Developing WQS and evaluating the impact of new loads in NY
Chesapeake Bay TOWG

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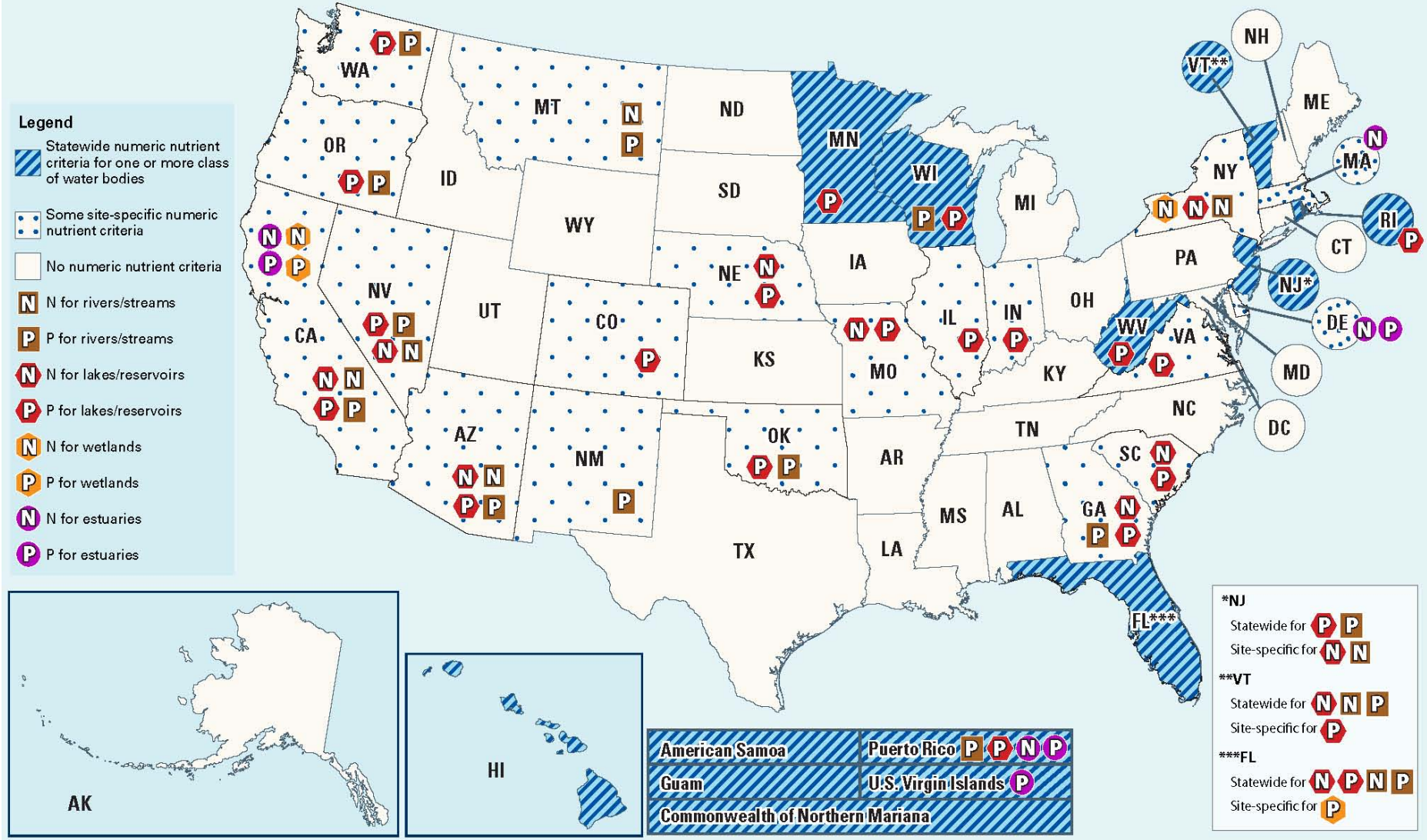
NYSDEC , Division of Water
September 19, 2012

August 2012

Progress Toward Clean Water Act Adopted Numeric Nutrient Criteria



NNC Summary

- Numeric nutrient criteria are needed to translate narrative standards to tradable loads
  - Already lots of nutrient impaired waters
  - Credible NNC will increase the number of impaired streams that are bottlenecks to trading
  - Phosphorus is limiting in fresh water (impairments)
- Response variables are better indicators of use attainment, but complicate analysis of new loads
  - While TP levels are still important for new discharges, need to consider prediction uncertainty of response
  - Need to consider all designated uses

Why the Concern About Nutrients ?

Water Supply

University of Toledo

www.dlwc.nsw.gov.au

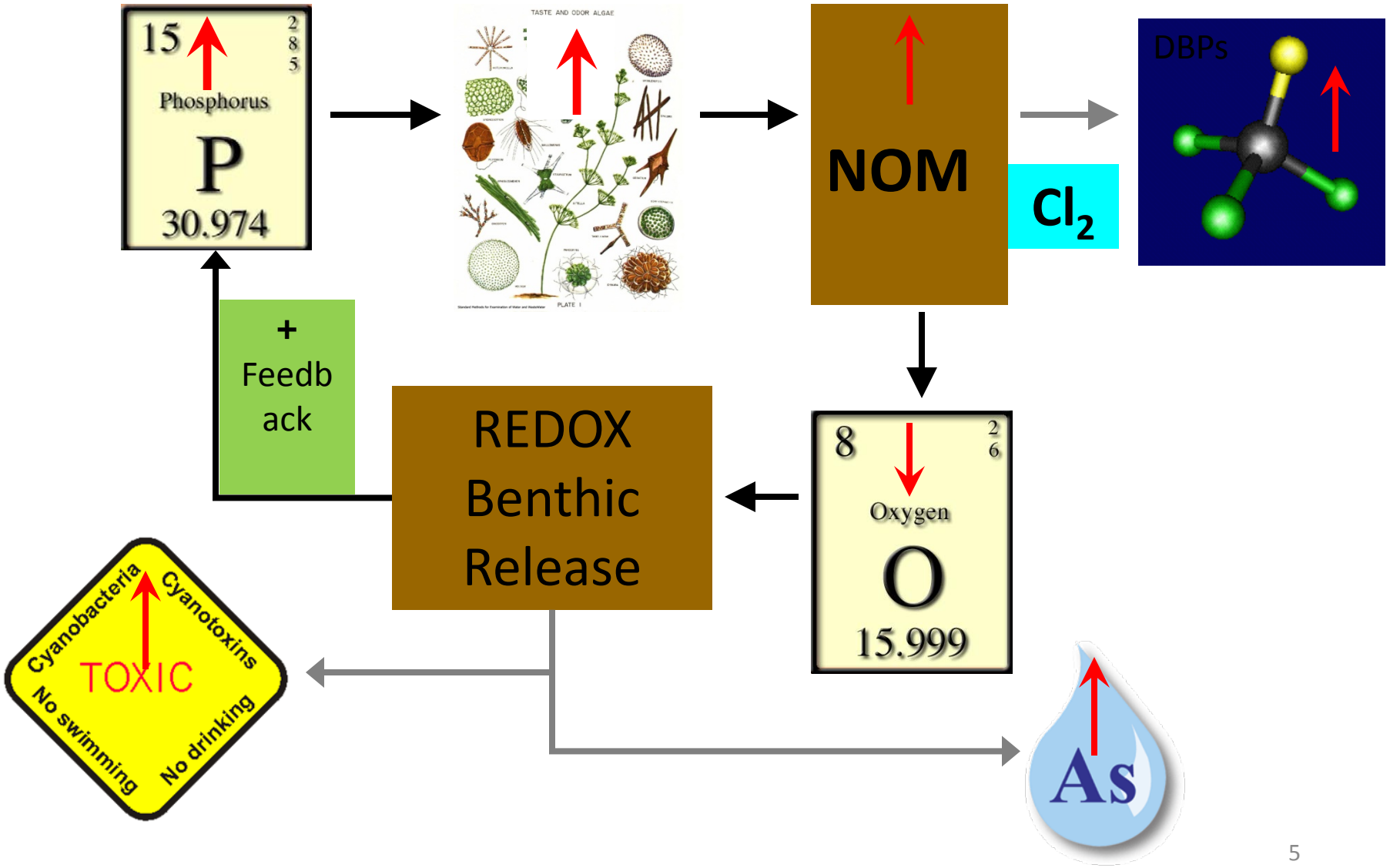
Recreation

www.cig.ensmp.fr

Aquatic Life

www.initrogen.org

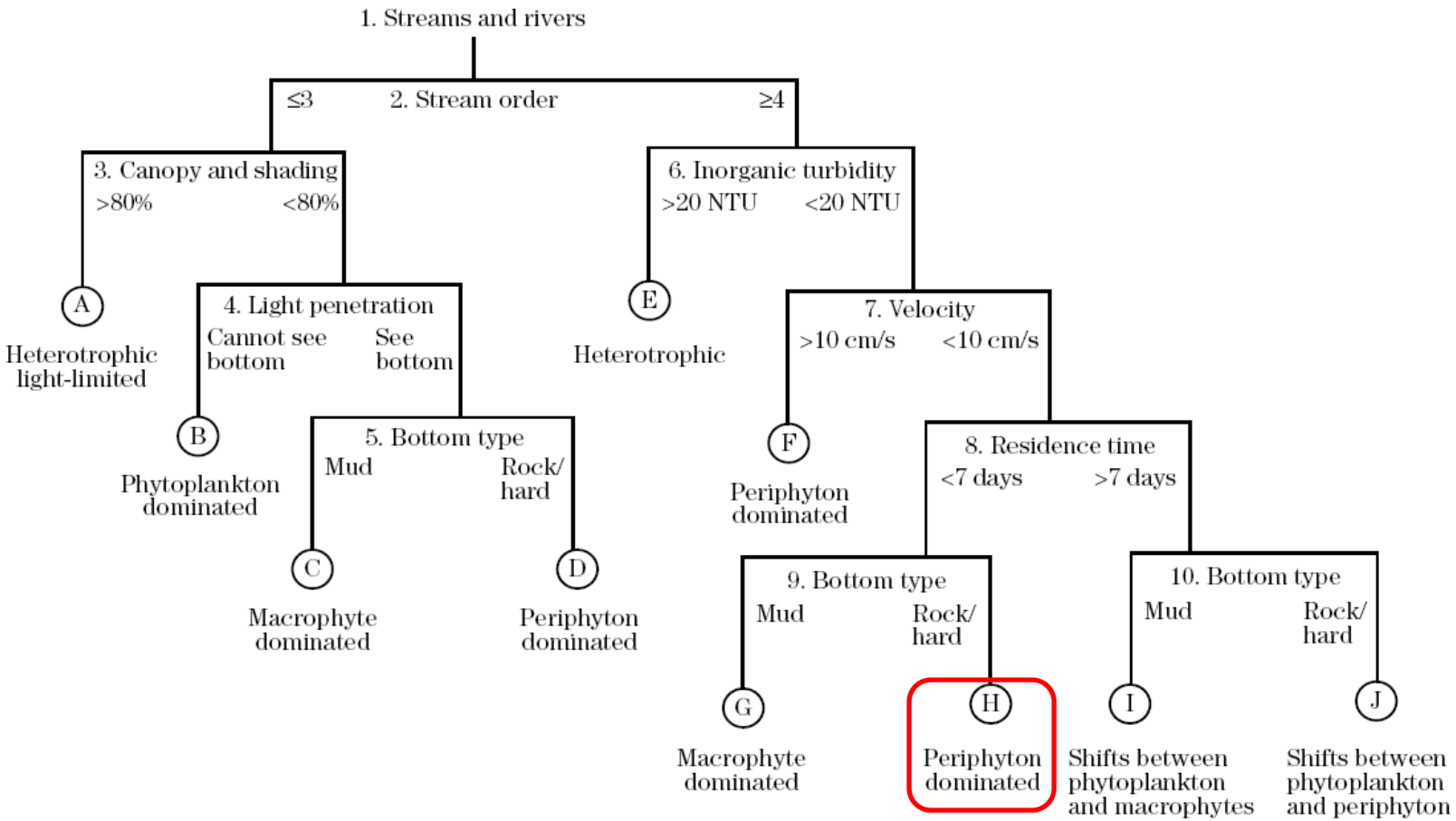
Conceptual Model & WHY Phosphorus is Important for Protection of Drinking Water Use



A Procedure to Estimate the Response of Aquatic Systems to Changes in Phosphorus and Nitrogen Inputs

NRCS, 1999

Figure 4 Classification key structure



A Procedure to Estimate the Response of Aquatic Systems to Changes in Phosphorus and Nitrogen Inputs

NRCS, 1999

System H—Periphyton-dominated large stream or lake

	Increased loading	Decreased loading
Phosphorus	Sensitive	Sensitive
Nitrogen	Potentially sensitive	Potentially sensitive

System functioning: These systems do not have sufficient residence time to allow phytoplankton populations to establish and are clear enough to support periphyton growth. The substrate is hard and not optimal for macrophytes. Periphyton, therefore, are the dominant type of producer.

Management considerations: These systems are highly susceptible to inputs that continually enter the system. Periphyton make efficient use of low concentrations of soluble P or N in water. Sediment retention of nutrients will be low so the system should quickly respond to reductions in loading.

Monitoring and further analysis: Input of nutrients via surface and ground water is the critical factor for these systems. However, monitoring is complicated by the removal of nutrients from the water column by periphyton. Loads can be estimated by monitoring water concentrations during periods when algae are not growing. However, the sampling should be as representative as possible of growing season conditions. Ground water concentrations and discharge may be important.

Effective Phosphorus Loading

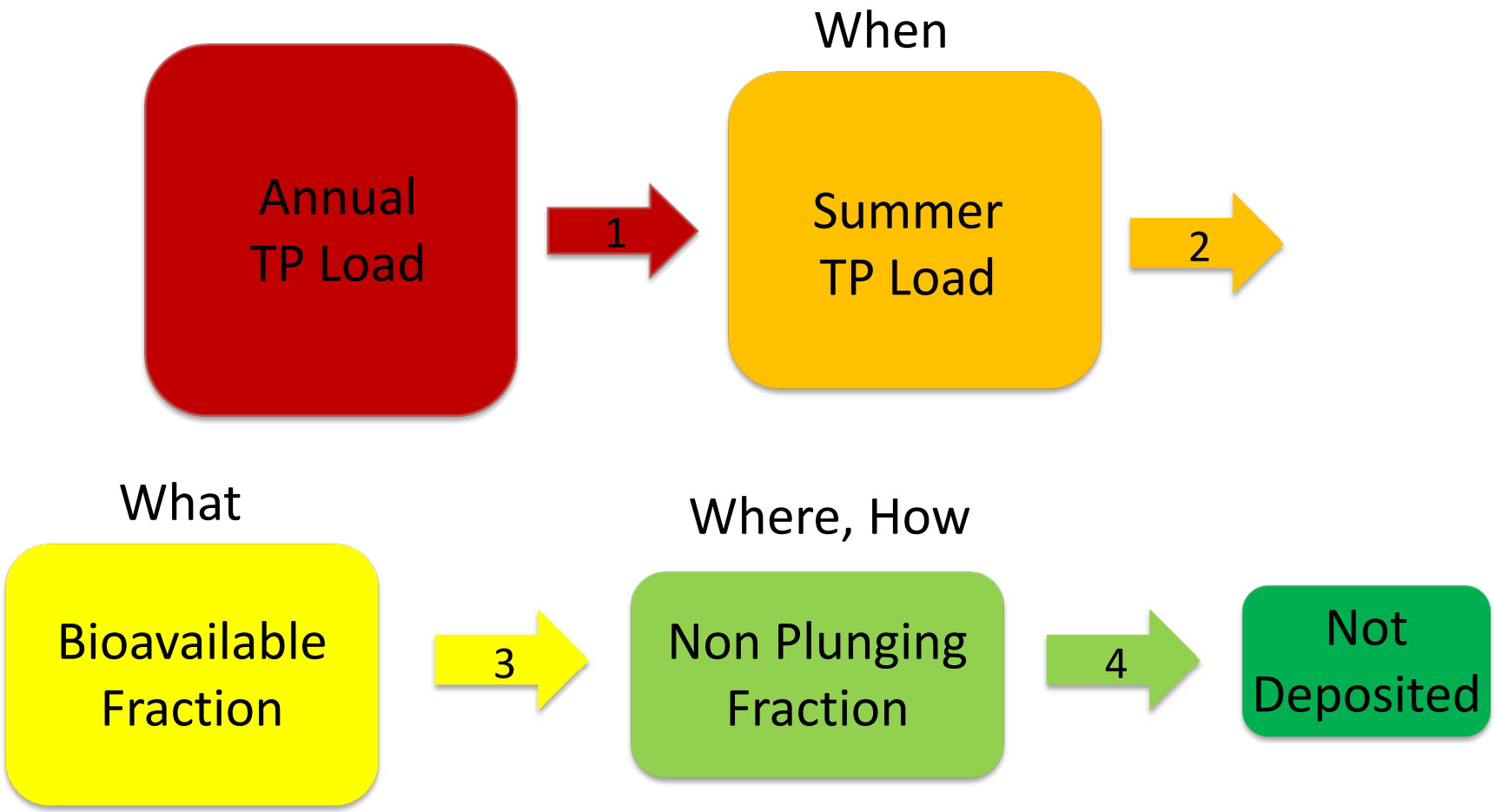
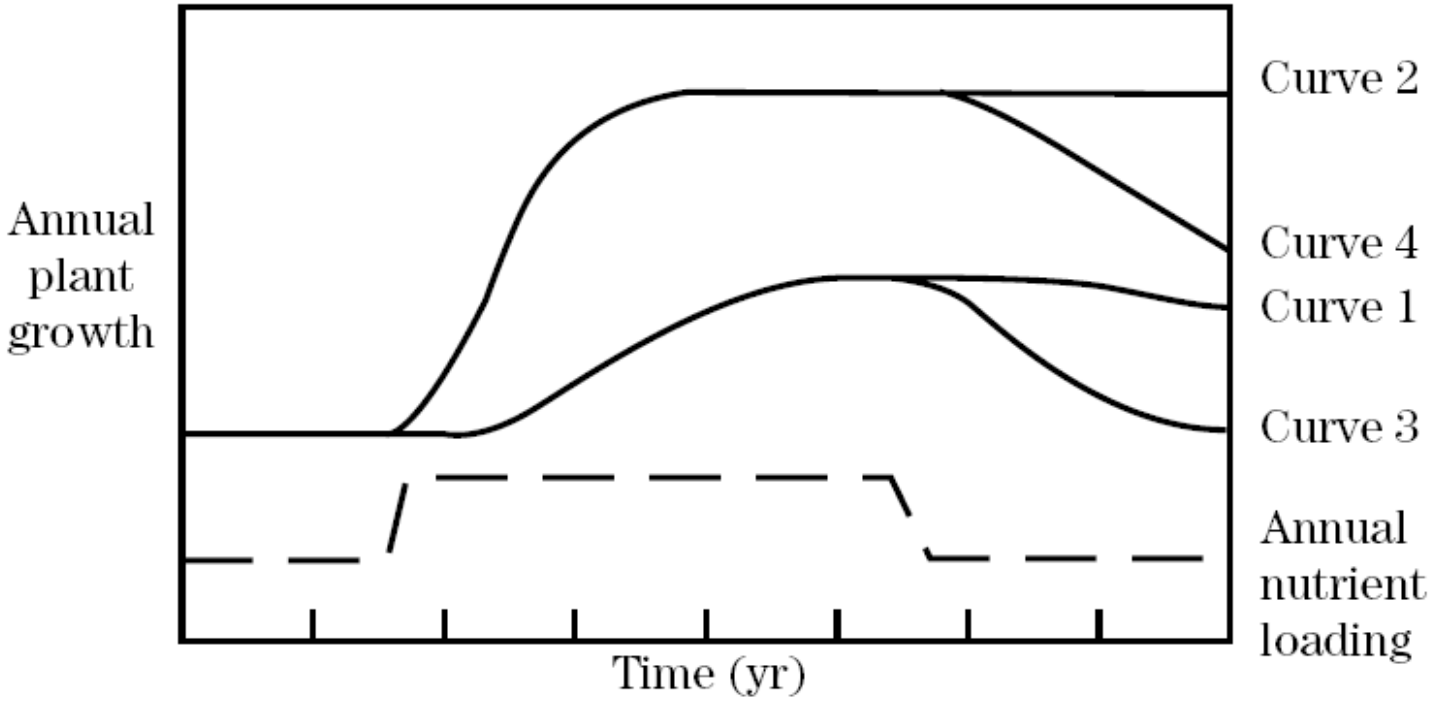


Figure 1 Potential responses of aquatic systems to changing nutrient loading



		Sensitivity to loading increase	
		Low	**High**
Sensitvity to loading decrease	**Low**	Curve 1	Curve 2
	High	Curve 3	Curve 4

New York State Nutrient Standards Plan
(Revised July 7, 2011)
http://www.dec.ny.gov/chemical/77704.html.

- Nutrients are currently regulated in NYS by a **narrative water quality standard** rather than a numeric standard.
  - *None in amounts that result in the growths of **algae**, weeds and **slimes** that will **impair** the waters for their best **usages**.*
- DEC is currently working to identify nutrient criteria values -- initially focusing on **phosphorus** in fresh waters -- that are protective of water quality needed to support designated uses in New York State.
  - The scientific and technical basis for the draft specific criteria as well as **implementation plans** are expected to be released in 2012
  - A formal nutrient criteria proposal is not expected until 2013.

National Association of Clean Water Agencies Nutrient Summit

Outcomes and Issue Paper, March 2011

Recommendations for Improving Current Approaches

- 1) Range of Approaches for Establishing Criteria and Selection of Controls Must Be Available
  - point source controls based on
    - reasonable potential determinations (for un-impaired waters)
    - TMDL waste load allocations for impaired waters.
  - Cause –>effect relationship: Stressor (P) ->Response *(algae)*
  - Technology based effluent limits *(KS, WI hybrid approach)*
    - *E.g., 1 mg/l TP as has been the requirement in Great Lakes*
- 2) Goal Implementation Should Be Achieved Through Adaptive Management (water quality and technology-based approaches)

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Recommendations for Improving Current Approaches

- 3) Flexible Permit Limit Expression Needed
  - *Short term (daily, monthly) inappropriate*
  - *Seasonal variability, connect to stream flow?*
  - *Bio-available phosphorus (nutrient simulation zones)?*
- 4) Cost and Benefit Considerations Must Be Effectively Incorporated
- 5) Know Your Waters – Monitoring Programs Must Be Sufficiently Robust
  - *Biological impact (algae, macro-invertebrates)*
  - *Full range of stressors (habitat loss, tree canopy, flow modifications)*
  - *Bio-available phosphorus (from various WWTP processes – WERF study)*

National Association of Clean Water Agencies Nutrient Summit

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Recommendations for Improving Current Approaches

- 6) Uses of Waterbodies Must Be Evaluated
  - *Drinking water use (Lakes near proposal, Rivers in research stage)*
  - *Aquatic life being developed (will likely be driver for most streams)*
  - *Recreational (Anacostia decision)*
- 7) Existing Tools Need Added Clarity and Improvement
  - Adaptive Implementation; compliance schedules
  - Watershed based permitting *(bubbles, PS to PS trading, N:P exchanges)*
  - Variances (time to allow technology to develop)
- 8) Nonpoint Sources Must Participate in a Meaningful Fashion
  - *MS4 and CAFO permits require significant actions to address nutrients*
  - *State law: dishwasher detergent P ban; lawn fertilizer restrictions*

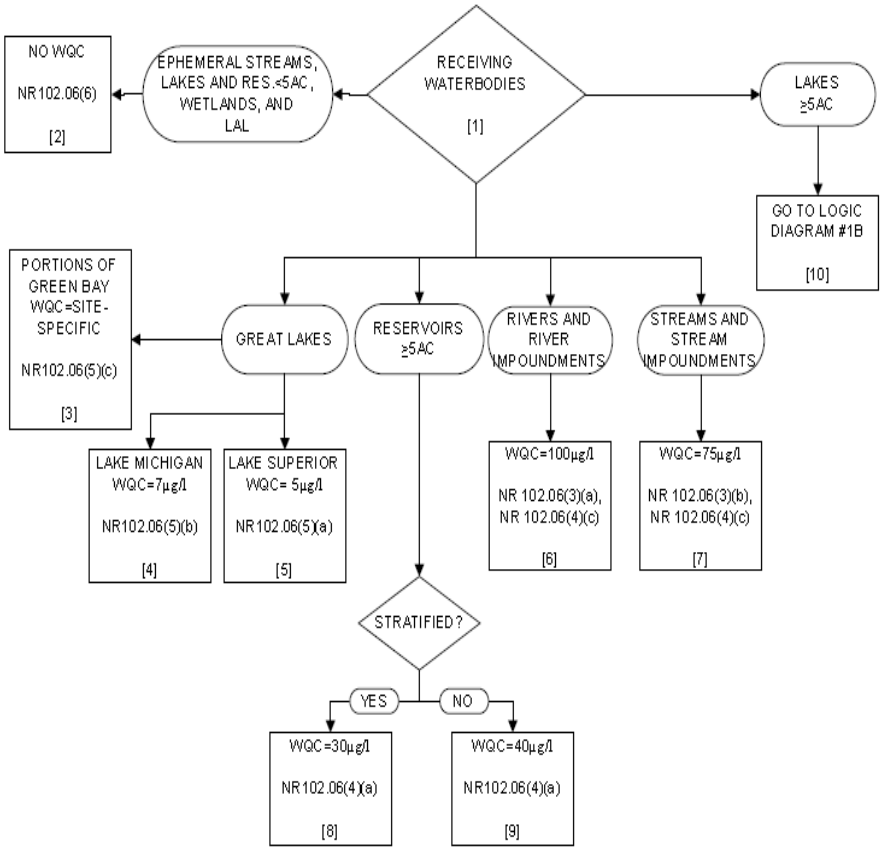
WWTP Statistics

Provisional, Subject to Verification (delivery factors/ trading ratio to change)

FACILITY	AVERAGE FLOW (MGD)	95th % FLOW (MGD)	DESIGN FLOW (MGD)	90Q10 FLOW (cfs)	DILUTION RATIO	TN DELIVERY FACTOR	P:N Trading Ratio?
	0.45	0.60	0.6	0.64	2.7	0.32	19
	0.39	0.61	1.0	1	2.7	0.12	51
	0.51	0.79	0.85	2.2	5	0.49	13
	2.20	3.00	4.0	18	8	0.22	28
	5.40	8.80	9.0	54	10	0.54	11
	7.70	9.80	12.0	173	23	0.44	14
	0.57	0.93	1.75	26	24	0.37	17
	19.90	28.20	35, 45, 60	313	25	0.59	10
	6.20	11.20	12.0	173	29	0.44	14
	2.00	2.40	2.37	57	37	0.55	11
	0.30	0.62	0.7	24	54	0.22	28
	7.40	10.00	10.0	345	54	0.56	11
	2.20	3.60	4.0	139	55	0.45	14
	0.64	0.69	1.0	39	61	0.22	28
	1.00	1.22	0.9	39	68	0.37	17
	1.40	1.90	3.08	181	91	0.44	14
	0.17	0.25	0.42	25	93	0.27	23
	0.23	0.33	0.43	38	138	0.53	12
	0.60	0.90	0.67	73	162	0.35	18
	0.50	0.74	1.7	212	194	0.49	13
	0.21	0.29	0.45	75	233	0.55	11
	0.43	0.52	0.75	139	288	0.23	15
	0.17	0.23	0.5	134	416	0.44	14
	0.54	0.64	0.8	226	438	0.58	11
	0.96	1.41	2.0	659	518	0.6	10
	0.38	0.53	1.0	659	1020	0.6	10
	0.50	0.53	0.85	659	1200	0.6	10
	0.73	0.85	0.85	663	1208	0.56	11

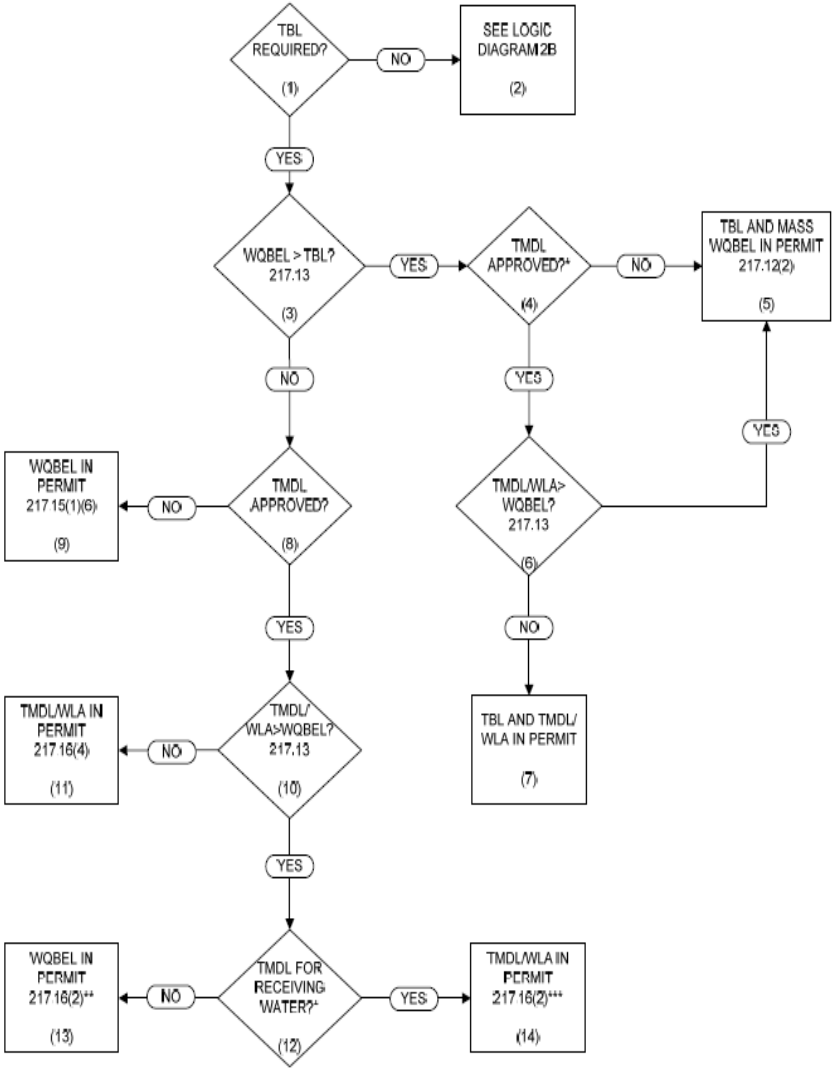
LOGIC DIAGRAM 1

DETERMINING APPLICABLE TOTAL PHOSPHORUS WATER QUALITY CRITERIA (WQC)

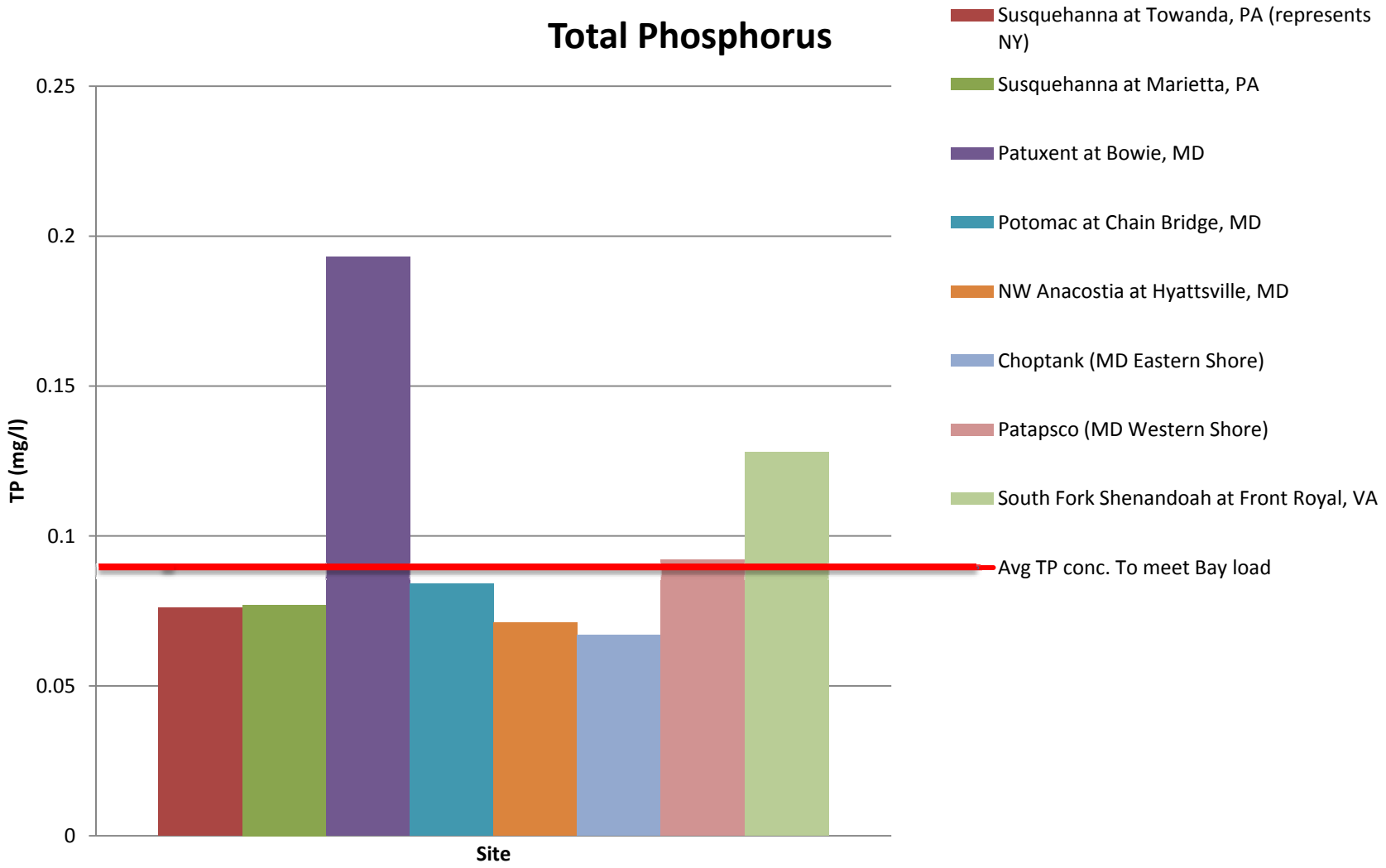


LOGIC DIAGRAM 2

Selecting Effluent Limits for Existing Dischargers



Some CBP watershed perspective on NNC (monitored TP in Rivers)



Considerations for new discharges

- WQS Not Attained (@ proposed discharge and downsteam segments)
  - TMDL for that segment and downstream
  - No TMDL (Is there enough offset?)
- WQS Attained (40 C.F.R. 122.4(i)
  - **No permit may be issued to a new source** or a **new discharger** if the discharge from its construction or operation will ***cause or contribute*** **to the violation of water quality standards.**

Wisconsin Guidance:

http://dnr.wi.gov/topic/surfacewater/phosphorus.html

- A **new** discharge of phosphorus to a **phosphorus impaired** water may not be permitted unless:
  - 1) it is allocated in the reserve capacity of a U.S. EPA approved **TMDL**;
  - 2) the discharge will improve the phosphorus water quality; or
  - 3) a trade or other means of **offsetting** the phosphorus contained in the discharge has been implemented prior to initiating the discharge.
- Note: In order for a trading scheme to occur to allow a new phosphorus discharge on an impaired water, a comprehensive phosphorus cap must first be developed. Absent a U.S. EPA approved TMDL, the new discharger and Department may need to work collaboratively to determine what the appropriate phosphorus **cap** would be for the **receiving and downstream** water.
- A discharge to a flowing waterbody that has a phosphorus concentration which is **less than** or equal to the water quality criteria of the phosphorus impaired segment will be considered an improvement of the phosphorus water quality.
- A new discharge must meet the phosphorus limits upon initiation of the discharge. No compliance schedule (or variance) can be provided in the discharge permit.

Water Quality Based Effluent Limit to a steam currently meeting WQS

Option 2: Change in concentration analysis for LAL tributary with one phosphorus discharge

A "change in concentration" analysis quantifies the potential for a phosphorus load (mass) to change receiving water concentrations. In this case, the phosphorus load is the discharge to the LAL tributary and the "receiving water" of interest is the stream or river segment downstream with applicable water quality criteria. For this calculation, the design capacity of the facility, the phosphorus effluent concentration, and ambient conditions of the downstream segment with the applicable criterion must be know.

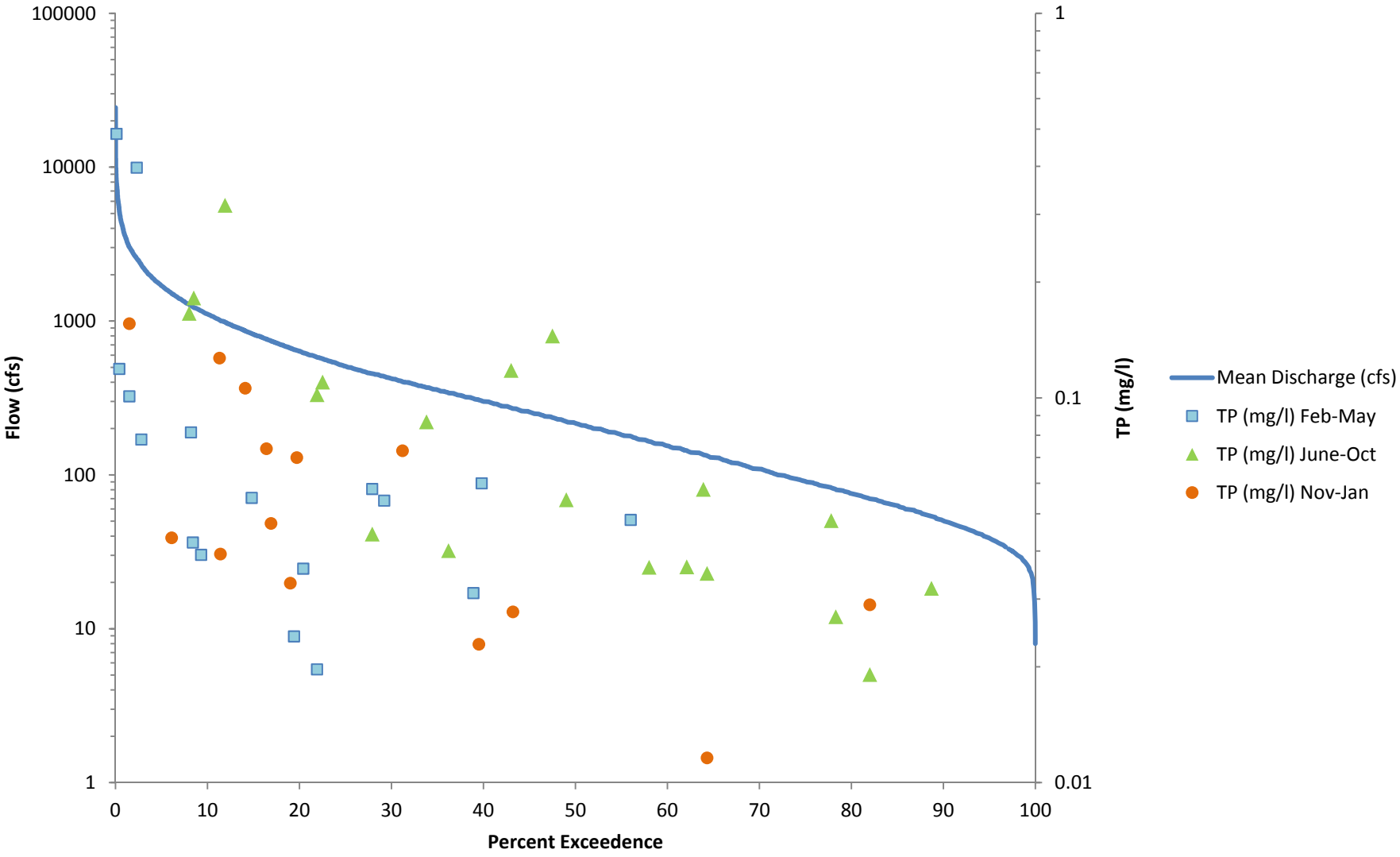
Using this data, it is possible to calculate the projected phosphorus concentration (Cr) of the downstream stream or river segment:

$$Cr = [Cs * Qs + Ce * Qe] / [Qs + Qe]$$

Where:

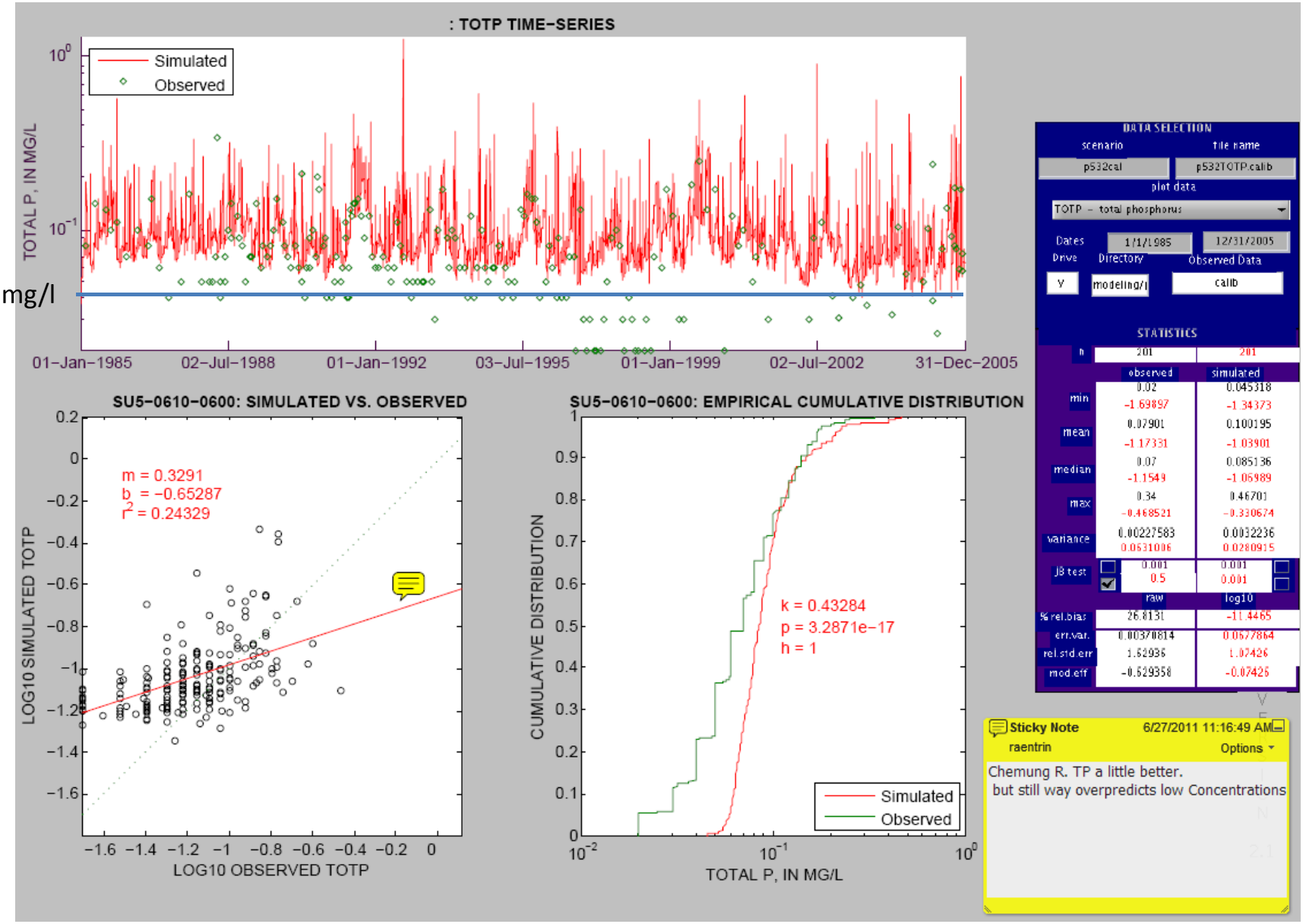
Cr	=	Concentration in "receiving water" downstream of LAL tributary
Cs	=	Concentration in "receiving water" upstream of the LAL tributary
Ce	=	Concentration in effluent discharged
Qs	=	7Q2 or 30Q3 of "receiving water" upstream of the LAL tributary
Qe	=	Design average annual flow for facility

Cohocton River near Campbell, NY
Flow Duration Curve
USGS Gage 01529500



WSM 5.3.2 TP calibration for Chemung River

0.04 mg/l



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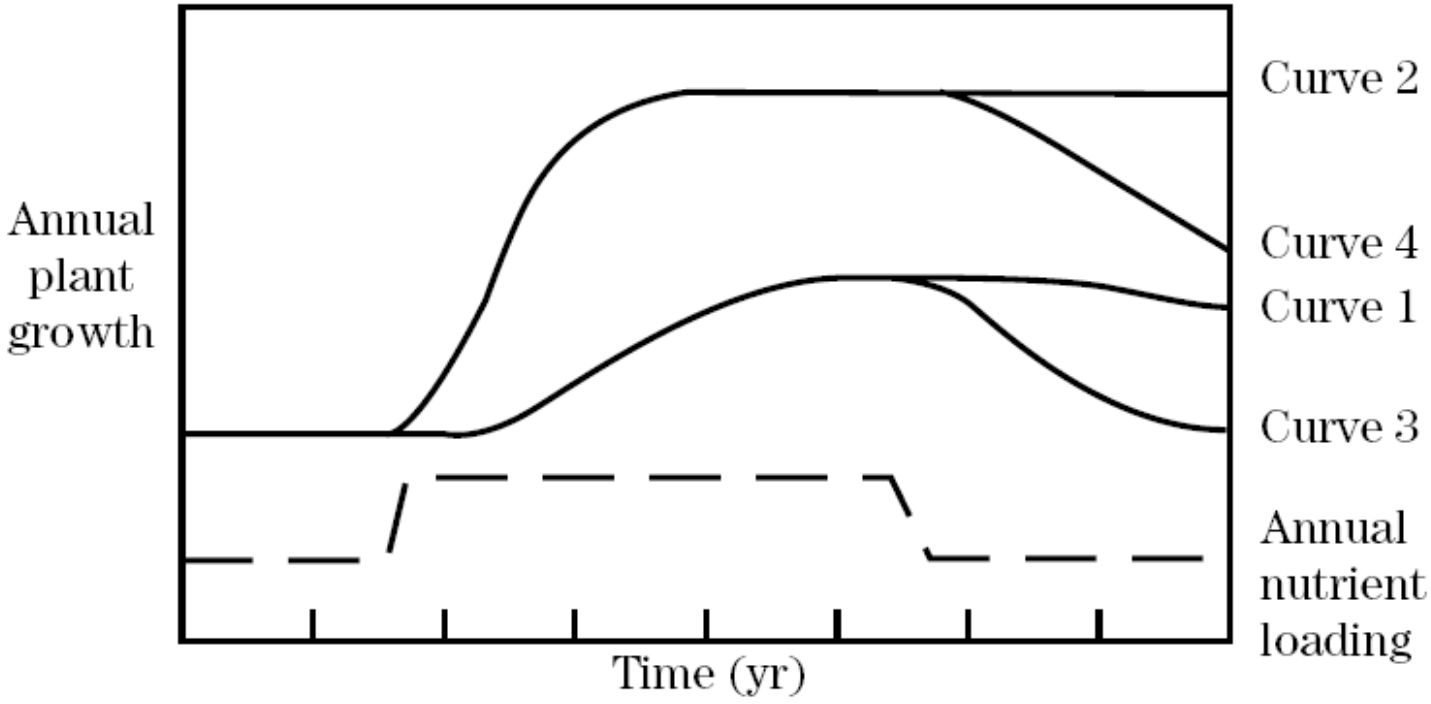

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New Permit Matrix

(example under consideration- do not cite or quote)

Table 4.3: Matrix for new permits and permit modifications with nutrient load expansion

Total Phos./Chl-a Status	Chl-$a_{(A)}$ < Chl-*a* Criteria	Chl-$a_{(A)}$ > Chl-*a* Criteria
$TP_{(A)} < TP_{(UC)}$	**A**: $TP_{(UC)}$ = target	**E**: WQAC endpoint = TBD
$TP_{(UC)} < TP_{(A)} < TP_{(BF)}$	**B**: $TP_{(BF)}$ = target	**F**: WQAC endpoint = $TP_{(UC)}$
$TP_{(BF)} < TP_{(A)} < TP_{(LC)}$	**C**: $TP_{(BF)}$ = target; Cap & Mon.	**G**: WQAC endpoint = $TP_{(BF)}$
$TP_{(A)} > TP_{(LC)}$	**D**: $TP_{(BF)}$ = target; Cap & Mon.	**H**: WQAC endpoint = $TP_{(BF)}$

WQAC: water quality assimilative capacity

$TP_{(A)}$: Ambient total phosphorus concentration

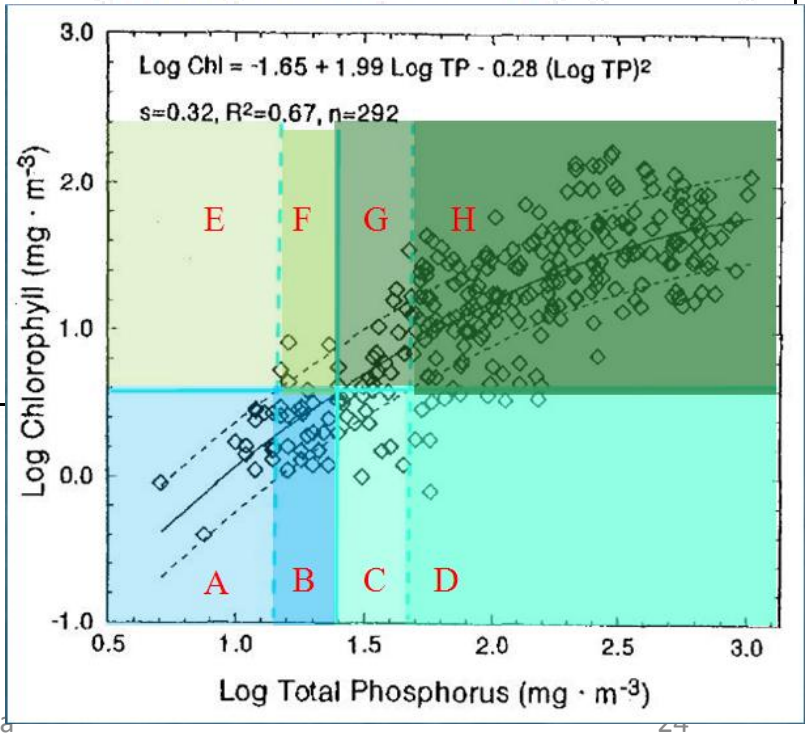
$TP_{(LC)}$: Lower confidence band threshold concentration

$TP_{(UC)}$: Upper confidence band threshold concentration

$TP_{(BF)}$: Best fit (regression) threshold concentration

Chl-$a_{(A)}$: Ambient chlorophyll-*a* concentration

TBD: To be determined based upon further study



Offsets for septic hookup
WWTP service extension; *MS4 IDDE?*

- Nitrogen credits
  - MD, PA, VA, WV (loads vary: 4.6 – 25 lb TN/unit/y)
  - WSM 5.3.2 average EOS load for NY (8.2 lb TN/unit/y)
- Phosphorus credits
  - WSM 5.3.2 does not recognize TP load from septics
    - (if you will buy that, NY has a bridge for sale)
  - NY estimates septic TP load in Lake TMDLs
    - Failing systems (surfacing effluent)
    - Inadequate systems
      - Distance to lake or stream
      - Depth to water table
      - Inadequate design (age)

NNC Summary

Take-home message to "would-be traders"

- Numeric nutrient criteria are needed to translate narrative standards to tradable loads
  - Already lots of nutrient impaired waters
  - Credible NNC will increase the number of impaired streams that are bottlenecks to trading
  - Phosphorus is limiting in fresh water (impairments)
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