Beaver Creek Watershed Benthic and Bacterial TMDL Revision

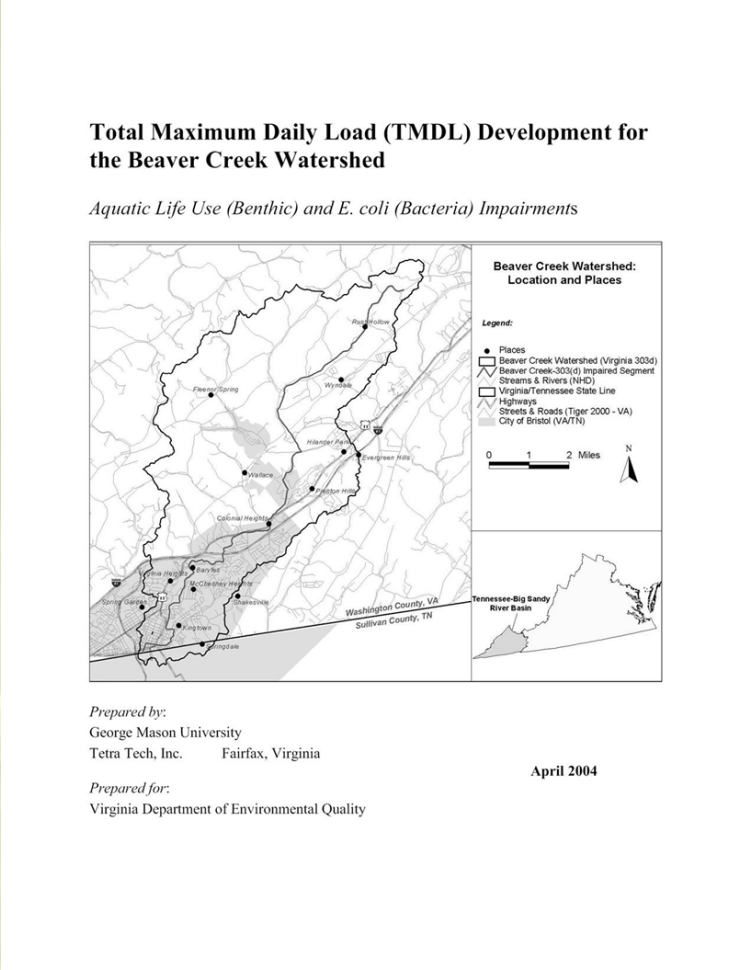
Public Meeting
March 1, 2016

MapTech

Natural Resource Solutions
Through Science and Engineering

Why revise the TMDL?

- Changes within the watershed
  - Additional permitted discharge
  - Land use change
- Changes to the fecal bacteria standard



Total Maximum Daily Load (TMDL) Development for the Beaver Creek Watershed

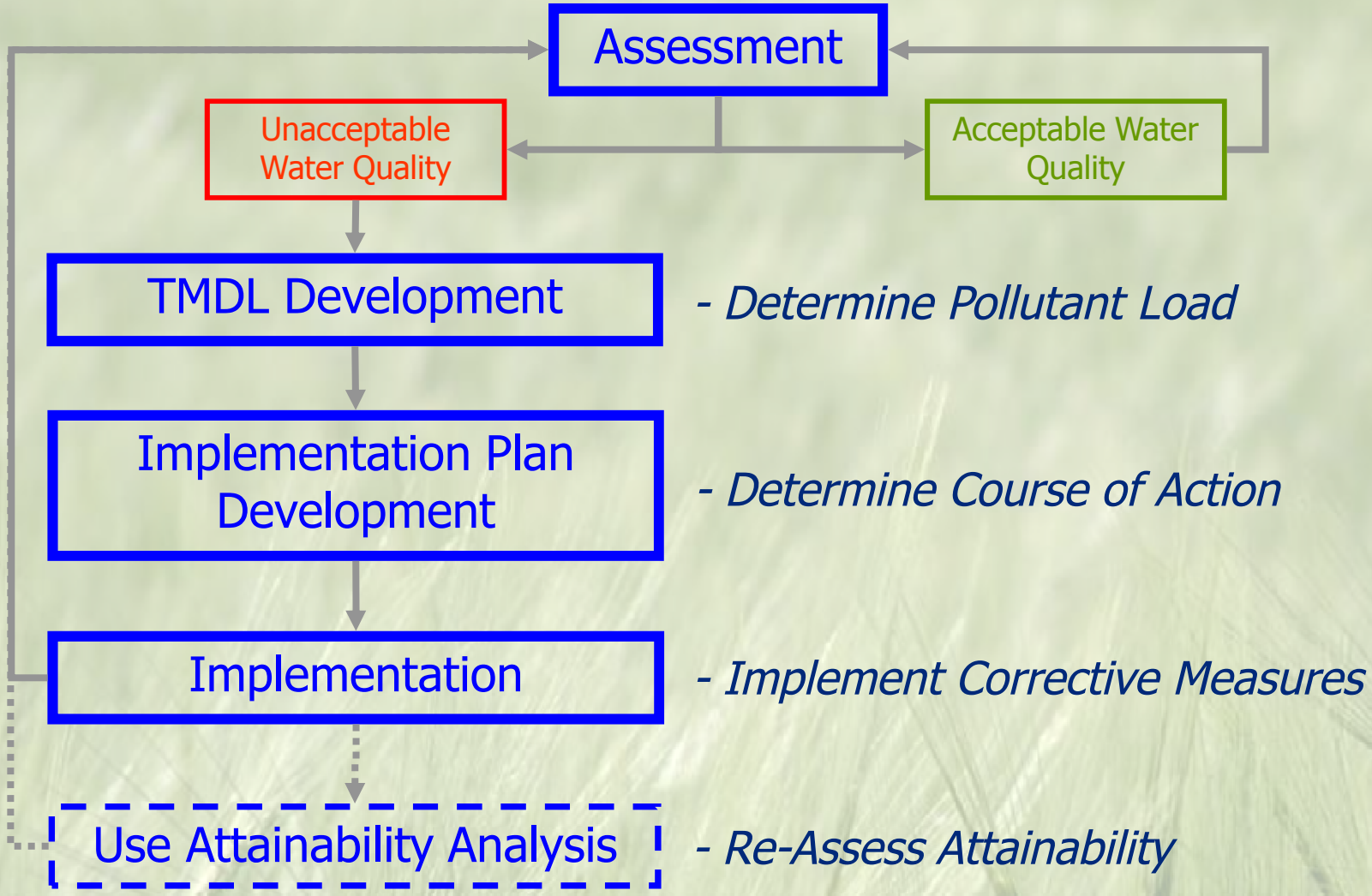
Aquatic Life Use (Benthic) and E. coli (Bacteria) Impairments

Prepared by:
George Mason University
Tetra Tech, Inc. Fairfax, Virginia

April 2004

Prepared for:
Virginia Department of Environmental Quality

TMDL Process



Total Maximum Daily Load (TMDL) Equation

TMDL = Sum of WLA + Sum of LA + MOS

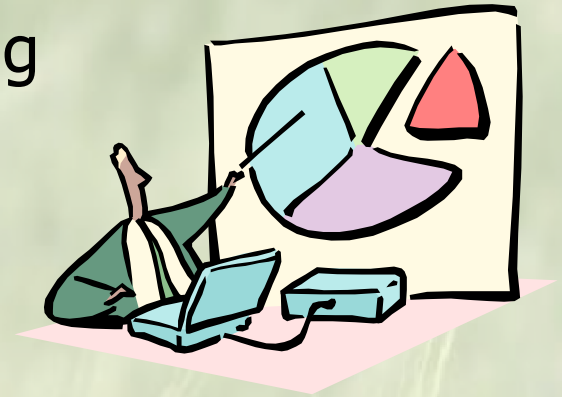
Where:

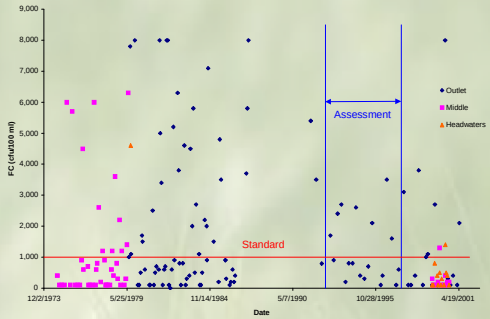
TMDL	**=**	**Total Maximum Daily Load**
WLA	**=**	**Waste Load Allocation (point sources)**
LA	**=**	**Load Allocation (nonpoint sources)**
MOS	**=**	**Margin of Safety**

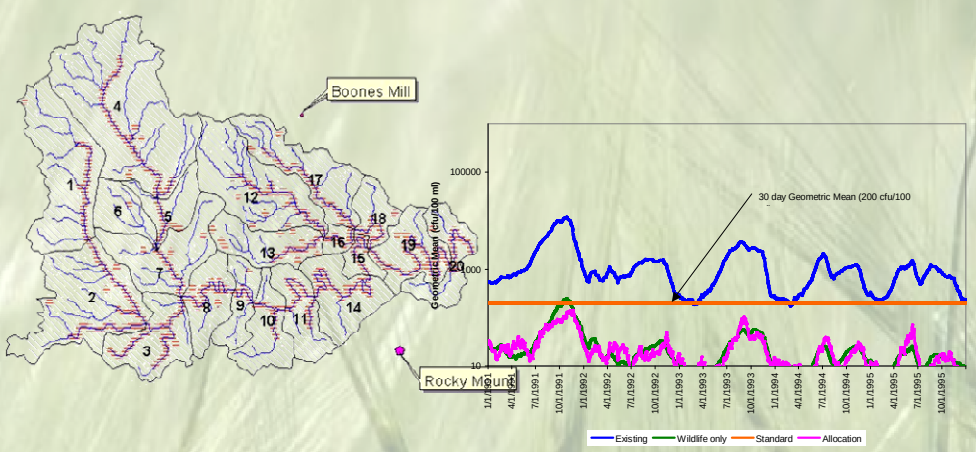
A TMDL is the maximum amount of a pollutant a water body can receive and still meet water quality standards.

Major Components of the TMDL Revision

- Additional Monitoring
- Source Assessment
- Modeling
  - Hydrology
  - Water Quality
  - Load Allocation
- Public Participation

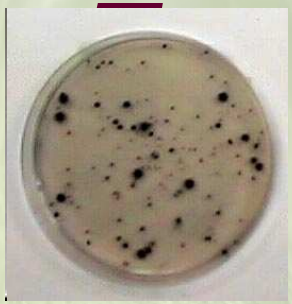






Bacteria Impairment

- Fecal Bacteria in Beaver Creek
  - What are Fecal Bacteria?
    - Bacteria associated with feces from warm blooded animals (fecal coliform, *E. coli*)
  - Why should we care?
    - Pathogens (including some strains of *E. coli)*
    - Parasites
  - Water Quality Standard
    - Swimming & Fishing Use
    - Single Sample Maximum: 235 cfu/100 ml *E. coli*
    - Monthly Geometric Mean: 126 cfu/100 ml *E. coli*



Aquatic Life Impairment

- Aquatic Life (Benthic) Impairment
  - Why should we care?
    - Benthic macroinvertebrate community good indicator of overall stream health
  - VA Stream Condition Index (VASCI)
    - Standardized sample collection and analysis methodology
    - Multimetric
    - Rating Scale

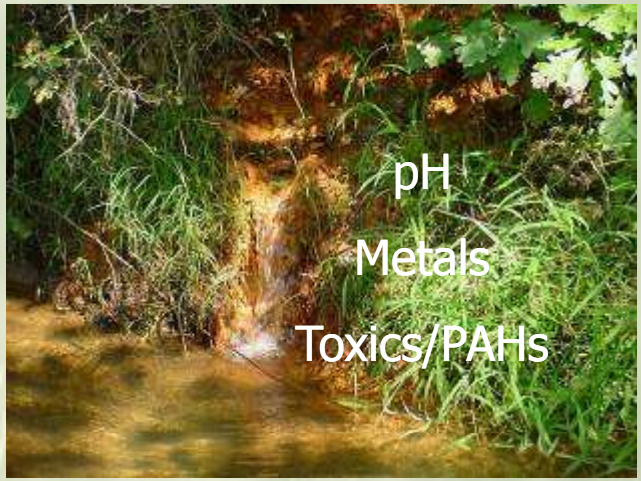
Mayfly Larvae

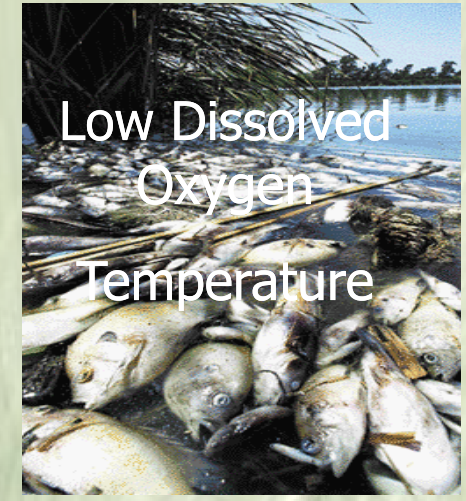
Stonefly Larvae

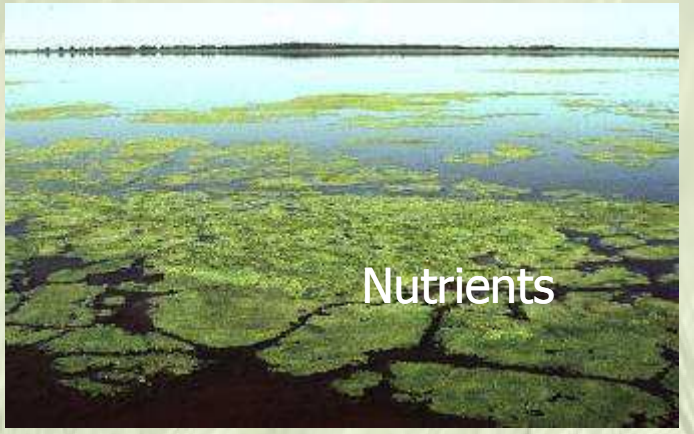
Crayfish

Aquatic Worms

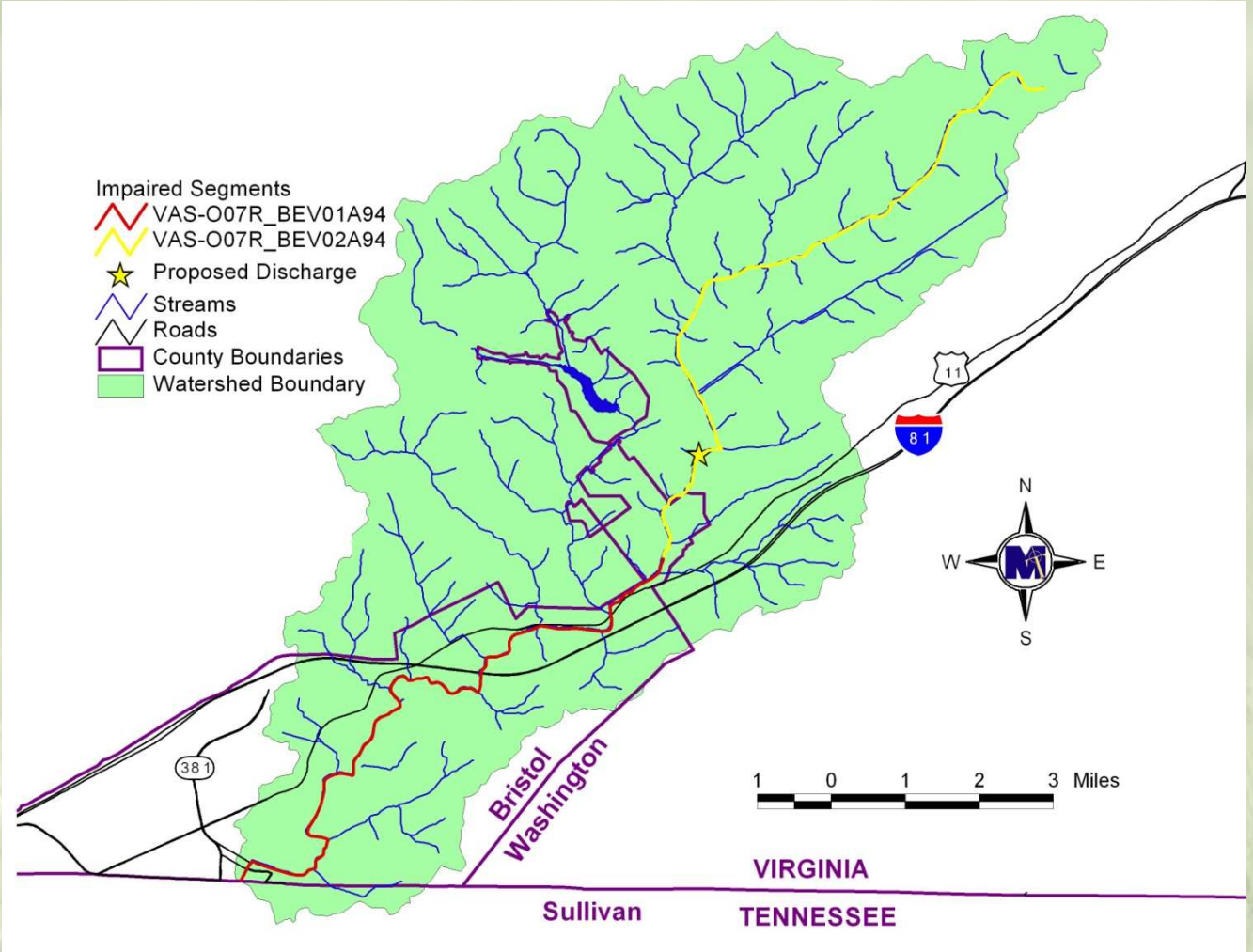
Beaver Creek: What is harming the Aquatic Life?







Impaired Segment



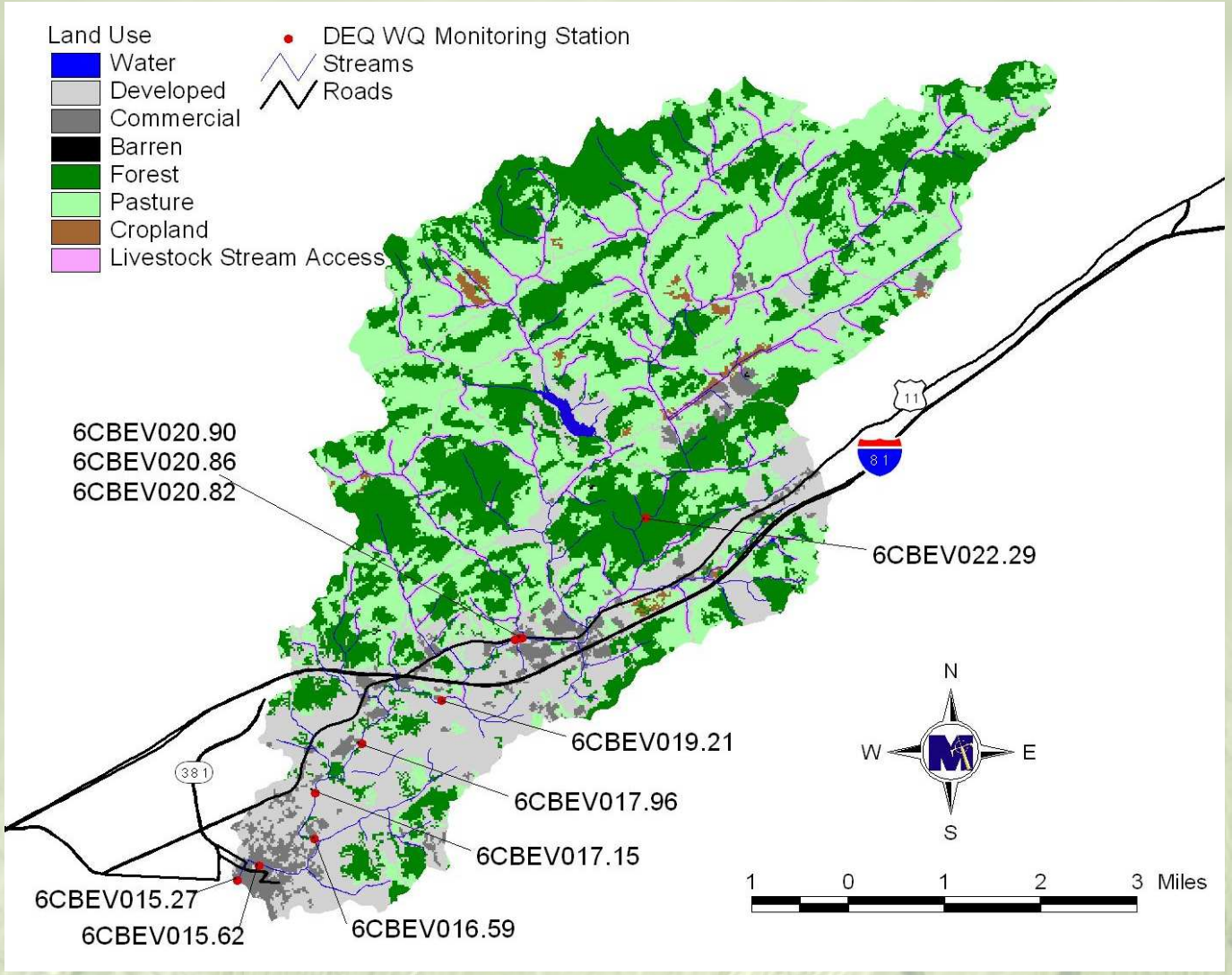
How do we determine a TMDL?

+

Watershed data

TMDL

DEQ Monitoring Stations



Monitoring Data Summary
Fecal Coliform cfu/100mL

Station	Date	Count	Minimum	Maximum	Mean	Median	% Violation*
6CBEV015.27	1/01 - 10/02	10	350	5000	2073	1250	90.0
6CBEV015.62	8/01 - 6/03	12	200	6000	1625	800	91.7
6CBEV016.59	8/01 - 6/03	12	100	3300	592	300	41.7
6CBEV017.15	8/01 - 6/03	12	100	1700	625	600	58.3
6CBEV017.96	8/01 - 6/03	12	100	900	383	300	33.3
6CBEV019.21	8/01 - 6/03	12	100	1500	483	350	50.0
6CBEV020.82	10/01 - 6/03	20	50	2000	418	238	30.0
6CBEV020.86	2/01 - 1/02	8	100	8000	1213	200	25.0
6CBEV020.90	10/01 - 1/02	4	200	400	300	300	0.0
6CBEV022.29	8/01 - 6/03	12	100	6000	917	450	50.0

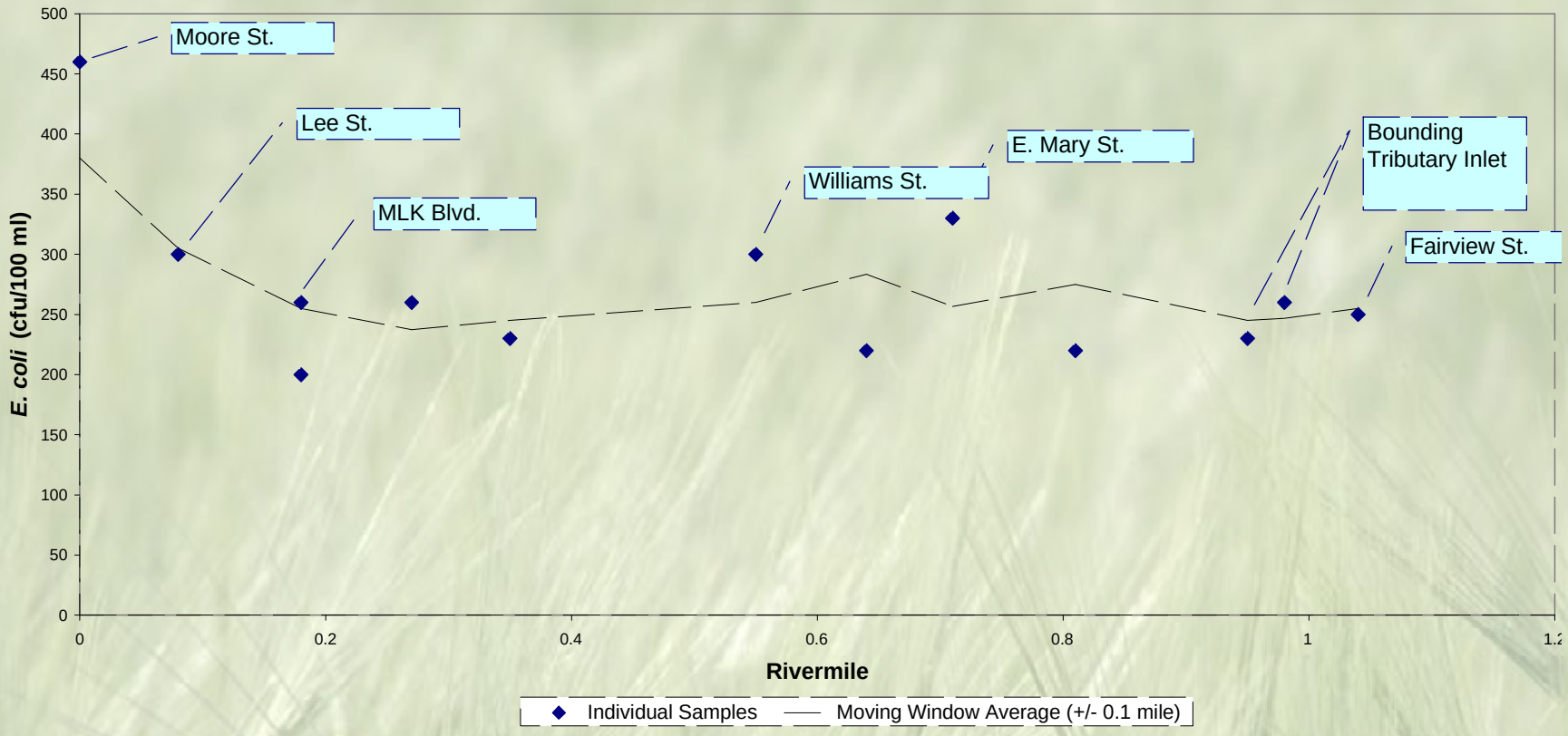
*Based on an instantaneous fecal coliform standard of 400 cfu/100mL.

Monitoring Data Summary
E. coli cfu/100mL

Station	Date	Count	Minimum	Maximum	Mean	Median	% Violation*
6CBEV015.27	1/01 - 6/13	36	25	2000	901	738	78
6CBEV020.86	9/12 - 6/13	10	25	600	195	63	40
6CBEV022.29	9/12 - 7/13	10	25	2000	510	100	40

*Based on the current instantaneous *E. coli* standard of 235 cfu/100mL.

Monitoring Sweep



Bacteria Reduction Scenarios

Scenario	Percent Reductions to Existing Bacterial Loads						Percent Violations of VADEQ Standards	
	Unidentified Source	Livestock Direct	Livestock Land Based	Agricultural Land Based	Human Direct	Human Land Based	Monthly Geometric Mean	Single Sample Maximum
			Pasture, LAX	Cropland		Developed, Commercial	126 cfu/100mL *E. coli*	235cfu/100mL *E. coli*
1	0	0	0	0	0	0	100	94
2	100	0	0	0	100	0	58	34
3	100	50	50	50	100	50	33	18
4	100	98	85	85	100	85	0.00	5
5	**100**	**98**	**50**	**50**	**100**	**85**	**0.00**	**9**

Annual TMDL for Beaver Creek
(cfu/yr *E. coli*)

Impairment	WLA	LA	MOS	TMDL
Beaver Creek	4.38E+12	4.17E+13		4.61E+13
VAG400012	1.74E+09			
VAG400209	1.74E+09			
VAG400210	1.74E+09			
VPG210001	0.00E+00			
City of Bristol MS4 (VAR040048)	1.30E+12			
Proposed Permit	2.61E+12			
Future Load	4.61E+11			

Implicit

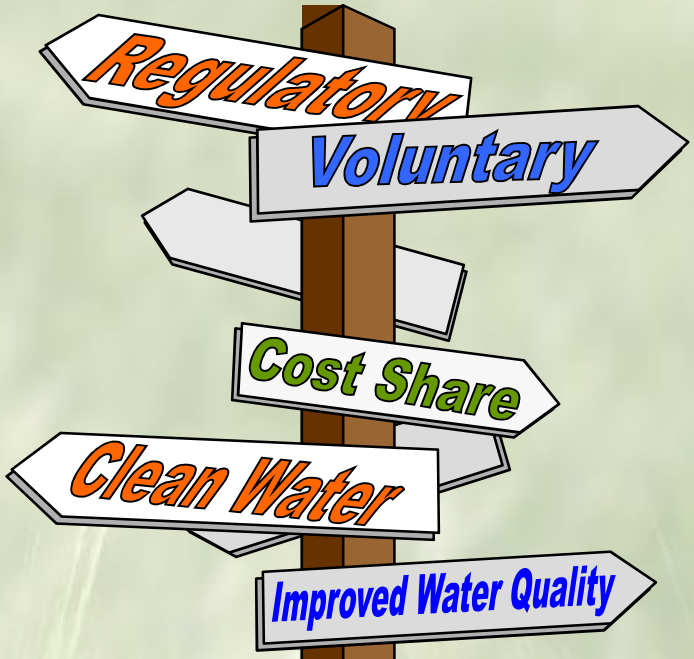
Sediment Reduction Scenarios

Sediment Source	Existing Beaver Creek Loads	Scenario 1 Reductions	Scenario 1 Allocated Loads	Scenario 2 Reductions	Scenario 2 Allocated Loads	Scenario 3 Reductions	Scenario 3 Allocated Loads	Scenario 4 Reductions	Scenario 4 Allocated Loads	Scenario 5 Reductions	Scenario 5 Allocated Loads
	t/yr	%	t/yr	%	t/yr	%	t/yr	%	t/yr	%	t/yr
Pervious Area											
Row Crop - High Till	317.81	**16.7**	**264.73**	0.0	317.81	21.2	250.43	0.0	317.81	0.0	317.81
Row Crop - Low Till	32.41	**16.7**	**27.00**	0.0	32.41	21.2	25.54	0.0	32.41	0.0	32.41
Pasture	1457.01	**16.7**	**1213.69**	26.3	1073.82	21.2	1148.13	18.0	1194.75	11.0	1296.74
Hay	53.13	**0.0**	**53.13**	0.0	53.13	0.0	53.13	0.0	53.13	0.0	53.13
Forest	19.22	**0.0**	**19.22**	0.0	19.22	0.0	19.22	0.0	19.22	0.0	19.22
Barren	12.93	**16.7**	**10.77**	0.0	12.93	0.0	12.93	0.0	12.93	0.0	12.93
Developed	84.03	**16.7**	**69.99**	0.0	84.03	0.0	84.03	0.0	84.03	0.0	84.03
Commercial	10.44	**16.7**	**8.70**	0.0	10.44	0.0	10.44	0.0	10.44	0.0	10.44
Impervious Area											
Developed	33.47	**16.7**	**27.88**	0.0	33.47	0.0	33.47	0.0	33.47	0.0	33.47
Commercial	25.27	**16.7**	**21.05**	0.0	25.27	0.0	25.27	0.0	25.27	0.0	25.27
Direct Sources											
Channel Erosion	323.75	**16.7**	**269.68**	0.0	323.75	0.0	323.75	38.0	200.73	73.0	87.41
Permitted Sources											
General Permits	0.01	**0.0**	**0.01**	0.0	0.01	0.0	0.01	0.0	0.01	0.0	0.01
Construction Permits	6.48	**0.0**	**6.48**	0.0	6.48	0.0	6.48	0.0	6.48	0.0	6.48
Stormwater Permits	56.60	**0.0**	**56.60**	0.0	56.60	0.0	56.60	0.0	56.60	0.0	56.60
MS4	159.97	**0.0**	**159.97**	0.0	159.97	0.0	159.97	0.0	159.97	0.0	159.97
Proposed Permit	0.00	**0.0**	**62.22**	0.0	62.22	0.0	62.22	0.0	62.22	0.0	62.22
Future Load	0.00	**0.0**	**25.52**	0.0	25.52	0.0	25.52	0.0	25.52	0.0	25.52
Margin of Safety	0.00	**0.0**	**255.24**	0.0	255.24	0.0	255.24	0.0	255.24	0.0	255.24
Watershed Totals	**2592.53**	**1.57**	**2551.90**	**1.55**	**2552.32**	**1.55**	**2552.38**	**1.63**	**2550.23**	**2.07**	**2538.91**

Annual TMDL for Beaver Creek
(t/yr)

Impairment	WLA	LA	MOS	TMDL
Beaver Creek	310.91	1985.74	255.24	2551.90
VAG400012	0.041			
VAG400209	0.041			
VAG400210	0.041			
VPG210001	0.00			
City of Bristol MS4 (VAR040048)	159.97			
VAR050028	8.65			
VAR050043	12.99			
VAR050053	7.04			
VAR050080	3.41			
VAR050081	2.55			
VAR050084	11.26			
VAR050468	6.49			
VAR051522	1.29			
VAR051907	2.93			
Construction Permits	6.48			
Proposed Permit	62.22			
Future Load	25.52			

And then:



- Public Review
  - Written Comments due by ***April 1***
- State Approval
- Submit to EPA

Send Comments To:

Martha Chapman

TMDL Coordinator

Department of Environmental Quality

Martha.Chapman@deq.virginia.gov

(276) 676-4845

The plan can be found at the following web address:

http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/DraftTMDLReports.aspx

Questions????

Contact Information

- MapTech, Inc.

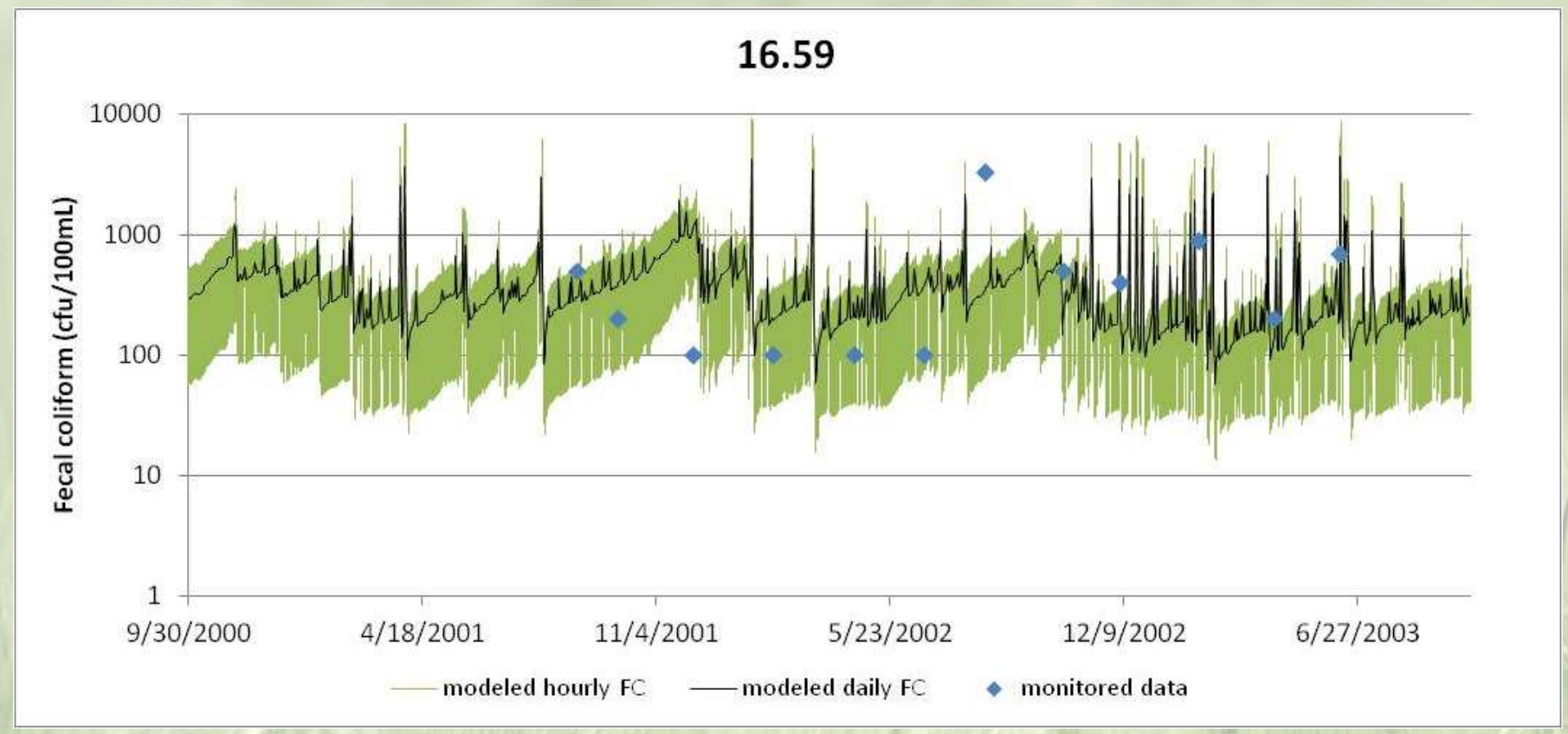
  James Kern

  jkern@maptech-inc.com

  (540) 961-7864

Upstream of Unidentified Source

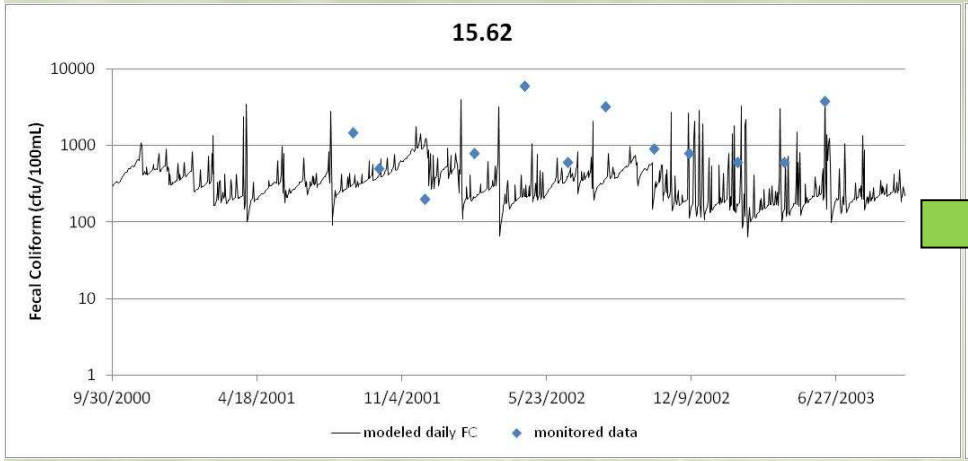
Water Quality Calibration = Good

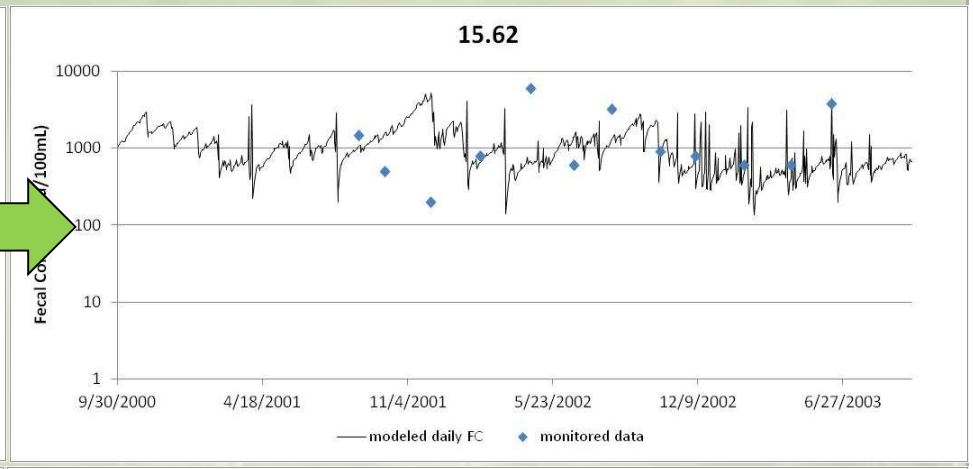


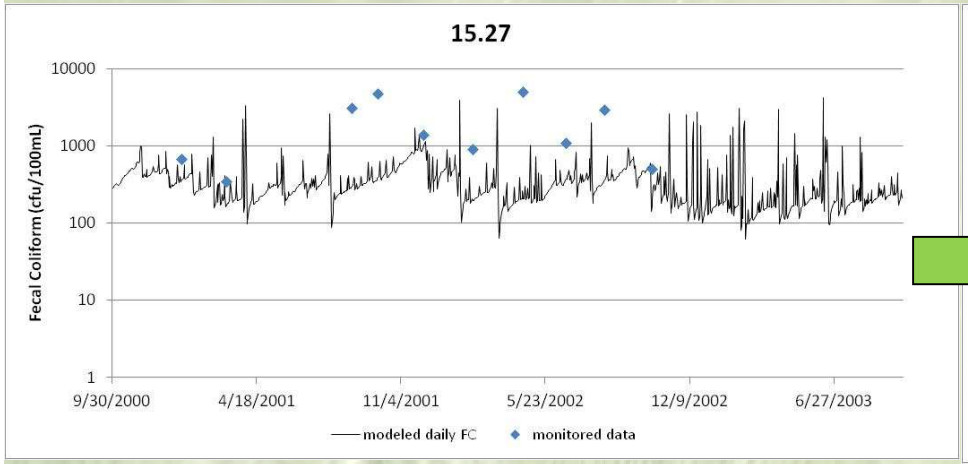
Unidentified Source

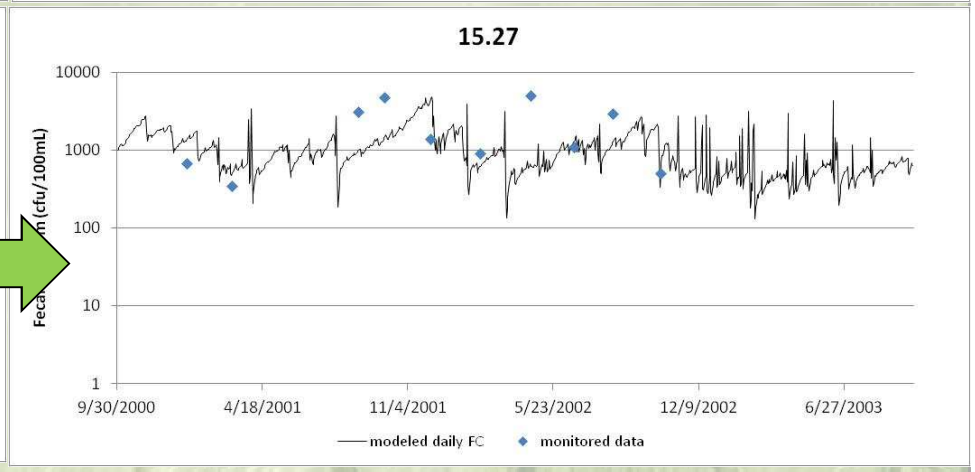
Significant Improvement in Calibration Downstream

Before **After**









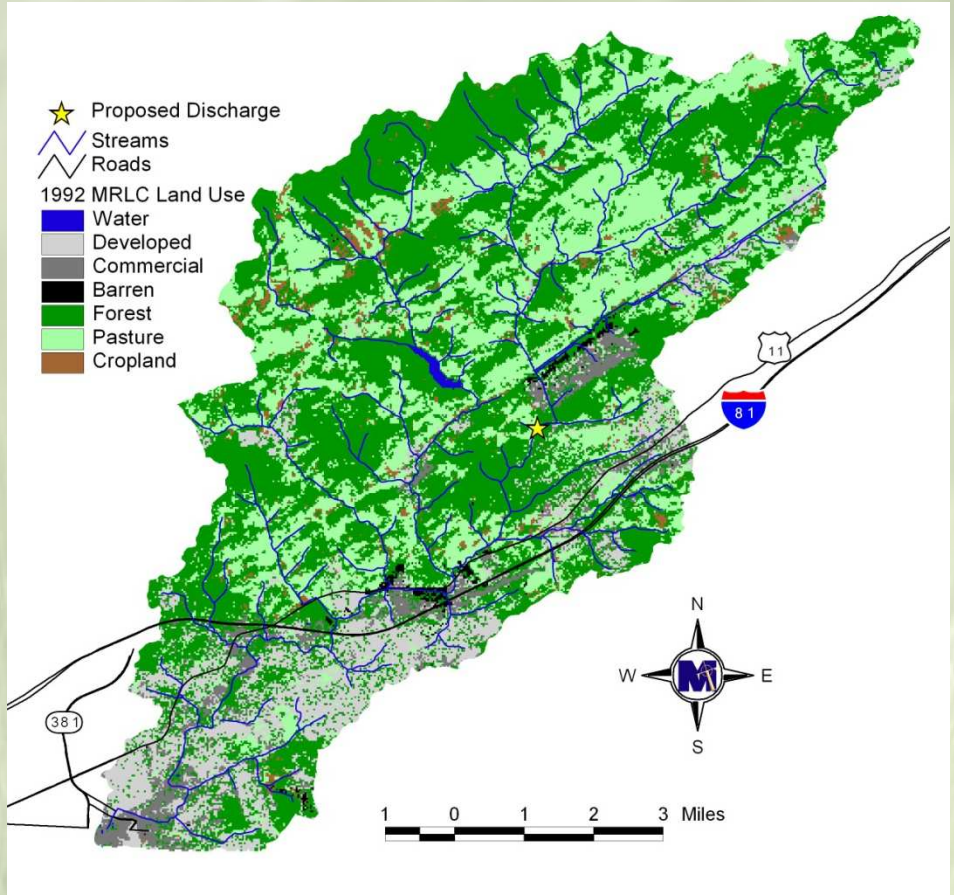
Unidentified Source

Significant Improvement in Calibration Downstream

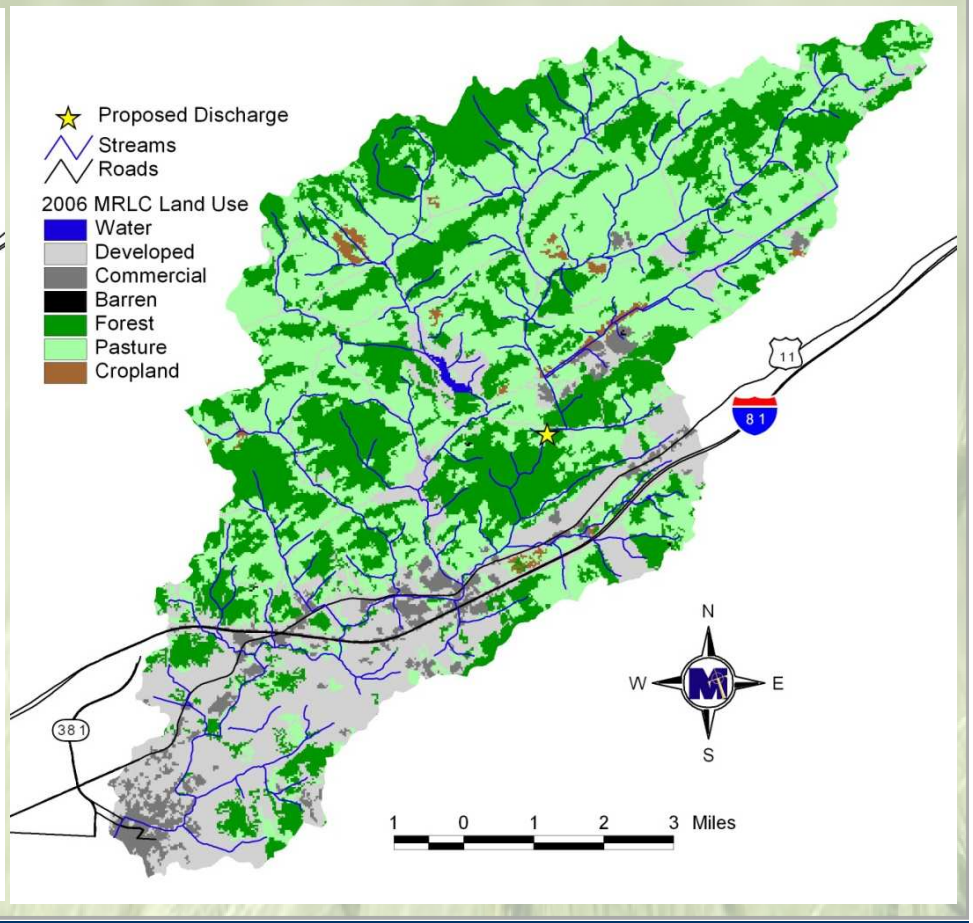
Monitoring Station	Subwatershed	Number of Monitored Samples	Single Sample Instantaeous Standard Violations (%)			Geometric Mean (cfu/100mL)		
			Monitored Data	Calibrated Model	Calibrated Model Incl. Unidentified Source	Monitored Data	Calibrated Model	Calibrated Model Incl. Unidentified Source
6CBEV015.27	1	10	90.00	27.49	90.96	1429.30	317.97	976.92
6CBEV015.62	2	12	91.67	30.59	91.87	1026.06	332.51	1025.21
6CBEV016.59	3	12	41.67	30.05	30.05	311.41	326.75	326.75
6CBEV017.15	4	12	58.33	32.05	32.05	417.14	337.27	337.27
6CBEV017.96	5	12	33.33	32.33	32.33	278.50	340.11	340.11
6CBEV019.21	6	12	50.00	35.07	35.07	299.89	359.03	359.03
6CBEV020.82	7	20	30.00	45.84	45.84	239.30	427.27	427.27
6CBEV022.29	11	12	50.00	57.08	57.08	424.83	546.18	546.18

Land Use Change and New Permitted Discharge

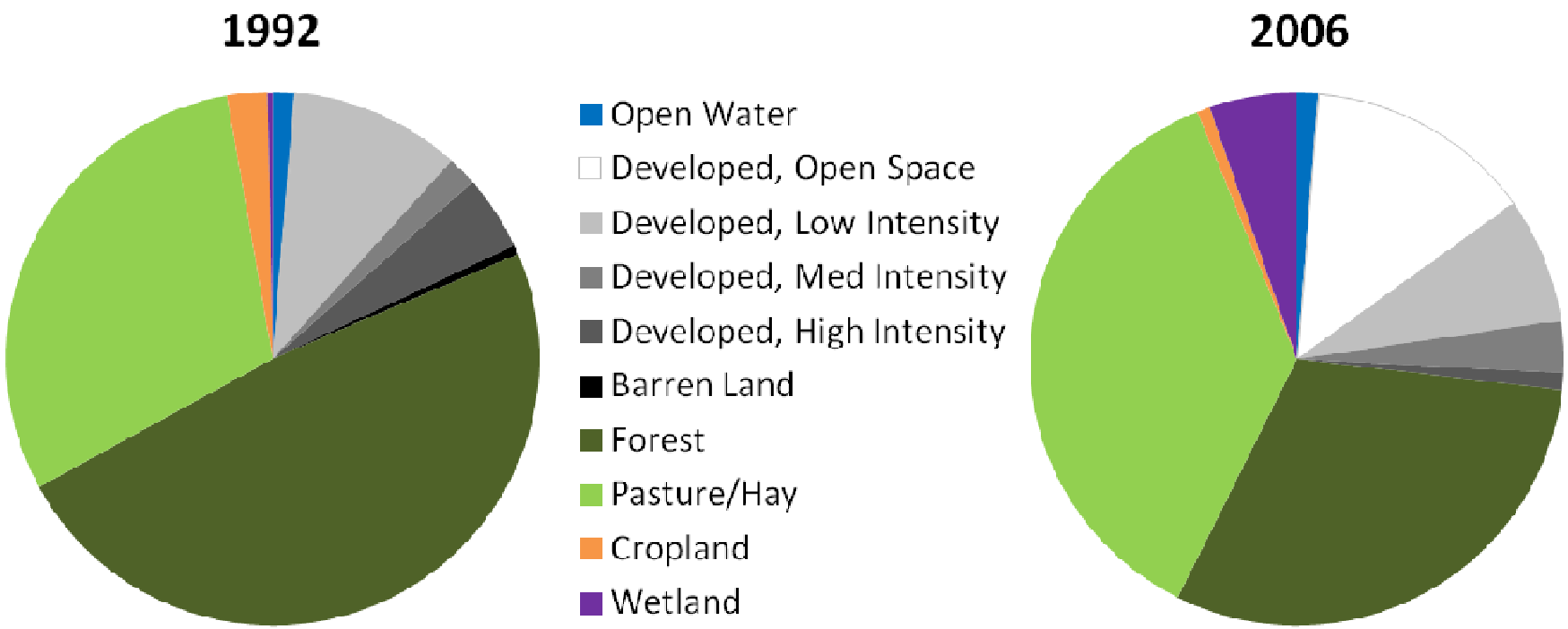
1992



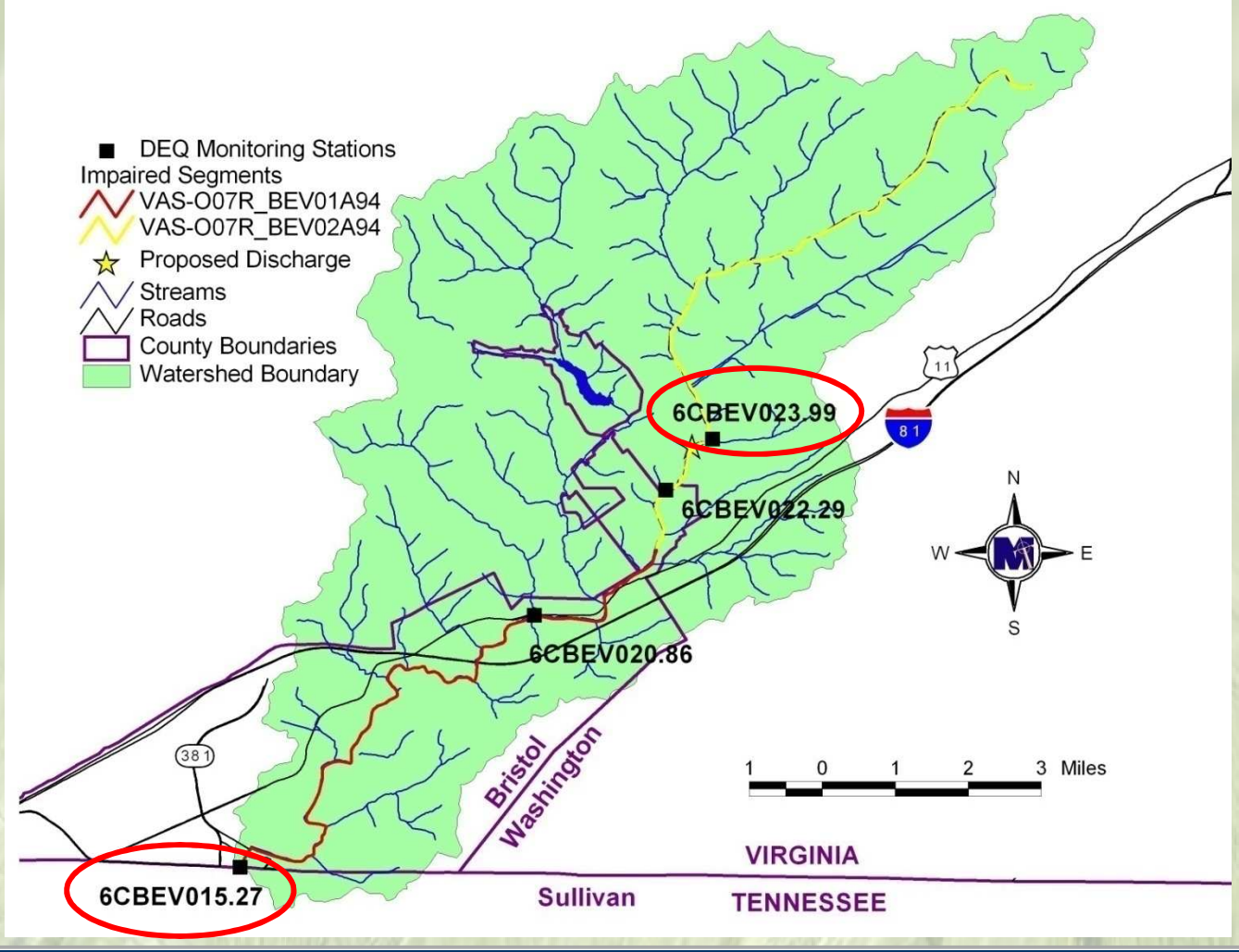
2006



Land Use Change



DEQ Monitoring Stations



Source Assessment

- Permitted Discharges
  - Wastewater Treatment Facilities
  - Other Permitted Discharges
- Human
  - ~~Biosolids~~
  - Failed Septic Systems
  - Straight Pipes
- Pets
- Livestock
- Wildlife

Permits in the Study Area (2012)

- 1 VPDES Permitted Discharge, permitted for control of fecal bacteria (proposed)
- 3 General Permits for single family homes
- 1 Confined Animal Feeding Operation (CAFO) permit
- MS4 for the City of Bristol

Source Assessment (2012)

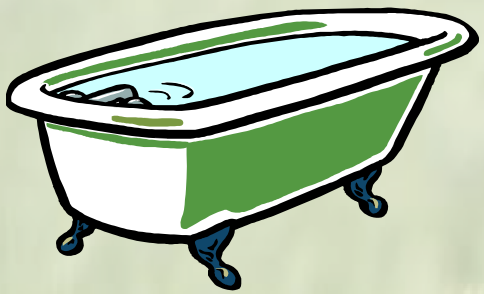
Population	Housing Units	Housing Units with Sanitary Sewer	Housing Units with Septic Systems	Housing Units with Other
17,126	8,277	6,503	1,697	77

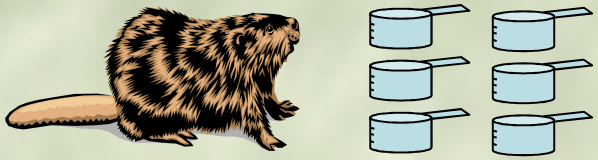
Dog	Cat
4,084	4,573

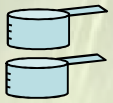
Beef Cattle	Dairy Cattle	Sheep	Swine	Horse	Chicken
6,527	490	713	0	322	1,200,000

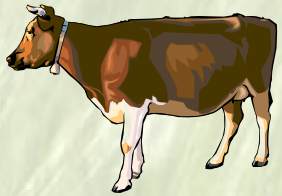
Deer	Turkey	Beaver	Raccoon	Muskrat	Duck	Goose
759	150	879	1,569	2,209	46	23

How much waste fouls a bathtub?









= 1 cup

= 1 Tbsp

= 1 tsp

How many beaver equal a cow?

Fecal Bacteria Production Ratios

Source	Ratio to one Beef Cow	Source	Ratio to one Beef Cow
Beef Cattle	1	Horse	79
Goat	1.22	Deer	95
Sheep	1.22	Layers	243
Dairy Cattle*	1.31	Raccoon	292
Dairy Heifer	3	Wild Turkey	355
Dog	8	Turkey	355
Mallard	14	Broilers	485
Wood Duck	14	Human	1,162
Goose	41	Muskrat	1,320
		Beaver	165,000

* Milked or Dry Cow