A Statewide Approach to Pathogen TMDLs

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TMDL Requirements

- Clean Water Act regulations require states to calculate a **T**otal **M**aximum **D**aily **L**oad for each surface water impaired by a pollutant

- TMDL must be expressed as a load (amount of pollutant per day)
  - Bacteria: colonies/day of *E. coli* or fecal coliform

- Total load is allocated among sources of the pollutant

A TMDL Calculation Represents…

- Maximum amount of a pollutant a water body can receive in a day and still meet water quality standards
- Receiving water's capacity to assimilate the pollutant of concern
- *Allowable loading* of the pollutant

<u>Goal of pathogen TMDL</u>: protect recreational uses

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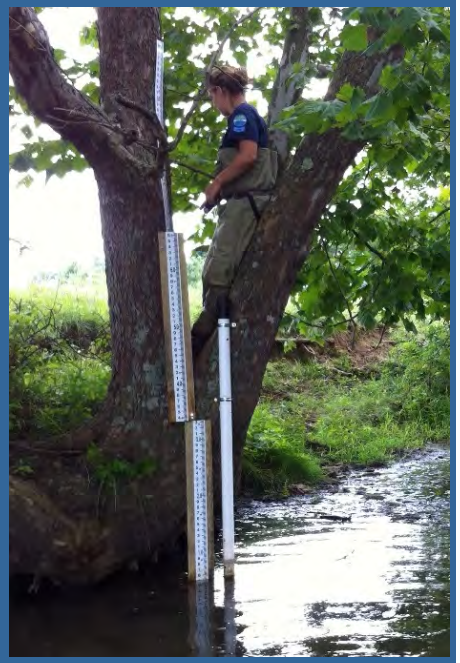
Watershed-based TMDL Process…

- 2-3 year data collection effort
- Sample multiple streams in watershed for bacteria levels
- Assess previously unassessed streams
- Collect flow data from multiple streams
- Identify all KPDES-permitted sources, obtain design flows

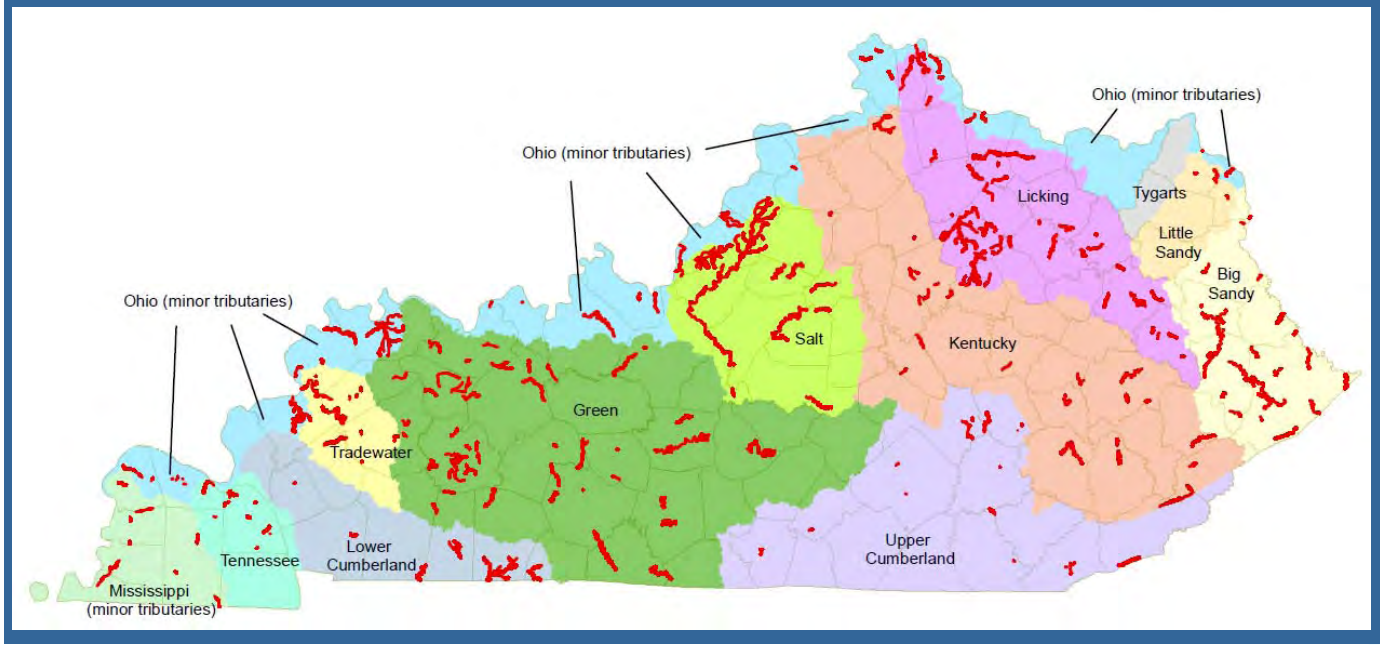


…Watershed TMDL Process

- Use data to develop flow & load duration curves
- Determine critical flow – when conditions at their worst
- Use critical flow to calculate TMDL
- Use GIS to analyze land use within MS4 boundaries
- Identify & evaluate relative impact of nonpoint sources

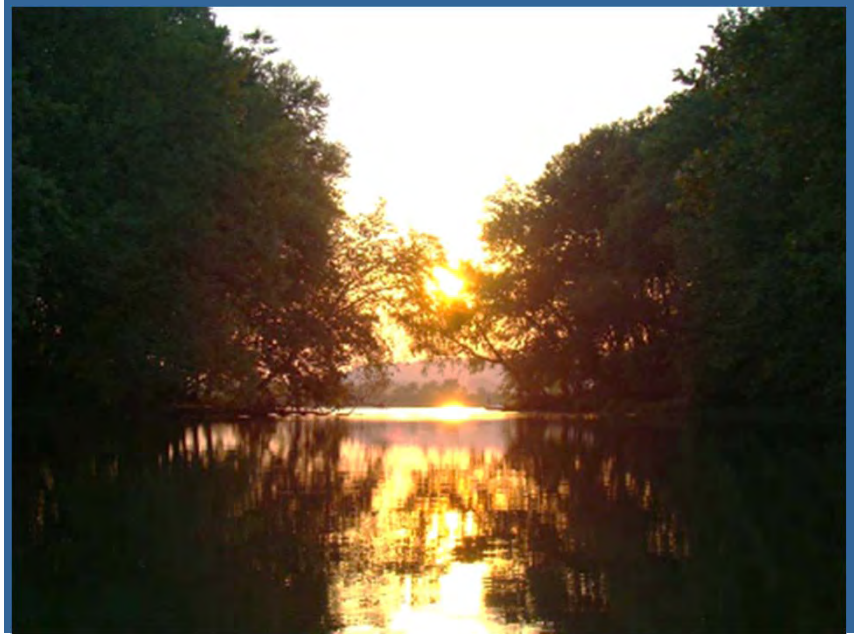
Current KY Pathogen TMDL Reality

- 2014 303(d) list: 331 segments listed for bacteria
- Decades to complete TMDLs for all current bacteria listings using watershed method – & new waters get added each listing cycle
- KPDES facility permits: require year-round disinfection; bacteria limits based on most protective criterion
- MS4, CSO, and NPS programs have frameworks tailored to addressing bacteria from these sources



Pathogen TMDL Method Goals

- Efficient/simple method allowing many TMDLs to be produced within a few years
- Applicable to all bacterial indicators and recreational uses, even if indicator changes
- Applicable to all sizes of stream systems
- Does not require additional data collection



- Minimizes or eliminates the need to work with other state TMDL programs
- Meets CWA requirements and EPA TMDL guidance

Streamlined Method Overview

- **Produce Segment TMDLs instead of Watershed TMDLs.**

  Upstream and tributary loadings are noted separately from the segment loadings

- **Leave TMDLs & allocations in equation form**

  as opposed to solving equations for one critical condition using one bacteria criterion

The Equation Driving the Process

- Total load for a water is divided among pollutant sources, with a margin of safety (MOS) factored in to address uncertainties
- KPDES-permitted dischargers (point sources) each receive individual **Wasteload Allocation** (WLA)
- Nonpoint sources receive a **Load Allocation** (LA)

$$TMDL = \sum WLA + \sum LA + MOS$$

point sources — nonpoint sources

Deriving the Segment Method

$$TMDL = \sum_{\text{Point sources}} WLA + \sum_{\text{Nonpoint sources}} LA + MOS$$

$$\sum WLA = \sum WLA_{segment} + \sum WLA_{upstream} + \sum WLA_{tributary}$$

$$\sum LA = \sum LA_{segment} + \sum LA_{upstream} + \sum LA_{tributary}$$

Regroup and "lump":

$$TMDL = (\sum WLA + \sum LA)_{Segment} + \underbrace{(\sum WLA + \sum LA)_{Upstream}}_{\text{Lumped allowable upstream load}} + \underbrace{(\sum WLA + \sum LA)_{Tributary}}_{\text{Lumped allowable tributary load}} \ldots + MOS$$

In Other Words…

Allowable loads for direct sources
+ Allowable upstream load
+ Allowable tributary load
+ MOS
= TMDL

How to Determine Allowable Loads?

- Start with the water quality criteria (WQC) – the standards to meet

Recreational Use Protected →	**Primary Contact (swimming)**	**Secondary Contact (wading, boating)**
Instantaneous Criterion →	240 colonies E. coli/100 ml 400 colonies fecal coliform/100 ml	2,000 colonies fecal coliform/100 ml
Geometric Mean Criterion →	130 colonies E. coli/100 ml 200 colonies fecal coliform/100 ml	1,000 colonies fecal coliform/100 ml
Season Applied →	May 1 - Oct. 31	year-round

- Instantaneous criteria shall not be exceeded in 20 percent or more of all samples taken during a 30-day period.
- Geometric mean based on not less than 5 samples taken during a 30-day period.

- 401 KAR 10:031

Calculating Loads

Allowable Load = Q×WQC×CF

Where:
Q is the flow
WQC is the applicable criterion
CF is the conversion factor to obtain a load (colonies/day)

Segment TMDL = Q_S×WQC×CF

Where Q_S : instantaneous flow in the segment
MOS is implicit based on conservative assumptions

Next, substitute flow-based equation into allowable load terms for upstream, tributary, and direct sources to obtain allocations…

Segment TMDL Allocations

$$(\sum WLA + \sum LA)_{Segment} + (\sum WLA + \sum LA)_{Upstream} + (\sum WLA + \sum LA)_{Tributary}$$

Allocations for Direct Loads to the Segment				Allocations for Upstream Loads to the Segment	Allocations for Tributary Loads to the Segment
SWS-WLA	MS4-WLA	CSO-WLA	LA		
$\sum(Q_{SWS} \times WQC \times CF)$	$\sum(Q_{MS4} \times WQC \times CF)$	$\sum(Q_{CSO} \times WQC \times CF)$	$\sum(Q_{LA} \times WQC \times CF)$	$\sum(Q_{Upstream} \times WQC \times CF)$	$\sum(Q_{Tributary} \times WQC \times CF)$

Q_{SWS} : flow in the segment due to a KPDES sanitary water system
Q_{MS4} : flow in the segment due to a MS4 entity
Q_{CSO} : flow in the segment due to a combined sewer overflow entity
Q_{LA} : flow in the segment due to a nonpoint/runoff source
$Q_{Upstream}$: flow contribution from upstream of the segment
$Q_{Tributary}$: flow contribution from a tributary of the segment

- All flows (Q) are instantaneous
- All allowable loads remain in equation form

Allowable load for each entity depends on the flow contributed by that entity.

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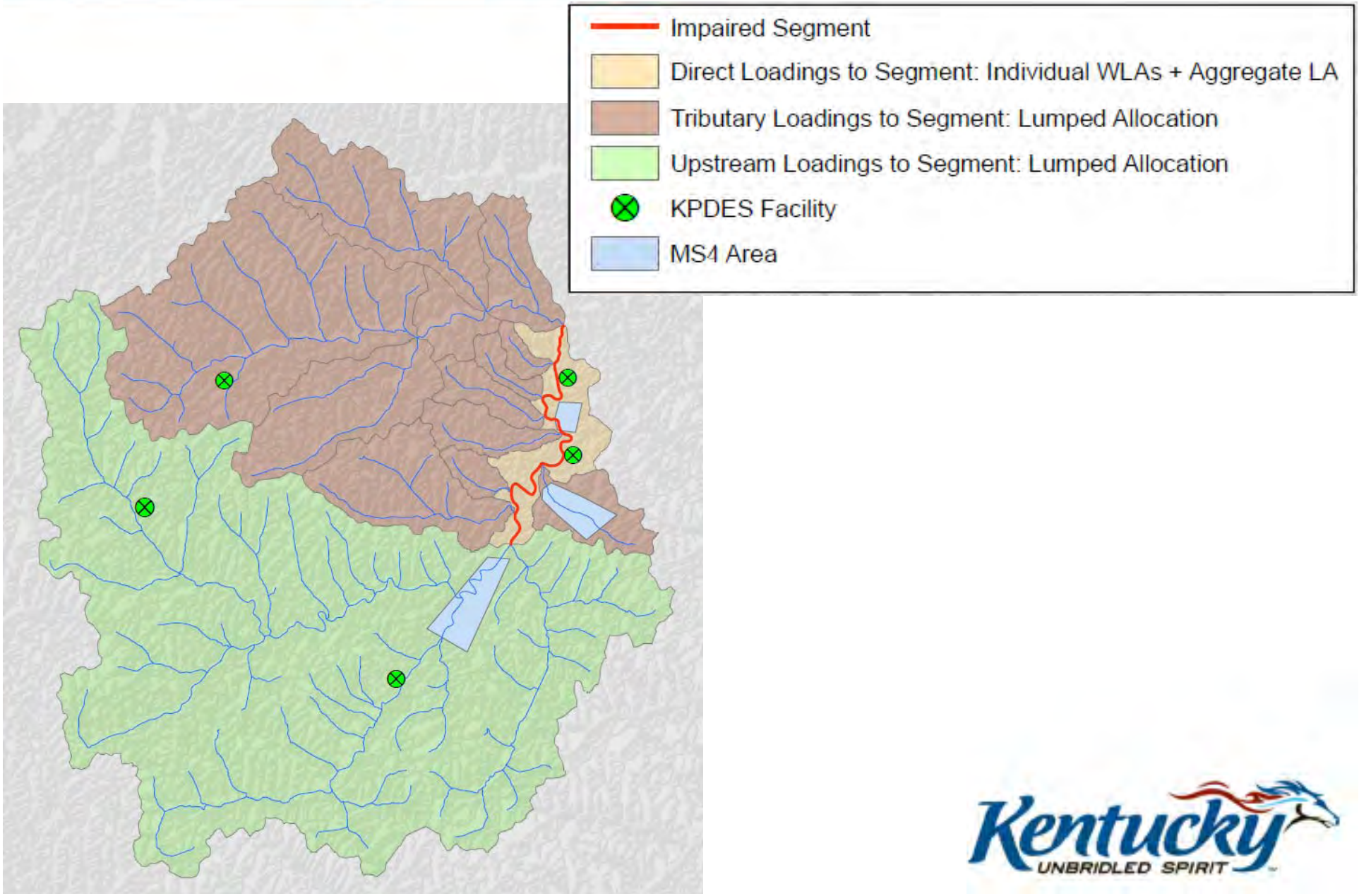
Example Impaired Segment



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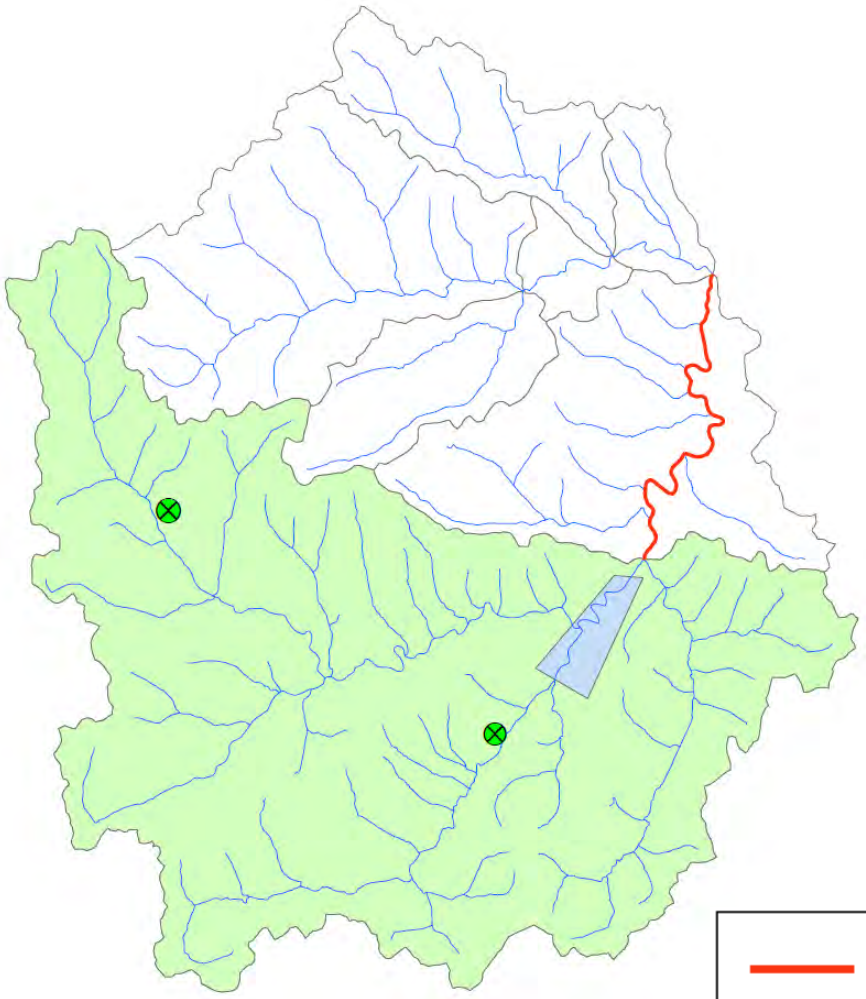
Upstream Loadings



A lumped allocation is given to the area upstream of the segment.

$$\sum(Q_{upstream} \times WQC \times CF)$$

Point sources are not identified with individual WLAs.

Their contribution is accounted for as a portion of total flow & load coming from upstream.

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Tributary Loadings

A lumped allocation is given to tributary contributions to the segment.

$$\sum(Q_{tributary} \times WQC \times CF)$$

Point sources are not identified with individual WLAs.

Their contribution is accounted for as a portion of total flow & load coming from tributaries.

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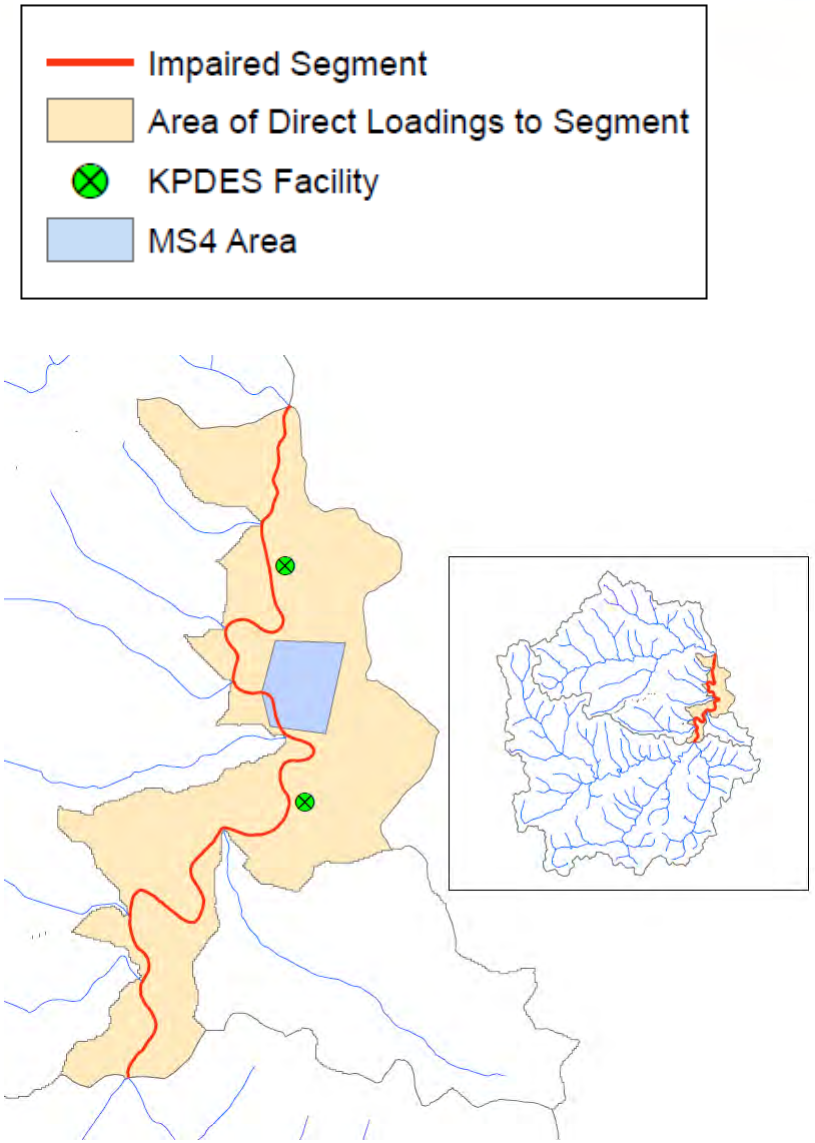
Direct Loadings



KPDES sanitary dischargers and CSOs get individual WLAs.

MS4 areas get an in-stream allocation proportional to their flow contribution.

Nonpoint sources receive a load allocation.

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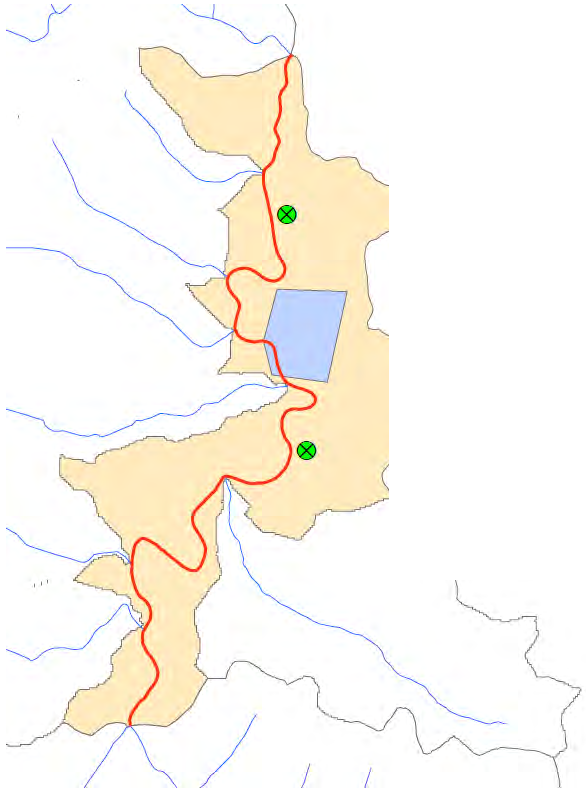
Direct Loading Allocations

Allocations for direct loads to the segment:

$\sum(Q_{SWS} \times WQC \times CF)$ = WLA for KPDES sanitary system discharges



$\sum(Q_{MS4} \times WQC \times CF)$ = WLA for MS4s

$\sum(Q_{CSO} \times WQC \times CF)$ = WLA for CSOs

$\sum(Q_{LA} \times WQC \times CF)$ = Load Allocation for nonpoint sources

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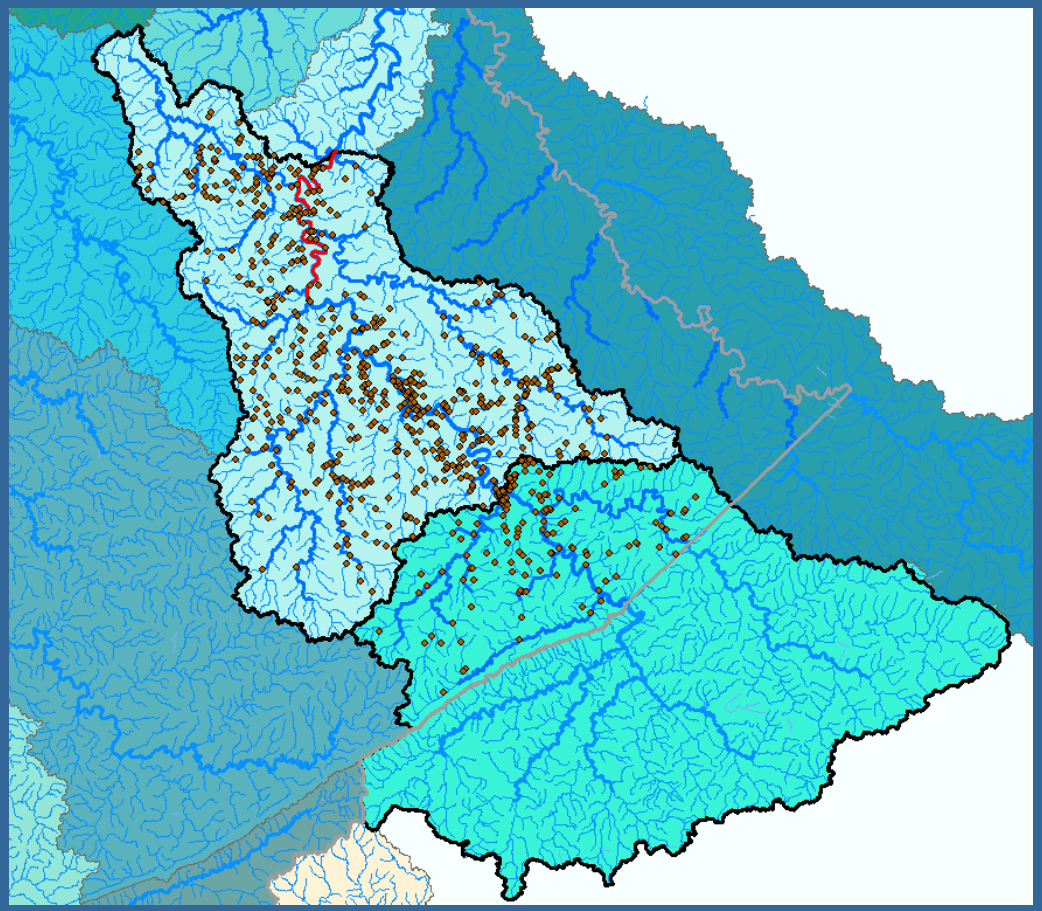
Impact on Example Watershed TMDL

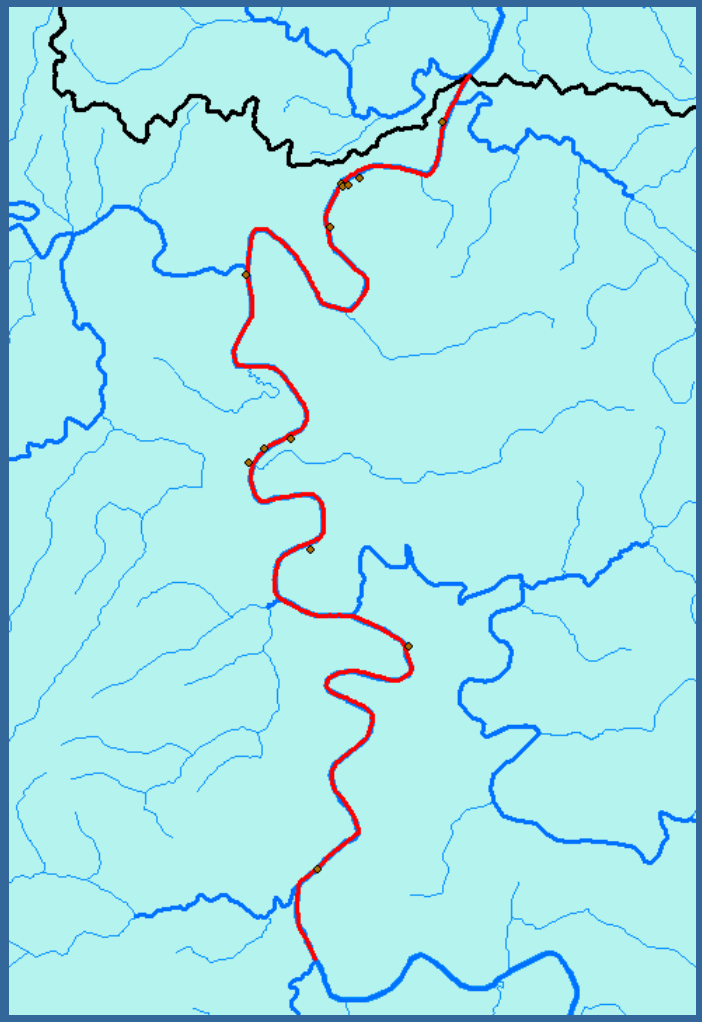
- Levisa Fork 34.1 to 54.7 (3130 mi^2):
  - 791 KPDES sanitary discharges in KY plus unknown number in VA



Segment TMDL Method

Levisa Fork 34.1 to 54.7:

- 12 KPDES sanitary discharges directly into segment (tributaries at 1:24K)



What about Storm Water? CSOs

- During wet weather events, a CSO entity is considered to be compliant with its CSO-WLA if it is compliant with its KPDES permit.

- Dry weather CSO flows are prohibited.

MS4s

- Only MS4s with land directly adjacent to the impaired segment would be identified in the segment MS4-WLA.

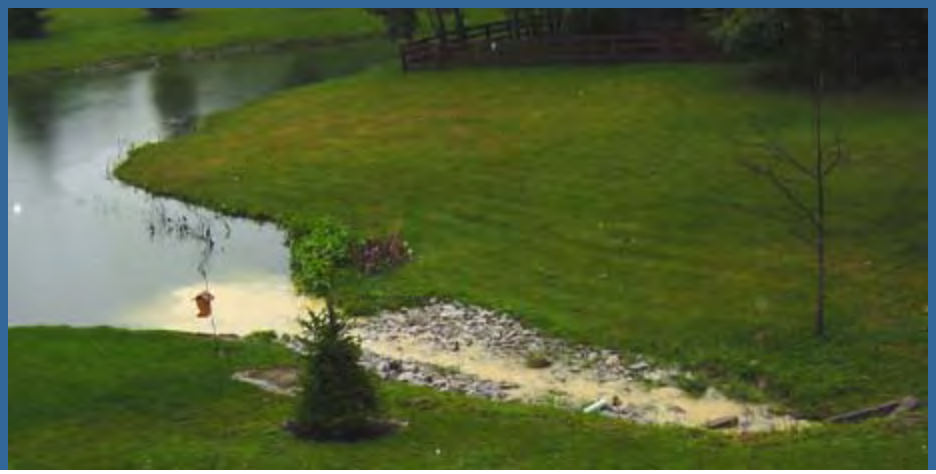
- Any other MS4s in the watershed would be included in a “lumped allocation” under the tributary or upstream category.

MS4s

- <u>The MS4-WLA is an in-stream allocation, not an end-of-pipe limit.</u>

  "The MS4-WLA is an aggregate of the in-stream contribution of all MS4 outfalls within the MS4 jurisdiction, not the storm water contribution from individual MS4 outfalls.

  The MS4-WLA will be addressed through the MS4 permit and implemented through the Storm Water Quality Management Plan (SWQMP) to the Maximum Extent Practicable (MEP)."



Benefits of Segment Method

- ✓ Flexible
  - Applicable to PCR/SCR uses, *E. coli*/fecal coliform, large river/small stream
  - Accommodates changes to standards
- ✓ Efficient
  - Does not require collection of new data
  - 5-6 years to complete TMDLs for currently listed segments
- ✓ TMDL applies to all flow conditions
  - Allocations are a continuum based on flow from each source
- ✓ Aligns with permitting programs

Drawback: loss of watershed information

Final Thoughts

- Segments/watersheds recommended for TMDL alternative or watershed-based TMDL can be withheld from statewide document
- The streamlined approach allows KDOW to allocate resources for water quality projects more strategically

Finding TMDL Info- TMDL Program

- www.water.ky.gov/waterquality

Questions?