Snapshot of Upper Narragansett Bay: NBC Water Quality Initiatives

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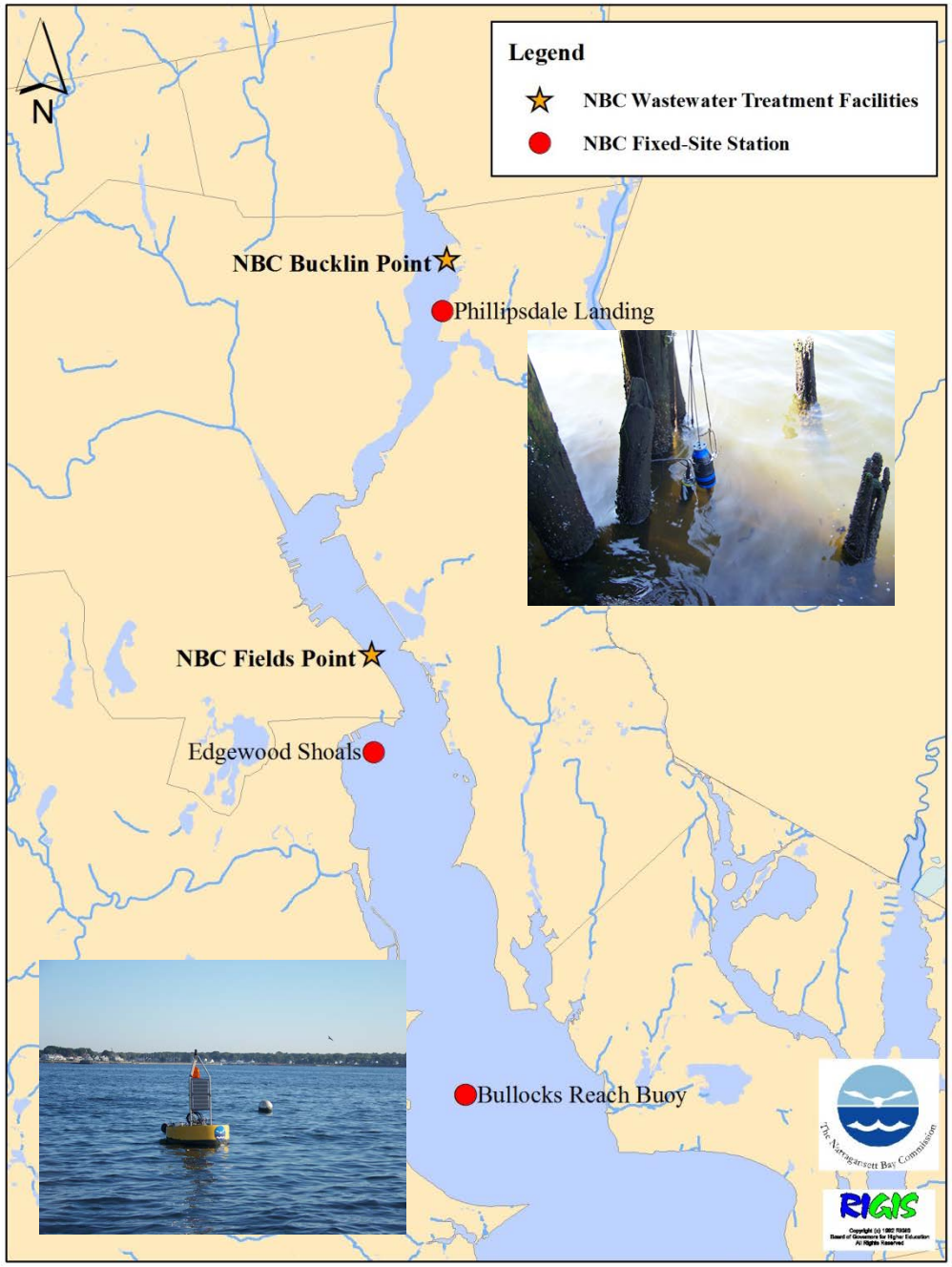
Overview of Presentation

* Snapshot Website
* Fixed Site Monitoring
* Seabird Profiles
* Water Clarity
* National Coastal Condition Report
* Surface Mapping
* Plankton monitoring
* Benthic Video Monitoring

Snapshot of Upper Narragansett Bay

* NBC's external website dedicated to educating the public about the water quality of upper Narragansett Bay
* Online since 2011
* Received NACWA award for Excellence - Public Information and Education in E-Media 2013
* Targeted to educators, researchers, students, regulators, fishermen, boaters & the interested public
* http://snapshot.narrabay.com/app/

Fixed Site Water Quality Monitoring



Monitoring Stations

* Two stations
  * 2000 EMPACT grant
  * 2002 NBC
* NB Fixed Site Monitoring Network
* Phillipsdale (PD)
  * 2 sondes (surface & bottom)
  * affixed to dock in Seekonk River, south of Bucklin Point
* Bullocks Reach (BR)
  * buoy system
  * 3 sondes (surface, mid, bottom)
* Temporary site at Edgewood Shoals

Parameters

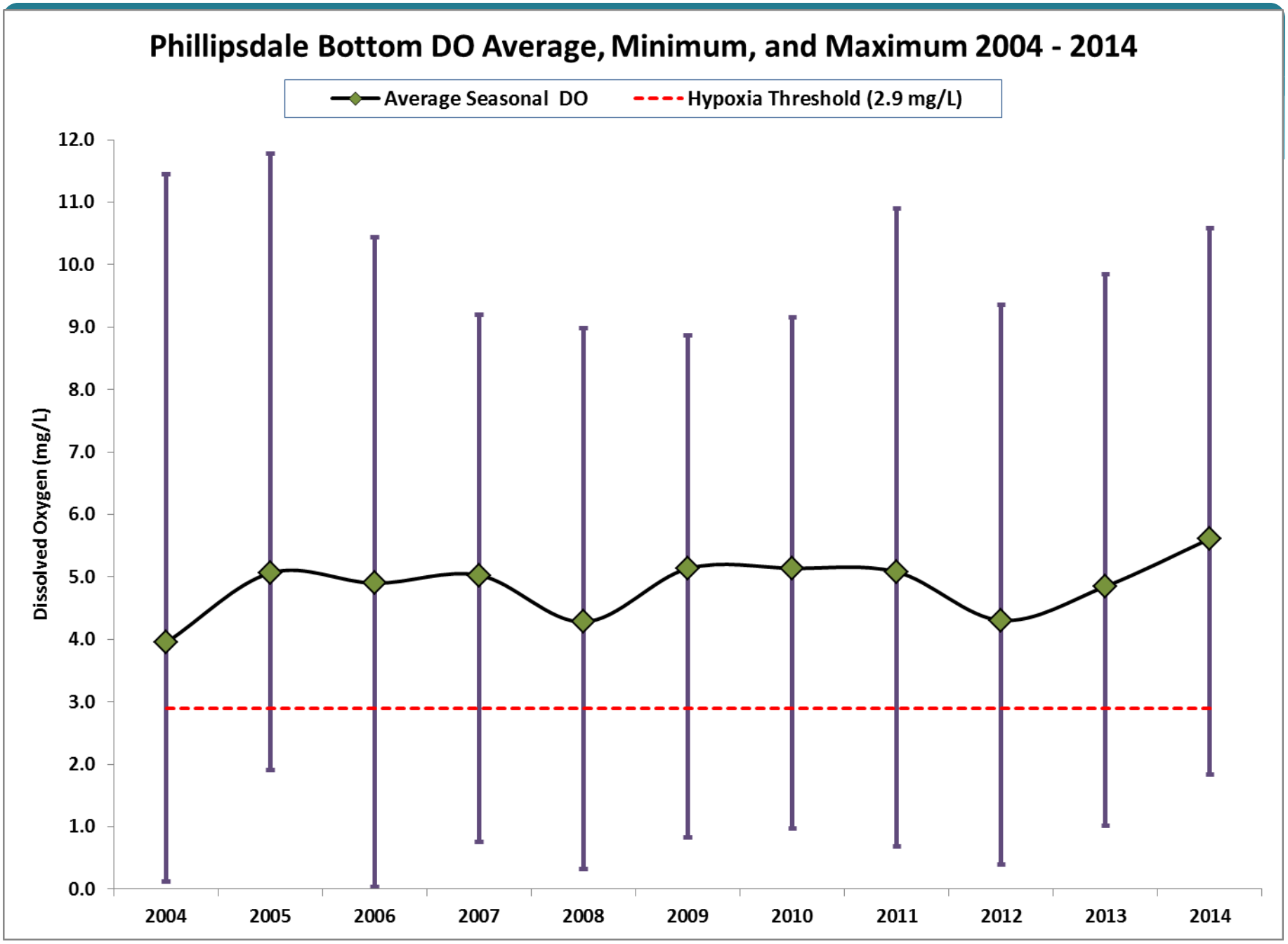
Bullocks Reach

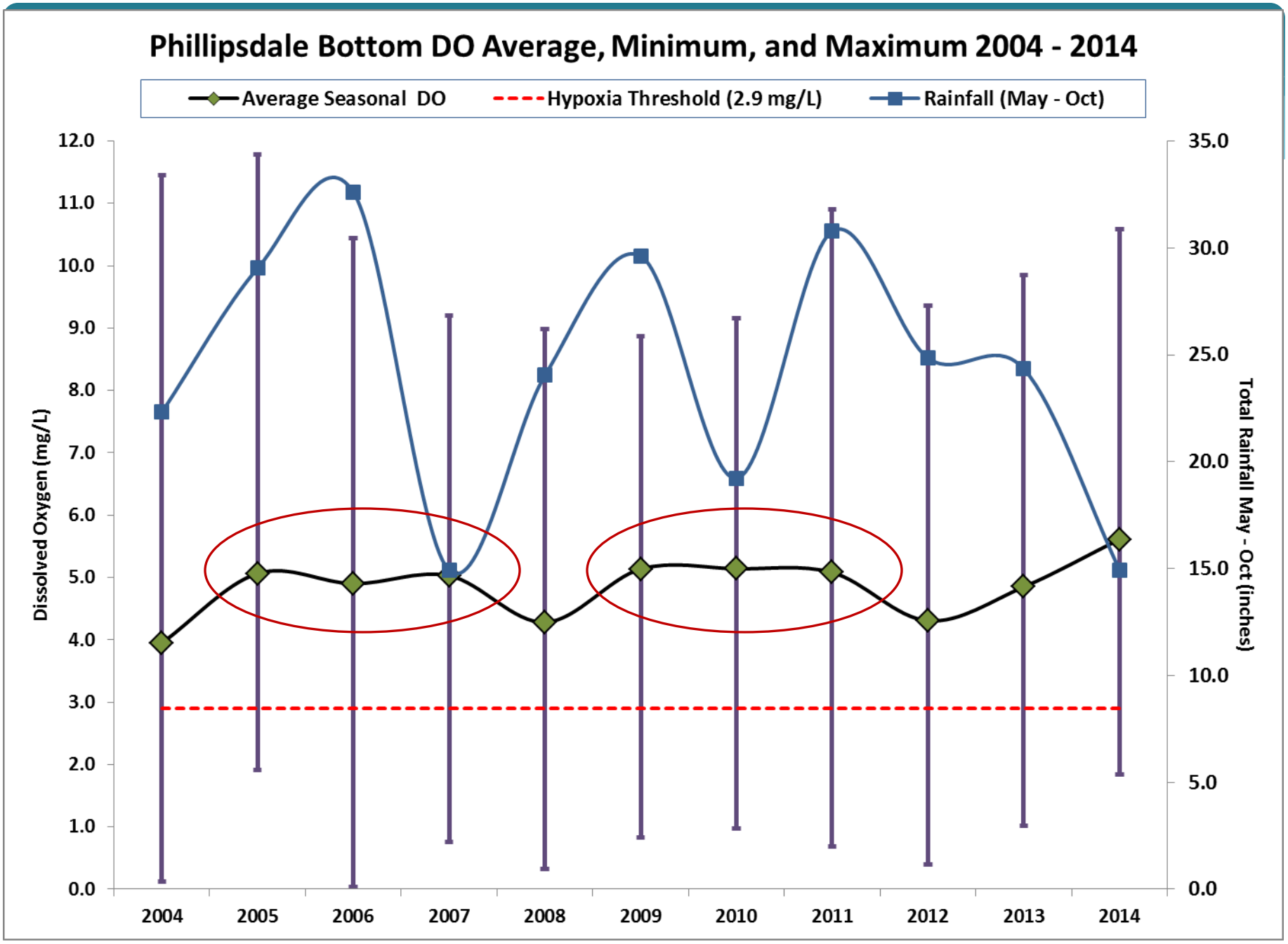
* Temperature
* Sp. Conductivity
* Dissolved oxygen
* pH
* Depth
* Chlorophyll (S,M)
* Turbidity (B)

Phillipsdale

* Temperature
* Sp. Conductivity
* Dissolved oxygen
* pH
* Depth
* Chlorophyll (S)

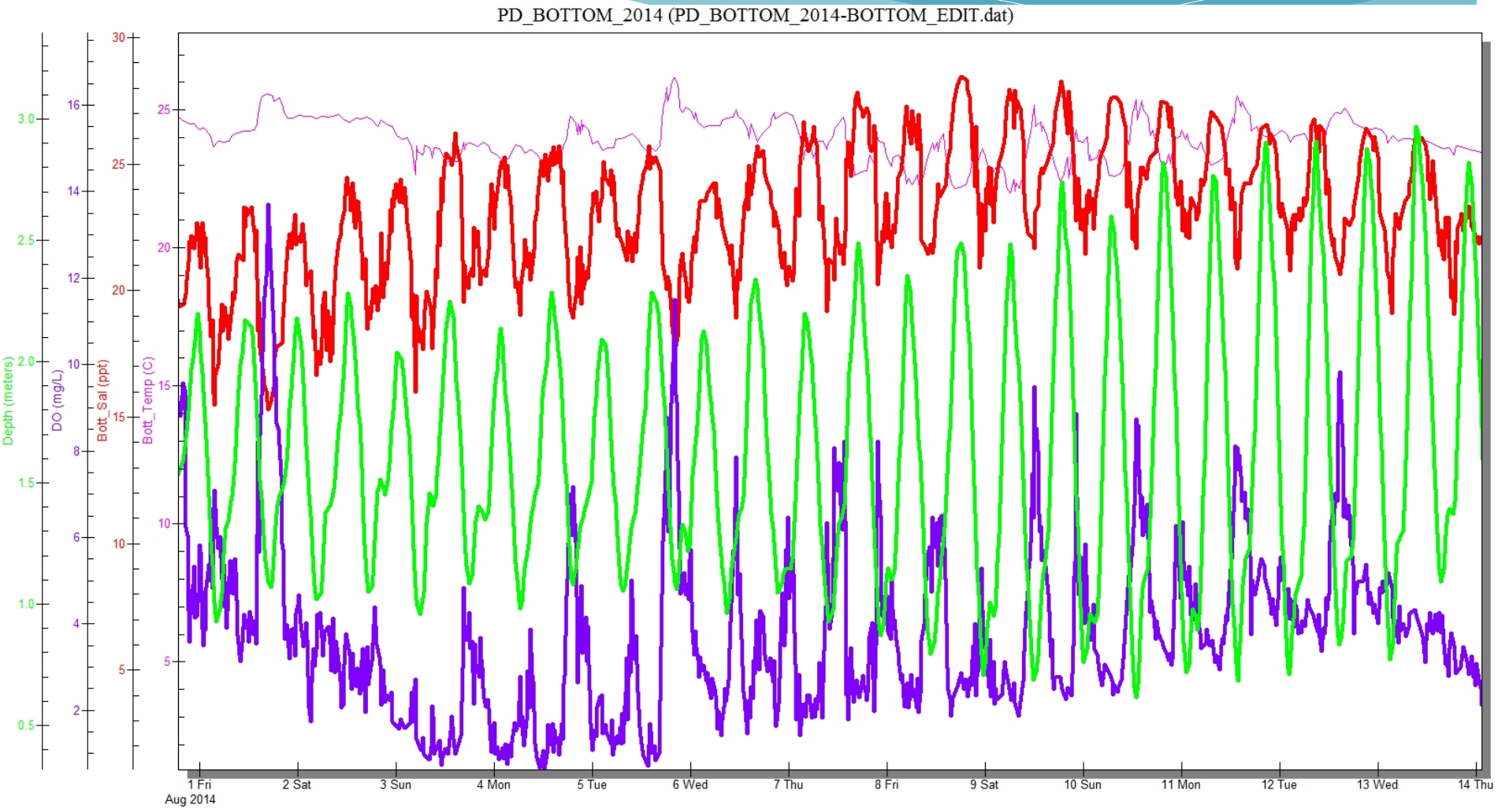
Data is collected every 15 minutes


Phillipsdale Bottom DO Average, Minimum, and Maximum 2004 - 2014
Average Seasonal DO
Hypoxia Threshold (2.9 mg/L)
Dissolved Oxygen (mg/L)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

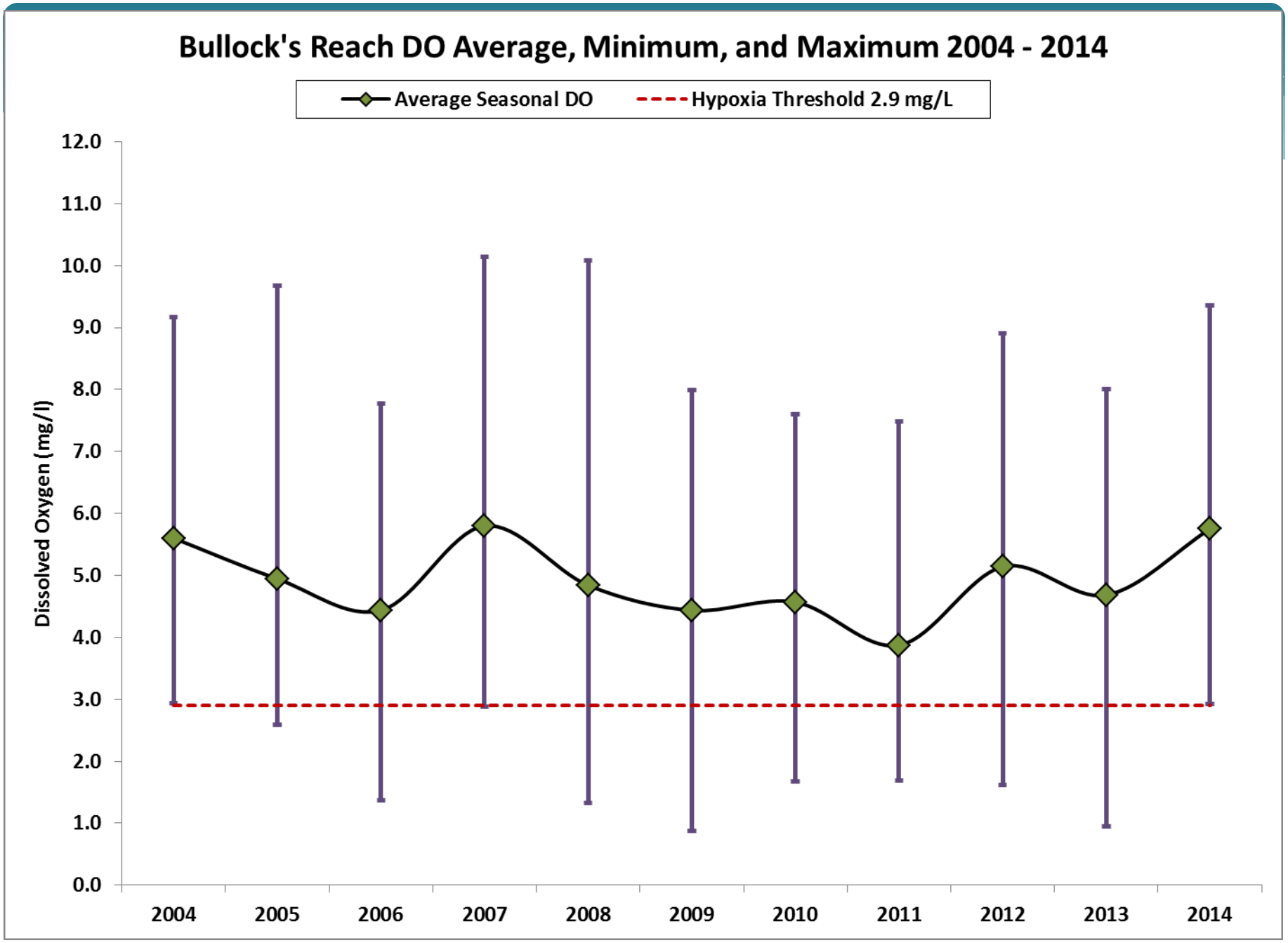

Phillipsdale Bottom DO Average, Minimum, and Maximum 2004 - 2014
Average Seasonal DO
Hypoxia Threshold (2.9 mg/L)
Rainfall (May - Oct)
Dissolved Oxygen (mg/L)
Total Rainfall May - Oct (inches)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

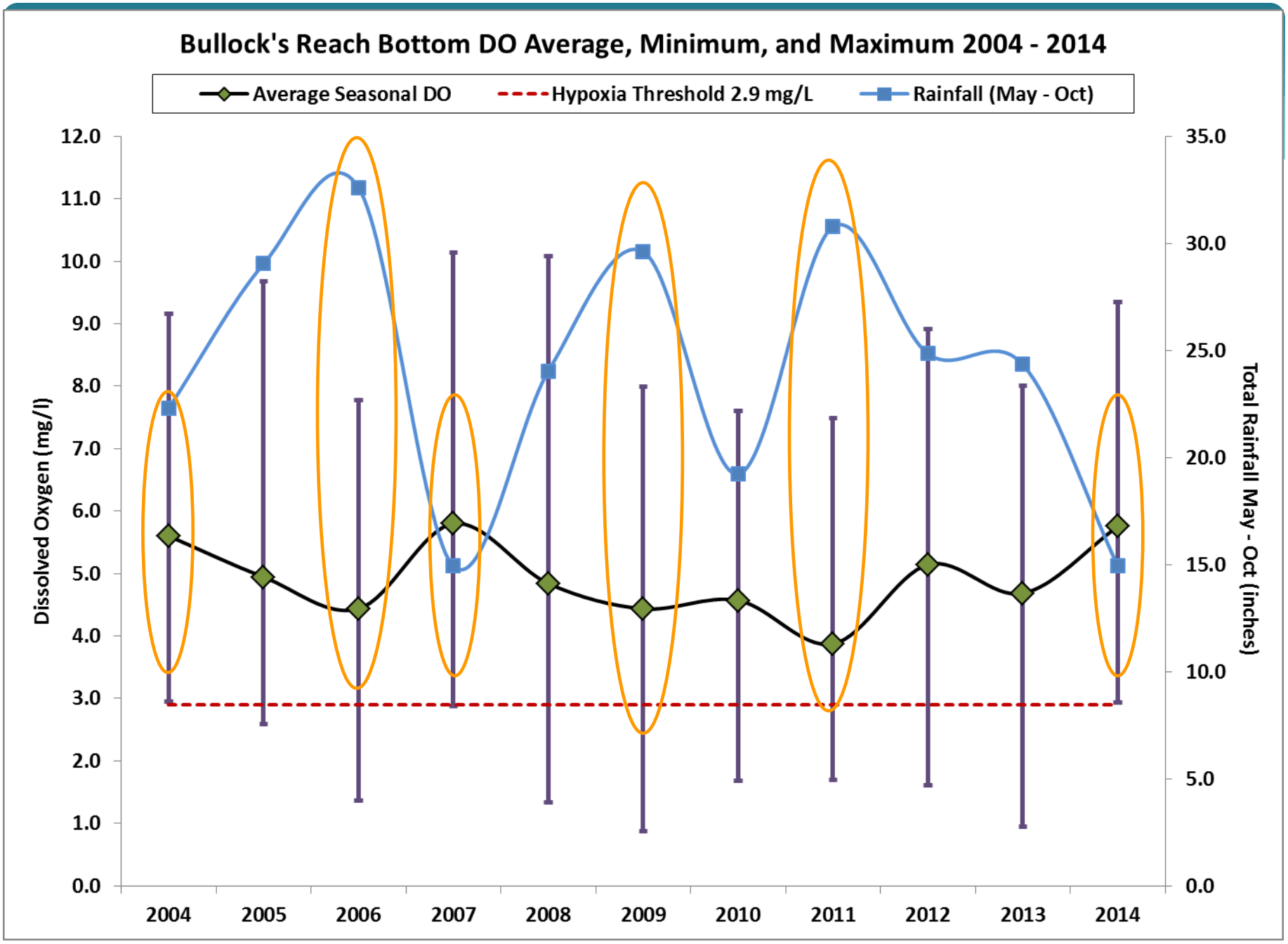
Ebb and Flow of DO - Phillipsdale

* PD – Tidal influence on DO
* Bottom DO decreases with flood tide and increases with ebb tide
  * Highly influenced by tidal cycle and Blackstone River flow
  * Salt wedge, lower DO water = stratification



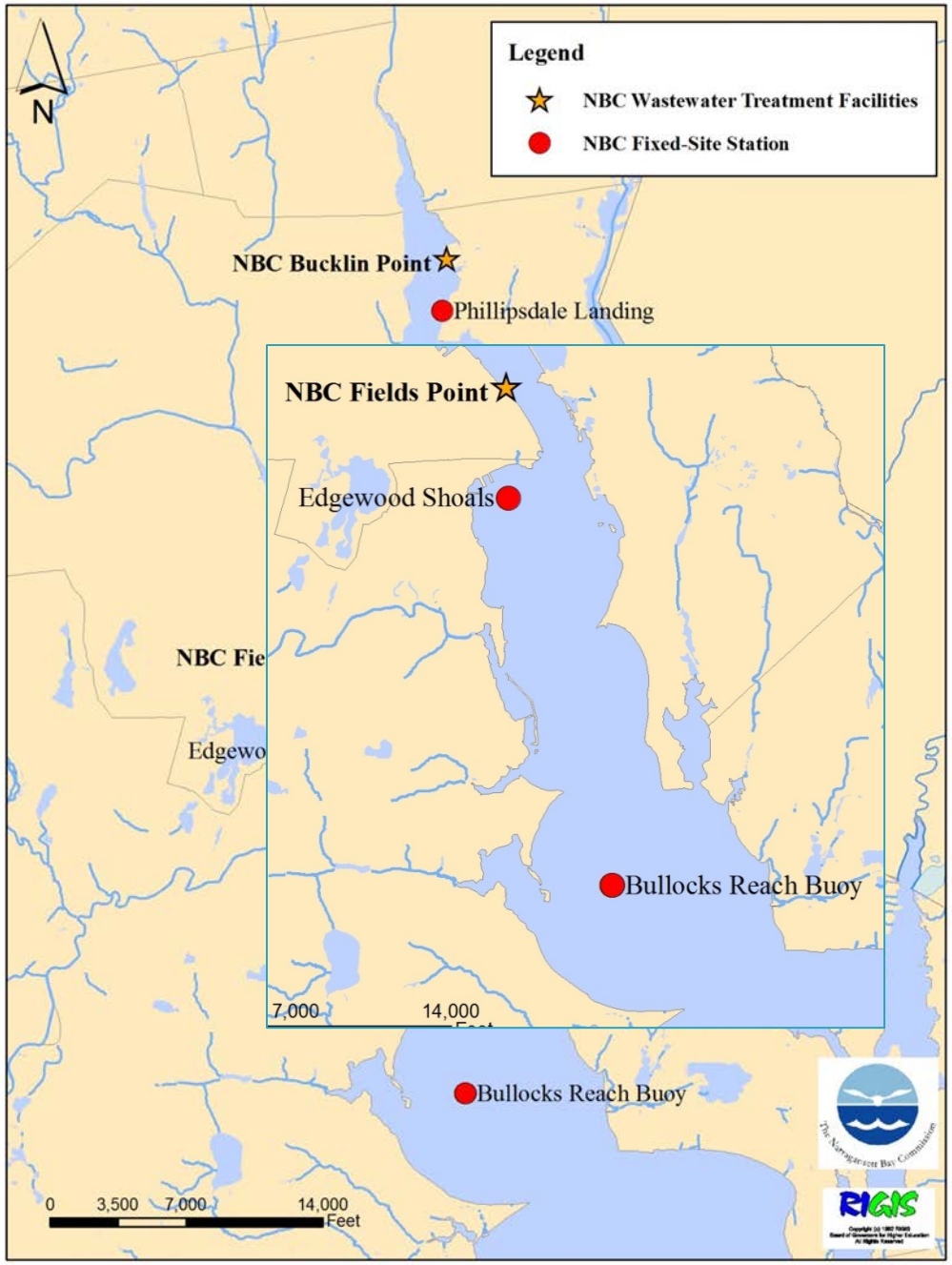
Red –Salinity Purple – DO Green - Depth

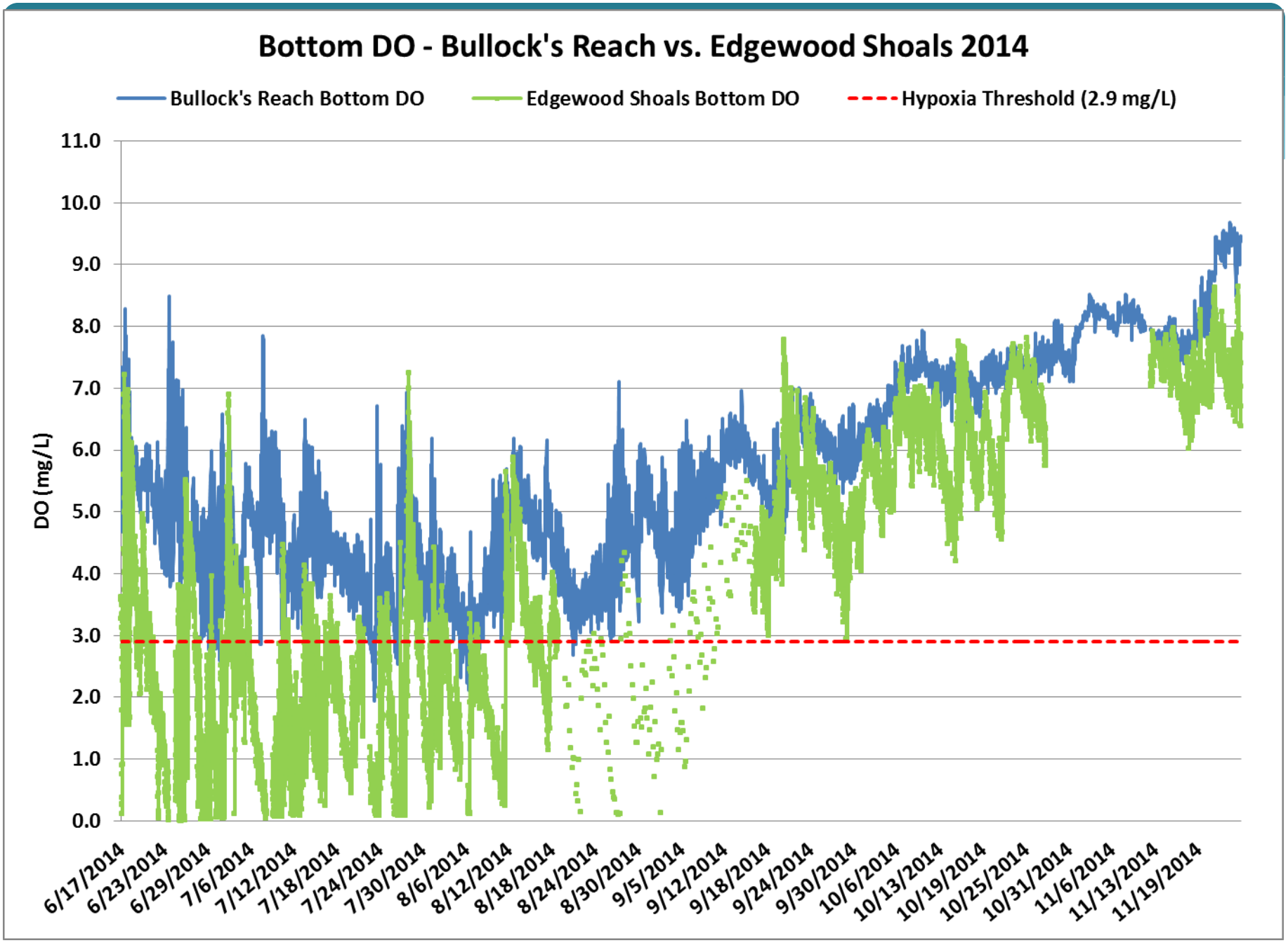

Bullock's Reach DO Average, Minimum, and Maximum 2004 - 2014
Average Seasonal DO
Hypoxia Threshold 2.9 mg/L
Dissolved Oxygen (mg/l)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Bullock's Reach Bottom DO Average, Minimum, and Maximum 2004 - 2014
Average Seasonal DO
Hypoxia Threshold 2.9 mg/L
Rainfall (May - Oct)
Dissolved Oxygen (mg/l)
Total Rainfall May - Oct (inches)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Edgewood Shoals

* Placed in “gyre” to support ROMS model data collection
* Movable buoy system
* Surface and Bottom sondes
  * Temp, Sal, DO, pH, Depth, Chl
* June – November 2014
* Deployed in April of 2015

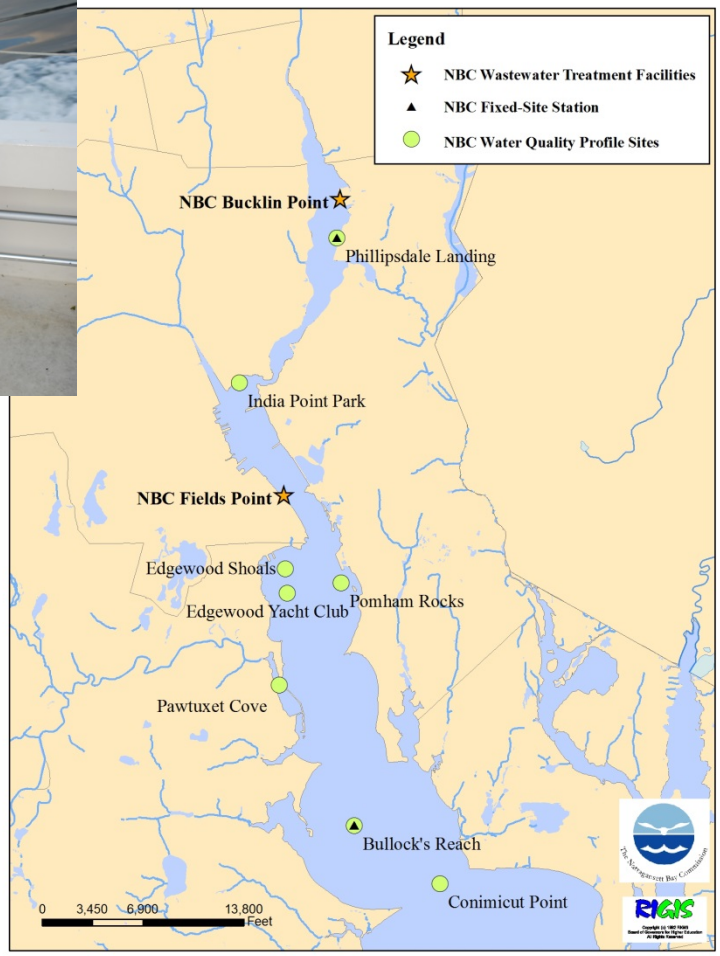



Bottom DO - Bullock's Reach vs. Edgewood Shoals 2014
Bullock's Reach Bottom DO
Edgewood Shoals Bottom DO
Hypoxia Threshold (2.9 mg/L)
DO (mg/L)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
6/17/2014
6/23/2014
6/29/2014
7/6/2014
7/12/2014
7/18/2014
7/24/2014
7/30/2014
8/6/2014
8/12/2014
8/18/2014
8/24/2014
8/30/2014
9/5/2014
9/12/2014
9/18/2014
9/24/2014
9/30/2014
10/6/2014
10/13/2014
10/19/2014
10/25/2014
10/31/2014
11/6/2014
11/13/2014
11/19/2014

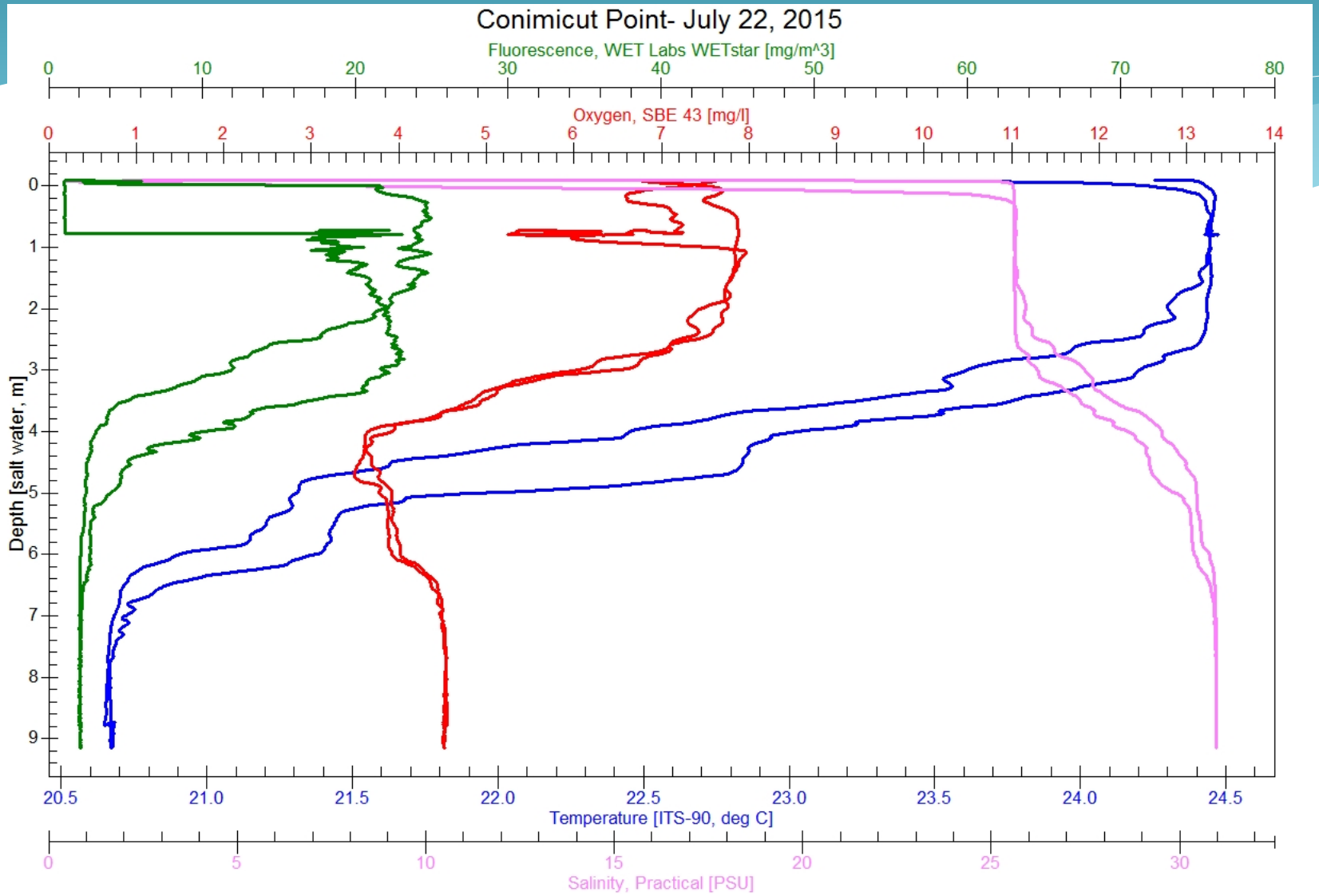
Seabird Water Quality Profiles

Seabird Profiles

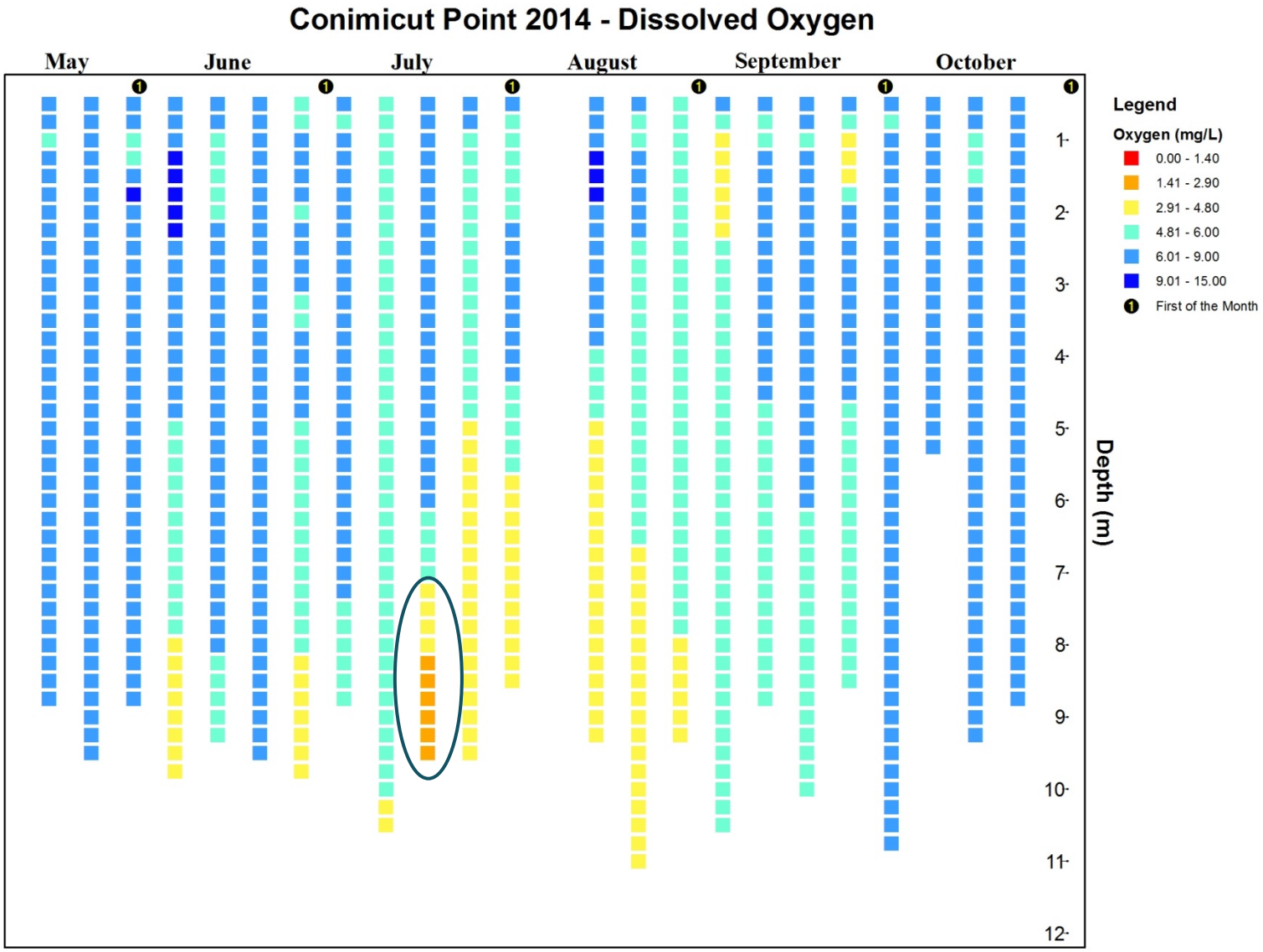
* Seabird Electronics SBE 19 measures:
  - Pressure/Depth
  - Conductivity
  - Salinity
  - Temperature
  - Density
  - Dissolved Oxygen
  - Photosynthetically active radiation (PAR)
  - Fluorescence
* Profiles collected weekly during the permit season & bi-monthly out of season
* Data process using Seabird software
* "Binned" data presented online



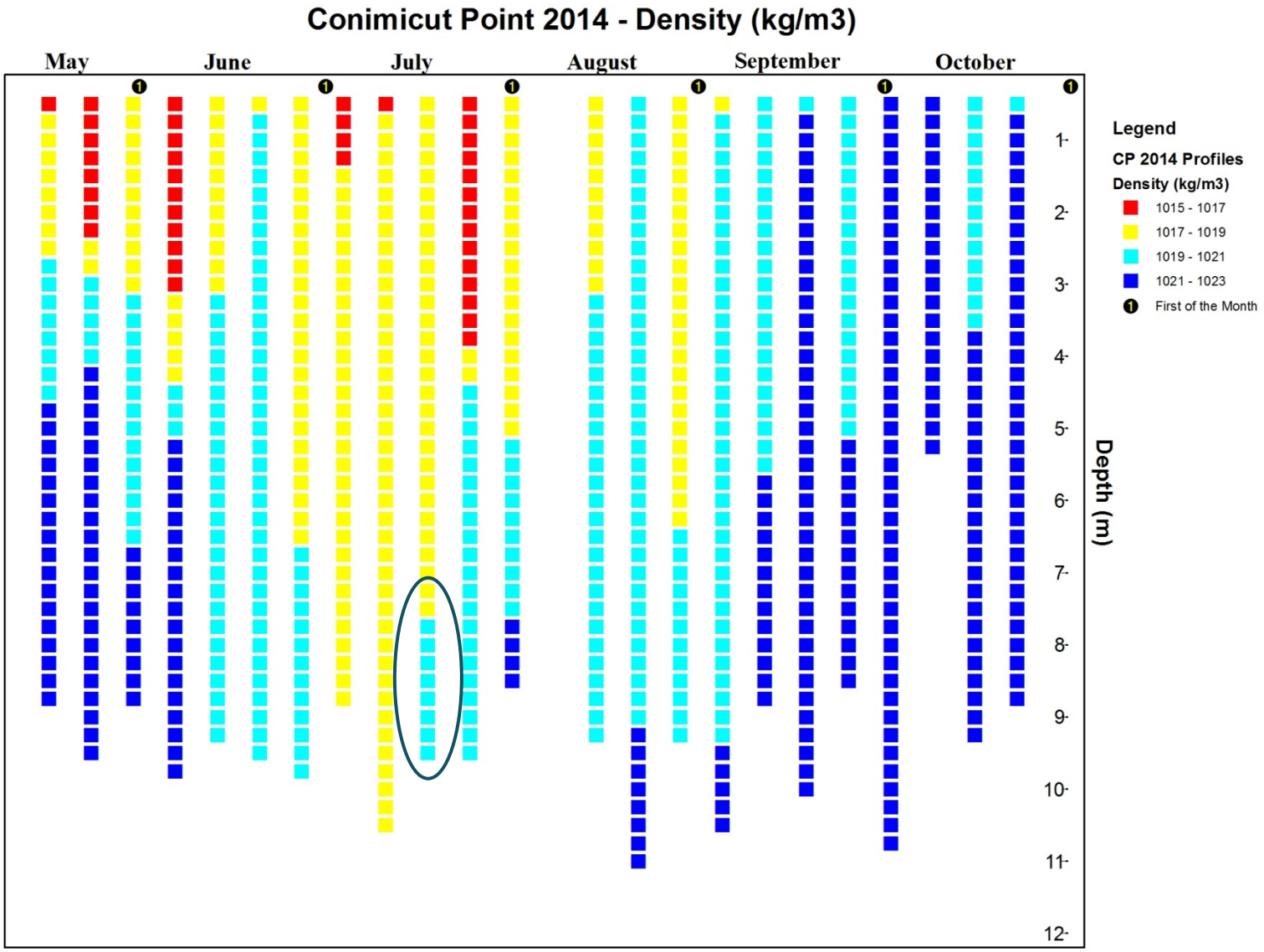
Seabird Profiles



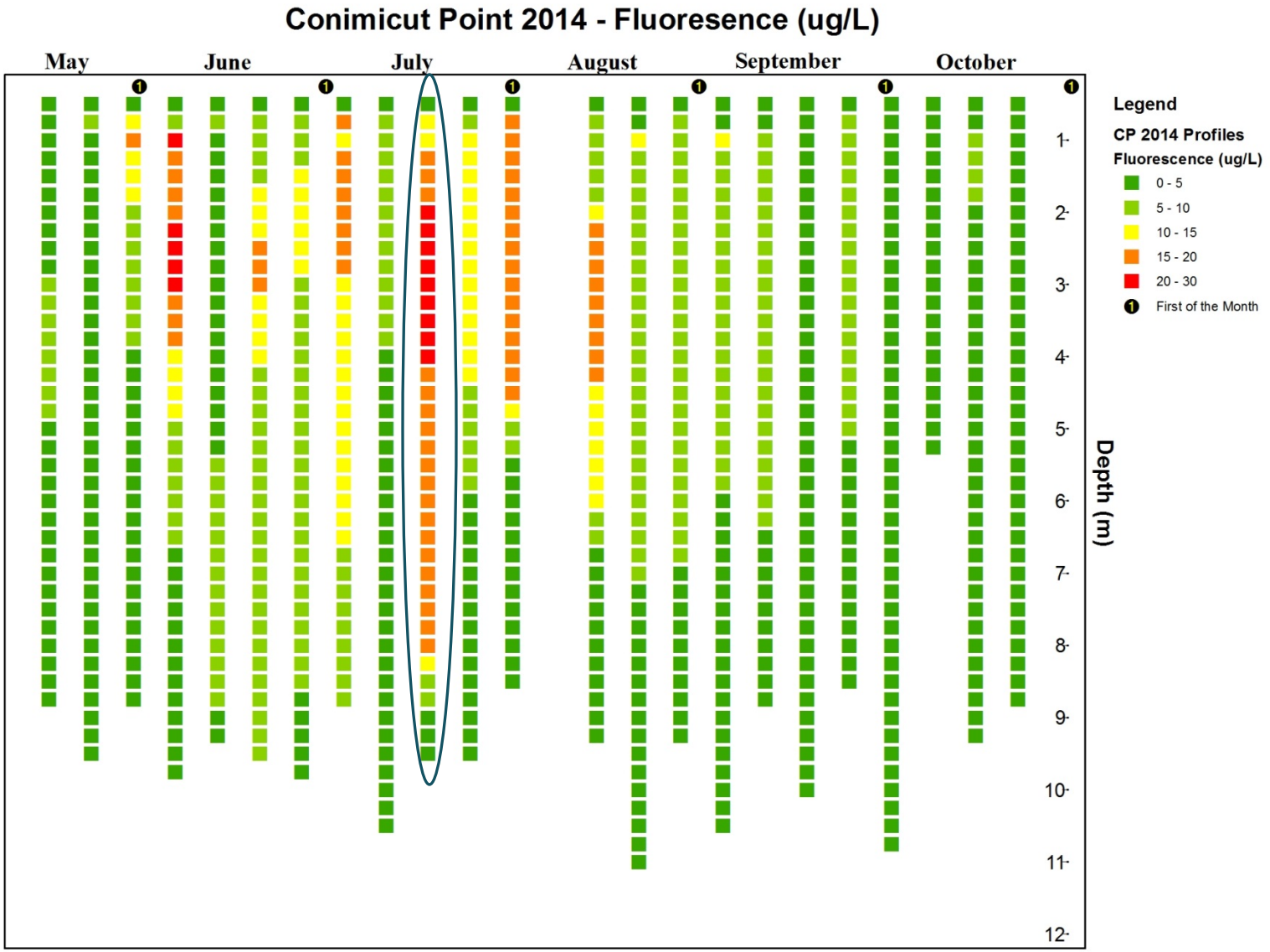
Seabird Yearly Profiles



Seabird Yearly Profiles



Seabird Yearly Profiles



Water Clarity Monitoring

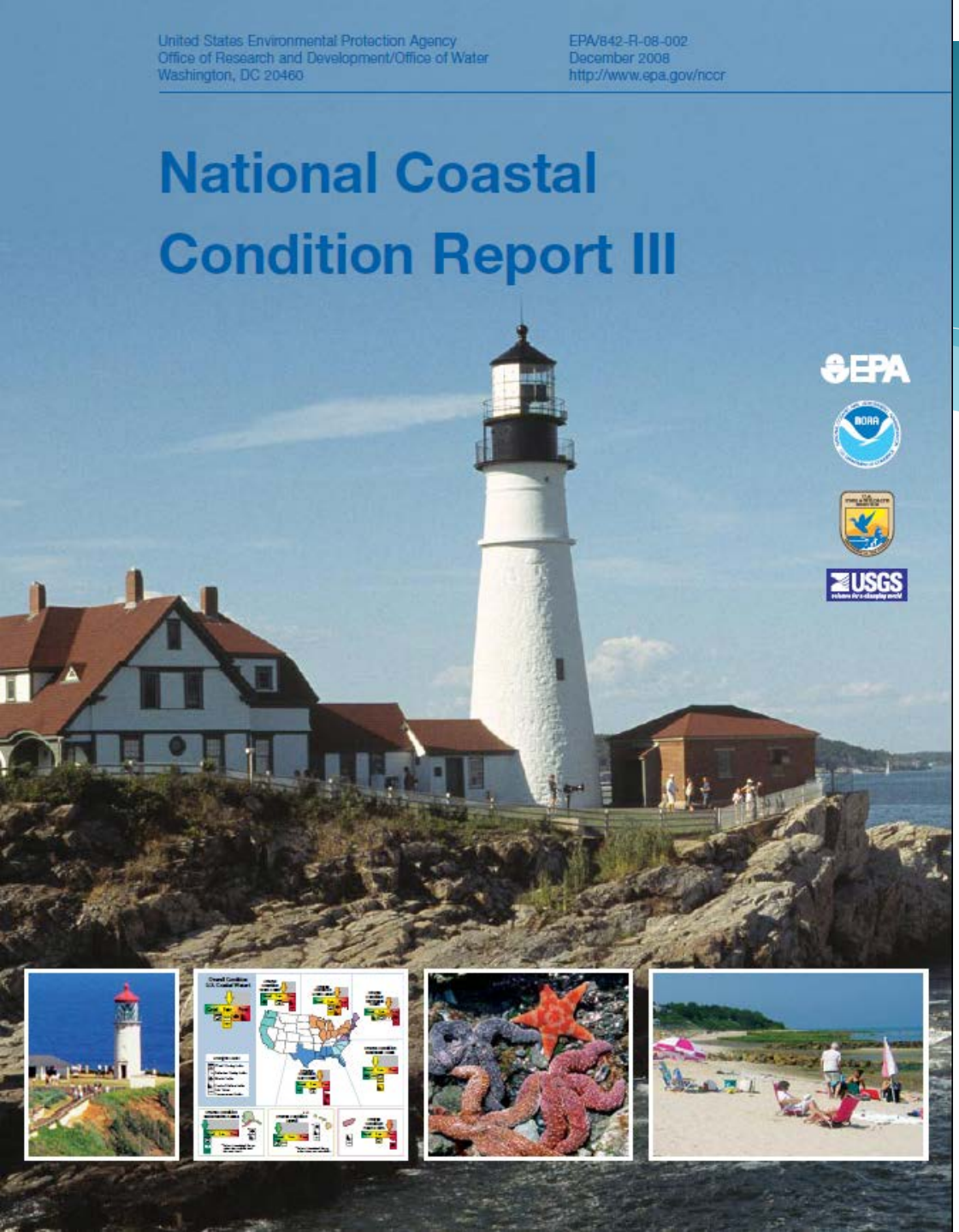
Water Clarity Monitoring

* Water clarity measured multiple ways:
  - Secchi disk collected at 8 Bay Stations bi-monthly to weekly
  - Photosynthetic active radiation (PAR) measured with WQ profiles
  - Total Suspended Solids (TSS) collected with nutrients (Bi-monthly)
  - Turbidity sensor on bottom sonde at Bullock's Reach measuring continuously

PAR Deck Sensor

Underwater PAR sensor

National Coastal Condition Report Evaluation

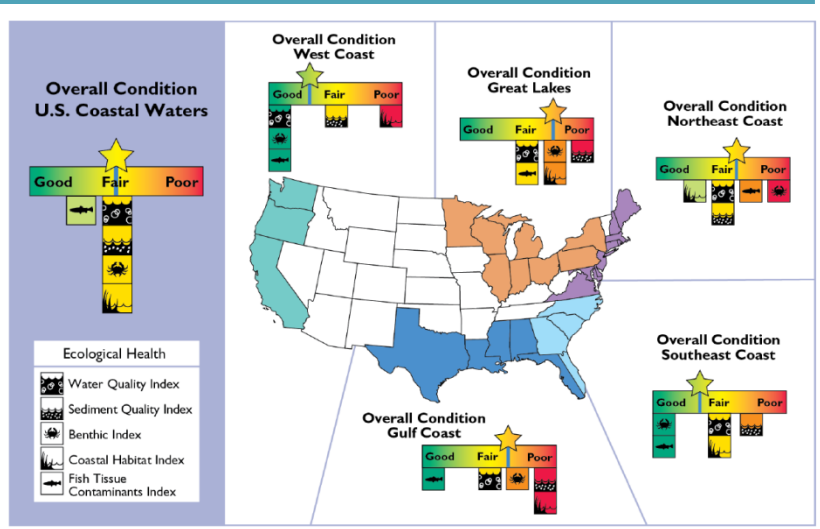


National Coastal Condition Report

* Developed thresholds for regions to evaluate environmental health based on:
  * **Water quality**
  * Sediment quality
  * Benthic health
  * Coastal habitat
  * Fish tissue

Water Quality Index

* Water quality index is based upon five different parameters:
  * Dissolved inorganic nitrogen
  * Dissolved inorganic phosphorus
  * Chlorophyll a
  * Water Clarity
  * Dissolved oxygen
* Evaluated NBC seasonal data (May – Oct) against established thresholds



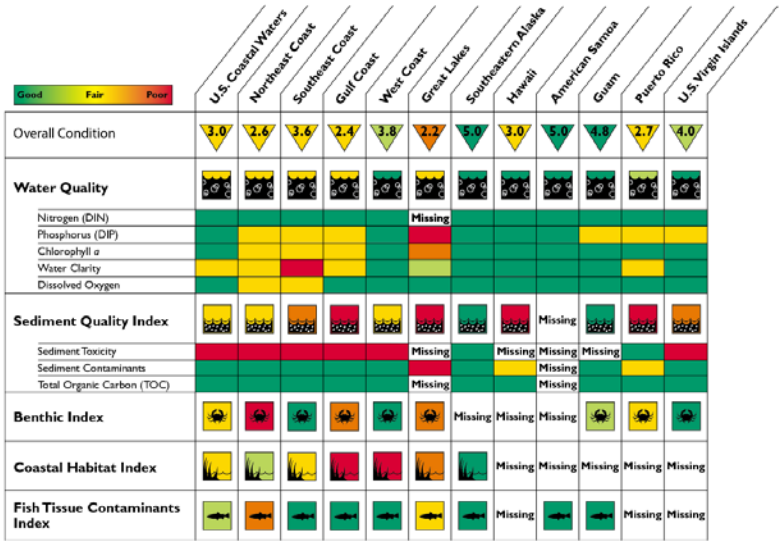
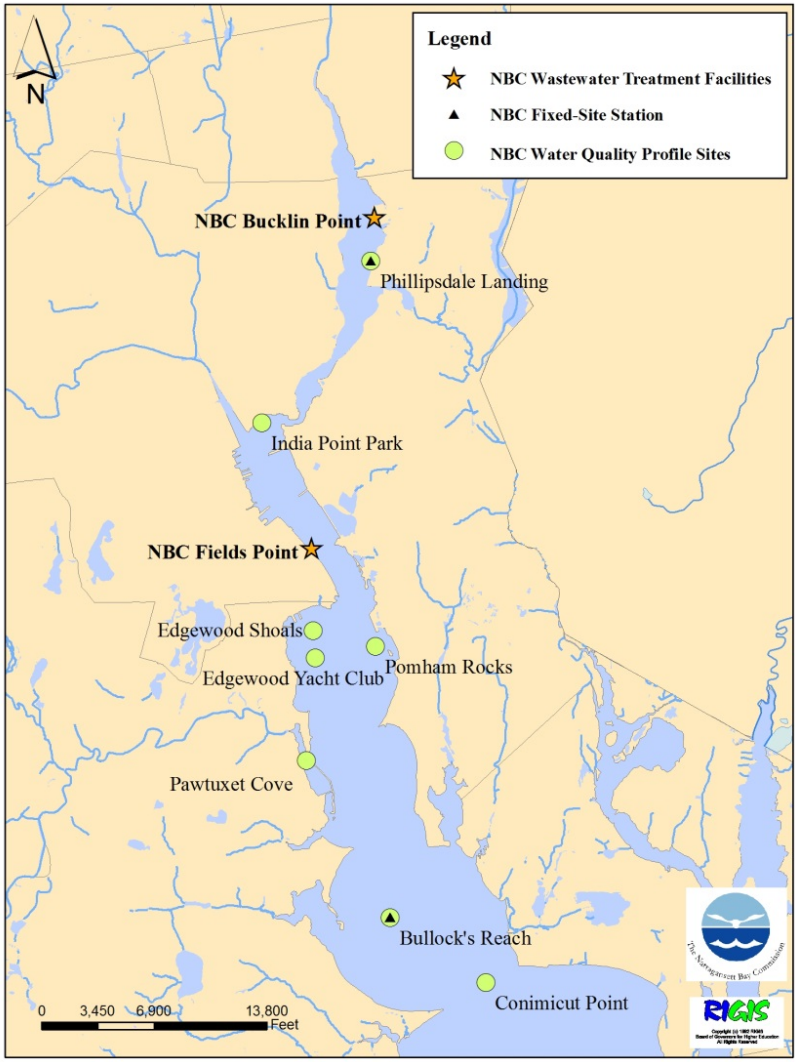


Figure 2-4. Overall national and regional coastal condition, 2003–2006 (U.S. EPA/NCA).

NBC Data Evaluated

* Surface DIN – Laboratory analyzed
* Surface DIP – Laboratory analyzed
* Water Clarity – PAR collected with Seabird profiles
* Dissolved oxygen – Seabird profiles
* Chlorophyll a – Laboratory analyzed



Dissolved Inorganic Nitrogen

Table 1-3. Cutpoints for Assessing Dissolved Inorganic Nitrogen (DIN)[a]

Area	Good	Fair	Poor
Northeast Coast, Southeast Coast, Gulf Coast, and Guam[a] sites	< 0.1 mg/L	0.1–0.5 mg/L	> 0.5 mg/L
West Coast, Alaska, and American Samoa sites	< 0.35 mg/L	0.35–0.5 mg/L	> 0.5 mg/L
Hawaii, Puerto Rico, U.S. Virgin Islands, and Florida Bay sites	< 0.05 mg/L	0.05–0.1 mg/L	> 0.1 mg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 25% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 25% of the coastal area is in poor condition.

[a] In Guam, the cutpoints apply to concentrations of nitrate-nitrogen.

	Dissolved Inorganic Nitrogen (mg/L)							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	0.72	0.95	0.99	0.55	0.70	0.62	0.50	0.32
India Point Park	0.49	0.57	0.54	0.28	0.44	0.39	0.27	0.23
Edgewood Yacht Club	0.37	0.29	0.32	0.23	0.30	0.19	0.15	0.14
Pomham Rocks	0.33	0.34	0.31	0.20	0.28	0.19	0.12	0.11
Pawtuxet Cove							0.40	0.53
Bullock's Reach	0.23	0.20	0.17	0.13	0.22	0.13	0.14	0.095
Conimicut Point	0.21	0.15	0.20	0.10	0.20	0.06	0.08	0.08
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Dissolved Inorganic Phosphorus

Table 1-4. Cutpoints for Assessing Dissolved Inorganic Phosphorus (DIP)

Area	Good	Fair	Poor
Northeast, Southeast, and Gulf Coast sites	< 0.01 mg/L	0.01–0.05 mg/L	> 0.05 mg/L
West Coast, Alaska, and American Samoa sites	< 0.07 mg/L	0.07–0.1 mg/L	> 0.1 mg/L
Hawaii, Puerto Rico, U.S. Virgin Islands, and Florida Bay sites	< 0.005 mg/L	0.005–0.01 mg/L	> 0.01 mg/L
Guam sites	< 0.025 mg/L	0.025–0.1 mg/L	> 0.1 mg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 25% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 25% of the coastal area is in poor condition.

	Dissolved Inorganic Phosphorus (mg/L)							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	0.184	0.180	0.131	0.128	0.110	0.172	0.143	0.131
India Point Park	0.113	0.116	0.070	0.073	0.085	0.100	0.072	0.087
Edgewood Yacht Club	0.083	0.066	0.048	0.053	0.054	0.076	0.066	0.061
Pomham Rocks	0.084	0.077	0.046	0.054	0.060	0.073	0.059	0.062
Pawtuxet Cove							0.044	0.058
Bullock's Reach	0.066	0.042	0.023	0.039	0.039	0.059	0.041	0.043
Conimicut Point	0.056	0.046	0.019	0.033	0.039	0.047	0.035	0.041
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Chlorophyll a

Table 1-5. Cutpoints for Assessing Chlorophyll *a*

Area	Good	Fair	Poor
Northeast Coast, Southeast Coast, Gulf Coast, West Coast, and Alaska sites	< 5 µg/L	5–20 µg/L	> 20 µg/L
Hawaii, Puerto Rico, U.S. Virgin Islands, Guam, American Samoa, and Florida Bay sites	< 0.5 µg/L	0.5–1 µg/L	> 1 µg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 20% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 20% of the coastal area is in poor condition.

	Chlorophyll a (µg/L)							
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Phillipsdale Landing				46.66	24.83	22.20	17.95	36.80
India Point Park				30.09	18.75	31.71	20.14	15.96
Edgewood Yacht Club				29.11	30.31	22.94	13.53	13.82
Pomham Rocks				34.42	24.83	22.20	17.95	19.33
Pawtuxet Cove							20.53	14.61
Bullock's Reach				28.77	22.72	12.85	11.04	12.84
Conimicut Point				17.15	17.53	15.93	12.05	10.84
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Water Clarity

Table 1-6. Cutpoints for Assessing Water Clarity

Area	Good	Fair	Poor
Sites in coastal waters with naturally high turbidity	> 10% light at 1 meter	5–10% light at 1 meter	< 5% light at 1 meter
Sites in coastal waters with normal turbidity	> 20% light at 1 meter	10–20% light at 1 meter	< 10% light at 1 meter
Sites in coastal waters that support SAV	> 40% light at 1 meter	20–40% light at 1 meter	< 20% light at 1 meter
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition	10% to 25% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 25% of the coastal area is in poor condition.

	Percent of Light at 1 m							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	38%	32%		29%	33%	17%	17%	37%
India Point Park	50%	47%	53%	43%	45%	30%	37%	52%
Edgewood Yacht Club	36%	34%	30%	48%	41%	36%	41%	44%
Pomham Rocks	42%	48%	55%	40%	39%	32%	39%	52%
Pawtuxet Cove							37%	40%
Bullock's Reach	51%	44%	56%	48%	46%	33%	32%	55%
Conimicut Point	50%	47%	51%	54%	42%	30%	37%	56%
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Water Clarity

Table 1-6. Cutpoints for Assessing Water Clarity

Area	Good	Fair	Poor
Sites in coastal waters with naturally high turbidity	> 10% light at 1 meter	5–10% light at 1 meter	< 5% light at 1 meter
Sites in coastal waters with normal turbidity	> 20% light at 1 meter	10–20% light at 1 meter	< 10% light at 1 meter
Sites in coastal waters that support SAV	> 40% light at 1 meter	20–40% light at 1 meter	< 20% light at 1 meter
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition	10% to 25% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 25% of the coastal area is in poor condition.

	Percent of Light at 1 m							
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Phillipsdale Landing	38%	32%		29%	33%	17%	17%	37%
India Point Park	50%	47%	53%	43%	45%	30%	37%	52%
Edgewood Yacht Club	36%	34%	30%	48%	41%	36%	41%	44%
Pomham Rocks	42%	48%	55%	40%	39%	32%	39%	52%
Pawtuxet Cove							37%	40%
Bullock's Reach	51%	44%	56%	48%	46%	33%	32%	55%
Conimicut Point	50%	47%	51%	54%	42%	30%	37%	56%
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Dissolved Oxygen

Table 1-7. Cutpoints for Assessing Dissolved Oxygen

Area	Good	Fair	Poor
Individual sampling sites	> 5 mg/L	2–5 mg/L	< 2 mg/L
Regions	Less than 5% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	5% to 15% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 15% of the coastal area is in poor condition.

	Dissolved Oxygen Concentration (mg/L) 1 m Off Bottom							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	3.48	5.84	3.50	4.75	3.61	4.33	3.34	4.27
India Point Park	3.24	3.63	4.33	4.92	3.54	3.50	2.86	3.96
Edgewood Yacht Club	4.66	6.18	5.43	6.38	5.92	4.82	3.82	6.00
Pomham Rocks	4.25	4.27	4.68	4.69	4.21	5.17	3.95	4.92
Pawtuxet Cove					1.71	5.21	5.21	6.95
Bullock's Reach	5.03	5.16	5.10	4.98	4.44	5.07	4.25	5.23
Conimicut Point	5.17	4.92	5.17	4.64	4.99	5.22	4.50	5.33
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Dissolved Oxygen

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Area	Good	Fair	Poor
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Regions	Less than 5% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	5% to 15% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 15% of the coastal area is in poor condition.

	Dissolved Oxygen Concentration (mg/L) 0.5 m Off Bottom							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	3.45	4.01	2.79	4.34	3.29	3.76	3.15	4.09
India Point Park	3.22	3.43	4.17	4.78	3.16	3.42	2.64	3.79
Edgewood Yacht Club	4.54	4.84	5.25	5.27	5.00	4.26	3.43	5.72
Pomham Rocks	4.08	4.18	4.63	4.60	3.93	4.60	3.77	4.77
Pawtuxet Cove					2.13	4.63	4.74	6.26
Bullock's Reach	4.88	4.64	4.93	4.76	4.29	4.95	4.12	5.07
Conimicut Point	5.15	4.74	5.16	4.59	4.92	5.14	4.57	5.27
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Dissolved Oxygen

Table 1-7. Cutpoints for Assessing Dissolved Oxygen

Area	Good	Fair	Poor
Individual sampling sites	> 5 mg/L	2–5 mg/L	< 2 mg/L
Regions	Less than 5% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	5% to 15% of the coastal area is in poor condition, or 50% or less of the coastal area is in good condition.	More than 15% of the coastal area is in poor condition.

	Dissolved Oxygen Concentration (mg/L) on Bottom							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	3.44	2.41	2.24	4.12	2.85	3.60	2.85	3.46
India Point Park	3.22	3.22	4.04	4.55	2.94	3.36	2.46	3.69
Edgewood Yacht Club	3.64	3.85	4.46	3.72	3.62	4.06	2.96	5.31
Pomham Rocks	3.89	3.46	4.48	4.16	3.83	4.54	3.67	4.64
Pawtuxet Cove					2.23	4.48	4.34	5.88
Bullock's Reach	4.60	3.31	5.01	4.56	4.08	4.83	4.10	4.96
Conimicut Point	5.11	4.40	5.15	4.59	4.70	5.08	4.49	5.22
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Water Quality Index

Table 1-8. Cutpoints for Determining the Water Quality Index Rating by Site

Rating	Cutpoints
Good	A maximum of one indicator is rated fair, and no indicators are rated poor.
Fair	One of the indicators is rated poor, or two or more indicators are rated fair.
Poor	Two or more of the five indicators are rated poor.

	Water Quality Index							
	2007	2008	2009	2010	2011	2012	2013	2014
Phillipsdale Landing	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
India Point Park	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Fair
Edgewood Yacht Club	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Fair
Pomham Rocks	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Fair
Pawtuxet Cove							Fair	Poor
Bullock's Reach	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Conimicut Point	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Rainfall (May-Oct; inches)	14.93	24.04	29.62	19.22	30.78	24.85	24.34	14.94

Evaluation included the Water Clarity that supported SAV & DO at 0.5 m off the bottom

Surface Mapping

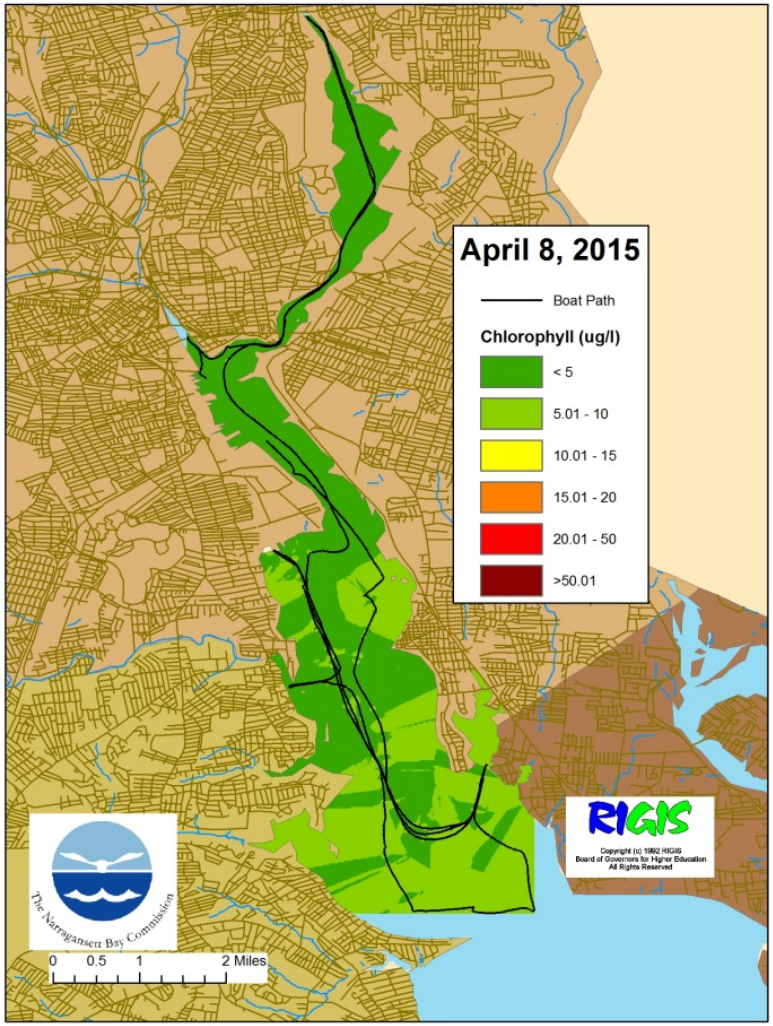
Surface Mapping

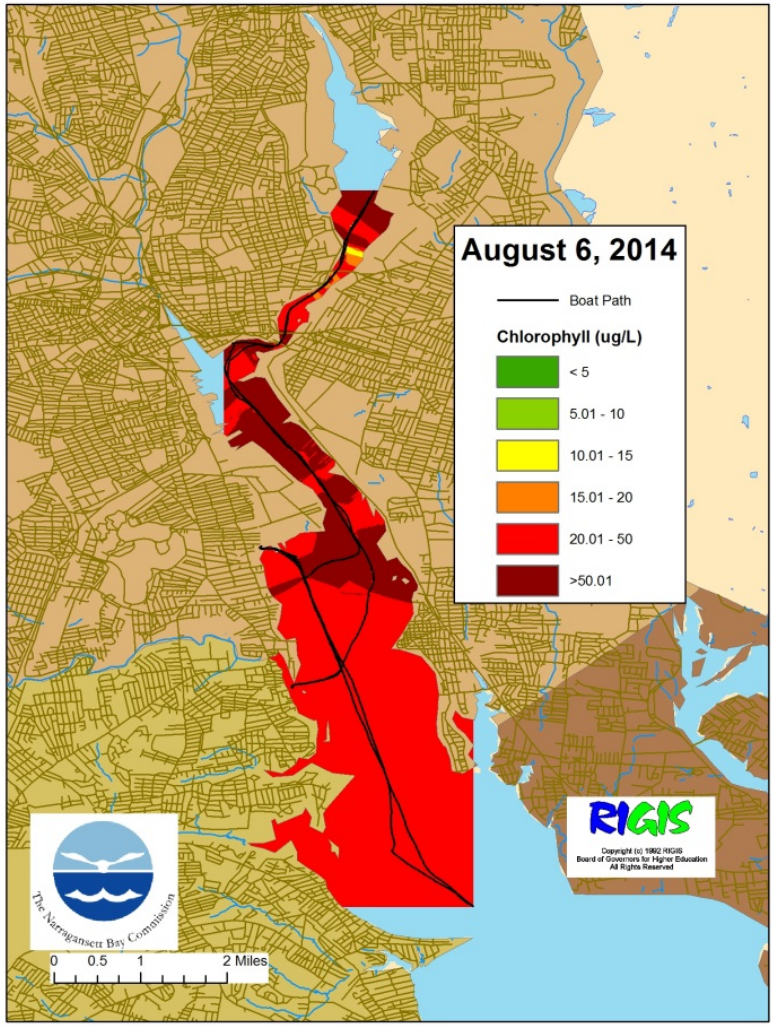
* Use YSI sonde flow-through system to continuously measure surface water quality while boat is underway
* Computer program integrates GPS coordinates and depth finder data with water quality data sets
* GIS spatial analyst is used to interpolate values
* Create surface water quality maps for dissolved oxygen, chlorophyll, temp…

Surface Mapping

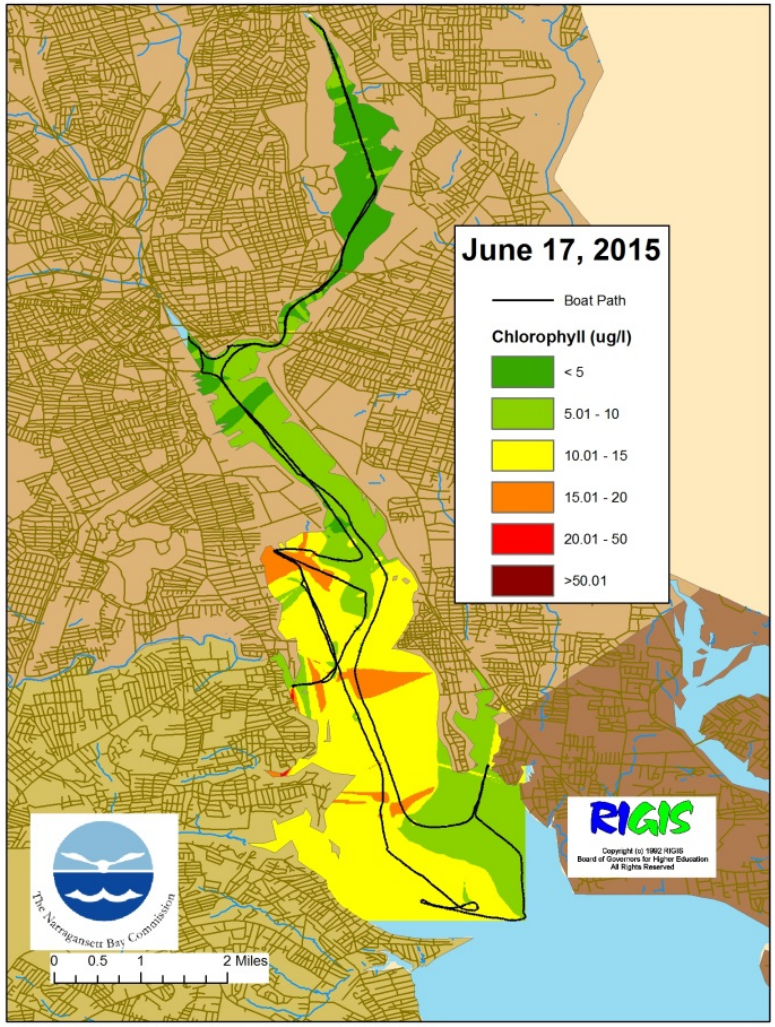
* Conduct mapping weekly in summer while vessel is underway performing routine monitoring
* Allow identification & tracking of algae blooms
* Provides a great picture of what is happening in the surface waters

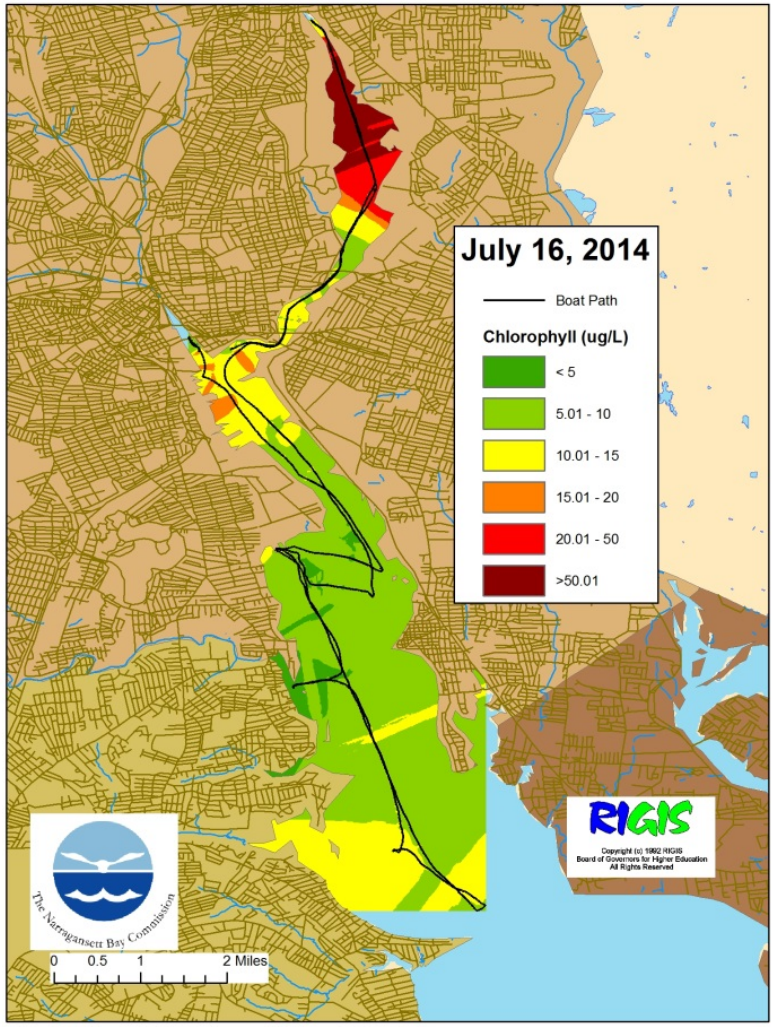
Chlorophyll Surface Mapping

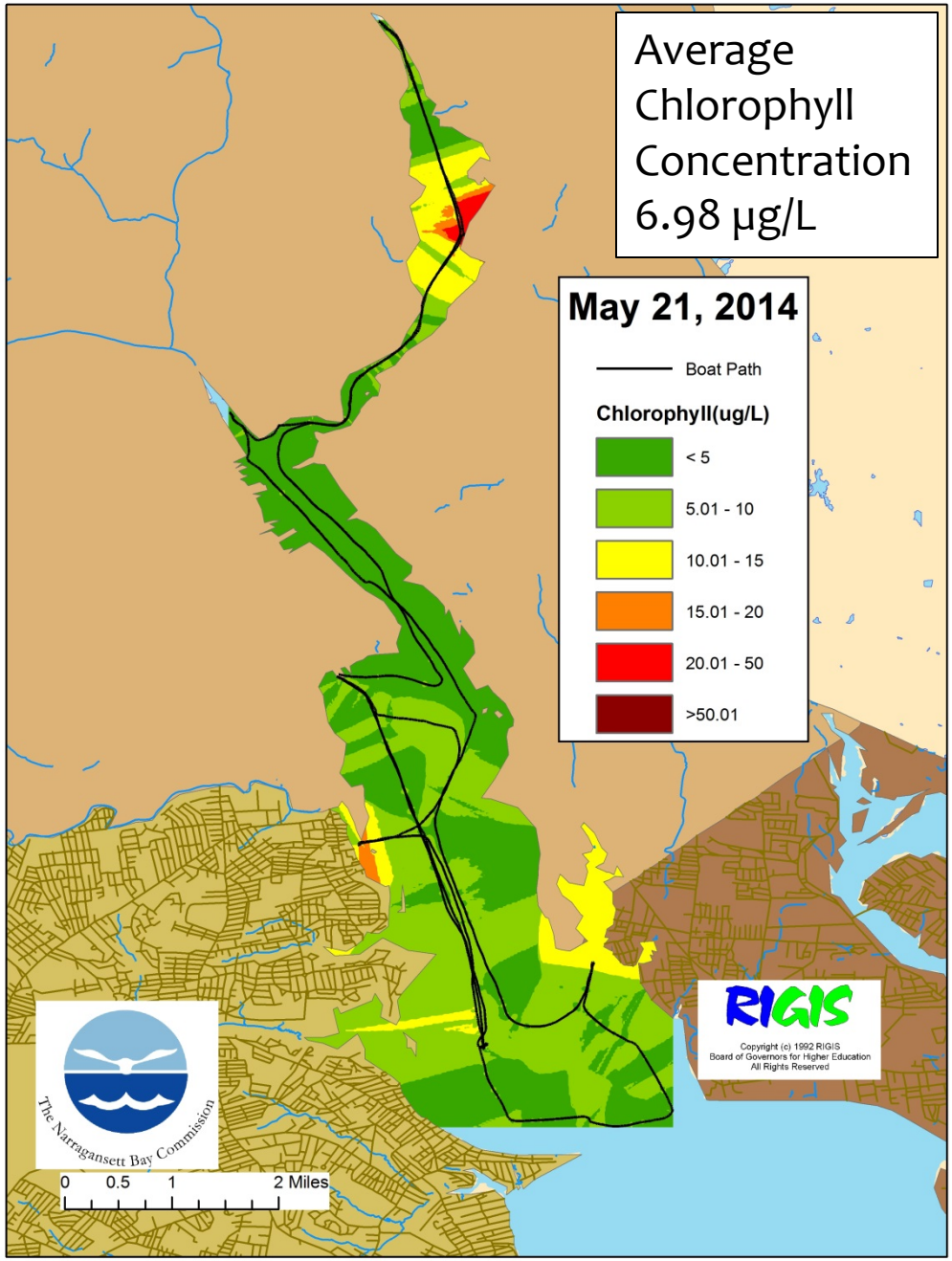




Chlorophyll Surface Mapping






Average Chlorophyll Concentration 6.98 µg/L
May 21, 2014
Boat Path
Chlorophyll(ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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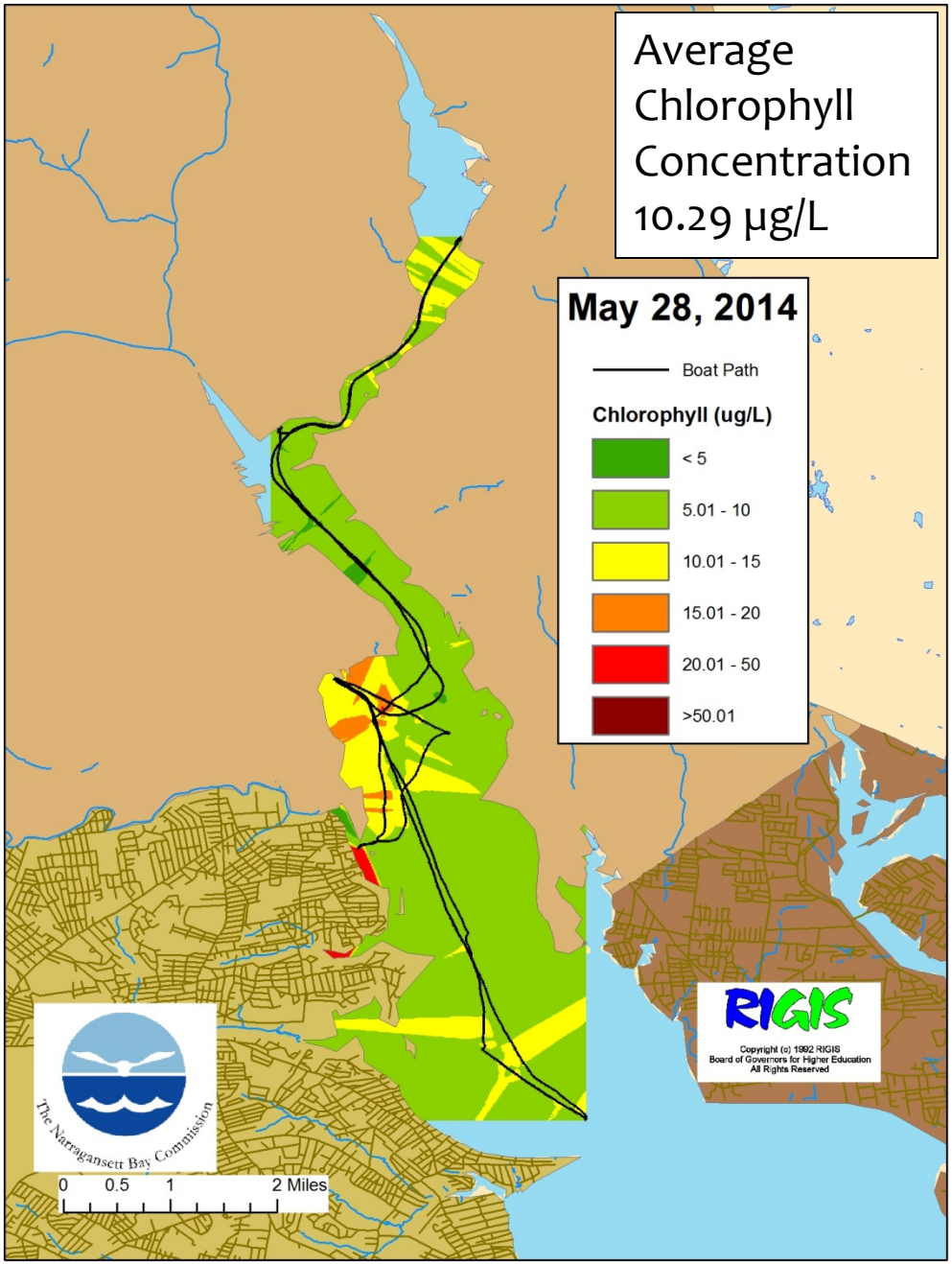
Average Chlorophyll Concentration 10.29 µg/L
May 28, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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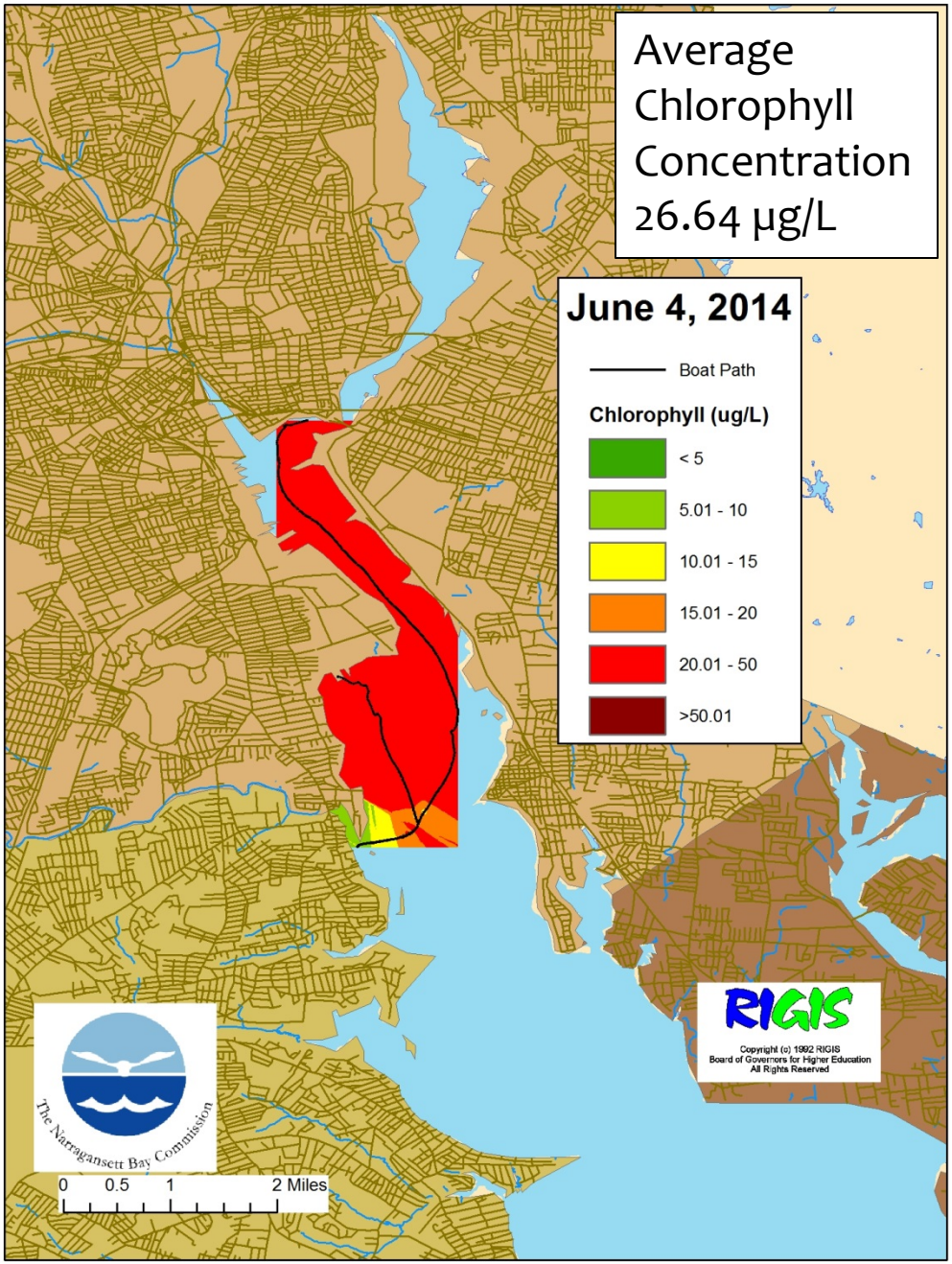
Average Chlorophyll Concentration 26.64 µg/L
June 4, 2014
Boat Path
Chlorophyll (ug/L)
< 5
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10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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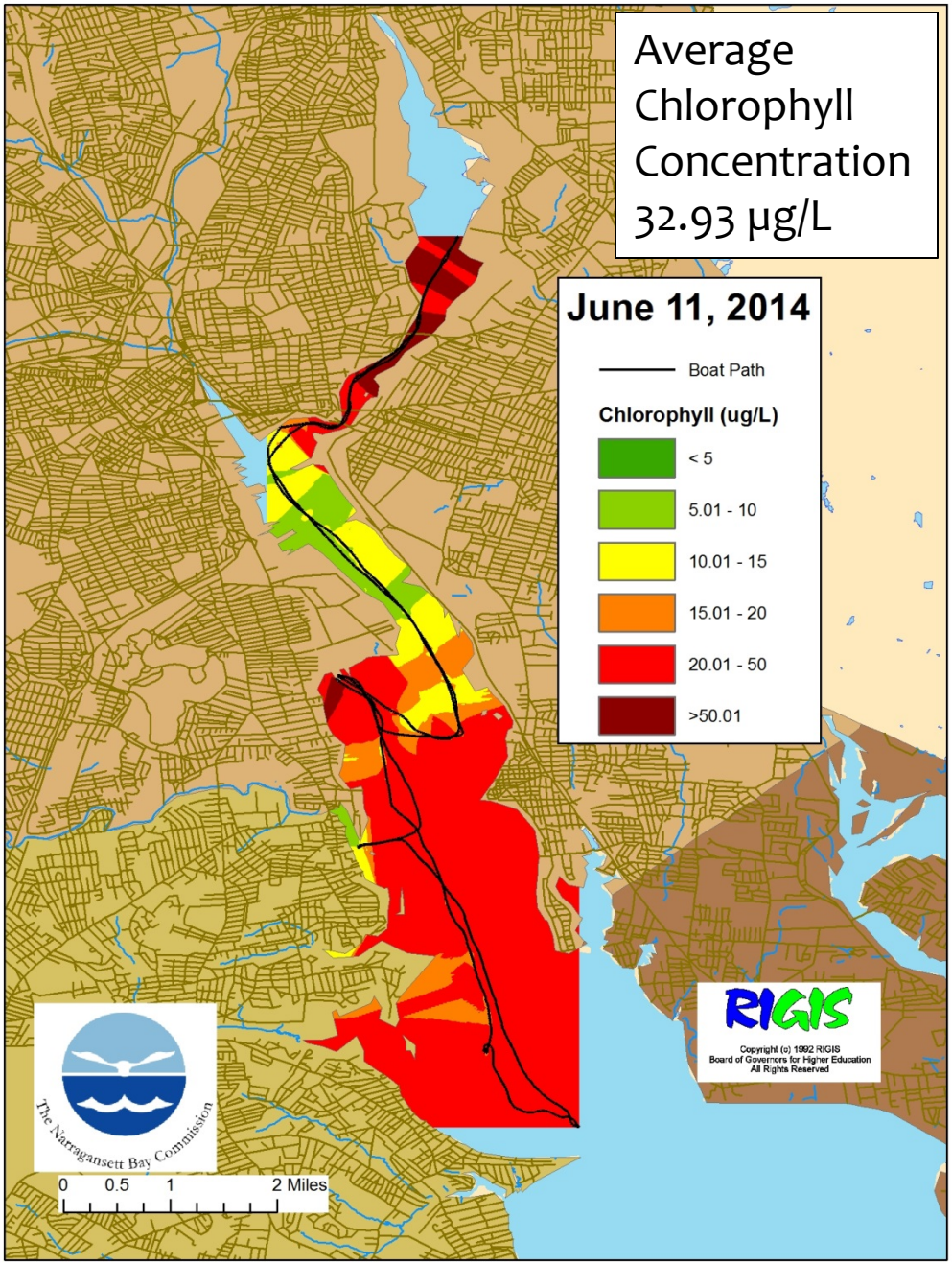
Average Chlorophyll Concentration 32.93 µg/L
June 11, 2014
Boat Path
Chlorophyll (ug/L)
< 5
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10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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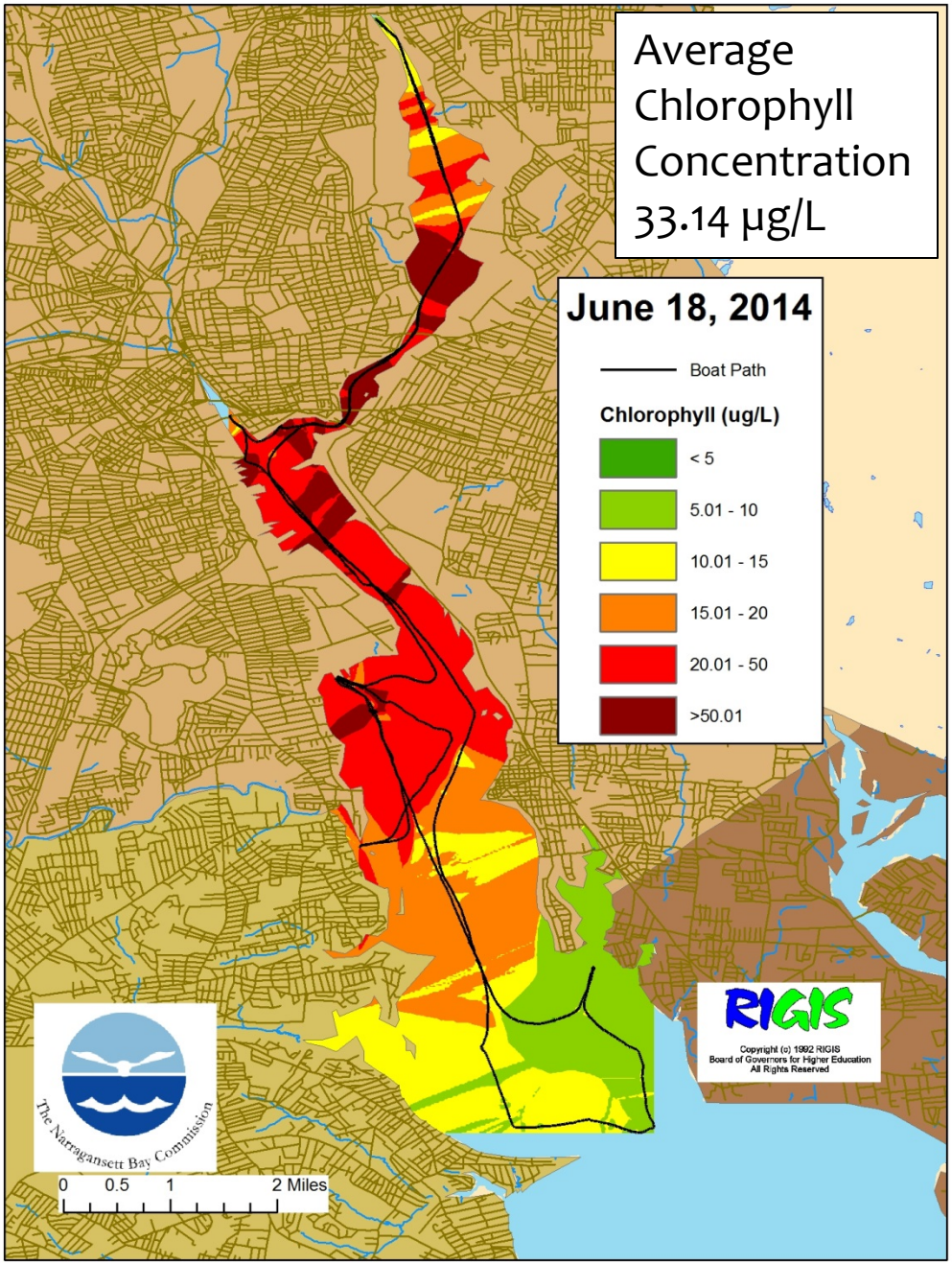
Average Chlorophyll Concentration 33.14 µg/L
June 18, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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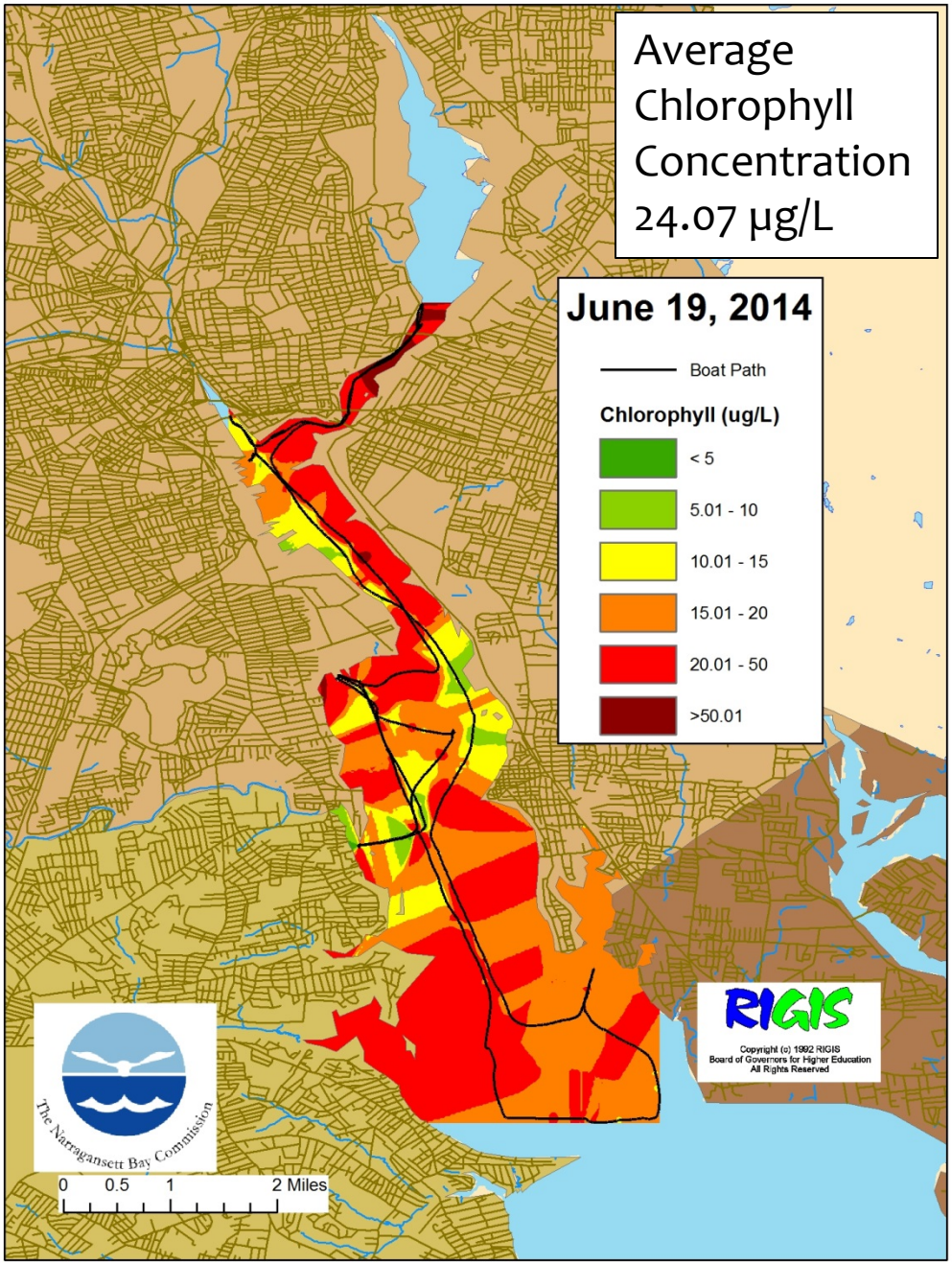
Average Chlorophyll Concentration 24.07 µg/L
June 19, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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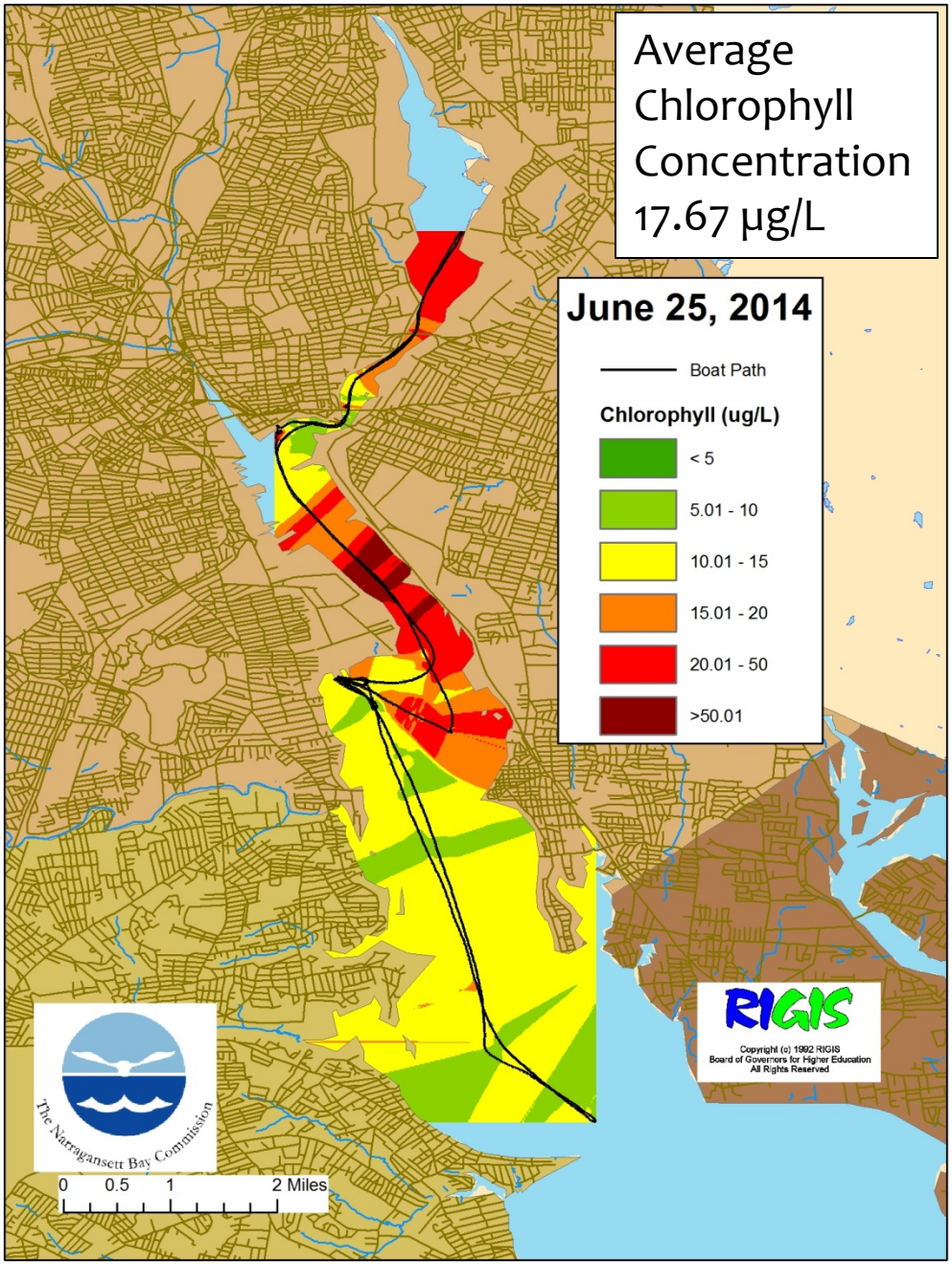
Average Chlorophyll Concentration 17.67 µg/L
June 25, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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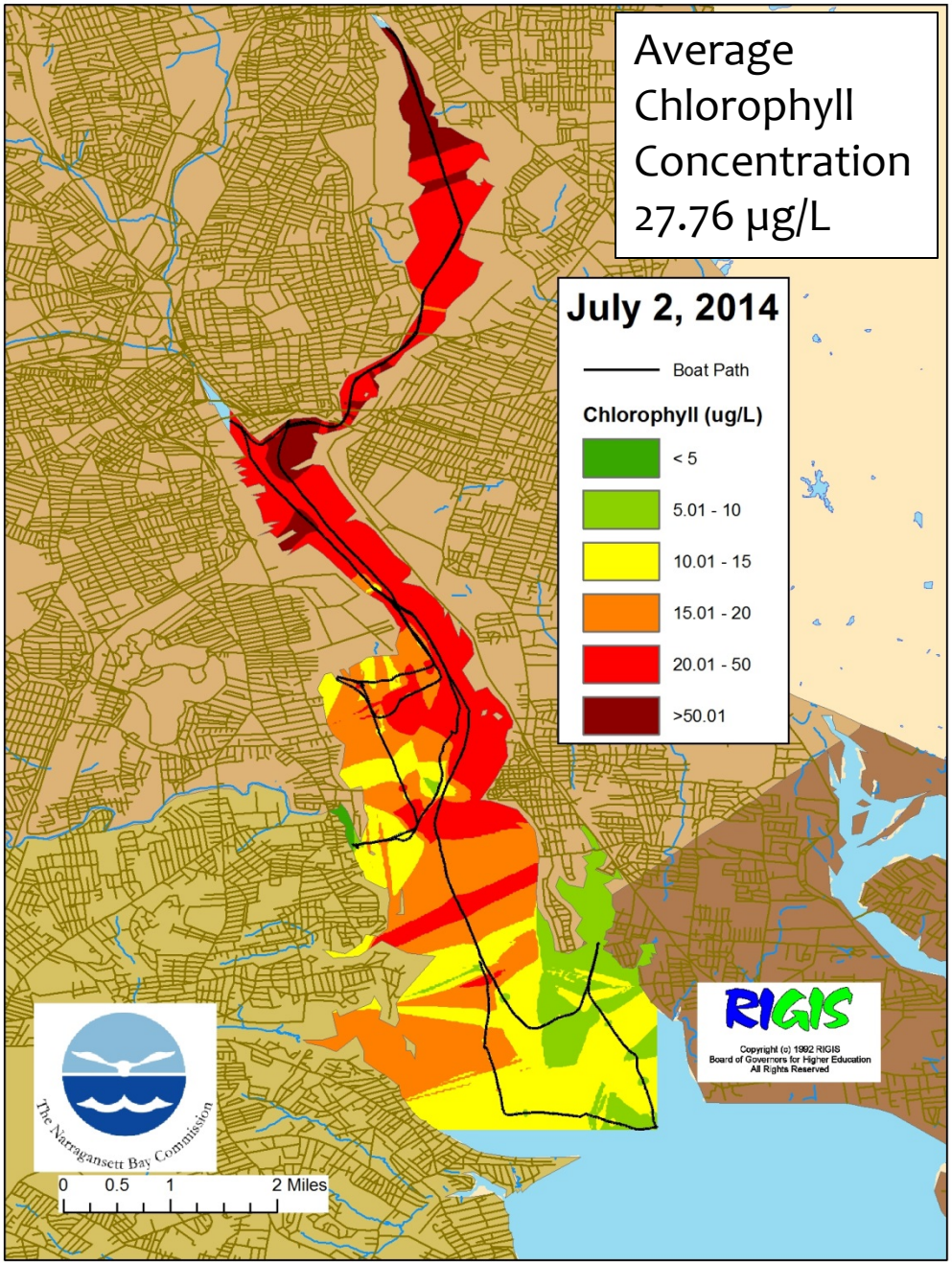
Average Chlorophyll Concentration 27.76 µg/L
July 2, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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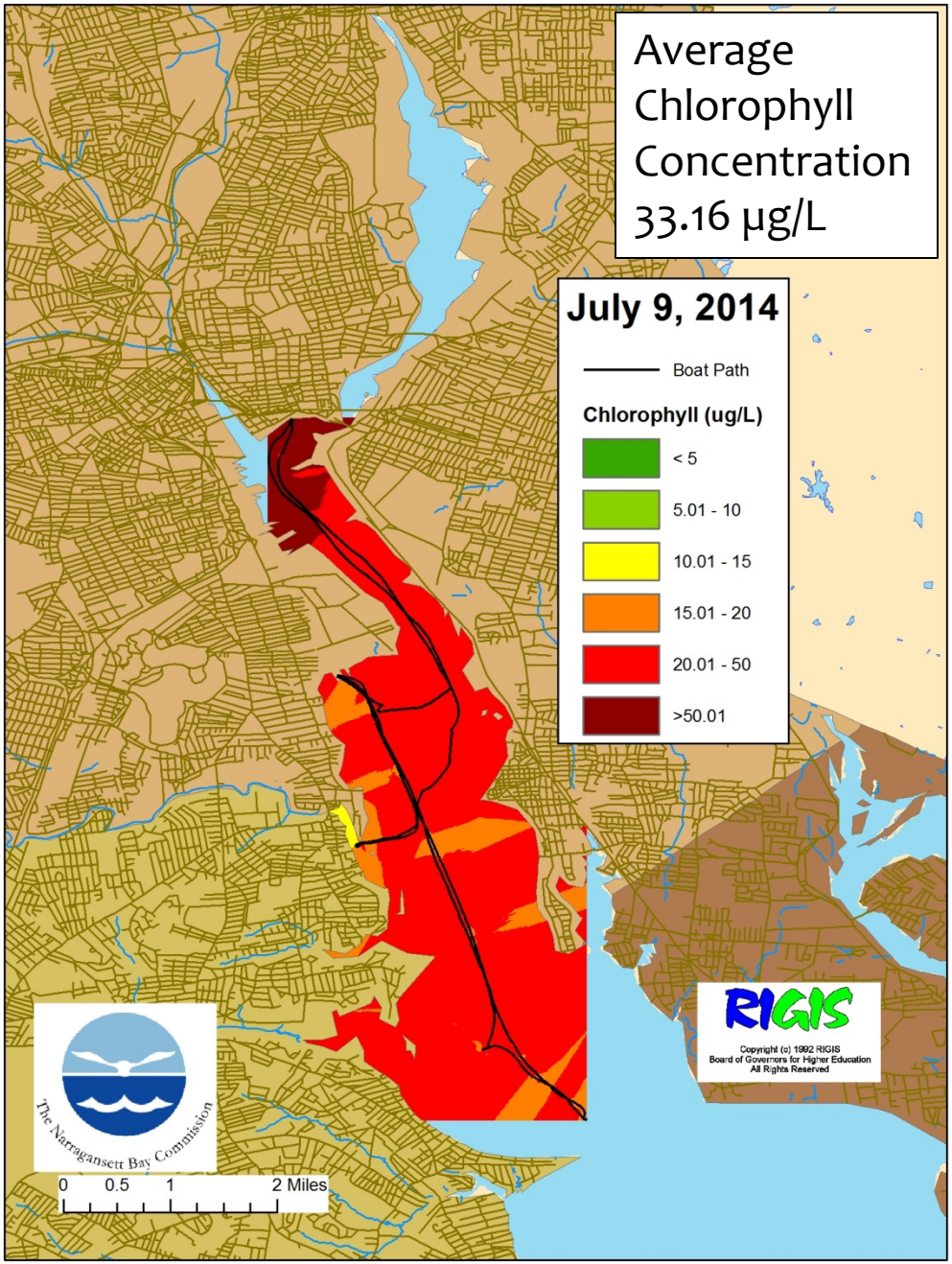
Average Chlorophyll Concentration 33.16 µg/L
July 9, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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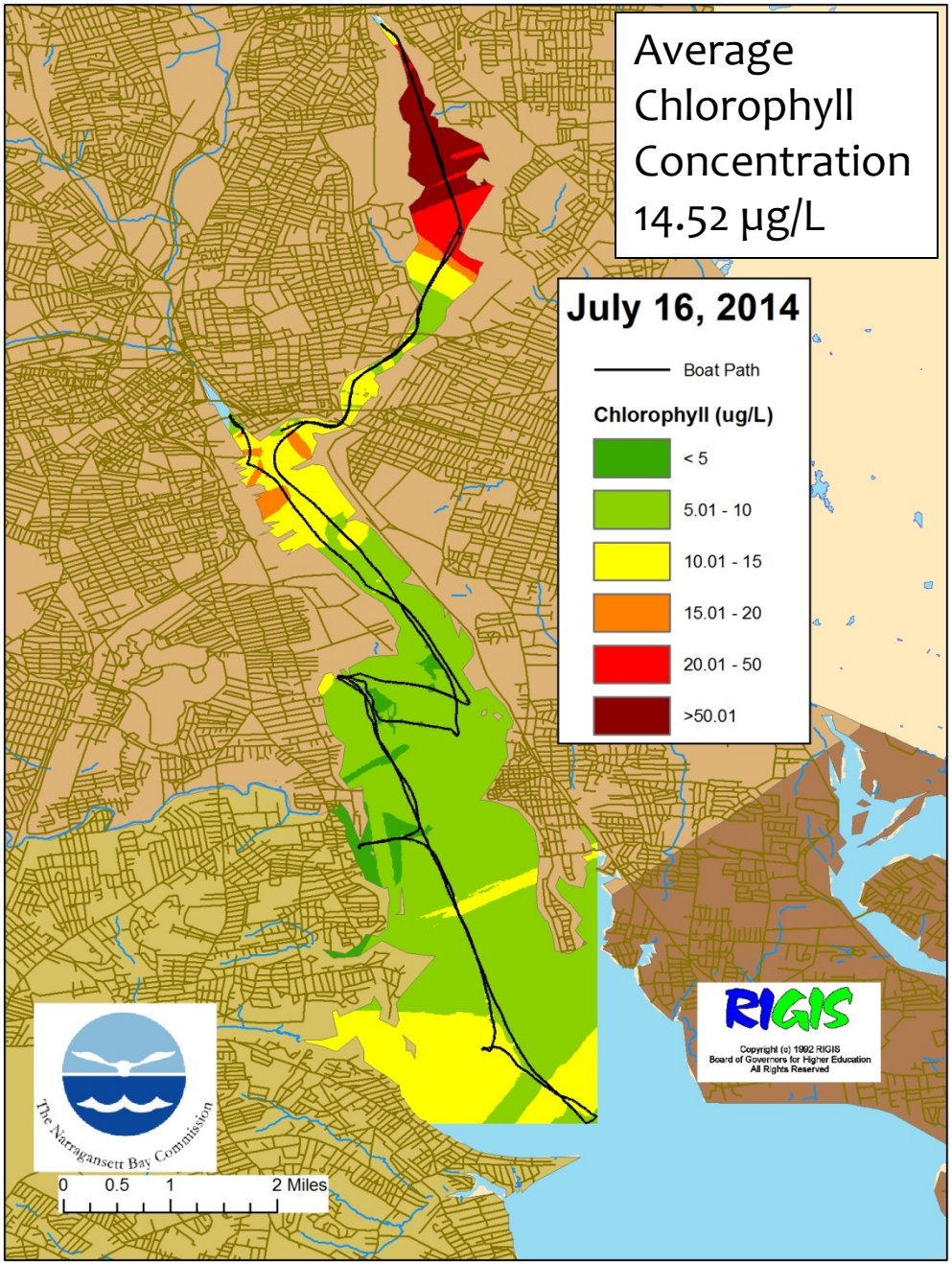
Average Chlorophyll Concentration 14.52 µg/L
July 16, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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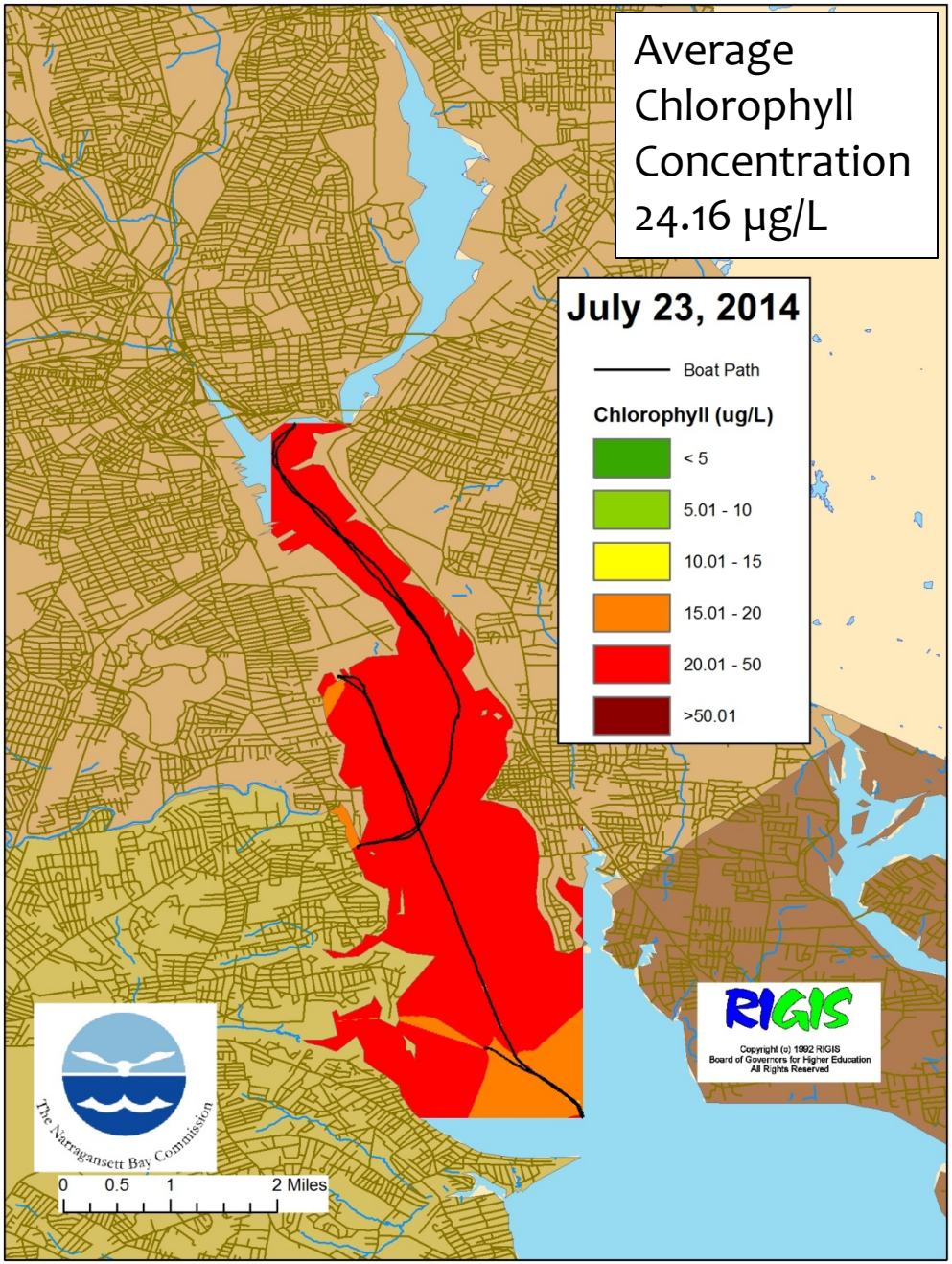
Average Chlorophyll Concentration 24.16 µg/L
July 23, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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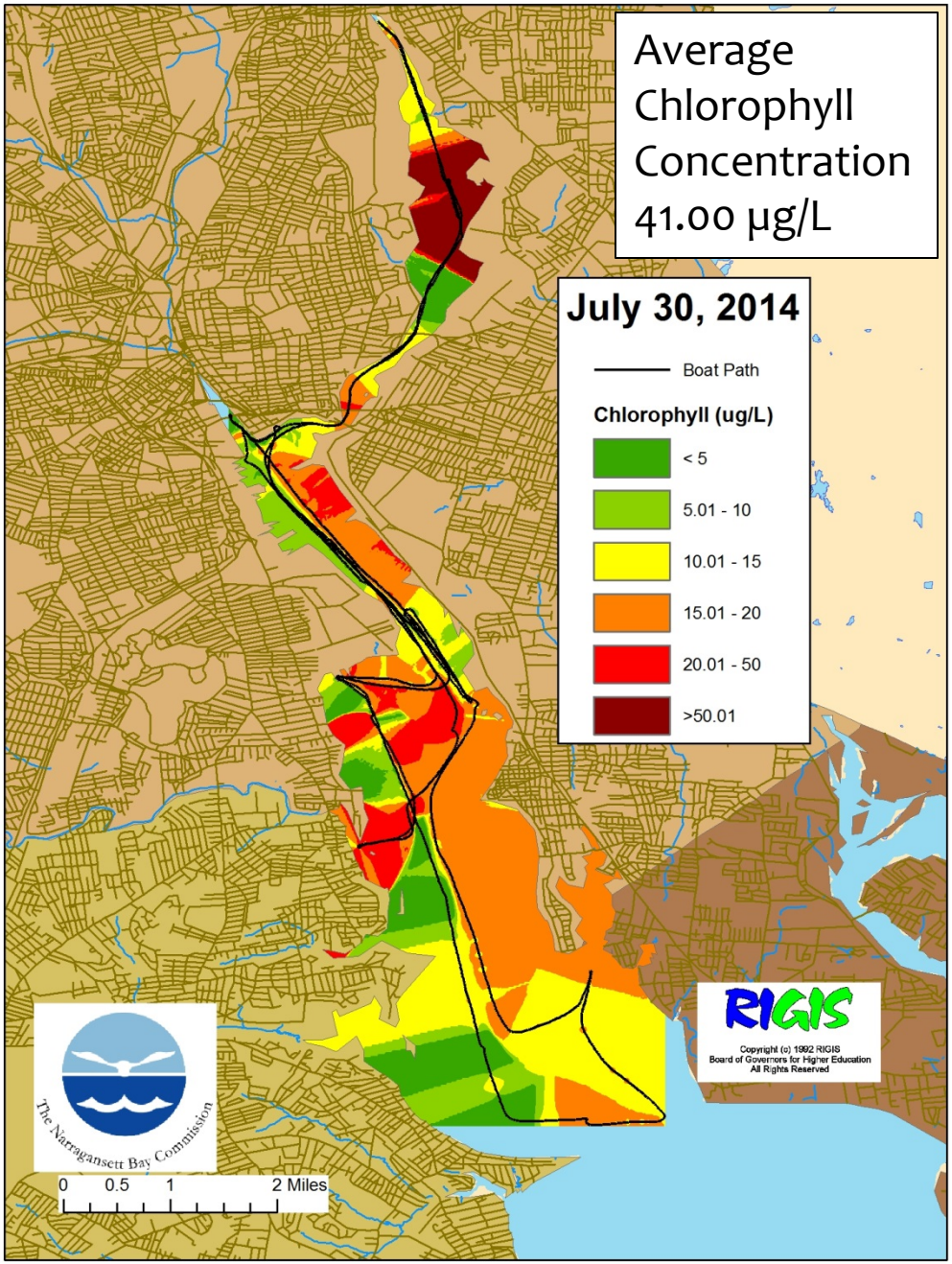
Average Chlorophyll Concentration 41.00 µg/L
July 30, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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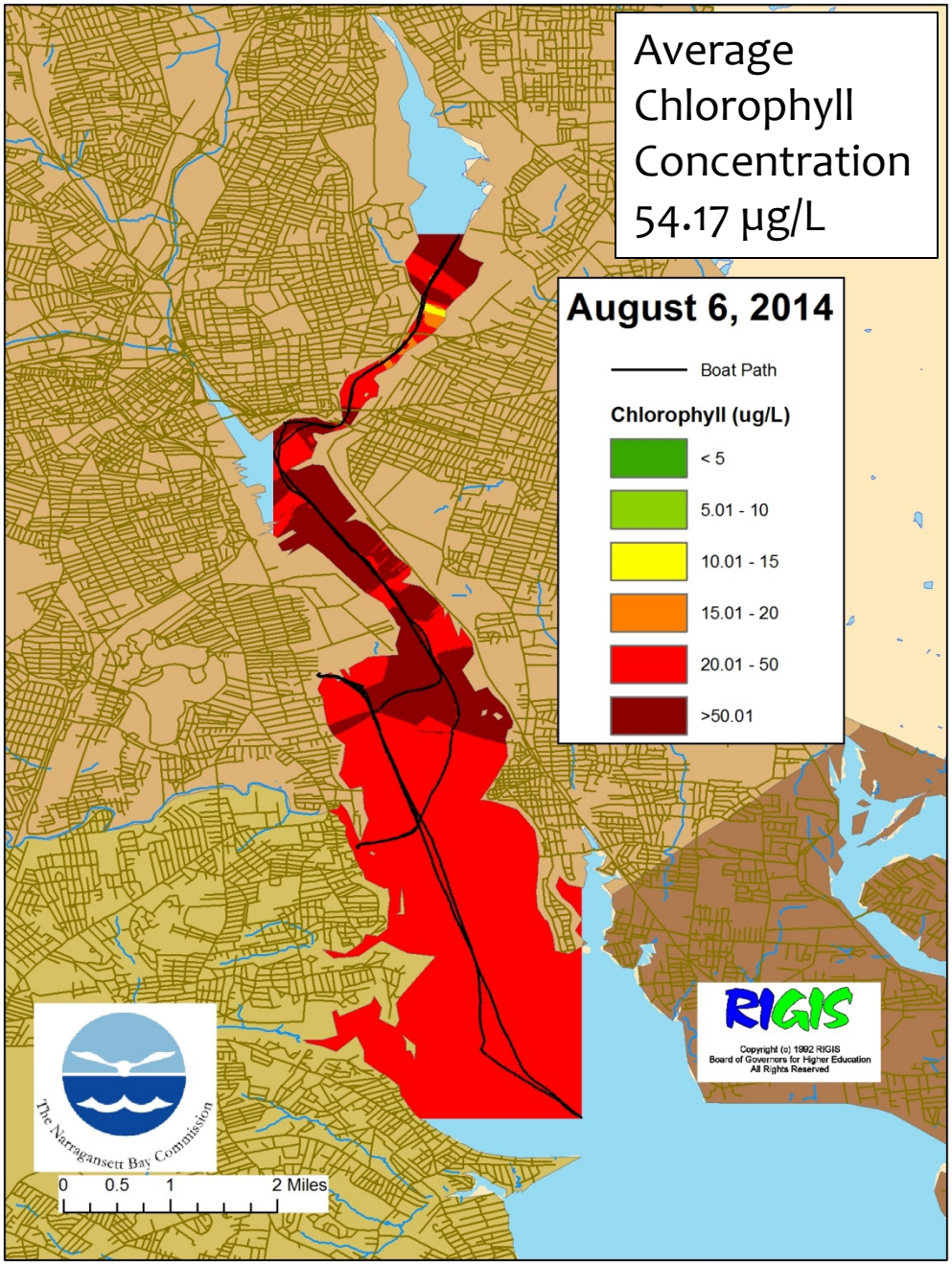
Average Chlorophyll Concentration 54.17 µg/L
August 6, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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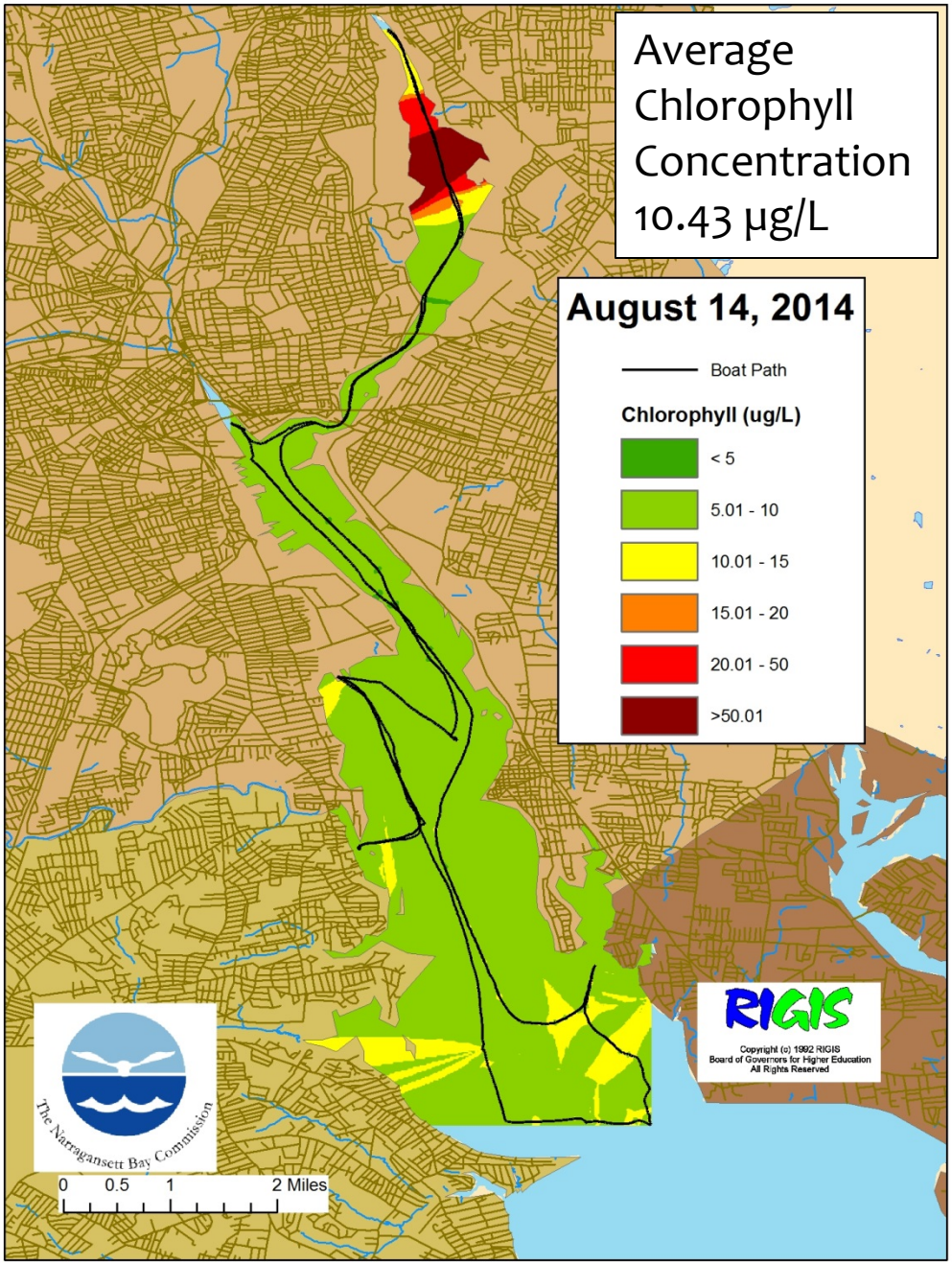
Average Chlorophyll Concentration 10.43 µg/L
August 14, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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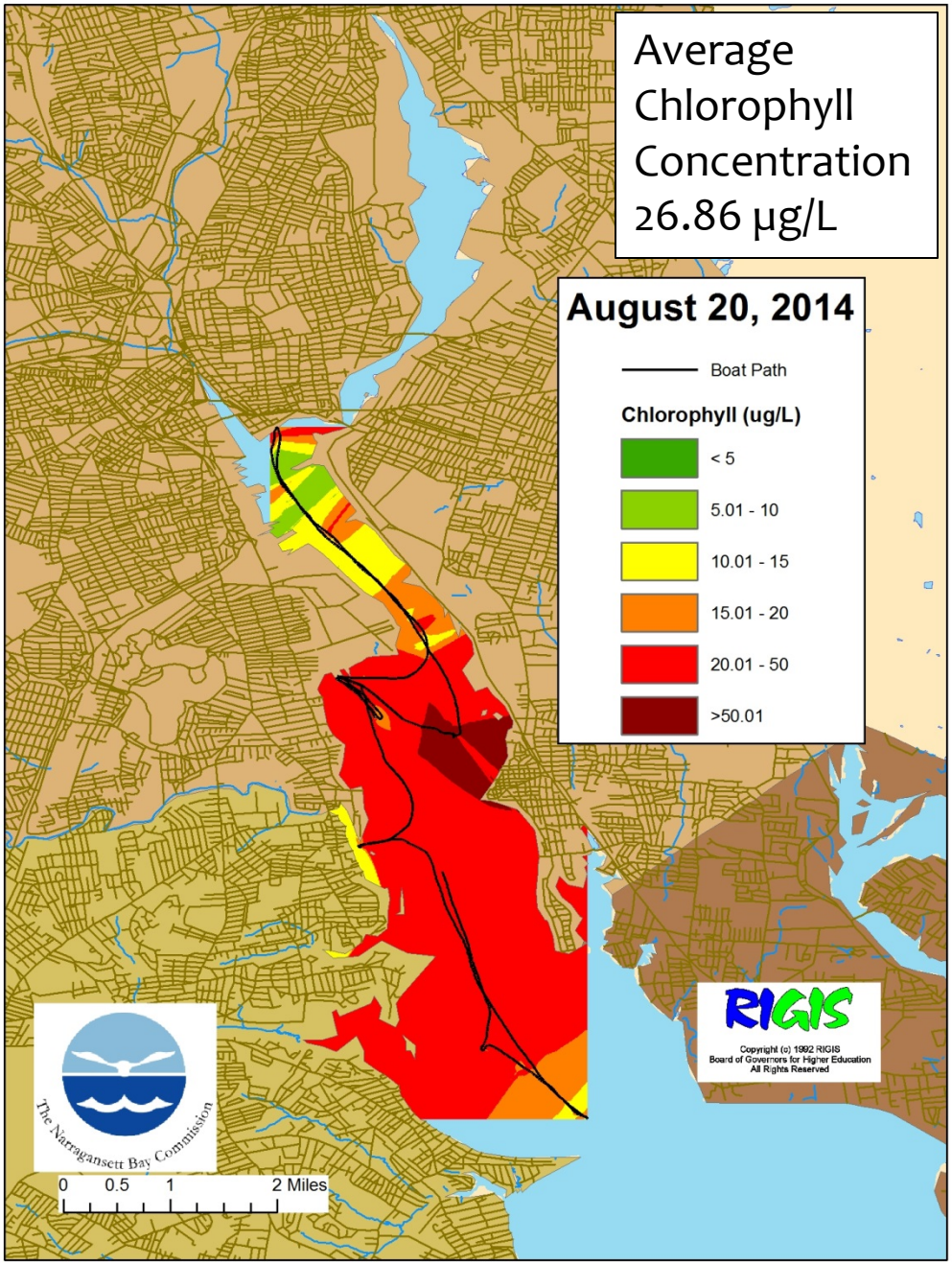
Average Chlorophyll Concentration 26.86 µg/L
August 20, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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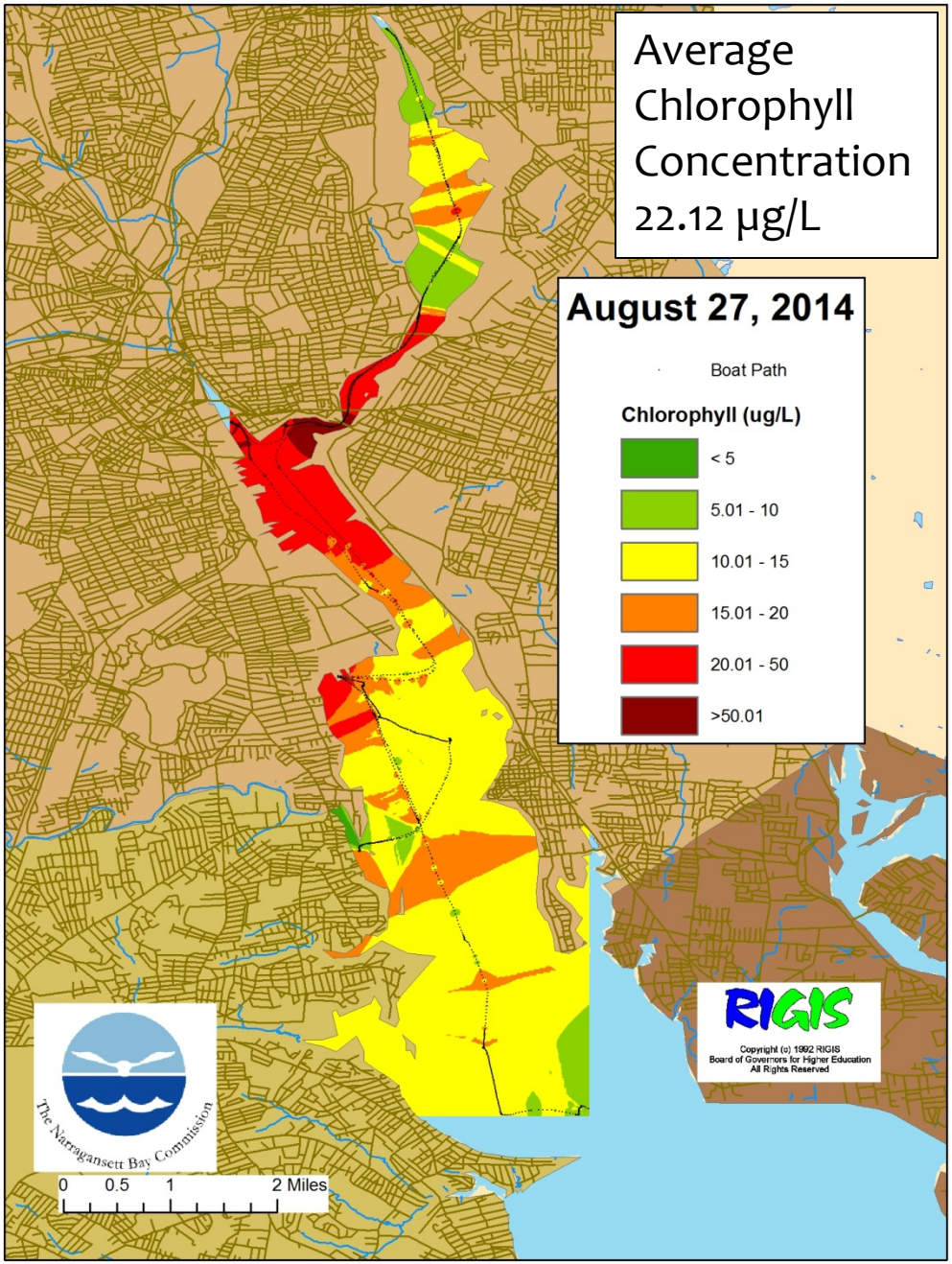
Average Chlorophyll Concentration 22.12 µg/L
August 27, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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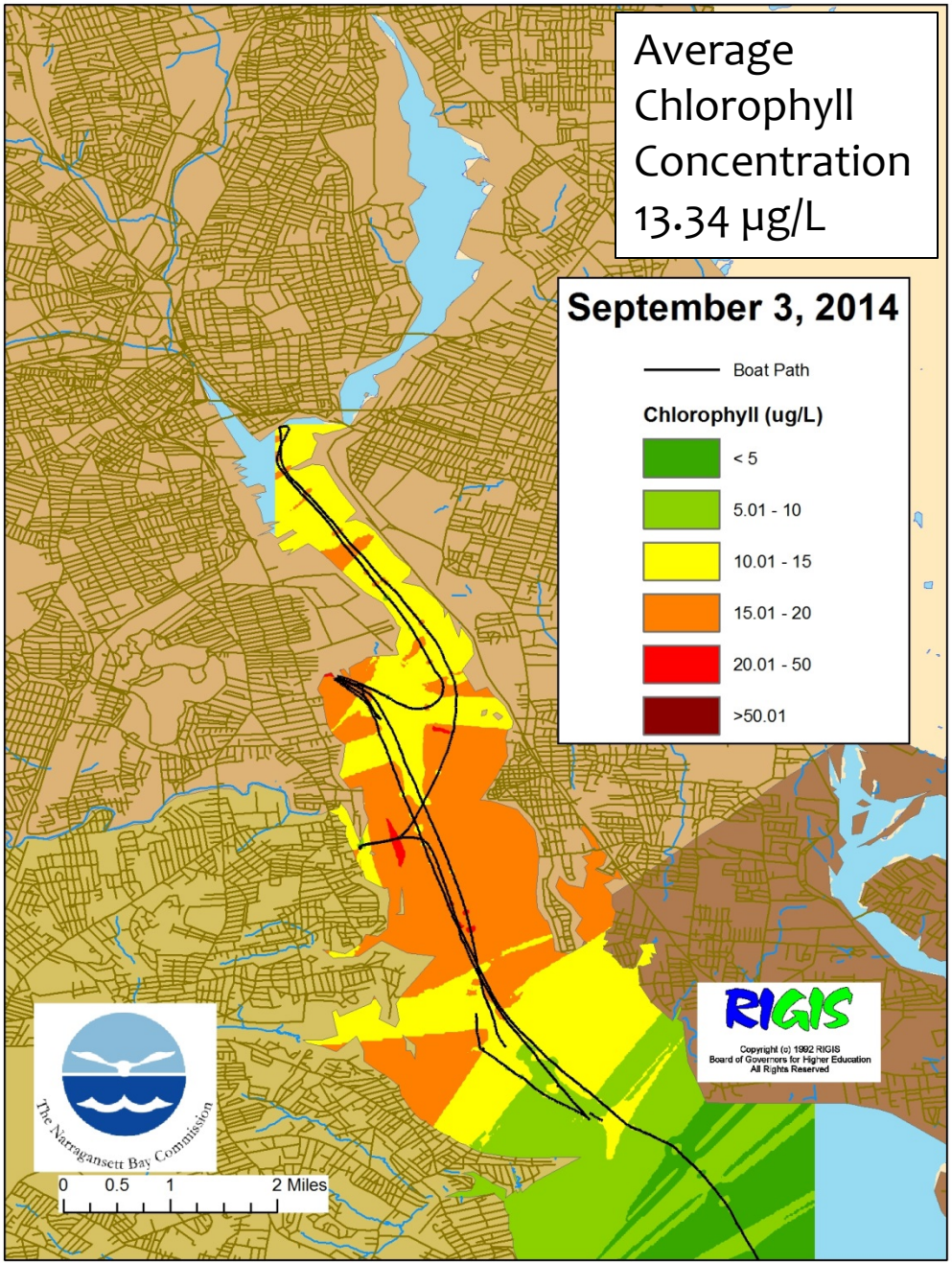
Average Chlorophyll Concentration 13.34 µg/L
September 3, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
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0 0.5 1 2 Miles
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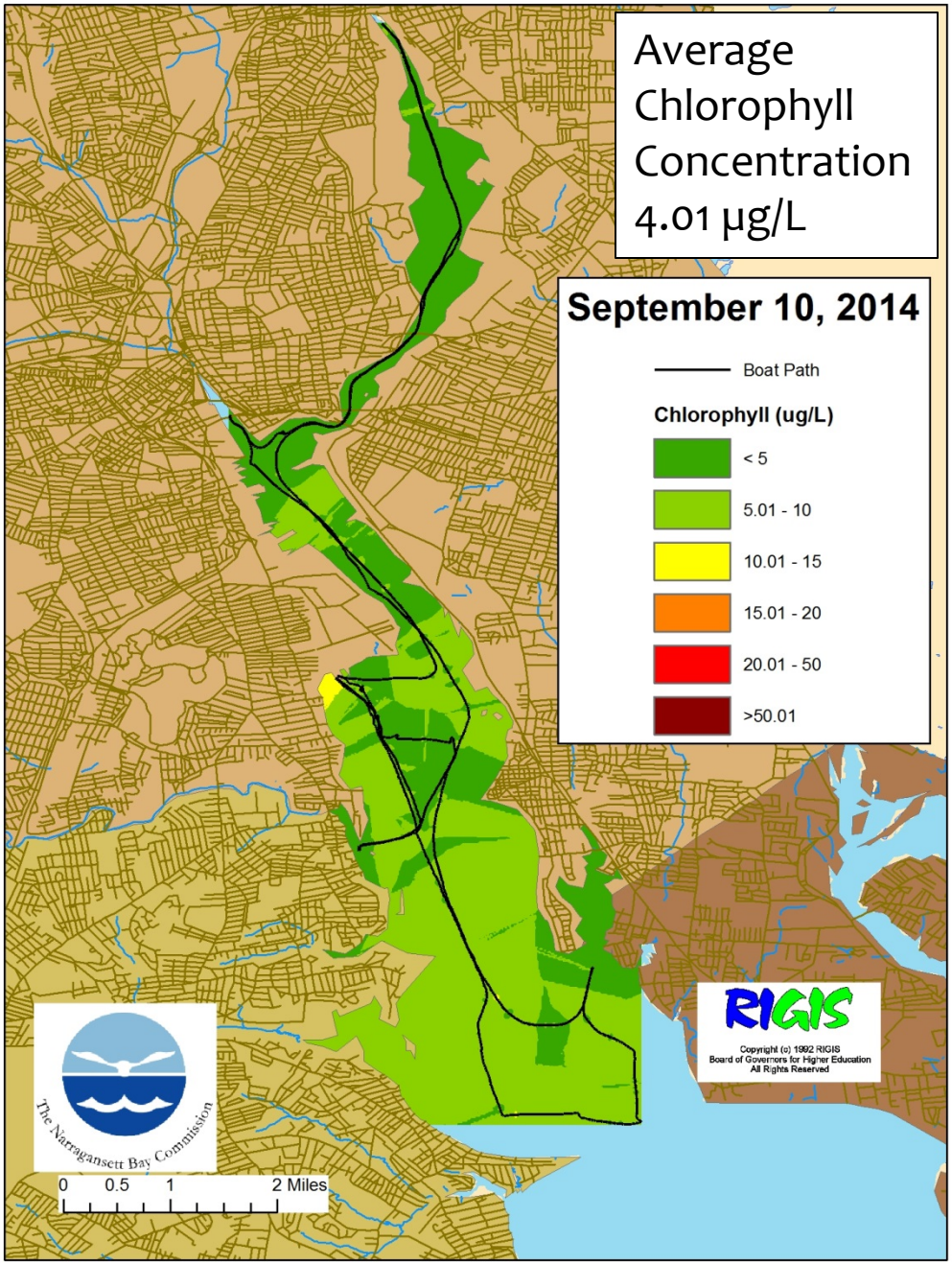
Average Chlorophyll Concentration 4.01 µg/L
September 10, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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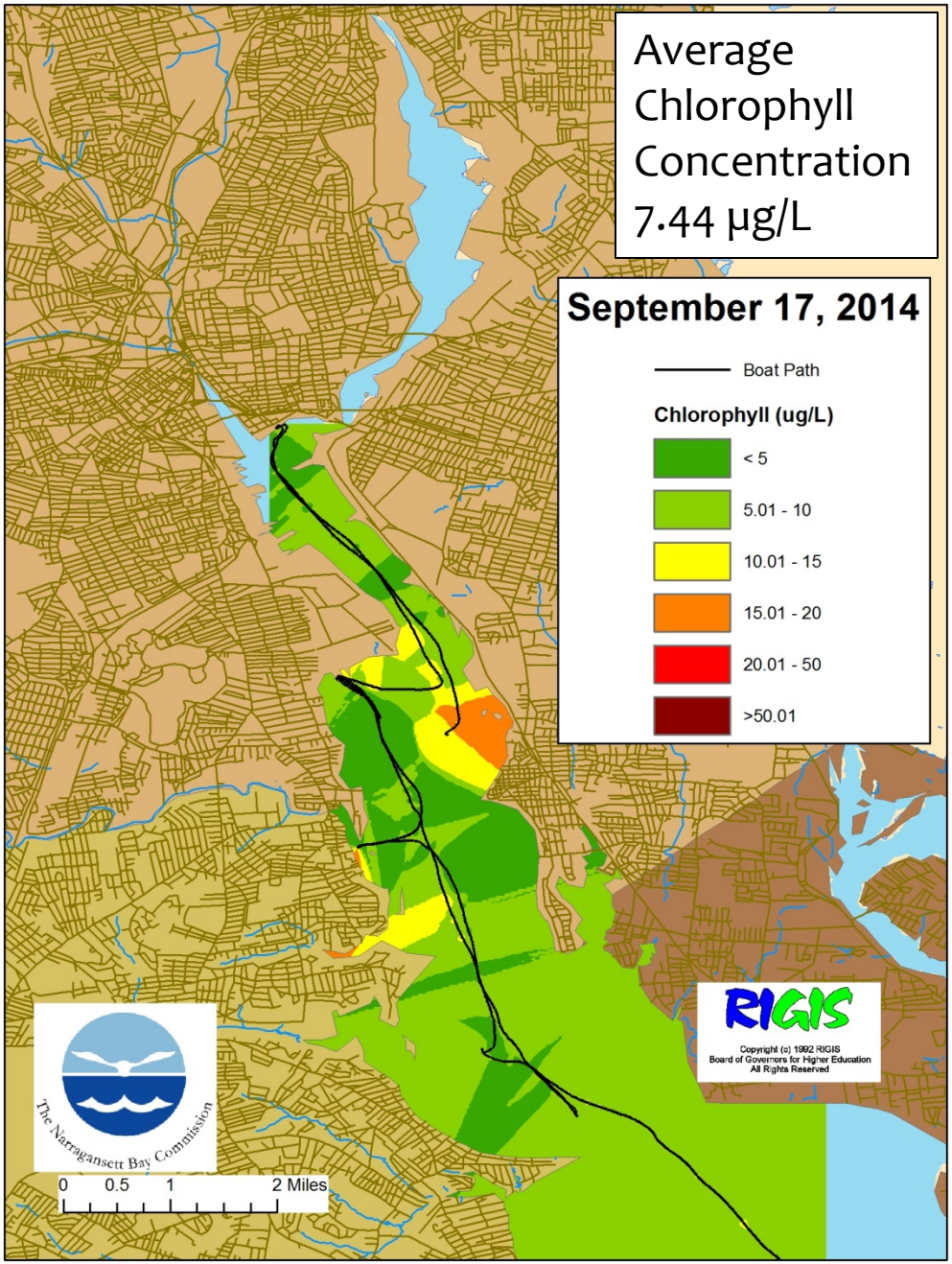
Average Chlorophyll Concentration 7.44 µg/L
September 17, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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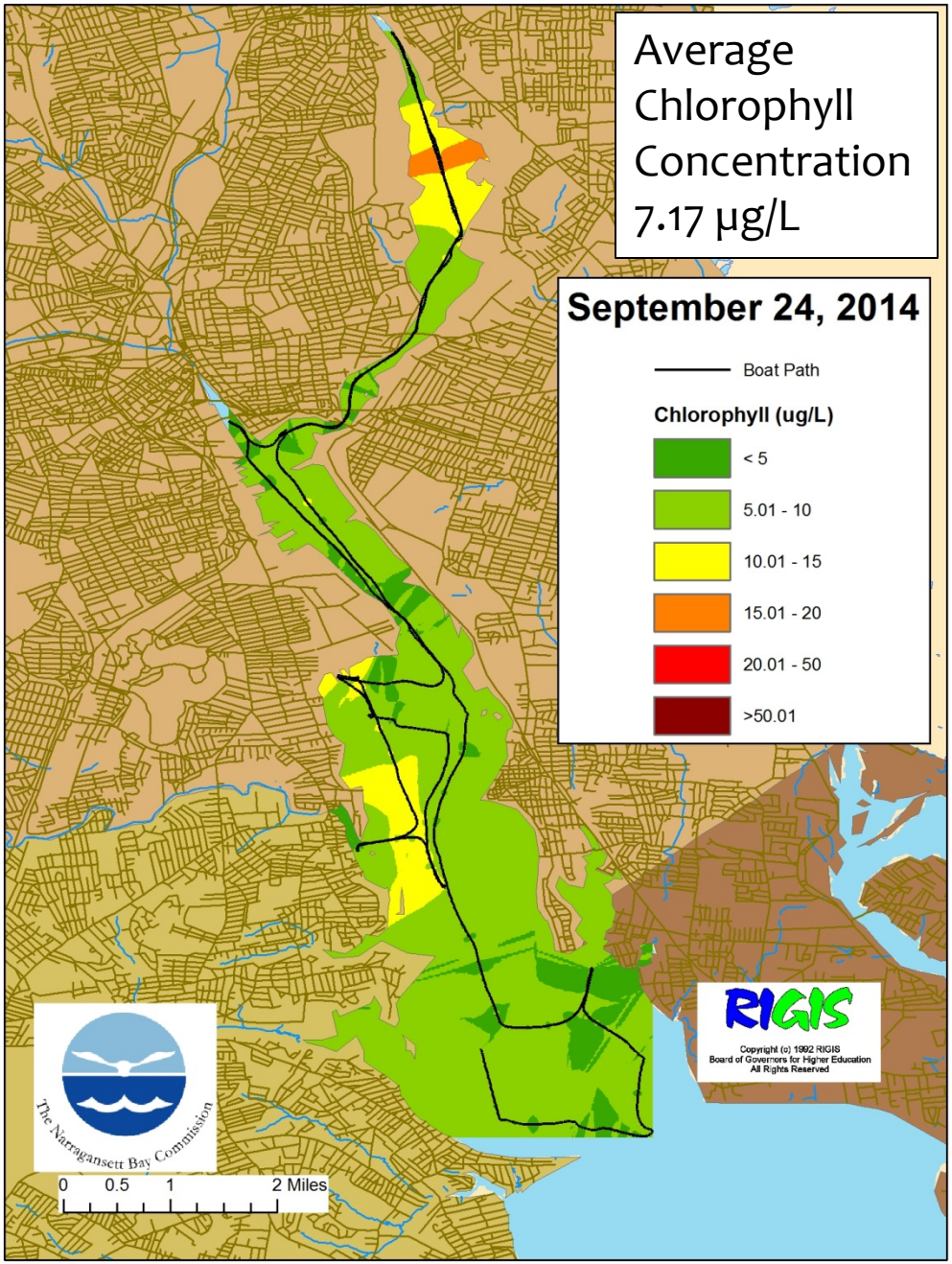
Average Chlorophyll Concentration 7.17 µg/L
September 24, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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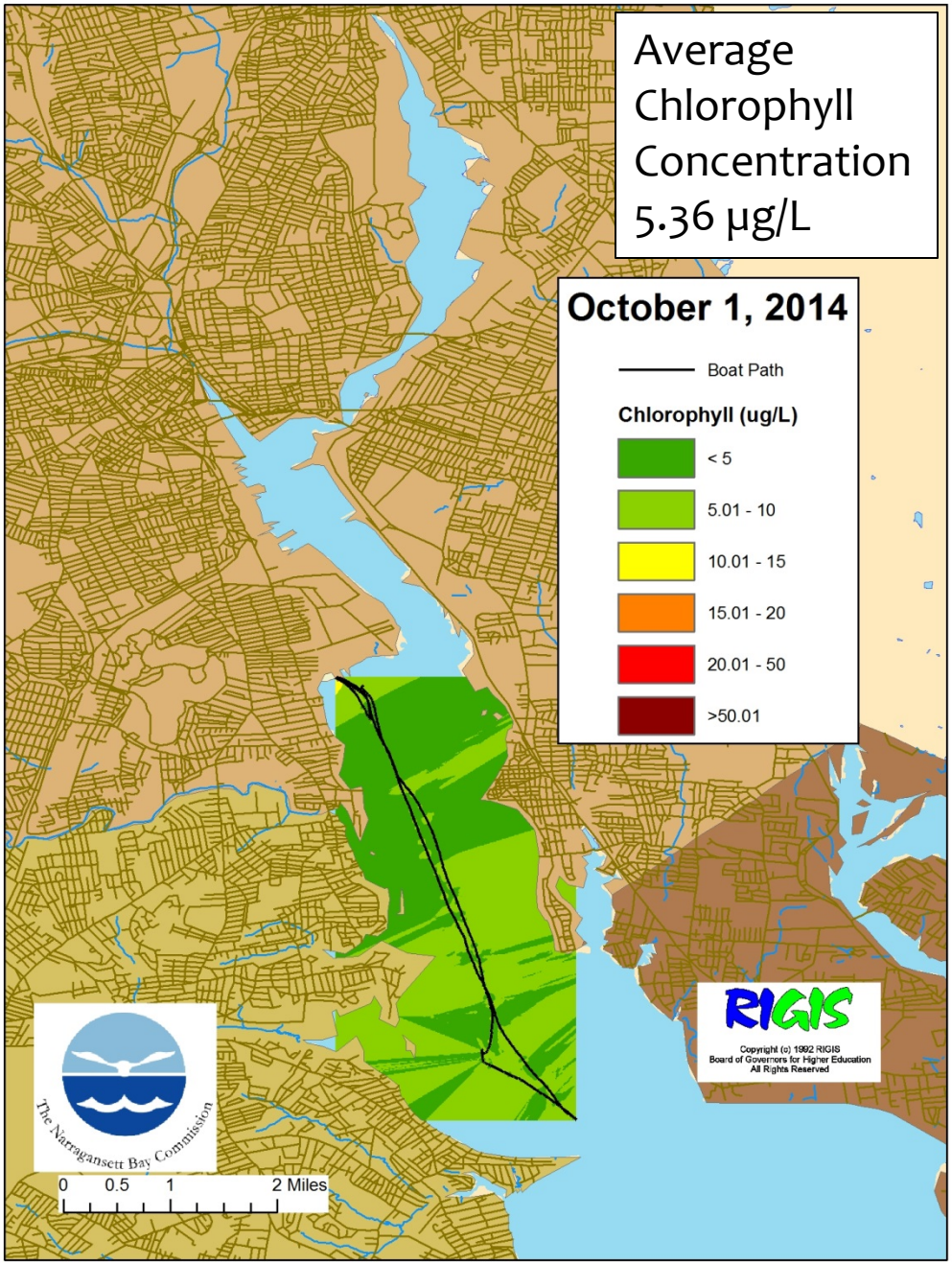
Average Chlorophyll Concentration 5.36 µg/L
October 1, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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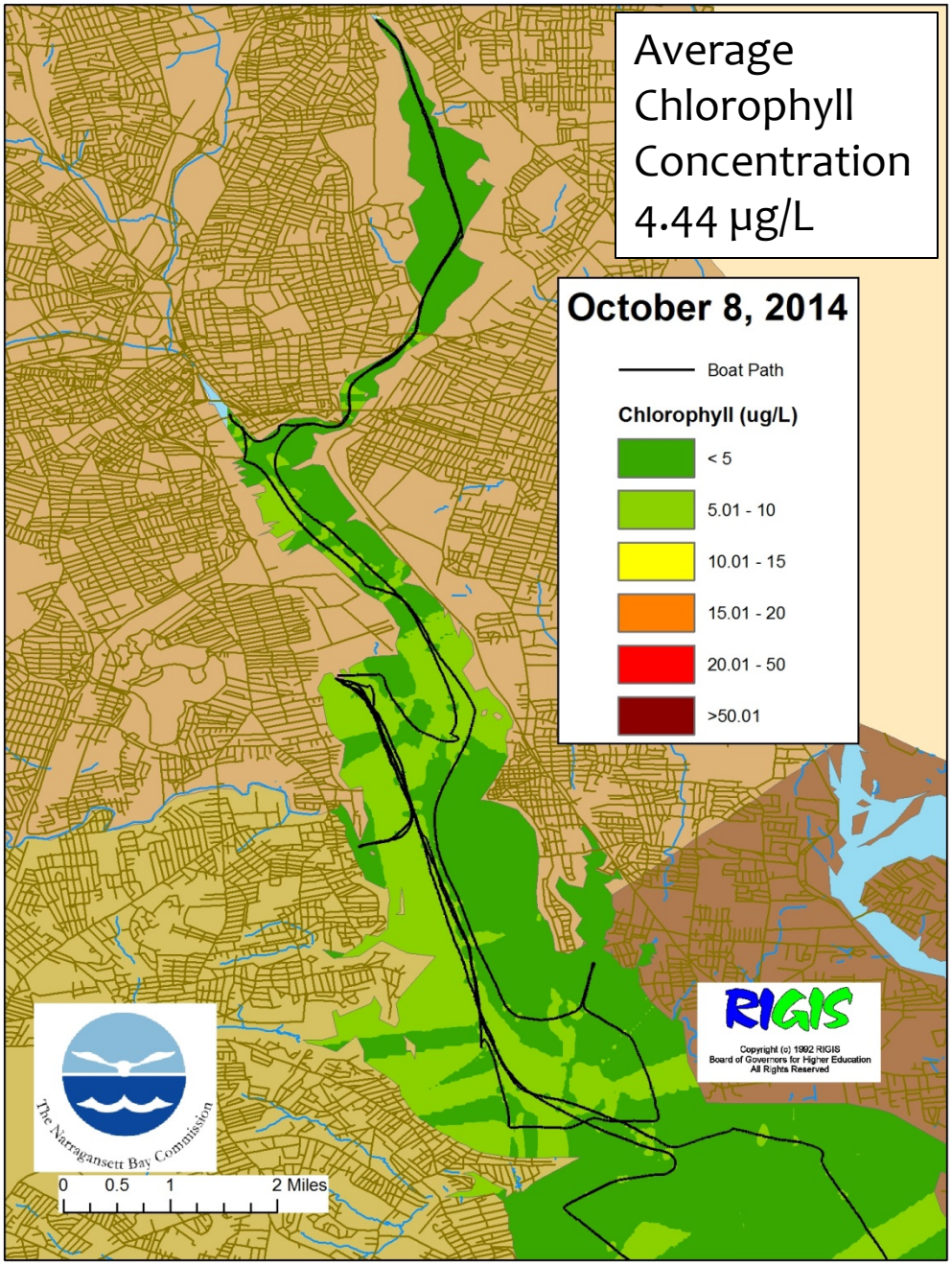
Average Chlorophyll Concentration 4.44 µg/L
October 8, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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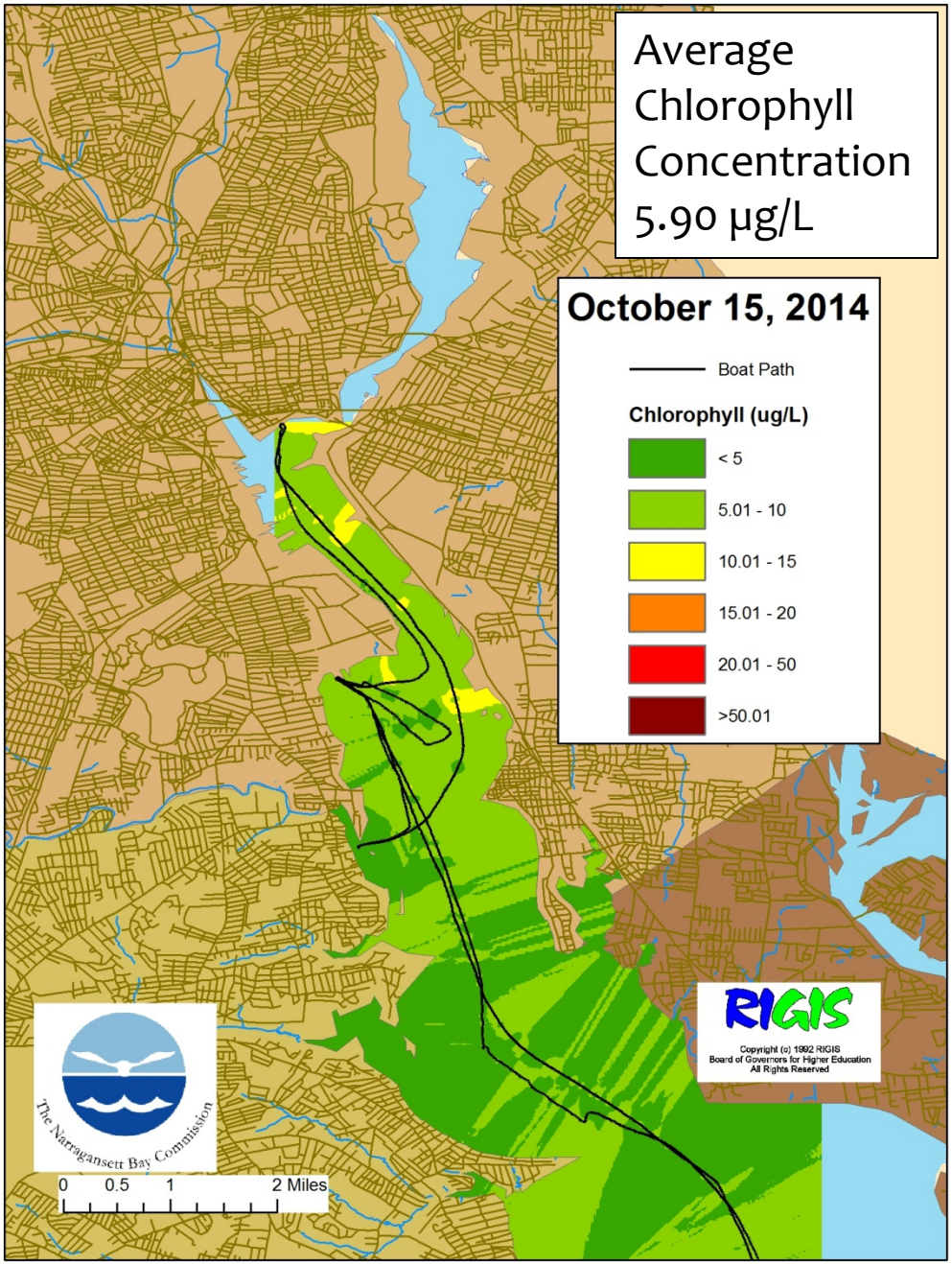
Average Chlorophyll Concentration 5.90 µg/L
October 15, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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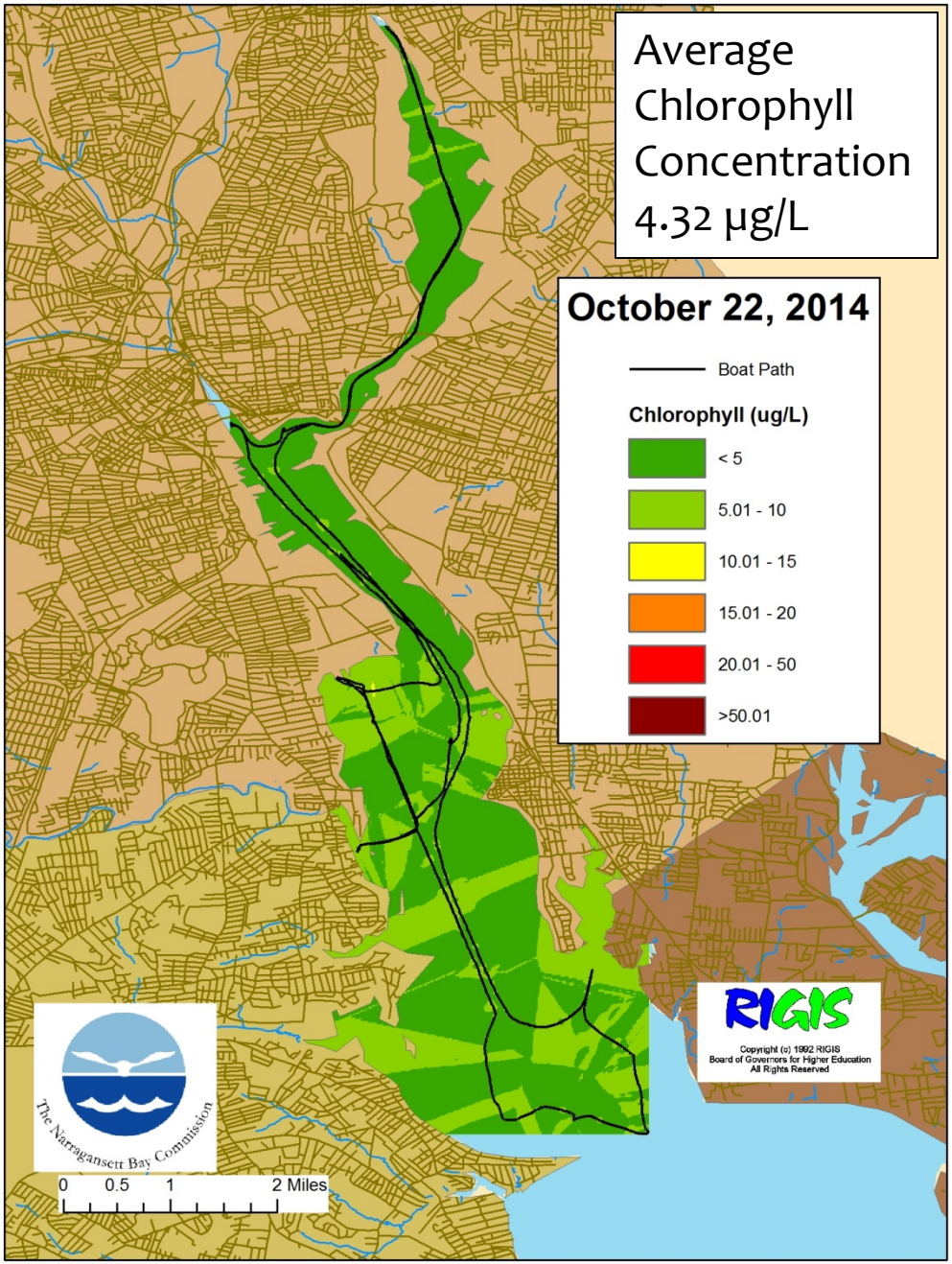
Average Chlorophyll Concentration 4.32 µg/L
October 22, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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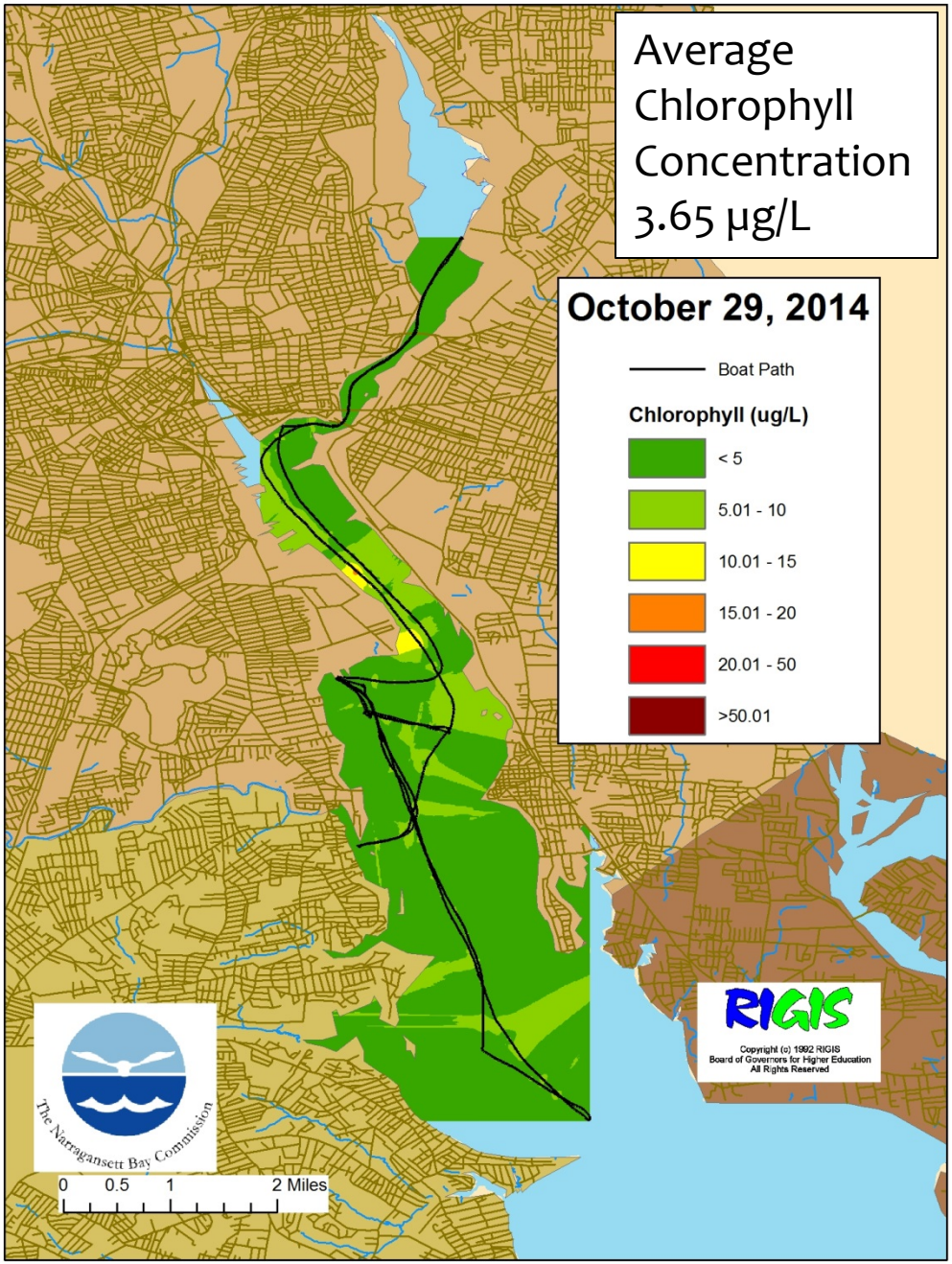
Average Chlorophyll Concentration 3.65 µg/L
October 29, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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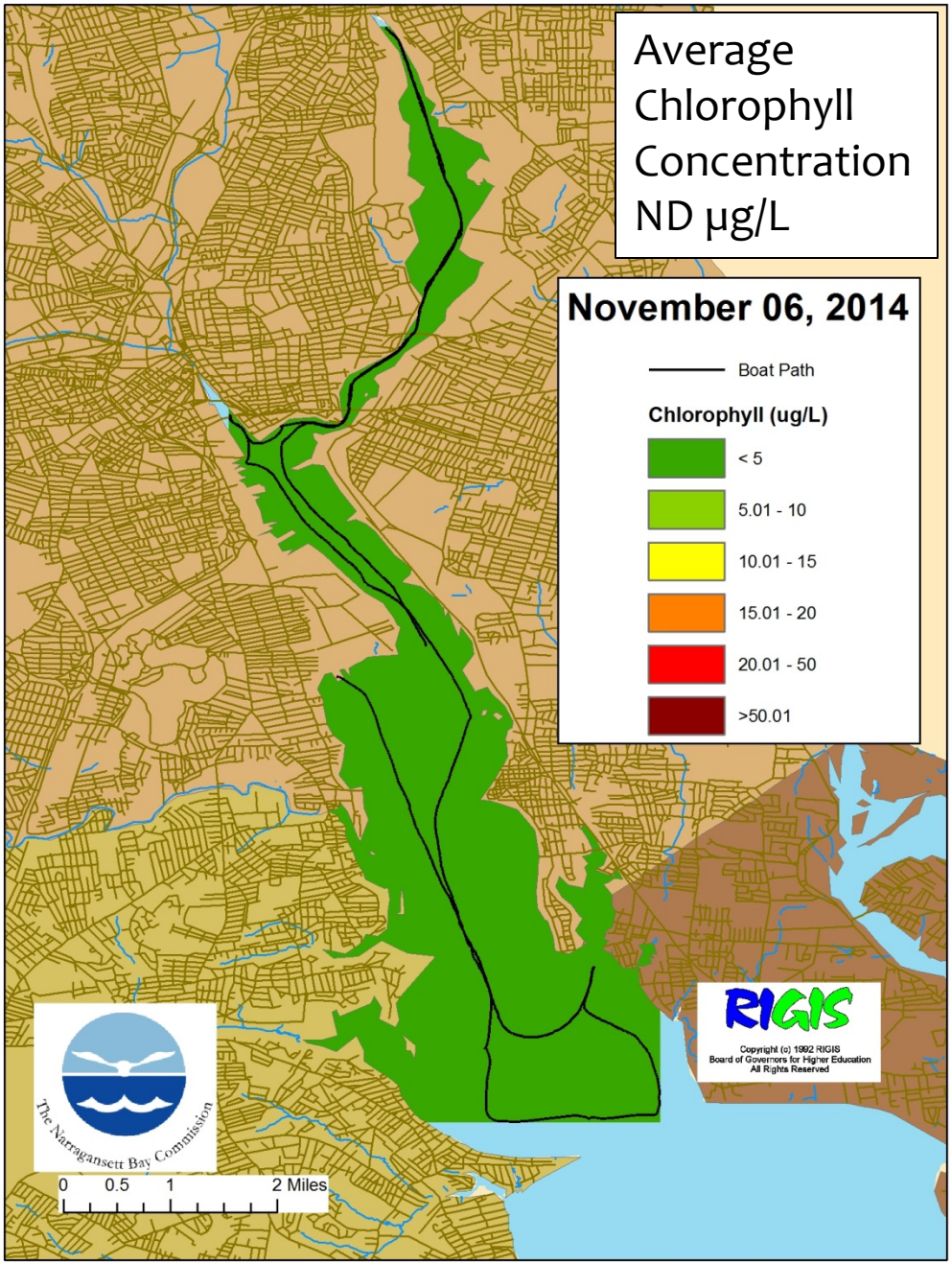
Average Chlorophyll Concentration ND µg/L
November 06, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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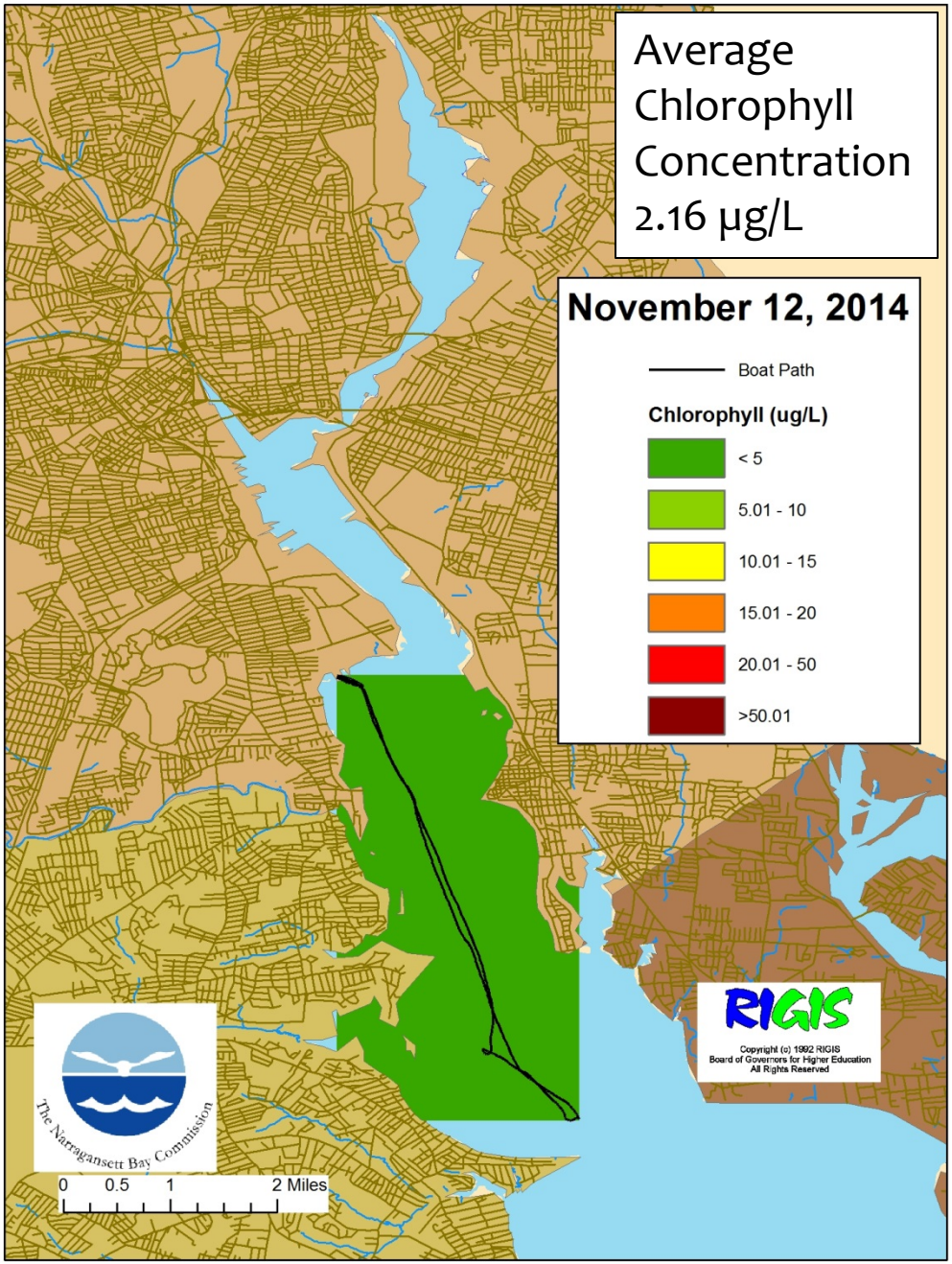
Average Chlorophyll Concentration 2.16 µg/L
November 12, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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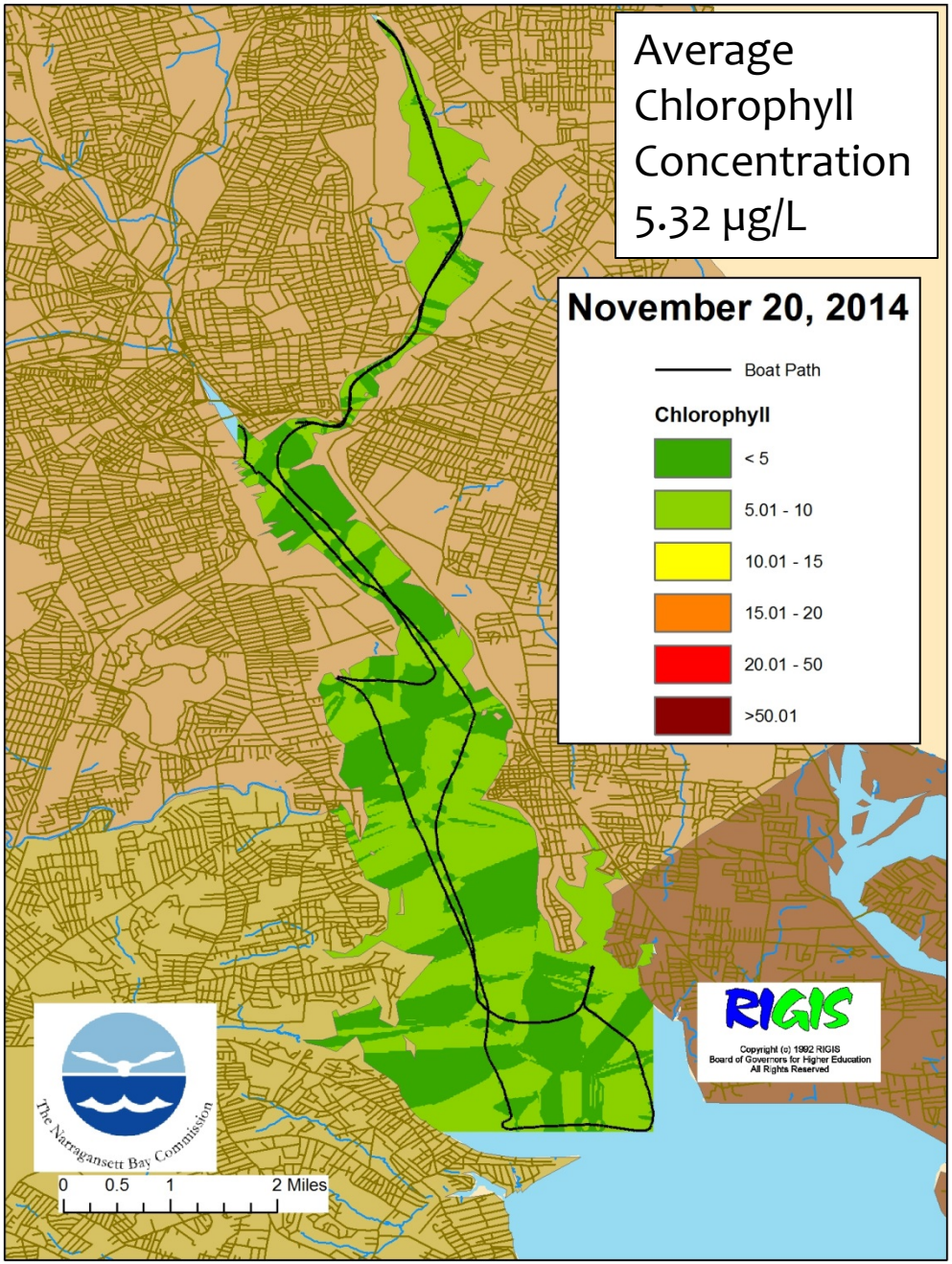
Average Chlorophyll Concentration 5.32 µg/L
November 20, 2014
Boat Path
Chlorophyll
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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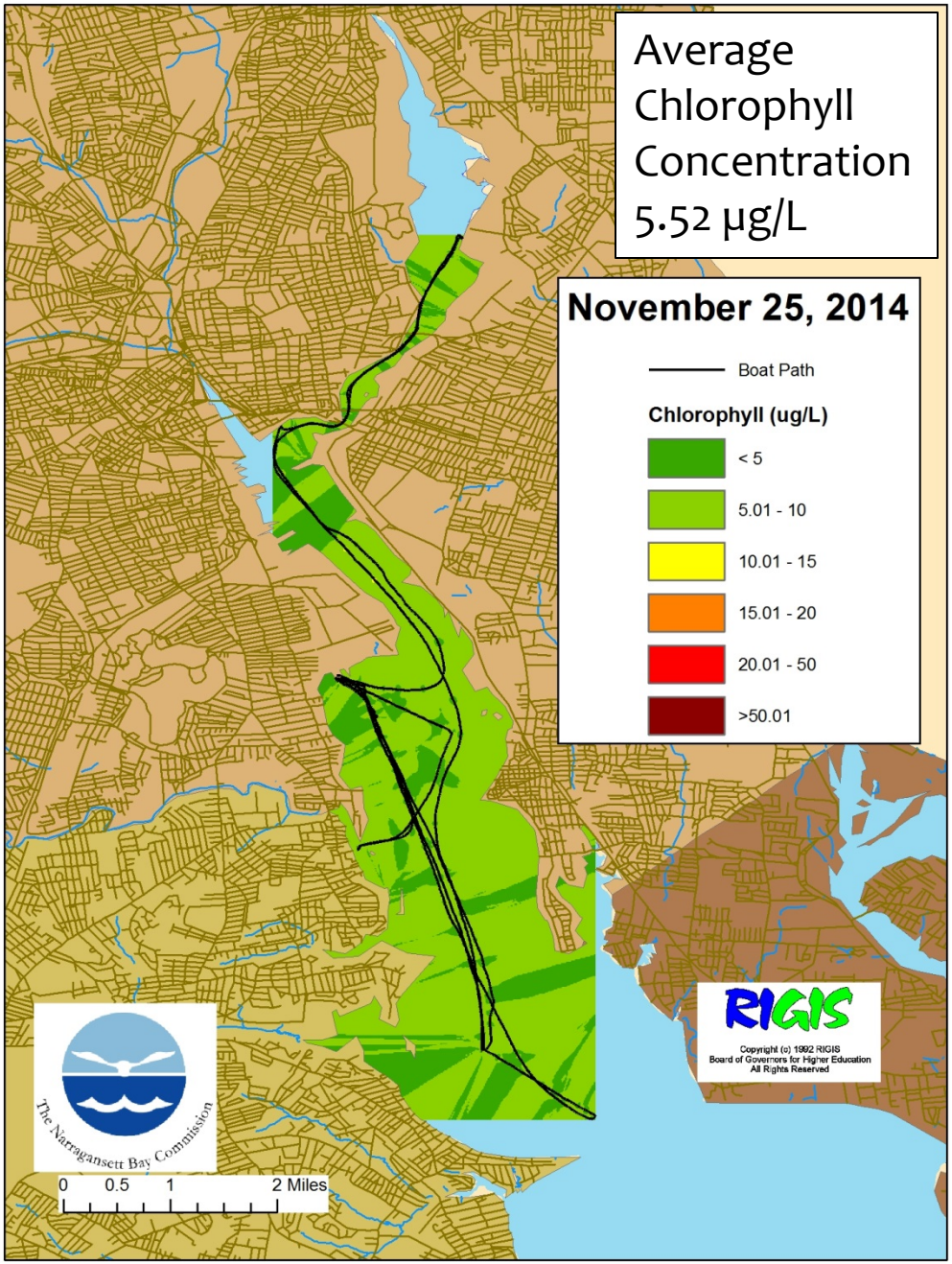
Average Chlorophyll Concentration 5.52 µg/L
November 25, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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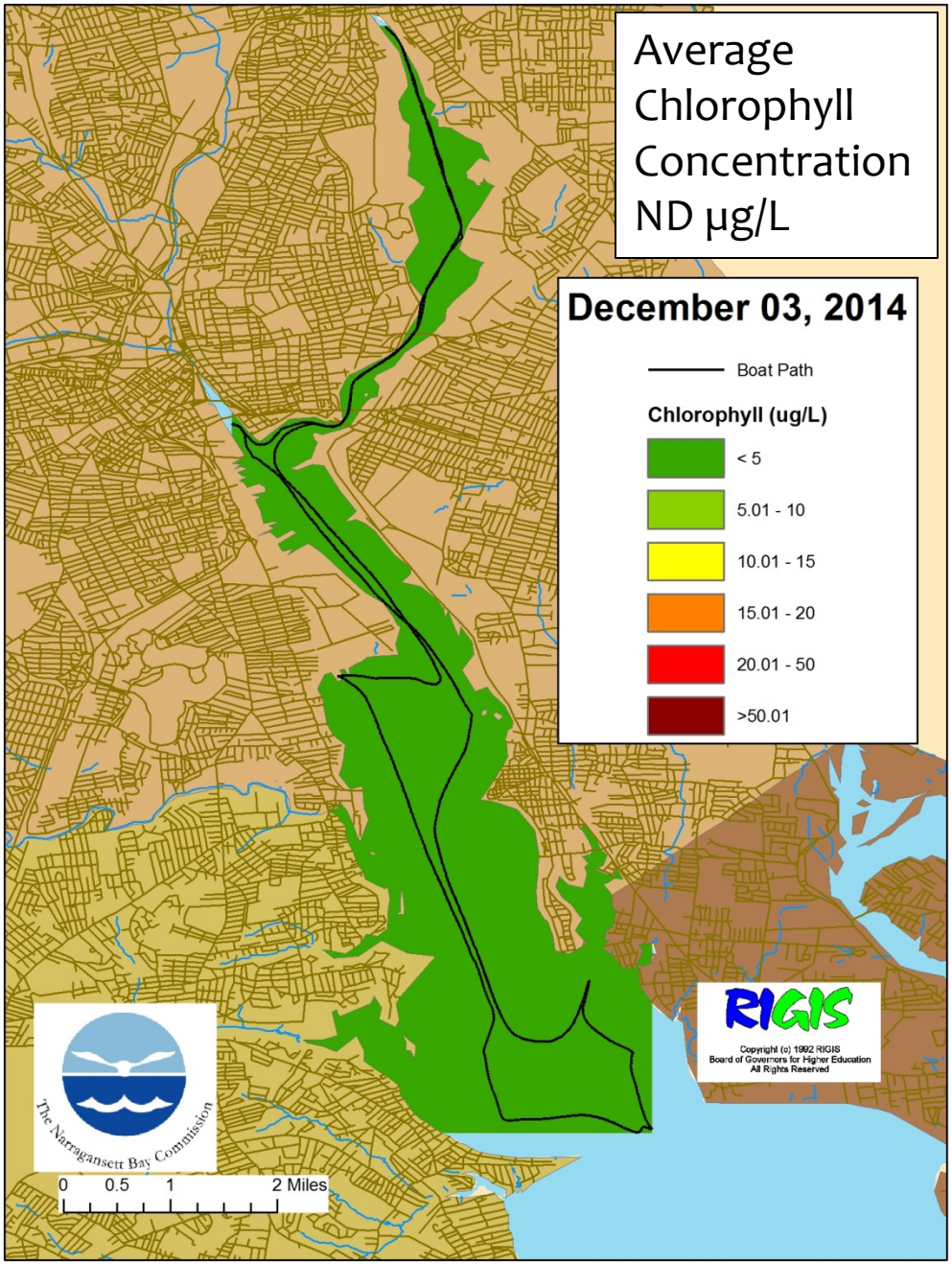
Average Chlorophyll Concentration ND µg/L
December 03, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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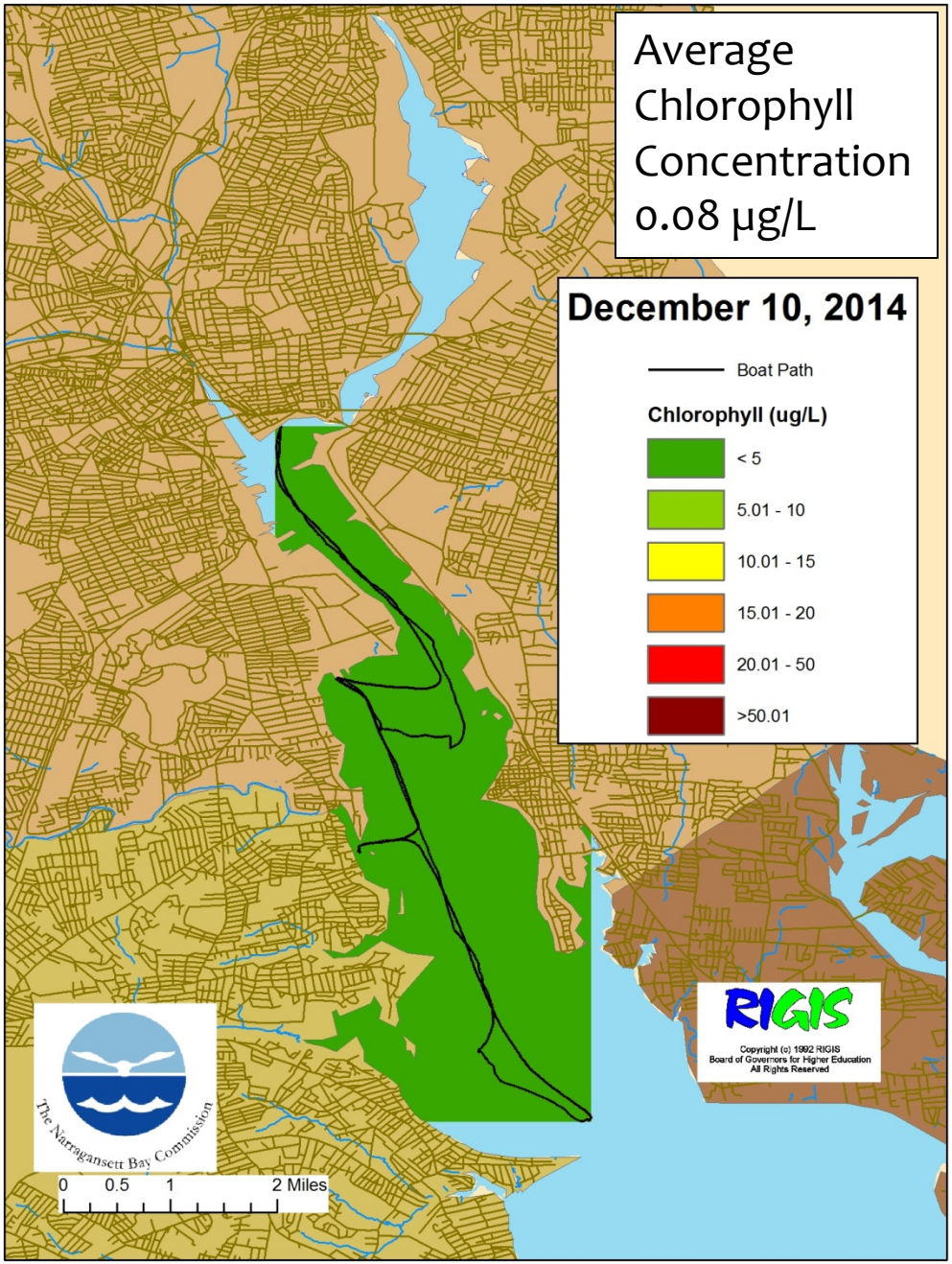
Average Chlorophyll Concentration 0.08 µg/L
December 10, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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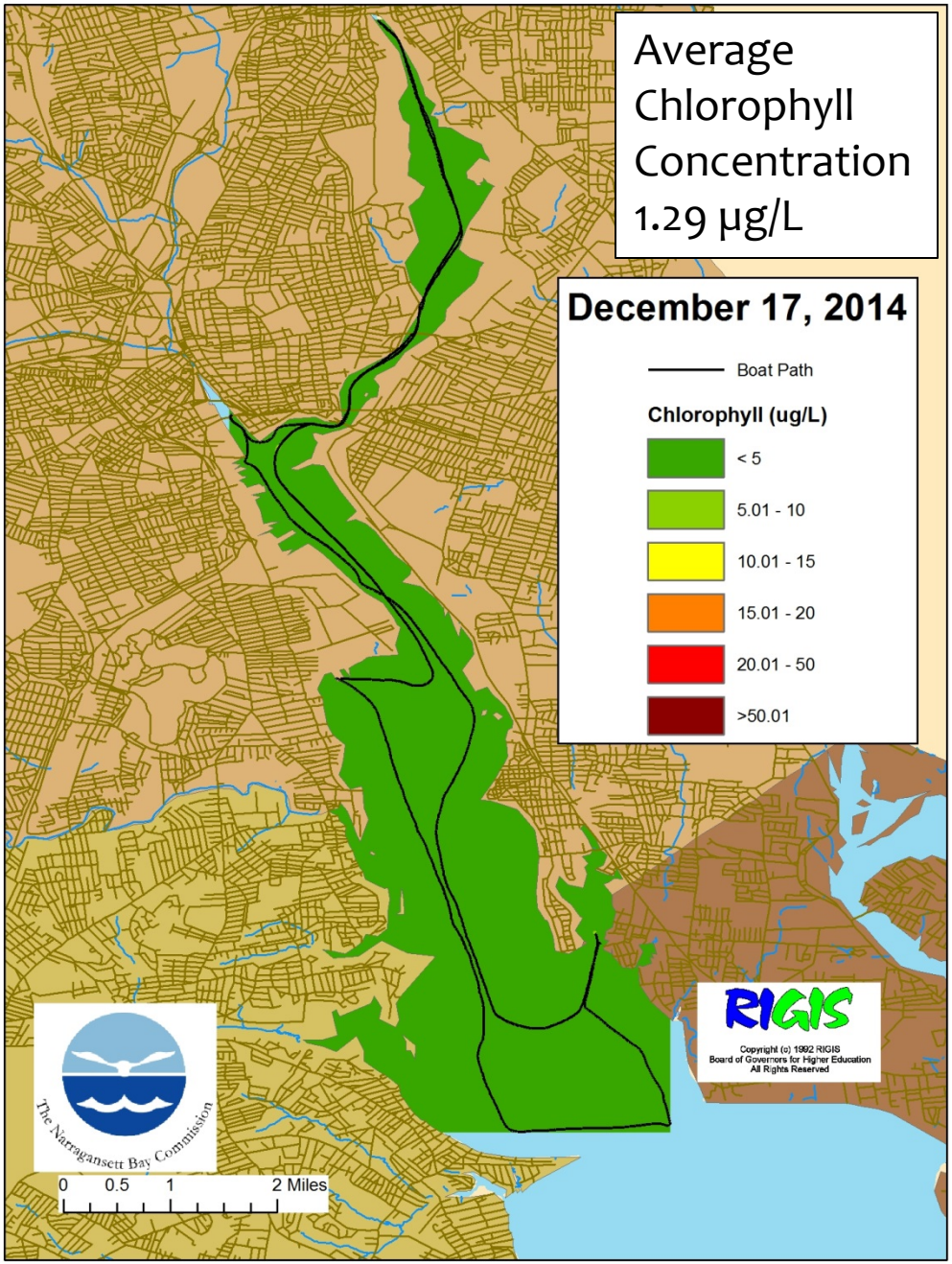
Average Chlorophyll Concentration 1.29 µg/L
December 17, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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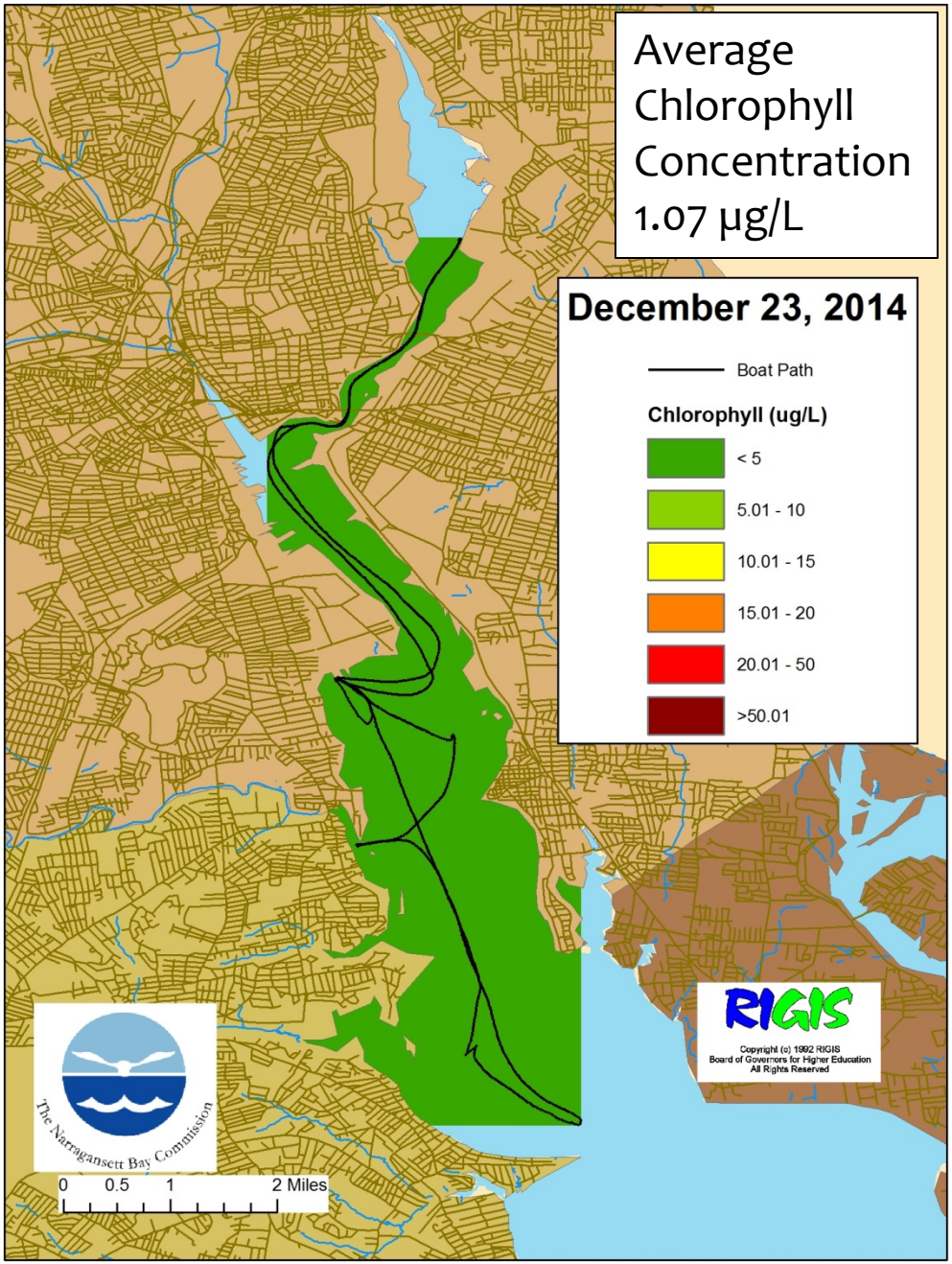
Average Chlorophyll Concentration 1.07 µg/L
December 23, 2014
Boat Path
Chlorophyll (ug/L)
< 5
5.01 - 10
10.01 - 15
15.01 - 20
20.01 - 50
>50.01
The Narragansett Bay Commission
0 0.5 1 2 Miles
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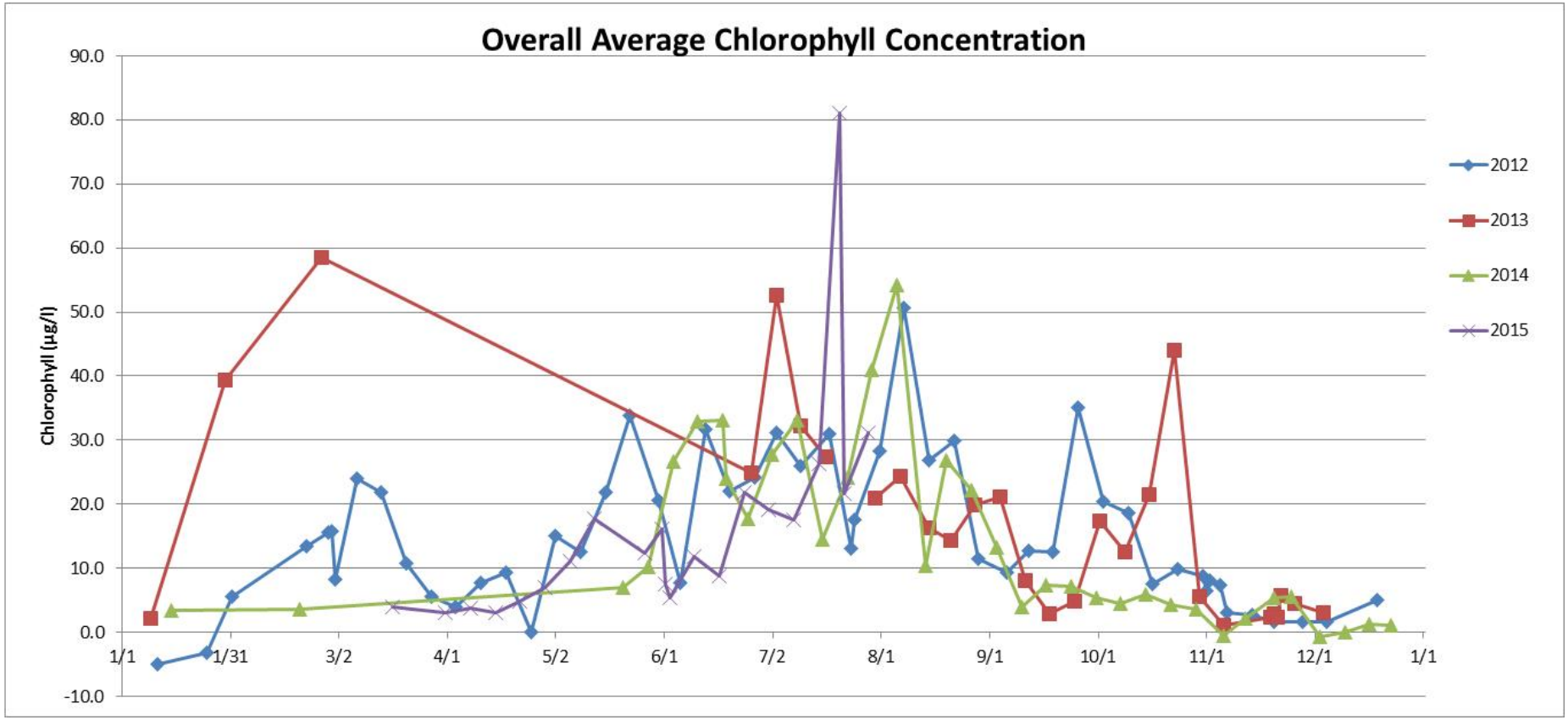
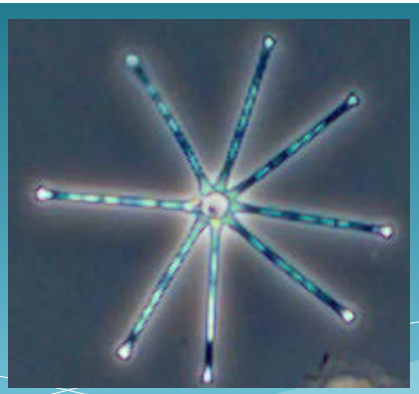
Surface Mapping



Plankton Monitoring

Plankton Monitoring

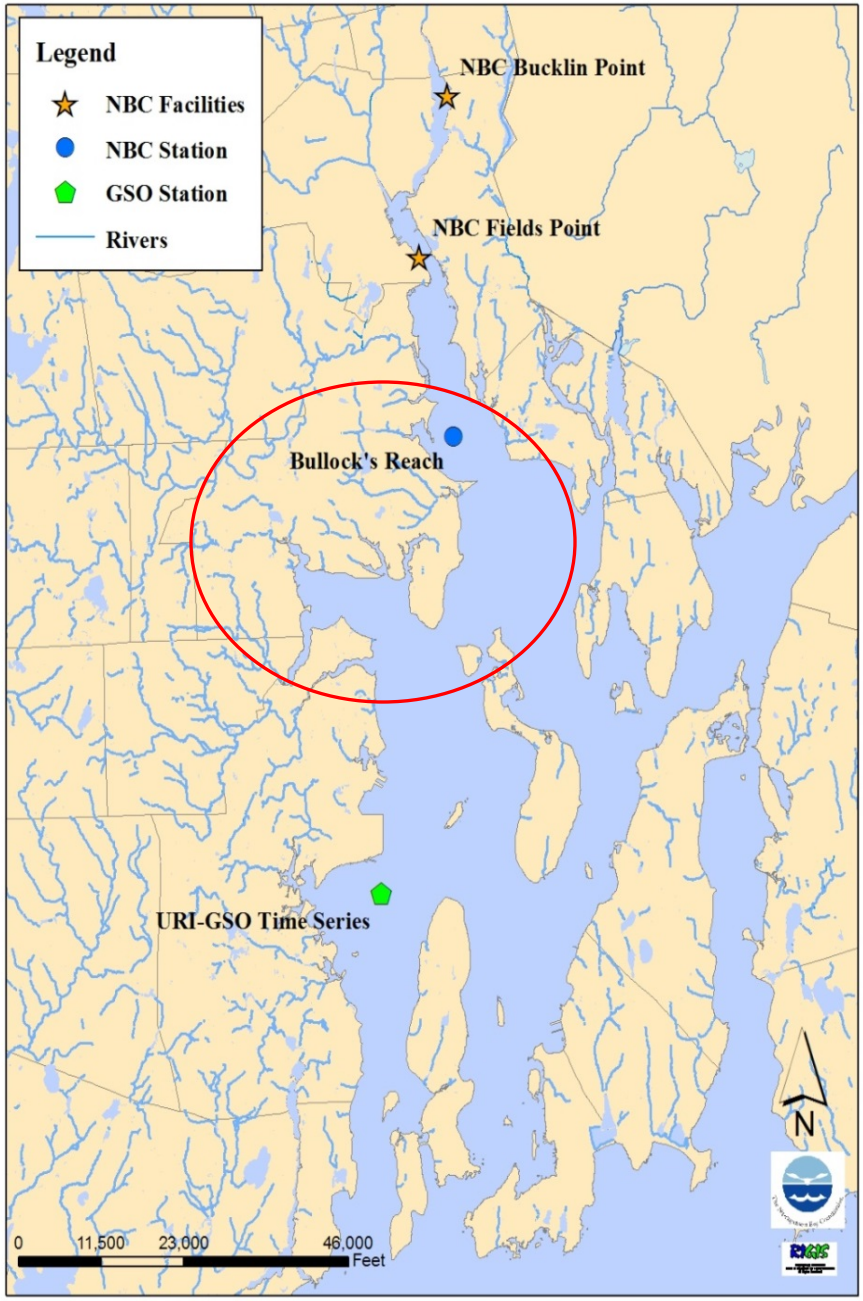


Goals

* Characterize and track the phytoplankton species composition and abundance prior to, during, and after nutrient reductions
* Assess a biological component of water quality
* Provide readily available data to scientific community and researchers

Methods and Equipment

* Direction and guidance from URI-GSO Professor Dr. Tatiana Rynearson
* Procedures replicate the "Monitoring of the Plankton of Narragansett Bay" ongoing time-series project
* Equipment partially funded by the RI Bays, Rivers, and Watershed Coordination Team



Bullock's Reach Buoy

* Bimonthly sampling and analysis
  * Special monitoring of blooms as needed
* Physical and chemical data alongside plankton results
  * Temperature, salinity, chlorophyll
  * Nutrient monitoring
* Fulfill data gap between upper and lower Narragansett Bay

Plankton Monitoring Sampling

Quantitative Analysis

Whole Bucket Sample
Near surface grab
Cells/L

Qualitative Analysis

Tow Net Sample
Near surface 30 min. deployment
Seen but not counted

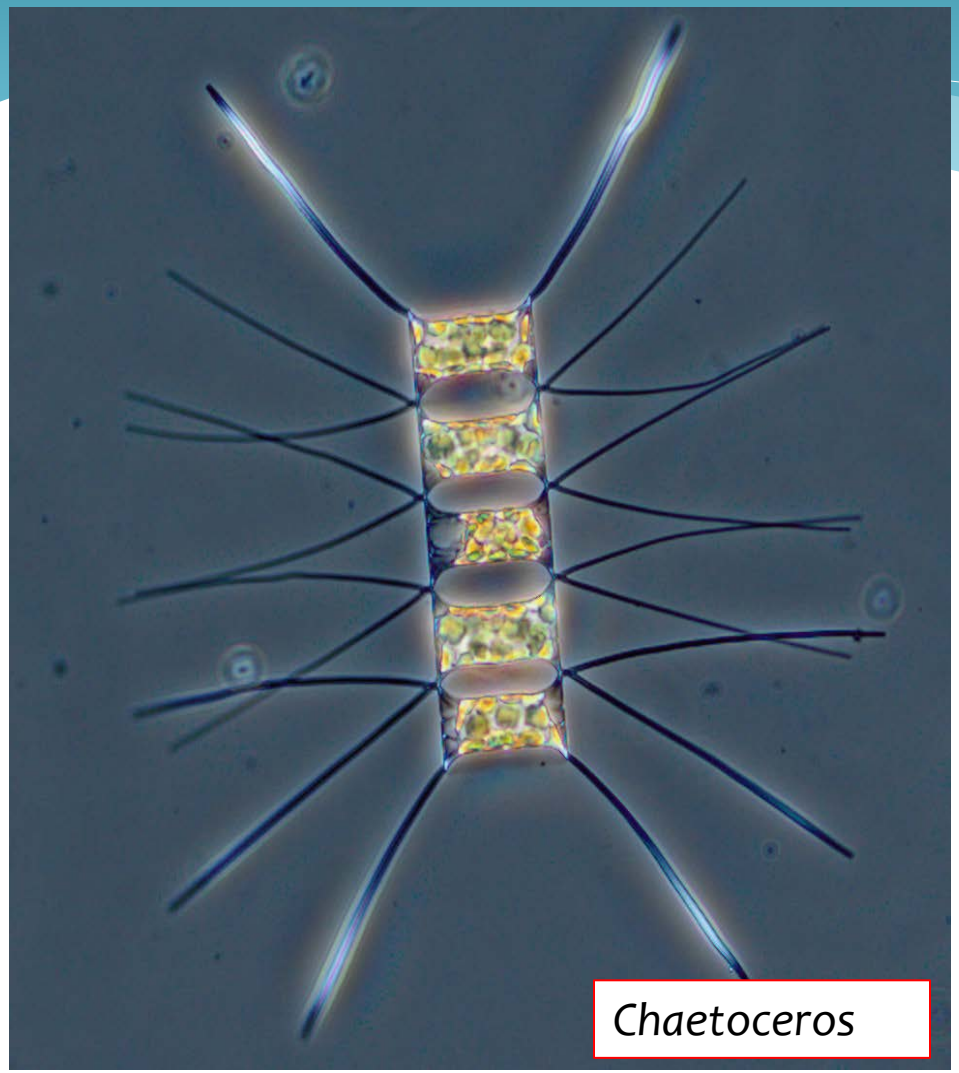
Plankton Monitoring

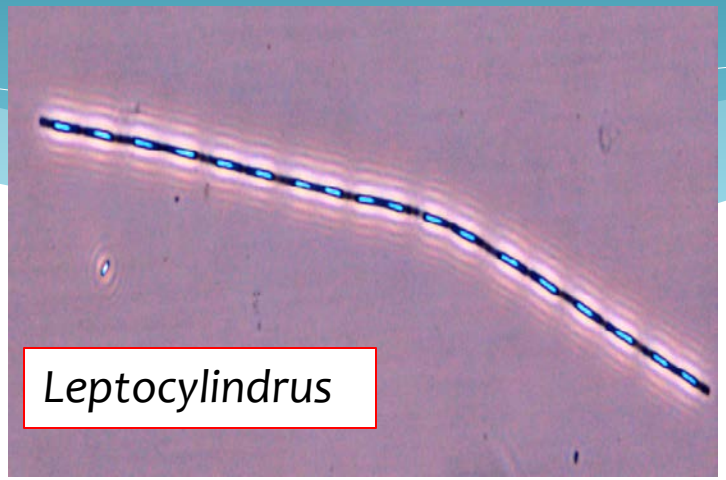
Olympus BX53 Phase Contrast Microscope and DP25 Camera

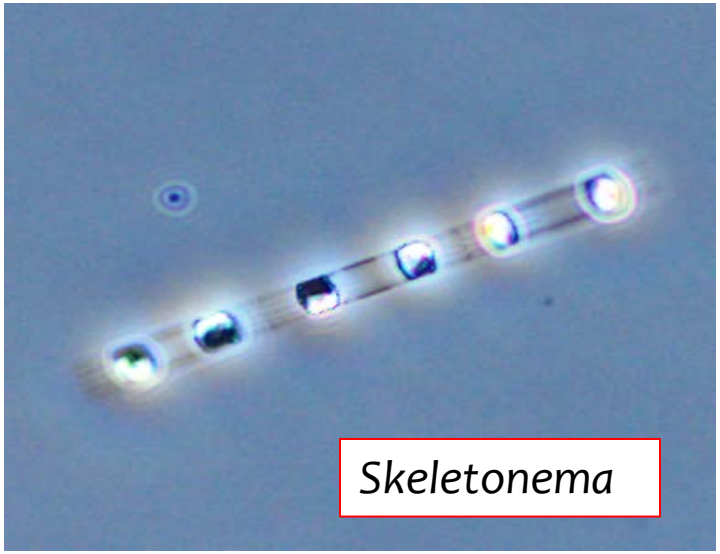
Hensen-Stemple Pipette

Sedgewick- Rafter Counting Chamber

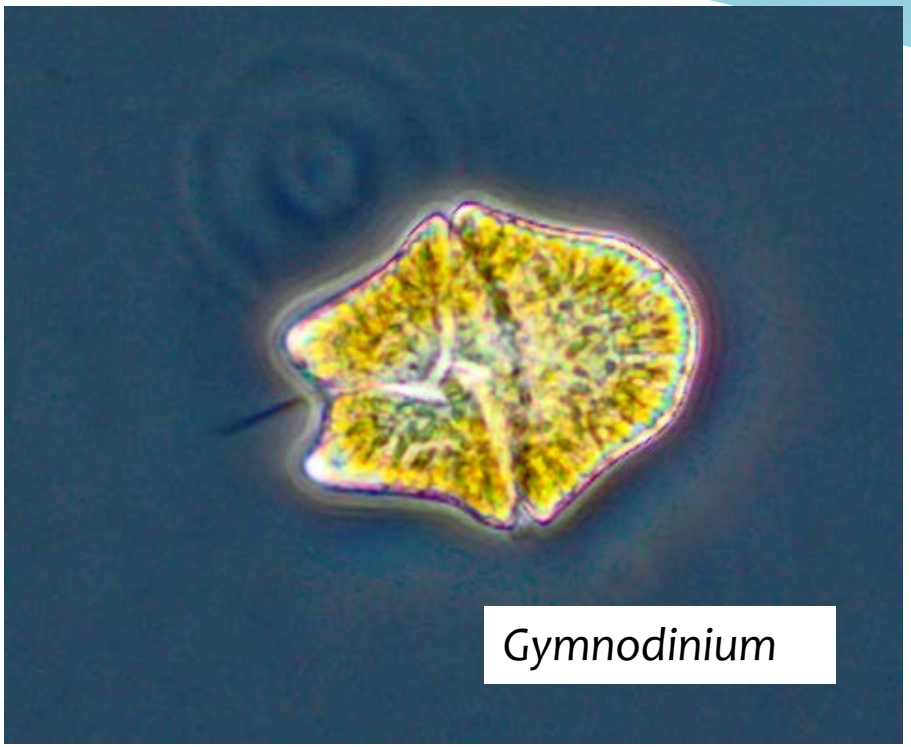
Plankton Monitoring
Common Diatoms

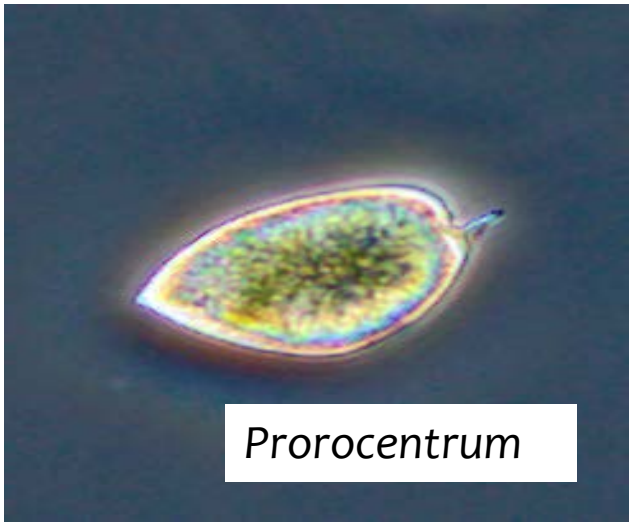






Plankton Monitoring
Common Dinoflagellates

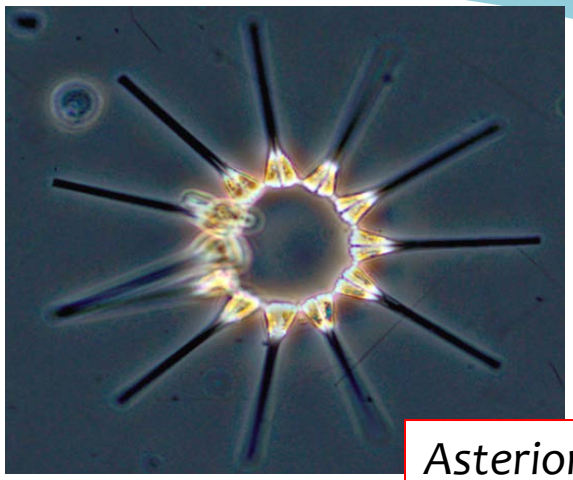




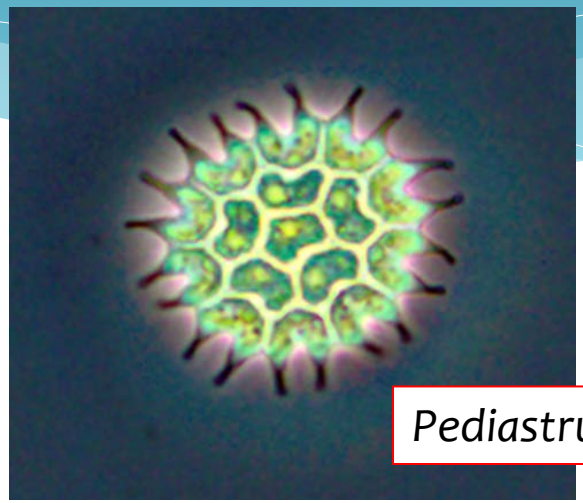
Quantitative Analysis Whole Water Sample

	Cells/mL			cells/L	
DATE	8-Jul-15	8-Jul-15	8-Jul-15	8-Jul-15	8-Jul-15
COUNT TYPE	S/R Surface	S/R Depth	seen not counted	S/R Surface	S/R Depth
LOCATION	Bullocks Reach	Bullocks Reach	Bullocks Reach	Bullocks Reach	Bullocks Reach
Total cells/L	1474	0		1474000	0
Achnanthes spp.				0	0
Actinocyclus sp.				0	0
Actinomonas sp.				0	0
Actinoptychus senarius				0	0
Akashiwo sanguineum				0	0
Alexandrium sp.			x	0	0
Amphidinium cf				0	0
Amphidinium longum				0	0
Apedinella sp.				0	0
Asterionella sp.				0	0
Asterionellopsis glacialis				0	0
Asterionellopsis glacialis cf				0	0
Asterionellopsis spp.				0	0
Baccillaria paxillifer				0	0
Baccillaria sp.				0	0
Bacteriastrum hyalinum				0	0
Bacteriastrum sp.				0	0
Biddulphia sp.				0	0
Centric unknown				0	0
Cerataulina sp.				0	0
Ceratium sp				0	0
Ceratulina dentata				0	0
Chaetoceros	75		x	75000	0
Choanoflagellate				0	0
Chrysochromulina				0	0
Chrysophyte				0	0
Cilliate unknown	2		x	2000	0
Cochlodinium				0	0

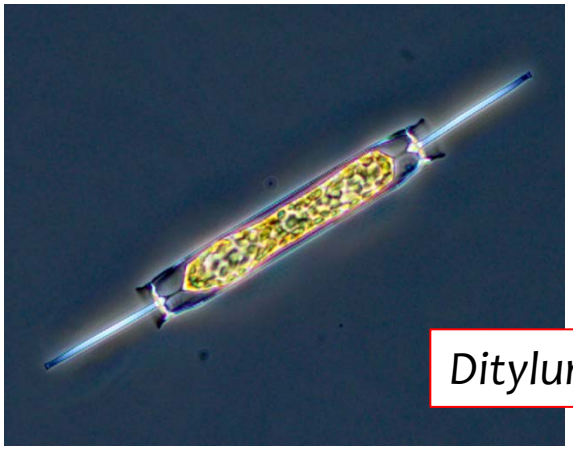
Qualitative Analysis
Tow Net Sample



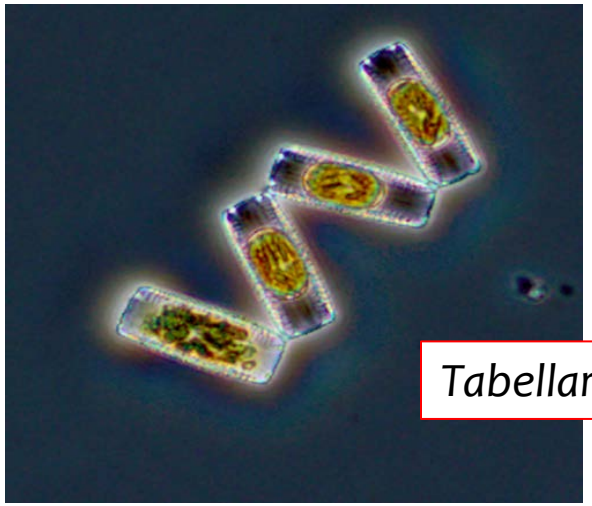
Asterionellopsis



Pediastrum

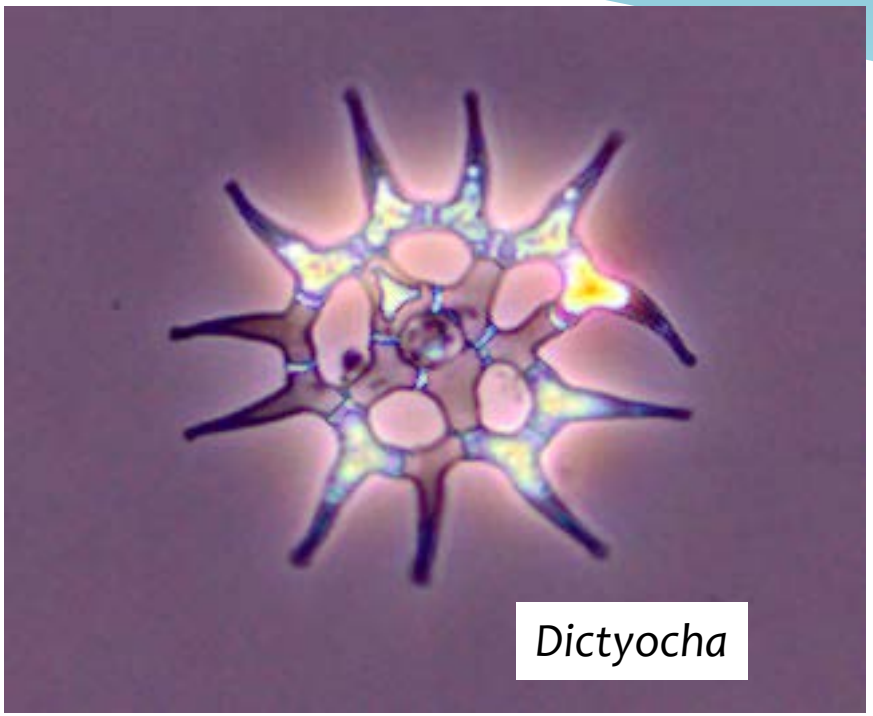


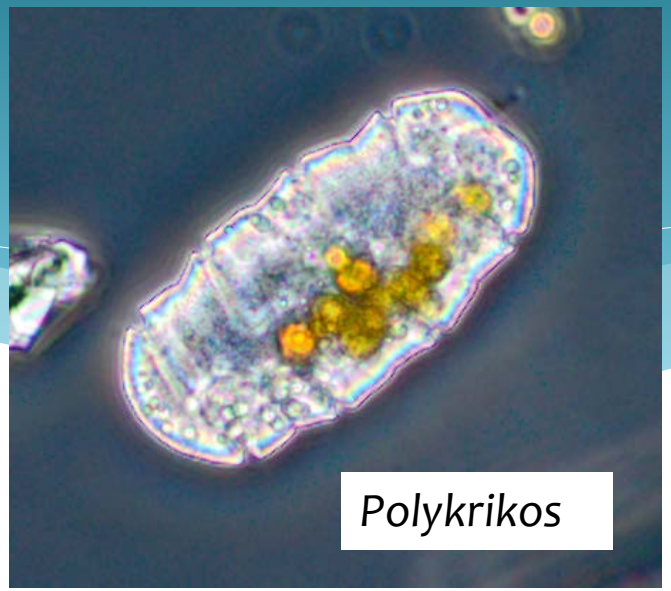
Ditylum

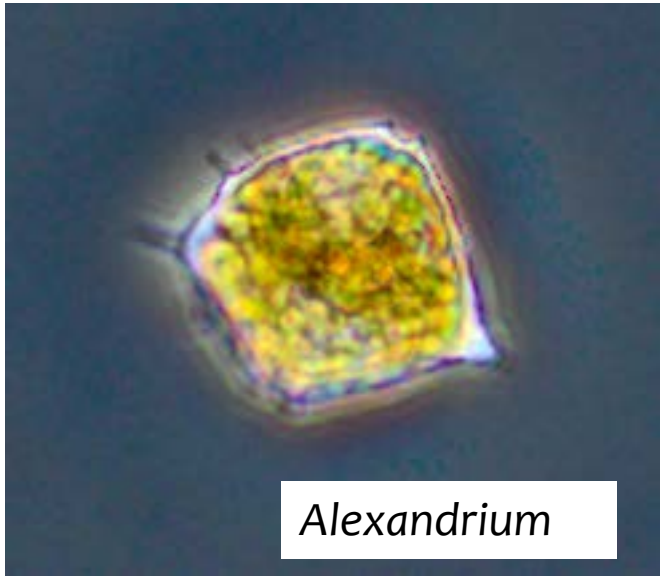


Tabellaria

Tow Net Sample







Qualitative Analysis

Tow Net Sample
(seen but not counted)

	Cells/mL			cells/L	
DATE	8-Jul-15	8-Jul-15	8-Jul-15	8-Jul-15	8-Jul-15
COUNT TYPE	S/R Surface	S/R Depth	seen not counted	S/R Surface	S/R Depth
LOCATION	Bullocks Reach	Bullocks Reach	Bullocks Reach	Bullocks Reach	Bullocks Reach
Total cells/L	1474	0		1474000	0
Achnanthes spp.				0	0
Actinocyclus sp.				0	0
Actinomonas sp.				0	0
Actinoptychus senarius				0	0
Akashiwo sanguineum				0	0
Alexandrium sp.			x	0	0
Amphidinium cf				0	0
Amphidinium longum				0	0
Apedinella sp.				0	0
Asterionella sp.				0	0
Asterionellopsis glacialis				0	0
Asterionellopsis glacialis cf				0	0
Asterionellopsis spp.				0	0
Baccillaria paxillifer				0	0
Baccillaria sp.				0	0
Bacteriastrum hyalinum				0	0
Bacteriastrum sp.				0	0
Biddulphia sp.				0	0
Centric unknown				0	0
Cerataulina sp.				0	0
Ceratium sp				0	0
Ceratulina dentata				0	0
Chaetoceros	75		x	75000	0
Choanoflagellate				0	0
Chrysochromulina				0	0
Chrysophyte				0	0
Cilliate unknown	2		x	2000	0
Cochlodinium				0	0

Snapshot of the Bay Blog

Phytoplankton Sampling

Week of October 26 - November 1, 2014

Phytoplankton samples were collected at Bullock's Reach on October 29, 2014 and analyzed in the laboratory shortly after collection. It was a warm and delightful day on Narragansett Bay. Surface water quality data indicated a temperature of 15.100C and salinity at 28.94 ppt. Sonde data revealed the chlorophyll to be 6.6 ug/L.

The plankton tow net sample was easily filterable with a 20 micron mesh. This concentrate was a light tan color with easy filterability and was analyzed qualitatively for microorganisms. Microscopic examination of the sample under 100x phase contrast microscopy revealed phytoplankton activity.

The whole water sample was analyzed quantitatively under 200x phase contrast microscopy. A Hensen Stempel pipette was used to accurately deliver 1ml of sample to a Sedge-wick Rafter chamber. This analysis revealed a total of 478,000 cells per Liter.

The most predominant phytoplankton genus was the micro flagellates which were found at 268,000 cells/L. Other representative genera include *Leptocylindrus*, *Chaetoceros*, and *Thalassiosira*.

200x phase contrast image of *Eucampia* spp.

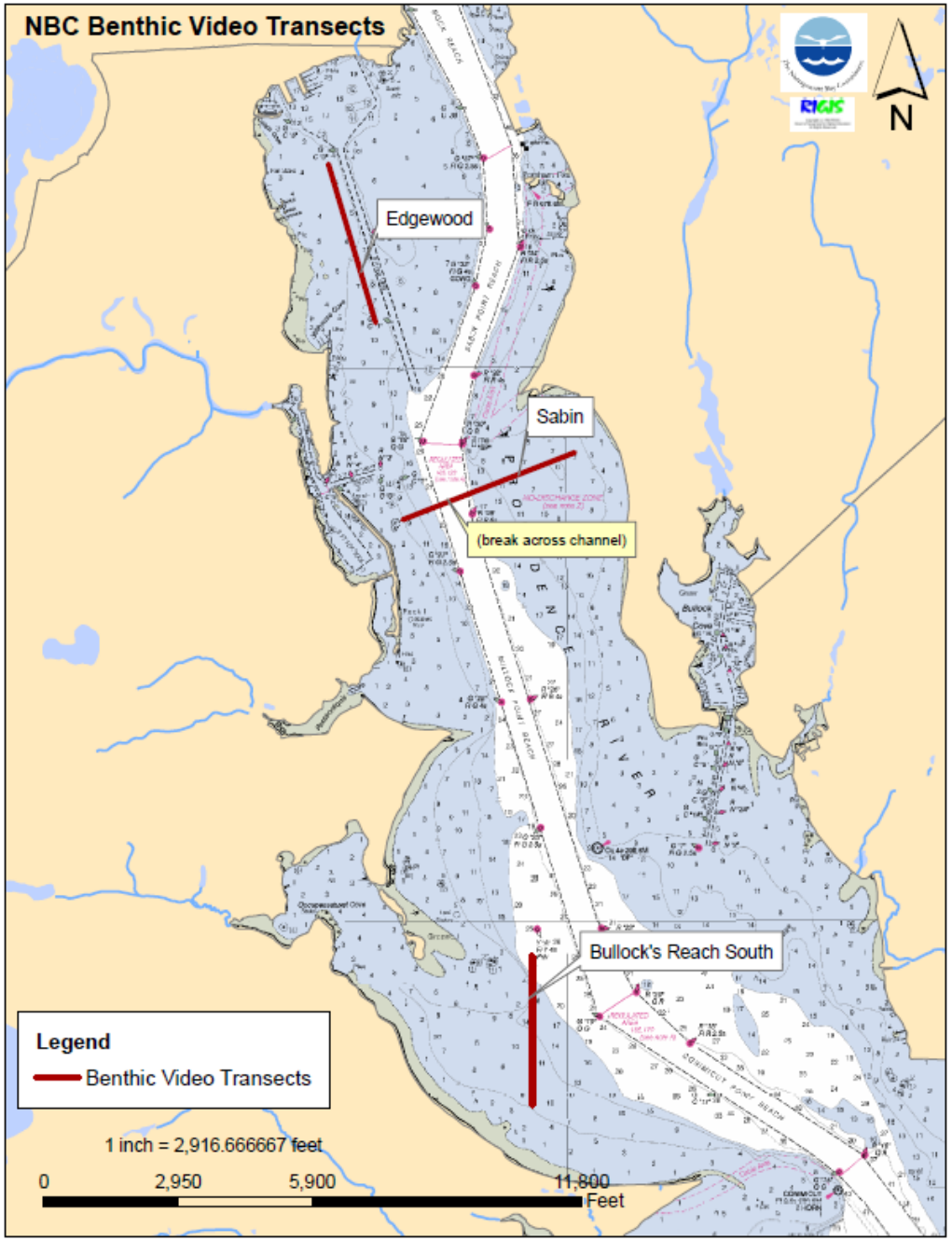
Plankton Monitoring

* **Phytoplankton Data**
  * Does the phytoplankton biomass and community differ from the URI-GSO monitoring station?
  * Are there any shifts in the phytoplankton community as a result of the nutrient reductions?
  * Can analyzing the phytoplankton data show trends which can be related to physical and chemical analyses as well as environmental conditions?

Benthic Video Monitoring

Benthic Vid

- Began in 2011; in earnest in 2014
- Goal – note observable changes to benthos
- Underwater camera towed on custom sled
- Three "permanent" transects, ~1 km length each, ~1 hr footage each
- Attempt to survey monthly



Benthic Video Monitoring

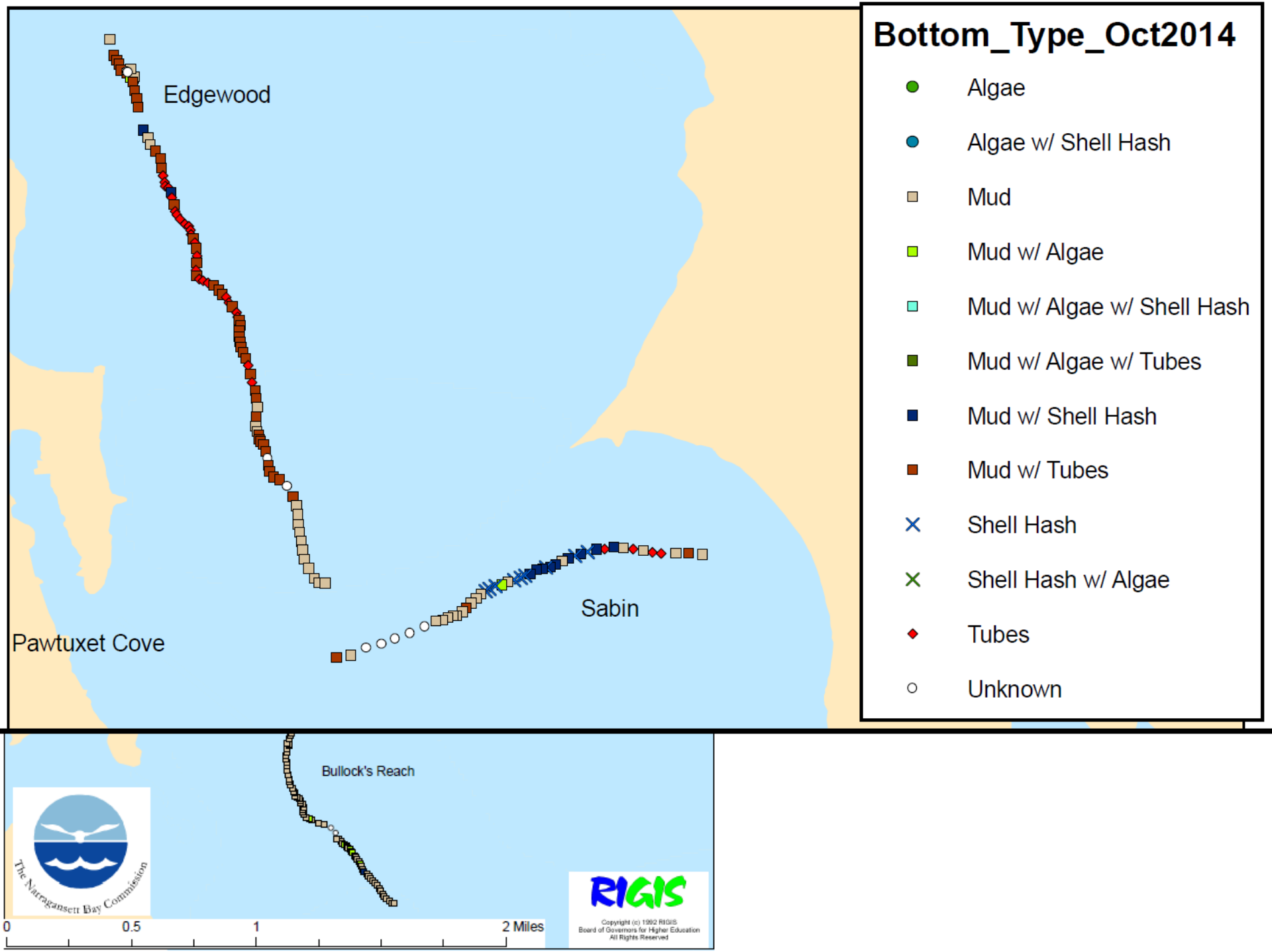
* Video subsampled
* “Qualitative quantification” of observations…
* **Bottom Type**
  * Assessed every minute
  * Percent coverage

* Shell Hash – HIGH (>75%)
* Algae – MODERATE (25-75%)

* "Shell Hash with Algae"

* Shell Hash – MODERATE (25-75%)
* Algae – LOW (<25%)

* "Mud with Shell Hash"


Edgewood
Pawtuxet Cove
Sabin
Bullock's Reach
Bottom_Type_Oct2014
Algae
Algae w/ Shell Hash
Mud
Mud w/ Algae
Mud w/ Algae w/ Shell Hash
Mud w/ Algae w/ Tubes
Mud w/ Shell Hash
Mud w/ Tubes
Shell Hash
Shell Hash w/ Algae
Tubes
Unknown
The Narragansett Bay Commission
0
0.5
1
2 Miles
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Benthic Video Monitoring

* Video subsampled
* “Qualitative quantification” of observations…
* **Bottom Type**
  * Assessed every minute
  * Percent coverage
* **Common Organisms**
  * Assessed every 5 minutes
  * 60-second counts
  * Approximate abundance

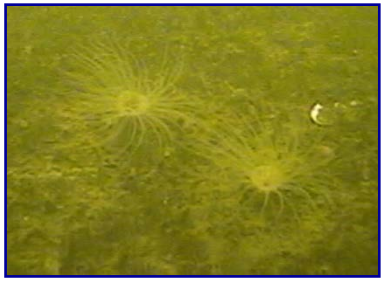
Common Organisms

Seastar – *Asterias forbesii*

Soft-shell Clams – *Mya arenaria*

Mud Snails – *Ilyanassa obsoleta*

Green Crab – *Carcinus maenas*

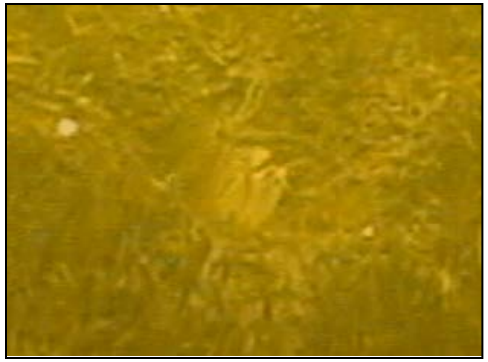


Mud Tube Anemones – *Cerianthus* sp

Benthic Video Monitoring

* Video subsampled
* “Qualitative quantification” of observations…
* **Bottom Type**
  * Assessed every minute
  * Percent coverage
* **Common Organisms**
  * Assessed every 5 minutes
  * 60-second counts
  * Approximate abundance
* **Rare Observations**
  * Entire video reviewed

Rare Observations



Mantis Shrimp –
Squilla empusa

Spider Crab molting assemblage –
Libinia sp

Summer Flounder –
Paralichthys dentatus

Thank you to all the NBC staff that support these initiatives!!

Questions????