Water Quality Results and Discussion

State of the Bays 2016

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Introduction

- Review of water quality data from both DNREC's General Assessment Monitoring Network, and the University of Delaware's Citizen Monitoring Program
- Short term trends were assessed as changes in status since the previous State of the Bays Report (2011)
- Long term trends cover the full data set (>10 years) and were assessed via Mann Kendall test

Determining Status

For Nutrients, Algae, and Water Clarity:

- Data was subset to March through November
- Only years with at least 3 observations were preserved
- Only stations with at least one valid year from 2013 or later were preserved
- Median values were calculated for each year at each station
- Median of the yearly medians between 2011 and 2015 was the station's status

Determining Status

For Dissolved Oxygen:

- Data was subset to June through mid-September between hours of 5 AM – 9 AM
- Status was the percent of samples below 4 mg/L

For Bacteria:

- Data was subset to June through September
- Each site needed at least 5 observations per year
- At least one valid year of data between 2011-2015
- Status was percent of samples exceeding safe swimming single sample limit of 104 cfu/100 mL

Determining Trend

For Nutrients, Algae, Water Clarity, and Dissolved Oxygen:

- Mann Kendall on each station's yearly medians

For Bacteria:

- Mann Kendall on each station's geometric mean bacteria concentration each year

For all parameters:

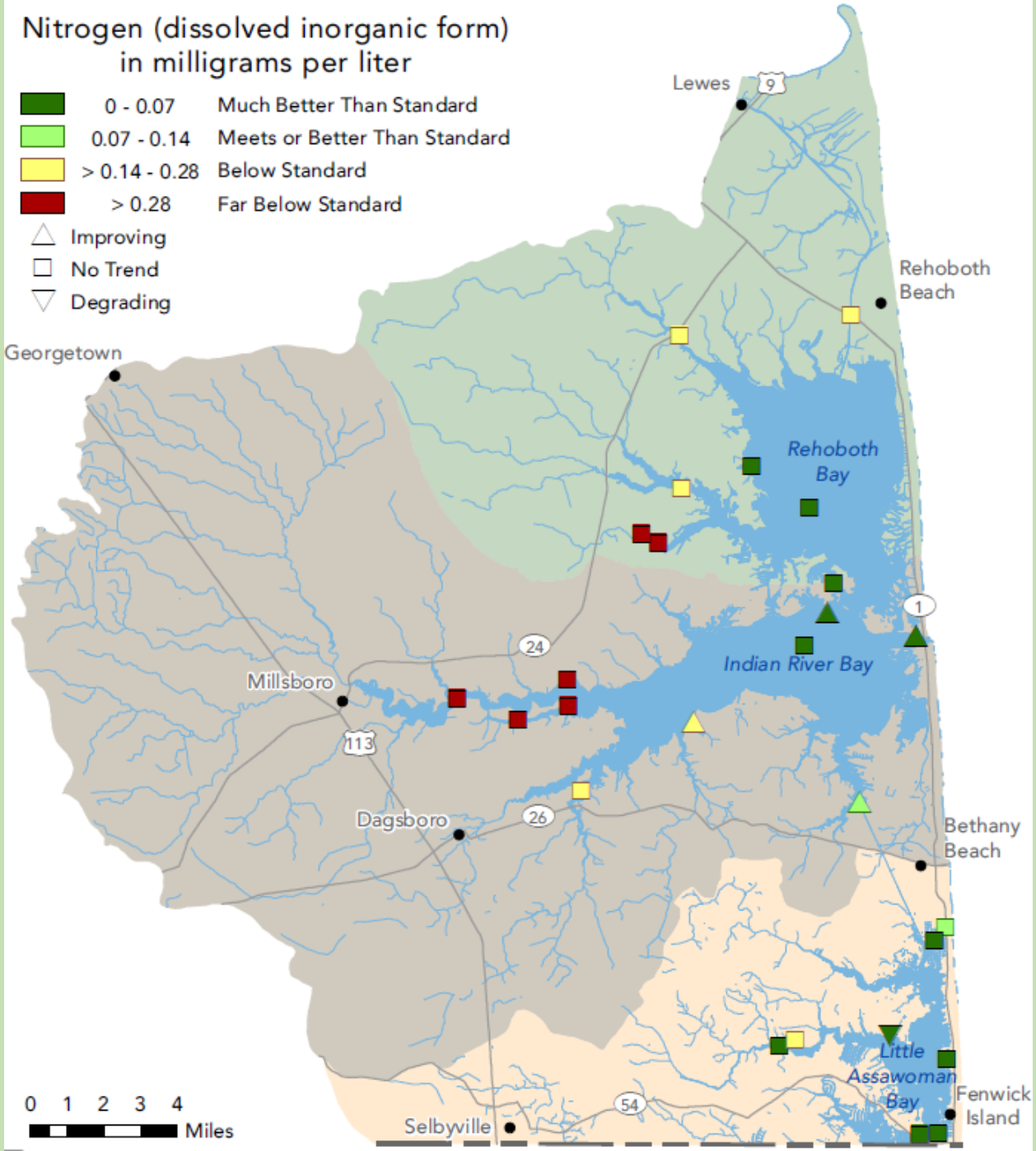
- Only stations with at least 10 years of valid data were assessed

Water Quality Standards

- Standards based on eelgrass growing conditions

Indicator	Criteria for Indicator Status			
	Far Below Standard	Below Standard	Meets Standard	Much Better than Standard
Dissolved Inorganic Nitrogen (mg/L)	>0.28	>0.14 to 0.28	0.07 to 0.14	<0.07
Dissolved Inorganic Phosphorus (mg/L)	>0.020	>0.010 to 0.020	>0.005 to 0.010	<0.005
Chlorophyll a (µg/L)	>30 to 100	>15 to 30	>7 to 15	<7
Secchi Depth (feet)	<1.3	1.3 to <2.2	2.2 to <3.3	>3.3

- Batiuk, R.A., P. Bergstrom, M.J. Kemp, E. Koch, L. Murray, J.C. Stevenson, R. Bartleson, V. Carter, N.R. Rybicki, J.M. Landwehr, C. Gallegos, L. Karrh, M. Naylor, D. Wilcox, K.A. Moore, S. Ailstock, and M. Teichberg. 2000. Chesapeake Bay submerged aquatic vegetation water quality and habitat-based requirements and restoration targets: A second technical synthesis. Chesapeake Bay Program.
- U.S. Environmental Protection Agency Region III Chesapeake Bay Program and Office and Water Protection Division. 2003. Ambient water quality criteria for dissolved oxygen, water clarity, and chlorophyll *a* for the Chesapeake Bay and its tidal tributaries. EPA 903-R-03-002, Annapolis, MD.
- Valdes-Murtha, L. M. 1997. Analysis of critical habitat requirements for restoration and growth of submerged vascular plants in the Delaware and Maryland Coastal Bays. MS Thesis. University of Delaware, Lewes, DE.



DIN

STATUS:

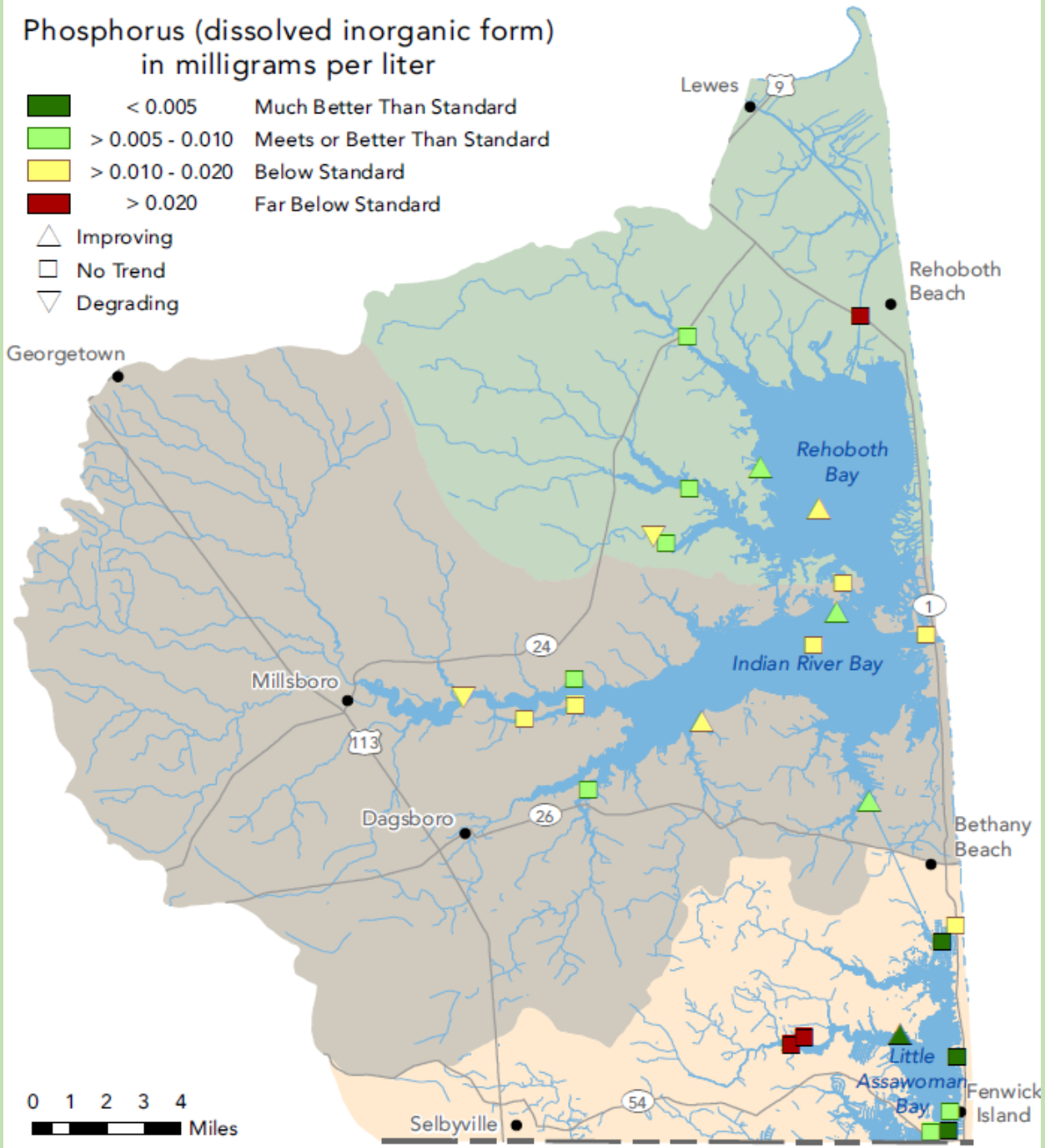
- 52% of stations meet standard

CHANGES SINCE 2011 SoB:

- In 2011 35% of sites met standard
- Currently 50% of those same sites now meet standard

LONG TERM TRENDS:

- Four significantly improving stations near inlet
- One degrading station at Dirickson Creek



DIP

STATUS:

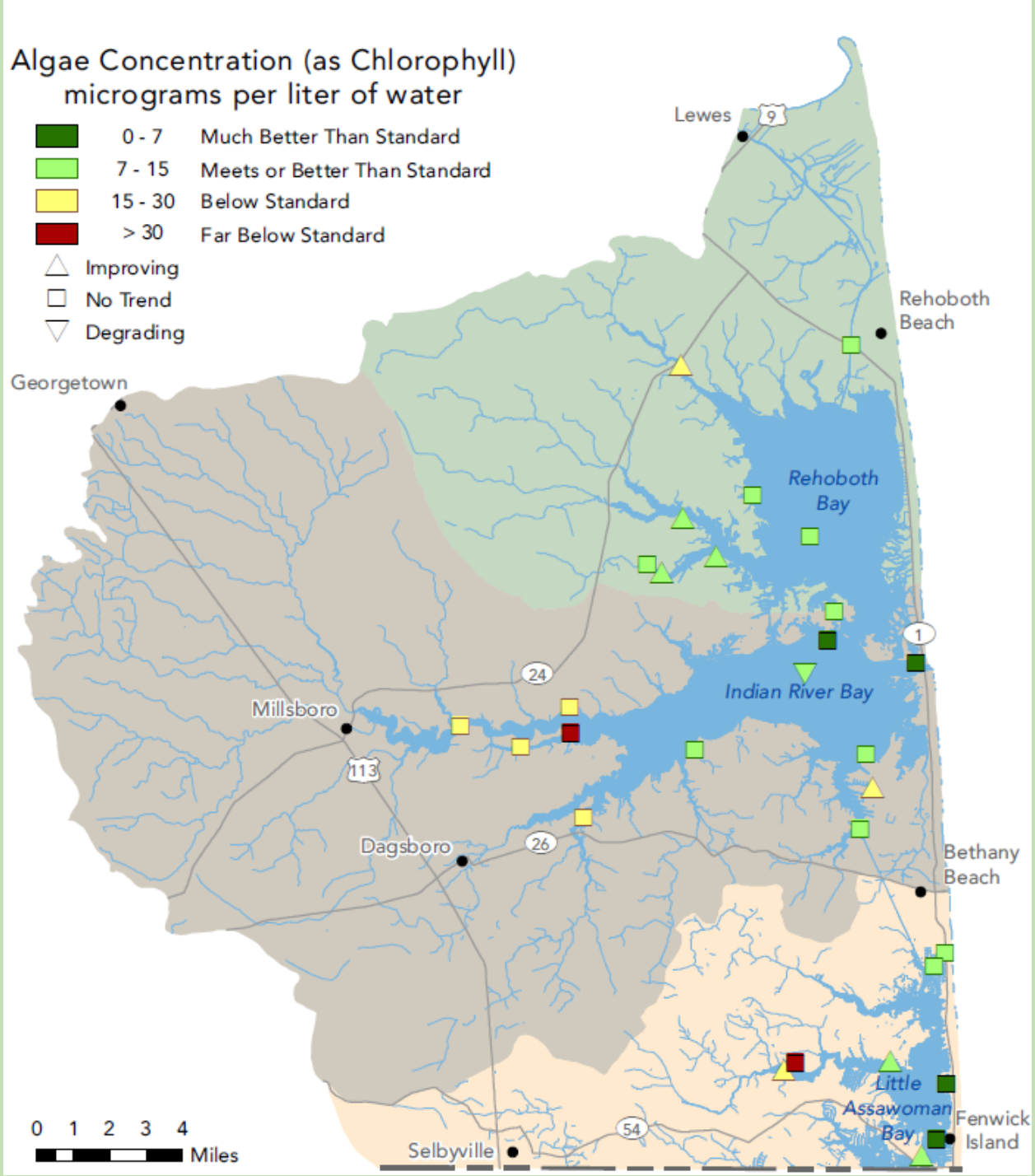
- 46% of stations meet standard

CHANGES SINCE 2011 SoB:

- In 2011 33% of sites met standard
- Currently 48% of those same sites now meet standard

LONG TERM TRENDS:

- Six significantly improving stations
- Two degrading stations



CHLOROPHYLL A

STATUS:

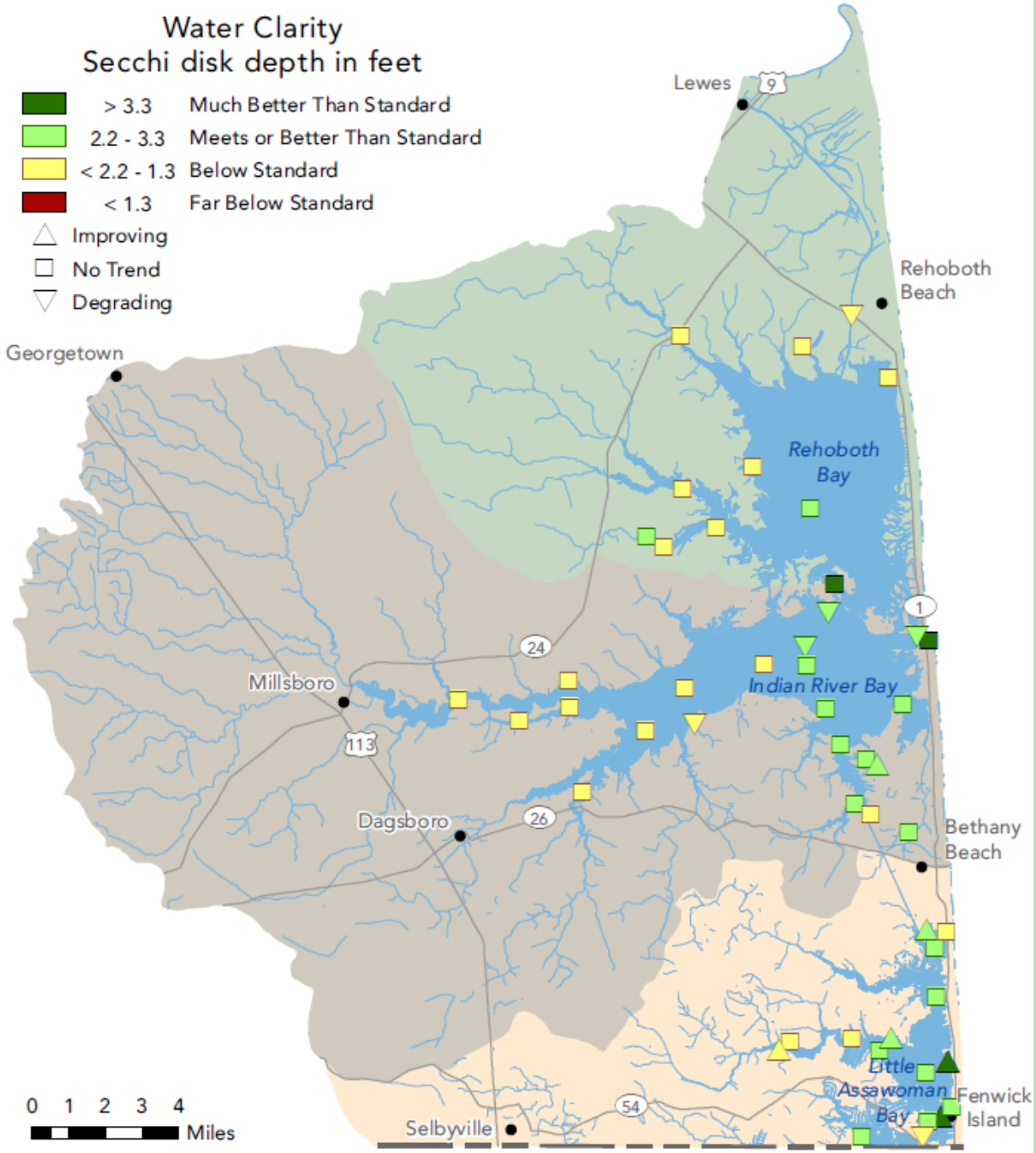
- 73% of stations meet standard

CHANGES SINCE 2011 SoB:

- In 2011 53% of sites met standard
- Currently 72% of those same sites now meet standard

LONG TERM TRENDS:

- Eight significantly improving stations spread throughout watershed
- One degrading station



WATER CLARITY

STATUS:

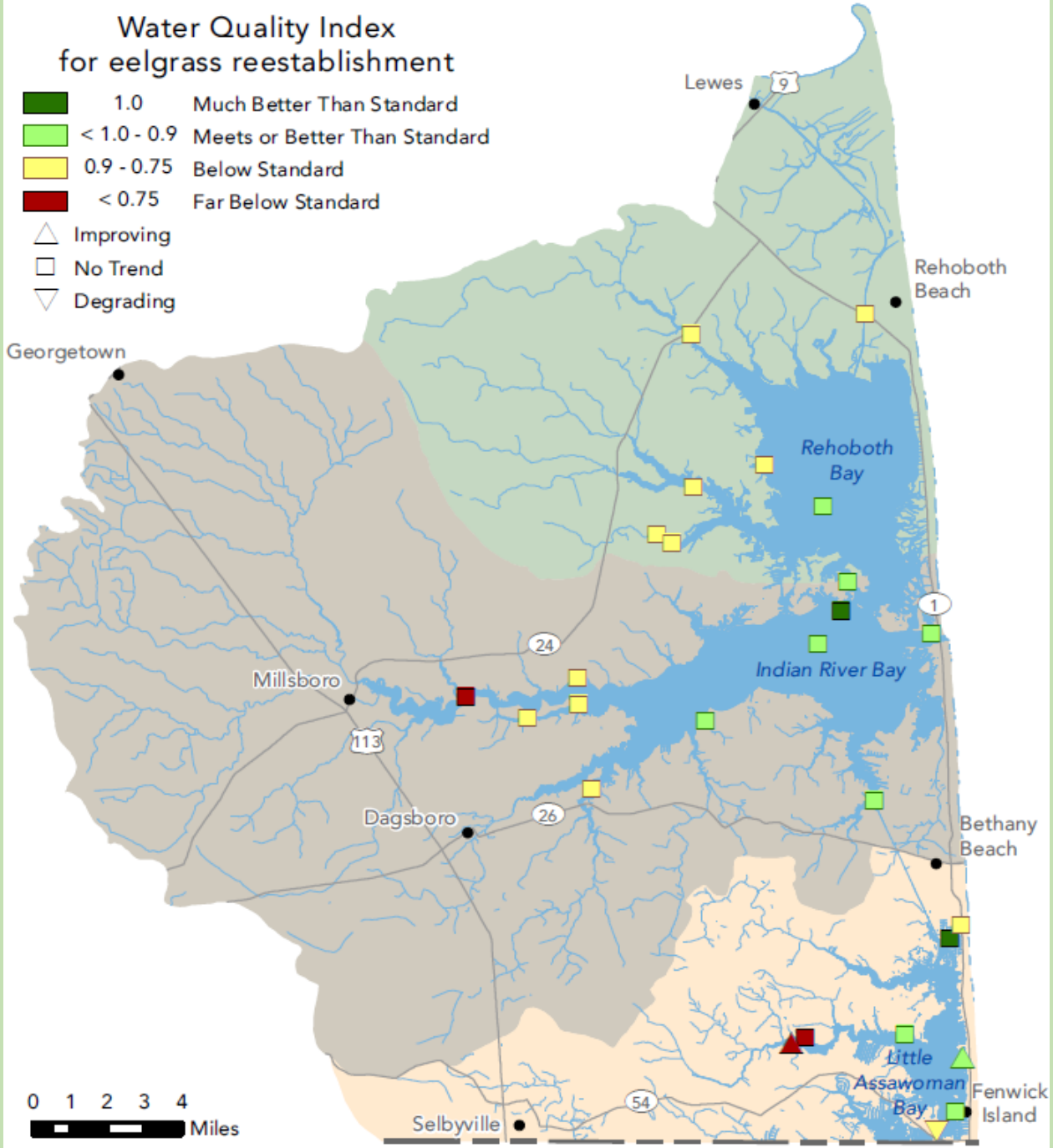
- 55% of stations meet standard

CHANGES SINCE 2011 SoB:

- In 2011 48% of sites met standard
- Currently 52% of those same sites now meet standard

LONG TERM TRENDS:

- Six significantly improving stations, five of which are in Little Assawoman Bay
- Six degrading stations including 3 in open water near inlet



WQI

STATUS:

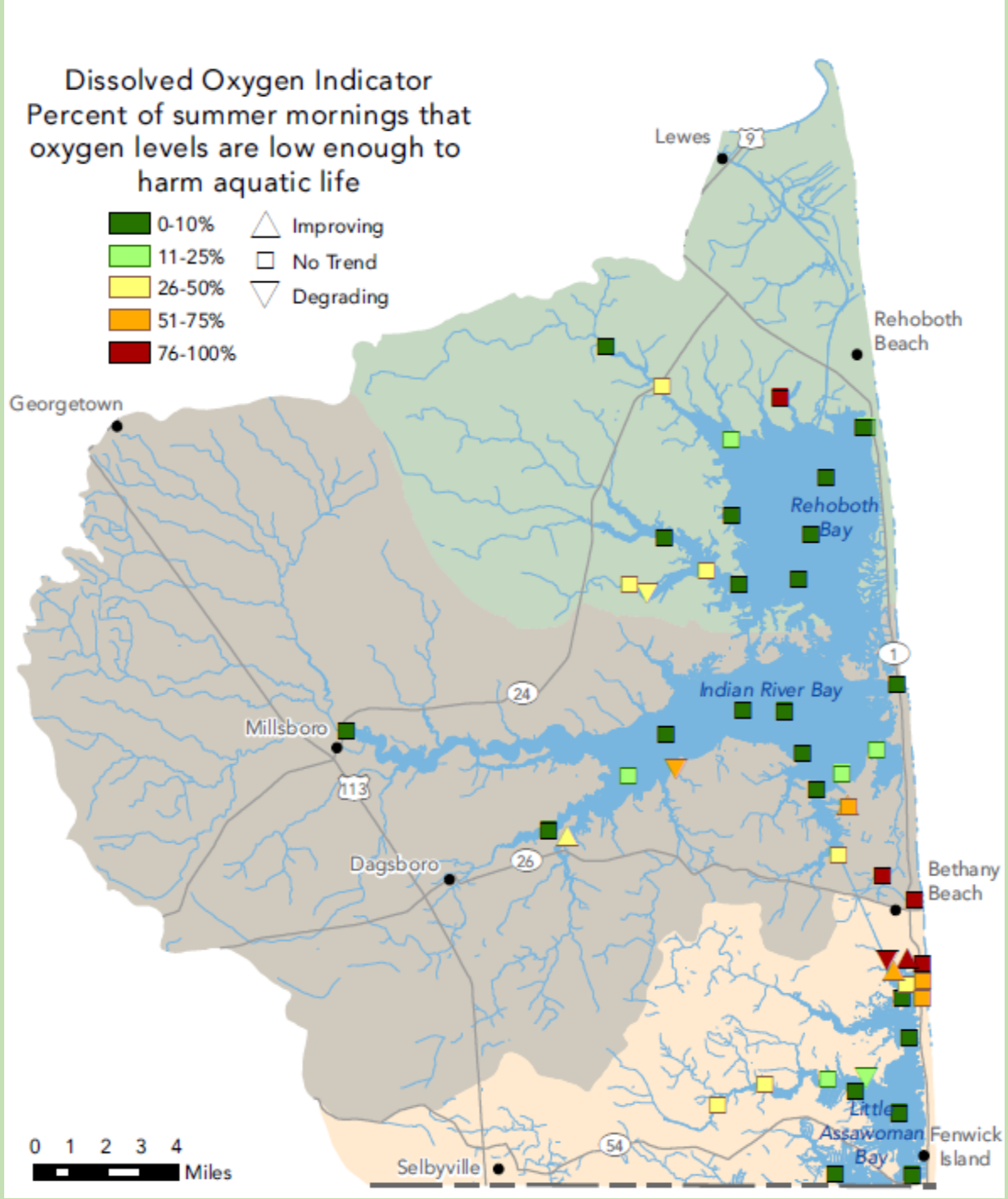
- 41% of stations meet standard

CHANGES SINCE 2011 SoB:

- One fewer site now meets standards than in 2011

LONG TERM TRENDS:

- Two significantly improving stations both in Little Assawoman Bay
- One degrading station also in Little Assawoman Bay



DISSOLVED OXYGEN

STATUS:

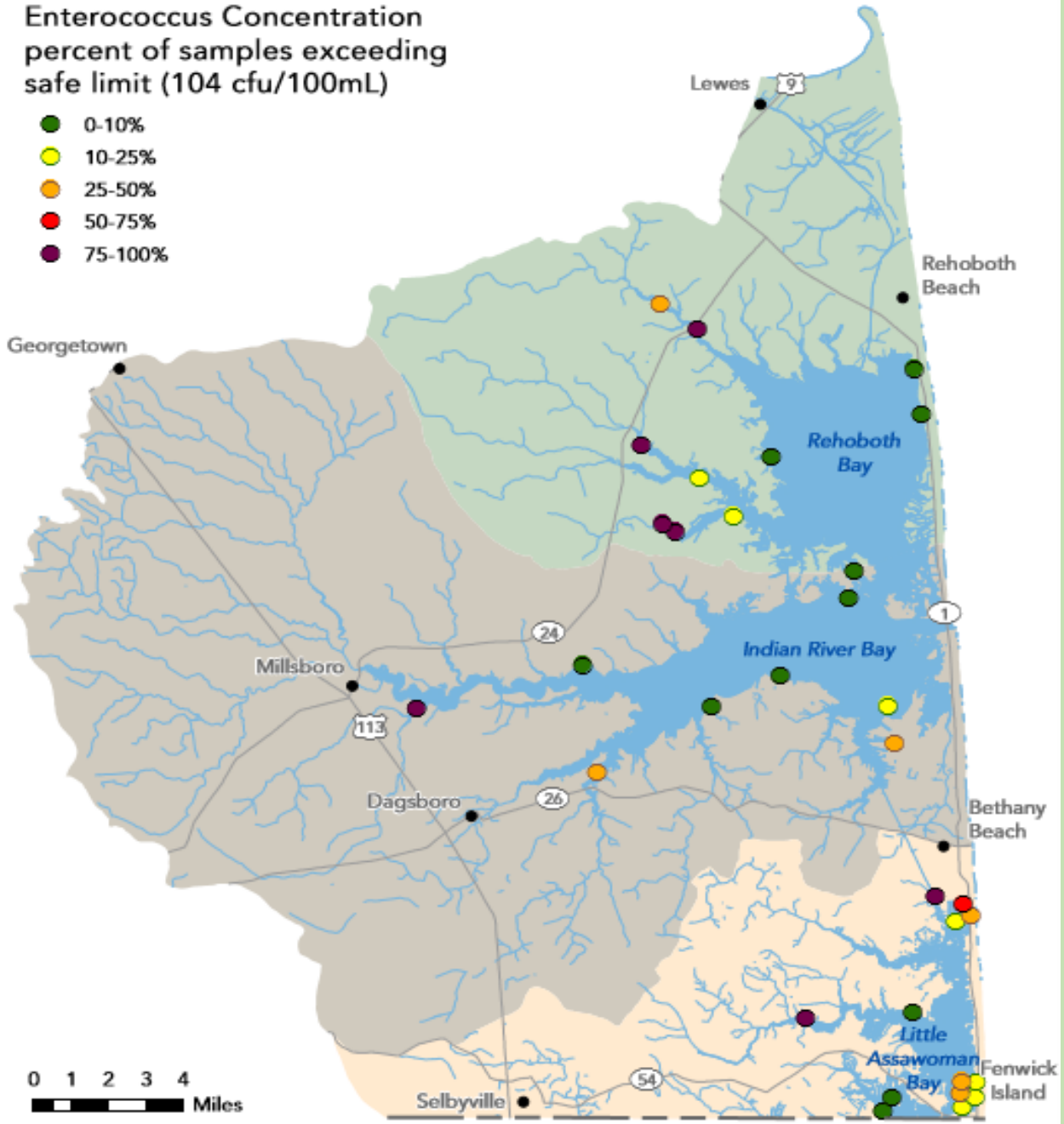
- 44% of stations meet standard

CHANGES SINCE 2011 SoB:

- Three fewer sites now meet standard compared to 2011

LONG TERM TRENDS:

- Trends are highly localized, with neighboring stations showing opposite patterns



ENTEROCOCCUS BACTERIA

STATUS:

- 34% of stations meet standard

CHANGES SINCE 2011 SoB:

- Fecal bacteria concentrations have remained mostly the same
- Tributaries largely exceed threshold
- Open water largely meets threshold

LONG TERM TRENDS:

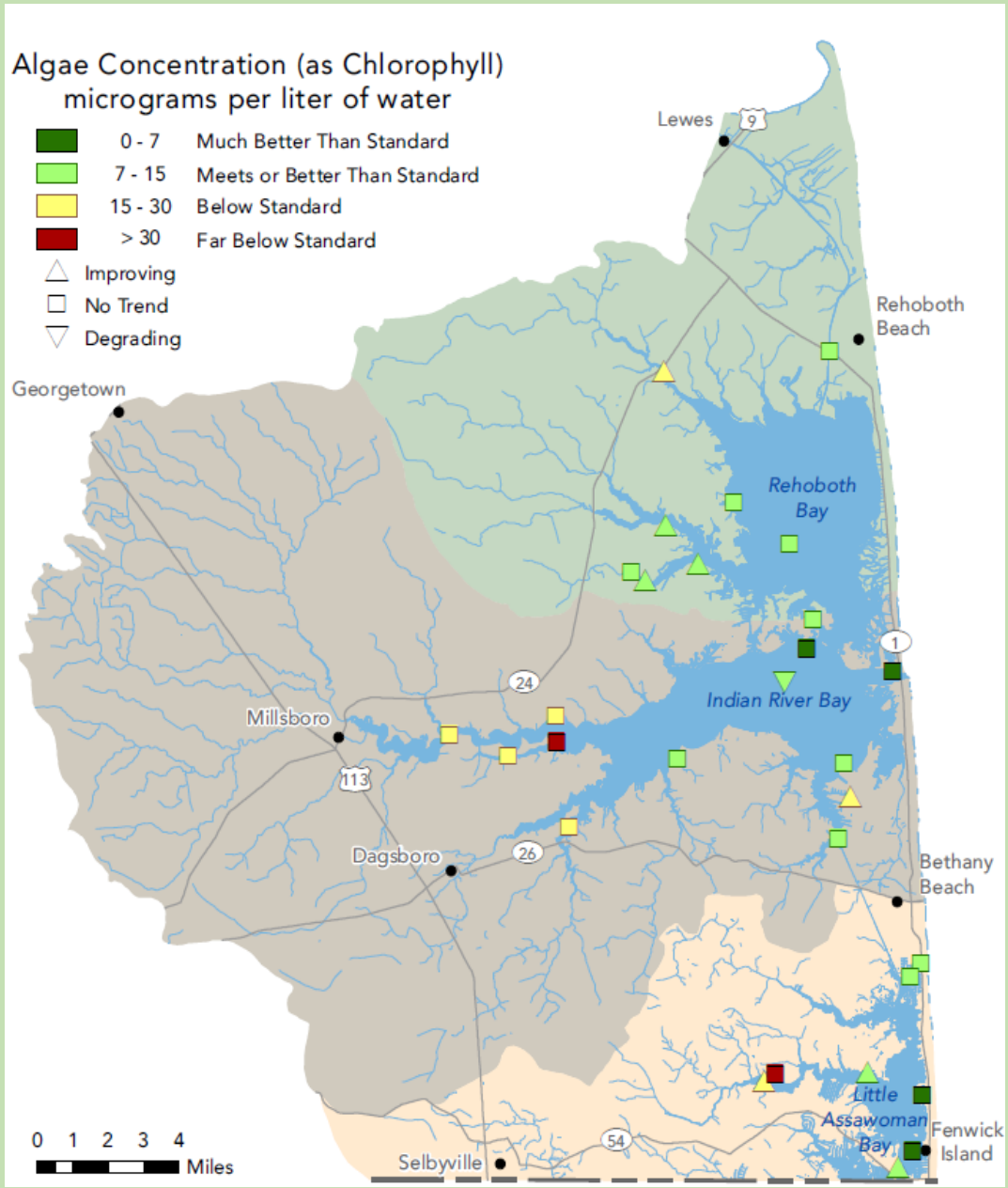
- 1 significantly increasing site located at the mouth of Love Creek

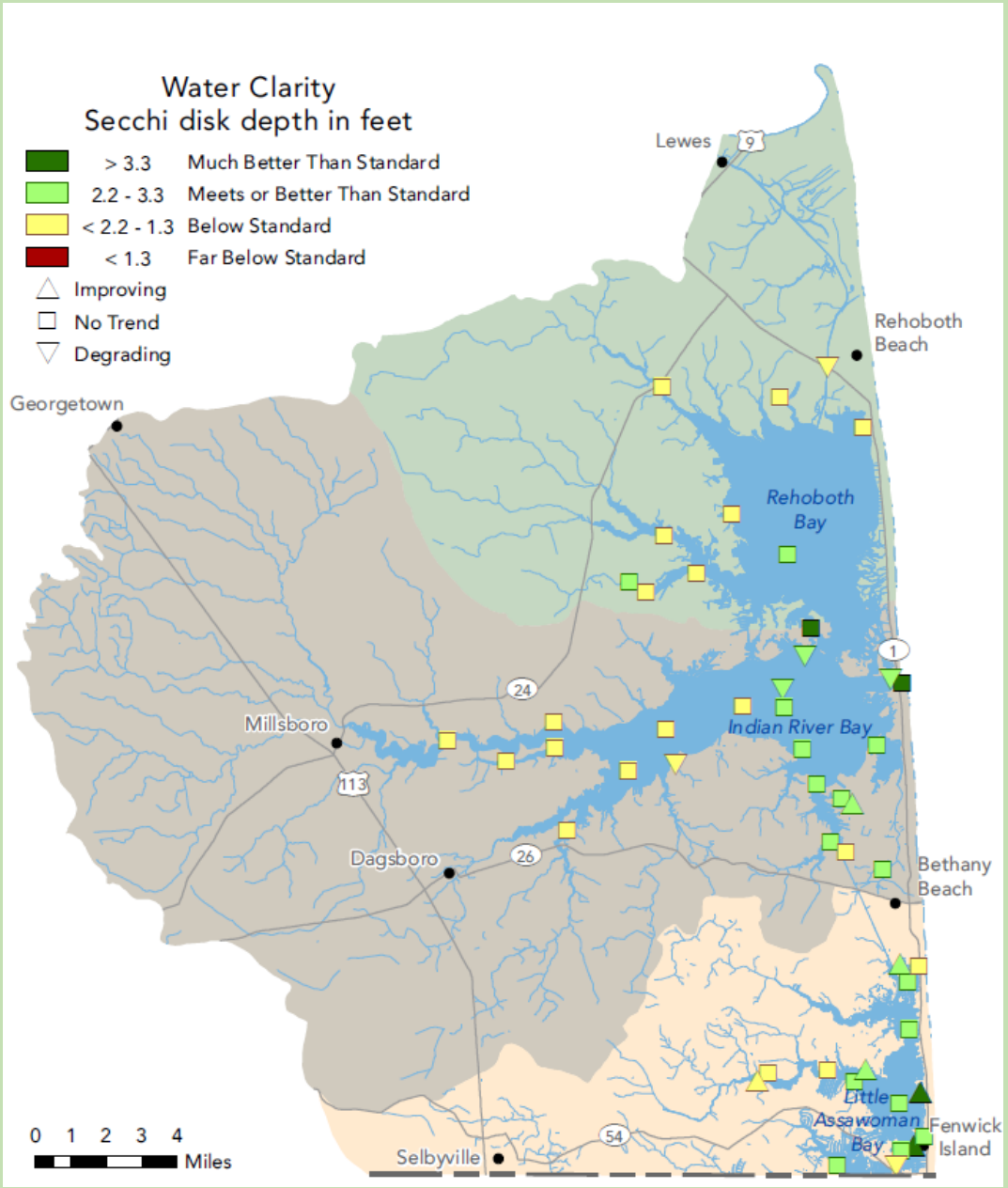
Conclusions

- Nutrient concentrations have improved both over the short term (since last report) and over long term with a number of sites showing significant improvements
- Algae has shown decline both short term and long term
- Clarity has seen no discernable improvement
- WQI remains poor
- Dissolved Oxygen has seen no discernable improvement and remains very variable
- Bacteria levels are still high in tributaries and canals

Discussion Questions

Why have Clarity levels remained the same while large improvements in Algae have been seen?

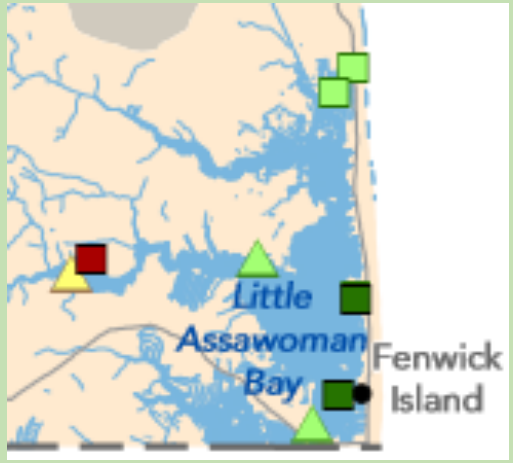




Why is Little Assawoman Bay changing the most?

- Conversion from agriculture to developed?
- Greater water to land area ratio?
- Better nutrient management?

Chlorophyll a



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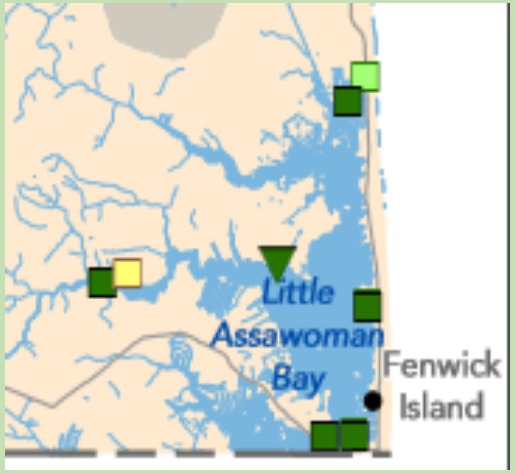

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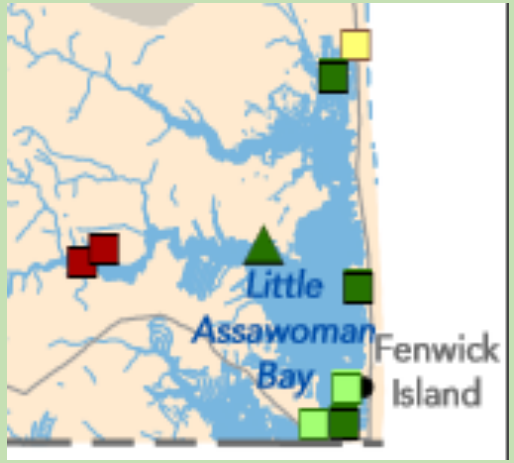
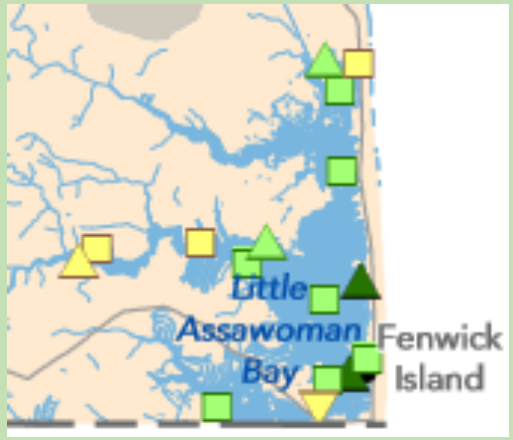
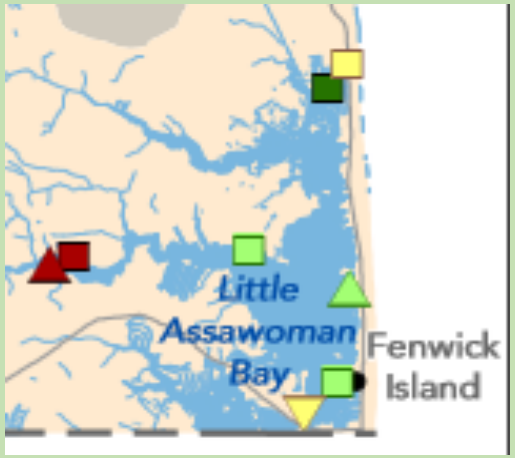


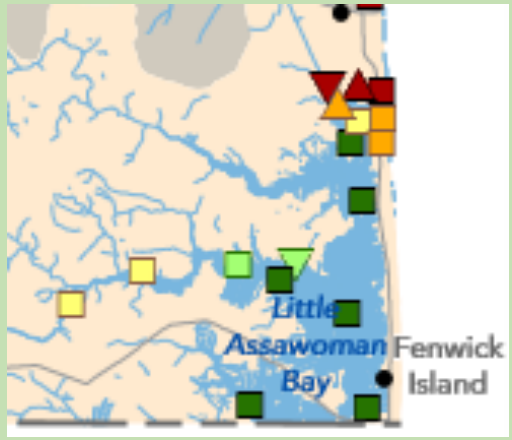
Water Clarity



WQI



Dissolved Oxygen



Data recommendations to better explain changes in water quality

- How can we get better and more readily accessible, geospatial information about BMP's, septic conversion, storm water retrofits, cover crops, and manure relocation?
  - GIS portal?
  - Watershed level if parcel level is unavailable

- A need for an additional inlet flushing data point to help explain changes seen immediately surrounding the inlet

Acknowledgements

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