Nutrient Criteria

Water Quality Standards Academy

March 12-14, 2012

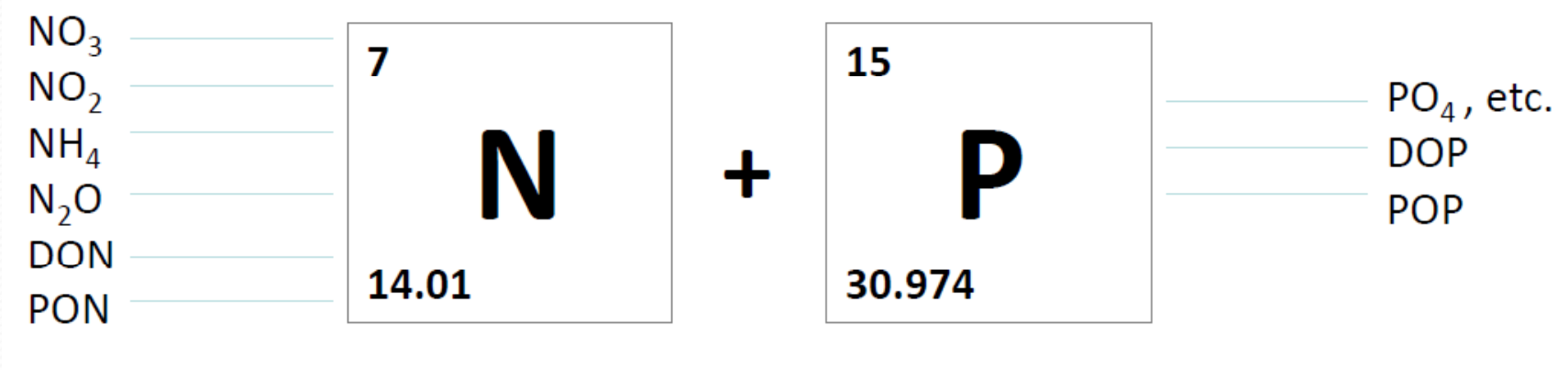
Anchorage

Water Quality Criteria for Nutrients

- Objectives:
  - Why nutrients are important – and different from toxics
  - Environmental Protection Agency nutrient criteria development
  - Alaska Department of Environmental Conservation (DEC) current water quality standards (WQS) for nutrients and plan for criteria development
  - Example of how nutrient criteria has been developed in Florida

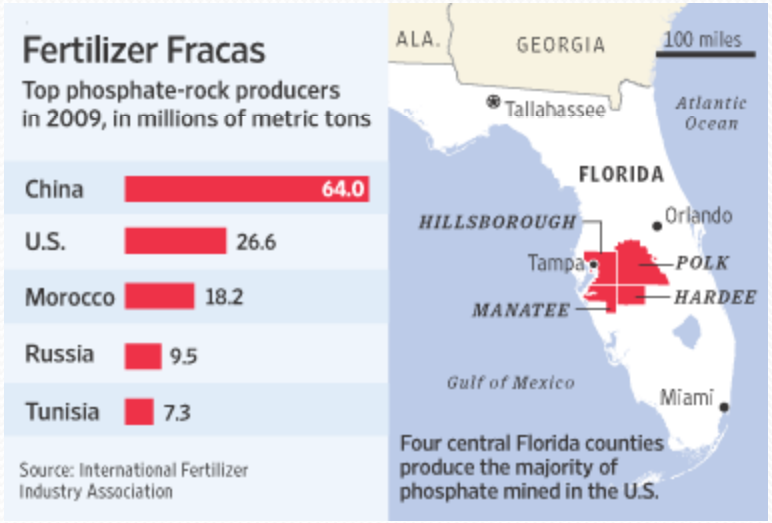
What are nutrients?

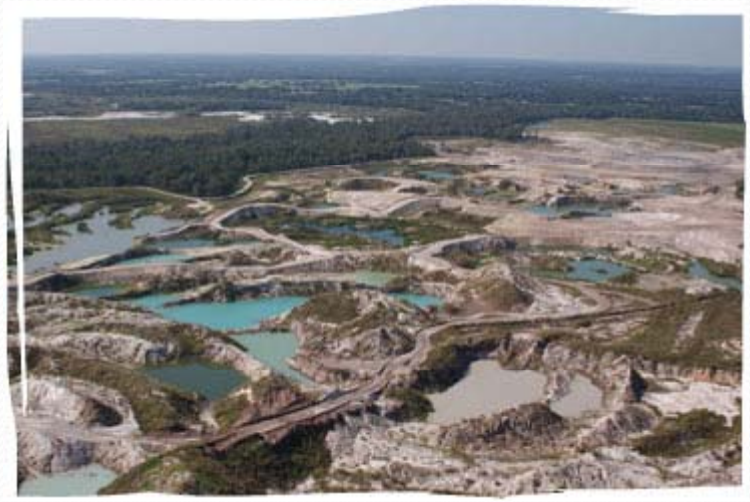
- Nutrients = nitrogen and phosphorus
- Total nitrogen (TN) = dissolved (inorganic + organic), particulate
- Total phosphorus (TP) = dissolved (inorganic + organic), particulate



Anthropogenic sources of nutrients

- Precipitation
- Minerals
- Fertilizer
- Sewage effluent

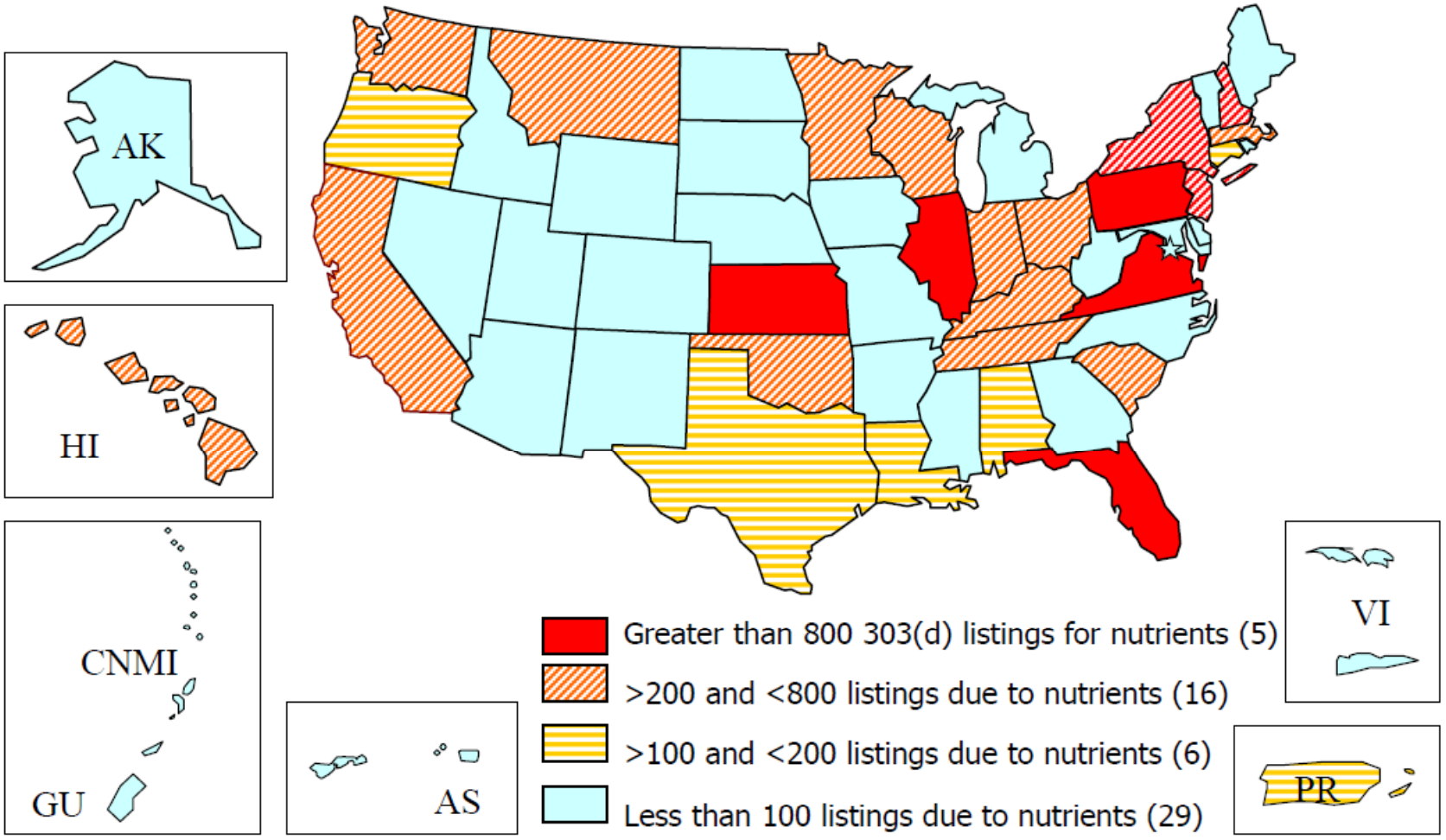




Major influences on nutrient concentrations in water

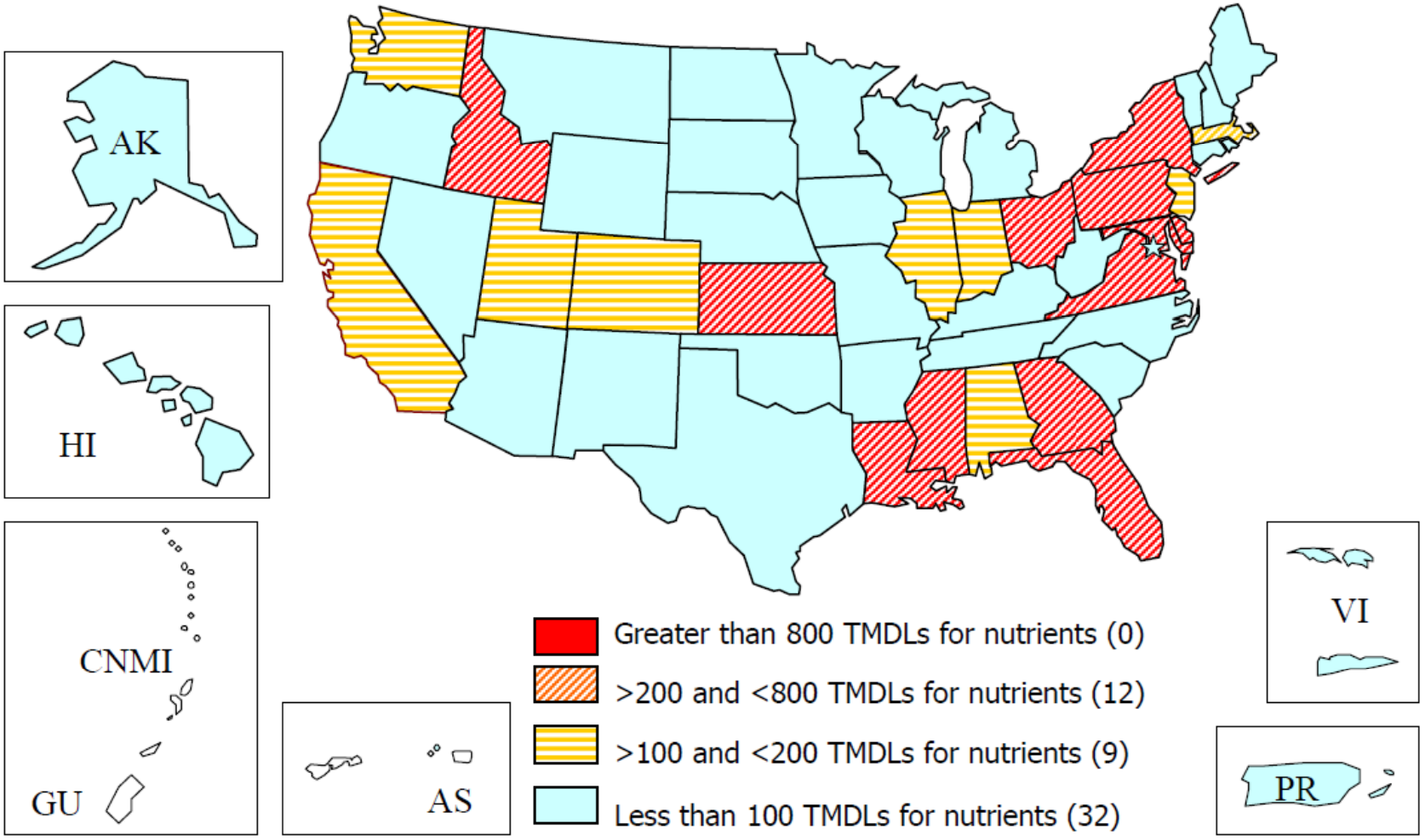
- Land use
- Soil drainage
- Geology
- Depth to ground water

303(d) Listed Water Quality "nutrient-related" impairments



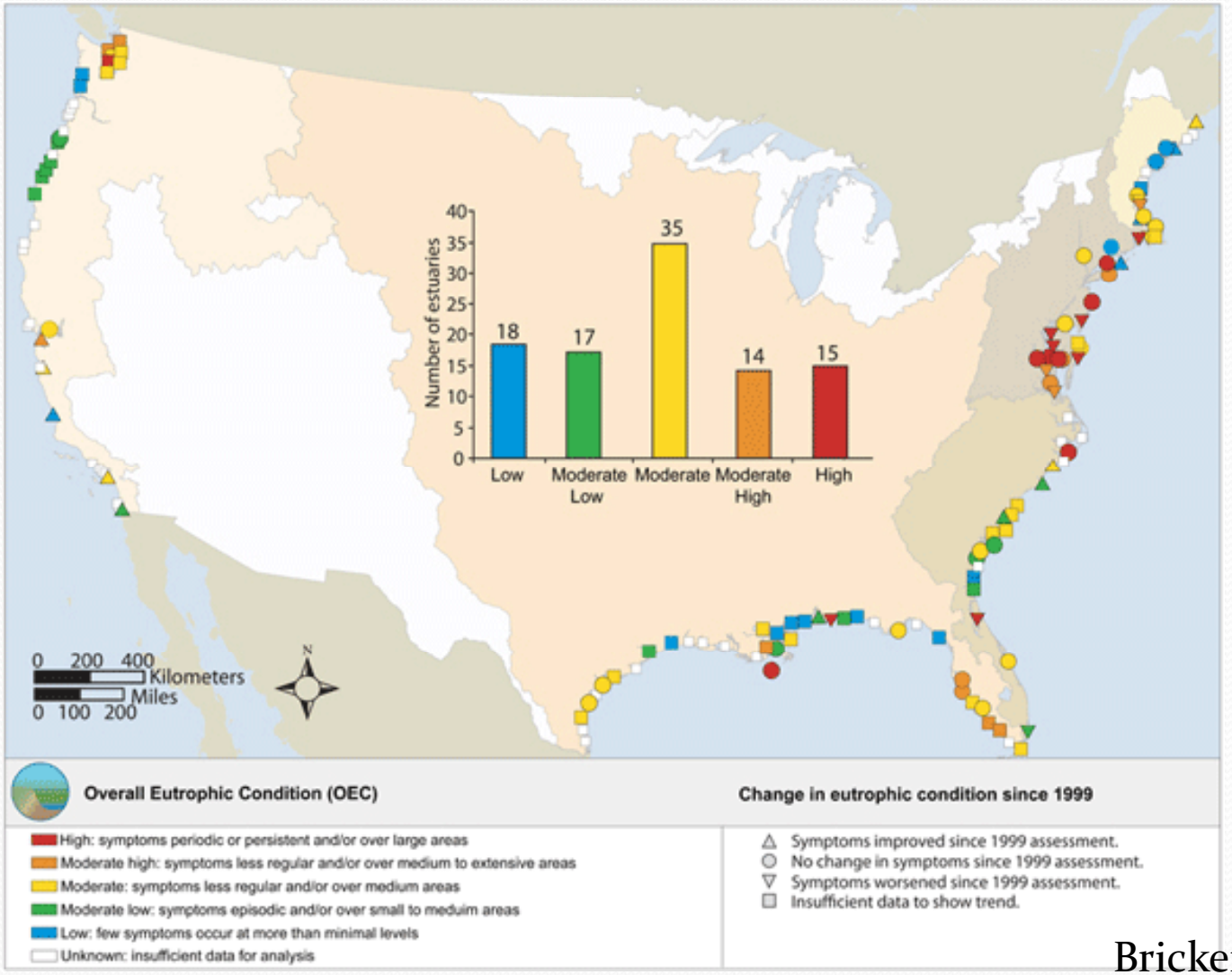
Based on information in Expert Query (ATTAINS) as of 10/23/2009. Of 75,675 impairments nationwide, 15,101 (20%) are due to nutrient-related defined as 'nutrients, organic enrichment/oxygen depletion, noxious plants, algal growth, and ammonia'. These data are based on the most recent 303(d) list data available in ATTAINS.

"nutrient-related" TMDLs



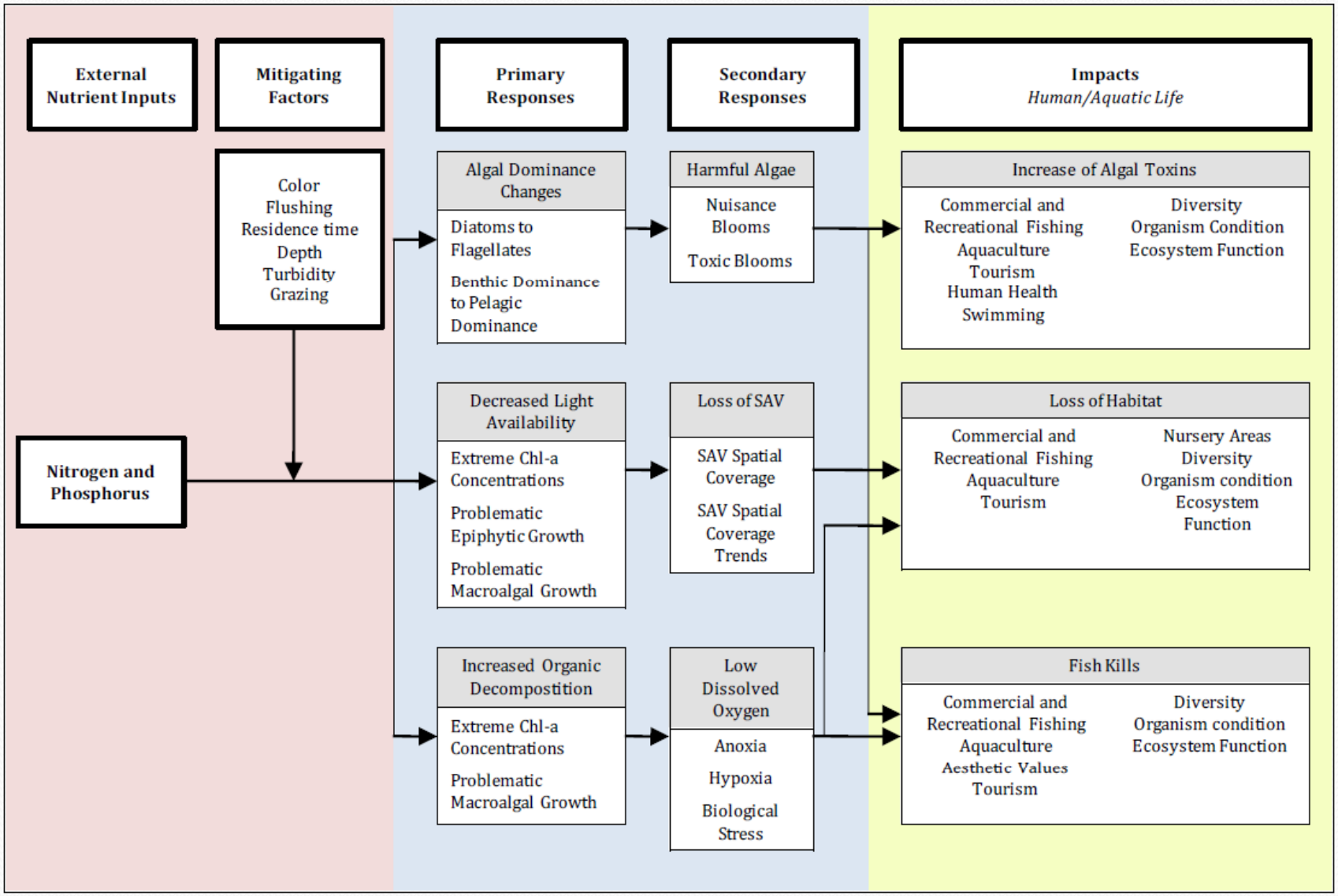
Based on information in Expert Query (ATTAINS) as of 01/14/2010. 7,261 TMDLs were nutrient-related. Nutrient-related is defined as 'nutrients, organic enrichment/oxygen depletion, noxious plants, algal growth, and ammonia'.

Eutrophication of estuaries



Bricker et al. 2007

Why have standards for nutrients?



Narrative versus numeric criteria

- Nutrients are one of the top three causes of impairment nationally
- Why are numeric criteria preferred?
  - Most state nutrient criteria are narrative
  - Narrative criteria are difficult to implement for:
    - Monitoring, assessment and listing
    - Pollutant limits (NPDES permits)
    - Remediation (TMDL, nutrient budgets and allocations)

Statutory and Regulatory Basis for Nutrient Criteria

- CWA 303(c)
  - WQS: protect public health, welfare, enhance water quality
- CWA 304(a)
  - Scientific information: guidance and recommendations
- 40 CFR 131.11(a)
  - Criteria to protect designated uses
  - Parameters/constituents to protect designated uses
  - Based on sound scientific rational
  - Economics do not factor into the scientific rationale
- 40 CFR 131.10(b)
  - Take into account the attainment and maintenance of downstream WQS

History of EPA's National Nutrient Criteria Program

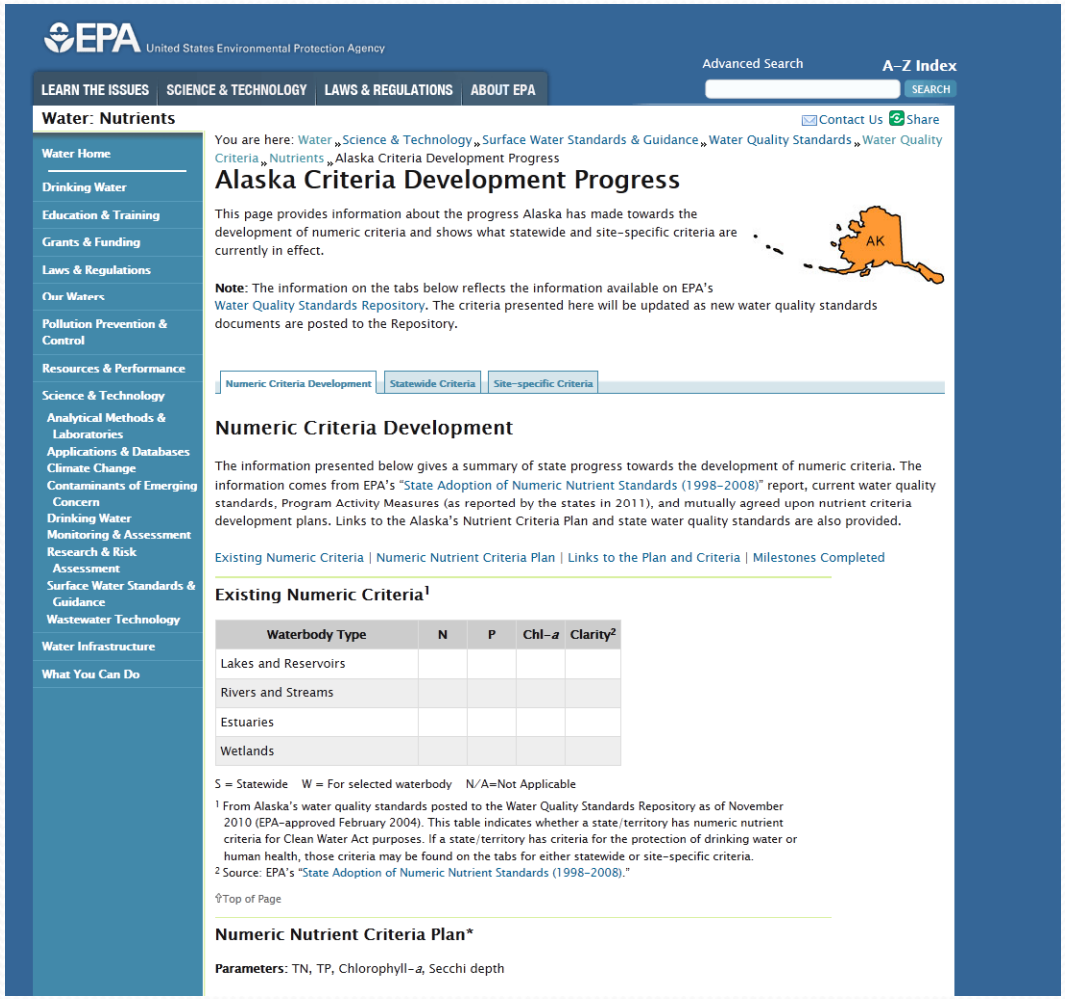
- 304(a) criteria – starting points from reference conditions – assuming protection of aquatic life
- 1998: National Nutrient Strategy
- 2000-2001: Ecoregional Nutrient Criteria (CWA 304(a))
- 2000-2001, 2007, 2010: Technical Guidance Manuals (CWA 304(a))
- 2004: EPA Office of Science and Technology (policy)
- 2007: EPA Office of Water (policy)
- 2009: EPA Determination in Florida (CWA 303(c))

Technical approaches to derive numeric nutrient criteria

- Classification
- Models
- Reference condition
- Empirical stressor-response
- Multiple lines of evidence

Nutrient Criteria in Alaska

- In response to EPA's request for states to develop nutrient criteria, a narrative criterion was included in the May 2003 (approved 2004) edition of Alaska WQS in 18 AAC 70.



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Alaska Criteria Development Progress

This page provides information about the progress Alaska has made towards the development of numeric criteria and shows what statewide and site-specific criteria are currently in effect.

Note: The information on the tabs below reflects the information available on EPA's Water Quality Standards Repository. The criteria presented here will be updated as new water quality standards documents are posted to the Repository.

Numeric Criteria Development | Statewide Criteria | Site-specific Criteria

Numeric Criteria Development

The information presented below gives a summary of state progress towards the development of numeric criteria. The information comes from EPA's "State Adoption of Numeric Nutrient Standards (1998–2008)" report, current water quality standards, Program Activity Measures (as reported by the states in 2011), and mutually agreed upon nutrient criteria development plans. Links to the Alaska's Nutrient Criteria Plan and state water quality standards are also provided.

Existing Numeric Criteria | Numeric Nutrient Criteria Plan | Links to the Plan and Criteria | Milestones Completed

Existing Numeric Criteria[1]

Waterbody Type	N	P	Chl–*a*	Clarity[2]
Lakes and Reservoirs				
Rivers and Streams				
Estuaries				
Wetlands				

S = Statewide W = For selected waterbody N/A=Not Applicable

[1] From Alaska's water quality standards posted to the Water Quality Standards Repository as of November 2010 (EPA-approved February 2004). This table indicates whether a state/territory has numeric nutrient criteria for Clean Water Act purposes. If a state/territory has criteria for the protection of drinking water or human health, those criteria may be found on the tabs for either statewide or site-specific criteria.

[2] Source: EPA's "State Adoption of Numeric Nutrient Standards (1998–2008)."

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Numeric Nutrient Criteria Plan*

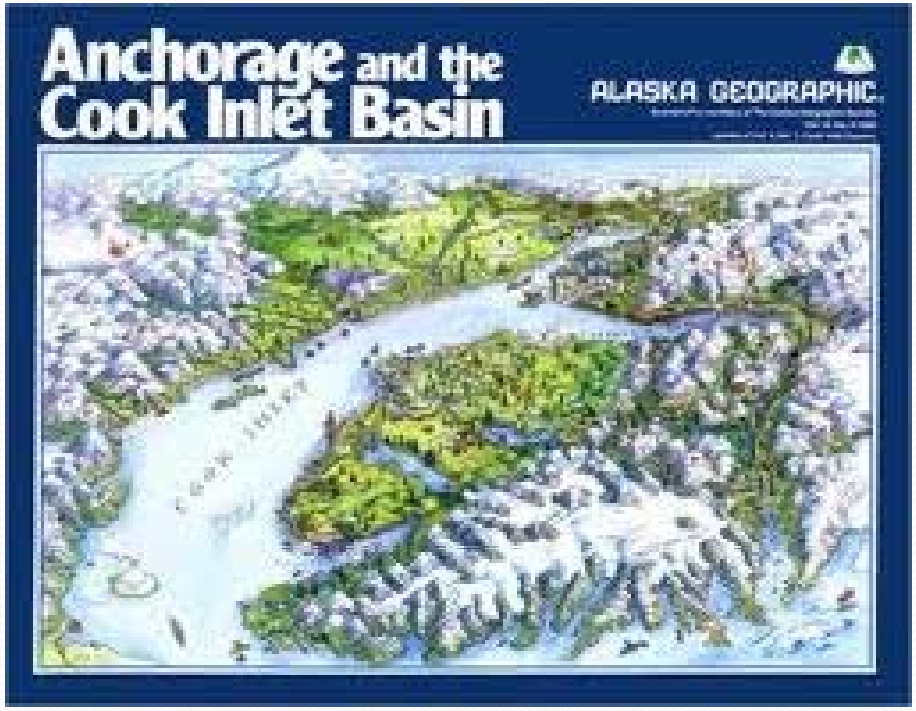
Parameters: TN, TP, Chlorophyll–*a*, Secchi depth

Water Quality Standards for Designated Uses	
(11) TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES, FOR FRESH WATER USES	
(A) Water Supply (i) drinking, culinary, and food processing	The concentratio exceed the numer human health for organisms shown *Manual* (see note at concentrations expected to cause taste, or other adv
(A) Water Supply (ii) agriculture, including irrigation and stock watering	The concentratio exceed the numer and irrigation wa *Criteria Manual* introduced at con reasonably be exp combination, odo use.
(A) Water Supply (iii) aquaculture	Same as (11)(C).
(A) Water Supply (iv) industrial	Concentrations o worker contact m
(B) Water Recreation (i) contact recreation	The concentration of substances in water may not exceed the numeric criteria for drinking water shown in the *Alaska Water Quality Criteria Manual* (see note 5). Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use.
(B) Water Recreation (ii) secondary recreation	Concentrations of substances that pose hazards to incidental human contact may not be present.

Water Quality Standards for Designated Uses	
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	The concentration of substances in water may not exceed the numeric criteria for aquatic life for fresh water and human health for consumption of aquatic organisms only shown in the *Alaska Water Quality Criteria Manual* (see note 5), or any chronic and acute criteria established in this chapter, for a toxic pollutant of concern to protect sensitive and biologically important life stages of resident species of this state. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.

Nutrient criteria development plan

- Submitted to EPA in 2004, approved in 2005
- Few sources for nutrient pollution
  - Only area to be investigated for nutrient criteria will be Mat-Su Valley



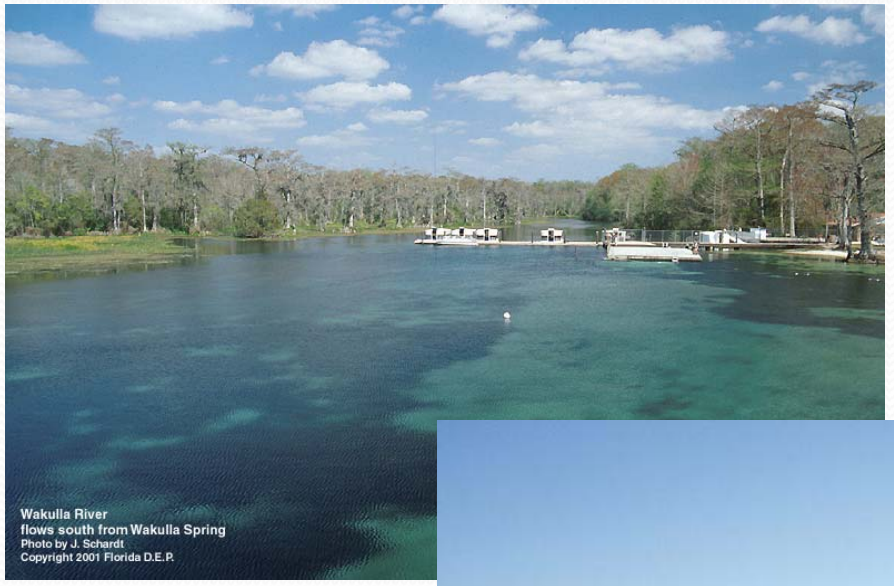
2007 Lakes Survey

- Temperature
- pH
- Conductivity
- Total nitrogen
- Nitrate + nitrite
- Total phosphorus
- Orthophosphate
- Secchi disk
- Dissolved oxygen
- Chlorophyll-a
- Shoreline characteristics
- Qualitative macrophyte survey
- Lake/catchment site activities
- Disturbances
- Surface conditions
- Hydrologic type
- Anadromous or stocked fish

Recommendations from final report

- Use generalized trends instead of exact numbers
- Continue future studies in the Mat-Su Valley
- Account for seasonality
- Conduct additional studies

Development of Criteria in other States: Florida



Florida nutrient criteria background

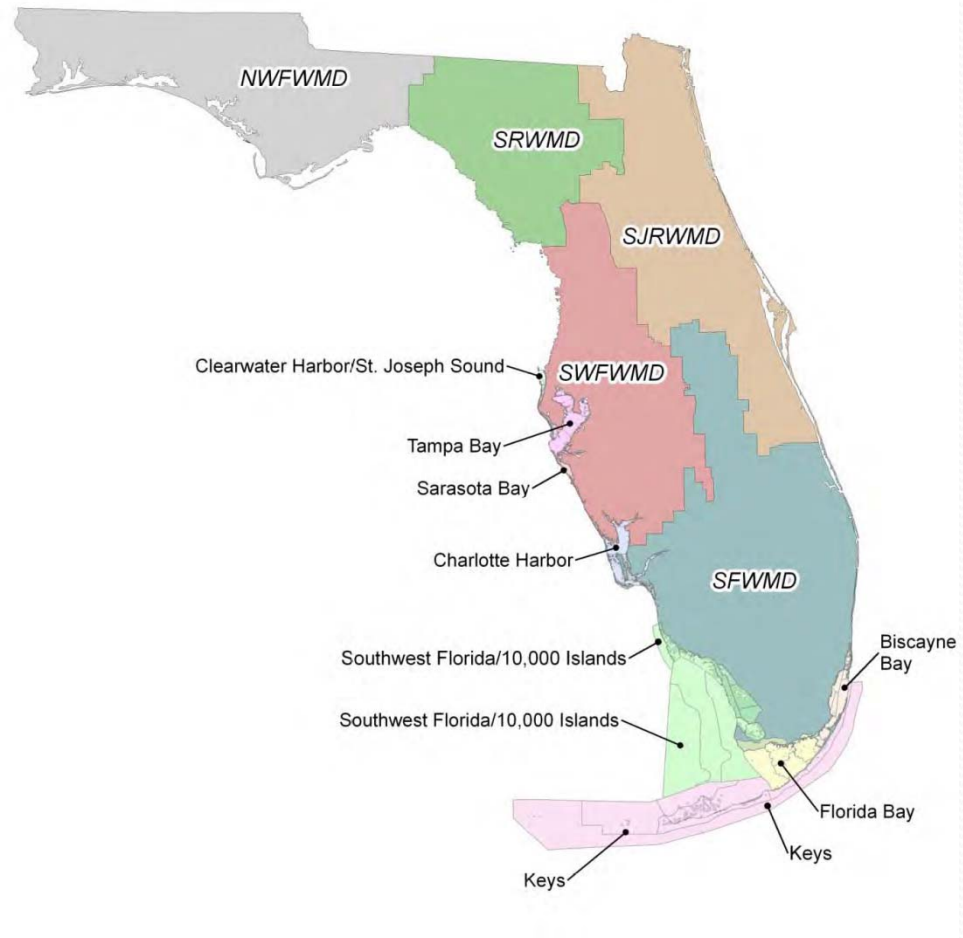
- EPA determined that numeric nutrient criteria were “necessary”
- Criteria would be promulgated by EPA unless the state submitted their own criteria
- DEP launched an effort to develop scientifically defensible and protective criteria values – multiple lines of evidence approach

Back at the beach….

- DEP divided the state into 30 estuarine units
- Compiled information for each unit
  - Physical/chemical description
  - Causal parameters (nutrients)
  - Supporting variables (hydrodynamics, residence time, transparency, salinity, dissolved oxygen)
  - Key biological response variables
- Worked with local scientists to identify the most sensitive valued ecological attributes for each estuary

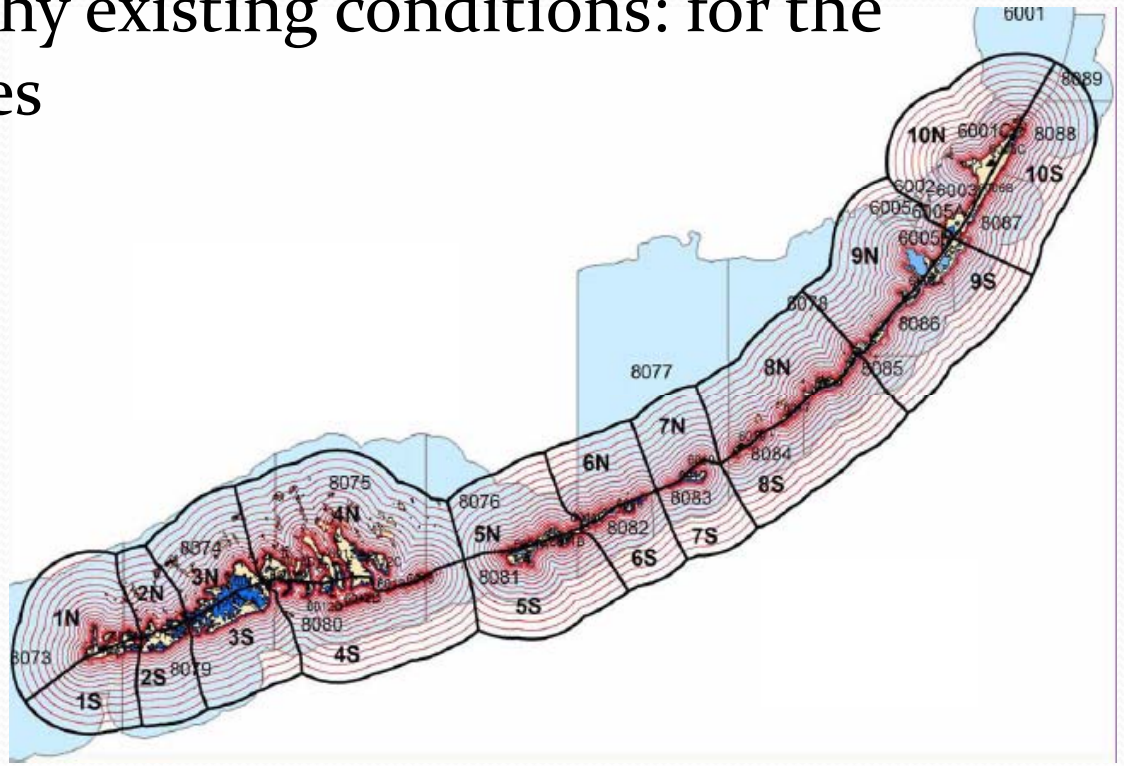
Proposed 4 criteria approaches

- Maintain healthy existing conditions
- Historical conditions
- Response-based using modeling or empirical evidence
- Reference

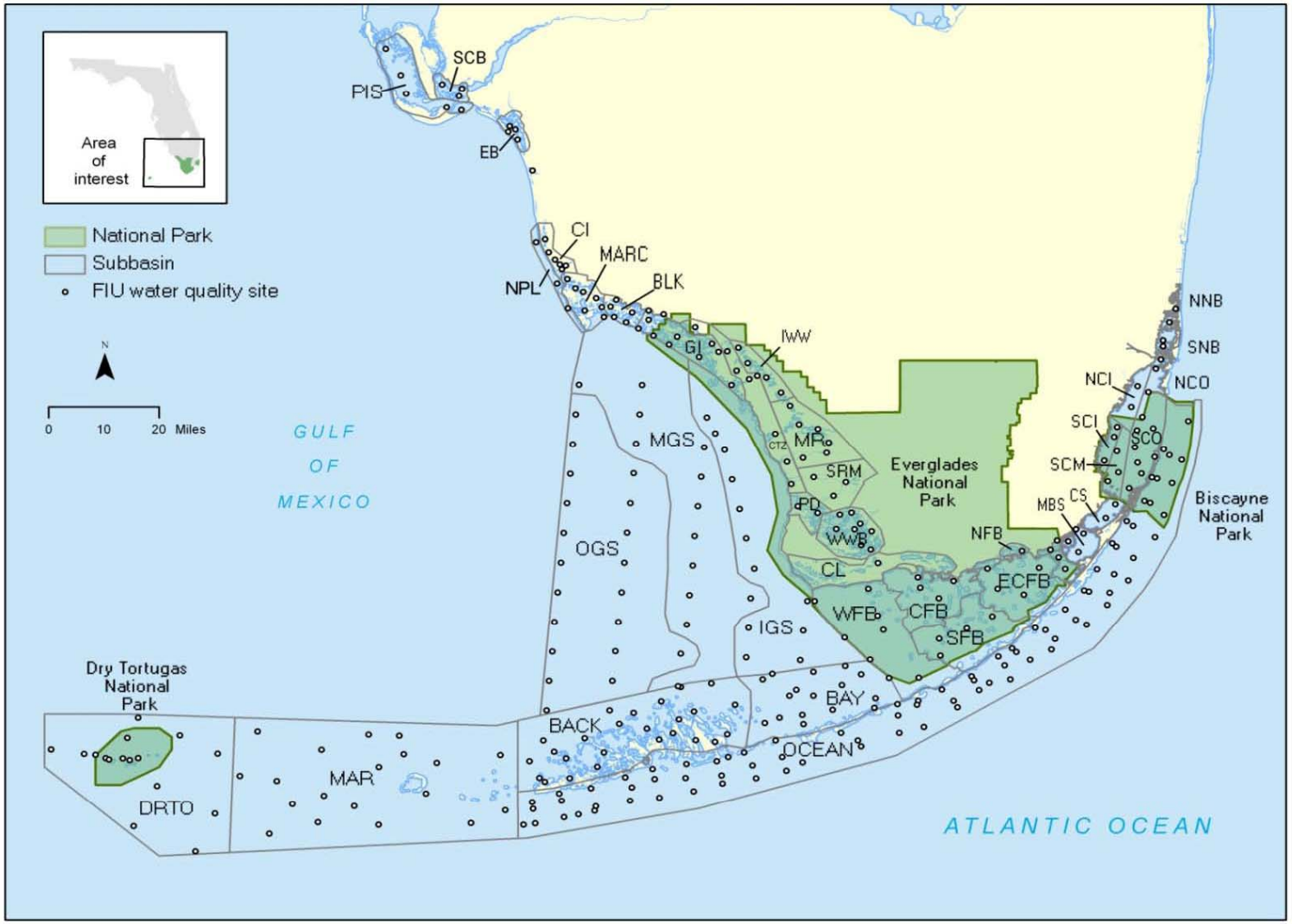


DEP proposed two of the approaches for the Florida Keys

- Response based: Florida Keys Reasonable Assurance Document (FKRAD) for the "halo" zones
- Maintain healthy existing conditions: for the nearshore zones



Florida Keys nearshore segments



FKRAD and DEP criteria for bay-side TP (µg l-1)

Halo Zone (500 m) targets (FKRAD)		Nearshore (beyond 500 m) criteria (FDEP and FIU)	
Modeled bubble WBIDs		Proposed criteria by sub-basin	
WBID model ID	**Target**	Sub-basin name	**Long term limit (2 out of 5 year single site assessment)**
1N	**11**	Backcountry	**9.59 (11.61)**
2N	**12**	Backcountry	**9.59 (11.61)**
3N	**12**	Backcountry	**9.59 (11.61)**
4N	**12**	Backcountry	**9.59 (11.61)**
5N	**10**	Bayside	**8.24 (10.42)**
6N	**10**	Bayside	**8.24 (10.42)**
7N	**13**	Bayside	**8.24 (10.42)**
8N	**11**	West Florida Bay*	**13.22 (17.63)**
9N	**10**	South Florida Bay*	**7.65 (9.83)**
10N	**8**	East Central Florida Bay*	**6.48 (7.89)**

What can AK learn from FL?

AK

- 656,425 square miles
- > 714,000 miles of rivers and streams
- 44,000 miles of coast
- 686,000 people

FL

- 58,681 square miles
- > 11,000 miles of waterbodies
- 1,197 miles of coast
- 18,801,310 people

Recommendations

- Use generalized trends instead of exact numbers
- Continue future studies in the Mat-Su Valley
- Account for seasonality
- Conduct additional studies

- Decades of data
- Biological indicators for freshwater
- Seasonality as part of assessment for impaired waters

Questions?

Special thanks to:

- EPA Office of Science and Technology for their nutrient PPT
- USGS Nutrients in the Nation's Waters – Too Much of a Good Thing?
- Florida DEP for nutrient criteria development PPTs and reports