



Extreme Wet Weather Monitoring in Narragansett Bay

Monitoring the Flood of 2010

June 16, 2011
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Narragansett Bay Commission

Photo courtesy of J. Burke
Warwick Wastewater Treatment
Plant



Woonasquatucket River



Blackstone River



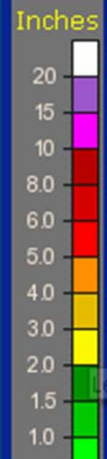
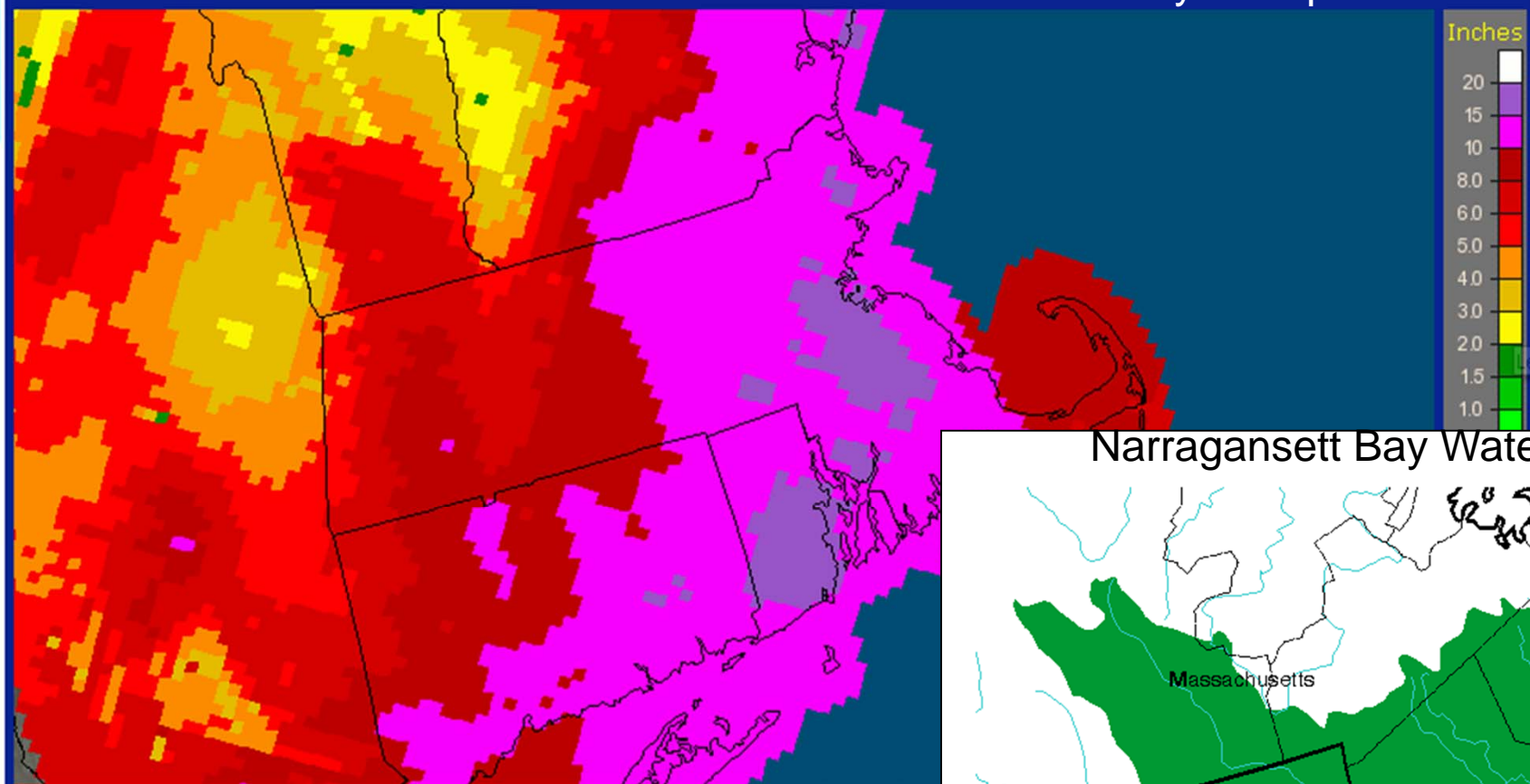
Warwick WWTF



(AP Photo/Charles Krupa)

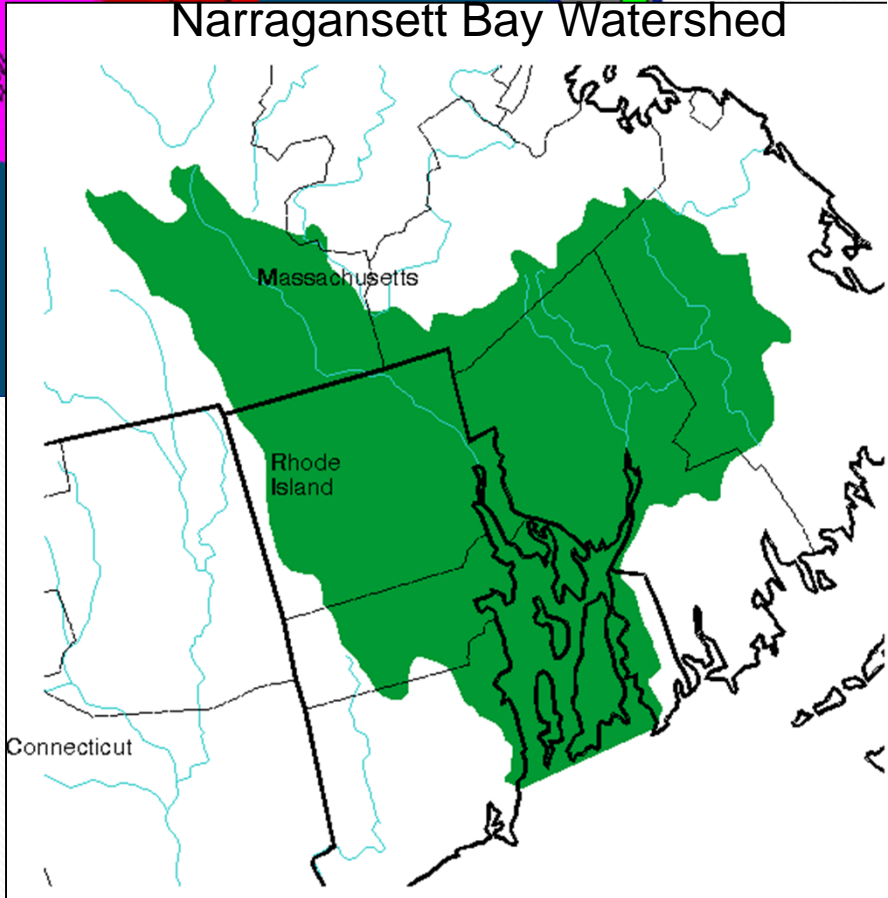
Massachusetts: March, 2010 Monthly Observed Precipitation
Valid at 4/1/2010 1200 UTC - Created 5/31/10 23:05 UTC

March 2010 Total Monthly Precipitation



www.water.weather.gov

Narragansett Bay Watershed



Wastewater Treatment Plants

- **Pawtuxet River –**
 - **Warwick and West Warwick WWTF flooded**
 - 3/30 plants evacuated and shut down
 - 4/3 temporary disinfection
 - 4/24 West Warwick and 6/8 Warwick - start secondary treatment
 - 6/19 Warwick and 7/25 West Warwick - BNR operational
 - **Cranston WWTF largest pump station overwhelmed**
 - 3/31 pump station shut down
 - 4/2 pump station back in operation
- **NBC FP and BP WWTFs performed well**
 - Greatly increased influent flows (*highest flows ever recorded*)
 - FP - 148 MGD (average = 45 MGD)
 - BP - 113 MGD (average = 28 MGD)
 - No major equipment failures
 - All final effluent fecals within compliance
 - CSO tunnel was full by 1:00 PM on Monday, March 30
 - Total of 263 MG captured during 3 major storms in March



NBC River and Bay Nutrient and Fecal Coliform Bacteria Sampling

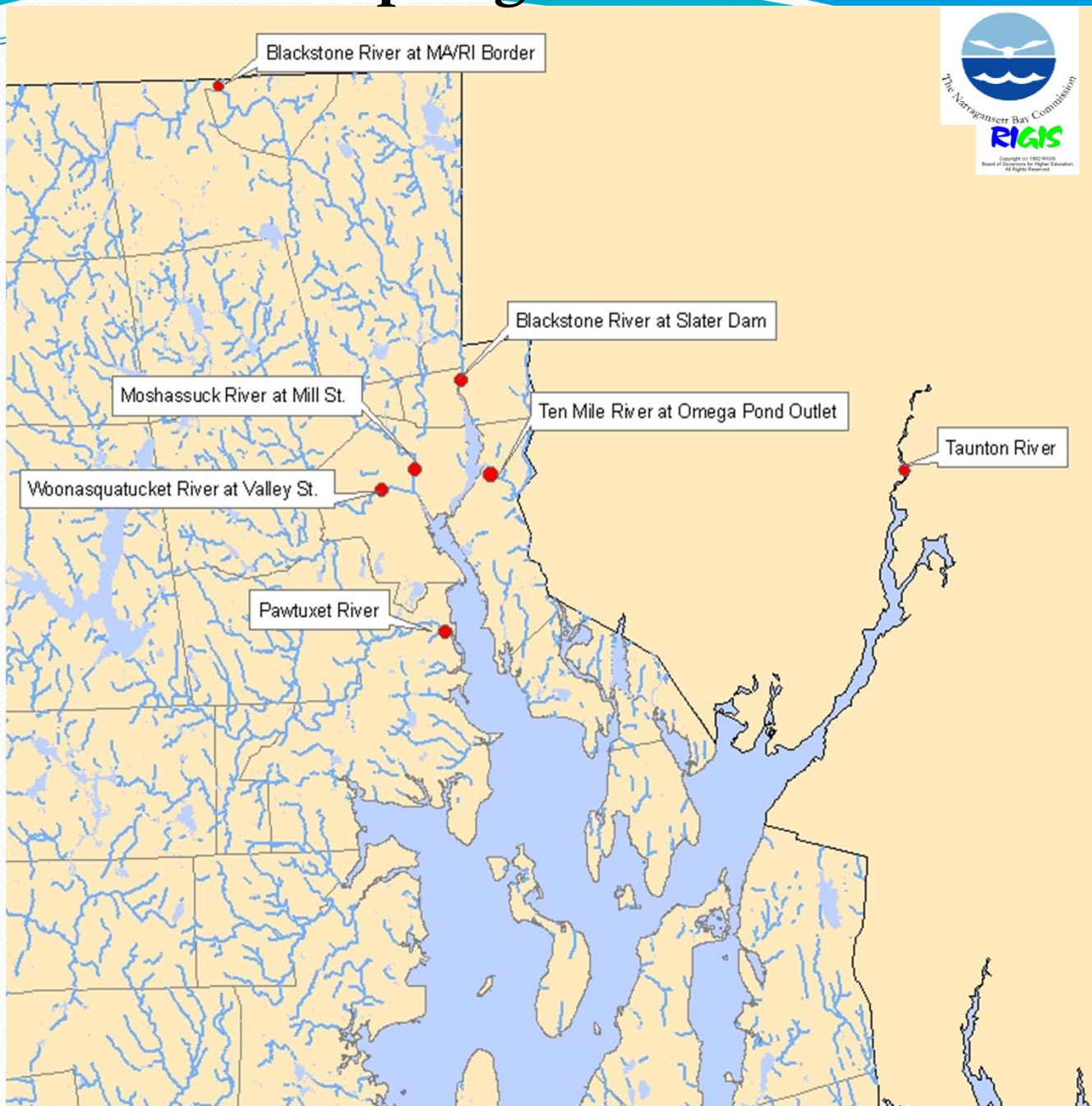
- Due to historic rainfall and flooding NBC implemented extreme weather monitoring initiative
- NBC conducts routine monitoring
 - bimonthly nutrient
 - weekly river bacteria
 - bimonthly bay bacteria
- Additional storm samples
 - 195 river and bay nutrient samples
 - 212 river and bay bacteria samples



Storm & Monitoring Timeline

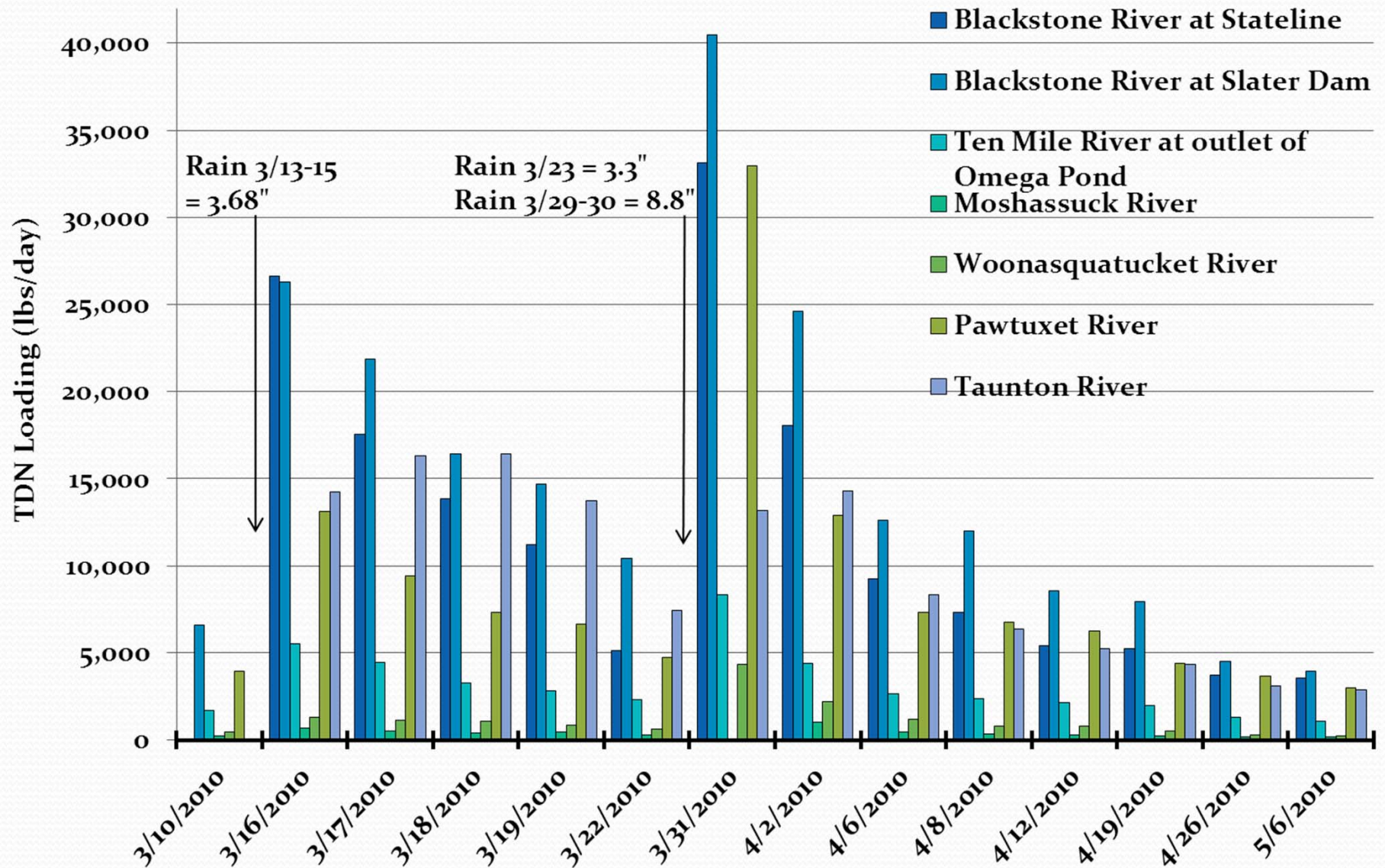
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	2/22	0.78" 2/23	1.80" 2/24	1.42" 2/25	2/26	2/27
Rain - Inches	✓	✓	✓			
Fecals - ✓			✓			
Nutrients - ✓	3/1	3/2	3/3	3/4	3/5	3/6
	✓	✓	✓			
3/7	3/8	3/9	3/10	3/11	3/12	1.90" 3/13
	✓	✓	✓			
1.28" 3/14	0.50" 3/15	3/16	3/17	3/18	3/19	3/20
	✓	✓	✓	✓	✓	
3/21	3/22	3.30" 3/23	3/24	3/25	0.21" 3/26	3/27
	✓	✓		✓	✓	
3/28	3.47" 3/29	5.32" 3/30	Cranston pump station down 3/31	4/1	Cranston pump station operational 4/2	Temp. Disinfection 4/3
	✓	✓	✓	✓	✓	✓
4/4	4/5	4/6	4/7	4/8	0.93" 4/9	4/10
✓	✓	✓	✓	✓	✓	✓
4/11	4/12	4/13	4/14	4/15	0.41" 4/16	0.11" 4/17
✓	✓	✓	✓	✓	✓	
4/18	4/19	4/20	4/21	0.38" 4/22	4/23	4/24
	✓	✓		✓	✓	W. Warwick 2 nd trtmt.
0.16" 4/25	4/26	0.11" 4/27	4/28	4/29	4/30	5/1
	✓	✓	✓			
5/2	0.36" 5/3	0.10" 5/4	5/5	5/6	5/7	0.84" 5/8
	✓	✓		✓		

River Nutrient Sampling Locations

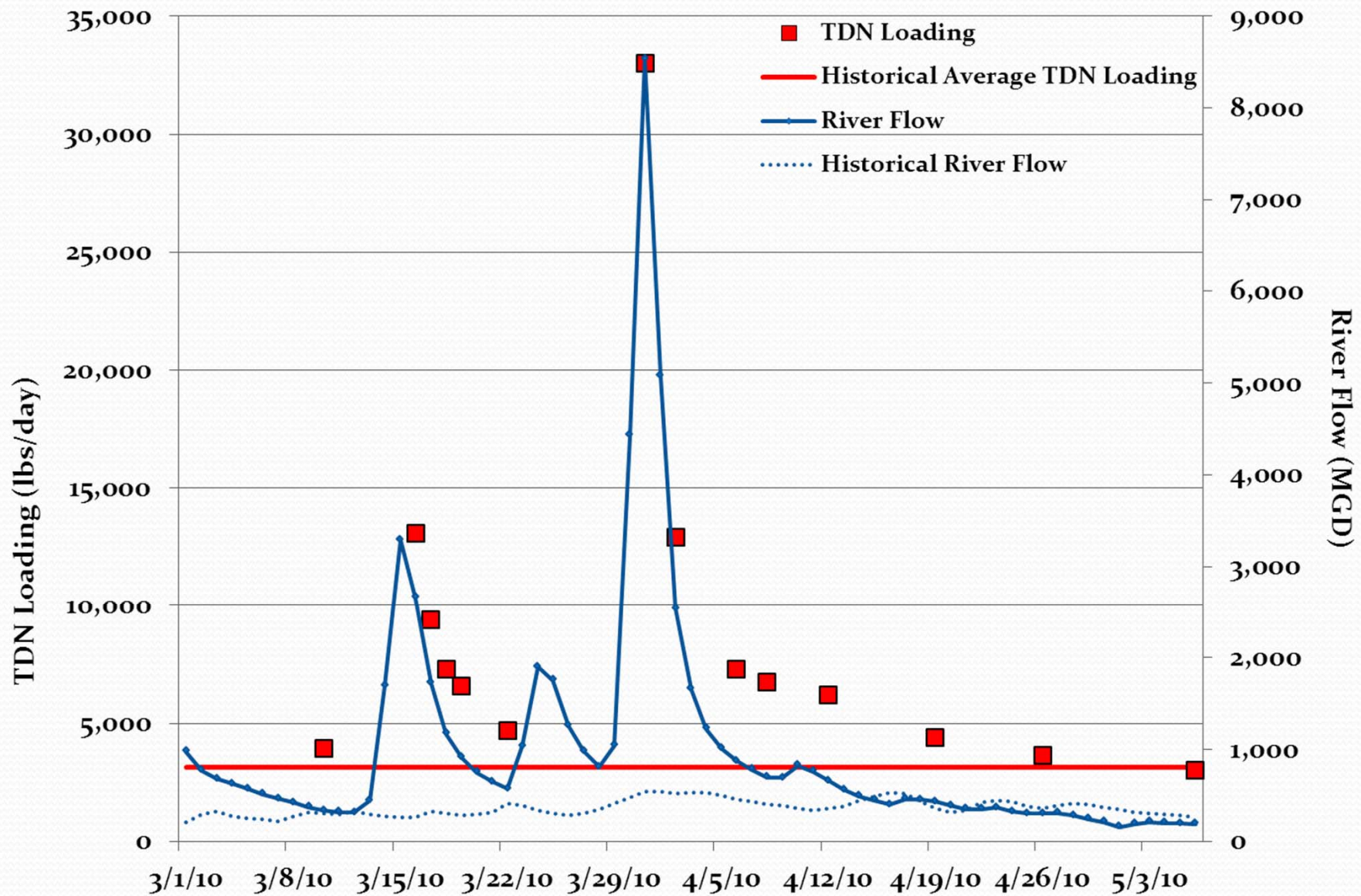


Local and Border Rivers

Total Dissolved Nitrogen (TDN) Loading



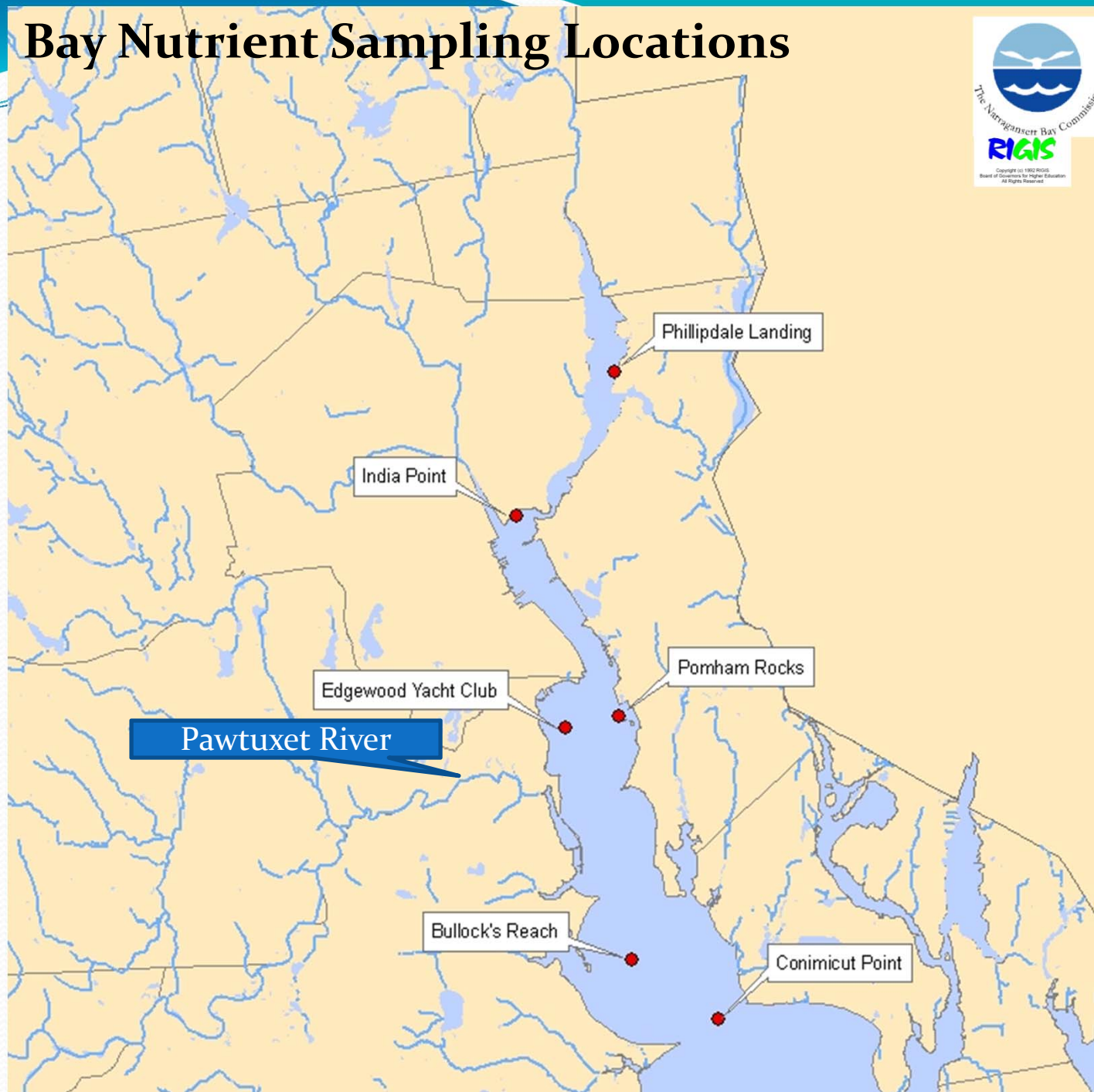
Pawtuxet River – Flow and TDN Loading



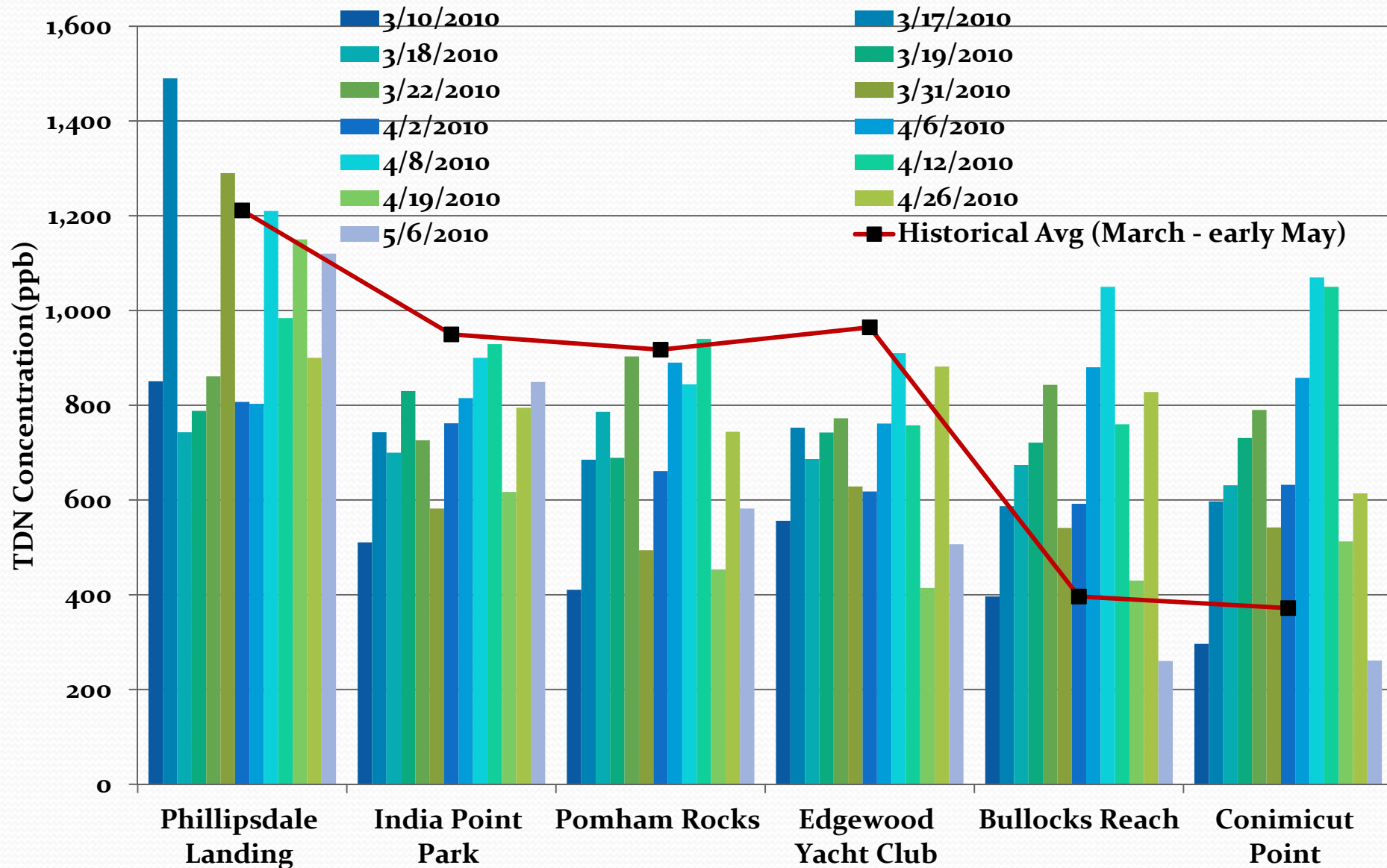
Conclusions – River Nutrients

- Mar – Apr 2010 river flows: Percent above historical Mar – Apr river flows
 - Blackstone River at Slater Dam - 44%
 - Blackstone River at Woonsocket - 46%
 - Taunton River - 53%
 - Pawtuxet River - 66%
- TDN loading for the various rivers –
 - 3/16: **149%** - **295%** above average wet weather TDN loading
 - 3/31: **131%** - **823%** above average wet weather TDN loading
- All locations had returned to within normal ranges of nutrient loading by 3-4 weeks after rainfall ended (4/26), except Pawtuxet River
- Pawtuxet River: highest % increase above average wet weather TDN loading.
 - At peak loading (3/31) it was **823%** above average wet weather TDN loading
 - Longest to recover - not back to within historical TDN loading until 5 weeks after rainfall ended (~ 5/6/10)

Bay Nutrient Sampling Locations



Upper Narragansett Bay Total Dissolved Nitrogen Concentrations

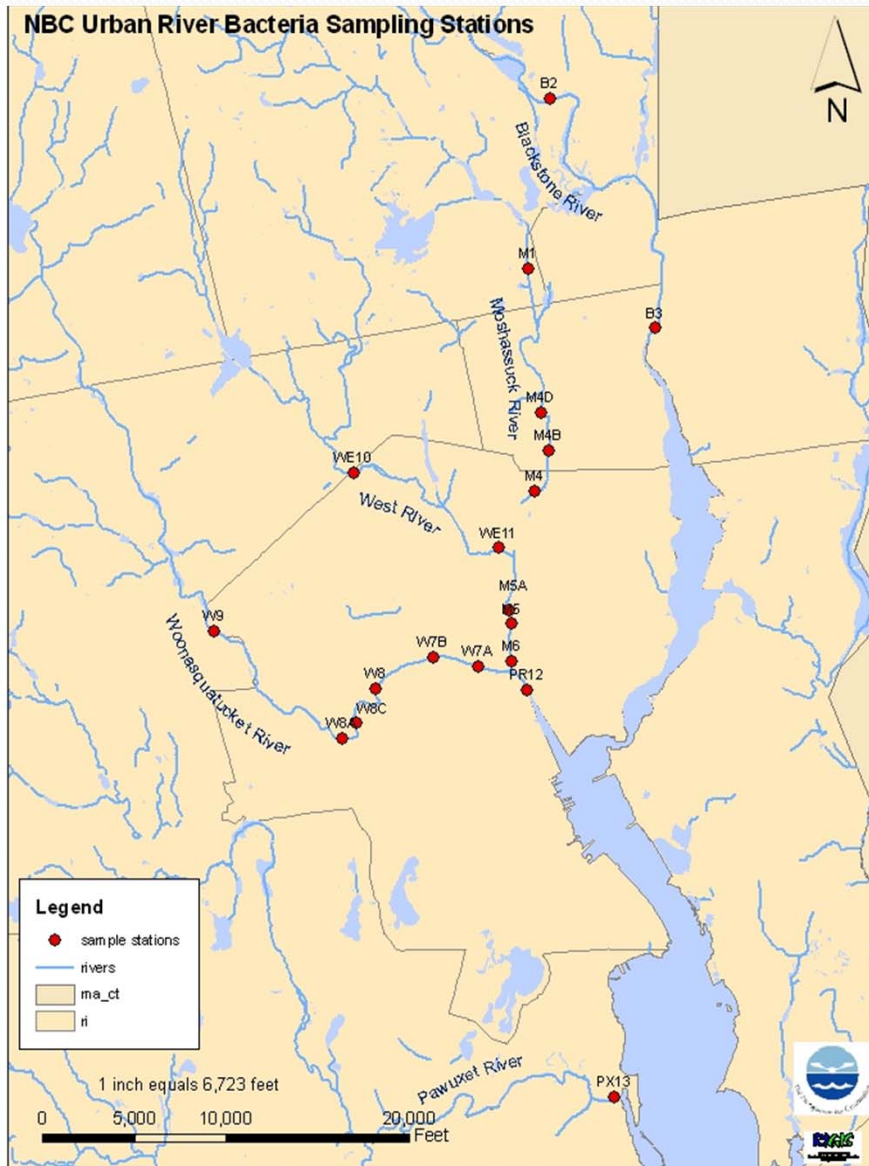


Conclusions – Bay Nutrients

- Four of the six sample sites averaged 25% - 44% below historical March – April TDN concentrations.
- Bullock's Reach and Conimicut Point, on the other hand, averaged 34% and 39% above historical March-April concentrations.
 - These 2 sites then dropped to below historical concentrations 5 weeks after the biggest storm (5/6/10)

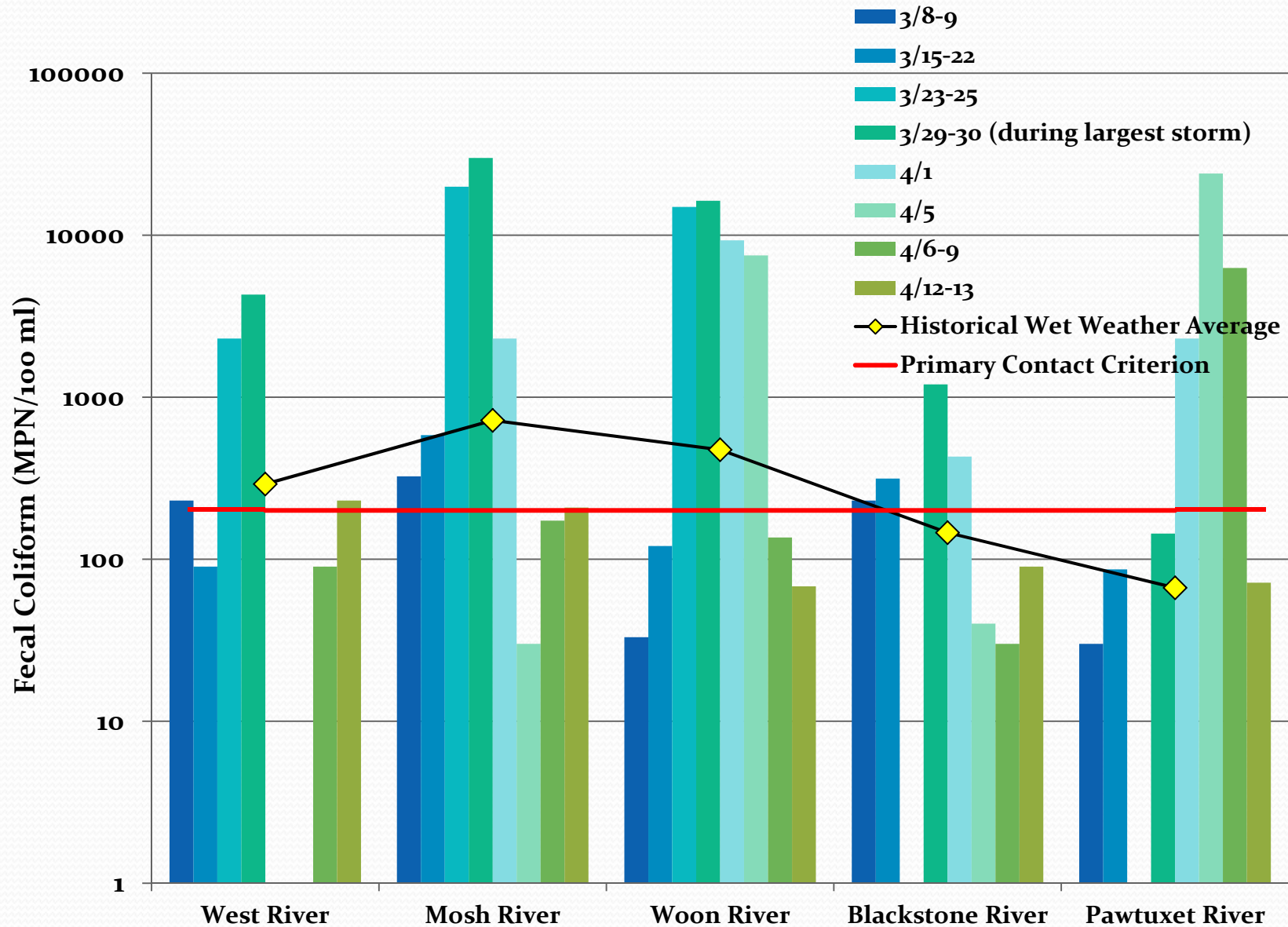


River Fecal Coliform Bacteria Monitoring

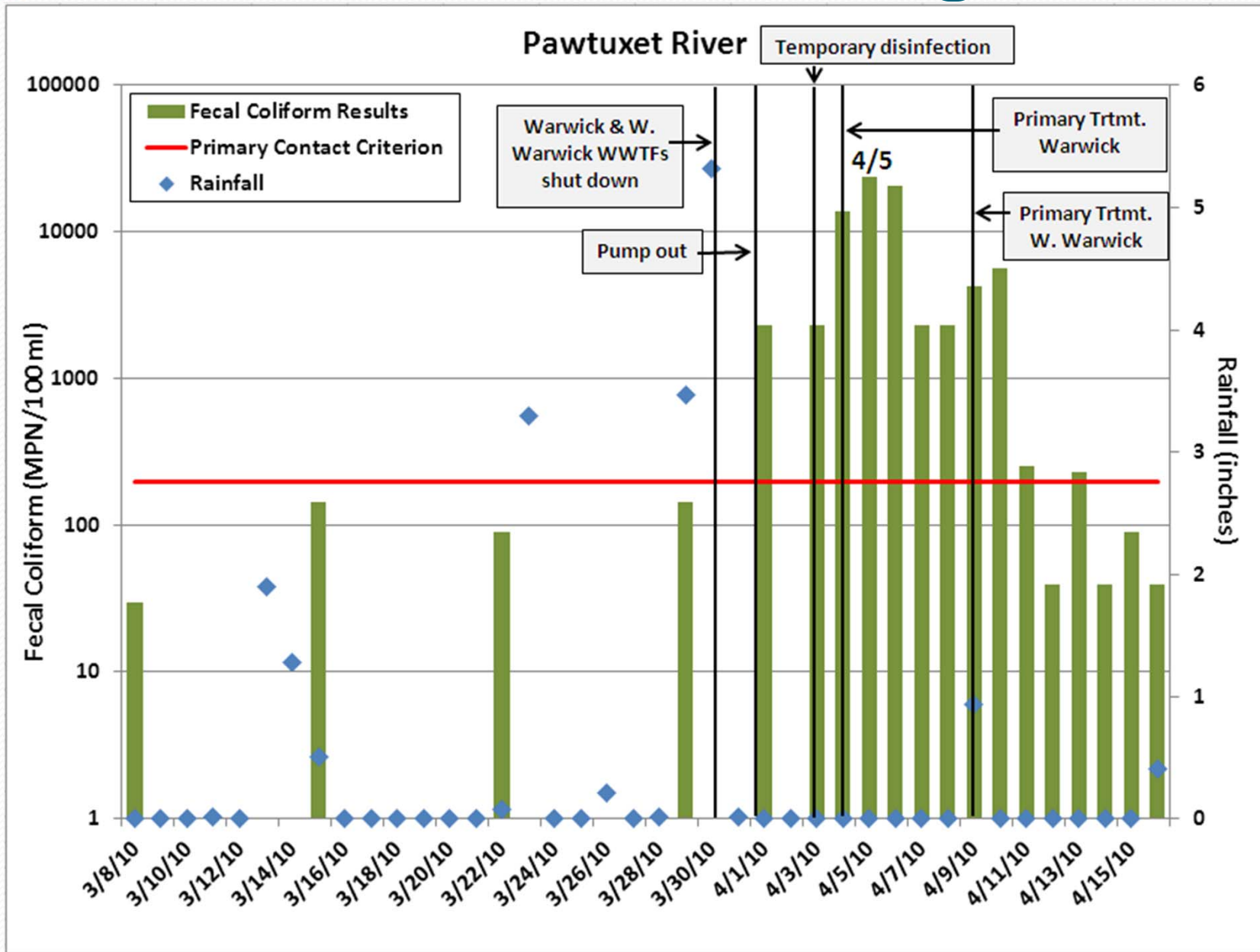


- Urban rivers - normally sampled once/week on Mondays and Tuesdays
- Additional sampling in each river after the biggest storm: on 4/1, 4/5, 4/7 and 4/9 (with regular sampling still done on 4/6 and 4/8)
- Pawtuxet River sampled daily 4/1-4/16 (except 4/2)

River Bacteria Monitoring Results



River Bacteria Monitoring Results



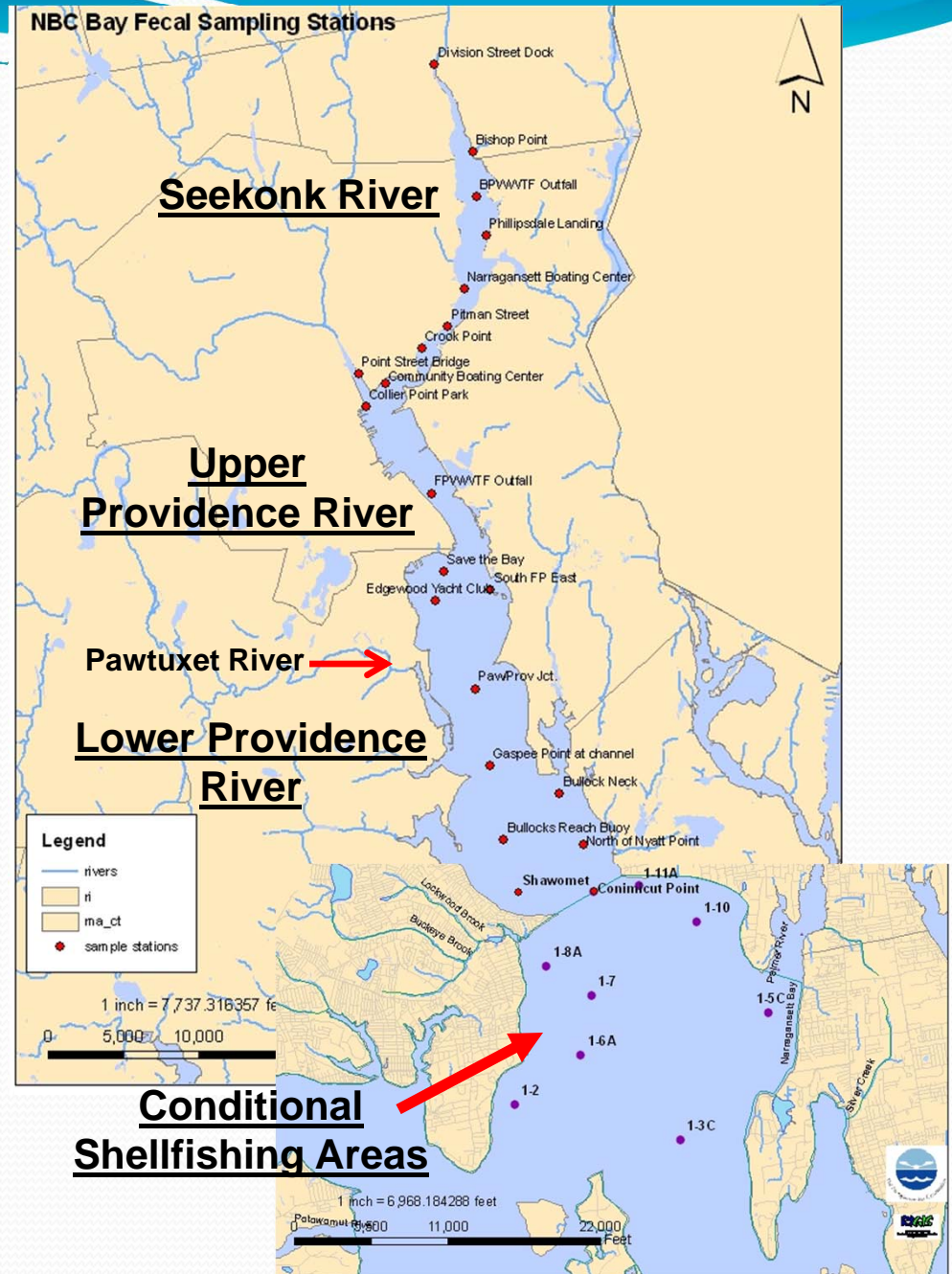
Conclusions of River Bacteria Monitoring

- Most rivers - highest bacteria levels during the historic storm (3/29-3/30)
- Pawtuxet River - highest the week after the storm
- Most rivers reached **8-56 times** historic wet weather bacteria levels on highest day; Pawtuxet **close to 100 times** historic wet weather bacteria levels
- Most rivers returned to normal dry weather bacteria levels the week after the storm
- The Pawtuxet did not return to historic dry weather levels until 13 days after the storm



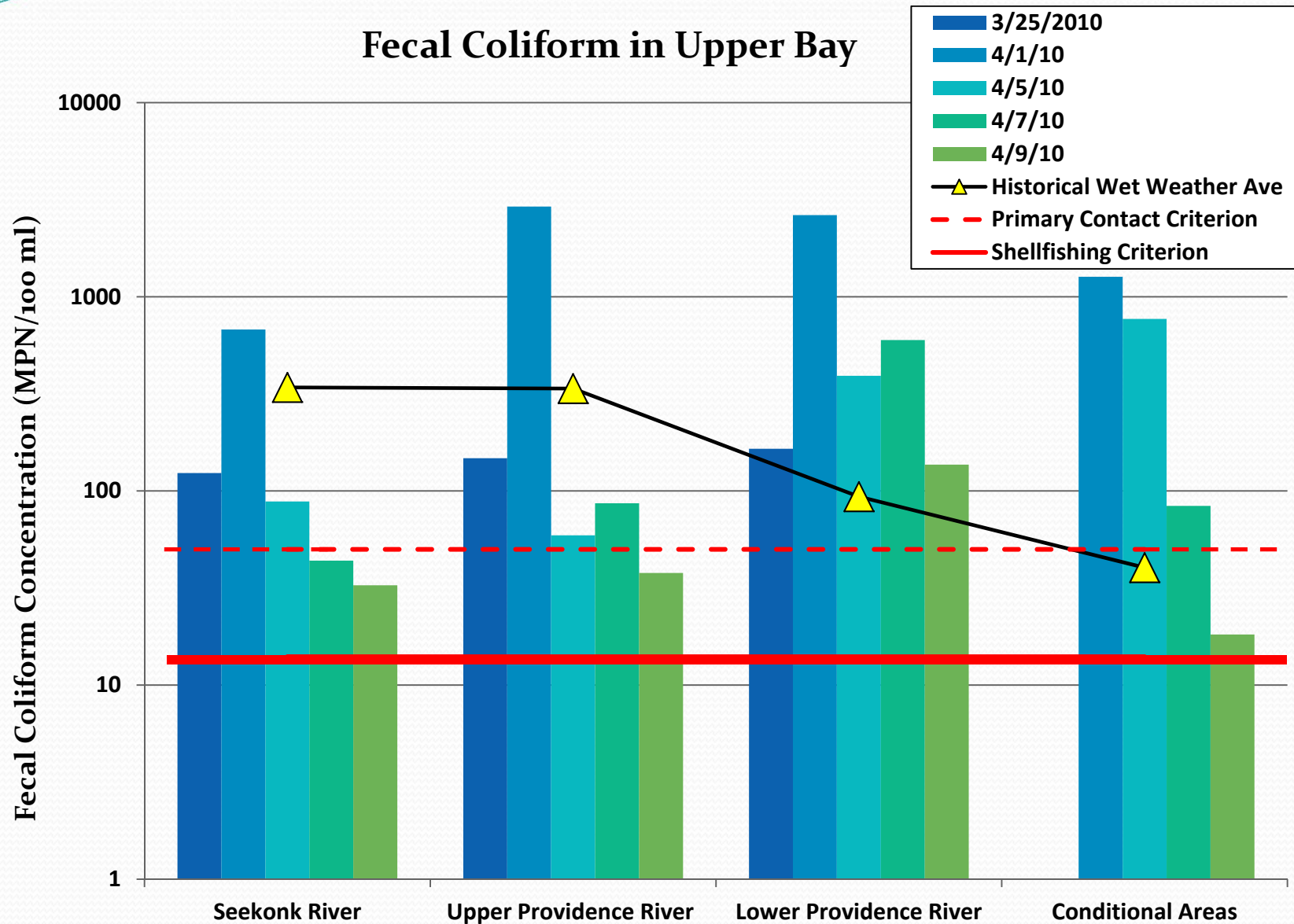
Bay Fecal Coliform Bacteria Monitoring

- Bay sites - normally sampled bimonthly
- Additional sampling done on 4/1, 4/5, 4/7, 4/9
- Additional stations - RIDEM's Conditional Shellfishing Area



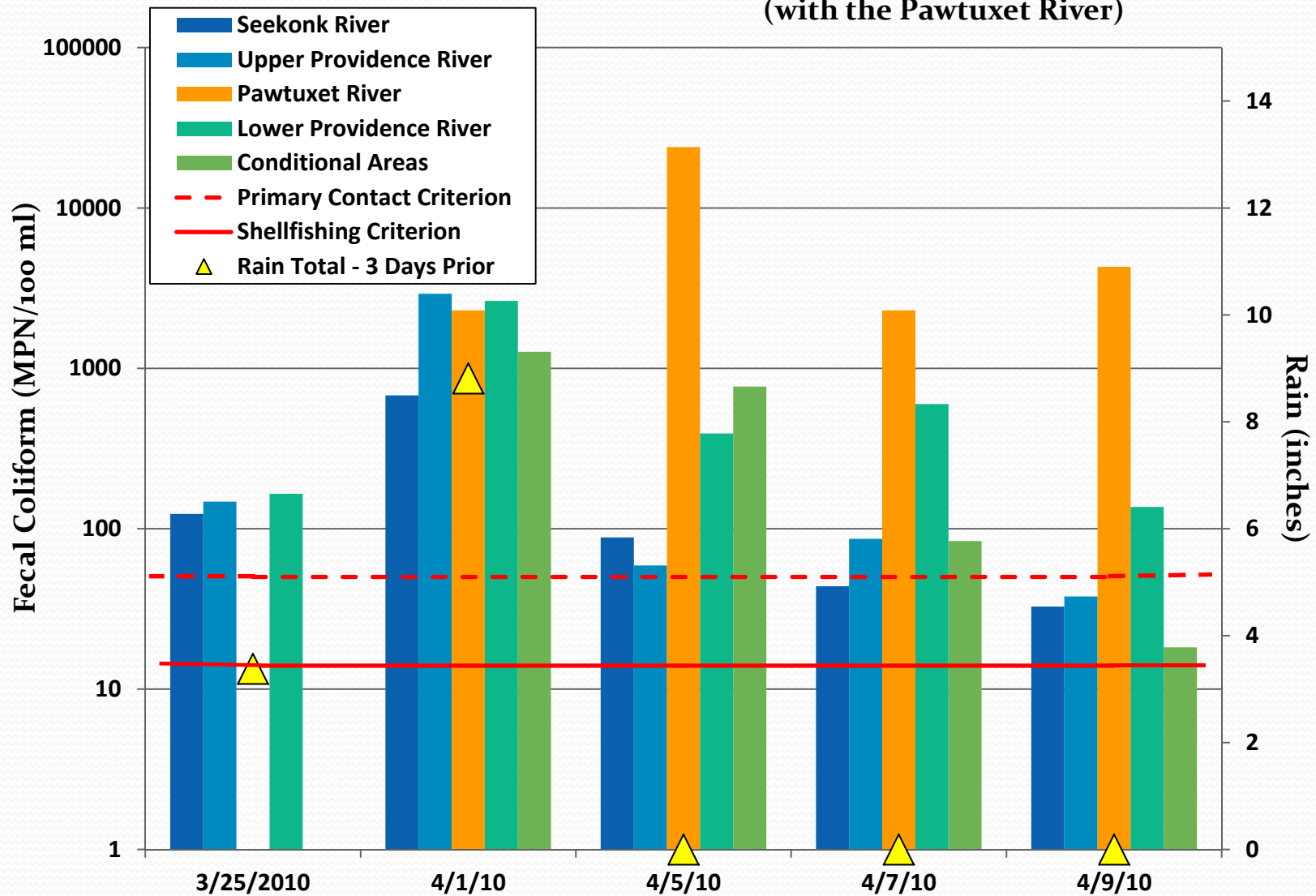
Bacteria Monitoring Results

Fecal Coliform in Upper Bay



Bacteria Monitoring Results

Fecal Coliform Averages in Each Area of the Bay
(with the Pawtuxet River)



Conclusions of Bay Bacteria Monitoring

- Bay had highest bacteria levels on the first post-storm sampling day - 2 days after the storm
 - Seekonk River and upper Providence River = **2-9 times average historic wet weather bacteria levels**
 - Lower Providence River and Conditional Shellfishing areas = **28-31 times average historic wet weather bacteria levels**
- Seekonk and Upper Providence Rivers back to historic dry weather bacteria levels 6 days after the rain event
- Conditional Areas back to historic dry weather bacteria levels 10 days after the rain event
- Lower Providence River bacteria levels remained elevated on the 10th day
 - This area seemed to be affected the most by this storm

Acknowledgements & Questions

- Warwick Sewer Authority
- Cranston Water Pollution Control Facility
- West Warwick Regional WWTF



All data is available at www.narrabay.com > Programs & Projects > Environmental Monitoring and Data Analysis Program

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