Development of Statewide Nutrient Standards Impacts to Wastewater Treatment

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EPA Mandate

- **1996 – states must adopt numeric nutrient criteria for surface waters**
- **Narrative standards do not adequately identify or protect problem waterbodies**
- **Nutrient pollution causes harmful algal blooms**
  - **Toxic algal events**
  - **Depleted dissolved oxygen**
- **Required a "Nutrient Criteria Development Work Plan"**

Work Plan

- Reservoirs
  - June 2010 TCEQ adopted criteria for chlorophyll *a* for 75 reservoirs
  - Still under EPA review
- Streams – In progress
- Triennial Standards Review will only include revision to nutrient work plan
  - No new nutrient criteria will be proposed
- Additional criteria may be considered around the 2016-2017 calendar years

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Implementation Plan

- **Draft 2012 IP Plan available at: http://www.tceq.texas.gov/assets/public/permitting/waterquality/standards/docs/2011draft-impprocedures.pdf**
- **Defines procedures used by TCEQ to apply water quality standards to TPDES permit**
- **Procedures based on location of discharge**
  - **Reservoir**
  - **Surface water**

Nutrient Standard Applicability

- **New or expanding domestic discharges**
  - **All will be evaluated for total phosphorus (TP) and total nitrogen (TN)**
  - **Will receive effluent limit if warranted**
- **Industrial Discharges**
  - **Evaluation depends on operation**
  - **May be subject to limitations on TP and/or TN**

Initial Assessment

- **General Guidelines**
- **Comprehensive, site-specific screening**
  - **Very detailed**
  - **Multi-step**

General Procedure - Reservoirs

- Generally focusing on TP limits
- Main Body or Near Reservoir
  - New/expanding discharges ≥1 MGD
- Shallow or Restricted Coves
  - New/expanding discharges ≥0.25 MGD
- Watershed rules or other specific regulatory requirements (TMDL, 305b)
- Smaller discharges will be evaluated if discharge is into a sensitive area.

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General Procedure - Streams

- **Generally focusing on TP limits**
- **New/expanding discharges ≥0.25 MG**
  - **Perennial, shallow, clear streams with rocky bottoms**
  - **Long, shallow, clear streams with perennial impoundments**
- **Watershed rules or other specific regulatory requirements (TMDL, 305b)**
- **Smaller discharges will be evaluated if discharge is into a sensitive area.**

Typical TP Effluent Limits

Permitted Flow (MGD)	TP Limit (mg/L)
<0.5	1.0
0.5-3.0	1.0 to 0.5
>3.0	0.5

Determining What it Means to Individual Dischargers

- Impact highly variable
- New v. Retrofit Existing
- Download IP Plan and perform evaluation to determining likelihood of receiving a standard in your permit
- Current Level and Type of Treatment
  - Nitrification
  - Denitrification
- Level of Removal Needed
  - Need to determine current TP loading

When Will Nutrient Criteria Impact Permits

- **Not sure**
- **Nutrient limits and/or monitoring requirements in some permits already**
- **Expect more during this round of permitting**
- **Do not have indication on how quickly TCEQ expects plants to meet requirements**

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Other Things to Consider

- **Plant capacity restraints**
- **Property restraints**
- **Energy costs**
- **Operational Controls**
  - **Automation**
  - **More staff time**
  - **More staff training**

Biological Nutrient Removal (BNR)

- **Most current facilities remove ammonia**
- **Some also remove nitrate**
- **Very few designed to remove phosphorus**
- **If you can achieve permit limits, BNR seems to be most cost effective**

Nitrogen (N) Removal through BNR

- Nitrification
  - Removes ammonia
  - Aerobic conditions
- Denitrificaion
  - Removes nitrate
  - Anoxic conditions
- Solids Separation
  - Removes particulate organic N
- No common removal mechanism for soluble organic nitrogen

Phosphorus (P) Removal through BNR

- **Removal of TP requires removal of both particulate and soluble P**
- **Particulate P**
  - **Solids separation**
- **Soluble P**
  - **Phosphate-accumulating organisms**
- **Must have an anaerobic zone free of dissolved oxygen and nitrate**
- **May require construction of additional treatment chamber**

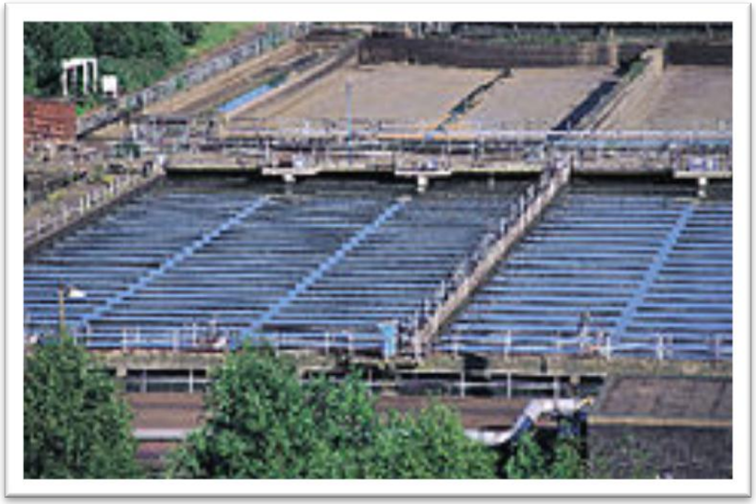
P Removal through Chemical Precipitation

- **Aluminum and iron coagulants**
- **Lime**
- **Has higher operating costs than BNR**
- **Produces more sludge with more chemicals = increased disposal costs**

Ultra Low Levels of P

(≈0.1 mg/L)

- May require a combination of BNR and chemical precipitation
- Sand or other filtration may be necessary to remove additional particulate P
- May require advanced treatment



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New Facilities

- More flexibility
- Can be designed to target specified levels of effluent quality

Retrofit

- May be constrained by existing land available and existing treatment units and sludge handling procedures
- Need to Consider
  - Aeration basin size and configuration
  - Clarifier capacity
  - Type of aeration system
  - Sludge processing units
  - Operator skill

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Costs

- New plant costs based on estimated influent quality, target effluent quality and available funding
- Retrofit costs are site-specific and vary considerably
- Costs based on discharge size and limit
  - Larger = more cost effective
  - Smaller limit = more expensive
- Cost increase no longer associated with population growth

Average Unit Capital Costs for BNR Upgrades

Maryland and Connecticut

Flow (mgd)	Cost/mgd (2006$)
>0.1 – 1.0	$6,972.000
>1.0 – 10.0	$1,742.000
>10.0	$588.00

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Montana

Estimated Costs to Reduce TN to 5.0 mg/L and TP to 0.5 mg/L

Cost	Annual Average Cost Flow			
	0.1 MGD	1.0 MGD	10 MGD	30 MGD
Capital	$241,000	$1,112,00	$4,927,000	$12,383,000
O&M	$7,046	$29,218	$157,469	$293,938

Estimated Costs to Reduce TN to 3.0 mg/L and TP to 0.1 mg/L

Cost	Annual Average Cost Flow			
	0.1 MGD	1.0 MGD	10 MGD	30 MGD
Capital	$312,000	$1,268,000	$9,620,000	$26,520,000
O&M	$22,993	$69,925	$311,634	$841,120

Utah

- To remove P to 1.0 mg/L
  - Statewide capital cost to upgrade = $24 million
  - Average monthly bill for residents would increase 7.1% or $1.19/month
  - Costs over 20 years (capital and O&M) = $114 million

Estimated Cost of Phosphorus Reduction to 1 mg/L TP at Six WWTPs Discharging to the North Bosque River

City	Permitted Discharge (mgd)	Effluent TP (mg/L)	Capital Cost ($)	O&M Cost ($/yr)	Base Residential Bill ($/mo)	Additional Treatment Cost ($/mo)	Revised Residential Bill ($/mo)	% Increase to Monthly Residential Bill
Stephenville	3.00	2.69	$786,288	$64,413	$20.69	$1.19	$22.88	11%
Clifton	0.65	2.40	$979,000	$14,775	$22.00	$3.77	$25.77	17%
Meridian	0.45	3.36	$2,290,860	$31,191	$18.64	$14.73	$33.37	79%
Hico	0.20	3.52	$825,000	$9,215	$12.00	$7.77	$19.77	65%
Valley Mills	0.36	3.14	$957,000	$20,154	$8.00	$12.02	$20.02	150%
Iredell	0.05	2.96	$792,100	$7,518	$15.14	$25.43	$40.57	168%

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Other Strategies to Consider

- **Treatment wetlands**
  - **Tarrant Regional Water District**
  - **North Texas Municipal Water District**
- **Watershed strategies/coalitions**
- **Reuse/No Discharge**
  - **Lake Travis Water Quality Area**
  - **Lake Austin Water Quality Area**

John Bunker Sands Wetlands – North Texas Municipal Water District

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References for Cost Data

- USEPA – Biological Nutrient Removal and Costs
  http://www.nj.gov/dep/wms/bwqsa/EPA%20-Biologicl%20nutrient%20removal%20processes&costs.pdf
- Montana Department of Environmental Quality – Wastewater Treatment Performance and Cost Data to Support an Affordability Analysis for Water Quality
  http://www.deq.mt.gov/wqinfo/Standards/default.mcpx
- Utah Division of Water Quality - Statewide Nutrient Removal Cost Impact Study
  http://www.waterquality.utah.gov/POTWnutrient/
- Keplinger et al. - Cost and Affordibility of Phosphorus Removal at Small Wastewater Treatment Facilities
  http://www.nesc.wvu.edu/pdf/ww/publications/smallflows/magazine/sfq_fa04.pdf