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Update on Current & Future Nutrients Regulations

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DISCLAIMER

Outline

- Nutrient impacts
- Water quality regulations
- Nutrient criteria:
  - background,
  - development
  - anticipated criteria
- Possible technology-based nutrient limits
- Also: new ammonia toxicity criteria
- Summary

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NUTRIENT - CAUSED WATER QUALITY IMPACTS

Nutrient Impacts

- Major cause of water quality impairment
- Nutrients can cause over-enrichment in receiving water bodies
  - Eutrophication in streams and lakes
  - Non-attainment of biological criteria . . . (Listed as ‘cause’ in many TMDLs)
  - Hypoxia – ‘dead zone’ – in coastal waters

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Nutrient Impacts

- Over-enrichment in receiving waters

- Excess phosphorus:
  ➔ potential over-enrichment of **freshwaters**
- Excess nitrogen:
  ➔ potential over-enrichment of **oceans & estuaries**

Ammonia-N ➔ oxygen demand

Ammonia-N ➔ toxicity

***NOT* nutrient issues!**

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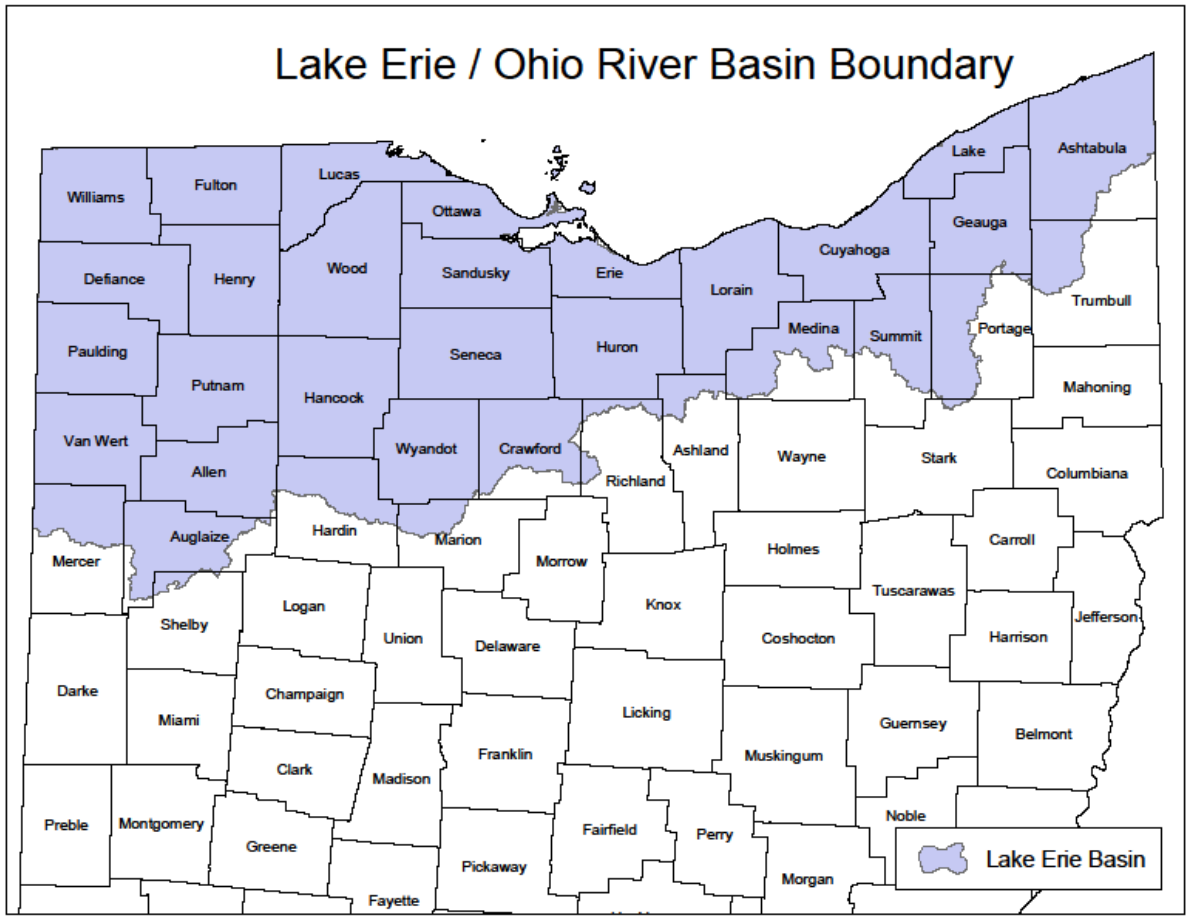
Nutrient Impacts Outside Ohio

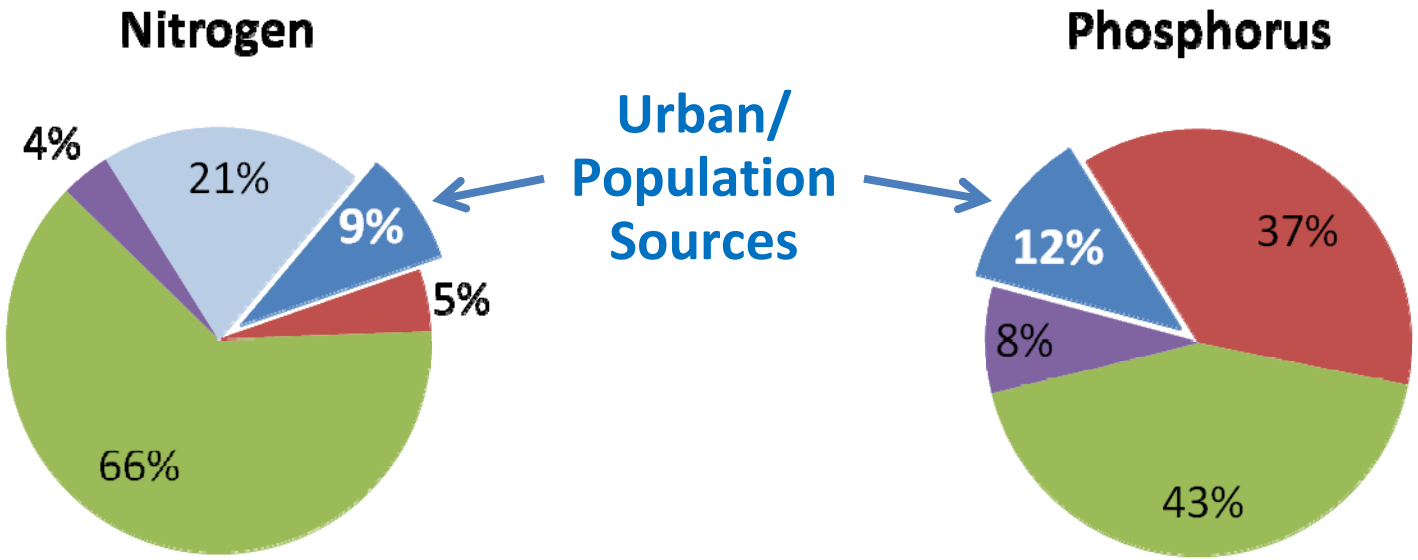
Lake Erie basin – subject to eutrophication and algal blooms

Ohio River basin drains to the **Gulf of Mexico** – subject to summer hypoxia



Source: Ohio EPA

Relative Nutrient Contributions to Gulf of Mexico



- **Urban & population related sources (WWTP effluents plus urban storm water)**
- Livestock
- Crops
- Natural
- Atmospheric deposition

Source: USGS 2008

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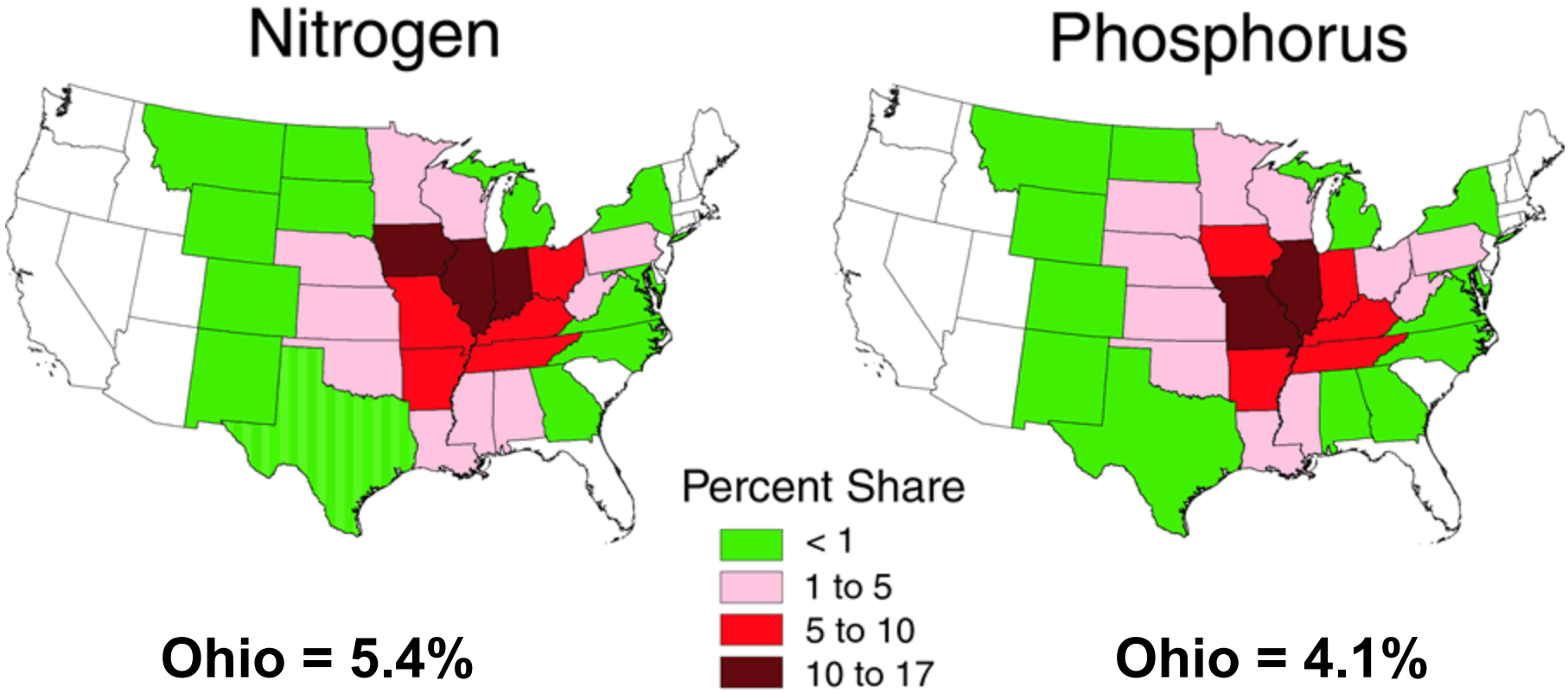
Ohio's Contribution to Gulf of Mexico



Ohio = 5.4%

Ohio = 4.1%

Source: USGS 2008

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WATER QUALITY REGULATIONS

Water Quality Based Requirements

- Water Quality Standards
  - •Water Use Designations
  - •Water Quality Criteria
  - •Antidegradation
- Watershed monitoring & assessment
  - 303(d) List of impaired waters
  - *"Integrated Water Quality Monitoring and Assessment Report"*
- TMDL Program
  - To identify and restore impaired waterbodies

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WQ Criteria and WQ-Based Permit Limits

- **WQ Criteria** are not **Permit Limits**

- NPDES **Permit Limits** are the maximum amount that can be discharged and still maintain **WQ Criteria** in receiving water

- If a **WQ Criterion** has not been attained in receiving water, then TMDL is used to determine how much each source is allowed to discharge – to bring receiving water into WQ attainment

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NUTRIENT CRITERIA

Nutrient Criteria: the Challenge

<u>Issue</u>: Nutrients are different from toxic or conventional pollutants

- Effects not predictable through dose-response curves
- WQ Criteria should be based upon: "cause and effect" ("stressor-response")
- Difficult to develop criteria for nutrients
- U.S. EPA working on *Empirical Approaches for Nutrient Criteria Derivation*
  - Science Advisory Board is reviewing – and critiquing

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Stressors for Biological Impairment

- **Nutrients**
- Riparian disturbance
- Streambed sedimentation
- In-stream habitat for fish & aquatic organisms
- Riparian vegetative cover
- Salinity (TDS)

Habitat

Reducing nutrients without solving habitat problems will not achieve biocriteria attainment

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Phosphorus and Habitat

- Concern: many watersheds have listed **nutrients** as cause of impairment, although data to support listing may be ambiguous
- Phosphorus 'basis of listing' … in many cases:
  - "*Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams*" (Ohio EPA, 1999). . . *aka* '**the Associations Report**'
- Poor habitat is often (one of) the most significant causes of impairment
- ***If habitat problems not solved, eliminating 'excess' phosphorus will not achieve biocriteria attainment***

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Nutrient Criteria Development

- USEPA Nutrient Strategy (1998 - 2001)
  - Eco-region based criteria, using “reference site” approach
  - Example: typical Guidance TP criteria ~0.07 mg/l Total P
  - States required to develop regional, scientifically defensible criteria
- Ohio (& most states)
  - Developing WQ “effects-based” criteria
  - To date: 7 states have numeric nutrient criteria for classes of water bodies
  - Some other states have numeric criteria for specific

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Nutrient Regulation in Ohio

- Current Ohio status (typical of most states):
  - Narrative criteria: **"Free of nutrients in concentrations that may cause algal blooms"**
  - No numeric criteria for Phosphorus or Nitrogen
- *"Associations Report"* (Ohio EPA,1999)
  - Used in many TMDLs to establish wasteload allocations
  - ***FLAWED APPROACH:*** ***statistical associations alone cannot prove cause-and-effect***
- Effects-based criteria development by Ohio EPA
  - 2003 thru present – criteria proposal expected 2010

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Ohio Nutrient Criteria Development

- OEPA nutrient criteria development plan …….. 2003
  - Approach: look for 'cause and effect'
  - Nutrient 'cause' resulting in: ♦Effect on biocriteria ♦Effect on algal biomass (chlorophyll *a*) ♦Effect on D.O.
- Data collection …….. 2004 - 2007
  - Typical stream monitoring data, incl. TP and TN (DIN)
  - Chlorophyll *a*; DO; stream physical conditions (cover)
  - Mostly small streams; some large rivers in 2007
- Data evaluation, criteria development …. 2008-2009
- Criteria proposal (small streams & rivers) …. ~ 2010
  - Criteria for large rivers: ??

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So, how low will they go?

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Possible Nutrient WQ Criteria

	US EPA-Recommended Ecoregion VI WQ Criteria (2001)	***Possible*** † **Ohio EPA WQ Criteria (2010 ?)**
Total Phosphorus (TP)	0.076 mg/l	**~ 0.1 mg/l ***
Total Nitrogen	2.18 mg/l (TN)	**~ 1.1 mg/l * (DIN)**

† *Possible* rule proposal in 2010:
Ref: R.J.Miltner (2010). *A Method and Rationale for Deriving Nutrient Criteria for Small Rivers and Streams in Ohio*

* Criteria would apply only if watershed is impaired by nutrient.

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(Potential) Ohio Nutrient Criteria Implementation Approach

- Determine biocriteria attainment in receiving water ?
- *IF* biocriteria impaired, then examine impacts to determine possible excess nutrient cause:
  - **High levels of chlorophyll *a***
  - **Large DO concentration swings**
    - (afternoon DO minus early morning DO)
  - **High in-stream nutrient concentrations**
    - TP and TN (or TIN)

  } ?

- *IF* nutrient cause, then derive nutrient limit
  - Nitrogen limitation is rare in Ohio … in nearly all cases, only TP would have effluent limits
  - Limits may be applied seasonally: June – October

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Possible Concern: OEPA vs. USEPA

- Ohio's approach for nutrient criteria implementation:
  - **If no nutrient-caused impairment in watershed, then no nutrient effluent limits for dischargers**
- US EPA
  - Has expressed opinion that nutrient criteria should be applied to all water bodies in ecoregion
- Ohio EPA is hopeful EPA can be convinced otherwise

Future Ohio Nutrients Criteria Timetable

OEPA development of nutrient WQ Criteria:

- Small rivers (watershed < 500 sq. mi.)
  - Draft criteria: interested party review – 2010
  - Draft criteria: public notice – 2010 ?
  - Final criteria: *effective date* – 2011 ?
- Large rivers (watershed > 500 sq. mi.)
  - Draft criteria: interested party review – 2012 ?
  - Final criteria: *effective date* – 2013 ?

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2008 Petition to EPA: Establish Numeric Nutrient Criteria for Mississippi Basin

- July 2008 – petition to US EPA from multiple environmental groups
- Petition requests that EPA:
  - Adopt numeric criteria for N and P
    - For Northern Gulf of Mexico and all waters within Mississippi River Basin (without numeric criteria)
  - Prepare TMDLs for Mississippi River, all tributaries & Northern Gulf
- EPA has not responded . . . yet

Note: If state has established numeric criteria, US EPA criteria would (likely) not supersede

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TECHNOLOGY - BASED REQUIREMENTS FOR NUTRIENTS

Technology-Based Standards

- Treatment Technology basis for effluent discharge
  - Uniform limits for similar wastewater-generating facilities
  - Effluent limits based upon performance of selected technology
- Federal technology-based treatment requirements:
  - POTWs must achieve **Secondary Treatment** performance
  - CWA required EPA to define Secondary Treatment removals, and update from "time to time" – Section 304(d)(1)

Industrial categories have their own technology-based standards: "Effluent Guidelines" – 40 CFR Parts 401-471

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Secondary Treatment Standards (Technology Based Standards)

- Current "Secondary Treatment" – *40 CFR 133*
  - **BOD_5** < 30 mg/l (30-d avg)
    or $CBOD_5$ < 25 mg/l
  - **TSS** < 30 mg/l (30-d avg)
  - **85 % removal** of both BOD_5 and TSS
  - **pH** > 6 and < 9

- No treatment technology-based requirement for nutrient removal at present

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2007 Petition to EPA: Revise Secondary Treatment Definition

- November 2007 – several environmental groups – petition to US EPA
- Request that EPA: revise definition of "Secondary Treatment" to include nutrient removal
- Different levels of nutrient removal suggested:

Petition Suggested Technology Level	TP	TN
'biological-only' treatment technology	1.0 mg/L	8.0 mg/L
'current' treatment technology	0.3 mg/L	3.0 mg/L

?

?

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Ohio Draft Surface Water Quality Rules Revision: new P, N limits for BADCT

- Draft Antidegradation Rule (OAC 3745-1-05)
  - Proposed October 2008 . . . delayed . . . 2010 ?
  - BADCT (**Best Available Demonstrated Control Technology**) applicable to sanitary WWTPs :

	30-day Limit (mg/l)	7-day Limit (mg/l)
TN	10	15
TP	2.0	3.0

  - Would apply only to new portion of existing WWTP

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FUTURE AMMONIA CRITERIA

Future LOWER Ammonia Limits

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Recent Studies Indicate Mussels More Sensitive Than Other Aquatic Species

- 2004 – USEPA announced intent to re-evaluate ammonia WQC based on recent mussel toxicity data
  - Significant scientific objections raised
  - 2007 – USEPA resolved objections

- 2009 (Dec) – USEPA proposed draft criteria for both conditions: presence or absence of freshwater mussels

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Comparison of Ammonia Criteria

- Ohio EPA (2010) *vs.* USEPA Draft (2009) Criteria

Temp. (°C)	pH	Chronic Criteria, mg/l as N		
		Existing Ohio Criteria*	USEPA 2009 Draft Recommended Criteria	
			Freshwater mussels present	Freshwater mussels absent
15	7.5	2.2	**0.88**	6.3
20	7.5	2.1	**0.63**	4.6

* 30-day avg., warmwater habitat (OAC 3745-1-07, Table 7-5)

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SUMMARY:
WHAT SHOULD YOU EXPECT?

How Will Future Nutrient Regulations Affect Your Plant?

?

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Future Ohio Nutrients WQ Criteria
-- *'anticipated . . . best guess'* --

- Numeric criteria values for both P and N
  - Likely to be very low values:
    - **TP = ~0.1 mg/l**
    - TIN = ~1 mg/l -- **but rarely used for NPDES limits**
- Implementation procedure: three steps
  1) Do biocriteria show impairment?
  2) Do response variables indicate nutrient cause?
     - Diurnal DO swing
     - chlorophyll *a*
     - excess nutrients
  3) If both 1 & 2, then use criteria to develop limits
- If no adverse effects, then **no** WQ based Limits

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Implications of Ohio Nutrient Criteria *(as currently anticipated)*

- Expect many (most?) discharges will not require WQ based effluent limits for nutrients
- If/when limits – likely TP only (no TIN)
- If TIN effluent limits required & minimal mixing available from stream, then limits may be below limit of treatment technology
  - Variance provision?
- Attainment may/will require NPS reductions

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Will You Get Future Nutrient Limits?

- You *may* have future effluent TP limitation:
  - ***If*** biocriteria non-attainment in your watershed *and* response variables indicate excess nutrient cause
  - ***If*** TMDL completed before Ohio criteria finalized *and* if TMDL concludes nutrient-caused impairment
  - ***If*** Federal secondary treatment definition revised to include nutrient discharge limits
  - ***If*** Ohio antidegradation rule becomes applicable to a future plant modification

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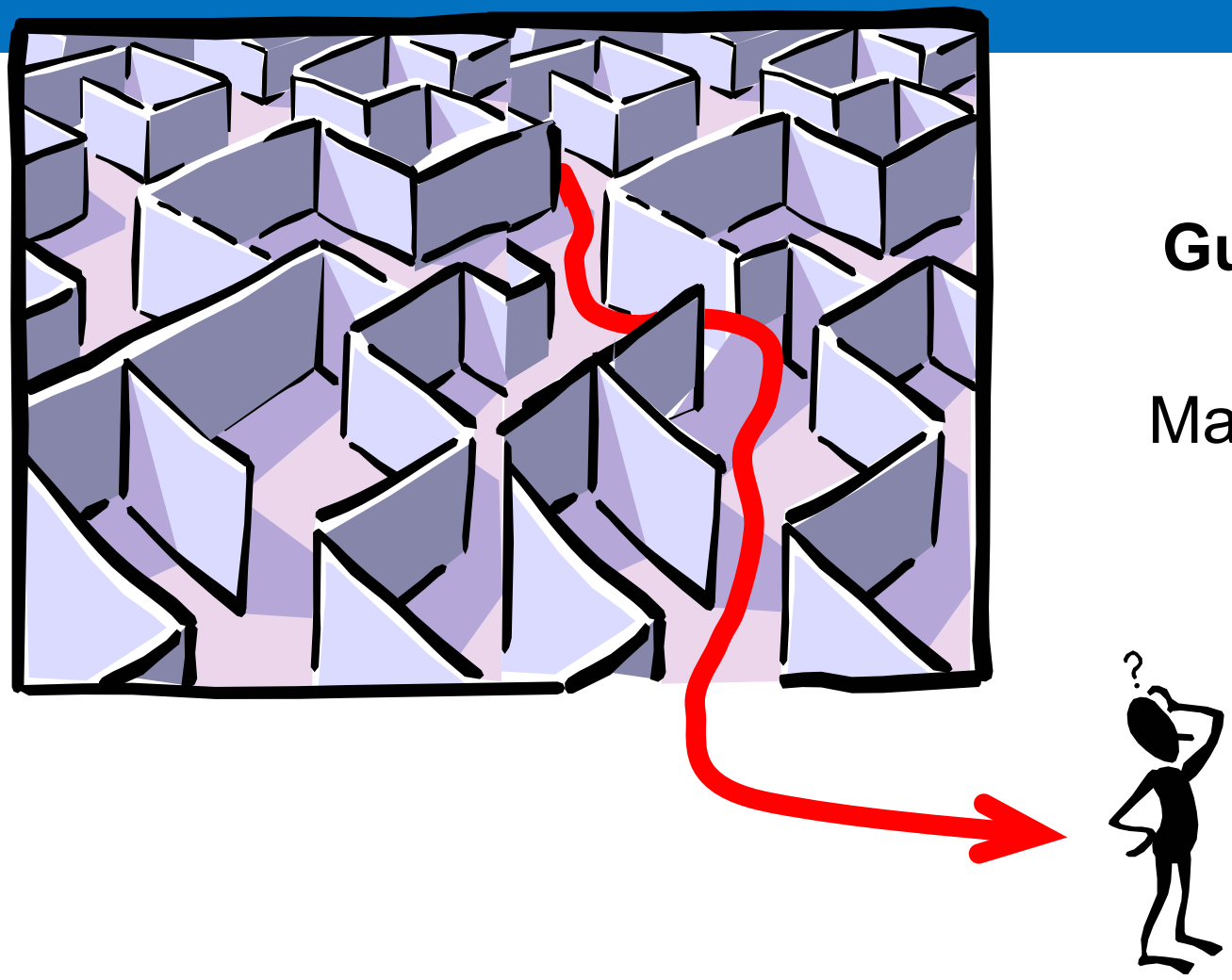
Questions ?



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NUTRIENT CHEMICAL FORMS

Forms of Phosphorus

- **Soluble-P** (inorganic, orthophosphate, PO_4-P)
- **Organic-P** (may be soluble or particulate)
- **Total Phosphorus** (TP)

  TP = soluble-P + particulate-P

  TP = inorganic-P + organic-P

Forms of Nitrogen

- **Ammonia** (inorganic, soluble, NH_3-N)
- **Organic-N** (may be soluble or particulate)
- **TKN** (Total Kjeldahl Nitrogen)

  TKN = Ammonia-N + Organic-N
- **Nitrate** (NO_3-N)
- **Nitrite** (NO_2-N)
- **Total Inorganic Nitrogen** (TIN) ≈ DIN (dissolved)

  TIN = NH_3-N + NO_2-N + NO_3-N
- **Total Nitrogen** (TN)

  TN = TKN + NO_2-N + NO_3-N

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Nutrient Forms to be Regulated

- Phosphorus
  - Soluble, orthophosphate readily bio-available
  - Other P forms may also be converted & bio-available
  - Total Phosphorus – **TP for nutrient WQ criteria**
- Nitrogen
  - Dissolved, inorganic forms most readily bio-available
  - Other N forms may also be converted & bio-available
  - Organic N form less bio-available
  - USEPA, most states – **TN for nutrient WQ criteria**
  - Ohio EPA – considering **DIN (TIN) for WQ criteria**