

NARROW RIVER NOTES

Narrow River Preservation Association: Preserving the Narrow River Watershed Since 1970 / December 2017

Art on the River

On August 5th, 20 guests attended NRPA's 6th Annual Art on the River.

Held at the scenic Middlebridge Education Area, children and adults enjoyed Narrow River in an artistic vein with water color and oil painting, drawing, photography, fish printing and seaweed pressing.



From top: Richard Grant, NRPA President, demonstrates perspective to beginning artists, an artist paints in plein air alongside Narrow River and Sarah Gaines, NRPA Board Member, shows Aurora and Ben Eddy how to make fish prints. *Photos by Alison Kates*

Narrow River Water Quality: Trends and Findings Spanning a Quarter Century!

by Annette DeSilva and Veronica Berounsky

In 2016, NRPA reached the 25-year milestone of our River Watch program. Since 1992, volunteers have taken measurements and collected water samples to help us assess the water quality of the Narrow River. To mark the 25 year milestone, we have compiled and plotted all of the data to examine the water quality trends and to assess the condition of our River. At the 2017 NRPA Annual Meeting, we highlighted trends and findings spanning the past quarter century. The full presentation is available on the NRPA website at narrowriver.org. Here, we will summarize many of the findings.

In the early 1990's, water quality was on the minds of many. Sewers had been installed in Middlebridge and they were starting to be installed along the Narragansett side of the river. However, stormwater from the watershed neighborhoods was still draining directly into the river. NRPA had a strong interest in



NRPA River Watch started in 1992 with 10 monitoring locations. It has since grown to 14 locations throughout the river.

starting a volunteer water monitoring program because of reports of high bacteria levels. Also, since there were no industries along the river (obvious "point sources"), a watershed watch approach to studying water quality was desired.

Narrow River is seven miles long and its watershed is located in North Kingstown, South Kingstown, and Narragansett. The original monitoring sites (NR 1-10) were chosen to span the length of the river from Gilbert Stuart Stream in the north to Pettaquamscutt Cove in the south.

The site at Sprague Bridge is closest to the mouth of the river. Over the years, we added four additional sites. In 1996, Mettatumet



Map courtesy of Eric Peterson

continued on page 6

President's Cove

I wanted to speak with you about the 2017-2018 membership drive. The response to date has been even stronger than previous years both in number of responses and the dollar amount of donations. What this means to me is that the residents and friends of the Narrow River Watershed appreciate NRPA's work and accomplishments.

These accomplishments were well stated at our recent Annual Meeting, our 47th. NRPA Board of Directors are volunteers and through asking residents and friends to help, a lot was achieved this past year. Without the combination of financial support and volunteer effort accomplishments would have been few. Please allow me to thank you for your support by naming a few of our successes this past year.

They are:

Land Category: planting of 35,000 seedlings in lower Narrow River with The US Fish and Wildlife Service, assisting stormwater treatment projects at Narragansett and South Kingstown (more about this on page 4), and assisting with the plan for improving the area to the southeast of Sprague Bridge.

Water Category: River Watch (in October, we completed our 26th year of testing water quality at fourteen sites in the river), NRPA participation in RI Rivers Council, Tide Chart for Middlebridge location (coming soon!).

Education Category: Science Fair Environmental Awards, Lesa Meng College Scholarship Awards, What Lives in the River, Art on the River, On Pettaquamscutt Winter Speaker Series, *Narrow River Notes*, new NRPA website and our Osprey tracking program with local fourth graders.

With your membership, we plan to continue and expand these and other programs in the coming year. Thank you for your support.

Best,

Richard Grant
NRPA President

2017 Kayak Raffle Winner

Congratulations to NRPA River Watch and saltmarsh planting volunteer Lynn Almond of Narragansett who won this year's Kayak Raffle. We look forward to seeing you on the river in the spring!

MISSION STATEMENT

The Narrow River Preservation Association (NRPA) works to preserve, protect, and restore the natural environment and the quality of life of all communities within the Narrow (Pettaquamscutt) River Estuary and Watershed.

www.narrowriver.org

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NRPA is part of the United Way Workplace Campaign.
Our donor option number is 6239
If you plan to give to United Way, please consider designating a portion of your gift to NRPA.

NRPA is participating in the 2017 Rhode Island State Employees Charitable Appeal (SECA).
Our fund number is 6239.

Rhode Island Rivers Council

Narrow River Land Trust Welcomes Volunteers

The Narrow River Land Trust is grateful for the many volunteers in 2017 who cleared trails and invasive species and hauled lumber into the woods to build bridges. Special thanks go out to the crews from Dassault Systemes, Schneider Electric, Alex & Ani and the Youth Conservation League. More volunteer activities including walks and talks will be coming up in 2018. Write to us at Office@NarrowRiverLandTrust.org



From top: Volunteers from Schneider Electric build a bridge, Dassault Systemes volunteers take a break and helpers from Alex and Ani clear invasive species. *Photos courtesy of NRLT.*

Kathie Kelleher Honored with 2017 W.E.R. La Farge Friend of the River Award

The 2017 W.E.R. La Farge Friend of the River Award was presented to Kathie Kelleher at the Narrow River Preservation Association's 47th Annual Meeting on October 3.

"We honor Kathie for her dedication to the stewardship of Canonchet Farm, engaging countless volunteers in the life of the Farm, collaborating with partners, and teaching residents and visitors about the cultural and natural history of the area" said Richard Grant, NRPA President, as he presented the award.

Kelleher is a founding member of Friends of Canonchet Farm, an organization devoted to preserving and improving one of the largest parcels of public land in the Narrow River Watershed. Among other successes, Kathie has been a leader in the habitat restoration project removing invasive vegetation along Lake Canonchet and Little Neck Pond, has organized more than 60 guided walks through Canonchet introducing residents and visitors to the unique natural and cultural history of the 167-acre former estate of Governor Sprague, now owned by the Town of Narragansett, and is currently developing plans for a linear park at Canonchet Farm in collaboration with the URI Landscape Architecture Class.

Kathie was completely surprised to receive the award, telling us "I found out that I was the awardee when it was announced at NRPA's annual meeting. I could not believe it."

Kelleher was quick to credit others for the impact she has made on the area. "What I am ... grateful for is the wonderful volunteers we have, they form the basis for my receiving this award. For example, this past Saturday six volunteers came to work on the trail in the rain. They are truly amazing people" she said.

The Friend of the River award is given annually in the name of long time Narrow River Watershed supporter W.E.R. La Farge.



Kathie Kelleher receives the 2017 W.E.R. La Farge Friend of the River Award from NRPA President Richard Grant. *Photo by Veronica Berounsky*

Stormwater Treatment Efforts in Narragansett and South Kingstown

Narragansett leading the BMP charge.

by Chris Hubbard, NRPA Board of Directors

On October 24th, Narragansett town Engineer John Lawless gave NRPA Board of Directors members a tour of one of the town's stormwater treatment project sites.

What is a BMP? In a nutshell, a BMP or 'Best Management Practice' is a system to prevent contaminants from polluted storm water runoff from reaching a body of surface water (in this case, the Narrow River, of course). BMPs range from sophisticated tanks with filtration systems down to simple rain gardens or even catch basins.

The BMP selected for a specific location is determined based on many factors including available space, pitch and geology of the area and land ownership (private property v. municipality owned).

For years, Narragansett has worked diligently to identify locations where BMPs will help prevent pollution from entering the Narrow River, design appropriate systems, and aggressively pursue funding sources to make these projects a reality. Dedicated to keeping the Narrow River clean, Narragansett has a number of sites identified and will be adding many more BMPs over the next years. The BMP installations toured by NRPA are understreet filtration systems in the Inkberry Trail area.

South Kingstown is in the planning stages of BMPs within the Narrow River Watershed. NRPA is working with the town and engineers to ensure that the most effective BMPs are implemented.

NRPA is grateful to our surrounding communities and their dedication to keeping pollutants out of the Narrow River. For more information, visit narrowriver.org.

NRPA Lesa Meng College Scholarship Applications Due April 23

This spring, NRPA will award up to four \$1,000 college scholarships to students graduating from high schools in the watershed: Narragansett High School, North Kingstown High School, The Prout School and South Kingstown High School.

NRPA began awarding college scholarships in 1995 and has granted over \$52,000 to local high school seniors since its inception.

Scholarship applications are available at narrowriver.org, or at the Guidance Departments of all four high schools in the watershed.

The scholarship applications are judged on:

- Student's environmentally oriented activities in and out of high school
- An original essay on mitigating an environmental problem or issue relevant to Narrow River
- Science teacher's recommendation
- Academic achievement in math and science courses.

Completed applications must be submitted to the student's guidance counselor (not to NRPA) by Monday, April 23, 2018.

Do we have your email address?

Stay up to date on events and activities in the Narrow River Watershed. Send your email to nrpa@narrowriver.org to subscribe to NRPA email updates

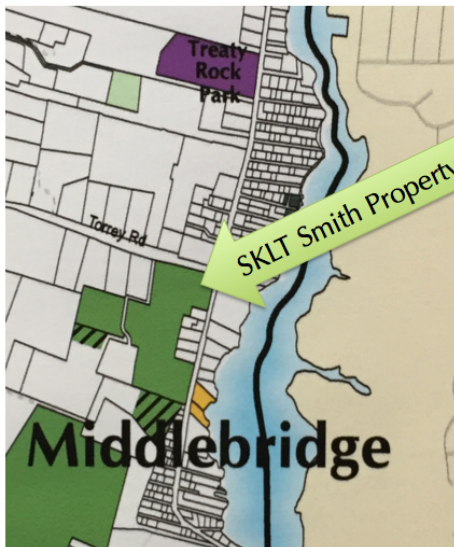


John Lawless, Town of Narragansett Project Engineer, points out areas of interest to NRPA Board Members and friends on a map of the Narrow River Watershed as he describes stormwater treatment efforts currently under way. The Narrow River and a catch basin (one type of stormwater BMP) are visible in the background.

Depending on factors such as geology, available space and water runoff patterns, stormwater BMPs vary greatly and include underground filtration systems (top photo) and rain gardens (bottom).

South Kingstown Land Trust Protects 22 Acres in the Narrow River Watershed

The South Kingstown Land Trust recently protected 22 acres in Middlebridge owned by the Smith family. Preservation of this area, southwest of the intersection of Torrey Road and Middlebridge Road, “prevents an increase of surface runoff into the Narrow River that could have been generated by the development of 10 additional lots”, according to SKLT Land Protection Director Joanne Riccitelli.



Areas in solid green are now owned by South Kingstown Land Trust. Cross-hatched areas are privately owned and protected by a conservation easement.

often seen on the river in winter. This land is also home to cottontails, coyotes, foxes, fishers and deer. The property is not open to the public.

By working with SKLT to protect the property, the children of Jane Campbell Smith and Barton P. Smith continued their family’s long time commitment to the preservation of this area. “Our family has long appreciated the many extraordinary features and the view from this beautiful piece of land located up the hill from Middlebridge. The current generation is pleased to fulfill our Campbell family’s wishes in entrusting this land to the South Kingstown Land Trust to preserve in perpetuity”, noted Heather Collins, one of the five Smith siblings who collaborated with SKLT to protect the property.

Funded by a Local Open Space grant from the RI Department of Environmental Management, a grant from the Bafflin Foundation, a private donation, and a significant bargain sale from the family, the property contains a dense unfragmented second growth forest, typical habitat for various bird migrants and residents that rely on intact forested areas, such as scarlet tanager, turkey, woodcock, various warblers, wood thrush and ovenbird. Other birds that benefit from this habitat include hawks, owls, and bald eagles, which are

Workshop Including Bike Path Jan 23

The Rhode Island Moving Forward Planning Group will be holding a workshop at the Neighborhood Guild in Peace Dale on January 23, 2018 from 6:30 until 8:30 p.m. All are welcome.

NRPA Thanks the 2017 River Watch Volunteers

In 2017, 31 citizen volunteers participated in NRPA’s River Watch Program. From May through October, these volunteers contributed their time to make measurements and collect water samples on the Narrow River. Their assistance and dedication is greatly appreciated.

This year’s volunteers included: Lynn Almond, Joyce Anderson, Vanessa Anderson, Veronica Berounsky, Melissa Campbell, Jennifer Carey, Jesse and Kathryn Grande, Enzo Gravante, the Kaprielian Family, Eric and Jennifer Kohlsaas, Marc Lamson, Shelby and Bob Lefoley, Abby and Perry Moylan, John and Eric Pederson, Forrest and Susan Sancomb, The Sarubbi Family, Rosemary and David Smith, Rodrigue Spinette, Christopher Wakefield, Craig Wood, Hossam Zaki. Special recognition goes out to Jennifer Carey who reached the milestone of completing 20 years of monitoring in 2017!

The continued success of NRPA’s River Watch program is due to the dedicated service of the volunteers. It is through their efforts that we continue to learn more about the quality of the Narrow River waters. NRPA greatly appreciates the many hours of service provided by the volunteers.

Thank you very much!

Annette DeSilva

Benjamin Gaspar Given Environmental Appreciation Award

At its 47th Annual Meeting, NRPA presented Ben Gaspar, Biological Technician for U.S. Fish and Wildlife Service with an Environmental Appreciation Award in recognition of his enthusiastic collaboration in the salt marsh replanting project in lower Narrow River.

In particular, NRPA highlighted Ben’s exceptional stewardship and public outreach in caring for the changing environment of the Narrow River.



Water Quality, from front page

Brook (site NR-11) was added in response to land development demand. In 2000, Mumford Brook (near Narragansett Elementary School, site NR-12) was added because a Rhode Island Department of Environmental Management (RIDEM) study identified this as an area of concern [1]. Sites were added at Lakeside Rd and Lakeside Outfall (in Edgewater, sites NR-13 and 14) in 2004 because they were near an area where a stormwater management plan would be implemented. With this data, we hope to observe pre- and post-management results.

The River Watch monitoring season runs from May to October each year. Every two weeks during the season, volunteers measure temperature and dissolved oxygen. They also collect samples for salinity and chlorophyll that are analyzed by the URI Watershed Watch Lab. Once a month, samples are also collected for bacteria, nutrient, and pH analysis. Lab analysis services are provided by URI's Watershed Watch office, which also trains all new volunteers, supplies the monitoring equipment, compiles data into the database, and creates charts and graphs.

Twenty-five years of data for an entire river is a large data set to evaluate. Plots have been created for every parameter for all sites for all years and these are available upon request. For purposes of the Annual Meeting presentation, we wanted to provide a snapshot of the parameters monitored at all sites. To do this we evaluated the averages of the data parameters over 25 years. The only exception was with the bacteria data, which is displayed as the geometric mean, which indicates the typical value of a set of numbers and is consistent with RIDEM bacteria standards.

The parameter plots (temperature, salinity, dissolved oxygen, bacteria, nutrients, chlorophyll, and pH) are arranged so that each monitoring location is shown starting in the north of the river and ending in the south. There are two charts for each parameter, one for salt water and one for fresh water. The freshwater sites are streams or outfalls that flow into the river. The average values for the data are divided into two sets. One set represents the first 12 years (typically 1992 to 2003) and is shown as the blue bars on the charts. The average of the next 13 years (2004 – 2016) is shown as the green bar. This split is close to half way along the 25 years, but it also happens to coincide with the construction of the new bridge at Middlebridge in 2004, so we might see if that had any influence on the water quality. For the freshwater sites, which started collections later, the break is after 2006, which is when the Mettatuxet stormwater treatment project was completed. For some of

the nutrients, collections started only in 2006.

Data Observations:

Temperature - The average temperature over the past 25 years has been relatively stable; however, in more recent years the temperature is slightly higher than the initial years of monitoring at many sites. As expected, the water temperature at the sites closer to the mouth of the river, which are influenced by ocean water temperatures is cooler at the sites at the north end of the river. We have also observed seasonal trends annually, with cooler water in the spring and fall and warmer water in the summer.

Salinity - The Narrow River is an estuary and has flows of both freshwater and salt water. Freshwater enters through the streams and brooks and saltwater enters through the mouth of the river in the south. As expected, the sites at the south end of the river that are near the mouth have the highest average salinity, approaching the levels that you would see in the ocean and bay. The Narrow River is a brackish water body, and the data shows that salinity extends all the way to the Upper Pond. At the fresh water sites, salinity measurements are not taken.

Dissolved Oxygen - Dissolved oxygen is very important to a water body. Without oxygen, the waterbody could not support life. All organisms in the river, from fish to insects to microscopic zooplankton, need oxygen for respiration. The average dissolved oxygen levels all are within ranges that can support life. However, on occasion, very

Figure 1: Geometric Mean Fecal Coliform Bacteria Data

Figure 1a: Fecal Coliform Data from Saltwater Sites

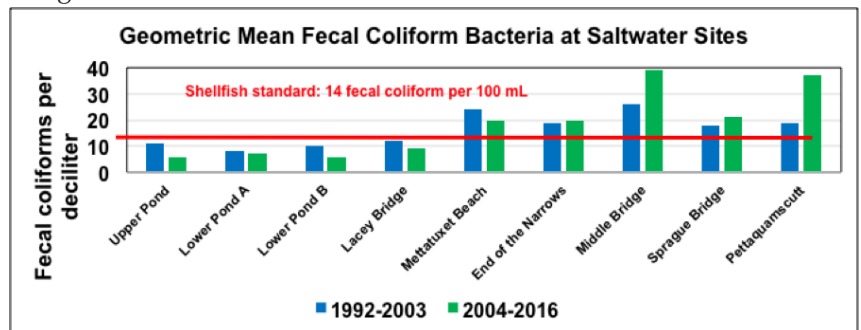
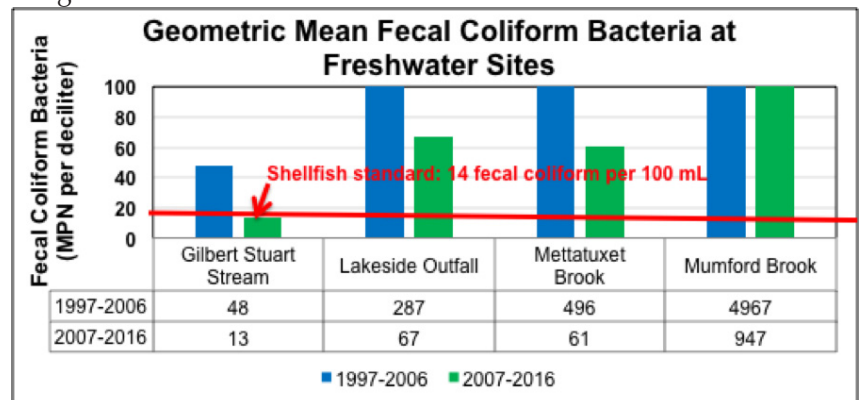


Figure 1b: Fecal Coliform Data from Saltwater Sites



low dissolved oxygen levels have been observed. It was interesting to see that in the past 13 years, the dissolved oxygen levels are on average lower than the first 12 years. This is something we will want to watch in future years.

Bacteria - The analysis of the water samples for bacteria levels screen the water for its suitability for swimming and for shellfishing, and may indicate contamination. Two groups of bacteria are commonly monitored to indicate the presence of human sewage and associated pathogens, or disease causing organisms - fecal coliforms and enterococci. These are the ones that were evaluated by us in this study.

Fecal Coliform Bacteria - Since 1994, the entire Narrow River has been closed to shellfishing due to high coliform bacteria levels. The RI DEM standard for shellfishing is the "Geometric mean is not to exceed 14 fecal coliform per 100 mL" [2]. Figure 1 shows the geometric mean values for fecal coliform levels at all sites. The horizontal red line represents the shellfishing standard and the bars that extend above the red line exceed the safe standard for shellfishing.

At the saltwater sites, the shellfishing standard is exceeded at all sites south of Lacey Bridge (Fig 1a). For the freshwater sites, with the exception of Gilbert Stuart Stream, the fecal coliform geometric means are extremely high (Fig 1b). These sites are inputs to the river and are of concern. The data supports the rationale for why the river is still closed for shellfishing and also why it is still very important to try to implement best practices and stormwater improvements within the watershed.

Enterococci Bacteria - The Rhode Island RIDEM uses a geometric mean approach for their safe swimming standards. Their standards are defined as follows [2]:

- The safe swimming Standard for salt water: not to exceed 35 enterococci per 100 mL Geometric Mean Density
- The safe swimming Standard for fresh water: not to exceed 33 enterococci per 100 mL Geometric Mean Density

In Figures 2 and 3, the horizontal red line illustrates the safe swimming standard. Any data above the standard (the red line) is considered unsafe for swimming.

The URI Watershed Watch office began enterococci analyses in 2007 (consistent with RIDEM standard) and so our enterococci data also begins in 2007.

Some observations that can be made from the enterococci plots (Fig 2) include:

- For the saltwater sites (Fig 2a), the enterococci geometric mean does not exceed the standard for safe swimming. This is a good sign.

Figure 2: Geometric Mean Enterococci Bacteria Data

Figure 2a: Enterococci Data from Saltwater Sites

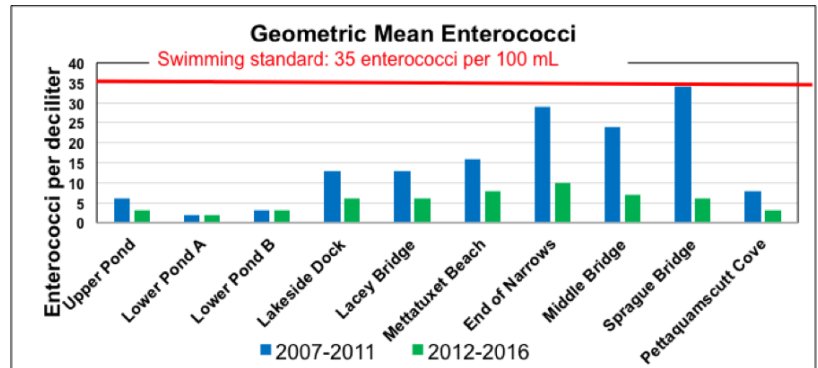
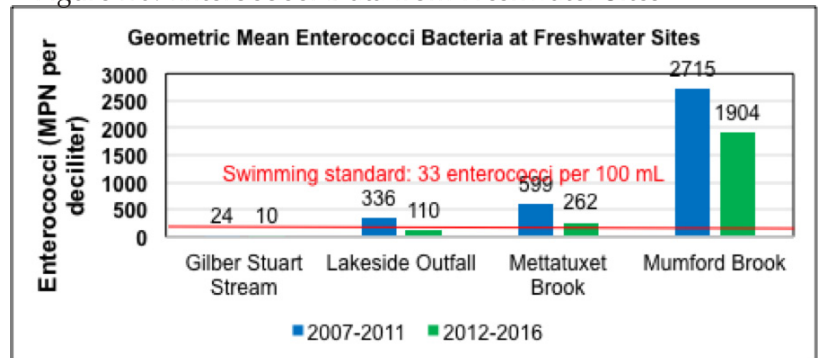


Figure 2b: Enterococci Data from Freshwater Sites



- The deep-water sites at the north end of the river have the lowest enterococci geometric means. This area has the lowest density of homes/development and the least impacts from human sources.

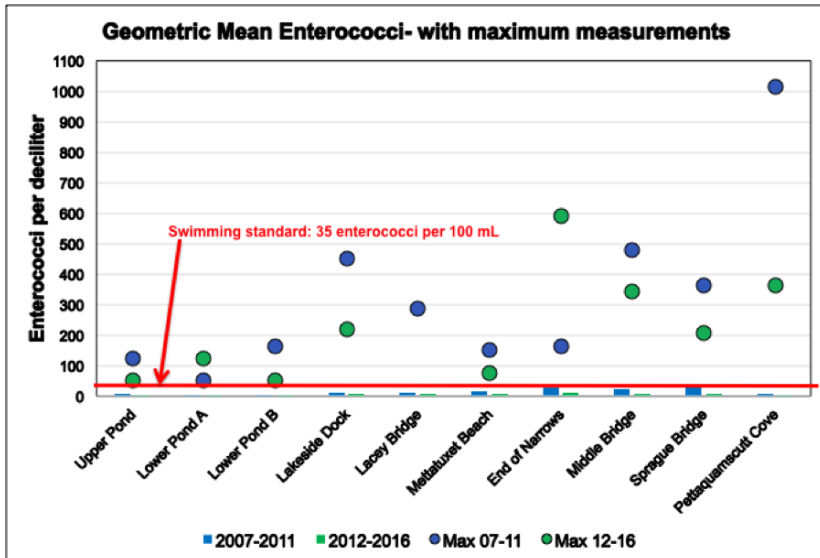
The enterococci levels increase as you go south along the river. These areas are more densely populated and the impacts from human sources are greater.

- In contrast to the saltwater sites, the enterococci levels are very high at most of the fresh water sites. To display the data, a much larger scale had to be applied. With the exception of Gilbert Stuart Stream, the safe swimming standard is greatly exceeded. This is of concern because these are in the inputs into the river. However, it should be noted these streams are very shallow, so no one is swimming in them.

- One very interesting observation is that at the saltwater sites, the geometric means are lower in the more recent years that in the earlier year. Perhaps we are starting to see the positive impact of the new stormwater abatement systems and sewers.

It is important to recognize that while the URIWW's Analytical Laboratories are certified by the State of Rhode Island, Watershed Watch data is intended for screening purposes only. Our data are very valuable for targeting areas of concerns and for tracking potential sources of bacterial contamination. The data should not be used to determine daily safe swimming conditions.

Figure 3: Enterococci Bacteria – Geometric Mean with Maximum Data Values



Although it is a positive sign to see that the geometric mean values for the enterococci did not exceed the safe swimming standard in salt water, the individual enterococci data values sometimes exceed the standard significantly. In Figure 3, the maximum enterococci values (shown as blue and green dots) have been plotted above the geometric mean bars. A very large scale was required in order to show the maximum data values (the geometric mean bars are just blips at the bottom of the plot). The standard for swimming is shown as the red horizontal line. Unfortunately, the maximum enterococci values are well above the standard for safe swimming.

Nutrients

Why nutrients are important: Nutrients are substances necessary for the survival and growth of plant and animals. The most important nutrients in water ecosystems are nitrogen and phosphorus. Nitrogen is more important in salt waters, phosphorus is more important in fresh waters. For the River Watch Program, Total Nitrogen and Total Phosphorus (the sum of all types of nitrogen or phosphorus) have been measured since River Watch started in 1992. Some components of these: Ammonia, Nitrate, Nitrite and Phosphate have been measured since 2006.

How nutrients get into Narrow River: These nutrients enter the Narrow River from “nonpoint” sources such as ground water, rain, and the atmosphere (i.e. the burning of fossil fuel puts nitrogen into the atmosphere). Even without rain, excess fertilizer (which is mainly nutrients) can run off lawns into the river. During a storm, rain washes along lawns and impervious surfaces such as driveways and roads, collecting more nutrients and bacteria, and sending them towards “point sources” of streams and outfall pipes and eventually the river.

How nutrients can be a problem: Nutrients are necessary for life, but too much of a good thing is bad. If nutrient levels are too high, plants floating in the water will grow and explode in population, causing a ‘bloom’, blocking sunlight from penetrating into the water, inhibiting the rooted plants, such as eelgrass, from growing. Eelgrass provides an important nursery area for juvenile fish and other organisms. Also, as the algae bloom ages, it uses up oxygen, taking it out of the water. Oxygen is necessary for animals, so fish, shellfish, and other animals may die.

Nutrient graphs: A few graphs will be shown here, for all the graphs discussed in this article, see the full presentation at narrowriver.org. As for the bacteria graphs, the top graph will show the values at the saltwater sites from the least salty (Upper Pond) to the most salty (Sprague Bridge and Pettaquamscutt Cove) of Narrow River. The lower graph shows the freshwater streams entering Narrow River. Also,

as before, the yearly data is split in half for the river itself (the salt water sites), before and after the bridge at Middlebridge was completed and open to traffic in 2004. For the freshwater sites, which started collections later, the break is after 2006, which is when the Mettatuxet BMP (stormwater treatment project) was completed.

Total Nitrogen: The most important point to note in Figures 4a and 4b is that the values of Total Nitrogen in the

Figure 4a:

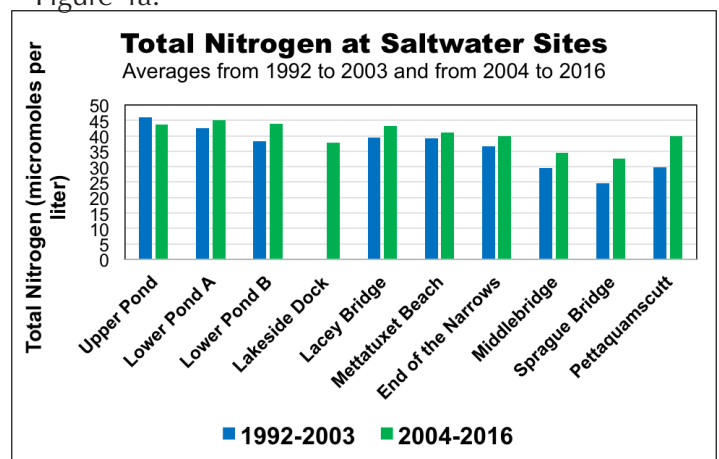
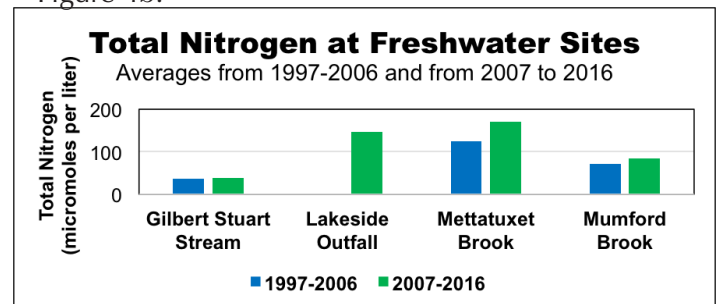

















Figure 4b:



Narrow River Water Quality Trends Over 25 Years

-  Increasing temperatures are typical as indicators of global warming
-  Good that dissolved oxygen levels are high enough to support life, despite occasional low oxygen measurements
-  Increases in salinity at sites that are closer to the mouth of the river indicate sufficient inflow of RI Sound water (and with lower nutrient levels)
-  Fecal coliform bacteria levels suggest the ponds and down to Lacey Bridge and the streams and outfall are improving, but the rest of the river may have some problems 
-  Enterococci bacteria levels are lower in more recent years indicating improvements and swimming continues to be safe
-  Higher total nitrogen values in recent years (except for Upper Pond) suggests that the increase in homes, lawns and driveways is counteracting the improvement of municipal sewers for organic nitrogen
-  Lower recent ammonia levels indicate improvements
-  Lower recent nitrate plus nitrite values indicate some improvements particularly due to BMPs and municipal sewers
-  Low total phosphorus levels that are similar for all years indicates there has not been a problem with phosphorus
-  Lower, recent dissolved phosphorus levels are good, but problems may exist at Pettaquamscutt Cove, Gilbert Stuart Stream, and Mettatuxet Brook 
-  Although chlorophyll values have increased in recent years, they are still at a good level of production and not a problem
-  Not part of this study, but another study shows that since 2012 eelgrass has returned to Narrow River
-  Streams (particularly Mumford Brook and Mettatuxet Brook) and the outfall are bringing in bacteria and nutrients and other parts of our data shows that after major rain events, we see elevated levels of bacteria and nutrients, so stormwater is still a source

freshwater streams and outfall are much larger than in the river itself. As a result of these inputs, the river sites near Mettatuxet Brook (Metatatuxet Beach, End of the Narrows) and Mumford Brook (Pettaquamscutt Cove) are higher than expected based on the distance down the estuary. The second point is that in general, total nitrogen decreases as sites get closer to the mouth. This is because the off shore (RI Sound) waters are low in total nitrogen. The third point is that the values of recent years are (except for Upper Pond) higher than earlier years. This suggests that the increase in houses (and lawns and driveways) in recent years (which has not happened in Upper Pond) has contributed total nitrogen despite the introduction of municipal sewers.

Ammonia: Ammonia one of the components of total nitrogen. It is the first form of nitrogen that is released from

decaying organic matter, excreted by animals (including humans) and seeps out of leaking septic systems. For the River Watch sites, it has only been measured separately since 2006 (the year the Mettatuxet BMP was completed). The values, both at the salt water sites (Figure 5a) and the freshwater sites (Figure 5b) are not particularly high, only going to 10 μmol or less, this is good news. Also the ammonia levels in recent years are always lower, in some cases about half the values, seen in earlier years. This is more good news. This all suggests that sources of ammonia have been reduced.

Nitrate and nitrite: Nitrate and nitrite are measured together and are also components of total nitrogen. Values of nitrate and nitrite are often high in ground water, and these concentrations are the results of fertilizers, and human and animal waste. For the River Watch sites, they have only been measured separately since 2006. The values in the river itself are low, less than 4 μmol (Figure 6a). As for ammonia, values nitrate and nitrite in recent years

are much lower than in earlier years. This suggests there is less nitrate plus nitrite contamination in the river. Except for Gilbert Stuart Stream, the values are for the freshwater sites are very high, between 50 and 200 μmol (Figure 6b) and the values of recent years are higher than earlier years. This suggests the brooks and outfall are a source of nitrate plus nitrite to the river. It is interesting that the two streams flowing through undeveloped areas (Gilbert Stuart Stream and Mumford Brook) are the lowest, while the outfall which drains a neighborhood and the brook that drains both a neighborhood and a wooded area are the highest, suggesting humans and households are the ultimate sources of this nitrogen and most of the total nitrogen is nitrate plus nitrite.

Total Phosphorus: In contrast to the nitrogen, the total phosphorus levels are low, 2 μmol or less, even in the freshwater sites. There is not much difference between older years and recent years.

Dissolved Phosphorus: The inorganic component of total phosphorus, dissolved phosphorus, is low, 1.6 μmol or less, suggesting that phosphorus is not a problem in this ecosystem. Values are lower in recent years. The highest levels are at Mumford Brook and Pettaquamscutt Cove (where Mumford Brook drains) suggesting natural sources since Mumford drains a vegetated area (unless a home nearby has a leaky septic system).

Chlorophyll: Chlorophyll is a plant pigment and is a measure of how well plants are using sunlight and nutrients to grow. It is also a measure of how productive (or eutrophic) the ecosystem is. Chlorophyll values of between 2-11 $\mu\text{g/L}$ for all the sites are not problematic. Note the values in recent years are all higher than earlier years, but still not eutrophic.

Concluding Remarks:

In conclusion, NRPA's River Watch program has allowed us to learn much about the water quality of Narrow River and its tributaries (and one outfall) and how it has varied over a quarter century.

These data have been very useful to the state of Rhode Island and the three towns in the Narrow River watershed by providing evidence of areas of poor water quality so that improvements could be made in the watershed such as the increased span width of the rebuilt bridge at Middlebridge, the removal of the outhouse at Gilbert Stuart Birthplace in North Kingstown, the construction of the detention ponds and sand filters in several neighborhoods in Narragansett, and the planned stormwater abatement projects in South Kingstown (see related article on page 4). Stormwater continues to be a problem and more BMPs (stormwater abatement projects) are needed.

Because of the retention and then slow leakage of nutrients from the soils and groundwater of the watershed, it takes years to see the effect of improvements (such as municipal sewers), but our 25 years of data are showing areas of improvement in both bacteria levels and nutrient concentrations.

Levels of fecal coliform bacteria and also nitrate plus nitrite in streams and at the outfall continue to be high and the sources need to be identified.

Acknowledgements:

NRPA thanks all who have provided financial support for the NRPA River Watch program: RI Department of Environmental Management, the towns of Narragansett, North Kingstown, and South Kingstown, Environmental Protection Agency, US Fish and Wildlife Service, Rhode Island Rivers Council, and NRPA members and supporters.

Linda Green and Elizabeth Herron from the URI Watershed Watch Office have been fantastic partners. Their knowledge, experience, and dedicated assistance has been instrumental in guiding NRPA's River Watch program through the past 25-plus years.

Figure 5a:

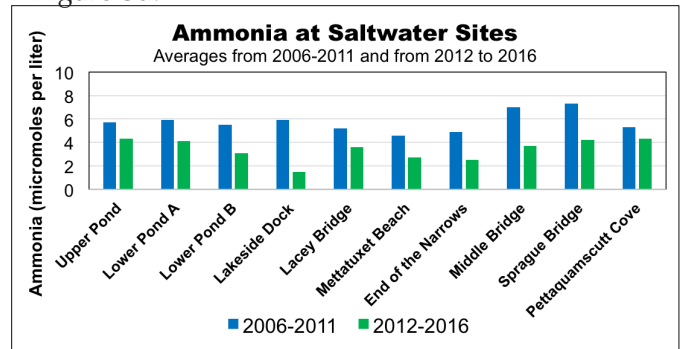


Figure 5b:

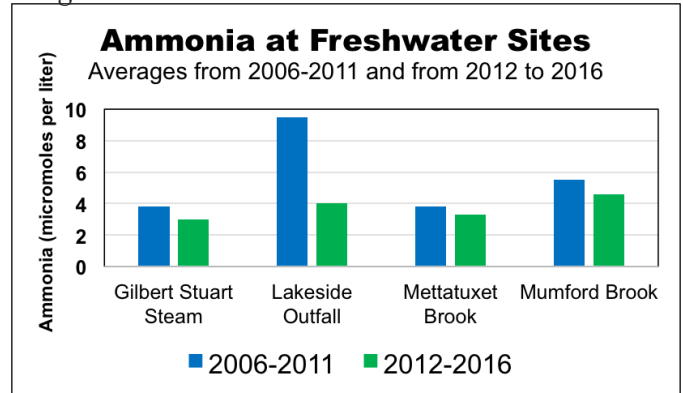


Figure 6a:

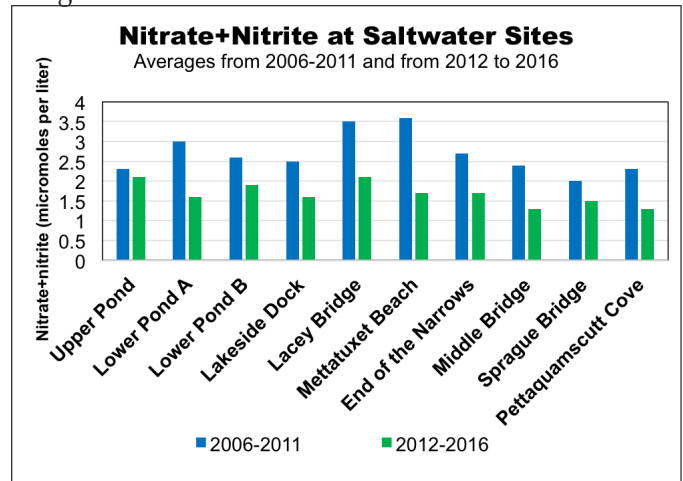
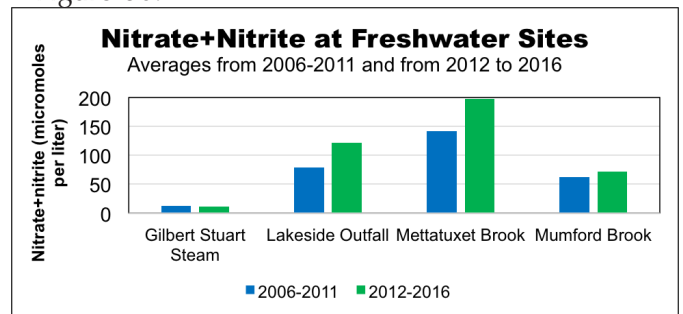


Figure 6b:





Many thanks and congratulations to Annette DeSilva for her 26 years of coordinating NRPA's River Watch.

All the data analysis seen here, plus additional work not shown, could not have been possible without the diligent work, mapmaking, and data management carried out through many years by NRPA interns Rahat Sharif and Eric Peterson. NRPA's SCWrite Intern Danielle Perry was a great help with the Annual Meeting PowerPoint presentation.

Finally, the River Watch program would not have been possible without the dedicated service of the volunteer monitors. Over the first 25 years of the program there have been more than 185 volunteers. They have collectively shared over 7800 hours of their time helping us to learn more about the quality of the Narrow River.

References:

[1] *Fecal Coliform TMDL for the Pettaquamscutt (Narrow) River Watershed, Rhode Island* <<http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/narrivdr.pdf>>; Rhode Island Department of Environmental Management; December 2001

[2] *Bacterial Monitoring*, URI Watershed Watch, Cooperative Extension, College of the Environment and Life Sciences (CELS), Department of Natural Resources Science (NRS) <<http://cels.uri.edu/docslink/www/water-quality-factsheets/Bacteria.pdf>>; Elizabeth Herron, Kelly Addy and Linda Green, June 2015

[3] *Nitrogen and Water Quality*, URI Watershed Watch, Cooperative Extension, College of the Environment and Life Sciences (CELS), Department of Natural Resources Science (NRS) <<http://seacomm.weebly.com/uploads/3/7/7/6/37768331/nitrogenfact-sheet.pdf>> Kelly Addy, Linda Green, and Elizabeth Herron, March 2005

What Lives in the River, 'Gansett Days



As part of 'Gansett Days, on Saturday, September 16th, in concert with the Narrow River Land Trust, Narragansett Land Conservancy Trust and the Town of Narragansett, NRPA hosted What Lives in the River.

Nearly 40 people attended this free, hands-on family education event at which locals and visitors of all ages are encouraged to explore and learn about animal and plant life in

the Narrow River. With nets and buckets, volunteers teach families to catch river creatures and then provide identification and information about what is caught. Touch tanks and microscopes provide more opportunities for exploration.

What Lives in the River volunteers include URI scientists and students, local science teachers, high school students and other local residents. 'Junior volunteers' assist other children and while earning community service hours.

We hope you will join us for upcoming What Lives in the River events, scheduled for June 16 and September 15, 2018.



Photos, clockwise from top left: Visitors enjoy exploring Narrow River with seine nets and dip nets (Photo credit: Charlie Biddle), NRPA Junior Volunteer Jaiden Spears, age 13 of Charlestown, shows a blue crab he caught (Photo credit: Veronica Berounsky), Cyrus and Kyra, ages 4 and 2, of Saunderson, reach for seaweed, fish and crabs in touch tanks (Photo credit: Alison Kates) Narrow River Land Trust member Sheldon Pratt shows 6 year old Maia Hubbard of Peace Dale small organisms living on the floor of the Narrow River (Photo credit: Veronica Berounsky).



The Friends of Canonchet Farm, Narrow River Preservation Association, South County Museum and the Maury Loontjens Memorial Library along with generous support from Trio Restaurant, are collaborating for the seventh year to sponsor the Winter Speaker Series *On Pettaquamscutt: Presentations on the Environment and the History of the Narrow River Watershed*.

The presentations will take place on selected Sundays from 1:00 to 3:00 p.m. at the Maury Loontjens Memorial Library, 35 Kingstown Road, Narragansett. After each event, participants are encouraged to continue the conversation at Trio Restaurant, 15 Kingstown Road, Narragansett.

Sunday, January 28, 2018 South County Museum Associate Director Blaire O. Gagnon "The Sampler - A Young Lady's Education in the 18th & 19th Centuries" Sponsored by South County Museum

Sunday, February 25, 2018 Gary Cassabona, Natural Resources Conservation Service, U.S.D.A. "Habitat Management for Pollinators" Sponsored by Friends of Canonchet Farm

Sunday, March 25, 2018 URI Watershed Watch Program Director Linda Green "Narrow River and its Watershed: Twenty-five Years in Review", Sponsored by Narrow River Preservation Association

Free and open to the public. Participants must preregister at OnPettaquamscutt.org or at the calendar page of the library website (www.narlib.org) as capacity is limited to 90 guests. For more information, call 401-783-5344 or email info@onpettaquamscutt.org.

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