Role of Plant and Soil Community Structure in Riparian Soil Nutrient Retention

QUALITY ASSURANCE PROJECT PLAN

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2.0. Table of Contents

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4.0 Project/Task Organization

QA Manager – James Vasslides

This is a small project with limited personnel and scope. Drs. Aronson and Krumins are the only senior personnel. For that reason, James Vasslides from the Barnegat Bay Partnership has agreed to serve as our outside quality assurance manager. Mr. Vasslides will be responsible for reviewing data and sampling logs throughout the project. He will make at least one site visit with the PIs and their student workers to ensure adherence to protocols. He will also document the project with digital photographs during each site visit and prepare a brief written report for each audit.

Project Manager – Dr. Jennifer Adams Krumins

Dr. Krumins will be responsible for overseeing the progress of the project throughout the entire grant period. She will be in communication with all partners in this project throughout this period and will coordinate the site sampling schedule. She will also be responsible, together with Dr. Aronson, for compiling the correspondence and all reports related to this project.

Principal Investigators –

Dr. Jennifer Adams Krumins, Montclair State University

Microbial Soil Community Characterization

Dr. Krumins will measure changes in the soil microbial community using molecular methods. Dr. Krumins (and trained students) will oversee and coordinate the sampling of the soil biologically community. Dr. Krumins is also responsible for planning and overseeing each sampling event, developing the sample design, collecting physical samples, reviewing data results, and preparing reports.

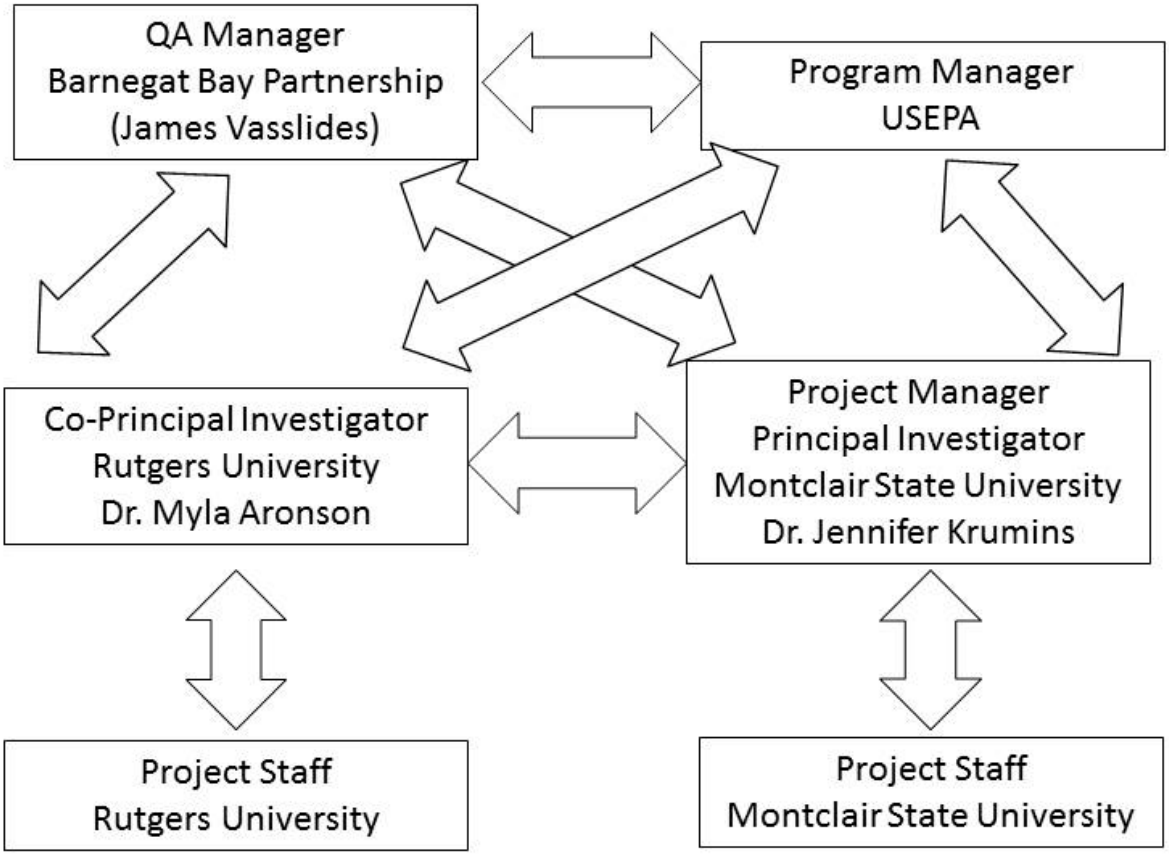
Dr. Myla Aronson, Rutgers University

Plant Community Characterization

Dr. Aronson will oversee the plant community data collection and analysis, assisted by an undergraduate student from Rutgers University. In the field, she will perform the plant community sampling, soil moisture and pH sampling. Dr. Aronson will use her own plant ID equipment and soil moisture and pH meters. She will also map the sites using her GPS equipment and GIS software. Dr. Aronson will perform the statistical analyses.

Communication between the project partners will be via email, telephone, and written, as needed throughout the duration of the project. Both project partners will be present at all sampling and field events.

Organizational Chart:



5.0 Special Training Needs/Certification

Individuals involved in the project will be trained in the requirements of the QAPP. Specifically, Drs. Krumins and Aronson will train all student researchers working on the project. Dr. Krumins is in charge of training the students working on the molecular microbial ecology. She will train them to use the thermal cycler, centrifuge and electrophoresis equipment. Dr. Aronson will train students to use the field equipment including: FieldScout SoilStik pH meter and soil a FieldScout TDR 100. All training is at the level of a technician. Participating in data collection and using the equipment does not require advanced technical skills.

6.0. Problem Definition/Background

6.1. Problem Definition

Riparian corridors serve as critical buffer zones in urban and suburban habitats, supporting a diverse biota and providing essential ecosystem services. They are often targets for intense restoration efforts. In watersheds dominated by urban and suburban land uses, the ability of a riparian ecosystem to remediate nutrients is expected to be affected by plant and soil community composition in the riparian buffers. However, little is known on how plant and soil communities interact. The mechanisms of interaction between plants and soil processes will ultimately affect the ability of the urban stream soil to filter upland pollution and prevent excess discharge to bigger waterways. The work we propose here will address these mechanisms and define restoration target communities that improve riparian ecosystem nutrient retention in the Barnegat Bay Watershed (BBW). The goal of this research is to assess the feedbacks among non-point source pollution, plant communities, and soil community structure in riparian habitats. Ultimately, understanding the interactions between the plant and soil communities will allow us to make recommendations of restoration targets that will improve water quality in the BBW. Using the same data collected to achieve the primary goal, we will address a secondary objective of this study. We will examine the impact of water quality degradation on the resilience of native plant and soil communities to non-native invasion and address the following question. Does the soil under native or exotic communities differ in nutrient retention? The work we propose here will ultimately serve as a pilot study informing research into broad questions addressing the long term health of riparian corridors in urban ecosystems.

6.2. Background

Riparian corridors serve as critical buffer zones in urban and suburban habitats, supporting a diverse biota and providing essential ecosystem services. They are often targets for intense restoration efforts. Riparian zones are often the only remnant habitat for wildlife in suburban and urban landscapes. Locally, urban riparian corridors provide important habitat for plants and wildlife including birds (Luther et al. 2008, Palmer et al. 2008, Pennington et al. 2008) and salamanders (Price et al. 2006, Willson and Dorcas 2003). Regionally and across entire watersheds they serve to remediate and filter excess nutrients thus preventing downstream eutrophication (Groffman et al. 2003). Restoration of riparian habitats is an important tool to increase diversity of plants and animals in suburban and urban habitats as well as increase function of ecosystem services, such as enhancing water quality. However, targets for restoration are often only based on historical vegetation targets. As riparian habitats in urban and suburban areas are often dramatically impacted by high nutrients influxes and high propagule pressure of non-native invasive species, historical targets may not be successful. Instead, restoration targets should be based on vegetation and soil communities that are feasible in impacted stream reaches and that provide the greatest ecosystem function.

The ecosystem services provided by riparian areas are ever more critical as urbanization and the concentrations of non-point source pollutants increase (Brett et al. 2005). Nitrogen loads in coastal watersheds have been linked to urbanization and increases in residential development (Valiela and Bowen 2002). Non-point source pollution, or pollution originating from many diffuse sources, includes addition of excess nutrients (particularly nitrogen) associated with lawns and agricultural lands or metals and hydrocarbons associated with industrial areas. In a healthy riparian system, the negative effects of pollutants are filtered by a robust plant and soil community such that pollutants are remediated prior to entering water ways and ultimately polluting coastal ecosystems. However, as watersheds are increasingly urbanized, the ability of riparian systems to function is compromised. Urban streams have been shown to exhibit higher rates of nitrification relative to more rural streams (Stander and Ehrenfeld 2009a) resulting in increased transport of NO_3 to downstream waterways. However, due to the high variability in urban stream run off and interactions with hydrology, nutrient loading and ecological communities, an understanding of the role of riparian corridors in maintaining water quality is not complete (Stander and Ehrenfeld 2009b).

In watersheds dominated by urban and suburban land uses, the ability of a riparian ecosystem to remediate nutrients is expected to be affected by plant and soil community composition in the riparian buffers. In particular, the dominance of non-native invasive plant species increases in riparian habitats with increasing urban land use (Aronson et al. 2004, Loewenstein and Loewenstein 2005). Soils dominated by invasive plants have elevated pH and altered nutrient cycling through increased rates of nitrification (Ehrenfeld et al. 2001). An increased dominance of invasive plants may result in positive feedback loops in which alterations to nitrogen cycling support further establishment of invasives. Through time, the functional ability of the invaded riparian ecosystem to filter pollutants may become increasingly compromised (Ehrenfeld 2003). However, little research as of yet has connected these processes with soil communities.

The soil microbial community is responsible for mediating both nutrient cycling (Paul 2007) and the establishment of invasive plants (Engelkes et al. 2008). Therefore it is logical to focus on microbial community structure and function when considering the role of invasive plants in nutrient cycling of riparian ecosystems. Plant communities above ground are in a dynamic feedback with microbial and faunal communities below ground (Wardle et al. 2004), and plant and soil communities cannot be studied in isolation. However, we do not know how microbial nutrient cycling in soil will be affected by and influx of invasive plants along increasingly urban streams. The mechanisms of interaction between invasive plants and soil processes will ultimately affect the ability of the urban stream soil to filter upland pollution and prevent excess discharge to bigger waterways. The work we propose here will address these mechanisms and define restoration target communities that will improve riparian ecosystem nutrient retention.

7.0. Project/Task Description

Goals

The goal of this research is to assess the feedbacks among non-point source pollution, plant communities, and soil community structure in riparian habitats. We will examine soil and plant community composition in the spring of 2013 along the Toms River (and its tributaries) from an urban to rural gradient in the BBW. Ultimately, understanding the interactions between the plant and soil communities will allow us to make recommendations of restoration targets that will improve water quality in the BBW. Using the same data collected to achieve the primary goal, we will address a secondary objective of this study. We will examine the impact of water quality degradation on the resilience of native plant and soil communities to non-native invasion and address the following question. Does the soil under native or exotic communities differ in

nutrient retention? The work we propose here will ultimately serve as a pilot study informing research into broad questions addressing the long term health of riparian corridors in urban ecosystems.

Approaches

We have chosen, as our study system, an urban to rural gradient along the Toms River in Burlington and Ocean counties, NJ. Our sites are chosen along the gradient to determine the influences of non-point source pollution on plant and soil community structure as well as the role of these communities in enhancing water quality. We plan to coordinate our sampling effort with pre-existing USGS stream flow and water quality monitoring stations (See Table 1 in 10.1). By doing this, we will be able to compare current stream chemistry with historical data. At each sampling location we will sample natural riparian forested habitat. We will also sample forest sites approximately 100m perpendicular of the midpoint from the riparian transect. This serves as a control for our analyses of the patterns in the riparian sites (See Appendix 2). Microbial community composition will be correlated plant community composition, identifying microbial and plant community distinct units. Then, we will correlate these community units with soil chemistry, allowing us to identify microbial and plant communities that are associated with high or low inorganic nitrogen levels. We will then use these results to look for correlative differences in soluble inorganic nitrogen in the adjacent stream. This will allow us to define target plant and soil communities to maximize nutrient retention. We will use historic USGS water quality data to determine if the current trends we have captured are prevalent in the last 10 years. At each site, we will sample: vegetation composition, soil microbial community composition, abiotic soil chemistry, and water chemistry of the stream.

Timeline

May-June 2013	Field sampling: Plant community measures, collection of soil samples for soil microbial community sampling and soil chemistry, collection of water chemistry samples.
May-June 2013	Send soil and water samples to the New Jersey Analytical Lab (NJAL)
August 2013	Receive soil and water chemistry results from NJAL
June-July 2013	Data entry of plant community
August 2013	PI's receive results from soil and water chemistry samples sent to NJAL
August-December 2013	DNA extraction and molecular analysis of samples
January-June 2014	Data analysis and manuscript preparation
July 2014	Poster and Talk preparation
August 2014	Presentation of results at Ecological Society of America annual conference.
September-December 2014	Preparation of Final Technical Report

8.0 Quality Objectives and Criteria for Measuring Data

8.1 Precision

The precision of both the microbial molecular data and plant community data will be determined and assured multiple ways. First, only the PI and co-PI with their assistants will collect the data. Soil sampling is naturally highly variable due to the patchy distribution of microbes in the environment. Replicate samples will be collected until precision of the data exceeds the variability when new samples are added. This can be demonstrated graphically with rarefaction curves. Second, all samples will be statistically analyzed to detect outliers and for normality of variance. Soil chemistry data will be analyzed by a NJDEP certified lab (See Appendix 3 in a supplement), the New Jersey Analytical Lab in Pennington, NJ (NJAL).

8.2 Bias

In all molecular analysis, bias will be controlled through use of negative and positive controls. Negative controls are sterile water that will not respond to the assay, and positive controls are a known DNA standard that is proven to respond to the assay. Further, samples are coded such that their identity must be verified in a log. This prevents experimenter bias. There are no major issues of bias in plant community sampling.

8.3 Representativeness

Again, as in the objective to maximize precision, rarefaction curves of the sampling data will be constructed. In this curve, it compares sampling effort versus number of new observations. Once sampling is extensive enough that no new observations are found, it is assumed that the sampling effort is representative of the system.

8.4 Comparability

Standard plant community measurements and analyses will be used at all times. The measurements and identification of the vegetation will be done by only the co-PI and her assistant, this allows for consistency in sampling effort. Standard soil collection, analysis and molecular protocols will be used at all times. Further, the microbial community work will be conducted in one laboratory for consistency in sampling effort. This will maximize ability to compare between sites. Standard statistical analysis (outlined below) will be used to compare between sites and across data sets. Soil and stream chemistry data will be analyzed by NJAL.

8.5 Completeness

As sampling effort is critical to precision and representativeness, 100% of the samples will be required for a complete statistical analysis.

8.6 Sensitivity

Sensitivity of methods is an ongoing problem in molecular analysis. Microbial abundance can be low, and then amplification of DNA can be challenging. This issue will be addressed by always maintaining positive controls in every step of extraction through amplification. The analysis of plant community composition is far more direct and objective. As stated, the soil and stream chemistry analysis will be carried out by a proven lab that has certified standards of analysis

and quality control. The SoilStick pH meter is accurate to ±0.01 pH. The TDR 100 soil moisture meter is accurate to ±3.0% volumetric water content with electrical conductivity < 2 mS/cm.

9.0 Non-direct Measurement (Secondary Data)

Not all USGS sampling sites have the same sampling history. Where water quality data is available, we will compare the water quality data we collected to the USGS from the last 10 years, measurements including but not limited to: Nitrate plus Nitrite and NH_4. USGS Water Quality Laboratory Quality Assurance can be found at the following link: http://nwql.usgs.gov/quality.shtml. We will use this data to compare current water quality in the river (our samples) to historic water quality, enabling us to examine the long-term correlations between the riparian biotic communities and water quality.

10.0. Field Monitoring Requirements

10.1. Monitoring Process Design

We will establish each riparian and upland site near a USGS station listed in Table 1. Riparian sites cannot be established at the exact location of the USGS stations because most stations are located on banks that are too high (5-6 feet) from the river to be hydrologically connected to the river. Therefore, we will establish each riparian site at the nearest riparian wetland to the USGS station. We will establish two riparian sites, one 20 meters upstream of the midpoint and one 20 meters downstream, and one upland site 100 meters from the river (please also see Appendix 2). Within each riparian site, one 100m transect will be established within the floodplain approximately parallel to the stream bank. For the upland site, one 100m transect (parallel to the riparian transects) will be established 100m upland of the midpoint of the riparian transect. In both the riparian and upland transects, three $100m^2$ plots will be established every 30 meters along this transect. In these $100m^2$ plots, trees and shrubs will be sampled. Three $1m^2$ subplots will be established randomly within each $100m^2$ plot to sample for ground vegetation. To sample the soil microbial community, we will pull three mini cores at random from within each of the three $1m^2$ sub-plots used to sample ground vegetation. The three cores will be aggregated to minimize variation due to the patchy distribution of microbes in soil (Franklin and Mills 2007). We will measure differences in the soil microbial community using molecular methods. At each three $1m^2$ sub-plots, we will measure soil pH and soil moisture and we will collect additional soil cores to aggregate across each $100m^2$ plot and send to the NJAL.

Table 1. Sampling Locations.

USGS Site Number	Approximate Location
1408500	Near Toms River, NJ
1408380	Blacks Branch at Lakehurst, NJ
1408290	Dove Mill Branch at Whitesville, NJ
1408260	near Van Hiseville, NJ

10.2. Monitoring Methods

Vegetation sampling

At each of the sampling sites, we will establish two riparian sites, one 20 meters upstream of the midpoint and one 20 meters downstream, and one upland site 100 meters perpendicular to the river but running parallel to the riparian transects. Within each riparian site, one 100m transect will be established within the floodplain approximately parallel to the river. For the upland site, one 100m transect (parallel to the riparian transects) will be established 100m perpendicular to the riparian sites. In both the riparian and upland transects three 100 m^2 plots will be established every 30 meters along this transect. Within each $100m^2$ plot, all trees and saplings will be measured for diameter-at-breast-height (dbh) and identified. Shrubs will also be measured for length and width of cover in meters and identified in each $100m^2$ plot. Three $1m^2$ subplots will be established randomly within each $100m^2$ plot to sample for ground vegetation. To randomly establish these plots, we will use a random number generator to generate x-y points from 1 to 9 meters along the North and West axes of each $100m^2$ plot. We will do this three times to generate 3 x-y coordinates for each $100m^2$ plot. These will be the locations of the $1m^2$ plots to sample for ground vegetation, soil chemistry and microbial community composition. Herbaceous plant species and woody plant seedlings will be identified and percent cover of each species will be measured. All plant identification will be done using expert opinion by the Co-PI and validated using Gleason and Cronquist (1991), the foremost identification guide for plants of the Northeastern United States.

Soil Microbial Community Sampling

We will pull three mini cores at random from within each of the three $1m^2$ sub-plots used to sample ground vegetation. The three cores will be aggregated to minimize variation due to the patchy distribution of microbes in soil (Franklin and Mills 2007). We will measure differences in

the soil microbial community using molecular methods. We will use DNA fingerprinting techniques to characterize both the bacterial community structure. Specifically, we will use terminal restriction fragment length polymorphism (tRFLP) using primers that target the 16s region for bacteria. tRFLP is a whole-community polymerase chain reaction (PCR) based method that creates a characteristic DNA banding pattern unique to that community's composition. This method is expedient, inexpensive relative to sequencing and has been used extensively to characterize soil bacterial communities (Krumins et al. 2009).

Soil Chemistry Sampling

To evaluate the capacity for nutrient retention in the soil, we must also measure abiotic soil characteristics. At each site, we will measure soil pH using a FieldScout SoilStik pH meter and soil moisture with a FieldScout TDR 100 soil moisture meter in each of the $1m^2$ plots. We will also collect three soil cores from within each of the $1m^2$ sub-plots, aggregate and send to the NJAL to measure soil chemistry including: NO_3, NO_2 and NH_4. Costs for these analyses are reasonable and documented in the budget. In the field, we will use a stainless steel corer that is two cm in diameter to collect three cores from each $1m^2$ plot for soil chemistry analysis. Cores will be pulled out of the soil to a depth of at least 8 cm.

Stream Chemistry Sampling

Water samples will be collected at the midpoint of the riparian transect and sent to the NJAL to measure stream chemistry including but not limited to: NO_2, NO_3, NH_4. Water samples will be collected in a new sterile, clean, plastic bottle with a screw cap. We will collect 250 mL of stream water from each site, which is the total required for all water chemistry analyses proposed here.

Equipment Required

2cm steel corer
Ethanol
Cooler with cold packs
Clean Ziploc bags
Sharpie markers
60cc syringes (top cut off)
100 m and 15 m tapes
Dbh tape
$1m^2$ square made of pvc pipe

Sterile, clean, plastic bottles with screw caps

10.3. Field Quality Control

All plant identification will be done using expert opinion by the Co-PI and validated using Gleason and Cronquist (1991), the foremost identification guide for plants of the Northeastern United States. To ensure quality control of soil field samples, the corer will be surface sterilized with ethanol between each sample collection. Pseudo replicate cores will be pulled and consolidated to minimize sampling variation. To ensure quality control of stream chemistry samples, sterile, clean plastic bottles will be used. Further, only the PI and trained assistant will pull samples at the site. This will minimize experimenter variation.

Safety

During field sampling, we will not work alone. The PI's and student assistants will always sample together. We will do hourly checks for the presence of ticks to reduce the risk of exposure to tick-borne diseases. We will have a first aid kit in the field at all times. Otherwise, sampling presents limited safety risks.

Training

The student assistants will require training in field sampling. The PI and co-PI have over ten years experience in field sampling plant and microbial communities in soil. They will provide that training.

11.0 Analytical Requirements

11.1 Analytical Methods

Plant Community Analysis

Plant community data will be collected in the field. There are no laboratory analytical requirements for this portion of the work.

Microbial Community Analysis

From the aggregated sample we will quantify bacterial community composition. Specifically, we will use terminal restriction fragment length polymorphism (tRFLP) using primers that target the 16s region for bacteria (Krumins et al 2009). An online protocol can be found at: http://www3.appliedbiosystems.com/cms/groups/mcb_marketing/documents/generaldocuments/

cms_042272.pdf. Further, the procedure can be found in detail within (Krumins et al. 2009). This can be seen attached as Appendix 5.

Soil Chemistry Analysis

Soil samples collected in the field will be sent to the NJAL to measure soil chemistry including: NO_3, NO_2 and NH_4. The NJAL is NJDEP certified (Appendix 3). See Appendix 4 in a supplement for SOP of the NJAL with respect to nitrogen chemistry.

Stream Chemistry Analysis

Water samples collected in the field will be sent to the NJAL to measure stream chemistry including but not limited to: NO_2, NO_3, NH_4,. The NJAL is NJDEP certified (Appendix 3). See appendix 4 in a supplement for SOP of the NJAL with respect to nitrogen chemistry.

By tying our sampling to USGS water quality sites to the four stations listed in Table 1, we can compare our recent data to historical data when available to assess changes in water quality. USGS water quality data is not currently available for all sites, however historical data is available. For example, we can compare the water quality data we collect to that collected by the USGS in 2005. USGS water quality data can be found at: http://nwis.waterdata.usgs.gov/nj/nwis/qw). USGS Water Quality Laboratory Quality Assurance can be found at the following link: http://nwql.usgs.gov/quality.shtml.

11.2 Analytical Quality Control

Detection limit is a re-occurring problem in molecular microbial community analysis. To address this, positive controls will be run with all samples and a consistent threshold level will be applied for peak detection of restriction fragments. All data will be tested for normality and homoscedasticity (constancy of variance). We will use multivariate ordination techniques like principle components analysis (PCA) or Non metric multidimensional scaling (NMDS) to evaluate differences in the composition of the plant, bacterial and fungal communities. For the tRFLP analysis, each sample community's characteristic peak pattern will be the basis for a binary array of presence or absence of operational taxonomic units (OTU). The OTU are the variables for the PCA or NMDS. Component scores for the microbial community composition will be correlated plant community composition, identifying microbial and plant community distinct units. Then, we will correlate these community units with soil chemistry, allowing us to identify microbial and plant communities that are associated with high or low inorganic nitrogen

levels. We will then use these results to tie to concentrations of inorganic nitrogen in the stream. All statistical analysis will be conducted in SAS version 9.3, PC- ORD version 5.31 or R version 2.12.2.

Safety

For tRFLP analysis in the laboratory, all standard lab safety procedures apply including wearing lab coats, safety eye wear and gloves. MSDS are available for all chemicals used in the lab, and it is equipped with an eye wash and safety shower.

12.0 Sample Handling and Custody Requirements

Samples will be in the possession of the PI or co-PI at all times from initial sampling in the field through analysis. Samples will be labeled with the date, treatment site number to be determined by Dr. Krumins and replicate number. For example: 5May13 / Site X / Plot X. All samples will be maintained at room temperature or 4°C until analysis. Specifically, biological samples (molecular microbial) will be kept in a cooler in the field, and then transferred to a refrigerator at the lab until analysis within two weeks. The NJAL Lab SOP indicates that the ammonia samples are to be preserved with sulfuric acid. The NJAL lab SOP indicates that the holding time for the nitrate and nitrite samples is 48 hours. Soil and water chemistry samples will be stored in a cooler or the refrigerator after returning from the field to the lab. The PIs have arrangements with NJAL for sample pick up. See Appendix 1 for the Chain of Custody Tracking Sheet.

13.0 Testing, Inspection, Maintenance and Calibration Requirements

13.1 Instrument/Equipment Testing, Inspection and Maintenance

All field and laboratory equipment are part of the PIs laboratory supplies. The labs were established in 2010, so all equipment is new and of the most recent technology. The equipment is regularly maintained and inspected by the PI and co-PI.

13.2 Instrument/Equipment Calibration and Frequency

Montclair State University has a contract for professional calibration of equipment. This occurs annually. Relevant to the work proposed here, pipettes will be calibrated. Balances used in the lab are auto-calibrated. Molecular equipment used in the lab is new and within manufacturer's warranty for precision and accuracy. We will calibrate the Field Scout Soil Stik pH meter and TDR 100 twice daily during each day of sampling. These instruments also have internal features for calibration.

13.3 Inspection/Acceptance of Supplies and Consumables

The PIs are in charge of ordering and inspecting all supplies and consumables used in the proposed work. All consumables are purchased from the same vendor for consistency in quality.

14.0 Data Management

All data will be maintained in two formats: paper copies in binders and excel spread sheets saved to a mutually accessible folder in dropbox. After entering data into excel spread sheets, entry will be double checked by a second individual in the lab. Further, all spurious data points will be scrutinized for accuracy (see section 16.1). All data will be stored for five years in digital format on a web server like dropbox.

15.0 Assessments/Oversight

On the first day of data collection students will be observed by each PI in sampling techniques to ensure compliance with the QAPP. Students will never sample without the presence of Dr. Aronson or Dr. Krumins so they will always be observed to make sure they are collecting and handling samples properly. Dr. Krumins will be in charge of direct observation of student researchers analyzing samples in the laboratory. Student research schedules in the lab can be erratic due to their own course work. However, Dr. Krumins will make once daily checks on student data collection in the lab to ensure attention to procedures. This will be done by observing student researcher work, and actively reviewing output and data.

Initial review and audit of data collection and the data itself will be carried out by Drs. Krumins and Aronson at each field sampling event. Mr. Vasslides will attend one sampling event early in the process to ensure compliance with the QAPP and will also audit one round of laboratory analysis. The results of the audit will be transmitted to the QAPP file via a memo identifying any issues and recommended corrective actions. Further, the Krumins and Aronson labs hold weekly lab meetings where all students and technicians come together to discuss procedures and further inspect data.

16.0 Data Review, Verification, Validation and Usability

Prior to statistical analysis, all data will be reviewed and verified in Excel. Further, prior to analysis, all data will be checked for normality and conformance to statistical assumptions. Any transformations necessary will be carried out prior to analysis.

16.1 Data Review, Verification and Validation

All data collected will be reviewed by both PIs and their students. Prior to statistical analysis and hypothesis testing, all data will be analyzed for normality and homogeneity of variance. If outside of two standard deviations range, data points will be inspected and possibly rejected as an outlier. Outliers due to error will be discarded from analysis. Non-normal data will be log, ln, or arc sin transformed to reach normality. If data cannot be transformed to reach normality, data will be analyzed using a non-parametric statistics.

16.2 Reconciliation with user Requirements

Data Validation and Verification

Data verification will be performed by personnel involved with the processing and the responsible party for the collection of samples or data; (the PI's: Dr. Myla Aronson, Rutgers & Dr. Jennifer Krumins, Montclair State U.) The procedures outlined in this QAPP will be the reference that will provide the specifications for the environmental data collection effort.

Data verification is a part of what field and laboratory staff and managers routinely do to ensure that they are producing appropriate outputs. Data verification in the field or within the laboratory will occur at each level (i.e., all personnel will verify their own work) and data verification will also occur as information is passed from one level to the next (i.e., the sample custodian will verify the information provided by the field personnel, and supervisors verify the information produced by their staff). The PI's will properly train assistants on the procedures and field sample protocol.

Data validation is an examination of the data package down to the level of the raw data. Validation helps to ensure that the samples have been collected and analyzed correctly and according to the requirements laid out in the QAPP. The Quality Assurance Manager will perform a compliance check to make sure that requirements laid out in the QAPP were followed. Validation also includes a look at the data set as whole to ensure that the data makes sense in terms of representativeness and comparability; the PI's will do this.
The five steps will be:

1. evaluate the field records for consistency,
2. review QC information,

3. summarize deviations and determine impact on data quality,
4. summarize samples collected, and
5. prepare field data validation report.

Type of Document or Record Purpose of Document or Record

A field notebook will be used to maintain accurate records of field and lab research by providing written notes of all activities. A notebook will be kept by each PI as part of the research/report. Sample collection logs will be included in the notebook for an accurate record of samples collected, including location/plot #, date, time, name. Chain-of-custody maintains proof that samples were not tampered with and that samples were under the appropriate possession at all times.

17.0 Reporting, Documents and Records

The Principal Investigators will be responsible for preparing the final report. The final report will include a summary of the findings of the study, the raw data in tabular form, and a quality assurance summary. The Principal Investigators will keep copies of all the records for five (5) years. PIs will be responsible for providing summary documents and research conclusions within 180 days of the project's completion.

A final technical report will be provided to the Barnegat Bay Partnership within 180 days of the completion of the project (December 2014).

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Appendix 1. Chain of Custody Tracking Sheet

Project Name:

_____

Chain of Custody Tracking Sheet

Company:_____
Address:_____
City:_____
State:_____ Zip:_____

Contact:_____
Phone:_____
Fax:_____
E-mail:_____
Bill To:_____

Date Collected:_____
Date Sent:_____

Laboratory Name:_____
Lab Contact:_____

Sample No.	Sample Type	Area	Location	Sample Description	Analysis

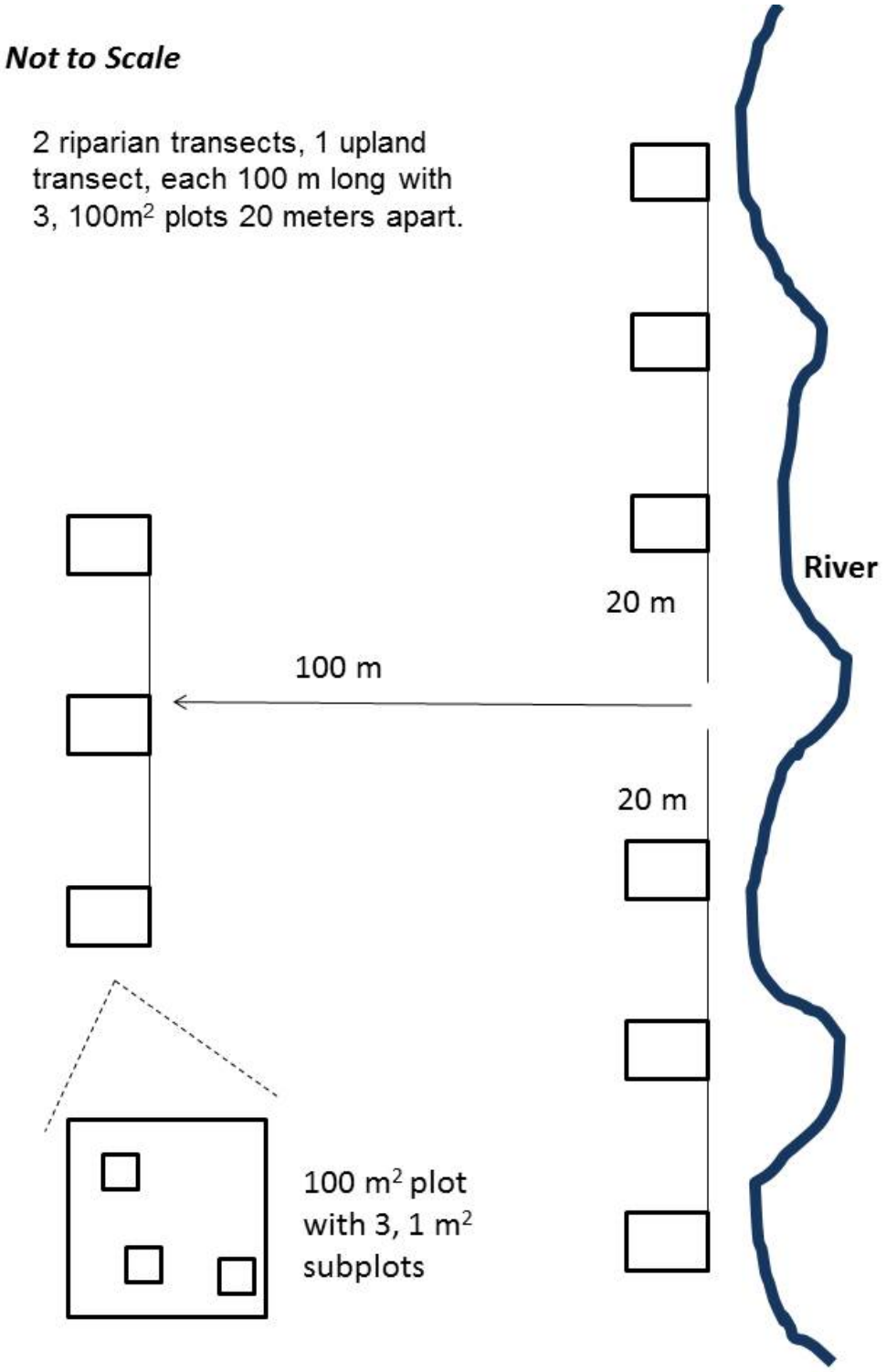
Turn Around Time:_____ Analysis Requested:_____

Relinquished by:_____ Date:_____ Time:_____
Received by:_____ Date:_____ Time:_____

Relinquished by:_____ Date:_____ Time:_____
Received by:_____ Date:_____ Time:_____

Relinquished by:_____ Date:_____ Time:_____
Received by: Date: Time:

Appendix 2. Experimental Plot Layout and Design



Appendix 3. Please see attached pdf supplement titled “Appendix 3 NJDEP Certification for NJAL”

Appendix 4: Please see attached pdf supplement titled “Appendix 4 NJAL SOP”

Appendix 5: Please see attached pdf supplement titled “Appendix 5 Krumins 2009”

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Office of Quality Assurance
401 E. State Street
P.O. Box 420, Mail Code 401-02D
Trenton, NJ 08625-0420
TEL: # (609) 292-3950
FAX # (609) 777-1774

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

March 15, 2013

Allen Thomas
Laboratory Manager
New Jersey Analytical Laboratories
1580 Reed Road
Pennington, New Jersey 08534

Dear Mr. Thomas:

RE: Laboratory Certification Number 11005
Changes to Certification

Based upon your request and the review of submitted documentation the following changes were made to your Annual Certified Parameter List (ACPL). An updated ACPL is enclosed.

The following parameters have been upgraded from Applied to Certified:

Parameter Code	Parameter	Approved Method	Matrix
SHW06.12005-12220	25 pesticides	SW846 8081B	SCM, NPW
SHW06.13110-13170	7 PCBs	SW846 8082A	SCM, NPW
WPP05.09005-09200	24 pesticides	EPA 608	NPW
WPP05.11010-11070	7 PCBs	EPA 608	NPW

If we can be of further assistance, please call Peter Boughton at (609) 292-3950.

Sincerely,

Joseph F. Aiello, Manager

Enclosure: Revised ACPL

New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 03/14/2013 until 06/30/2013

Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW01 – Microbiological Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW01.06000	DW	Colisure (P-A)	[SM 9223B]	Total coliform / E. coli
Applied	SDW01.06020	DW	Membrane Filter - M-Coliblue 24 Test (P-A)	[OTHER Hach COMPANY]	Total coliform / E. coli
Applied	SDW01.06021	DW	Membrane Filter - M-Coliblue 24 Test, Enumeration	[OTHER Hach Company]	Total coliform / E. coli
Certified	SDW01.14000	DW	Pour Plate	[SM 9215 B]	Heterotrophic bacteria

Category: SDW02 – Inorganic Parameters Including Na + Ca

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW02.01000	DW	Nephelometric	[EPA 180.1]	Turbidity
Certified	SDW02.04000	DW	Ion Chromatography	[EPA 300.0]	Nitrate
Certified	SDW02.08000	DW	Ion Chromatography	[EPA 300.0]	Nitrite
Certified	SDW02.14000	DW	Ion Chromatography	[EPA 300.0]	Fluoride
Applied	SDW02.15200	DW	Spectrophotometric, Distill, Semi Automated	[EPA 335.4]	Cyanide
Certified	SDW02.19000	DW	Ion Chromatography	[EPA 300.0]	Sulfate
Applied	SDW02.20000	DW	ICP	[EPA 200.7]	Sodium
Certified	SDW02.21000	DW	AA, Direct aspiration	[SM 3111 B (18/19th ed)]	Sodium
pplied	SDW02.22000	DW	ICP	[EPA 200.7]	Potassium
ertified	SDW02.24000	DW	Gravimetric At 180	[SM 2540 C]	Total dissolved solids (TDS)
uspended	SDW02.26000	DW	AA, Direct aspiration	[SM 3111 B (18/19th ed)]	Calcium
pplied	SDW02.27000	DW	ICP	[EPA 200.7]	Calcium
ertified	SDW02.27400	DW	Titrimetric, EDTA	[SM 2340 C]	Total hardness
ertified	SDW02.29000	DW	Electrometric Titration	[SM 2320 B]	Alkalinity
uspended	SDW02.29500	DW	Ion Chromatography	[EPA 300.0]	Bromide
ertified	SDW02.31000	DW	Ion Chromatography	[EPA 300.0]	Chloride
pplied	SDW02.31120	DW	Ion Chromatography	[EPA 314.0]	Perchlorate
ertified	SDW02.32000	DW	Platinum-Cobalt	[SM 2120 B]	Color
ertified	SDW02.33000	DW	Methylene Blue	[SM 5540 C]	Foaming agents
ertified	SDW02.34000	DW	Consistent Series	[SM 2150 B]	Odor
ertified	SDW02.35000	DW	Conductance	[SM 2510 B]	Conductivity
ertified	SDW02.36100	DW	Molybdosilicate	[SM 4500-Si D (18/19th ed)]	Silica
ertified	SDW02.38000	DW	Ion Chromatography	[EPA 300.0]	Orthophosphate

EY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW03 -- Analyze-Immediately Inorganic Parameter

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW03.00002	DW	All Categories Sample Handling Procedures	[OTHER NJAC 7:18-6 & 9]	PWTA Sampling Parameters
Certified	SDW03.03000	DW	DPD, Colorimetric	[SM 4500-Cl G]	Chlorine - residual
Certified	SDW03.08000	DW	Electrometric	[SM 4500-H B]	pH
Certified	SDW03.09000	DW	Thermometric	[SM 2550 B]	Temperature

Category: SDW04 -- Inorganic Parameters, Metals

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW04.03100	DW	ICP/MS	[EPA 200.8]	Aluminum
Certified	SDW04.07000	DW	ICP/MS	[EPA 200.8]	Antimony
Certified	SDW04.12000	DW	ICP/MS	[EPA 200.8]	Arsenic
Certified	SDW04.17000	DW	ICP/MS	[EPA 200.8]	Barium
Certified	SDW04.21000	DW	ICP/MS	[EPA 200.8]	Beryllium
Certified	SDW04.25000	DW	ICP/MS	[EPA 200.8]	Cadmium
Certified	SDW04.29000	DW	ICP/MS	[EPA 200.8]	Chromium
Certified	SDW04.34000	DW	ICP/MS	[EPA 200.8]	Copper
Certified	SDW04.34900	DW	AA, Direct	[SM 3111 B (18/19th ed)]	Iron
Certified	SDW04.40000	DW	ICP/MS	[EPA 200.8]	Lead
Certified	SDW04.41000	DW	AA, Direct	[SM 3111 B (18/19th ed)]	Magnesium
Certified	SDW04.42800	DW	AA, Direct	[SM 3111 B (18/19th ed)]	Manganese
Certified	SDW04.45000	DW	ICP/MS	[EPA 200.8]	Manganese
Applied	SDW04.46000	DW	Manual Cold Vapor	[EPA 245.1]	Mercury
Certified	SDW04.48000	DW	ICP/MS	[EPA 200.8]	Mercury
Certified	SDW04.53000	DW	ICP/MS	[EPA 200.8]	Nickel
Certified	SDW04.57000	DW	ICP/MS	[EPA 200.8]	Selenium
Certified	SDW04.63000	DW	ICP/MS	[EPA 200.8]	Silver
Certified	SDW04.65000	DW	ICP/MS	[EPA 200.8]	Thallium
Certified	SDW04.65100	DW	ICP/MS	[EPA 200.8]	Uranium
Suspended	SDW04.68000	DW	ICP/MS	[EPA 200.8]	Zinc

Category: SDW05 -- Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW05.22010	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Bromochloroacetic acid

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW05 – Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW05.22020	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Bromodichloroacetic acid
Certified	SDW05.22030	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Chlorodibromoacetic acid (CDBAA)
Certified	SDW05.22050	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Dibromoacetic acid
Certified	SDW05.22060	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Dichloroacetic acid
Certified	SDW05.22070	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Monobromoacetic acid (MBAA)
Certified	SDW05.22080	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Monochloroacetic acid (MCAA)
Certified	SDW05.22090	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Tribromoacetic acid (TBAA)
Certified	SDW05.22100	DW	Liquid/Liquid Extraction/GC	[EPA 552.2]	Trichloroacetic acid

Category: SDW06 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW06.01010	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Bromoform
Certified	SDW06.01020	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chloroform
Certified	SDW06.01030	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dibromochloromethane
Certified	SDW06.01040	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Bromodichloromethane
Certified	SDW06.02010	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Benzene
Certified	SDW06.02020	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Carbon tetrachloride
Certified	SDW06.02030	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chlorobenzene
Certified	SDW06.02040	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichlorobenzene (1,2-)
Certified	SDW06.02050	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichlorobenzene (1,3-)
Certified	SDW06.02060	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichlorobenzene (1,4-)
Certified	SDW06.02070	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloroethane (1,1-)
Certified	SDW06.02080	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloroethane (1,2-)
Certified	SDW06.02090	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloroethene (cis-1,2-)
Certified	SDW06.02100	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloroethene (trans-1,2-)
Certified	SDW06.02110	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methylene chloride (Dichloromethane)
Certified	SDW06.02120	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropane (1,2-)
Certified	SDW06.02130	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Ethylbenzene
Certified	SDW06.02140	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methyl tert-butyl ether
Certified	SDW06.02150	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Naphthalene
Certified	SDW06.02160	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Styrene
Certified	SDW06.02170	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tetrachloroethane (1,1,2,2-)

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW06 -- Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SDW06.02180	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tetrachloroethene
Certified	SDW06.02190	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichloroethane (1,1,1-)
Certified	SDW06.02200	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichloroethene
Certified	SDW06.02210	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Toluene
Certified	SDW06.02220	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichlorobenzene (1,2,4-)
Certified	SDW06.02230	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloroethene (1,1-)
Certified	SDW06.02240	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichloroethane (1,1,2-)
Certified	SDW06.02250	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Vinyl chloride
Certified	SDW06.02260	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Xylenes (total)
Certified	SDW06.03010	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Bromobenzene
Certified	SDW06.03020	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Bromochloromethane
Certified	SDW06.03030	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Bromomethane
Certified	SDW06.03040	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Butyl benzene (n-)
Certified	SDW06.03050	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Sec-butylbenzene
Certified	SDW06.03060	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tert-butylbenzene
Certified	SDW06.03070	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chloroethane
Certified	SDW06.03080	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chloromethane
Certified	SDW06.03090	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chlorotoluene (2-)
Certified	SDW06.03100	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chlorotoluene (4-)
Suspended	SDW06.03110	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dibromo-3-chloropropane (1,2-)
Certified	SDW06.03120	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dibromoethane (1,2-) (EDB)
Certified	SDW06.03130	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dibromomethane
Certified	SDW06.03140	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichlorodifluoromethane
Certified	SDW06.03150	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropane (1,3-)
Certified	SDW06.03160	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropane (2,2-)
Certified	SDW06.03170	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropene (1,1-)
Certified	SDW06.03180	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropene (cis-1,3-)
Certified	SDW06.03190	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropene (trans-1,3-)
Certified	SDW06.03200	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Hexachlorobutadiene (1,3-)
Certified	SDW06.03210	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Isopropylbenzene
Certified	SDW06.03220	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Isopropyltoluene (4-)
Certified	SDW06.03230	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Propylbenzene (n-)
Certified	SDW06.03240	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tetrachloroethane (1,1,1,2-)

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW06 – Organic Parameters, Chromatography/MS

tatus	Code	Matrix	Technique Description	Approved Method	Parameter Description
ertified	SDW06.03250	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichlorobenzene (1,2,3-)
ertified	SDW06.03260	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichlorofluoromethane
ertified	SDW06.03270	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trichloropropane (1,2,3-)
ertified	SDW06.03280	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trimethylbenzene (1,2,4-)
ertified	SDW06.03300	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Trimethylbenzene (1,3,5-)
ertified	SDW06.03310	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Nitrobenzene
ertified	SDW06.03410	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Acetone
ertified	SDW06.03420	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Acrylonitrile
ertified	SDW06.03430	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Allyl chloride
ertified	SDW06.03440	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Butanone (2-)
ertified	SDW06.03450	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Carbon disulfide
ertified	SDW06.03460	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chloroacetonitrile
ertified	SDW06.03470	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Chlorobutane (1-)
ertified	SDW06.03480	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloro-2-butene (trans-1,4-)
ertified	SDW06.03490	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Dichloropropanone (1,1-)
ertified	SDW06.03500	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Diethyl ether (Ethyl ether)
ertified	SDW06.03510	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Ethyl methacrylate
ertified	SDW06.03520	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Hexachloroethane
ertified	SDW06.03530	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Hexanone (2-)
ertified	SDW06.03540	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methacrylonitrile
ertified	SDW06.03550	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methyl acrylate
ertified	SDW06.03560	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methyl iodide
ertified	SDW06.03570	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Methyl methacrylate
ertified	SDW06.03580	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Pentanone (4-methyl-2-) (MIBK)
ertified	SDW06.03590	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Nitropropane (2-)
ertified	SDW06.03600	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Pentachloroethane
ertified	SDW06.03610	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Propionitrile
ertified	SDW06.03615	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tert-butyl alcohol
ertified	SDW06.03620	DW	GC/MS, P & T or Direct Injection, Capillary	[EPA 524.2]	Tetrahydrofuran

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New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 03/14/2013 until 06/30/2013

Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SDW07 -- Radiochem.: Radioactivity / Radionuclide

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SDW07.01001	DW	48-Hour Rapid Gross Alpha Test	[OTHER ECLS-R-GA]	Gross - alpha (incl. Ra & U excl. radon)

Category: SHW04 -- Inorganic Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SHW04.01000	NPW	Acid Digestion/Surface and Groundwater, ICP, FLAA	[SW-846 3005A]	Metals, Total Rec and Dissolved
Applied	SHW04.01500	NPW	Acid Digestion/Aqueous Samples, ICP, FLAA	[SW-846 3010A]	Metals, Total

Category: SHW05 -- Organic Parameters, Prep. / Screening

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW05.01000	NPW	Separatory Funnel Extraction	[SW-846 3510C]	Semivolatile organics
Certified	SHW05.07000	NPW	Purge & Trap Aqueous	[SW-846 5030B]	Volatile organics

Category: SHW06 -- Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW06.23100	NPW	GC, Headspace, FID	[OTHER J. Chrom. Sci. RSK-175]	Ethane
Certified	SHW06.23105	NPW	GC, Headspace, FID	[OTHER J. Chrom. Sci. RSK-175]	Ethene
Certified	SHW06.23110	NPW	GC, Headspace, FID	[OTHER J. Chrom. Sci. RSK-175]	Methane

Category: WPP01 -- Microbiological Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP01.02000	NPW	Membrane Filter (MF), Single Step	[SM 9222 D]	Fecal coliform
Certified	WPP01.04000	NPW	MF Single Step or Two Step	[SM 9222 B]	Total coliform
Certified	WPP01.06000	NPW	Membrane Filter	[EPA p. 136]	Fecal streptococci
Certified	WPP01.10100	NPW	Spread Plate	[SM 9215 C]	Heterotrophic plate count
Certified	WPP01.16100	NPW	Membrane Filter (Modified mTEC)	[EPA 1603]	Escherichia coli (E coli)
Certified	WPP01.16105	NPW	Membrane Filter - M-Coliblue 24 Test	[OTHER Hach Company]	Escherichia coli (E coli)

Category: WPP02 -- Inorg. Parameters, Nutrients and Demands

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP02.01500	NPW	Electrometric or Color Titration	[SM 2320 B]	Alkalinity as CaCO3
Certified	WPP02.03000	NPW	Distillation, Titration	[SM 4500-NH3 B+C (19/20th ed.)]	Ammonia

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Environmental Laboratory Certification Program

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP02 – Inorg. Parameters, Nutrients and Demands

tatus	Code	Matrix	Technique Description	Approved Method	Parameter Description
ertified	WPP02.03500	NPW	Distillation, Electrode	[SM 4500-NH3 B+D or E (19/20th ed.)]	Ammonia
ertified	WPP02.05000	NPW	Dissolved Oxygen Depletion - Membrane Electrode	[SM 5210 B]	Biochemical oxygen demand
pplied	WPP02.06000	NPW	ICP	[EPA 200.7]	Boron
ertified	WPP02.07100	NPW	Ion Chromatography	[EPA 300.0]	Bromide
uspended	WPP02.07500	NPW	Digestion, AA Direct	[SM 3111 B (18/19th ed)]	Calcium
pplied	WPP02.08000	NPW	Digestion, ICP	[EPA 200.7]	Calcium
ertified	WPP02.09500	NPW	Diss. Oxygen Depl., Nitrif. Inhib. - Membrane Electrode	[SM 5210 B]	Carbonaceous BOD (CBOD)
ertified	WPP02.10500	NPW	Spectrophotometric Manual/Auto	[EPA 410.4]	Chemical oxygen demand
ertified	WPP02.12600	NPW	Ion Chromatography	[EPA 300.0]	Chloride
ertified	WPP02.12850	NPW	Spectrophotometric	[SM 10200H 1 + 2]	Chlorophyll
ertified	WPP02.13500	NPW	Colorimetric (Platinum-Cobalt)	[SM 2120 B]	Color
pplied	WPP02.15500	NPW	Distillation, Spectrophotometric (Auto)	[EPA 335.4]	Cyanide
ertified	WPP02.18100	NPW	Ion Chromatography	[EPA 300.0]	Fluoride
ertified	WPP02.19000	NPW	Titrimetric, EDTA	[SM 2340 C]	Hardness - total as CaCO3
ertified	WPP02.20500	NPW	Digestion, Distillation, Titration	[SM 4500-N Org B or C + NH3 B + NH3 C (19/20th ed)]	Kjeldahl nitrogen - total
ertified	WPP02.21500	NPW	Digestion, Distillation, Electrode	[SM 4500-N Org B or C + NH3 B + NH3 F or G (18th ed)]	Kjeldahl nitrogen - total
pplied	WPP02.23500	NPW	Digestion, AA Direct	[SM 3111 B (18/19th ed)]	Magnesium
pplied	WPP02.24000	NPW	Digestion, ICP	[EPA 200.7]	Magnesium
ertified	WPP02.26100	NPW	Ion Chromatography	[EPA 300.0]	Nitrate
ertified	WPP02.28600	NPW	Ion Chromatography	[EPA 300.0]	Nitrite
ertified	WPP02.29100	NPW	Gravimetric, Hexane Extractable Material-LL	[EPA 1664A]	Oil & grease - hem-LL
ertified	WPP02.29200	NPW	Gravimetric, Silica Gel Treated-Hem	[EPA 1664A]	Oil & grease - sgt-non polar
ertified	WPP02.30500	NPW	Total Kjeldahl-N Minus Ammonia-N	[SM 4500-NH3 B, C, E, F, G, H]	Organic nitrogen
ertified	WPP02.32000	NPW	Ascorbic Acid, Manual Two Reagent	[EPA 365.3]	Orthophosphate
ertified	WPP02.32100	NPW	Ion Chromatography	[EPA 300.0]	Orthophosphate
pplied	WPP02.32500	NPW	Manual Distillation, Colorimetric 4AAP, Manual	[EPA 420.1]	Phenols
ertified	WPP02.34000	NPW	Persulfate Digestion + Manual	[SM 4500-P B5 + E]	Phosphorus (total)
ertified	WPP02.36000	NPW	Digestion, AA, Direct	[SM 3111 B (18/19th ed)]	Potassium
pplied	WPP02.36500	NPW	Digestion, ICP	[EPA 200.7]	Potassium
ertified	WPP02.38500	NPW	Gravimetric, 180 Degrees C	[SM 2540 C]	Residue - filterable (TDS)
ertified	WPP02.39000	NPW	Gravimetric, 103-105 Degrees C, Post Washing	[SM 2540 D]	Residue - nonfilterable (TSS)

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Environmental Laboratory Certification Program

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Effective as of 03/14/2013 until 06/30/2013

Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP02 -- Inorg. Parameters, Nutrients and Demands

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP02.39500	NPW	Volumetric (Imhoff Cone) or Gravimetric	[SM 2540 F]	Residue - settleable
Certified	WPP02.40100	NPW	Gravimetric, 500 Degrees C	[SM 2540 G SM 18th Ed.]	Total, fixed, and volatile solids (SQAR)
Certified	WPP02.41500	NPW	0.45u Filtration + Colorimetric (Manual)	[SM 4500-Si D (18/19th ed)]	Silica - dissolved
Certified	WPP02.43000	NPW	Digestion, AA, Direct	[SM 3111 B (18/19th ed)]	Sodium
Applied	WPP02.44000	NPW	Digestion, ICP	[EPA 200.7]	Sodium
Certified	WPP02.45500	NPW	Wheatstone Bridge	[EPA 120.1]	Specific conductance
Certified	WPP02.47100	NPW	Ion Chromatography	[EPA 300.0]	Sulfate
Applied	WPP02.48000	NPW	Colorimetric (Methylene Blue)	[SM 4500-S D]	Sulfides
Certified	WPP02.48500	NPW	Colorimetric (Methylene Blue)	[SM 5540 C]	Surfactants
Certified	WPP02.50000	NPW	Nephelometric	[EPA 180.1]	Turbidity

Category: WPP03 -- Analyze-Immediately Inorganic Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP03.05000	NPW	Spectrophotometric, DPD	[SM 4500-Cl G]	Chlorine
Certified	WPP03.07000	NPW	Winkler, Azide Modification	[SM 4500-O C]	Oxygen (dissolved)
Certified	WPP03.08000	NPW	Membrane Electrode	[SM 4500-O G]	Oxygen (dissolved)
Certified	WPP03.09000	NPW	Electrometric	[SM 4500-H B]	pH
Certified	WPP03.14000	NPW	Thermometric	[SM 2550 B]	Temperature

Category: WPP04 -- Inorganic Parameters, Metals

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	WPP04.02000	NPW	Digestion, ICP	[EPA 200.7]	Aluminum
Certified	WPP04.02100	NPW	Digestion, ICP/MS	[EPA 200.8]	Aluminum
Applied	WPP04.04500	NPW	Digestion, ICP	[EPA 200.7]	Antimony
Certified	WPP04.04600	NPW	Digestion, ICP/MS	[EPA 200.8]	Antimony
Applied	WPP04.05600	NPW	Digestion, ICP	[EPA 200.7]	Arsenic
Certified	WPP04.05700	NPW	Digestion, ICP/MS	[EPA 200.8]	Arsenic
Applied	WPP04.08000	NPW	Digestion, ICP	[EPA 200.7]	Barium
Certified	WPP04.08200	NPW	Digestion, ICP/MS	[EPA 200.8]	Barium
Applied	WPP04.11000	NPW	Digestion, ICP	[EPA 200.7]	Beryllium
Certified	WPP04.11100	NPW	Digestion, ICP/MS	[EPA 200.8]	Beryllium
Applied	WPP04.13500	NPW	Digestion, ICP	[EPA 200.7]	Cadmium

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Environmental Laboratory Certification Program

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP04 – Inorganic Parameters, Metals

tatus	Code	Matrlx	Technique Description	Approved Method	Parameter Description
'ertified	WPP04.13600	NPW	Digestion, ICP/MS	[EPA 200.8]	Cadmium
'ertified	WPP04.15000	NPW	0.45u Filter, Colorimetric DPC	[SM 3500-Cr D (18/19th ed)]	Chromium (VI)
,pplied	WPP04.18000	NPW	Digestion, ICP	[EPA 200.7]	Chromium
'ertified	WPP04.18100	NPW	Digestion, ICP/MS	[EPA 200.8]	Chromium
,pplied	WPP04.19500	NPW	Digestion, ICP	[EPA 200.7]	Cobalt
'ertified	WPP04.19600	NPW	Digestion, ICP/MS	[EPA 200.8]	Cobalt
ertified	WPP04.20500	NPW	Digestion, AA Direct	[SM 3111 B or C (18/19th ed)]	Copper
,pplied	WPP04.21500	NPW	Digestion, ICP	[EPA 200.7]	Copper
ertified	WPP04.21600	NPW	Digestion, ICP/MS	[EPA 200.8]	Copper
ertified	WPP04.25500	NPW	Digestion, AA Direct	[SM 3111 B or C (18/19th ed)]	Iron
pplied	WPP04.26500	NPW	Digestion, ICP	[EPA 200.7]	Iron
pplied	WPP04.26550	NPW	Digestion, ICP/MS	[EPA 200.8]	Iron
pplied	WPP04.28000	NPW	Digestion, ICP	[EPA 200.7]	Lead
ertified	WPP04.28100	NPW	Digestion, ICP/MS	[EPA 200.8]	Lead
ertified	WPP04.30000	NPW	Digestion, AA Direct	[SM 3111 B (18/19th ed)]	Manganese
pplied	WPP04.31000	NPW	Digestion, ICP	[EPA 200.7]	Manganese
ertified	WPP04.31100	NPW	Digestion, ICP/MS	[EPA 200.8]	Manganese
pplied	WPP04.33000	NPW	Manual Cold Vapor	[EPA 245.1]	Mercury
pplied	WPP04.35000	NPW	Digestion, ICP	[EPA 200.7]	Molybdenum
ertified	WPP04.35200	NPW	Digestion, ICP/MS	[EPA 200.8]	Molybdenum
pplied	WPP04.37500	NPW	Digestion, ICP	[EPA 200.7]	Nickel
ertified	WPP04.37600	NPW	Digestion, ICP/MS	[EPA 200.8]	Nickel
pplied	WPP04.45500	NPW	Digestion, ICP	[EPA 200.7]	Selenium
ertified	WPP04.45600	NPW	Digestion, ICP/MS	[EPA 200.8]	Selenium
pplied	WPP04.48000	NPW	Digestion, ICP	[EPA 200.7]	Silver
ertified	WPP04.48200	NPW	Digestion, ICP/MS	[EPA 200.8]	Silver
pplied	WPP04.50000	NPW	Digestion, ICP	[EPA 200.7]	Thallium
ertified	WPP04.50100	NPW	Digestion, ICP/MS	[EPA 200.8]	Thallium
pplied	WPP04.51100	NPW	Digestion, ICP	[EPA 200.7]	Tin
pplied	WPP04.51200	NPW	Digestion, ICP/MS	[EPA 200.8]	Tin
pplied	WPP04.52050	NPW	Digestion, ICP	[EPA 200.7]	Titanium
pplied	WPP04.52070	NPW	Digestion, ICP/MS	[EPA 200.8]	Titanium
pplied	WPP04.52500	NPW	Digestion, ICP/MS	[EPA 200.8]	Uranium

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Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP04 -- Inorganic Parameters, Metals

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	WPP04.54000	NPW	Digestion, ICP	[EPA 200.7]	Vanadium
Certified	WPP04.54100	NPW	Digestion, ICP/MS	[EPA 200.8]	Vanadium
Applied	WPP04.56500	NPW	Digestion, ICP	[EPA 200.7]	Zinc
Certified	WPP04.56600	NPW	Digestion, ICP/MS	[EPA 200.8]	Zinc

Category: WPP05 -- Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP05.09005	NPW	Extract/GC (ECD)	[EPA 608]	Alachlor
Certified	WPP05.09010	NPW	Extract/GC (ECD)	[EPA 608]	Aldrin
Certified	WPP05.09015	NPW	Extract/GC (ECD)	[EPA 608]	Atrazine
Certified	WPP05.09020	NPW	Extract/GC (ECD)	[EPA 608]	Alpha BHC
Certified	WPP05.09030	NPW	Extract/GC (ECD)	[EPA 608]	Beta BHC
Certified	WPP05.09040	NPW	Extract/GC (ECD)	[EPA 608]	Delta BHC
Certified	WPP05.09050	NPW	Extract/GC (ECD)	[EPA 608]	Lindane (gamma BHC)
Certified	WPP05.09060	NPW	Extract/GC (ECD)	[EPA 608]	Chlordane
Certified	WPP05.09062	NPW	Extract/GC (ECD)	[EPA 608]	Chlordane (alpha)
Certified	WPP05.09063	NPW	Extract/GC (ECD)	[EPA 608]	Chlordane (gamma)
Certified	WPP05.09070	NPW	Extract/GC (ECD)	[EPA 608]	DDD (4,4'-)
Certified	WPP05.09080	NPW	Extract/GC (ECD)	[EPA 608]	DDE (4,4'-)
Certified	WPP05.09090	NPW	Extract/GC (ECD)	[EPA 608]	DDT (4,4'-)
Certified	WPP05.09100	NPW	Extract/GC (ECD)	[EPA 608]	Dieldrin
Certified	WPP05.09110	NPW	Extract/GC (ECD)	[EPA 608]	Endosulfan I
Certified	WPP05.09120	NPW	Extract/GC (ECD)	[EPA 608]	Endosulfan II
Certified	WPP05.09130	NPW	Extract/GC (ECD)	[EPA 608]	Endosulfan sulfate
Certified	WPP05.09140	NPW	Extract/GC (ECD)	[EPA 608]	Endrin
Certified	WPP05.09150	NPW	Extract/GC (ECD)	[EPA 608]	Endrin aldehyde
Certified	WPP05.09160	NPW	Extract/GC (ECD)	[EPA 608]	Endrin ketone
Certified	WPP05.09170	NPW	Extract/GC (ECD)	[EPA 608]	Heptachlor
Certified	WPP05.09180	NPW	Extract/GC (ECD)	[EPA 608]	Heptachlor epoxide
Certified	WPP05.09190	NPW	Extract/GC (ECD)	[EPA 608]	Methoxychlor
Certified	WPP05.09200	NPW	Extract/GC (ECD)	[EPA 608]	Toxaphene
Certified	WPP05.11010	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1016

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Environmental Laboratory Certification Program

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP05 -- Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP05.11020	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1221
Certified	WPP05.11030	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1232
Certified	WPP05.11040	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1242
Certified	WPP05.11050	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1248
Certified	WPP05.11060	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1254
Certified	WPP05.11070	NPW	Extract/GC (ECD)	[EPA 608]	PCB 1260

Category: WPP06 -- Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.02000	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Allyl chloride
Certified	WPP06.02003	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Acetone
ertified	WPP06.02007	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Acrolein
ertified	WPP06.02009	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Acrylonitrile
ertified	WPP06.02010	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Benzene
ertified	WPP06.02015	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromobenzene
ertified	WPP06.02017	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromochloromethane
ertified	WPP06.02020	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromodichloromethane
ertified	WPP06.02025	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromoethane
ertified	WPP06.02030	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromoform
ertified	WPP06.02040	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Bromomethane
ertified	WPP06.02041	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Butanone (2-)
ertified	WPP06.02044	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Butyl benzene (n-)
ertified	WPP06.02045	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Carbon disulfide
ertified	WPP06.02050	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Carbon tetrachloride
ertified	WPP06.02060	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chlorobenzene
ertified	WPP06.02070	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chloroethane
ertified	WPP06.02080	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chloroethyl vinyl ether (2-)
ertified	WPP06.02090	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chloroform
ertified	WPP06.02100	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chloromethane
ertified	WPP06.02103	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chlorotoluene (2-)
ertified	WPP06.02105	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Chlorotoluene (4-)
ertified	WPP06.02107	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dibromo-3-chloropropane (1,2-)

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP06 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.02110	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dibromochloromethane
Certified	WPP06.02115	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dibromoethane (1,2-) (EDB)
Certified	WPP06.02116	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dibromomethane
Certified	WPP06.02118	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloro-2-butene (cis-1,4-)
Certified	WPP06.02120	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichlorobenzene (1,2-)
Certified	WPP06.02130	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichlorobenzene (1,3-)
Certified	WPP06.02140	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichlorobenzene (1,4-)
Certified	WPP06.02145	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichlorodifluoromethane
Certified	WPP06.02150	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloroethane (1,1-)
Certified	WPP06.02160	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloroethane (1,2-)
Certified	WPP06.02170	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloroethene (1,1-)
Certified	WPP06.02175	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloroethene (cis-1,2-)
Certified	WPP06.02180	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloroethene (trans-1,2-)
Certified	WPP06.02190	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropane (1,2-)
Certified	WPP06.02192	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropane (1,3-)
Certified	WPP06.02194	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropane (2,2-)
Certified	WPP06.02195	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropene (1,1-)
Certified	WPP06.02198	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Diethyl ether (Ethyl ether)
Certified	WPP06.02200	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropene (cis-1,3-)
Certified	WPP06.02210	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dichloropropene (trans-1,3-)
Certified	WPP06.02212	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Ethyl acetate
Certified	WPP06.02220	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Ethylbenzene
Certified	WPP06.02230	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Methylene chloride (Dichloromethane)
Certified	WPP06.02232	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Methyl tert-butyl ether
Certified	WPP06.02233	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Methyl isobutyl ketone (MIBK)
Certified	WPP06.02234	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tert-butyl alcohol
Certified	WPP06.02235	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tetrahydrofuran
Certified	WPP06.02238	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Styrene
Certified	WPP06.02240	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tetrachloroethane (1,1,2,2-)
Certified	WPP06.02245	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tetrachloroethane (1,1,1,2-)
Certified	WPP06.02250	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tetrachloroethene
Certified	WPP06.02260	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Toluene
Certified	WPP06.02270	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichloroethane (1,1,1-)

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Effective as of 03/14/2013 until 06/30/2013

Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP06 -- Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.02280	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichloroethane (1,1,2-)
Certified	WPP06.02290	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichloroethene
Certified	WPP06.02300	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichlorofluoromethane
Certified	WPP06.02305	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
Certified	WPP06.02307	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Vinyl acetate
Certified	WPP06.02310	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Vinyl chloride
Certified	WPP06.02312	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Xylenes (total)
Certified	WPP06.02315	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Xylene (o-)
Certified	WPP06.02317	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Xylene (m- + p-)
Certified	WPP06.02320	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Acetonitrile
Certified	WPP06.02322	NPW	GC/MS, P&T, Capillary Column	[EPA 624]	Cyclohexane
Certified	WPP06.02325	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Hexanone (2-)
Certified	WPP06.02326	NPW	GC/MS, P&T, Capillary Column	[EPA 624]	Methyl acetate
Certified	WPP06.02328	NPW	GC/MS, P&T, Capillary Column	[EPA 624]	Methylcyclohexane
ertified	WPP06.02330	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Methyl iodide
ertified	WPP06.02410	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Dioxane (1,4-)
pplied	WPP06.02420	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Ethanol
ertified	WPP06.02430	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Ethyl methacrylate
ertified	WPP06.02440	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Hexachlorobutadiene (1,3-)
ertified	WPP06.02460	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Isopropylbenzene
ertified	WPP06.02470	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Isopropyltoluene (4-)
ertified	WPP06.02500	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Methyl methacrylate
ertified	WPP06.02510	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Naphthalene
ertified	WPP06.02520	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Propionitrile
ertified	WPP06.02530	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Pentachloroethane
ertified	WPP06.02540	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Propylbenzene (n-)
ertified	WPP06.02550	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Sec-butylbenzene
ertified	WPP06.02590	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Tert-butylbenzene
ertified	WPP06.02610	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichlorobenzene (1,2,3-)
ertified	WPP06.02620	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichlorobenzene (1,2,4-)
ertified	WPP06.02630	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trichloropropane (1,2,3-)
pplied	WPP06.02640	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trimethylbenzene (1,2,3-)
ertified	WPP06.02650	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trimethylbenzene (1,2,4-)

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: WPP06 -- Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.02660	NPW	GC/MS, P & T, Capillary Column	[EPA 624]	Trimethylbenzene (1,3,5-)
Certified	WPP06.03010	NPW	Extract, GC/MS	[EPA 625]	Acenaphthene
Certified	WPP06.03020	NPW	Extract, GC/MS	[EPA 625]	Acenaphthylene
Certified	WPP06.03030	NPW	Extract, GC/MS	[EPA 625]	Anthracene
Certified	WPP06.03040	NPW	Extract, GC/MS	[EPA 625]	Benzo(a)anthracene
Certified	WPP06.03050	NPW	Extract, GC/MS	[EPA 625]	Benzo(b)fluoranthene
Certified	WPP06.03060	NPW	Extract, GC/MS	[EPA 625]	Benzo(k)fluoranthene
Certified	WPP06.03070	NPW	Extract, GC/MS	[EPA 625]	Benzo(a)pyrene
Certified	WPP06.03080	NPW	Extract, GC/MS	[EPA 625]	Benzo(ghi)perylene
Certified	WPP06.03090	NPW	Extract, GC/MS	[EPA 625]	Butyl benzyl phthalate
Certified	WPP06.03100	NPW	Extract, GC/MS	[EPA 625]	Bis (2-chloroethyl) ether
Certified	WPP06.03110	NPW	Extract, GC/MS	[EPA 625]	Bis (2-chloroethoxy) methane
Certified	WPP06.03120	NPW	Extract, GC/MS	[EPA 625]	Bis (2-ethylhexyl) phthalate
Certified	WPP06.03130	NPW	Extract, GC/MS	[EPA 625]	Bis (2-chloroisopropyl) ether
Certified	WPP06.03140	NPW	Extract, GC/MS	[EPA 625]	Bromophenyl-phenyl ether (4-)
Certified	WPP06.03150	NPW	Extract, GC/MS	[EPA 625]	Chloronaphthalene (2-)
Certified	WPP06.03160	NPW	Extract, GC/MS	[EPA 625]	Chlorophenyl-phenyl ether (4-)
Certified	WPP06.03170	NPW	Extract, GC/MS	[EPA 625]	Chrysene
Certified	WPP06.03172	NPW	Extract, GC/MS	[EPA 625]	Chloronaphthalene (1-)
Certified	WPP06.03180	NPW	Extract, GC/MS	[EPA 625]	Dibenzo(a,h)anthracene
Certified	WPP06.03186	NPW	Extract, GC/MS	[EPA 625]	Dibenzofuran
Certified	WPP06.03188	NPW	Extract, GC/MS	[EPA 625]	Dibenzo(a,e)pyrene
Certified	WPP06.03190	NPW	Extract, GC/MS	[EPA 625]	Di-n-butyl phthalate
Certified	WPP06.03230	NPW	Extract, GC/MS	[EPA 625]	Dichlorobenzidine (3,3'-)
Certified	WPP06.03235	NPW	Extract, GC/MS	[EPA 625]	Dichlorophenol (2,6-)
Certified	WPP06.03240	NPW	Extract, GC/MS	[EPA 625]	Diethyl phthalate
Applied	WPP06.03246	NPW	Extract, GC/MS	[EPA 625]	Dimethyl benzidine (3,3-)
Certified	WPP06.03250	NPW	Extract, GC/MS	[EPA 625]	Dimethyl phthalate
Certified	WPP06.03260	NPW	Extract, GC/MS	[EPA 625]	Dinitrotoluene (2,4-)
Certified	WPP06.03270	NPW	Extract, GC/MS	[EPA 625]	Dinitrotoluene (2,6-)
Certified	WPP06.03280	NPW	Extract, GC/MS	[EPA 625]	Di-n-octyl phthalate
Certified	WPP06.03281	NPW	Extract, GC/MS	[EPA 625]	Diphenylamine
Certified	WPP06.03290	NPW	Extract, GC/MS	[EPA 625]	Fluoranthene

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Category: WPP06 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.03300	NPW	Extract, GC/MS	[EPA 625]	Fluorene
Certified	WPP06.03310	NPW	Extract, GC/MS	[EPA 625]	Hexachlorobenzene
Certified	WPP06.03320	NPW	Extract, GC/MS	[EPA 625]	Hexachlorobutadiene (1,3-)
Certified	WPP06.03330	NPW	Extract, GC/MS	[EPA 625]	Hexachloroethane
Certified	WPP06.03340	NPW	Extract, GC/MS	[EPA 625]	Indeno(1,2,3-cd)pyrene
Certified	WPP06.03350	NPW	Extract, GC/MS	[EPA 625]	Isophorone
Certified	WPP06.03358	NPW	Extract, GC/MS	[EPA 625]	Methylnaphthalene (2-)
Certified	WPP06.03360	NPW	Extract, GC/MS	[EPA 625]	Naphthalene
Certified	WPP06.03366	NPW	Extract, GC/MS	[EPA 625]	Chloroaniline (4-)
Certified	WPP06.03367	NPW	Extract, GC/MS	[EPA 625]	Nitroaniline (2-)
Certified	WPP06.03368	NPW	Extract, GC/MS	[EPA 625]	Nitroaniline (3-)
Certified	WPP06.03369	NPW	Extract, GC/MS	[EPA 625]	Nitroaniline (4-)
Certified	WPP06.03370	NPW	Extract, GC/MS	[EPA 625]	Nitrobenzene
Certified	WPP06.03380	NPW	Extract, GC/MS	[EPA 625]	N-Nitroso-di-n-propylamine
ertified	WPP06.03390	NPW	Extract, GC/MS	[EPA 625]	Phenanthrene
ertified	WPP06.03400	NPW	Extract, GC/MS	[EPA 625]	Pyrene
ertified	WPP06.03402	NPW	Extract, GC/MS	[EPA 625]	Pentachlorobenzene
ropped	WPP06.03403	NPW	Extract, GC/MS	[EPA 625]	Tetrachlorobenzene (1,2,3,4-)
ropped	WPP06.03404	NPW	Extract, GC/MS	[EPA 625]	Tetrachlorobenzene (1,2,3,5-)
ertified	WPP06.03405	NPW	Extract, GC/MS	[EPA 625]	Tetrachlorobenzene (1,2,4,5-)
ertified	WPP06.03410	NPW	Extract, GC/MS	[EPA 625]	Trichlorobenzene (1,2,4-)
ertified	WPP06.03420	NPW	Extract, GC/MS	[EPA 625]	Methyl phenol (4-chloro-3-)
ertified	WPP06.03430	NPW	Extract, GC/MS	[EPA 625]	Chlorophenol (2-)
ertified	WPP06.03440	NPW	Extract, GC/MS	[EPA 625]	Dichlorophenol (2,4-)
ertified	WPP06.03450	NPW	Extract, GC/MS	[EPA 625]	Dimethylphenol (2,4-)
ertified	WPP06.03460	NPW	Extract, GC/MS	[EPA 625]	Dinitrophenol (2,4-)
ertified	WPP06.03470	NPW	Extract, GC/MS	[EPA 625]	Dinitrophenol (2-methyl-4,6-)
ertified	WPP06.03480	NPW	Extract, GC/MS	[EPA 625]	Nitrophenol (2-)
ertified	WPP06.03490	NPW	Extract, GC/MS	[EPA 625]	Nitrophenol (4-)
ertified	WPP06.03500	NPW	Extract, GC/MS	[EPA 625]	Pentachlorophenol
ertified	WPP06.03510	NPW	Extract, GC/MS	[EPA 625]	Phenol
ertified	WPP06.03512	NPW	Extract, GC/MS	[EPA 625]	Tetrachlorophenol (2,3,4,6-)
ertified	WPP06.03518	NPW	Extract, GC/MS	[EPA 625]	Trichlorophenol (2,4,5-)

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Category: **WPP06 – Organic Parameters, Chromatography/MS**

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP06.03520	NPW	Extract, GC/MS	[EPA 625]	Trichlorophenol (2,4,6-)
Certified	WPP06.03530	NPW	Extract, GC/MS	[EPA 625]	Benzoic acid
Certified	WPP06.03540	NPW	Extract, GC/MS	[EPA 625]	Methylphenol (4-)
Certified	WPP06.03550	NPW	Extract, GC/MS	[EPA 625]	Acetophenone
Certified	WPP06.03570	NPW	Extract, GC/MS	[EPA 625]	Aniline
Certified	WPP06.03580	NPW	Extract, GC/MS	[EPA 625]	Benzidine
Certified	WPP06.03590	NPW	Extract, GC/MS	[EPA 625]	Carbazole
Certified	WPP06.03605	NPW	Extract, GC/MS	[EPA 625]	Diphenylhydrazine (1,2-)
Certified	WPP06.03610	NPW	Extract, GC/MS	[EPA 625]	Methylphenol (2-)
Certified	WPP06.03612	NPW	Extract, GC/MS	[EPA 625]	Methylphenol (3-)
Certified	WPP06.03660	NPW	Extract, GC/MS	[EPA 625]	Hexachlorocyclopentadiene
Certified	WPP06.03675	NPW	Extract, GC/MS	[EPA 625]	N-Nitroso-di-n-butylamine
Certified	WPP06.03677	NPW	Extract, GC/MS	[EPA 625]	N-Nitrosodiethylamine
Certified	WPP06.03680	NPW	Extract, GC/MS	[EPA 625]	N-Nitrosodimethylamine
Certified	WPP06.03690	NPW	Extract, GC/MS	[EPA 625]	N-Nitrosodiphenylamine
Certified	WPP06.03695	NPW	Extract, GC/MS	[EPA 625]	N-Nitrosopyrrolidine
Certified	WPP06.03712	NPW	Extract, GC/MS	[EPA 625]	Toluidine (2-) (2-Methylaniline)
Certified	WPP06.03720	NPW	Extract, GC/MS	[EPA 625]	Pyridine

Category: **SDW02 – Inorganic Parameters Including Na + Ca**

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SDW02.05000	NPW, SCM	Ion Selective Electrode	[SM 4500-NO3 D]	Nitrate

Category: **SHW02 – Characteristics of Hazardous Waste**

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SHW02.03000	NPW, SCM	Aqueous Waste, Potentiometric	[SW-846 9040C]	Corrosivity - pH waste, >20% water
Certified	SHW02.06900	NPW, SCM	TCLP, Toxicity Procedure, ZHE	[SW-846 1311]	Volatile organics
Certified	SHW02.06950	NPW, SCM	TCLP, Toxicity Procedure, Shaker	[SW-846 1311]	Semivolatile organics
Certified	SHW02.07000	NPW, SCM	TCLP, Toxicity Procedure, Shaker	[SW-846 1311]	Metals
Certified	SHW02.08000	NPW, SCM	Synthetic PPT Leachate Procedure	[SW-846 1312]	Metals - organics

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Category: SHW04 – Inorganic Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SHW04.05000	NPW, SCM	ICP	[SW-846 6010B]	Aluminum
Applied	SHW04.06500	NPW, SCM	ICP	[SW-846 6010B]	Antimony
Applied	SHW04.09000	NPW, SCM	ICP	[SW-846 6010B]	Arsenic
Applied	SHW04.11500	NPW, SCM	ICP	[SW-846 6010B]	Barium
Applied	SHW04.13500	NPW, SCM	ICP	[SW-846 6010B]	Beryllium
Applied	SHW04.15100	NPW, SCM	ICP	[SW-846 6010B]	Boron
Applied	SHW04.15500	NPW, SCM	ICP	[SW-846 6010B]	Cadmium
Applied	SHW04.17500	NPW, SCM	ICP	[SW-846 6010B]	Calcium
Applied	SHW04.18500	NPW, SCM	ICP	[SW-846 6010B]	Chromium
Applied	SHW04.21000	NPW, SCM	Colorimetric	[SW-846 7196A]	Chromium (VI)
Applied	SHW04.22500	NPW, SCM	ICP	[SW-846 6010B]	Cobalt
Applied	SHW04.24500	NPW, SCM	ICP	[SW-846 6010B]	Copper
Applied	SHW04.26000	NPW, SCM	ICP	[SW-846 6010B]	Iron
Applied	SHW04.27500	NPW, SCM	ICP	[SW-846 6010B]	Lead
Applied	SHW04.30500	NPW, SCM	ICP	[SW-846 6010B]	Magnesium
Applied	SHW04.31500	NPW, SCM	ICP	[SW-846 6010B]	Manganese
Applied	SHW04.34000	NPW, SCM	ICP	[SW-846 6010B]	Molybdenum
Applied	SHW04.35500	NPW, SCM	ICP	[SW-846 6010B]	Nickel
Applied	SHW04.38000	NPW, SCM	ICP	[SW-846 6010B]	Potassium
Applied	SHW04.39000	NPW, SCM	ICP	[SW-846 6010B]	Selenium
Applied	SHW04.41000	NPW, SCM	ICP	[SW-846 6010B]	Silver
Applied	SHW04.43000	NPW, SCM	ICP	[SW-846 6010B]	Sodium
Applied	SHW04.44000	NPW, SCM	ICP	[SW-846 6010B]	Strontium
Applied	SHW04.45000	NPW, SCM	ICP	[SW-846 6010B]	Thallium
Applied	SHW04.46600	NPW, SCM	ICP	[SW-846 6010C]	Thorium
Applied	SHW04.47100	NPW, SCM	ICP	[SW-846 6010B]	Tin
Applied	SHW04.47145	NPW, SCM	ICP	[SW-846 6010B]	Titanium
Applied	SHW04.47200	NPW, SCM	ICP	[SW-846 6010C]	Uranium
Applied	SHW04.47500	NPW, SCM	ICP	[SW-846 6010B]	Vanadium
Applied	SHW04.49000	NPW, SCM	ICP	[SW-846 6010B]	Zinc
Applied	SHW04.51045	NPW, SCM	ICP	[SW-846 6010B]	Zirconium

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Category: SHW05 -- Organic Parameters, Prep. / Screening

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW05.13000	NPW, SCM	Cleanup-Silica Gel	[SW-846 3630C]	Semivolatile organics

Category: SHW06 -- Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Dropped	SHW06.02010	NPW, SCM	Microextraction, GC, ECD	[SW-846 8011]	Dibromoethane (1,2-) (EDB)
Dropped	SHW06.02020	NPW, SCM	Microextraction, GC, ECD	[SW-846 8011]	Dibromo-3-chloropropane (1,2-)
Dropped	SHW06.02030	NPW, SCM	Microextraction, GC, ECD	[SW-846 8011]	Trichloropropane (1,2,3-)
Certified	SHW06.04540	NPW, SCM	Extraction, GC, FID	[OTHER NJDEP EPH 10/08, Rev. 3]	Extractable Petroleum Hydrocarbons
Certified	SHW06.12005	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Alachlor
Certified	SHW06.12010	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Aldrin
Certified	SHW06.12015	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Atrazine
Certified	SHW06.12020	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Alpha BHC
Certified	SHW06.12030	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Beta BHC
Certified	SHW06.12040	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Delta BHC
Certified	SHW06.12050	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Lindane (gamma BHC)
Certified	SHW06.12060	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Chlordane (technical)
Certified	SHW06.12070	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Chlordane (alpha)
Certified	SHW06.12080	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Chlordane (gamma)
Certified	SHW06.12090	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	DDD (4,4'-)
Certified	SHW06.12100	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	DDE (4,4'-)
Certified	SHW06.12110	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	DDT (4,4'-)
Certified	SHW06.12120	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Dieldrin
Certified	SHW06.12130	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endosulfan I
Certified	SHW06.12140	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endosulfan II
Certified	SHW06.12150	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endosulfan sulfate
Certified	SHW06.12160	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endrin
Certified	SHW06.12170	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endrin aldehyde
Certified	SHW06.12180	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Endrin ketone
Certified	SHW06.12190	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Heptachlor
Certified	SHW06.12200	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Heptachlor epoxide
Certified	SHW06.12210	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Methoxychlor
Certified	SHW06.12212	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Mirex

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New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

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Laboratory Name: NEW JERSEY ANALYTICAL LABORATORIES LLC Laboratory Number: 11005 Activity ID: SLC120008
1580 REED RD
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Hopewell Twp, NJ 08534

Category: SHW06 – Organic Parameters, Chromatography

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW06.12220	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8081B]	Toxaphene
Certified	SHW06.13110	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1016
Certified	SHW06.13120	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1221
Certified	SHW06.13130	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1232
Certified	SHW06.13140	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1242
Certified	SHW06.13150	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1248
Certified	SHW06.13160	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1254
Certified	SHW06.13170	NPW, SCM	GC, Extraction, ECD or HECD, Capillary	[SW-846 8082A]	PCB 1260

Category: SHW07 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW07.04010	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Benzene
Certified	SHW07.04011	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Bromobenzene
Certified	SHW07.04012	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Butyl benzene (n-)
Certified	SHW07.04013	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Sec-butylbenzene
Certified	SHW07.04014	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tert-butylbenzene
Certified	SHW07.04020	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chlorobenzene
Certified	SHW07.04022	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chlorotoluene (2-)
Certified	SHW07.04023	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chlorotoluene (4-)
Certified	SHW07.04030	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichlorobenzene (1,2-)
Certified	SHW07.04040	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichlorobenzene (1,3-)
Certified	SHW07.04050	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichlorobenzene (1,4-)
Certified	SHW07.04060	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Ethylbenzene
Certified	SHW07.04065	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Isopropylbenzene
Certified	SHW07.04067	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Propylbenzene (n-)
Certified	SHW07.04070	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Toluene
Certified	SHW07.04071	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Isopropyltoluene (4-)
Certified	SHW07.04072	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichlorobenzene (1,2,3-)
Certified	SHW07.04073	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trimethylbenzene (1,2,4-)
Certified	SHW07.04074	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trimethylbenzene (1,3,5-)
Certified	SHW07.04080	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Xylenes (total)
Certified	SHW07.04081	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Xylene (m-)

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1580 REED RD
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Category: SHW07 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW07.04082	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Xylene (o-)
Certified	SHW07.04083	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Xylene (p-)
Certified	SHW07.04088	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Allyl chloride
Certified	SHW07.04089	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Bromochloromethane
Certified	SHW07.04090	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Bromodichloromethane
Certified	SHW07.04100	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Bromoform
Certified	SHW07.04110	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Bromomethane
Certified	SHW07.04111	NPW, SCM	GC/MS, P&T, or Direct Injection, Capillary	[SW-846 8260B]	Cyclohexane
Certified	SHW07.04117	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloro-2-butene (cis-1,4-)
Certified	SHW07.04120	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Carbon tetrachloride
Certified	SHW07.04130	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chloroethane
Certified	SHW07.04140	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chloroethyl vinyl ether (2-)
Certified	SHW07.04150	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chloroform
Certified	SHW07.04160	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Chloromethane
Certified	SHW07.04165	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Diethyl ether (Ethyl ether)
Certified	SHW07.04170	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropene (trans-1,3-)
Certified	SHW07.04180	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dibromochloromethane
Certified	SHW07.04185	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dibromoethane (1,2-) (EDB)
Certified	SHW07.04186	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dibromomethane
Certified	SHW07.04187	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dibromo-3-chloropropane (1,2-)
Certified	SHW07.04190	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichlorodifluoromethane
Certified	SHW07.04200	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloroethane (1,1-)
Certified	SHW07.04210	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloroethane (1,2-)
Certified	SHW07.04220	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloroethene (1,1-)
Certified	SHW07.04230	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloroethene (trans-1,2-)
Certified	SHW07.04235	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloroethene (cis-1,2-)
Certified	SHW07.04240	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropane (1,2-)
Certified	SHW07.04241	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropane (1,3-)
Certified	SHW07.04242	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropane (2,2-)
Certified	SHW07.04249	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropene (1,1-)
Certified	SHW07.04250	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloropropene (cis-1,3-)
Certified	SHW07.04255	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dichloro-2-butene (trans-1,4-)
Applied	SHW07.04259	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Ethanol

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1580 REED RD
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Category: SHW07 – Organic Parameters, Chromatography/MS

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW07.04260	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methylene chloride (Dichloromethane)
Certified	SHW07.04270	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tetrachloroethane (1,1,2,2-)
Certified	SHW07.04280	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tetrachloroethene
Certified	SHW07.04282	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tetrahydrofuran
Certified	SHW07.04290	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichloroethane (1,1,1-)
Certified	SHW07.04300	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichloroethane (1,1,2-)
Certified	SHW07.04310	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichloroethene
Certified	SHW07.04320	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichlorofluoromethane
Certified	SHW07.04322	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
Certified	SHW07.04325	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichloropropane (1,2,3-)
ertified	SHW07.04330	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Vinyl chloride
ertified	SHW07.04340	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Acetone
ertified	SHW07.04350	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Carbon disulfide
ertified	SHW07.04360	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Butanone (2-)
ertified	SHW07.04367	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Ethyl methacrylate
ertified	SHW07.04370	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Hexanone (2-)
ertified	SHW07.04371	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methacrylonitrile
ertified	SHW07.04372	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methyl acrylate
ertified	SHW07.04373	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methyl methacrylate
ertified	SHW07.04374	NPW, SCM	GC/MS, P&T, or Direct Injection, Capillary	[SW-846 8260B]	Methyl acetate
ertified	SHW07.04375	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methyl iodide
ertified	SHW07.04379	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Pentachloroethane
ertified	SHW07.04380	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Pentanone (4-methyl-2-) (MIBK)
ertified	SHW07.04385	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Propionitrile
ertified	SHW07.04390	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Methyl tert-butyl ether
ertified	SHW07.04395	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tert-butyl alcohol
ertified	SHW07.04400	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Acrolein
ertified	SHW07.04410	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Acrylonitrile
ertified	SHW07.04500	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Hexachlorobutadiene (1,3-)
ertified	SHW07.04530	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Hexachloroethane
ertified	SHW07.04535	NPW, SCM	GC/MS, P&T, or Direct Injection, Capillary	[SW-846 8260B]	Methylcyclohexane
ertified	SHW07.04540	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Naphthalene
ertified	SHW07.04550	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Styrene

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Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW07.04560	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Tetrachloroethane (1,1,1,2-)
Certified	SHW07.04570	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Trichlorobenzene (1,2,4-)
Certified	SHW07.04580	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Nitrobenzene
Certified	SHW07.04590	NPW, SCM	GC/MS, P & T or Direct Injection, Capillary	[SW-846 8260B]	Dioxane (1,4-)
Certified	SHW07.04665	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Acetophenone
Certified	SHW07.04702	NPW, SCM	GC/MS, Extract, or Direct Injection, Capillary	[SW-846 8270C]	Biphenyl (1,1'-)
Certified	SHW07.04755	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorophenol (2,6-)
Dropped	SHW07.04775	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dimethyl benzidine (3,3-)
Certified	SHW07.04895	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pentachlorobenzene
Dropped	SHW07.04965	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Tetrachlorobenzene (1,2,3,4-)
Dropped	SHW07.04970	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Tetrachlorobenzene (1,2,3,5-)
Certified	SHW07.04975	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Tetrachlorobenzene (1,2,4,5-)
Certified	SHW07.04980	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Tetrachlorophenol (2,3,4,6-)
Applied	SHW07.04985	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Toluidine (2-) (2-Methylaniline)
Certified	SHW07.05004	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitrosodiethylamine
Certified	SHW07.05005	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitrosodimethylamine
Certified	SHW07.05006	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitroso-di-n-propylamine
Certified	SHW07.05010	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitrosodiphenylamine
Certified	SHW07.05012	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitrosopyrrolidine
Certified	SHW07.05020	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Diphenylamine
Certified	SHW07.05030	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Carbazole
Certified	SHW07.05038	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzidine
Certified	SHW07.05040	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorobenzidine (3,3'-)
Certified	SHW07.05048	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Aniline
Certified	SHW07.05050	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chloroaniline (4-)
Certified	SHW07.05060	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitroaniline (2-)
Certified	SHW07.05062	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitroaniline (3-)
Certified	SHW07.05063	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitroaniline (4-)
Certified	SHW07.05070	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chloronaphthalene (2-)
Certified	SHW07.05080	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachlorobenzene
Certified	SHW07.05090	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachlorobutadiene (1,3-)
Certified	SHW07.05100	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachlorocyclopentadiene
Certified	SHW07.05110	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachloroethane

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New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 03/14/2013 until 06/30/2013

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1580 REED RD
STE A1
Hopewell Twp, NJ 08534

Category: SHW07 – Organic Parameters, Chromatography/MS

tatus	Code	Matrix	Technique Description	Approved Method	Parameter Description
ertified	SHW07.05120	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Trichlorobenzene (1,2,4-)
ertified	SHW07.05130	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Bis (2-chloroethoxy) methane
ertified	SHW07.05132	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Bis (2-chloroethyl) ether
ertified	SHW07.05140	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Bis (2-chloroisopropyl) ether
ertified	SHW07.05150	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chlorophenyl-phenyl ether (4-)
ertified	SHW07.05160	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Bromophenyl-phenyl ether (4-)
ertified	SHW07.05165	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[USER DEFINED SW-846 8270C]	Dioxane (1,4-)
ertified	SHW07.05170	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dinitrotoluene (2,4-)
ertified	SHW07.05180	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dinitrotoluene (2,6-)
ertified	SHW07.05190	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Isophorone
ertified	SHW07.05200	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitrobenzene
ertified	SHW07.05210	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Butyl benzyl phthalate
ertified	SHW07.05220	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Bis (2-ethylhexyl) phthalate
ertified	SHW07.05230	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Diethyl phthalate
ertified	SHW07.05240	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dimethyl phthalate
ertified	SHW07.05250	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Di-n-butyl phthalate
ertified	SHW07.05260	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Di-n-octyl phthalate
ertified	SHW07.05270	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Acenaphthene
ertified	SHW07.05280	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Anthracene
ertified	SHW07.05290	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Acenaphthylene
ertified	SHW07.05300	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(a)anthracene
ertified	SHW07.05310	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(a)pyrene
ertified	SHW07.05320	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(b)fluoranthene
ertified	SHW07.05330	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(ghi)perylene
ertified	SHW07.05340	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(k)fluoranthene
ertified	SHW07.05350	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chrysene
ertified	SHW07.05360	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dibenzo(a,h)anthracene
ertified	SHW07.05370	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Fluoranthene
ertified	SHW07.05380	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Fluorene
ertified	SHW07.05390	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Indeno(1,2,3-cd)pyrene
ertified	SHW07.05400	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylnaphthalene (2-)
ertified	SHW07.05410	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Naphthalene
ertified	SHW07.05420	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Phenanthrene

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Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW07.05430	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pyrene
Certified	SHW07.05440	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methyl phenol (4-chloro-3-)
Certified	SHW07.05450	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chlorophenol (2-)
Certified	SHW07.05460	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorophenol (2,4-)
Certified	SHW07.05470	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dimethylphenol (2,4-)
Certified	SHW07.05480	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dinitrophenol (2,4-)
Certified	SHW07.05490	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dinitrophenol (2-methyl-4,6-)
Certified	SHW07.05500	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylphenol (2-)
Certified	SHW07.05510	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylphenol (4-)
Certified	SHW07.05520	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitrophenol (2-)
Certified	SHW07.05530	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Nitrophenol (4-)
Certified	SHW07.05540	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pentachlorophenol
Certified	SHW07.05550	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Phenol
Certified	SHW07.05560	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Trichlorophenol (2,4,5-)
Certified	SHW07.05570	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Trichlorophenol (2,4,6-)
Certified	SHW07.05590	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylphenol (3-)
Certified	SHW07.05600	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dibenzofuran
Certified	SHW07.05691	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorobenzene (1,2-)
Certified	SHW07.05692	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorobenzene (1,3-)
Certified	SHW07.05700	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dichlorobenzene (1,4-)
Certified	SHW07.05705	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzaldehyde
Certified	SHW07.05710	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzoic acid
Certified	SHW07.05720	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzyl alcohol
Certified	SHW07.05750	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pyridine
Certified	SHW07.05765	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Caprolactam
Applied	SHW07.05770	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Aldrin
Applied	SHW07.05780	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Alpha BHC
Applied	SHW07.05790	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Beta BHC
Applied	SHW07.05800	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Delta BHC
Applied	SHW07.05810	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Lindane (gamma BHC)
Applied	SHW07.05820	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chlordane (technical)
Applied	SHW07.05830	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chlordane (alpha)
Applied	SHW07.05840	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chlordane (gamma)

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tatus	Code	Matrix	Technique Description	Approved Method	Parameter Description
pplied	SHW07.05850	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	DDD (4,4'-)
pplied	SHW07.05860	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	DDE (4,4'-)
pplied	SHW07.05870	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	DDT (4,4'-)
pplied	SHW07.05880	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dieldrin
pplied	SHW07.05890	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endosulfan I
pplied	SHW07.05900	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endosulfan II
pplied	SHW07.05910	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endosulfan sulfate
pplied	SHW07.05920	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endrin
pplied	SHW07.05930	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endrin aldehyde
pplied	SHW07.05940	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Endrin ketone
pplied	SHW07.05950	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Heptachlor
pplied	SHW07.05960	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Heptachlor epoxide
pplied	SHW07.05970	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methoxychlor
pplied	SHW07.05980	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Toxaphene
ertified	SHW07.05990	NPW, SCM	GC/MS, Extract or Dir Inj, Capillary	[SW-846 8270C]	Atrazine
pplied	SHW07.07578	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Acenaphthene
pplied	SHW07.07580	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Acenaphthylene
pplied	SHW07.07582	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Anthracene
pplied	SHW07.07584	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(a)anthracene
pplied	SHW07.07586	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(a)pyrene
pplied	SHW07.07588	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(b)fluoranthene
pplied	SHW07.07590	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(k)fluoranthene
pplied	SHW07.07592	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Benzo(ghi)perylene
pplied	SHW07.07593	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Chrysene
pplied	SHW07.07594	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dibenzo(a,h)anthracene
pplied	SHW07.07596	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachlorobenzene
pplied	SHW07.07597	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Hexachlorobutadiene
pplied	SHW07.07598	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Indeno(1,2,3-cd)pyrene
pplied	SHW07.07600	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylnaphthalene (1-)
pplied	SHW07.07602	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Methylnaphthalene (2-)
pplied	SHW07.07604	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Naphthalene
pplied	SHW07.07608	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	N-Nitrosodimethylamine
pplied	SHW07.07610	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Fluoranthene

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Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SHW07.07612	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Fluorene
Applied	SHW07.07614	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Dinitrophenol (2-methyl-4,6-)
Applied	SHW07.07616	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pentachlorophenol
Applied	SHW07.07618	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Phenanthrene
Applied	SHW07.07620	NPW, SCM	GC/MS/SIM, Extract or Dir Inj, Capillary	[SW-846 8270C]	Pyrene

Category: SHW09 – Miscellaneous Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Suspended	SHW09.13050	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Sulfate
Certified	SHW09.29150	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Nitrite
Certified	SHW09.30150	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Nitrate
Certified	SHW09.30250	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Bromide
Certified	SHW09.33100	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Chloride
Certified	SHW09.34150	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Fluoride
Certified	SHW09.54150	NPW, SCM	Ion Chromatography	[SW-846 9056A]	Orthophosphate

Category: SHW04 – Inorganic Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Applied	SHW04.03000	SCM	Acid Digestion, Soil Sediment & Sludge	[SW-846 3050B]	Metals
Applied	SHW04.03700	SCM	Chromium VI Digestion	[SW-846 3060A]	Metals

Category: SHW05 – Organic Parameters, Prep. / Screening

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	SHW05.03000	SCM	Soxhlet Extraction	[SW-846 3540C]	Semivolatile organics
Certified	SHW05.05000	SCM	Ultrasonic Extraction	[SW-846 3550B]	Semivolatile organics
Certified	SHW05.07300	SCM	Closed System Purge & Trap	[SW-846 5035L]	Volatile organics - low conc.
Certified	SHW05.07310	SCM	Methanol Extract, Closed System P & T	[SW-846 5035H]	Volatile organics - high conc.

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Category: **SHW09 – Miscellaneous Parameters**

tatus	Code	Matrix	Technique Description	Approved Method	Parameter Description
pplied	SHW09.29000	SCM	Flow-Through Paint Filter, Observation	[SW-846 9095]	Free liquid

Joseph F. Aiello, Manager

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SM 4500-NH3 B+D
Ammonia-Selective Electrode Method-Direct Probe

1. Scope and Application

1.1 The ammonia-selective electrode uses a hydrophobic gas-permeable membrane that separates the sample solution from an internal solution of ammonium chloride. Dissolved ammonia is converted to $NH_{3(aq)}$ by raising the pH above 10 with a strong base. $NH_{3(aq)}$ diffuses through the membrane and changes the internal solution pH that is sensed by a pH electrode. The fixed level of chloride in the internal solution is sensed by a chloride ion-selective electrode, which serves as a reference electrode. Potentiometric measurements are made with a pH meter having a millivolt scale mode. This method is applicable to measurements of 0.03 to 1400 mg NH_3-N/L in potable and surface waters.

2. Summary of Method

2.1 A 5-point ammonia standard curve is linearized daily with the ammonia-selective electrode. One hundred mls of sample are used, continuously stirred, and the electrode meter allowed to stabilize. Sodium hydroxide is added to raise the pH and convert the ammonia. The concentration of ammonia is based on the relative mV reading and the linearized curve. *All samples, including ambient ammonia samples, are put through a distillation procedure before analysis.* However, if turbidity is measured and recorded in the field and is <10NTU, the distillation is not required.

3. Sample Handling and Preservation

3.1 Samples are to be preserved with 2 ml of conc. H_2SO_4 per liter and stored at 4°C.
3.2 Sample holding times are 28 days with preservation.

4.0 Interferences

4.1 Amines are positive interferences, which may be enhanced by acidification. Mercury and silver interfere by complexing with ammonia. Residual chlorine also interferes.

5.0 Apparatus

5.1 Electrometer: A pH meter with expanded millivolt scale capable of 0.1 mV resolution between -700 mV and +700 mV, read in relative mV mode. (Orion model 290A)
5.2 Ammonia-Selective electrode: ThermoOrion 9512 or equivalent.
5.3 Stir plate and magnetic stirrer, thermally insulated, with TFE-coated stirring bar.
5.4 Glassware.
5.5 B'U'CHI Distillation Unit, B-324
5.2 B'U'CHI tubes, 300ml, 5 cm wide, 26 cm long.

6. Reagents

6.1 Deionized water must be free of ammonia. The water is passed through an ion exchange column containing a strongly acidic cation exchange resin mixed with a strongly basic anion exchange resin.
NOTE 1: All solutions must be made of ammonia-free, distilled water.
6.2 Ammonia Stock Solution: Purchased commercially, 1000 ppm Nitrogen Standard, Ricca Chemical, Cat No. 5455-16 or; Dissolve 3.819g NH_4Cl in 1.0 liter of DI water in a 1 liter volumetric flask, 1.0 ml=1.0 mg NH_3-N.
6.3 Sodium Hydroxide, 10 N: Dissolve 400 g NaOH in 1000 ml DI water.
6.4 Sodium Thiosulfate, 0.35 $Na_2S_2O_3$*$5H_2O$ in 100 ml DI water. 1 ml solution will remove 1 mg/L residual chlorine.
6.5 Sodium Hydroxide (10 N): Dissolve 400 g NaOH in 1 liter of ammonia-free water.
6.6 Dechlorinating reagents:
a. Sodium Thiosulfate (1/70 N): Dissolve 0.35 g $Na_2S_2O_3$*$5H_2O$ in 100 ml of distilled water. One ml of the solution will remove 1 mg/L of residual chlorine in 500 ml of sample.
b. Hach Aquacheck-water quality test strips for total and free chlorine, Cat No. 27450-50.
6.7 Phenolphthalein Indicator: 1% (w/v) in 95% (w/v) alcohol, Ricca Chemical, Cat No. 5620-16.
6.8 Borate Buffer Solution: Ad 88 ml 0.1N NaOH solution to 500 ml approximately 0.025 M sodium tetraborate ($Na_2B_4O_7$) solution (9.5 g $Na_2B_4O_7$ · 10H H_2O/L
6.9 0.04N Sulfuric Acid Solution: Dilute 1.0 ml conc. H2SO4 to 1 Liter DI water.

7. Procedure

7.1 Preparation of equipment: Warm-up B'U'CHI distillation unit by running through the preheating cycle and one cycle in the ammonia mode.
7.2 Sample Preparation: Allow to warm to room temperature and check for residual chlorine and dechlorinate if necessary.
7.3 Distillation: Use a necessary amount of volume for sample, blanks, and quality control and bring to a final volume of 100 ml in B'U'CHI tube, adding phenolphthalein indicator. Program distillation unit to add 25 ml borate buffer solution and the appropriate amount of NaOH (~5 ml) to raise to pH 9.5. Use a pH meter or short range pH paper to verify pH of 9.5 and record in laboratory logbook. Distill sample for 5.5 minutes, with distillate collected in 250ml beaker containing 50 ml 0.04N H2SO4.
7.4 *Preparation of Standards:* Prepare a series of standard solutions covering the concentrations of 0.1, 0.5,1.0,5.0,10.0 mg NH_3-N/L in 100 ml DI water.
7.5 *Electrometer Calibration:* Place 100 ml of each standard solution in 250-ml beaker. Immerse electrode in standard of lowest concentration and mix with magnetic stirrer. Do not stir so rapidly that air bubbles are sucked into solution and get trapped on membrane. Maintain the same stir rate and temperature throughout the procedure. Add a sufficient amount of 10 N NaOH solution, approximately 1 ml, to raise pH to above 11. Use short range pH paper to verify pH of >11 and record in laboratory logbook. Keep electrode in solution until stable rel. mV reading is obtained. Repeat procedure from lowest concentration to highest, allowing enough time for mV reading to stabilize for concentrations lower than 1.0 mg NH_3-N/L.
7.6 *Preparation of Standard Curve:* Use Excel spreadsheet to plot the ammonia concentration in mg NH_3-N/L on log axis vs. rel. mV potential on the linear axis starting from the lowest concentration. This must produce a linear curve with an R-value of 0.995 or better. Check the performance of the probe by comparing two standards tenfold apart. The millivolt readings must be 57 (+/- 3) millivolts apart in order for the probe to be functioning properly. The standard curve must be run at least every three months and confirmed with a calibration check and QC standard (see below for criteria and concentrations).
7.7 *Measurement of samples:* Dilute if necessary to bring concentration within range of the curve. If necessary, neutralize chlorine. Bring sample to room temperature and place 100 ml of sample in 250 ml beaker and follow procedure of 7.2 above. Read NH_3-N concentration from standard curve.
7.8 *Quality Control:* A blank must be read before the standard curve to ensure ammonia is below detection limit. A blank and standard spike must be run every 10 samples, as well as quality control,

such as duplicates and matrix spikes every 20 samples. A QC standard must be run at the beginning of every set to ensure accuracy of standards.

Cal Check Conc.	Cal Check Criteria	QC Check Conc	QC Check Criteria	MS Conc	MS Rec Criteria	Duplicate Criteria	LFB Conc	LFB Criteria	RL Conc.
5 ppm	+/- 10%	5 ppm	+/- 10%	5 ppm	+/- 20 %	+/- 20 %	5 ppm	+/- 10%	0.05 ppm

8.0 Calculations

8.1 Excel spreadsheet calculations based on linearized curve

mg NH_3-N/L=10^(rel. mV* Intercept Coefficient* X Variable Coefficient)

$$\text{mg } NH_3\text{-N/L} = A \times B \times \frac{100 + D}{100 + C}$$

where:

A = dilution factor
B = concentration of NH_3-N, mg/L from cal curve
C = volume of 10N NaOH added to calibration standards, mL
D = volume of 10N NaOH added to sample, mL

Method EPA 300.0
Determination of Inorganic Anions by Ion Chromatography

1.0 Scope and Application

1.1 This method covers the determination of the following inorganic anions:
Bromide, Chloride, Fluoride, Nitrate, Nitrite, Ortho-Phosphate-P, and Sulfate.
The matrices applicable to this method are listed below:
Drinking water, surface water, mixed domestic and industrial waters.

2.0 Summary of Method

2.1 A small volume of sample, 25 ul is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, analytical column, suppressor device, and conductivity detector.

3.0 Definitions

3.1 Calibration Blank – A volume of reagent water fortified with the same matrix as the calibration standards, but without the analytes.
3.2 Calibration Standard – A solution prepared from the primary dilution standard solution or stock standard solutions. The standard solutions or used to calibrate the instrument response with respect to analyte concentration.
3.3 Field Duplicates – Two separate samples collected at the same time and placed under identical circumstances and treated exactly the same throughout field and laboratory procedures. Analyses of field duplicates indicate the precision associated with sample collection, preservation and storage, as well as with laboratory procedures.
3.4 Instrument Performance Check Solution (IPC or Cal Check) – A solution of one or more method analytes or other used to evaluate the performance of the instrument system with respect to a defined set of criteria.
3.5 Laboratory Fortified Blank (LFB or Blank Spike) – An aliquot of reagent water or other blank matrices to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements. The LFB is fortified with the primary dilution standard.
3.6 Laboratory Fortified Sample Matrix (LFM or Matrix Spike) – An aliquot of an environmental sample which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.
3.7 Laboratory Reagent Blank (LRB) – An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.
3.8 Linear Calibration Range – The concentration range over which the instrument response is linear.
3.9 Method Detection Limit – The minimum concentration of an analyte that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.

3.10 Quality Control Sample (QCS or QC Check) – A solution of method analytes of known concentrations that is used to fortify an aliquot of LRB or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check laboratory performance with externally prepared test materials.
3.11 Stock Standard Solution (SSS) – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

4.0 Interferences

4.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. Large amounts of an anion can interfere with the peak resolution of an adjacent anion. Sample dilution and/or fortification can be used to solve most interference problems associated with retention times.

4.2 The water dip or negative peak that elutes near, and can interfere with, the fluoride peak and can usually be eliminated by the .01 ml addition of concentrated eluent to 5 ml of each standard and sample.

4.3 Method interferences may be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus that lead to discrete artifacts or elevated baseline in ion chromatograms.

4.4 Samples that contain particles larger than 0.45 microns and reagent solutions that contain particles larger than 0.20 microns require filtration to prevent damage to instrument columns and flow systems.

4.5 Any anion that is not retained by the column or only slightly retained will elute in the area of fluoride and interfere. Known coelution is caused by carbonate and other small organic anions. At concentrations of fluoride above 1.5 mg/L, this interference may not be significant, however, it is the responsibility of the user to generate precision and accuracy information in each sample matrix.

4.6 The acetate anion elutes early during the chromatographic run. The retention times of the anions also seem to differ when large amounts of acetate are present. Therefore, this method is not recommended for leachates of solid samples when acetic acid is used for pH adjustment.

5.0 Safety

5.1 The toxicity or carcinogenicity of each reagent used in this method have not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable.

6.0 Equipment and Supplies

6.1 Balance – Analytical, capable of accurately weighing to the nearest 0.0001g.

6.2 Ion Chromatograph – Dionex DX-120 analytical system and all required accessories including syringes, analytical columns, compressed gasses and detector.

6.2.1 Anion guard column: Dionex CAG4A-SC, a protector of the separator column. If omitted from the system the retention times will be shorter. Usually packed with a substrate the same as that in the separator column.
6.2.2 Anion separator column: Dionex AS4A-SC 4mm, this column produces the separation of the individual components.
6.2.3 Anion suppressor device: Dionex P/N 53946
6.2.4 Conductivity cell: Approximately 1.25ml internal volume, Dionex D54-1.

6.3 The Dionex Peaknet SE V5.10d is used to generate all the data in the attached tables.

7.0 Reagents and Standards

7.1 Sample bottles: Glass or polyethylene of sufficient volume to allow replicate analyses of anions of interest.
7.2 Reagent water: Deionized water , free of the anions of interest. Water contains particles no larger than 0.20 microns.
7.3 Eluent solution: 1.8 mM carbonate/1.7 mM bicarbonate concentrate:
Prepare 100x concentrate = 180 mM Na_2CO_3/170 mM $NaHCO_3$ by dissolving 19.078 g of sodium carbonate and 14.282 g sodium bicarbonate in 700 ml deionized water in a 1 Liter volumetric flask. Dilute to 1000 ml.
Make final eluent by pipetting 10 ml of the eluent concentrate prepared above into a 1 Liter volumetric flask. Dilute to 1000 ml with deionized water.
7.4 Stock Standard Solutions, 1000 mg/L: Stock standard solutions are purchased commercially as certified solutions.
7.5 Stock Second Source (QC) Solutions, 1000 mg/L: Stock standard solutions are purchased commercially as certified solutions.
7.6 Stability of Standards: Stock standards are stable as per manufacturer expiration, usually one year when stored at 4°C. A working standard from the stocks is prepared at a combined 100ppm level and is stable for 3 months at 4°C. Dilute working standards are prepared weekly, nitrite and ortho-phosphate solutions are prepared daily, from these daily standards are prepared daily and used one time.

8.0 Sample Collection, Preservation and Storage

8.1 Samples are collected in plastic or glass bottles. All bottles must be thoroughly cleaned and rinsed with reagent water however, NJAL purchases certified clean bottles from a reputable manufacturer. The volume collected should be sufficient to insure a representative sample, allow for replicate analysis, if required, and minimize waste disposal. A 125 ml plastic bottle is usually sufficient to meet these requirements.
8.2 Sample preservation and holding times for the anions that can be determined by this method are as follows:

Analyte	Preservation	Holding Time
Bromide	None required	28 days
Chloride	None required	28 days
Fluoride	None required	28 days
Nitrate-N	Cool to 4°C	48 hours
Nitrite-N	Cool to 4°C	48 hours
0-Phosphate-P	Cool to 4°C	48 hours
Sulfate	Cool to 4°C	28 days

8.3 The method of preservation and the holding time for samples analyzed by this method are determined by the anions of interest. In a given sample, the anion that requires the most preservation treatment and the shortest holding time will determine the preservation treatment. It is recommended that all samples be cooled to 4°C and held for no longer than 28 days. Typically samples received on a given day are analyzed in that 24hour cycle in order to evaluate whether dilutions are needed to meet 48hour holding times.

9.0 Quality Control

9.1 The minimum requirements of this program consist of an initial demonstration of laboratory capability (MDL and P&A), and the daily analysis of laboratory reagent blanks, fortified blanks and other laboratory solutions as a continuing check on performance. The laboratory is required to maintain performance records that define the quality of the data that are generated.

9.2 A typical analytical set is as follows: (see sample run Item 1 attached)

1 Rinse System stabilization
2 10 ppm standard - A Calibration sample to verify recovery of +/-10% of the true slope of the existing calibration curve.
3 Calibration Blank – Must be below the reporting limit of the compound.
4 5 ppm LFB - A check at alternate level from the calibration source, +/-10% of the true slope of the existing calibration curve.
5 5 ppm QC - A check from a third party at the same level as the LFB, +/-10% of the true slope of the existing calibration curve. (1 per 20 samples)
6 0.25 RL sample - A check at the reporting limit no recovery limits exist at this time.
7 Calibration - Blank - A sample of dilution water that may be used on that day
8 Calibration Blank - A sample of the dilution water used in preparation of the calibration standards.
9 Samples: Up to 10 samples will be analyzed at this point, of which an MS/MSD may be in the sequence (1 per 20 samples ms-msd)
10 Sample MS - A sample spiked at the sample level as the LFB using the same material, used to evaluate matrix recovery and statistical records are tabulated.
11 Sample MSD - A sample spiked at the sample level as the LFB/MSD using the same material, used to evaluate matrix recovery and precision as related to the MS statistical records are tabulated.
12 10 ppm standard - A Calibration sample to verify recovery of +/-10% of the true slope of the existing calibration curve.
13 Calibration Blank - A sample of daily dilution water

9.3 INITIAL DEMONSTRATION OF PERFORMANCE

9.3.1 The initial demonstration of performance is used to characterize instrument performance (determination of LCRs and analysis of QCS) and laboratory performance (determination of MDLs) prior to performing analyses by this method.

9.3.2 Linear Calibration Range (LCR) -- The LCR must be determined initially and verified every 6 months or whenever a significant change in instrument response is observed or expected. The initial demonstration of linearity must use sufficient standards to insure that the resulting curve is linear. The verification of linearity must use a minimum of a blank and five standards. If any verification data exceeds the initial values by ±10%, linearity

must be reestablished. If any portion of the range is shown to be nonlinear, sufficient standards must be used to clearly define the nonlinear portion.

9.3.3 Quality Control Sample (QCS) -- When beginning the use of this method, on a daily basis, and for every 20 samples, verify the calibration standards and acceptable instrument performance with the preparation and analyses of a 5 ppm QCS. If the determined concentrations are not within ±10% of the stated values, performance of the determinative step of the method is unacceptable. The source of the problem must be identified and corrected before proceeding.

9.3.4 Method Detection Limit (MDL) -- MDLs must be established for all analytes, using reagent water (blank) fortified at a concentration of two to three times the estimated instrument detection limit. To determine MDL values, take seven replicate aliquots of the fortified reagent water and process through the entire analytical method. Perform all calculations defined in the method and report the concentration values in the appropriate units.

Calculate the MDL as follows: where,

$$\mathbf{MDL = t * s}$$

t = Student's t value for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom [t= 3.14 for seven replicates]
S = standard deviation of the replicate analyses MDLs should be determined every six months, when a new operator begins work or whenever there is a significant change in the background or instrument response.

9.4 ASSESSING LABORATORY PERFORMANCE

9.4.1 Laboratory Reagent Blank (LRB) -- The laboratory must analyze at least one LRB with each batch of samples. Data produced are used to assess contamination from the laboratory environment. Values that exceed the MDL indicate laboratory or reagent contamination should be suspected and corrective actions must be taken before continuing the analysis. *If any samples are filtered in the batch then a filter blank must be included.*

9.4.2 Laboratory Fortified Blank (LFB) (5 ppm) -- The laboratory must analyze at least one LFB with each batch of samples. Calculate accuracy as percent recovery (Section 9.4.2). If the recovery of any analyte falls outside the required control limits of 90-110%, that analyte is judged out of control, and the source of the problem should be identified and resolved before continuing analyses.

9.4.3 The laboratory must use LFB analyses data to assess laboratory performance against the required control limits of 90-110%. When sufficient internal performance data become available (usually a minimum of 20-30 analyses), optional control limits can be developed from the percent mean recovery (x) and the standard deviation (S) of the mean recovery. These data can be used to establish the upper and lower control The spike level as mentioned above is the same level as the MS/MSD or LFM.
limits as follows:

UPPER CONTROL LIMIT = x + 3S
LOWER CONTROL LIMIT = x - 3S

The optional control limits must be equal to or better than the required control limits of 90-110%. After each five to 10 new recovery measurements, new control limits can be calculated using only the most recent 20-30 data

points. Also, the standard deviation (S) data should be used to establish an on-going precision statement for the level of concentrations included in LFB. These data must be kept on file and be available for review.

9.4.4 Instrument Performance Check Solution (IPC) -- For all determinations the laboratory must analyze the IPC (a mid-range check standard) and a calibration blank immediately following daily calibration, after every tenth sample (or more frequently, if required) and at the end of the sample run. Analysis of the IPC solution and calibration blank immediately following calibration must verify that the instrument is within ±10% of calibration. Subsequent analyses of the IPC solution must verify the calibration is still within ±10%. If the calibration cannot be verified within the specified limits, reanalyze the IPC solution. If the second analysis of the IPC solution confirms calibration to be outside the limits, sample analysis must be discontinued, the cause determined and/or in the case of drift, the instrument recalibrated. All samples following the last acceptable IPC solution must be reanalyzed. The analysis data of the calibration blank and IPC solution must be kept on file with the sample analyses data.

9.5 ASSESSING ANALYTE RECOVERY AND DATA QUALITY

9.5.1 Laboratory Fortified Sample Matrix (LFM) -- The laboratory adds 5mg/l of analytes to a minimum of 10% of the routine samples. In each case the LFM aliquot must be a duplicate of the aliquot used for sample analysis.. The added analyte concentration should be the same as that used in the laboratory fortified blank.
9.5.2 If the concentration of fortification is less than 25% of the background concentration of the matrix the matrix recovery should not be calculated.

9.5.3 Calculate the percent recovery for each analyte, corrected for concentrations measured in the unfortified sample, and compare these values to the designated LFM recovery range 90-110%. Percent recovery may be calculated using the following equation:

$$R=(C_s-C/S)*100$$

where,

R = percent recovery
Cs = fortified sample concentration
C = sample background concentration
s = concentration equivalent of analyte added to sample

9.5.4 Until sufficient data becomes available (usually a minimum of 20-30 analysis), assess laboratory performance against recovery limits for Method A of 80-120% and 75-125% for Method B. When sufficient internal performance data becomes available develop control limits from percent mean recovery and the standard deviation of the mean recovery.
9.5.5 If the recovery of any analyte falls outside the designated LFM recovery range and the laboratory performance for that analyte is shown to be in control (Section 9.3), the recovery problem encountered with the LFM is judged to be either matrix or solution related, not system related.
9.5.6 Where reference materials are available, they should be analyzed to provide additional performance data. The analysis of reference samples is a valuable tool for demonstrating the ability to perform the method acceptably.
9.5.7 In recognition of the rapid advances occurring in chromatography, the analyst is permitted certain options, such as the use of different columns and/or eluents, to improve the separations or lower the cost of measurements. Each time such modifications to the method are made, the analyst is required to repeat the procedure in Section 9.
9.5.8 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field duplicates may be analyzed to monitor the precision of the sampling technique. When doubt exists over the identification of a peak in the chromatogram, confirmatory techniques such as sample dilution and

fortification, must be used. Whenever possible, the laboratory should perform analysis of quality control check samples and participate in relevant performance evaluation sample studies.
9.5.9 At least quarterly, replicates of LFBs should be analyzed to determine the precision of the laboratory measurements. Add these results to the on-going control charts to document data quality.
9.5.10 When using Part B, the analyst should be aware of the purity of the reagents used to prepare standards. Allowances must be made when the solid materials are less than 99% pure.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Ion chromatographic operating parameters as shown in the attached method example are established. The pump rate is set to 1.4 ml/min.
10.2 For each analyte of interest, prepare calibration standards at 0.5,1.0,2.0,5.0,10.0, and 15.0 levels and a blank by adding accurately measured volumes of one or more stock standards (Section 7.5) to a volumetric flask and diluting to volume with reagent water. If a sample analyte concentration exceeds the calibration range the sample may be diluted to fall within the range.

IC Standard Preparation Scheme

Standard	Working Stock Volume	Final Volume in DI (mL)
15 ppm Mix	75 mL of 100 ppm	500
10 ppm Mix	50 mL of 100 ppm	500
5 ppm Mix	25 mL of 100 ppm	500
2 ppm Mix	10 mL of 100 ppm	500
1 ppm Mix	50 mL of 10 ppm	500
0.5 ppm Mix	50 mL of 5 ppm	500
0.25 ppm Mix	25 mL of 1 ppm	100

10.3 Using injections of 0.025 mL (determined by injection loop volume) of each calibration standard, the responses are collected and processed by the peaknet software. The results are used to prepare a calibration curve for each analyte using linear regression with a correlation coefficient of 0.995 or better for each analyte. During this procedure, retention times must be recorded and are used as the retention time windows for all samples and standards until the next calibration curve.
10.4 The calibration curve must be verified on each working day, or whenever the anion eluent is changed, and after every 20 samples. If the response or retention time for any analyte varies from the expected values by more than ±10%, the test must be repeated, using fresh calibration standards. If the results are still more than ±10%, a new calibration curve must be prepared for that analyte.

11.0 PROCEDURE

11.1 The attached method from the Dionex DX120 platform, summarize the recommended operating conditions for the ion chromatograph. Included in these tables are estimated retention times that can be achieved by this method.
11.2 Check system calibration daily and, if required, recalibrate as described in Section 10.0.

11.3 Load and inject a fixed amount of well mixed sample. Flush injection loop with 2.0ml of sample, using each new sample. A 25ul size loop is used for standards and samples. Record the resulting peak size in area units. An automated constant volume injection system is used.
11.4 The width of the retention time window used to make identifications should be based upon measurements of actual retention time variations of standards over the course of a day. The tolerances of the retention times for each analyte are listed below. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

Analyte	Retention Time Tolerance
Fluoride	10%
Chloride	5%
Nitrite	5%
Bromide	5%
Nitrate	10%
Ortho Phosphate	10%
Sulfate	10%

11.5 If the response for the peak exceeds the working range of the system, dilute the sample with an appropriate amount of reagent water and reanalyze.
11.6 If the resulting chromatogram fails to produce adequate resolution, or if identification of specific anions is questionable, fortify the sample with an appropriate amount of standard and reanalyze.
11.7 Should more complete resolution be needed between peaks the eluent (7.3) can be diluted. This will spread out the run but will also cause the later eluting anions to be retained longer. The analyst must determine to what extent the eluent is diluted. This dilution should not be considered a deviation from the method.
11.8 If solids are present in the sample, filter the sample through a 0.45 um filter. A filter blank must accompany the sample to determine if any contamination has occurred.

12 DATA ANALYSIS AND CALCULATIONS

12.1 Prepare a calibration curve for each analyte by plotting instrument response against standard concentration. Compute sample concentration by comparing sample response with the standard curve. Multiply answer by appropriate dilution factor.
12.2 Report only those values that fall between the lowest and the highest calibration standards. Samples exceeding the highest standard should be diluted and reanalyzed.
12.3 Report results in mg/L.
12.4 Report NO2 as N, NO3 as N, HPO4 as P

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Soil microbial community response to nitrogen enrichment in two scrub oak forests

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ABSTRACT

Microbial communities play a pivotal role in soil nutrient cycling, which is affected by nitrogen loading on soil fungi and particularly mycorrhizal fungi. In this experiment, we evaluated the effects of allochthonous nitrogen addition on soil bacteria and fungi in two geographically distinct but structurally similar scrub oak forests, one in Florida (FL) and one in New Jersey (NJ). We applied allochthonous nitrogen as aqueous NH_4NO_3 in three concentrations (0 kg ha^{-1} yr^{-1} (deionized water control), 35 kg ha^{-1} yr^{-1} and 70 kg ha^{-1} yr^{-1}) via monthly treatments over the course of 1 yr. We applied treatments to replicated 1 m^2 plots, each at the base of a reference scrub oak tree (*Quercus myrtifolia in* FL and *Q. ilicifolia* in NJ). We measured microbial community response by monitoring: bacterial and fungal biomass using substrate induced respiration, and several indicators of community composition, including colony and ectomycorrhizal morphotyping and molecular profiling using terminal restriction fragment length polymorphism (TRFLP). Bacterial colony type richness responded differently to nitrogen treatment in the different sites, but ectomycorrhizal morphotype richness was not affected by nitrogen or location. Both experimental sites were dominated by fungi, and FL consistently supported more bacterial and fungal biomass than NJ. Bacterial biomass responded to nitrogen addition, but only in FL. Fungal biomass did not respond significantly to nitrogen addition at either experimental site. The composition of the bacterial community differed between nitrogen treatments and experimental sites, while the composition of the fungal community did not. Our results imply that bacterial communities may be more sensitive than fungi to intense pulses of nitrogen in sandy soils.

1. Introduction

Soil microbial processes play a critical role in shaping plant community structure and function (Bever et al., 1997; Simard et al., 1997; van der Heijden et al., 1998; Packer and Clay, 2000; Baxter and Dighton, 2001; Bever, 2003). For example, mycorrhizal fungi can help defend a plant against pathogens in experimental systems (Smith and Read, 1997), and there is often a direct relationship between mycorrhizal diversity and plant productivity (Baxter and Dighton, 2001) or plant diversity (van der Heijden et al., 1998). Energy transfer and metabolic activity in the soil food web hinges on the obligate exchange of carbon and inorganic nutrients between producers, their microbial symbionts and consumers. Mycorrhizae helper bacteria (MHB) can promote the relationship between mycorrhizal fungi and the host plant by improving root receptivity to the fungus, facilitating fungal growth and improving rhizosphere soil conditions (Garbaye, 1994). This response is not universal, and differences in environmental conditions or species composition may reduce the benefits of the mutualism (Jumpponen and Egerton-Warburton, 2005).

Nitrogen loading associated with fertilizer use and atmospheric deposition can accelerate the decline of plant diversity and affect the soil organisms in the rhizosphere (Vitousek et al., 1997, Galloway and Cowling, 2002). This may have profound influences on nutrient cycling and influence the biotic and abiotic interactions of soil organisms and the environment. Arnolds (1991) first noted the relationship between nitrogen loading and declining soil diversity of ectomycorrhizal fungi (EMF) in Europe. Since that time, multiple field experiments using both natural nitrogen deposition

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gradients and fertilization manipulations have confirmed shifts in diversity and community composition of mycorrhizae with increasing nitrogen concentration. These studies have found a negative relationship between nitrogen concentration in the soil and diversity of EMF colonizing host trees (Taylor et al., 2000; Lilleskov et al., 2002; Dighton et al., 2004). Some even describe a shift in community composition and the identity of dominant EMF species with the decline in diversity (Lilleskov et al., 2002). Further, this idea has been extended (through molecular profiling) to show that decomposer fungi are sensitive to allochthonous nitrogen input as well (Allison et al., 2007).

The spatial distribution of microbial species and diversity is the subject of debate and comparison to macroorganism patterns (Martiny et al., 2006). Indeed, fungi (Green et al., 2004) and bacteria (Franklin et al., 2000; Franklin and Mills, 2003; Horner-Devine et al., 2003) demonstrate local and regional biogeographic patterns. However, very little is known about these factors or the relationship between geographic distribution and function in the environment. This is important because microbes mediate the bulk of biogeochemical processes, particularly nitrogen cycling. Environmental heterogeneity and regional distribution of microbial diversity may cause soil microbial communities to respond differently to nitrogen loading in different locations. For this reason, we carried out the following experiments in two structurally similar but distinct oak forests.

Fungi, particularly mycorrhizal fungi, may be more sensitive than bacteria to allochthonous nitrogen inputs due to their relatively higher C:N and obligate relation with host plants. Our work will simultaneously examine the effects of nitrogen loading on bacterial and fungal communities. Further, this work is novel because we evaluate bacterial and fungal response to nitrogen loading in oak forests characterized by oligotrophic, sandy soils as opposed to coniferous stands.

The objective of this study was to evaluate the simultaneous response of bacterial and fungal communities to allochthonous nitrogen loading in two structurally similar but geographically distinct scrub oak forests. The results of this work show that geographic context and environmental influences interact with the microbial community response to nitrogen loading. We manipulated nutrients by adding NH_4NO_3 in high and low concentration over the course of 1 yr to replicate experimental plots in Florida (FL) and New Jersey (NJ). We then measured the microbial community response using the following methods: substrate induced respiration (SIR) to determine total microbial biomass (bacterial and fungal), bacterial colony morphotyping, EMF morphotyping, and molecular analysis of bacterial and fungal communities using terminal restriction fragment length polymorphism (TRFLP). The molecular analysis and biomass measures captured both saprotrophic and mycorrhizal fungi; when discussing these results we use the word 'fungi' to refer to the entire fungal community. The EMF morphotyping only examined the ectomycorrhizal fungi colonizing root tips. Therefore, when discussing these results, we use the acronym EMF to differentiate a subset of the fungal community.

2. Methods

2.1. Site characteristics

Both experimental sites have dry, low-nutrient, sandy soils (see bulk densities in Table 1). Both sites are fire prone and contain structurally similar scrub oak communities. Prior to starting experiments, we surveyed plant community composition in all plots at each site. Composition was measured as percent cover of each plant within the each plot; those numbers were summed to create a relative rank of each plant across the entire site. The rank dominance of plants is presented in Table 1. The FL study site is in the NASA Kennedy Space Center/Merritt Island National Wildlife Refuge, an approximately 57,000 ha managed area comprised of brackish estuaries, marshes, scrub oaks, pine forests, and oak/palm hammocks on the Atlantic Coast of central Florida. The research plots are in scrub habitat, adjacent to a brackish marsh, dominated by *Quercus myrtifolia* with *Serenoa repens* (saw palmetto) in the under story. The NJ site is within the Rutgers University Pinelands Field Station that is part of the greater New Jersey Pinelands Preserve in south-central NJ. The Pinelands includes approximately 304,000 ha of land with heavily restricted development as part of the 445,000 ha NJ Pine Barrens ecosystem. The research plots in NJ are dominated by *Q. ilicifolia* with *Vaccinium angustifolia*

Table 1
Comparison of biotic and abiotic characters from the New Jersy and Florida experimental sites.

	New Jersey Pinelands	Cape Canaveral Florida
Ranked dominance of vegetation across all plots at each site[a]	*Quercus ilicifolia* *Q. prinus* *Q. velutina* *Vaccinium angustifolium* *Carex striata Q. alba* *Pinus echinata* *Q. coccinia* *Q. stellata* *P. rigida* *Gaylussacia* sp.	*Quercus myrtifolia* *Q. incana* *Serrenoa repens* *Q. chapmanii* *Rhynchospora megalocarpa Vaccinium myrsinities* *Ximenia americana* *Aristida stricta* *Tellansia* sp. *Galactia elliota*
Average depth to O horizon (cm ± SE)[b]	3.67 ± 0.3255	2.47 ± 0.5259
Average total C:N of soil (±SE)	61.19 ± 5.28	76.38 ± 11.41
Average bulk density of soil (±SE)	0.888 ± 0.027	0.748 ± 0.035
Fungal/bacterial biomass ratio (±SE)	1.32 ± 0.015	1.37 ± 0.028
Rainfall June 2005–May 2006[c]	94.43 cm	132.91 cm
NH_4 deposition June 2005–May 2006[c]	4.1 mg l^{-1}	1.71 mg l^{-1}
NO_3 deposition June 2005–May 2006[c]	19.18 mg l^{-1}	8.77 mg l^{-1}
Latitude and longitude	39.958 and −74.628	28.615 and −80.694
Average annual temperature[d]	12.3 °C	22.4 °C
Soil series[e]	Evesboro (mesic, coated lamellic quartzipsamments)	Pomello (sandy, siliceous, hyperthermic oxyaquinc alorthods)

[a] Percent cover was measured for each plant in each plot; these numbers were summed to create a ranked abundance across the site.
[b] Values significantly different by *t*-test ($P < 0.05$).
[c] National Atmospheric Deposition Program (NADP), Champaign, IL.
[d] National Oceanic and Atmospheric Administration (NOAA).
[e] Web soil survey: http://websoilsurvey.nrcs.usda.gov/app/.

(low bush blueberry) in the under story. The two sites are similar in gross vegetation structure and soil types, though differ in species composition and experience very different seasonal and climatic influences (Table 1).

2.2. Experimental design and sampling

This experiment used a 2×3 factorial design with two geographically distinct treatment sites (factor 1) and three different nitrogen addition treatments (factor 2). Over the course of 1 yr beginning in May 2005, we simulated different levels of nitrogen deposition by dispensing aqueous NH_4NO_3 each month in doses of $70\ kg\ ha^{-1}\ yr^{-1}$, $35\ kg\ ha^{-1}\ yr^{-1}$ and $0\ kg\ ha^{-1}\ yr^{-1}$ (deionized water control). We chose these levels of nitrogen as they are comparable to or in excess of levels affecting Europe today (Arnolds, 1991). We replicated each treatment combination five times for a total of 15 plots at each treatment site. Each experimental plot measured $1m^2$ and was at the base of a distinct, tree tag numbered scrub oak tree, *Quercus ilicifolia* in NJ and *Q. myrtifolia* in FL.

We randomly removed three 5 cm diameter soil cores from each plot after 12 months of nitrogen additions. We removed each of the three cores for: (1) EMF morphotyping (stored at 4 °C prior to analysis), (2) bacterial colony morphotyping, biomass measurements using SIR (immediate analysis) and molecular profiling (soil stored at −20 °C prior to extraction) and (3) nutrient analysis (immediate analysis). Regarding the second and third core retained for bacterial, SIR and nutrient analyses, we retained the top 10 cm of soil from each core and homogenized the mineral and organic layers. We chose to do this rather than separate organic and mineral horizons because many of the FL plots had a negligible organic layer.

2.3. Soil nutrient analysis

We measured soil nutrients by collecting the litter, humus and mineral soil fractions from each soil core to a depth of 10 cm. We homogenized this material for further analysis. The moisture content was determined by drying soil at 70 °C. We extracted samples from each core using 2.0 M KCl and analyzed for NH_4^+ by ion selective electrode (ISE). We also extracted samples with deionized water (DI) and analyzed for NO_3^- and PO_4^{-3} using the Dionex DX90 ion chromatograph, (Dionex Corp, Sunnyvale CA). We performed all extractions on an approximate 4:1 extractant/dry weight material basis within 24 h of sample collection. We performed ISE analysis of NH_4^+ and IC analysis of PO_4^{-3} and NO_3^- according to Standard Methods protocols (Clesceri et al., 1998). We analyzed oven-dried samples for total carbon by infrared CO_2 detection and total nitrogen by N_2 thermal conductivity detection following high temperature combustion using a Leco TruSpec carbon/nitrogen analyzer (Leco Corp., St. Joseph MI).

2.4. Microbial community characterization

We enumerated cultivable bacteria using standard plating techniques on 10% nutrient agar (Difco Labs, Detroit, MI). We characterized the colony morphotypes that grew after 48 h at room temperature (~25 °C) by their color, size, margin and elevation. These counts provided a proxy measure of bacterial diversity and composition, and they have been used successfully to capture relative differences in bacterial community structure (Garland et al., 2001, Muller et al., 2002; Krumins et al., 2006). We recognize that only a small fraction of the community is cultivable on solid media (*e.g.* in soils, Olsen and Bakken, 1987), but we can still make useful comparisons of the cultivable bacteria among treatments.

We removed a random and representative sample of root fragments from an intact core designated for EMF analysis and suspended it in water in a gridded petri dish. We characterized the EMF community through direct examination of root tips and ectomycorrhizal morphotyping following the methods of Agerer (1987–1999) using a Nikon SMZ dissecting microscope. We counted between 200 and 400 root tips from each core and quantified the relative abundance of each type.

We used a modified SIR method (Beare et al., 1991, Sparling, 1995) to separately quantify bacterial and fungal biomass in the soil. We lightly homogenized approximately 13 g of wet soil and placed it into 250 ml media jars. We then treated soil with either 5 ml of $0.064\ g\ ml^{-1}$ (320 mg) aqueous cyclohexamide in (Sigma–Aldrich, St. Louis, MO) to inhibit fungi and isolate the bacterial community, or 5 ml of $0.013\ g\ ml^{-1}$ (65 mg) aqueous streptomycin (Sigma–Aldrich, St. Louis, MO) to inhibit bacteria and isolate the fungal (eukaryotic) community. We treated another set of soil in jars with DI water (positive control for full microbial activity) or cyclohexamide and streptomycin together (negative control assuming a near sterile jar). For simplicity, we present the results of treated jars and not controls. All treated and control jars were incubated with their antimicrobial compound (or deionized water) for 12 h at 4 °C. After incubation, we combined an excess of dry glucose (>300 mg, a preliminary dose response experiment determined the saturating mass of glucose) with the soil and attached the jars to an infra-red gas analyzer (Columbus Instruments, Columbus, OH) to measure CO_2 evolution. Under the assumption that respiration and CO_2 evolution correlate with microbial biomass, we calculated bacterial or fungal biomass using the regression equations of Beare et al. (1991) as μg C fungal gdw^{-1} soil or μg C bacterial gdw^{-1} soil. We used the percent moisture of a proximate soil core to calculate dry weight based on the known wet weight of soil added to the jar.

Following collection, samples for molecular analysis were stored at −20 °C. Later, we extracted whole community DNA from 0.25 g sub-samples using the Ultra Clean Soil DNA Isolation Kit according to their guidelines for maximum yield (MoBio Laboratories, Solana Beach, CA). We analyzed both fungal and bacterial communities for composition differences by amplifying extracted DNA using PCR followed by terminal restriction fragment length polymorphism (TPFLP) (Liu et al., 1997). Targeting the fungal community, we used a 6FAM (fluorescently labeled) forward primer, ITS1-F (CTTGGTCATTTAGAGGAAGTAA), and an unlabeled reverse primer, ITS4 (TCCTCCGCTTATTGATATGC). These primers amplify the intergenic transcribed spacer region (ITS) of ribosomal DNA and have been used successfully to amplify ascomycete and basidiomycete fungi (Klamer et al., 2002; Allison et al., 2007). Therefore, we assume our molecular profiling captured mycorrhizal as well as saprotrophic fungi. Targeting the bacterial community, we used a 6FAM (fluorescently labeled) forward primer, SSU 27F (AGAGTTTGATCCTGGCTCAG), and an unlabeled reverse primer SSU 1492R (GGTTACCTTGTTACGACTT). These primers amplify the small subunit 16 s of ribosomal DNA, and are used extensively to characterize bacterial community structure (*e.g.*, Blum et al., 2004).

We carried out the bacterial community PCR in 50 μl reactions that included: $1\times$ PCR buffer, 2.0 mM $MgCl_2$, 200 μM dNTP (each), 1.0 μM primer (forward and reverse), $0.4\ \mu g\ \mu l^{-1}$ BSA (bovine serum albumin) (Roche Diagnostics, Indianapolis, IN), and 1.25 U DNA polymerase per 50 μl reaction. Unless stated, all PCR reagents were obtained from Applied Biosystems (Foster City, CA). We performed amplification reactions in an MJ Research PTC-200 Thermocycler (Waltham, MA) using the following reaction conditions: initial denaturation at 94 °C for 5 min followed by 34 cycles of 0.5 min at 94 °C, 1 min at 62 °C and 2 min at 72 °C and a final elongation for 3 min at 72 °C. We carried out fungal

community PCR under identical reagent conditions, but within the 34 cycles, the reaction conditions included an annealing temperature of 50 °C for 2 min and elongation at 72 °C for 3 min. The final elongation was held for 5 rather than 3 min at 72 °C. We validated all PCR reactions on a 1.5% agarose gel.

We digested amplified fungal and bacterial DNA using the restriction enzyme *Hha1* (New England Biolabs, Beverly, MA). We desalted and purified the restriction fragments using the QIAquick Nucleotide Removal Kit (Quiagen, Hilden, Germany) then denatured the fragments at 95 °C for 10 min prior to electrophoretic analysis. We separated denatured restriction fragments using capillary electrophoresis with an ABI310 Genetic Analyzer (Applied Biosystems, Foster City, CA). Capillary electrophoresis produces an array of multiple terminal fragments of varying length that are detected by their fluorescent marker. Each fragment theoretically represents a unique fungal or bacterial taxa or operational taxonomic unit (OTU). We used Applied Biosystems' GeneScan software to analyze the fragment patterns of each sample and produced a binary array of presence or absence of each OTU in each of our treatment combinations. We established a minimum response threshold of 50 relative fluorescence units for a fragment to be considered an OTU.

2.5. Data analysis

We used a two-way analysis of variance (ANOVA) to test for effects of nitrogen treatment and geographic location on: soil nutrients, bacterial colony and EMF morphotype richness, fungal and bacterial biomass (F/B), and the fungal/bacterial biomass ratio (SIR). When appropriate we separated means between nitrogen treatments with a Bonferroni test.

We were able to separate differences in microbial community structure for the following parameters: colony morphotypes of cultivable bacteria, EMF morphotypes and molecular profiles for bacteria and fungi using principle components analysis (PCA). We used a separate PCA for each parameter. The relative abundance of colony morphotypes and EMF morphotypes for bacteria and fungi respectively served as variables for the PCA that separated the communities based on visual morphotype. The presence or absence of OTU served as variables for the PCA that separated bacterial and fungal communities based on molecular profile. We followed all PCA with a multivariate analysis of variance (MANOVA) of the first three component scores to determine significant effects of nitrogen treatment or geographic location. All statistical analyses were conducted in SAS Version 9.1 (SAS Institute, Inc. Cary, NC).

3. Results

3.1. Soil nutrient response

Concentrations of extractable soil nutrients were not affected by additions of NH_4NO_3 within either the NJ or the FL sites (Table 2). However, across all plots concentrations of NO_3 are significantly higher in NJ than FL ($F_{1,29} = 10.19$, $P < 0.01$), and concentrations of PO_4 are significantly higher in FL than NJ ($F_{1,29} = 24.37$, $P < 0.0001$) (Table 2). NH_4 concentrations were not affected by nitrogen treatment nor did they differ between sites. Therefore, FL soils have less available nitrogen (as NO_3) than NJ soils, and NJ soils have less available phosphorus relative to FL soils. The higher PO_4 concentrations in the FL soil may have resulted in part from abiotic effects like sea spray and geology, or alternatively, biotic effects arising from an inability of the microbial community to utilize the PO_4 due to possible nitrogen limitation (*per* Liebig's Law) (Liebig, 1840) may be the proximal cause. Total soil carbon, total nitrogen and the ratio of the two (C:N, Table 1) were not significantly different between sample sites or across nitrogen treatments. However, these data were high and variable likely due to the low N content in the soil and patchy distribution of vegetation and litter (cores used for analysis also included the litter layer).

3.2. Microbial community characterization

We found a significant interaction between site and nitrogen treatment affecting bacterial colony morphotypes richness (Fig. 1A, $F_{2,24} = 3.82$, $P < 0.05$). FL supports significantly higher richness of bacterial morphotypes (Fig. 1A, $F_{1,29} = 33.93$, $P < 0.0001$), and there was no effect of nitrogen treatment on bacterial colony morphotypes. We found no significant interaction between site and nitrogen treatment affecting ectomycorrhizal morphotype richness (Fig. 1B), and there was no significant difference in EMF morphotype richness between FL and NJ or among the nitrogen treatments. These interactions refer to different effects of nitrogen depending on geographic site. Bacterial morphotype richness is lower in nitrogen treated plots than control plots in NJ, but it increases with nitrogen in FL (Fig. 1A). EMF morphotype richness was consistent across sites and nitrogen treatments (Fig. 1B).

We plotted sampling area (assuming each 5 cm diameter soil core removed is equivalent to 19.6 cm^2 of area sampled) versus richness of colony morphotypes (Fig. 2A) and EMF morphotypes (Fig. 2B) described. These results follow logically from Fig. 1. The number of bacterial and EMF morphotypes increased with increasing area sampled, and FL supports a higher richness of bacterial morphotypes than NJ. Our sampling effort may not have been adequate to completely characterize the bacterial and fungal communities in these sites. However, we can still make meaningful comparisons between the sites and treatments.

Both fungal (Fig. 3A, $F_{1,29} = 8.79$, $P < 0.01$) and bacterial (Fig. 3B, $F_{1,29} = 18.97$, $P < 0.001$) biomass determined by SIR were significantly greater in FL than NJ. Fungal biomass did not respond significantly to nitrogen at either site. In FL, there was a significant difference in bacterial biomass between the low and high nitrogen treatments but not the control (Fig. 3A, $F_{1,29} = 4.63$, $P < 0.05$). The fungal to bacterial biomass ratio did not significantly change with

Table 2
Average soil nutrient concentration after 1 yr of nitrogen additions. Values indicate the mean ± SE ($n = 5$).

Site	Nitrogen treatment	NO_3–N ($\mu g\ g^{-1}$ soil)	NH_4–N ($\mu g\ g^{-1}$ soil)	PO_4–P ($\mu g\ g^{-1}$ soil)
Florida	0 kg ha^{-1} yr^{-1}	0.17 ± 0.02	3.34 ± 1.96	1.16 ± 0.47
	35 kg ha^{-1} yr^{-1}	0.15 ± 0.01	0.52 ± 0.07	1.45 ± 0.49
	70 kg ha^{-1} yr^{-1}	0.15 ± 0.03	1.66 ± 0.68	1.48 ± 0.13
New Jersey	0 kg ha^{-1} yr^{-1}	0.13 ± 0.03	3.00 ± 0.59	0.31[a]
	35 kg ha^{-1} yr^{-1}	0.10 ± 0.01	1.95 ± 0.49	bdl
	70 kg ha^{-1} yr^{-1}	0.14 ± 0.02	2.17 ± 0.39	bdl

[a]Only one replicate was above detection limit.
bdl: below detection limit (for PO_4 detection limit = 0.04 mg PO_4–P l^{-1}).

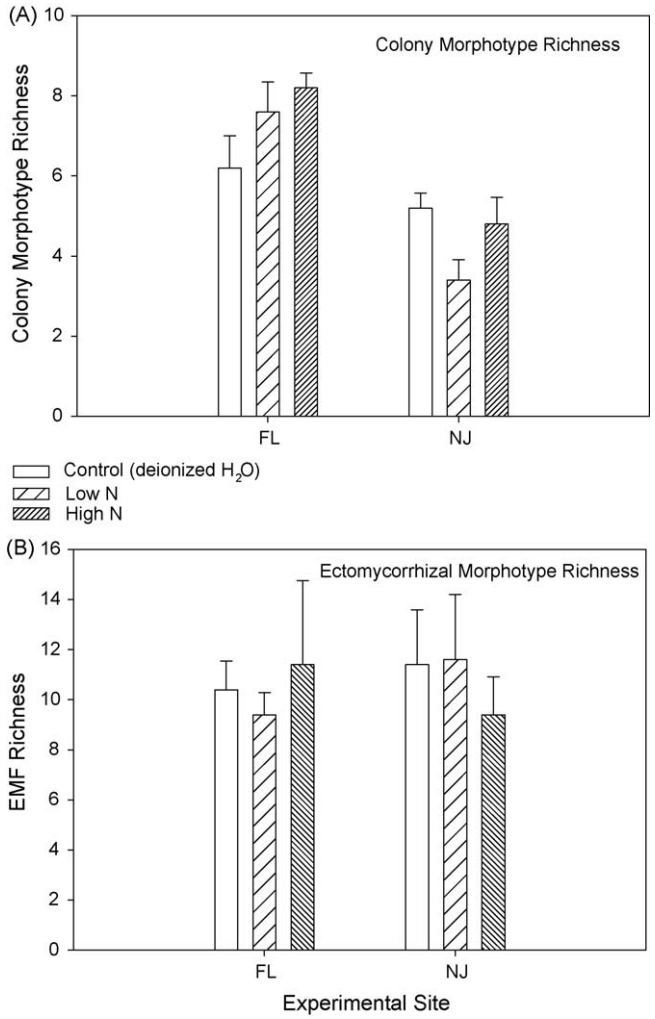

Fig. 1. Bacterial colony morphotype richness (A) and ectomycorrhizal morphotype richness (B). All bars represent mean ± SE and $n = 5$.

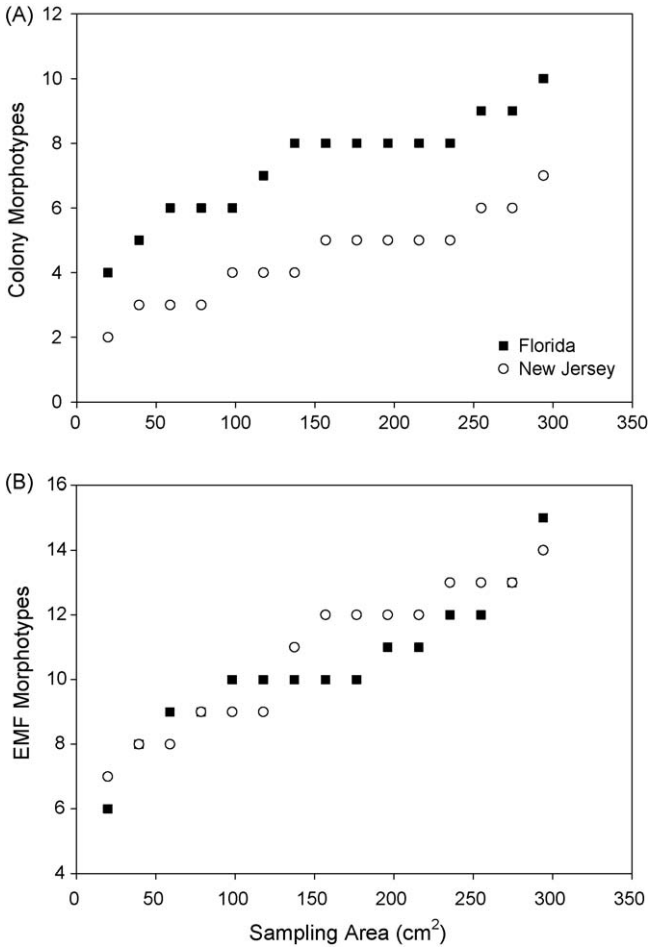

Fig. 2. Sampling effort versus morphotype accumulation curves for (A) colony morphotypes and (B) EMF morphotypes from both FL and NJ. Each point represents one soil core within one sampled plot.

nitrogen addition and only showed a non-significant trend (Table 1, $F_{1,29} = 2.96$, $P = 0.098$) to be higher in FL than NJ.

Bacterial community composition was significantly different between the two experimental sites. This result was seen both in community characterization of colony morphotypes (Fig. 4A, Wilk's Lamda $F_{1,29} = 8.24$, $P < 0.001$) and molecular fingerprints using TRFLP (Fig. 4B, Wilk's Lamda $F_{1,29} = 3.37$, $P < 0.05$). We found significant effects of nitrogen treatments in the bacterial colony morphotypes in NJ only (Fig. 4A, Wilk's Lambda $F_{2,29} = 2.35$, $P < 0.05$), but not in the molecular profiles. Interestingly, fungal community composition was not different at either site or under nitrogen treatments. We found this result through both ectomycorrhizal morphotypes (Fig. 5A) and TRFLP (Fig. 5B).

4. Discussion

4.1. Soil nutrient response

The soil from FL (Schmalzer and Hinkle, 1996, Schortemeyer et al., 2000) and NJ (Tedrow, 1998) is highly porous, sandy, and known to leach soluble nutrients. Bulk densities of soils in this experiment support this conclusion (Table 1). Data from greenhouse experiments using native soil from the NJ site shows that additions of NH_4NO_3 (in concentrations comparable to this study) did not result in a change in oak seedling (*Quercus rubra*) biomass relative to controls (J.A. Krumins, unpublished data). Therefore, we do not believe the nitrogen added in the present study was assimilated by the plants. However, even if it was taken up by plants, indirect effects of the nitrogen on the microbial component of the detrital food web should have been seen as the 'brown world' (detrital based food webs), and 'green world' (producer based food webs) connect in the rhizosphere (Wardle, 1999, Moore et al., 2003, Moore et al., 2004). We suspect that our aqueous nitrogen additions quickly leached from the biologically active portion of the soil, before effects on the biota could take place. This conclusion has very important environmental implications. Soluble nitrogen not assimilated into biotic components of soil will be transported to waterways and groundwater where it can lead to eutrophication (Aber et al., 2003; Galloway et al., 2003).

4.2. Microbial community response

There was no difference in composition of the EMF community (Fig. 5A) or molecular profiles of fungi (Fig. 5 B) with nitrogen concentration or between sites. Porous soil at these sites may explain the lack of fungal response to allochthonous nitrogen additions even though other studies have found an effect of nitrogen additions on EMF morphotype diversity (Dighton et al., 2004), spores of vesicular arbuscular mycorrhizae (VAM) (Johnson, 1993) and molecular profiles of fungal communities (Allison et al., 2007). In fact, most of the evidence for an effect of nitrogen deposition on mycorrhizae comes from naturally occurring

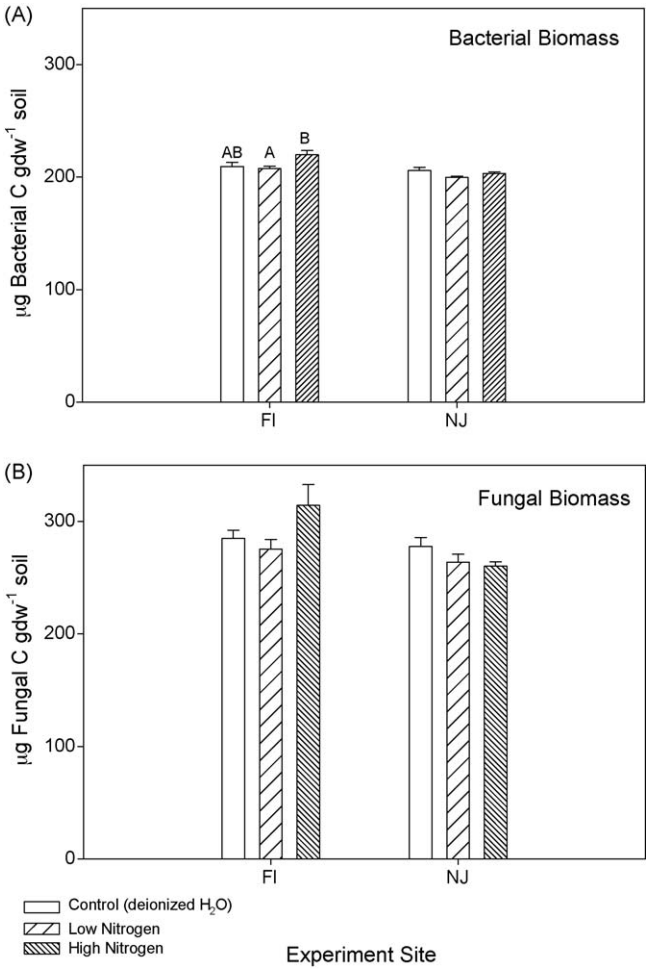

Fig. 3. Bacterial (A) and fungal (B) biomass as measured by SIR. Different letters over FL bars indicate significant effects of the nitrogen treatments (means separation by the Bonferroni test). All bars represent the mean ± SE of all treatments at each site and $n = 5$.

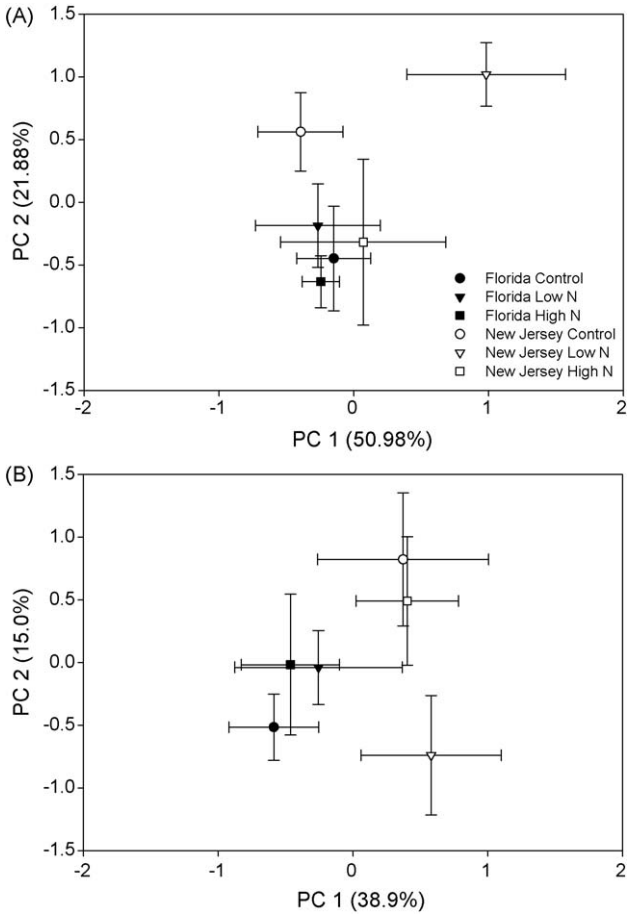

Fig. 4. PCA plot of bacterial community characterization of colony morphotypes (A) and molecular fingerprints using TRFLP (B). Each symbol represents the mean ± SE of the component scores and $n = 5$.

deposition gradients that have been affecting the environment for extended periods of time (Arnolds, 1991; Egerton-Warburton and Allen, 2000; Lilleskov et al., 2002; Dighton et al., 2004; Lilleskov, 2005). Relative to the time scale of the industrial age and modern nitrogen deposition, our treatments were an intense pulse onto soils known to leach nutrients. Further, ambient nitrogen deposition is higher in NJ than FL (Table 1). Between site differences may in part be attributable to the press of ambient nitrogen deposition. Significant declines in EMF diversity have been observed across naturally occurring, shallow nitrogen deposition gradients (Dighton et al., 2004). The results of Dighton et al. (2004) contrasted with the findings we present here speak to the importance of time and the long-term effects of even a small amount of nitrogen on a fungal community. Furthermore, our study examines the response of EMF to nitrogen in association with oaks. It is believed that fungi in association with hardwoods may be less sensitive to excess nitrogen (Taylor et al., 2000). The field results of Dighton et al. (2004) were from data collected from mature pitch pine (*Pinus rigida*) within the NJ Pine Barrens ecosystem, and they found significant differences in EMF morphotype richness.

As opposed to EMF, bacterial colony morphotypes were affected by an interaction between nitrogen concentration and geographic location (Fig. 1A). In FL, colony morphotype richness increased with increasing nitrogen concentration. In NJ, the response was mixed; the lowest diversity of colony morphotypes was found in the low nitrogen treatment and not the control. Interestingly, we found a similar response in FL when bacterial biomass decreased in the low treatment relative to the control, but increased in the high treatment relative to the control (Fig. 3A). This result is difficult to interpret because neither nitrogen treatment was different than the control. Non-linear responses to nitrogen addition may be due to the spatially patchy concentration of soluble nutrients in these plots (see standard error of the mean for NH_4 and PO_4 in Table 2). We think the biomass change was seen in the bacterial community and not the fungal community due to differences in their individual growth patterns. Individual bacteria can access nutrients and divide quickly. Fungi grow more slowly and may not have been able to access soluble nutrients that were quickly leached from the soil.

4.3. Synthesis and implications

The divergent responses of bacterial and fungal communities may have a significant impact on the health of forest communities and ecosystem functioning. Bacterial biomass responded to nitrogen addition in FL (Fig. 3A), and bacterial community compositional changed in both FL and NJ (Fig. 4A). Nitrogen addition appears to be differentially affecting bacterial and fungal communities, and for bacteria, this may depend on their environmental or geographic context. The outcome of diverging bacterial and fungal communities will have a significant impact on functional relations in soil. Changes in the bacterial but not fungal community could alter long standing symbioses between bacteria and EMF (Garbaye, 1994), or it could disrupt soil processes like decomposition and nutrient cycling by altering the balance

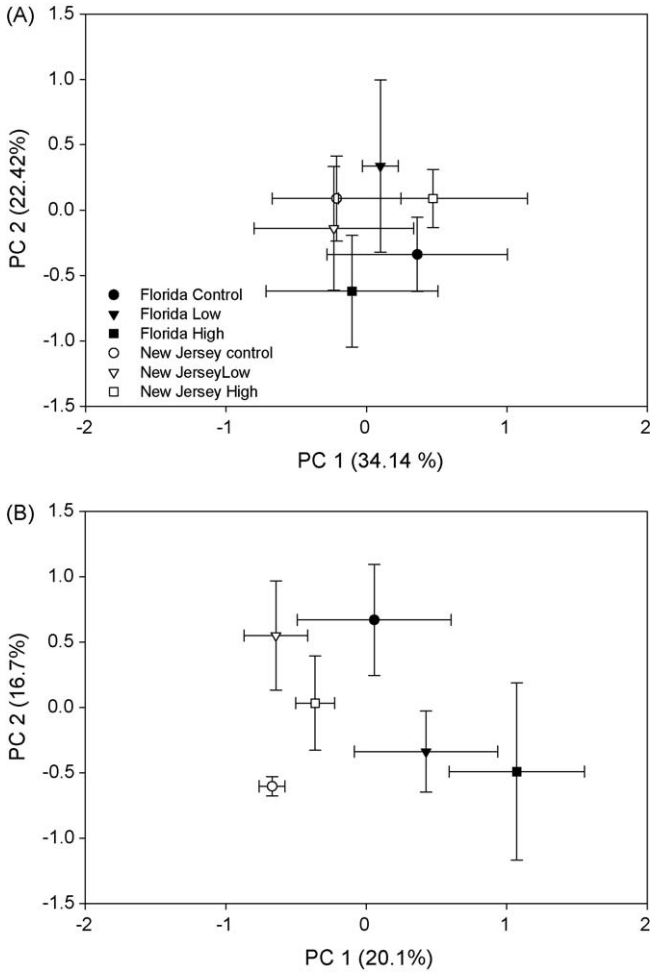

Fig. 5. PCA plot of fungal community composition characterized by EMF morphotype (A) and molecular fingerprint using TRFLP (B). Each symbol represents the mean ± SE of the component scores and $n = 5$.

between the fungal and bacterial energy channels in soil (Moore and Hunt, 1988).

The number of bacterial and EMF morphotypes increased with each additional plot sampled (Fig. 2) underscoring the highly diverse (Torsvik et al., 2002) and patchy nature (Franklin and Mills, 2003) of microbial communities in soil. The incomplete sampling of these communities may have limited our ability to detect differences between the two sites or in the response to the nitrogen treatments. All microbial sampling methods are selective (Hughes et al., 2001). Hence, it is important to view microbial communities through multiple 'lenses' as we have done here. The molecular methods may not have resolved differences in the communities to the extent the microscopic or culture based methods did due to the challenges of amplifying whole community DNA from environmental samples. The NJ samples in particular were difficult to amplify due to relatively low microbial biomass. In spite of the sampling variability we encountered in this experiment, meaningful trends in microbial community response (or non-response) emerge. This emphasizes the importance of studying microbial community response to environmental change within the context of different geographic locations.

4.4. Conclusions

Bacterial and fungal communities responded differently to allochthonous nitrogen inputs. This perhaps reflects their differing stoichiometry, growth rates and ability to acquire nutrients. However it is interesting that bacterial community composition changed with nitrogen addition and the fungal community did not. We think this differential response is due to the limited ability of these soils to retain soluble nitrogen. Bacteria utilize resources and grow faster; possibly they were able to incorporate some of the nitrogen whereas the fungi were not. This was particularly the case at the FL sites where phosphorus is in excess allowing fast growing bacteria to possibly immobilize the nitrogen. The results presented here have important implications for understanding microbial communities and forest ecosystem health. Our results show that the microbial response to environmental perturbations like excess nitrogen loading can vary between geographic locations. In a changing world, microbial communities are likely to respond to environmental perturbation in complex and unpredictable ways.

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