

Title: Probabilistic Monitoring	No: SOP 13.1	Page 1 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB)

Standard Operating Procedure (SOP) for

PROBABILISTIC MONITORING SURVEYS

Approval Signatures

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Date

Title: Probabilistic Monitoring	No: SOP 13.1	Page 2 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

1.0 Purpose and Scope

The purpose of this procedure is to describe the process for conducting probabilistic stream sampling. Probabilistic monitoring is a randomized sample design for stream monitoring designed to provide an unbiased evaluation of the condition of the state's perennial, wadeable streams as defined in the SWQB Comprehensive Assessment and Listing Methodology, or CALM, for Sedimentation (NMED/SWQB 2021b). Probabilistic sampling entails collecting physical habitat measurements, benthic macroinvertebrate samples, flow data, sonde grab data and collecting both chemical and bacteriological samples at each sampling site.

2.0 Personnel Responsibilities

Program Manager – responsible for ensuring that sufficient resources are allocated to complete program commitments, that monitoring activities support protection of the surface waters of New Mexico and that grant deliverables are fulfilled.

Project Manager – responsible for organizing and planning data collection activities and ensuring monitoring activities adhere to applicable SOPs and Field Sampling Plans.

Project Team – responsible for exclusion of sample sites through office and field reconnaissance, and for performing chemical, physical habitat, benthic macroinvertebrate, and flow sampling at probabilistic monitoring sites; preparation and submittal of chemical and biological samples to state and/or contract laboratories; entering sampling information into the Bureau's database. Responsible for performing QA checks on data entry and calculations.

The Quality Assurance Officer (QAO) is involved in the development and revision of this SOP to ensure the SOP meets the requirements of the SWQB's Quality Assurance Project Plan. The QAO, along with the Subject Matter Expert and Program Manager will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with SOP 1.1 for the Creation and Maintenance of SOPs (<https://www.env.nm.gov/surface-water-quality/sop/>). Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

Personnel who conduct probabilistic monitoring (including physical habitat sampling, water chemistry sampling, sonde deployment, and benthic macroinvertebrate sampling), and data verification and validation activities or who supervise those who do must be familiar with this SOP.

Technical staff should have experience collecting chemical, geomorphic, hydrological, and biological data in New Mexico streams. All new Monitoring Team employees will receive training and perform each of the field measurements described in this SOP under the supervision of a senior technical staff member at least once before being permitted to make these measurements without a senior technical staff member present.

Title: Probabilistic Monitoring	No: SOP 13.1	Page 3 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

3.0 Background and Precautions

3.1 Background

The SWQB utilizes probabilistic monitoring to achieve the objectives of assessing the condition of New Mexico’s waters in addition to targeted sampling conducted on a rotational basis throughout the state. For probabilistic monitoring surveys, sampling sites are randomly selected and each sampling site represents a specific portion of the rivers and streams within the state’s watersheds. Because sites are selected randomly, the results from the sample population (rivers and streams within a specific watershed) can be extrapolated to the entire population and be used for making unbiased assessments of the condition of the waterbodies within a given watershed in New Mexico without monitoring every waterbody within the watershed.

3.2 Procedural Precautions

This SOP is designed to be used in wadeable perennial streams and is not appropriate for generating sedimentation/siltation data for assessment of large river systems, intermittent or ephemeral streams, lakes and reservoirs, beaver ponds or backwater features, or wetlands.

Probabilistic Monitoring surveys should be completed during stable low flow conditions, between August 15 and November 15 (preferably before deciduous tree leaves have dropped), because this is the SWQB’s historic biomonitoring index period. Both physical habitat and biological field measurements will be collected during the biomonitoring index period and at least six weeks after a scouring flow event (Biggs & Kilroy 2000). Refer to SOP 5.0 Physical Habitat Measurements for further instruction on determining whether a scouring flow event has occurred.

If other stream sampling work is to be done simultaneously or prior to the collection of water samples, collect water samples at enough distance upstream to prevent interference or wait for disturbed water to flow past the collection site. It is recommended that field staff use gloves when conducting field measurements in waters suspected of having high bacterial contamination.

3.3 Safety Precautions

Wading across a stream bed can be very dangerous depending on flow and substrate conditions. Do not attempt to wade into a stream if the depth (in ft) multiplied by the velocity (in ft/s) equals or exceeds 10 square feet per second (ft²/s). For example, a stream that is 2 ft deep, and has velocities of 5 ft/s or more, should be considered too dangerous to wade. If you unknowingly start to take measurements and discover part of the way across that you violate this rule (“the rule of ten”), return to the nearest bank and note “too fast/deep to measure” on the field form. Do not attempt to wade a stream if you feel it is unsafe, regardless of the outcome of the “rule of ten.” Some wadeable streams may be unwadeable during spring runoff but will be wadeable when base flow resumes and during the period (August 15-November 15) in which probabilistic monitoring will occur. Refer to SWQB’s Job Hazard Analysis (JHA) for

Title: Probabilistic Monitoring	No: SOP 13.1	Page 4 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

further safety precautions when conducting field work.

Some channels have quicksand-like areas, deep holes, sharp rocks, excessive fallen logs, etc., that can lead to foot entrapment, injury, or falls. A wading rod, surveyor’s rod, ski pole, or stick can be used for stabilization and to probe the streambed when conditions are uncertain. Staff should use best professional judgement to assess risks involved with data collection. Refer to SWQB’s JHA for further safety precautions when conducting field work.

Field staff should exercise their professional judgement regarding all sampling conditions and whether to begin or continue traveling to a field site or conduct sampling. Field staff should not risk traveling to remote sites during weather events such as severe monsoon rainstorms or snow-storms and should not sample during nearby thunderstorms. Sampling should be rescheduled or delayed to accommodate unsafe conditions. Field staff should alert their supervisor on their sampling plan for the day and carry a cell-phone at all times in case of emergency. Field staff should carry driving directions, a GPS, and a map of the area surrounding the site for navigating.

If a wastewater treatment plant (WWTP) is upstream of a site, check with staff from the Point Source Regulation Section to determine if the plant is properly treating wastewater before discharging to the water course. If available, review data from a routinely sampled stations to see if there have been elevated levels *E. coli*. Watercourses receiving untreated water should be avoided.

4.0 Definitions

Assessment Units (AUs) – River or stream reaches defined by various factors such as hydrologic or watershed boundaries, geology, topography, incoming tributaries, surrounding land use/land management, water quality standards, etc. AUs are designed to represent waters with assumed homogeneous water quality (WERF 2007). Stream or river AUs in New Mexico are typically no more than 25 miles in length unless there are no tributaries or land use changes to consider along the reach (NMED/SWQB 2019).

Field Sampling Plan (FSP) – A document that provides guidance for all fieldwork by defining in detail the sampling and field data-gathering methods as well as resource requirements for the project.

Program Manager – An individual within the SWQB that manages a program such as the Watershed Protection Section (WPS), the Point Source Regulation Section (PSRS) or the Monitoring, Assessment and Standards Section (MASS). The Program Manager and Project Manager are not necessarily synonymous.

Quality Assurance Officer (QAO) – An individual within the MASS that is responsible for overseeing the development and implementation of all quality assurance procedures and processes within the SWQB including those projects that receive support or funding from the SWQB. The QAO is also responsible for reviewing data sets to ensure the quality assurance requirements of the most up to date SWQB QAPP have been met for potential use in various SWQB activities.

Title: Probabilistic Monitoring	No: SOP 13.1	Page 5 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

RID – A reference ID. This is a unique number and barcode assigned to each water chemistry and benthic macroinvertebrate sample. RID stickers provided by SLD contain both the number and barcode and can be adhered to the sample container.

Sampling Frame – The sampling frame for this SOP consists of approximately 25,000 500-meter stream increments in New Mexico.

Sample Population – Perennial, actively flowing, wadeable streams and rivers in New Mexico within a specific watershed as defined in the SWQB Comprehensive Assessment and Listing Methodology, or CALM, for Sedimentation (NMED/SWQB 2019).

Sampling queue – Thirty sites within a specific watershed that are selected from the sample population using the “Probabilistic Stream and River Site Criteria” listed in this SOP.

State Laboratory Division (SLD) – A state-run laboratory located in Albuquerque, New Mexico. The majority of SWQB water chemistry samples are submitted to this laboratory for analysis.

Subject Matter Expert (SME) – A person who is familiar with the purpose and procedure for accomplishing a task. The SME may be the same individual as the Project Manager.

Standard Operating Procedure (SOP) – A document that lists the steps that should be completed when doing a task.

Surface Water Quality Bureau (SWQB) – A Bureau under the Water Protection Division of the New Mexico Environment Department. The SWQB’s mission is to preserve, protect, and improve New Mexico’s surface water quality for present and future generations.

Surface Water Quality Information Database (SQUID) – The SWQB database for storing, retrieving and reporting environmental results which include laboratory results, field observations, biologic assemblage data, long-term datasets (LTD) summary data, stream habitat/geomorphic data and their associated monitoring locations.

Trainee – A person undergoing training for a particular data collection survey(s) identified in this SOP.

5.0 Equipment and Tools

- Field forms for physical habitat, flow, benthic macroinvertebrate, and water chemistry data
 - Habitat and Biota Field Work Cover Sheet
 - Pebble Count Field Form
 - Cross Section, Thalweg Profile, and Large Woody Debris Form
 - Slope Field Form
 - Bankfull Cross-Section and Stream Flow Field Form
 - Percent Canopy Cover Field Form
 - Stream/River Field Data Form
- Pencil
- Multi-parameter sonde

Title: Probabilistic Monitoring	No: SOP 13.1	Page 6 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

- Tablet or other Bluetooth enabled device for sonde
- GPS enabled device for recording latitude/longitude coordinates (preferably decimal degrees)
- SOPs for reference – SWQB SOP 5.0, 6.1, 6.2, 7.0, 8.2, 9.1, 11.1
- Digital camera or device for photos (cell phone)
- Refer to SOP 5.0, 6.2, 7.0, 8.2, 9.1, and 11.1 for field equipment required for physical habitat, flow, chemical, bacteriological, and benthic macroinvertebrate sampling.

6.0 Step-by-step Process Description

6.1 Office Procedures (Prior to field work)

The *Planning Process* for environmental data collection activities (NMED/SWQB 2021a) is utilized for the development of an FSP for probabilistic monitoring. Probabilistic sampling entails collecting physical habitat measurements, benthic macroinvertebrate samples, flow data, sonde grab data and collecting both chemical and bacteriological samples at each sampling site. Sampling sites are randomly selected on a watershed approach from a sampling frame which consists of over 25,000 500-meter stream increments in NM.

6.1.1 Developing a Sampling Population from the Sample Frame

The first step in the *Planning Process* for probabilistic monitoring is developing a statistically sound sampling frame from a target population. The target sample population for SWQB probabilistic sampling is perennial, actively flowing, wadeable streams and rivers in New Mexico. Probabilistic monitoring is watershed based and focuses on sampling within a specific watershed dependent on the targeted 8-year rotational survey identified in the Surface Water Quality 10-year Monitoring and Assessment Strategy (NMED/SWQB 2016). Potential sampling sites are randomly selected from the sample frame by staff at the USEPA National Health and Environmental Effects Research Laboratory in Corvallis, OR within the specific watershed by computer using USGS National Hydrography Dataset (NHD) Plus (a stream network coverage at the 100k scale) as a sample frame, which is then validated with SWQB Assessed Streams information. This process occurs externally and is outside the scope of this SOP. See the SWQB MASS Program Manager for further information regarding the probabilistic sampling frame and generation of a sampling population. Random site generation produces three hundred sites for a specific watershed from the sampling frame selected for each year of the survey with the first thirty sites serving as the sample population and the remaining 270 sites as alternates. Each probabilistic sampling site is a point (longitude and latitude) along the stream length determined during the development of the sampling population.

The sampling population for the current year probabilistic monitoring is included in the field sampling plan for the survey. An excel file containing a siteID, stream name (if available), latitude and longitudes, Hydrological Unit Code (HUC), SWQB Assessment Unit (AU) name and comments, Water Quality Standards (WQS) reference, ecoregion, and other pertinent information is generated as part of the sampling frame and made available to SWQB monitoring

Title: Probabilistic Monitoring	No: SOP 13.1	Page 7 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

staff. The site ID for each location is provided in the following format: NM"*last two digits of survey year*"-10 "*number indicating order in which site was randomly generated*". This naming convention should be adapted to include the stream name at the beginning of the siteID once the stream name has been identified. For example, probabilistic site NM20-10302 in the Gila River selected for sampling in the year 2020, would become Gila-NM20-10302.

6.1.2 Site Selection and Elimination

Once a sample population has been made available, the next step in the probabilistic monitoring *Planning Process* is determining which sites can be sampled. The SWQB monitoring team staff will individually validate sampling sites from the list of 300 randomly-generated sites (the "sampling population"), beginning with the first 30 and working consecutively down the list until 30 suitable probabilistic monitoring sites are found and placed on the list of sites to be sampled, or the "sampling queue." In order to determine sampling feasibility for each site, utilize the Probabilistic Site Criteria and Accessibility Site Criteria for probabilistic monitoring as defined in this section of this SOP. If a site does not meet the criteria, it should be excluded from the sampling queue. GIS programs, such as ArcMap, can be used to exclude sites due to the accessibility. Excluded sites should be replaced by alternate sites in successive order. If staff are unsure about the eligibility of a site for sampling they should consult with their supervisor and other field staff for secondary opinions and make every reasonable effort to gain more information about the site before ruling it out for sampling (i.e. contacting the forest service, landowner, land grant, or some other person familiar with the area etc.).

Systematic sampling site determination

Beginning with the first 30 of the 300 possible sites, view satellite imagery using the online SWQB mapping tool or another online imagery application (e.g. Google Earth) to determine whether a site is perennial, actively flowing, wadeable, accessible, sufficient in length, and whether land owner permissions are needed. Select sites in order of occurrence, starting with site number one (1) until thirty (30) sites have been determined to meet the Probabilistic River and Stream Site Criteria and the Accessibility Site Criteria, and have been placed in the sampling queue.

Probabilistic Stream and River Site Criteria – all sites selected for sampling must meet all of the following:

- Sites must be selected or eliminated in numerical order from the provided list. Sites may not be selected or eliminated preferentially (for instance, because they appear to have easier access than sites occurring earlier on the list or alternatively lie within an undesirable location).
- Sites must be located on a perennial, wadeable stream with no confluences or tributaries within the reach length to be sampled.
- A sufficient length of stream either beginning or ending within 500 meters of stream length from the site of the GPS coordinates should be available for sampling. This means that at least 160 meters and at least 40 times the average width of the stream should be available, accessible, perennial, wadeable, and not include any tributaries.
- A site that has 100% of its flow from WWTP effluent and has been shown to routinely

Title: Probabilistic Monitoring	No: SOP 13.1	Page 8 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

exceed the primary contact single sample of 410 cfu/100 mL or MPN/100 mL may be excluded. A site may also be excluded if an upstream WWTP is known to not be treating wastewater before discharge.

Probabilistic Stream and River Accessibility Site Criteria – accessibility outside these conditions may be considered on a case-by-case basis.

- Sites should be within a 1-hour hike from the vehicle (approximately 2 miles via hiking trail or open and even terrain along a stream bank, or approximately 0.5 miles via backcountry bushwhack). A site greater than 2 miles from vehicular access via hiking trail or greater than 0.5 mile via bushwhack access can be automatically eliminated from the site sampling list.
- Sites should be within 2-hours of a road traversable in inclement weather. Oftentimes, there are forest service roads visible on the map or satellite imagery, but such roads may be closed. Consult the Forest Service travel management map for up-to-date road closures or call the local ranger district.
- Sites should be either on public land or private land for which property ownership can be determined and permission for entering the property can be obtained.
- If mailers requesting land owner permission for sampling streams have not been returned within 30 days of being sent out, then the site is determined to be inaccessible and the next site should be considered.
- No foreseeable physical barriers to sampling the site exist. Examples of physical barriers to sampling could be waterfalls, cliffs, streams consistently too deep to wade, or a stream that has become impounded for instance, by a beaver dam or other unsurmountable obstacles that make sampling either dangerous or impossible. If there are physical barriers prohibitive to hiking into the site or sampling the site other than landownership issues (e.g. a gated road), sites may be automatically eliminated from the sampling list. Sites should be promptly eliminated for sampling if they fall inside private property and land owner permission to sample is not granted.

Satellite imagery (e.g., Google Earth), the SWQB Mapper application, or stream gauge data (if available) can help staff determine whether a site is located within a perennial stream and wadeable. Streams may have a perennial designation in the NHD dataset but upon further examination of aerial satellite imagery it may become apparent that a stream has either been mistakenly designated or the previously perennial stream has since become impounded, diverted, or otherwise naturally or artificially altered so that it is no longer flowing. Careful inspection of the riparian corridor throughout multiple years of satellite imagery, professional knowledge of the stream, and information from land owners or others familiar with the stream can also assist in determining whether a site is perennial, flowing (not artificially or naturally impounded) and should be sampled. Topographic maps may also be used, combined with satellite imagery to aid in determining whether stream gradient is too steep or the terrain traveling into the stream is impossible to reasonably traverse. Best professional judgment should be exercised when determining what terrain and conditions field staff are capable of traveling and sampling in. Time permitting, field reconnaissance of the site is highly encouraged. Field safety precautions should be used at all times to determine whether sampling should take place.

Title: Probabilistic Monitoring	No: SOP 13.1	Page 9 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

6.1.3 Mailers

Use a county assessors’ online tool or a landownership application to determine land ownership. Permission to sample must be granted by private landowners and/or land grant leadership before sites can be placed in the sampling queue. Mailers with a letter explaining the survey and the location of interest, as well as a post card with pre-paid postage granting or denying the SWQB permission should be mailed out to land owners and/or land grants no later than 6 weeks before surveying commences. An easy way to create a large shipment of mailers with many associated addresses is to use the “mail merge” function in Microsoft Word. See “mailers” instructions sheet on the SOP webpage under “related SOP forms.”

6.1.4 Scheduling

All 300 sampling sites making up the sampling population for the current year probabilistic monitoring are included in the field sampling plan (FSP) for the survey. The FSP for the current year’s survey is used for generating a sampling schedule, and is critical for project management. All probabilistic sampling must occur between August 15th and November 15th each year because biological data (benthic macroinvertebrates) must be collected during the SWQB Biomonitoring Index Period. Typically, a team of three (3) is used to conduct probabilistic sampling. Site conditions, access, proximity of sites, and land owner permissions and schedules must all be accounted for when determining sample schedule. Additionally, considerations for chemical and benthic macroinvertebrate sample hold times and submittal to the laboratory should be taken under consideration when arranging the sampling schedule. Because probabilistic sampling must occur within the SWQB Biomonitoring Index Period, sites should be sampled from higher, more mountainous ecoregions first, working down to lower elevation sites as the sampling index period progresses. This ensures that data from higher elevation sites is not skewed due to colder temperatures. For instance, leaf cover may not be present later in the season as trees drop their leaves, leading to lower densiometer readings. Additionally, benthic macroinvertebrates may be present in lower numbers, and may be more difficult to sample and sort due to excessive leaf litter on the streambed.

6.2 Field Protocols

6.2.1 Site Verification

Each probabilistic sampling site is a point (longitude and latitude) along the stream/river length determined during the development of the sampling population as stated previously. Sampling teams should use all available means to ensure that they are at the correct site location by verifying latitude and longitude using mobile GIS programs, maps, or a GPS unit. Once the site location has been verified, the sampling site is translated into an associated reach dependent on the stream/river average wetted width; the Reach Layout section (6.2.3) of this SOP provides details regarding sample reach length. Reaches must begin or end within 500 meters of stream length from the GPS coordinates listed for the site. Unforeseen obstacles to sampling may be identified during initial site verification in the field. For instance, the site may be inaccessible due to a gated road not visible during aerial reconnaissance, impounded (e.g. beaver dam), too deep, or simply not perennial.

Title: Probabilistic Monitoring	No: SOP 13.1	Page 10 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

Note: If a stream is flowing but there is uncertainty as to whether the stream is perennial, refer to the SWQB Hydrology Protocol (HP) in the WQMP/CPP (NMED/SWQB 2020) and complete a Level 1 field assessment using the HP. If the results of the Level 1 HP meet the requirements for determining that a stream is perennial, proceed with sampling. If the results of the complete Level 1 HP do not concretely determine that the stream is perennial, do not proceed with sampling and relocate to an alternative site. If a rain event occurred recently it is recommended to wait 48 hours from the rain event to conduct the level 1 HP. If the HP results for a water course differ from what is listed in the standards, alert the Standards Planning and Reporting Team Supervisor to the inconsistency.

6.2.2 Reach Selection

Reaches may be adjusted to fall within 500 meters of stream length (beginning or ending) from the site’s GPS location, provided adjusting the sample location does not cause the reach to intersect with a stream confluence. Prior to field work, use an online imagery application to identify points 500 stream length meters upstream and downstream of the sampling site. Do not adjust the reach location to avoid human disturbances like bridges, culverts, rip/rap, or channelized areas (a key difference from SOP 5.0 Physical Habitat Measurements). If probabilistic sampling sites occur near enough to each other along the same stream, stream reaches may over-lap. In this case, if it is possible to shift a stream reach upstream or downstream to begin within 500 meters of stream length from the probabilistic site GPS coordinates field staff should do so and otherwise proceed normally with sampling. Include GPS coordinates from the top and bottom of the reach (Transect A and Transect E) on the data sheets so that discrepancies between actual sample location and the assigned site are recorded.

6.2.3 Reach Layout

Refer to SOP 5.0 Physical Habitat Measurements for a detailed description of reach layout. Sample reach should be walked in entirety prior to beginning reach layout. Reaches should be at least 160 meters in length or 40x time average wetted width, with 5 transects (“A,” “B,” “C,” “D,” “E”). When laying out a probabilistic sampling reach, ensure that flagging for the halfway points between transects is placed to mark benthic macroinvertebrate sampling transects (i.e., “A.5,” “B.5,” “C.5,” “D.5,” “E.5”) which occur in addition to the regularly lettered habitat cross-section transects. If a reach crosses private property, ensure that permission has been secured for sampling that portion of the stream reach. Otherwise, relocate the stream reach to a portion (within 500 meters of stream length from the random site location) for which access has been granted.

During reach layout proceed with laying out the reach regardless of any human-constructed structures. For the purposes of probabilistic sampling this SOP differs from SOP 5.0 in this respect because the goal of probabilistic sampling is to assess the condition of the stream at each randomly selected point regardless of site condition instead of selecting a section of stream considered to be representative of a SWQB assessment unit. Sample as close to normal under bridges and in human-constructed channels. If a culvert occurs in the sample reach, proceed with reach layout but eliminate the culvert from the reach measurements. Measure the length of any culverts occurring within the reach and make a comment on the field form that a culvert was skipped. Note the length of the culvert and the meter measurement along the reach at which the culvert occurred and continue reach layout immediately on the other side of the

Title: Probabilistic Monitoring	No: SOP 13.1	Page 11 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

culvert with the next consecutive meter measurement.

6.3 Logistics and Field Data Collections

Data to be collected at each sample location includes physical habitat measurements (SWQB SOP 5.0), stream flow (SWQB SOP 7.0), benthic macroinvertebrates (SWQB SOP 11.1), chemical samples (SWQB SOP 8.2), bacteriological samples (SWQB SOP 9.1) and sonde grab data (SWBQ SOP 6.2). For detailed protocols on how to collect this data please refer to the appropriate SWQB SOP. All SWQB SOPs can be found at <https://www.env.nm.gov/surface-water-quality/sop/>. All data collection and measurements are recorded on field forms that can be found under Related SOP Forms next to their associated SOP.

For Probabilistic Monitoring, all data collection at a specific sampling site should be performed concurrently but no greater than 48 hours apart. Once a particular survey (e.g., pebble count) has been started by an observer, the initial observer will be required to complete the survey in its entirety for that sampling site. Observers may change from one particular survey to another at each sampling site (e.g., one observer may collect data for the pebble count survey and a different observer may collect data for percent canopy cover survey for the same sampling site). While not required, it is recommended that one member of field staff performs benthic macroinvertebrate collections while two other field staff (recorder and observer) perform habitat data components of the probabilistic survey.

6.3.1 Physical Habitat Measurements and Flow Data Collection

Collect all physical habitat measurements according to SOP 5.0, which includes pebble counts, slope, percent canopy cover, thalweg, cross-sectional profiles, and bankfull cross sections including flow measurements. The reach should be walked in entirety prior to beginning reach layout, and 5 wetted width measurements taken to calculate an average wetted width for the reach. While not required, slope measurements may be taken in conjunction with measuring and laying out the reach for efficiency. It is also recommended but not required that all other physical habitat measurements be collected in one single trip through the stream reach. It is most efficient if the pebble count, cross-sectional profile and percent canopy transects are measured out by counting thalweg measurements as the observer moves upstream. For example, if the stream reach is 160 meters long, thalweg measurements are taken every one meter and therefore every 8th thalweg measurement a pebble count would occur (transects are spaced 8 meters apart) and every 40 thalweg measurement (at each lettered transect) a cross-sectional profile and percent canopy cover measurement would occur. Record GPS locations for Transects A and E on the habitat data field form cover sheet. Ideally, a team of two people (one recorder and one observer) is available for these tasks.

Perform bankfull cross-section and stream flow in conjunction, as measurements are recorded on one field sheet. Refer to SOP 5.0 for bankfull cross-section and SOP 7.0 for stream flow procedures. The preferred location for collecting bankfull cross-section and flow is at Transect C, but the location may be moved as necessary to a transect with a straight flow-path and flow perpendicular to the cross section.

6.3.2 Benthic Macroinvertebrate Sampling

Refer to SOP 11.1 for benthic macroinvertebrate data collection procedures. The SWBQ uses the

Title: Probabilistic Monitoring	No: SOP 13.1	Page 12 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

EMAP Transect methodology. Benthic macroinvertebrate samples are collected at every lettered physical habitat transect (A-E), as well as at the halfway point between each lettered transect (A.5-D.5). Place a request ID (RID) sticker on each container of macroinvertebrates and write the station ID (e.g. Pecos-NM19-10020), date, and container series number (e.g. 2 of 3) in pencil on a piece of tape across the top of the container. Upon returning to the lab, place a piece of write-in-the-rain paper with the station ID, date, RID, and container series number written in pencil in the sample container.

6.3.3 Chemical Sampling and Bacteriological Sampling

Refer to SOP 8.2 for Chemical Sampling protocols and 9.1 for Bacteriological Sampling protocols. Typically, chemical samples are collected at the top of the sample reach after physical habitat and benthic macroinvertebrate sampling is complete to minimize risk of hold time violations. At probabilistic sampling sites the following chemical samples are taken: TDS/TSS/Cl⁻/ SO₄²⁻, Dissolved Organic Carbon, Nutrients, *E. coli*, Total Metals, and Dissolved Metals. Aluminum is sampled separately if the turbidity is greater than 30 NTU. For sites that require long hikes, pre-acidify the nutrient and metal sample containers to avoid violating the hold-time prior to acidification. The SWQB 2021 QAPP (NMED/SWQB 2021c) states that samples should be preserved as soon as reasonably possible, preferably immediately after sample collection, and note that pre-preserved sample containers may be used. The SWQB 2021 QAPP also states that aluminum samples should be filtered within 15 minutes of sample collection, when the streams turbidity is above 30 NTUs. Collect aluminum samples last and at the very end of sampling to meet this hold-time.

6.3.4 Sonde Grab Data

Sonde grab data are collected at the time of chemical and bacteriological sampling. Refer to SWQB SOP 6.2 for sonde deployment protocols and SOP 6.1 for maintenance and calibration requirements for sondes.

6.3.5 Photo-documentation

It is essential to take several photos of the reach condition and any disturbances or modifications that are relevant to data collection and assessment. Use a camera with GPS capabilities so that locations are collected with the metadata. Once back from the field, download photos into the project file.

6.4 Field Verification of Data Sheets for Completion and Accuracy

Prior to departing the probabilistic sampling site ensure that all data forms for habitat, flow, chemical, and benthic macroinvertebrate data are present and complete. Verify that sampling location information such as station ID, field data, GPS coordinates from the top and bottom of the reach, and field staff are recorded.

7.0 Data Entry/Management

Enter all field form data into appropriate electronic field forms when returning to the office (forms can be found on the SWQB SOP website). Save these forms in the electronic project folder. Save paper

Title: Probabilistic Monitoring	No: SOP 13.1	Page 13 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

copies in the project binder stored at the SWQB office. See section 7.2 of this SOP for uploading physical habitat, chemical sampling event, flow, benthic macroinvertebrate, and bacteriological field data. Refer to SOP 15.0 for data verification and validation procedures.

7.1 SQUID Probabilistic Sampling Event Creation

7.1.1 Creating a New Sampling Station in SQUID

Because probabilistic sample locations are randomly generated, pre-existing or historic SWQB sampling stations will not exist for probabilistic sites and new stations must be created in SQUID prior to sampling event and data upload. Occasionally, a new assessment unit (AU) will also need to be created to accompany the new station if the stream in question has no associated data in SQUID. See the SWQB project manager or SQUID manager administrator for permissions for creating new stations, , and adding new stations to a project folder. Refer to the SWQB SQUID manual for further instruction on creating a new sampling station.

7.1.2 Creating a New Assessment Unit in SQUID

Contact the Bureau assessment coordinator for the creation of new assessment units.

7.2. Uploading Data to a Sampling Event in SQUID

7.2.1 Uploading Habitat Data to a Sampling Event

Refer to SOP 5.0 for guidance on uploading Physical Habitat data into SQUID. In the metadata pop-up box for the sampling event, ensure that that “All” is selected in the “data collected” field in order to allow for the upload of all applicable components of the habitat survey.

7.2.2 Uploading Chemical and Bacteriological Data to a Sampling Event

Refer to SOP 8.2 and 9.1 for Chemical and Bacteriological data upload.

7.2.3 Uploading Flow Data to a Sampling Event

Refer to SOP 7.0 (Stream Flow) for instructions on adding a flow sampling event to a station. Utilize the calculated flow measurement from the bankfull cross-section and flow field form from the physical habitat data collection. Create a flow sampling event if one was not created automatically with the chemical data upload (detailed in SOP 8.2).

7.2.4 Uploading Benthic Macroinvertebrate Data to a Sampling Event

Refer to SOP 11.1 (Benthic Macroinvertebrates) for instructions on uploading benthic macroinvertebrate data to SQUID.

7.3. Viewing Uploaded Data from SQUID in Excel

1. In SQUID, select *Adhoc Report*.
2. Select *Project and Station*.
3. To view physical habitat data navigate to the *Reports* section, then select the *Geomorph/Habitat* tab at the bottom of the screen, then select the *Raw data report*.
4. To view chemical data from the *Reports* section of SQUID, select the *RIDs/QA* tab at the bottom of the screen and then select the *Raw Results* report from the sub-menu.

Title: Probabilistic Monitoring	No: SOP 13.1	Page 14 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

5. To view flow event data from the *Reports* section of SQUID, select the RIDs/QA tab at the bottom of the screen and then select the *Raw Results* report from the sub-menu. Filter for “flow” in the characteristic column.
6. To view the macroinvertebrate data from the *Reports* section in SQUID, select the Biological Data tab at the bottom of the screen and select *Benthic Metric Report multi station* from the sub-menu.

8.0 QA/QC

The SWQB controls the quality of the probabilistic field data by using standardized methods that are documented in this SOP and SOPs 5.0, 6.1, 6.2, 7.0, 8.2, 9.1, 11.1 and 15.0. All personnel who collect probabilistic monitoring data must be familiar with these protocols, sign the acknowledgment form associated with this specific SOP and collect data in accordance with the procedures as they are defined in this SOP and all other applicable SOPs. In addition to standardized methods, proper training of field personnel represents a critical aspect of meeting the data quality objectives in order to fulfill the goals of the SWQB’s QAPP (NMED/SWQB. 2021c).

Assurance of field data collection for probabilistic monitoring are done through adherence to the process outlined in this and other applicable SOPs and oversight of the process by the QAO. If at any time the QAO determines this process is not being adhered to, the QAO has the authority to cease activities specific to this SOP with prior support and approval by the SWQB Bureau Chief and MASS Program Manager, until such a time that the issue can be resolved.

9.0 Related Forms

Field Equipment Checklist for physical habitat measurements
 SOP and field forms for physical habitat measurements
 SOP and field forms for chemical sampling
 SOP for stream flow sampling
 SOP for benthic macroinvertebrate sampling
 SOP for sonde measurements
 Hydrology Protocol
 WQMP/CPP

Field Forms:

Habitat Field Forms

- Habitat and Biota Field Work Cover Sheet
- Pebble Count Field Form
- Cross Section, Thalweg Profile, and Large Woody Debris Form
- Bankfull Cross Section and Stream Flow Field Form
- Slope Field Form
- Percent Canopy Cover Field Form

Chemical Sampling/Flow/Sonde Grab Data Field Forms

- Stream/River Field Data Form

Title: Probabilistic Monitoring	No: SOP 13.1	Page 15 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

Benthic Macroinvertebrate Field Forms

-macroinvertebrate sampling field sheets (on Habitat and Biota Field Work Cover Sheet)

Miscellaneous

-Hydrology protocol field sheets, Level 1 Hydrology Determination Field Sheet (WQMP/CPP 2020)

10.0 Revision History

- Revision 0. March 20, 2020. Original.
Miguel Montoya, QAO; Meredith Zeigler, SME; Kristopher Barrios, Program Manager.
- Revision 1. November 19, 2021. The numbering of the SOP has been changed from 17.1 to 13.1 to align with revisions approved in the 2021 SWQB QAPP. The SME for the SOP has been updated to reflect current staff responsibilities. References updated throughout the SOP to reflect the most up to date SWQB WQMP/CPP, QMP, QAPP and CALM.
Miguel Montoya, QAO; Elizabeth Stuffings, SME; Kristopher Barrios, Program Manager.
- Revision 2. January 31, 2022. Better define the 500 meters from a site as 500 meters of stream length. Update safety concerns and site exclusion due to untreated wastewater. The definition for SQUID has been updated to better describe the internal database. Reference to the HP was revised so that the procedures align with the 2020 WQMP/CPP.

11.0 References

Biggs, B. and C. Kilroy. 2000. *Stream Periphyton Monitoring Manual*. NIWA Christchurch, New Zealand.

Manual for Wadeable Streams. EPA/620/R-06/003. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2016. State of New Mexico Water Quality 10-Year Monitoring and Assessment Strategy. Available at:
<https://www.env.nm.gov/surface-water-quality/protocols-and-planning>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). State of Mexico Surface Water Quality Bureau Standard Operating Procedure. Available at:
<https://www.env.nm.gov/surface-water-quality/sop/>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2020. State of New Mexico Statewide Water Quality Management Plan and Continuing Planning Process. Available at:
<https://www.env.nm.gov/surface-water-quality/wqmp-cpp/>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2021a. Quality Management Plan for Environmental Data Operations [QMP], Planning Process for Environmental *Data Collection Activities*. Available at:
<https://www.env.nm.gov/surface-water-quality/protocols-and-planning>

Title: Probabilistic Monitoring	No: SOP 13.1	Page 16 of 16
	Revision 2	
Effective Date: 2/1/2022	Next Revision Date: 2/1/2024	

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2021b. Comprehensive Assessment and listing Methodology (CALM). Available at: <https://www.env.nm.gov/surface-water-quality/calm/>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2021c. Quality Assurance Project Plan for Water Quality Management Programs. Available at: <https://www.env.nm.gov/surface-water-quality/protocols-and-planning>

Peck, D.V., A.T. Herlihy, B.H. Hill, R.M. Hughes, P.R. Kaufmann, D.J. Klemm, J.M. Lazorchak, F.H. McCormick, S.A. Peterson, P.L. Ringold, T. Magee, and M. Cappaert. 2006. *Environmental Monitoring and Assessment Program -Surface Waters Western Pilot Study: Field Operation*.

Water Environment Research Foundation (WERF). 2007. Evaluating waterbody assessment and listing processes: Integration of monitoring and evaluative techniques. Alexandria, VA.