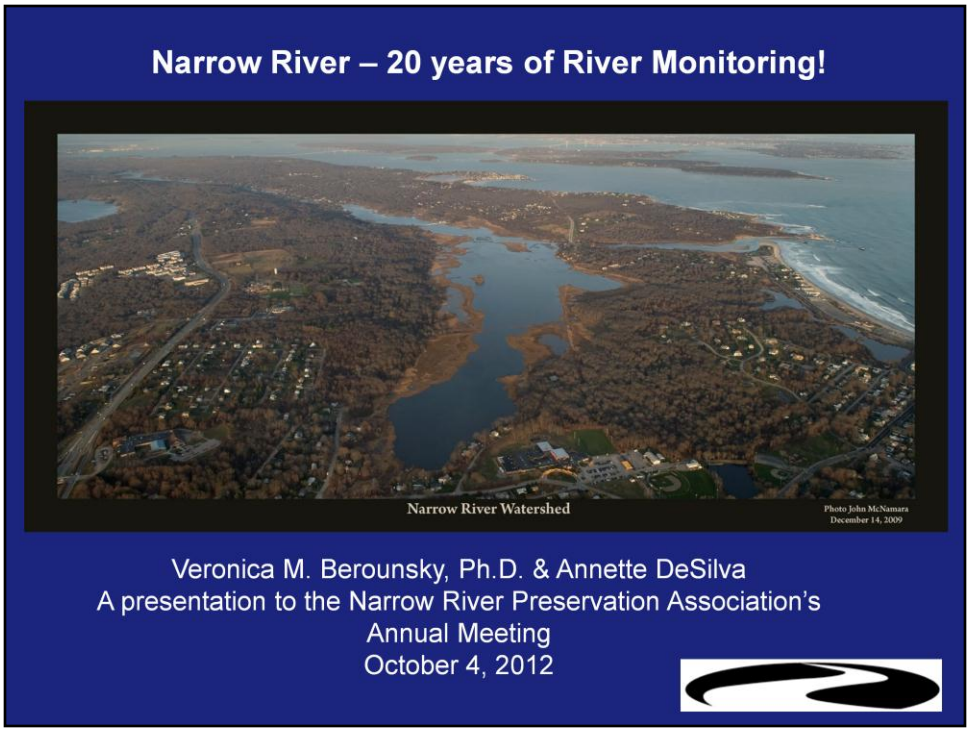



As our featured presentation tonight, Veronica Berounsky and I (Annette DeSilva) will present an overview of the data collected over the past 20 years!

Veronica and I have been on the NRPA Board for about the past 22 years. Since its inception I have overseen the monitoring program and we are both volunteer water monitors. This year volunteers completed 21 years of the River Watch monitoring program.

At the 20 year milestone - we decided that it would be a good time to try to compile all of the data and take a look at long-term look at some of the parameters.

With funding from the RIRC, we hired URI graduate Ms. Rahat Sharif to compile the data into a central database that would allow us to more easily manage it. Rahat has much experience in this type of work.

As you might imagine, we have a lot of information to share, so we would like to suggest that all questions be held until the end. That would ensure that we have enough time to cover everything.

# Topics to be covered

- The River Watch volunteer monitoring program –overview
- A review of Twenty Years of Data
- Observations and Trends
- What can we do?
- How has the data been used?
- Partners and Funding
- 2012 Narrow River Volunteers

Photo by Veronica Berounsky

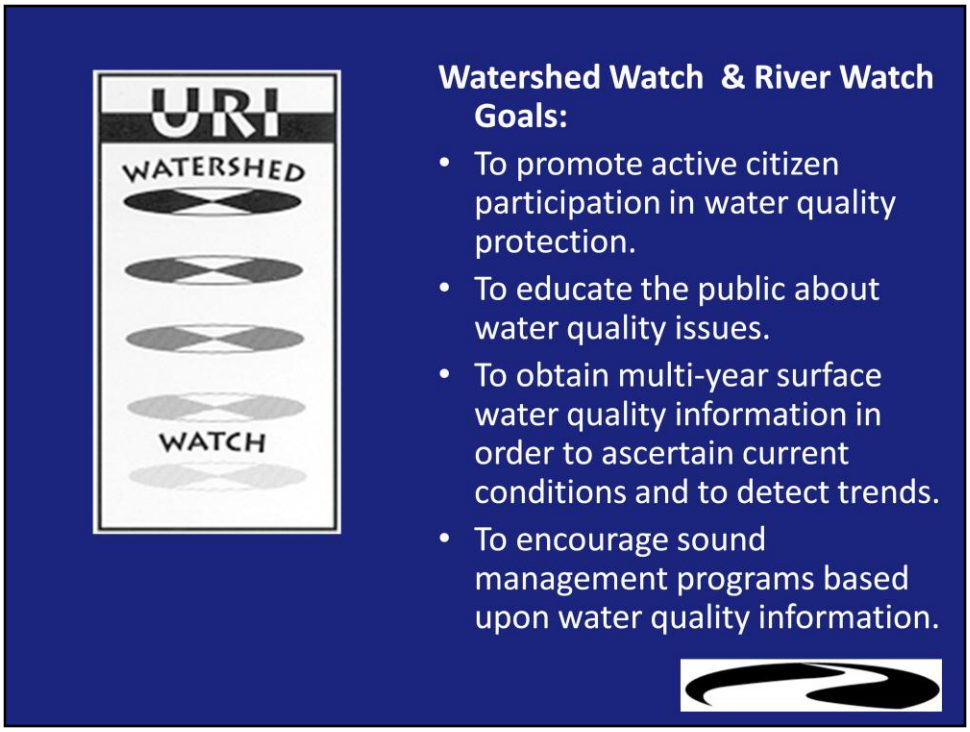
## River Watch – Background Information

- 1991 - The Narrow River Stormwater Management Project - As part of this project, funds were allocated for citizen water quality monitoring.
- 1992 - "River Watch" officially begins with 10 monitoring locations and is part of the URI Watershed Watch Program
- 2011 – Completed 20 years of volunteer monitoring of the Narrow River! – 14 sites

In the late 80s, NRPA had a strong interest in starting a volunteer water monitoring program because:

- We wanted to learn about the health of the river.
- Since there was no industry along the river (obvious point sources), a watershed watch approach for residential areas would be useful.
- Sewers were being extended along the River at this time.

1991 - The Narrow River Stormwater Management Project (financed by RIDEM Aqua fund) was developed. This was a tri-town study on how to manage stormwater discharge into the river. As part of this project, funds were allocated for citizen water quality monitoring. The Project provided the seed money needed to get the program off the ground.
1992 - "River Watch" officially began in 1992 with 10 monitoring locations.



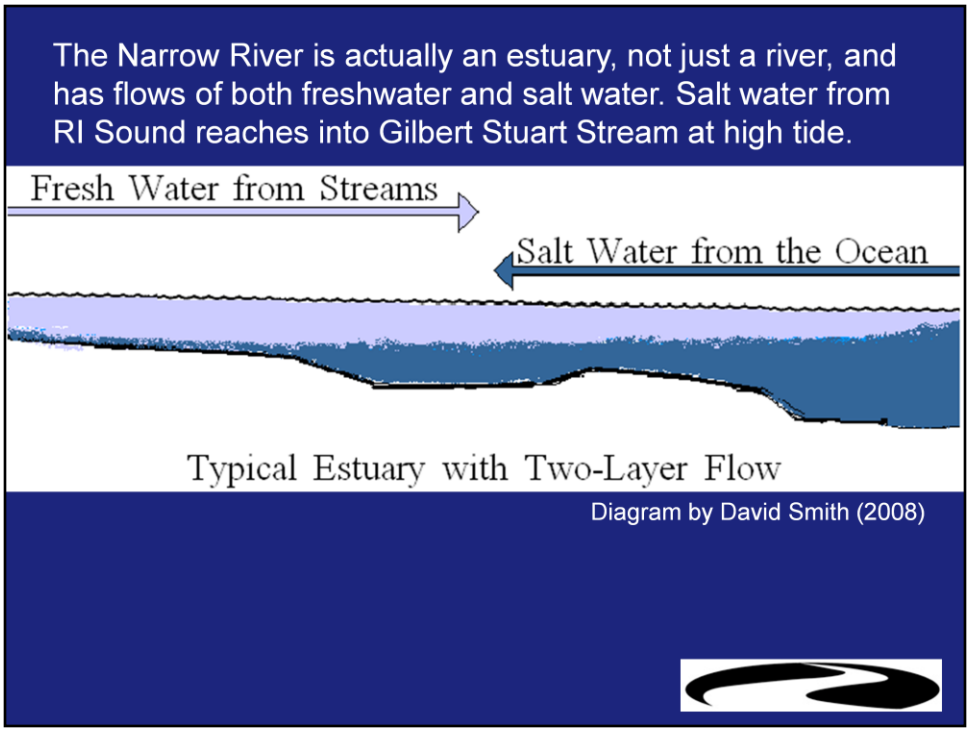

In 1992 NRPA partnered with the University of Rhode Island Watershed Watch Program for bi-weekly monitoring and monthly (May – October) sampling of the Narrow River.
We share the same goals:

## Satellite view of Narrow River and its Watershed

- Watershed boundary is approximately Rt. 1 and Rt. 1A
- Watershed area is 8,700 acres or 14.4 sq. miles or 35.5 sq. km
- Length is 7 miles or 9 km long
- Located in North Kingstown, South Kingstown & Narragansett

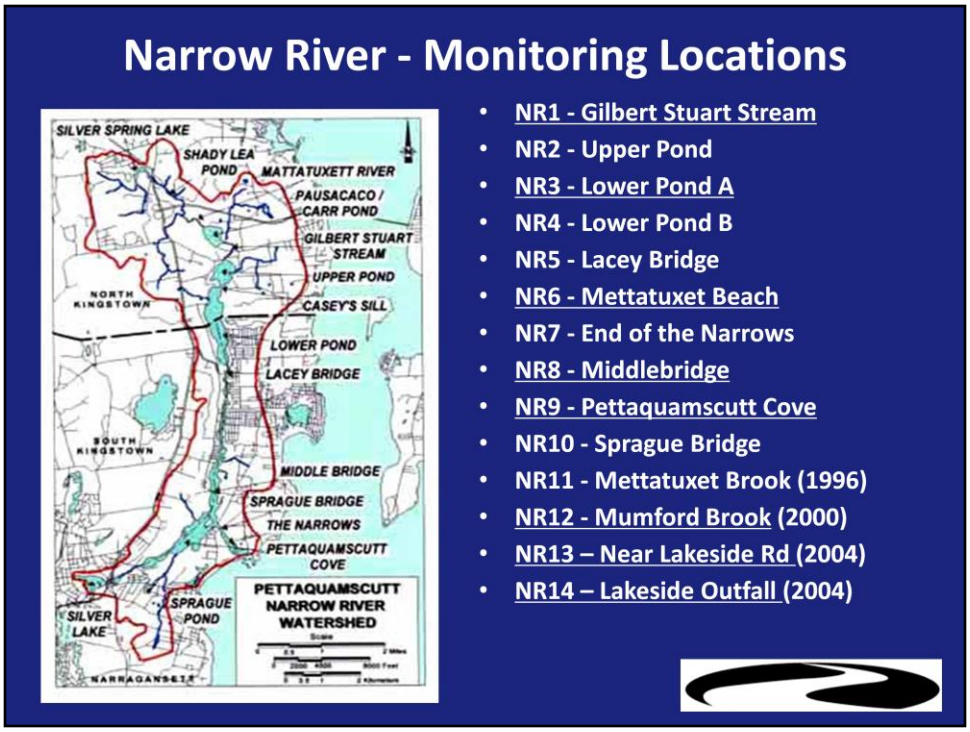
Land use is primarily residential

(Photo from Google Earth)




Most of Narrow River is a typical two-layered flow of an estuary. Fresh water is on the top. Denser salt water flows along the bottom of the river. Normally there is some mixing of these two layers where they meet.

4/22/08




As I mentioned we now have 14 monitoring sites. The original sites (NR 1 – 10) were picked so that they would span the length of the river. They would also be fairly easy to access, some by motorboat or canoe, some by land.

1996 – NR 11 Mettatuxet Brook added – in response to land development demand.

2000 – NR 12 Mumford Brook was added – DEM's TMDL study identified this as an area of concern.

In 2004 – Veronica started monitoring NR13 and NR14 – Lakeside Road and Lakeside Outfall. These are located in the Lower Pond on the East side shore. The town had identified this as an area where a stormwater management plan would be implemented. With Veronica's data, we should be able to observe pre- and post-management results.

In this presentation, we will focus on the sites that are underlined since there is not time to cover all the sites. We selected these sites because they span the length of the river and they represent some diverse regions.

## What is monitored?

- Monitoring Season: May – Oct
- Temperature
- Salinity
- Dissolved Oxygen
- Chlorophyll
- Bacteria
- Nutrients

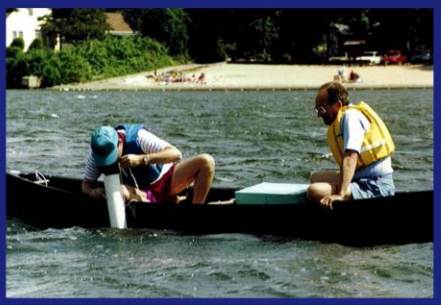


*Photo by Annette DeSilva*

Monitoring Season: May – Oct

Volunteers measure Temperature, Salinity, and Dissolved Oxygen every two weeks. They also collect samples for Chlorophyll that will be analyzed by the Watershed Watch Lab.

Once a month, samples are collected for Bacteria and Nutrient analysis by the Watershed Watch Lab.

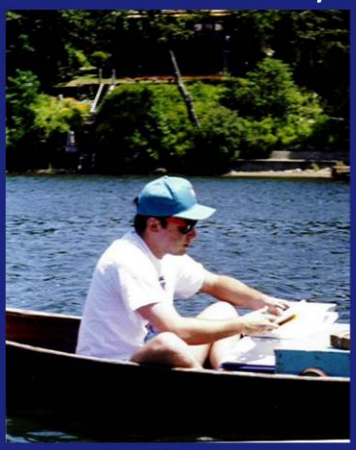
We have so much data, it was difficult to decide what to present in such a small time. So we decided to focus our attention on Bacteria and nutrients (so they are highlighted).


With 20 years of monitoring, many volunteers have participated and a large body of data has been collected.

- 170 volunteers devoting over 4,200 hours of their time.
- Total Field Measurements = over 30,000
- Total Lab Analyses = over 10,000

# River Watch Data

## ~ a brief summary ~



**Monitor Robert Schelleng 1992**
(Photo by Annette DeSilva)

With 20 years of monitoring, it is a challenge deciding what would be most useful to present. We decided to focus on bacteria and nutrients

# Bacteria Data and Trends

Photo by Annette DeSilva

I will present bacteria data and Veronica will follow with nutrients.

## Bacteria – Why are we concerned?

- Bacteria analyses screen for suitability for recreational water uses (swimming) and shellfishing, and may indicate sewage contamination.

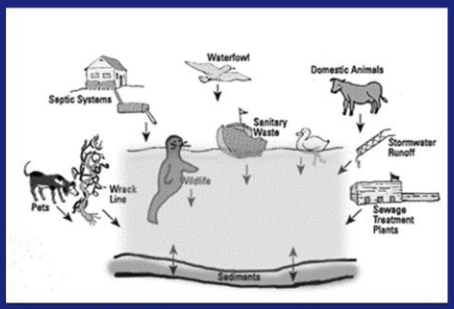



*Figure 1: Potential sources of bacteria to a waterway (from Ely, 1997).*

Marine standards:

- Recreation (safe swimming) = 50 fecal coliform/100 ml
- Shellfishing = 14 fecal coliform/100 ml

Fresh Water Standard:

- Recreation = 200 fecal coliform/100 ml

Why is bacteria monitoring important?

The analysis of the water samples for bacteria levels screen the water for its suitability for recreational (swimming) and for shellfishing, and may indicate sewage contamination.

Laboratory analysis examines three different bacteria indicators: fecal coliform, Entericoci, and E. coli. Although Entericoci is now the preferred indicator by RI DEM for recreational contact, we have decided here to examine the fecal coliform values, because it was the preferred indicator 20 years ago and so we have 20 years of data. Also fecal coliforms values are still used for shellfish standards.

And we will mostly look at marine standards since most sites along the river are marine waters – brackish/salt water

- For safe swimming = the fecal coliform levels should be at or below 50 fecal coliform/100 ml.
- For shellfishing = at or below 14 fecal coliform/100 ml

We will use fresh water standards for streams, brooks and outfalls

- Recreation = 200 fecal coliform/100 ml

Bacterial sources: this figure shows some of the sources of bacteria such as pets, wildlife, failed septic systems, and so on.

# Sites and Bacteria Trends

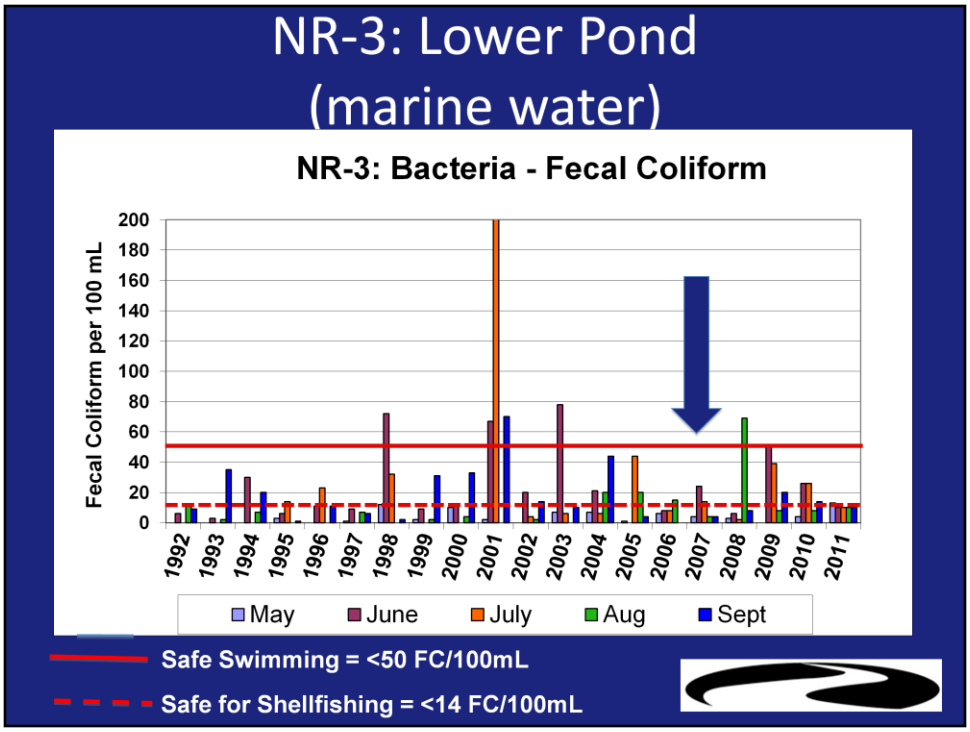
- The next slides will include a photograph of a selected River Watch site followed by a graph of the 20 years of bacteria values at that site.
- Graphs of nutrient trends will follow.


We will take you on a cruise down the river from North to South, with a photo or two of the site and then the graph of bacteria values.

The first location is NR-3, home to URI crew teams and the annual NRPA Turnaround S swim.

Housing density is low.

The water is brackish (not fresh).




The data will be in graphs that look similar to this.
For each river location, we will show the 20 years of monitoring on the horizontal axis.

- The FC/100 mL is on the vertical axis; the scale is the same for on each chart for the marine water locations.
- Each year we collect water samples once a month for five months, so you can see the bacterial level in the colored bars on the chart – should be about five bars per year.
- Solid Red line is the standard for safe swimming. Bacteria levels should be at or below the red bar for safe swimming.
- Dashed Red line is the shellfish standard. Bacteria levels should be at or below the line for safe shellfish harvesting.

One more thing I should mention, when I refer to safe swimming, it is on the dates that were sampled. The data needs to be sampled more frequently to actually make that statement.

At NR-3 The water is brackish. With only a few exceptions, the data shows that the waters are safe for swimming.
The arrow denotes 2007, when an anoxic water ventilation (also called overturn) occurred in Upper Pond in October and some of the low oxygen water flowed into Lower Pond by NR 3.

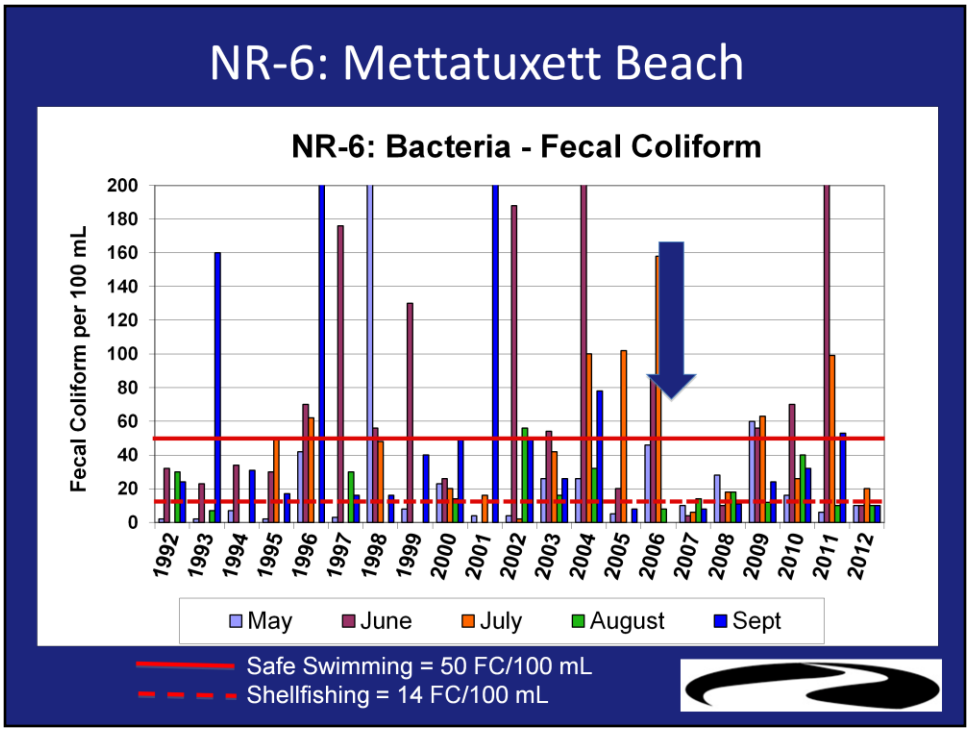
# NR 6 - Mettatuxet Beach Detention Pond outfall

Photo by Veronica Berounsky

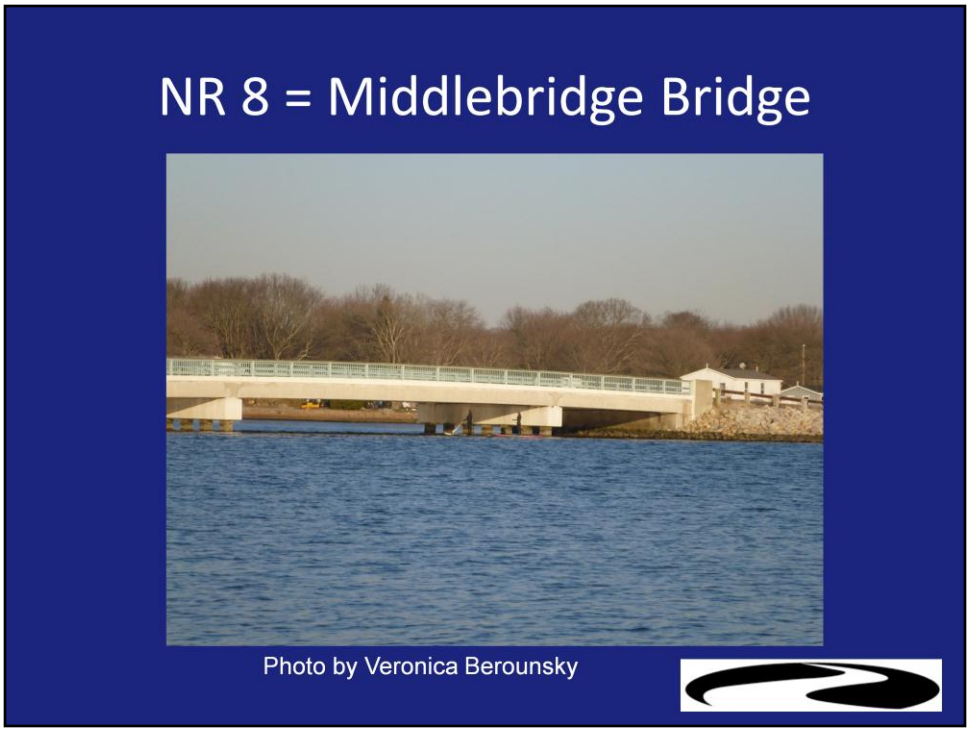
NR6 is located at Mettatuxet Beach, a marine water site.

This site is of interest for a variety of reasons:

- High density neighborhood
- Recreational uses
- A storm outfall pipe
- New Best Management Practices (BMP) stormwater management system installed in 2006.




Red solid line is the safe swimming line and dash line is safe shellfishing line.
The safe swimming standard is exceeded on more days than in Lower Pond (previous site looked at).
Many of these occur in June and July, but there are also a few Sept dates early on.
Notice that the shellfishing standard is exceeded on most dates, and often the safe swimming limit was exceeded.
The arrow denotes 2006, when the Stormwater Abatement System came into operation. With the exception of 2011, the levels are generally lower than in the previous years.
The data looked good for the first few years after the abatement system was installed.

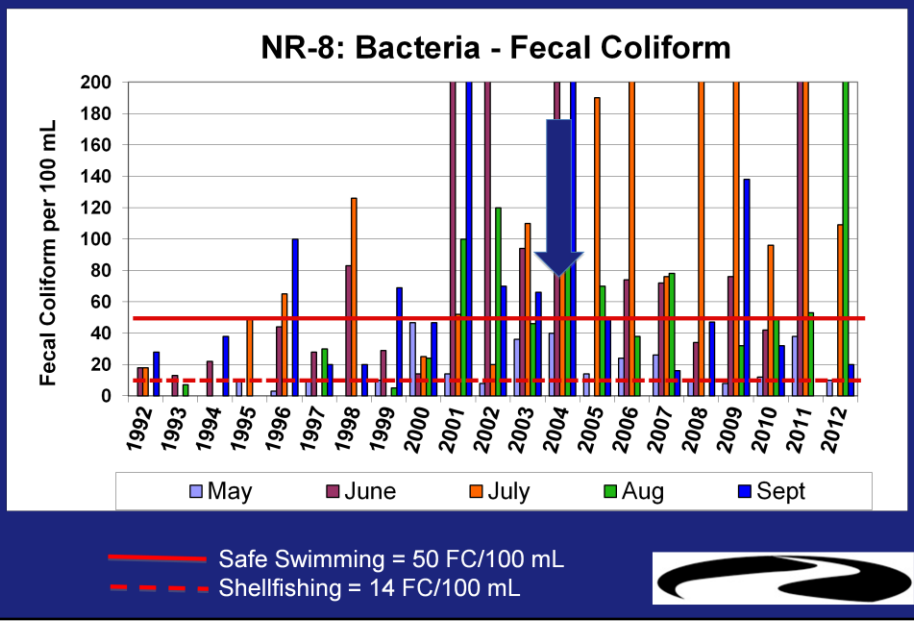



NR 8 is the site next to Middlebridge Bridge.

It is a marine water site.

In 2004 a new bridge span was completed that was a longer span (a wider opening).

# NR-8: Middlebridge



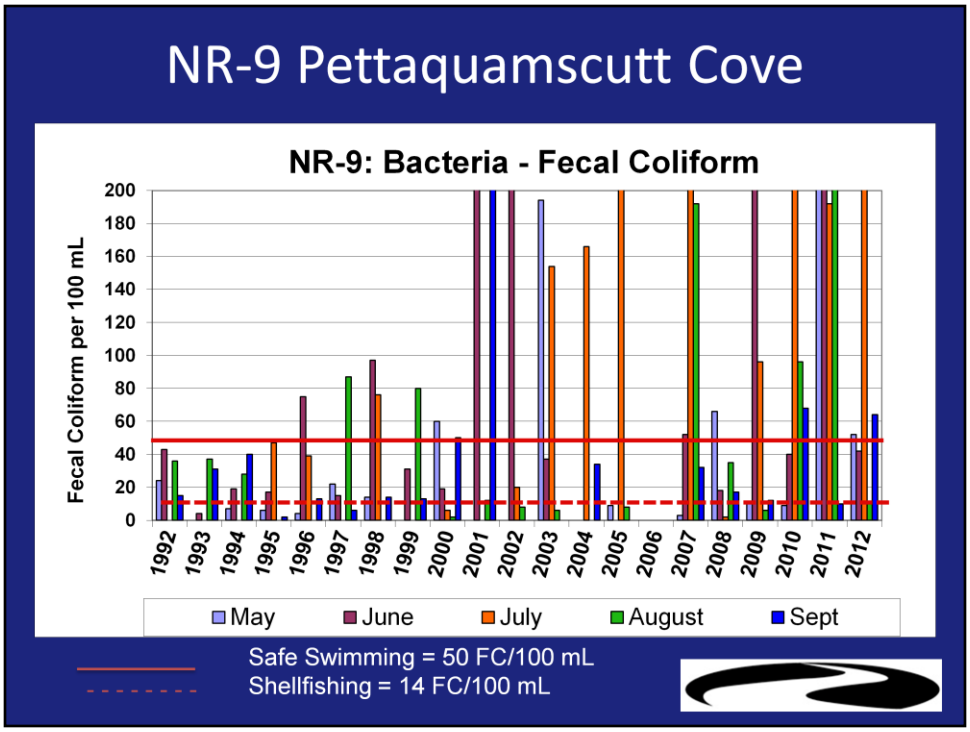

NR 9 is the site in Pettaquamscutt Cove

The site is interesting because:

- It is in a cove and the whole cove is mostly very shallow.
- There is low density of housing
- One of the main freshwater streams enters Narrow River via the western shore of Pettaquamscutt Cove.

This is a marine water site.

It is also the location of the *Pettaquamscutt Paddle*, one of the organized paddles on the river that is also a fundraiser for NRPA.




We see a pattern similar to Middlebridge, showing a rise in levels after 2001.

Before 2001, bacteria values rarely exceeds safe swimming levels but often do after 2001.

Shellfishing standards are often exceeded throughout the data set.

In 2006 we did not  have a monitor for that site, so there are no data.

The Cove is bordered by the Chafee Wildlife Refugee. Maybe there was an increase in some bird population, namely cormorants?

Now we will look at monitoring trends at sites where waters enter Narrow River….


Now I am going to look at several sites where freshwater enters the River and brings in bacteria.

I'm heading back up the river to look at an outfall near Veronica Berounsky's house and dock on Lower Pond.

Site NR-13 is at Veronica's dock.

In the distance you can see the outfall, which is NR 14.

# NR-14: OLD Edgewater outfall pipe

photo by Veronica. Berounsky

This a close-up of the old outfall pipe at NR 14.

# The NEW Edgewater BMP system: sand filter and outfall

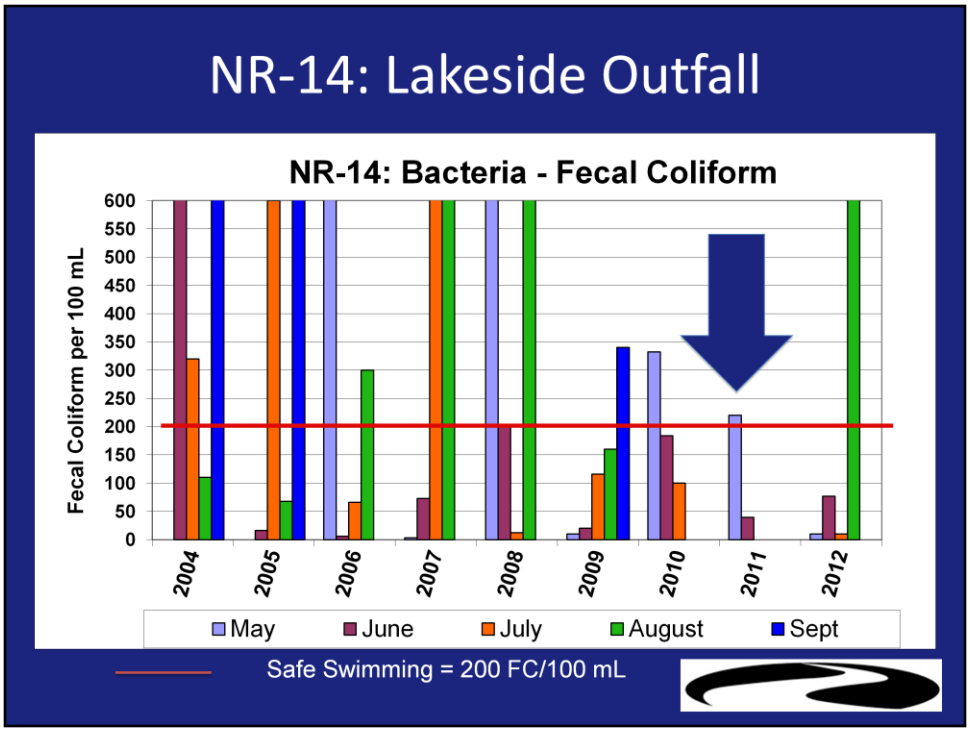
The sand filter slows down the flow of stormwater, keeps it in the sunlight, and filters it to reduce the amount of bacteria and nitrogen

Photos by Veronica Berounsky

This is the BMP that replaced the old pipe. On the left is the sand filter on Edgewater Road where the stormwater enters and is retained for some time. Construction of the sand filter was completed in December of 2010, but there were leaks in pipes that were not fixed until late fall of 2011.

We wanted to look at these two sites for a couple reasons:

- To see the potential impact of the old outfall on the water quality during the early years
- To observe any changes after the new BMP stormwater abatement system was in place



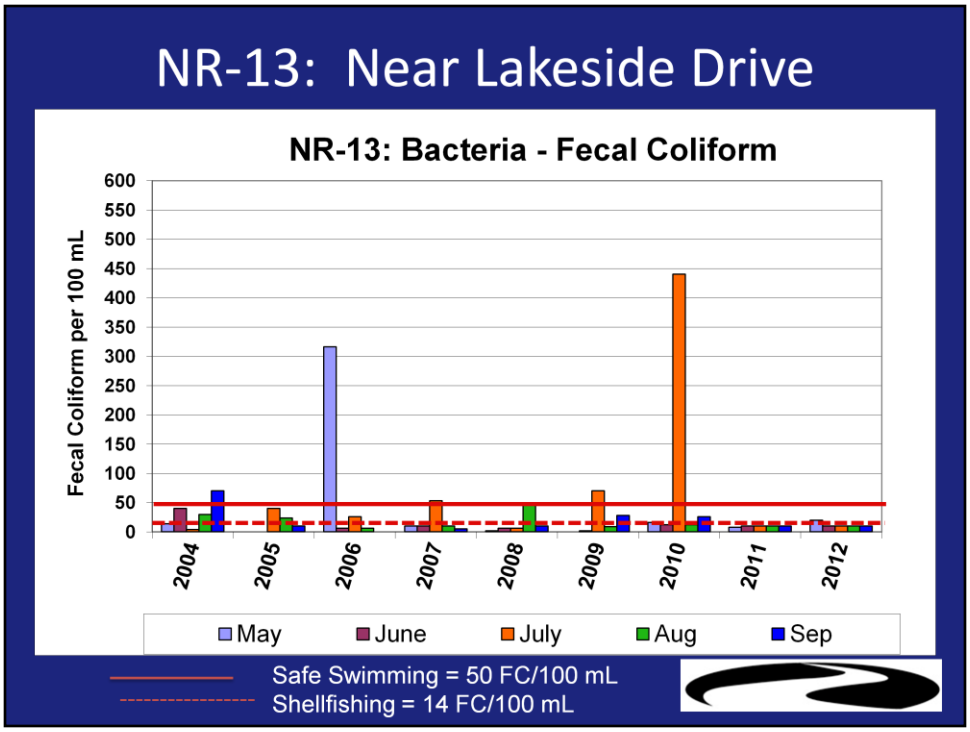

NR-14 only has freshwater flow.

With the old pipe there might be some flow all the time, but with the new BMP there is only flow during and after rainfalls (so some months there is no flow and no data points).

The wide arrow denotes that most of the BMP was completed by December 2010, but it was not fully operational until late fall 2011.

For safe swimming in fresh water, the standard is 200 FC/100 mL, solid red line.

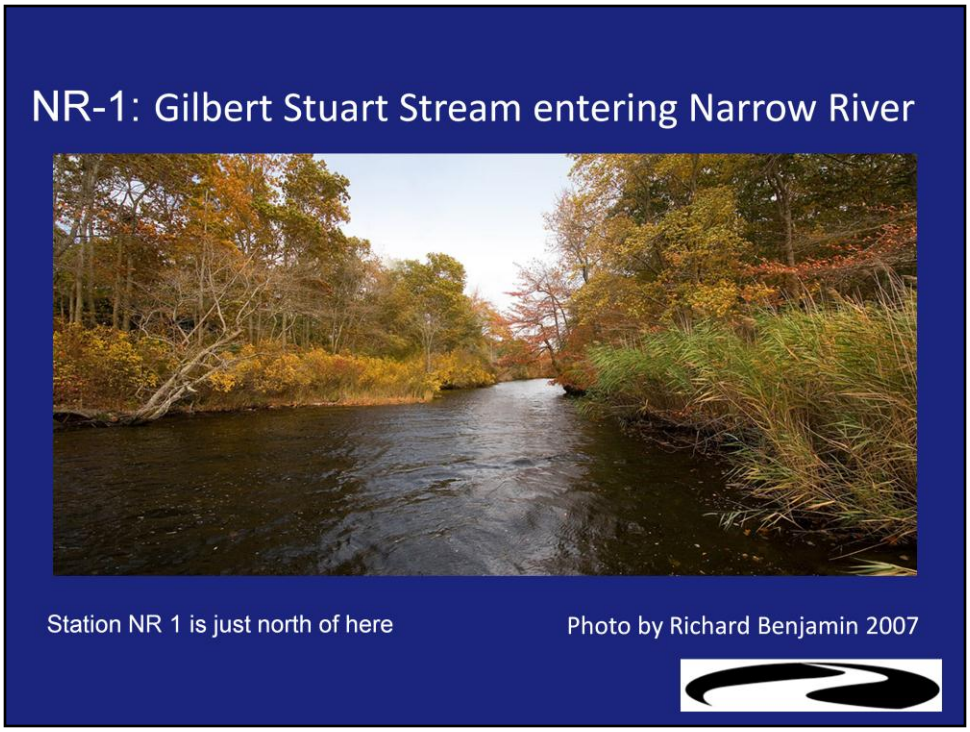
On many occasions, this site exceeded the freshwater safe standard for swimming.




NR-13 is marine water, but we wanted to compare the data to NR-14 data, so we are showing the values on that scale (but the red lines denote the marine standards).

Only once (July 2010) did bacteria levels here exceed those at the outfall location (NR-14).

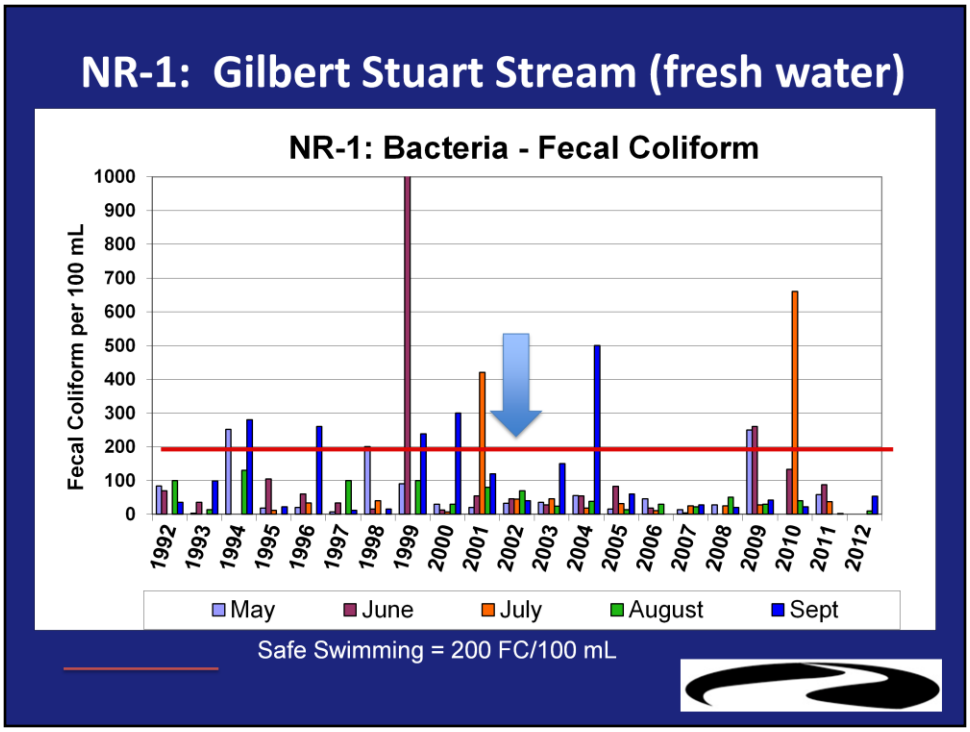
This is good. Despite high bacteria levels entering the River a short distance away, they dissipate quickly.



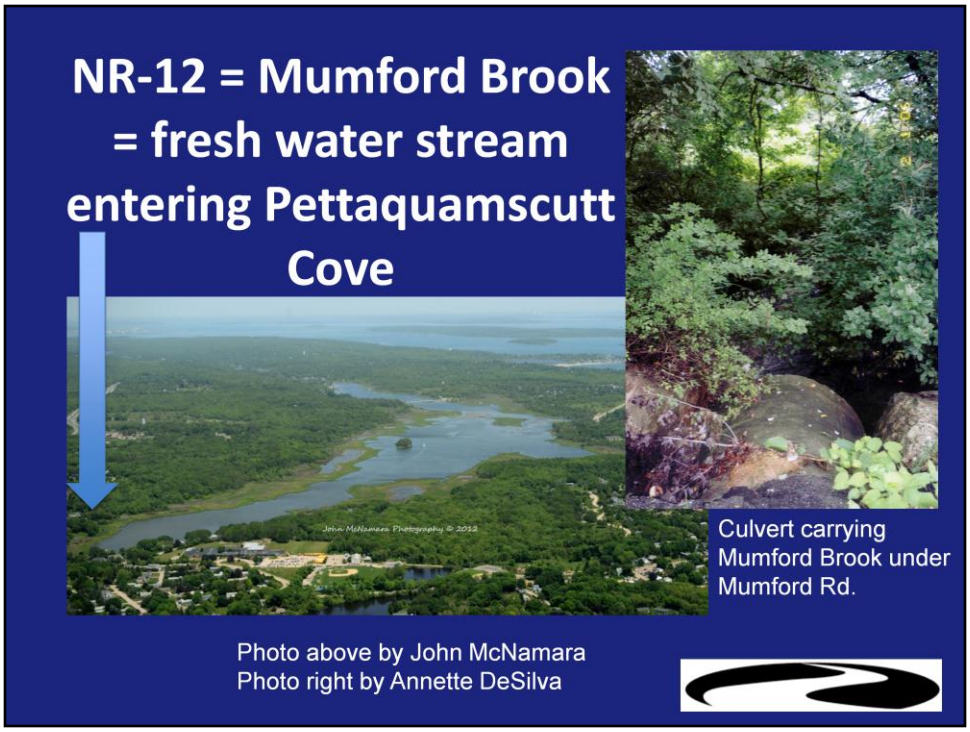

The next few slides show fresh water sites, starting with NR-1.

NR-1 is at Gilbert Stuart Steam which starts at the Gilbert Stuart Birthplace Museum. It is considered a fresh water site, although salt water reaches here at high tide.

There is not much development here, Gilbert Stuart Road is beside the stream and there are a few houses on either side.

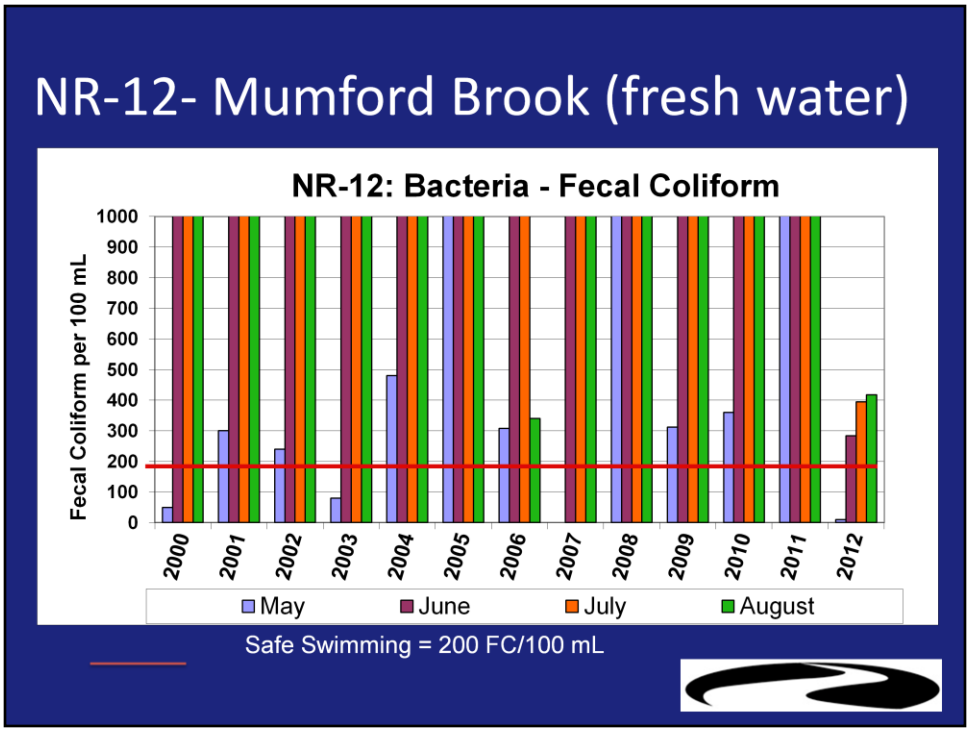



Before 2002, we saw mysterious peaks, surprising since this is an area of low density housing. The mystery was solved when an older (but still used) outhouse at Gilbert Stuart Birthplace and Museum was closed. Since then there have been peaks only on a couple occasions..




At the other end of the river, about as far away as you can get, you find Mumford Brook.

The fresh water standard for recreational contact is not to exceed 200 fecal coliform/100 mL.




The Mumford Brook values are a **horror story**.

On the graph is a red line for fresh water standard for recreational contact , that is, not to exceed 200 fecal coliform/100 mL. Values here are extremely high.

- The problem was discovered initially by DEM
- NRPA began monitoring in 2000
- NRPA repeatedly reminds DEM of problem

Are the high values caused by a faulty septic system in the area?

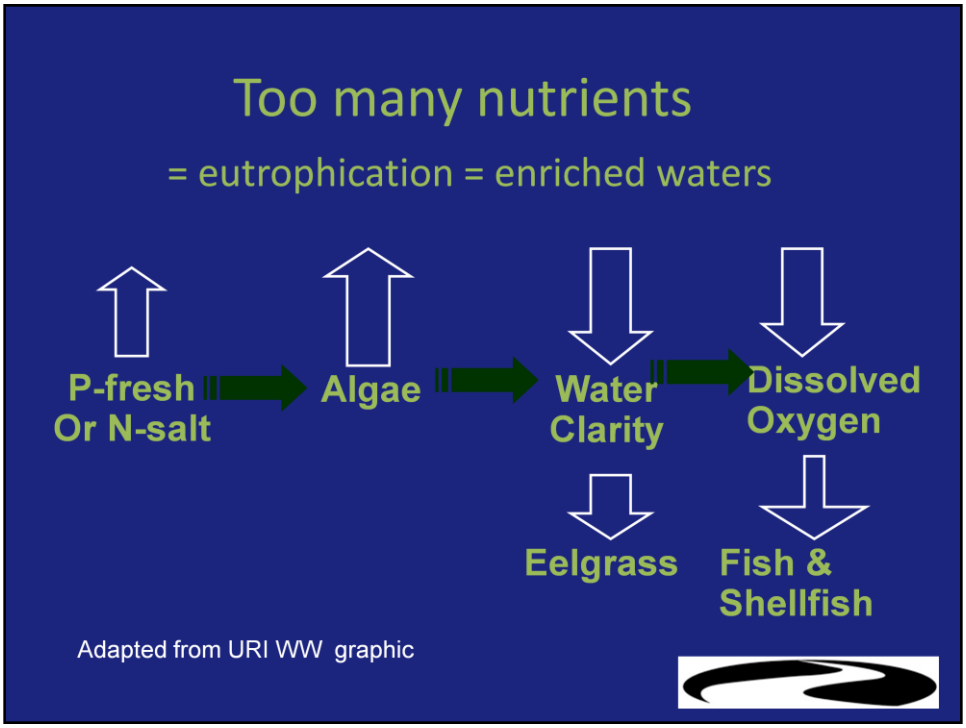
A study by URI GSO graduate students to identify the source of the bacteria found nothing that pointed to warm blooded sources.

Still a mystery ! From birds?

# Nitrogen Data and Observations

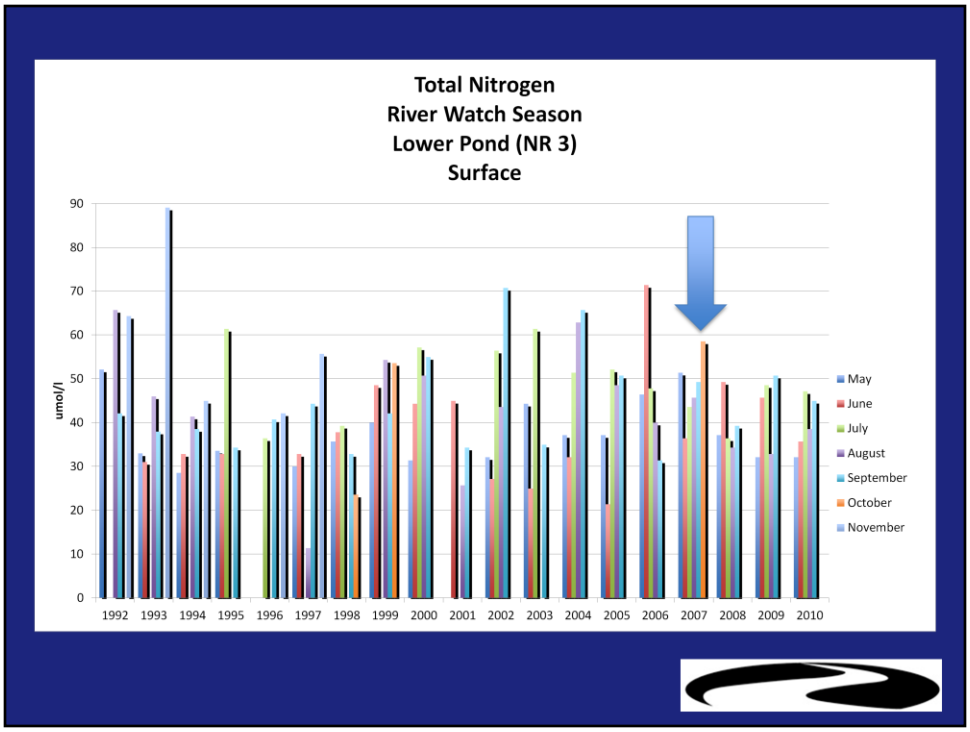
# Why do we worry about Nitrogen?

- Excess fertilizer use leads to runoff of excess nitrogen to the River
- Stormwater runoff is often high in nitrogen and fecal coliform bacteria
- Nitrogen leads to algal blooms that decrease sunlight and harm eelgrass beds
- Decaying algae depletes dissolved oxygen forming hypoxic (low oxygen) conditions and harming fish and shellfish.

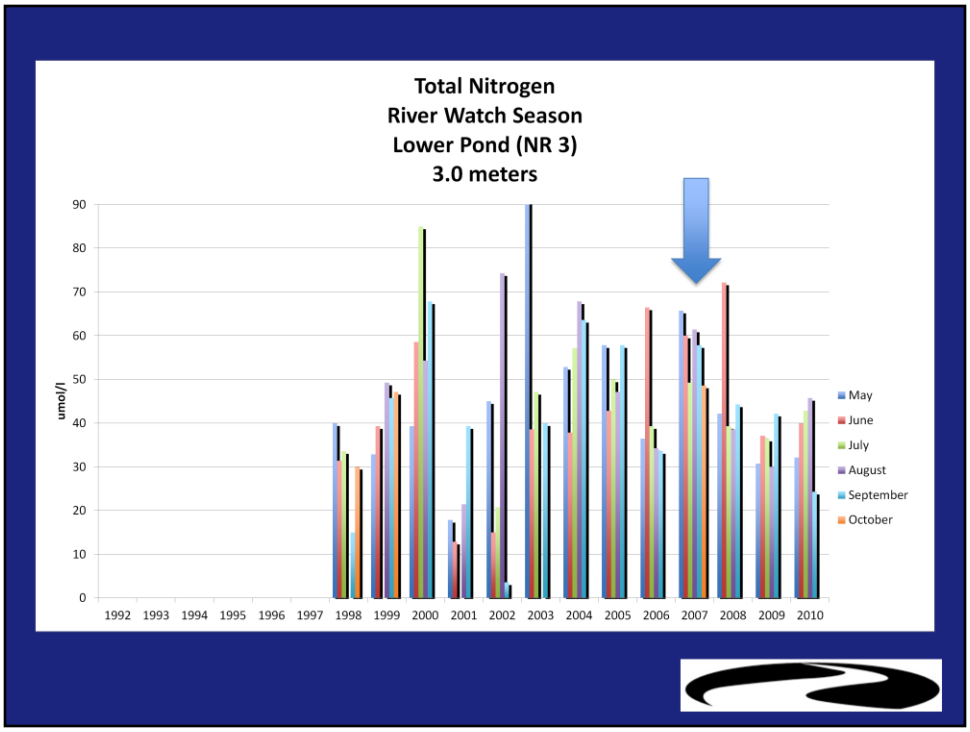

Too many nutrients
= eutrophication = enriched waters
P-fresh
Or N-salt
Algae
Water
Clarity
Dissolved
Oxygen
Eelgrass
Fish &
Shellfish
Adapted from URI WW graphic

# Observations and Trends looked at today:

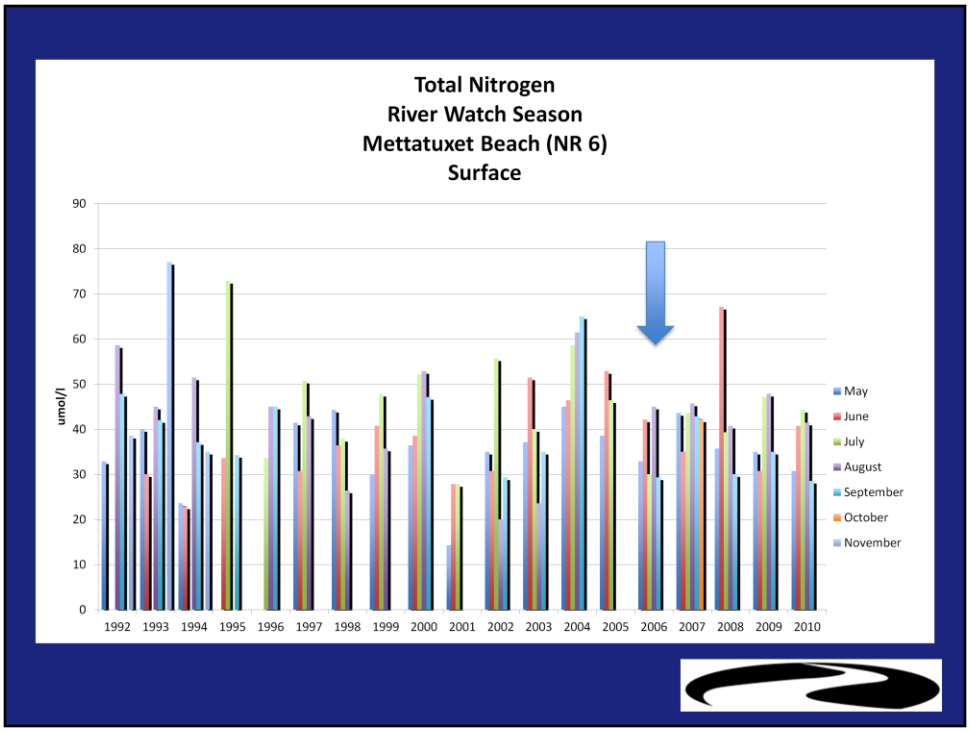
- 5 stations along the River:
  NR3 = Lower Pond (at surface & at 3m deep)
  NR 6 = Mettatuxet Beach
  NR 8 = Middlebridge
  NR 9 = Pettaquamscutt Cove
  NR 10 = Sprague Bridge



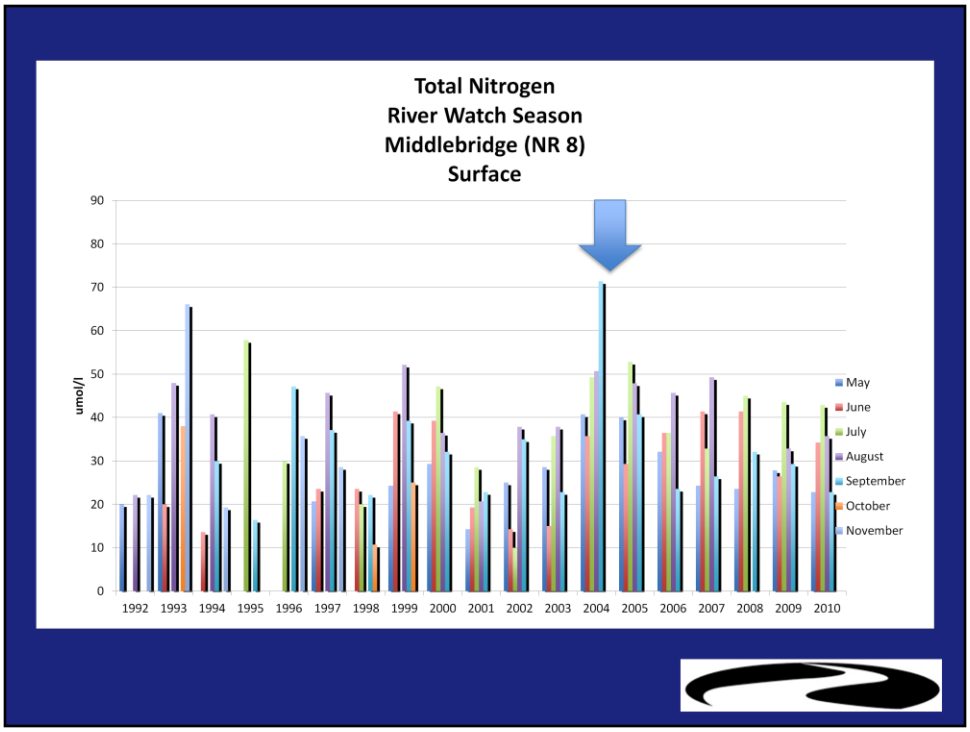

The blue arrow indicates the overturn (or ventilation) that occurred in October 2007.




The blue arrow indicates the overturn (or ventilation) that occurred in October 2007.

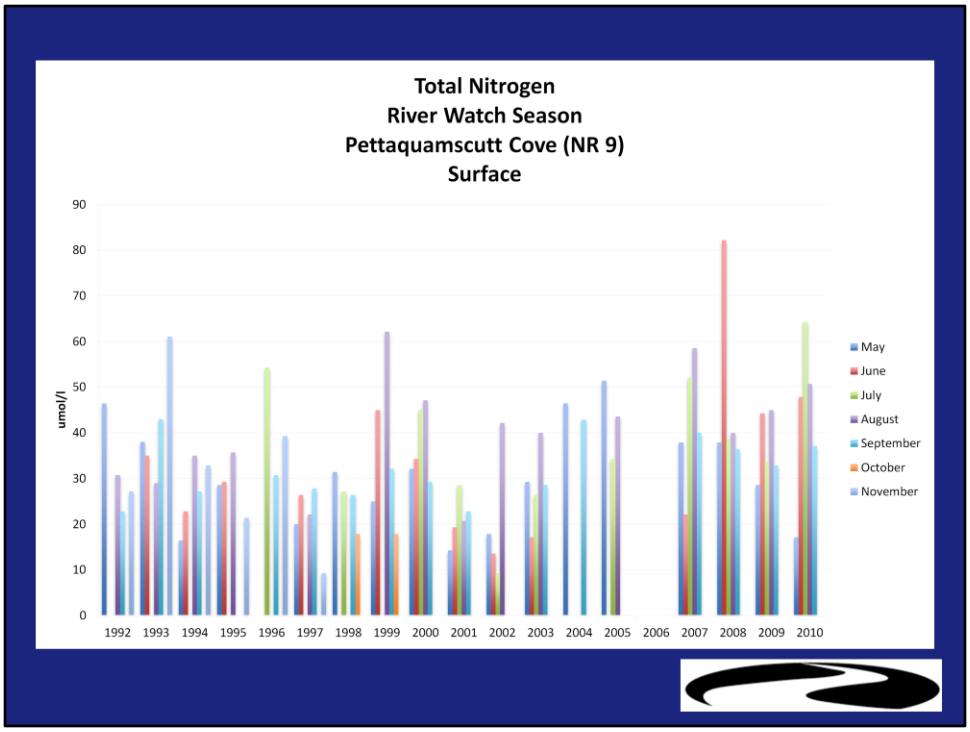


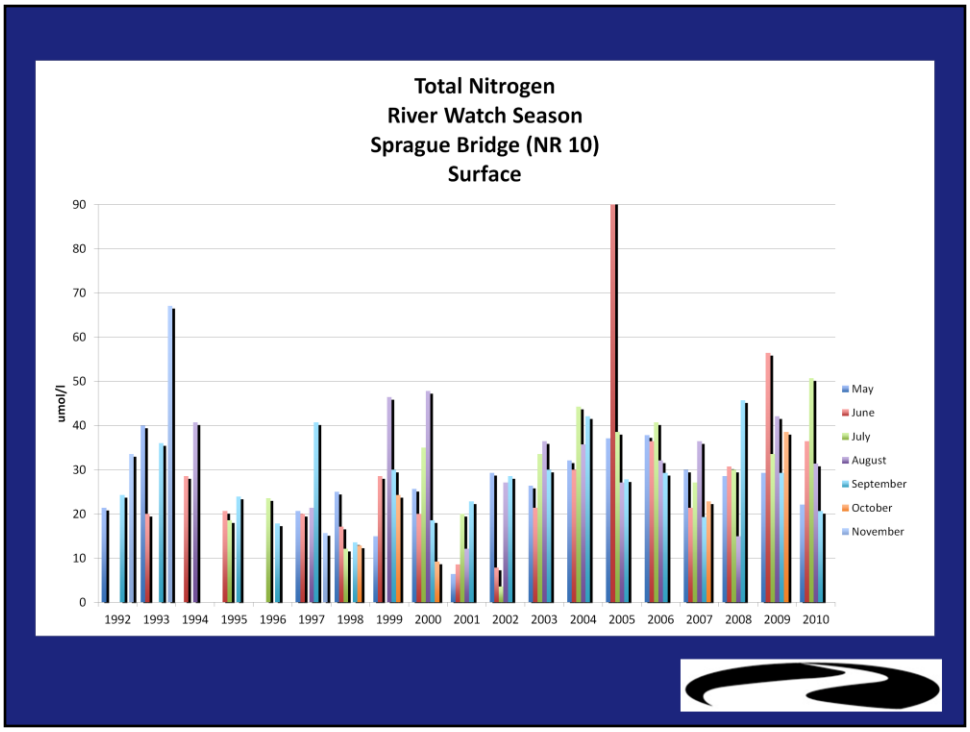

Stormwater abatement system operating in 2006, after that values are more consistent from month to month, that is, there are fewer spikes.




New bridge with a wider span opened in 2004 at NR-8.

Note the nitrogen values are more consistent from month to month after the opening, that is there are fewer spikes.


Total Nitrogen
River Watch Season
Pettaquamscutt Cove (NR 9)
Surface
umol/l
0
10
20
30
40
50
60
70
80
90
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
May
June
July
August
September
October
November




Note that at Sprague Bridge, the levels are lower, as there is less nitrogen in water entering from Rhode Island Sound.

Water Quality Trends :

What we have learned from
20 years of River Watch data…..

# Conclusions for bacteria and nitrogen

- Streams and the outfall have highest levels of bacteria and nitrogen- these are inputs
- After major rain events, see elevated levels of bacteria and nutrients -so stormwater is a source
- Pond sites have lower bacteria levels than other sites – more land area for filtering?
- Sites close to the mouth have lower nitrogen – because less nitrogen offshore
- Fewer spikes in nitrogen after about 2004 in Middlebridge and Mettatuxet – due to BMP and bridge span increase?

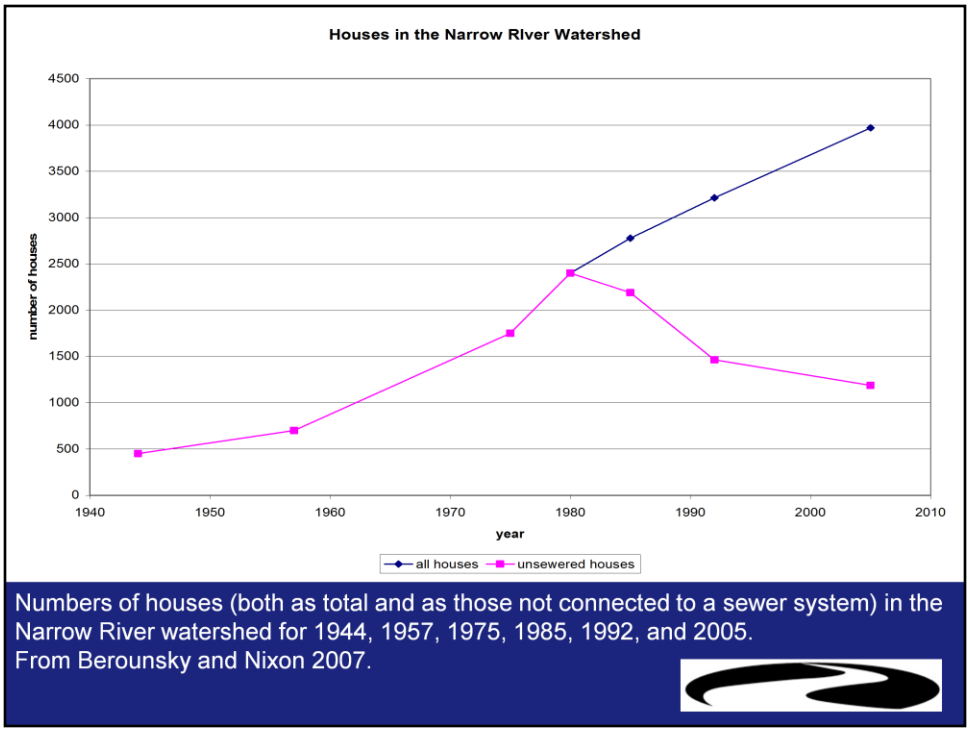
## Also, we haven't yet seen a consistent reduction in levels of nitrogen and sewers were supposed to help…

- Why don't we see a decrease in nitrogen right after the sewers went in?
- Information from other watersheds shows a 5-10 year lag after sewers are put in and before any improvements are seen. It's a long term investment.
- Sewers make "unbuildable" lots buildable, so there are more houses with more pavement
- See upcoming graphs…..

# Important Issue for Narrow River: Increase in residential development

**Why is this a problem?**

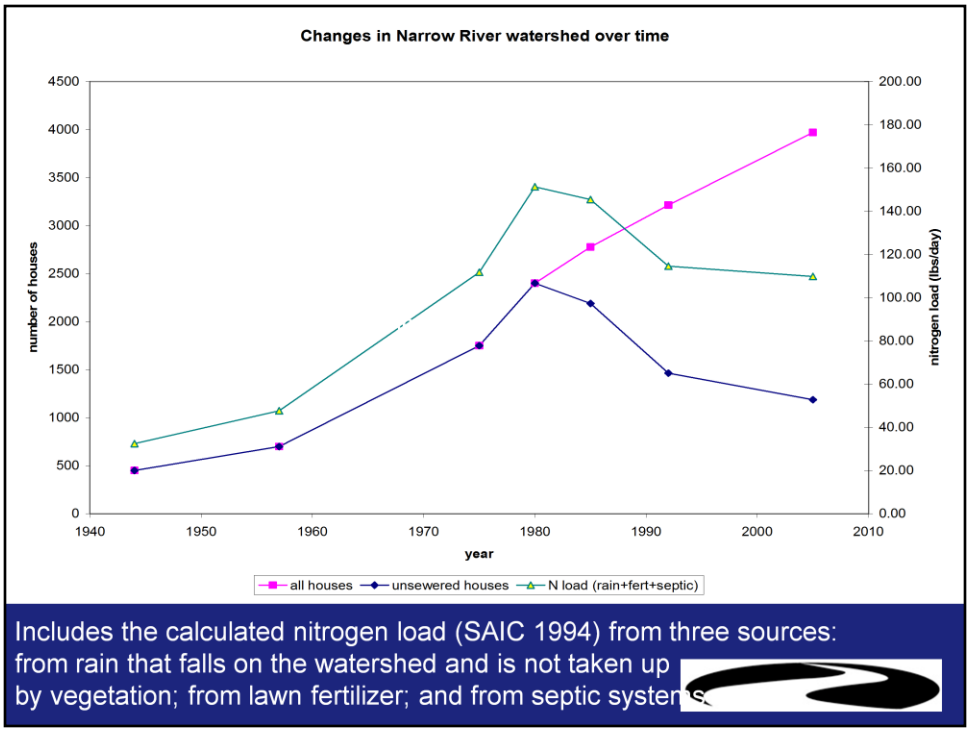
- more people = more paved surfaces (roads and driveways and sidewalks) = more stormwater runoff volume
- More people = more fertilizer and pets = more nitrogen in the runoff




Numbers of houses (both as total and as those not connected to a sewer system) in the Narrow River watershed for 1944, 1957, 1975, 1985, 1992, and 2005.
From Berounsky and Nixon 2007.

We can see that the number of houses in the watershed has increased dramatically from 1944 to 2005!

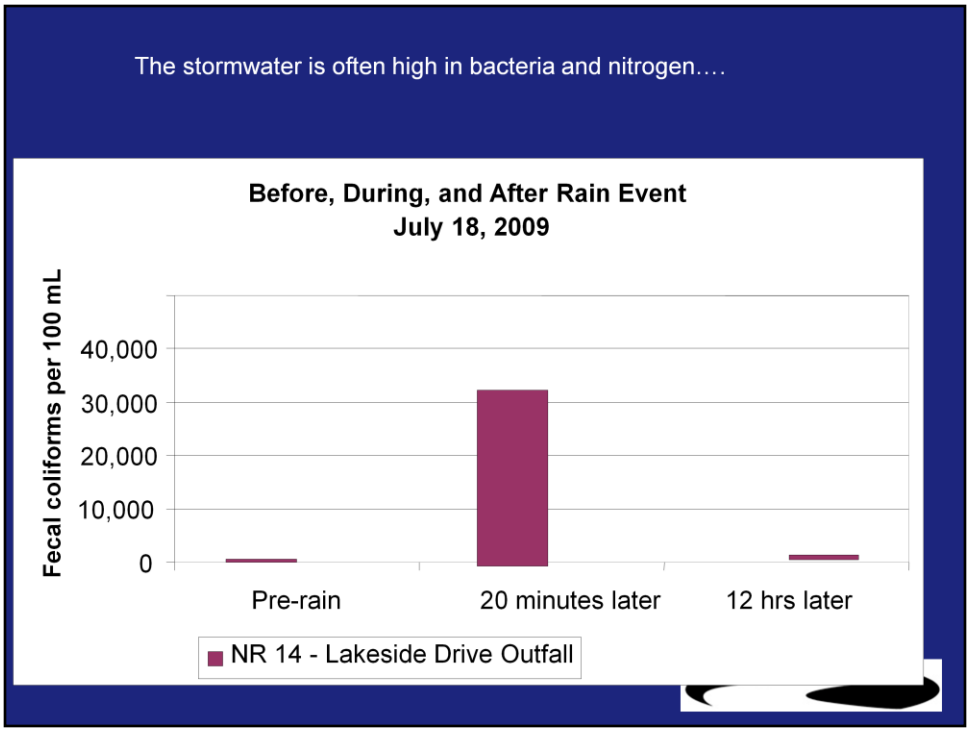
Starting about 1980, most of these houses were on town sewers.




The graph (also from the Berounsky and Nixon 2007 report to the Army Corp of Engineers) shows that the amount of nitrogen entering the watershed from rainfall, lawn fertilizer, and remaining individual septic disposal systems (ISDSs) also increased from 1944 to about 1980, then decreases and levels off.

# Important Issue for Narrow River: Stormwater

- Stormwater brings both bacteria and nitrogen to the River
- Highest levels are in “first flush” of rain that pushes most material down the streets
- The town of Narragansett has been pro-active in seeking funds to design and implement “best management practices” structures to replace outfall pipes

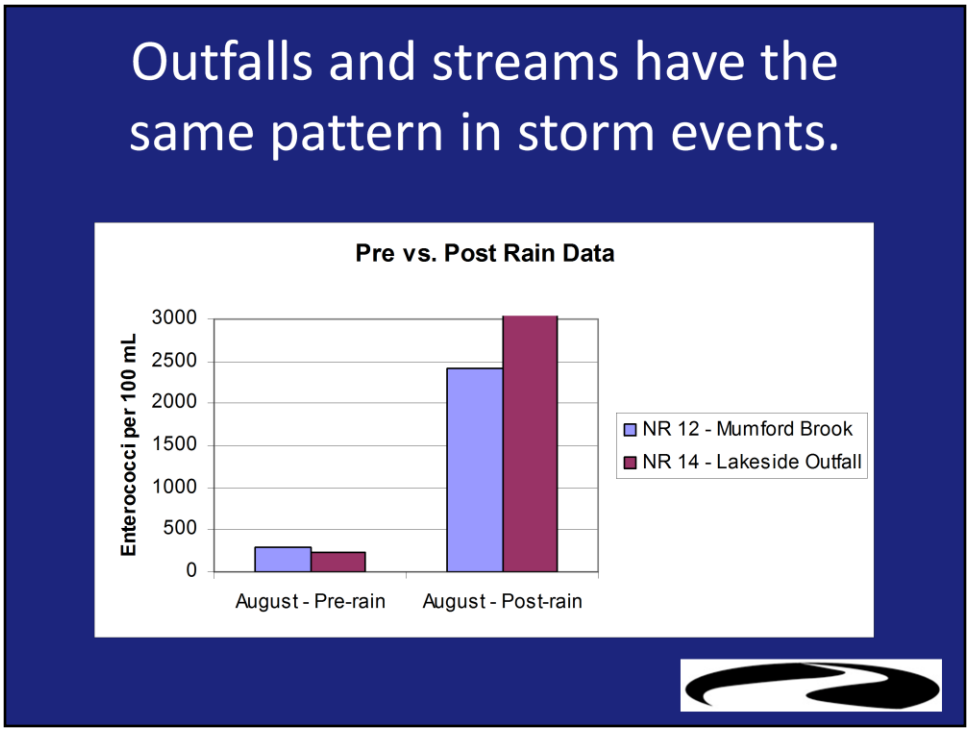



Some sources are known to bring both nitrogen and bacteria to Narrow River. We presently do not have any accessible storm-related data for nitrogen but we do for bacteria.

This graph is from a stormwater outfall (NR-14) with samples during and after a rain event:

- As rain was starting and flow was low: 100 fecal coliforms/100 ml
- 20 minutes later when the flow was high and discolored : 32,000 fecal coliforms/100 ml
- 12 hours later (about 10 hours after the rain stopped: 116 fecal coliforms/100 ml) and flow was low.

So stormwater brings in much bacteria and most likely nitrogen to the River.




In 2006, we were able to directly observe the impact of a major rain event on bacteria levels.
Samples were taken at both Mumford Brook and the Lakeside outfall before and after a major rain event
The samples taken after the rain were over five times higher then the pre-rain levels.

# Important Issue: Shellfishing Ban due to high bacteria levels

The problem:

- "Since 1959, the Narrow River has failed to meet state standards for total coliform bacteria levels"
- "In 1979, parts of the Narrow River were closed to shellfishing"
- "Beginning in 1994, the entire expanse of the Narrow River was closed to shellfishing and remains closed today due to high coliform bacteria levels."

from The Narrow River Special Area Management Plan, CRMC, April 1999

The actions:

This has brought about reports, actions, and funds from the town of Narragansett, the state of Rhode Island, the Coastal Resources Management Council, and the Army Corps of Engineers

## The Good News:

- The Narrow River has no commercial or industrial enterprises on its banks.
- But this means that most contamination and pollution to the River is from human and wildlife sources
- And the good news is that we can help by our actions

# What can we do about nitrogen and bacteria entering the River?

- Support and encourage municipal stormwater BMPs (go to town meetings)
- Develop other ways to keep pollutants away such as raingardens (public and private)
- Don't feed the birds and do educate others.
- Keep trash and waste away from the River.
- Don't dump down stormdrains.
- Help determine levels in the River as a volunteer monitor.

# Support BMPs (Detention Ponds, etc.)

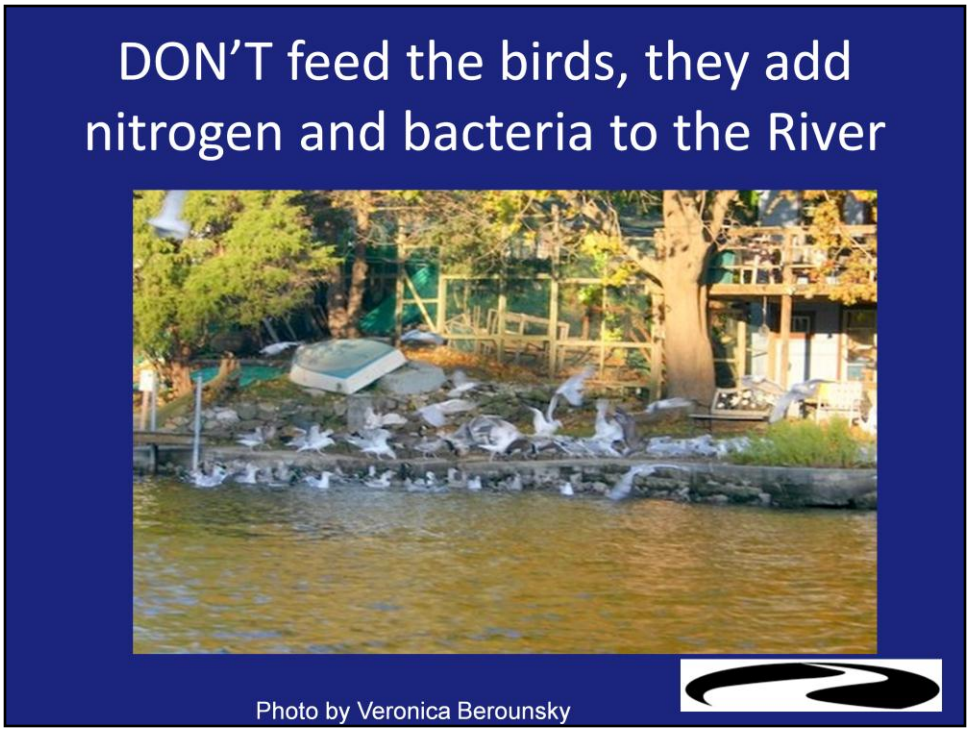
Purpose:

- Temporarily store excess stormwater runoff
- Filter this water by nutrient uptake from aquatic plants
- Sunlight also kills bacteria
- Trap sediment and trash for later removal

Photo by V. Berounsky

# Rain gardens allow nitrogen to stay in the soil and vegetation and not flow to the River

Example of a rain garden at North Kingstown Town Hall




This is important enough to say again – don't feed the birds.

As you can see in this photo, feeding attracts the birds and keeps them returning to one place. There are about 20 birds in this one yard, and there were more before I snapped the picture.


Some people wait for others to clean up after them. Keeping the river and its shores trash-free is everybody’s business.


Ask family members to clean up after dogs so that our water will remain clean and not be polluted by animal waste.


Storm drain marking
Photo by Veronica Berounsky


Neighbors along the river test it every other week from May until October as part of the University of Rhode Island Watershed Watch program. Perhaps this is something you could do some day.

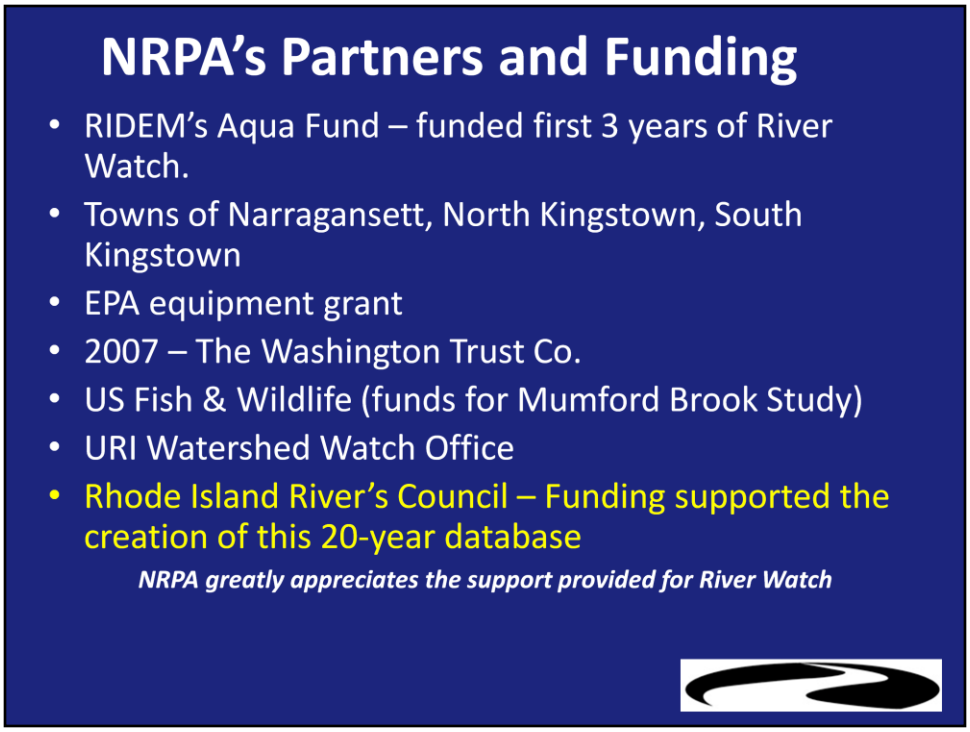
# The future of the communities of life in the Narrow River Watershed depends on you !

Sunset over Pettaquamscutt Cove

Photo by Jason Considine

# Who has used the River Watch data?

- Tri-town Stormwater Study
- URI Researchers and Students
- Army Corps of Engineers
- Department of Environmental Management
- Save the Bay
- Bryant College
- Environmental Protection Agency
- The Nature Conservancy
- And others




Although this is a volunteer program, funds are necessary to support the cost of analysis, data compilation and materials provided by URI Watershed Watch Program.


A major partner in the River Watch program is URI's Watershed Watch office headed by Linda Green and Elizabeth Herron. They provide training, supplies and a manual on techniques for sampling, and post results on Watershed Watch website:

www.uri.edu/ce/wq/ww/index.htm

In compiling 20 years of data, we had many questions for Linda and Elizabeth and they are always there to assist and have been a pleasure to work with!

Ms. Rahat Sharif was hired on the R.I. Rivers Council grant to compile the 20 years of data and develop graphs – that was invaluable work!

## We could not do this without our 2012 Volunteer Monitors

- Lynne Finnegan & Daughter – 1 year
- Lynn Wolslegel – 2 years
- Laura and Howard Reed – 2 years
- Elizabeth Castro – 3 years
- Annie and Susan Hall – 3 years
- Liz Hill – 3 years
- Abby & Perry Moylan - 3 years
- Craig Wood – 3 years
- Omar Zaki – 3 years

# 2012 Volunteer Monitors (continued)

- Will Cummer – 6 years
- Rosemary Smith – 6 years
- Dave Adelman – 7 years
- The Sarubbi Family – 7 years
- Bette Carey - 8 years
- The Kaprielian Family – 8 years
- Marc Lamson – 8 years
- Dorothy & Dudley Mann – 8 years
- Veronica Berounsky – 9 years

## And 2012 Volunteer Monitors who have been with us for over 10 years:


Sue Van Ness – 11 years

Jennifer Carey – 15 years

Robert Schelleng – 20+ years (in photo in 2012)

Annette DeSilva – 21 years

Thank you all! We would not have this data without you!