It’s Not Easy Being Green

How nutrients are assessed within the scope of the TCEQ’s Antidegradation Determination

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What are nutrients?

Nitrogen and phosphorus support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and smaller organisms that live in water.

What are the Sources of Nutrients

- Point Sources
  - Municipal WWTP
  - Industrial
  - Concentrated Animal Feeding Operations
- Nonpoint Sources
  - Commercial fertilizers on agricultural and residential land
  - Livestock and pet waste
  - Septic tanks
  - Atmospheric deposition (nitrogen): lightning, combustion of fossil fuels or volatilization of ammonia from fertilizer and manure

Nonpoint Sources of Nutrients

- Nutrients can be transported to streams in runoff from precipitation
- Or irrigated fields
- Or inflowing groundwater
- Or drainage ditches
- And subsurface tile-drain systems
- Nonpoint sources are the leading and most widespread cause of nutrient degradation of water
- USGS National Water Quality Assessment studies estimate that more than 90 percent of nitrogen and phosphorus released to the environment originates from nonpoint sources (Puckett, 1995)

Too Much of a Good Thing

ENRICHMENT

- EXCESSIVE ACCUMULATION OF ALGAE (EUTROPHICATION)
- LARGE DIURNAL SWINGS OF DISSOLVED OXYGEN OR HYPOXIA
- FOUL TASTE AND ODORS
- TOXICITY
- IMPAIRMENT OF AQUATIC COMMUNITIES AND HABITATS
- REDUCED RECREATIONAL USES SUCH AS SWIMMING, BOATING, & FISHING

Antidegradation Review for Nutrients

- Tier 1: maintain existing uses
- Tier 2: less than noticeable decrease in water quality
- Narrative nutrient criteria is used for streams and rivers
- Nutrient screen is based on rating the potential for eutrophication for a range of factors that affect algal growth

Screening Factors Explained

- Size of discharge: Larger nutrient load/reduced dilution/impacts further downstream
- Dilution: effluent dominated streams are like a waste stream
- Bottom substrate: like bedrock & cobble can promote the growth of attached algae
- Shallow depths: are more sensitive to algal growth
- Water clarity: high water clarity allows more light into the water column & enhances algal growth
- Sensitivity to algal growth in the presence of the discharge: indicates that additional nutrient loads will be problematic

Screening Factors Explained (cont.)

- Canopy: can minimize algal response to nutrients & allow them to flow downstream unassimilated until it hits sunlight
- Stream Type: Streams that are intermittent with pools and slower moving & spring fed streams are more sensitive to algal growth
- Impoundments: lacustrine environments can promote algal blooms
- Consistency: other permits in the same watershed or same type of watershed, for example like the Hill County, that have nutrient limits can be a red flag
- Texas Integrated Report: is a summary of existing water quality, including potential enrichment issues such as concerns regarding total phosphorus, chlorophyll a, impaired aquatic community, etc.
  - Note: there are currently no surveys done for attached algae in the Texas Integrated Report

Nutrient Screen Ratings

- Each factor is rated for the potential for eutrophication on a scale of low (1), moderate (3), and high (5)
- All factors are then averaged to determine if nutrient controls are warranted: <2, no limits; 2-4, limit or monitoring, >4, limit required
- Once the screening is completed, a more in depth analysis is done to determine the appropriate limit
- Other sources of information are nutrient data on a specific water body, or similar water bodies in the same watershed, or ecoregion
- Literature is reviewed to identify the specific effects of nutrients on the receiving water

Additional Considerations

- Proposed large increase in discharge volume
- High density of WWTPs discharging into same water body
- Endangered species
- Public water supply/aquifer protection uses
- Presence of private wells on or in the vicinity of creek
- Proposed discharge into a pristine area
- Public recreation areas

Phosphorus limits vs. Nitrogen limits

Why focus on phosphorus controls instead of nitrogen

- phosphorus is a primary nutrient in freshwater
- limited data on total nitrogen in Texas for reservoirs, streams, and rivers (according to 2010 IPs)
- nitrogen can be fixed directly from the atmosphere
- treatment technologies make reducing phosphorus more effective than reducing nitrogen

When nitrogen limits are considered

- to prevent the growth of nuisance aquatic vegetation
- to protect public drinking water supplies, groundwater and private wells
- the potential for eutrophication of unusually sensitive tidal waters & seagrass beds

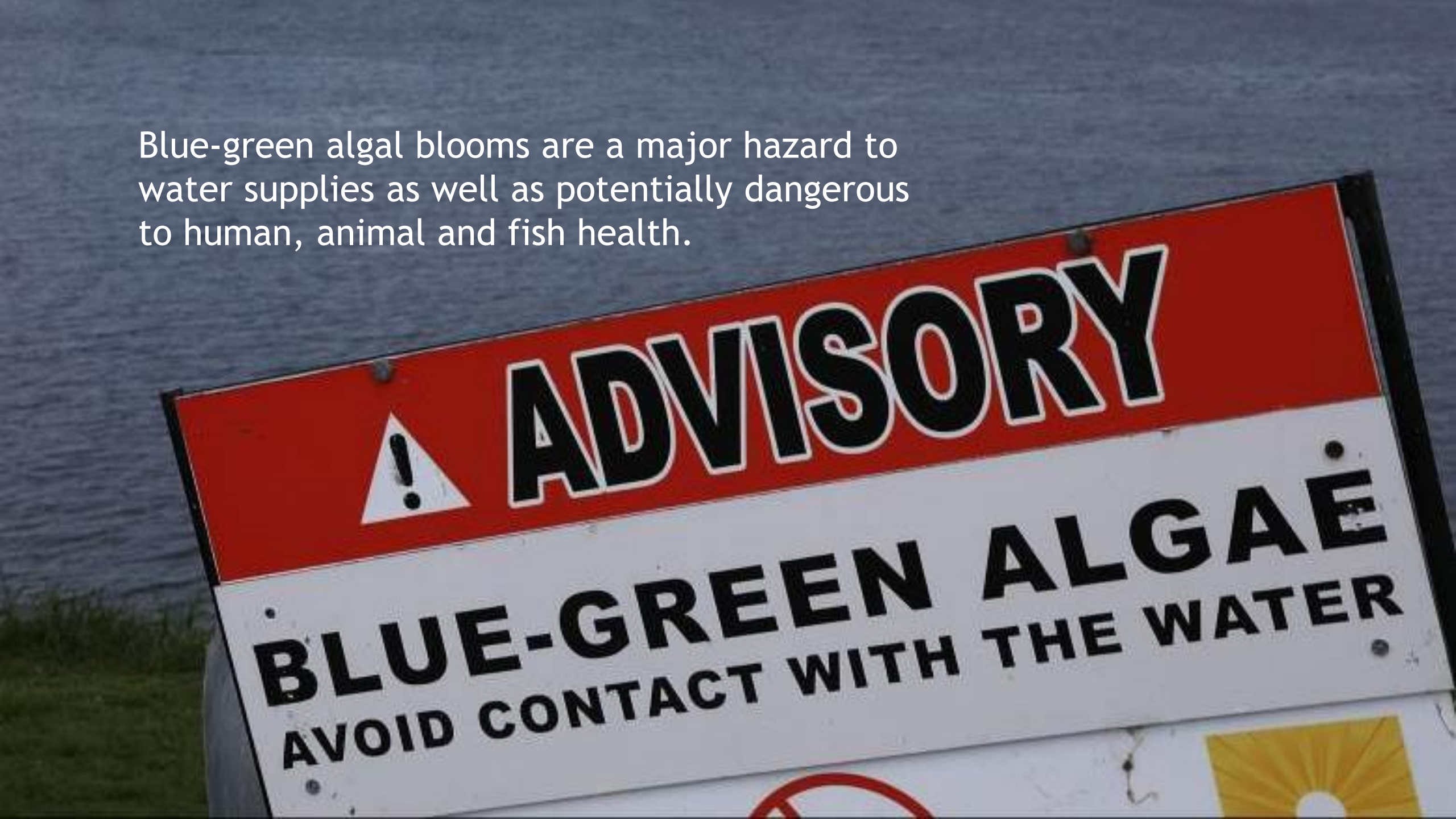
RULES THAT ADDRESS NUTRIENTS IN WASTEWATER DISCHARGES

- General narrative criteria for nutrients in the Standards (§ 307.4)
- Antidegradation provisions of the Standards (§ 307.5)
- Watershed rules (30 TAC Chapter 311) (1.0 mg/L TP)
- Edwards Aquifer rules (30 TAC Chapter 213) (1.0 mg/L TP)

Algae Can Poison Your Dog-NYT

Dogs have become fatally ill after frolicking in water infused with the toxic algae, owners said.

Blue-green algal blooms are a major hazard to water supplies as well as potentially dangerous to human, animal and fish health.



What is Blue Green Algae???

- Blue-green algae are NOT algae (eukaryote), but types of bacteria known as Cyanobacteria
- They are called blue-green algae because they have a bluish pigment phycocyanin, which they use to capture light during photosynthesis
- Not all "blue-green" bacteria are blue; the Red Sea gets its name from occasional blooms of a reddish species of Oscillatoria, and African flamingos get their pink color from eating Spirulina
- Other forms include Dinoflagellates and Golden Algae
- Taste and odor problems commonly occur with large concentrations of blue-green algae and some species are capable of producing toxins

Fun Facts about Blue Green Algae

- The oldest known fossils, in fact, are cyanobacteria from Archaean rocks of western Australia, dated 3.5 billion years old
- The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era
- Cyanobacteria also form symbiotic relationships with many fungi, forming complex symbiotic "organisms" known as lichens
- One of very few groups of organisms that can convert inert atmospheric nitrogen into an organic form, such as nitrate or ammonia AKA fix nitrogen

Nutritious or poisonous?

- The cyanobacterium Spirulina has long been valued as a food source
- High in protein
- Can be cultivated in ponds quite easily
- Eaten regularly by the Aztecs
- Popular in Asian dishes
- In the US, Spirulina is a "health food”
- Many other species of cyanobacteria are toxic to humans and animals
- Blue-green pond scums have been linked to the poisoning of cattle and dogs
- Not recommended that wild populations be harvested & eaten without some knowledge of the organisms involved!

Take home message: "how to avoid stringent nutrient limits"

- Don't discharge in the Edwards Aquifer contributing or transition zone
- Don't discharge in spring fed streams
- Don't be a major discharge into small headwater streams with low baseflow
- Don't discharge into streams that are intermittent with pools
- Don't discharge into an intermittent stream that flows into a pond, lake or reservoir
- Don't forget to consider Chapter 210 Reuse Authorization

Contact Information

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