DEVELOPING A TOOL TO MANAGE INDUSTRIAL RUNOFF RELEASES USING THE WATER QUALITY BASED EFFLUENT LIMITS (WQBEL) PROTOCOL

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Outline

- WQBELs? What are they and how do they work?
- WQBELs simple vs. complex
- Case Study: Tolko OSB Facility
- Developing a tool for calculating WQBELs
- Conclusions and future applications

Water Quality Based Effluent Limits Procedures Manual – Alberta Environmental Protection (AEP), 1995

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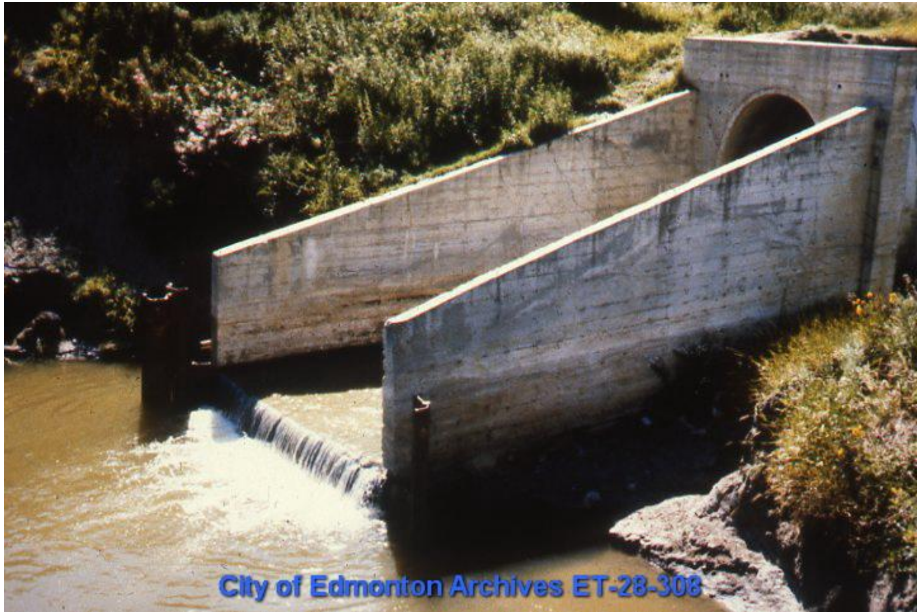
Intro to WQBELs

- Often applied:
  - municipal facilities
  - ambient conditions restrain effluent limits (e.g. Calgary and the bow river)
  - point sources of pollution
- Incorporates site specific hydrology and water quality



WQBEL - Procedure

Evaluate discharge, is there a potential to exceed instream guidelines?

Wasteload allocation modelling. I.e. analyze effluent under a variety of conditions

Setting "end of pipe" WQBEL's that provide a high level of environmental protection

WQBELs Simplified vs. Complex

Review Data

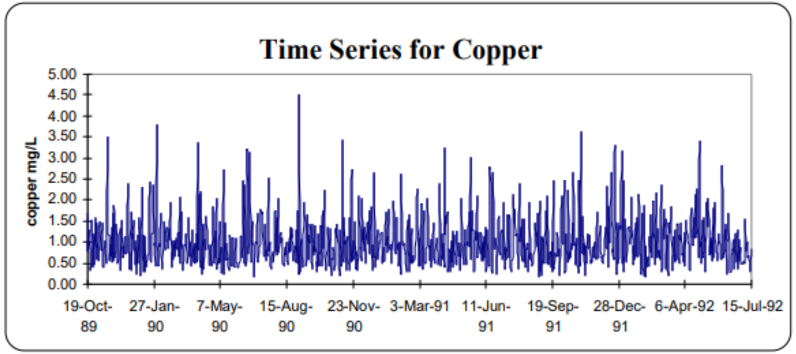
- Determine sample size
- Create distribution
- Identify gaps and select method

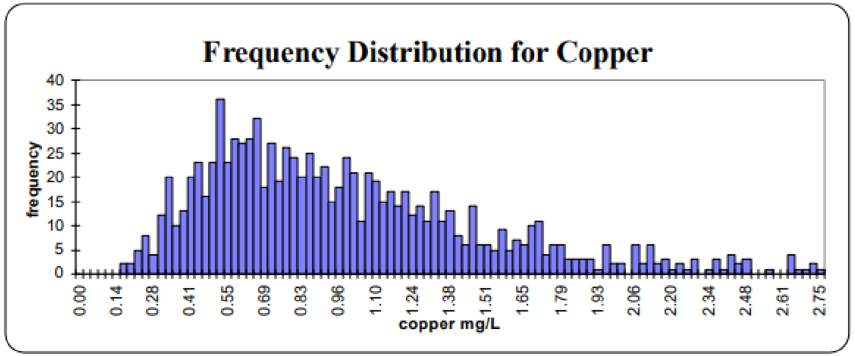
Simplified

- Assume steady state conditions
- Use worst case conditions to set limits

Complex

- Use dynamic modelling
- Use percentiles to create limits (95% typically)





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WQBELs Simplified vs. Complex

Simplified

Pros
- Limited data required
- Limited calculation/statistics required

Cons
- Likely yields more stringent results (based on "worst-case" conditions)
- Assumptions may not be accepted by regulator

Complex

Pros
- Increased accuracy in water quality predictions
- Can calculate the likelihood of exceedances, instead of assuming worst case conditions

Cons
- Requires a minimum set of measurement, ideally taken at regular intervals.
- More complex calculations required.

This presentation will use the simplified method

Calculation

$$C = \left(QeCe + ff(Qs)Cs\right) / \left(Qe + ff(Qs)\right)$$

Qe = effluent volume

Qs = receiving watercourse volume

Ce = effluent concentration

Cs = background concentration (receiving watercourse)

ff = fraction of flow

C = Resultant instream concentration

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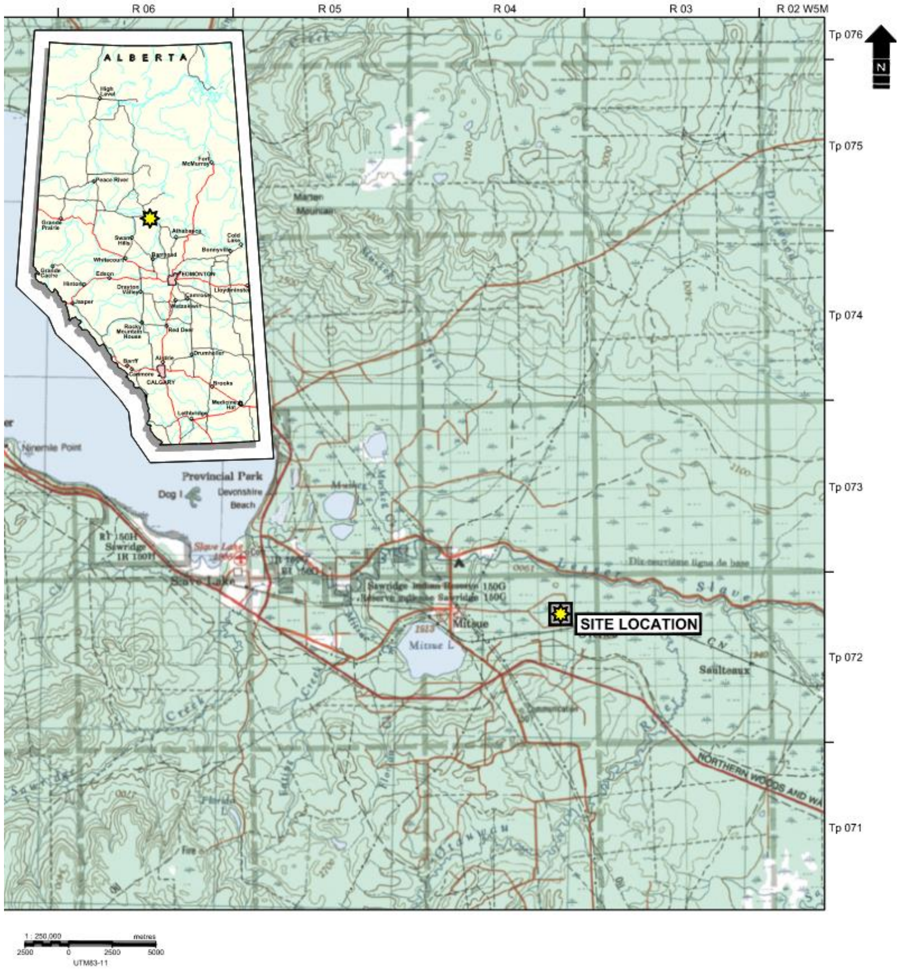
Case Study – Tolko OSB Facility

- Slave Lake Engineered Wood Product Processing Plant
- 18km east of Slave lake, operating consistently since 2013
- Initially run as a zero-discharge site, but since 2018 this has not been possible
- Tolko/Matrix submitted an Industrial Runoff Management Plan in 2019
- AEP requested WQBELs be calculated that consider the receiving watercourse



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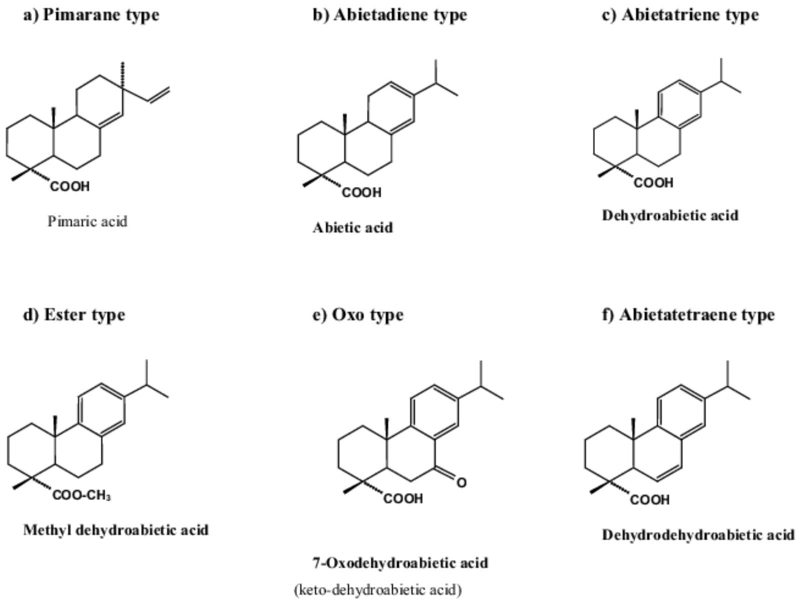
Water Quality and the Forest Products Industry

- Unique water quality challenges related to the processing and storage of wood products.
- Wood extractives function as fungicides, insecticides, and anti-oxidants. Contribute to toxicity in waste streams.
- Common contaminants of concern include:
  - TSS
  - Organics (biochemical oxygen demand, chemical oxygen demand, total carbon, and Phenols)
  - Tannins and lignins
  - Nutrients (Phosphorus, ammonia)
  - Resins and fatty acids (especially high in softwood lumber)
  - Metals and ions (specific to onsite industrial processing)



Koller *et al*. 2003

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- Two industrial runoff ponds on site, one combined waste stream during release
- Small watercourse north of site, eventually discharges into the Lesser Slave River (~7.5km downstream)

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Problem

$$C = (QeCe + ff(Qs)Cs)/(Qe + ff(Qs))$$

Qe = effluent volume
Qs = receiving watercourse volume
Ce = effluent concentration
Cs = background concentration (receiving watercourse)
ff = fraction of flow
C = Resultant instream concentration

Fill data gaps to calculate WQBELs

- *Qe* – Controlled during release, not fixed
- *Qs* – Unknown, this analysis occurred in winter!
- *Ce* - pond water quality data from 2014 to 2020, but wasn't completely representative…
- *Cs* – limited data, needed to be expanded
- *ff* - assumed complete mixing
- C = ?

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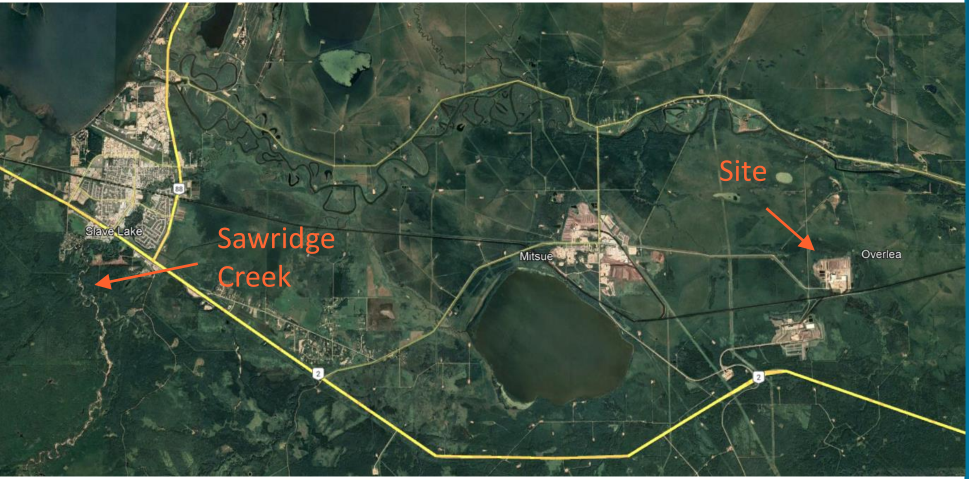

Hydrology

- Flow rate for the receiving watercourse unknown
- Used Water Survey of Canada data for nearby Sawridge Creek
- Calculated drainage area using lidar
- Created an estimate of monthly flow

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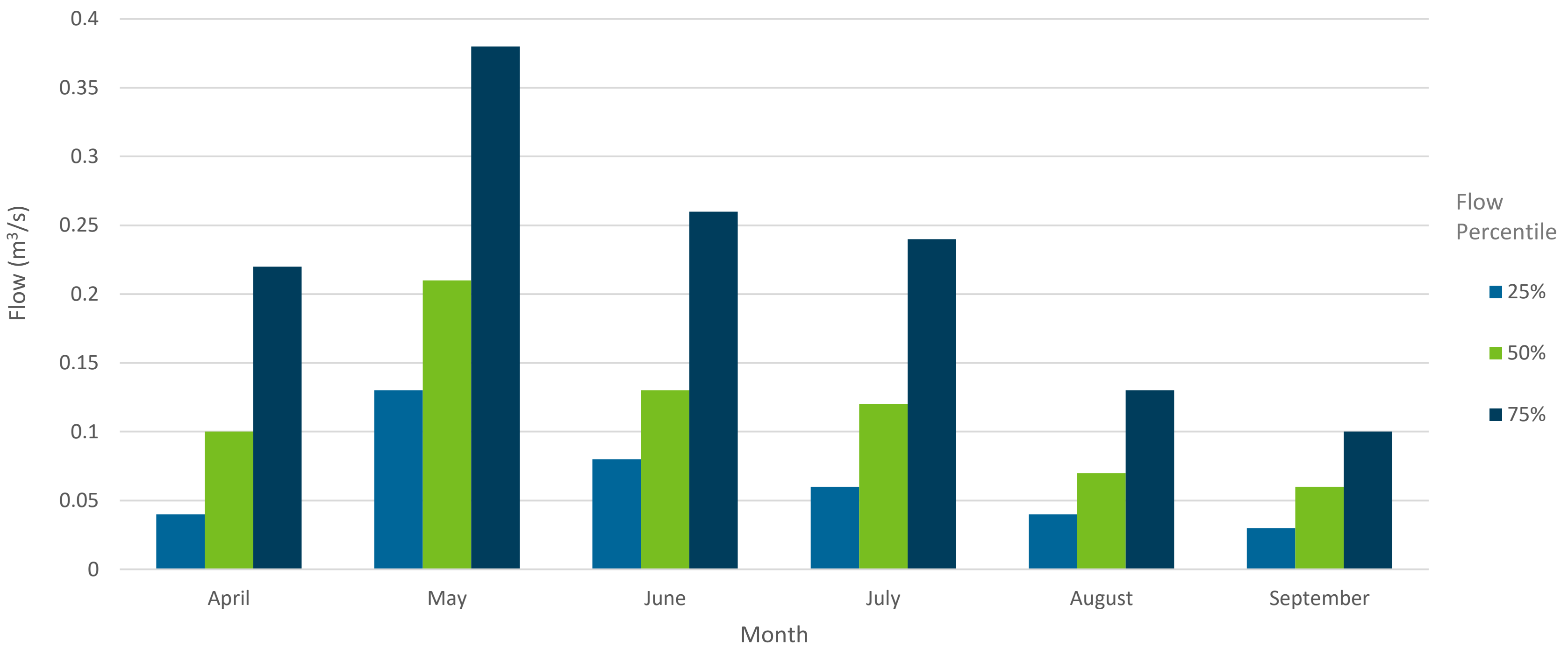
Hydrology



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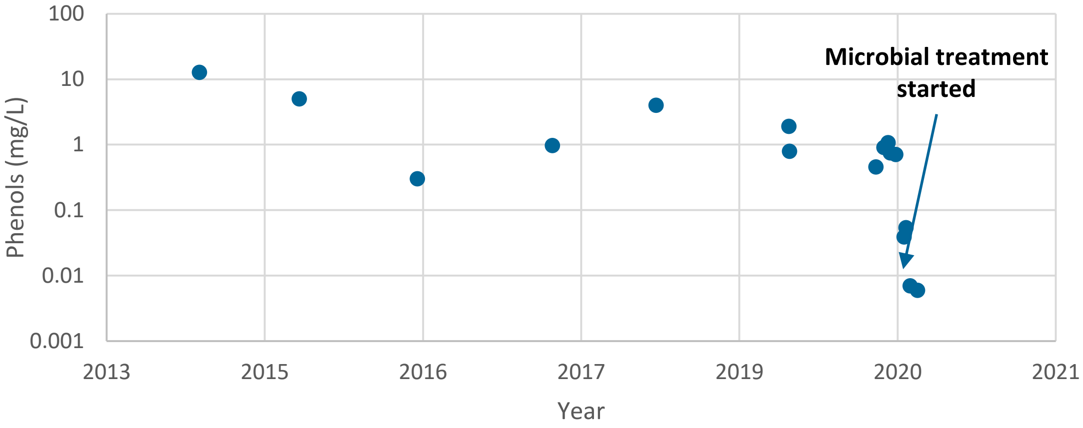
Water Quality



- Site was previously zero discharge
- Couldn't use 2014 to 2019 historical water quality data, not representative of current conditions

Water Quality

- Additional data was collected from the receiving watercourse and ponds in 2020 during different seasons (data had previously been annual)
- Collected sediment from the ponds to create a TSS-Turbidity curve
- COCs likely to exceed were chosen based on historical data
  - TSS
  - Chloride
  - Phenols
  - BOD
  - Total metals
  - Resins and fatty acids

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Tool - Assumptions

- Release is flexible, 4-5 times per year
- Assumed no natural attenuation during discharge (exception for TSS)
- Use conservative flow estimate, 25^{th} percentile

Tool – Calculator

Month	June	<---
Flow Rate (m3/day)	800	

Select month and Flow Rate

Month	June	<---
Flow Rate (m3/day)	400	

Table 2: Pond Water Quality vs. Receiving Watercourse Water Quality (Flow Rate 800)

Sample Location	pH	Cl mg/L	TSS mg/L	COD mg/L	BOD mg/L	Phenols mg/L
Pond WQ	8.0	***300***	20	700	***30***	***0.040***
Receiving WQ	7.5	5	10	300	5	0.001

Table 2: Pond Water Quality vs. Receiving Watercourse Water Quality (Flow Rate 400)

Sample Location	pH	Cl mg/L	TSS mg/L	COD mg/L	BOD mg/L	Phenols mg/L
Pond WQ	8.0	***300***	20	700	***30***	***0.040***
Receiving WQ	7.5	5	10	300	5	0.001

Table 1: Resultant Instream Concentration (Flow Rate 800)

Flow Estimate	General Parameters					
	pH	Cl	TSS	COD	BOD	Phenols
	7.6	36	11	342	8	***0.005***

Table 1: Resultant Instream Concentration (Flow Rate 400)

Flow Estimate	General Parameters					
	pH	Cl	TSS	COD	BOD	Phenols
	7.5	21	11	322	6	0.003

Phenol PAL guideline = 0.004 mg/L

Tool – Calculator (TSS)

Pond Turbidity	50.0	Pond TSS	*69.9*
Receiving Watercourse Turbidity (Downstream)	25.0	Downstream Watercourse TSS	50.2
Receiving Watercourse Turbidity (Background)	15.0	Receiving Watercourse TSS	30.1

TSS Exceedance in Pond

No TSS exceedance in watercourse

Background TSS

- TSS should not be >25 mg/L relative to background
- Turbidity values can be converted to TSS
- Daily turbidity reading collected by staff
- Pond TSS values can be used prior to release, but downstream watercourse values can be used during release

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Conclusions

- WQBELs can be applied to sites with variable releases and changing water quality.
- WQBEL calculators allow flexibility. Site not constrained by previous exceedances.
- Desktop hydrology can be used to guide release. Can be confirmed or updated if too restrictive (rating curve development recommended).

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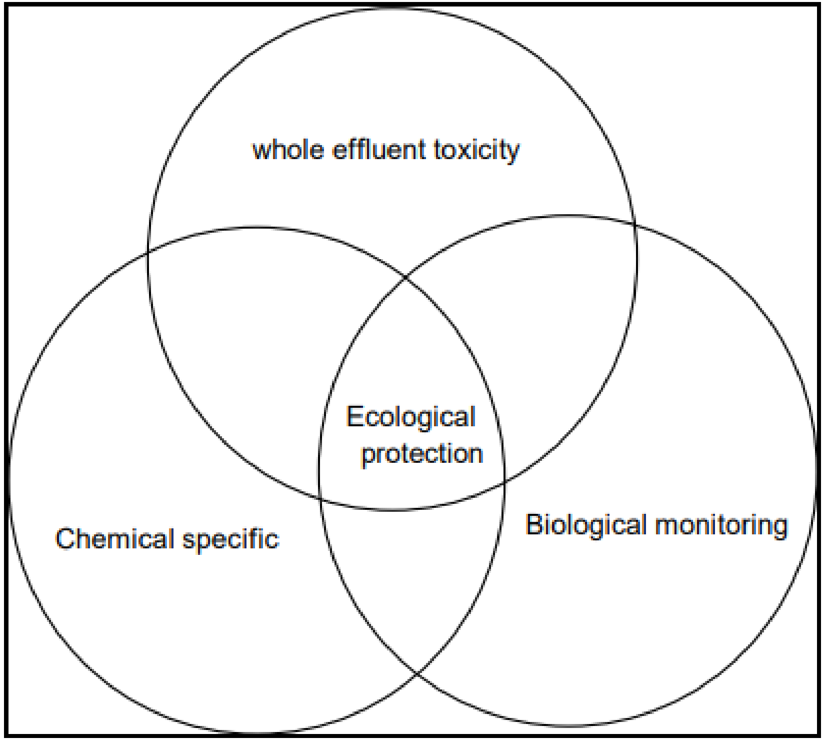
Applicability to other Industrial Sites

- Water chemistry not the only factor, need to consider the triad
- WQBELs can be applied (and may be requested) for other industrial sites
- Goal is to protect aquatic life, human health and limit sedimentation/erosion
- Simple vs. Complex? Depends on site and data availability
- Non-point source applications possible (risk management)?



Questions?

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