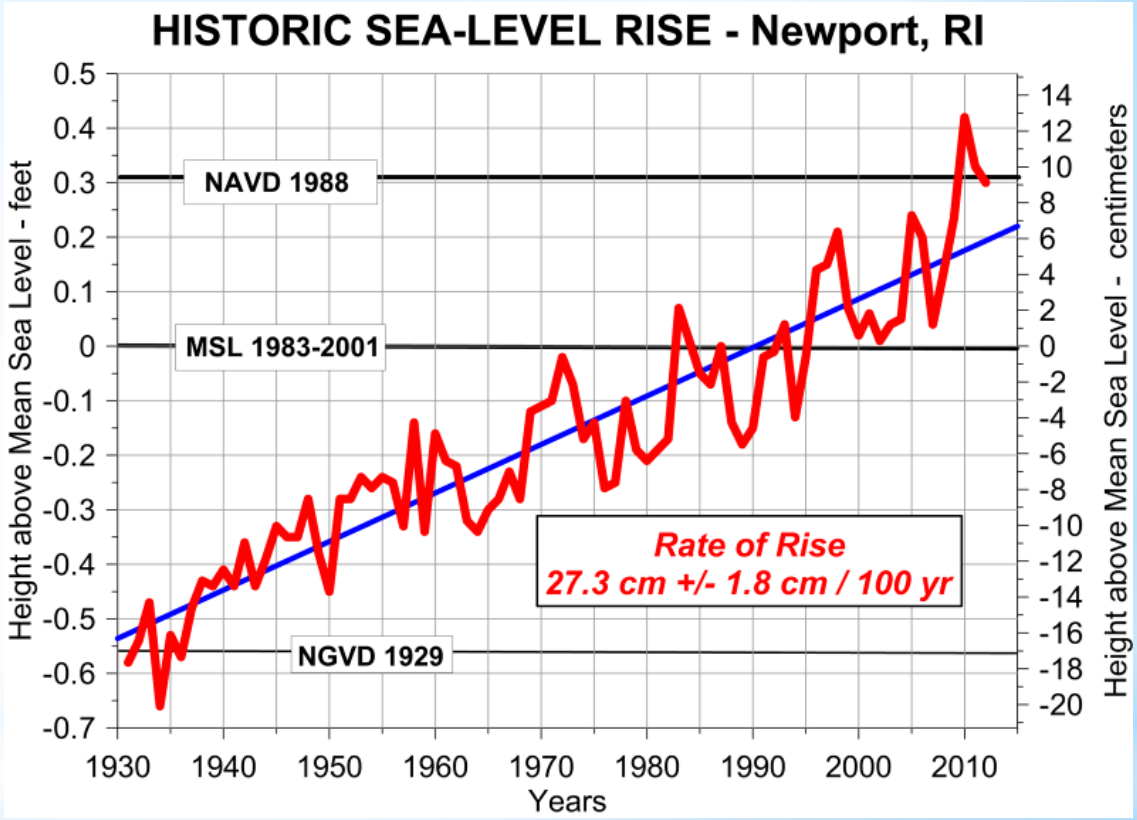
Narragansett Bay Commission

Overview of NBC Energy & Climate Change Activities

Thomas Uva
Director of Planning, Policy & Regulation
Narragansett Bay Commission

Climate Change is Real!!!

- ✓ **Historic Sea Level Rise**
- ✓ Loss of Wetlands & Coastal Buffers
- ✓ Ocean Acidification
- ✓ Increase in Water & Air Temperatures
- ✓ Increase in Extreme Weather Events



Adapted from: http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8452660%20Newport,%20RI

GEOLOGICAL SURVEY RHODE ISLAND

COASTAL HAZARDS GROUP GEOSCIENCES Univ RI

Sea Level is Rising Faster along the Northeast US Coast

- ✓ Sea-level rise has increased three to four times faster than the global average along the 600-mile stretch of coastal zone from Cape Hatteras, NC to north of Boston, MA since 1990.
- ✓ Likely 8 to 11+ inches above global average SLR by 2100.

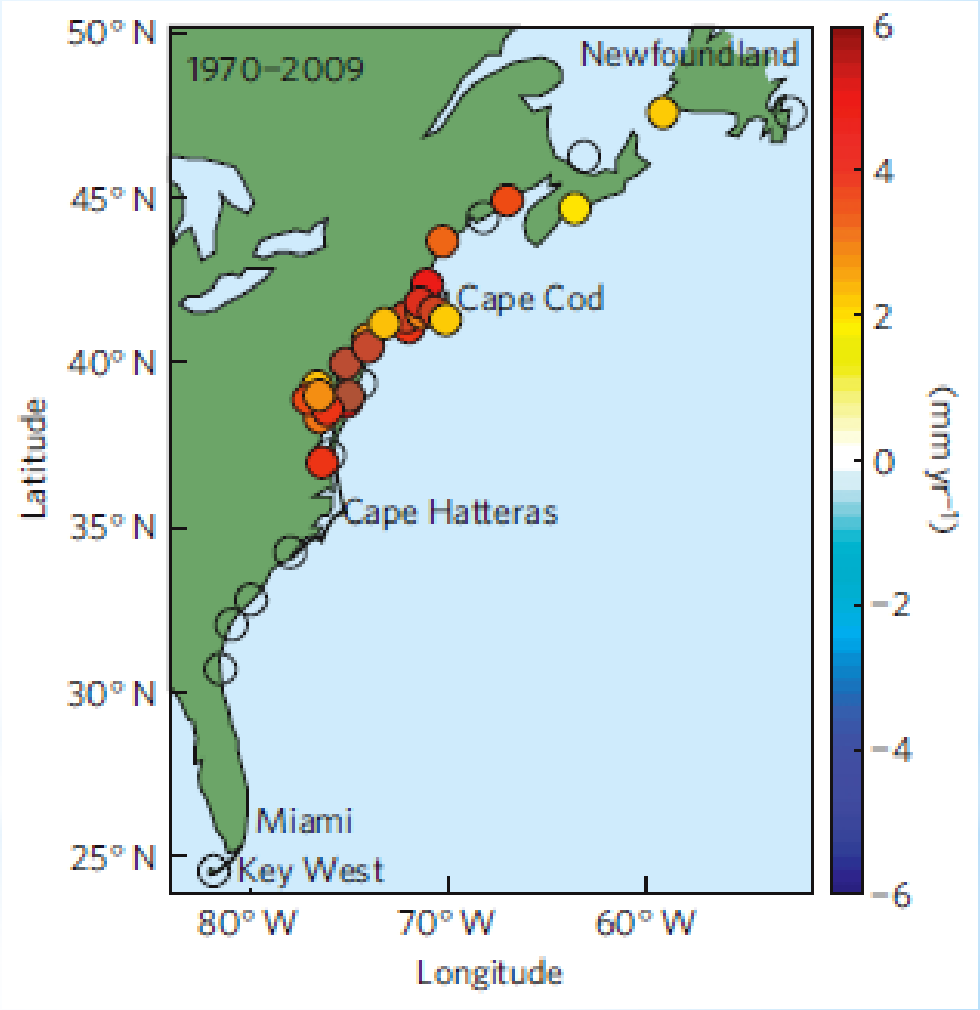
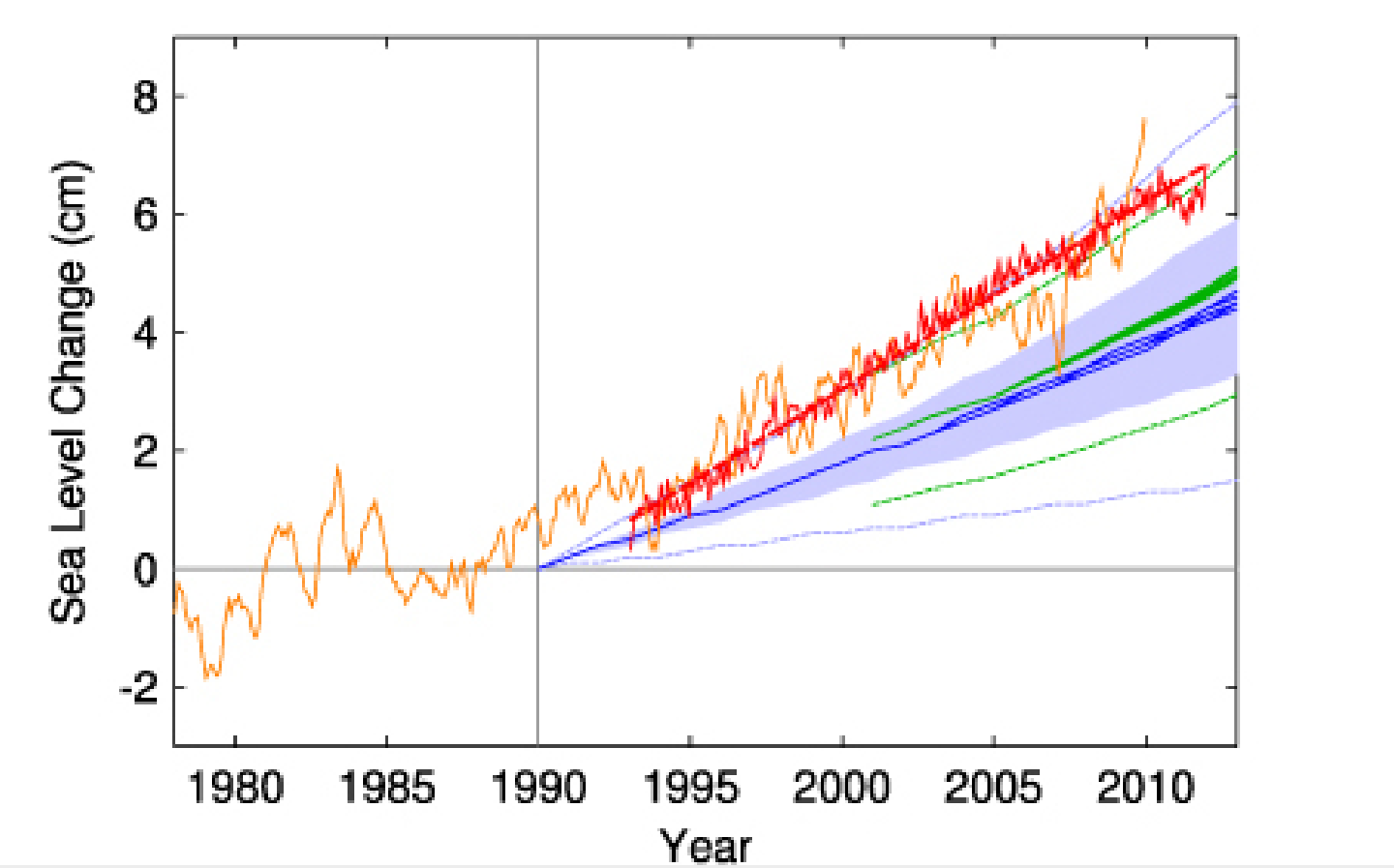


Figure from "Hotspot of accelerated sea-level rise on the Atlantic coast of North America" Asbury Sallenger et al., 2012 Nature Climate Change doi:10.1038/NCLIMATE1597

Observed Sea Level Rise is HIGHER than Projections

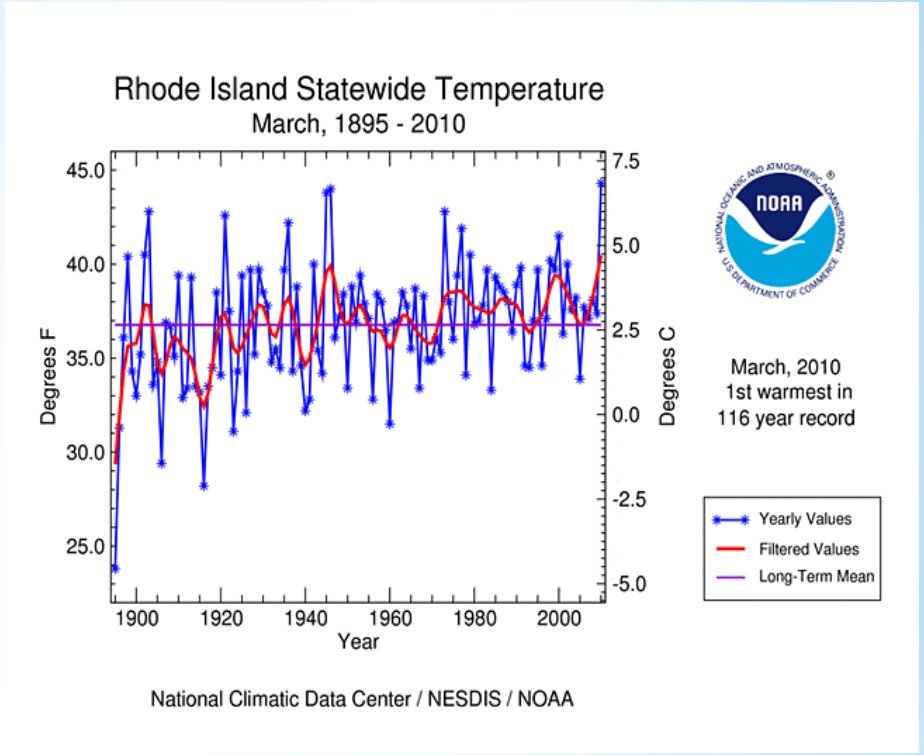


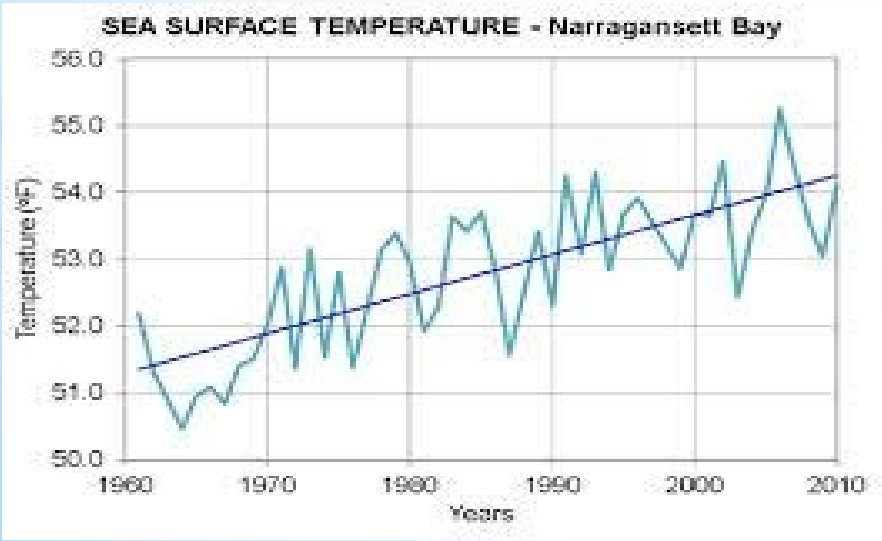
3.3 mm/year observed (satellite) vs. IPCC FAR estimate of 2.0 mm/year (1993-2011)

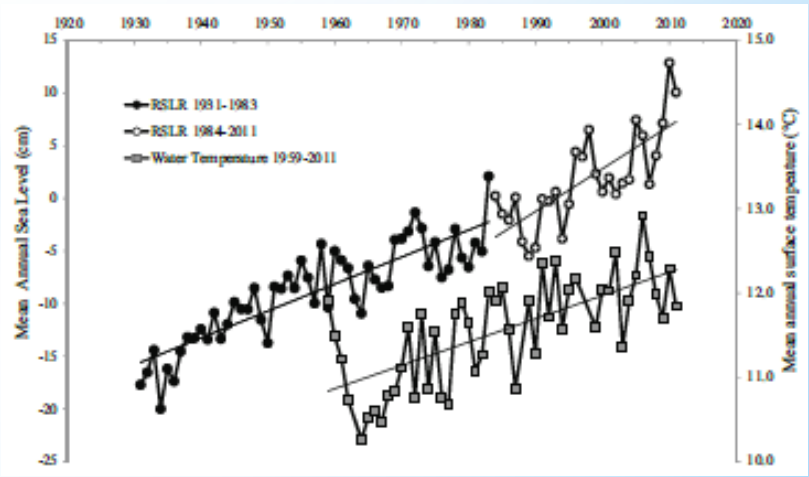
Rahmstorf et al., 2012

Climate Change is Real!!!

- ✓ Historic Sea Level Rise
- ✓ Loss of Wetlands & Coastal Buffers
- ✓ Ocean Acidification
- ✓ **Increase in Water & Air Temperatures**
- ✓ Increase in Extreme Weather Events







Climate Change is Real!!!

- ✓ Historic Sea Level Rise
- ✓ Loss of Wetlands & Coastal Buffers
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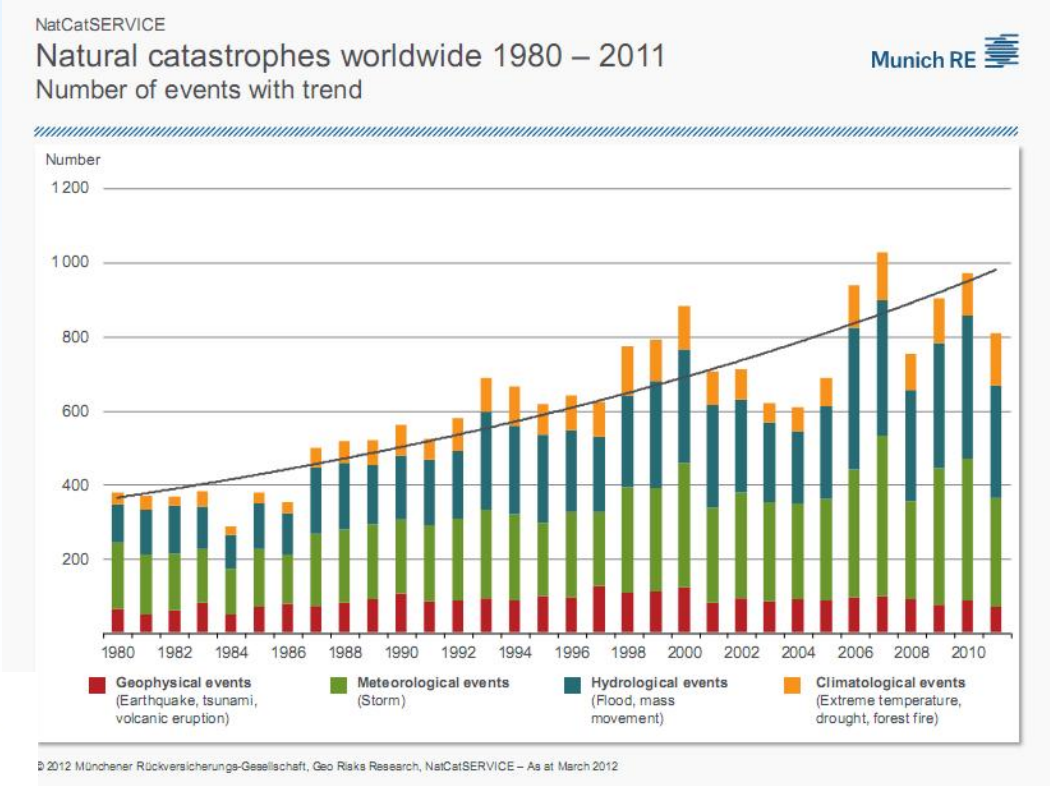
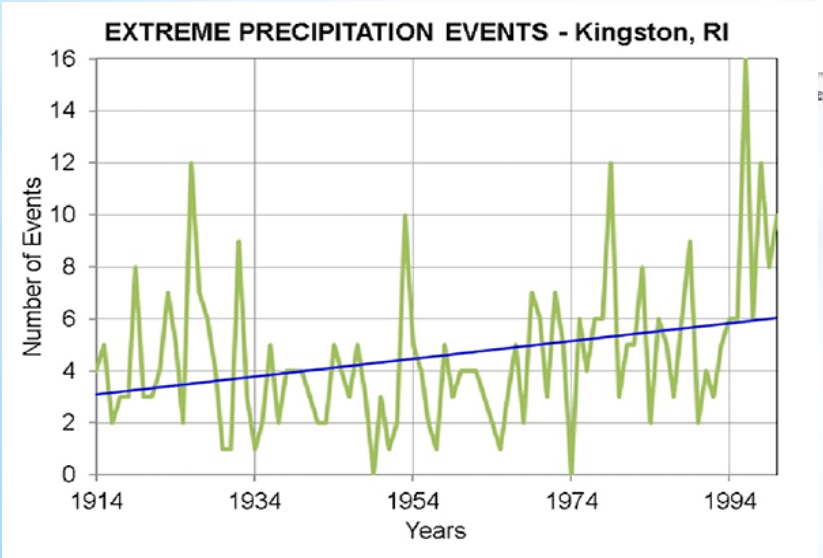
- ✓ Increase in Water & Air Temperatures
- ✓ **Increase in Extreme Weather Events**





And Wastewater Plants are Vulnerable!!!

March 2010 Floods hit Rhode Island

- ✓March 2010 - Extended Rainfall Hit Rhode Island
- ✓Over 16 inches of rainfall over 2 weeks (3/14 -3/30/2010)
- ✓8.79 inches of rainfall over two days (3/29-3/30/2010)
- ✓Worst Flooding in over 200 Years
- ✓Pawtuxet River Crested at 20.79 Feet
  - ✓River Flood Level = 9 Feet
  - ✓Crested 4 feet above 100 Year Storm Level
- ✓2 Sewage Plants located along River Completely Underwater!!!
- ✓3rd Plant on river had a major Pump Station Failure

Warwick WWTF Berm Designed for 100 Year Storm

And Wastewater Plants are Vulnerable!!!

Warwick Wastewater Treatment Facility

- ✓River Overflowed the 100 year Berm
- ✓Facility had to be completely rebuilt
- ✓Berm being Raised to 500 Year Storm Level

Warwick, RI WWTF under water

And Wastewater Plants are Vulnerable!!!

West Warwick Wastewater Treatment Facility

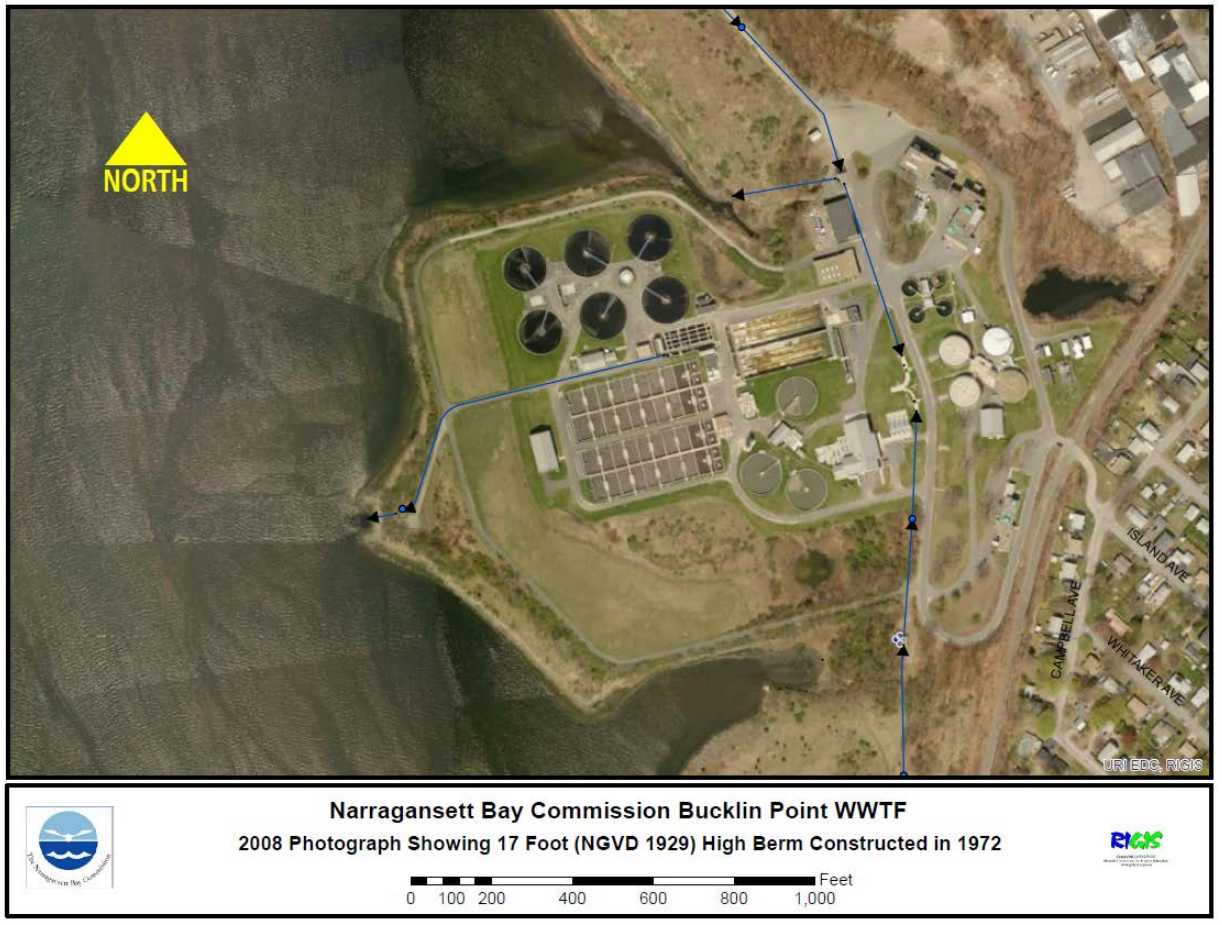
Wastewater Facilities are Vulnerable!!!

- ✓WWTFs are typically located at lowest elevations
- ✓Typically located at sea level along rivers and bays
- ✓WWTFs need to proactively assess their vulnerability
- ✓WWTFs need to improve defenses against Sea Level Rise, Extreme Weather Events & Inundation

NBC is Addressing Climate Change

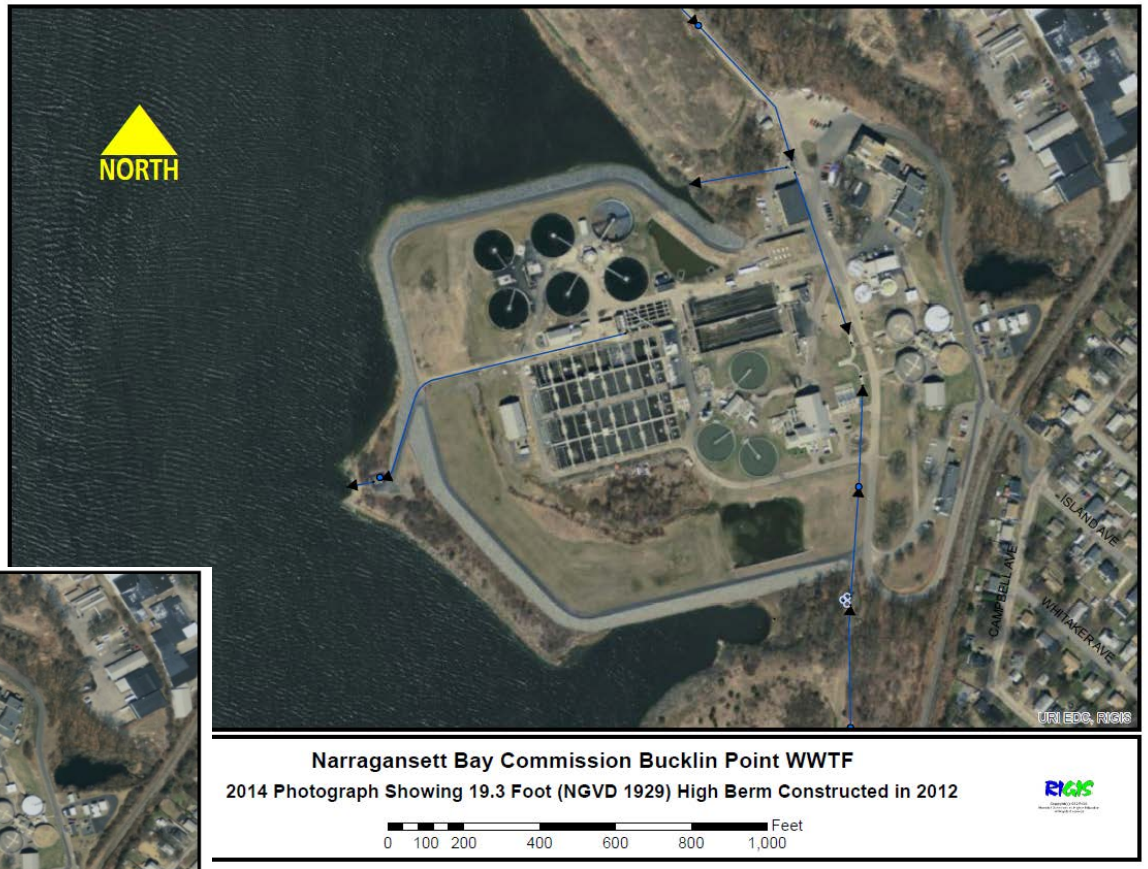
Bucklin Point Berm Replacement

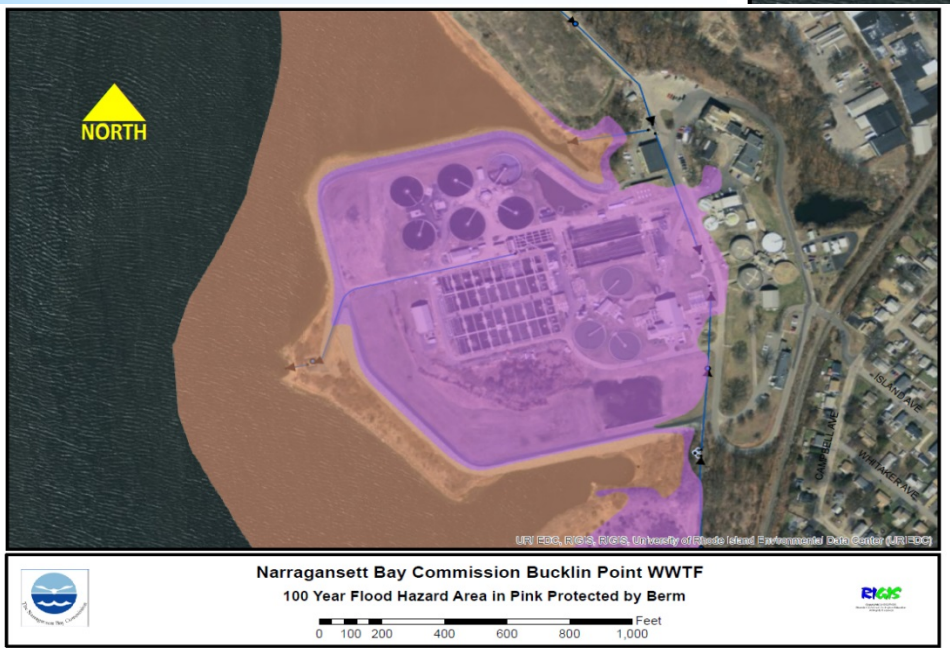
- ✓NBC is addressing Flood & Inundation Concerns
- ✓Original Flood Berm built in 1972
- ✓Design Basis was 1938 Hurricane
- ✓Berm was showing signs of Deterioration
- ✓FEMA 100 Year Flood Level was higher than original design



NBC Bucklin Point Berm Replacement

- ✓ Berm was Upgraded and Raised 2 Feet in 2012
- ✓ New Protection Elevation 19.3 Feet (NGVD 1929)
- ✓ Exceeds 100 Year Flood Level by 0.5 Feet
- ✓ Cost $2.3 Million





New Bucklin Point WWTF Berm

NBC is Addressing Climate Change

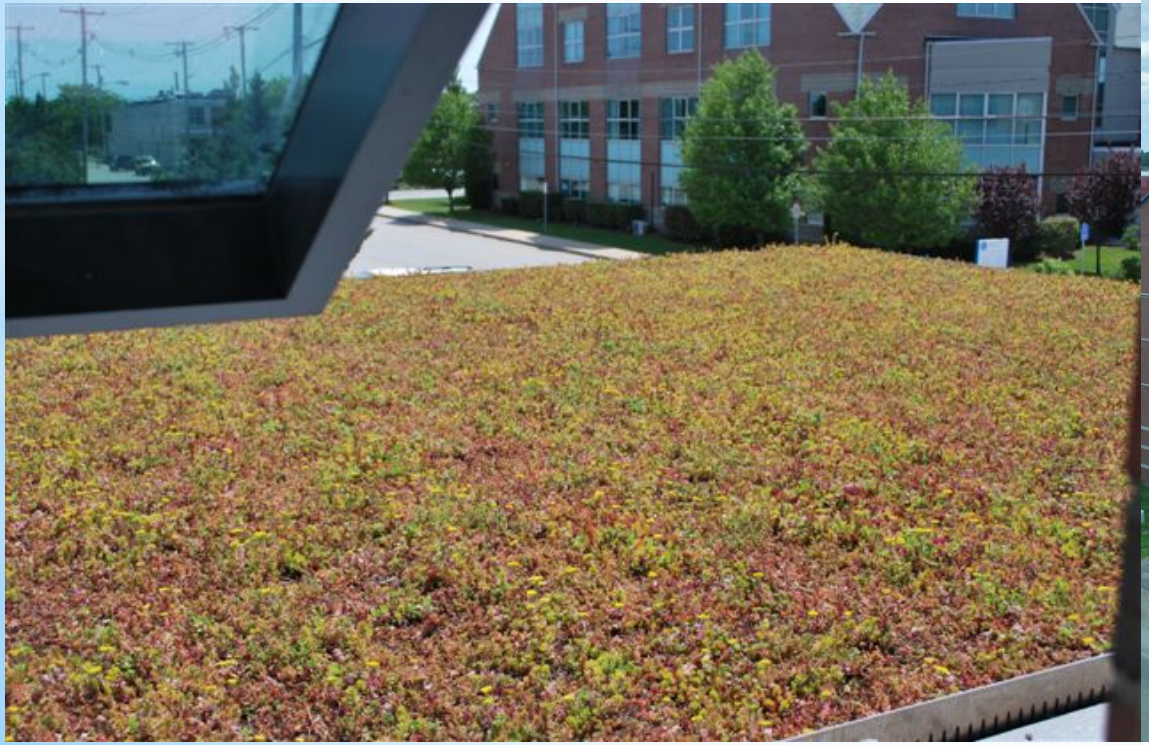
New NBC Operations Building

- ✓Built in 2012 in conjunction with Field's Point nitrogen upgrades
- ✓Leadership in Energy & Environmental Design (LEED) Silver Certification
- ✓29.2 foot first floor elevation
- ✓First Floor Exceeds 100 year flood elevation by 10.4 feet
- ✓Significantly raised elevation of computer control room (2nd floor) for treatment plant and CSO tunnel

NBC is Addressing Climate Change

New NBC Operations Building

- ✓Building design incorporated Green Roofs and LID Technology
- ✓Building has two greens roofs



NBC is Addressing Climate Change

New NBC Operations Building

- ✓Porous Pavement
- ✓Installed in parking spaces

NBC is Addressing Climate Change

New NBC Operations Building

- ✓Bioretention Areas Surround the Building
- ✓Rain Gardens
- ✓Swales

NBC is Addressing Climate Change

New NBC Operations Building

- ✓Provides Greenspace around our Buildings
- ✓Low Maintenance – No Mowing the lawn!
- ✓Provides green habitat for wildlife

NBC is Addressing Climate Change

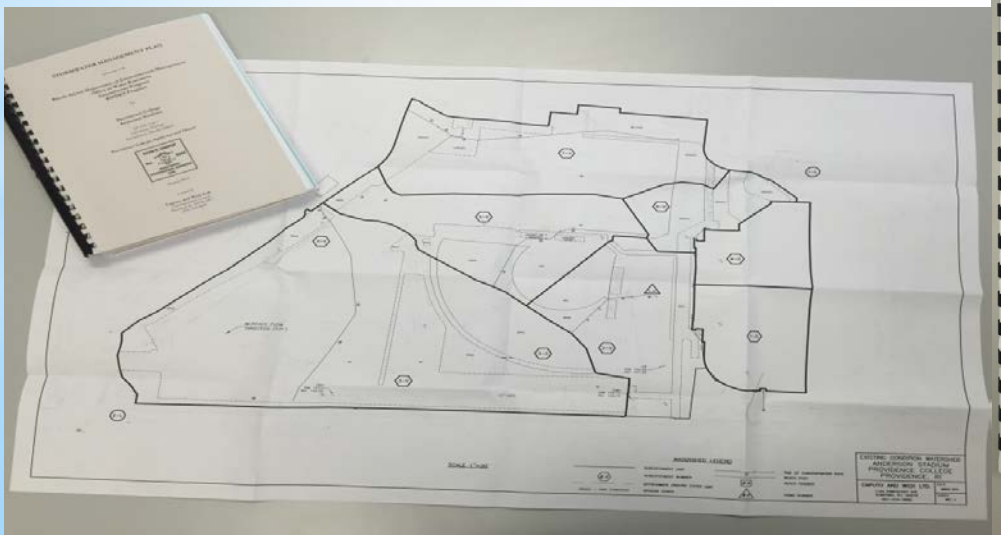
New NBC Operations Building

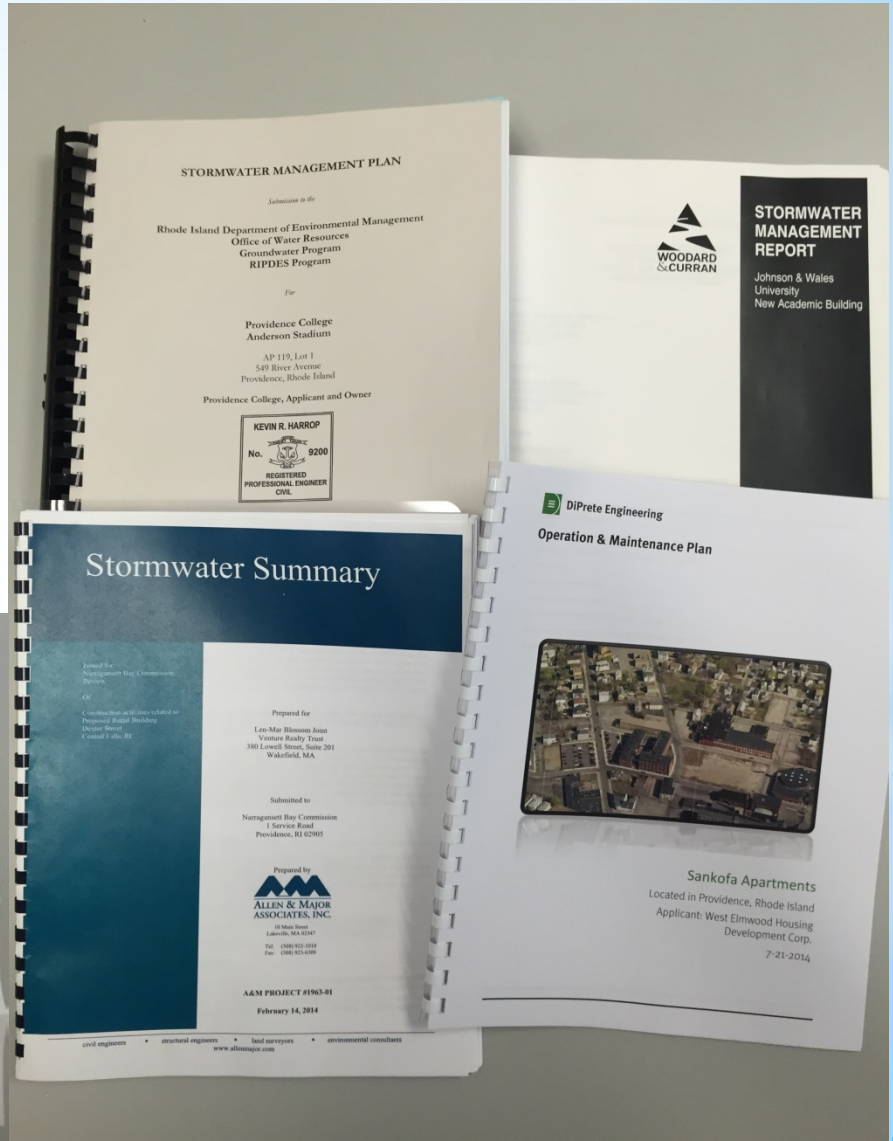
- ✓LID Demonstration Projects enhance Public Awareness
- ✓NBC LID projects an element of our facility tours enjoyed by hundreds of school kids each week

NBC is Addressing Climate Change

NBC Stormwater Mitigation Program

- ✓NBC Regulations Prohibit the discharge of Stormwater, unless….
- ✓NBC established a Stormwater Mitigation Program in 2003
- ✓Requires Builders of New & Redevelopment Projects to Mitigate Stormwater discharges from sites
- ✓Must develop a Stormwater Mitigation Plan





NBC is Addressing Climate Change

NBC Stormwater Mitigation Program

Stormwater Mitigation Plan Requirements:

- ✓ Investigate Measures To Eliminate or Reduce Stormwater Flows
- ✓ Investigate On-Site Flow Infiltration, Retention and Reuse options
- ✓ Use Low Impact Design (LID) Methods
- ✓ Use Best Management Practices
- ✓ Investigate options to redirect stormwater to Storm System or Natural Waterways if LID options not possible
- ✓ ***Mitigation Plan is Mandatory*** to Obtain a Stormwater and Sewer Connection Permits


NARRAGANSETT BAY COMMISSION
STORMWATER CONNECTION PERMIT
Narragansett Bay Commission
1 Service Road
Providence
June 13, 2007
SC070085
Service Road
Page 1 of 1

NBC is Addressing Climate Change

NBC Stormwater Mitigation Program

- ✓NBC approved 123 Stormwater Management Plans since 2003
- ✓Reduced 14,755,338 Gallons from NBC Combined System
  - ✓Based upon a 2 year Storm Event 3.3” rainfall in 24 hours
- ✓Reduced 7,373,478 Gallons from NBC Combined Sewer System
  - ✓Based upon a 3 Month Storm – 1.65” rainfall in 6 hours - Design basis for NBC CSO Project
- ✓Program Eliminated 6.4 Million Gallons from Field’s Point collection system since 2003 for the 3 month storm
  - ✓Equivalent to ~10% of CSO Tunnel Capacity

Stormwater Flows Abated

		3 Month Storm Event	2 Year Storm Event
Year	**Number of Approved Stormwater Mgt. Plans**	**Total Gallons of Stormwater Mitigated**	**Total Gallons of Stormwater Mitigated**
2003	8	415,900	839,800
2004	11	647,154	1,294,318
2005	10	1,062,576	2,126,351
2006	9	568,086	1,034,750
2007	16	1,089,332	2,177,905
2008	13	790,865	1,580,989
2009	9	486,852	973,847
2010	10	258,719	517,438
2011	6	489,519	979,038
2012	13	772,336	1,544,672
2013	8	159,149	318,828
2014	5	182,047	364,094
2015	5	501,654	1,003,308
Total	**123 Stormwater Plans Approved**	**7,373,478 Gallons**	**14,755,338 Gallons**

NBC is Addressing Climate Change

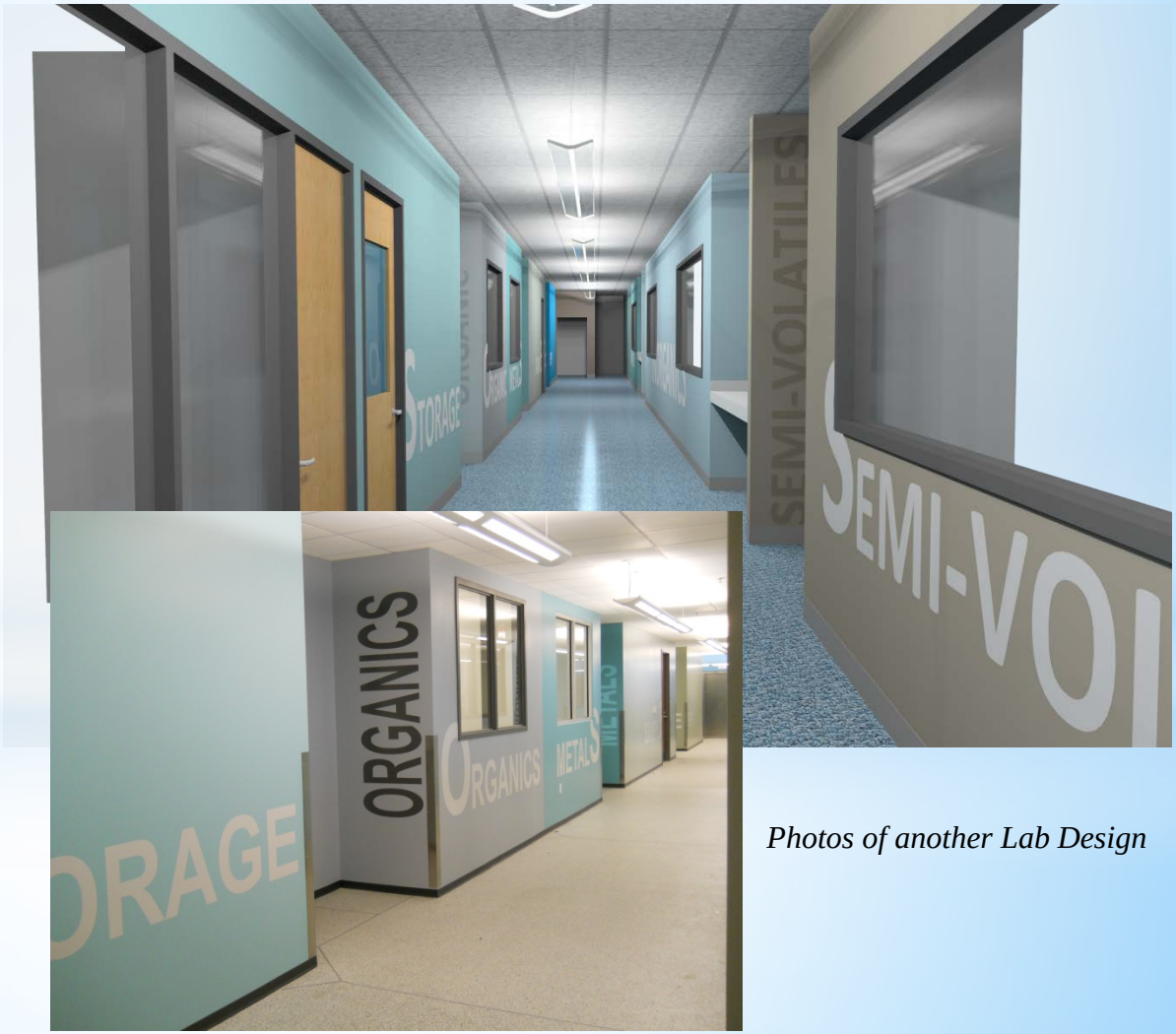
New NBC Water Quality Science Building

- ✓NBC is building a new Water Quality Science Building
- ✓Will house Environmental Monitoring, Data Analysis & Laboratory Staff
- ✓EMDA Collected 29,206 Samples in 2014
- ✓Lab performed 110,686 biological & chemical parameter analyses in 2014
- ✓Existing Lab is in the former Hudson Asphalt lab
  - ✓Insufficient space, with many building issues
  - ✓Not adequate for ultra low level analyses
- ✓New Lab will be state of the art with Clean Room
- ✓Will be able to analyze to ultra low Water Quality Standard Levels

NBC is Addressing Climate Change

New NBC Water Quality Science Building

- ✓Building to be completed in 2016
- ✓NBC is addressing Flood & Inundation Concerns in the design
- ✓32.7 foot first floor elevation
- ✓First Floor Exceeds 100 year flood elevation by 13.9 feet
- ✓Major walkway through Lab will be all glass to facilitate visibility for worker safety and tours



Photos of another Lab Design

NBC is Addressing Climate Change

New NBC Operations Building

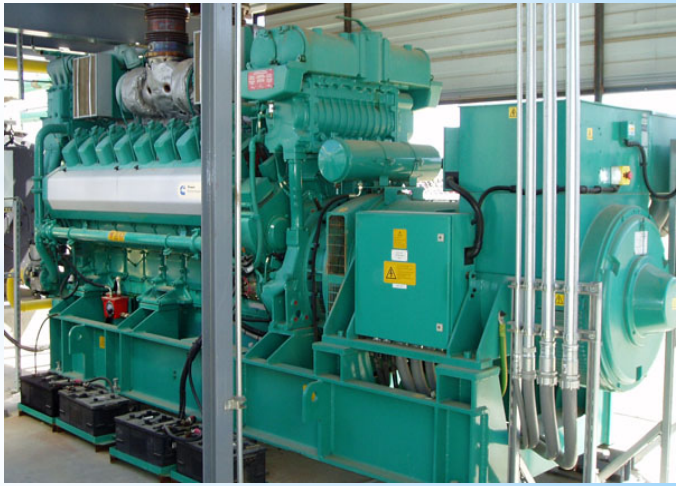
- ✓Graphic shows a 21’ Storm Surge Impacting Field’s Point
- ✓Typical of Cat 3 Hurricane
- ✓The following critical pieces of infrastructure are above the flood waters:
  - ✓Administration, COB, IM, Grit, Maintenance, New Lab, Operations & Sludge Processing Buildings
  - ✓Sludge Thickeners & Aeration tanks
  - ✓Computer Control Systems

URI GSO Hurricane Resilience Project Graphic

NBC is Addressing Climate Change

Comprehensive Energy Evaluations

- ✓Conducted **Comprehensive Energy Conservation and Alternative Energy Evaluations** in 2005 with $35,000 EPA Grant:
  - ❑Project identified **Energy Efficiency & Conservation Opportunities** at NBC Facilities
  - ❑Identified **Alternative Energy Opportunities:** Low Hanging Fruit:
    - ✓Wind Energy at Field's Point
    - ✓Biogas CHP at Bucklin Point
- ✓Performed Wind Energy Feasibility Study for Field's Point with $25,000 state grant
- ✓Performed Biogas Combined Heat & Power Feasibility Study for Bucklin Point with $25,000 state grant



NBC Energy Efficiency Projects

Location	Description of Energy Efficiency Project	Energy Savings (kWh/year)
Bucklin Point	Efficient Blower Selection	618,757
Bucklin Point	Optimal DO and Blower Control	502,416
Bucklin Point	VFDs on Recycle Pumps	81,858
Fields Point	VFDs on Blowers 1, 2 & 3	198,345
Fields Point	Power Washing Diffuser Heads	25,266
Fields Point	Pilot Tube Air Station Sensors	24,788
COB	Lighting upgrade at Corporate Office Building	63,419
Total Energy Savings		1,514,849 kWh/year

Energy Saving Project		Cost	Utility Incentive	Annual Savings	Annual Savings $(kWh)_{eq.}$
Lights	BP - Replace approximately 60 fixtures that use 400 W lamps such as mast lights with LEDs	-	-	$11,984	105,694
VFD	FP Plant Water - 100 hp	-	$121,000	-	-
	Reservoir Avenue PS - 5 hp	-	$1,000	-	-
	WPPS - 40 HP	$11,000	$5,500	-	-
	FP Base Blower - Install 500 hp VFDs on new centrifugal blowers equipped with inlet vane dampers	$200,845	$71,067	$41,816	368,808
ERU	FP Bisulfite Storage Building - Space Ray heaters & split system	$37,895	$18,900	$9,283	227,308
	ESPS - Dry Well Ventillation Control	$21,800	$7,050	$28,740	703,743
	PSPS - 7,000 cfm Energy Recovery Ventilator	$19,650	$9,825	$6,266	153,433
MISC	BP - Steam Trap Survey	-	-	-	-
	BP Storage Building - Install Radiant Heat Tubes and heat pump to replace old steam heating system	$38,000	-	-	-
Sum		$329,190	$234,342	$98,089	1,558,986

Estimated $268,000/year in Electric Savings!!!
Estimated 1,001 M Tons/Year CO2(e) Reduced

ENERGY STAR

NBC Field's Point WWTF

Field's Point WWTF Operations

- ✓45 MGD Average Daily Flow
- ✓65 MGD Secondary/Advanced Treatment
- ✓200 MGD Primary
- ✓Chlorination/De-chlorination
- ✓Sludge Gravity Thickeners
- ✓4 Pumping Stations

Field's Point WWTF Energy Use

- ✓**1.8 MW Electrical Load**
- ✓**15,930,000 kWh/year**

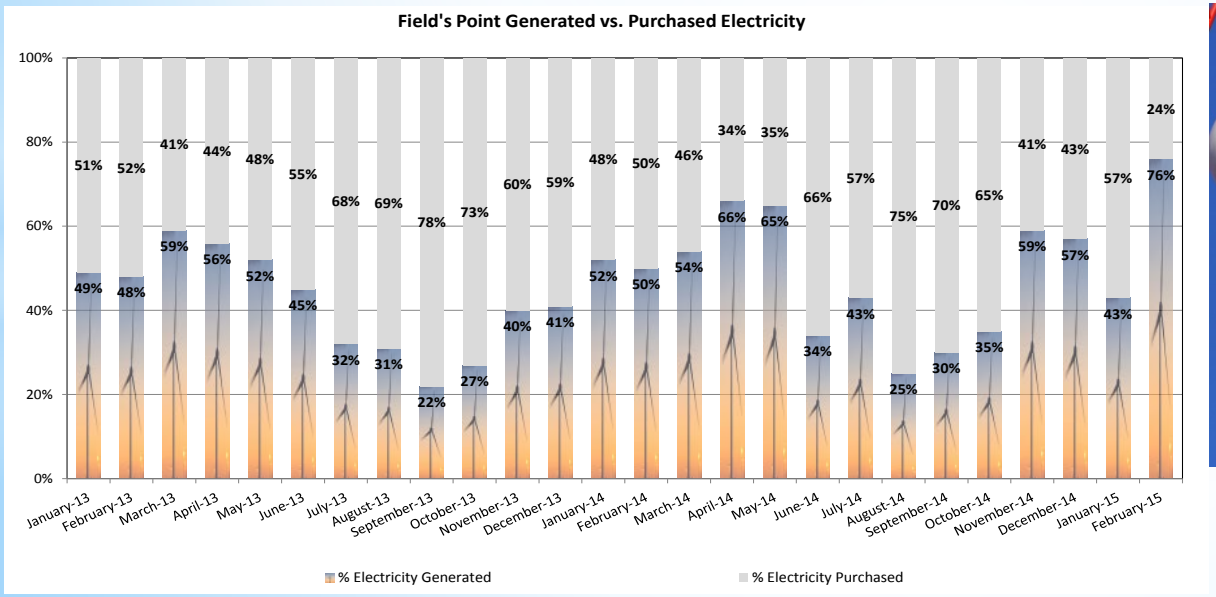
Renewable Opportunities:

- ✓ Wind Turbines
- ✓ Small Hydro-Electric Projects
- ✓ Small Solar Projects

Field's Point Wind Energy

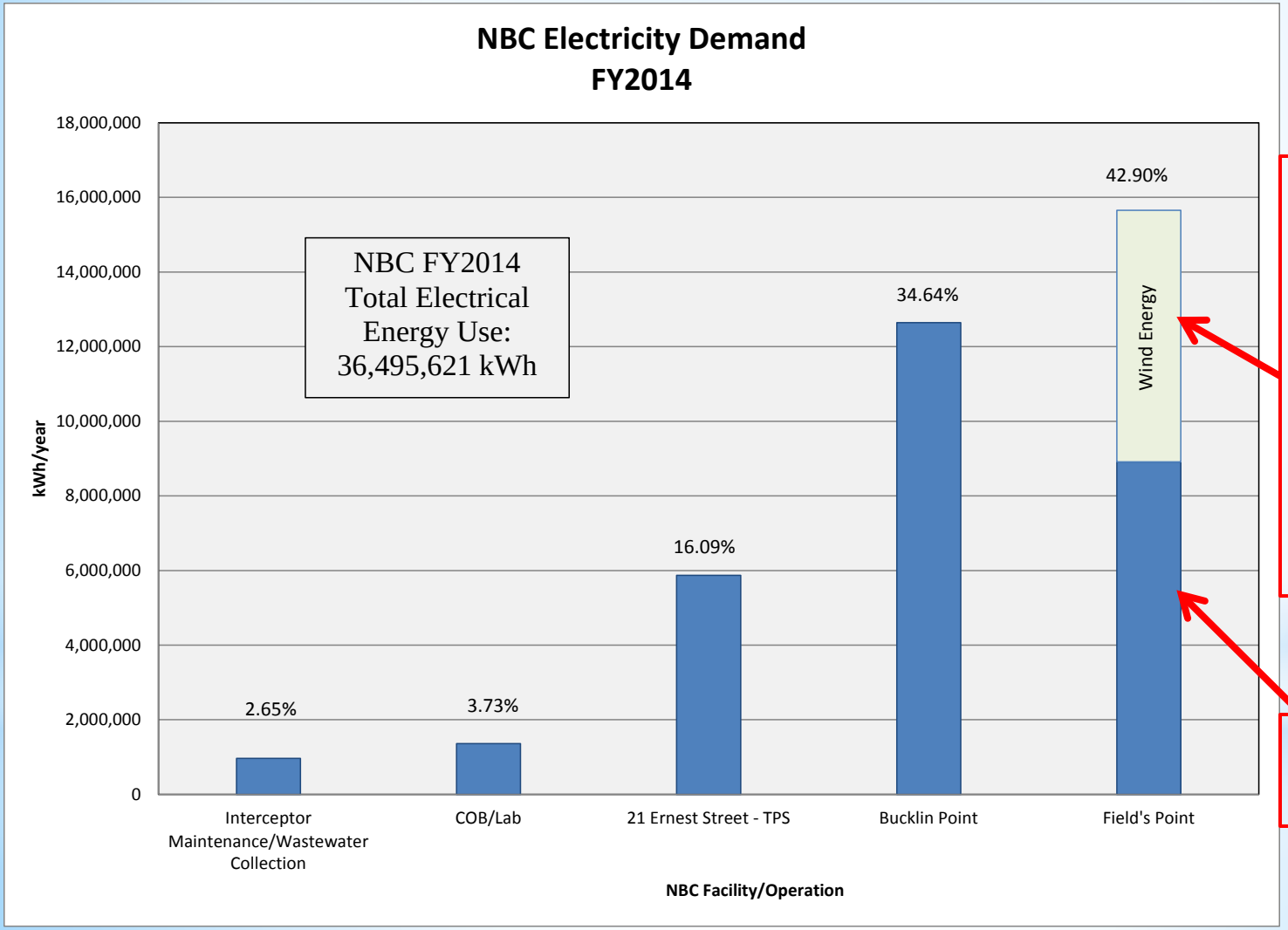
Field's Point Wind Energy Project:

- ✓ **First and Only Wind Farm in RI!!!**
- ✓ 4.5 MW Wind Farm (3 – 1.5MW Turbines)
- ✓ Operational - October 2012
- ✓ **47% of Facility Energy Demand in 2014**
- ✓ **GHG CO_2(e) Offsets: 2,325 Metric Tons/Year**
- ✓ **$892,672** in REC Revenue since project went on-line
- ✓ **~$1,195,163** Financial Benefit to NBC in 2014
- ✓ **~$ 2,220,924** Financial Benefit to NBC since the project went on-line!



Field's Point Energy Consumption and Wind Energy Production

NBC Electrical Energy Use



- ✓ Wind Turbines powered **47%** of Field's Point needs in 2014
- ✓ **21%** of ALL NBC Power Needs
- ✓ 7,600,000 kWh of Electricity per year from Turbines

- ✓ 8,330,000 kWh per year of Electricity from the Grid

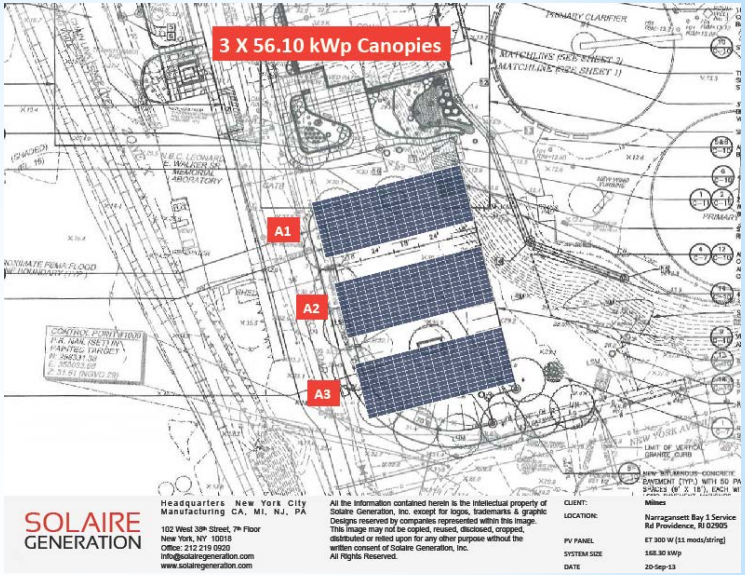
Other Field's Point Projects Under Investigation:

Hydroelectric Turbine

Typical Siphon Turbine Installation

Estimated Project Values	
Turbine Design Flow (min)	30 MGD
Average Available Head	10.5 Feet
Theoretical Energy	41.2 kW
Turbine Efficiency	72%
Nameplate Power	29.7 kW
Total Project Cost	$684,237 (Waterline)
Installed Cost	$23,009 per kW
Capacity Factor	96%
Output	250,656 kWh/yr
Estiamted Net Electric Value	$0.16 per kWh
Annual Savings	$40,105
Useful Life	20 years
Unsubsidized Payback	17 years

Solar Carports



Number of Modules	166	Total
Capacity	49,800 W	$34,860
Percent of Building	30% of estimated peak	
Installed Cost	$3.50 per Watt from NREL	
Total Cost		$174,300
Unit Cost Adjustment	0%	
Final Cost		$174,300
Capacity Factor	12% annual average	
Output	52,350 kWh/yr	
Avg 15 yr elec Cost	$0.14 per kW	
Electric Savings	$7,548 per year	
ITC (for eligible entity)	0%	$0
RI Grant	20%	$34,860
Customer Cost		$139,440
RECs Generated	52.3 MWh/yr	
Forecasted Rec Value	$40 /MWh	
REC Annual Amount	$2,094 per year	
Payback Period	14 years	

NBC Bucklin Point WWTF

Bucklin Point WWTF Operations

- ✓24 MGD
- ✓46 MGD Secondary/Advanced
- ✓116 MGD Primary
- ✓UV Disinfection
- ✓Anaerobic Digestion
- ✓3 Pumping Stations

Bucklin Point WWTF Energy Use

- ✓**1.5 MW Average Demand**
- ✓**13,106,000 kWh/year**

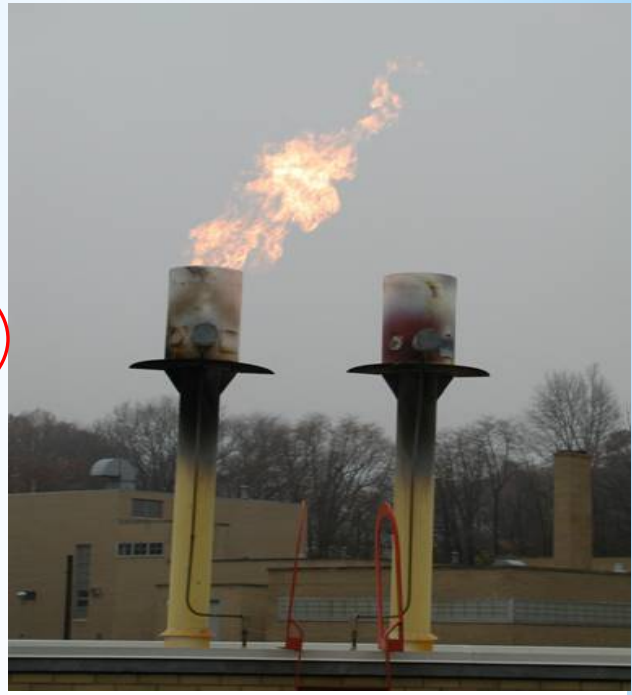
Renewable Opportunities:

- ✓Biogas Reuse Project
- ✓Large Solar Project

NBC Bucklin Point Biogas Combined Heat and Power Energy Project

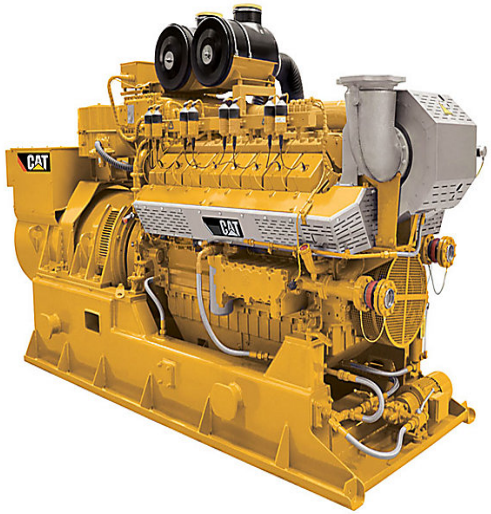
$25,000 Grant from State of RI - Feasibility Study

- ✓ 600 kW Combined Heat and Power (CHP) System
- ✓ **37% of BP Electricity Demand**
- ✓ **90 % of BP Digester Heat Demand**
- ✓ **GHG CO_2(e) Offsets: 1,514 Metric Tons/Year**
- ✓ **Estimated Annual Electricity Cost Savings & Revenue $577,678**
- ✓ 250,000 SCFD Biogas Production (60% Methane)
- ✓ Estimated Project Cost: $6,440,000
- ✓ Estimated Annual Operating Cost: $172,000
- ✓ Heat output satisfies digester demand on all but the coldest of winter days



Project Status as of March 2015

- ✓ Feasibility Study completed: December 2009
- ✓ Design completed: December 2014
- ✓ RFP for construction issued February 2015
- ✓ Proposals received in February and economic feasibility finalized
- ✓ Grants to be utilized from sources including RIREF, RGGI and National Grid
- ✓ Board Approval March 2015;Project awarded to DOC Construction



Other Bucklin Point Projects Under Investigation:
Large Solar Energy Project

Photovoltaic System

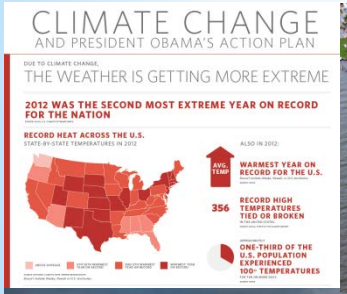
- ✓ 2.6 MW Array on Closed Landfill
- ✓ **22% of BP Electricity Demand**
- ✓ **GHG CO_2(e) Offsets: 842 Metric Tons/Year**
- ✓ **Estimated Savings & Revenue $352,770/yr**
- ✓ 2,251,000 kWh/year
- ✓ 11.4 acres – Former Landfill
- ✓ Estimated Cost $8,348,470
- ✓ **Will need to be done in phases**

Project Status as of July 2015

- ✓ Internal feasibility study being finalized
- ✓ RFQP for civil work feasibility study completed
- ✓ RFQP to be issued Summer/Fall 2015

Climate Change Legislation & Regulations

- ✓ Many new Regulations & Legislation being proposed & enacted annually to address Climate Change
- ✓ Regulations & Goals Vary Widely
- ✓ WWTFs will eventually have to meet Greenhouse Gas Reduction Targets



Various GHG Reduction Targets

(H 7904):

- ✓ 25% below 1990 levels by 2025
- ✓ 50% below 1990 levels by 2035
- ✓ 85% below 1990 levels by 2050

(S 7952A) 10% below 1990 levels by 2020

- ✓ 45% below 1990 levels by 2035
- ✓ 80% below 1990 levels by 2050

Renewable Energy Portfolio Standard

- ✓ Obtain 16.5% electricity from renewable resources by 2019
- ✓ 2012 – 6.5% : 528,014 MWh

RIDEM

- ✓ CO_2 Budget Trading Program – RGGI participation

Regional Greenhouse Gas Initiative (RGGI)

- ✓ Cap and reduce power sector CO_2 emissions
- ✓ 10% Reduction by 2018

RI Climate Change Council

- ✓ Develop strategies to reduce RI GHG emissions (below 1990 levels):
- ✓ 10% by 2020,
- ✓ 45% by 2035, and
- ✓ 80% by 2050

EPA Mandatory Reporting of GHGs 40 CFR 98 (2010)

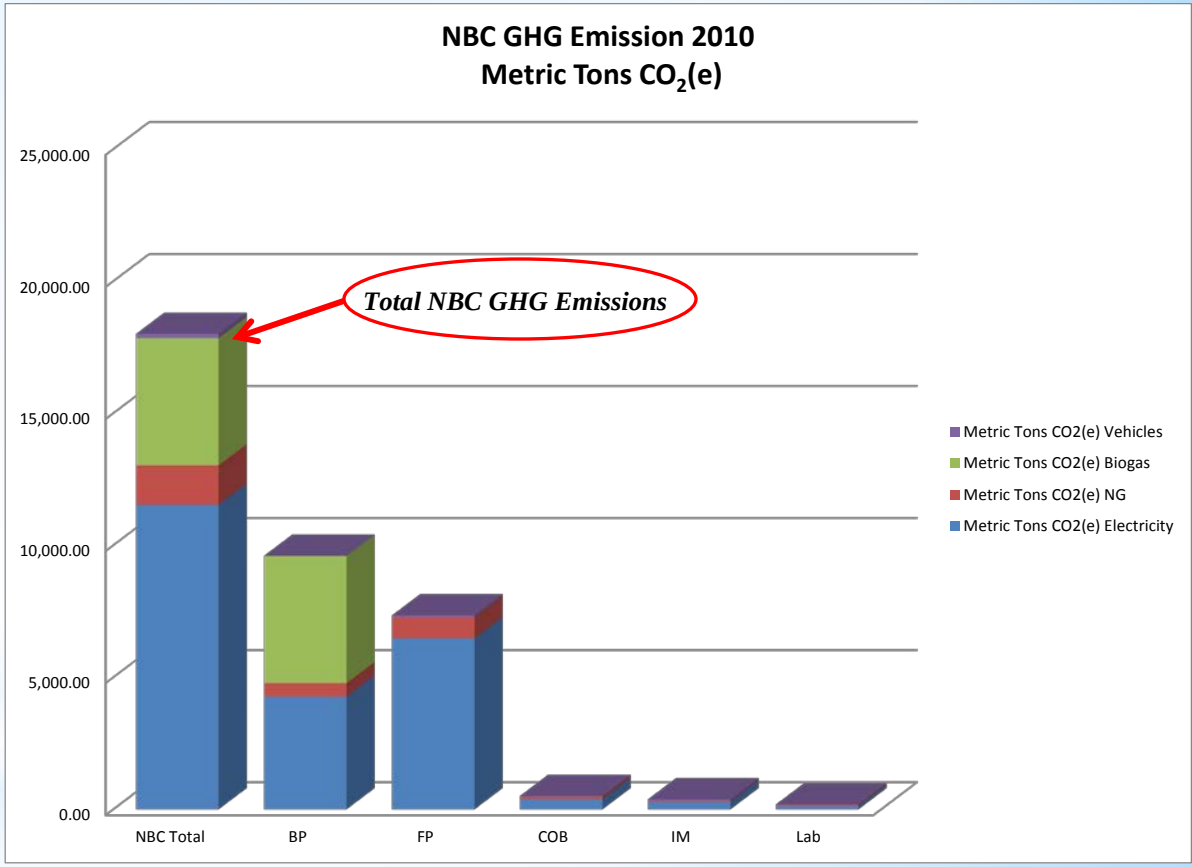
List Categories Regulated

- Listed Source (Table A–3) Category
  - ✓ Specifies Industry Types Regulated
  - ✓ WWTFs were listed in Proposed Regs, but deleted
- Listed Source (Table A–4)
  - ✓ Emits 25,000 metric tons CO_2e or more per year
- Not a Listed Source Category but:
  - ✓ 45% below 1990 levels by 2035
  - ✓ Has stationary fuel combustion units with 30 mmBTU/hr nameplate capacity or greater, and
  - ✓ Emits 25,000 metric tons CO_2 equivalents or more per year in combined emissions from all stationary fuel combustion sources

✓ ***NBC is Well Below the 25,000 metric ton cut-off***

✓ ***NBC is NOT Regulated YET!!!***

✓ ***But we are being Proactive and Preparing for Future Regulation!!!***



GHG Emissions in Blue are not Reportable under present regulations

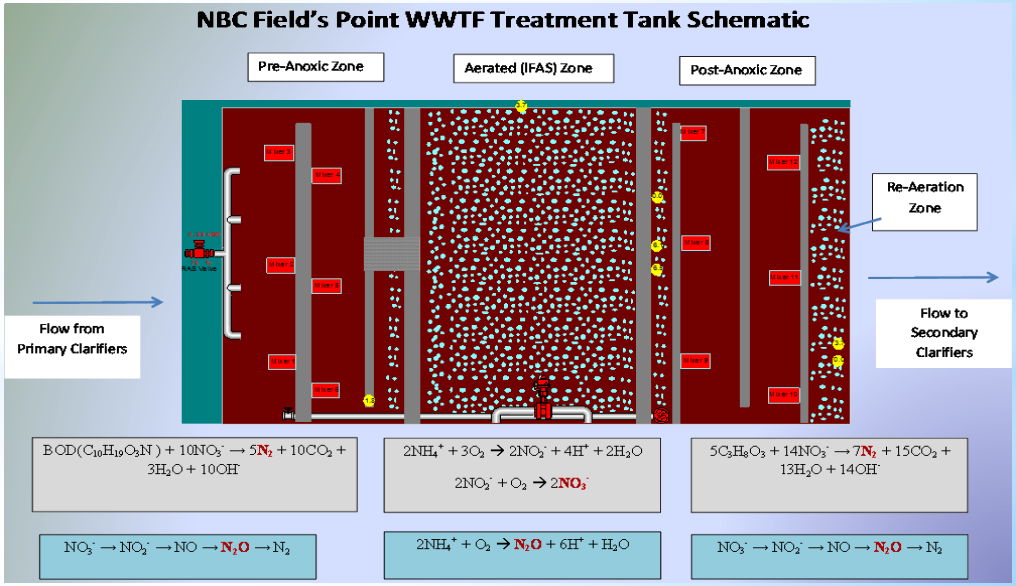
GHG Emissions Analysis of Treatment Processes

Floating chamber placed on water surface to measure GHG concentrations

GHG analyzer that uses cavity ring down spectrometry to measure the ppm concentrations of GHGs: CO_2, N_2O and CH_4

Preliminary Findings:

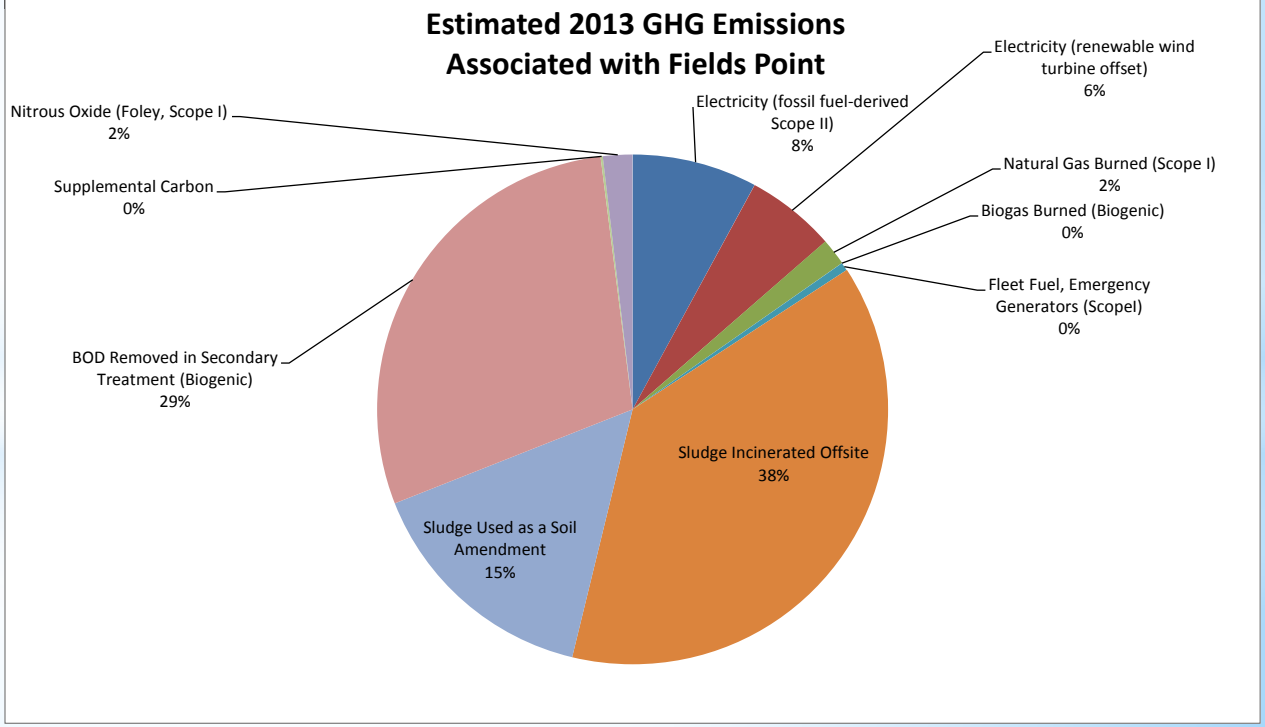
- ✓ % of TKN emitted as N_2O is lower than literature values
- ✓ Grams of CH_4 m^{-2} d^{-1} and g CO_2 m^{-2} d^{-1} can vary from reference values and vary widely depending on process operating parameters



NBC Carbon Footprint Estimates

- ✓ These estimates are based on published Emission Factors
- ✓ Off-site Sludge Incineration is the largest percentage (38%) of NBC GHG emissions
- ✓ Note that Sludge incineration is a ***beneficial reuse*** because it is used to generate energy
- ✓ BOD Removal second largest contributor at 29% for CO_2 emissions

FP GHG Emission Sources	Units	Value	Equivalent MT
Electricity (fossil fuel-derived Scope II)	kWh/yr	**8,973,149**	**2,593**
Electricity (renewable wind turbine offset)	kWh/yr	**6,410,000**	**1,852**
Natural Gas Burned (Scope I)	therms/yr	**102,484**	**560**
Biogas Burned (Biogenic)	SCFY	**0**	**0**
Fleet Fuel, Emergency Generators (ScopeI)	gpy (as gasoline)	19,042	**170**
Sludge Incinerated Offsite	DTY VS oxidized to CO2	**4,095**	**12,446**
Sludge Used as a Soil Amendment	dry ton VS/yr	**2,274**	**4,981**
BOD Removed in Secondary Treatment (Biogenic)	ton/yr C_xH_n biologically oxidized to CO_2	**6,902**	**9,493**
Supplemental Carbon	Gallons Per Year MicroC	**29,740**	**49**
Nitrous Oxide (Foley, Scope I)	ton/yr nitrous oxide	**2.3**	**609**
Nitrous Oxide Emission Factor (Foley)	Based on mass of N processed*	0.25%	
Approximate Nitrogen Removed (ton/yr)	Allows for incomplete DIN removal	890	



Energy Focused Environmental Management System

Sustainable Energy Management Program for WWTFs

Energy Focused –Environmental Management Systems (EF-EMS)

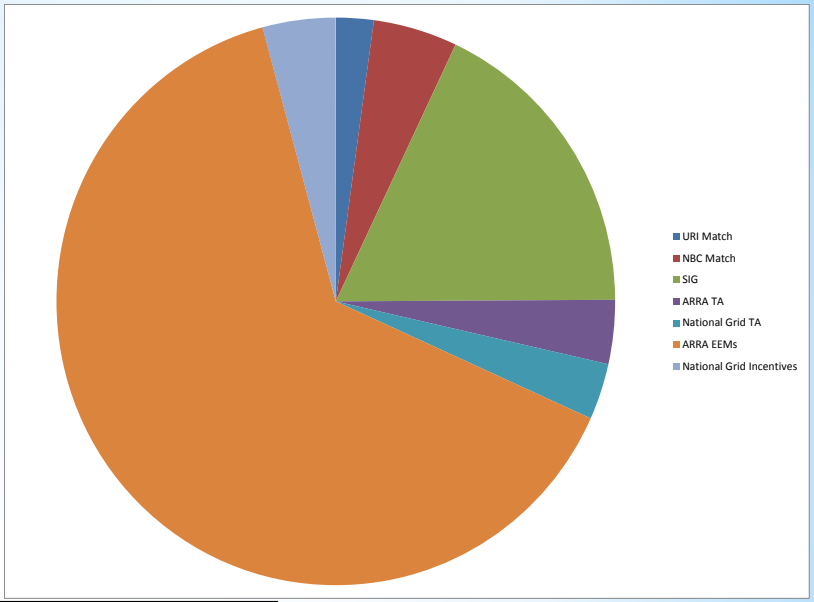
- ✓NBC Applied for EPA State Innovations Grant in 2008
- ✓$275,000 Grant Award Received
- ✓Leveraged $1.2 M in additional funding
- ✓Project Grew with other Support to $1.54Million
- ✓EPA Energy Management Guidebook for Wastewater and Water Utilities
- ✓Energy Star Portfolio Manager
  - Measure and Benchmark Energy Use Performance
  - Energy Conservation and Efficiency
  - Renewable Energy Opportunity Assessments

URI Match	$33,512
NBC Match	$75,000
EPA SIG	$275,000
ARRA TA	$55,904
National Grid Energy TA	$49,147
ARRA EEMs	$985,460
National Grid Incent.	$65,000
Total:	$1,539,023

WWTF Sustainability Project Outcomes

Projects Outcomes

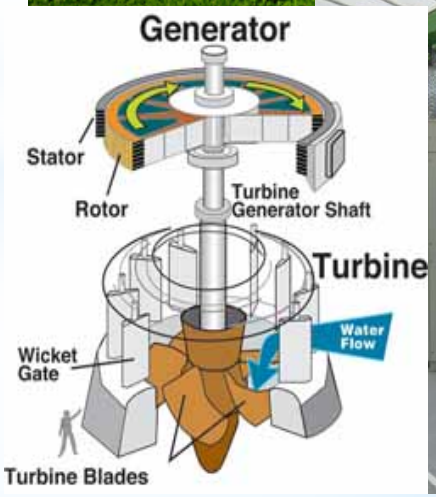
- ✓ Energy Assessment of all 19 WWTFs
- ✓ **4,470,000 kWh/year of potential energy savings**
- ✓ **11,000 kWh/year of clean renewable energy opportunities**
- ✓ Heightened energy use awareness to WWTFs
- ✓ Improved energy related communications



WWTF ID	Population	Electricity kWh	Gas therms	Oil gallons	Energy Mbtu	Flow MGD	Volume MG/Yr	Electric kWh/MG	Heat kBtu/MG	Total kBtu/MG
RI-WWTF-2	1,720	247,300	0	3,000	1,324	0.54	195	1,266	2,150	6,777
RI-WWTF-1	750 / 8500	322,418	0	0	1,100	0.11	38	8,378	0	28,586
RI-WWTF-4	***16,361***	492,600	2,790	1,900	2,288	0.70	255	1,932	2,137	8,973
RI-WWTF-3	6,000	496,534	0	2,000	2,014	0.54	196	2,532	1,428	10,269
RI-WWTF-5	8,000	750,700	0	7,158	3,707	0.84	306	2,453	3,274	12,111
RI-WWTF-8	13,000	979,874	0	9,427	4,852	2.01	734	1,335	1,798	6,609
RI-WWTF-6	2,500	1,051,878	20,350	0	5,624	1.08	393	2,676	5,177	14,307
RI-WWTF-7	8,000	1,095,268	0	16,018	6,300	1.90	694	1,579	3,234	9,084
RI-WWTF-9	25,396	1,277,575	0	17,500	7,159	2.89	1,056	1,210	2,321	6,782
RI-WWTF-10	16,900	1,431,124	10,569	1,112	6,118	3.65	1,333	1,073	909	4,588
RI-WWTF-19	10,000	2,234,168	0	4,800	8,391	2.70	986	2,267	682	8,514
RI-WWTF-15	38,385	2,703,613	23,758	0	11,601	11.83	4,318	626	550	2,687
RI-WWTF-13	47,935	2,776,279	48,531	0	14,326	7.42	2,710	1,025	1,791	5,286
RI-WWTF-11	28,000	3,159,000	27,469	0	13,525	5.01	1,829	1,727	1,502	7,395
RI-WWTF-12	30,000	4,776,225	0	19,411	19,402	6.45	2,354	2,029	1,154	8,242
RI-WWTF-16	77,000	7,874,578	58,735	0	32,742	13.92	5,079	1,550	1,156	6,446
RI-WWTF-14	52,200	8,716,754	4,195	3,085	30,655	33.14	12,097	721	70	2,534
RI-WWTF-18	208,743	10,486,807	74,004	0	43,181	48.67	17,765	590	417	2,431
RI-WWTF-17	119,809	12,507,940	39,883	0	46,665	21.75	7,938	1,576	502	5,879
	709,949	63,380,636	310,284	85,411	260,973		60,276	1,052	713	4,330

Additional NBC Activities

- ✓RFQ/P to be issued to identify off-site Virtual Net Metering Alternative Energy Projects
  - ✓NBC GOAL: Become Net Zero and Carbon Neutral?
- ✓Participating in RI DEM Project to Assess Climate Change Vulnerability at all state WWTFs
- ✓Conduct an Engineering Analysis of NBC Infrastructure when new flood and inundation criteria are developed.
- ✓Continue to participate in all RI state Climate Change Activities.



Some Final Thoughts

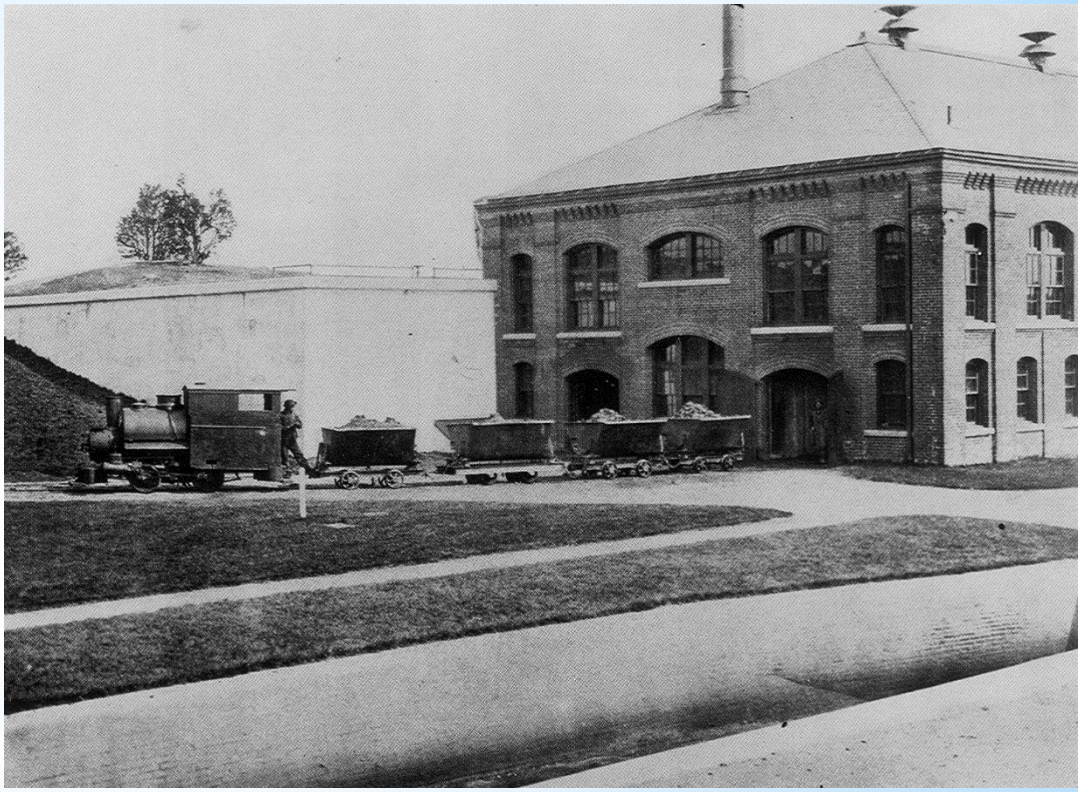
NBC is Working Proactively to:

- ✓ Determine and Reduce our Carbon Footprint

Construction Nevers Stops for Wastewater Treatment Plants, but we have many unanswered questions?

- ✓ What is the 100 Year Storm today?
- ✓ What Design Criteria should we build to?
  - ✓ 100 year storm?
  - ✓ 100 year storm + 1 - 2 Feet?
  - ✓ 500 year storm?

We await the science and new construction specifications



Field's Point Sludge Processing c1910

Addressing Climate Change will be Expensive, but not addressing it will be More Expensive!

Questions?

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