Fecal Coliform Bacteria

Practical Thoughts for WSGs
on TMDLs and Source ID

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From Martin…

- How are TMDL allocation calculations made ?

- What source tracking DEP does? What kind of work must be done so that watershed groups can be confident they are tackling the right problem(s) – agricultural or residential or both. Don’t forget public sewer areas!

- How have bacteria levels been reduced?

A word about bacteria samples

- “Fecal coliform” and *E. coli* are INDICATOR bacteria.
  - “Most *E. coli* are harmless and actually are an important part of a healthy human intestinal tract.” CDC
  - Indicate that a **contamination pathway exists**

- Lower level of accuracy/precision that other analyses.

Duplicate 1 result (col/100 ml)	Duplicate 2 result (col/100 ml)	Percent difference
840	860	2.4
118	92	25
112	74	41
600	345	54
1040	540	63

WV WQS

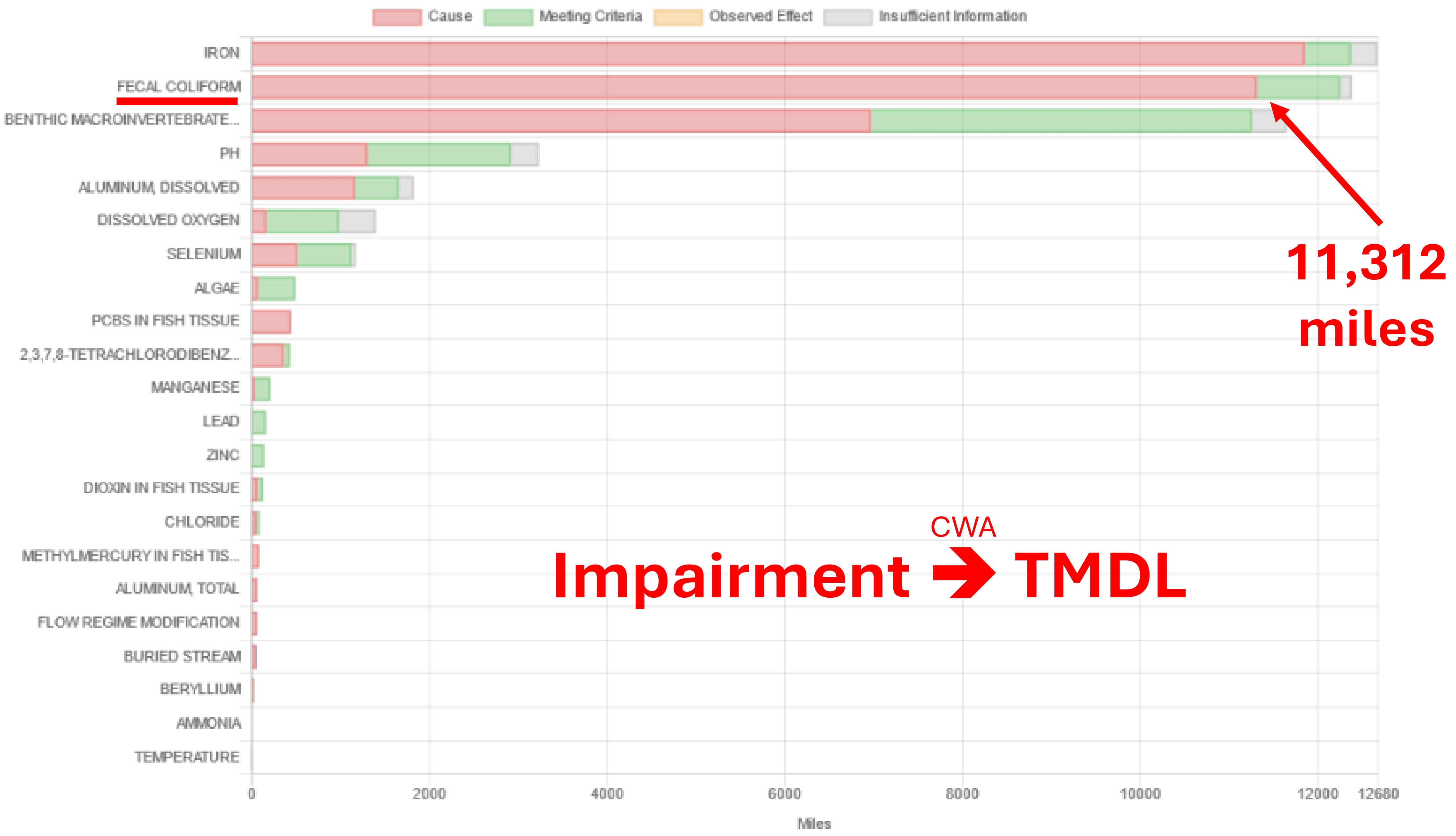
- shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.

When evaluating bacteria sample results...

DON'T ASSIGN TOO MUCH WEIGHT TO A SINGLE SAMPLE.

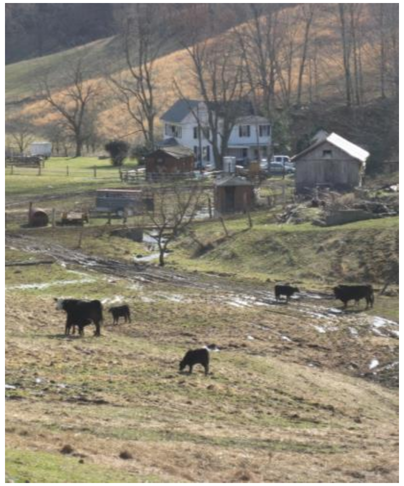
LOOK AT TRENDS WITH MULTIPLE SAMPLES

Miles of WV Stream Impairments by Parameter



The 5-minute TMDL overview…

- TMDL = Mathematical Plan to Reduce Excess Pollution Loading
  - Based on computer modeling.
  - Starts with current pollutant loading (baseline)
  - Specifies how much reduction is needed in each source category to meet water quality standards:


Pasture


Failing Septics

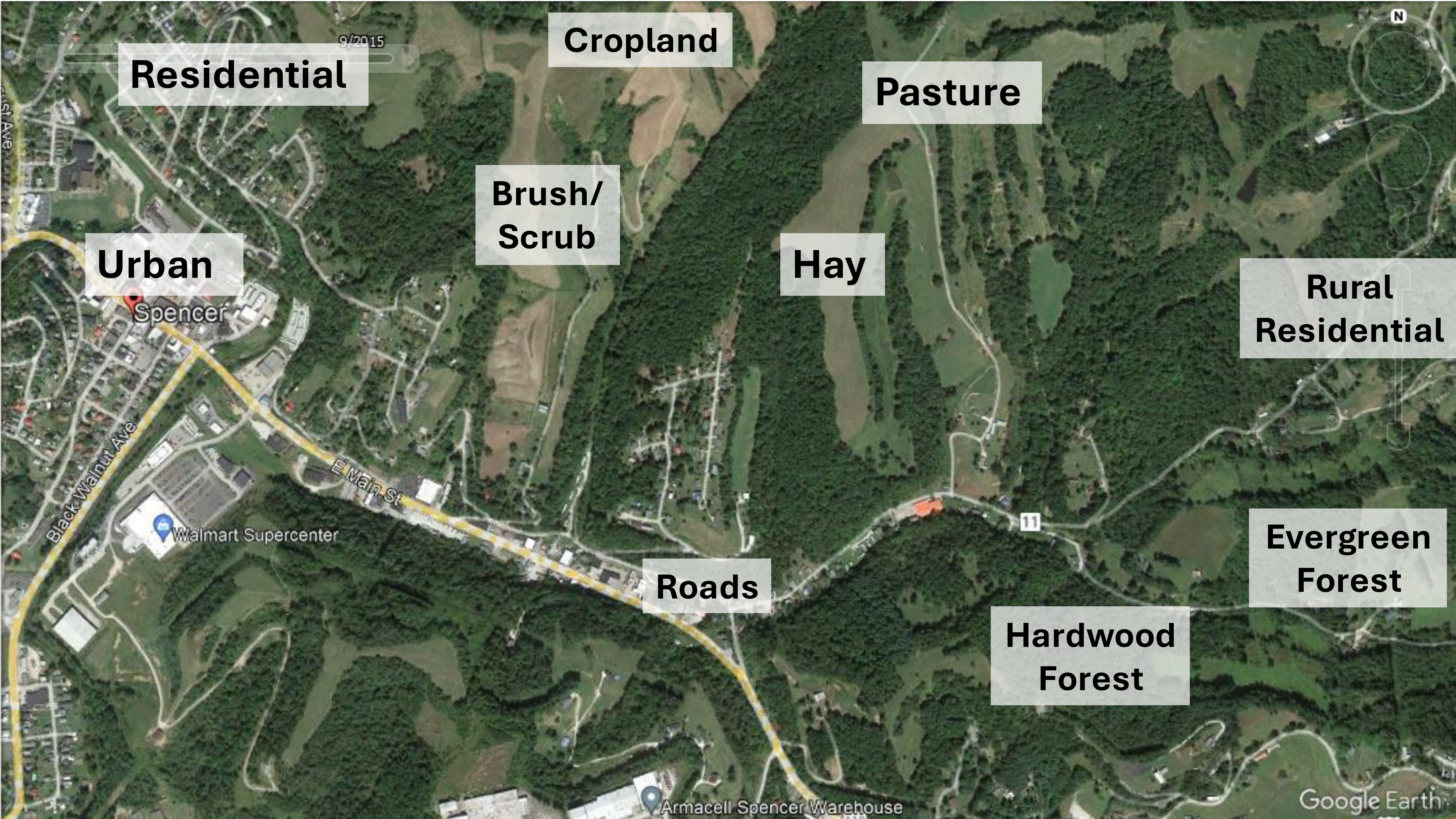

Sewer Overflows


Urban/Res Runoff

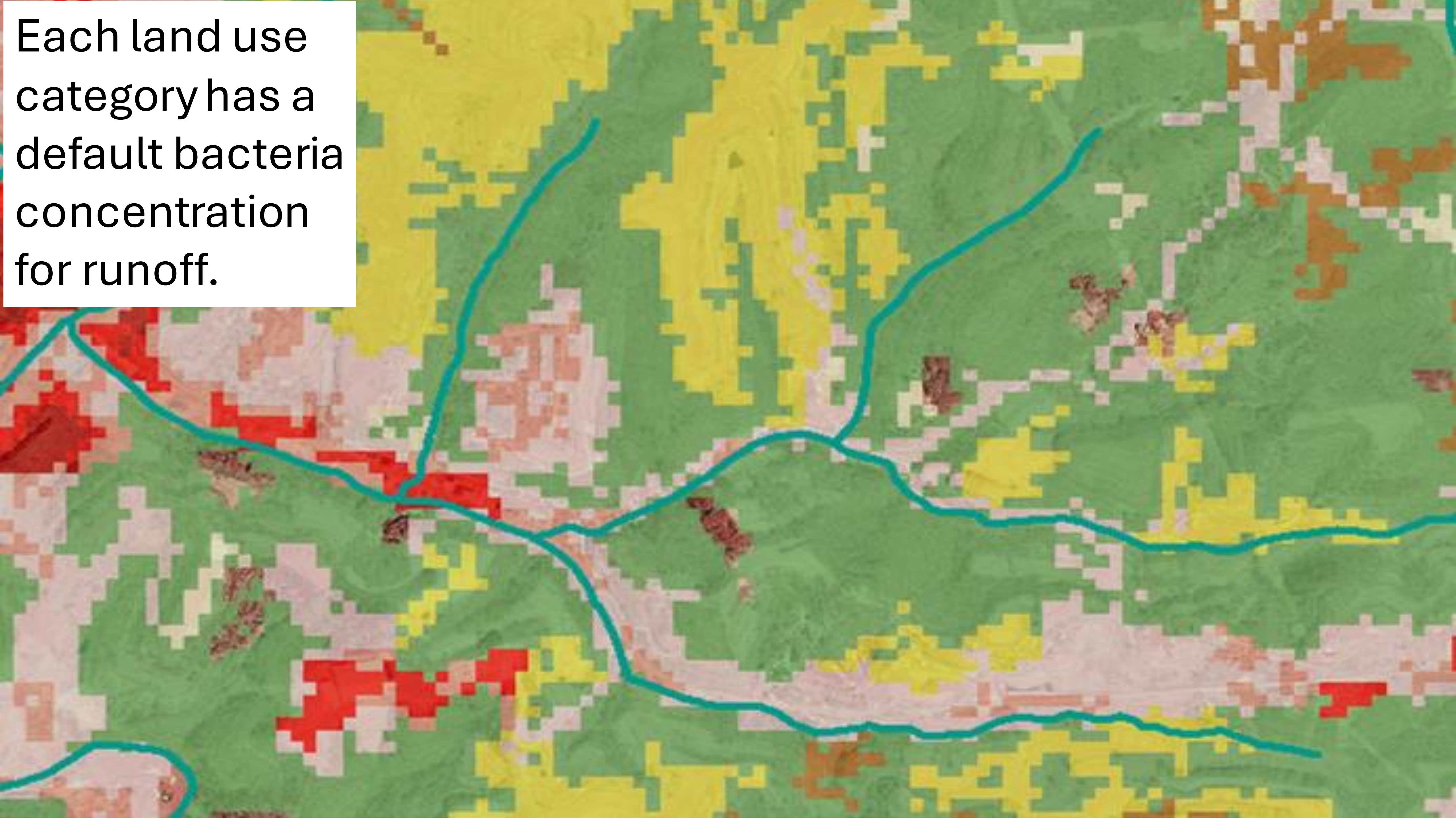

Background

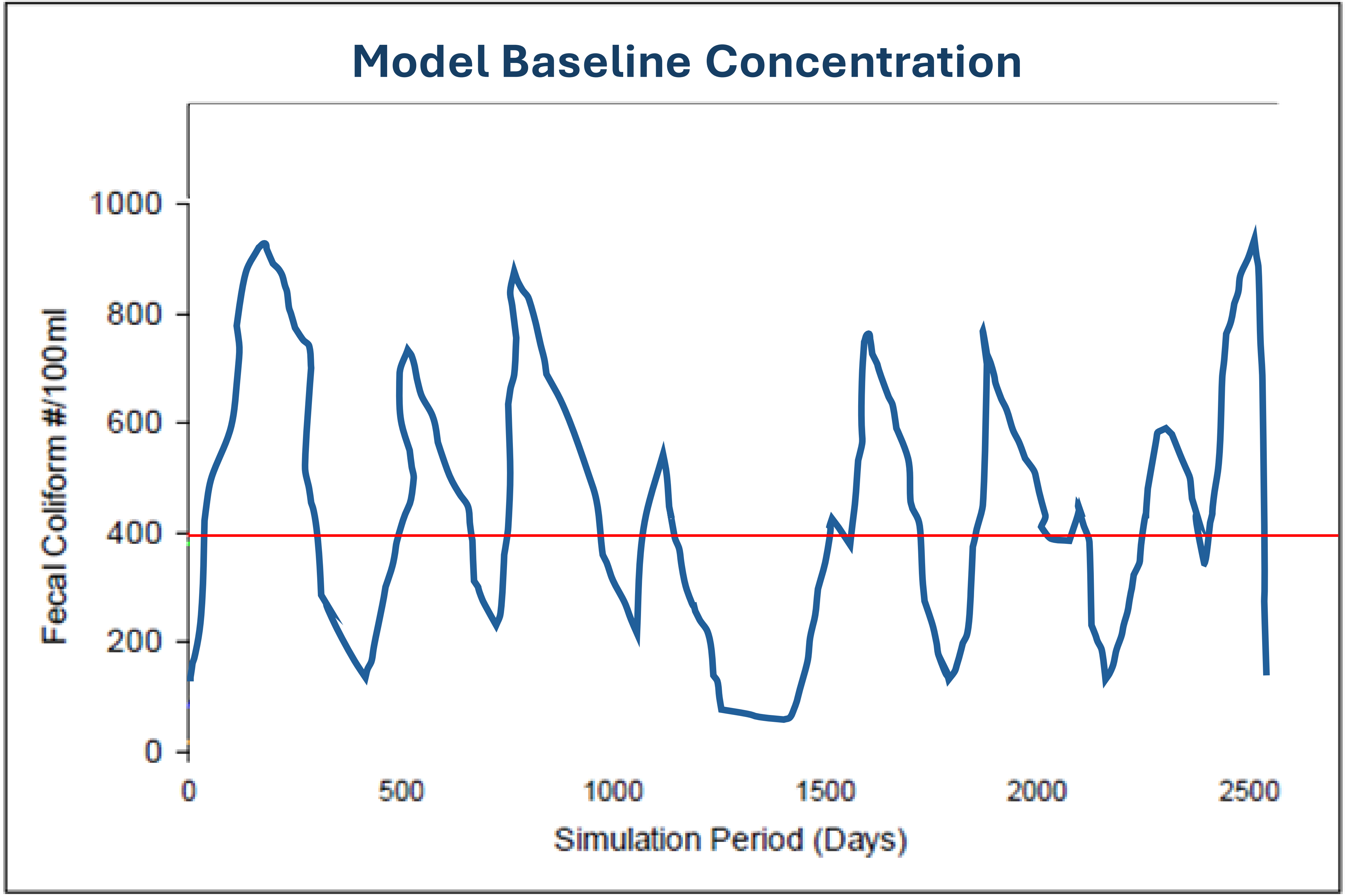
Basic Model Inputs

- Sample results
- Specific sources
- Land Uses
- Weather data


Residential
9/2015
Cropland
Pasture
Brush/
Scrub
Urban
Spencer
Hay
Rural
Residential
Black Walnut Ave
E Main St
Walmart Supercenter
11
Evergreen
Forest
Roads
Hardwood
Forest
Armacell Spencer Warehouse
Google Earth

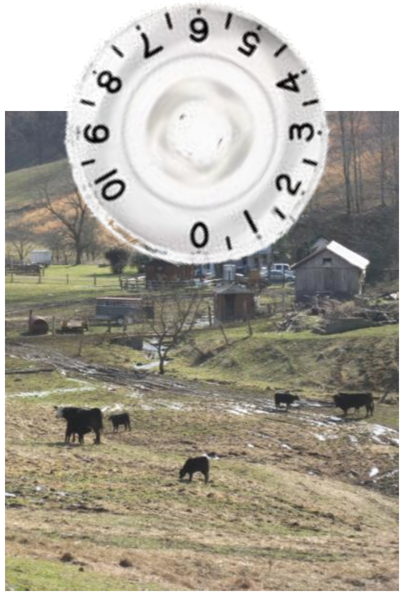
Each land use category has a default bacteria concentration for runoff.




Model Baseline Concentration
Fecal Coliform #/100ml
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
Simulation Period (Days)

Making “modeled reductions”

- How much reduction in each category of pollutants needs to be made to meet water quality standards:


Pasture


Failing Septics


Sewer Overflows


Urban/Res Runoff


Background

Making “modeled reductions”

- How much reduction in each category of pollutants needs to be made to meet water quality standards:

Pasture

Failing Septics

Sewer Overflows

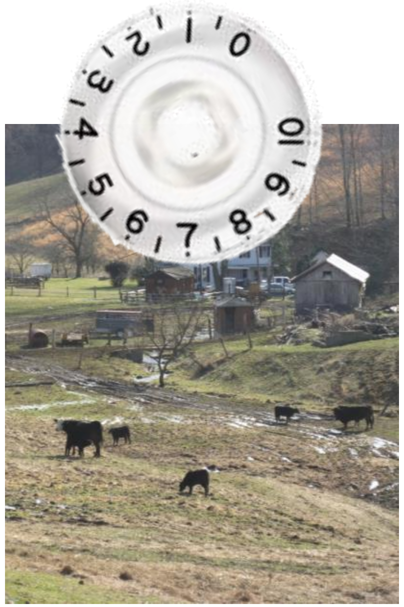
Urban/Res Runoff

Background

Making “modeled reductions”

- How much reduction in each category of pollutants needs to be made to meet water quality standards:

70% Reduction



Pasture

100% Reduction

Failing Septics

85% Reduction

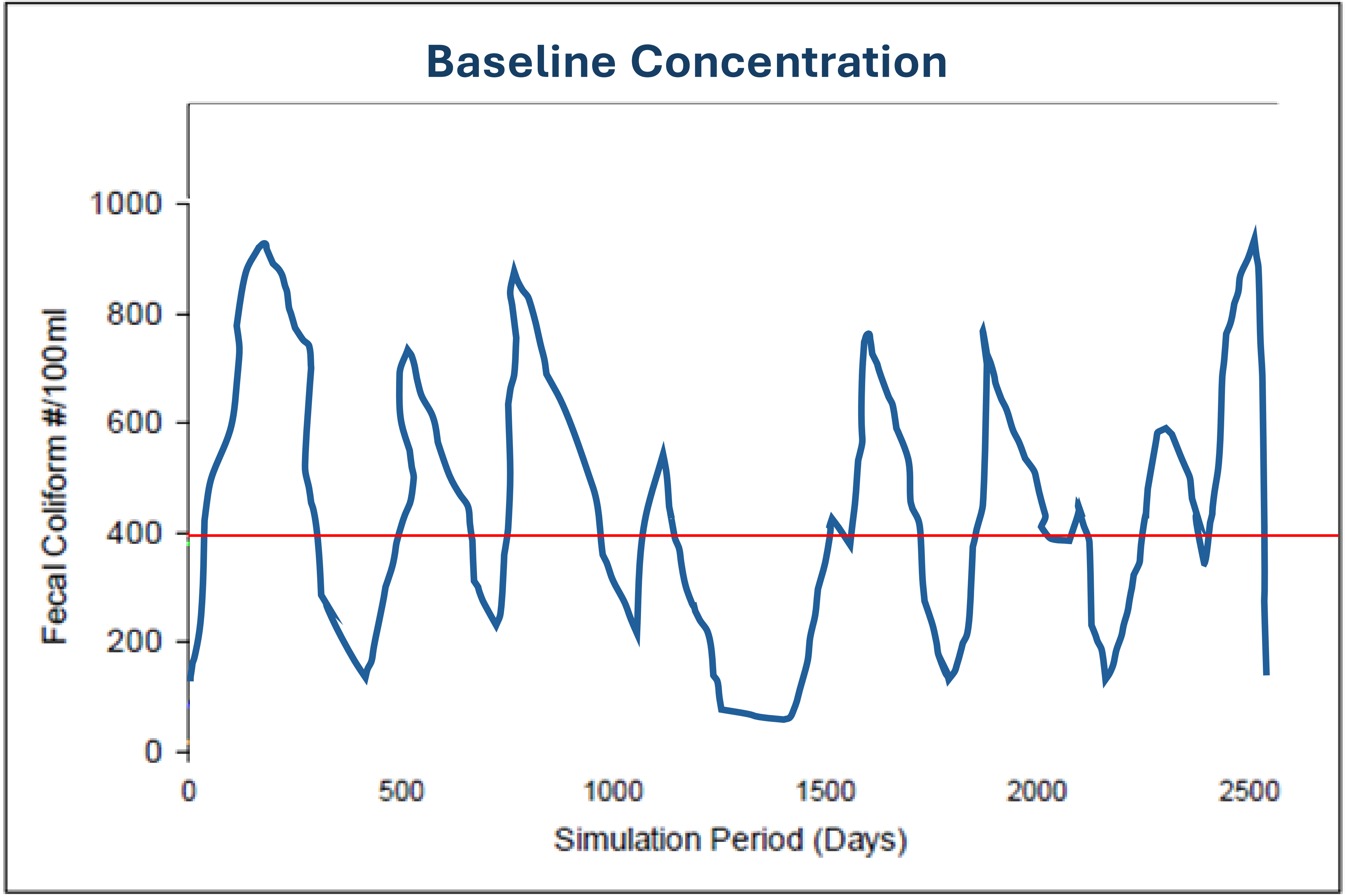
Sewer Overflows

45% Reduction

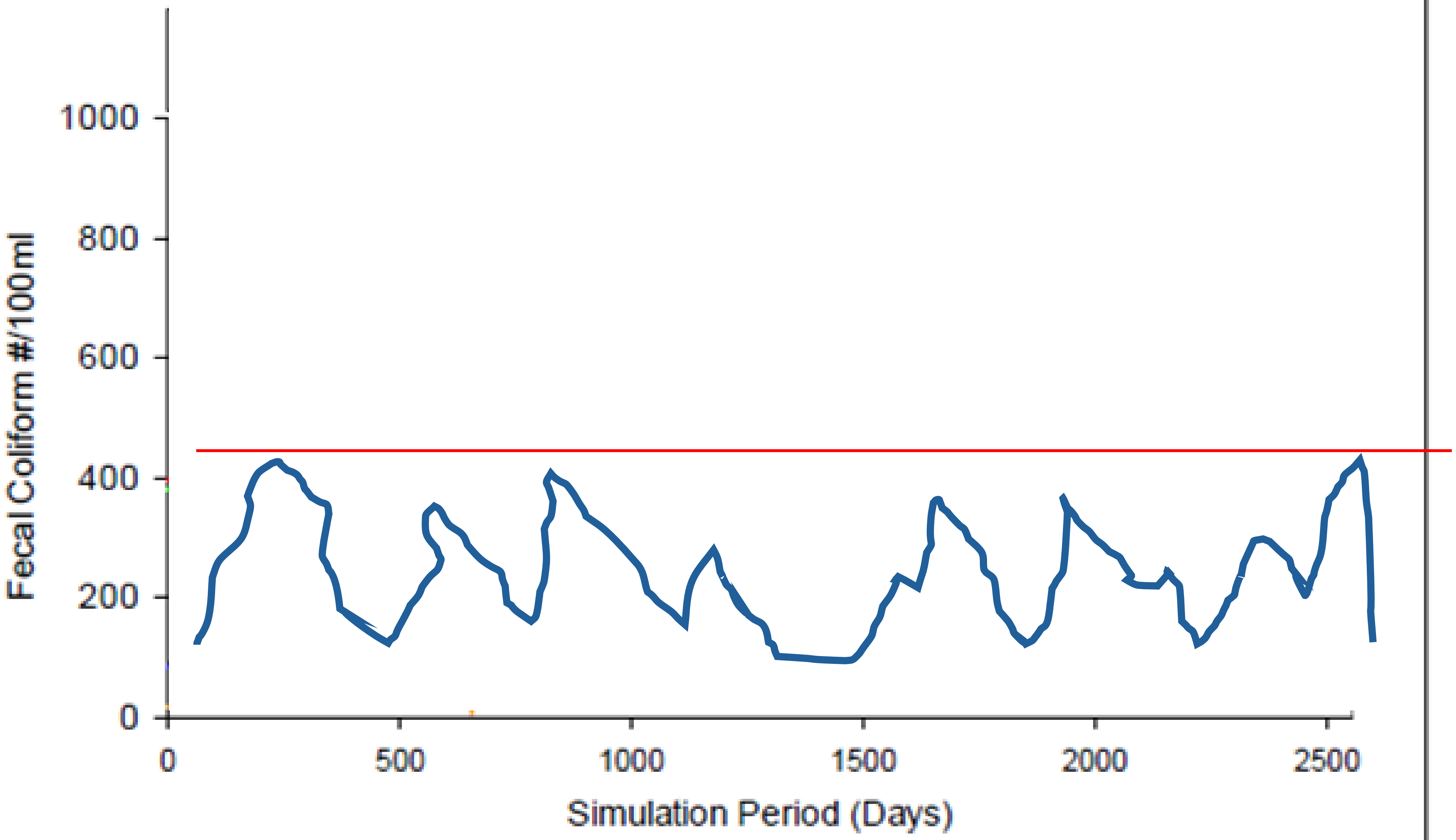
Urban/Res Runoff

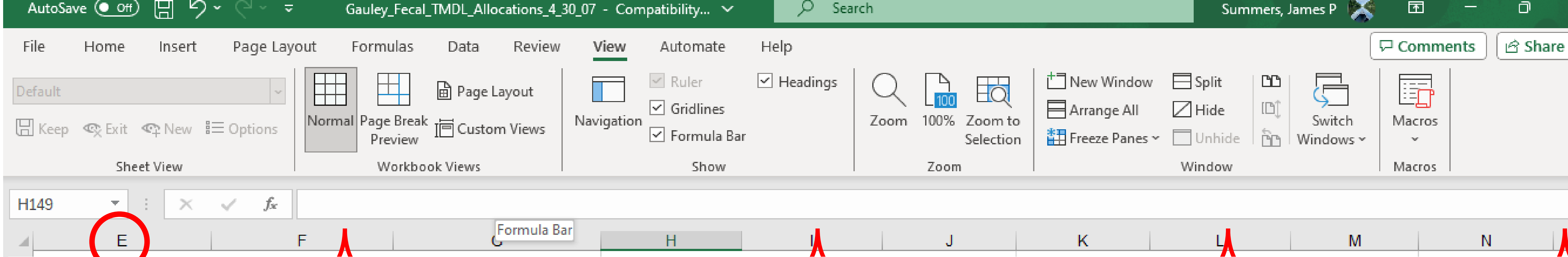
0% Reduction

Background


Baseline Concentration
Fecal Coliform #/100ml
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
Simulation Period (Days)

Modeled Output Concentration

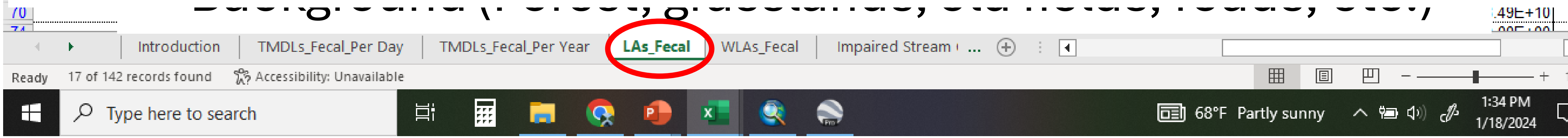




Don't get caught up in the details of the numbers. They are outputs from a computer model – not exact reality!

The real end GOAL isn't specific reductions; it's improving WQ.

Find the real problems and work for WQ improvements.



Source Identification:

Are we barking up the right tree?

Gauley_Fecal_TMDL_Allocations_4_30_07 - Compatibility...

H149

n Load Allocations

Row	Pasture/Grassland Baseline Load (counts/yr)	Pasture/Grassland Allocated Load (counts/yr)	Pasture/Grassland Percent Reduction	Background & Other Nonpoint Sources Baseline Load (counts/y	Background & Other Nonpoint Sources Allocated Load (counts/y	Background & Other Nonpoint Sources Percent Reduction	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction	Residential Baseline Load (counts/yr)
36	[illegible]	7.81E+11	95.7	1.10E+12	1.10E+12	0.0	[illegible]	0.00E+00	100	1.41E+11
44	1.14E+13	9.42E+11	91.8	6.03E+12	6.03E+12	0.0	5.41E+14	0.00E+00	100	6.24E+11
45	6.90E+12	5.68E+11	91.8	3.03E+12	3.03E+12	0.0	1.62E+15	0.00E+00	100	1.06E+12
48	2.05E+12	2.09E+11	89.8	2.66E+11	2.66E+11	0.0	4.33E+13	0.00E+00	100	2.21E+10
49	2.57E+12	2.61E+11	89.8	3.60E+11	3.60E+11	0.0	2.60E+14	0.00E+00	100	1.35E+11
51	9.19E+12	9.41E+11	89.8	8.98E+11	8.98E+11	0.0	2.16E+14	0.00E+00	100	1.64E+11
52	1.76E+13	1.10E+12	93.8	3.81E+12	3.81E+12	0.0	3.59E+15	0.00E+00	100	5.88E+11
54	4.49E+12	4.57E+11	89.8	3.60E+11	3.60E+11	0.0	3.90E+14	0.00E+00	100	2.15E+11
55	3.85E+12	3.92E+11	89.8	3.56E+11	3.56E+11	0.0	4.33E+13	0.00E+00	100	4.16E+10
56	1.14E+13	1.16E+12	89.8	6.36E+11	6.36E+11	0.0	4.98E+14	0.00E+00	100	3.22E+11
58	1.22E+13	1.25E+12	89.8	1.21E+12	1.21E+12	0.0	1.66E+15	0.00E+00	100	4.72E+11
59	1.53E+13	2.33E+12	84.8	3.62E+12	3.62E+12	0.0	3.91E+14	0.00E+00	100	1.18E+11
64	2.38E+13	1.25E+12	94.8	3.14E+12	3.14E+12	0.0	1.96E+15	0.00E+00	100	7.30E+11
68	1.26E+13	6.85E+11	94.6	1.94E+12	1.94E+12	0.0	8.31E+14	0.00E+00	100	3.10E+11
69	9.57E+12	4.94E+11	94.8	2.25E+12	2.25E+12	0.0	6.85E+14	0.00E+00	100	2.19E+11
70	5.47E+12	2.83E+11	94.8	4.95E+11	4.95E+11	0.0	[illegible]	0.00E+00	100	[illegible]

Introduction | TMDLs_Fecal_Per Day | TMDLs_Fecal_Per Year | LAs_Fecal | WLAs_Fecal | Impaired Stream ...

Ready 17 of 142 records found

How to narrow down and quantify sources…

- Source Inventories
- Sampling

- Start with Existing Data
  - Ask for it!
  - Nick Murray, DEP-TMDL, 304-926-0499 (ext. 43887)
    - Stream Sample results
    - Pollutant Source Report for TMDL

- james.p.summers@wv.gov

Inventorying fecal bacteria sources…

- Public Sewer Systems
  - Don’t assume these don’t contribute (esp. older systems)
- Private sewage systems
  - Septic Systems
  - Home Aeration Units
  - Package plants
- Pasturing
  - Unrestricted Stream Access
  - Feedlots
- Other
  - Pets
  - Odd occurrences

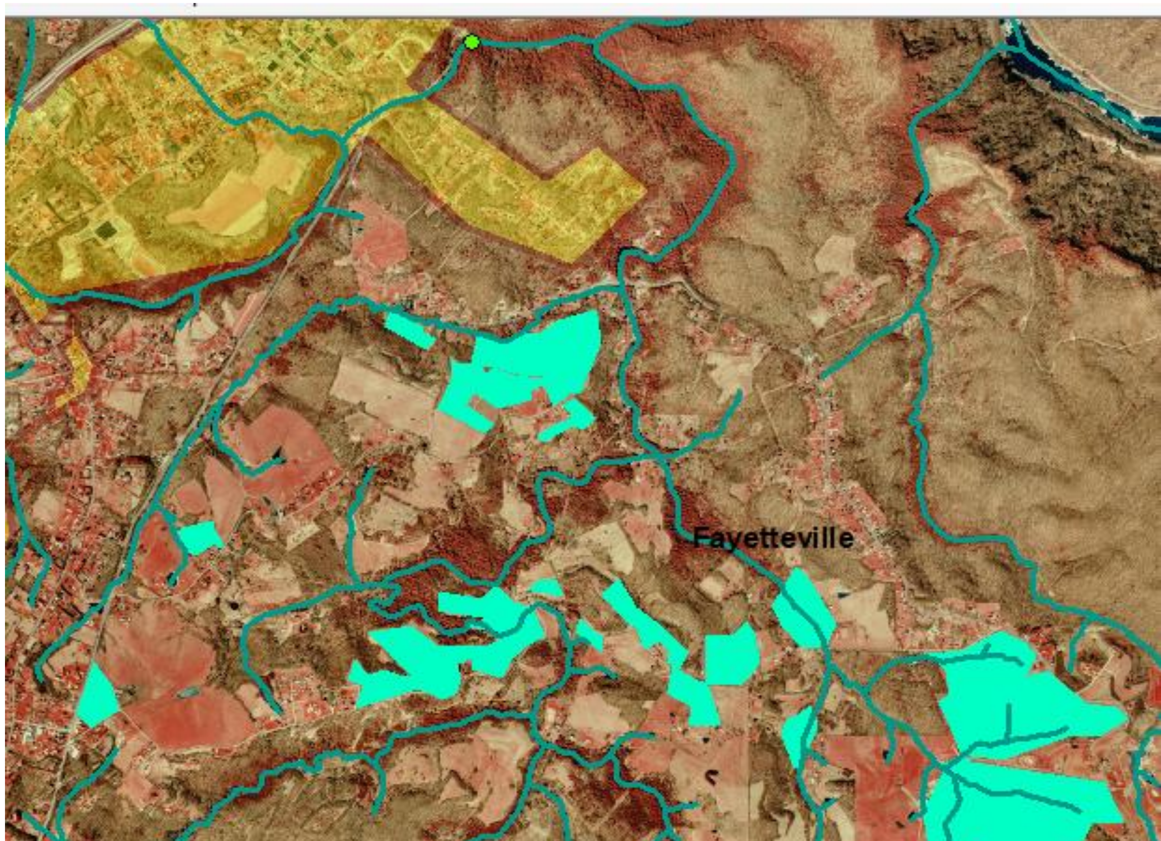
Inventory before developing a sampling plan!

Design **Sample Plan** Around Natural Geographical Separations

- Public sewer areas ***vs*** individual septic systems

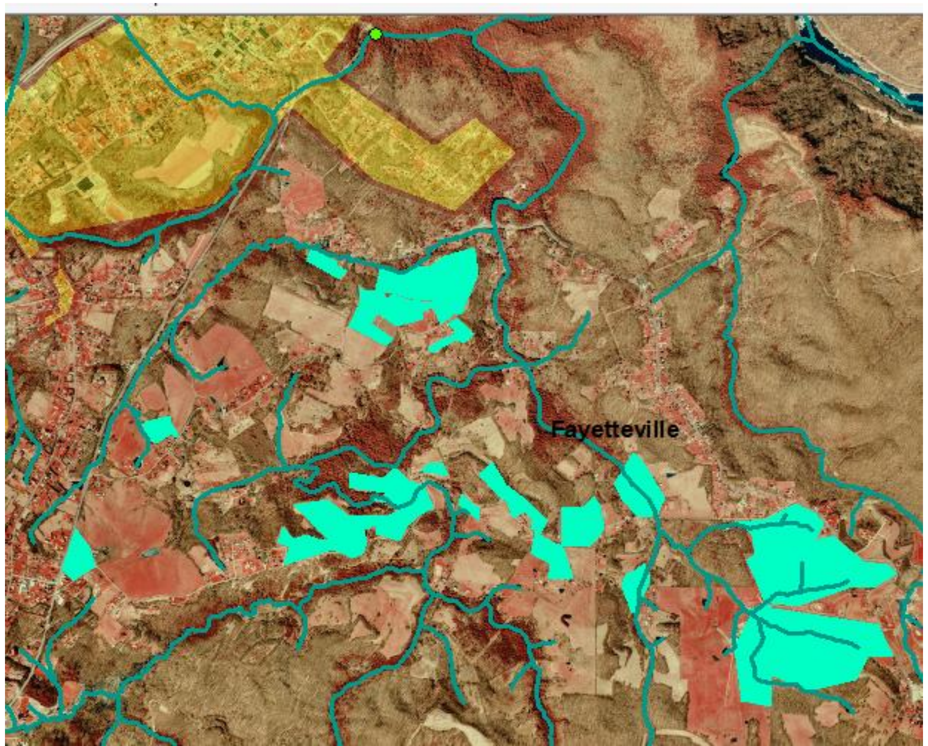
- Agricultural ***vs*** Urban/suburban

- Agricultural ***vs*** rural residential



Public Sewer Considerations

- Extent of sewered area
  - TMDL
  - “WV IJDC Utility GIS”
  - Local WWTP
- Where are extensions planned
  - Residential areas or “Development”
- WWTP discharge and pump station location
- Age and material of sewer lines (older/newer)
- Any CSOs present?
- Evidence of manhole overflows




~100,000 gpd
(eq. >500 straight pipes)

Sewered area considerations

- Most systems in WV have at least portions that are old.
- Leaks and overflows do occur!
- Impacts are (kind of) ~~“hidden”~~ not obvious in the TMDL.

“Unsewered Areas”

- Areas not served by a public sewer
- Various Issues
  - True “straight pipes” (TP instream)
  - Community straight pipes (Old company towns)
  - Inadequate systems
    - Relief pipes/ditches
    - Downward failure
    - Seasonal failure

- <u>Most</u> private systems do function fine…
  - if there is adequate space.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Extent of impact varies…

- Size of stream
- Number of sources
- Distance to source(s)
  - Overland
  - By stream
- Canopy/clarity/depth
- Temperature
- pH/metals content

Considerations for areas w/o public sewer

- What's the age of the homes?
  - Not individually, but as a whole, are they <20, 20-40, >40
- Generally, how big are the house lots?
- How close are the houses to the creek?

- Drive-through
  - Evidence of failing/inadequate systems?

- Talk with county sanitarian & honey dippers
  - In their experience, where are the problem areas?

TMDL helps b/c already considered

- Number of unsewered houses (in SWS)

- Failure Rates
  - Depth to bedrock
  - Depth to groundwater
  - Permeability
  - Drainage capacity

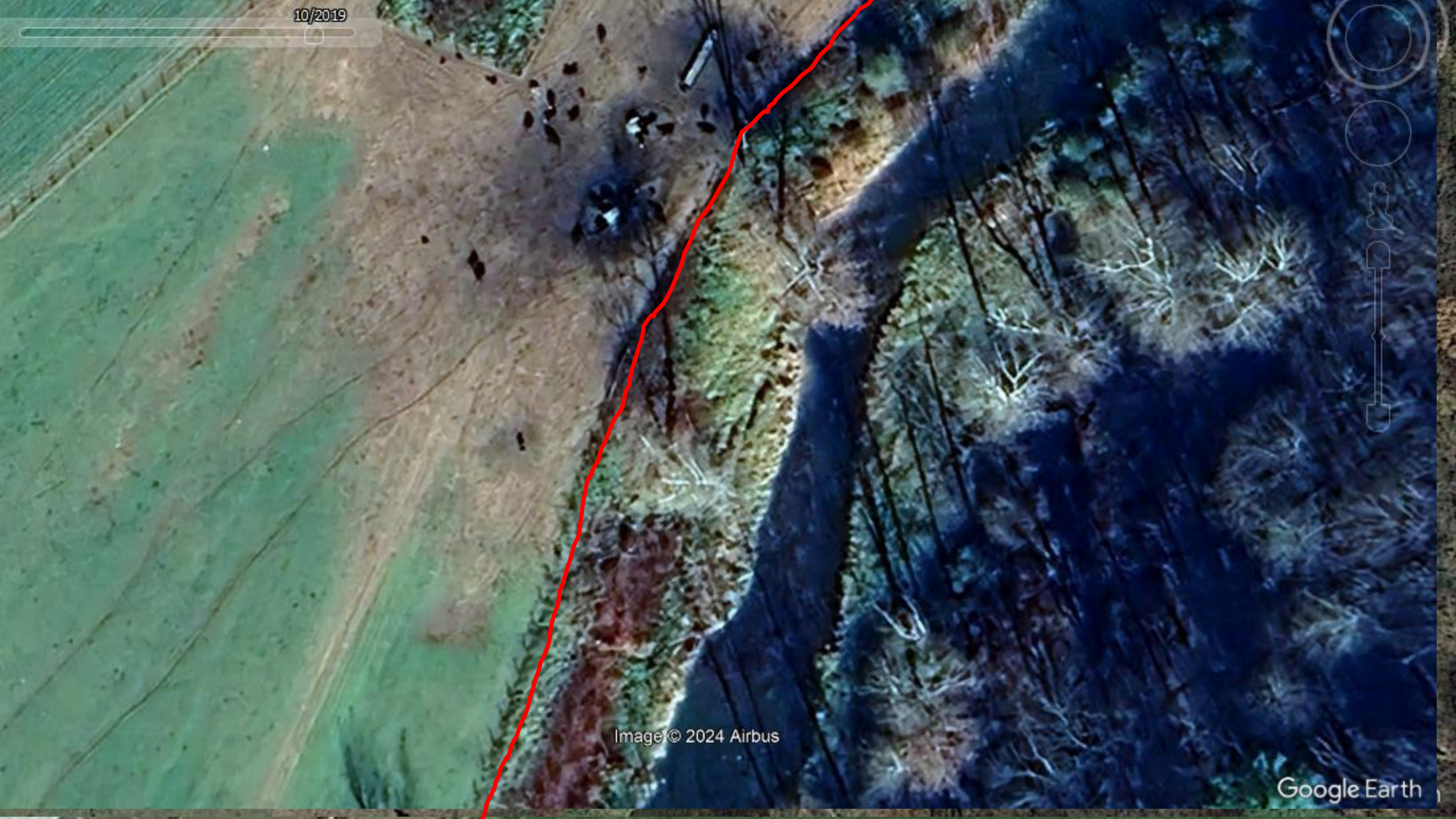
- Distance to stream

Pasture Inventory

- Stream access
- Winter feeding areas
- High Slope






10/2019
Image © 2024 Airbus
Google Earth

“Riparian Pasture”

Total Pas	Upland Ac	Rotational Pa	miles s	Acres R	LOW R	MODER	HIGH R	Total Tr	sition	Pasture	% Past	Occupied_Category
117	3.83	0	1.54	6.53	25.14	81.51	0	106.65			8	Developed
124.9	4.22	33.59	0.7	2.97	42.03	42.09	0	84.12			6	Developed
1.62	0	0	0.06	0.25	0	1.37	0	1.37			0	Rural varied
59.33	0	0	1.16	4.92	23.14	31.27	0	54.41			3	Rural varied
0.39	0.39	0	0	0.00	0	0	0	0.00			0	Rural varied
0	0	0	0	0.00	0	0	0	0.00			0	Rural varied
106.02	0	0	0.35	1.48	42.43	62.11	0	104.54			4	Rural varied
558.54	0	136	1.45	6.15	143.31	273.07	0	416.38			19	Ag Dominant
71.75	0	0	0	0.00	71.75	0	0	71.75			11	Developed
308.97	0	0	3.15	13.36	166.19	129.41	0	295.60			12	Ag Dominant
309	0	26.11	0	0.00	282.89	0	0	282.89			24	Developed
355.37	0	108.88	0.77	3.27	3.73	239.5	0	243.23			21	Ag Dominant
76.43	0	0	0	0.00	0	76.43	0	76.43			9	Rural varied
14.64	0	6.05	0.042	0.18	0	8.41	0	8.41			0	Rural varied
0	0	0	0	0.00	0	0	0	0.00			0	Rural varied
0	0	0	0	0.00	0	0	0	0.00			0	Rural varied
161.8	0	52.96	1.08	4.58	0	54.75	49.51	104.26			7	Rural varied
1.76	0	0	0	0.00	1.76	0	0	1.76			0	Rural varied
34.85	0	13.04	0	0.00	0	21.8	0	21.80			4	Rural varied
87.7	0	23.38	0.06	0.25	0.07	63.88	0.13	64.08			5	Rural varied
48.01	0	9.62	0	0.00	0	38.39	0	38.39			23	Ag Dominant
184.28	0	70.16	1.24	5.26	1.17	101.15	6.54	108.86			5	Rural varied
44.31	0	17.71	0.24	1.02	0	25.58	0	25.58			18	Rural varied
10.26	0	4.95	0.15	0.64	0	4.67	0	4.67			1	Rural varied
2.31	0	1.09	0	0.00	0	1.22	0	1.22			0	Rural varied
189.73	0	62.3	1.85	7.85	9.91	107.11	2.56	119.58			6	Rural varied

Pasturing

- Newer TMDL source reports specify acres of riparian pasture:
    - Meadow
    - Guyandotte
    - Tug/Big Sandy River
    - Twelvepole Creek
    - Little Kanawha/Hughes
    - Lower New
    - Upper Elk
    - Stoney
    - Cacapon
    - Some of Potomac tribs
    - (Gauley)
- Older Projects
    - Approximate <u>total acres</u> of pasture for each subwatershed

Windshield surveys

- If you can only do one, do “leaf off” .
- Add late summer or early fall if you’re able.
  - Low flow stream conditions: enrichment/algae

- Ag: stream access or overall high runoff potential.

Sample Plan

- Allow for duplicates, blanks, and background
  - Duplicates on 10% of samples
  - Establish a forested background site, if possible

Base Flow vs Runoff Events

	Base Flow	Runoff Event
Failing septics	Fairly Consistent higher values.	"Pools" can wash into stream.
Pasture	Consistent values at base flow indicate access to the creek.	Compare to background.
Public Collection lines	High values indicate leaks/cracks in old lines and/or cross connections.	High values indicate overflows or bypasses.
Background	Low values.	Can be in the 1000s
Soils/sediment	Not a factor	???

What about bacteria DNA samples?

- WQSAS/TMDL do not use these
  - USGS study
- (Probably) Improving
  - qPCR
- Expensive (~10x)

- "The salesman *said* it would work."
- Can't argue with photos.

Success stories

- WQSAS is/will be focusing more on these.
- Most documented are public sewer related.
  - New treatment systems
  - Line extensions
  - Pump/line upgrades
  - Surge Tanks
- Lost improvement (ag related)
- Some evaluation now of Second Creek (Greenbrier)

Summary

- "There is no single method that is capable of identifying specific sources of fecal pollution in the environment with absolute certainty."
- FC and EC are indicators of pathway of contamination.
  - Not necessarily harmful levels.
- Use trends and significant differences.
- Do a Source Inventory to design a good sample plan.
- Municipal systems can contribute too.

Contact Info

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