Quality Assurance Project Plan

Hudson River Water Quality Testing Program

Riverkeeper, Inc.

May-October 2014

Project Code 2013-066

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NY's clean water advocate

Title and Approval Page

Riverkeeper, Inc.

Hudson River Water Quality Testing Program

Effective Date of Plan: May-October 2014

John Lipscomb, Boat Captain and Water Quality Program Director — Date: 7/24/14

Jennifer Epstein, Citizen Science Manager — Date: 7/24/14

Dan Shapley, Water Quality Program Manager — Date: 7/24/14

Alene Onion, NEIWPCC/ NYSDEC Project Manager — Date: 7/29/14

Mike Jennings, NEIWPCC QA Program Manager — Date: _____

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Mike Jennings, NEIWPCC QA Program Manager — Date: 7/29/14

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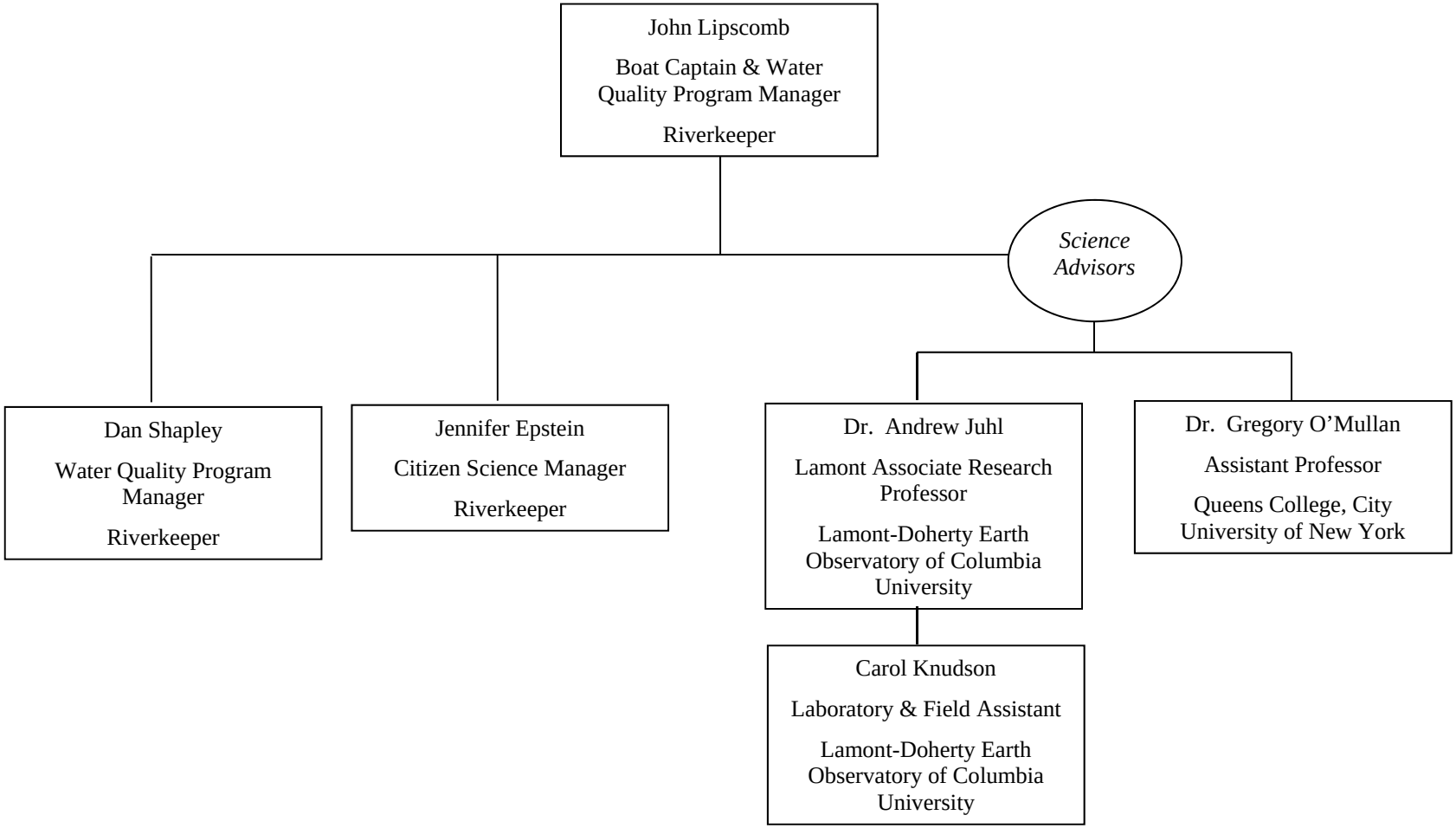
1 Project Organization Chart



2 Project Distribution List

Name/Title	Contact Information
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Mike Jennings NEIWPCC QA Program Manager	mjennings@neiwpcc.org

In addition being directly distributed to the individuals above, this document will be posted on the Riverkeeper website where it may be viewed or downloaded by the general public.

3 Project and Task Organization

Name	Title	Responsibilities
John Lipscomb Riverkeeper	Boat Captain & Water Quality Program Manager	Provides overall direction for the Water Quality Program; Operates the Riverkeeper vessel and mobile laboratory, including supply purchasing and equipment maintenance; Performs sampling, sample processing, and sample analysis; Supervises program staff
Jennifer Epstein Riverkeeper	Citizen Science Manager	Maintains online database and data records; Assists with water quality reports and program operations; Maintains the QA Project Plan

Name	Title	Responsibilities
Dan Shapley Riverkeeper	Water Quality Program Manager	Conducts public policy and outreach activities associated with the Water Quality Program; Writes blog updates and water quality reports; Oversees online database and program website
Dr. Andrew Juhl Lamont-Doherty Earth Observatory of Columbia University	Science Advisor Project QA Manager	Performs data QA; Advises Riverkeeper staff on all science-related aspects of program; Assists with field sampling; Analyzes data and provides findings for reports
Dr. Gregory O'Mullan Queens College, City University of New York	Science Advisor	Advises Riverkeeper staff on all science-related aspects of program; Assists with field sampling; Analyzes data and provides findings for reports
Carol Knudson Lamont-Doherty Earth Observatory of Columbia University	Laboratory & Field Assistant	Calibrates sampling equipment; Performs sampling, sample processing, and sample analysis; Compiles and distributes field and laboratory data; Performs data QC

4 Problem Definition and Project Objectives

4.1 Problem Definition

One of the most important water quality factors to consider when deciding whether to swim is the presence of fecal contamination, because exposure to the microbial pathogens found in human and animal waste can lead to short-term and chronic illness. Most beach closings and advisories in the United States are triggered by high levels of sewage contamination.[1] However, in the Hudson River testing is not widespread or frequent enough to safeguard public health, nor are the results made publicly available. In addition, there is a lack of predictive modeling that would warn the public if fecal contamination was likely to occur due to heavy rainfall or a sewage break.

In response to public demand for information about water quality, Riverkeeper, in collaboration with our scientific partners, began testing for *Enterococcus* concentrations ("Entero counts") in the Hudson River Estuary in 2006. *Enterococcus* is a genus of bacteria that live in the human digestive system and is recognized by the U.S. Environmental Protection Agency (EPA) as an indicator of fecal contamination in fresh and saline waters.

[1] Dorfman, M. and K.S. Rosselot. Testing the Waters: A Guide to Water Quality at Vacation Beaches. Natural Resources Defense Council. 20 November 2012. <http://www.nrdc.org/water/oceans/ttw/48803.html>

Riverkeeper's Hudson River Water Quality Testing Program is designed to:

1. Raise awareness of the need for more regular, localized, water quality monitoring and reporting along the Hudson shoreline;
2. Provide insight into the factors influencing local water quality;
3. Identify contamination hot spots;
4. Engage citizens in solutions that eliminate pollution sources and improve water quality; and
5. Provide a consistent, long-term record to evaluate sewage loading in the Hudson River Estuary.

4.2 Project Objectives

We sample for *Enterococcus* at 74 fixed locations to document the location, frequency, timing and intensity of fecal contamination in the Hudson River.

- Objective 1: Collect water samples to analyze Entero counts at fixed points in the Hudson River during the swimming season. These data are critical to the project.
- Objective 2: Collect background water quality information (salinity, temperature, dissolved oxygen saturation, chlorophyll, and turbidity) at Entero sampling sites to inform our interpretation of fecal indicator results. These data are for contextual purposes.

4.3 Data Users

Riverkeeper urges citizens to use our water quality data to inform themselves about local conditions in their communities and to pursue local solutions to pollution problems in the Hudson River watershed. Riverkeeper staff use the water quality data to advocate for increased investment in wastewater infrastructure, better enforcement of existing water quality protections, more frequent water quality sampling, and better prediction and public notification of sewage contamination.

Riverkeeper rates the water quality at each site for each sampling event using the EPA's 2012 Recreational Water Quality Criteria. The Entero count and rating are uploaded to our website (http://www.riverkeeper.org/water-quality/locations) after the close of each sampling patrol. The site explains the rating system that we use.

The Riverkeeper website displays information gathered from our Hudson River Water Quality Testing Program (the 74 sampling sites sampled approximately monthly as defined in this QAPP). All samples are collected and processed according to the procedures outlined in this QAPP.

The website also displays data from our Citizen Science Water Quality Testing Program. Sampling sites and data from the two programs are separately located in the website and are distinguished using page headings and iconography. The Citizen Science program QAPP will also be available for viewing and download on the Riverkeeper website once it is approved.

Periodically we release reports summarizing data and findings. These reports explain our methods, highlight key findings and suggest ways for citizens to take action. Riverkeeper's reports include guidance about how our water quality data should be interpreted. The reports are available on the Riverkeeper website for viewing or download, and are available in print format upon request.

We collaborate with Dr. Andrew Juhl from Columbia University's Lamont-Doherty Earth Observatory (LDEO) and Dr. Gregory O'Mullan from Queens College, City University of New York. Our science partners contribute their expertise to all aspects of the project.

5 Background and History

5.1 Background

In 2009, New York State set the goal of a swimmable Hudson River by 2020 (except following rainstorms). The Hudson River from north of the Bronx borough line to the northern end of Columbia County is designated by New York State Department of Environmental Conservation (NYSDEC) as acceptable for swimming use.

There are four official beaches on the Hudson River north of New York City. These locations are required to be tested for fecal-indicating bacteria only six times per swimming season, and the results are not made public. Furthermore, people get into the water at more than 100 unofficial sites along the estuary, none of which are tested regularly for fecal contamination.[2]

Through our water quality testing Riverkeeper has learned that fecal contamination varies by location, over time, and in severity. Wet weather is a common trigger of sewage contamination, particularly in communities with combined sewer systems.

5.2 History

Water quality in the Hudson River has improved in the 30 years since the Clean Water Act was put into law. This change has come about largely due to controls on point pollution sources and improvements in wastewater infrastructure. However, much of this infrastructure is reaching the

[2] Lawler, Matusky & Shelly Engineers, The Hudson Group, Swimming in the Hudson River Estuary: Feasibility Report on Potential Sites, Hudson River Estuary Program, New York State Department of Environmental Conservation, 2005, p. 16. http://www.dec.ny.gov/lands/5452.html.

end of its designed lifespan. Meanwhile, development has overwhelmed capacity in many wastewater treatment systems. Likewise, onsite septic systems are often poorly sited or maintained. NYSDEC's 2012 list of the top ten causes of water quality impairment in the state included two sources related to wastewater: aging/inadequate wastewater infrastructure and inadequate onsite wastewater treatment.[3]

6 Project Location

Sampling sites are distributed along approximately 155 miles of the Hudson River from New York Harbor to the confluence of the Mohawk River. The river is tidally influenced up to the Troy Dam and can be brackish as far upstream as Poughkeepsie.

Our study includes four types of sampling sites: (1) mid-channel, (2) near-shore, (3) sewage treatment plant outfalls, and (4) tributaries. Sites were selected based on our knowledge of the watershed, wastewater and drinking water infrastructure, public access points, and our intention to evaluate both the near-shore and mid-channel environments of the river.

At all sites we collect water samples to be analyzed for Entero counts. The data are used to describe the spatial and temporal occurrence of fecal contamination. We also record temperature, salinity, chlorophyll, turbidity, and dissolved oxygen saturation at the time of sampling. These data provide background information that can be used when interpreting Entero results.

Site ID	Site Name	Approx. Latitude	Approx. Longitude	Type of Site
GO1	Gowanus Canal	40.67145	-73.99881	Tributary
0	The Battery mid-channel	40.70004	-74.02503	Mid-channel
ER1	East River mid-channel at 23rd St.	40.73608	-73.96718	Mid-channel
NT1	Newtown Creek- Dutch Kills	40.73733	-73.94672	Tributary
NT2	Newtown Creek- Metropolitan Ave. Bridge	40.71478	-73.9314	Tributary
ER2	East River mid-channel at Roosevelt Is.	40.75509	-73.95335	Mid-channel
4.7W	Castle Point, NJ	40.74351	-74.02237	Near-shore
6E	Pier 96 Kayak Launch	40.77242	-73.99752	Near-shore
7	79th St. mid-channel	40.78836	-73.99168	Mid-channel
7.9E	125th St. Pier	40.81846	-73.9624	Near-shore
8E	North River STP at 145th	40.82623	-73.95797	WWTP outfall
HA1	Harlem River- Willis Ave. Bridge	40.84683	-73.92788	Mid-channel
12	GW Bridge mid-channel	40.84838	-73.95001	Mid-channel
HA2	Harlem River- Washington Bridge	40.80256	-73.9286	Mid-channel

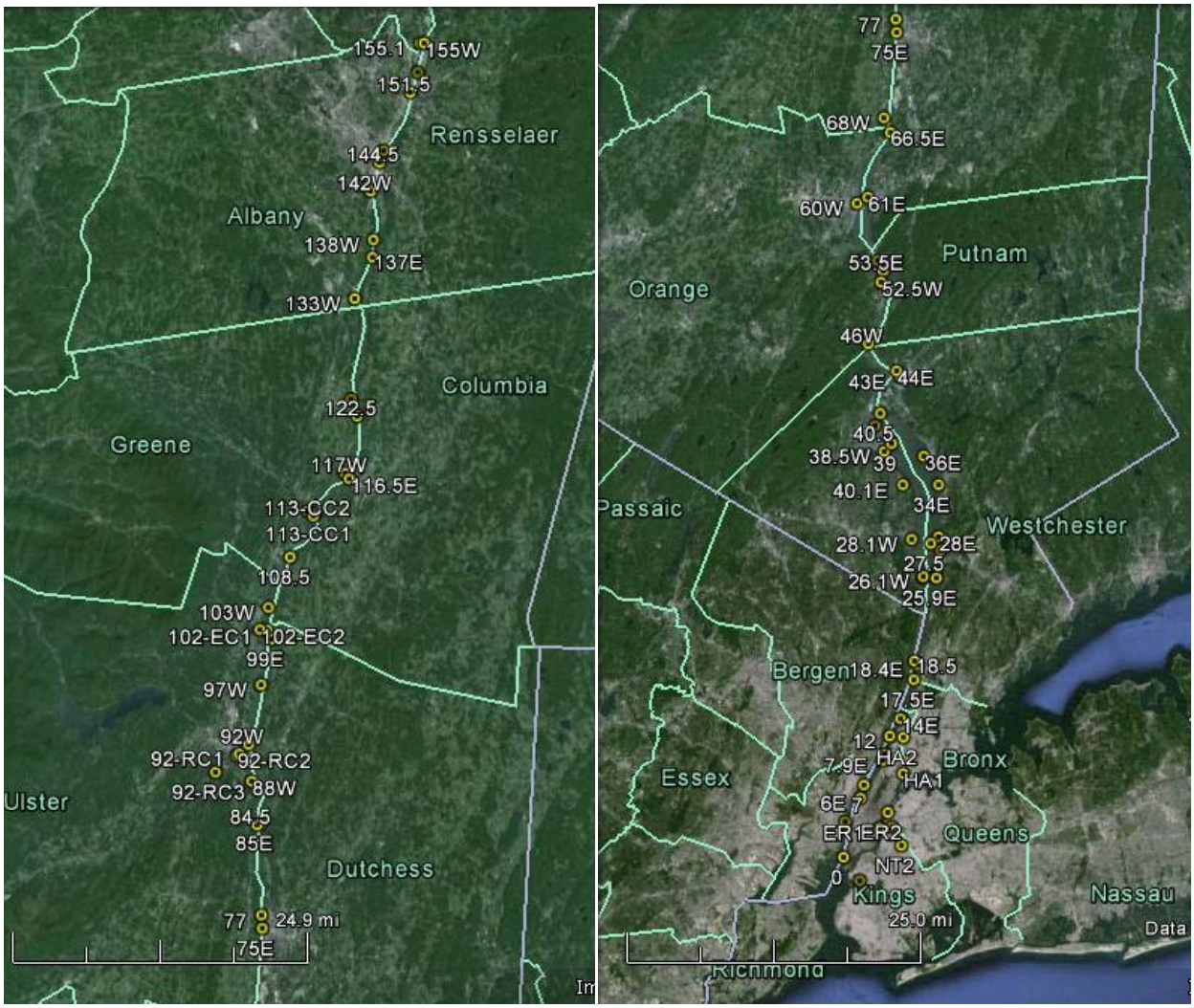
[3] "2012 Section 305(b) Water Quality Report." New York State Department of Environmental Conservation, 2012, http://www.dec.ny.gov/chemical/66532.html

Site ID	Site Name	Approx. Latitude	Approx. Longitude	Type of Site
14E	Dyckman Street Beach	40.8696	-73.93262	Near-shore
17.5E	Yonkers STP Outfall	40.91714	-73.91101	WWTP outfall
18.4E	Saw Mill River	40.93571	-73.90443	Tributary
18.5	Yonkers mid-channel	40.94005	-73.91001	Mid-channel
25.9E	Irvington Beach	41.04132	-73.87429	Near-shore
26W	Orangetown STP Outfall	41.04155	-73.89575	WWTP outfall
26.1W	Piermont Pier*	41.04316	-73.89554	Near-shore
27E	Tarrytown Marina	41.07552	-73.86723	Near-shore
27.5	TZ Bridge mid-channel	41.08342	-73.88335	Mid-channel
28E	Kingsland Pt. Park- Pocantico River*	41.09154	-73.87068	Tributary
28.1W	Nyack Launch Ramp	41.08838	-73.91435	Near-shore
34E	Ossining Beach	41.15479	-73.87061	Near-shore
36E	Croton Point Beach	41.18971	-73.89451	Near-shore
38.5W	Emeline Beach- Haverstraw	41.19531	-73.9586	Near-shore
39	Haverstraw Bay mid-channel	41.20505	-73.94669	Mid-channel
40W	Cedar Pond Brook	41.22686	-73.97346	Tributary
40.1E	Furnace Brook	41.15479	-73.92855	Tributary
40.5	Stony Point mid-channel	41.2417	-73.965	Mid-channel
43E	Peekskill Riverfront Green Park	41.286	-73.93246	Near-shore
44E	Annesville Creek	41.2934	-73.93825	Tributary
46W	Fort Montgomery	41.32634	-73.98466	Near-shore
52.5W	West Point STP Outfall	41.40176	-73.96465	WWTP outfall
53.5E	Cold Spring Harbor	41.41543	-73.96132	Near-shore
54E	Little Stony Point	41.42816	-73.97059	Near-shore
60W	Newburgh Launch Ramp	41.4982	-74.00484	Near-shore
61E	Beacon Harbor	41.50564	-73.98714	Near-shore
66.5E	Wappingers- New Hamburg	41.5845	-73.95042	Near-shore
68W	Marlboro Landing	41.60242	-73.96115	Near-shore
75E	Poughkeepsie Launch Ramp	41.70682	-73.94075	Near-shore
77	Poughkeepsie Drinking Water Intake	41.72289	-73.94202	Mid-channel
84.5	Norrie Point mid-channel	41.8334	-73.94867	Mid-channel
85E	Norrie Point Yacht Basin	41.83532	-73.94219	Near-shore
88W	Port Ewen Drinking Water Intake	41.88678	-73.95794	Near-shore
92W	Kingston Point Beach*	41.93158	-73.96303	Near-shore
92-RC1	Kingston STP Outfall	41.92026	-73.97816	WWTP outfall
92-RC2	Rondout Creek- Kingston Public Dock	41.91793	-73.98212	Tributary
92-RC3	Rondout Creek- Eddyville Anchorage*	41.8977	-74.017	Tributary
97W	Ulster Landing Beach	42.00457	-73.94285	Near-shore
99E	Tivoli Landing	42.06025	-73.92475	Near-shore
102-EC1	Esopus Creek Entrance*	42.07154	-73.93331	Tributary
102-EC2	Esopus Creek West	42.07195	-73.9446	Tributary
103W	Malden Launch Ramp	42.09902	-73.93074	Near-shore
108.5	Inbocht Bay	42.16059	-73.89482	Mid-channel
113-CC1	Catskill Launch Ramp	42.21319	-73.85416	Near-shore

Site ID	Site Name	Approx. Latitude	Approx. Longitude	Type of Site
113-CC2	Catskill Creek- East End*	42.2106	-73.85682	Tributary
113-CC3	Catskill Creek- First Bridge	42.2169	-73.867	Tributary
116.5E	Hudson Landing Ramp	42.2563	-73.79807	Near-shore
117W	Athens	42.26298	-73.80488	Near-shore
122.5	Gay's Point mid-channel	42.33248	-73.78487	Mid-channel
124W	Coxsackie Waterfront Park	42.35332	-73.79511	Near-shore
133W	Coeymans Landing	42.47614	-73.7891	Near-shore
137E	Castleton	42.52656	-73.75986	Near-shore
138W	Bethlehem Launch Ramp	42.5478	-73.75825	Near-shore
142W	Island Creek/Normans Kill	42.60737	-73.76288	Tributary
144.5	Dunn Memorial Bridge- Albany	42.64242	-73.74802	Mid-channel
146W	Albany Rowing Dock	42.65669	-73.74138	Near-shore
151.5	Congress St. Bridge- Troy	42.72805	-73.69718	Mid-channel
152.5	Hudson River above Troy Lock	42.7527	-73.68503	Mid-channel
155W	Mohawk River at Waterford	42.78836	-73.68082	Tributary
155.1	Hudson above Mohawk River	42.78838	-73.67446	Mid-channel

*Sites where water samples are collected on additional scheduled days in conjunction with citizen science sampling program.

Site Map


155.1
155W
151.5
Rensselaer
144.5
142W
Albany
138W
137E
133W
Columbia
122.5
Greene
117W
116.5E
113-CC2
113-CC1
108.5
103W
102-EC1
102-EC2
99E
97W
92W
92-RC1
92-RC2
92-RC3
88W
84.5
85E
Ulster
Dutchess
77
24.9 mi
75E
77
75E
68W
66.5E
60W
61E
53.5E
Putnam
Orange
52.5W
46W
43E
44E
40.5
38.5W
39
36E
40.1E
34E
Passaic
Westchester
28.1W
28E
27.5
26.1W
25.9E
Bergen
18.4E
18.5
17.5E
14E
12
HA2
Bronx
7.9E
HA1
Essex
6E
7
ER1
ER2
Queens
NT2
0
Kings
Nassau
25.0 mi
Richmond
Data

7 Project Schedule

Activities	Organization/Group Responsible for Activity Completion	Timeframe
Purchase laboratory supplies	Riverkeeper	January-October 2014
Conduct Sampling	Riverkeeper Science Partners	Scheduled patrols: April-October 2014 Exploratory sampling: January-October 2014
Sample Processing	Riverkeeper Science Partners	Concurrent with sampling
Post Results Online	Riverkeeper	April-October 2014
Data QA	Riverkeeper	April-October 2014

8 Quality Objectives

8.1 Precision

Field:

The datasonde (for measuring temperature, salinity, *in vivo* chlorophyll fluorescence, turbidity, and oxygen saturation) will be calibrated before each sampling patrol according to the manufacturer's recommended protocols.

Laboratory:

At least one sample will be processed in replicate on each sampling date by dividing one grab sample. If results vary greatly, we will investigate the condition, handling, and storage of the reagents and sampling equipment currently in use to ascertain whether contamination has likely occurred. In the case of contamination, reagents and supplies will be discarded and replaced where necessary.

8.2 Bias

Field:

Our study is designed to detect fecal contamination at specific points at specific times, and the full subset of samples may not describe general conditions in the river. Sampling points are distributed to provide insight into possible sewage exposure by river users, to locate contamination hot spots, and to identify potential pollutant sources. We collect data about basic water quality parameters to provide additional information when interpreting results.

Laboratory:

At least one blank sample will be processed alongside field samples on each sampling date. If a blank has a positive *Enterococcus* measurement greater than 3 cells/100 mL, the field samples since the last acceptable blank will be removed from the data set and additional blanks will be included until the source of contamination has been eliminated.

8.3 Representativeness

We will sample once approximately monthly from May to October, which is the time of year when most people get in the water. The data is not meant to be representative of average conditions for the recreational season, nor is it to be used to predict conditions at a specific time and place along a waterway. In addition, data should not be used to draw conclusions about conditions during the winter months.

8.4 Comparability

The Hudson River estuary has saline, fresh, and brackish waters. We will use *Enterococcus* as a fecal indicator because it is the only indicator recognized by EPA for use in both saline and fresh water. This way, we can directly compare results among all of our sampling sites. We will rate water quality in comparison to EPA guidelines for safe swimming so that our results can be compared with results from other waterways nationwide.

8.5 Completeness

We will collect and analyze samples from the 74 sites identified above on an approximately monthly basis from May to October, totaling at least 444 samples per year. We intend to analyze two quality control (QC) samples (one replicate and one blank) per sampling day for an approximate total of 8 QC samples per month, for a total of approximately 48 QC samples per year. Sampling is conducted unless river conditions are unsafe for boating or as the boat schedule allows. If a sampling event must be cancelled or rescheduled, we will sample when conditions are clear, as scheduling permits within a month and QC samples will be included each day in the altered scheduled.

8.6 Sensitivity

The IDEXX Quanti-Tray 2000 Enterolert Most Probable Number (MPN) method allows detection of 1 *Enterococcus* per 100 mL in undiluted samples. As per standard methods, samples collected in saline or brackish water, or when higher maximum detection levels are required, are diluted tenfold, so the lower limit at those sites is 10 *Enterococci* per 100 mL. The MPN method can quantify up to 2,419.6 *Enterococci* per 100 mL without dilution (24,196 with a tenfold dilution).

9 Data Collection Methods

9.1 Site Names

Each site is assigned an ID consisting of the approximate river mile and an "E" or "W" to designate whether the site is closer to the east or west shore when it is not located mid-channel (e.g., "26.1W"). For tributary sites, the initials of the tributary and a number indicating the site's relative position in the tributary are appended to the river mileage at the tributary's mouth (e.g., "113-CC1"). Each site is also assigned a descriptive name (e.g., "Ulster Landing Beach").

9.2 Sampling Design

We will sample on an approximately monthly basis from May to October. The Riverkeeper vessel will visit the 74 sampling sites over four to six consecutive days (a "sampling patrol"). The vessel is equipped with a global positioning system (GPS) for locating sites. Water samples will be collected for *Enterococcus* using sterile polypropylene bottles. Samples will be collected by reaching over the side of the vessel and dipping the inverted sample bottle into the water with a gloved hand. Sample bottles will be rinsed three times with river water before collecting sample water. Samples will be capped and immediately placed on ice in a dark container until processing. Samples will be held no more than six hours before being placed in the incubator.

Sample processing will be conducted on the Riverkeeper vessel following IDEXX instructions (https://www.idexx.com/water/products/enterolert.html). Samples from Annesville Creek in Westchester County and downstream (site IDs 44E to GO1) will be diluted 1:10 with sterile distilled water. All samples will be incubated and scored on the Riverkeeper vessel. All sample bottles and distilled water will be sterilized using an autoclave at LDEO.

For other parameters (temperature, salinity, chlorophyll, turbidity and oxygen saturation), river water will be continuously pumped through the datasonde chamber from approximately 0.25 meters below the surface. Instantaneous readings will be recorded concurrently with Entero sample collection.

We will collect one additional sample approximately monthly at each of six sites near tributaries where Riverkeeper also conducts citizen science sampling. These sites are:

- 26.1W: Piermont Pier
- 28E: Kingsland Pt. Park- Pocantico River
- 92W: Kingston Point Beach
- 92-RC3: Rondout- Eddyville Anchorage
- 102-EC1: Esopus Creek Entrance
- 113-CC2: Catskill Creek- East End.

These samples will be collected on dates when citizen science partners collect water samples from the tributary watersheds. On these dates, we will also collect a sample from station 26.2W-Pirelli Park. This station is not included in monthly patrols, and is only sampled approximately once per month on citizen sampling days. The samples will handled and processed using the same methods described above, but additional water quality parameters (temperature, salinity, chlorophyll, turbidity and oxygen saturation) will not be measured. The Citizen Science program is covered in a separate QAPP.

From time to time we will collect additional samples to investigate sewage pollution reported to Riverkeeper or observed by staff. These samples will handled and processed using the same methods as employed during our monthly sampling patrols. However, additional water quality parameters (temperature, salinity, chlorophyll, turbidity and oxygen saturation) may not be measured.

Matrix	# of Sites	# of Samples	Parameter	Field QC Samples	Total # Samples/ Measurements	Sampling SOP Reference	Project Objective for Sampling and Analysis or Monitoring
Water	74	6	*Enterococcus* concentration	1 replicate/day 1 blank/day	444 samples/yr 48 QC samples/yr	Standard Methods for the Examination of Water and Wastewater Section 9060	Meets objective for sampling of *Enterococcus* in Hudson River
Water	7	6	*Enterococcus* concentration	1 replicate/day 1 blank/day	42 samples/yr 48 QC samples/yr	Standard Methods for the Examination of Water and Wastewater Section 9060	Meets Citizen Science Water Quality Testing Program objective for sampling of *Enterococcus* in tributaries
Water	74	6	Temperature	N/A	444 samples/yr	Hach Hydrolab DS5 User Manual	Meets objective for background information
Water	74	6	Salinity	N/A	444 samples/yr	Hach Hydrolab DS5 User	Meets objective for background

Matrix	# of Sites	# of Samples	Parameter	Field QC Samples	Total # Samples/ Measurements	Sampling SOP Reference	Project Objective for Sampling and Analysis or Monitoring
						Manual	information
Water	74	6	Chlorophyll	N/A	444 samples/yr	Hach Hydrolab DS5 User Manual	Meets objective for background information
Water	74	6	Turbidity	N/A	444 samples/yr	Hach Hydrolab DS5 User Manual	Meets objective for background information
Water	74	6	Oxygen	N/A	444 samples/yr	Hach Hydrolab DS5 User Manual	Meets objective for background information

10 Equipment List and Instrument Calibration for a Typical Monthly Sampling Patrol

10.1 Equipment List

- Cooler with ice
- sterile polypropylene bottles
- Disposable gloves
- Permanent marker
- Watch
- Hach Hydrolab DS5 sonde
- Pipette bulb and spare
- 10-mL sterile disposable plastic pipettes
- Sterile distilled water
- IDEXX 100-mL sealed sterile disposable plastic bottles with sodium thiosulfate
- IDEXX Enterolert reagent powder snap packs
- IDEXX Quanti-Tray 2000 incubation trays
- Incubator
- Quanti-tray sealer

- Quanti-tray holder
- UV viewing cabinet
- IDEXX MPN table

10.2 Instrument Calibration and Maintenance

The datasonde will be sent to the manufacturer for servicing annually, and will be calibrated at LDEO per manufacturer's instructions prior to each sampling patrol. Proper functioning of the autoclave will be tested regularly by LDEO staff using spore test kits.

11 Analytical Methods

Matrix	Analytical Group/ Parameter	Reporting Limit	Detection Limit	Analytical & Preparation Method/ SOP Reference	Sample Volume	Containers	Preservation Requirements	Max Holding Time	Laboratory Used for Analysis
Water	*Enterococcus*	Non-diluted samples: lower limit 1 Entero/100 mL, upper limit 2,420 Entero/100 mL; Diluted samples: lower limit 10 Entero/100 mL, upper limit 24, 196 Entero/100 mL	Non-diluted samples: lower limit 1 Entero/100 mL, upper limit 2,420 Entero/100 mL; Diluted samples: lower limit 10 Entero/100 mL, upper limit 24, 196 Entero/100 mL	IDEXX instruction manuals	100 mL Fresh water: no dilution; Brackish and salt water: 1:10 dilution	For collection: polypropylene bottles For processing: IDEXX Enterolert 100mL bottles and Quanti-trays	Store bottle on ice in dark	6 hours	Riverkeeper mobile laboratory Used Quanti-trays are returned to LDEO for disposal

12 Field Data Sheets

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Date:	Filename:
Surveyor:	Sonde:
Time inc start:	Time/Date read:
Notes:	

Sta:	Time:	pH units:	Entero vol ml:
Temp ˚C:	Turb NTU:	Chl vol:	Lg : Sm:
Sal ppt:	O2 % sat:	Nut vol:	Uncorr. MPN:
Chl rfu:	O2 mg/l:	Secchi m:	Corr. MPN:
Notes, other samples taken: ☐ Opt B collected?			

Sta:	Time:	pH units:	Entero vol ml:
Temp ˚C:	Turb NTU:	Chl vol:	Lg : Sm:
Sal ppt:	O2 % sat:	Nut vol:	Uncorr. MPN:
Chl rfu:	O2 mg/l:	Secchi m:	Corr. MPN:
Notes, other samples taken: ☐ Opt B collected?			

Sta:	Time:	pH units:	Entero vol ml:
Temp ˚C:	Turb NTU:	Chl vol:	Lg : Sm:
Sal ppt:	O2 % sat:	Nut vol:	Uncorr. MPN:
Chl rfu:	O2 mg/l:	Secchi m:	Corr. MPN:
Notes, other samples taken: ☐ Opt B collected?			

Sta:	Time:	pH units:	Entero vol ml:
Temp ˚C:	Turb NTU:	Chl vol:	Lg : Sm:
Sal ppt:	O2 % sat:	Nut vol:	Uncorr. MPN:
Chl rfu:	O2 mg/l:	Secchi m:	Corr. MPN:
Notes, other samples taken: ☐ Opt B collected?			

13 Training and Specialized Experience

13.1 Training

Riverkeeper staff who are present on sampling patrols have received training in proper collection, handling, and processing of microbial samples from Dr. Andy Juhl and Dr. Gregory O'Mullan, the project science partners. John Lipscomb was trained beginning in 2006. Carol Knudson was trained onboard and at LDEO beginning in 2008, and she continues to work under the direct supervision of Dr. Andy Juhl. From time to time, John Lipscomb has received additional training from IDEXX via telephone Training is not documented; however, procedures are periodically reviewed by project staff and science partners. John Lipscomb is responsible for ensuring that only trained staff handle and process samples.

13.2 Specialized Experience

Person	Specialized Experience	# of Years Experience
John Lipscomb	Collection and analysis of water samples for presence of *Enterococcus*	7
Jennifer Epstein	Collection and analysis of water samples for multiple parameters M.S., Biological Sciences	7
Dr. Andrew Juhl	Aquatic ecologist and oceanographer Growth, physiology, and community ecology of planktonic microorganisms Biogeochemistry of coastal, estuarine, and freshwater ecosystems Ph.D., Biological Oceanography	25
Carol Knudson	Biological oceanographer Collection and analysis of water samples for multiple parameters M.S., Oceanography	18
Dr. Gregory O'Mullan	Environmental microbiologist Biogeochemical function in aquatic environments Interaction between human activities and pathogen dynamics in the environment Ph.D., Ecology and Evolutionary Biology	16

14 Assessments and Oversight

Assessment Type	Frequency of Assessment	What Is Being Assessed	Who Will Conduct the Assessment	How Issues or Deviations Will Be Addressed
Data transcription	Each sampling patrol	Field report or marked sample trays checked against digital spreadsheet	Field & Lab Assistant Riverkeeper Staff	Correct error in digital spreadsheet
Water quality ratings	Each sampling patrol	Accuracy of rating	Riverkeeper	Correct error in spreadsheet
Online database	Each sampling patrol	Completeness and accuracy of online data	Riverkeeper	Remove and re-upload data

NEIWPCC may implement, at their discretion, various audits or reviews of this project to assess conformance and compliance to the Quality Assurance Project Plan in accordance with the NEIWPCC Quality Management Plan.

15 Data Management

Field Data:

Field data sheets will be saved at LDEO after transcribing observations to digital spreadsheets. Data from the datasonde will be downloaded at LDEO and checked for missing information and errors. Verified datasonde data will be copied into summary spreadsheets which will be emailed to Riverkeeper, as described below.

Laboratory Data:

Trained Riverkeeper or LDEO staff will count the number of large and small fluorescing wells on the Enterolert trays and record the corresponding Entero count from the IDEXX MPN table after accounting for the dilution factor, if needed. Results will be written on field datasheets.

For sampling patrols, original or photocopied data sheets will be delivered to LDEO, where staff will transcribe all results into a digital spreadsheet. LDEO staff will compile all datasonde data and Entero results for the patrol and email the spreadsheet to Riverkeeper staff for uploading to the Riverkeeper website. Riverkeeper staff will check a minimum of 10 sites online for accuracy immediately after uploading.

For samples collected alongside citizen science samples, Riverkeeper staff will receive Entero results via scanned data sheets or verbal communication, and will enter results into digital spreadsheets. Entero counts will be uploaded to the website promptly after sampling and will be subject to data checks as described in the Citizen Science QAPP.

Digital spreadsheets from LDEO and scanned copies of Citizen Science data sheets will be saved on Riverkeeper's server, which is backed up regularly.

16 Data Review and Usability Determination

16.1 Data Checks

At the end of each year's sampling, 3% of data lines in the master spreadsheet (cumulative back to 2006) will be selected at random to check for errors. This spreadsheet contains data from sampling patrols, additional tributary sampling and investigative sampling. A data line contains all data recorded for a given station (date, time, location, Entero count, temperature, salinity, chlorophyll, turbidity, oxygen saturation). The values in the master spreadsheet and the Riverkeeper website for each entry on the selected data lines will be verified against the field data sheets. If discrepancies are found, the data lines for the rest of the samples collected on that date will also be verified. The number of data lines per year will also be checked to ensure that there are no missing data lines. Any errors will be corrected in the master spreadsheet, summary spreadsheets and the Riverkeeper website database.

17 Reporting

Data will be uploaded to the Riverkeeper website (http://www.riverkeeper.org/water-quality/locations/) promptly after the close of each sampling patrol.

A summary of data usability determinations will be submitted with the final quarterly project report to NYSDEC/NEIWPCC.