is responsible for performing chemical analyses of environmental samples collected at hazardous substance sites. The laboratory is local and is able to receive and prep samples 24/7. The laboratory is capable of providing complete environmental analytical services consistent with U.S. EPA protocols and site-related Daily Quality Objectives (DQOs). The Laboratory Quality Assurance Manual (LQAM), provided by the approved laboratory, will supply details on laboratory operations, certifications, and personnel qualifications. The Data Quality Reviewer reviews all laboratory reports for quality and completeness before sending them to Apex and Microbac.

Apex has selected Retaw Engineering (Retaw) to provide QA/QC Support, additional technical, sampling and laboratory support.

RETAW ENGINEERING

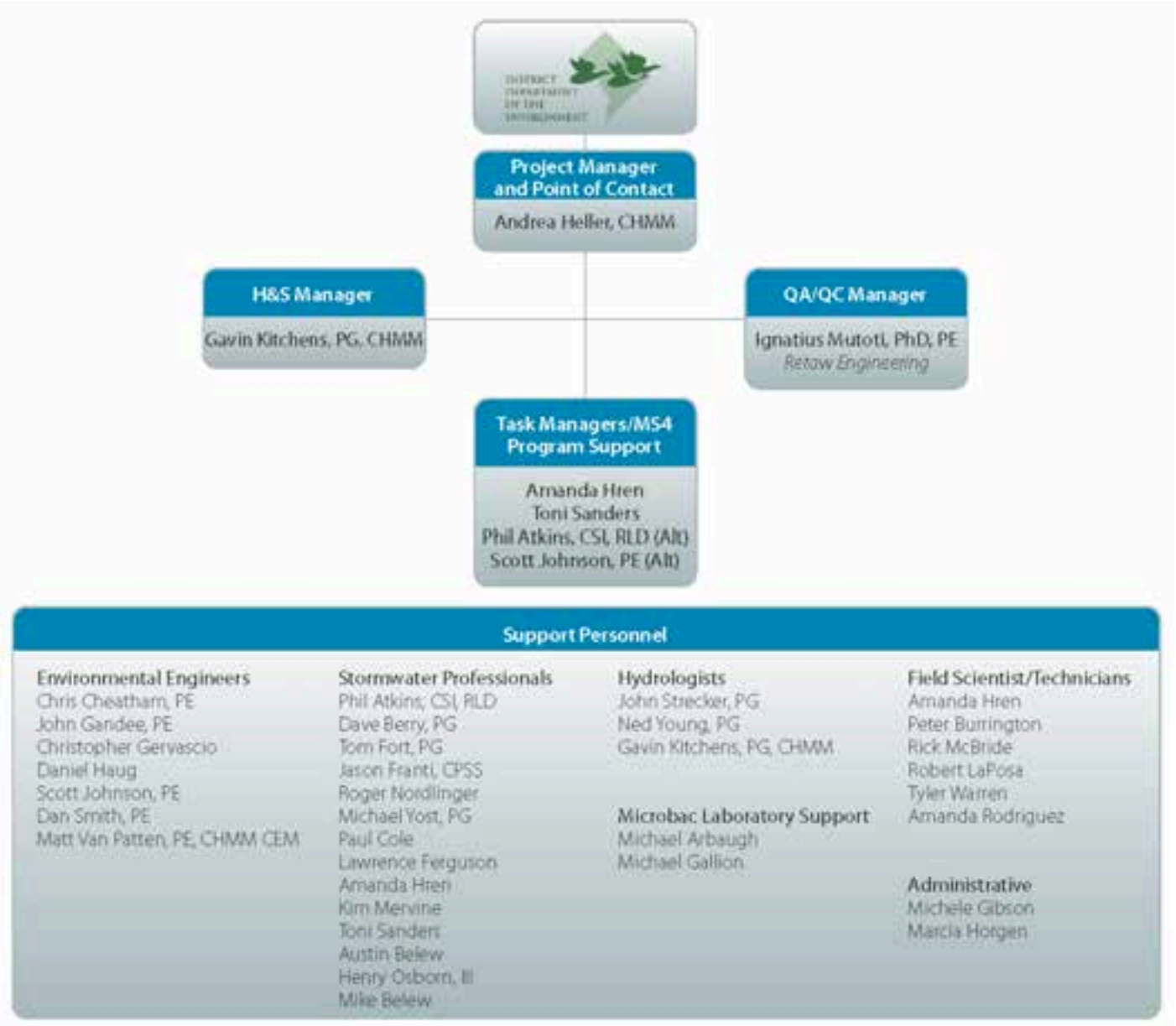
2903 Sagecreek Circle
Midlothian, Virginia 23112
(804) 245-2979
Ignatius.mutoti@retaweng.com

Retaw and Apex have selected Microbac Laboratories, Inc. (Microbac) which is responsible for performing chemical analyses of stormwater samples. The laboratory will be capable of providing complete environmental analytical services consistent with 40 CFR part 136 U.S. EPA protocols and site-related DQOs. The Laboratory Quality Assurance Manual (LQAM), provided by the approved laboratory, will supply details on laboratory operations, certifications, and personnel qualifications. The LQAM is attached in Appendix 1.

Microbac Laboratories, Inc.

Gascoyne Division
2101 Van Deman Street,
Holabird Business Park
Baltimore MD 21224
(410) 633-1800

Apex has worked extensively with both Retaw and Microbac on other projects and has assembled the Team to meet all of the anticipated projects outlined in the Solicitation. An organizational chart showing the relationships and the lines of communication among all project participants is presented below.



A5. Problem Definition/Background

The DC Office of Contracting and Procurement have contracted Apex Companies, LLC (Apex) to perform storm water sample collection for the District of Columbia Municipal Separate Storm Sewer System (MS4) permit DC0000221. The project is designed to supply the DC Department of Energy and Environment (DOEE) with the data necessary to show compliance with the National Pollutant Discharge Elimination System (NPDES) Permit issued in May of 2018.

In fulfillment of C.5.6 of the Storm Water Collection and Analysis contract number CW58584, the Quality Assurance Project Plan (QAPP) has been incorporated into this document. This document provides procedures for the sample collection, analysis, and evaluation of data. The DC stormwater

collection project will require close coordination with the client and the laboratory to ensure the viability of the samples and the integrity of the holding times.

Apex recognizes that analytical data quality management at all levels and phases of environmental work is critical to the ultimate success of any environmental project. Quality Assurance (QA) starts with the field crews taking the environmental samples in accordance with approved sampling methods, proper sample handling, preservation, sample shipment, clear and accurate chain-of-custody forms and documentation. The process continues to the laboratory, where the samples are analyzed in accordance with 40 CFR Part 136 - approved analytical methods following good laboratory practices to ensure the precision, accuracy, representativeness, comparability, and completeness of the chemical analytical results. To achieve these goals, the laboratory chemists must properly and routinely maintain analytical instruments, and non-laboratory chemists must periodically audit laboratory operations and procedures.

The following sections describe Apex's approach to ensure that these QA goals are met for any environmental program conducted or managed by Apex. This approach applies to all environmental media samples, i.e., air, soils, storm water, surface water, groundwater, and sediments, etc.

A6. Project/Task Description and Schedule

The objective for the storm water sampling is to determine if the Separate Storm Sewer System is compliant with the NPDES Permit. The DOEE has identified nine locations that storm water samples will be collected from by Apex. The nine locations consist of three locations within the Anacostia River Watershed, three locations within the Potomac River Watershed, and three locations within the Rock Creek Watershed. These locations are described in the table below:

Table 1-Watershed and Sampling Locations

Site	Sampling Location	Watershed	Type of Site
1	Tributary to Anacostia-Gallatin Street & 14th Street NE	Anacostia River	Continuous Record
2	Oxon Run-Mississippi Ave and 15th St. SE	Potomac River	Continuous Record
3	Soapstone Creek-Connecticut Avenue and Albemarle Street NW	Rock Creek	Continuous Record
4	TBD	Anacostia River	TBD
5	TBD	Anacostia River	TBD
6	Outfall 950-Tributary to Potomac	Potomac River	Stratified Random
7	Outfall 103-Oxon Run	Potomac River	Stratified Random

8	TBD	Rock Creek	TBD
9	Outfall 901-Tributary to Pinehurst Branch	Rock Creek	Stratified Random

The flow characteristics for each location will be defined in advance of a storm event. The geometry of the outfall or storm water structure will be evaluated and a method of determining flow will be determined in advance of the sampling event. The flow will be determined by the cross-sectional geometry of the outfall, depth of flow and the velocity of the water passing through the structure. The velocity of the flow will be estimated and recorded and the estimated flow rate will be recorded using a digital flow meter reading or other acceptable industry methods.

Sampling will occur during wet weather events. A wet weather sampling event will occur when rainfall amounts to 0.10 inches or more. A wet weather sampling event must occur 72 hours from previous 0.10 inches of recorded rain and the site must not have been previously sampled within a 30 day period. Samples will be collected using both grab and composite techniques. Samples will be collected at outfalls and manholes in each of the prospective watersheds as directed by the Permit.

Samples from wet weather events will be delivered under the Chains of Custody to Microbac. Sample event reports will be produced within 30 days of the sampling event.

A7. Quality Objectives and Criteria

A7.1. Data Quality Objectives

Data Quality Objectives (DQOs) are developed to achieve the level of data quality required for the anticipated data use and are implemented so that for each task, the data is legally and scientifically defensible. The development of DQOs for a specific site and measurement takes into account project needs, data uses and needs, and data collection. These factors help in determining the appropriate quality assurance objectives necessary to ensure the quality and quantity of data are adequate for the end use of the data.

DQOs are attained through sound chemical quality management and achieved through the implementation of this plan. This QAPP is in accordance with applicable U.S. EPA standards and regulations.

A7.2. Analytical Data Quality Assurance

The objective of the Analytical Quality Control Program is to provide sampling and analysis data of acceptable quality.

- Accuracy (Bias) is a measure of confidence that describes how close a measurement is to its “true” value. Accuracy for field and laboratory tests shall be determined using various approaches including: instrument calibrations, various types of QC checks – e.g. sample split measurements, sample spike recoveries, matrix spike duplicates, continuing

calibration verification checks, internal standards, sample blank measurements (field and lab blanks), external standards), and performance audit samples (DMRQA). Accuracy shall be assessed using the following formula:

$$Accuracy = \frac{MeasuredValue}{TrueValue} \times 100$$

Precision. Measure of mutual agreement among repeated measurements of the same parameter, and provides information about the consistency of methods usually under prescribed conditions. Precision is expressed in terms of the relative percent difference between two measurements (A and B). The objective for precision is to equal or exceed the precision demonstrated for similar samples, and should be within the established control limits for the methods. Precision shall be determined as follows:

For field measurements, precision shall be assessed by measuring duplicate samples at the same *locations* and as soon as possible to limit temporal variance in sample results. Field and laboratory precision shall be measured by collecting blind (to the laboratory) field duplicate samples. For paired and small data sets project precision is calculated using the following formula:

$$Precision = (A - B)/\left(\frac{(A + B)}{2}\right)x100$$

For larger sets of paired precision data sets (e.g. overall project precision) or multiple replicate precision data, use the following formula:

RSD = 100*(standard deviation/mean)

- Completeness. Measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions. The objective is to generate a sufficient database with which to make informed decisions with statistical confidence. Project completeness is determined for each pollutant parameter using the following formula:

  $$\frac{T - (I+NC)}{T} \times (100\%) = \text{Completeness}$$

  Where T = Total number of expected sample measurements.
  I = Number of invalid sample measured results.
  NC = Number of sample measurements not produced (e.g. spilled sample, etc.)

- Representativeness. Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness includes what parameters to sample for, where to sample, type of sample (grab, continuous, composite, etc.) and frequency of sample collection and shall be in accordance with the DC 0000221 NPDES Permit. To meet the objective of obtaining representativeness of samples, a Work Plan is developed.

- Comparability. The confidence with which one data set can be compared to another collected by using standardized methods of sampling and analysis. Comparability shall be shown by referencing the appropriate measurement method approved by as specified in 40 CRF Part 136 or other approved methods for the parameter(s) to be sampled and measured (e.g., ASTM, Standard Methods). For each parameter to be analyzed, the method to be used and the measurement quality objective shall be listed to meet the overall data quality objectives. This applies to both direct field measurements (e.g., field pH meters, DO meters, etc.) as well as samples collected for subsequent laboratory analyses. This objective is met by using 40 CFR Part 136 and standard methods for sampling procedures and analyses, and by following techniques and methods set forth in the Work Plan.

- Sensitivity. Measure of a method's detection limits and ability to distinguish between two values. The sensitivity and detection limits of a method will be reviewed to determine a method based on the method's detection limit (MDL) and practical quantification limit (PQL).

A8. Special Training/Certification

Apex team leaders and full-time staff are OSHA 40 Hour HAZWOPER trained. All staff members working on this project receive in house sampling and safety training. Microbac will be capable of providing complete environmental analytical services consistent with 40 CFR part 136 U.S. EPA protocols and site-related DQOs. The Laboratory Quality Assurance Manual (LQAM), provided by Microbac, will supply details on laboratory operations, certifications, and personnel qualifications. Laboratory certifications are presented in Appendix 1.

Under the National Pollutant Discharge Elimination System (NPDES) program, the laboratory is required to participate in the annual Discharge Monitoring Report–Quality Assurance (DMR-QA) study program. DMR-QA evaluates the analytical ability of the laboratories that routinely perform self-monitoring analyses required by the NPDES permit. Microbac will participate in this annual study.

The quality assurance (QA) laboratory will deliver the sample results and data package, which will be reviewed by the QA/QC Manager. The data reviewed will include all blank, sample, and internal quality control results such as spike and surrogate recoveries and replicate analyses. Any significant differences or problems discovered will be addressed; corrective action, such as reanalysis and/or resampling, may result at the Project Manager's discretion.

A9. Documents and Records

The records for this project will include field logs, field data worksheets, laboratory data reports, and sample event report. Field logs will include observations about weather conditions at the site when samples are collected and field analyses conducted. Any other pertinent observations or deviations from the procedures in this QAPP, deemed noteworthy by any member of the field team will also be recorded in the field log book. Field data worksheets (Appendix 2) will be used to record all field measurements. Each page of the field logs and field data worksheets will be dated and signed by the person making the entries.

The sample event report will be submitted within approximately 30 days of the actual sampling event and based on actual analytical results receipts from the Microbac laboratory. The results of the field parameters tested during the sampling event, field data collection sheet, site narrative report of the event and sampling locations where the actual storm water samples collected, site photographs and meteorological data predicting the storm-water event, flow monitoring, precipitation data including rainfall hydrograph, signed chain-of-custody forms and the laboratory analytical results of analyzed samples will be included in the sample event report. Two hard copies of the report and an electronic report copy will be submitted for each event report to the DOEE.

Data packages generated from analyses shall include the following:

1. Pertinent physical data presented in concise, easy to follow formats (i.e., sample number, client, date of sample preparation, date analyzed, percent moisture, etc.).

2. Data from each discrete sample reported using cross referencing between normal samples and quality control samples.

3. Reported data to include associated quality control samples such as blanks, spikes and spike duplicates, laboratory duplicates, field duplicates, and appropriate check standards.

4. Copies of chain of custody sheets.

Data reduction is the process that raw analytical data generated from laboratory instrument systems is converted into usable concentrations. The raw data, which may take the form of area counts, instrument responses or observations, is processed by the laboratory and converted into concentrations expressed in the part per million or part per billion range. Raw data from these systems include compound identifications, concentrations, retention times, and data system printouts. Raw data is usually reported in graphic form, bar-graph form or tabular form. Data reduction procedures will be discussed in greater detail in the LQAM (Appendix 1).

B. DATA GENERATION AND ACQUISITION

B1. Sampling Process Design (Experimental Design)

The storm water sample collection and analyses will supply the DOEE with the data necessary to show compliance with the Municipal Separate Storm Sewer System (MS4) Permit. The samples will be collected at the following locations (9 outfalls).

For each sampling location, the field sampling team will record estimated flow velocity, odor, pH, dissolved oxygen content, temperature, specific conductivity, and approximate water depth. The field sampling team will complete a sample data collection form to document the event. Digital photography will be collected if necessary to further document conditions during the event.

B1.1. Wet Weather Sampling

Mobilization and preparing the samplers starts with coordination and notification. Communication will come from the PM who then will notify the integral field sampling team. The field sampling team will begin by organizing and preparing all necessary sampling and sample transportation equipment for the event approximately 24 hours in advance, so the equipment is charged and available when the storm reaches the monitoring area. Any in-situ autosamplers being used for the rain event are reviewed to ensure required bottleware, power sources, and sample preservation materials are in place. For direct sampling of sites, the field sampling team will mobilize to sampling site locations approximately 1-2 hours prior to the predicted beginning of a storm event.

Once the sampling event (3 hours for composite samples) has been completed, the field sampling team will meet with the designated lab or courier to deliver the event samples with their respective Chains of Custodies.

B1.1.1. Collection Procedures, Sampling Handling, and Transportation of Samples for Wet Weather Sampling

Collection Methods for Wet Weather Sampling:

GRAB SAMPLES

- E. coli

COMPOSITE SAMPLES

- Total nitrogen
- Total phosphorus
- Total Suspended Solids
- Cadmium
- Copper
- Lead
- Zinc

FIELD ANALYSIS

- pH
- Temperature
- Dissolved oxygen
- Conductivity
- Hardness

1. The storm water samples shall be collected at the locations designated in the contract and at a minimum of four (4) sites for each wet weather event. Samples will be collected using both grab and composite techniques. Samples will be collected at outfalls and manholes in each of the prospective watersheds as directed by the Permit. When a qualifying event (storms with at least 0.1 inch of precipitation, 72 hours, and one month since the last collection at a specific site) is anticipated based on the available meteorology, the auto-samplers will be charged and set up in advance using all appropriate safety precautions. The suction stub of the auto-sampler will be positioned upstream of the grab sample locations and field parameter test points.

2. The auto-samplers will be equipped with a pre-cleaned 2 1/2 gallon lab supplied glass container to collect composite samples. The auto-sampler will be packed with ice to ensure the composite sample is kept adequately preserved during sample collection.

3. When it is determined that a qualifying event is highly likely to occur, the field teams will mobilize to the site, don any required Personal Protective Equipment (PPE), and exercise appropriate safety precautions. Apex is experienced in after-hours sampling and minimizes safety concerns by working in teams, using reflective clothing and equipment, utilizing flashlights and headlamps.

4. Data quality depends, in part, on proper collection and preservation to guarantee representativeness of the sample. Sample containers will be labeled in such a manner as shown in Section B3.2.2 and B3.2.3. Once collected, samples will be immediately placed in a cooler filled with ice and held at 4°C. Disposable gloves and other appropriate PPE will be worn by the sampling personnel and changed between sampling points to avoid cross contamination. Personnel will also be equipped with appropriate rain gear. The information collected in the field shall be recorded in a dedicated field logbook and on the sample collection form at the time of sampling.

5. The field sampling team will perform the required analytical field tests (Conductivity, Hardness, Dissolved Oxygen, pH, Temperature, and Flow) using direct reading equipment in accordance with manufacturers written procedures. These readings will be noted in the field data sheets.

6. It is the policy of Apex to calibrate required equipment, collect samples properly and to ensure that they maintain the characteristics of the sample source using appropriate sampling and preservation techniques. It is critical that the sampling be performed correctly and documented thoroughly,

following protocols. The techniques used are based on EPA-National Field Manual for the Collection of Water-Quality Data (USGS updated 2008), the NPDES Permit DC0000221, and the "NPDES Storm Water Sampling Guidance Document" (EPA 833-B-92-001).

7. When sampling an outfall, the field sampling team will stand downstream of the sampling location and work upstream to collect samples.

8. Grab samples will be collected for the required parameters and these will be placed in pre-cleaned containers prepared with the appropriate preservatives and properly labeled. The samples will be placed in a cooler charged with ice in preparation for delivery to the laboratory.

9. The auto-samplers will be checked and if they have completed the collection routine and the composite sampling is complete, the container will be removed from the unit and included in the shipment to the lab. The auto-samplers will be set to take samples as a time weighted average (TWA) at a minimum of every 15 minutes. The full composite sampling container will be transported to the laboratory for division into appropriate sample containers and will be preserved in accordance with the requirements of the specific analytical procedures.

10. The field sampling team will complete the sample collection data forms, chain of custody forms and field logbook prior to moving to next site. The team will perform a QC check to ensure that all required data has been captured prior to moving on to the next location.

11. The field sampling team will communicate via company supplied mobile phones to ensure that all scheduled sites can be completed within the 3 hour window for the event. These phones allow the sampling crews to check weather patterns and forecasts from the field as well as keep in contact with the PM via text messaging, emails, or phone. Sampling will be completed within the first three hours of a qualifying event.

12. The team will meet at a predetermined location and the coolers for each location will be inspected for quality control, completeness and then packaged for transport to the laboratory. The samples will be transferred under chain of custody to one vehicle or to a courier service for transportation to the laboratory. This effort is expected to take approximately 30 minutes.

13. The proposed laboratory for this project is located Baltimore, MD and is approximately one hour from Washington, DC. This laboratory is equipped to receive samples on a 24 hour seven day a week basis. Based on the above scenario and time frames, this will leave approximately 90 minutes at the lab to prepare the micro-biological samples and meet the six hour holding time for the micro-biological parameters.

14. All used field equipment will be properly decontaminated after each event.

B1.2. Field Documentation

The following information will be recorded in a field notebook and on the sample data collection form at the time of sampling:

- Sample location
- Name of field technicians present during sampling
- Method of sample collection utilized
- Time/date of sampling
- Type of sample
- Analyses required and sample container types
- Field measurements and calibration (if applicable)
- Observed conditions that may impact the chemistry of the sample
- Observations and remarks: A bound field logbook will be maintained in which to record the daily activities. All entries will be made in indelible ink. Incorrect entries will be corrected by a single stroke through the error and will be verified with the recorder's initials. Entries to the log book, in addition to the required sampling entries, will include:

    - Date
    - Start and finish times
    - Summary of work performed (including samples collected)
    - Names of personnel present
    - Weather observations
    - Calibration of equipment
    - Observations and remarks
    - Field measurements

B1.3. Meteorological Event Planning Procedures

Accurate prediction, evaluation and documentation of qualifying weather events are necessary to determine when to engage each sampling team to the necessary locations. Accuracy in these matters also ensures close coordination with the client and the laboratories to ensure the viability of the samples and the integrity of the holding times.

Although meteorological and storm events can be unpredictable, they can be forecasted using various resources including electronic and broadcast media, historical weather trends, newspapers, and visual observation. Tools such as thermometers, barometers, electronic weather stations, and rain gauges accessed with staff smartphones will also be on-hand to aid in predicting a qualifying storm event. The project manager will use this data to produce weekly in-house weather forecasts each week and to alert field managers and sampling teams of pending storm events.

B1.4. Qualifying Storm Event Criteria

According to the EPA's guidelines, the storm water discharge permit requires that each qualifying rain event have the following criteria:

- The depth of the storm must be greater than 0.10 inch accumulation;

- The storm must be preceded by at least 72 hours of dry weather;
- The depth of rain and duration should not vary by more than 50 percent from the average depth and duration for each location.
- The same site is not to sampled more than once in a 30 day period.

This specific criterion ensures that:

- Adequate flow would be discharged from each location;
- Some build-up of pollutants during dry weather intervals occurs;
- The storm would be typical for the area (i.e. intensity, depth, and duration).

Data on local weather patterns is provided by the National Weather Service's (NWS) website at www.weather.gov and includes historic, future, and current weather conditions. National Oceanic and Atmospheric Administration (NOAA) supplies average rain and duration figures for the immediate and surrounding areas based on normal data records collected since 1971. This information will be analyzed to determine if the range of the storm is within the duration, intensity, and depth typical of the representative area and time of year.

A variety of sources will be used retrieve and verify weather data. Numerous sources have been investigated and deemed acceptable meteorological sources to predict upcoming weather patterns. Electronic resources will be the primary source of weather prediction; however, secondary sources such as newsprint, radio, and television will assist in forecasting.

NOAA's National Weather Service (NWS) website will serve as Apex's principal daily forecast source. The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States up to 10 days in advance. They also provide forecast maps that display anticipated amounts of precipitation to occur within the upcoming 72 hours. These interactive maps loop instantly in 6-hour increments to show expected depths of precipitation in this 72 hour window.

- National Oceanic and Atmospheric Administration's National Weather Service http://www.weather.gov/
- Reagan National Airport (Washington, DC) http://weather.noaa.gov/weather/current/KDCA.html
- Radio/Television
- FM radio channel: 88.5 WAMU or 103.5 WTOP
- The Weather Channel on various cable outlets

- Electronic Tools

- Smartphones to access specific online tools

B1.5. Daily Weather Logs

The Project Manager or qualified representative will maintain a daily weather log using information from NOAA.gov

1. Time & Date of report- as 24-hour day, as day month year (1730 01/11/2006)
2. High and Low Daily Temperature in degrees Fahrenheit (Hi-85° F/Lo-35° F)
3. High and Low Record Temperature in degrees Fahrenheit (1905-Hi-85°F/1945-Lo-35°F)
4. Conditions- Categorized as
   CLEAR- little to no clouds
   CLOUDY- fifty percent or greater sky cover
   NON-QUALIFYING EVENT- less than one tenth of an inch (<00.1")
   QUALIFYING EVENT- greater than one tenth of an inch (>00.1")
   SEVERE STORM- severe winds and storms that create unsafe work environments
5. Wind Speed & Direction- at the time log is written in miles per hour (15.0mph)

The field sampling team will maintain a weather log for every qualifying weather event. They will record the following information;

1. Time & Date of report
2. Author's name/source
3. Current Weather alerts and warnings
4. Temperature in degrees Fahrenheit
5. Site locations expected to be sampled
6. Site locations sampled
7. Time arrived on site
8. Number and size of samples taken
9. Time samples were taken
10. Time left site
11. Time Chain of Custody was completed

The QA/QC Manager will review these logs on a weekly basis.

B1.6. Coordination of Events for Storm Sampling

Apex's Project Manager will manage the notification of all involved parties in the event of a pending qualifying weather 24 hours in advance. Apex personnel are equipped with cell phones to facilitate efficient mobilization. The Project Manager will notify each member of the sampling teams to ensure proper dissemination of information regarding locations to be sampled and other vital information. Phone notifications will be made and a follow up email, after demobilization, will be sent stating the locations and quantity of samples, if any, were collected and sent to the laboratory.

B2. Sampling Methods Requirements

Samples will be collected using the containers and preservatives specified in Appendix 3. Unless otherwise stated, the order of sample collection will be:

1. In-situ measurements
2. Microbiological
3. Total metals, other parameters, etc.

Sample containers will be labeled with the following information: location identification, date, parameter(s) to be analyzed, and type of preservative. Samples will then be immediately placed in a cooler and held at 4°C. Disposable gloves will be worn by the sampling personnel and changed between sampling points. The field data collected shall be recorded in the field logbook and on the sample collection form at the time of sampling.

While performing any equipment decontamination, phthalate-free gloves (neoprene or natural rubber) will be worn in order to prevent phthalate contamination of the sampling equipment by interaction between the gloves and the organic solvent(s). To the greatest extent possible disposable sample collection equipment will be used and will be disposed of in accordance with applicable Federal, state and local regulation.

At the end of each sampling event, the sampling team shall report any problems requiring corrective action that were encountered during the event. Corrective action will be undertaken when a nonconforming condition is identified. A nonconforming condition occurs when QA/QC objectives for precision, accuracy, completeness, representativeness, or comparability are not met, or when procedural practices or other conditions are not acceptable. The report shall be filed with the Project Manager which documents the problems encountered and the corrective action implemented.

B2.1. Sampling Equipment

This project is specifically for the collection and analysis of storm water. A list of typical field equipment and devices used for sample collection are presented below.

Sampling Equipment:

- Personal Protective Equipment (Reflective Vests) & Rain Gear
- Mobile Phones
- Work, Safety and Traffic Control Plan
- Permits- DDOT, National Park Services (NPS), and DC Water.
- pH, dissolved oxygen, temperature, and specific conductivity meter
- Flow-meter
- Stainless Steel Buckets
- Auto-sampler
- Coolers
- Flashlights – Various Types
- Manhole Removal Tool
- Digital Camera

- Small Hand Tools
- Gloves

Field analytical equipment:

- Dissolved Oxygen Meter
- pH meter
- Specific Conductivity Meter
- Chlorine Meter/Test
- Temperature Probe - YSI 3510

Field Sample Collection Devices:

- Glass/plastic beaker or dipper for surface water samples
- Stainless steel buckets
- ISCO auto samplers

B2.2. Decontamination of Sampling Equipment

To avoid cross-contamination of samples, equipment used in sampling must be clean and free from the residue of previous samples. To the greatest extent possible, Apex will utilize dedicated pre-cleaned and disposable equipment to minimize the potential for cross contamination. Non-dedicated sampling equipment must be cleaned initially and prior to being reused and will be appropriately packaged to prevent contamination. The following is the procedure for decontamination and does not apply to heavy equipment or drilling equipment.

- Wash and scrub with low phosphate, laboratory grade detergent (bucket 1)
- Tap water rinse
- Wash and scrub with low phosphate, laboratory grade detergent (bucket 2)
- Thorough rinse with distilled water
- Wash and scrub with low phosphate, laboratory grade detergent (bucket 3)
- Thorough rinse with distilled water
- Air dry
- Wrap appropriate equipment in aluminum foil, plastic sheets, plastic bags or place in clean ziplock bag

  Note: A variation of the above decontamination procedure may be used depending on the DQO level and parameters to be sampled.

  Field instrumentation shall be cleaned and calibrated per manufacturer's instructions. Probes, such as those used in pH and conductivity meters, and thermometers must be decontaminated and rinsed prior to and after use with deionized water and shall be properly calibrated.

B2.3. Decontamination Solutions

- Deionized demonstrated analyte-free water

- Low phosphate laboratory grade detergent
- Concentrated nitric acid (HNO_3)
- Concentrated hydrochloric acid (HCl)
- Distilled Water

Note: Decontamination fluids are highly specific to the type of sample being collected and the analysis being performed. To the greatest extent possible Apex will use dedicated disposable equipment to minimize equipment decontamination.

A table of parameters, holdings times and methods are listed in Table 2.

Table 2 – Wet Weather Parameters

Parameter	Container Type	Preservation	Sample Type	Method	Holding Times
E. coli	4 oz. sterile polypropylene	Sodium Thiosulfate	Grab	SM 9221 F	6 hours
Total nitrogen	500 ml plastic	HNO3	Composite	SM 4500N-org/NH3G	28 days
Total phosphorus	500 ml plastic	HNO3	Composite	SM 4500-P	28 days
Total Suspended Solids	1000 ml plastic	Neat	Composite	SM 2540 D	7 days
Cadmium	1000 ml plastic	H2SO4	Composite	EPA 200.8	180 days
Copper	500 ml plastic	HNO3	Composite	EPA 200.8	180 days
Lead	500 ml plastic	HNO3	Composite	EPA 200.8	180 days
Zinc	500 ml plastic	HNO3	Composite	EPA 200.8	180 days
pH	N/A	N/A	In Field	SM 4500 H B	15 minutes
Dissolved Oxygen	N/A	N/A	In Field	N/A	N/A
Hardness	N/A	N/A	In Field	N/A	N/A
Temperature	N/A	N/A	In Field	N/A	N/A
Conductivity	N/A	N/A	In Field	N/A	N/A

B3. Sample Handling and Custody Requirements

The samples will be packaged, preserved and handled in a manner to ensure the integrity of the sample. The laboratory may preserve sample containers before sending them to the field sampling team or they may be preserved in the field before or after sample collection depending on the analytical parameter and project specifications. All required preservatives would be specified by the analytical method to be used. The samples will be packaged and shipped in a manner to minimize the potential for breakage and ensure the holding time for all parameters is not exceeded.

1. Samples requiring pH adjustment in the sample jar shall be obtained with the appropriate preservative pre-measured in the sample container by the laboratory. If preservation of the sample causes effervescence, the sample will be submitted without pH adjustment and all samples will be cooled to +/- 4°C. Appropriate safety precautions when handling sample containers preserved with acids, or caustics.

2. Each cooler shall be prepared to contain the exact number and type of sample containers required for one suite of parameters for each outfall/location. The sample containers will be

pre-labeled and preserved and all required sample packaging material will be prepared and included in the cooler.

3. After collection the samples will be placed in lined cooler using a large plastic bag. Each cooler will have the correct number of sample containers inside and the containers will be pre-labeled. Waterproof labels will be used.

4. The field sampling team will double check to ensure that all sample containers have been filled properly and are properly protected against breakage and will then secure the bag.

5. The field sampling team will complete the chain of custody for each cooler and will seal it in a ziplock bag. Chain of custody will filled-out to the greatest extent possible prior to mobilizing to the field and will be completed in the field. The bag will be taped to the interior lid of the cooler. The cooler will then be sealed with clear packaging tape and equipped with tamper proof seals and labeled for shipment to the Lab.

6. The sample coolers will be shipped to the lab using the most expedient method. This may include courier, commercial transporter or hand delivery.

B3.1. Overview

Sample custody during the field investigations will be performed in three phases. The first phase encompasses sample collection, pre-laboratory treatment procedures (preservation), packaging, and field custody shipping procedures. The second custody phase involves sample shipment, where mode of shipment, airbill numbers, dates, and times are documented. The third phase involves the custody procedures employed by the laboratory.

All three phases of sample custody will be performed to provide that:

- All samples are uniquely identified
- The correct samples are tested and are traceable to their source
- Important sample characteristics are preserved
- Samples are protected from loss or damage
- A record of sample integrity is established and maintained through the entire custody process

Custody and shipping procedures are modeled after standard U.S. EPA procedures.

B3.2. Field Custody Procedures

B3.2.1 Sample Identification

All samples collected must be identified with a sample label in addition to an entry on a chain-of-custody record. Indelible ink will be used to complete sample labels, then labels will be covered with clear plastic waterproof tape.

B3.2.2. Sample Labels

Sample labels will require the field team to complete the following information for each sample bottle:

1. Site Name
2. Sample Number
3. Sample Matrix
4. Parameters to be analyzed
5. Date of Collection
6. Time of Collection
7. Preservation Technique Employed
8. Sampler's Name

Sample labels will be attached to the sample bottles and covered with clear plastic waterproof tape.

B3.2.3. Sample Numbering

Samples shall be numbered in such a manner that the site, location, type of sample, and depth of sample or date of sample is evident. Below are suggested examples of sample numbering.

Stormwater samples will be labeled as follows:

SWXX – Composite
SWXX – Grab

SW:	Storm-water sample
XX:	Identifies site location (Per Table 1)
Composite:	Composite sampling
Grab:	Grab sampling

Trip blanks will be labeled by adding TB to the end of the sample number.

B3.3. Chain-of-Custody-Record

The chain-of-custody guidelines create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. Chain-of-custody forms will be completed for each sample at the time of collection and will be maintained while shipping the sample to the laboratory. A person is in custody of a sample if the sample is:

- Sample is in that person's physical possession.
- Sample is visible after being in that person's physical possession.
- Sample placed in a locked repository by that person.
- Placed in a secure restricted area by that person.

Prior to the sampling event or soon as practical after sample collection, preferably after decontamination, the following information must be entered on the chain-of-custody form. All information is to be recorded in ink.

1. Project number. Enter the alphanumeric designation that uniquely identifies the project site.

2. Project name. Enter the site name.

3. Samplers. Sign the name(s) of the sampler(s).

4. Sample number(s). Enter the sample number for each sample in the shipment. This number appears on the sample identification label.

5. Date. Enter a 6-digit number indicating the day, month, and year (MMDDYY) that each sample was collected.

6. Time. Enter a 4-digit number indicating the time of collection of each sample based on the 24-hour clock: for example, 1354.

7. Sample matrix. Enter the matrix (e.g., soil, aqueous, drum waste, etc.) of the sample.

8. Parameters for analysis. Enter the analyses to be performed for each sample.

9. Number of containers. For each sample number, enter the number of sample bottles that are contained in the shipment by parameter for analysis.

10. Remarks. Enter any appropriate remarks.

B3.4. Sample Shipment

Custody of samples must be maintained through the shipment of samples to the selected laboratory. All samples will be packaged and delivered so that the samples are not held at the site more than 6 hours. Samples will be delivered directly to the laboratory by sampling personnel or courier to ensure the 6-hour holding time for micro-biological samples is complied with. The samples will be packaged using the following procedures.

- Use waterproof high-strength plastic ice chests or coolers only.

- After filling out the pertinent information on the sample label and tag, put the sample in the bottle or vial and screw on the lid.

- Tape cooler drain shut.

- Place inert cushioning material such as bubble wrap will be placed in the bottom of the cooler. Styrofoam packing cannot be used when sampling for volatile organics.

- Enclose the bottles in clear plastic bags through which sample labels are visible, and seal the bag. Bottles are to be placed upright in the cooler in such a way that they

do not touch and will not touch during shipment. Place cushioning material around the bottles.

- Enclose temperature blank in each cooler.
- Additional inert packing material will be put in to partially cover sample bottles (more than halfway). Place bags of ice or ice-gel packs around, among, and on top of the sample bottles in a separate plastic bag
- Custody seals will be applied to the front and back of the cooler.
- Tape will be used to secure lids. Wrap the cooler completely with strapping tape at a minimum of two locations. Do not cover any labels.
- Attach completed shipping label to top of the cooler. The shipping label shall have a return address.
- The cooler will be delivered/shipped via courier or directly delivered by Apex personnel to the respective laboratory or laboratory personnel.

Custody forms will be placed in a "ziplock" bag and taped to the inside cover of the shipping cooler.

B3.5. Laboratory Custody Procedures

When the sample arrives at the laboratory following shipment, the custodian receives the sample. The label will be identified upon receipt by the laboratory and cross-referenced to the -chain-of-custody record. Any inconsistencies will be noted on the custody record. Laboratory personnel will notify the Project Manager immediately if any inconsistencies exist in the paper work associated with the samples.

Laboratory personnel, following laboratory protocols, will maintain custody of the samples throughout analysis. The laboratory custody procedures are detailed in the LQAM.

B3.6. Documentation and Tracking Deficiencies

Complete documentation of sample custody and shipment will be performed. Copies of chain-of-custody forms and field documentation notes are to be kept on file by the Project Manager. Mode of shipment, air-bill numbers, dates and times of all sample shipments will also be documented. Any deficiencies (including coolers lost by the shipper) requiring corrective actions will be reported to the Project Manager, who will document the problem and respond with corrective action after consultation with the QA/QC Manager. Corrective action may include resampling where the tracking deficiency resulted in exceeding sample holding times, etc. Additional information regarding nonconformance is presented in Section C2.1. Laboratory procedures for responding to deficiencies and the resultant corrective actions are discussed in further detail in the LQAM.

B4. Analytical Methods

Retaw and Apex have selected Microbac Laboratories, Inc. to be responsible for sample analysis. Analytical methods and parameters will be determined on a project-specific basis. A copy of the laboratory's standard operating procedures (SOPs) for common analytical methods will be included in the LQAM. The SOPs will include target analytes, practical quantitation limits, spiking conditions, and precision and accuracy criteria for all matrices.

The contract requires a specific set of analysis be performed on a highly specific schedule.

B5. Quality Control

Apex will ensure that Microbac participates in the annual U.S. Environmental Protection Agency's Discharge Monitoring Report-Quality Assurance Study Program and submit testing results for all parameters. All analytical laboratory instruments should have initial and subsequent daily calibration verified after every set of samples. Quantitative limits should be defined for individual parameters and should be expressed as the lowest calibration standard employed. Values below the quantitative limit should be reported as estimated values. Values below the laboratory method detection limit should be reported as less than the method detection limit. The method detection limit studies, analytical data and results should be on file at the laboratory.

Table 3 – Quality Control

QC Parameter	QC Limit	Frequency
Initial Calibration	(Intentionally blank)	A minimum of 3 concentration levels (or a specified by the method) and after the laboratory control sample, continuing calibration verification or method blank failure
Method blank	Method detection limit	One per set of samples
Lab control sample	85-115%	1 per batch
Continuing Calibration Verification	85-115%	at daily start up, 1 after each 10 determinations, and at the end of the batch
Laboratory Duplicate	20% relative percent difference	One per set of samples
Matrix Spike	75-125%	One per set of samples

Definitions:

- Initial calibration curve: calibration is needed for all analytes for example, calibration standards for ion chromatography, turbidimetric and spectrophotometric tests (correlation coefficient. ≥ .995). Initial calibration criteria must be met prior to analysis of samples.

- Continuing calibration verification (CCV): a verification of calibration is to be performed at the beginning of each analytical batch using a mid-range reference/ standard (as appropriate for method) from a source different from the initial calibration. If CCV is outside of QC limits, recalibrate instrument and rerun samples analyzed since the last compliant continuing calibration check.

- Laboratory control sample (LCS); a mid-level standard/reference (as appropriate for method) carried through the entire analytical procedure as for a sample. If QC criteria are not met for the LCS, determine the source of contamination, and repeat the analysis of the samples, method blank and LCS. The limits must be set for analysis to be acceptable.

- Method Blank: if the method blank is outside of QC limits, determine the source of contamination, and prepare a new blank and re-prepare all samples. Repeat until criteria are met.

- Duplicate: if the relative percent difference is outside of QC limits, flag the data results and report results in the narrative.

- Matrix Spike: If the percent recovery is outside of QC limits, flag the results and report. Spike levels are based on 2 x CRQL

B5.1. Laboratory Quality Control

The analyses shall include the following QC procedures, when applicable:

Table 4 – Laboratory Quality Control

Procedure	Frequency
Calibration	As required
Standards	Daily
Method Blanks	Daily
Duplicates	5 percent
Matrix Spikes	5 percent
Surrogates	Each sample

Duplicate samples, rinsate blanks, and trip blanks will be collected in the field at the rate required for each particular project. Laboratory blanks, standards, and check samples will be run at the rate specified in the appropriate analytical method. Matrix spikes and matrix spike

duplicates will be run at the rate of one per 20 samples or one per batch, whichever is more frequent. Performance evaluation samples will be run at a rate of once per calendar quarter or at a frequency determined by the Project Manager. Internal performance evaluation samples will be run at a frequency determined by the internal laboratory QC staff.

The analytical method performance will be evaluated by an examination of precision, accuracy, and completeness. Analytical data quality assurance objectives are presented in Section A7.2.

Precision is the ability to replicate a value. Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions. The degree of agreement, expressed as the relative percent difference (RPD), is calculated using the formula below.

Precision:

$$RPD = \frac{|V_1 - V_2| \times 100}{\frac{(V_1 + V_2)}{2}}$$

Where:

V_1=value 1
V_2=value 2

Accuracy is a measure of the closeness of an individual measurement to the true or expected value. To determine accuracy, a reference material of known concentration is analyzed or a sample that has been spiked with a known concentration is reanalyzed. Accuracy is expressed as a percent recovery and is calculated using the following formula.

Accuracy:

$$\%recovery = \frac{measured\ \ value}{true\ \ value} \times 100$$

Completeness is a measure of the quantity of valid data acquired from a measurement process compared to the amount expected under the measurement conditions. Completeness is usually expressed as a percentage.

Data reduction is the process by which raw analytical data generated from laboratory instrument systems is converted into usable concentrations. The raw data, which may take the form of area counts, instrument responses or observations, is processed by the laboratory and converted into concentrations expressed in the part per million or part per billion range. Raw data from these systems include compound identifications, concentrations, retention times, and data system printouts. Raw data is usually reported in

graphic form, bar-graph form or tabular form. Data reduction procedures will be explained in greater detail in the LQAM.

Laboratory audit procedures are presented in the LQAM.

B5.3. Field Audits

Field audits are performed by the QA/QC Manager or his designate on a periodic basis (based on project-specific needs) throughout the duration of the field program. The field audits will include an evaluation of sampling methods; sample handling and packaging; equipment use; equipment decontamination, maintenance, and calibration procedures; and -chain-of-custody (COC) procedures. In addition, all records and documentation procedures will be reviewed to ensure compliance with the project requirements. Any deviations from the Work Plan (WP) or Quality Assurance Project Plan (QAPP) will be recorded in the field notebook by the person conducting the audit, which will then inform the personnel involved in the activity of the problem and notify the Project Manager for initiation of any necessary corrective action procedures.

B6. Instrument/Equipment Testing, Inspection, & Maintenance

B6.1. Preventive Maintenance

A preventive maintenance program is necessary to help prevent delays in project schedules, poor output performance, or erroneous results in investigative and/or remedial operations. Qualified personnel will perform preventive maintenance on laboratory analytical equipment used in this program. Maintenance of field equipment will be performed routinely for sampling events. More extensive maintenance will be performed, based on hours of use, by a qualified servicing organization. Repairs, adjustments, and calibrations will be recorded. Records will be available for inspection by the Project Manager on request.

B6.2. Field Equipment

The three elements of the field equipment maintenance program include normal upkeep of equipment, service and repair (when required), and formalized recordkeeping of all work performed on each piece of equipment. This section addresses the normal equipment upkeep element of the maintenance program. For most of the equipment, normal maintenance will consist of cleaning outside surfaces, lubrication of all moving parts, and, if applicable, a battery level check and recharge or replacement as necessary. This program will include the maintenance of all monitoring, measuring, and test equipment returning from field use or any equipment used on a daily basis. The frequency of maintenance checks will be dependent on the individual needs and use of each piece of equipment. Details regarding the required maintenance and operational procedures for the field equipment can be found in the associated manufacturer's handbook or instruction manual. Maintenance procedures will be only those necessary for keeping an instrument in service or to prepare for everyday use. Repair problems will be referred to the manufacturer or other qualified servicing organizations.

The Project Manager or the designated task leader will be responsible for keeping all maintenance records, making sure all equipment used is maintained properly, informing field

team members of any specific maintenance requirements for equipment used at the site, and shipping any instrument in need of repair to the correct source.

The field personnel responsibilities include maintaining each piece of equipment located at the site and the maintenance of equipment after use. A record of equipment maintenance and repair will be kept in the field logbook.

B6.3. Rental Equipment

Rental equipment used on the project will be obtained only from a reliable rental supplier. The equipment will require an equipment test sheet to verify accuracy, maintenance, and upkeep of the equipment. A receipt indicating that the equipment has been checked upon return will be required as well.

B6.4. Laboratory Equipment

An important factor in maintaining accuracy and precision, achieving required holding times, and addressing contract schedule is preventive maintenance. As part of the laboratory's standard operating procedures, service contracts will be held on critical analytical instruments.

B7. Instrument/Equipment Calibration and Frequency

B7.1. Field Calibration Procedures

Measuring and test equipment shall have an initial calibration and shall be recalibrated at scheduled intervals against certified standards that have known and valid traceability to recognized national standards. Calibration intervals for each item shall be, at a minimum, in accordance with manufacturer's recommendations as defined in the equipment manual. Test equipment used for calibration of sensors shall be recalibrated at least once a year or when maintenance or damage indicates a need for recalibration.

Calibration standards shall be maintained and used in an environment with temperature, humidity, and cleanliness controls that are compatible with the accuracy and operating characteristics of the standards. An inspection will be made during the equipment calibration to evaluate the physical condition of the equipment. The purpose of the inspection is to detect any abnormal wear or damage that may affect the operation of the equipment before the next calibration. Equipment found to be out of calibration or in need of maintenance or repair will be identified and removed from service.

The QA/QC Manager shall be notified if the test equipment is found to be out of tolerance during inspection and calibration. The corrective actions to be taken include evaluating the validity of previous inspection or test results; evaluating the acceptability of the items inspected or tested since the last calibration check; and repeating the original inspections or tests using calibrated equipment when it is necessary to establish the acceptability of previous inspections or tests.

Each item of measuring or testing equipment in the calibration program shall be identified in such a way as to show its calibration status and calibration expiration date. Equipment history

records for measurement and test equipment shall be used to indicate calibration status and conditions, corrections to be applied, results of in-service checks, and repair history. This will provide a basis for establishing calibration frequencies and for remedial action if the instrument is found to be out of calibration.

Calibration frequency and procedures for each piece of equipment can be found in the manufacturer's manual.

B7.2. Laboratory Calibration Procedures

Laboratory instrumentation calibration procedures, frequency, and standards will be consistent with the requirements of the applicable analytical method. Additional information on instrumentation calibration procedures and frequency are presented in the LQAM.

B8. Inspection/Acceptance of Supplies and Consumables

The task manager will be responsible for inspecting sample containers before leaving for a dry or wet weather sampling event. The sample containers will be supplied by Microbac and will be inspected for cracks, ill-fitting lids, and other obvious defects before use and will be discarded if defects are found to be present.

The Microbac laboratory analyst assigned to conduct the analysis will be responsible for inspecting equipment and supplies upon receipt.

B9. Non-direct Measurements

No existing data was obtained or provided for this project.

B10. Data Management

B10.1. Data Management Locations

Data for this project will be produced in two locations: in the field and in the laboratory. The field data collection will be recorded on the field data sheets and in the field notebooks. The field data sheets and field notebooks will be submitted to the task manager when field activities are complete and will become part of the project file.

Field book entries will be completed for each day of field activities by the field sampling team and forwarded to the Project Manager. The report includes the weather during sampling, samples taken, instrument maintenance and calibration, and any field changes, problems, or corrective actions. The field books will document the enforcement of the Quality Control program through the field audit program.

All field books, laboratory data reports, and reports will be stored in one central location at Apex's office in Manassas, VA.

C. ASSESSMENT AND OVERSIGHT

C1. Assessment and Response Actions

Planned assessments include routine monitoring of field activities and the verification and validation of all reported data (conducted in accordance with sections D1 and D2). The monitoring of field activities will be conducted by the Project Manager or QA/QC Manager, on-site, at the time(s) when samples are being collected for both field and laboratory analysis and when field analyses are conducted. The purpose of this audit will be to identify any performance deficiencies and to verify conformance with the procedures discussed and referenced in this QAPP. The findings from this audit will be used to plan any follow-up actions needed to ensure resolution of performance deficiencies. The Project Manager or QA/QC Manager will have the authority to stop work on-site if he/she deems the findings from the audit to justify such actions. The Task Manager/Key Personnel, in consultation with the Project Manager, will be responsible for corrective actions relating to field activities.

The narrative report included with each laboratory data report will include a discussion of the quality of the reported laboratory data, which will result from the Microbac Laboratory Director's audit of data quality according to SOP No. QM-001-020 Issue No. 001, "Quality Assurance Manual- Baltimore Division". The Microbac Laboratory Director will be responsible for corrective actions at the laboratory. The Project Manager or QA/QC Manager will review the results from all reported data to verify that it is useable for the purposes of this project, and that it is reasonable when taken with other facts known about the site. Sections D1 and D2 of this QAPP discuss the verification and validation process in detail.

If a particular analysis is deemed "out-of control," corrective action will be taken to ensure continued data quality. Actions that may be taken include, but are not limited to:

- Rechecking calculations
- Checking QC data on other samples
- Auditing laboratory procedures
- Reanalyzing the sample if the holding time requirements have not been exceeded
- Accepting data with the acknowledged level of uncertainty
- Discarding data

The coordinator of the laboratory's analytical section will be responsible for initiating laboratory corrective action when necessary. The laboratory Data Quality Reviewer will make recommendations for corrective actions outside the laboratory to the Apex Project Manager or QA/QC Manager.

C2. Reports to Management

Reports to management will include a DOEE Notifications and a Sampling Report following each successfully sampled qualifying rain event (greater than 0.1" of rain).

Apex will notify the DOEE by email of all attempts (successful or not successful) within 48-hours of the first business day following each attempt to collect samples.

Following successfully sampled rain events, Sampling Reports will be generated by the Project Manager for inclusion in DOEE's project file upon receipt of analytical results. Reports will be submitted no later than 30 days following each sampling event. These reports will include a summary description of sampling activities, field analysis results, a summary of analytical data, and a discussion of any problems encountered and associated corrective actions. Attachments will include field data sheets, Chain-of-Custody documents, precipitation data including hydrographs, and a full copy of the laboratory analytical report.

Field activity reports will be generated by Project Manager within thirty days of the sampling event. Laboratory analytical reports will be generated by Microbac laboratory staff and submitted to the Project Manager after receipt of the samples. Apex will then include the analytical information, in conjunction with the field information, in a Sampling Report to DOEE. Any significant QA problems encountered in the laboratory or in the field, as deemed by Microbac or the QA/QC Manager will be reported immediately to the Project Manager via telephone.

C2.1. Nonconformance Reporting

A nonconformance is defined as an identified or suspected deficiency in an approved document (e.g., technical report, analysis, calculation, computer program); or a deficiency in an item where the quality of the end item itself or subsequent activities using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with the established plans or procedures.

Any team member (including laboratory team members) engaged in project work that discovers or suspects a nonconformance is responsible for initiating a nonconformance report. This team member shall obtain a nonconformance report number from the QA/QC Manager. The QA/QC Manager shall evaluate each nonconformance report and shall provide a disposition that describes the actions to be taken.

The Project Manager shall ensure that no further project work dependent on the nonconforming item or activity is performed until approval is obtained and the nonconformance report is closed out. If the nonconformance is related to material, the Project Manager shall be responsible for marking or identifying, with the nonconformance report number, the nonconforming item (if practical), and indicating that it is nonconforming and is not to be used.

A copy of each closed nonconformance report shall be included in the quality assurance file. The QA/QC Manager shall maintain copies of all nonconformances.

D. DATA REVIEW AND USABILITY

D1. Data Review, Verification, and Validation

Data will be accepted if they meet the following criteria:

1. Field data sheets are complete and signed.
2. Field data and laboratory data were validated.
3. Actual sample locations and collection procedures match the proposed sample locations and collection procedures identified in sections A6 and B1.1.1, respectively.
4. Sample handling procedures are documented on COC forms.
5. Field book narrative matches the proposed sample handling procedures identified in sections B2 and B3 (e.g., samples properly preserved, microbiological holding time of six hours not exceeded).
6. Field QC was conducted as outlined and meets the acceptance criteria in section B5 (field equipment was calibrated daily, field duplicate sample results within 5%, field rinsate blank indicated no cross-contamination).

Any deviations from the QAPP must be reported in the field book or analytical data report. The analytical data report will include the information described in section A9. The DOEE Water Quality Division Contract Administrator will verify the content of these reports.

If the data fails to meet the criteria, they will be flagged by the Project Manager as estimated values. Any flagged data will be discussed with the project team and DOEE Water Quality Division to determine if the data point will be rejected and re-sampling done.

D2. Verification and Validation Methods

The Project Manager will validate the field data and any problems identified during this process will be reported to the Project Manager in field book activity reports.

The Microbac Laboratory Director will validate the laboratory data according to SOP No. QM-001-020 Issue No. 001, “Quality Assurance Manual- Baltimore Division”. Any problems identified during this process will be reported to Apex Companies, LLC Project Manager in the analytical data report.

The Project Manager or QA/QC Manager will review and verify the field sheets, field book activity reports, and the analytical data report. Any problems or deviations identified will be discussed with the project team.

D3. Reconciliation with User Requirements

The laboratory shall review data prior to its release. Objectives for review are in accordance with the QA/QC objectives stated earlier in this document. The laboratory is required to evaluate their ability to meet these objectives. Outlying data shall be flagged in accordance with laboratory SOPs and

corrective action shall take place to rectify the problem. Laboratory review SOPs will be found in the LQAM.

Under the National Pollutant Discharge Elimination System (NPDES) program, the laboratory is required to participate in the annual Discharge Monitoring Report–Quality Assurance (DMR-QA) study program. DMR-QA evaluates the analytical ability of the laboratories that routinely perform self-monitoring analyses required by their NPDES permit. Microbac Laboratory will participate in this annual study.

The quality assurance (QA) laboratory will deliver the sample results and data package, which will be reviewed by the QA/QC Manager. The data reviewed will include all blank, sample, and internal quality control results such as spike and surrogate recoveries and replicate analyses. Any significant differences or problems discovered will be addressed; corrective action, such as reanalysis and/or resampling, may result at the Project Manager's discretion.

The sample event report will be submitted within 30 days of the actual sampling event and based on actual analytical results receipts from the Microbac laboratory. The results of the field parameters tested during the sampling event, field data collection sheet, site narrative report of the event and sampling locations where the actual storm water samples collected, site photographs and meteorological data predicting the storm-water event, signed chain-of-custody forms and the laboratory analytical results of analyzed samples will be included in the sample event report. Two hard copies of the report and an electronic report copy will be submitted for each event report to DC DOEE. The electronic environmental measurement data will be submitted in a format specified by the Contract Administrator.

Appendix 1

(Laboratory Quality Assurance Manual)

MICROBAC®

Quality Manual

Corporate Headquarters
One Allegheny Square, Suite 400
Pittsburgh, PA 15212
412.459.1060 p
866.515.4668 f

www.microbac.com

Table of Contents

Section 2: References

2.1 References

The following is a list of primary sources for obtaining analytical methods. This list is not all-inclusive.

Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136 (Federal Water Pollution Control Act Amendments of 1972 as amended by the Clean Water Act of 1977) as most recently published in the Federal Register.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, Revised March 1983.

Methods for the Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, USEPA, Office of Research and Development, Environmental Monitoring and Support Laboratory, July 1982.

Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88/039, USEPA, Office of Research and Development, Environmental Monitoring Systems Laboratory, Revised July 1991 and supplements.

Test Methods for Evaluating Solid Wastes, SW-846, Fifth Edition and earlier editions, USEPA, Office of Solid Waste and Emergency Response, November 1986 and updates.

Standard Methods for the Examination of Water and Wastewater, on-line version and earlier editions.

Annual Book of ASTM Standards, current editions, American Society for Testing and Materials (ASTM), Philadelphia, PA.

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA-600/4-89-017, ORD, Atmospheric Research and Exposure Assessment Laboratory, June 1988.

Methods for the Determination of Metals in Environmental Samples, Supplement I, EPA-600/R-94/111, USEPA, Office of Research and Development, May 1994.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, USEPA, Office of Research and Development, August 1993.

Official Methods of Analysis, AOAC, 18th edition and earlier editions.

Compendium of Methods for the Microbiological Examination of Foods, APHA, current edition.

Standard Methods for the Examination of Dairy Products, APHA, current edition.

Bacteriological Analytical Manual, FDA, online version.

Microbiology Laboratory Guidebook, USDA/FSIS, 3rd ed., online version.

The United States Pharmacopoeia/The National Formulary, United States Pharmacopoeia Convention, Inc., Rockville, MD.

2.2 Other Documents Used in QA Manual Preparation

ISO/IEC 17025: 2005, General requirements for the competence of testing and calibration laboratories.

2009 TNI Environmental Laboratory Sector Standard – Vol 1 - Management and Technical Requirements for Laboratories Performing Environmental Analysis.

Guidelines for Laboratories Performing Microbiological and Chemical Analyses of Food and Pharmaceuticals, an Aid to Interpretation of ISO/IEC 17025, AOAC International, 2015.

Manual for the Certification of Laboratories Analyzing Drinking Water, 5th edition, EPA 815-B-97-001, USEPA Office of Groundwater and Drinking Water, March 2005.

Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-01, March 1979.

Quality Assurance Principles for Analytical Laboratories, 3rd ed., AOAC International, 2000.

Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1 Department of Defense (DoD), 2016.

Good Laboratory Practice for Non-Clinical Laboratory Studies, 21 CFR Part 58

Current Good Manufacturing Practices in Manufacturing, Packing or Holding Human Food, 21 CFR Part 110

Current Good Manufacturing Practices in Manufacturing, Packing or Holding Operations for Dietary Supplements, 21 CFR Part 111

Good Laboratory Practice Standards for FIFRA, 40 CFR Part 160

Current Good Manufacturing Practices., 21 CFR Parts 210. 211 and 820.

Section 3: Introduction

3.1 General

Microbac laboratories are located across many states which often differ in both regulatory and laboratory accreditation requirements. This Quality Manual is not intended to supersede regulatory requirements. Where state regulatory and/or laboratory accreditation bodies provide additional requirements, those will be followed and/or contained either in a laboratory work instruction or in an appendix to this Quality Manual.

Quality control terms are generally defined within the Section that describes the activity. Other definitions can be found in Q-024, Quality Glossary and Acronyms

3.2 Purpose

This Quality Manual contains all the requirements that our laboratories use to demonstrate our quality management system, technical competence, and valid results.

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratories.

In addition, this Quality Manual outlines how we meet:

- ISO/IEC 17025:2005
- AOAC INTERNATIONAL Guidelines for Laboratories Performing Microbiological and Chemical Analyses of Food and Pharmaceuticals.
- TNI Standard and/or Department of Defense, QSM
- State certification and accreditation standards
- GxP Regulations

It is the responsibility of each laboratory identified in Appendix A to carry out its testing and calibration activities in accordance with the requirements and this Quality Manual. All personnel take an active role in establishing, implementing and maintaining our quality management program. We do not separate quality from our daily business. Quality cannot be something that we do just to pass audits. Quality is integrated into every facet of the decision-making process in the management of our laboratories and the science we practice.

3.3 Distribution

This Quality Manual is maintained on the Company SharePoint site.

Revision History

Section 3, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

Section 4: Management Requirements

4.1 Organization

4.1.1 Legal Identification/Registration

Microbac Laboratories, Inc.
One Allegheny Square, Suite 400
Pittsburgh, PA 15212
Phone: 412.459.1060
Fax: 866.515.4668
Web: www.microbac.com

Location specific information is listed in Appendix A.

4.1.2 Laboratory Requirements

The Divisions of Microbac Laboratories, Inc. have been organized to satisfy the needs of the client and regulatory authorities (as shown in Appendix B by laboratory location) and to also meet the standards and regulations listed in Section 3.2 of this manual.

4.1.3 Scope of Management System

The management system covers activities in the laboratory's permanent facilities, satellite facilities, and temporary mobile facilities. The fields of activities include:

Potable and Non-Potable Water
Solid and Hazardous Waste
Food Microbiological and Chemical Analysis
Pharmaceutical Products
Tobacco Testing
Dietary Supplements Analysis
Sanitizer Efficacy Studies
Mechanical Testing
Fuel Analysis
Air Testing
Product Testing
Clinical Testing
Viral Clearance

4.1.4 Potential Conflicts of Interest

Not applicable. Each laboratory is a standalone testing entity that provides independent testing services. All laboratories are wholly owned by a corporation based in Pennsylvania.

4.1.5 Organization

A. Management and Technical Personnel

Policy:
The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas including the implementation, maintenance and improvement of the management system.

Details:
Responsibilities are detailed in 4.1.5 (F).

Departures from the organizational and management policies in this manual can only be approved by the Microbac senior management and Quality Manager.

Departures from quality management system procedures can only be approved by the Quality Manager.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Technical Manager and Quality Manager. (See also section 4.9.1).

Departures from protocols can only be approved by the GLP study director.

Departures from clinical protocols are approved by Principle Investigator, Sponsor and Institutional Review Board (IRB) and regulatory authorities.

B. Undue Pressure

Policy:
Microbac is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data.

Details:
Microbac's Ethics and Data Integrity program includes:

- documented data integrity procedures authorized by Microbac senior management and reviewed annually
- an Ethics and Data Integrity Policy signed by all management and staff on hire. This policy is approved, dated and distributed by the Chief Executive Officer.
- annual ethics and data integrity training for all staff
- procedures for confidential reporting of alleged data integrity issues
- an audit program that monitors data integrity and procedures for handling data integrity investigations and client notifications

The following topics and activities are covered in initial training:

- organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
- how and when to report data integrity issues

- record keeping
- training, including discussion regarding all data integrity procedures
- data integrity training documentation
- in-depth data monitoring and data integrity procedure documentation
- specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal. Annually all employees are required to sign conflict of interest statements. For additional information, please see HR-011, Conflict of Interest.

Confidential reporting of data integrity issues is provided through Microbac's Open Door Policy where employees can report possible violations of the Ethics and Data Integrity Policy, anonymously, without the fear of reprisal. Employees can email their concern to opendoor@microbac.com which goes only to the Company's Ethics Compliance Officer.

All investigations resulting from data integrity issues are conducted confidentially. Documentation of the investigation is maintained by Corporate Quality. If the investigation identifies an ethical concern, corporate quality advises the laboratory management of the need for any further detailed investigation.

C. Client Confidentiality

Policy:

It is the policy of our laboratory to protect the confidential information and proprietary rights of our client including the electronic storage and transmission of results.

Details and Procedures:

All employees sign an Employee Confidentiality Agreement. The signed agreement is retained in each employee's personnel file.

Test results are only released to the client. Release to someone other than the client requires the express permission of the client, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the client requires the permission of Corporate Counsel. Refer to SOP# Q-009 Confidentiality of Client Data.

D. Operational Integrity

Policy:

The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:

To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through check sample programs. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational

integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E. Organizational Structure

Policy:

The organization and management structure of the Microbac Laboratories, Inc. and the relationships between management, technical operations, support services, and the quality management system is presented in the current Microbac Laboratories, Inc. Organization Chart. Refer to Appendix C

Details

Both corporate and laboratory organizational charts are available with this manual as a reference record and is considered the official record on the date it is marked.

F. Responsibility and Authority

Depending on the size, complexity, and needs of individual laboratories, some personnel may perform multiple functions. In addition, certain roles may be split among multiple people. The laboratory must define these circumstances. All personnel have the responsibility to inform laboratory management of any departures from the management system and test procedures in addition to any actions that can be taken to prevent or minimize such departures.

President

- Develops primary goals, operating plans, policies, and short and long range objectives for the Company.
- Directs and coordinates activities to achieve profit and return on capital.
- Establishes organizational structure; delegates authority to subordinates.
- Leads the Company towards objectives, meets with and advises other executives, and reviews results of business operations.
- Determines action plans to meet the needs of stakeholders.
- Represents organization to major clients, government agencies, shareholders, and the public.

Corporate Quality

- Develops and maintains corporate policies and procedures for the Company.
- Maintains Company Master Document List
- Supports implementation of management system companywide.
- Provides training tools for laboratories related to management system.
- Facilitates internal audit system.
- Assists laboratories with accreditation efforts.
- Develops and facilitates tabulation of company quality benchmarks.
- Reviews quality manual annually to maintain its currency.

Managing Director/Division Manager

- Responsible for the quality, safety, financial, technical, human resource and service performance of the laboratory
- Interface with Corporate management regarding administrative policy, capital expenditures and business planning.

- Ensures that personnel are free from any commercial, financial and other undue pressures that might adversely affect the quality of their work
- Develops primary goals, operating plans, policies, and short and long range objectives for the laboratory.
- Directs and coordinates activities to achieve profit and return on capital.
- Establishes organizational structure and delegates authority to subordinates within the Guidelines established by Corporate and this document.
- Provides the necessary resources (personnel, equipment) to implement and maintain an effective quality and data integrity program.
- Leads the laboratory towards objectives, meets with and advises other executives, and reviews results of business operations
- Determines action plans to meet the needs of stakeholders
- Represents organization to major clients, government agencies, shareholders, and the public

Technical Manager

- Ensures that the laboratory complies with ISO 17025, TNI Standard, AOAC Guidelines, and/or DoD QSM as appropriate for their location.
- Is/are knowledgeable of the scope of all processes under their supervision
- Makes recommendations to management related to required resources necessary to ensure confidence in the laboratory's results
- Ensures equipment is maintained and calibrated, reporting all deficiencies (e.g., equipment malfunctions) in the appropriate manner
- Ensures personnel are trained for the duties they perform - includes substitutes when regular personnel are absent
- Ensures appropriate corrective actions are taken to address analyses identified as requiring such actions by external, internal or procedural audits
- Maintains current employee job descriptions for their area of responsibility
- Maintains records and manages all aspects of testing activities

Quality Manager

- Ensures that the Quality Management System is established, implemented and maintained in accordance with the ISO 17025, TNI Standard, AOAC Guidelines, GxP, and/or DoD QSM as appropriate for their location.
- Serves as the focal point for QA/QC; has a general knowledge of the analytical methods for which data review is performed and is responsible for the oversight and/or review of quality control data.
- Functions independently from laboratory operations for which they have oversight being able to evaluate data objectively and perform assessments without outside influence
- Manages the internal audit program including in-depth data monitoring.
- Coordinates laboratory accreditation activities
- Maintains a master list of current versions of local quality documentation; handles the distribution locally maintained documents.
- Trains personnel on Quality Management System activities
- Monitors the Quality Management System
- Reports on the performance of the Quality Management System to senior management for review and as a basis for improvement of the Quality Management System
- Supervises the laboratory's proficiency testing program
- Notifies laboratory management of deficiencies in the quality system
- Monitors corrective actions
- For GxP laboratories:

- Maintains a Master Schedule
- Monitors and inspects GLP studies
- Monitors laboratory for compliance with regulations
- Issues QA Report
- Reviews Final Report
- Record retention

Supervisors and Group Leaders

- Implements company policies, procedures and practices within their respective groups.
- Responds to client inquiries and provides professional advice
- Provides technical leadership within their discipline.
- Recommends need for personnel; approves new hires
- Orientates new personnel
- Determines technical training needs of personnel
- Conducts employee performance reviews
- Schedules vacation and coverage
- Ensures that all health and safety regulations are followed
- Prioritizes workload
- Facilitates operational concerns in their area
- Ensures accurate and consistent testing procedures through the validation of all current procedures and by developing, validating and implementing new procedures
- Coordinates purchasing requests
- Ensures that the operational needs are within budget and advising management of any discrepancies
- Controls and improves work group processes.

Analysts and Technicians

- Maintains records of all quality activities as required in SOPs and test methods
- Handles samples and perform analyses according to SOPs and test methods
- Writes SOPs and test methods
- Signs reports when designated with signing authority
- Maintains and calibrates equipment
- Reports deficiencies or malfunctions to the supervisor
- Identifies and records nonconformities in the Conformance Management System (CMS)
- Identifies and records potential nonconformities in the CMS.
- Corrects nonconformities and potential nonconformities
- Improves laboratory and/or quality activities on a continuous basis

Sample Administration and Project Managers

- Performs work functions and keeps records as per approved SOPs and/or laboratory policies
- Determines scope and schedule for each job in new work review, as assigned
- Accepts work with a typical scope (i.e., standard turnaround, testing, matrices and reporting).
- Reviews sample log-in.
- Prepares, reviews and signs reports, as assigned; approves client invoices
- Coordinates technical needs of the client
- Identifies and records nonconformities in the Conformance Management System (CMS)
- Corrects nonconformities and potential nonconformities
- Improves laboratory and/or quality activities on a continuous basis
- Represents the laboratory to the client

Logistics Support Personnel

- Fill bottle orders for sample containers.
- Pick-up samples from local clients and pick-up locations.
- Process sample receipt and log-in accurately and in a timely manner
- Store samples and maintain sample storage areas
- Coordinate the receipt of materials with the laboratory staff

G. Laboratory Supervision

Policy:

Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:

Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. A thorough orientation and training program is adhered to for all new employees. Ongoing training for regular personnel is required.

H. Technical Management

Policy:

A Technical Manager is assigned for each major department of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality of laboratory operations.

Details:

Technical Managers monitor standards of performance in quality control and quality assurance, as well as the validity of the analyses performed and the reporting of results. While the Technical Manager may at times delegate duties to other personnel, the Technical Manager is accountable for any nonconforming activities.

I. Quality Manager

Policy:

The Quality Manager is approved through Corporate Quality and appointed by the Managing Director. The Quality Manager has documented training and/or experience in QA/QC procedures and in the laboratory's quality management system. The Quality Manager, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Manager reports directly to corporate quality and has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Note: Where staffing is limited, the quality manager may also be the technical manager.

Details:

This statement notifies all laboratory personnel that the following personnel in Appendix D are the Quality Managers as assigned by the table and authorized below by the Vice President of Quality. Any change in this position requires the reissue of this appendix to all holders of controlled copies of the Quality Manual. The following signature also serves as approval for this Quality Manual

and affirms senior management's commitment to the policies and procedures set forth in this manual.

Bradley A. Stawick
Vice President, Quality

J. Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel's duties in their absence.

Details:
Each laboratory must define their key roles and assign deputies. This information will be approved by the local senior management and local Quality Manager and filed on SharePoint in the laboratory's "Deputy" folder maintained in the laboratory's Quality Manual Appendix Training and qualifications for deputies shall be documented and filed in the training files.

Laboratory management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments due to employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. If sufficient human resources are not available, management will identify the best possible solution to meet operational and quality requirements.

Accrediting bodies require notification of changes in personnel for key roles. The Quality Manager is responsible for complying with the schedule for these notifications to meet the laboratory's accreditation requirements.

K. Awareness

Policy:
Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee's job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy and Details:
Senior management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

Revision History:
Section 4.1, Rev 0: Effective 03.31.16
Section 4.1, Rev 1: Effective 04.01.17
Changed corporate office address; 4.1.5 -A-added authorities for departures for protocols and clinical protocols; B-authority for EDI policy is now CEO; C-Corporate Counsel permission required for release of test results to someone without client authorization; E- added corporate organization chart, removed reference to Microbac Leadership structure memo; F- added responsibility to implement appropriate quality standards including ISO17025 to Technical Manager; added responsibility of implementing company policies and practices within their departments and to provide technical leadership to Supervisors; removed reference to Study Directors and Principle Investigators for GxP from sample administration section; updated samples administrative responsibilities and added section on logistics personnel; J- state that Deputy folder is kept in laboratories' Quality Manual appendix.

Approved by:

Bradley A. Stawick
Vice President, Quality

4.2 Management Systems

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services satisfy the client's requirements and have been designed, performed, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by client complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the Quality Manager.

This Quality Manual and associated documents (including procedures) and records serve as the quality plan for the laboratory. Other documents and records include:

- standard operating procedures
- quality control plans in test methods
- organizational charts
- proposals
- project management schemes
- protocols
- sampling plans

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement, and endorsed by all management, and reviewed during management review.

Quality Policy Statement:
To ensure accurate and timely testing services and to continuously meet or exceed the stated or implied expectations of our clients through day-to-day interactions.

a) ***Management commitment to good professional and ethical practice and quality of services provided to the client***: tests and calibrations are always carried out in accordance with stated standardized methods and clients' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected.

b) ***Standards of service** include*:
- client satisfaction
- accuracy
- timeliness

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) ***Purpose of management system related to quality***: to manage our business by meeting the needs of our clients.

d) ***Personnel***: familiarize themselves with quality documentation and implement the policies and procedures in their work.

e) ***Management is committed to complying with ISO 17025, TNI Standard, GxP, DoD QMS, and AOAC Food Program requirements as defined in Appendix B and to continually improve the effectiveness of the management system***: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and locked into the management system.

Additional objectives include:
- to establish the level of the laboratory's performance
- to make test method changes to improve performance
- to participate in proficiency testing or quality evaluation programs with peer laboratories
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests

4.2.3 Commitment to the Management System

Policy:
Microbac management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (section 4.15) and continual improvements are made as outlined in section 4.10.

4.2.4 Communication of Requirements

Policy:
Microbac management communicates to the organization the importance of meeting client requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting requirements. Meeting client requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory

requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet client needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual references supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:

I. Quality Manual
II. Standard Operating Procedures and Test Methods
III. Records

Sections of this manual are updated by making a change to the section and then increasing the section revision number by one. The Table of Contents and the company master document list are also updated.

Laboratory specific appendices to this manual are approved by the laboratory's Managing Director and Vice President, Quality. These appendices include documents that supplement the Quality Manual to address additional requirements and information that are facility-specific.

Quality Project Plans may be prepared on a client specific basis. These Quality plans supplement the general requirements as stated in this Manual and associated documents as necessary to comply with client project requirements.

The documents referenced above written in English and are controlled documents.

The following records and directive documents are referenced in the Quality Manual, but maintained separately:

- laboratory's scope of tests (section 4.1.3)
- confidentiality agreements (section 4.1.5 C)
- organizational chart(s) (section 4.1.5.E)
- copies of the Quality Policy Statement posted in the laboratory (section 4.2.2)
- master document list (section 4.3.2)
- contract review (section 4.4.2)
- procurement and subcontracting records (sections 4.6 and 4.5.4)
- client complaint records (section 4.8.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- audit schedule and records (section 4.14.3)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- training records (section 5.2.5)
- facility floor plan (section 5.3.1)
- quality control plan / criteria for workmanship (section 5.4.1)
- validation of test methods (section 5.4.5)

- equipment inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory's approved signatures (section 5.10.2)
- concurrence statement (environmental laboratories only, see appendix L)

4.2.6 Technical Management and the Quality Manager

The roles and responsibilities for technical management and the Quality Manager are outlined in section 4.1.5 (F) of this manual.

Technical management ensures that section 5 of this manual is implemented and maintained. The Quality Manager ensures that section 4 of this manual is implemented and maintained.

4.2.7 Maintenance

Policy and Details:
Corporate Quality ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

Revision History
Section 4.2, Rev 0: Effective 03.31.16
Section 4.2, Rev 1: Effective 04.01.17
Section(s): 4.2.1: added protocols to details section; 4.2.5: added approval of laboratory appendices; replaced "modify" with "supplement" in discussion of quality project plans; added location of quality manual concurrence statements in Appendix L.

Approved By:

Bradley A. Stawick
Vice President, Quality

4.3 Document Control

4.3.1 Policies and Procedures

Policy:
SOP# Q-010 describes the process used to control quality management system documents (internally generated and from external sources). These include documents of external origin, such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, calibration tables, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled by Corporate Quality include:
- Quality Manual
- Standard Operating Procedures and corporate issued test methods
- Standards (See 3.2)

Note: Laboratory issued SOPs approved prior to January 1, 2017 are controlled locally until they are revised.

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.2 Document Approval and Issue

A. Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list identifying the current revision status and distribution of documents in the quality management system is readily available to preclude the use of invalid and/or obsolete documents (see SOP# Q-010). A revision history of documents is also maintained.

Documents, except for the Quality Manual, are formally reviewed to ensure their continuing suitability on a biennial basis except where programs or regulations dictate a more frequent review. The Quality Manual is reviewed annually. Refer to Q-010 for examples of programs that require more frequent review.

B. Availability and Obsolete Documents

Policy and Details:
The master list shows the status of all controlled documents. The master list document is organized with the following information:
- Document #

- Title
- Revision #
- Effective Date
- Date of last review
- Locations

Controlled documents are approved before issue.

SOP# Q-010 for document control ensures that:

- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are either suitably marked (i.e., stamped "OBSOLETE" and dated) or moved to an archived directory.

Where applicable, obsolete documents will be stored in an archive as historical documents according to 21 CFR Part 58, Retention of Records.

C. Identification

Policy and Details:

All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., approval signature)

4.3.3 Document Changes

A. Review / Approval

Policy:

Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review. The designated personnel have access to pertinent background information upon which to base their review and approval.

Details:

Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by Corporate Quality. Records are kept of this review.

Unless otherwise required by a specific program or regulation, test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# Q-010.

Obsolete documents are withdrawn, but a copy is retained for archive purposes and clearly labeled as “obsolete” and archived.

B. Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# Q-010. In general, changes are identified in the document revision history section.

C. Amendments by Hand

Policy and Details:
Hand-written amendments to documents are not permitted.

D. Computerized Documents

Policy and Details:
SOP# Q-010 details how changes in documents maintained in computerized systems are made and controlled.

Revision History
Section 4.3, Rev 0: Effective 03.31.16
Section 4.3, Rev 1: Effective 04.01.17
Sections: 4.3.1: Added laboratory-issued SOPs approved prior to 01.01.17 are controlled locally until they are revised; 4.3.2.A: Added reference to Q-010 for example of programs where document review requirements supersede the biennial review; deleted specific program references from this section. 4.3.2.B: Added reference to 21 CFR, Part 58 for storage of obsolete documents in archive; will mark documents “obsolete” instead of “archived”; 4.3.3.A: Annual Quality Manual review is corporate responsibility.

Approved By:

Bradley A. Stawick
Vice President, Quality

4.4 Review of Requests, Tenders, and Contracts

4.4.1 Policies and Procedures

Policy:

SOP# Q-011 is used to review requests, tenders, or contracts. This procedure ensures that:

a) the client requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the capability and resources to meet the requirements
c) the appropriate test method is selected and capable of meeting the client's requirements (see section 5.4.2)

Any differences between the request or tender and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the client.

Details:

The request, tender and contract review is conducted in a practical and efficient manner, and the effect of financial, legal, and time schedule aspects are considered. Internal client review of requests, tenders, and contracts are performed in a simplified manner.

The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value to determine uncertainties of measurement, limits of detection, and confidence limits.

The contract review ensures that each client's requirements are adequately defined and documented before the services are provided. This should ensure that any order, once accepted, can be completed without delay, and that the client's requirements including delivery date, technical specification, and cost can be met.

If the contract review highlights any ambiguities or uncertainties, then the client will be contacted and the problem resolved before the order is accepted.

SOP# Q-011 also describes the activities that take place should there be a subsequent amendment to a client's order.

Typical types of contracts include:

- Approved service quotations
- Confidentiality agreements
- Non-disclosure agreements
- Sample submission requests or chains of custody
- Memorandum of agreement
- Memorandum of understanding
- Research proposals and contracts
- Verbal orders (oral agreements)
- Activity plans
- Client specific quality assurance project plans

4.4.2 Records of Review

Policy:
Records of request, tender and contract review, including significant changes, are maintained. Records of pertinent discussions with a client relating to the client's requirements or the work during the period of execution of the contract are also maintained.

Details:
For review of routine and other simple tasks, the date and the identification (e.g., initials) of the person in the laboratory responsible for carrying out the contracted work are considered adequate. For repetitive routine tasks, the review need be made only at the initial enquiry stage or on grant of the contract for on-going routine work performed under a general agreement with the client, if the client's requirements remain unchanged. For new, complex or advanced testing tasks, a more comprehensive record is maintained.

4.4.3 Review of Subcontracted Work

Policy:
Request, tender, and contract review also includes work that is to be subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5.

4.4.4 Notification of Client

Policy and Details:
Clients are informed of deviations from the contract. This is typically communicated to the client prior to the performing the deviation.

4.4.5 Contract Amendment

Policy and Details:
If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

Revision History
Section 4.4, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

4.5 Subcontracting Tests and Calibrations

4.5.1 Subcontractor Competence

Policy:
Work that must be subcontracted for any reason is subcontracted to a technically competent laboratory. For environmental testing, certain states require certification from the same state when subcontracting occurs.

Details:
The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis
- audit of the subcontractor's quality management system by our auditors

It is the responsibility of the Quality Manager to assess and approve the competence level of subcontractor laboratories.

4.5.2 Client Approval

Policy:
Clients are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing).

Details:
Clients are advised of subcontracted work through fee schedules or any type of contract listed in section 4.4.1.

Subcontracted work is identified on the final report.

4.5.3 Assurance of Subcontractor Competence

Policy:
The laboratory is responsible to the client for the subcontractor's work. Technical competence of subcontractor laboratories is demonstrated through various records.

> **Note** – there may be circumstances where the client specifies which subcontractor is to be used. In such cases, we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence may include, but are not limited to, the following:

- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Manager

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests and calibrations is maintained.

Details:
The approved register of subcontractors and all assessment records are maintained by the Quality Manager.

Revision History
Section 4.5, Rev 0: Effective 03.31.16
Approved By:

Bradley A Stawick
Vice President, Quality

4.6 Purchasing Services and Supplies

4.6.1 Policies and Procedures

Policy:
The laboratory ensures that purchased supplies and services that affect the quality of tests are of the required or specified quality, by using approved suppliers and products.

Details:
SOP# Q-012 is used for purchasing, receiving, and storage of supplies that affect the quality of testing. Consumable materials are stored according to the appropriate test method, SOP, work instruction or manufacturer's specifications.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the purchase order and/or ordering database if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are maintained on file after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where needed. Uncertified chemicals are purchased from ISO 9000 registered companies. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any precautions to be observed in its preparation or use.

Suppliers of calibration services and reference standards must be ISO 17025 accredited. Suppliers of reference materials must be ISO 17034 and/or Guide 34 accredited, if available and practical for A2LA accreditation only.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the purchase order or in an ordering database containing data describing the product ordered and/or requested services. The purchase order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the purchase order is the responsibility of the purchasing individual. They review the purchase order for accuracy and approve the technical content prior to release with their signature and the date.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services and supplies are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services and supplies prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by the laboratory.

Once a supplier is approved, it is reevaluated biennially per the criteria listed above along with service and performance to the laboratory. This review is recorded and the approved supplier list updated.

Revision History
Section 4.6, Rev 0: Effective 03.31.16
Section 4.6, Rev 1: Effective 04.01.17
Section(s): 4.6.2 & 4.6.3: Added reference to ordering databases; 4.6.4: Added supplies to the policy and details; changed review of approved suppliers from “biannually” to “biennially.”

Approved by:

Bradley A. Stawick
Vice President, Quality

4.7 Service to the Client

4.7.1 Service

Policy:
Client requests are clarified for the clients or their representatives. Furthermore, the client or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, if the laboratory ensures confidentiality to other clients.

Details and Procedures:
Service to the client includes:

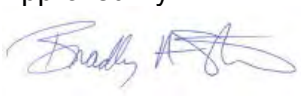
- Affording the client or the client's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the client; it is understood that such access should not conflict with rules of confidentiality of work for other clients or with safety.
- Preparing, packaging, and dispatching of test items needed by the client for verification purposes.
- Maintaining of open contacts. The client values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the client, especially in large assignments, should be maintained throughout the work. The laboratory should inform the client of any delays or major deviations in the performance of the tests.
- GxP laboratories permit an authorized employee or duly designated representative of EPA or FDA, to inspect the facility and to inspect (and in the case of records also to copy) all records and specimens required to be maintained regarding studies. The records inspection and copying requirements should not apply to quality assurance unit records of findings and problems, or to the action recommended and taken, except that EPA or FDA may seek production of these records in litigation or formal adjudicatory hearings.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the client. Positive and negative feedback can be obtained passively through ongoing communications with the client (e.g., review of test reports with clients) or actively through client satisfaction surveys. The corporate office requests feedback from clients annually by way of an online survey. The feedback is used to improve the quality management system, testing activities, and client service.

Revision History
Section 4.7, Rev 0: Effective 03.31.16
Section 4.7, Rev 1: Effective 04.01.17
Section(s): 4.7.1: Added discussion of GxP; 4.7.2: Added annual corporate survey.

Approved By:



Bradley A. Stawick
Vice President, Quality

4.8 Complaints

Policy:
SOP# Q-017 describes the process used to handle and resolve complaints received from clients or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- details of the complaint
- investigation
- corrective action
- follow-up verification

See also section 4.11.

All personnel are responsible for recording and responding to complaints.

Revision History
Section 4.8, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

4.9 Control of Nonconforming Testing

4.9.1 Procedures to Control Nonconforming Work

Policy:
SOP# Q-016 is used to control any aspect of testing and/or calibration work, or the results of this work, when they do not conform to the test methods or the agreed requirements of the client.

Details:
The procedure ensures that:

- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the client is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:

- client complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report checking
- management reviews
- internal or external audits

Planned departures will be fully documented by the laboratory Quality Manager and include the reason for the departure, the affected standard operating procedures, the intended results of the departure and the actual results. Planned departures do not require audits or investigations. The corrective action procedure is used for documenting this process. Refer to 4.1.5.A.

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory's operations with its own policies and procedures, the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate this (these) cause(s).

Details:
SOP# Q-008 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:

- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failures related to compliance with support procedures such as sample receipt, procurement or information management necessary to ensure the integrity and representative nature of the sample
- failures or suspected failures in method performance as demonstrated by unacceptable quality control sample and proficiency test sample results
- deficiencies identified by quality audit(s) and client complaints
- deficiencies identified through data validation
- neglect to check the inherent property of the sample that compromises the testing

Revision History

Section 4.9, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

4.10 Improvements

Policy:
The laboratory continually improves the effectiveness of its management system using the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization.

Inputs for improvement opportunities can be obtained but are not limited to the following sources:

- client satisfaction surveys and any other client feedback
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends
- market research and analysis

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:

- improving usefulness of bench space
- reducing excessive handling and storage
- reducing test/calibration failures
- reducing instrument downtime
- eliminating rework

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, client feedback, and test failures) are evaluated by the Technical or Quality Manager. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 5.4 of this manual and appropriate level of quality control is performed on an ongoing basis.

Revision History

Section 4.10, Rev 0: Effective 03.31.16

Bradley A. Stawick
Vice President, Quality

4.11 Corrective Action

4.11.1 General

Policy:
The SOP# Q-008 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions. The procedure includes root cause analysis, selection and implementation of corrective action, and monitoring of actions for effectiveness

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from clients, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded in the CMS system.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem.

Details:
Potential causes of the problem could include client requirements, the samples, sample specifications, methods and procedures, personnel skills and training, consumable materials, or equipment and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:
After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that any corrective actions taken to eliminate the cause(s) of nonconformities or other departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered. Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR, the originator's manager or the Quality Manager. Changes resulting from corrective action are documented. If corrective actions are shown to be ineffective, the investigation is reopened; additional root causes proposed and corrective action implemented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are, whenever resources permit, independent of the activity to be audited. See section 4.14 for more details.

Revision History
Section 4.11, Rev 0: Effective 03.31.16
Section 4.11, Rev 1: Effective 04.01.17
Section 4.11.4: Added proposed corrective actions are found to be ineffective, the investigation is reopened.

Approved By:

Bradley A. Stawick
Vice President, Quality

4.12 Preventive Action

4.12.1 Preventive Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:
Records of preventive action include the following information:

- details of potential nonconformities
- action plan
- preventive action
- follow-up verification

These records are maintained in the CMS system.

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

SOP# Q-008 is utilized to implement opportunities for needed improvement and prevent potential sources of nonconformities.

Revision History
Section 4.12, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

4.13 Control of Records

4.13.1. Procedures

Policy:
The laboratory maintains a record system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required. The SOP# Q-013 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose of quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also maintained.

All records, including test reports, are safely stored in secured areas in confidence to the client, restricted from unauthorized access and locked when appropriate. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval.

GxP laboratories maintain a master index of records.

The dating format for records is MM/DD/YYYY.

4.13.1.2 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention times for records are generally set at five years. Exceptions to this are client and program specific requirements.

Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.1.3 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to stored records is controlled and documented. An access log is kept for records taken from and returned to the storage area. Access to electronic records is secured through password control. Refer to IT-100-1, Password Security Policy.

Access to protected records in our GxP laboratories is secured (locked). The Managing Director assigns a record archivist who monitors day-to-day activities. Only persons authorized by the

record archivist may enter the archive. A log is kept of the material taken and replaced from the archive.

4.13.1.4 Record Backup

Policy:
SOP# Q-013 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.

Details:
Data is password protected.

Electronic backups of records ensure integrity and availability of data / information in the event of a system / power failure.

4.13.2 Technical Records

4.13.2.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five years or for a period specified in program or client requirements.

The records for each test or calibration shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, client's notes, papers and feedback, and test reports to clients.

The records for each test contain sufficient information to permit its repetition. Records may include:

- sampling records (environmental)
- sample receipt
- sample handling, storage, and disposal
- sample preparation
- sample analysis (raw data)
- identification of personnel for all steps of the analysis
- analyst proficiency
- equipment identification and performance
- calibration records
- media and reagent performance, where appropriate
- standards batch # or lot #, where appropriate

- results
- reviews
- reports (including transmissions)

Note - the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

A record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record is maintained.

4.13.2.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded in the designated record and identifiable to the specific job at the time they are made.

Details:
Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.2.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out using a single line and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records include a reason for the change and are signed or initialed and dated by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

Revision History
Section 4.13, Rev 0: Effective 03.31.16
Section 4.13, Rev 1: Effective 04.01.17
Section 4.13.1: Deleted detail for Master List of Records; relocated the information to SOP Q-013; 4.13.1.3: Revised "safely stored and held in secured locked areas" to "restricted from unauthorized access and locked when appropriate."; added use of storage access log; added section on GxP archive; 4.13.2.3: Added need to document reason for all error correction; removed allowance for not recording a reason for transcription errors in non-GxP laboratories.

Approved By:

Bradley A. Stawick
Vice President, Quality

4.14 Internal Audits

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. This program is defined on an annual basis and conducted as outlined in this section with further details found in SOP# Q-014. All elements of this Quality Manual will be audited each year and all relevant laboratory records are available to personnel conducting the audit. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Manager to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits may be performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit.

Generally, the types of audits include:

- quality management system
- processes and procedures
- method, services, and reports
- regulatory compliance

GLP, GCP and cGMP require that the Quality Assurance Unit (QAU) inspect each study at intervals adequate to ensure the integrity of the study. The QAU must maintain written records of each periodic inspection showing the date, the study inspected, the phase or segment, the person performing the inspection, findings and problems, recommended actions and any scheduled re-inspection date. Results from audits (status reports) are reported to test facility management and study director.

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and clients are notified if investigations show that laboratory results may have been affected. For environmental work, if audit findings cast doubt on the validity of test results, clients shall be notified within 72 hours of completing the investigation of the finding and any actions are discharged within the agreed timeframe.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and client modifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations
- audit report distribution

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are maintained.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the CAR is issued.

Revision History
Section 4.14, Rev 0: Effective 03.31.16
Section 4.14, Rev 1: Effective 04.01.17
4.14.1: Added paragraph related to QAU inspections performed in GxP laboratories.

Approved By:

Bradley A. Stawick
Vice President, Quality

4.15 Management Reviews

4.15.1 Review of Quality Management System and Testing

Policy:

Senior management periodically (at least annually) and in accordance with a predetermined schedule and SOP# Q-015, conduct a review of the laboratory's quality management system and testing and/or calibration activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:

The review takes account of:

- suitability of policies and procedures
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from clients, including complaints and client satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:

Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

Revision History

Section 4.15, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

Chapter 5: Technical Requirements

5.1. General

5.1.1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- human factors (see section 5.2)
- accommodation and environmental conditions (see section 5.3)
- test and calibration methods and method validation (see section 5.4)
- equipment (see section 5.5)
- measurement traceability (see section 5.6)
- sampling (see section 5.7)
- handling of test and calibration items (see section 5.8)

5.1.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of equipment.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between (types of) tests and between (types of) calibrations.

See section 5.4.6 for more details.

Revision History
Section 5.1, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

5.2. Personnel

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all specific equipment operators, those performing tests and/or calibrations, those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified based on appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:

- relevant knowledge of the technology used for the manufacturing of the items, materials, products tested, or the way they are used or intended to be used and of the defects or degradation that may occur during or in service
- knowledge of the general requirements expressed in the legislation and standards
- an understanding of the significance of deviations found regarding the normal use of the items, materials, or products concerned

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. In some technical areas, it may be required that the personnel performing certain tasks be certified. The laboratory is responsible for fulfilling specified certification requirements of personnel. The requirements for personnel certification might be regulatory, might be included in the standards for the specific technical field, or required by the client. (NELAP accredited laboratories to reference TNI V1M2 5.2.6)

New employees or employees new to a given task must successfully complete initial demonstration of competence on the portion of the method that they are responsible for prior to working on client samples.

Continued competence is monitored and where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, the verification of personnel performance before they undertake tests may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks of the laboratory. SOP# Q-018 is utilized to identify training needs and providing the necessary training for personnel. The effectiveness of the training actions taken is evaluated.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.4. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency through

observation by trainer and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description.

In some cases, it may be appropriate to define competence related to a technique or instrument rather than methods. If so, it will be necessary to define for each method, the necessary technique-based competence required together with any additional requirements.

5.2.3 Employees

Policy:
Competent permanent or contractual employees are employed in the laboratory. The technical manager ensures that contractual, additional technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Laboratory duties must be either performed or supervised by an appropriately experienced person qualified to perform the task. Personnel must demonstrate competence and have authorization for the task prior to working on client samples.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in tests and/or calibrations are maintained. See section 4.1.5.f. Further detail may be maintained by local management.

Details:
Minimum contents of job descriptions may include:

- the duties required of the position
- the act of planning tests and/or calibrations and evaluation of results
- the responsibility of developing and validating new methods as / when requested
- expertise and experience
- qualifications and training programs
- managerial duties

5.2.5 Authorized Personnel

Policy:
Management authorizes specific personnel to perform sampling, test and/or calibration, to issue test reports, to give opinions and interpretations and to operate equipment. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:

The purpose of these records is to provide evidence that personnel have been adequately trained and their competence to perform tests has been assessed. In some cases, it may be pertinent to state any specific limitations to competence. The records are maintained in the training file and include:

- academic and professional qualifications
- external and internal courses attended
- relevant on-the-job training and retraining as necessary (i.e., demonstration of competence)
- skills and experience (i.e., resume)
- relevant authorizations

Revision History

Section 5.2, Rev 0: Effective 03.31.16
Section 5.2, Rev 1: Effective 04.01.17
Section(s): 5.2.1: Details: Added employees new to a given task must demonstrate competence prior to working on client samples; 5.5.2: replaced “management” with “trainer” when observing analyst competency; 5.2.3: clarified authorization to work on client samples is required; 5.2.4: Added reference to 4.1.5.f and added further detail may be maintained by local management.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.3. Accommodations and Environmental Conditions

5.3.1 Facility

Policy:
Laboratory facilities are appropriate to attain correct performance of tests and/or calibrations. This may include, but not limited to, energy sources, lighting, HVAC and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. Care is taken when sampling, tests and/or calibrations are undertaken at sites other than a permanent laboratory facility. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, HVAC, and sample storage, are appropriate to facilitate proper performance of tests.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Due attention is paid, for example, to biological sterility, dust, air quality, electromagnetic interference, radiation, humidity, electrical supply, temperature, and sound and vibration levels, as appropriate to the technical activities concerned. Testing is stopped when the environmental conditions jeopardize the results of the tests.

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are climate controlled. Airborne microorganisms are controlled by air systems with filters. Verification is done using air sampling devices or air settling plates and surface swabs.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is adequate workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned. Critical work surfaces are monitored for pathogens where pertinent to the scope of the laboratory.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must be segregated, ideally in a separate area from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

An example of space segregation would be for ultra-trace analysis. Physical separation of the ultra-trace analysis from high-level analysis is achieved by separate rooms.

An example of time segregation would be the coordination of activities at different times. It may be appropriate to perform work on "cleaner" samples first before starting "dirtier" type samples.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the tests and/or calibrations is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel. The authorized personnel are made aware of the following items:

- the intended use of the area
- the restrictions imposed on working within such areas
- the reasons for imposing the restrictions

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are prepared when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements. The laboratory must maintain a master cleaning schedule of its facilities.

Revision History
Section 5.3, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick,
Vice President, Quality

5.4. Tests and Calibration Methods and Method Validation

5.4.1 General

Policy:
Methods and procedures used for all tests and/or calibrations are appropriate not only for the tests and or/calibrations, but also support activities such as:

- sampling, handling, transport, storage, and preparation of items to be tested and/or calibrated
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test and/or calibration data where appropriate

Instructions on the use and operation of all relevant equipment and on the handling and preparation of items for testing and/or calibration are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from test and calibration methods must be documented, technically justified, authorized, and accepted by the client.

Details:
There are SOPs for sampling, sample handling, transport, storage, preparation of test items, QA/QC procedures (media QC, incubation times and temperatures, equipment calibration and maintenance, process control QC), and standards for approving / rejecting results. These may be combined with or separate from the method. See SOP Q-010, Document Control for details.

International, national, or regional standards or other recognized specifications that contain sufficient and concise information on how to perform the tests and/or calibrations are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Test and/or calibration methods, including methods for sampling, meet the needs of the client and are appropriate for the tests and/or calibrations it undertakes. Preference is given to reference methods published as international, national, or regional standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, national, or regional standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the client does not specify the method to be used. These methods may be adopted from the EPA, SMEWW, ASTM, AOAC, FDA, USDA, SMEDP, and Compendium of Methods for the Microbiological Examination of Foods, USP, etc. Methods used for regulatory compliance monitoring can only be modified to the extent that the program allows.

The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The client is informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the tests or calibrations. If the standardized method changes the confirmation is repeated.

The client is informed when the method proposed by the client is inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test and calibration methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensure effective communication amongst all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. Determination of uncertainty must be part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the client and includes a clear specification of the client's requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. The client will be notified of this situation.

New test and/or calibration methods are documented prior to providing test and/or calibration results to clients and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated

- parameters or quantities to be determined
- apparatus and equipment, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
- affixing identification marks, handling, transporting, storing and preparing of items
- ensuring checks are made before the work is started
- checking that the equipment is working properly and, where required, calibrating and adjusting the equipment before each use
- listing method of recording the observations and results
- indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)
- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

A. Performance Characteristics

Policy:
Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:
The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- ruggedness
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery
- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable
- interpretation of population results as applicable

Performance characteristics that are selected consider the intended use of the method, whether for screening, confirmatory analysis, or quantitation.

The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.

Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control. Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured
- proficiency testing programs as appropriate

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias
- intra-laboratory variations
- inter-laboratory variations

Judgment is required to determine if some or all of the above is required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or glassware, the amended method is verified as fit for use. If proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body and follows regulatory guideline

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be “This memo serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver] along with the approval date.

B. Fit for Use

Policy:
The laboratory validates non-standardized methods, laboratory-designed/developed methods; standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:
Validation records are kept as in section 5.4.5.A. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials
- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience.

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

C. Client's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the client's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the client are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

A. Calibration

Policy:
Physical, chemical, and biological standards are calibrated or characterized by qualified suppliers.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement is available on the supplier's certificate of analysis or calibration certificate.

Note – in-house calibrations include procedures for uncertainty of measurement estimates where this is common practice.

Note – certain accreditation program requirements (e.g. TNI) allow a laboratory to have a procedure but not calculate uncertainty for methods in that testing market. The way methods are defined and performed makes laboratory error very consistent batch to batch. Other testing markets, such as food and life sciences require measurement uncertainty determination.

B. Testing

Policy:
The SOP# Q-019 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. In certain cases, it is not possible to undertake metrologically and statistically valid estimations of uncertainty of measurement. In these cases, the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the client
- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

C. Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and equipment used, the environmental conditions, the item being tested or calibrated and the operator.

The effects of sampling and the long-term behavior of the sample is normally not accounted for when estimating the measurement uncertainty.

5.4.7 Control of Data

A. Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are validated through the following arrangements by the Technical Manager

- checks to determine accuracy of calculations, conversions, and data transfers
- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

Test data is reviewed and accepted or rejected based on a set of quality assurance and control criteria defined in the test method or program. Data review occurs at several levels: by the analyst through evaluation of quality control checks; by a peer or technical supervisor and finally by a project manager before the report is sent to the client.

B. Computers and Automated Equipment

Policy:
When computers or automated equipment are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated equipment are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records
- manual manipulation of chromatographic software is done in accordance with SOP# Q-004, Manual Integration Policy.
- all electronic tracking and audit functions must be enabled where available in the instrument software

Details and Procedures:

Data generated using computer software programs that are interfaced directly to instruments often incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction. Whenever possible instruments are interfaced directly into LIMS eliminating the need for manual data reduction.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory-developed spreadsheets using features such as calculations and conditional formatting must be validated prior to use and protected to prevent accidental changes Laboratory software configuration / modifications are validated as outlined in SOP# Q-020 Equipment.

If a digital signature is applied to a record, it must be equivalent to the handwritten signature on paper.

Revision History

Section 5.4, Rev 0: Effective 03.31.16
Section 5.4, Rev 1: Effective 04.01.17
Section 5.4.2: Added that method use for regulatory compliance monitoring can only be modified to the extent the program allows; 5.4.5.A: Added need for approval date to method performance validation; 5.4.7: added spreadsheets are to be protected to prevent accidental changes.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.5. Equipment

5.5.1 Required Equipment

Policy:
The laboratory is furnished with all items for sampling, measurement and test equipment required for the correct performance of the tests and/or calibrations (including sampling, preparation of test and/or calibration items, processing and analysis of test and/or calibration data). When equipment is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Equipment is used in an environment appropriate to its proper performance. All equipment required by a test is described in each method, including the equipment's range and specifications of operation.

5.5.2 Required Accuracy

Policy:
Equipment and software used for testing, calibration and sampling can achieve the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant effect on the results. When received, equipment, including that used for sampling, is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received equipment are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Equipment is operated by authorized personnel.

Details:
Access to laboratory equipment is controlled to ensure that only authorized personnel use equipment.

5.5.4 Unique Identification

Policy:
Each item of equipment used for testing and calibration is uniquely identified as appropriate.

Details:
Measuring and testing equipment is uniquely identified using any system that provides an identifier for each piece of equipment, such as serial numbers, asset numbers, or laboratory IDs. Measuring and testing equipment includes any instrument that could affect the quality of test

results. Components that can be interchanged between various instruments such as autosamplers are typically assigned individual asset numbers as well.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of equipment significant to the tests and/or calibrations performed.

Details:
A database is used to capture the inventory information. The information below related to service and maintenance is kept in individual equipment files and/or binders. The records include the following:

- identity of the item of equipment (and its software)
- manufacturer's name, type identification, and serial number, company asset number and/or other unique identification
- date received and date placed in service
- operation status
- current location, where appropriate
- checks that equipment complies with the specification (see section 5.5.2)
- the manufacturer's instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the equipment
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification (IQ/OQ)
- performance history (PQ), where appropriate (e.g., response time, drift, noise level)

5.5.6 Equipment Procedures

Policy:
SOP# Q-020 is utilized as an established plan for safe handling, transport, storage, use and maintenance (including calibration) of measuring equipment, and appropriate use of correction factors to ensure proper functioning and to prevent contamination or deterioration.

Note – additional procedures may be necessary when measuring equipment is used outside the permanent laboratory for tests, calibrations, or sampling.

Details and Procedures:
The procedures for each piece of measuring equipment are handled according to the Document Control SOP (Q-010). These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring equipment.

5.5.7 Out of Service Equipment

Policy:
Equipment that has either been subjected to overloading or mishandling, gives suspect results, has shown not to function to specifications, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Testing work is discontinued on equipment that shows repeated nonconformance or failures. Not only do we do this for ethical reasons in support of our client, but minor repeated nonconformance may be indicative of more serious issues or pending malfunction.

Out of service equipment is clearly identified, initialed and dated by the person pulling the unit out of service.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the "Control of Nonconforming Work" procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:
Where practicable, equipment requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, the equipment's identification number, and any correction factors.

Where the use of pressure sensitive adhesive labels is not possible, other methods of identification may be used; e.g., metal tags or placards.

Measuring equipment that has failed calibration is taken out of service and labeled (see 5.5.7).

5.5.9 Return to Service

Policy:
When equipment goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the equipment are checked and validated and shown to be satisfactory before the equipment is returned to service.

Details and Procedures:
Before equipment is returned to service the equipment is checked to ensure that the function and calibration status of the equipment are satisfactory per the governing SOP for that piece of equipment.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of equipment, these checks are carried out periodically according to a defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring equipment are available. SOP# Q-020 outlines a general maintenance plan for equipment and includes various checks. Internal quality control checks are specified in individual test methods.

5.5.11 Correction Factors

Policy:
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the Quality Manager to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test and calibration equipment, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory equipment include:

- detailed SOPs and manufacturer's manuals on the operation of the equipment
- policies permitting only fully trained and competent personnel to operate equipment
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software include:

- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel

Revision History
Section 5.5, Rev 0: Effective 03.31.16
Section 5.5, Rev 1: Effective 04.01.17
Section(s): 5.5.7: Added language to the Detail section related to repeated equipment nonconformance; 5.5.8: allow use of metal tags or placards to indicate calibration status; 5.5.10: removed need to keep a copy of the SOP in the same room with the equipment.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.6. Measurement Traceability

5.6.1 General

Policy:
Test equipment for subsidiary measurements (e.g., for environmental conditions) having a significant effect on the accuracy or validity of the result of the test, calibration, or sampling are calibrated before being put into service. All measurement and test equipment influencing the accuracy or validity of tests is calibrated and/or verified before being put into service. As mentioned in section 5.5, SOP# Q-020 outlines an established program for the maintenance of equipment and includes calibration.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:

- measurement standards
- reference standards used as measurement standards
- measuring and test equipment used to perform analyses

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained for each standard. These records include, as applicable:

- laboratory identification#
- supplier, grade, batch#
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, sterilization)
- identification of personnel involved

Records are maintained for each lot of test organisms. These records include, as applicable:

- laboratory identification #
- source, including age, species, and lot#
- date of arrival
- arrival condition
- culture and/or holding conditions

Reagents prepared in the laboratory are labelled to identify substance, strength, solvent (where not water), and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified both the label and records.

5.6.2 Specific Requirements

A. Calibration

Policy:
The program for calibration equipment is designed and operated to ensure that calibration measurements are traceable to the Système International (SI) units of measurement.

Details:
Traceability of measurement is assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these laboratories show that there is a link to a primary standard or to a natural constant realizing the SI unit by an unbroken chain of calibrations. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification.

Calibration laboratories accredited to ISO 17025 are considered competent to provide the appropriate calibration services.

Traceability to SI units of measurement may be achieved by reference to an appropriate primary standard or by reference to a natural constant the value of which, in terms of the relevant SI unit, is known.

The term “identified metrological specification” means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms “international standard” or “national standard” are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring equipment, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

B.1 Testing - Traceability to SI Units

Policy:
The requirements given in section 5.6.2.A apply to measuring and test equipment with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation arises, the laboratory ensures that equipment used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.A are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2. B.2.

B.2 Testing - Traceability to SI Units Not Possible

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Manager.

5.6.3 Reference Standards and Reference Materials

A. Reference Standards

Policy:
SOP# Q-021 outlines the program for the calibration of reference standards. Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.A. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:
Reference standards are calibrated from ISO 17025 accredited providers. If an accredited provider is not available, the laboratory must consult with Corporate QA before proceeding.

B. Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reference materials cannot be used past their expiry. Reagents used in the preparation of reference materials, including calibration standards are of certified purity. Reference materials for methods listed on A2LA Scopes of Accreditation are obtained from ISO 17034 and/or Guide 34 accredited providers. If an accredited provider is not available, the laboratory must consult with Corporate QA before proceeding.

Certified reference cultures are traceable to a national or internationally recognized type culture collection. Reference cultures from laboratory sources must be identified to standard reference sources. These reference cultures must be handled to maintain their biochemical reaction and physiological characteristic integrity. All Reference Cultures and Certified Reference Cultures are not transferred more than five times from a type culture collection. Alternatively, re-identify the culture for key biochemical and physiological characteristics using national or internationally recognized

reference sources. Another alternative is to grow the type culture, then freeze it (or freeze-dry it), and use periodically. Thus, extending the length of time required before repurchase or re-identification. These may also be commercially available and purchased for use. Companies selling Certified Reference Cultures must comply with the requirements of ISO 17025 for a calibration laboratory.

C. Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are preferably prepared from a separate lot # or source.

D. Transport and Storage

Policy:
SOP# Q-021 outlines safe handling, transport, storage and use of reference standards and reference materials to prevent contamination or deterioration and to protect their integrity.

Details:
Additional procedures may be necessary when reference standards and reference materials are used outside the permanent laboratory for tests, calibrations, or sampling.

Proper conditions are established for housing, handling, and care of reference standards, reference materials and test organisms. All information needed to properly identify references appears on their housing or containers.

Revision History:
Section 5.6, Rev 0: Effective 03.31.16
Section 5.6, Rev 1: Effective 04.01.17
Section(s): 5.6.1: Added laboratory identification to records maintained for standards and test organisms; 5.6.2: Added clarification to headers B.1 and B.2; 5.6.3.B: added reference materials cannot be used past their expiry.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.7. Sampling

5.7.1 Sampling Plan and Procedures

Policy:
The laboratory uses sampling plans provided by clients or prepared in consultation with the client. The sampling plan and procedures are available at the location where sampling is performed. Sampling plans are based on appropriate statistical methods whenever reasonable. The sampling process addresses the factors to be controlled to ensure validity of the test and calibration results, including representative subsampling. SOP# Q-022 outlines the sampling plan and procedures for sampling substances, matrices, materials for subsequent testing.

Details:
Sampling is a defined procedure whereby a part of a substance, matrix, material or product is taken to provide for testing or calibration as a representative sample of the whole. Sampling can also be required by the appropriate specification for which the substance, matrix, material or product is to be tested or calibrated. In certain cases, (e.g., forensic analysis), the sample may not be representative, but determined by availability.

The sampling plan describes the allocation, withdrawal and preparation of a sample. All samples are collected and placed in sealed containers except for unit packages of products which may be submitted in their entirety.

5.7.2 Deviations, Additions or Exclusions

Policy:
Where the client requires deviations, additions or exclusions from the sampling procedure, these are recorded in detail with the appropriate sampling data and included in all documents containing test and/or calibration results, and communicated to the appropriate personnel.

Details:
The physical appearance and temperature of all test items is observed and recorded upon receipt. Any deviations from specifications or observations are discussed with the client as to the suitability of the sample. Cross-contamination is the most critical issue from broken, leaking samples for both qualitative and quantitative tests.

5.7.3 Records

Policy:
SOP# Q-021 outlines the procedures for recording relevant data and operations relating to sampling that forms part of the testing or calibration that is undertaken. These records include reference to the sampling plan, the sampling procedure used, the identification of the sampler, environmental conditions (if relevant) and any diagrams or other equivalent means to identify the sampling location as necessary, and, if appropriate, the statistics upon which the sampling procedures are based.

Details:
Adequate sample identification upon receipt in the laboratory includes:

- unique and unambiguous sample identification, usually a number or alphanumeric identification, retained throughout the testing life of the test item
- client name and person(s) the report will be sent to
- identification number or description from (client) if any
- sample source
- tests desired and/or methods requested
- containers provided, as applicable
- date of receipt
- delivery carrier
- Additional for environmental laboratories
  - sample collector
  - sample condition at receipt, including temperature and/or the presence of ice.
  - date and time of sampling
  - type of sample: composite or grab
  - sample preservation type
  - matrix

Revision History
Section 5.7, Rev 0: Effective 03.31.16
Section 5.7, Rev 1: Effective 04.01.17
Section(s): 5.7.1: allows exception for unit packages of products when placing samples in sealed containers; 5.7.3: added sample preservation type and matrix to environmental laboratories record keeping.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.8. Handling of Test Items

5.8.1 Procedures

Policy:
SOP# Q-023 outlines the procedures for the transportation, receipt, handling, protection, storage, retention and/or disposal of test and/or calibration items, including all provisions necessary to protect the integrity of the test or calibration item, and the interests of the laboratory and the client.

Details:
Test samples are stored to ensure their integrity by preventing against deterioration, contamination, and loss of identity. It is recognized that this is a general statement, but details are elaborated upon in SOP# Q-023.

5.8.2 Identification of Test and/or Calibration Items

Policy:
Test and/or calibration items are systematically identified as they arrive at the laboratory. The identification is retained throughout the life of the item in the laboratory. The system is designed and operated to ensure that items cannot be confused physically, or when referred to in records or other documents. The system accommodates a sub-division of groups of items and the transfer of items within and from the laboratory when appropriate.

Details:
Sample labelling indicates the unique identification and conforms to applicable legal requirements. Where conformity of possession of a test sample must be maintained for forensic or evidentiary purposes, the laboratory establishes and documents a system for appropriate chain-of-custody.

5.8.3 Receipt

Policy:
Upon receipt of the test item, any abnormalities or departures from normal or specified conditions, as described in the relevant test method, are recorded. When there is any doubt as to the suitability of an item for testing, or when an item does not conform to the description provided, or the test required is not specified in sufficient detail, the laboratory consults the client for further instructions before proceeding and keeps a record of the discussion. Environmental laboratories maintain a record of rejected samples.

Details:
Conform to applicable regulations or contractual arrangements. The condition of sample may include or relate to damage, quantity, preparation, packaging, or temperature. Preparation may include addition of chemical preservative, removal of moisture, isolation of portion of sample to be tested, homogenization, or subsampling.

Arrangements are in place to ensure that elapsed time between sampling and testing does not exceed test method specifications (holding time).

5.8.4 Protection

Policy:

SOP# Q-023 outlines the procedures and appropriate facilities for avoiding deterioration, loss or damage to the test or calibration item during storage, handling and preparation and testing; instructions provided with the item are followed. When items must be stored or conditioned under specified environmental conditions, these conditions are maintained, monitored, and recorded. Where a test item is to be held secure (e.g., for reasons of record, safety or value, or to enable complementary tests to be performed later), the laboratory has arrangements for storage and security that protect the condition and integrity of the secured item concerned.

Details:

A sampling procedure and information on storage and transport of test items including all information that may influence the test or calibration result, is provided to those responsible for taking and/or transporting these items.

The laboratory establishes whether the sample has received all necessary preparation or whether the client requires preparation to be undertaken or arranged by the laboratory. Proper requirements for packaging, environmental conditions, and separation from incompatible materials are observed. Where test items must be stored or conditioned under specific conditions, these conditions are maintained, monitored, and recorded, where necessary.

Where a sample, or portion of a sample, is to be held secure (e.g., for reasons of record, safety, or value, or to enable check tests to be performed later), the laboratory has storage and security arrangements that protect the condition and integrity of the sample.

Where test items are to be returned into service after testing (e.g., for non-destructive testing or human subjects in clinical trials), special care is required to ensure that they are not damaged or injured during the handling, testing or storing/waiting processes.

Revision History

Section 5.8, Rev 0: Effective 03.31.16
Section 5.8, Rev 1: Effective 04.01.17
Section 5.8.3: added requirement for environmental laboratories to maintain a record of rejected samples.

Approved By:

Bradley A. Stawick
Vice President, Quality

5.9 Assuring the Quality of Test and Calibration Results

5.9.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.

As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently, a full system validation is performed on each occasion. This may typically involve the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the "Quality Control" section" of each test method and/or in laboratory quality control standard operating procedures.

Internal quality control schemes using statistics may include:

- design of experimental/factorial analysis
- variation/regression analysis
- safety evaluation/risk analysis
- tests of significance
- quality control charts
- statistical sampling inspection

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and to take action as necessary.

The Quality Manager maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results. Refer to SOP# Q-007, PT Plan.

Technical personnel use both certified reference materials and reference materials to evaluate test performance and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is sometimes performed when quality control checks fail; when test results seem anomalous; or as a result of an out-of-spec investigation. Retests are allowed as long as sample integrity has not been compromised.

5.9.2 Correction and Prevention

Policy and Details:

Quality control checks are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

Revision History

Section 5.9, Rev 0: Effective 03.31.16
Approved By:

Bradley A. Stawick
Vice President, Quality

5.10 Reporting of Results

5.10.1 General

Policy:
The results of each test, or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test methods.

The results are reported, normally in a test report and include all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used. This information may include what is outlined in section 5.10.2, 5.10.3 and 5.10.4.

In the case of tests performed for internal clients, and in the case of a written agreement with the client, the results may be reported in a simplified way. The information listed in section 5.10.2 to 5.10.4, and not reported, is kept readily available.

Details:
Test reports are issued as either hard copy or by electronic data transfer.

5.10.2 Test reports

Policy:
Test reports include the following information, as appropriate:

- a title (e.g., “Test Report”)
- name and address of laboratory, and location where tests and/or calibrations were carried out if different from the address of the laboratory
- unique identification of the test report (such as a serial number), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report
- name and address of the client
- identification of the preparation method used
- identification of the method used
- description, condition, and unambiguous identification of the item(s) tested date of receipt of test items (where this is critical to the validity and application of the results) and date(s) of performance of the test
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- date of analysis
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- where relevant, a statement to the effect that the results relate only to the items tested
- if accredited and non-accredited tests are on the same report, a notation of which are not accredited tests
- identification of subcontracted testing
- environmental test reports also require:
  - time of sample preparation and/or analysis if the required holding time for either is less than or equal to 72 hours
  - results that are reported on a basis other than as received (e.g. dry weight)
    - clear identification of numerical results outside of the calibration range

- GLP, GCP laboratories test reports also include:
  - The statement prepared and signed by the Quality Assurance Unit;
  - Location of all raw data and location of the final report;
  - Initiation and termination of the study; and
  - Names of the Study Director and other technical personnel involved in the study.

Details:
Signing authority for test reports is the responsibility of the person authorizing release of the data, typically the Project Manager or Managing Director; the Study Director or Principle Investigator. Records for individuals with signing authority for test reports are approved by the Managing Director and maintained by the Quality Manager.

Hard copies of test reports include the page number and total number of pages.

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory.

5.10.3 Test Reports

A. Additional Reporting Requirements for Interpretation of Results

Policy and Details:
In addition to the requirements listed in section 5.10.2, test reports include the following, where necessary for the interpretation of results:

- deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a client's instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.10.5)
- additional information required by specific methods, clients, or groups of clients

B. Additional Reporting Requirements Related to Sampling

Policy and Details:
In addition to the requirements listed in sections 5.10.2 and 5.10.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:

- date of sampling
- unambiguous identification of substance, matrix, material or product sampled (including name of manufacturer, model or type of designation and serial numbers as appropriate)
- location of sampling, including any diagrams, sketches or photographs
- reference to sampling plan and procedures used
- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

C. Additional Reporting Requirements Related to SDWA MCL Exceedances

Policy and Details:
Laboratories certified to analyze drinking water compliance samples for public water suppliers must report compliance data to the public water system and/or regulatory agency when there is a Maximum Contaminant Limit (MCL) exceedance in a timely manner. The notification period is defined in states' regulation.

5.10.4 Calibration Certificates

Policy: This section is not applicable as the testing laboratory does not issue calibration certificates.

5.10.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report generally in a narrative.

Note - Opinions and interpretations should not be confused with inspections and product certifications as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations are provided by trained individuals designated by laboratory management and included in a test report may comprise, but not be limited to, the following:

- opinion on conformity of the results with requirements
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements

In many cases, it is appropriate to communicate the opinions and interpretations by direct dialogue with the client. This dialogue is written down.

5.10.6 Testing and Calibration Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory. The laboratory shall make a copy of the subcontractor's report available to the client when requested.

5.10.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, telex, facsimile or other electronic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.4.7).

Details:
Reports that are “published” electronically contain the image of the signature of the person approving the report.

5.10.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

The headings are standardized as far as possible.

5.10.9 Amendments to Reports

Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement “Supplement to Test Report”, or equivalent wording. Such amendments meet all the requirements in this Quality Manual.

Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces. The reason for the amendment will be noted.

Revision History
Section 5.10, Rev 0: Effective 03.31.16
Section 5.10, Rev 1: Effective 04.01.17
Section(s) 5.10.1: removed reference to calibration reports; 5.10.2: added preparation method to contents of environmental test reports; 5.10.3: added C: Additional Reporting Requirements Related to SDWA MCL Exceedances

Approved By:

Bradley A. Stawick
Vice President, Quality

Appendix A: Microbac Laboratory Directory

FACILITY	CODE	LABORATORY MANAGEMENT	
BALTIMORE	(007)G	James Williams James.williams@microbac.com	
		Baltimore James Williams james.williams@microbac.com 2101 Van Deman St Baltimore, MD 21224 410.633.1800 p 410.633.6553 f	Richmond Curtis Read curtis.read@microbac.com 2028 Dabney Rd. Suite E-17 Richmond, VA 23230 804.353.1999 p
BOULDER	(025)Y	TBD	
		Boulder 4750 Nautilus Court South Unit A Boulder, CO 80301 720.406.4800 p 303.581.0195 f	
MERRILLVILLE	(012)L	Ron Misiunas ron.misiunas@microbac.com	
		Merrillville Ron Misiunas ron.misiunas@microbac.com 250 West 84th Drive Merrillville, IN 46410 219.769.8378 p 219.769.1664 f	Indianapolis (service center) Kristin Gehlbach Kristin.gehlbach@microbac.com 5713 West 85th Street Indianapolis, IN 46278 317.872.1375 p 317.872.1379 f
CORTLAND	(040)	Christine Pechacek Christine.pechacek@microbac.com	
		Cortland 3821 Buck Drive Cortland, NY 13045 607.753.3403 p 607.753.3415 f	Scranton 1620 N. Main Avenue Scranton, PA 18508 571.348.0775 p

FACILITY	CODE	LABORATORY MANAGEMENT	
CORTLAND (CONT)		Sayre (service center) 2369 Elmira Street, Suite C Sayre, PA 18840 570.888.0169 p	Harrisburg (service center) 4359 Linglestown Rd Harrisburg, PA 17112 717.651.9700 p 717.657.0752 f
ERIE	(003)C	Jeffrey Ogle jeffrey.ogle@microbac.com Erie 1962 Wager Rd. Erie, PA 16509 814.825.8533 p 814.825.9524 f	
FAIRWATER	(029)	Sarah Muellenbach Sarah.muellenbach@microbac.com c/o Bonduelle 101 Kennedy Street Fairwater, WI 53931 855.962.2105 p	
FAYETTEVILLE	(011)K	James Williams james.williams@microbac.com 2592 Hope Mills Rd Fayetteville, NC 28306 910.864.1920 p 910.864.8774 f	
LOUISVILLE	(005)E	Jeffrey Ogle jeffrey.ogle@microbac.com Louisville Jeffrey Ogle jeffrey.ogle@microbac.com 3323 Gilmore Industrial Blvd. Louisville, KY 40213 502.962.6400 p 502.962.6411 f Hazard 100 Grand Vue Plaza, Suite 22 Hazard, KY 41701 606.487.0511 p 606.910.0086 f	Lexington Lisa Martin Lisa.martin@microbac.com 2520 Regency Rd. Lexington, KY 40503 859.276.3506 p 859.278.5665 f Evansville 3119 North First Avenue Evansville, IN 47710 812.464.9000 p 812.424.0667 f

FACILITY	CODE	LABORATORY MANAGEMENT	
LOUISVILLE (CONT)		Paducah Ted Meriwether Ted.meriwether@microbac.com 5309 Reidland Rd. Paducah, KY 42003 270.898.3637 p 270.898.3666 f	
DAYVILLE	(033)	Ron Warila Ron.warila@microbac.com Dayville Ron Warila Ron.warila@microbac.com 61 Louisa Viens Drive Dayville, CT 06241 860.774.6814 p	Lee (034) Christine Furcinite-Reynolds Christine.furcinite-reynolds@microbac.com 8080 Run Way Lee, MA 01238 413.776.5025p
WESTBOROUGH	(006) F	Westborough Trevor Craig Trevor.craig@microbac.com 117 Flanders Road, Suite 101 Westborough, MA 01581 508.329.7927 p	
MARIETTA	(015)O	Leslie Bucina Leslie.bucina@microbac.com Marietta 158 Starlite Drive Marietta, OH 45750 800.373.4071 p 740.373.4835 f	
PITTSBURGH	(001)A	Robert Dempsey robert.demsey@microbac.com Warrendale 100 Marshall Drive Warrendale, PA 15086 724.772.0610 p 724.373.1686 f	

FACILITY	CODE	LABORATORY MANAGEMENT
MARYVILLE	(018)F	Joe Sloan Joe.sloan@microbac.com Knoxville 505 E. Broadway Ave. Maryville, TN 37804 865.977.1200 p 865.984.8618 f Nashville 2631 Grandview Ave. Nashville, TN 37211 615.242.1480 p 615.242.5522 f Johnson City Kim Storey Kimberly.storey@microbac.com 2109 W. Market St. Suite 177 Johnson City, TN 37604 423.926.6385 p 423.926.6997 f
WILSON – F&N		Jateisha Lowe Jateisha.lowe@microbac.com Wilson Food & Nutrition 3809 Airport Drive Wilson, NC 27896 910.864.1921 p 910.864.8774 f

Revised: 06.18.2018

Appendix B: Accreditation, Approvals and Certifications

Laboratory	Accrediting Body	Matrix	Type	Certification
COLORADO				
Boulder	US Consumer Product Safety Commission	Toys, Jewelry, Textiles	Registered	ID 1130
	American Assoc. for Laboratory Accreditation	Chemical	Accredited	Cert 0018.01
	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 0018.03
	American Assoc. for Laboratory Accreditation	Mechanical	Accredited	Cert 0018.04
CONNECTICUT				
Dayville	Connecticut Dept. of Public Health	DW, WW, SW	Certified	ID PH-0465
	Kentucky Energy and Env Cabinet	DW	Certified	ID 90151
	Massachusetts DEP	DW, WW	Certified	ID M-CT008
	Maryland Department of Env.	DW	Certified	ID 349
	New Hampshire ELAP	DW, WW, SW	Accredited	ID 2020
	New York Department of Health	DW, WW, SW	NELAP Accredited	ID 11549
	Pennsylvania DEP	DW, WW, SW	Accredited	ID 68-04413
	Rhode Island Dept. of Public Health	DW, WW, SW	Certified	ID PH-0465
	Tennessee Dept. of Env. & Cons.	DW	Certified	ID 04903
	UCMR4 Laboratory Approval	DW	Approved	ID CT00008
	Virginia Dept. of General Services	DW	Certified	ID 460279
	Vermont Department of Health	DW	Certified	ID VT 11549
INDIANA				
Merrillville	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3045.01
	American Assoc. for Laboratory Accreditation	Environmental-DoD	Accredited DoD ELAP	Cert 3045.02
	US Center for Disease Control	Legionella	Proficient	
	US Coast Guard	WW-Cruise Vessels	Recognized	
	Illinois EPA	DW, WW, SW	Accredited	ID 200064
	Illinois Dept. of Public Health	DW	Approved	
	Indiana Board of Animal Health	Dairy	Certified	
	Indiana Dept. of Environ Mgt	WW, SW	Approved	
	Indiana State Dept. of Health	DW	Approved	ID C-45-03
	Indiana State Dept. of Health	DW	Approved	ID M-45-08
	Kansas Dept. of Health and Env.	WW, SW	NELAP Accredited	Cert E-10397
	Kentucky Energy and Env. Cabinet	WW, SW-UST	Approved	ID 90147
	North Carolina DENR	WW	Certified	Cert 597

Merrillville (cont.)	New York Department of Health	DW, WW - LL Hg; Legionella	Approved	ID 12006
	Pennsylvania DEP	DW, WW - LL Hg	Accredited	ID 68-04863
	Virginia Dept. of General Services	DW, WW	Accredited	ID 460280
Evansville	Kentucky Energy and Env. Cabinet	WW	Certified	ID 98021
KENTUCKY				
Louisville	American Assoc. for Laboratory Accreditation	Chemical	Accredited	Cert 0085.04
	Kentucky Energy and Env. Cabinet	DW, WW	Certified	ID 00074
	US Coast Guard	WW-Cruise Vessels	Recognized	
	Indiana State Dept. of Health	DW	Approved	ID C-KY-05
	Indiana State Dept. of Health	DW	Approved	ID M-KY-02
Lexington	Kentucky Energy and Env. Cabinet	DW, WW-WET	Certified	ID 00040
	West Virginia DEP	WETT	Certified	Cert 404
Paducah	Kentucky Energy and Env. Cabinet	DW, WW	Certified	ID 00089
MARYLAND				
Baltimore	American Assoc. for Laboratory Accreditation	Environmental	Accredited	Cert 0410.01
	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 0410.02
	Maryland Dept. of Environment	DW	Certified	ID 109
	US Consumer Product Safety Commission	Lead	Registered	
	Virginia Dept. of General Services	DW, WW, SW	Accredited	ID 8574
	West Virginia DEP	WW - Available CN	Certified	Cert 054
	Florida DOH	DW, WW, SW	NELAP	E871126
MASSACHUSETTS				
Lee	Massachusetts DEP	DW, WW	Certified	ID M-MA1146
	New Hampshire ELAP	DW, WW	Accredited	ID 2067
Westborough	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3302.01
	MA Health and Human Services	Dairy	Approved	ID 0056
NEW YORK				
Cortland	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3881.01
	NY Ag and Markets	Dairy	License	ID 158650
	New York Department of Health	DW, WW	NELAP Accredited	ID 10795
	Pennsylvania DEP	DW, WW	Accredited	ID 68-01385

N. CAROLINA

Fayetteville	NC Dept. of Health and Human Service	DW	Certified	ID 37714
	North Carolina DENR	WW	Certified	Cert 11
Wilson F&N	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3275.01
	USDA Meat & Poultry Export Program	Microbiology	Approved	

OHIO

Marietta	American Assoc. for Laboratory Accreditation	Environmental-DoD	Accredited	Cert 2936.01
	Arizona Department of Health Services	WW, SW	Licensed	ID AZ0723
	California ELAP	WW, SW	Approved	Cert 2730
	Connecticut Dept. of Public Health	DW, WW, SW	Certified	ID PH-0304
	Florida DOH	DW, WW, SW	Accredited	ID E87551
	Georgia Dept. of Natural Resources	WW, SW	Reciprocal	
	Illinois EPA	WW, SW	Accredited	ID 200019
	Indiana State Dept. of Health	DW-Radiochemistry	Recognized	
	Kansas Dept. of Health and Environment	WW, SW	Accredited	Cert E-10290
	Kentucky Energy and Env. Cabinet	WW	Certified	ID 460187
	Kentucky UST	SW	Approved	Cert 72
	Louisiana Dept. of Env. Quality	WW, SW	Accredited	Cert 01976
	North Carolina DENR	WW	Certified	Cert 583
	New Jersey DEP	WW, SW	Accredited	ID OH004
	New York Department of Health	WW, SW	Approved	ID 10861
	Ohio EPA	SW	Certified	ID CL0012
	Ohio EPA	DW	Certified	ID 4125
	Oklahoma Department of Env. Quality	WW, SW	Accredited	ID 9611
	Pennsylvania DEP	WW, SW	Accredited	ID 68-01670
	Rhode Island Department of Health	WW	Certified	ID E87551
	Texas Commission on Env Quality	WW, SW	Accredited	Cert T104704254-14-7
	UCMR4 Laboratory Approval	DW	Approved	ID OH00218
	Virginia Department of General Services	WW, SW	Accredited	ID 460187
	West Virginia DEP	WW, SW	Certified	Cert 361

PENNSYLVANIA

Erie	New York Department of Health	DW, WW, SW	Approved	ID 10121
	Pennsylvania DEP	DW, WW, SW	NELAP Accredited	ID 25-00067
Pittsburgh	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 2413.01
	American Assoc. for Laboratory Accreditation	Chemistry	Accredited	Cert 2413.02
	PA Department of Agriculture	Dairy	Approved	

Pittsburgh	Pennsylvania DEP	DW, WW	Accredited	ID 02-00257
Scranton	Pennsylvania DEP	DW, WW	Accredited	ID 35-05082
	PA Department of Agriculture	Dairy	Approved	

TENNESSEE

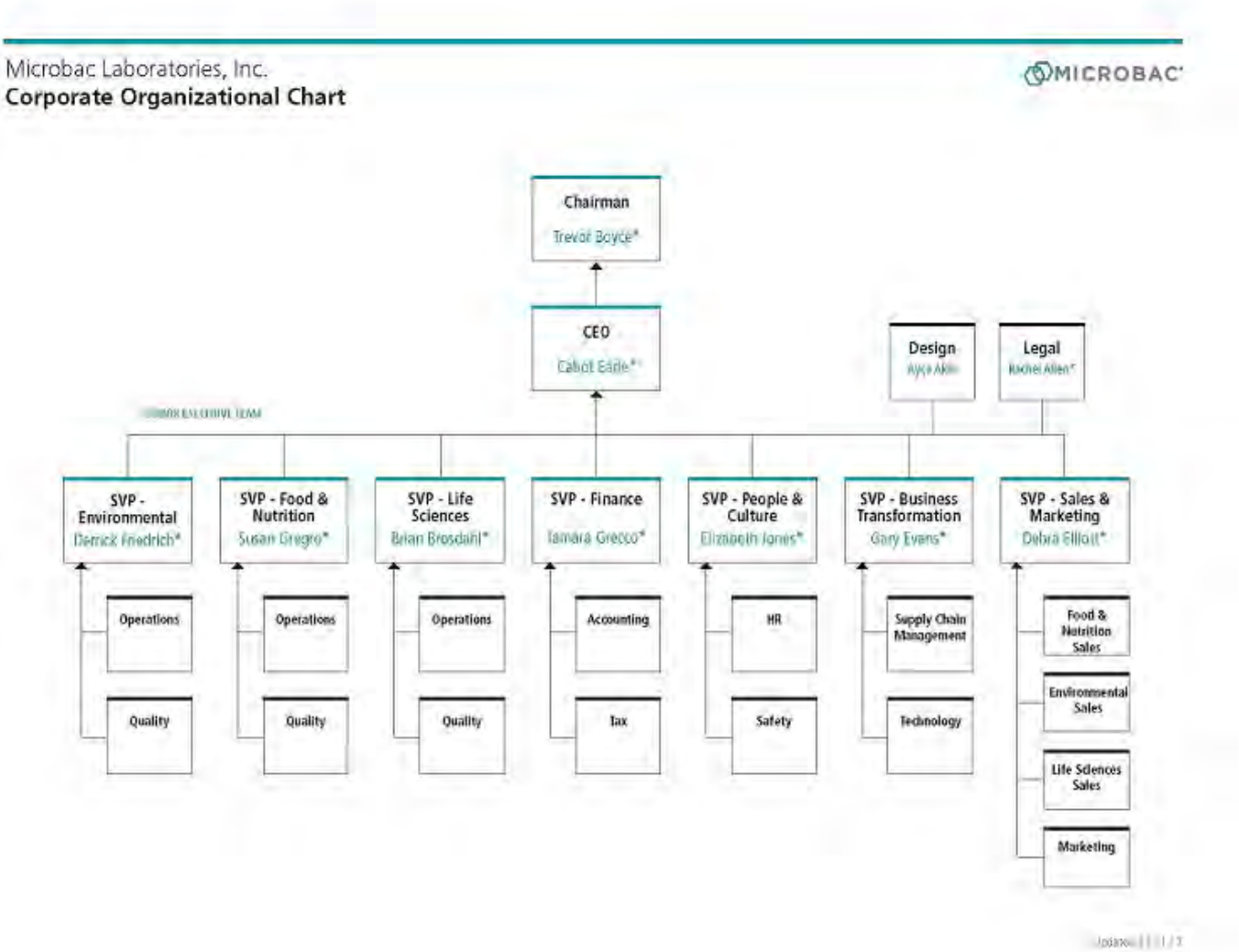
Knoxville	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3131.01
	American Assoc. for Laboratory Accreditation	Environmental	Accredited	Cert 3131.03
	Georgia Dept. of Natural Resources	DW	Certified	ID 980
	USDA Meat & Poultry Export Program	Microbiology	Approved	
Nashville	American Assoc. for Laboratory Accreditation	Biological	Accredited	Cert 3131.02
TN Operations	Tennessee Dept. of Env. & Conservation	DW	Certified	ID 02017

VIRGINIA

Richmond	Virginia Dept. of General Services	DW, WW - Micro	Accredited	ID 460022

Current as of 06.18.18

Appendix C: Corporate Organization Chart



Appendix D: Quality Managers by Laboratory

Facility	Quality Manager	Contact Information
Baltimore, MD Richmond, VA	Env TBD Christina Urban, QA Specialist Dave Danis (F&N)	christina.urban@microbac.com david.danis@microbac.com
Boulder, CO	Whitney Griebel	whitney.griebel@microbac.com
Merrillville, IN	Teresa Dyson	teresa.dyson@microbac.com
Scranton, PA Harrisburg, PA	Tiffany Barnes	tiffany.barnes@microbac.com
Cortland, NY Sayre, PA	Jennifer Walker	jennifer.walker@microbac.com
Erie, PA	Interim: Chuck Piano	chuck.piano@microbac.com
Fayetteville, NC	Janice Reyes	janice.reyes@microbac.com
Fairwater, WI	Whitney Griebel	whitney.griebel@microbac.com
Louisville, KY Evansville, IN Paducah, KY Hazard, KY Lexington, KY	Megan Rothgerber	megan.rothgerber@microbac.com
Dayville, CT Lee, MA	Melisa Montgomery	melisa.montgomery@microbac.com
Worcester, MA	Elizabeth DiBonaventura	elizabeth.dibonaventura@microbac.com
Marietta, OH	Maren Beery	maren.beery@microbac.com
Pittsburgh, PA	Lauren Zeleny	lauren.zeleny@microbac.com
Knoxville, TN Nashville, TN Johnson City, TN	LeAnne Burns	leanne.burns@microbac.com
Wilson, NC (F&N)	David Danis	dave.danis@microbac.com

Revised: 06.18.2018

Appendix 2

(Sample Field Collection Sheet)

8854 Rixlew Lane
Manassas, VA 20109
Phone: 703-396-6730
Fax: 703-396-6743

Watershed: **Outfall ID#/Name:** Soapstone Creek	**Samplers:**	**Date:**
	Signature	**Time of Arrival:**
Outfall Address: Albemarle and 32nd Street, NW	x	**Time of Departure:**
Outfall Weather: Temperature (F˚) (C˚): General Conditions:	**Sampling Methods:** Composite Sampling grabs directly from flow	**Composite Sample Time Started:** **Composite Sample Time Ended:** **Grab Sample Time:**
Field Measurements: Temperature of Water (F˚): Conductivity Hardness pH Level: Dissolved Oxygen (mg/L) Depth of Discharge : Width of Discharge : Velocity of Discharge: **Flow Rate at Outfall (GPM):**	**Comments/Remarks:** Measurements of depth and width taken with tape measure	

Appendix 3

(Sample Chain of Custody Form)

MICROBAC

Microbac Laboratories, Inc., Baltimore Division
2101 Van Deman Street • Baltimore, MD 21224

Phone: 410-633-1800
Fax: 410-633-6553
www.microbac.com

17C0320

Tentatively Scheduled Date: **3/6/2017**

Client: **Retaw Engineering**
Project: **DC DOE-Wet Weather - Apex Sampled**
Project Number: **DC DOE-Wet Weather**

Report To:
Andrea Owen Hellier
P.O. Box 5881
Midlothian, VA 23112
Phone: (804) 744-1792

Invoice To:
Ignatius Muteti, PhD, PE
P.O. Box 5881
Midlothian, VA 23112
Phone :(804) 744-1792

TAT 7 days

Sample ID: A2-SW2 - Composite

Lab Sample ID: 17C0320-01
Matrix: Stormwater
Type: Composite

Sample Start Date & Time: 3/8/17 2:15
Sampled Date & Time: 3/8/17 2:15
Volume: 13L

Analysis	Method	Container	Hold
Nitrogen, Total HL	varies		28
Hard_Titration	SM 2340 C-11		28
M_Cd_ICPMS	EPA 200.8		180
M_Cu_ICPMS	EPA 200.8		180
M_Pb_ICPMS	EPA 200.8		180
M_Zn_ICPMS	EPA 200.8		180
		A- 500ml Plastic HNO3 to pH <2	
P_T_Seal	SM 4500-P B5+E-11		28
		B-1000ml Plastic H2SO4 to pH <2	
TSS	SM 2540 D-11		7
		B-1000ml Plastic Neat	
		Total Containers: 3	

Sample ID: A2-SW2 - Grab

Lab Sample ID: 17C0320-02
Matrix: Stormwater
Type: Grab

Sampled Date & Time: 3/8/17 2:15

Analysis	Method	Container	Hold
Chlorophyll	SM 10200 H 1 plus 2		2
		E-4oz Amber Glass NM Neat	
E_coli_MPN_W	SM 9221 E-06		0.333
Fecal_Col_MPN_W	SM 9221 E-06		0.333
		S-4oz Sterile Plastic w/Thiosulfate	
		Total Containers: 2	

Sampled by: [signature]	Date/Time: 3/8/17 01:15	Received by: [signature]	3/9/17
Printed Name: Tom Sanders / Alicia Ferguson		Printed Name: V. Shivers	15
Relinquished by:	Date/Time:	Received by:	
Printed Name:		Printed Name:	
Relinquished by:	Date/Time:	Received by:	
Printed Name:		Printed Name:	

As Received at Laboratory: On Ice: Yes / No Cooler Temp _____ Rad Scan Acceptable: Yes / No Total Bottles 5

Notes:

Temp 1.7

MICROBAC® **Microbac Laboratories, Inc., Baltimore Division**
2101 Van Deman Street • Baltimore, MD 21224
Phone: 410-633-1800
Fax: 410-633-6553
www.microbac.com

17C0320

Tenatively Scheduled Date: **3/6/2017**

Client: **Retaw Engineering**
Project: **DC DOE-Wet Weather - Apex Sampled**
Project Number: **DC DOE-Wet Weather**

Ship bottle order back to below with clean pickle jar for next event.

Andrea Owen
Apex Companies, LLC
8854 Rixlew Lane
Manassas, VA 20109
O) 703-396-6730 x103 M) 703-675-7055

Cooler Receipt Form / Sample Acceptance & Noncompliance Form

Microbac Laboratories, Inc., Baltimore Division
Control # 606-03
Effective Date: 11/30/2016
Page 1 of 1

Number of Coolers Received: 1
Client: Ritaw Engineering
Form Completed By: HN Dillinade
Shipper: [Microbac] Microbac ☐ Client ☐ UPS ☐ FedEx
Custody Tape Intact: YES / NO / NA (YES circled)
Containers Intact: YES / NO (YES circled)
Sample Received on Ice or refrigerated: YES / NO / NA (YES circled)
Infrared (IR) Temperature: 1.7 °C

Receipt Date / Time: 03/14/17 0115
Work Order # 17C0320 | 0321

Chain of Custody Present with shipment: YES / NO (YES circled)
Sample Bottle IDs agree with COC: YES / NO (YES circled)
Preservation requirements met: YES / NO / Not Checked (YES circled)
Correct Number of Containers / Sample Volume: YES / NO (If No, contact client immediately)
Headspace in container: YES / NO / NA
Type of Sample: Water Soil Wipes Oil Filter Solid Sludge Food Swab Other

***Container Type / Quantity*:**

A - ___ Unpreserved ___ H2SO4 2 HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid: If preserved pH <2 ✓ , pH >10___
B - 2 Unpreserved 2 H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2 ✓ , pH >10___
C - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
D - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
E - 2 Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
H - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
K - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
L - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
M- ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
P - ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
W- ___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
V - ___ Unpreserved ___ HCl ___ HCl / Ascorbic Acid ___ HCl / NaTHIO **(Checked at time of Analysis)**
F - ___ Unpreserved ___ NaTHIO **(Checked at time of Analysis)**
S - ___ Unpreserved 2 NaTHIO **(Checked at time of Analysis)**
SN- ___ Unpreserved ___ NaTHIO ___ NaTHIO/EDTA **(Checked at time of Analysis)**

___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___
___ Unpreserved ___ H2SO4 ___ HNO3 ___ HCl ___ NaOH ___ NaOH/Ascorbic Acid If preserved pH <2___, pH >10___

Describe preservation requirements not met:

All Acid preserved <2 pH *NaOH preserved >12 pH* *All others >2 and <10 (usually 4-8)*

Sample ID:________ H_2SO_4 HNO_3 NaOH ______ mls added
Sample ID:________ H_2SO_4 HNO_3 NaOH ______ mls added
Sample ID:________ H_2SO_4 HNO_3 NaOH ______ mls added
Sample ID:________ H_2SO_4 HNO_3 NaOH ______ mls added

H_2SO_4 – Sulfuric Acid, HNO_3 – Nitric Acid, NaOH – Sodium Hydroxide, ASC – Ascorbic Acid, NaTHIO – Sodium Thiosulfate

Describe Anomalies:
17C0320-01B & 17C0321-01B both split into a P w/ H2SO4 for subsample of NO2/NO3 & Total Phos. HMW 03/20/17

Contact information / Summary of Actions:
Date / Time:________ Contact:________ Contact By:________
Comments:________

List of Appendices

Appendix 1:
Field Data Collection Guide for Rapid Stream Assessment

Field Data Collection Guide for Rapid Stream Assessment

District Department of Energy & the Environment

Water Quality Division

DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA

2019

Edition #3

LimnoTech
Water Environment | Scientists Engineers

Contact	Telephone
Field Team Coordinator: Matt English	(202) 481-3943 (desk) (202) 308-0453 (cell)
For immediate threat to human health and/or the environment: **DC Fire and EMS Services (FEMS)** **DOEE Emergency Operations:** **Janye Deichmeister** *For controlled spill (typically 5 gallons or less under control), minor equipment leaks, minor sheen, sediment plumes, or sewage (observed or odor):* **DOEE MS4 Operations:** **Ibrahim Famuditimi**	 **911** (202) 535-2262 (desk) (202) 369-3656 (cell) (202) 535-2643 (desk) (202) 439-5698 (cell)
Emergency/Police/Fire/Ambulance	911
Poison Control Center (National Toll Free)	(800) 222-1222
National Response Center	(800) 424-8802

Purpose

This *Field Data Collection Guide for Rapid Stream Assessment* documents data collection protocols, procedures, and assessment and scoring guidance for the evaluation of stream reaches conducted by DOEE's Natural Resources Administration. This guide is intended for use by field assessment teams to help ensure consistent data collection.

Important Safety Reminders

When conducting stream assessments, DOEE's number one priority is to do so safely. Important safety reminders include:

- Always conduct stream assessments in pairs
- Do not enter high stream flows, such as after a rainstorm
- Ensure you are visible, such as in high-traffic areas
- Make sure you carry a charged cell phone in case of emergency
- Make sure the field coordinator knows where you are conducting assessments for the day

TABLE OF CONTENTS

RAPID STREAM ASSESSMENT OVERVIEW

The intent of the Rapid Stream Assessment (RSA) is to collect information to provide a high-level overview of the entire wadeable stream network within the District. This information can help identify potential issues as well as locations that may warrant follow-up inspections or more in-depth evaluations. The information from the RSA can also serve as a baseline with which to compare information from these assessments in the future.

The RSA includes several types of assessments including:

- Reach assessments
    - Open channel (above-ground) streams;
    - Closed channel (underground) streams
    - Outfall reach
- Point assessments
- Watershed notes

Reach and Point assessment types, as well as watershed notes, are discussed further in the following pages.

An assessment will not be performed if:

- *There is no access to a site (e.g., site is fenced off, the property owners have expressly restricted site access),*
- *If there are dangerous conditions, or*
- *If the reach is part of the mainstem (only tributary reaches are assessed in the RSA).*

Reach Assessment: Open Channel Streams

Both perennial and temporary streams are evaluated through the RSA. Reach assessments are performed on 300-meter (approximately 1,000 foot) segments unless a change in stream character occurs first, which will trigger the beginning of a new stream reach. Changes in character may be the result of:

Note: metric as well as **approximate** *conversions in standard measurements (e.g., inches, feet) are provided to aid staff in quickly evaluating data in the field.*

- Changes in flow or water quality characteristics (*e.g.*, clarity, odor)
- Changes in stream geomorphology (*e.g.*, floodplain connectivity, approximate Rosgen classification)
- Changes of in-stream physical habitat (*e.g.*, substrate type, erosion, riparian area)

As shown in Figure 1, data collection will occur from downstream to upstream. The right and left banks will then be oriented as such while looking upstream.

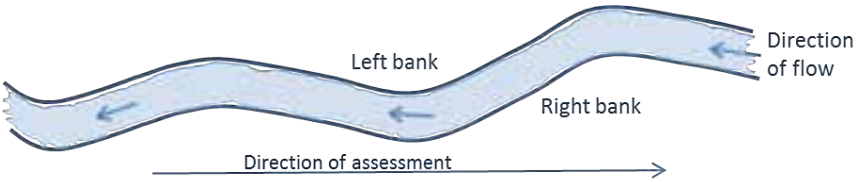


Figure 1. Direction of data collection

Additional discussion on differentiating between overall stream character and identifying the need for a Point Assessment, which captures these discrete issues, is included on page 8.

Within each stream reach, particular points of interest may be identified that are distinct from the overall stream character. This may include features such as a buffer deficiency, which may be visually distinct from the surrounding riparian area conditions.

It could also include distinct or discrete erosion points, which may be more dramatic than surrounding bank erosion.

For each stream reach:

- Basic data, such as field team members, will be recorded.
- A broad range of physical habitat metrics will be assessed for perennial reaches.
- An abbreviated assessment will be conducted on temporary reaches that includes fewer metrics.
- At least one representative photo will be provided for each reach regardless of flow type. Optional comments describing features of reach not fully captured in assessment questions.

How do I identify a temporary reach?

The RSA begins with a field crew following a perennial reach upstream. At some point in the assessment, flow will reduce and, ultimately, cease. While possibly dry during the RSA, there may be pathways for flow following rain events or when the water table is high.

Understanding temporary reaches is an important part of understanding the District's stream network. Identifying these temporary reaches, however, is often challenging as the channel can be inconspicuous, including being covered by leaves and lighter debris. Indicators of a temporary reach can include:

- *slight depression in the substrate*
- *presence of pools*
- *damp or black decomposing leaf litter*
- *silt or sediment accumulating on debris or plants*
- *drift lines where sticks, leaves, and other debris may accumulate on the streambank or surrounding vegetation*

A stream reach will be identified within the GIS-based field form as a line feature (as shown with the two red lines in Figure 2).

The process for identifying and assessing reaches includes:

1. Identifying where the stream reach begins (location "A")
2. Walking upstream from location "A"
3. Identifying any discrete issues that require a Point assessment (*e.g.*, dump sites, deficient buffers). See page 7 for additional information on conducting Point Assessments
4. Identifying when either 300 meters has been walked or there is a change in character that signifies the beginning of a new reach (location "B" in Figure 2)

> *The measurement tool in Collector can be used to determine if 300 meters has been reached.*

5. Drawing a line from the beginning of the reach (location "A) to the end of the reach (location "B")
6. Completing the questions associated with the stream reach metrics at location "B"

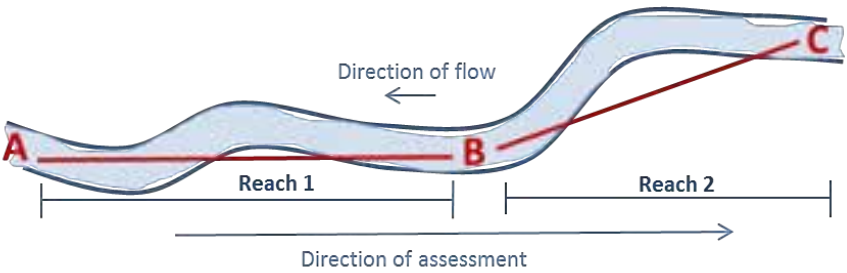


Figure 2. Open channel stream assessment

Note: The line depicting the stream reach (red line in Figure 2) may not coincide with the actual stream channel in some cases, which is acceptable in this assessment.

Reach Assessment: Closed-channel Streams

A closed channel, or underground or piped stream, is typically a conveyance that collects stream flow from an open channel and transports it to downstream point or another open channel reach. A simplified example is depicted in Figure 3, below. The process for identifying and assessing a closed-channel stream includes:

1. Assessing the preceding reach (Reach 1, Figure 2) as discussed on page 5
2. Beginning to draw a line from location "B" (the beginning of the closed channel reach)

   Note: this initial line may be short and not extend yet the length of the channel
3. Evaluating initial reach metrics at location "B"
4. Proceeding upstream to location "C", the end of the closed-channel reach, where the remainder of the metrics will be evaluated
5. Editing the line, if needed, to extend it fully to location "C"

> ***Closed-channel stream*** *– in line with the rest of the stream reach*
>
> ***Outfall*** *– pipes, ditches, and swales that discharges into a waterway*
>
> ***Crossing*** *– structure less than 75 meters that is placed across a waterway, such as a bridge. A crossing may also include culverts/ pipes through which stream flow moves*

Reach 3 (Figure 3) will then be assessed as discussed on page 5.

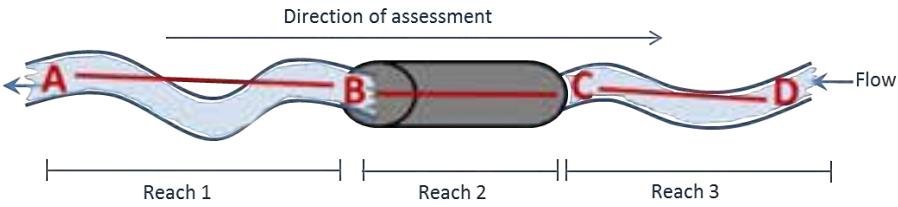


Figure 3. Closed channel stream assessment

Reach Assessment: Outfall Reach

These assessments are to be performed on reaches less than 75 meters in length that have been created by flow coming from an outfall. The same metrics will be evaluated for this assessment as are evaluated for open channel stream reach assessments. Additionally, the outfall at the end of the outfall reach also will need to be assessed separately within a point assessment.

Point Assessments

Points are considered locations within a stream reach where a distinct or discrete feature is identified. This includes:

- Deficient Buffers
- Crossings
- Dumpsites
- Erosion
- Pipes
- Utility lines
- Non-piped Blockage to Fish Passage
- Inaccessible Reach
- Other Impacts

Reminder: *Points are discrete in nature - they are not representative of an entire reach nor reflect a change in character of the reach, which would necessitate the beginning of a new stream reach.*

Each Point Assessment can be flagged as requiring "urgent attention". This allows field staff to identify issues that will require additional follow-up. As the default for this question is "no", it must be actively changed to "yes" is a problem is flagged. Contacts are included in Appendix 4 of the QAPP.

General Data Collection Procedures

Field teams will:

- Collect information on the Point features encountered in each reach regardless of perennial or temporary status.
- Record each observed instance encountered in the field with the following exception:

- Discrete areas of erosion along a reach may be aggregated into a single point as long as the characteristics and impacts are identical.

More than one photo should be taken at a Point if additional visual information will help provide clarification of an issue at a particular location.

- Place Point at center of each feature.
- Take at least one representative photo of each feature.
- Optional comments describing features of the reach not fully captured in assessment questions.
- Place multiple points when a Point feature crosses a Reach break (*e.g.*, deficient buffer or erosion that spans two or more reaches).

Evaluating stream character vs. discrete issues

Stream buffers and erosion issues are evaluated both through the Reach Assessments as well as the Point Assessments. These metrics, however, are evaluated in different ways.

In a Reach Assessment, *Riparian Vegetation* and *Riparian Width* are assessed. These metrics are used to reflect the average character of a stream reach.

A Point Assessment is used to evaluate a specific *Erosion* point or *Deficient Buffer* at a particular location.

Figure 4 demonstrates, in a simplified way, how buffers and erosion points can be evaluated differently. "A" shows a "patchwork" of riparian buffer representing the character of the stream in the Reach Assessment (where green is a riparian buffer and the white gap is the deficient buffer). Alternatively, "B" shows a more isolated and specific location along the reach that should be evaluated further through a Buffer Point Assessment.

Similarly, “C” shows how erosion is part of the overall stream character (depicted through a Reach Assessment), while there are two discrete erosion points in “D” that can be specifically assessed through two Erosion Point Assessments.

Note: Points will be assessed as they are found as the field team walks the 300-meter (approximately 1,000 foot) stream reach (the reach may be shorter if it is determined the character of the reach has changed before this).

These Point assessments will be evaluated before the assessment for that Reach is completed. **It is important to finish either a point or a reach assessment before another is started. Data may be lost if field crews attempt to toggle between assessments.**

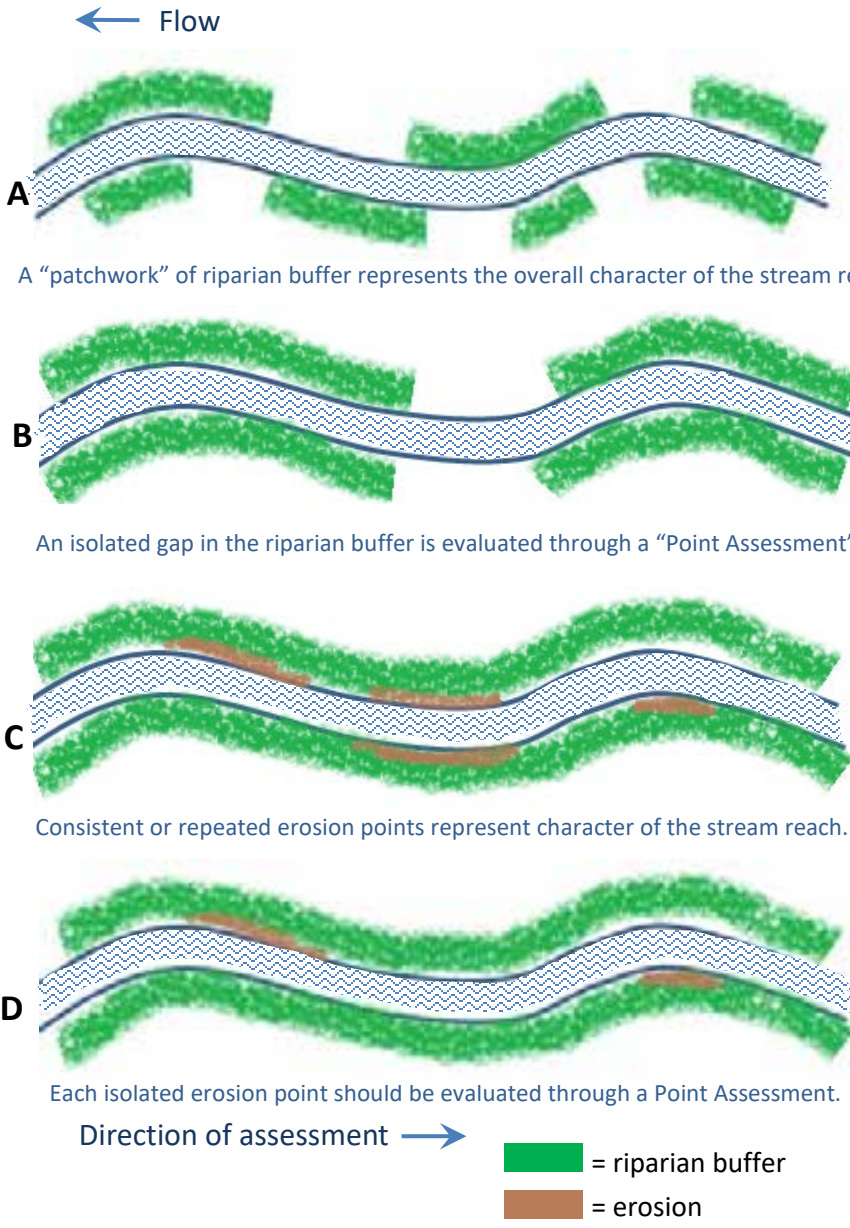


Figure 4. Differentiating between stream character and Point Assessments

REACH ASSESSMENTS

Reach Assessment Metrics

For each stream reach, the following will be evaluated:

Water presence	Is water present: Yes / No • If water is present: is there flow or is the water stagnant/not flowing • If water is not present, but there are characteristics indicative of a stream channel or previous flow, the field form will focus the evaluation on metrics such as, riparian buffer width, etc.
Water clarity	Choose one or more of the following: Clear / Foamy / Greenish / Dark Brown / Light Brown / Milky / Oily Sheen / Reddish / Turbid / Iron Floc / Other • If water clarity is characterized as “other”, describe in text box. • Take a photo of any water discoloration/ clarity issue that may be indicative of a larger issue or may warrant subsequent investigation
Odor (from water or sediment)	Choose one or more of the following: Chlorine / Fishy / Petroleum / Rotten Eggs / Sewage / None / Other • If odor is characterized as “other”, describe in text box

Maximum depth encountered	Record the maximum depth encountered along the reach in centimeters • Enter as positive, numeric value (no fractions)
Average depth	Record the estimated average depth of the reach 0-30 cm / 30-60 cm / >60 cm (0-12 in / 12-24 in / >24-in)
Maximum width	Record the wetted width of the stream in meters 0-1 m / 1-3 m / 3-6 m / >6 m (0-3 ft / 3-10 ft / 10-20 ft / >20 ft)
Aquatic vegetation (not algae)	Choose one or more of the following (examples shown below): Submerged / Emergent / Floating / None If present, note if vegetation type is extensive

Fish presence	Note if fish are absent or present. *(Only note if fish are seen, not if it is <u>possible</u> fish may be present)*
Algae	Note if algae are absent or present (examples shown below). • If present, note if algae area extensive (such as in the photos below)? • If extensive, take a photo of the algae for subsequent evaluation.




If there is a question regarding any metric (e.g., if algae are extensive or not), drop an "other impacts" point, record observations in the comment section, and take a photo at that point for subsequent follow-up.

Bacteria presence	Note if bacteria are absent or present. Bacterial presence can be identified by what appears to be an oily sheen or a rusty coating on the stream bank (iron flocculant). If present: • Is it extensive? • If extensive, take a photo of the bacteria for subsequent evaluation. • Describe the character (iron floc / sheen/ other)

Trash	Note if trash is: Absent – little or none visible in stream channel or riparian area Minor – trash present in minor amounts Moderate – trash present in moderate amounts Extensive – abundant and unsightly

<u>Trash abundance</u>:

1. Minor (e.g., one or two tires)
2. Moderate
3. Extensive (e.g., widespread within stream or riparian area)

Riparian vegetation width	Note the vegetation width on each side of the stream channel Right bank: None / 0-25 m / 25-50 m / >50 m (0-80 ft / 80-165 ft / >165 ft) Left bank: None / 0-25 m / 25-50 m / >50 m (0-80 ft / 80-165 ft / >165 ft) Determine if any lack of vegetation is characteristic of the whole stream reach or if it is a discrete issue that will require further evaluation through a "Deficient Buffer" point assessment (reminder: see page 8).
Dominant riparian vegetation	Rank up to four the types of riparian vegetation in order of abundance within 50 meters of the stream (or visual distance if 50 meters is not within the sightline): Right bank: Grasses / Forbs / Shrubs / Trees / None / Other Left bank: Grasses / Forbs / Shrubs / Trees / None / Other • If "other" is specified, describe in text box

A forb is defined as an herbaceous plant that is not a grass.

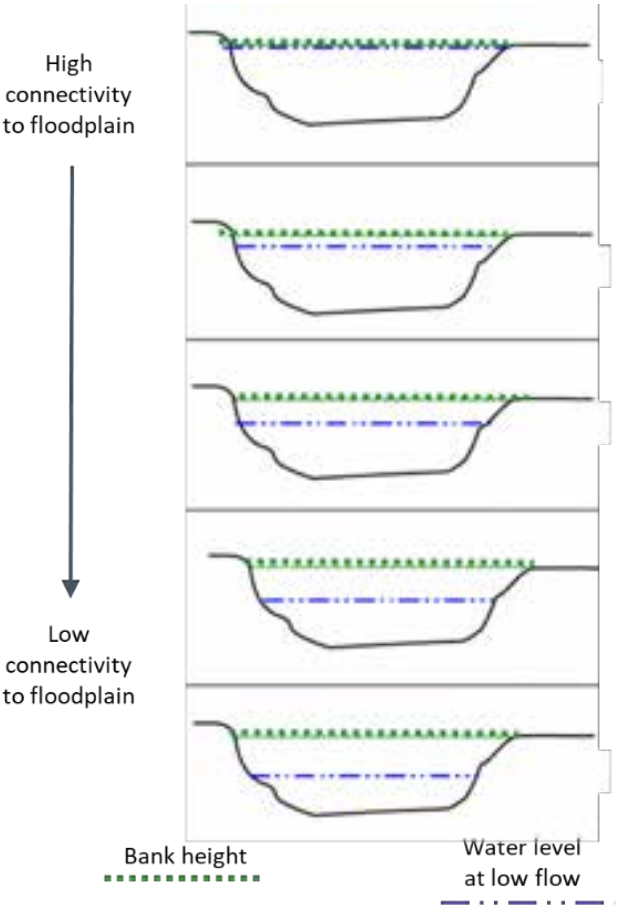
Substrate type	Rank in order of abundance (up to 4): Sand / Gravel / Clay / Cobbles / Boulders / Concrete Channel / Bedrock / Other • If “other” is specified, describe in text box
Shading	Estimate degree and duration of shading during summer leaf-out as: Low shading – less than 25% shaded Medium shading – 25% to 75% High shading – more than 75% shaded

Floodplain Connectivity

The figure below provides a simplistic guide for evaluating how readily flows may escape the channel into the floodplain. Other indicators can include matted vegetation in the riparian area and deposition of sediment, trash or debris.

Characterize the connectivity to the floodplain:

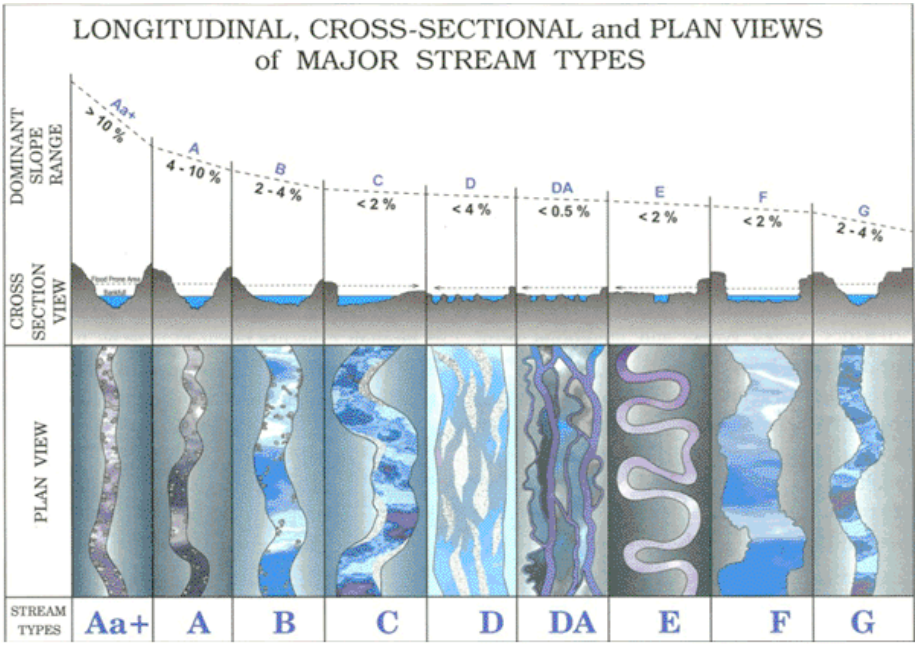
High / Medium / Low:



Bank erosion	Evaluate the impact of erosion on each bank. The banks are oriented by looking upstream. The right bank and left bank will be evaluated separately. Check all that apply: • None (little to no erosion is present or does not appear to be causing issues) • Instream degradation (e.g., substrate sedimentation, filling in of riffles) • Adding to sediment loading (e.g., turbidity) • Slumping banks • Falling trees/vegetation • Threat to property (e.g., buildings, yards) • Threat to infrastructure (e.g., bridge or road may collapse, fence may fall) • Exposed infrastructure (e.g., exposed pipe) • Other (describe observations)
Woody debris and root wads	Count the woody debris/root wads within the channel as the field team moves up stream. This should include: • Woody debris >10 cm (4 in) diameter, more than 1.5 m (5 ft) long • Root wads on live trees with a diameter at breast height (DBH) of at least 15 cm (6 in) • Only woody debris or root wads found in wetted (or likely to become wetted) portions of stream

Approximate Rosgen Classification

Perform quick estimate of Rosgen Level I stream type classification using the following figure:



Rosgen, David L. "A classification of natural rivers." Catena 22 (1994): 179. www.wildlandhydrology.com

> ***Note**: Photos can be labeled within the data collection platform to help distinguish what the photo is of (e.g., 1st photo: "downstream view", 2nd photo "upstream view".*

Photo Tips

Where possible, take photo from a location that best captures channel sinuosity and slope represented by the Rosgen category.

Recreation evidence	Identify if there is any evidence of recreation along the stream reach. Select all that apply: None / Rafts / Life jackets / Rope swings / Marked Trails / Unmarked Paths / Coolers / Fishing line / Other If “other” is selected, describe observations.

Photo Tips

Take photo within channel. Photo should capture channel cross section and floodplain (see below) and should be representative of entire reach.

POINT ASSESSMENTS

Deficient Buffers

Deficient buffers are stretches of riparian area without sufficient canopy or understory. The deficient buffer may still include vegetation (*e.g.*, lawn) or may consist of impervious surface (*e.g.*, parking lot).

Buffer deficiencies should be recorded for areas within 50 meters (approximately 165 feet) of the stream channel.

Linear footage of the buffer deficiency should be reported as the longitudinal distance along the stream. A deficiency reported on both sides of the stream should be measured as the average distance on both sides of the stream

> ***Note:*** *The riparian area is considered 50 meters on each side of the stream reach, for a total of 100 meters.*

Example: the deficiency should *not* be doubled if it appears on both sides of the stream; if there is 20 meters (65 feet) of deficiency on the right bank and 40 meters (130 feet) of buffer deficiency on the left bank, it should be recorded as 30 meters (approximately 100 feet) on both banks).

Stream bank where deficient buffer occurs	Looking upstream, on which side does the deficient buffer exist: • Right / Left / Both

Length of deficiency	The length of deficiency is the area along the length of stream Estimate the length of the deficiency within one of the following: 0-25 m / 25-50 m / >50 m (80 ft / 80-165 ft / >165 ft)
Type of cover in deficient buffer area	Identify what types of cover are present within the 50-meter riparian area: Lawn / Invasives / Pavement / Structure (*e.g.*, retaining wall) / Other • If “other”, describe in text box

Impact score	Estimate the extent of the impact that this deficient buffer has on the stream reach: • *Severe:* Impervious/commercial area in close proximity to stream, banks may be modified or engineered. Stream character such as bank/bed stability, sediment deposition, and/or shading is obviously degraded by adjacent use. • *Moderate:* Some impervious and/or just turf up to the bank, very little vegetation aside from turf within 50-meter (165 feet) riparian area, stream character probably degraded by adjacent uses. • *Minor:* Encroachment mostly from residential uses and yard; some vegetation within 50-meter riparian area, but very little other than turf within remainder of 50-meter riparian area; stream character may be changed slightly by adjacent use. • *None:* Vegetated buffer primarily intact within 50-meters of stream.

Photo Tips

Take photo that captures the buffer deficiency's proximity to the stream, if possible (*e.g.*, stream channel in the foreground). Also ensure that the buffer type is discernible.

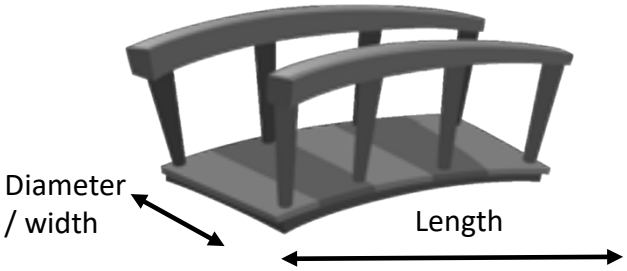
Crossings

Crossings are defined as points within the stream reach through which the stream must pass. This is different than an underground/ piped stream reach, which is in line with the remaining stream bed and is often longer than a crossing would be. If a crossing has already been documented, it will be included on the map included in the Collector tool that includes DCGIS GIS information.

- <u>If the Crossing is not inventoried</u> (does not already exist on the map):
  - Drop a point within GIS
  - Assess the metrics
- <u>If the Crossing is already documented:</u>
  - Verify the information currently documented
    - If correct, no additional steps are needed.
    - If not correct, then drop a point and address the metrics.

Type	Box / Elliptical / Circular / Bridge / Foot Bridge / Other • If another type of crossing is identified, specify in the notes section
Diameter/ width	0-1m / 1-5m / >5m (0-3 ft / 3-16 ft / >16 ft)

Length	0-1m / 1-5m / >5m (0-3 ft / 3-16 ft / >16 ft)



Material	Concrete / Corrugated Metal / Plastic / Wood / Other • If there is a material that is not one of the above, specify in the notes section
Downstream debris	Yes / No
Downstream bed erosion	Yes / No Erosion height: 0-1m / 1-2m / >2m (0-3 ft / 3-6 ft / >6 ft) • Erosion here can include the measurement from the bottom of the pipe, culvert, etc. to the stream bed.
Downstream sediment	Yes / No

Upstream debris	Yes / No
Upstream bed erosion	Yes / No Erosion height: 0-1m / 1-2m / >2m (0-3 ft / 3-6 ft / >6 ft) • Bed erosion is measured from the bottom of the pipe to the bottom of the eroded stream bed.
Upstream sediment	Yes / No
Impact score	Estimate the extent that this crossing has on the stream reach: • *Severe:* Condition probably poses threat to road or other structure. Problem should be addressed to avoid bigger problem in future. • *Moderate:* Condition does not appear to pose threat to road or other structure, but should be addressed to enhance stream integrity and future stability of structure. • *Minor:* Condition is noticeable but may not warrant repair. • *None:* No observable impact as a result of the crossing.

Photo Tips

Take photos at both the downstream and upstream ends of the crossing. If possible, take photos from within stream channel. Photo should provide appropriate context and include the crossing structure as well as the stream bed and banks. Include all barrels in single photo, if possible. Highlight erosion or sediment or debris deposition, if present, in additional photos, if needed.

Dumpsites

Dumpsites are points at which trash and debris has been purposely deposited (this is different than locations where trash appears to accumulate, although in some cases, distinguishing these may be difficult.

In general, record only dumpsites encountered within your visual distance within the riparian area.

Bank where the dumpsite is located	Right / Left / Both • Reminder: bank side (right or left) is determined by looking upstream.
Location of the dumpsite	Bank / Floodplain / Instream /Other • If "other", specify in the notes section
Cleanup potential	Yes / No • Consider the ease of access, the weight or bulk of the items, and any potential hazards to cleanup crews
Dumped material	Appliances / Petroleum / Tires / Trash / 55 gal drum / Other • If "other", specify in the notes section

Trash volume	<20 sq. m / 20-200 sq. m / >200 sq. m (215 sq ft / 215-2,150 sq ft / > 2,150 sq ft) • When estimating the volume of material at the dumpsite, this value must be a compacted volume. Estimates of volume should ignore void space and account only for the volume of physical materials that compromise the objects.
Impact score	*Severe:* Active and/or threatening. Material may be considered toxic or threatening to environment (concrete, petroleum, empty 55 gallon drums) or site is large (>750 sq. meters / 8,073 sq ft). *Moderate:* Dumpsite (<750 sq. meters) containing non-toxic material, does not appear to be used often, however clean-up would definitely be a benefit. *Minor:* Dumpsite appears small (<20 sq. meters / 215 sq ft) and material stable (will not likely be transported downstream by high water). Not high priority. *None:* No observable impact as a result of the dumpsite.

Photo Tips

Take photo that captures context of dumpsite relative to the stream, if possible. Take additional photos that capture the largest impact items.

Erosion

This Point Assessment is triggered by the identification of discrete erosion point that is distinct in nature from the character of the rest of the stream reach.

- Discrete areas of erosion along a reach may be aggregated into a single point as long as the characteristics and impacts are identical. For instance, similar erosion on both sides of a particular area of the stream bank can be included as one point.
- Multiple erosion points should be placed along the stream reach when erosion crosses a reach break (*e.g.*, erosion that spans two or more reaches).
- The length of the erosion point should be reported as the longitudinal distance along the stream.
- Reminder: bank side (right or left) is determined by looking upstream.

Erosion location	Note the side of the bank experiencing erosion: (Right / Left / Both)
Length	Note the length of the erosion point: Right bank: 0-3 m / 3-5 m / 5-8 m / >8 m (0-6.5 ft / 6.5-16 ft / 16- 26 ft / >26 ft) Left bank: 0-3 m / 3-5 m / 5-8 m / >8 m (0-6.5 ft / 6.5-16 ft / 16- 26 ft / >26 ft)

Bank height	Identify the bank height at the point of erosion: Right bank: 0-1m / 1-2m / 2-3m / 3-4m / 4-5m / 5-6m / >6m (0-3.5 ft / 3.5-6.5 ft / 6.5-10ft / 10-13 ft / 13-16 ft / 16-20 ft / >20 feet) Left bank: 0-1m / 1-2m / 2-3m / 3-4m / 4-5m / 5-6m / >6m (0-3.5 ft / 3.5-6.5 ft / 6.5-13 ft / 13-16 ft / 16-20 ft / >20 feet)
Impact	Evaluate the impact of erosion on each bank. The banks are oriented by looking upstream. The right bank and left bank will be evaluated separately. Check all that apply: • None (little to no erosion is present or does not appear to be causing issues) • Instream degradation (e.g., substrate sedimentation, filling in of riffles) • Adding to sediment loading (e.g., turbidity) • Slumping banks • Falling trees/vegetation • Threat to property (e.g., buildings, yards) • Threat to infrastructure (e.g., bridge or road may collapse, fence may fall) • Exposed infrastructure (e.g., exposed pipe) Other (describe observations)

Photo Tips

Take photos that capture bank(s) with erosion in context of the stream. Also include area upstream or downstream of immediate erosion, if possible.

Pipes

Pipes, or discharge points to open channels, are discharges into the stream reach. In general, record only pipe outfalls that are encountered within your line of sight within the riparian area.

Standing water in a downstream channel should not be used as a surrogate for discharge quality parameters when no flow is present. Poor quality standing water should be noted, however, in the *Notes* field.

Upon locating a pipe that discharges into the stream reach determine if the pipe/discharge point is currently included/inventoried in the GIS data layer.

> ***Note:*** *It can be difficult to know if a pipe or outlet has just been placed on the map in the wrong location or if it is actually missing from the map and needs to be added. If there is a question regarding this, drop a point and flag it for follow-up.*

- <u>If the Pipe is **not** inventoried</u>:
  - Drop a point within GIS
  - Assess the metrics in groups A and B.
- <u>If the Pipe is already documented:</u>
  - Verify the information currently documented
    - If correct and the pipe has no discharge, no action is necessary.
    - If correct but the pipe has discharge, assess metrics in group B

- If not correct, drop a point as if it was not inventoried and assess metrics in groups A and B.

A.

Bank where pipe is located	Right / Left / End of outfall reach
Pipe diameter	0-15cm / 15-30cm / 30-45cm / >45cm (0-6 inches / 6-12 inches / 12-18 inches / >18 inches)
Type of pipe material	Clay / Corrugated Metal / High-density Polyethylene (HDPE) / Iron / Polyvinyl Chloride (PVC) / Reinforced Concrete / Riprap / Other • If there is another type of material used, specify in the notes section
Floating solids/ trash	Yes / No
Erosion due to pipe	None / Minor / Moderate / Severe *Severe:* Large area of erosion that is damaging stream habitat and/or causing obvious instream degradation. *Moderate:* Moderate area of erosion that may be damaging habitat and causing some instream degradation. *Minor:* Minor area of erosion, no noticeable instream degradation.

Impact	Severe / Moderate / Minor / None *Severe:* Pipe causing a severe erosion and/or has discharge which may be illicit. *Moderate:* Pipe has discharge occurring but there is no indication this discharge is illicit. *Minor:* Pipe is causing some erosion but there is no discharge occurring. *None*: Pipe is not causing erosion problem and no discharge is occurring. No observable impact as the result of the pipe. • If severe, take a photo of the location
B.	
Discharge concern	Indicate all immediate concerns regarding this discharge which may indicate there is an illicit connection. Sheen (e.g. oil, bacterial) / Odor (e.g. chlorine, fishy, petroleum, sewage, rotten eggs) / Discharge is foamy or ill colored (e.g. greenish, dark brown, milky, reddish) / Deposit or Stain / Other / None • If “other”, specify in the text box • Enter “none” if discharge has no concerning characteristics

Photo Tips

Context is important, do not zoom in on pipe opening, include flow path out of pipe and erosion, if present.

Utility Line

Utilities are sometimes found near or crossing stream channels. In some cases, these crossings can impact the stream channel by causing erosion or by leaking pipe contents.

Utility line type	Is this an exposed sewer line: Yes / No • If not, note what type of utility line it is by entering text into the associated text box.
Utility line diameter	What is the diameter of this utility line? 0-6in / 6-12in / 12-18in / >18in
Utility line material	Note the type of material the utility line is made of from the drop down list: Clay / Corrugated Metal / High-density Polyethylene (HDPE) / Iron / Polyvinyl Chloride (PVC) / Reinforced Concrete / Riprap / Other
Utility line condition	Categorized the condition of the utility line: • Poor: utility line is exposed and in need of immediate repair or repair in the future • Fair: Utility line Is exposed and aging • Good: Utility line is exposed, but condition of pipe does not warrant urgent attention Take a photo of the utility line, being sure to capture any leaks or associated impacts to the stream reach.

Photo Tips

Include location of utility line relative to stream and/or banks. Use additional photos as necessary to capture any erosion or other impacts.

Non-piped blockage to fish passage

Blockages to fish passages are locations where there is greater than a **0.3 meters** (approximately one foot) change in stream bed elevation.

Fish blockage present	Record only non-piped blockages. Blockages will be assumed to be possible up/downstream of all closed channel reaches. Record the height of the fish blockage: 0.3-0.5 meters / 0.5-1 meters / >1 meter (1-1.6 feet / 1.6-3.3 feet / >3.3 feet) Take at least one photo of the fish blockage. Note if the blockage is natural or man-made.

Inaccessible Reach

Occasionally, a stream reach that should be assessed may be visible, but inaccessible, from the location where the field team is currently assessing. For instance, a side channel may require assessment, but access to this reach may be blocked by a fence or is too deep.

The location of this inaccessible reach will be identified by dropping a point in GIS. Include in the comment box any information that may be needed for the subsequent investigation.

Other Impacts

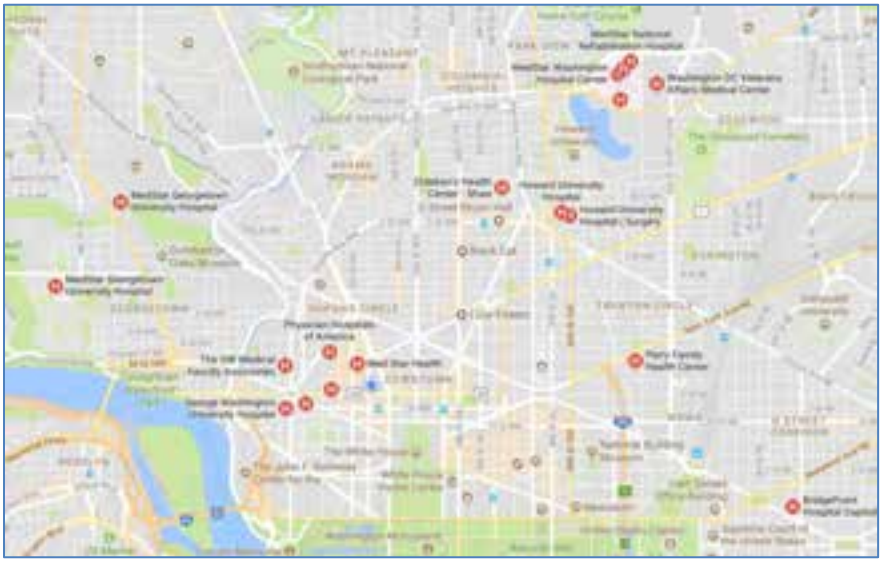
Any additional issues identified by field staff during the RSA (*e.g.*, erosion and sediment control violations; exposed utilities that are causing erosion issues; anything unsafe, such as sudden drops from an outfall, partially collapsed crossing, etc.) should also be documented. To do this:

- Select “Other Impacts”
- Drop a point
- Take one or more photos of the impact
- Provide a brief description of the impact in the notes section

WATERSHED NOTES

Due to the comprehensive nature of the RSA, it is possible that field staff may make observations representative at a watershed scale, in addition to individual stream reaches. When field staff make these observations they should be documented as ‘watershed notes’ either in the Collector/Survey 123 tool or in the ArcGIS dashboard.

Hospitals/Emergency Care Facilities



Hospital	Address	Phone Number
George Washington University Hospital	900 23rd Street NW	202-715-4000
MedStar Georgetown University Hospital	3800 Reservoir Road NW	855-546-2805
Howard University Hospital	2041 Georgia Ave NW	202-865-6100
Sibley Memorial Hospital	5255 Loughboro Road NW	202-537-4000
MedStar Washington Hospital Center	110 Irving Street NW	202-877-7000

Appendix 2:
Quality Assurance & Quality Control Program for Rapid Stream Assessments

Quality Control & Quality Assurance Program for Rapid Stream Assessments

District Department of Energy & the Environment

Water Quality Division

DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA

2019

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Water Environment | Scientists Engineers

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Purpose

The District Department of Energy and Environment's (DOEE) Water Quality Division (WQD) is responsible for assessment of receiving waters within the District of Columbia. The Rapid Stream Assessment (RSA) allows DOEE to provide a high-level overview of the entire wadeable stream network within the District.

DOEE developed the RSA program to comply with the District of Columbia's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit issued by the U.S. Environmental Protection Agency (USEPA).

This manual identifies a two-tiered approach to Quality Assurance and Quality Control in association with the RSA program and describes the level of accuracy and precision which is required to ensure RSA QAQC standards are upheld.

Important Safety Reminders

When conducting stream assessments, DOEE's number one priority is to do so safely. Important safety reminders include:

- Always conduct stream assessments in pairs
- Do not enter high stream flows, such as after a rainstorm
- Ensure you are visible, such as in high-traffic areas
- Make sure you carry a charged cell phone in case of emergency
- Make sure the field coordinator knows where you are conducting assessments for the day

Contents

Staff Certification

All certification related records (i.e. certification levels, training attendance, audit performance results) shall be maintained by the Project QA/QC Reviewer.

Certification Levels

The first tier of the RSA QA/QC approach is staff certification. All staff participating in the RSA program shall be certified to conduct these assessments. Certification level will be based upon completed training, audits, and the number of assessment hours complete. Certifications will be updated near the beginning of each field season immediately following annual training and audits.

Level A certification indicates that a staff person is an expert in the RSA program.

Level A certification can be obtained by staff members who have:

- Completed a lifetime minimum of 48 RSA hours as a Level B certified staff person
- Successfully completes annual training; and
- Passed a required field audits within the past two years

Level A certification is maintained by:

- Successfully completing annual training;
- Passing a required field audits every two years; and
- Completing a minimum of 48 RSA hours annually

Staff with Level A certification may serve as Field Data Collection Team Leads, conduct trainings, and/or serve as auditors.

Level B certification indicates that a staff person has demonstrated an ability to properly conduct assessments but does not have significant experience doing so.

Level B certification can be obtained by staff members who have:

- Completed a lifetime minimum of 16 RSA hours under the supervision of a Level A certified team lead;
- Successfully completed annual training; and
- Passed a required field audits within the past three years

Level B certification is maintained by:

- Successfully completing annual training;
- Passing a required field audits every three years; and
- Completing a minimum of 8 RSA hours annually

Whenever possible, Level B certified staff should work with a Level A certified staff person to conduct RSA activities. Level B certified staff should not be assigned to conduct RSA activities with an uncertified person.

Training Requirements

All staff participating in the RSA program will participate in appropriate training activities. All training will be conducted by Level A certified team leads. Returning staff will attend an annual, in-office training session focused on reviewing the procedures for RSA and for scoring the metrics described in the field manual. This annual training will be held each spring each spring within 1 month prior of RSA activities commencing. Training for new team members will consist of comprehensive in-office and field components.

Audit Requirements

All certified staff will be audited every 2-3 years based upon their certification level. The purpose of these audits are to ensure that all staff are able to demonstrate proper application of all knowledge and skills necessary for conducting RSAs. Audits will be held each spring within one month of RSA activities commencing. Audits will be performed by Level A certified staff observing auditees in the field while they conduct RSAs. A checklist of proficiencies which auditors expect to be demonstrated during these audits can be found in Appendix A.

All staff, regardless of certification level, must demonstrate 'acceptable' proficiency for at least 75% of the knowledge/skills. If 75% of the knowledge/skills are not deemed acceptable during an audit, field staff will receive repeat training before being allowed to retake their audit. Field staff who are unable to pass their audit will not participate in RSA that year. They may re-attempt certification the following field season.

Field Verification

The second tier of the RSA QA/QC approach is field verification. In order to ensure reproducible data are being collected, a subset of all streams (5%) will be assessed in duplicate. To the extent possible, both staff and streams for field verification will be selected at random.

Field verification will involve two assessment teams completing a RSA of the same stream reach(s) independently from one another. Teams will conduct the assessment at least two hours apart to minimize influence on each other, but on the same day to help ensure similar conditions exist in the reach. Teams will also record data using a mirror copy of the projects Collector/Survey123 data collection tool so that they cannot see each other's assessment data.

During the first year of the RSA program, duplicate assessments were used to determine expected levels of variation between by two, Level A certified teams. In subsequent years, field staff will be selected at random and the duplicate assessments they conduct must fall within the expected variation established in year one (Appendix B). Duplicate assessments will be evaluated using the appropriate acceptability rubric (Appendix C). If duplicate assessments exceed expected variation, the appropriate data flag will be assigned in the geodatabase and corrective action (i.e. additional training) will be taken as is detailed in the project's Quality Assurance and Protection (QAPP).

During subsequent years of the RSA program, field verification will occur on a monthly basis. A high-level review of the data will be performed to ensure that there are no significant differences in data collection that would warrant additional training or protocol review with staff. The full analysis of the QA/AC data will be performed at

the end of the field season to ensure sufficient data points[1] for a robust analysis.

[1] If 5% of the total assessed distance does not yield at least 20 reaches, duplicate assessments should continue until this minimum is reached.

Appendix A: RSA Auditor Checklist

Knowledge/Skill	Acceptable	Not Acceptable (note why)
Staff conducts RSAs in the correct direction, relative to flow direction		
Staff records RSA observations/survey in the appropriate order and at the appropriate[2] locations		
Staff creates new line features in Collector as intended		
Staff creates new point features in Collector as intended		
Staff accesses Survey 123 forms from within Collector		
After submitting a Survey 123 form, staff verifies it has synced back to Collector (cellular data/wifi service permitting)		
Staff is able to turn reference layers on/off in the Collector map		
Staff never edits an already submitted Survey 123 form from within the Collector app		

[2] Appropriate/appropriately is defined here as being done so according to applicable SOPs and protocols.

and they do not click the survey hyperlink within Collector in an attempt to re-open a previously submitted survey form.		
Staff demonstrates ability to use Collector's "measurement tool"		
Staff appropriately distinguishes between features characteristic of reach vs. discrete point features		
Staff knows where to appropriately break reaches based on maximum length		
Staff knows where to appropriately break reaches based on character change		
Staff appropriately identifies changes in flow or water quality (e.g. clarity, odor)		
Staff appropriately identifies changes in stream geomorphology (e.g. channel incision, Rosgen classification)		
Staff appropriately identifies changes of instream physical habitat (e.g. substrate type, erosion, riparian area)		
Staff appropriately identifies the presence of temporary reaches		

Staff appropriately identifies deficient buffers		
Staff appropriately identifies crossings		
Staff appropriately identifies dumpsites		
Staff appropriately identifies point erosion		
Staff appropriately identifies pipes		
Staff appropriately identifies utility lines		
Editing field collected data using RSA Dashboard (Level A staff only)		
Ability to contribute watershed notes (Level A staff only)		

Appendix B: Acceptable Variation in Data Collection

Many elements of the RSA program are inherently qualitative. Although staff certification is intended to help ensure that assessments are reproducible, some amount of variation is still expected. This section describes the amount of variation which is acceptable during field verification activities.

Two sets of criteria have been identified for this process. Criteria 1 includes the possible responses for each metric, as discussed below (e.g., identical match, difference with explanatory comment) at the site level (e.g., Overlap 1, Point 1). Each site will be scored according to the percent of all of the metrics passing at that site.

Criteria 2 includes the percentage of agreeance for a particular metric across all of the sites (e.g., shading at Overlap 1 through Overlap 18). Each metric will be assessed by factors such as the number of sites that matched identically for that metric and/or the percentage of responses that passed Criteria 1 evaluation.

Each of the metrics used in Criteria 1 and 2 are described below. Appendix C demonstrates how these criteria are scored and used in conjunction with one another to assess consistency at both the metric and overall site level.

Reach Assessment Metrics

Reach Type	90% of responses should pass. Passing Responses are: • Identical Match • Difference with explanatory comment *Example:* Team 1 - "Closed channel"; "Evidence of surface flow too" Team 2 - "Open channel"

Water presence	85% of responses should match identically and 90% of responses should pass. Passing responses are: • Identical Match • Difference with explanatory comment *Example:* Team 1 - "Yes" Team 2 - "No"; "Reach mostly dry but several wet patches present"
Water Flow	90% of responses should pass. Passing Responses are: • Identical Match • Difference with explanatory comment *Example:* Team 1 - "Stagnant" Team 2 - "Flowing"; "Very little to no distinguishable flow"
Water clarity	60% of responses should match identically and 75% of responses should pass. Passing responses are: • Identical Match • At least one common water clarity AND no more than two differing responses per assessment

Odor	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • If presence/absence of odor differs – no more than 1 odor present • If odor is present but differs – assessments should include at least one common odor
Maximum depth encountered	80% of responses should pass. Passing responses are: • Max depth is <100cm and responses differ by <5cm • Max depth is >100cm and responses differ by <20%
Average depth	75% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Maximum width	65% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Fish presence	85% of responses should pass. Passing responses are: • Identical Match
Aquatic vegetation	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Assessments include at least one common vegetation type and no more than one differing type
Algae	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match in regards to presence/absence • Compared responses do not indicate both “absent” and “extensive”
Bacteria presence	75% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match in regards to presence/absence • Responses do not match in regards to presence/absence but bacteria is not extensive

Trash	60% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Riparian vegetation width	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category on either bank
Riparian vegetation type	85% of responses should pass. Passing responses are: • Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 and top ranked vegetation type of Team 2 is within the top two vegetation types ranked by Team 1 • Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 AND Top ranked vegetation type of Team 2 is listed by Team 1.

Substrate type	85% of responses should pass. Passing responses are: • Top ranked substrate type of Team 1 is within the top two substrate types ranked by Team 2 AND Top ranked substrate type of Team 2 is within the top two substrate types ranked by Team 1. • Top ranked substrate type of Team 1 is within the top two substrate types ranked by Team 2 AND Top ranked substrate type of Team 2 is listed by Team 1.
Shading	60% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Floodplain Connectivity	75% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Bank erosion	75% of responses should pass. Passing responses are: • Identical Match • If presence/absence of bank erosion differs – Compared responses should not include both “non” and more than 1 impact • If bank erosion Is present – assessments should include at least one common impact and no more than 2 differing impacts
Woody debris and root wads	60% of responses should pass. Passing responses are: • Responses which do not differ by >5 or exceed 65% difference (whichever is greater)
Recreation evidence	60% of responses should match identically in regards to presence/absence and 85% of responses should pass. Passing responses are: • Identical Match • Responses which include “none” and not more than 1 recreation type • Responses which do not include “none” and include at least one common type and no more than 1 differing type of recreation per assessment

Rosgen Classification	60% of responses should match identically and 80% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Point Assessment Metrics

Deficient Buffers

Bankside	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Length of deficiency	85% of responses should pass. Passing responses are: • Identical Match • One common bankside
Type of cover in deficient buffer area	85% of responses should pass. Passing responses are: • Identical Match • All, or all but one, type of covers are the same on both assessments
Impact score	85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Crossings

Type	85% of responses should pass. Passing responses are: • Identical Match
Diameter/ width	65% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Length	65% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Material	75% of responses should pass. Passing responses are: • All, or all but one, of the material type(s) are the same on both assessments
Downstream debris	85% of responses should pass. Passing responses are: • Identical Match

Downstream bed erosion	75% of responses should match in regards to presence/absence and 85% of responses should pass. Passing responses are: • Responses match in regards to presence/absence and erosion height is within one category (if present) • Responses do not match in regards to presence/absence but erosion height is 0-1m
Downstream sediment	85% of responses should pass. Passing responses are: • Identical Match
Upstream debris	85% of responses should pass. Passing responses are: • Identical Match
Upstream bed erosion	75% of responses should match in regards to presence/absence and 85% of responses should pass. Passing responses are: • Responses match in regards to presence/absence and erosion height is within one category (if present) • Responses do not match in regards to presence/absence but erosion height is 0-1m
Upstream sediment	85% of responses should pass. Passing responses are: • Identical Match

Impact score	85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Dumpsite

Bankside	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Location of the dumpsite	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Cleanup potential	85% of responses should pass. Passing responses are: • Identical Match

Dumped material	80% of responses should pass. Passing responses are: • All, or all but one, of the dumped material(s) are the same on both assessments
Trash volume	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Impact score	85% of responses should pass. Passing responses are: • Identical Match Responses do not differ by more than one category

Erosion

Bankside	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Bank height	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Impact	75% of responses should pass. Passing responses are: • Identical Match • If presence/absence of bank erosion differs: Compared responses should not include both “none” AND more than 2 impacts. • If bank erosion is present: Assessments should include at least one common impact AND no more than 2 differing character type per assessment

Pipes

Bank where pipe is located	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Pipe diameter	75% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Type of pipe material	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Difference with explanatory comment
Floating solids/ trash	85% of responses should pass. Passing responses are: • Identical Match
Erosion due to pipe	65% of responses should match identically and 75% should pass. Passing responses are: • Identical Match • If presence/absence of erosion differs: Compared responses should not include both “none” AND more than 2 impacts. • If erosion is present: Assessments should include at least one common impact AND no more than 2 differing character type per assessment

Impact	75% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Discharge concern	85% of responses should pass. Passing responses are: • All, or all but one, of the discharge concern is listed on both assessments (is discharge is present)

Utility Line

Utility line type – Is this an exposed sewer?	85% of responses should pass. Passing responses are: • Identical Match
Utility line diameter	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Utility line material	80% of responses should match identically and 85% pass. Passing responses are: • Identical match • Difference with explanatory comment

Utility line condition	80% of responses should match identically and 85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category
Utility line impact score	85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Fish blockage

Man-made	85% of responses should pass. Passing responses are: • Identical Match
Height	85% of responses should pass. Passing responses are: • Identical Match • Responses do not differ by more than one category

Appendix C: Acceptability Rubrics

Reach Rubric

Point Rubric

Assessment Conflicts

Appendix 3:
Standard Operating Procedures for using RSA Technical Tools

Standard Operating Procedures for Using RSA Technical Tools

Department of Energy & the Environment

Water Quality Division

DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA

2019

LimnoTech
Water | Environment | Scientists | Engineers

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Water Quality Division

TYPE	REVISION
Planning and Reporting Branch	**0**
TITLE	EFFECTIVE DATE
Standard Operating Procedures for Using RSA Technical Tools	**5/1/2019**

PURPOSE

This document provides instructions for using Rapid Stream Assessment (RSA) Technical Tool including Collector for ArcGIS, Survey 123, and Operations Dashboard. It also covers procedures for backing up, viewing, and downloading collected data.

REVISION SUMMARY

APPROVED BY

Branch Chief _____ Date _____

Associate Director _____ Date _____

Table of Contents

1.0 Background

The District Department of the Environment (DOEE) Water Quality Division is responsible for the assessment of receiving waters within the District of Columbia. The Rapid Stream Assessment (RSA) allows DOEE to provide a high-level overview of the entire wadeable stream network within the District. This information can help identify potential issues as well as locations that may warrant follow-up inspections or more in-depth evaluations. The information from the RSA can also serve as a baseline with which to compare information from these assessments in the future. This assessment is being used to help comply with the District of Columbia's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit issued by the U.S. Environmental Protection Agency (USEPA).

This document provides instructions for using Rapid Stream Assessment (RSA) Technical Tool including Collector for ArcGIS, Survey 123, and Operations Dashboard. It also covers procedures for backing up, viewing, and downloading collected data.

2.0 Hardware and Software Set-up

2.1. Selection of Mobile Devices

Mobile devices used for RSA data collection must have ESRI's Collector and Survey 123 downloaded (See Section 2.2 for system requirements). Devices must have cellular data service and/or be capable of connecting to a mobile wi-fi hotspot. In addition mobile devices should have a built-in camera and have GPS capabilities.

2.2. Mobile App Downloads

Mobile devices used for RSA data collection must have ESRI's Collector and Survey 123 downloaded. Downloading Adobe Acrobat Reader or another pdf reader is also recommended to allow the electronic version of the Field Guide to be saved to the device before initiating the RSA.

2.2.1. Collector

There are two versions of Collector currently available:
- Classic Collector
- Collector for ArcGIS[1]

The choice between which version of Collector can be made based upon the specs of the available mobile device and/or user preference. The RSA tool is fully featured and compatible with both.

The system requirements for Classic Collector can be referenced here:

https://doc.arcgis.com/en/collector-classic/overview/requirements.htm

[1] Collector for ArcGIS is currently only available for iOS (*March 2019*)

The system requirements for Collector for ArcGIS can be referenced here:

https://doc.arcgis.com/en/collector/faq/requirements.htm

Classic Collector can be downloaded at:

https://doc.arcgis.com/en/collector-classic/

Collector for ArcGIS can be downloaded at:

https://www.esri.com/en-us/arcgis/products/collector-for-arcgis/resources

2.2.2. Survey 123

The system requirements for Survey 123 can be referenced here:

https://doc.arcgis.com/en/survey123/reference/systemrequirements.htm

Survey123 can be downloaded at:

https://doc.arcgis.com/en/survey123/download/

2.3. Login Credentials

An ArcGIS Online (AGOL) or Enterprise account will be needed to sign into Collector and Survey 123. Note that ESRI does not allow the same account to be logged into at the same time on multiple devices.

DOEE staff who do not have an AGOL or Enterprise account should contact IT in order to obtain one. Participating staff should contact the field coordinator with their AGOL/Enterprise username and request to be added to RSA AGOL group.

2.3.1. Signing in with an Enterprise account:

Collector:

1. Start Collector
2. Click on “Sign In with ArcGIS Online”
3. Click on “Enterprise Login” if not already selected
4. type “***dcgis***” in the box in front of ***.maps.arcgis.com*** (click on remember URL) if this step has already been done previously, skip down below
5. Click Continue
6. Click on the blue box with “DC GOV AD Credentials”
7. Sign in with your DC Network login information (email address and password)

Survey123:

1. Start Survey 123.
2. Click on the 3 dashes on the top right corner
3. Click Sign in
4. Click on “Enterprise Login” if not already selected
5. type “***dcgis***” in the box in front of ***.maps.arcgis.com*** (click on remember URL) if this step has already been done previously, skip down below
6. Click Continue

7. Click on the blue box with “DC GOV AD Credentials”
8. Sign in with your DC Network login information (email address and password)

2.3.2. Signing in with an AGOL account:

Collector:

1. Start Collector
2. Click on “Sign In with ArcGIS Online”
3. Click on “ArcGIS login” if not already selected/expanded
4. Sign in with your AGOL login information (username and password)

Survey123:

1. Start Survey 123.
2. Click on the 3 dashes on the top right corner
3. Click on “ArcGIS login” if not already selected
4. Sign in with your AGOL login information (username and password)

2.4. Collector Settings

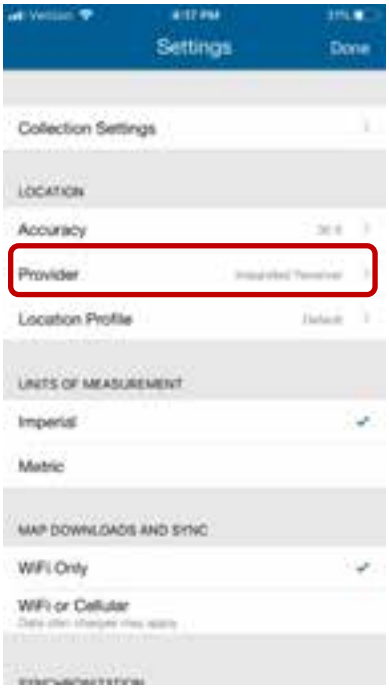
2.4.1 Setting the GPS Receiver

Collector will use the devices internal GPS receiver unless otherwise specified. If an external GPS receiver is paired to your devices you select it within Collector's settings.

1

2

3



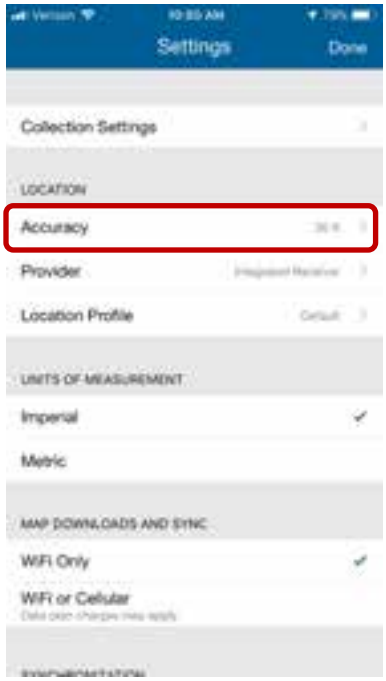
2.4.2 Required Accuracy

Although the RSA program will use manually placed points and features, not based upon the GPS, Collector may persistently notify the user if the GPS signal accuracy is out of range. To change the accuracy required by Collector, modify within Collector's settings.

1

2

3



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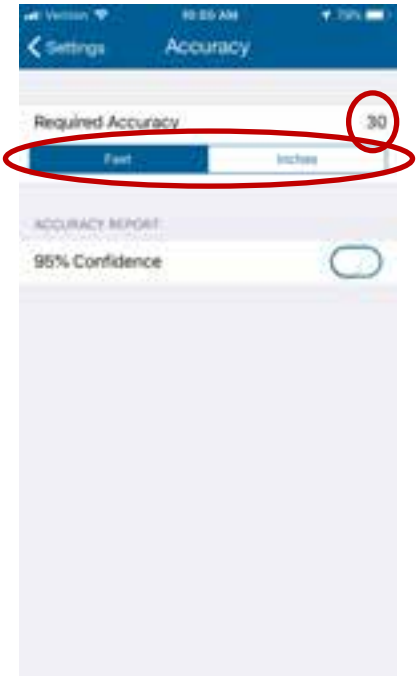


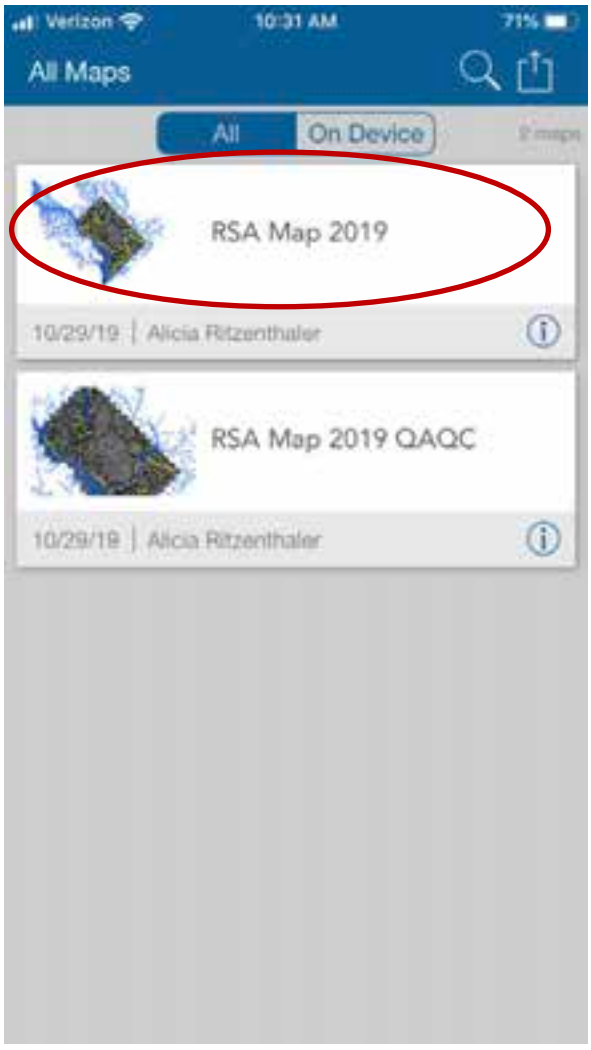
3.0 RSA Collector/Survey 123 Tool

3.1. Adding new points and reaches

Open Collector and sign in with AGOL user account info. Tap the final/most recent version of the RSA map to open it. If the GPS of the device is active, the map will open to your current location. Use the touchscreen to navigate, zoom in, and/or otherwise adjust your view.

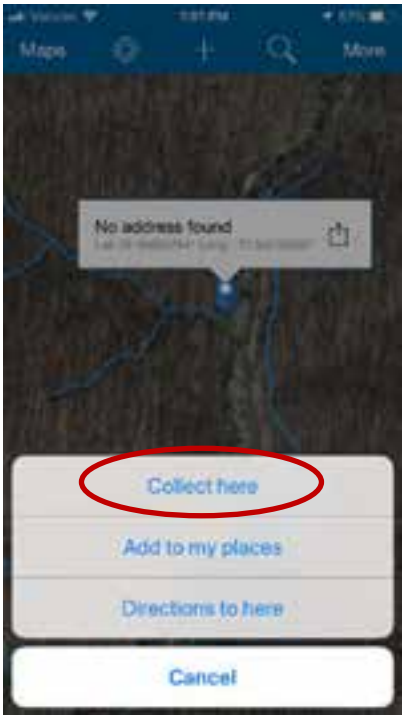
1

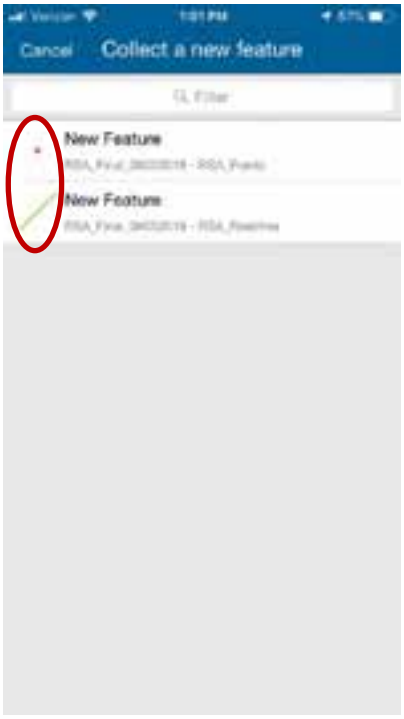
2



Briefly hold your finger on the screen where you would like to place a point or at one end of the reach you would like to draw. Lift finger and tap the box & arrow icon (1). Tap “Collect here” (2). Tap to select if the new feature is a point or a reach (3).

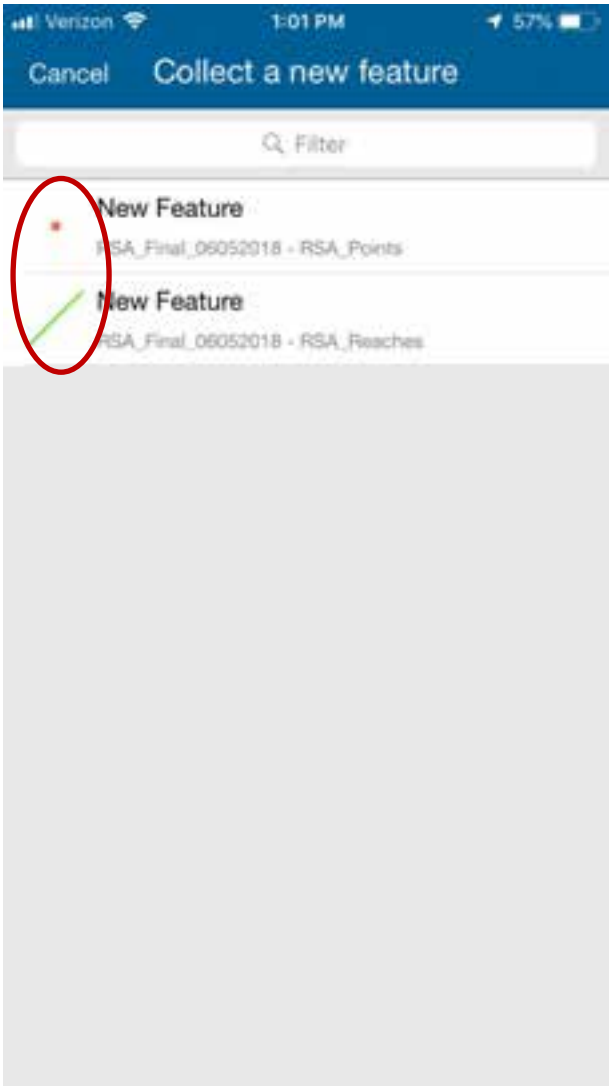
1 **2** **3**





Select the red dot (•) to place a point feature. Select the green line (/) to place a reach feature.

1

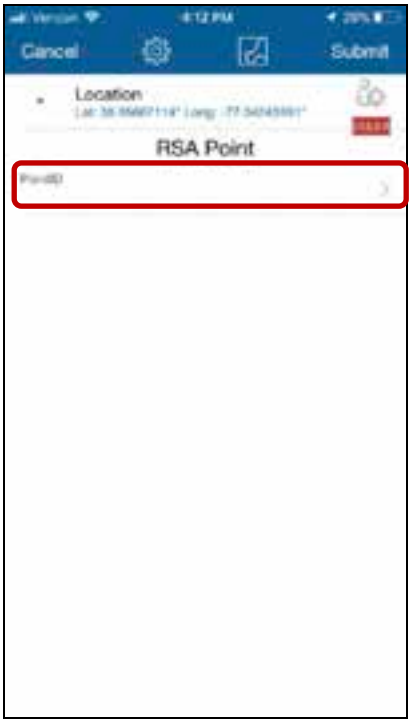


3.1.1. Point Features

Initiate a point survey (See Section 2.1).

Enter User defined PointID. This ID does not have to be unique but should be meaningful to you.

1 Tap PointID



2 Type ID
Tap 'Done'

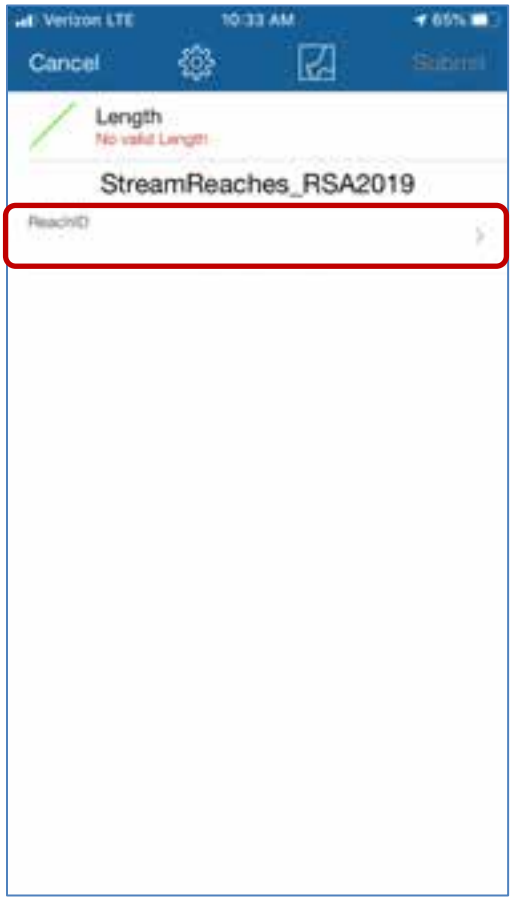
3 Tap Submit

3.1.2. Reach Features

Initiate a reach survey (See Section 2.1).

Enter User defined ReachID. This ID does not have to be unique but should be meaningful to you.

1 Tap ReachID



2 Type ID
Tap 'Done'

Draw reach line onto the map and submit.

1 Tap the Map icon

2 Feature will begin where survey was initiated

3 Tap on map to draw reach line

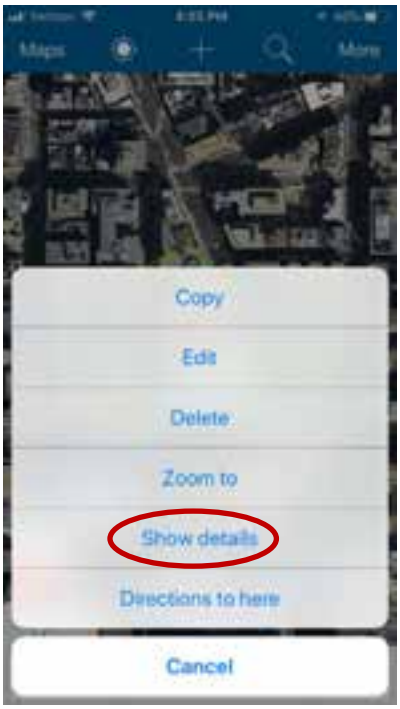
4 Use back button if you tapped the wrong place on the map and need to revise.

5 Submit reach feature when complete

3.2. Initializing survey

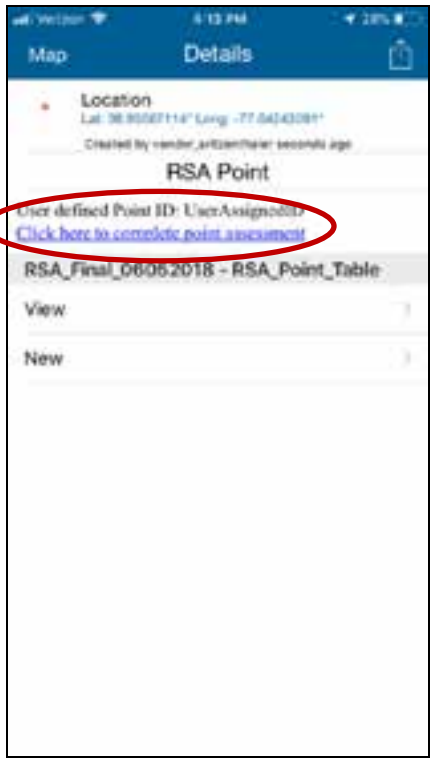
Once the feature (point or reach) is submitted, Collector will return to the map. The new point (or reach) will be selected (notice teal outline around point and banner along bottom of the screen). Tap the banner along the bottom of the screen to open the new, selected feature. Avoid the box & arrow icon.

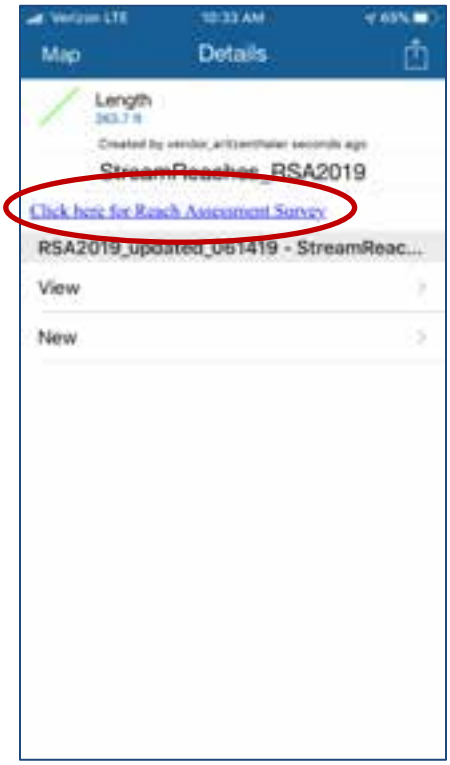
If you accidently tap the part of the banner with the box & arrow icon simply tap ‘show details’ to continue.



Verify the User defined Point ID (or Reach ID) and tap 'Click here to complete point assessment' (or 'Click here for reach assessment survey').

Don't be deceived, **DO NOT** tap 'new'!

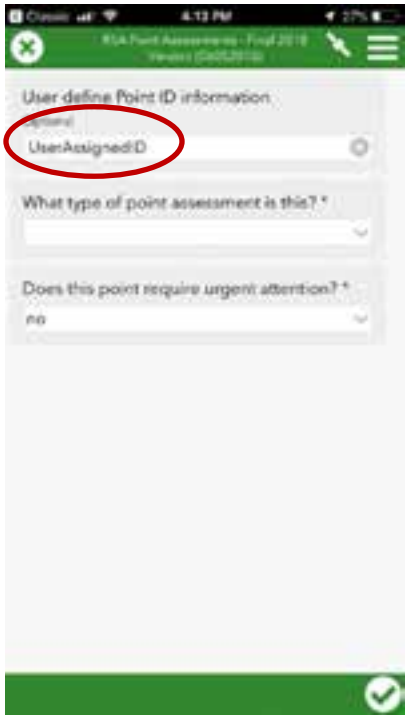




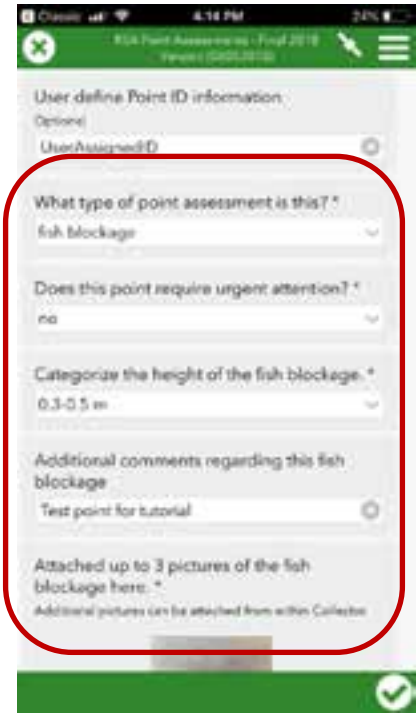
Survey 123 will launch and open, automatically, the correct survey form. DO NOT self-select a form, wait for a moment and let Survey 123 open the correct form for you! Continue to Section 2.3 and complete survey.

3.3 Complete Survey

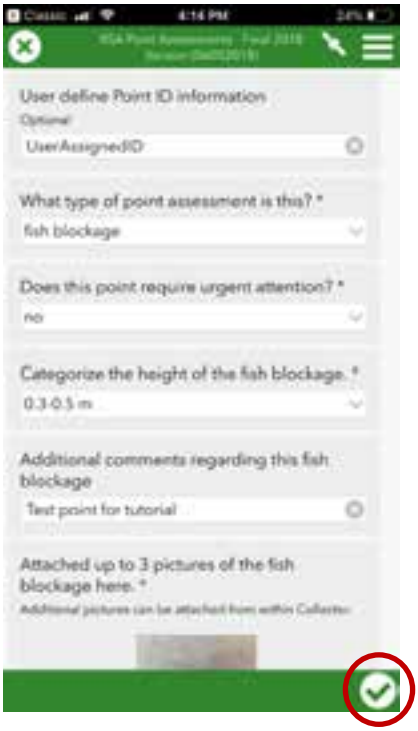
1 Verify user defined Point/Reach ID



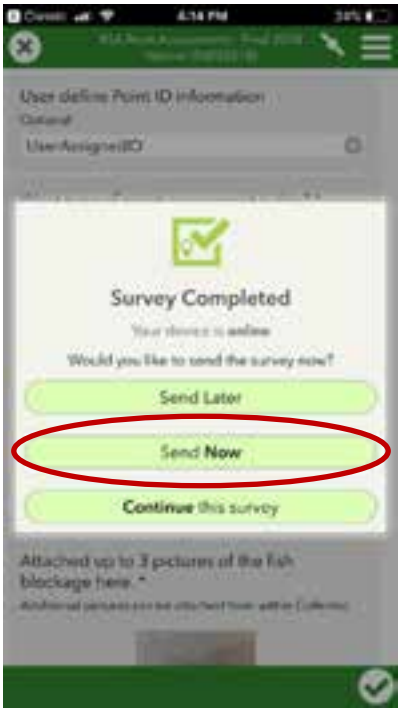
2 Respond to questions, take photos



3 Submit, tap the checkmark'



4 'Send now'

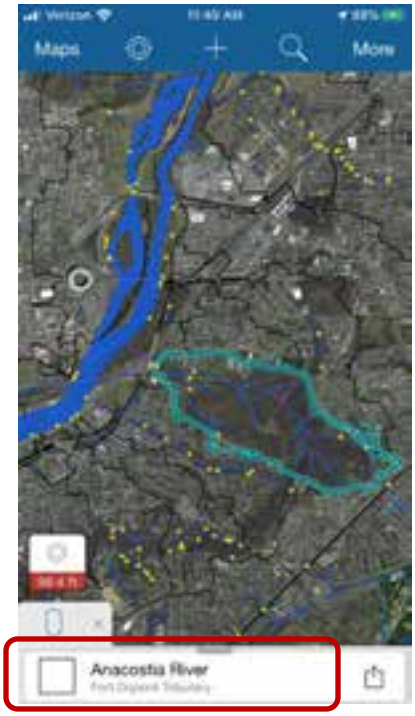


4.0 Watershed Notes

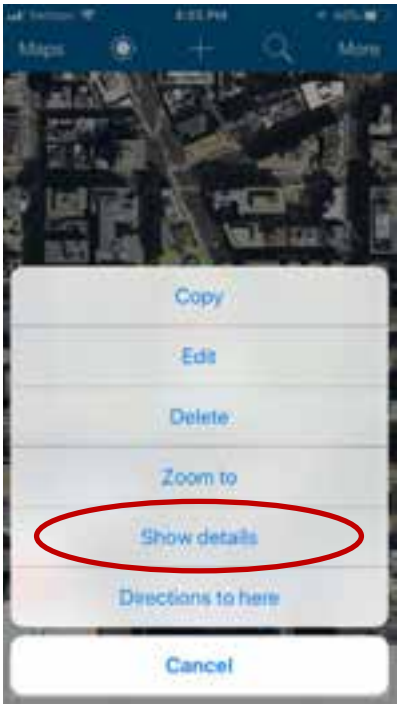
When observations are made at the watershed-scale, there notes should be added via the Collector/Survey 123 tool.

1 Tap watershed to select it

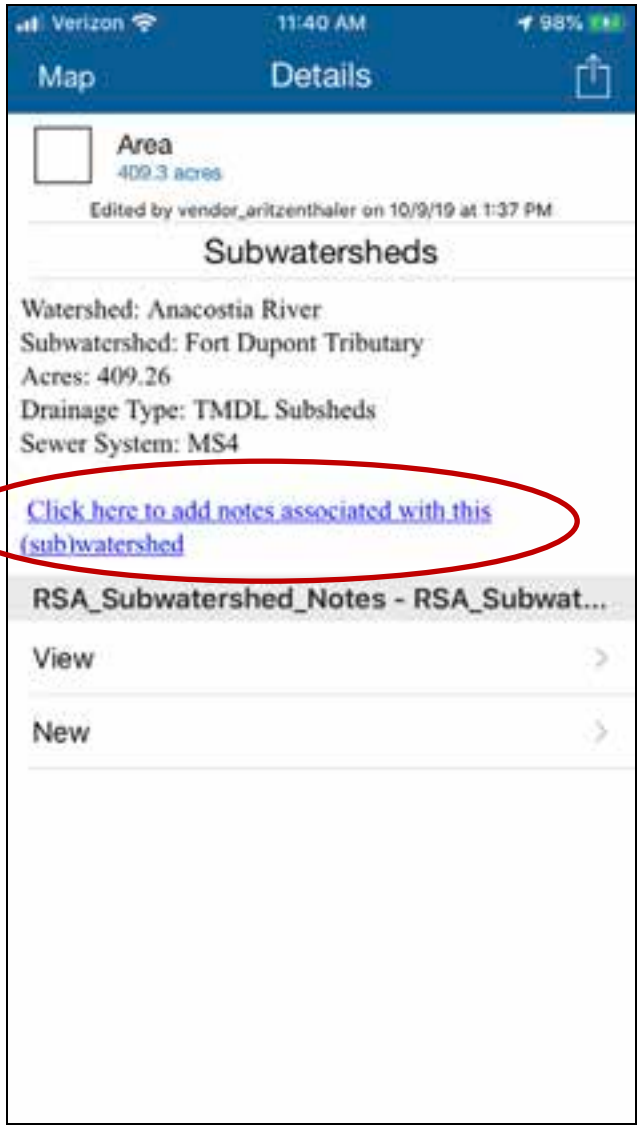
2 Tap the banner along the bottom of the screen to open the new, selected feature. Avoid the box & arrow icon.



3 If you accidently tap the box & arrow icon, tap “Show detials”.

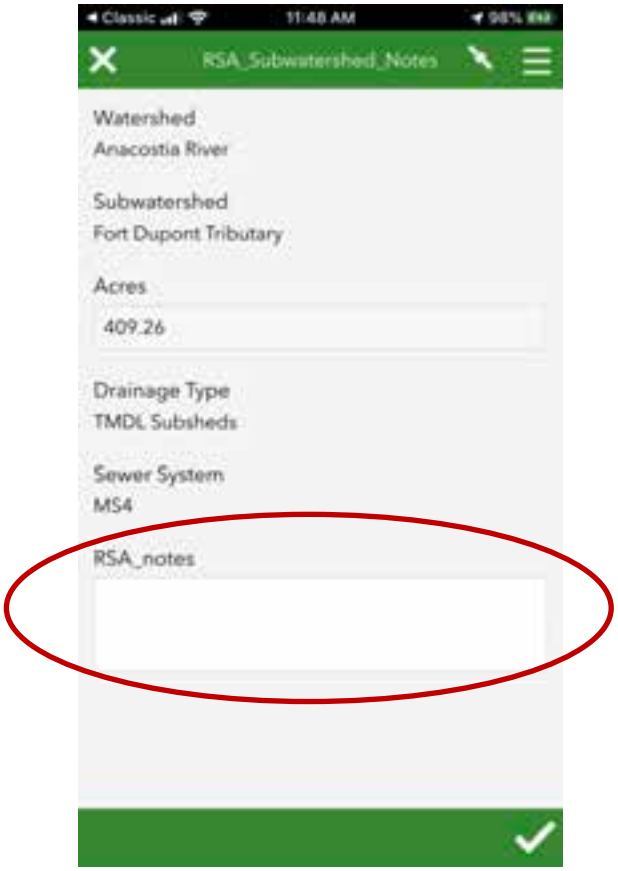


4 Verify the User defined Point ID (or Reach ID) and tap 'Click here to add notes associated with the (sub)watershed'.

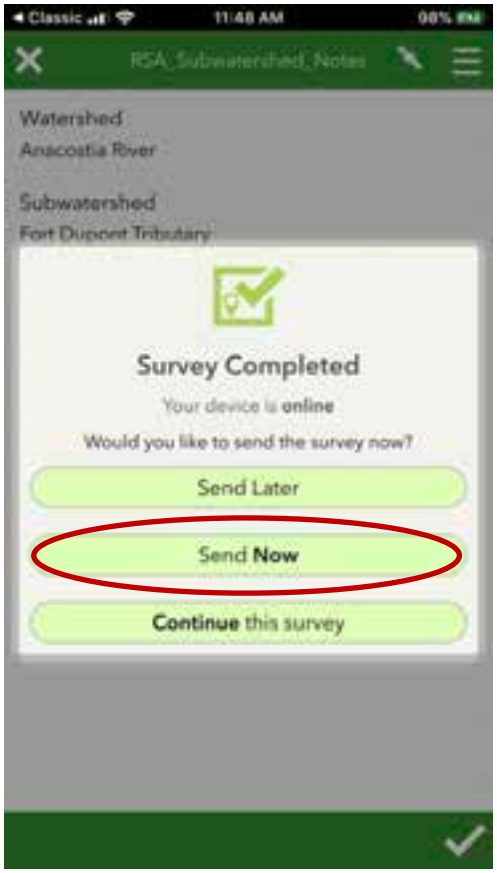


5 Survey 123 will launch and open, automatically, the correct survey form. DO NOT self-select a form, wait for a moment and let Survey 123 open the correct form for you!

6 Verify information and add your notes in the "RSA_notes" section.



7 Tap "Send now" to save/submit.

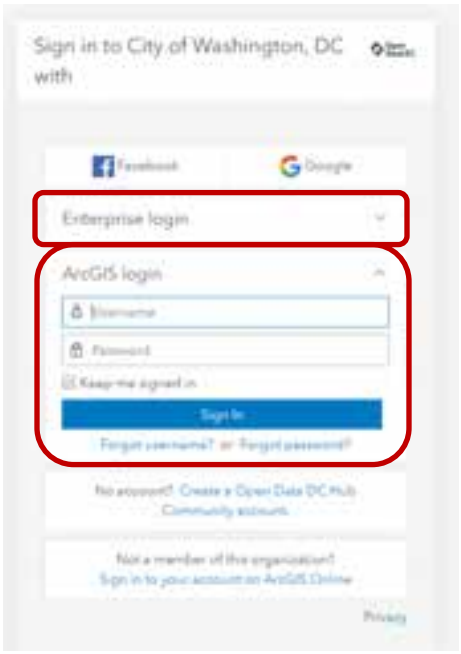


5.0 Operations Dashboard

The RSA Operations Dashboard allows staff to monitor assessment progress and provides and environment in which completed assessments can be edited if necessary.

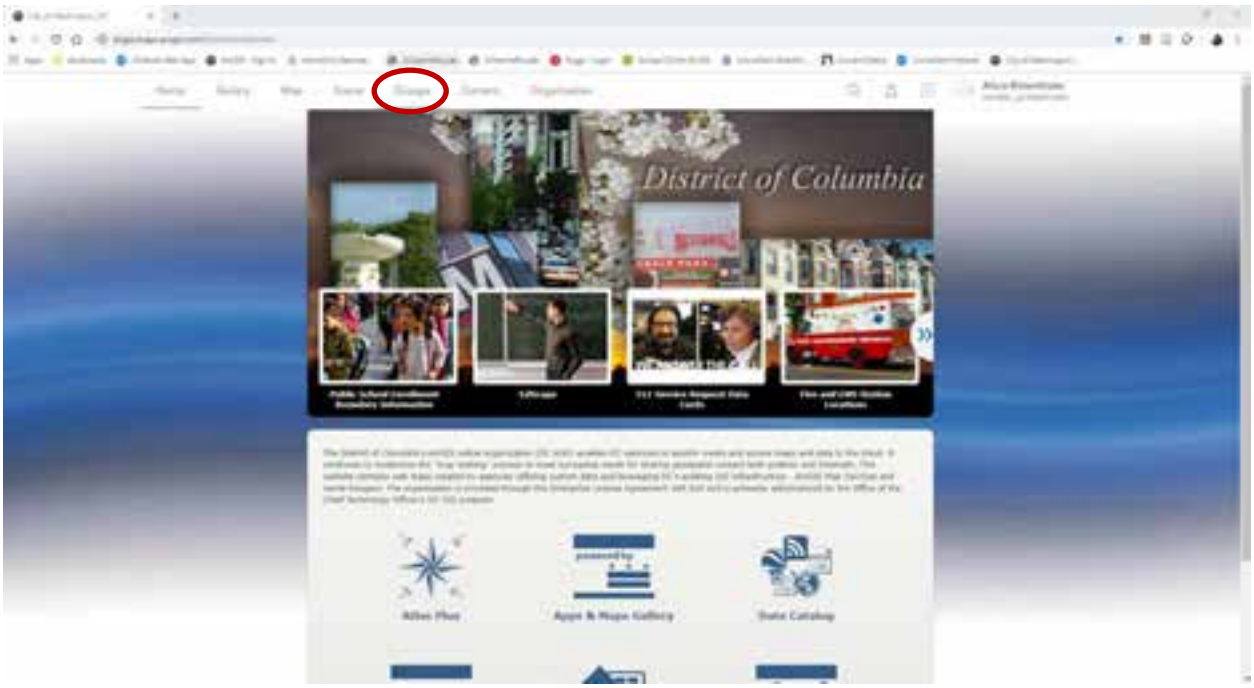
5.1. Accessing the Dashboard

The RSA Operations Dashboard is hosted on AGOL. Users must log in with their AGOL or Enterprise credentials. https://dcgis.maps.arcgis.com/home/index.html

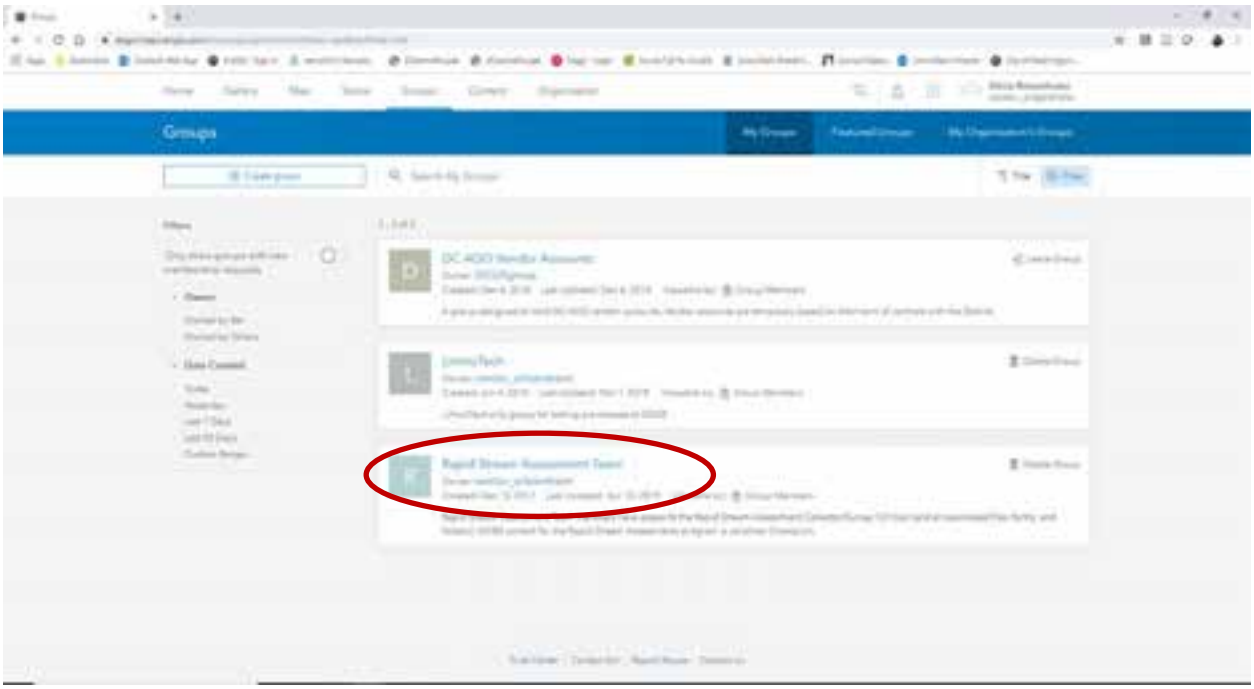


Navigate to the dashboard

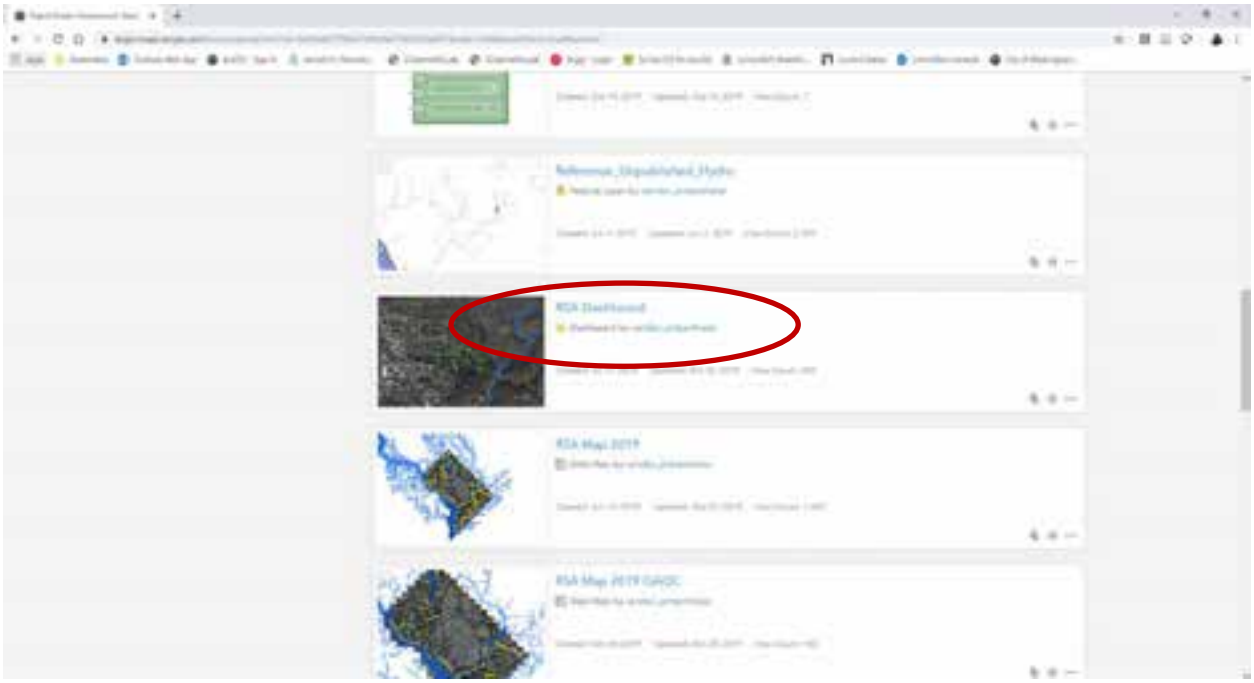
5 Click “Groups”



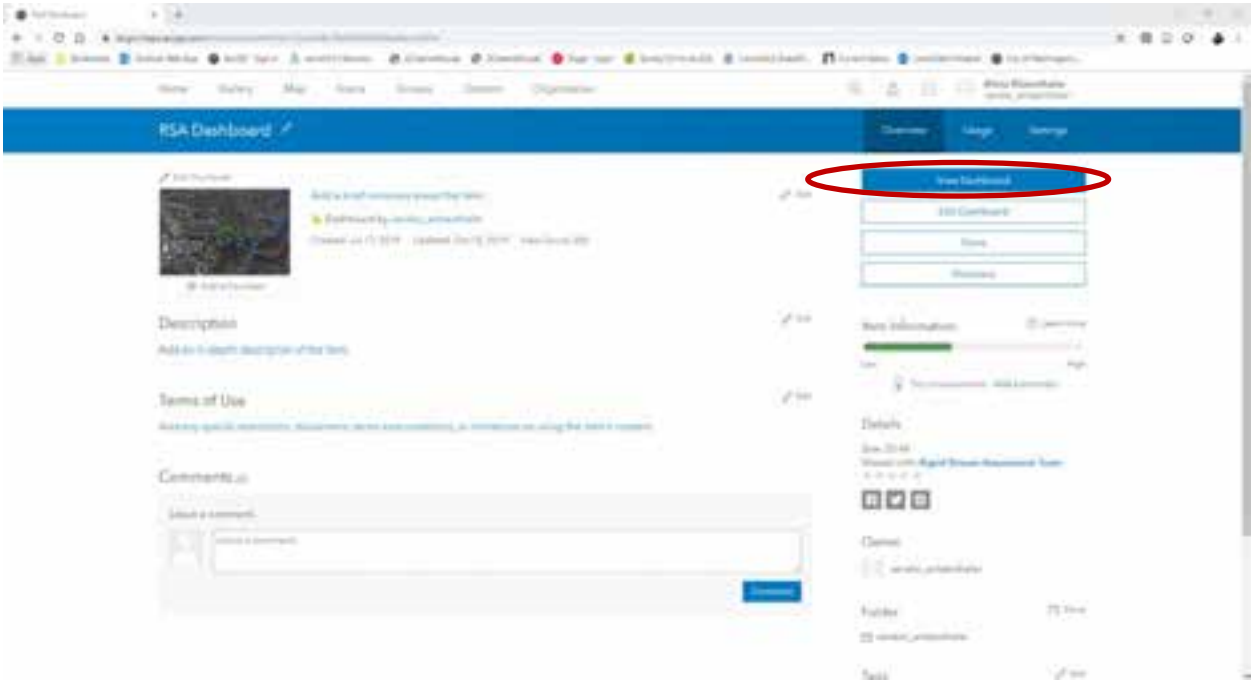
5 Find and click “Rapid Stream Assessment Team”



6 Find and click “RSA Dashboard”



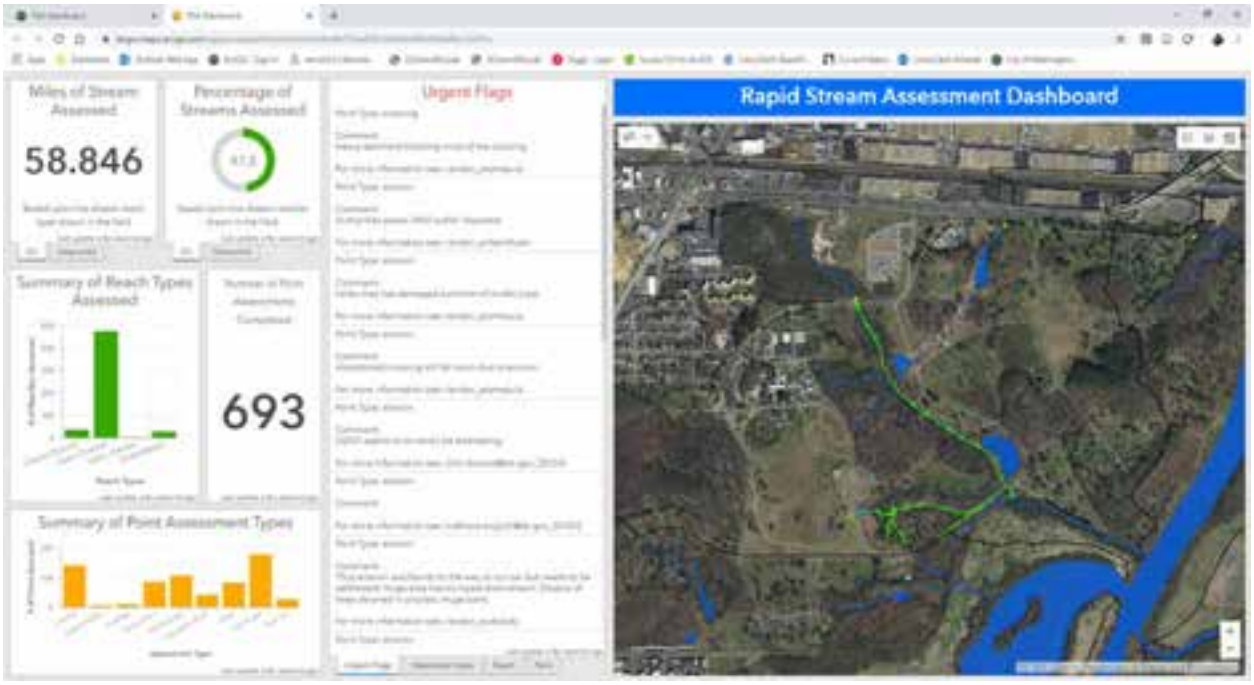
7 Click “View Dashboard”



5.2. Interacting with the Dashboard

5.2.1. Monitoring Progress

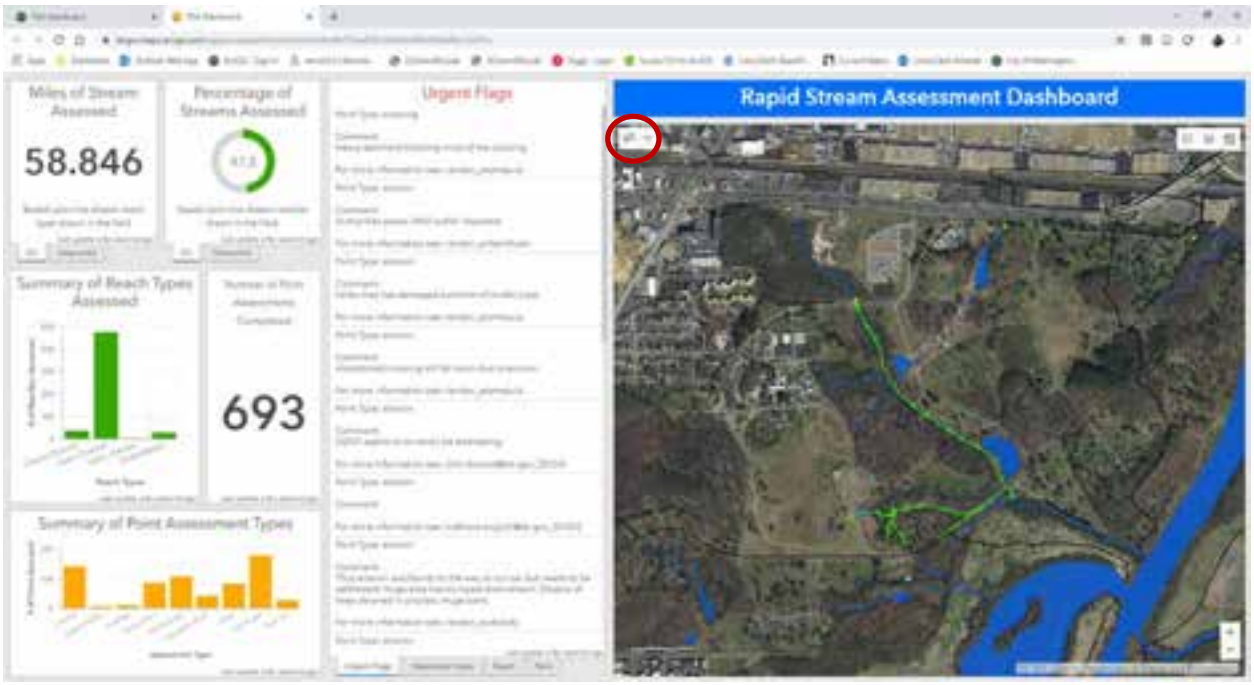
The main page of the RSA Operations Dashboard displays real-time information regarding assessment progress.



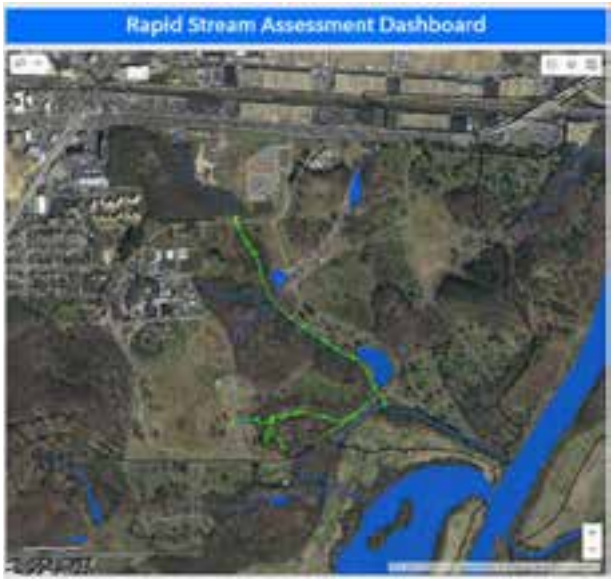
5.2.1. Editing Completed Surveys

The RSA dashboard provides a safe platform for editing already completed assessments.

1 Click the selection icon

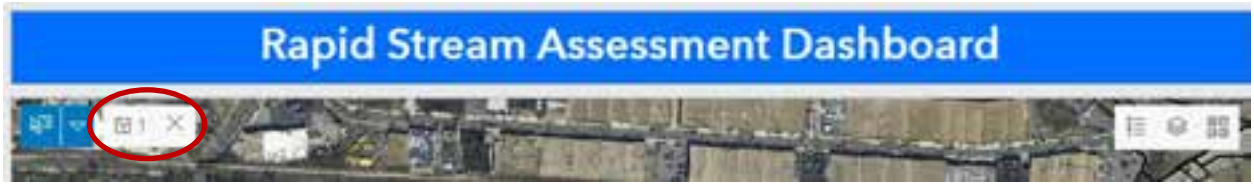


2 Tap the feature associated with the assessment requiring editing. Once selected, your feature will appear with a purple highlight.

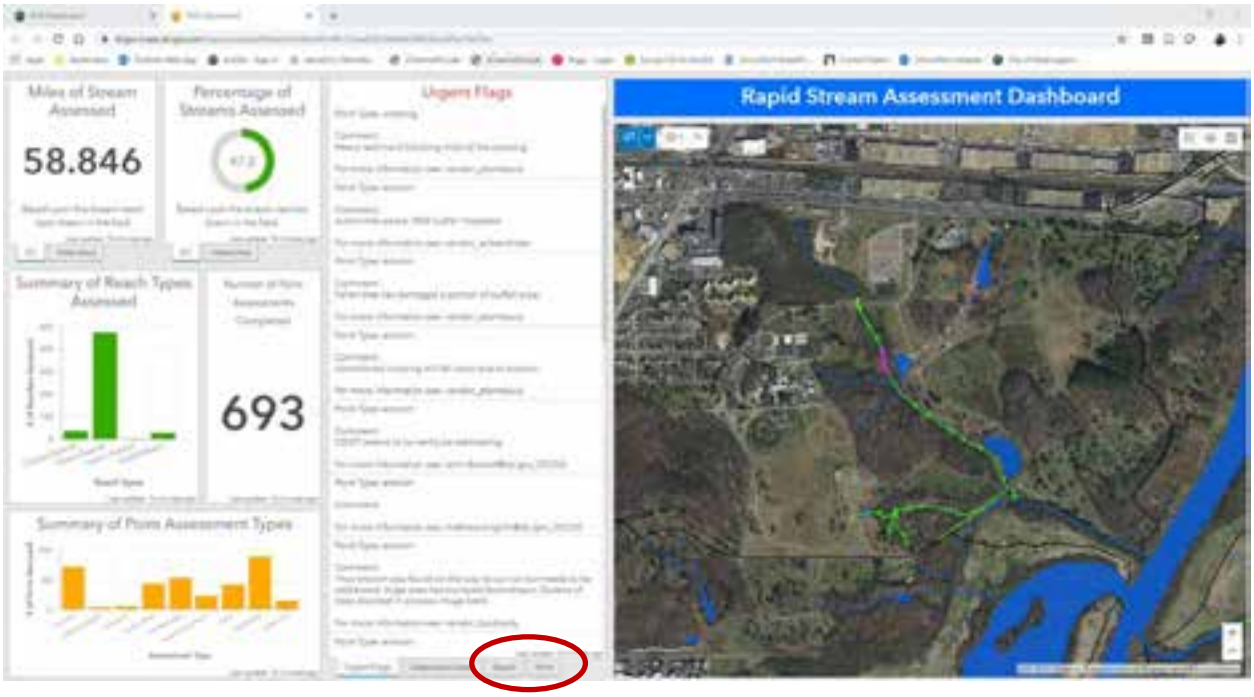


Note that you may be prompted to specify your tapped selection.

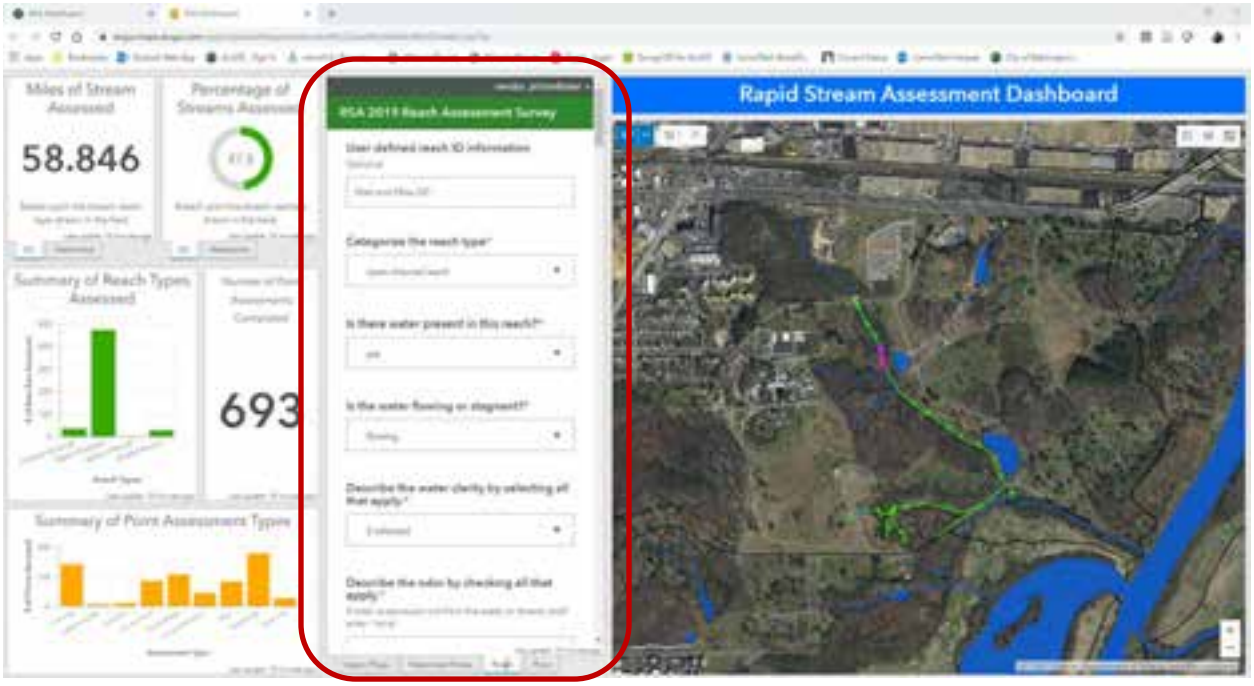
3 **Make sure you have only 1 selected feature before proceeding!!!!!** If you have multiple, click the "X" and try again.



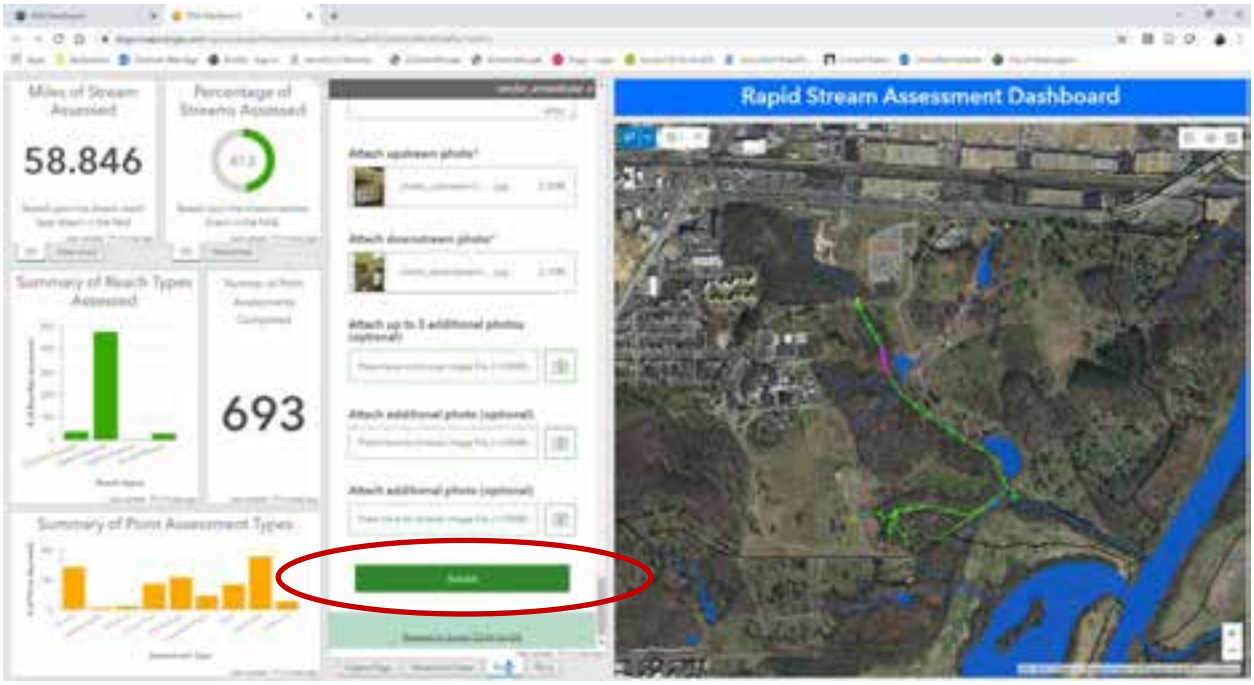
4 Select the appropriate tab based upon what feature type you have selected.



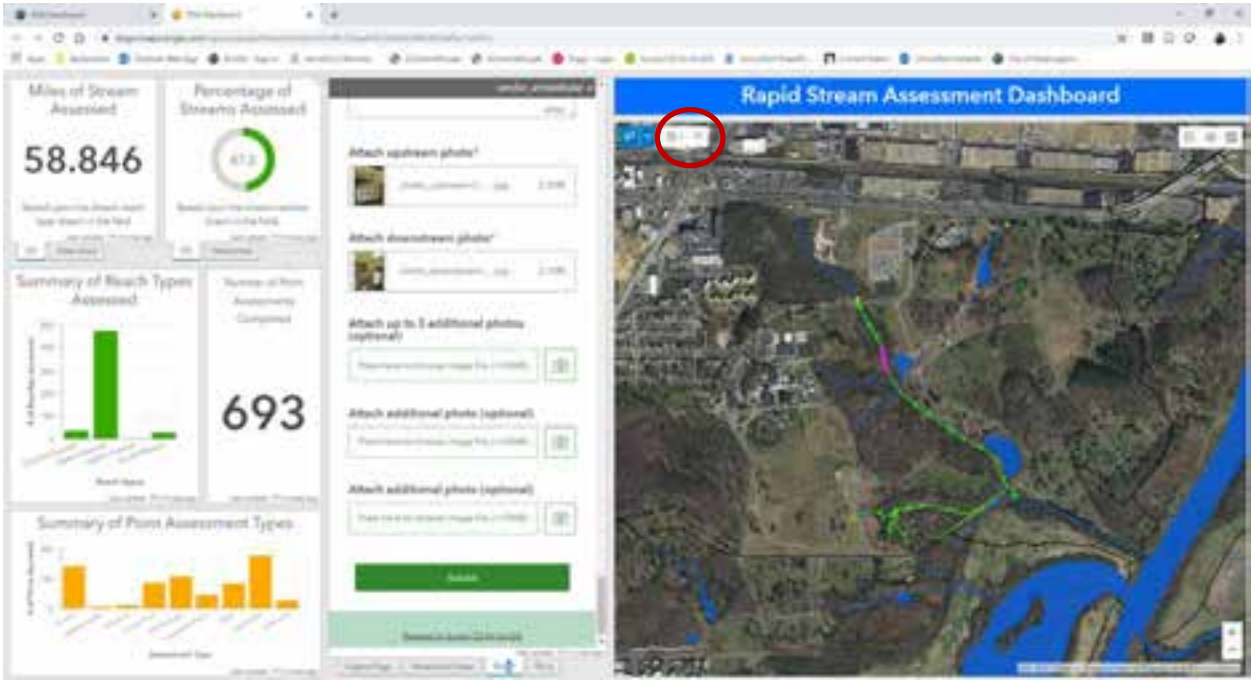
5 The previously completed Survey123 form will appear. Look through existing responses and ensure it's the one you want to edit!



6 Once your edits have been made, click “Submit”



7 Finally, unselect feature on the map by clicking the “x” to ensure no accidental changes are made.



6.0 Viewing and Downloading Data

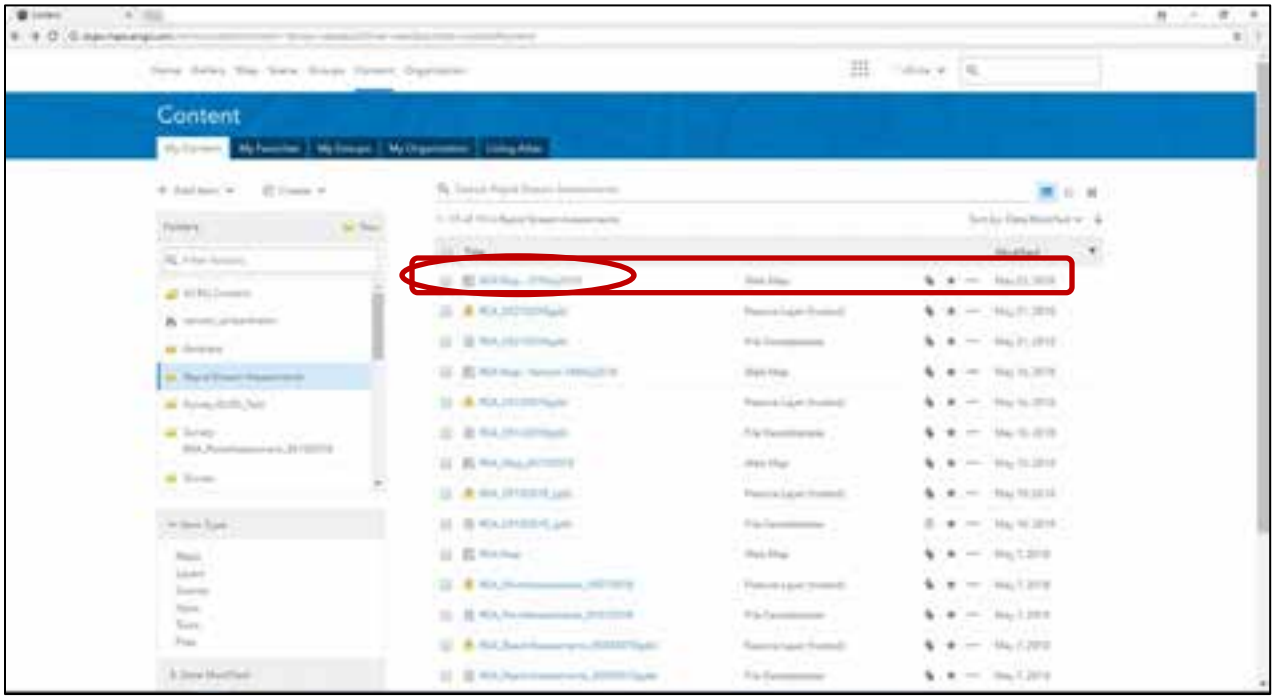
All data can be viewed in either ArcGIS online or by downloading a local copy to open and work within ArcMap/desktop.

6.1. Viewing in ArcGIS online

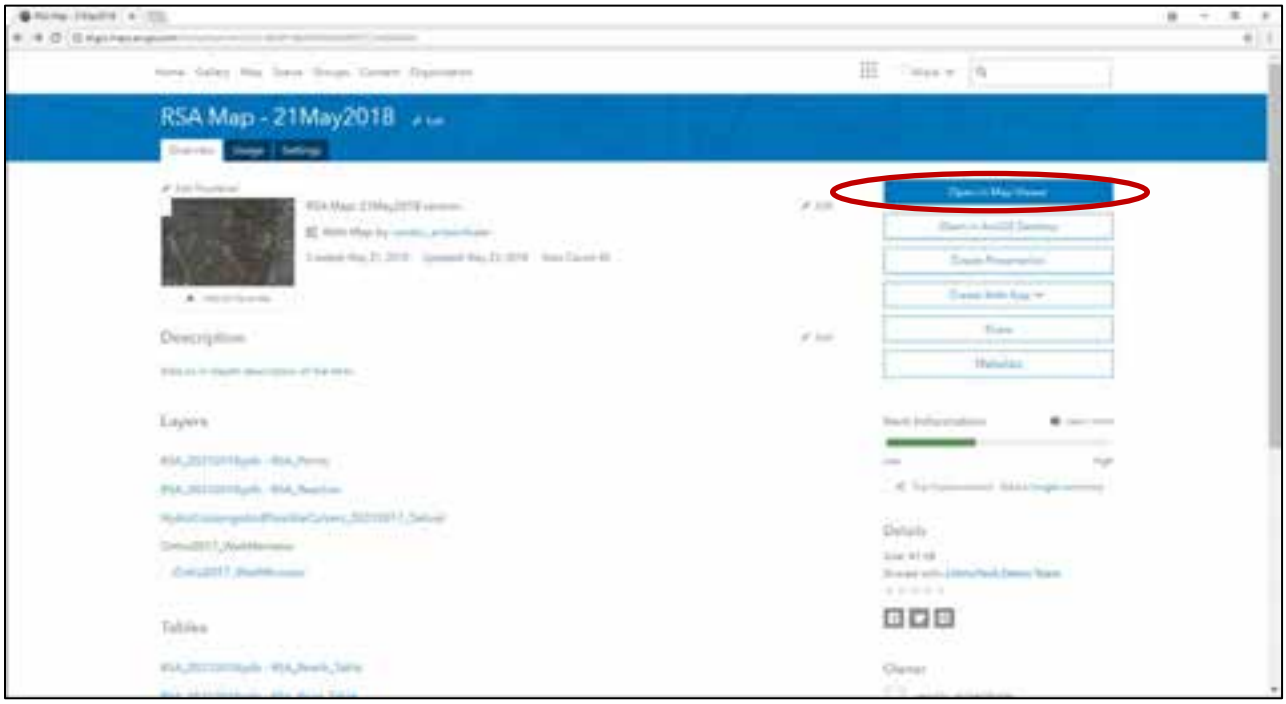
Sign into your ArcGIS online account.

Click “Content”

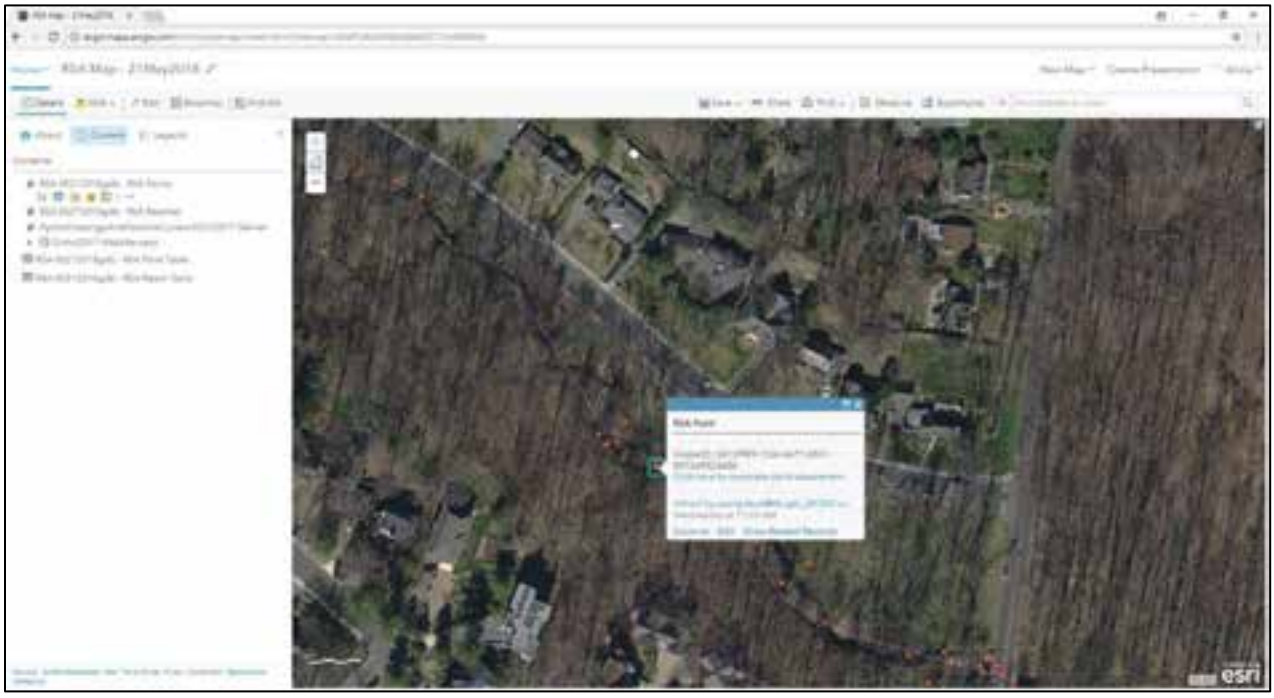
Navigate to your Web Map (same Map as used in the field) and select by clicking its title.



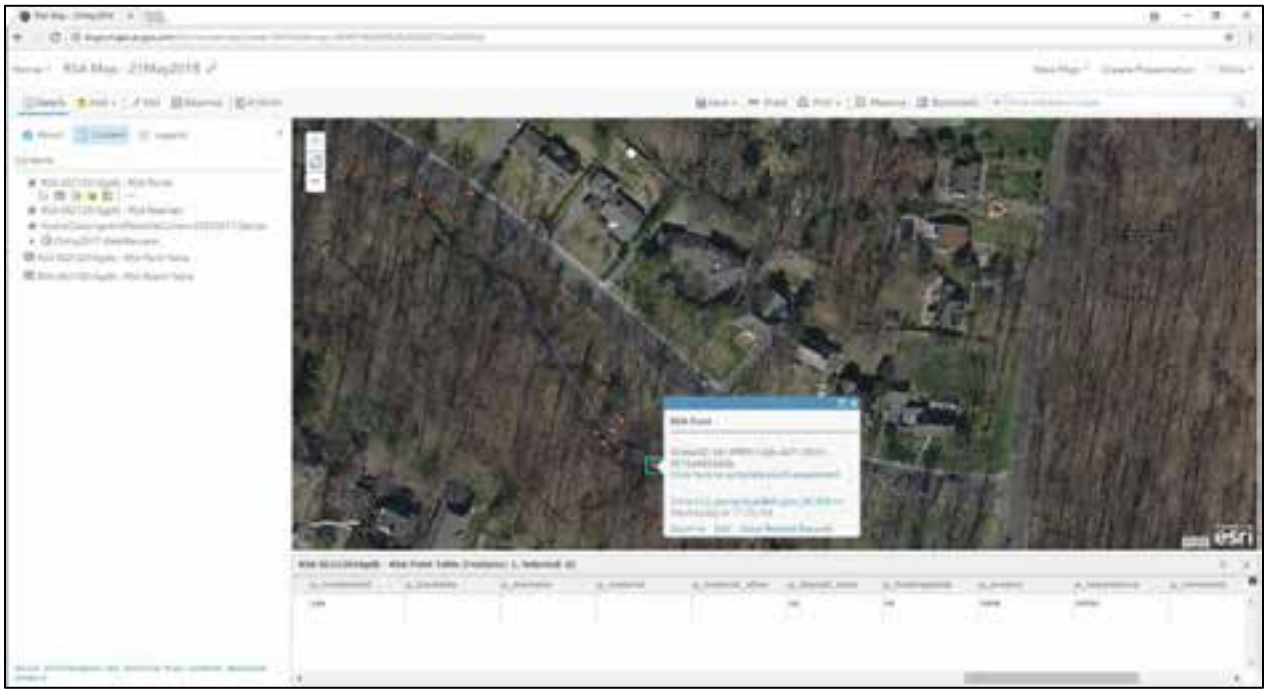
Click “Open in Map viewer”



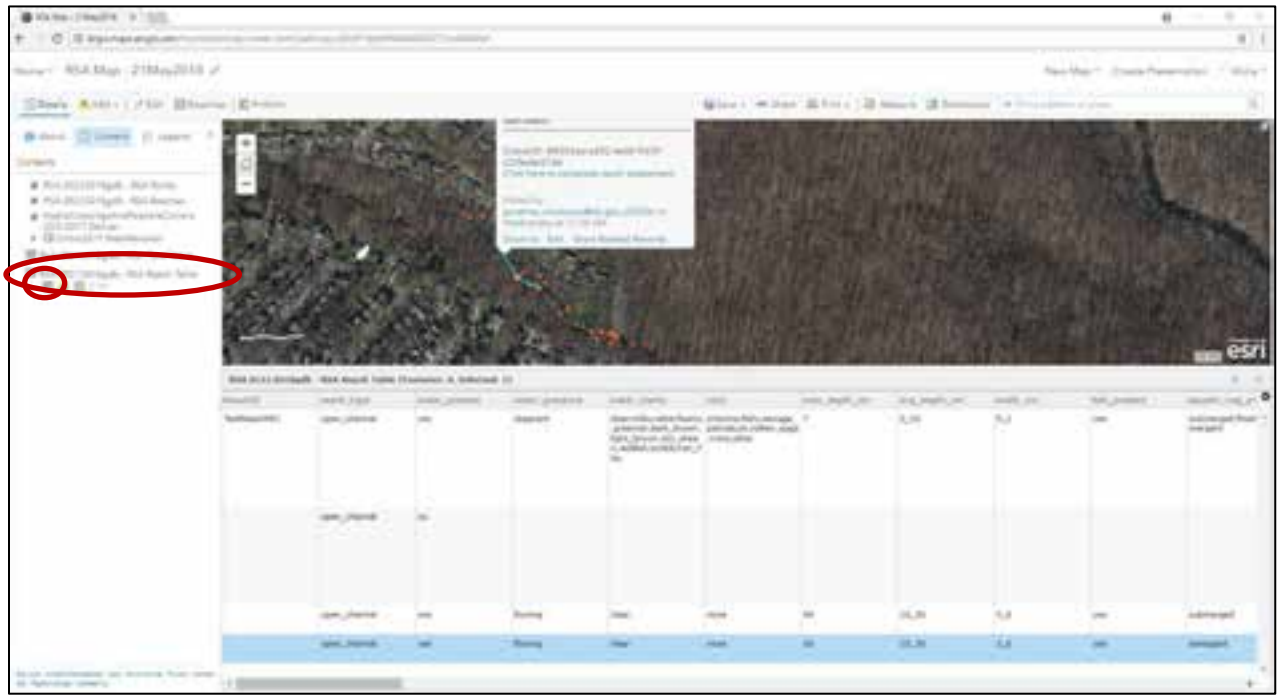
Features on the map can be selected by clicking on them.



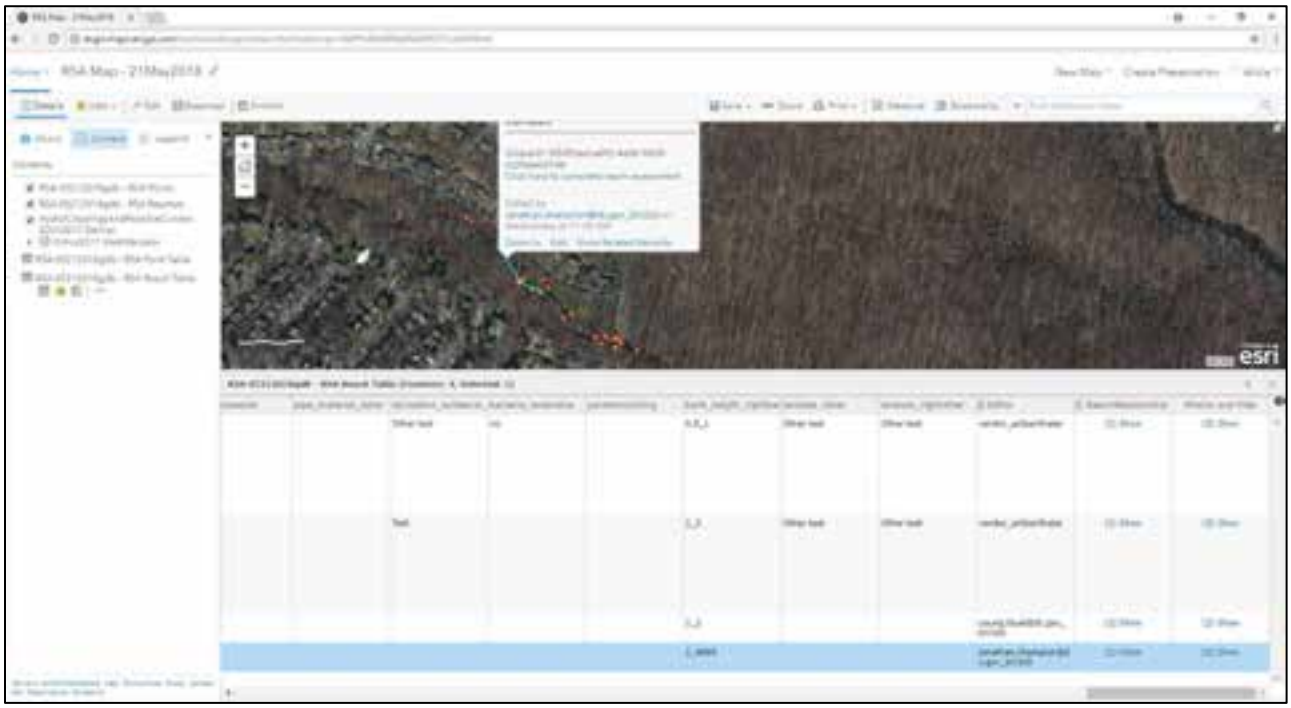
Attribute data collected about the selected feature can be viewed by clicking “Show Related Records” in the pop-up window.

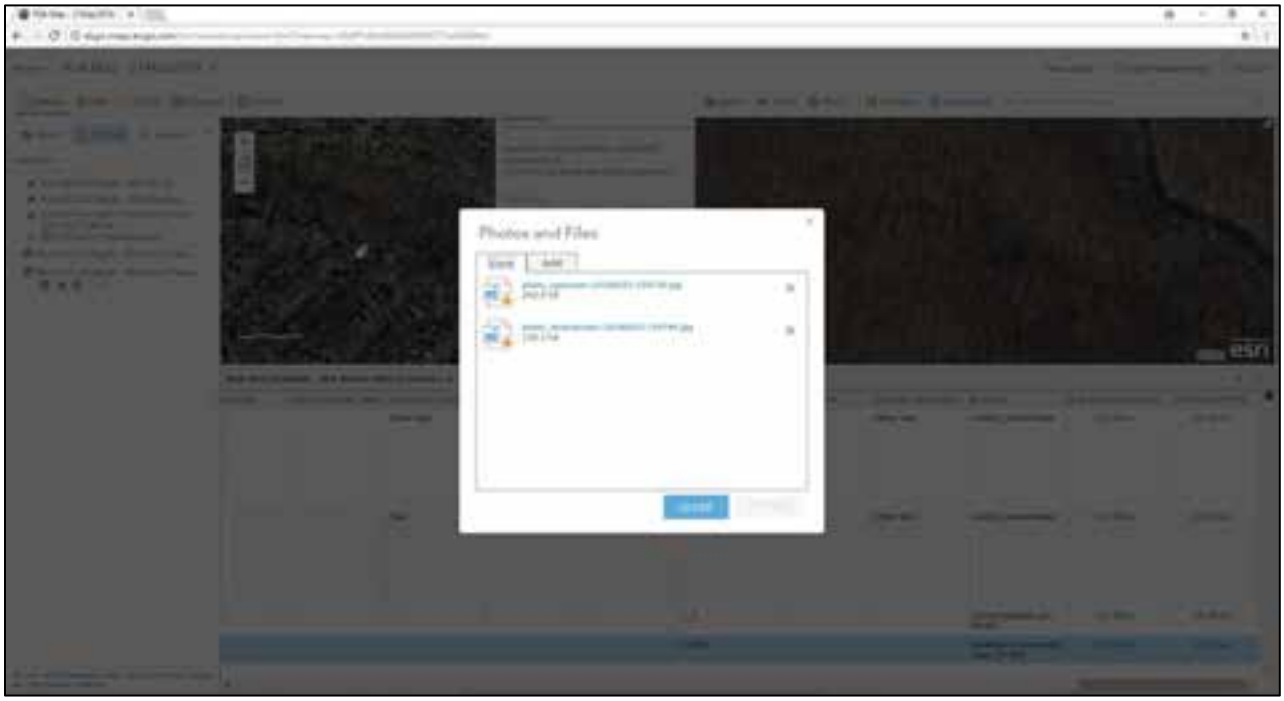


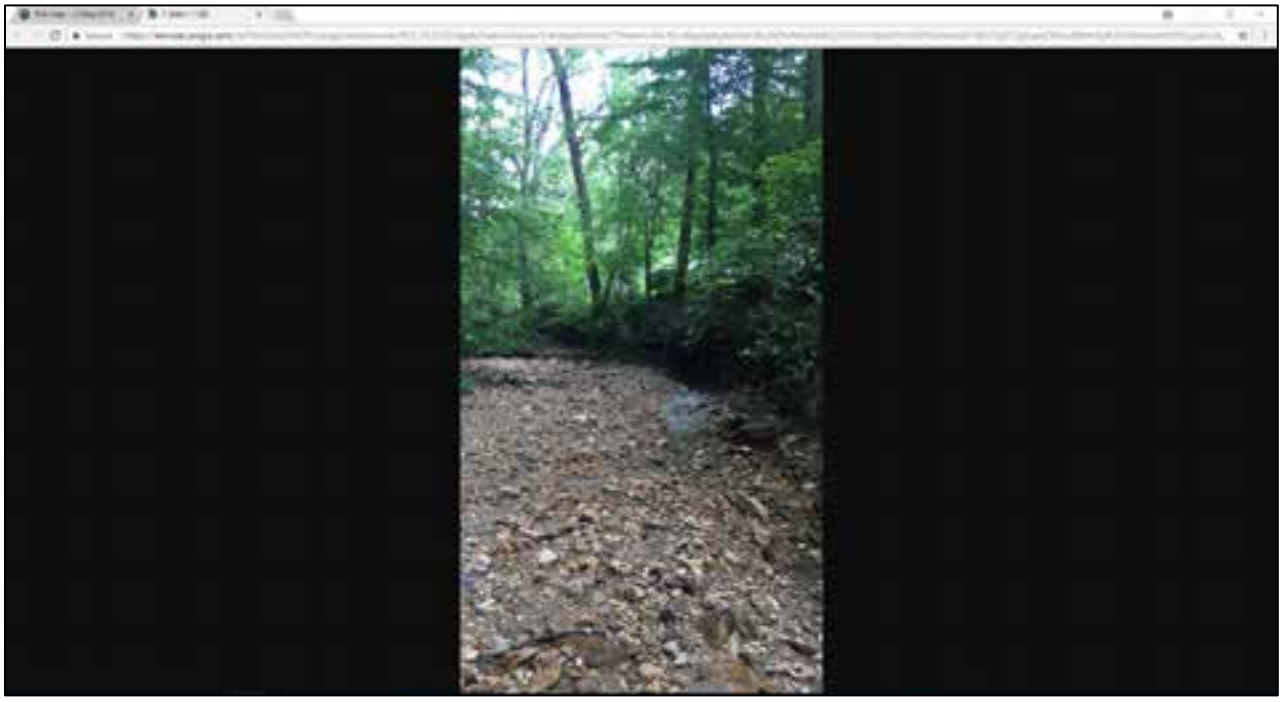
Attributes can also be viewed for all records at once, in a tabular format, by opening the table.



Once you're viewing attributes, either all records or for a selected record(s), scroll to the far right of the table to view photo attachments.




Photos and Files



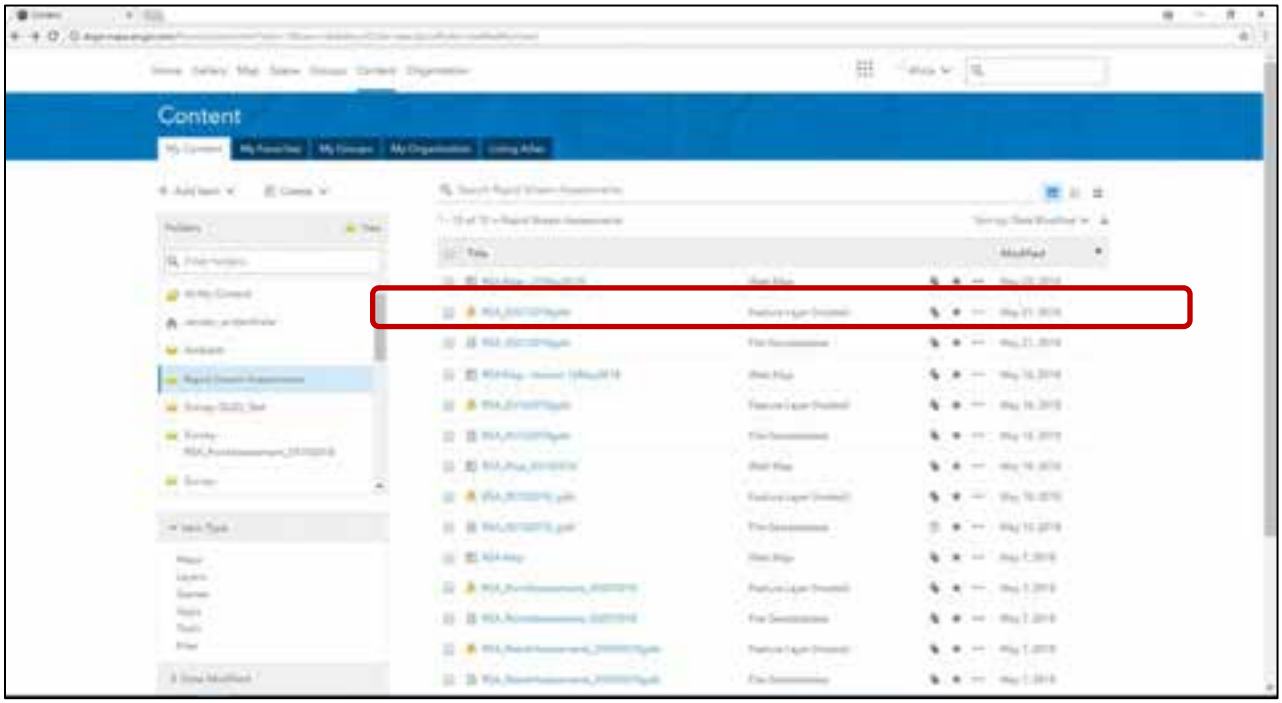
Right click photo to save and download if desired.

6.2. View in ArcMap

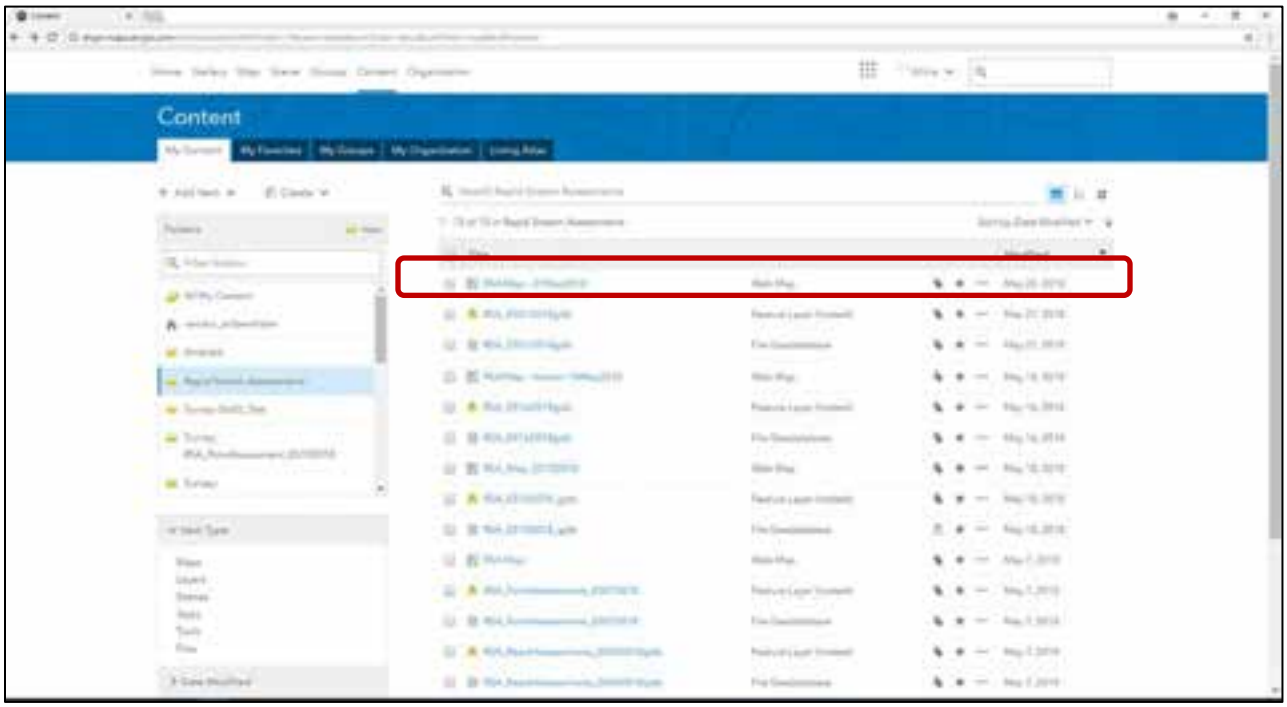
Sign into your ArcGIS online account.

Click “Content”

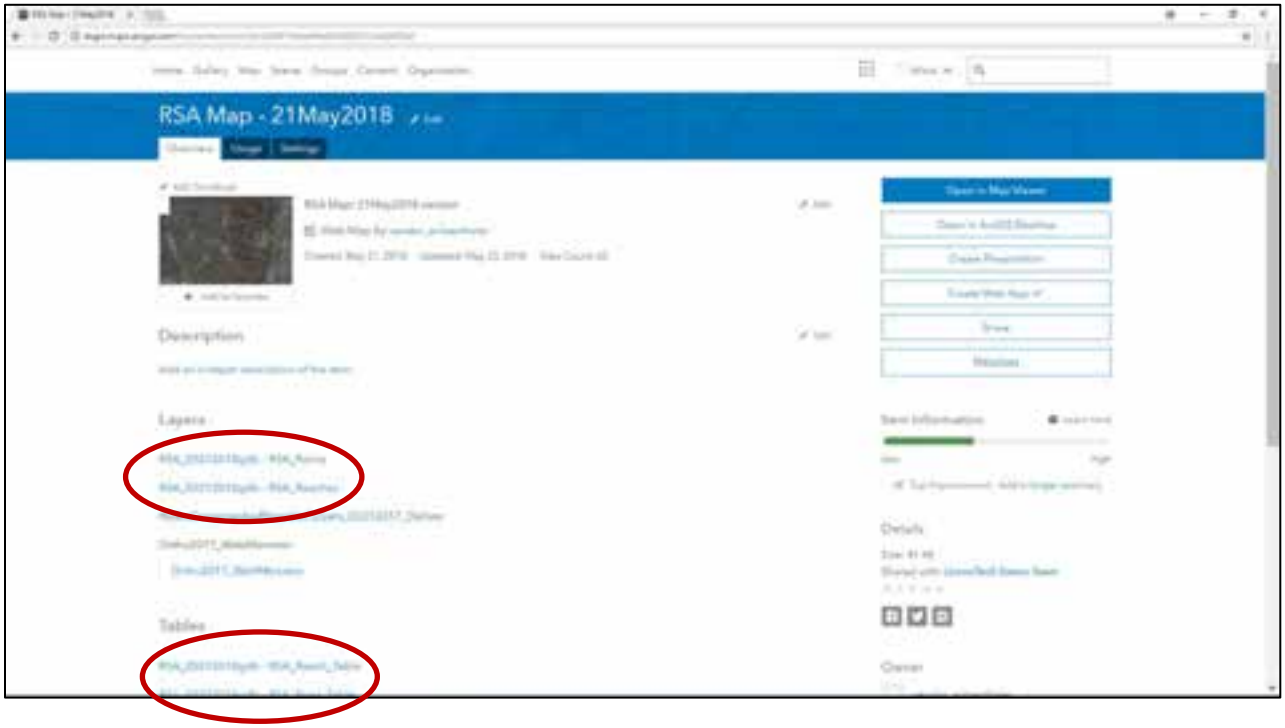
Navigate to your feature layer. Your feature layer is the file in which all data you’ve collected is saved.



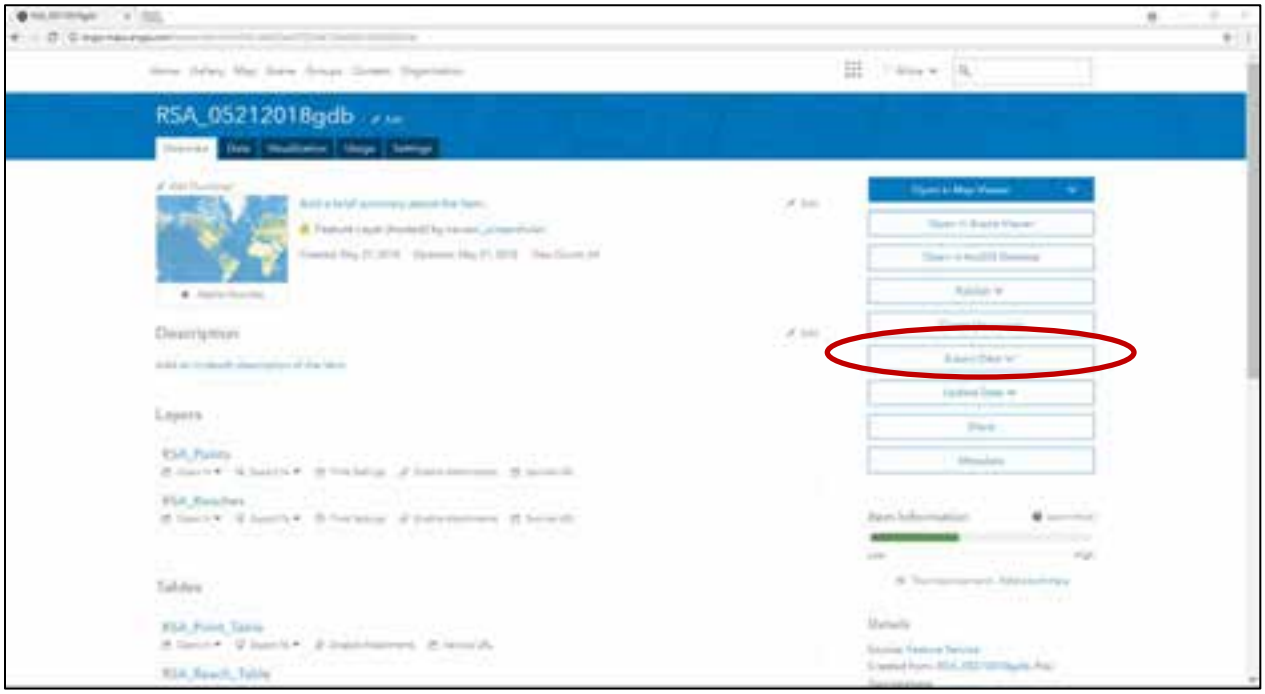
If you have trouble identifying which feature layer you need you can look this up by clicking on the Web Map that was used in Collector.



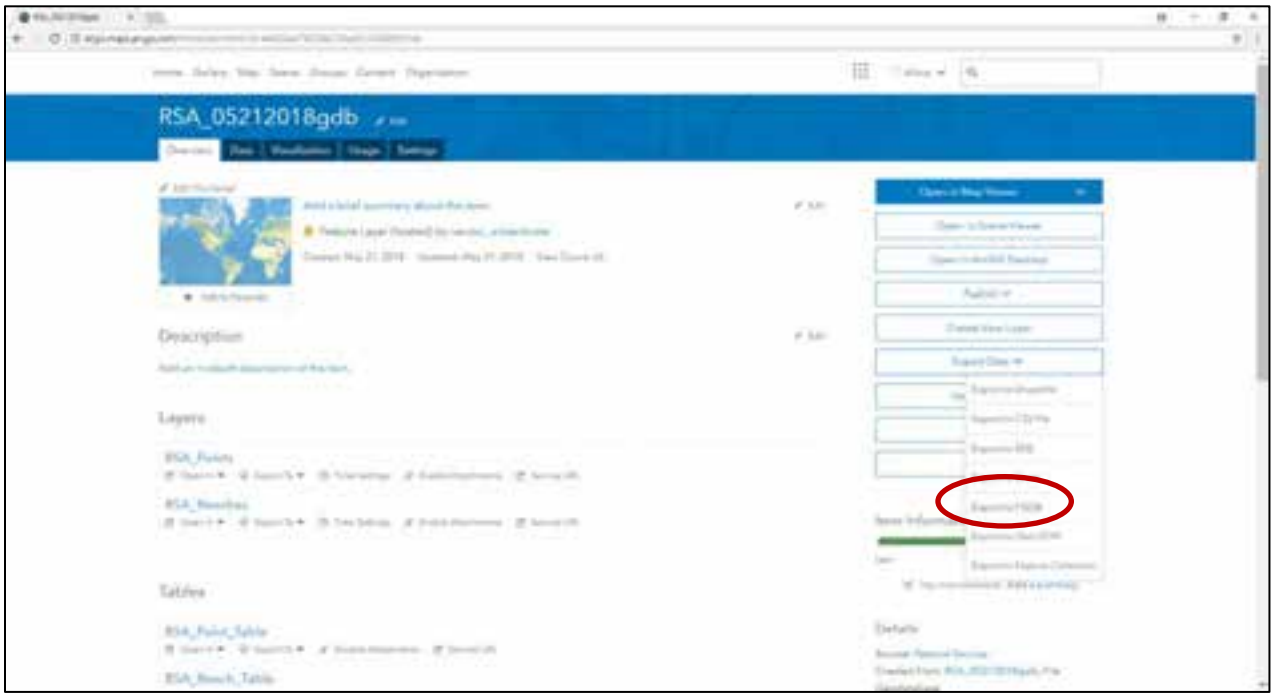
Check layer names present in map.



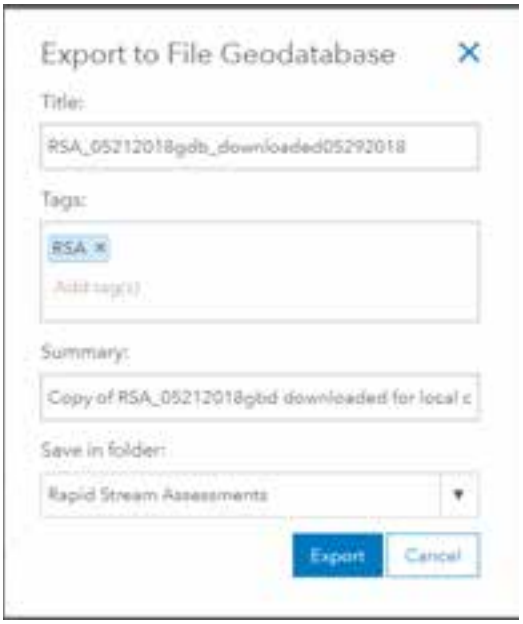
Once you've selected your feature layer click "Export Data".



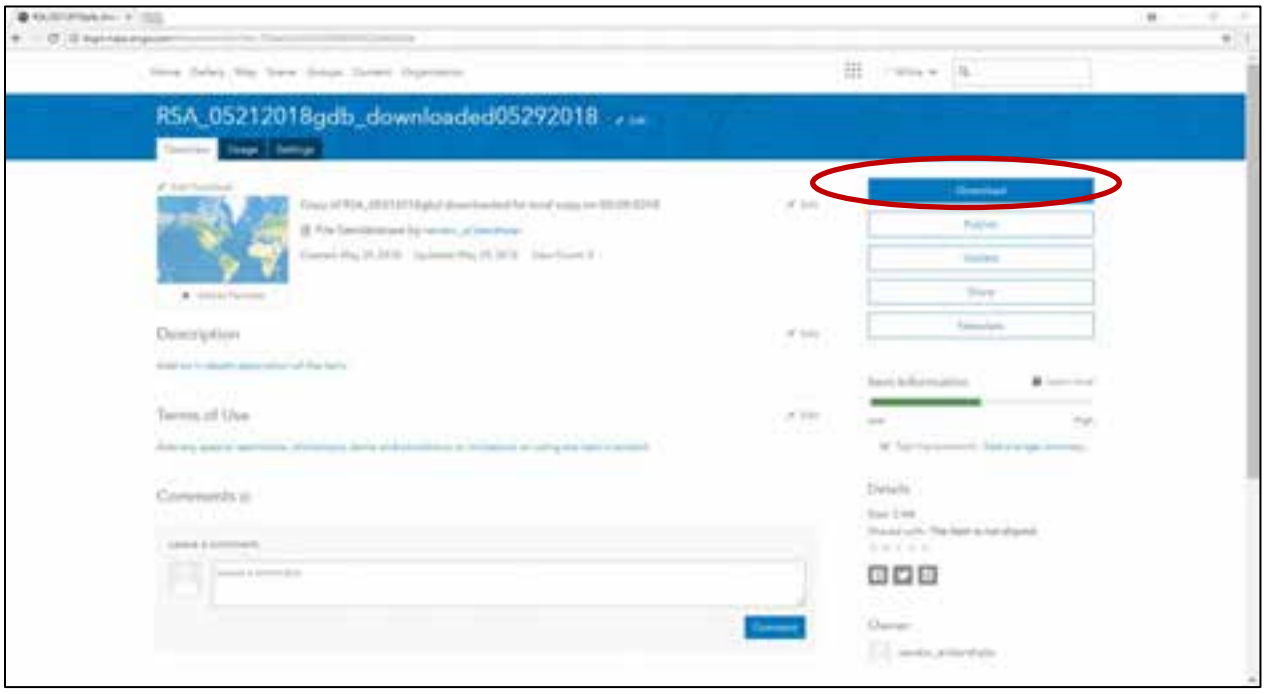
Then select "Export to FGDB".



Provide title, tags, summary, and a folder to which the file will be saved. Click “Export”.

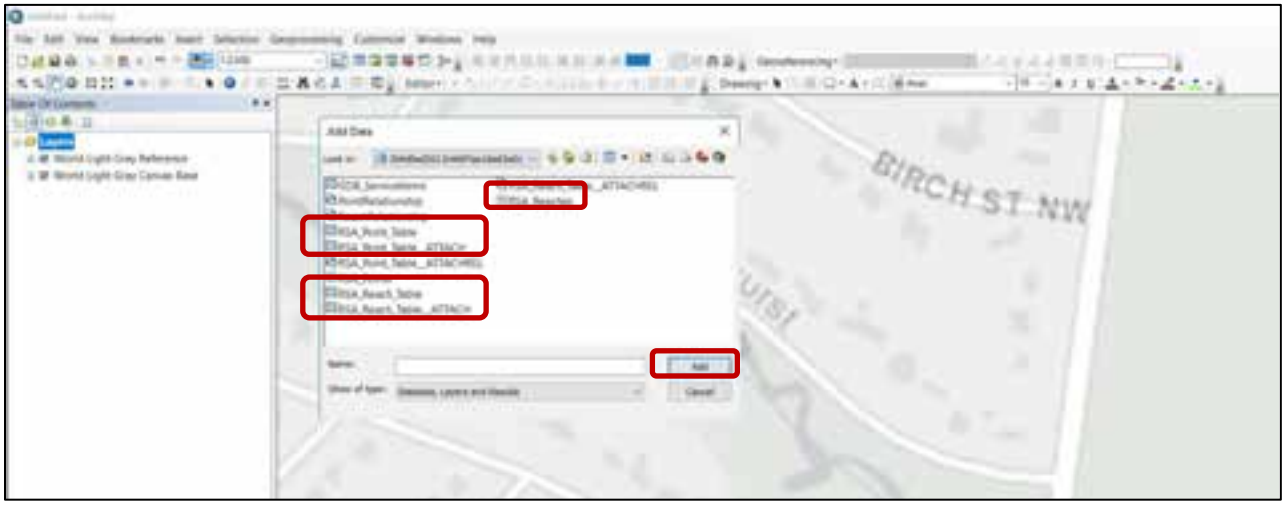


After the export is complete, download a local copy by selecting “Download”.



Open ArcMap.

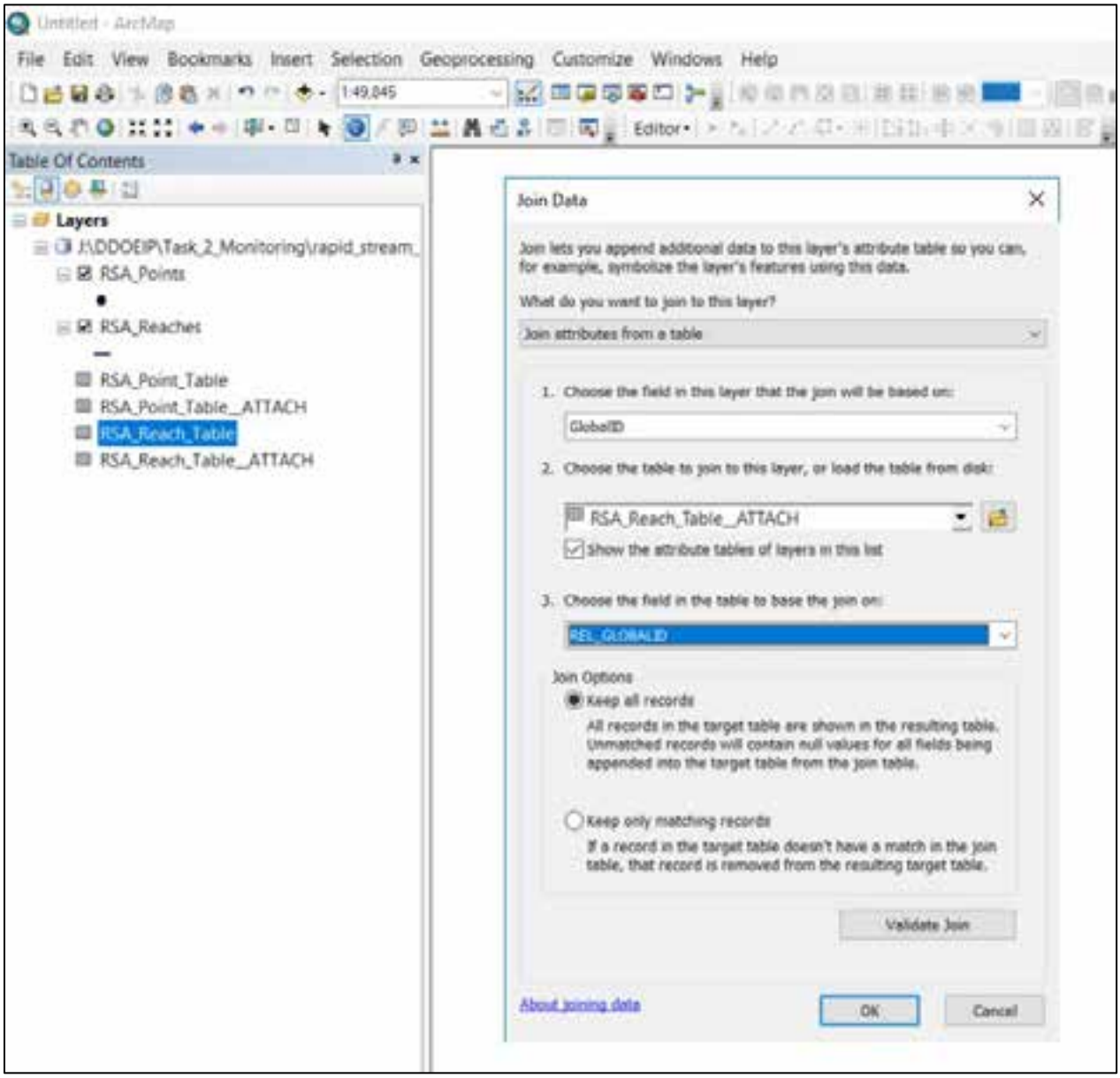
Click the “ ” icon and navigate to the folder your geodatabase is saved. Add your feature class(es), table(s), and ATTACH table(s) to your map.



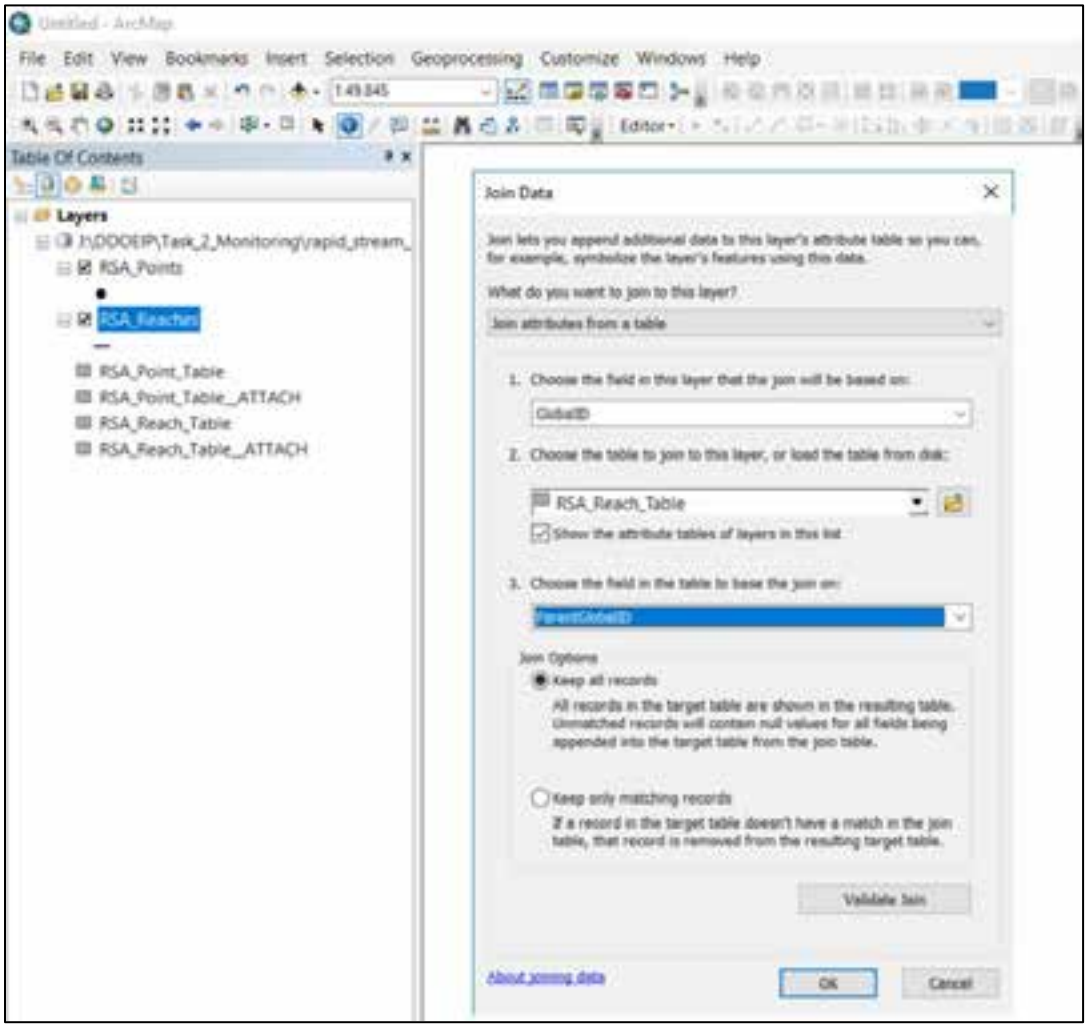
To see all the data in a single table, join the table and ATTACH table to the feature, as done below. Repeat the following steps for each set of features in your map (i.e. join the reach table, reach ATTACH table, and reach features. Repeat process with point table, point ATTACH table, and point feature.)

Right click the table and select “Join”.

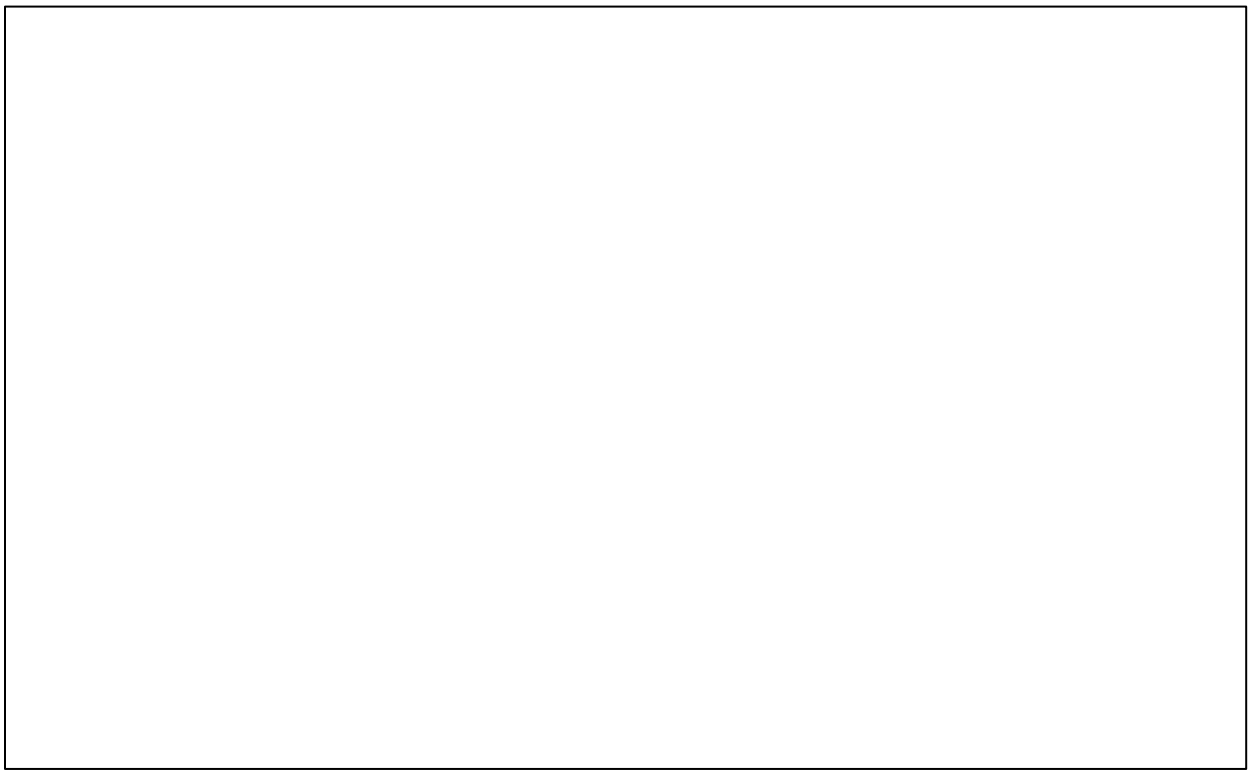
Join the ATTACH table to the table as illustrated below.



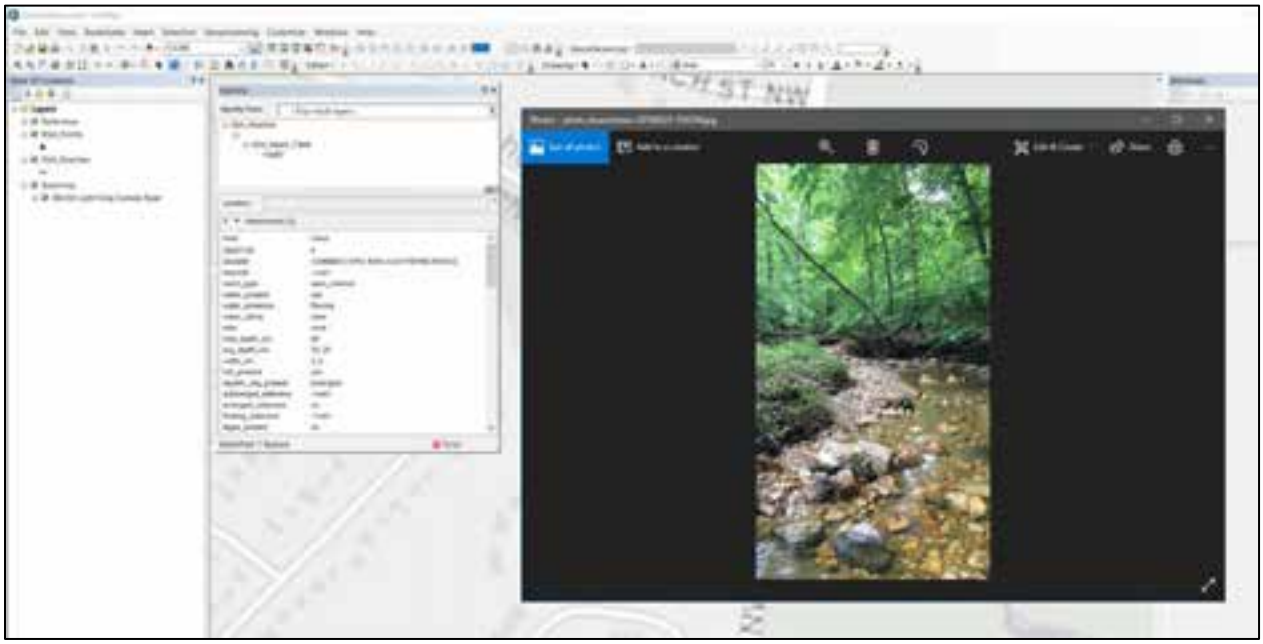
Now right click the feature and join the table to the features as shown below:


File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
RSA_Points
RSA_Reaches
RSA_Point_Table
RSA_Point_Table_ATTACH
RSA_Reach_Table
RSA_Reach_Table_ATTACH
Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
1. Choose the field in this layer that the join will be based on:
GlobalID
2. Choose the table to join to this layer, or load the table from disk:
RSA_Reach_Table
Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:
ParentGlobalID
Join Options
Keep all records
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.
Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.
Validate Join
About joining data
OK
Cancel

Data from the table can now be viewed in the attribute table of the feature class by right clicking the feature class and choosing “Open Attribute Table”.



Using the “Identify” tool, you can view (and download) the photos associate with an identified feature by clicking on the feature of interest, expanding the nested related layers, and clicking on attachments.



If you wish to export photos out of the geodatabase all at once you can do so following the directions ESRI has provided online here: https://support.esri.com/en/technical-article/000011912

7.0 Data backup

Data collected using the Collector/Survey 123 tool is backed up from AGOL as a geodatabase and saved to DOEE GIS servers using a python script, scheduled daily. This script is overseen by DOEE IT staff.

Appendix 4:
Contact List for Reporting Urgent Concerns/Flags

Appendix 4

Contact List for Reporting Urgent Concerns/Flags

Urgent concerns (i.e. downed power lines, leaking sewage lines, critical infrastructure damage threatening human safety) should be reported by the field collector immediately to the proper authority. The project manager or their designee should review the database for point assessments that have been flagged as needing non-urgent attention. Non-urgent concerns (i.e. dumpsite, bank erosion for potential restoration, aging infrastructure) should be reported to the appropriate department within six weeks of identifying the concern.

Contacts are as follows:

Issue	Contact
Immediate threats to humans and the environment	911
Downed power lines	202-872-3432 (Pepco)
Leaking sewage lines	202-612-3400
Water main breaks	202-612-3400
Fallen trees/limbs in public space	311 (DDOT)
Dumpsites	311 (DPW)
Severe bank erosion for potential restoration	NRA WPD
Illicit discharges	NRA IED
Deteriorating infrastructure • **Bridges** • **Outfalls**	DDOT –GI Section And Maintenance Division

Appendix 5:
Acceptability Rubrics

Appendix 5

Acceptability Rubrics

The following rubrics have been developed using the data collected during the first year of the Rapid Stream Assessment (RSA) program. This process has been used to establish an acceptable level of variation that can be expected between teams and across sites. As additional data are collected in subsequent years of this program, providing a more substantive basis upon which to establish acceptable variation, it is expected that minor modifications will be made (e.g., percentage of responses that must pass). Additionally, professional judgement should be taken into account in evaluating RSA data within these rubrics. This may include taking additional information into consideration in evaluating data including narrative comments associated with a site, the review of photos, and the a general understanding of a site/reach and its characteristics.

To ensure the quality of each survey conducted, 85% of the answers within each overlapping survey must achieve a passing score. To ensure the quality of all QAQC surveys throughout the field season, 85% of overlapping surveys must receive a passing score.

To determine if specific metric is being evaluated properly, 85% of all scores across all QAQC surveys throughout the field season must achieve a passing score for that specific metric.

Table 1. Reach Rubric

Metric	**Criteria 1**	**Criteria 2**
Reach Type	Identical Match	90% of responses should pass
	Difference w/ explanatory comment	
Water Presence	Identical Match	> 85% of responses should match identically **AND**
	Difference w/ explanatory comment	90% of responses should pass
Water Flow	Identical Match	90% of responses should pass
	Difference w/ explanatory comment	
Water Clarity	Identical Match	> 60% of responses should match identically **AND**
	At least one common water clarity **AND** no more than two differing response per assessment	75% of responses should pass

Odor	Identical Match	> 80% of responses should match identically **AND**
	If presence/ absence of odor differs: No more than 1 odor present	85% of responses should pass
	If odor is present but differs: Assessments should include at least one common odor	
Maximum Depth Encountered	Max depth is <100cm and responses differ by <5cm	80% of responses should pass
	Max depth is >100cm and responses differ by <20%	
Average Depth	Identical Match	> 75% of responses should match identically **AND**
	Responses which differ do not differ by more than one category	85% of responses should pass
Maximum Width	Identical Match	> 65% of responses should match identically **AND**
	Responses which differ do not differ by more than one category	85% of responses should pass
Fish Presence	Responses should match identically	85% of responses should pass
Aquatic Vegetation	Identical Match	> 80% of responses should match identically **AND**
	Assessments include at least one common vegetation type **AND** no more than one differing type	85% of responses should pass
Algae	Responses match in regards to presence/absence	> 80% of responses should match regarding presence/absence **AND**
	Compared responses do not indicate both "absent" and "extensive"	85% of responses should pass
Bacteria Presence	Responses match in regards to presence/absence	> 75% of assessments should match regarding presence/absence with common character **AND**

	Responses do not match regarding presence/absence but bacteria is not extensive	85% of responses should pass
Trash	Identical Match	> 60% of responses should match identically **AND**
	Responses which differ do not differ by more than one category	85% of responses should pass
Riparian vegetation width	Identical Match	> 80% of responses should match identically **AND**
	Responses which differ should not be more than one category apart on either bank.	85% of responses should pass
Riparian Vegetation Type - **Left Bank**	**Left Bank:** Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 AND Top ranked vegetation type of Team 2 is within the top two vegetation types ranked by Team 1.	85% of responses should pass
	Left Bank: Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 AND Top ranked vegetation type of Team 2 is listed by Team 1.	
Riparian Vegetation Type - **Right Bank**	**Right Bank:** Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 AND Top ranked vegetation type of Team 2 is within the top two vegetation types ranked by Team 1.	
	Right Bank: Top ranked vegetation type of Team 1 is within the top two vegetation types ranked by Team 2 AND Top ranked vegetation type of Team 2 is listed by Team 1.	

Substrate Type	Top ranked substrate type of Team 1 is within the top two substrate types ranked by Team 2 **AND** Top ranked substrate type of Team 2 is within the top two substrate types ranked by Team 1.	85% of responses should pass
	Top ranked substrate type of Team 1 is within the top two substrate types ranked by Team 2 **AND** Top ranked substrate type of Team 2 is listed by Team 1.	
Shading	Identical Match	> 60% of responses should match identically **AND**
	Responses which differ should not be more than one category apart.	85% of responses should pass
Floodplain Connectivity	Identical Match	> 75% of assessments should match identically **AND**
	Responses which differ should not be more than one category apart.	95% of responses should pass
Bank Erosion	Identical Match	75% of responses should pass
	If presence/absence of bank erosion differs: Compared responses should not include both "none" **AND** more than 1 impact.	
	If bank erosion is present: Assessments should include at least one common impact **AND** no more than 2 differing impacts per assessment	
Woody Debris	Responses should not differ >5 **OR** exceed 65% difference (whichever is greater)	60% of responses should pass
Recreation Evidence	Identical Match	> 60% of assessments should match identically in regards to presence/absence of recreation **AND**
	Compared responses include "none" **AND** 1 recreation type	85% of responses should pass

	Responses do **NOT** include "none" **AND** include at least one common type **AND** no more than 1 differing type per assessment	
Rosgen Classification	Identical Match	> 60% of responses should match identically **AND**
	Responses which differ should not be more than one category apart.	80% of responses should pass
OVERALL TARGETS	85% of All overlapping reaches pass	85% of all Metrics Pass

Table 2. Points Rubric

Metric		**Criteria 1**	**Criteria 2**
Deficient Buffer	Bankside	Identical response	> 80% of responses should match identically **AND**
		One common bankside	85% of responses should pass
	Length of deficiency	Identical response	85% of responses should pass
		Responses which differ do not differ by more than one category	
	Riparian Cover in Deficient Buffer Area	All, or all but two, of the cover type(s) are the same on both assesments.	85% of responses should pass
	Impact Score	Identical Match	85% of responses should pass
		Responses which differ do not differ by more than one category	
Crossing	Type	Responses should match identically	85% of responses should pass
	Diameter/width	Identical Match	>65% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	85% of responses should pass
	Length	Identical Match	> 65% of responses should match identically **AND**
		Responses which differ do not differ by more than one	85% of responses should pass

		category	
	Material	All, or all but one, of the material type(s) are the same on both assessments.	75% of responses should pass
	Downstream debris	Responses should match identically	85% of responses should pass
	Downstream Erosion	Responses match in regards to presence/absence **AND** erosion height is within one category (if present)	> 75% of assessments should match regarding presence/absence with similar height **AND**
		Responses do not match in regards to presence/absence **but** erosion height is 0-1m	85% of responses should pass
	Downstream sediment	Responses should match identically	85% of responses should pass
	Upstream debris	Responses should match identically	85% of responses should pass
	Upstream Erosion	Responses match in regards to presence/absence **AND** erosion height is within one category (if present)	> 75% of assessments should match regarding presence/absence with similar height **AND**
		Responses do not match in regards to presence/absence **but** erosion height is 0-1m	85% of responses should pass
	Upstream sediment	Responses should match identically	85% of responses should pass
	Impact Score	Identical Match	85% of responses should pass
		Responses which differ do not differ by more than one category	
Dumpsite	Bankside	Identical response	> 80% of responses should match identically **AND**
		One common bankside	85% of responses should pass
	Location	Identical response	> 80% of responses should match identically **AND**
		At least one common location	85% of responses should pass
	Cleanup potential	Responses should match identically	85% of responses should pass
	Material dumped	All, or all but two, of the dumped material(s) are the	75% of responses should pass

		same on both assessments.	
	Trash Volume	Identical Match	> 80% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	85% of responses should pass
	Impact Score	Identical Match	85% of responses should pass
		Responses which differ do not differ by more than one category	
Erosion	Bankside	Identical response	> 80% of responses should match identically **AND**
		One common bankside	85% of responses should pass
	LEFT Bank Height	Identical Match	> 80% of responses should match identically AND
		Responses which differ do not differ by more than one category	
	Right Bank Height	Identical Match	
		Responses which differ do not differ by more than one category	
			85% of responses should pass
	Impact of Erosion	Identical Match	75% of responses should pass
		If presence/absence of bank erosion differs: Compared responses should not include both “none” **AND** more than 2 impacts.	
		If bank erosion is present: Assessments should include at least one common impact **AND** no more than 2 differing character type per assessment	
Pipes	Bankside	Identical response	> 80% of responses should match identically **AND**
		One common bankside	85% of responses should pass
	Pipe diameter	Identical Match	> 75% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	85% of responses should pass

	Pipe material	Identical Match	> 75% of responses should match identically **AND**
		Difference w/ explanatory comment	85% of responses should pass
	Floating solids/trash	Responses should match identically	85% of responses should pass
	Erosion due to pipe	Identical Match	> 65% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	75% of responses should pass
	Impact Score	Identical Match	75% of responses should pass
		Responses which differ do not differ by more than one category	
	Discharge concern	All, or all but one, of the discharge concern is listed on both assessments (if discharge present)	85% of responses should pass
Utility Line	Exposed sewer	Responses should match identically	85% of responses should pass
		Fail Comparison	
	Utility diameter	Identical Match	> 80% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	85% of responses should pass
	Utility material	Identical Match	> 75% of responses should match identically **AND**
		Difference w/ explanatory comment	85% of responses should pass
	Condition	Identical Match	> 80% of responses should match identically **AND**
		Responses which differ do not differ by more than one category	85% of responses should pass
	Impact Score	Identical Match	85% of responses should pass
		Responses which differ do not differ by more than one	

		category	
Fish Blockage	Man-made	Responses should match identically	85% of responses should pass
	Height	Identical response	85% of responses should pass
		Responses which differ do not differ by more than one category	
OVERALL TARGETS		85% of all overlapping points pass	85 % of all Metrics pass

Table 3. Assessment Conflicts Rubric

Conflict	**Criteria 1**	**Criteria 2**
Feature Conflicts	Feature type conflicts; Assessments describe similar conditions/observations	Should account for >65% of feature conflicts
	Feature type conflicts; Assessments describe incomplete conditions/observations	Should account for <35% of feature conflicts
	Feature type conflicts; Assessments do NOT describe similar conditions/observations	Should account for <5% of feature conflicts
Missing Points	Located along unassessed reach	Should not exceed 10% of all points assessed
	Unobserved - Deficient Buffer	
	Unobserved - Crossing	
	Unobserved - Dumpsite	
	Unobserved - Erosion	
	Unobserved - Pipes	
	Unobserved - Utility line	
	Unobserved - Fish blockage	
	Unobserved - Other	
Differing Point Assessments	Considered unobserved, missing points	

Missing Reaches	Distance of reach when a feature conflict occurs (if assessments do not describe conditions/observations, or describe them incompletely)	Should not exceed 10% of the assessed distance
	Distance of reach that is unobserved	
Differing Reach Assessment Type	Assessment contains explanatory note	Should account for >95% of reach assessment type conflicts
	Assessment contains no explanation	Should account for <5% of reach assessment type conflicts