WQBELs Part II:
Characterizing the Effluent and Receiving Water

NPDES Permit Writers' Course
Online Training Curriculum

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Establishing WQBELs in NPDES Permits

Part I: Identifying the Applicable Water Quality Standards

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Part II: Characterizing the Effluent and Receiving Water

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Part III: Determining the Need for Chemical-specific WQBELs

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Part IV: Calculating Chemical-specific WQBELs

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Components of Water Quality Standards

- Components of water quality standards include:
  - Designated uses [§ 131.10]
  - Water quality criteria [§ 131.11]
  - Antidegradation policy [§ 131.12]
  - General policies [§ 131.13] (optional)

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WQS Implementation Procedures

- Water quality standards and their implementing procedures (including NPDES requirements) specify methods for determining the need for WQBELs and for calculating WQBELs that ensure that standards are attained.
- Where can these methods be found?
  - state regulations
  - state water quality management plans
  - state guidance
  - EPA's *Technical Support Document*

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Characterize the Effluent and Receiving Water

Step 1: Identify Pollutants of Concern

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Step 2: Determine Whether Consideration of Dilution and Mixing is Allowed by WQS

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Step 3: Select an Approach to Model Effluent and Receiving Water Interaction

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Step 4: Identify Critical Conditions for Effluent and Receiving Water Modeling

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Step 5: Establish Appropriate Dilution Allowance or Mixing Zone for Each Pollutant of Concern

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Step 1: Identify Pollutants of Concern

- Pollutants of concern (POCs) are any pollutants or pollutant parameters that:
  - permit writer has reason to believe are or may be discharged by the facility, and;
  - could affect or alter the physical, chemical, or biological condition of the receiving water
- POCs are not limited to those parameters covered by technology standards

What information does the permit writer have to build the list of POCs?

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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
  - with an applicable TBEL

§ 433.14 Effluent limitations representing the degree of effluent reduction attainable by applying the best available technology economically achievable (BAT).

(a) Except as provided in 40 CFR 125.30 through 125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by applying the best available technology economically achievable (BAT):

BAT EFFLUENT LIMITATIONS

Pollutant or pollutant property	Maximum for any 1 day	Monthly average shall not exceed
	Milligrams per liter (mg/l)	
Cadmium (T)	0.69	0.26
Chromium (T)	2.77	1.71
Copper (T)	3.38	2.07
Lead (T)	0.69	0.43
Nickel (T)	3.98	2.38
Silver (T)	0.43	0.24
Zinc (T)	2.61	1.48
Cyanide (T)	1.20	0.65
TTO	2.13	....

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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
  - with an applicable TBEL
  - ***with a WLA from a TMDL or watershed analysis***

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Total Maximum Daily Load (TMDL)

- CWA section 303(d)(1)
  - requires states, territories, and tribes to identify waters that will not achieve water quality standards after implementation of technology-based limitations
  - requires ranking of identified waters based on severity of pollution and uses
  - requires TMDLs in accordance with priority ranking

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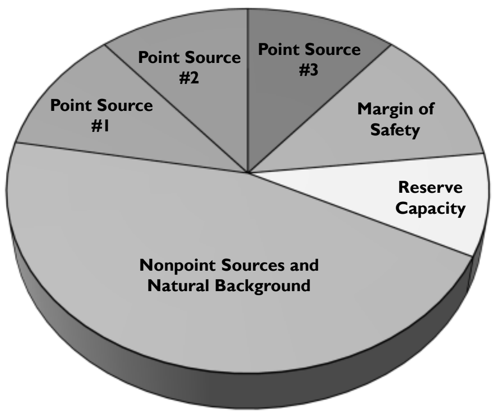
Components of TMDL

TMDL for Pristine Creek – Pollutant X



TMDL = ∑WLA + ∑LA + Margin of Safety (also may include Reserve Capacity)

- Wasteload allocations (WLAs) are assigned to each point source discharge
- Load allocations (LAs) are assigned to nonpoint sources
- WLAs and LAs are established so that predicted receiving water concentrations do not exceed water quality criteria
- Margin of safety ensures that water can attain designated uses
- Reserve capacity may be included to account for new or expanded discharges

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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
  - with an applicable TBEL
  - with a WLA from a TMDL or watershed analysis
  - ***identified as needing WQBELs in the previous permit***

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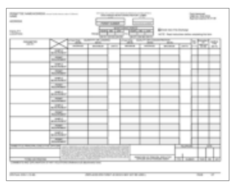
Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
  - with an applicable TBEL
  - with a WLA from a TMDL or watershed analysis
  - identified as needing WQBELs in the previous permit
  - ***identified as present in the effluent through monitoring***



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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
  - with an applicable TBEL
  - with a WLA from a TMDL or watershed analysis
  - identified as needing WQBELs in the previous permit
  - identified as present in the effluent through monitoring
  - ***otherwise expected to be present in the discharge***

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Characterize the Effluent and Receiving Water

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Step 2: Dilution and Mixing Zones in WQS

- Water quality standards:
  - generally allow dilution and mixing zones in applying water quality criteria
  - specify situations in which dilution and mixing zones may not be used

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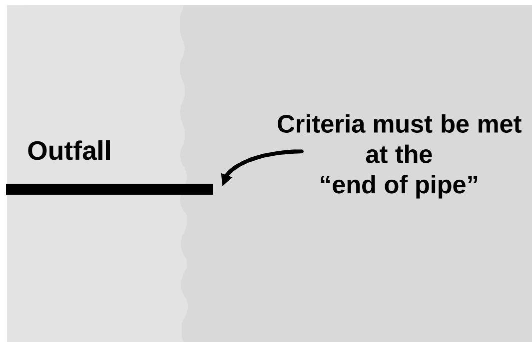
If Dilution or Mixing Zone <u>is not</u> Allowed by WQS

Where water quality standards **do not allow** consideration of dilution or mixing zones, water quality criteria must be attained at the **point of discharge**



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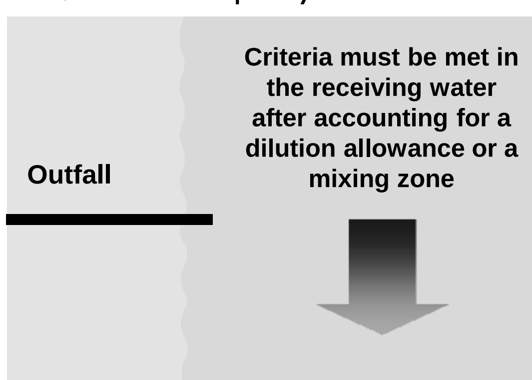
If Dilution or Mixing Zone <u>**is**</u> Allowed by WQS

Where water quality standards **allow** consideration of dilution or mixing zones, the water quality criteria must be met in the receiving water after **accounting for allowable dilution** or at the **edge of the regulatory mixing zone**



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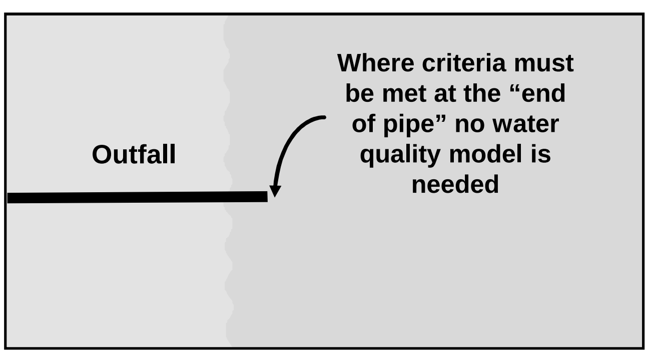
Step 3: Select Modeling Approach

Where dilution or mixing is not considered, no water quality model is needed.



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Step 3: Select an Approach to Model Effluent and Receiving Water Interaction

- Where dilution and mixing and the interaction of the effluent and receiving water are considered, there are two basic modeling techniques:
  - dynamic modeling
  - steady-state modeling

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Dynamic and Steady-State Modeling

Dynamic modeling

- Accounts for **variability** of model inputs
- Projects **probability distributions** rather than a single value based on critical conditions
- **Data intensive and more complex** than steady-state modeling

Steady-state modeling

- Predicts the impact of the effluent on the receiving water for a **single set of conditions**
- Assumes **critical conditions** for flow, pollutant concentrations, and environmental effects
- If criteria are **not exceeded under critical conditions**, the discharge should not cause criteria to be exceeded under other conditions

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Step 4: Identify Critical Conditions for Effluent and Receiving Water Modeling

- Effluent critical conditions:
  - effluent flow
  - effluent pollutant concentrations (pollutants of concern)
- Receiving water critical conditions:
  - receiving water flow (if applicable)
  - background pollutant concentrations (pollutants of concern)
  - hardness (some metals criteria)
  - other receiving water characteristics (e.g., temperature, pH, reaction rates)
- Critical conditions might depend on when impacts are expected to occur (dry weather, wet weather, or both)

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Critical Conditions – Dry Weather

- Water quality standards often identify critical receiving water low flow for rivers and streams [§ 131.13]
- ***Examples*** include:
  - **1Q10 low flow** (acute aquatic life criteria)
  - **7Q10 low flow** (chronic aquatic life criteria)
  - **harmonic mean flow or 30Q5 low flow** (human health criteria)
- Critical conditions other variables (e.g., effluent flow, background pollutant concentrations, etc.) might be specified by water quality standards or permitting procedures

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Critical Conditions – Wet Weather

- Critical flow and other critical conditions assumptions in wet weather likely to be highly site-specific and not defined in water quality standards or permitting procedures
- Considerations:
  - Do discharges occur only during precipitation events?
  - What is the "critical" precipitation event?
  - What are stream conditions during critical precipitation events?
  - What are the duration and frequency of discharges during precipitation events?

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Step 5: Establish Appropriate Dilution Allowance or Mixing Zone for Each Pollutant of Concern

- What type of mixing occurs under critical conditions?
  - rapid and complete mixing
  - incomplete mixing

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Rapid and Complete Mixing

- What is rapid and complete mixing?
  - the type of mixing occurring when the lateral variation in concentration in the direct vicinity of the outfall is small
  - Rapid and complete mixing occurs in rivers and streams under certain conditions
    - assumed
    - demonstrated

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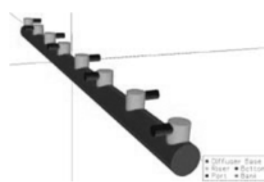
Assuming or Demonstrating Rapid and Complete Mixing



- Assuming rapid and complete mixing
  - **Examples** of situations where some permitting authorities **assume** rapid and complete mixing under critical conditions include:
    - diffuser located across entire stream width
    - effluent dominated systems
- Demonstrating rapid and complete mixing
  - An **example** of how water quality standards also might specify how a discharger can **demonstrate** rapid and complete mixing is:
    - demonstrate that there is less than 5% variation in pollutant concentration laterally (i.e., bank to bank across the stream) within a distance of 2 stream widths downstream of the point of discharge

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Rapid and Complete Mixing – Dilution Allowance

- What is the allowable dilution when there is rapid and complete mixing in a river or stream?
  - as much as ***100 percent of the critical low flow*** as a dilution allowance
  - ***a portion of the critical low flow*** (e.g., 50 percent of the critical low flow, applying a factor of safety)

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Incomplete Mixing

- What is incomplete mixing?
  - Where rapid and complete mixing cannot be assumed or demonstrated, there is ***incomplete mixing***
  - Where there is incomplete mixing, a **mixing analysis** will be required to understand how effluent and receiving water mix.
    - **field studies**
      - actual pollutant measurements
      - actual measurements using dye studies
    - **water quality modeling**
      - calibrated to actual measurements
      - simulate mixing under critical conditions

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WWTP Mixing Study: Missouri River–Kansas City, Missouri

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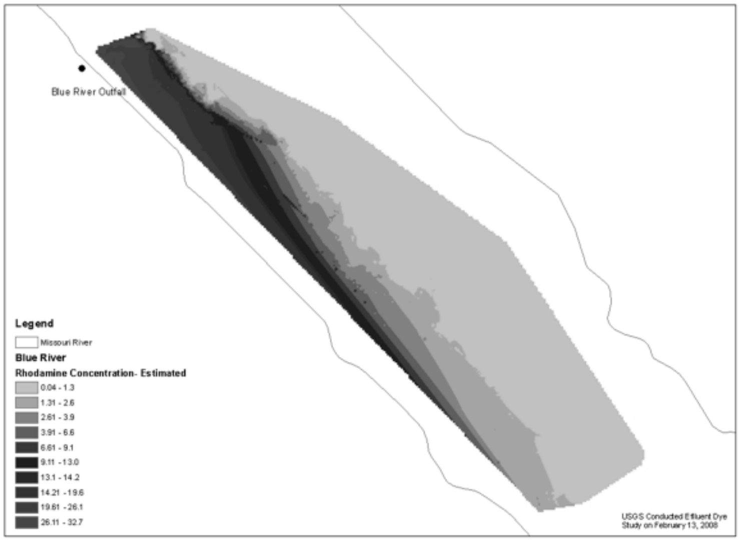
WWTP Mixing Study: Missouri River–Kansas City, Missouri



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Incomplete Mixing – Dilution Allowance or Mixing Zone

- What is the allowable dilution when there is incomplete mixing?
  - Water quality standards might allow a permit writer to consider a **limited dilution allowance** or a **regulatory mixing zone** under critical conditions where there is incomplete mixing
- What is a regulatory mixing zone?
  - A regulatory mixing zone is a **limited area or volume of water** where initial dilution of a discharge takes place and within which the water quality standards allow certain water quality criteria to be exceeded.

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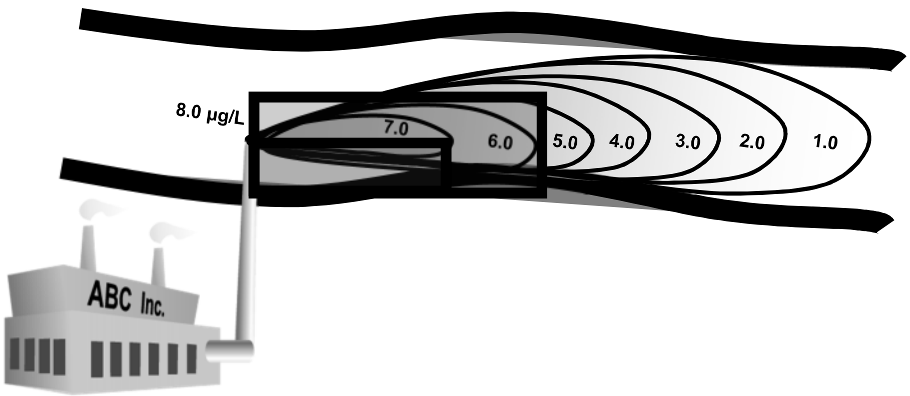
Examples of Regulatory Mixing Zones



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What Are the Limitations on Mixing Zone Size?

- No federal regulations establish a maximum mixing zone size
- Criteria for establishing mixing zones are found in:
  - state water quality standards or NPDES regulations
  - state water quality standards implementation policies
- Mixing zone size limitations could include:
  - specific areas or volumes of water
  - limitations on dilution ratios or dilution allowances
  - narrative constraints

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What Are the Limitations on Mixing Zone Size? Rivers and Streams

- Might be established in WQS or implementation policies
- **Examples** of ***maximum*** mixing zone sizes or ***maximum*** dilution allowances under incomplete mixing conditions:
  - mixing zones may not be larger than 1/4 of the stream width and 1/4 mile downstream
  - mixing zones may not be larger than 1/2 of the stream width with a longitudinal limit of 5 X stream width
  - dilution allowances may not be larger than 1/3 of the critical low flow

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What Are the Limitations on Mixing Zone Size? Lakes and Oceans

- Might be established in WQS or implementation policies
- **Examples** of ***maximum*** mixing zone sizes or ***maximum*** dilution allowances:
  - mixing zones may not be larger than 5% of the lake surface
  - dilution allowances may not be larger than 4:1 dilution for lake discharges
  - dilution allowances may not be larger than 10:1 dilution for ocean discharges
  - mixing zones may not be larger than 100 foot radius from the point of discharge

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What Are the Limitations on Mixing Zone Size?

Common Narrative Constraints on Mixing Zone Size

- may not impair integrity of the water body (i.e., compromise the designated use)
- no significant health risks
- no lethality to passing organisms

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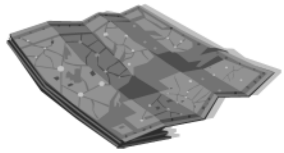
What's Next?



- Thus far:
  - identified the applicable water quality standards
  - characterized the effluent and receiving water
- Other presentations in this series:
  - model the interaction between the effluent and receiving water under critical conditions
  - determine whether WQBELs are needed
  - calculate WQBELs where needed

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Feedback and Other Presentations

Questions or comments?

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