
The ABCs of TMDLs for Stakeholders
Bruce Zander, EPA
28 September 2005
Webcast

Agenda

- Review the parts and pieces of the TMDL* program
- Understand terminology
- View some case examples
- Understand how TMDLs can be you friend in the water quality business.

* TMDL = total maximum daily load

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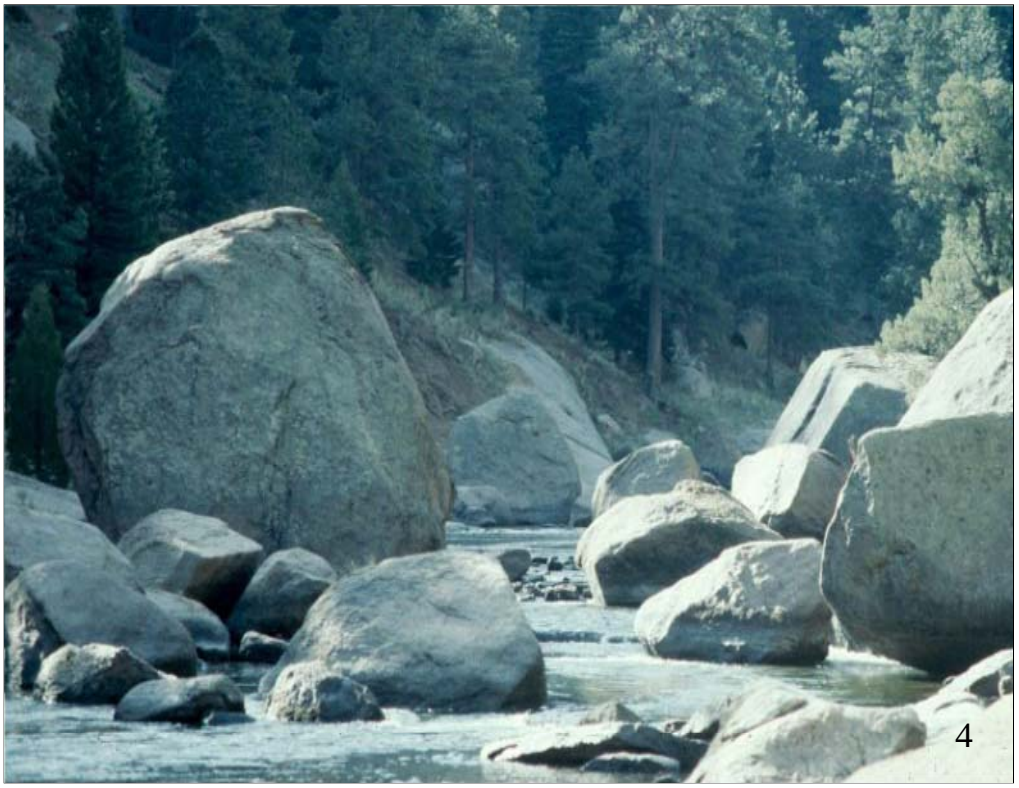
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CATERPILLAR


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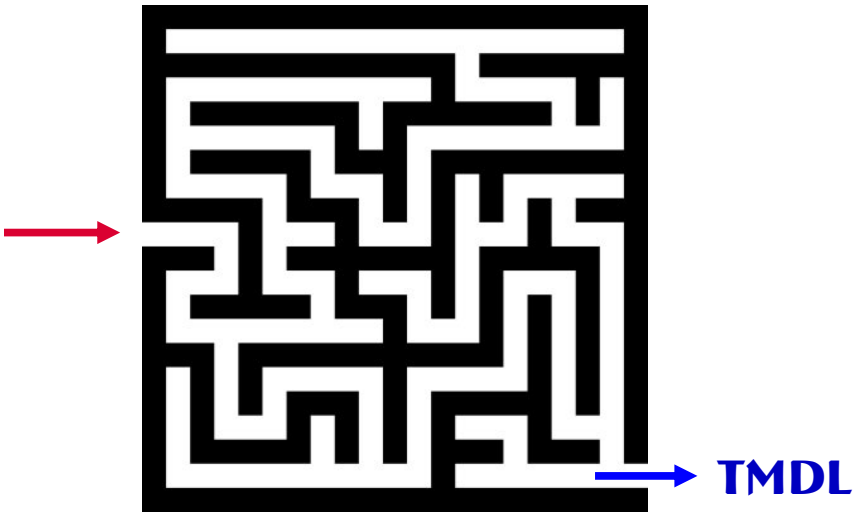
Clean Water Act Maze



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Water Quality Controls in the Clean Water Act

- Technology-based controls
- Water quality-based controls

Water Quality Controls in the Clean Water Act

- Technology-based controls (*point sources*)
- Water quality-based controls

Water Quality Controls in the Clean Water Act

- Technology-based controls (*point sources*)
- Water quality-based controls (*point sources & nonpoint sources*)

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TMDL agenda


Questions?
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TMDL Definition

- The amount of a specific pollutant that a waterbody can receive and still meet water quality standards.

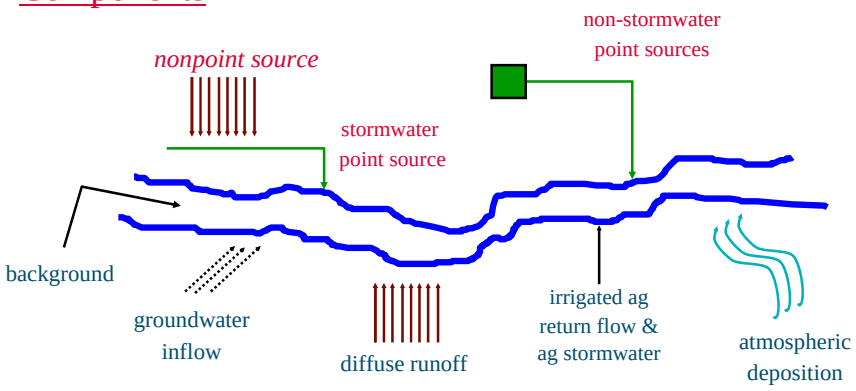
- A TMDL is made up of the sum of all the point source loads ("wasteload allocation") and load associated with nonpoint sources and background sources ("load allocation"). TMDLs must include a margin of safety (explicit or implicit) and consider seasonal variations.

TMDL Definition

$$\Sigma WLA + \Sigma LA + \{MOS\} = TMDL$$

WLA = wasteload allocation
(point source loads)
LA = load allocation
(nonpoint source and background loads)
MOS = margin of safety (explicit or implicit)
TMDL = total maximum daily load

Wasteload Allocation Components



Load Allocation Components

Water Quality Standards

[Ref: 40 C.F.R. 130.7(b)(3)]

- use classifications

  (e.g., aquatic life, irrigation, drinking water, recreation)

- numeric standards

  (e.g., 5.0 mg/l dissolved oxygen with corresponding averaging period and exceedence frequency)

- narrative standards

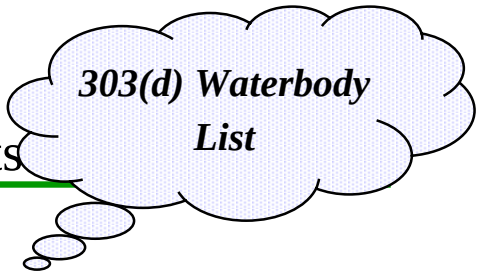
  (e.g., "free from toxics")

- antidegradation provisions

Clean Water Act
TMDL Requirements in Section 303(d)

- identify impaired/threatened waterbodies
- develop TMDLs for those waters

Clean Water Act TMDL Requirements



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Colorado 303(d) Waterbody List

Excerpt: Upper Colorado Basin

Waterbody	Pollutants	Priority
Blue River (French Gul. to Swan R.)	Cadmium, Zinc	medium
Snake River (below Peru Creek)	Cadmium, Zinc, Lead, Manganese, Copper	medium
Peru Creek		medium
French Gulch (1.5 mile below Lincoln to mouth)	Cadmium, Copper, Manganese pH, Cadmium, Zinc	high
Straight Creek	Sediment	medium
Eagle River (Belden to Gore Creek)	Cadmium, Manganese, Zinc	low
Cross Creek (lower portion near mouth)	Cadmium, Manganese, Zinc	low
Eagle River (Gore Cr. to Colorado R.)		low
Coal Creek	Manganese	medium
Unnamed Trib in Willow Cr. watershed	Iron	low
Williams Fork River	Ammonia, Manganese	medium

Colorado 303(d) Waterbody List

Excerpt: Upper Colorado Basin

Due April 1
(Every 2years)

Waterbody	Pollutants	Priority
Blue River (French Gul. to Swan R.)	Cadmium, Zinc	medium
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Clean Water Act
TMDL Requirements in Section 303(d)

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303(c)

Water Quality Standards

- States/Tribes* establish
- EPA reviews & approves
- EPA has authority to promulgate

** Authorized Tribes*

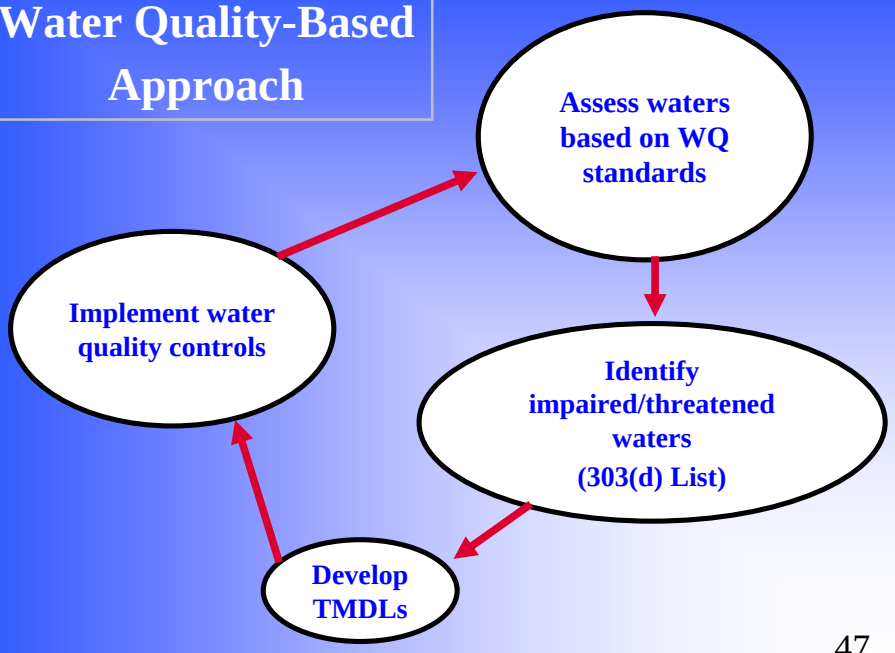
303(c)	303(d)
Water Quality Standards	**TMDLs**
▪States/Tribes* establish	▪States/Tribes * establish
▪EPA reviews & approves	▪EPA reviews & approves
▪EPA has authority to promulgate	▪EPA has authority to establish

** Authorized Tribes*

303(c)	303(d)	303(e)
Water Quality Standards →	**TMDLs** →	Water Quality Controls*
▪States/Tribes establish	▪States/Tribes establish	▪Point Source NPDES permits
▪EPA reviews & approves	▪EPA reviews & approves	▪Nonpoint management practices
▪EPA has authority to promulgate	▪EPA has authority to establish	▪ - - -
		▪ - - -

* Water quality controls include regulatory as well as voluntary controls

Water Quality-Based Approach




Questions?
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"Integrated Report"

State & Tribal Reporting of Water Quality Assessment Results

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

- 303(d) list - *list of impaired/threatened waters*

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

- 303(d) list - *list of impaired/threatened waters*
- 305(b) report - *report on overall health of waterbodies*

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

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- 314 report - *report on the health of lakes/reservoirs*

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

- 303(d) list - *list of impaired/threatened waters*
- 305(b) report - *report on overall health of waterbodies*

\+

- 314 report - *report on the health of lakes/reservoirs*

Integrated Report

Due April 1 every even-numbered year.

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

- Category 1 - All uses are being attained
- Category 2 - Some uses are being attained
- Category 3 - Insufficient data to determine if any use is attained.
- Category 4 - Impaired/threatened, but no TMDL is needed.
- Category 5 - Impaired/threatened; TMDL needed.

Integrated Report

State & Tribal Reporting of Water Quality Assessment Results

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Basic Provisions for TMDLs

- **TMDLs are designed to attain and maintain applicable water quality standards**
- **TMDLs apply to both point and nonpoint sources**
- **TMDLs apply to all pollutants**
- **TMDLs are pollutant-specific**
- **A waterbody will often have several TMDLs (one for each pollutant of concern)**

TMDLs can be described as:

- mass per time (e.g., pounds per day)
- toxicity (e.g., toxic units)
- other measure (e.g., % reduction)

Ref: 40 C.F.R. Part 130.2(i)

TMDL Implementation

- TMDLs are not self-implementing
  - Section 303(d) does not create any implementing authorities, TMDLs are implemented only through other programs and statutory mechanisms
- TMDLs do set the stage for implementation
- Implementation tools vary:
  - NPDES permits
  - other Federal, state, local laws & requirements
  - State and local laws and ordinances (enforceable & voluntary)
  - individual, voluntary-based actions

Dealing with Uncertainty in TMDLs

- Use margin of safety (explicit or implicit) to address uncertainties. The larger the uncertainty, the larger the margin of safety (MOS).

- Use phased TMDL* approach

* A phased TMDL is designed to achieve applicable water quality standards and is based on the best data and information that is available at the time the TMDL is established, but is subject to change as new data and information is collected. Using the phased TMDL approach triggers the need to include a monitoring plan in the TMDL.


Questions?
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TMDL Review Criteria

Is the TMDL approvable?

- Identification of waterbody/pollutant of concern
- Applicable water quality standards and numeric targets
- Technical analysis/supporting documentation
- Margin of safety & seasonality
- TMDL/loading capacity
- Wasteload & load allocations
- Reasonable assurances nonpoint source controls will be implemented if point source WLAs rely on those controls
- Public participation
- Monitoring plan (*for phased approach*)

- Implementation plan (*not required*)


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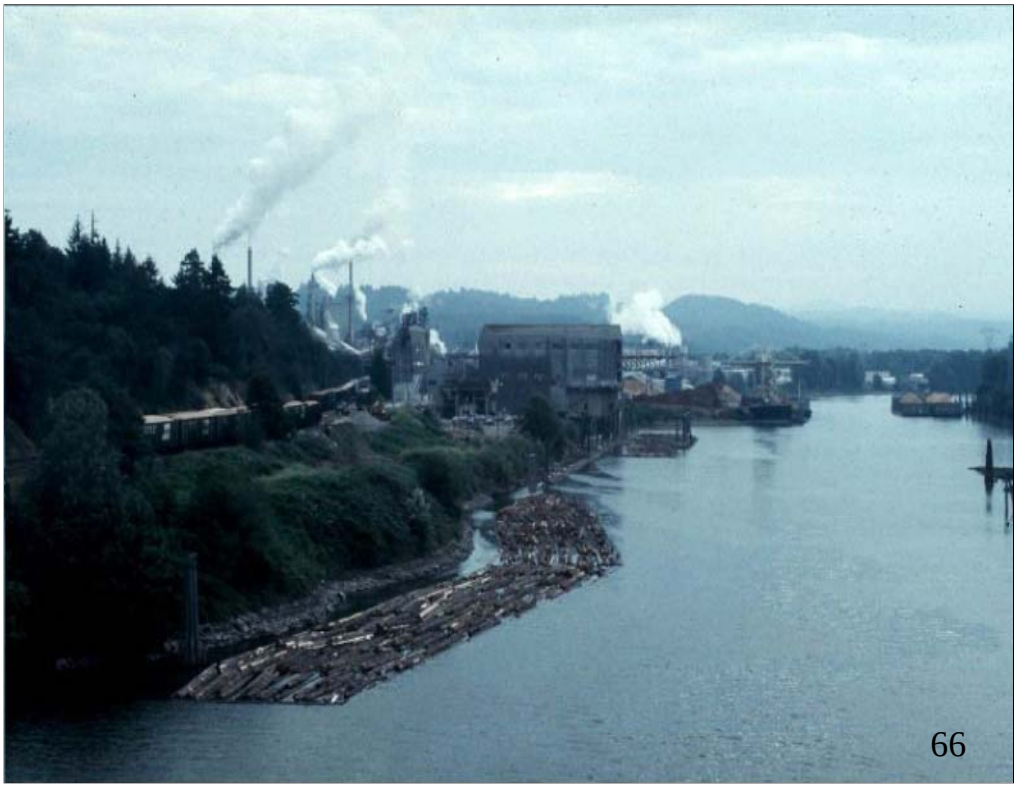
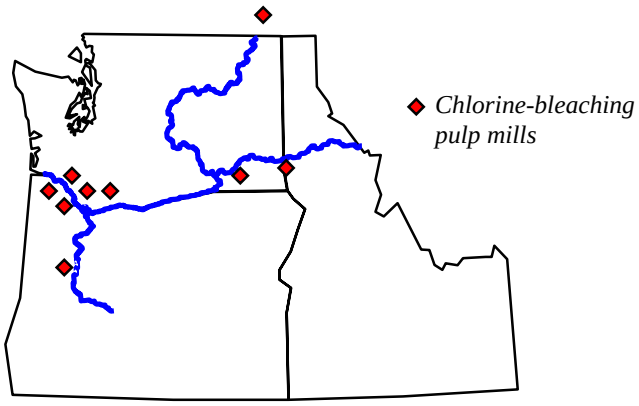


Columbia River Basin

Dioxin TMDL



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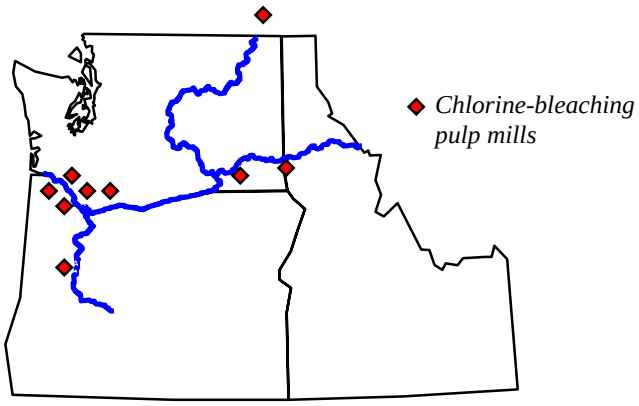
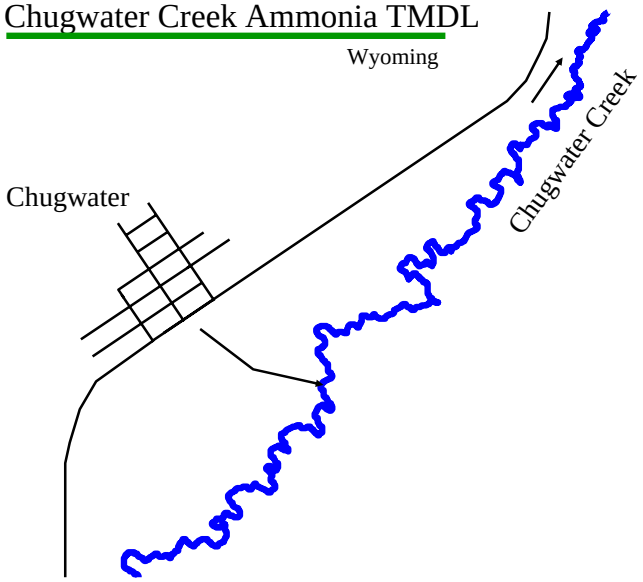


"complex TMDL"

Chugwater Creek Ammonia TMDL



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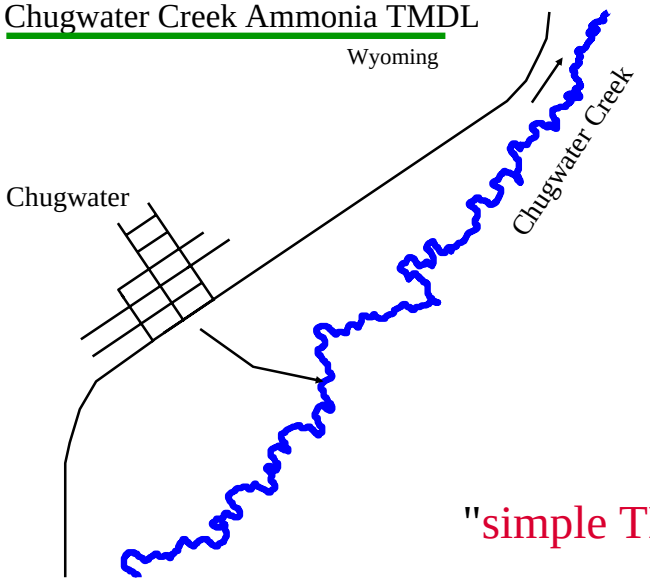

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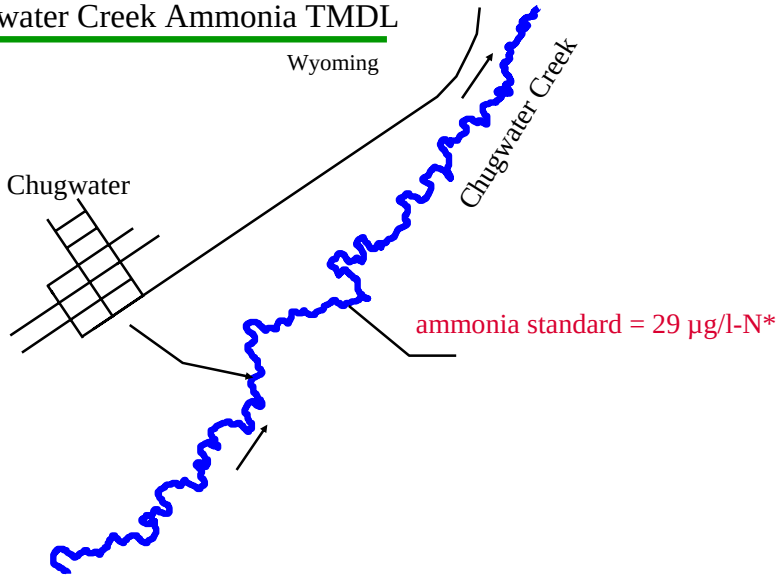
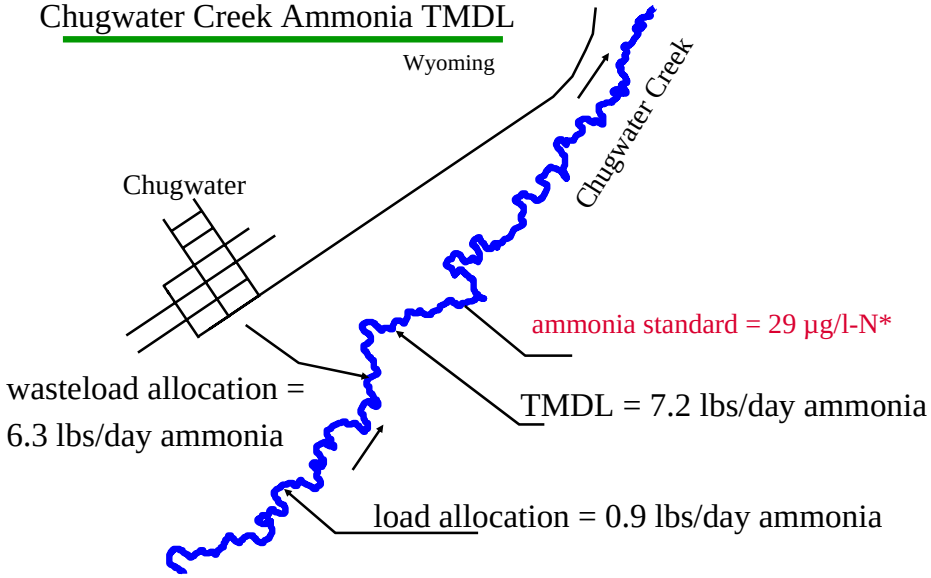


** 4 day average standard not to be exceeded once in 3 years*

Chugwater Creek Ammonia TMDL



** 4 day average standard not to be exceeded once in 3 years*

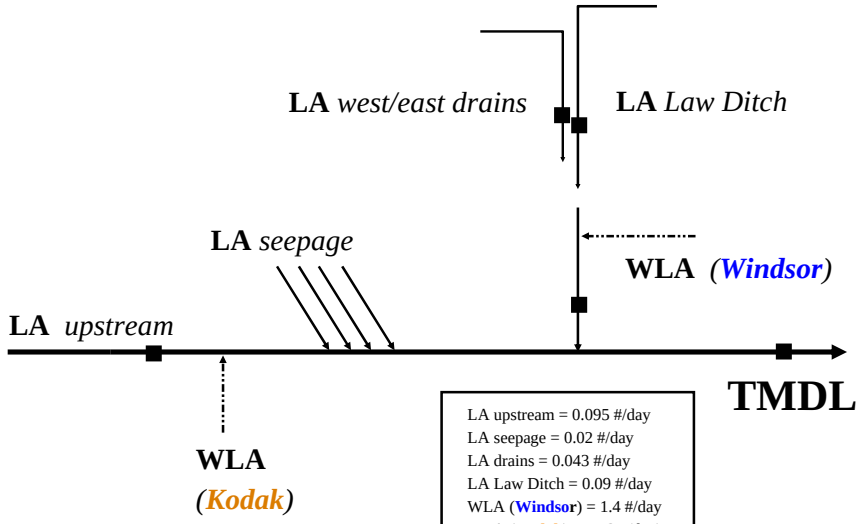
Chugwater Creek Ammonia TMDL

Water Quality Standards	→ **TMDL** →	Water Quality Controls
▪ 29 ug/l ammonia	▪ TMDL = 7.2 #/day ▪ WLA = 6.3 #/day ▪ LA = 0.9 #/day ▪ MOS implicit	▪ Water quality-based effluent limits in NPDES permit

$$\Sigma WLA + \Sigma LA + \{MOS\} = TMDL$$

Cache la Poudre River Copper TMDL

Kodak & Windsor Dischargers - Colorado



LA upstream = 0.095 #/day
LA seepage = 0.02 #/day
LA drains = 0.043 #/day
LA Law Ditch = 0.09 #/day
WLA (**Windsor**) = 1.4 #/day
WLA (Kodak) = 4.73 #/day)
TMDL = 6.4 #/day


Questions?
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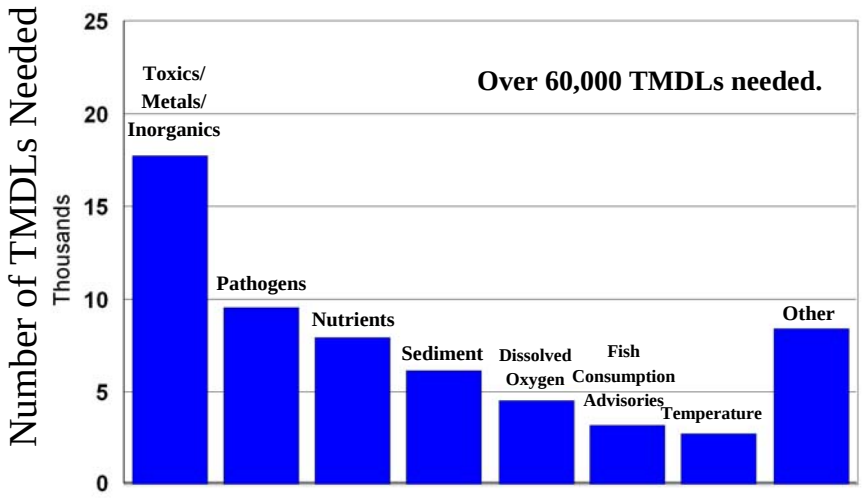
Whooooo,
me??

TMDLs Needed by Stressor Type

Numbers are for entire country.

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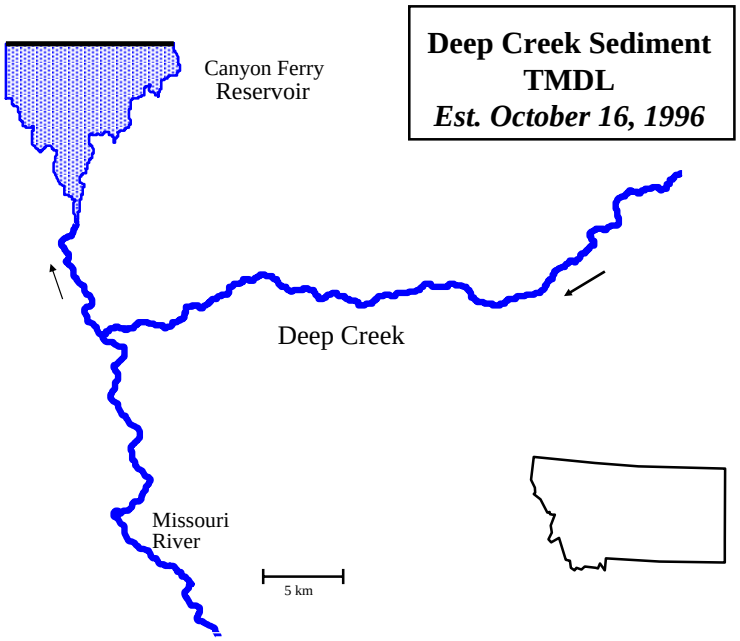
Sediment Water Quality Criteria Types

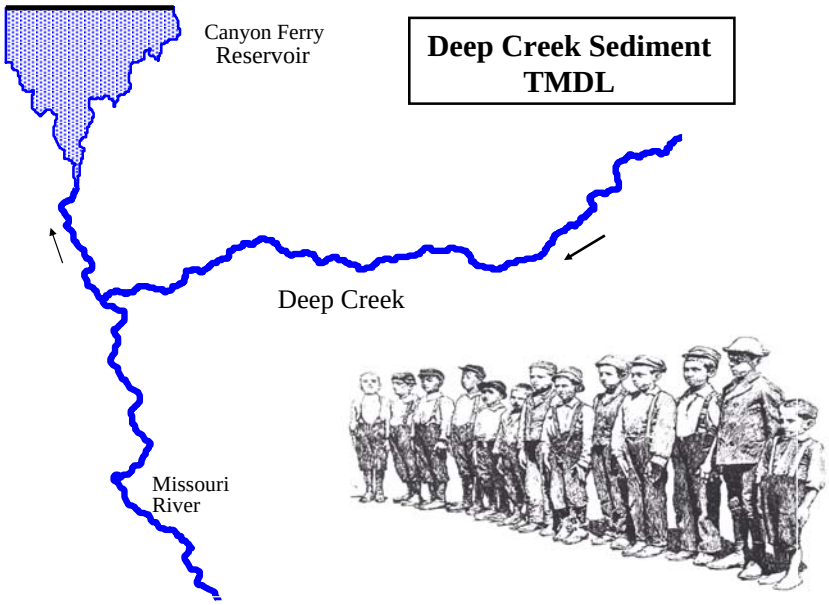
- water column sediment
- substrate sediment
- biological integrity
- channel form & stability
- near stream/riparian zone condition

Sediment TMDLs

Examples of how wq goals and TMDLs could be expressed

Water Quality Goals	→ TMDL →	*Water Quality Controls*
▪**water column sediment** (e.g., turbidity, suspended sediment, bedload) ▪**substrate sediment** (e.g., % fines in core samples, pool volume, median particle size) ▪**biological indicators** (e.g., fish, macro-invertebrate, redd counts) ▪**channel form and stability** (e.g., slope, sinuosity, cross sections, bank stability) ▪**near stream/riparian zone condition** (e.g., vegetation character, buffer width, upland erosion indices, roaded acreage) ▪.....		▪ **average annual sediment yield** (e.g., tons per year of suspended sediment) ▪ **reduction in sediment sources** (e.g., reduction in road acreage, reduction in mile of eroding banks, reduction in cropland sediment yield) ▪**slope of flow/sediment rating curve** ▪..... ▪.....


Deep Creek Sediment
TMDL
Est. October 16, 1996
Canyon Ferry
Reservoir
Deep Creek
Missouri
River
5 km


Canyon Ferry
Reservoir
Deep Creek Sediment
TMDL
Deep Creek
Missouri
River

Deep Creek TMDL (MT)

Sediment

Water Quality Goals → TMDL → Water Quality Controls

- Substrate sediment

  30% substrate fines (<6.35 mm)

- Water temperature

  > 73°F in only 10 days annually

- Trout population

  3,000 returning female trout captured/year

Deep Creek TMDL (MT)

Sediment

Water Quality Goals	TMDL	Water Quality Controls
▪ Substrate sediment ▪ Water temperature ▪ Trout population	▪ Sediment load ▪ Flow/sediment relationship ▪ % reduction in sediment sources ▪ Restoration of stream channel length ▪ 3 - 9 cfs minimum flow	▪ Riparian restoration BMPs ▪ Rosgen-type channel mods ▪ Tree revetments ▪ Re-activate abandoned channels ▪ Irrigation BMPs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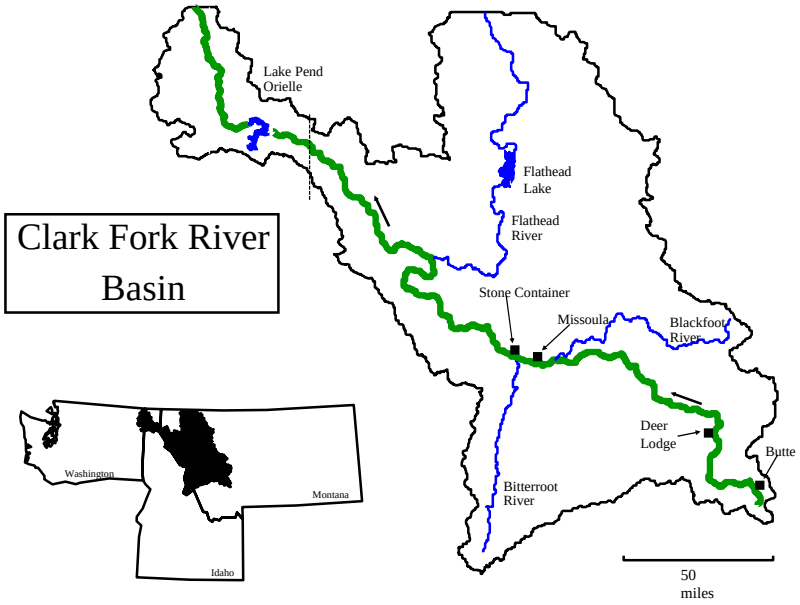
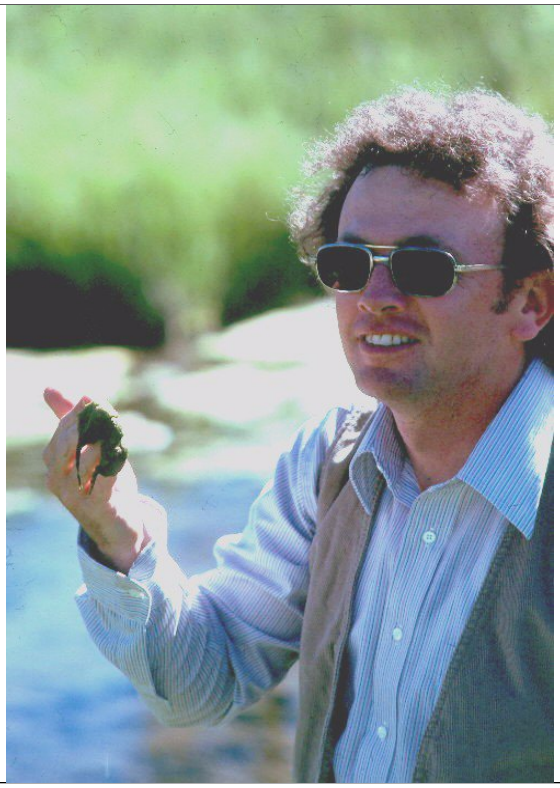

Clark Fork River Basin
Lake Pend Orielle
Flathead Lake
Flathead River
Stone Container
Missoula
Blackfoot River
Deer Lodge
Butte
Bitterroot River
50 miles
Washington
Montana
Idaho

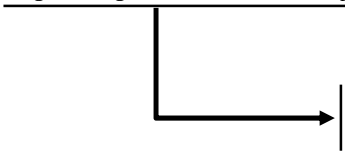


Clark Fork Nutrient Goals

benthic algal chlorophyll

Methods Used to Develop Goals
Based on State's Narrative Standards

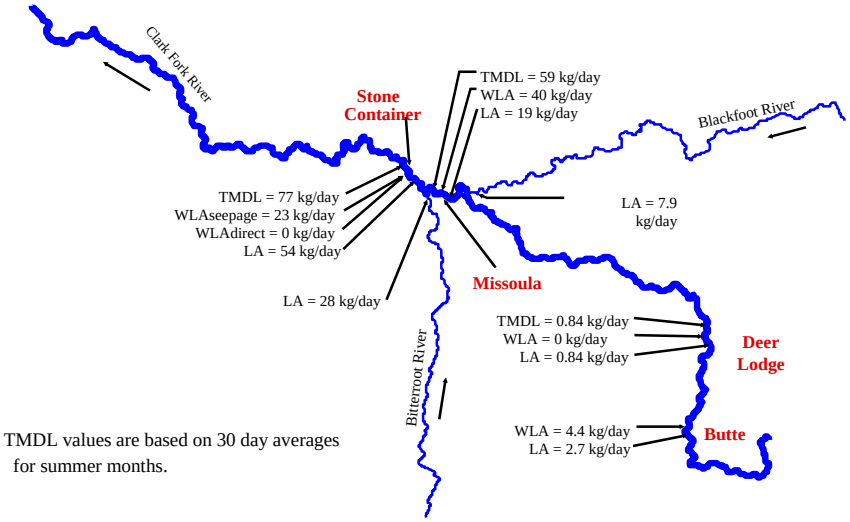
- artificial stream tests
- nutrient uptake tests with Cladophora
- cellular N/P analysis of Cladophora
- reference reach approach
- global regression of TN & chlorophyll *a*



Goals

- 300 ug/l total nitrogen (30 day avg)
- 30 ug/l total phosphorus (30 day avg)
- 100 mg/m^2 chlorophyll *a* (30 day avg)
- 150 mg/m^2 chlorophyll *a* (inst. max.)

Components of **Phosphorus** TMDL for the Clark Fork River



TMDL values are based on 30 day averages for summer months.

Nutrient TMDLs

Examples of how wq goals and TMDLs could be expressed

Water Quality Goals	→	TMDL	→	Water Quality Controls

- **nitrogen concentration**
- **phosphorus concentration**
- **chlorophyll-*a* conc.**
- **macrophyte density**
- **Carlson Trophic State Index**
- **tons of in-lake algal biomass**
- **pH**
- **transparency**
- **biological indicators such as health of fish or macroinvertebrates**
- **dissolved oxygen**
- **.....**
- **.....**

- **annual or seasonal loading of nitrogen or phosphorus**
- **percent reduction in nitrogen or phosphorus**
- **.....**
- **.....**


Questions?
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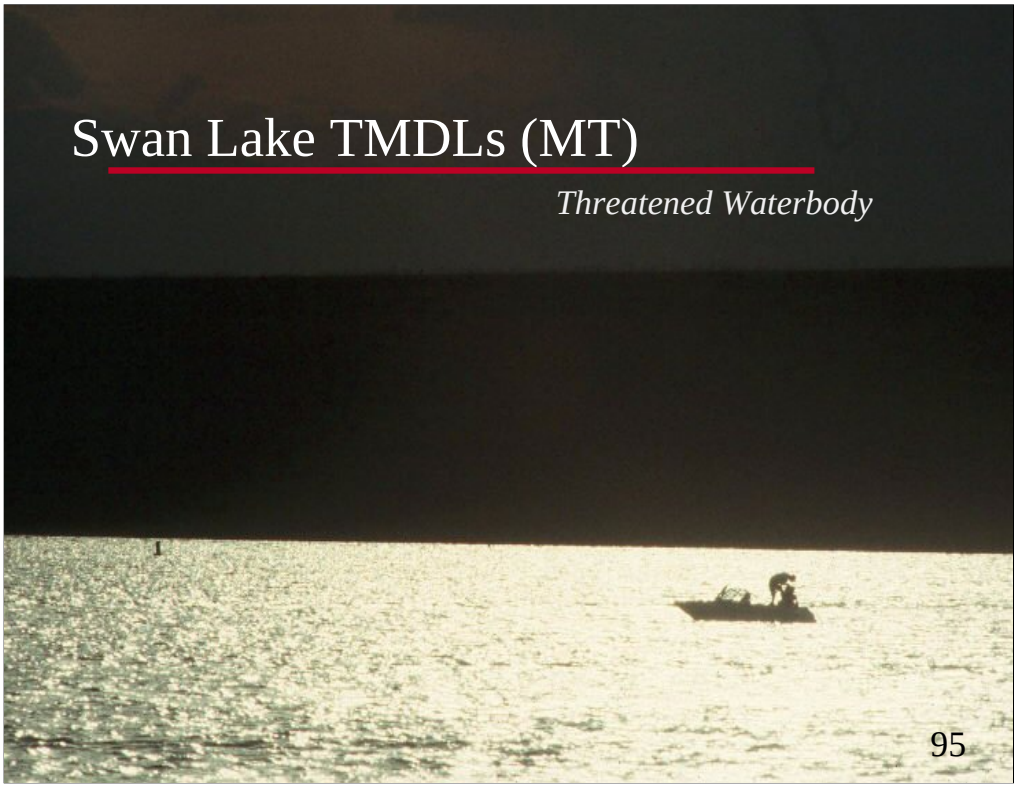
Swan Lake TMDLs (MT)

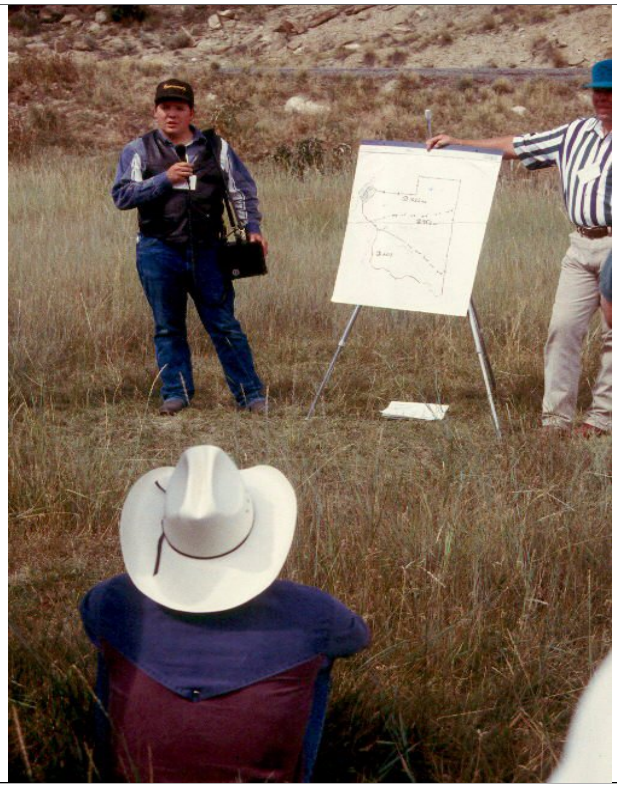
Threatened Waterbody



Swan Lake TMDLs (MT)

Siltation & Dissolved Oxygen

Water Quality Goals	TMDL	Water Quality Controls
▪ Siltation targets •secchi depth •TSS ▪ DO targets •epilimnion DO •nutrient conc. •chlorophyll *a* conc. •organic carbon	▪ Siltation •40% reduction in sediment from certain road systems ▪ DO •N & P allocations to septic tanks •POC & nutrient allocations to: ◆ riparian areas ◆ timber harvesting	▪ timber harvest BMPs ▪ forest road BMPs ▪ riparian protection BMPs to address future development ▪ septic tank controls ▪ restoration of fish passage



Shane Green, NRCS; Chalk Creek Project Officer

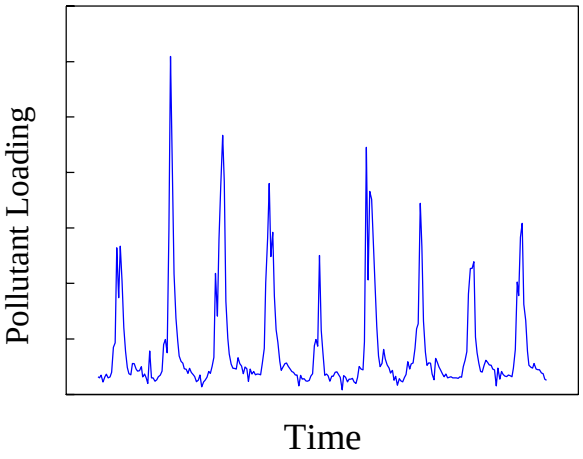
Public Participation

TMDLs involve some level of public involvement or review.

- The public should be involved from the very beginning of the process.
- It is recommended that a notification of the proposed TMDL be widely disseminated (e.g., newspapers, Internet).
- Notifications or solicitations for comments regarding the TMDL should clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review.
- When the TMDL is submitted to EPA for review, a copy of the comments received should be also submitted to EPA

Dealing with Temporal Variability in Nonpoint Source TMDLs

Variable Pollutant Loading



Dealing with Temporal Variability in Nonpoint Source TMDLs

Examples

- Long Averaging Period

  Chalk Creek, UT Sediment TMDL

  93,000 tons/year sediment reduction (255 tons/day)

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  Lake Dillon, CO Phosphorus TMDL

  10,165 lbs/year based on 1982 hydrologic conditions

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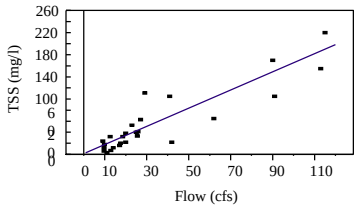
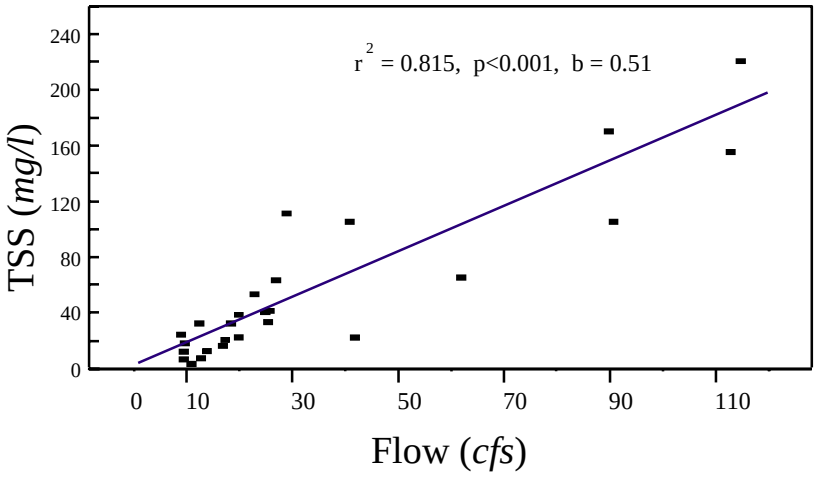
- Variable TMDL

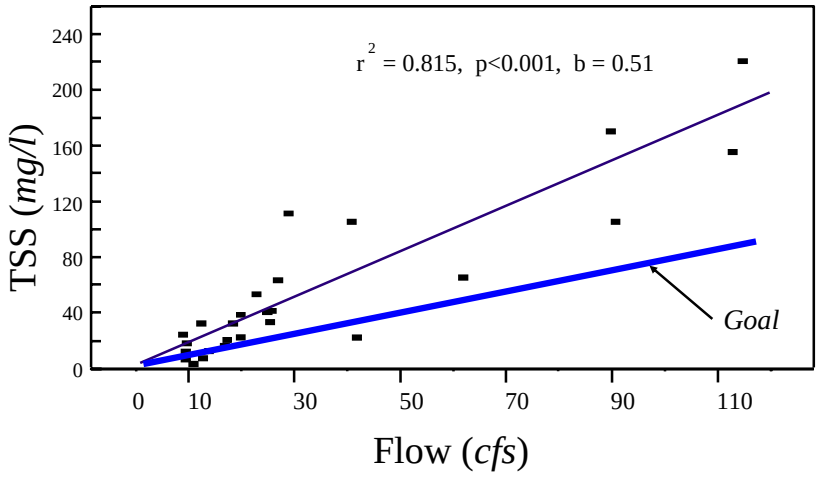
  Deep Creek, Mt Sediment TMDL

  TMDL based on TSS/Flow





Deep Creek: Relationship between TSS concentrations and flow (Deep Creek, MT) *(Endicott, et al., 1996)*



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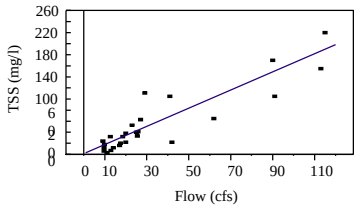


Allocation Options for TMDLs

Chap. 7; EPA's Sediment TMDL Protocol

- **Maximum allowable loads**

  . allocation to source categories, tributaries, channel types, specific parcels, erosion process categories

- **Percentage reduction targets**

  . reduction from estimated baseline load

- **Performance-based actions or practices**

  . for example, allocation of responsibilities of BMPs distributed throughout watershed

All allocation methods must demonstrate that water quality standards will be met.

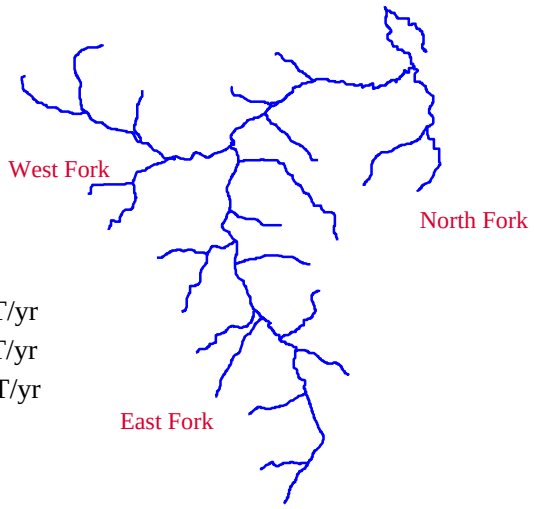
Allocation Methods

Example: **Maximum allowable loads**

Tributary	**Load**
East Fork	10,000 T/yr
West Fork	20,000 T/yr
North Fork	5,000 T/yr

or

Land Use	**Load**
Channel/Riparian	10,000 T/yr
Rangeland	20,000 T/yr
Forested Area	1,000 T/yr



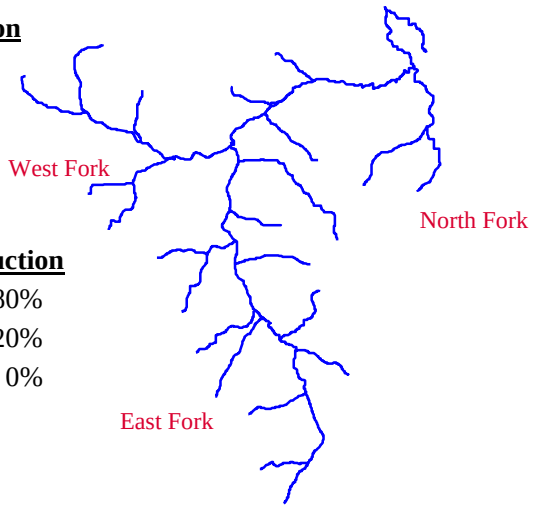
Allocation Methods

Example: **Percent Reduction**

Tributary	**Load Reduction**
East Fork	40%
West Fork	20%
North Fork	0%

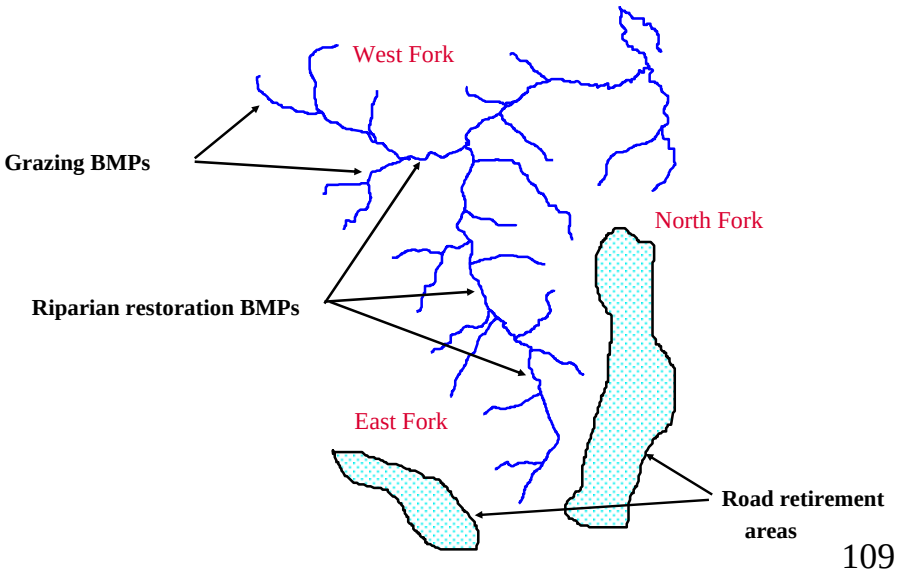
or

Land Use	**Load Reduction**
Channel/Riparian	80%
Rangeland	20%
Forested Area	0%



Allocation Methods

Example: **Performance Based Actions**




Questions?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Monitoring in the TMDL Process

Water Quality Standards	*TMDLs*	*Water Quality Controls*
▪ document extent of impairment ▪ define numeric endpoints/targets	▪ identify sources/ causes of pollutant loads ▪ support modeling in TMDL development	▪ document effectiveness of controls

Relationship to other Clean Water Programs

- Water quality standards
- Monitoring and Assessment
- Section 319 nonpoint source program
  - consistency between 303(d) list and 319 project priorities
  - TMDL development precursor to or part of 319 project
- NPDES permitting
- Wetlands
- Watershed innitiatives
- Water Quality Trading
- Tribal Programs
- CERCLA/Superfund
- Forest Planning/BLM Range Management

TMDL Development:
An Ongoing Process

Why?

- water quality standards changed
- environmental conditions changed
- shifting priorities
- new water quality problems uncovered
- previous assumptions changed
- - - - -


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