NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER MONITORING AND STANDARDS ELEMENT
BUREAU OF FRESHWATER AND BIOLOGICAL MONITORING
P.O. Box 420; Mail Code 35-01
TRENTON, NEW JERSEY

QUALITY ASSURANCE PROJECT PLAN
Ambient Macroinvertebrate Network (AMNET), Raritan Water Region, 2019

Project Officer: _____
Date

Anna Marie Signor, Environmental Specialist 2
NJDEP Bureau of Freshwater and Biological Monitoring (BFBM)

Project Supervisor: _____
Date

Dean Bryson, Environmental Specialist 4
NJDEP Bureau of Freshwater and Biological Monitoring (BFBM)

Approved By: _____
Date

Marc Ferko, Quality Assurance Officer, Research Scientist 1
NJDEP Office of Quality Assurance (OQA)

Project Data Manager: _____
Date

Leigh Lager, GIS Specialist 2
NJDEP Bureau of Freshwater and Biological Monitoring (BFBM)

Approved By: _____
Date

Victor Poretti, Section Chief
NJDEP Bureau of Freshwater and Biological Monitoring

Approved By: _____
Date

Leslie McGeorge, Administrator
NJDEP Bureau of Freshwater and Biological Monitoring

Reviewed By: _____
Date

Jack Pflaumer, Environmental Scientist 2
NJDEP Bureau of Environmental Analysis, Restoration and Standards

Table of Contents

1.0 Project Name: Ambient Macroinvertebrate Network (AMNET), Raritan Water Region

2.0 Requesting Agency: NJDEP, Bureau of Freshwater and Biological Monitoring (BFBM)

3.0 Date of Project: April 2019 – November 2019

4.0 Project Fiscal Information: 7W106CXX V38A

5.0 Project Oversight:

Project Officer, Field and Laboratory- Anna Marie Signor, BFBM

Project Officer, Data Analysis- Tom Miller, BFBM

Project Supervisor- Dean Bryson, BFBM

Project Data Manager- Leigh Lager, BFBM

Quality Assurance Officer - Marc Ferko, NJDEP-OQA

6.0 Special Training Needs/Certification

Any personnel assisting with field sampling and/or laboratory processing of samples for this project will be trained on all applicable methods and techniques. For physical/chemical analysis, the training will entail calibration of meters, deployment techniques, and data retrieval from the equipment. Assistants will also be trained in the proper methods for benthic macroinvertebrate sample collection, sample processing, performing habitat assessments and observations. Training in the laboratory will entail the proper sorting of a subsample. The Project Officer or Project Supervisor will be responsible for all necessary training.

Only designated, experienced, full-time professional staff will perform taxonomic identifications.

BFBM is certified by the Office of Quality Assurance (certified lab ID # 11896) for all physical/chemical parameters to be measured.

7.0 Project Description/Objective

The major goal of the AMNET program is to provide a cost-efficient means of gauging the quality of streams and watershed areas throughout the state. This objective is accomplished through sampling and analysis of macroinvertebrate communities from a stream network

representative of New Jersey's five (5) major Water Regions (Northwest {Upper Delaware}, Lower Delaware, Northeast, Raritan, and Atlantic). In addition to adequately assessing the major Water Regions, sites were also selected to represent and assess individual sub-watersheds (HUC 14 scale). The study area of the Raritan Water Region includes Watershed Management Areas (WMA's) 7, 8, 9, and 10.

The spatial distribution of stations is adequate to provide biological impact data on a long-term, region-wide or statewide scale. It is likely not enough, however, to assess the biological impact(s) of any one-point source of pollution, as this would be better served by a site-specific or intensive survey of the stream segment in question. The designated five-year sampling interval for AMNET reflects a realistic temporal lag between cessation of an environmental perturbation and recovery of the impacted biological community.

The methodology is based on the Rapid Bioassessment Protocols (RBP), scientifically designed and validated under the auspices of the U. S. Environmental Protections Agency (USEPA, 1999).

The AMNET program was initiated in 1992. To date, five full rounds have been completed which allows for trend analysis to be calculated. Sampling of the Raritan Water Region in 2019 continues the sixth round of statewide AMNET monitoring.

Samples will also be collected at AMNET sites designated in this QAPP for the Biological Nutrient Correlation Project. Sample collection will take place during the AMNET sampling visit. Total Phosphorus and Total Nitrogen (calculated) samples will be collected. Project description and other details are defined in the QAPP for the Biological Nutrient Correlation Project (2017-2019).

8.0 Data Usage

Data obtained will be used by NJDEP in the generation of the biennial Integrated Water Quality Assessment Report (includes 305(b) report and 303(d) list), to support sound policy decisions in water quality/watershed management, in designation of Category One (C1) waters based on "exceptional ecological significance", to track environmental trends with water quality, to inform regulatory or "permit" activities, and to correlate nutrient concentrations with biological impairments. Once all samples are analyzed and the data thoroughly reviewed, a data summary, including the index scores and ratings, will be posted on the BFBM website: www.nj.gov/dep/wms/bfbm.

9.0 Network Design/Site Selection

The Raritan Water Region now includes 159 active sites in the AMNET network (See Appendix A, Table 1). These sites were initially selected using a stratified approach to ensure complete and representative coverage of the Water Region. Enhancements to the network were instituted to include sites that best evaluate the sub-watersheds (HUC14 scale) of the Water Region for Aquatic Life Use attainment in the Integrated Water Quality Assessment Report.

Exact AMNET site locations were initially determined via the Global Positioning System (GPS) using a Trimble unit and the appropriate correction sources utilized by NJDEP. All positions were logged into the Geographic Information System (GIS). Hand-held GPS units, either Garmin model "GPSMAP 62s", Garmin Nuvi 2797, or Trimble "Geo XT", will be used to confirm correct locations at the time of sampling.

10.0 Sampling Procedures

Macroinvertebrate Sampling

Benthic macroinvertebrates will be sampled from each site focusing on the most productive habitats present at the site, as outlined in Rapid Bioassessment Protocols for Use in Streams and Rivers, Second edition (USEPA1999), and Standard Operating Procedures (SOP) For Ambient Biological Monitoring Using Benthic Macroinvertebrates (NJDEP 2007). A re-usable 800x900μm mesh D-frame dip net will be used to collect samples from the most productive habitats present in the stream.

Sites in the Raritan Water Region include both high gradient and low gradient (coastal plain) streams. Substrate of high gradient streams consists predominantly of cobble and have riffle/run type habitat. For high gradient streams, macroinvertebrate abundance and diversity are usually highest on cobble (riffle/run) habitats, which are, therefore, the focus of sampling. The sampler will use their feet and/or hands to dislodge organisms from these substrates, immediately upstream of the net, using current to carry them into the net.

Coastal plain streams are characterized as low-gradient streams with sandy beds, typically lacking riffle/run habitat. Macroinvertebrate abundance and diversity in these streams are highest on submerged macrophytes, submerged vegetated banks, and submerged snags (woody debris such as logs and branches). These habitats are the focus of sampling in low gradient streams. The sampler will use a D-net in a "jab and sweep" motion, as well as hands or feet if needed, to dislodge organisms from these substrates. After disturbing the targeted substrate, organisms are collected by sweeping net back and forth a few times in

the water column.

Approximately one liter of sample will be collected into a re-usable one-liter wide-mouth plastic container (thoroughly cleaned between uses) and preserved on site using a 5-10% formalin solution. Specimens fixed with formalin will remain preserved indefinitely. Each site in the Water Region will be sampled one time for the project within the April through November sampling window. Sampling will be postponed at a site if flow conditions have increased due to a storm event, making it temporarily unsafe to wade. Sampling will be rescheduled when the stream returns to normal wadeable flow conditions.

For quality control, a duplicate macroinvertebrate sample will be taken at an adjacent reach at approximately 10% of the samples. This adjacent reach for the duplicate sampling, will usually be immediately upstream from point where sampling for primary sampling ended. The reaches for both the primary and duplicate samples should be similar in terms of habitat, riparian zone condition, and land use. The results from only the primary sample will be reported. The duplicate results will be stored internally and used to provide precision estimates of the individual metrics and overall index scores and ratings (Stribling, 2008).

Physical/Chemical Parameters

Dissolved oxygen, pH, Water Temperature, and Specific Conductivity will be measured *in situ*, at each site as per procedures outlined in N.J.A.C. 7:18, Subchapter 8 and NJDEP Field Sampling Procedures Manual (2005). BFBM (#11896) is certified by NJDEP's OQA to perform these analyze-immediately parameters. The measurements are made mid-depth, mid-stream. Turbidity will also be measured from a grab sample taken mid-depth, mid-stream.

Habitat Assessment

A visual-based habitat assessment will be performed at each site using the appropriate form for high gradient streams or low gradient streams (USEPA, 1999). This method, which assesses 10 different in-stream and riparian zone parameters, is tabulated for each site. Based on the score, the habitat is rated as optimal, suboptimal, marginal, or poor. The habitat assessment is performed concurrent with the collection of the benthic macroinvertebrate sampling. The stream reach sampled plus the immediate upstream area that can be adequately observed will be assessed using the respective protocol. The habitat assessment scores and rating will be presented along with the index score and rating. These habitat scores and ratings do not factor into the calculation of the index scores but are collected as additional information in the assessment of sampling results, along with photographs and observations related to potential stressors.

Field Precautions for Invasives

To prevent the potential spread of nuisance or invasive organisms such as *Didymosphenia* sp. from stream to stream, all nets, waders, etc. will be decontaminated in the field between sites by spraying with a commercial disinfectant cleaner and rinsing with tap water. Also, the use of felt-soled waders will be avoided.

11.0 Data Quality/Quality Control Requirements

Water Temperature, pH, Specific Conductivity, and Dissolved Oxygen (DO) are measured using a Hydrolab MS5. The Hydrolab MS5 is a multi-parameter water quality meter that combines temperature, pH, Specific Conductivity and Luminescent DO probes into one device that is submersible to the desired depth. All equipment will be calibrated, maintained, and used following manufacturer's instructions and in accordance with the specifications given in N.J.A.C. 7:18 (NJDEP, as amended 2017). All calibration and water quality data will be recorded in a spiral- bound logbook.

Conductivity: This probe is calibrated on a weekly basis per the manufacturer recommendations. The probe is also checked each day of use with a certified standard which corresponds to the expected range of the values to be measured. Records of all calibrations and calibration checks shall be maintained in the field log.

Dissolved Oxygen: A Winkler check is performed on a weekly basis and the meter is barometrically calibrated on the day of use in the field. A calibration check is performed once daily. A 100% oxygen saturated water bath is checked at the beginning and end of day when in use. Records of all calibrations and calibration checks shall be maintained in the field log.

pH: The probe is calibrated daily with two certified buffers that bracket the expected range of the value being measured per the manufacturer’s recommendations. A third certified pH buffer, within the bracket, is then used to check the calibration. After three hours of continuous use, the pH of the third certified buffer will be checked. Records of all calibrations and calibration checks shall be maintained in the field log.

Temperature: The probe is calibrated with a NIST-certified thermometer on a quarterly basis. Records of the calibration shall be maintained by the BFBM.

Barometer: Thommen TX Mechanical Barometer.

Turbidity meter: Hach Model 2100Q turbidimeter is calibrated once a month per manufacturer recommendations. The meter is then checked with certified standards for accuracy within the calibration range during each day of use. Records of all calibrations and calibration checks shall be maintained in the field log.

Chain of Custody

No chain of custody is required. Results of this study will not be used for compliance or enforcement actions. The project officer and project supervisor are responsible for sampling and laboratory method validation.

12.0 Macroinvertebrate Identification/QAQC

Macroinvertebrate Identification

In the laboratory, a 100-organism subsample will be randomly sorted from each sample, as described in USEPA (1999); all individuals will be identified to the lowest possible taxonomic level (usually genus or species). Only designated, experienced, staff will perform taxonomic identifications. A thorough program for taxonomic quality control, as given in the biomonitoring laboratory Standard Operating Procedures (SOP) is practiced (NJDEP, 2007). A comprehensive collection of over 50 major references (including books and monographs), by recognized experts in invertebrate taxonomy, is maintained in the laboratory; new references are added when appropriate to keep abreast of taxonomic advances.

For taxonomic quality control, 10% of the samples are sent to an outside qualified consultant for parallel identifications. Results of the parallel identifications will be analyzed by calculating the Percent Taxonomic Disagreements (%PTD), using procedure defined by Stribling *et al*., 2003. The project goal is less than 15% disagreements. Data from the duplicate identifications will be stored internally, with only the BFBM identifications being reported.

Equipment for Macroinvertebrate Identification

Macroinvertebrates will be identified using a stereomicroscope capable of up to 40x magnification. The biomonitoring laboratory uses Leica Model MZ6 stereomicroscopes,

each with fiber optic illumination. A compound microscope with 100x, 200x, 400x, and 1000x magnification will be used for very detailed identifying features. The biomonitoring laboratory currently uses Leica models DMLS (with phase contrast) and DME.

13.0 Resource Needs: BFBM will need 4 full-time staff to complete this project.

14.0 Sampling Schedule

All sites in the Raritan Water Region will be sampled once within the April 2019 through November 2019 index period, beginning on or around April 1, 2019.

15.0 Data Analysis

Multi-metric indices were developed for use in New Jersey, with guidance from the Rapid Bioassessment Protocols (USEPA, 1999), to assess the taxonomic data. The High Gradient Macroinvertebrate Index (HGMI) and the Coastal Plains Macroinvertebrate Index (CPMI) will be used to assess appropriate sites in the Raritan Water Region. Based on the index score, a rating is assigned, Excellent, Good, Fair, and Poor. Detailed methods for analysis are outlined in the biomonitoring laboratory Standard Operating Procedures (NJDEP, 2007).

16.0 Data Validation

The Project Officer and the Project Supervisor are responsible for all initial data validation. If apparent anomalous data is suspected, the Project Officer and/or the Project Supervisor will review the sampling procedures with the field sampler to make sure the proper collection and preservation procedures were followed. If the data is still suspect, an internal review of the laboratory procedures and/or calculations used in the analysis of the suspect sample will be conducted with special emphasis on transcription of data to assure that no transposition of figures occurred. If no problems are found in the laboratory procedures, the data may then be compared to any historical data that might have been collected at the same site prior to the most recent sampling event to see if similar anomalies might have been found previously. The suspect data may also be compared to literature values or standard analytical treatises to verify if the results are within the limits of accuracy of the test method.

If no obvious problems are found after these reviews, the complete data set will be reported with the suspect data identified as it relates to the objectives(s) and data accuracy required in this project.

17.0 Performance System Audits

BFBM is subject to audits and guidelines of the Office of Quality Assurance's Laboratory Certification Program as well as internal performance evaluations.

18.0 Data Storage and Distribution

All habitat assessment data, physical/chemical analysis, and site observations will be recorded on the BFBM's Biological Field Observations and Data Sheet, and also recorded electronically in a Microsoft Access database. All macroinvertebrate identifications will be recorded on the BFBM's Macroinvertebrate Laboratory Data Sheet and entered into a Microsoft Access database. Taxonomic data and counts, metric scores, index scores and ratings, habitat assessment scores and ratings, and analyze-immediately field parameters will be entered into NJDEP's Water Quality Data Exchange (WQDE) and will be accessible through the USEPA, USGS and National Water Monitoring Council's Water Quality Portal (www.waterqualitydata.us) by June the following year results are validated.

A data summary table, including index scores and ratings, will be posted on the BFBM website (www.nj.gov/dep/wms/bfbm) after completion of all sample analyses for the Water Region and data validation.

Following the QA/QC validation of results, data will be entered into NJDEP's WQDE and uploaded to USEPA's WQX by June of the year following verification. All raw data records shall be maintained for a period of no less than five years.

19.0 Data Reporting

Results and data analysis for the entire Water Region will be issued and will contain at a minimum: datasheets for each site with taxa and counts of benthic macroinvertebrates, field chemistry results and observations, index scores and impairment ratings, habitat assessment scores and ratings. Index scores and ratings will also be posted in tabular form on the Bureau's website. The appropriate GIS shapefiles of the study area will be updated to reflect these results.

Assessment Rating	HGMI Score	CMPI100 Score
Excellent	>=63	>=75
Good	42-<63	41-<75
Fair	21-<42	21-<41
Poor	<21	<21

20.0 Corrective Action

The Project Officer will be responsible for the oversight of all activities related to this project. The Project Officer will assess field collections functions and make corrections when necessary to maintain the data accuracy as defined in this plan. If any changes or modifications are made to this plan regarding data collection, as it relates to the objective(s) and data accuracy required in this project, all original signees of the QAPP will be notified.

21.0 References

Gerritsen, Jeroen and Erik W. Leppo, 2005. Biological Condition Gradient for Tiered Aquatic Life Use in New Jersey. Tetra Tech Inc., Owings Mill, MD.

Jessup, Benjamin, 2007. Development of New Jersey High Gradient Macroinvertebrate Index. Tetra Tech Inc., Owings Mill, MD.

NJDEP, 2005. Field sampling procedures manual. NJDEP, Trenton, NJ. 360pp.

NJDEP, as amended November 6, 2017. Regulations governing the certification of laboratories and environmental measurements. N.J.A.C. 7:18. NJDEP. Trenton, NJ.

NJDEP, 2007. Standard operating procedures (SOP) for the ambient biological monitoring using benthic macroinvertebrates. Doc.#BMNJ2, NJDEP, BFBM. Trenton, NJ. www.state.nj.us/dep/wms//bfbm/download/AMNET_SOP.pdf

Stribling, J. B., S. R. Moulton, and G. L. Lester, 2003. Determining the quality of taxonomic data. J.N. Am. Benthol. Soc. 22:621-631.

Stribling, J.B., B.K. Jessup, and D.L. Feldman, 2008. Precision of benthic macroinvertebrate indicators of stream condition in Montana. J.N. Am. Benthol. Soc. 27(1):58-67.

Tetra Tech, 2014. Monitoring Design and Application of CPMI, Upper Salem River, NJ. Technical Memorandum, Tetra Tech Inc., Owings Mill, MD.

USEPA, 1999. Rapid bioassessment protocols for use in streams and rivers: periphyton, benthic macroinverbrates, and fish. Second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency. Washington, D.C. Ch. 1–11 and appendices.

Appendix A Data Management Tables

For Data Management purposes, Water Chemistry is defined as parameters analyzed by a laboratory; Field measurements are defined as analyze-immediately parameters.

Table 1 Site List

Station ID (WQDE compliant and referenced)	Waterbody/Location	Latitude-dd	Longitude-dd	County	Site exists in WQDE already?	Location Type
AN0192	Rahway River @ Northfield Ave	-74.283224	40.769728	Essex	YES	River/Stream
AN0193	Rahway River @ Rt 82 (Morris Ave)	-74.301789	40.708005	Union	YES	River/Stream
AN0193A	UNT to Rahway River @ Mountain Ave	-74.313958	40.708142	Union	YES	River/Stream
AN0194	Rahway River @ Rt 509 Kenilworth Blvd	-74.312919	40.673336	Union	YES	River/Stream
AN0195	Rahway River @ River Rd & Church St	-74.278354	40.618179	Union	YES	River/Stream
AN0196	Robinsons Br @ Goodmans Crossing	-74.339072	40.615315	Union	YES	River/Stream
AN0199	Robinsons Br @ Rt 27 & Central Ave	-74.286521	40.610640	Union	YES	River/Stream
AN0201	South Br Rahway River @ in Merrill Park off Fairview Rd	-74.306156	40.578367	Middlesex	YES	River/Stream
AN0204	Elizabeth River @ North Ave	-74.225423	40.677602	Union	YES	River/Stream
AN0310	S Br Raritan River @ Smithtown Rd	-74.759960	40.860304	Morris	YES	River/Stream
AN0310A	S Br Raritan River @ River Rd	-74.738840	40.834306	Morris	YES	River/Stream
AN0311	Drakes Bk @ Emmans Rd	-74.678321	40.856092	Morris	YES	River/Stream
AN0312	Drakes Bk @ Bartley Rd	-74.729358	40.812099	Morris	YES	River/Stream
AN0313	Stony Bk @ Fairview Ave	-74.750836	40.805123	Morris	YES	River/Stream
AN0314	Electric Bk @ Fairview Ave	-74.776376	40.789840	Morris	YES	River/Stream
AN0315	S Br Raritan River @ Rt 517	-74.780019	40.785014	Morris	YES	River/Stream
AN0316	S Br Raritan River @ off Raritan River Rd (Rt 512)	-74.841788	40.718656	Hunterdon	YES	River/Stream
AN0317	S Br Raritan River @ River Rd (Ken Lockwood Gorge)	-74.871918	40.696922	Hunterdon	YES	River/Stream

AN0317A	S Br Raritan River @ Grayrock Rd	-74.908000	40.656300	Hunterdon	YES	River/Stream
AN0318	Spruce Run @ Newport Rd	-74.909443	40.724844	Hunterdon	YES	River/Stream
AN0319	Spruce Run @ Rt 31	-74.934009	40.687213	Hunterdon	YES	River/Stream
AN0320	Willoughby Bk @ Rt 31	-74.915108	40.671642	Hunterdon	YES	River/Stream
AN0321	Mulhockaway Ck @ Van Syckel Rd (Rt 635)	-74.968799	40.647472	Hunterdon	YES	River/Stream
AN0322	S Br Raritan River @ Rt 173 (CR 513)	-74.911574	40.635268	Hunterdon	YES	River/Stream
AN0323	Beaver Bk @ Herman Thau Rd	-74.865322	40.667551	Hunterdon	YES	River/Stream
AN0324	Beaver Bk @ Leigh St	-74.909655	40.636333	Hunterdon	YES	River/Stream
AN0324A	Sidney Bk @ Rt. 617 (Sidney Rd)	-74.924501	40.613629	Hunterdon	YES	River/Stream
AN0325	Cakepoulin Ck @ Lower Lands Down Rd	-74.915769	40.607819	Hunterdon	YES	River/Stream
AN0326	S Br Raritan River @ Stanton Rd	-74.867864	40.572421	Hunterdon	YES	River/Stream
AN0327	Prescott Bk @ Stanton Rd	-74.863398	40.573403	Hunterdon	YES	River/Stream
AN0328	Assiscong Ck @ River Rd	-74.847028	40.539772	Hunterdon	YES	River/Stream
AN0329	S Br Raritan River @ Rt 613 (Old York Rd)	-74.801920	40.516994	Hunterdon	YES	River/Stream
AN0330	First Neshanic River @ Rt 31	-74.862270	40.489717	Hunterdon	YES	River/Stream
AN0331	Second Neshanic River @ Rt 31	-74.863729	40.483184	Hunterdon	YES	River/Stream
AN0332	Third Neshanic River @ Rt 31	-74.862784	40.474816	Hunterdon	YES	River/Stream
AN0332A	UNT to Third Neshanic River @ Rt 579	-74.874097	40.446903	Hunterdon	YES	River/Stream
AN0333	Neshanic River @ Everitt Rd	-74.827634	40.473434	Hunterdon	YES	River/Stream
AN0335	Back Bk @ Manners Rd (Rt 609)	-74.806290	40.459370	Hunterdon	YES	River/Stream

AN0336	Furmans Bk @ Welisewitz Rd	-74.786110	40.464069	Hunterdon	YES	River/Stream
AN0337	Neshanic River @ Rt 514 (Amwell Rd)	-74.753296	40.493459	Somerset	YES	River/Stream
AN0338	S Br Raritan River @ Elm St / Rt 667	-74.726954	40.509379	Somerset	YES	River/Stream
AN0340	Pleasant Run @ South Branch Rd	-74.735689	40.520046	Somerset	YES	River/Stream
AN0341	S Br Raritan River @ Studdiford Drive	-74.696486	40.546850	Somerset	YES	River/Stream
AN0342	Holland Bk @ Holland Brook Rd	-74.776002	40.579122	Hunterdon	YES	River/Stream
AN0343	Holland Bk @ South Branch Rd	-74.700548	40.553187	Somerset	YES	River/Stream
AN0345	India Bk @ Mountainside Rd	-74.620527	40.786203	Morris	YES	River/Stream
AN0346	N Br Raritan River @ Rt 24	-74.625787	40.771231	Morris	YES	River/Stream
AN0348	Burnett Bk @ Old Mill Rd	-74.645081	40.782511	Morris	YES	River/Stream
AN0348A	N Br Raritan River @ Rt. 512	-74.646977	40.691542	Somerset	YES	River/Stream
AN0349	Peapack Bk @ Fox Chase Rd	-74.680674	40.754560	Morris	YES	River/Stream
AN0350	Peapack Bk @ Old Dutch Rd off Rt 512	-74.647853	40.691553	Somerset	YES	River/Stream
AN0353	Mine Bk @ Far Hills Rd (Rt 512)	-74.630063	40.682315	Somerset	YES	River/Stream
AN0354	Middle Bk @ Spook Hollow Rd	-74.678536	40.693866	Somerset	YES	River/Stream
AN0355	Middle Bk @ Cutting Witney Rd (River Rd)	-74.681054	40.647461	Somerset	YES	River/Stream
AN0355A	N Br Raritan River @ Burnt Mills Rd	-74.681377	40.636039	Somerset	YES	River/Stream
AN0356	Lamington River @ Ironia Rd	-74.644596	40.835259	Morris	YES	River/Stream
AN0357	Tanners Bk @ Tanners Brook Rd	-74.725675	40.788318	Morris	YES	River/Stream
AN0358	Lamington River @ Rt 24 (Cooper Mill Park)	-74.721672	40.778737	Morris	YES	River/Stream

AN0359	Trout Bk @ State Pk Rd	-74.731996	40.754554	Morris	YES	River/Stream
AN0360	Lamington River @ off Rt 512	-74.721564	40.715624	Hunterdon	YES	River/Stream
AN0361	UNT to Lamington River @ Black River Rd	-74.716489	40.706845	Somerset	YES	River/Stream
AN0362	Cold Bk @ Vliettown Rd	-74.737797	40.675007	Hunterdon	YES	River/Stream
AN0363	Lamington River @ Rt 523	-74.728958	40.660661	Somerset	YES	River/Stream
AN0364	N Br Rockaway Ck @ Fairmount Rd (Rt 512)	-74.786132	40.725346	Hunterdon	YES	River/Stream
AN0366	N Br Rockaway Ck @ Rockaway Rd (@Taylor's Mill Rd)	-74.765900	40.661774	Hunterdon	YES	River/Stream
AN0367	S Br Rockaway Ck @ Windy Acres Farm	-74.816228	40.639504	Hunterdon	YES	River/Stream
AN0368	S Br Rockaway Ck @ Rt 22	-74.766656	40.623487	Hunterdon	YES	River/Stream
AN0369	Rockaway Ck @ Island Rd	-74.720870	40.623326	Hunterdon	YES	River/Stream
AN0370	Lamington River @ Cowperthwaite Rd	-74.686721	40.634668	Somerset	YES	River/Stream
AN0371	Chambers(B) Bk @ Love Rd	-74.663032	40.623940	Somerset	YES	River/Stream
AN0373	Chambers(A) Bk @ Station Rd	-74.683011	40.592358	Somerset	YES	River/Stream
AN0374	N Br Raritan River @ Rt 202	-74.678193	40.569723	Somerset	YES	River/Stream
AN0374A	N Br Raritan River @ Easton Tpk (Rt 614)	-74.673505	40.600025	Somerset	YES	River/Stream
AN0374B	Raritan River @ Nevius Street foot bridge off River Rd	-74.635674	40.564622	Somerset	YES	River/Stream
AN0375	Dukes Bk @ Dukes Pkwy	-74.613396	40.553976	Somerset	YES	River/Stream
AN0376	Peters Bk @ Rt 28 (E. Main St)	-74.605241	40.567021	Somerset	YES	River/Stream
AN0377A	Raritan River @ Rt 533/N. Main St	-74.583309	40.555160	Somerset	YES	River/Stream
AN0379	Millstone River @ Rt 33	-74.420085	40.261959	Monmouth	YES	River/Stream

AN0380	Rocky Bk @ Perrineville Rd (Sweetman's Ln)	-74.439486	40.227325	Monmouth	YES	River/Stream
AN0381	Rocky Bk @ Main St	-74.522737	40.270285	Mercer	YES	River/Stream
AN0382	Millstone River @ Grovers Mill Rd	-74.607971	40.322126	Mercer	YES	River/Stream
AN0382C	Millstone River @ Old Cranbury Rd	-74.526912	40.293235	Middlesex	YES	River/Stream
AN0382D	Millstone River @ Applegarth Rd	-74.472096	40.274832	Middlesex	YES	River/Stream
AN0383	Big Bear Bk @ Old Trenton Rd	-74.576939	40.278111	Mercer	YES	River/Stream
AN0384	Bear Bk @ Cranbury Rd (Rt 615)	-74.612376	40.318145	Mercer	YES	River/Stream
AN0384A	Little Bear Bk @ Rt 571 (Washington Rd.)	-74.626517	40.322612	Mercer	YES	River/Stream
AN0385	Cranbury Bk @ Applegarth Rd	-74.473241	40.305150	Middlesex	YES	River/Stream
AN0385B	Cedar Brook @ Petty Rd	-74.545381	40.330054	Middlesex	YES	River/Stream
AN0386	Cranbury Bk @ Maple Ave	-74.602698	40.326661	Middlesex	YES	River/Stream
AN0388A	Shallow Bk @ industrial driveway off Shalks Crossing Rd	-74.578328	40.346182	Middlesex	YES	River/Stream
AN0389	Devils Bk @ off Schalks Crossing Rd ds of AMTRAK RR	-74.589187	40.343091	Middlesex	YES	River/Stream
AN0390	Camp Harmony Br of Stony Bk @ VanDyke Rd	-74.801669	40.403389	Mercer	YES	River/Stream
AN0390A	Stony Bk @ trail off Rt 31	-74.824141	40.385812	Hunterdon	YES	River/Stream
AN0391	Stony Bk @ Mine Rd	-74.793744	40.374055	Mercer	YES	River/Stream
AN0392	Stony Bk @ Old Mill Rd	-74.767167	40.331286	Mercer	YES	River/Stream
AN0393	Stony Bk @ Rt 206	-74.682208	40.333245	Mercer	YES	River/Stream
AN0393A	Stony Bk @ Province Line Rd	-74.710407	40.352676	Mercer	YES	River/Stream
AN0394	Duck Pond Run @ Rt 1 North	-74.667963	40.306527	Mercer	YES	River/Stream

AN0394A	Stony Bk @ Alexander Rd (US of Carnegie Lake)	-74.653460	40.332309	Mercer	YES	River/Stream
AN0394B	Harrys Bk @ Poe Rd	-74.630324	40.366010	Mercer	YES	River/Stream
AN0396	Heathcote Bk @ Academy St	-74.615827	40.369987	Middlesex	YES	River/Stream
AN0397	Millstone River @ outlet of Carnegie Lake off Rt 27	-74.620219	40.373799	Mercer	YES	River/Stream
AN0398	Bedens Bk @ Aunt Molly Rd	-74.740409	40.384444	Mercer	YES	River/Stream
AN0399	Rock Bk @ Long Hill Rd	-74.739346	40.439758	Somerset	YES	River/Stream
AN0400	Rock Bk @ Burnt Mill Rd	-74.684026	40.413022	Somerset	YES	River/Stream
AN0401	Bedens Bk @ Rt 206	-74.650426	40.414589	Somerset	YES	River/Stream
AN0402	Pike Run @ Rt 206	-74.657082	40.474076	Somerset	YES	River/Stream
AN0403	Cruser Bk @ Rt 206	-74.660140	40.454430	Somerset	YES	River/Stream
AN0404	Back Bk @ Rt 206	-74.659666	40.432695	Somerset	YES	River/Stream
AN0405	Pike Run @ Rt 533	-74.640462	40.420113	Somerset	YES	River/Stream
AN0406	Simonson Bk @ Canal Rd	-74.612969	40.438476	Somerset	YES	River/Stream
AN0407	Ten Mile Run @ Canal Rd	-74.585717	40.456415	Somerset	YES	River/Stream
AN0408	Six Mile Run @ Rt 27	-74.514491	40.455265	Somerset	YES	River/Stream
AN0409	Six Mile Run @ Canal Rd	-74.571120	40.472886	Somerset	YES	River/Stream
AN0410	Millstone River @ Blackwells Mills Rd	-74.576274	40.475138	Somerset	YES	River/Stream
AN0411	Royce Bk @ Rt 206	-74.647445	40.496587	Somerset	YES	River/Stream
AN0413	Royce Bk @ Rt 533	-74.589630	40.537045	Somerset	YES	River/Stream
AN0414A	Millstone River @ park access off Lincoln Ave	-74.587278	40.530990	Somerset	YES	River/Stream

AN0415	Cuckels Bk @ E. Main St	-74.563934	40.561441	Somerset	YES	River/Stream
AN0417	W Br Middle Bk @ Chimney Rock Rd	-74.563443	40.589361	Somerset	YES	River/Stream
AN0419	E Br Middle Bk @ Gilbride Rd	-74.555316	40.590654	Somerset	YES	River/Stream
AN0420	Middle Bk @ Talmadge Ave (Rt 533) near Tea St	-74.548661	40.560943	Somerset	YES	River/Stream
AN0421	Green Bk @ Raymond Ave	-74.413729	40.641036	Somerset	YES	River/Stream
AN0421A	Green Bk @ off New Providence Rd	-74.402905	40.665185	Union	YES	River/Stream
AN0422	Stony Bk @ West End Ave	-74.446081	40.614140	Union	YES	River/Stream
AN0423	Green Bk @ Clinton Ave	-74.449797	40.605454	Somerset	YES	River/Stream
AN0424	Bound Bk @ Bound Brook Rd (Rt 28)	-74.499282	40.580694	Middlesex	YES	River/Stream
AN0424B	Bound Bk @ Woodbrook Rd	-74.397493	40.561796	Middlesex	YES	River/Stream
AN0424C	Cedar Bk @ end of Lee St	-74.409217	40.588018	Middlesex	YES	River/Stream
AN0425	Ambrose Bk @ Raritan Ave (Rt 514 spur)	-74.520001	40.567621	Middlesex	YES	River/Stream
AN0425B	Ambrose Bk @ School St	-74.428299	40.534338	Middlesex	YES	River/Stream
AN0426	Green Bk @ Lincoln Blvd (Rt 607)	-74.524542	40.561874	Somerset	YES	River/Stream
AN0427	UNT to Raritan River @ Rt 527 (Main St)	-74.518891	40.545315	Somerset	YES	River/Stream
AN0428	Raritan River @ Riverside Park	-74.512615	40.540896	Middlesex	YES	River/Stream
AN0429	Mile Run @ Franklin Blvd & Easton Ave	-74.467208	40.504995	Middlesex	YES	River/Stream
AN0430	Lawrence Bk @ Ridge Rd / Rt 522	-74.543806	40.380974	Middlesex	YES	River/Stream
AN0430A	Great Ditch @ Viking Way	-74.518949	40.397182	Middlesex	YES	River/Stream
AN0432	Oakeys Bk @ Davidson Mill Rd	-74.497842	40.418361	Middlesex	YES	River/Stream

AN0433	Ireland Bk @ Riva Rd	-74.484858	40.420391	Middlesex	YES	River/Stream
AN0434	Lawrence Bk @ Riva Rd	-74.446205	40.448815	Middlesex	YES	River/Stream
AN0435	Sawmill Bk @ Ryders Lane	-74.425303	40.458560	Middlesex	YES	River/Stream
AN0436	Mill Bk @ nr. Rt 514 (Woodbridge Ave)	-74.378214	40.505425	Middlesex	YES	River/Stream
AN0437	Manalapan Bk @ Rt 524	-74.377216	40.201087	Monmouth	YES	River/Stream
AN0438	Manalapan Bk @ Rt 33	-74.349609	40.253149	Monmouth	YES	River/Stream
AN0439	Manalapan Bk @ Federal Rd	-74.397862	40.296148	Middlesex	YES	River/Stream
AN0440	Manalapan Bk @ Old Forge Rd	-74.415424	40.374744	Middlesex	YES	River/Stream
AN0443	Weamaconk Ck @ Water St	-74.361634	40.297352	Monmouth	YES	River/Stream
AN0444	McGellairds Bk @ Rt 9 (South)	-74.294500	40.279722	Monmouth	YES	River/Stream
AN0445	Tepehemus Bk @ Tennent Rd	-74.319735	40.296067	Monmouth	YES	River/Stream
AN0446	Milford Bk @ Pease Rd	-74.319549	40.301344	Monmouth	YES	River/Stream
AN0447	McGellairds Bk @ Rt 527	-74.356915	40.301806	Monmouth	YES	River/Stream
AN0448	Matchaponix Bk @ Rt 527	-74.361785	40.314332	Monmouth	YES	River/Stream
AN0449	Pine Bk @ Pension Rd	-74.350055	40.315435	Monmouth	YES	River/Stream
AN0450	Barclay Bk @ Rt 527	-74.356997	40.348350	Middlesex	YES	River/Stream
AN0451	Matchaponix Bk @ Texas Rd	-74.367692	40.359877	Middlesex	YES	River/Stream
AN0452	Iresick Bk @ Rt 527	-74.359277	40.393087	Middlesex	YES	River/Stream
AN0453	Deep Run @ Rt 9	-74.307984	40.384936	Middlesex	YES	River/Stream
AN0453A	Deep Run @ Texas Rd	-74.286590	40.368693	Monmouth	YES	River/Stream

AN0454	Deep Run @ Rt 516	-74.345822	40.409911	Middlesex	YES	River/Stream

Table 2 Sample Types

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection	Habitat	Metrics	Indices
All Sites	Yes	No	No	No	Yes	No	No	Yes	Yes	Yes

Table 3 Partners

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection
All Sites	DEP	NO	NO	NO	DEP	NO	NO

Table 4 Field Measures

Field Name	WQDE Name	Media	Units
Water Temp	Temperature, Water	Water	deg C
Spec Cond	Specific conductance	Water	uS/cm
pH	pH	Water	None
DO	Dissolved Oxygen (DO)	Water	mg/l
Turbidity	Turbidity	Water	NTU

Table 5 Habitat Assessment Parameters

CODE	NAME	DESCRIPTION
HAB_0207	RBP2, High G, Bank Stability, Left Bank	RBP2, High G, Bank Stability, Left Bank (choice list)
HAB_0208	RBP2, High G, Bank Stability, Right Bank	RBP2, High G, Bank Stability, Right Bank (choice list)
HAB_0209	RBP2, High G, Channel Alteration	RBP2, High G, Channel Alteration (choice list)
HAB_0210	RBP2, High G, Channel Flow Status	RBP2, High G, Channel Flow Status (choice list)
HAB_0211	RBP2, High G, Embeddedness	RBP2, High G, Embeddedness (choice list)
HAB_0212	RBP2, High G, Epifaunal Substrate/Available Cover	RBP2, High G, Epifaunal Substrate/Available Cover (choice list)
HAB_0213	RBP2, High G, Frequency of Riffles (or bends)	RBP2, High G, Frequency of Riffles (or bends) (choice list)
HAB_0215	RBP2, High G, Riparian Vegetative Zone Width, Left Bank	RBP2, High G, Riparian Vegetative Zone Width, Left Bank (choice list)
HAB_0216	RBP2, High G, Riparian Vegetative Zone Width, Right Bank	RBP2, High G, Riparian Vegetative Zone Width, Right Bank (choice list)
HAB_0217	RBP2, High G, Sediment Deposition	RBP2, High G, Sediment Deposition (choice list)
HAB_0218	RBP2, High G, Vegetative Protection, Left Bank	RBP2, High G, Vegetative Protection, Left Bank (choice list)
HAB_0219	RBP2, High G, Vegetative Protection, Right Bank	RBP2, High G, Vegetative Protection, Right Bank (choice list)
HAB_0220	RBP2, High G, Velocity/Depth Regime	RBP2, High G, Velocity/Depth Regime (choice list)
HAB_0221	RBP2, Low G, Bank Stability, Left Bank	RBP2, Low G, Bank Stability, Left Bank (choice list)
HAB_0222	RBP2, Low G, Bank Stability, Right Bank	RBP2, Low G, Bank Stability, Right Bank (choice list)
HAB_0223	RBP2, Low G, Channel Alteration	RBP2, Low G, Channel Alteration (choice list)

HAB_0224	RBP2, Low G, Channel Flow Status	RBP2, Low G, Channel Flow Status (choice list)
HAB_0225	RBP2, Low G, Channel Sinuosity	RBP2, Low G, Channel Sinuosity (choice list)
HAB_0226	RBP2, Low G, Epifaunal Substrate/Available Cover	RBP2, Low G, Epifaunal Substrate/Available Cover (choice list)
HAB_0228	RBP2, Low G, Pool Substrate Characterization	RBP2, Low G, Pool Substrate Characterization (choice list)
HAB_0229	RBP2, Low G, Pool Variability	RBP2, Low G, Pool Variability (choice list)
HAB_0230	RBP2, Low G, Riparian Vegetative Zone Width, Left Bank	RBP2, Low G, Riparian Vegetative Zone Width, Left Bank (choice list)
HAB_0231	RBP2, Low G, Riparian Vegetative Zone Width, Right Bank	RBP2, Low G, Riparian Vegetative Zone Width, Right Bank (choice list)
HAB_0232	RBP2, Low G, Sediment Deposition	RBP2, Low G, Sediment Deposition (choice list)
HAB_0233	RBP2, Low G, Vegetative Protection, Left Bank	RBP2, Low G, Vegetative Protection, Left Bank (choice list)
HAB_0234	RBP2, Low G, Vegetative Protection, Right Bank	RBP2, Low G, Vegetative Protection, Right Bank (choice list)

Table 6 Habitat Assessment Metrics

CODE	NAME	DESCRIPTION
HAB_0214	RBP2, High G, habitat assessment total score	RBP2, High G, habitat assessment total score
HAB_0240	RBP2, High G, habitat assessment total rating	RBP2, High G, habitat assessment total rating
HAB_0227	RBP2, Low G, habitat assessment total score	RBP2, Low G, habitat assessment total score
HAB_0241	RBP2, Low G, habitat assessment total rating	RBP2, Low G, habitat assessment total rating

Table 7 Individual Index Metrics

CODE	NAME	DESCRIPTION
HGMIG_001	Total number of genera	Total number of genera
HGMIG_002	Percent of genera that are not insects	Percent of genera that are not insects
HGMIG_003	Percent of sensitive EPT individuals	Percent of sensitive EPT individuals
HGMIG_004	Number of scraper genera	Number of scraper genera
HGMIG_005	Number of attribute 2 genera	Number of attribute 2 genera
HGMIG_006	Number of attribute 3 genera	Number of attribute 3 genera
CPHGMIG_001	Hilsenhoff Biotic Index	Hilsenhoff Biotic Index
CPMI_001	Total number of taxa	Total number of taxa
CPMI_002	Ephemeroptera taxa	Ephemeroptera taxa
CPMI_003	Percent Ephemeroptera taxa	Percent Ephemeroptera taxa
CPMI_004	Percent Clingers	Percent Clingers

Table 8 Overall Metrics

CODE	NAME	DESCRIPTION
COASTAL	Coastal Plain Macroinvertebrate Index	Coastal Plain Macroinvertebrate Index
CPMIR	CPMI Rating	CPMI Rating
HGMIG	High Gradient Macroinvertebrate Index - genera	High Gradient Macroinvertebrate Index - genera
HGMIGR	HGMI - genera Rating	HGMI - genera Rating

Table 9 Data Inventory Supplement

Geographic Regions	River Basins- North & South Branch of the Raritan; Lower Raritan, South River & Lawrence; Millstone
Counties	Essex, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Somerset, Union
Dates	April 1-November 30, 2019
Status	In progress- discrete
Sample Frequency	Once
Seasons Sampled	Spring; Summer; Fall;
Waterbody Type	River/Stream
Salinity Category	Fresh
Tidal Influence	Non-tidal
Project Description	Through sampling and analysis of macroinvertebrate communities at a network of freshwater, non-tidal rivers and streams sites, the biological condition of these waterbodies and watersheds in the Raritan Water Region is assessed.
Parameters analyzed type	Habitat; Biological- Benthic macroinvertebrates

Table 10 Data Management Supplement

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2019 QAPPS\2019 AMNET QAPP-Raritan Region
Where will data be recorded in field (media)	Paper
If on tablets or phones, will download at office occur or will you connect wirelessly?	N/A
If on tablets or phones, who will do the download?	N/A
If data collected electronically, where will it be stored?	N/A
Format to be received from Lab	N/A
Method of receipt from lab/s	N/A
Personnel receiving outside lab data	N/A
Is data expected to go to WQDE/STORET?	Yes
Data manager - (Bureau and Name)	BFBM- Leigh Lager