Flint Creek Watershed Nutrient TMDLs

Public Meeting Presentation 12/04/13

Smart Creek

What is a TMDL?

TMDL = Total Maximum Daily Load

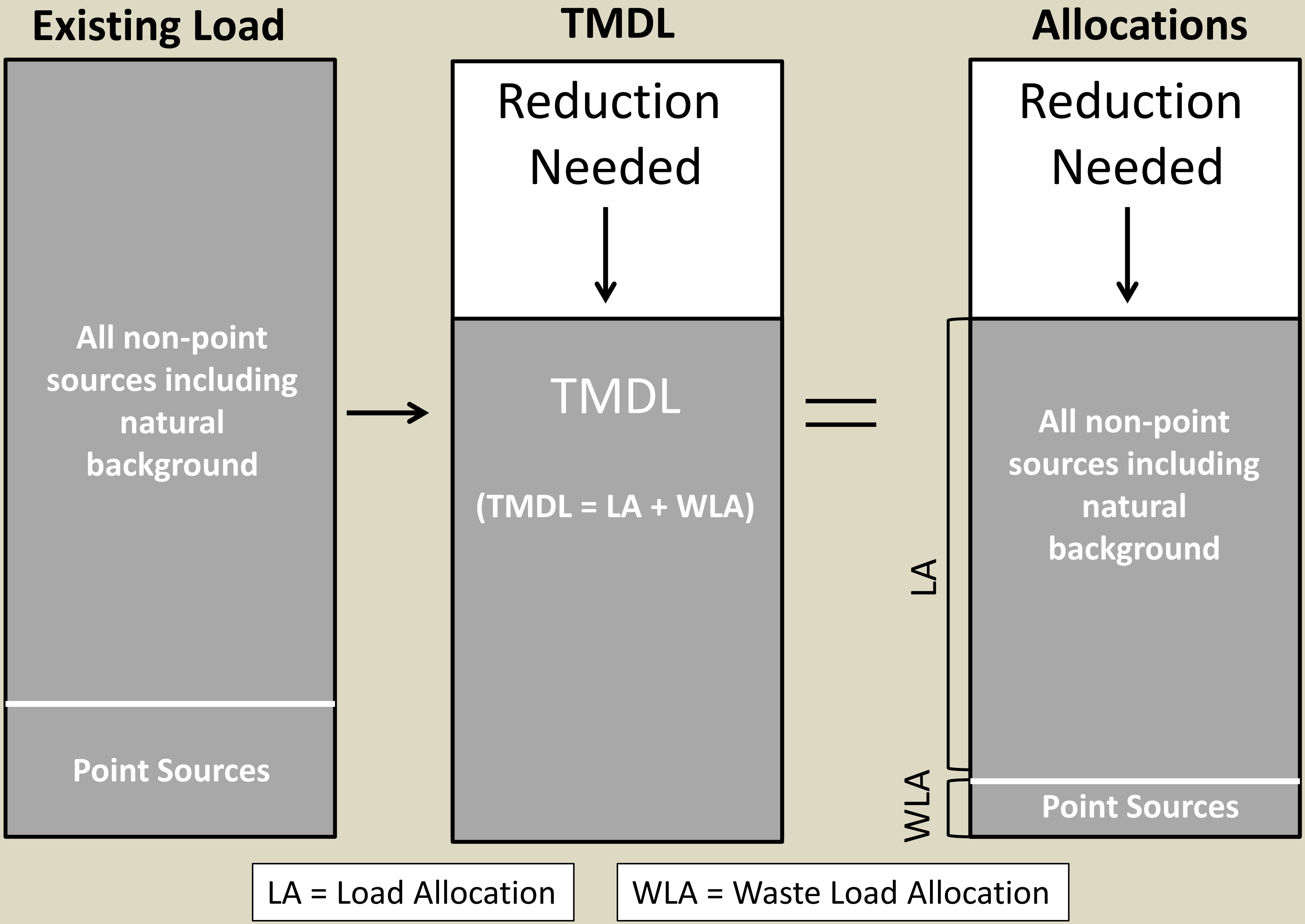
The amount of a pollutant that a waterbody can receive from point, nonpoint, and natural sources and still meet water quality standards

A pollutant can come from multiple sources

The document containing the TMDLs is also referred to as the TMDL

TMDL development involves assessing water quality, determining if there is a problem, developing solutions, and implementing the solutions

What is a TMDL?



What is involved?

Sample streams (is there a problem?)

Determine the source(s) of the problem (30,000 ft view)

Quantify the problem

Determine potential solutions

When the TMDL is completed:

Implement solutions/on-the-ground fixes

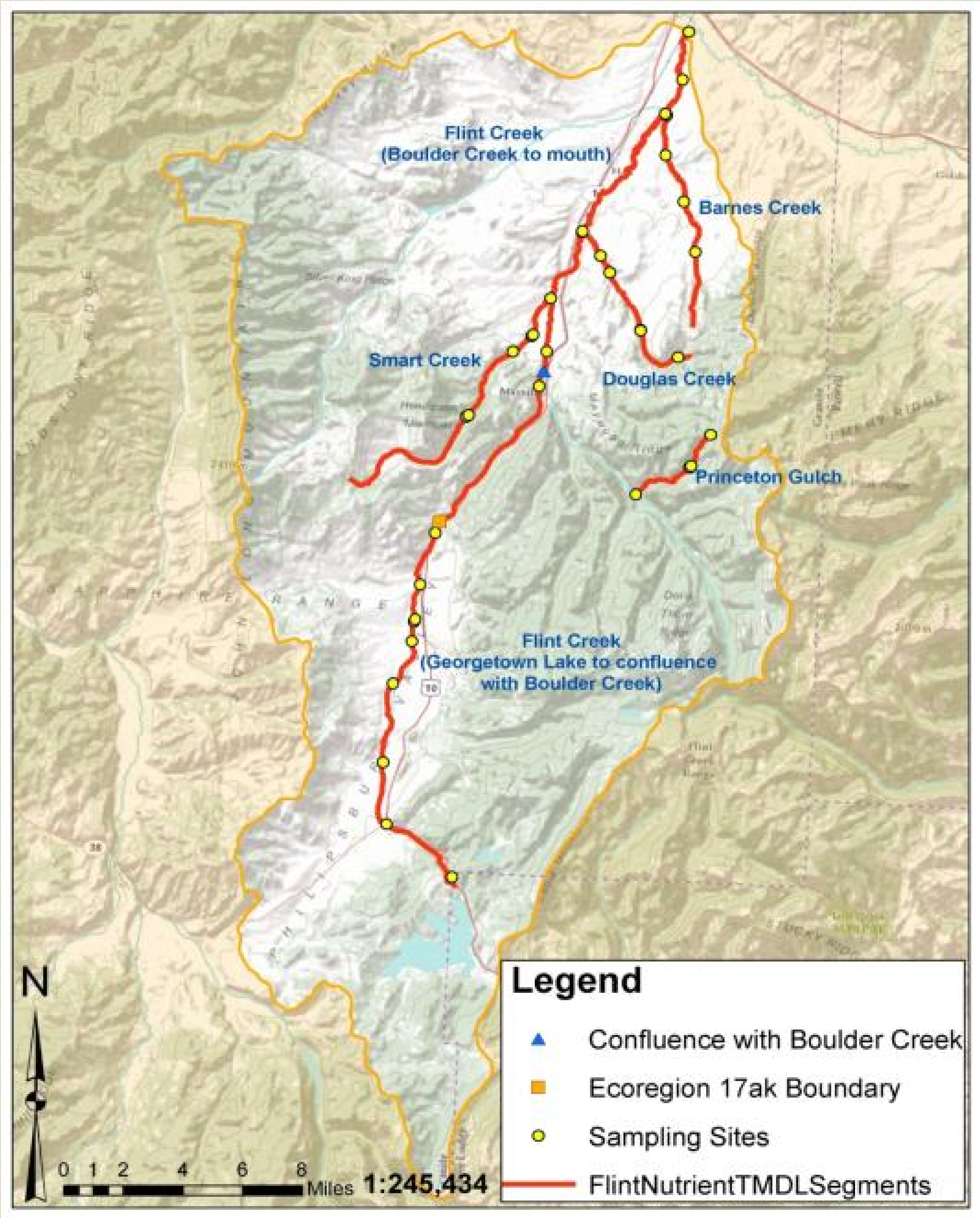
Monitor progress and success

The Flint Nutrients TMDL document is **a part** of a process, not the end.

Regulatory Framework

- 1972 Federal Clean Water Act
- Montana Water Quality Standards
- 303(d) list – Evaluation of stream health
- Prepare TMDLs for all impaired streams (Montana Law)

Flint Creek Watershed and nutrients impaired segments



Current (2012 IR) 303(d) Nutrients Listed segments and Causes that will be addressed

Waterbody & Location Description [1]	Waterbody ID	Impairment Cause [2]	Pollutant Category	Impairment Cause Status [2]	Included in 2012 Integrated Report [3]
Barnes Creek, from headwaters to mouth (Flint Creek)	MT76E003_070	TN	Nutrients	TN TMDL in this document	Yes
		Nitrate	Nutrients	Addressed by TN TMDL in this document	Yes
		TP	Nutrients	TP TMDL in this document	Yes
		Chlorophyll-*a*	Not Applicable; Non-pollutant	Addressed by TN and TP TMDLs in this document	Yes
Douglas Creek, confluence of Middle and South forks to mouth (Flint Creek), T9N R13W S10	MT76E003_020	Nitrate	Nutrients	Nitrate TMDL in this document	Yes
		TP	Nutrients	TP TMDL in this document	No
Flint Creek, Georgetown Lake to confluence with Boulder Creek	MT76E003_011	TP	Nutrients	TP TMDL in this document	No
Flint Creek, Boulder Creek to mouth (Clark Fork River)	MT76E003_012	TN	Nutrients	TN TMDL in this document	Yes
		TP	Nutrients	TP TMDL in this document	Yes
Princeton Gulch, headwaters to mouth (Boulder Creek)	MT76E003_090	Nitrate	Nutrients	Nitrate TMDL in this document	Yes
Smart Creek, headwaters to mouth (Flint Creek), T9N R13W S21	MT76E003_110	TN	Nutrients	TN TMDL in this document	No
		TP	Nutrients	TP TMDL in this document	Yes

[1] All waterbody segments within Montana's Water Quality Integrated Report are indexed to the National Hydrography Dataset (NHD)

[2] TN = Total Nitrogen, TP = Total Phosphorus, Nitrate = Nitrates = Nitrogen, Nitrate = NO_2+NO_3 = Nitrite + Nitrate; The term "nitrate" is used throughout the document and refers to any of the various nitrate-related impairment causes listed in the "2012 Water Quality Integrated Report."

[3] Impairment causes not in the "2012 Water Quality Integrated Report" were recently identified and will be included in the 2014 Integrated Report.

Determining Nutrient Sources (Source Assessment)

- Driving trip along impaired segments

- Review of aerial imagery, cadastral, and land use maps in GIS

- Database searches for point source permits and water quality data

- SWAT model: Eric Regensburger

Soil and Water Assessment Tool (SWAT)

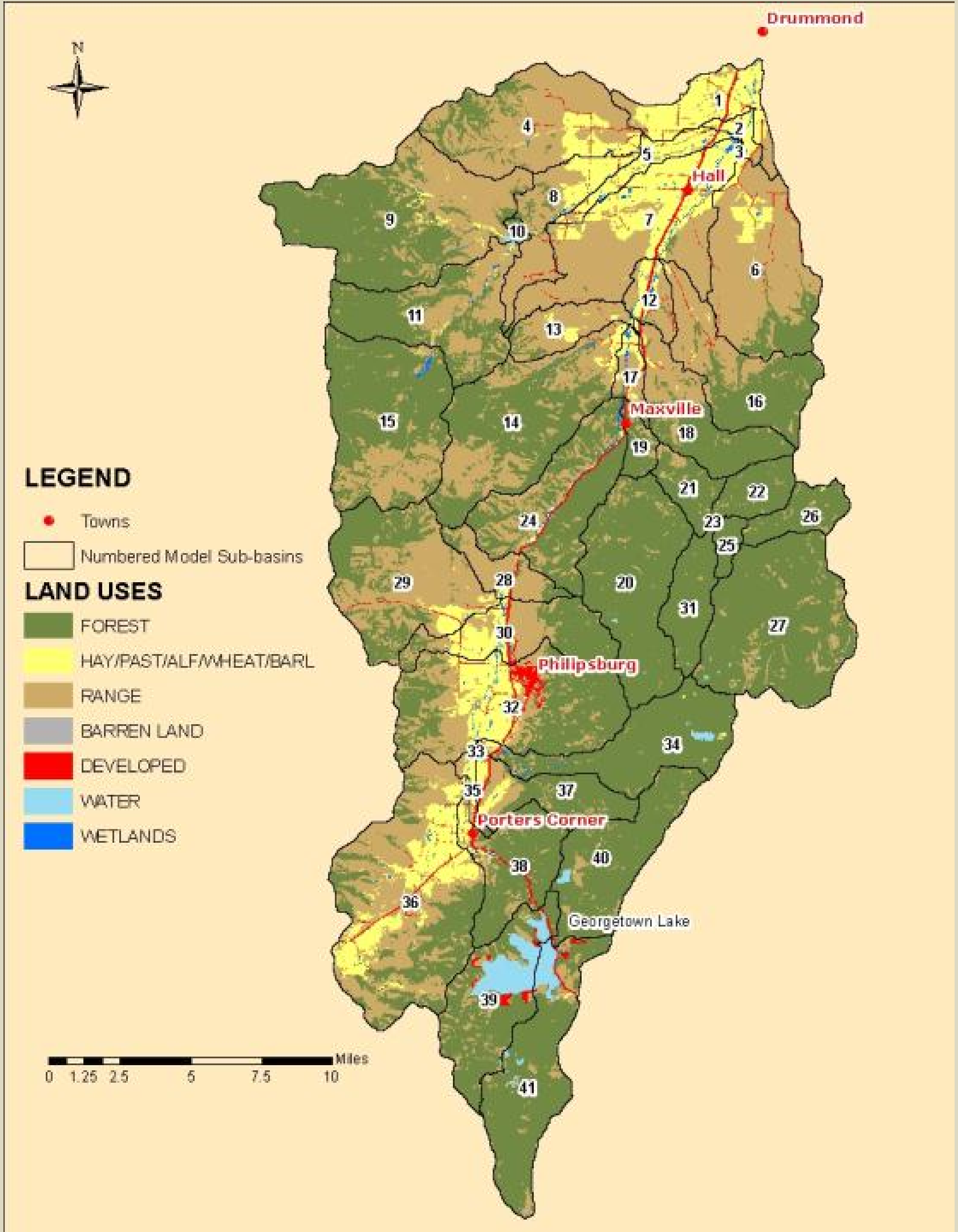
- Watershed scale model that incorporates climate, land use, soils, groundwater and topography to predict stream flows and quality
- CLIMATE (daily values for up to 7 climate stations)
  - Snow fall, snow melt (timing and amount)
  - Precipitation
  - Temperature (daily minimum and maximum)
  - Evapotranspiration
  - Wind, Solar radiation, Humidity
  - Accounts for variation due to elevation
- LAND USE
  - Forest
    - Canopy shading, seasonal growth/die-off
  - Rangeland
    - Summer grazing timing, density, and animal type
    - Manure production, grazing volume, trampling
    - Seasonal growth/die-off

SWAT (continued)

- Hay and Pasture
  - Irrigation timing and rates
  - Harvest timing and biomass remaining
  - Winter grazing timing, density and animal type
  - Manure production, grazing volume, trampling
- Agriculture
  - o Crop type with management specific to each type
  - o Alfalfa, Hay, Spring Wheat, Barley
  - o Timing and amount of irrigation and fertilizer
  - o Irrigation source (canal, stream, groundwater, etc.)
  - o Harvesting timing and biomass remaining
- Urban
  - o Amount of impervious surface with increasing density
  - o Grass irrigation and fertilizer (rates and timing)
  - o Septic and Philipsburg wastewater added as point sources

SWAT (continued)

- RESULTS
  - Calibrate measured daily stream flow patterns using climate, land use, soil, and groundwater factors
  - Calibrate measured intermittent nutrient water quality results using land use, soil, and groundwater factors
  - Existing conditions calibrated model used for source assessment (i.e. determine sources of nutrients)
- SCENARIOS
  - Compare nutrient loading reductions from BMPs
    - Assess improvements in terms of land use and locations
    - Watershed group uses scenarios to determine best bang for the buck to reduce nutrient loading



Drummond
N
Hall
Maxville
Philipsburg
Porters Corner
Georgetown Lake
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
LEGEND
Towns
Numbered Model Sub-basins
LAND USES
FOREST
HAY/PAST/ALF/WHEAT/BARL
RANGE
BARREN LAND
DEVELOPED
WATER
WETLANDS
Miles
0
1.25
2.5
5
7.5
10

The Process

- Determine potential nutrient sources within the watershed for each listed segment (SWAT Model)

- There are up to two types of load allocations for each TMDL: 1) Composite load (all non-point sources) and 2) Philipsburg WWTP wasteload allocation (only on Flint Creek segments)

- Set TMDL based on Middle Rockies Level III Ecoregion proposed nutrient criteria[1] (TN Criteria: 0.300 mg/L; TP Criteria: 0.030 mg/L; Nitrate[2]: 0.100 mg/L) and the proposed criteria specific to Flint Creek from the Georgetown Lake Dam to the ecoregion 17ak boundary (TN Criteria: 0.500 mg/L; TP Criteria: 0.072 mg/L; Nitrate[2]: 0.100 mg/L).

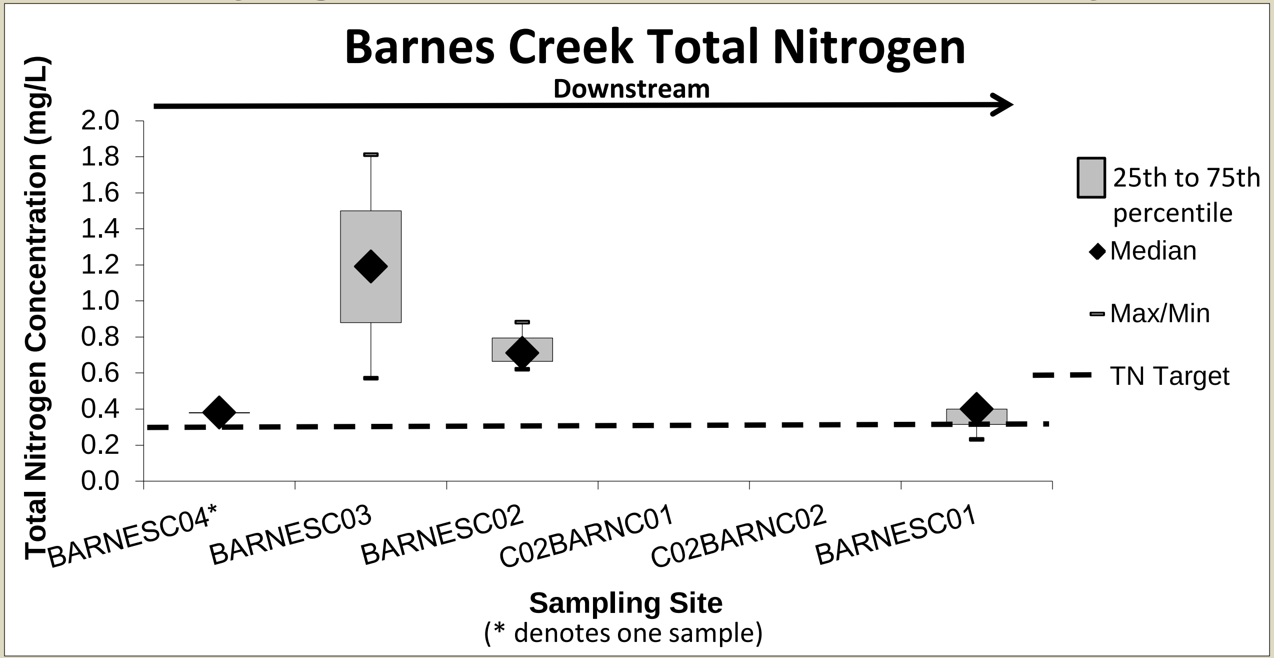
- Used data collected from the impaired streams to determine the current loading and necessary reductions

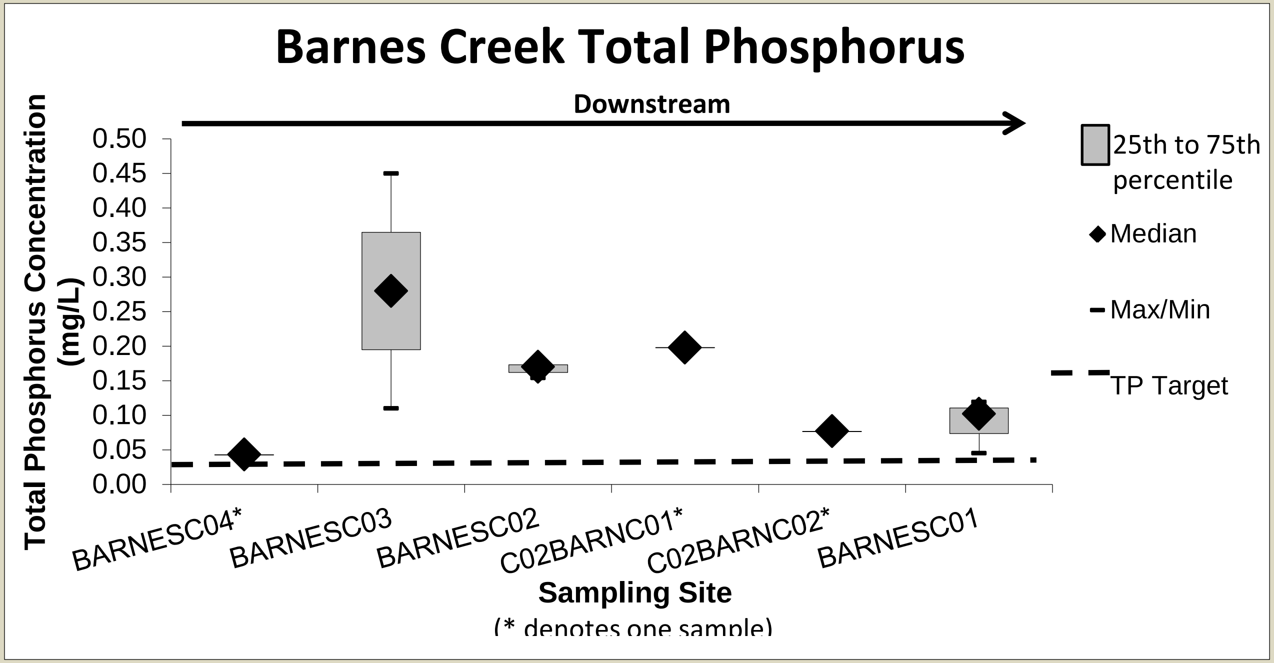
- Used SWAT model to demonstrate scenarios where reductions could occur

[1] http://deq.mt.gov/wqinfo/standards/NumericNutrientCriteria.mcpx

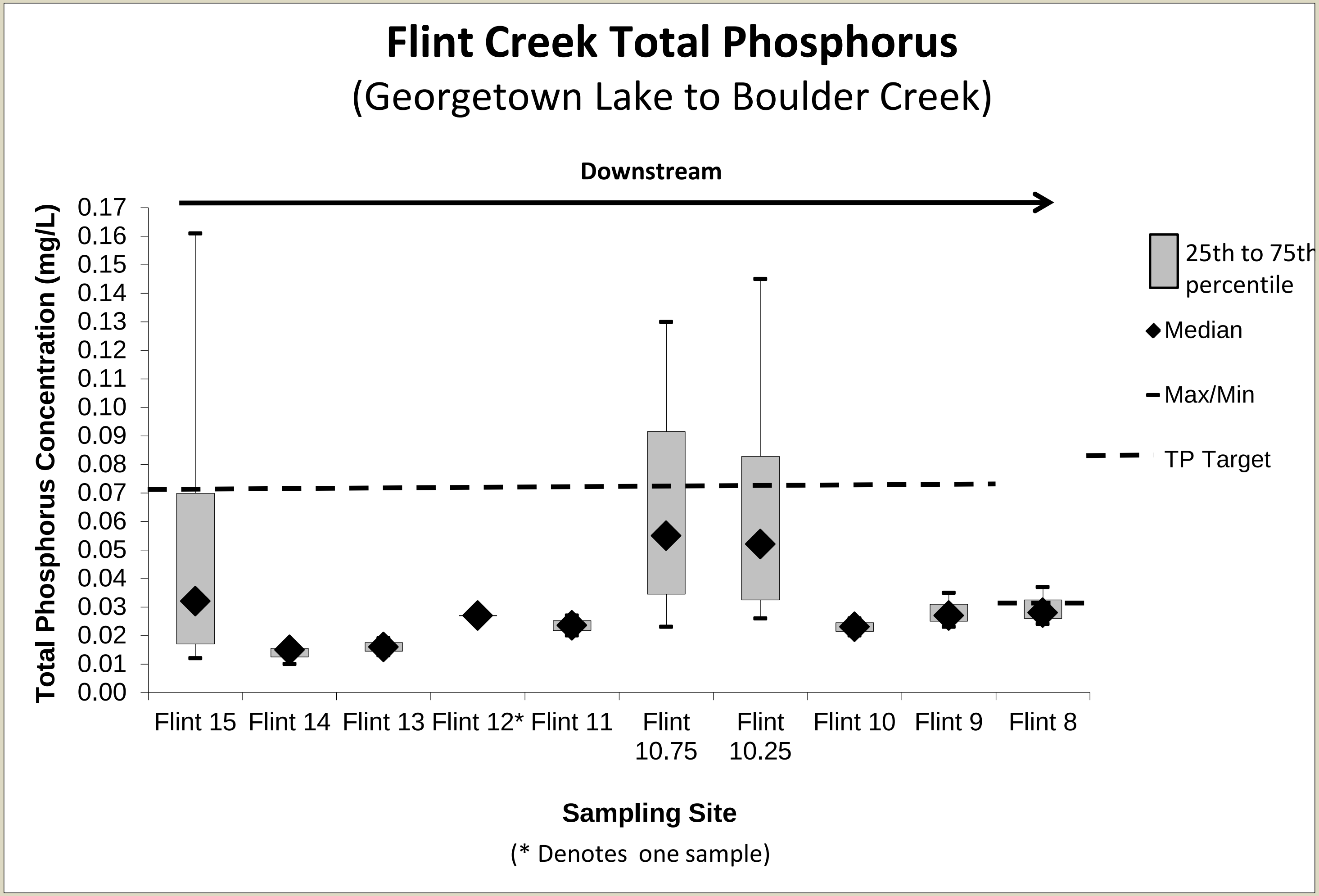
[2] Suplee et al. 2008

Quantifying the Problem – Water Quality data



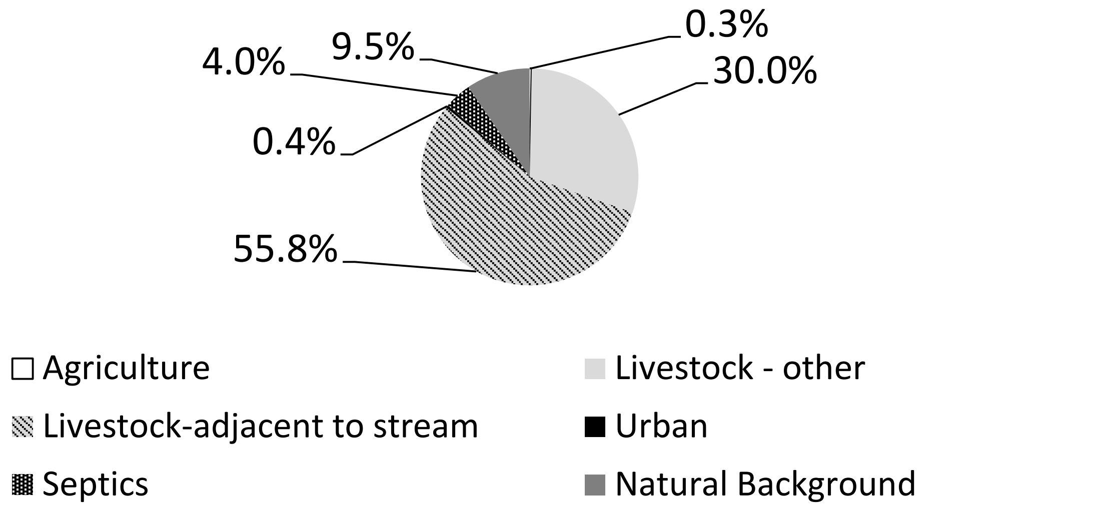


Quantifying the Problem– Water Quality data

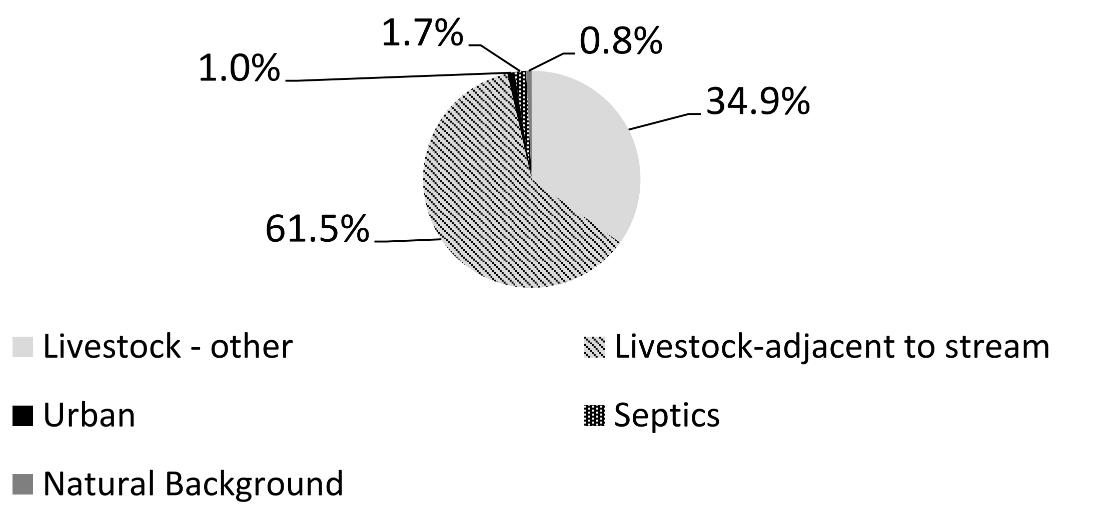


Source Assessment – SWAT Model Results

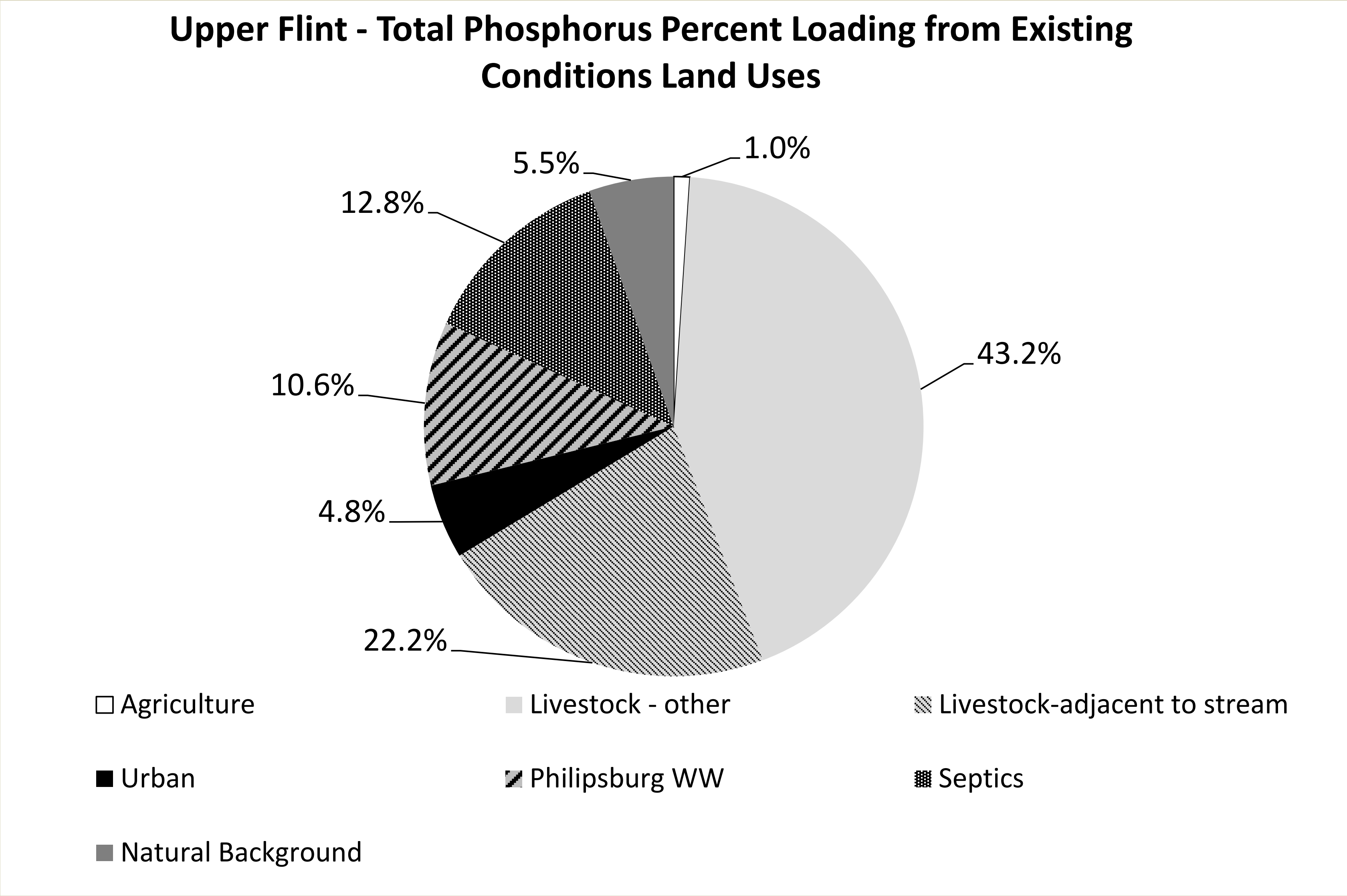
Barnes Creek - Total Nitrogen Percent Loading from Existing Conditions Land Uses



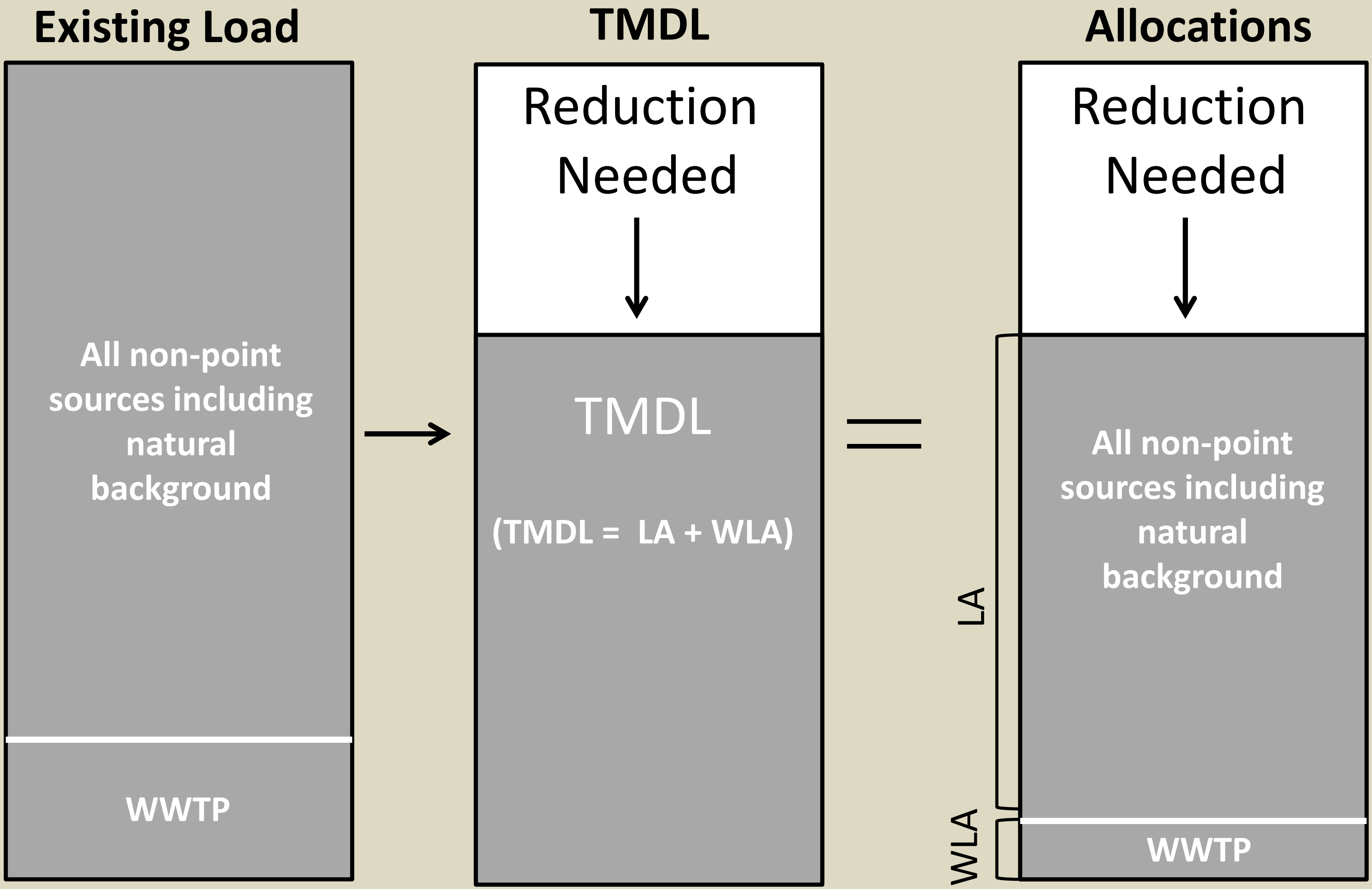
Barnes Creek - Total Phosphorus Percent Loading from Existing Conditions Land Uses



Source Assessment – SWAT Model Results



Reminder - What is a TMDL?



LA = Load Allocation

WLA = Waste Load Allocation

TMDL Equations

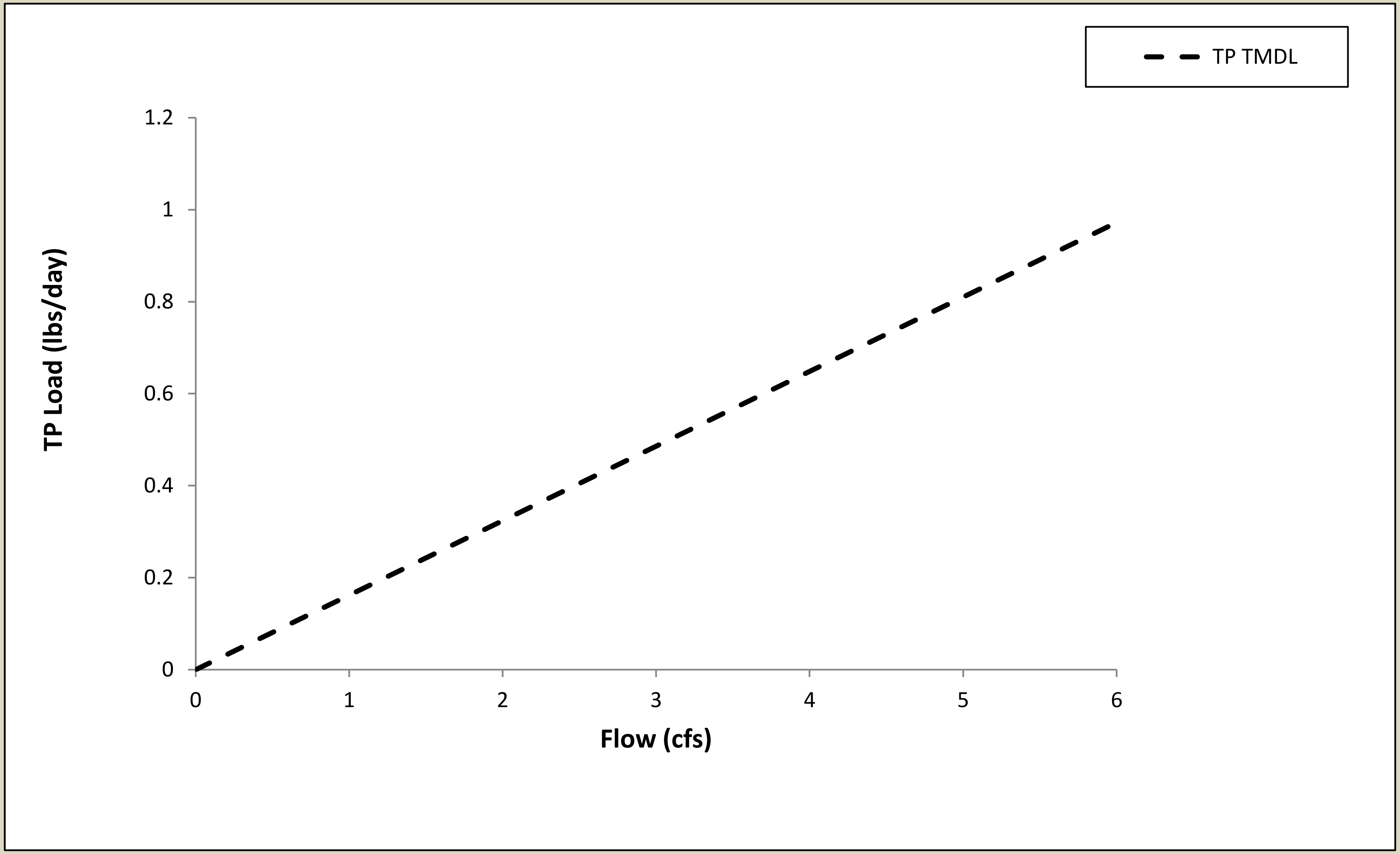
Equation 1: ***TMDL = (X) (Y) (5.4)***

TMDL= Total Maximum Daily Load in lbs/day

X = water quality target

Y = streamflow in cubic feet per second

5.4 = conversion factor



TMDL Equations

Equation 2: ***TMDL = LA***
LA = Composite Load Allocation to all nonpoint sources including natural background sources

Equation 3: ***TMDL = LA + WLA***
LA = Composite Load Allocation to all nonpoint sources including natural background sources
WLA = Waste Load Allocation to the Philipsburg WWTP (for the two Flint Creek segments only)

TMDL Equations

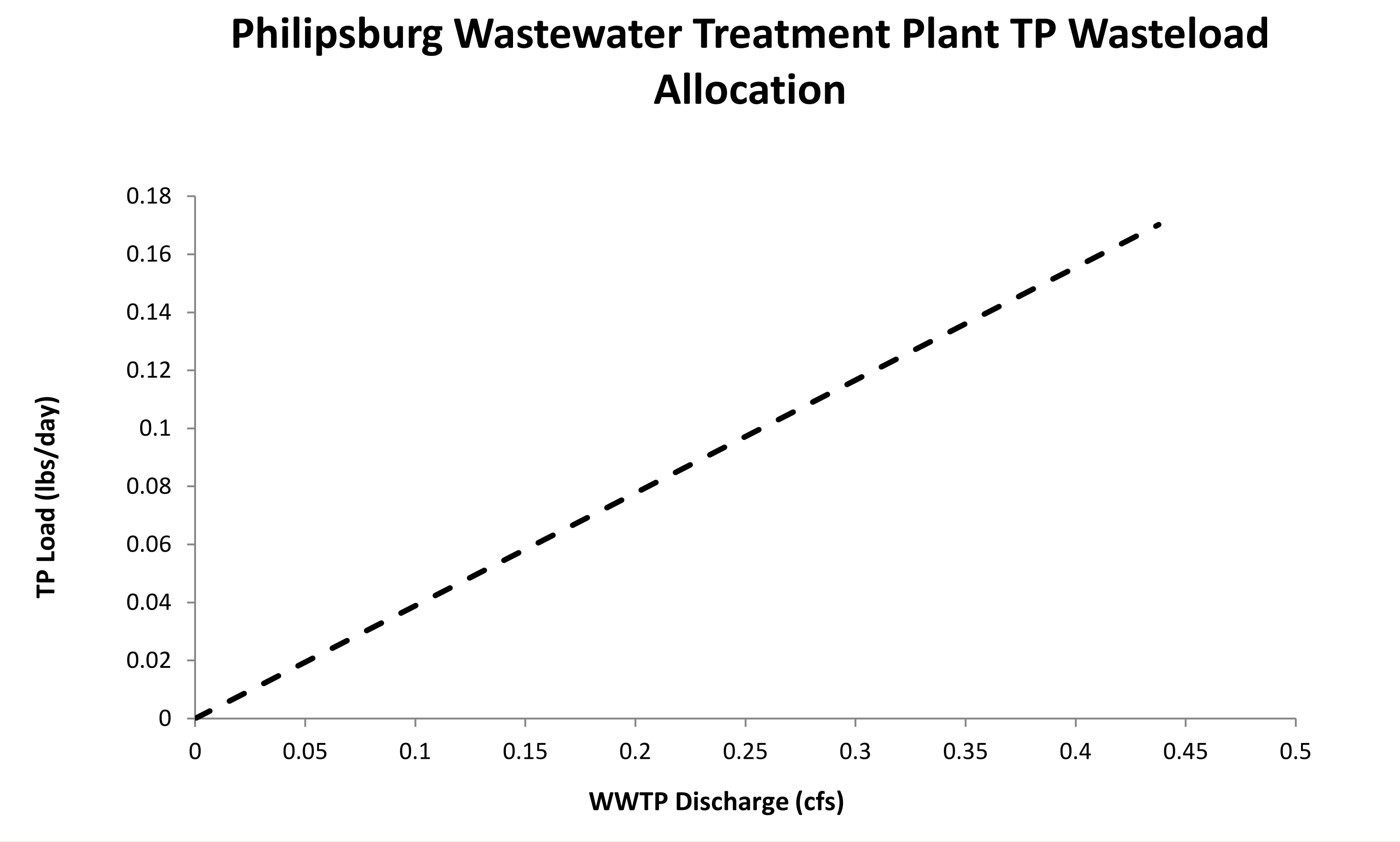
Equation 4: **WLA_{TP} *= (X) (Y) (5.4)***

WLA_{TP} = *Total Phosphorus Wasteload Allocation in lbs/day*

X = water quality target for Flint Creek from Georgetown Lake outlet to the ecoregion 17ak boundary *(0.072 mg/L;* ***Table 5-2****)*

Y = WWTP discharge in cubic feet per second

5.4 = conversion factor



TMDLs, Allocations, and Current Loading

Example: Barnes Creek

Table 5-19. Barnes Creek TN Example TMDL, Load Allocation, and Current Loading

Source Category	Allocation & TMDL (lbs/day)[1]	Existing Load (lbs/day)[1]
Composite Load	4.1	7.7

[1] *Based on a flow of 2.5 cfs*

Table 5-20. Barnes Creek TP Example TMDL, Load Allocation, and Current Loading

Source Category	Allocation & TMDL (lbs/day)[1]	Existing Load (lbs/day)[1]
Composite Load	1.1	4.2

[1] *Based on a flow of 6.53 cfs*

TMDL Equations

Equation 5: ***Total Existing Load = (X) (Y) (5.4)***

X = measured concentration in mg/L (associated with the median reduction for measured loads that exceed the TMDL or with the median measured load if none exceed the TMDL)

Y = streamflow in cubic feet per second (associated with the median reduction for measured loads that exceed the TMDL or with the median measured load if none exceed the TMDL)

5.4 = conversion factor

Equation 6: ***Existing Composite Load = Total Existing Load – Existing WWTP Load***

Equation 7: Load Reduction = ((Measured Load – TMDL) / Measured Load)*100

*Measured Load = measured nutrient concentration in mg/L*measured flow in cfs*5.4*

*TMDL = target concentration in mg/L*measured flow in cfs*5.4*

Equation 8: Concentration Reduction = ((Measured Concentration in mg/L – Target Concentration in mg/L) / Measured Concentration in mg/L)*100

Nutrient Uptake Complications

- Instream measured load does not necessarily equal the total load from all sources

- When nutrients enter a stream there is uptake by organisms in the water (e.g., algae, aquatic plants), which reduces the amount of nutrients in the water column

- Excessive loading can occur while measured nutrient values meet targets

  - Expect to see excessive algal growth and we have seen that on these streams

TMDLs, Allocations, and Current Loading

<u>Example:</u> Flint Creek (Georgetown Lake to Boulder Creek)

Table 5-23. Flint Creek (Georgetown Lake to ecoregion 17ak boundary) TP TMDL, Load Allocations, Wasteload Allocation, and Current Loading Example 1

Source Category	Allocation & TMDL (lbs/day)[1]	Existing Load (lbs/day)[1]
Composite Load	25.55	6.9
Wasteload (Philipsburg WWTP)	0.06	2.7[2]
	TMDL = 25.61	**Total = 9.6**

[1] Based on a median growing season flow of 65.87 cfs

[2] Based on summer growing season monthly averages from the Philipsburg WWTP

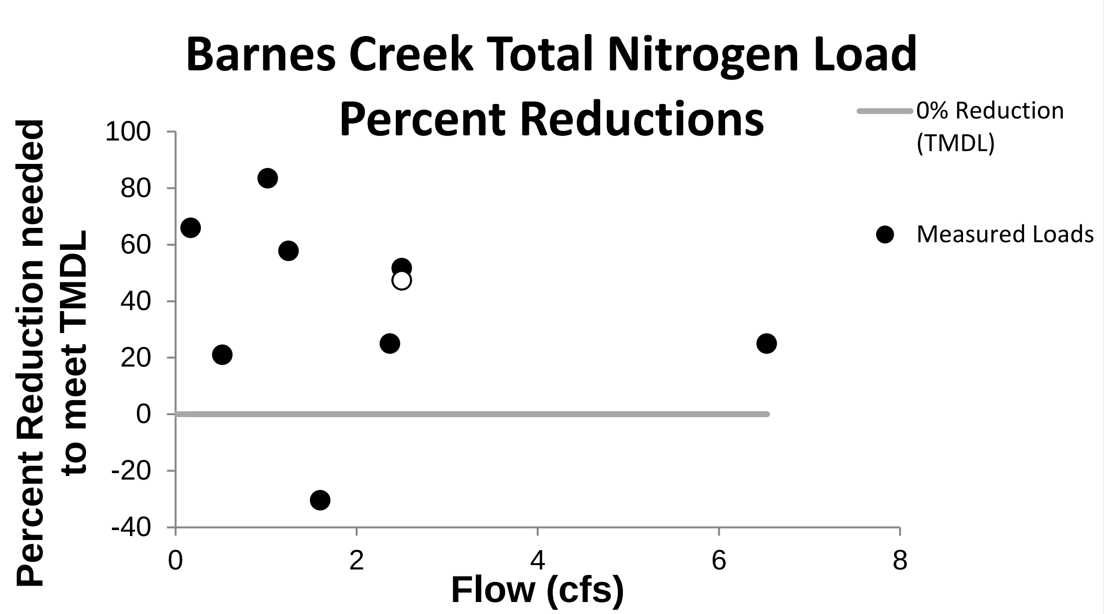
Table 5-24. Flint Creek (ecoregion 17ak boundary to confluence with Boulder Creek) TP TMDL, Load Allocations, Wasteload Allocation, and Current Loading Example 2

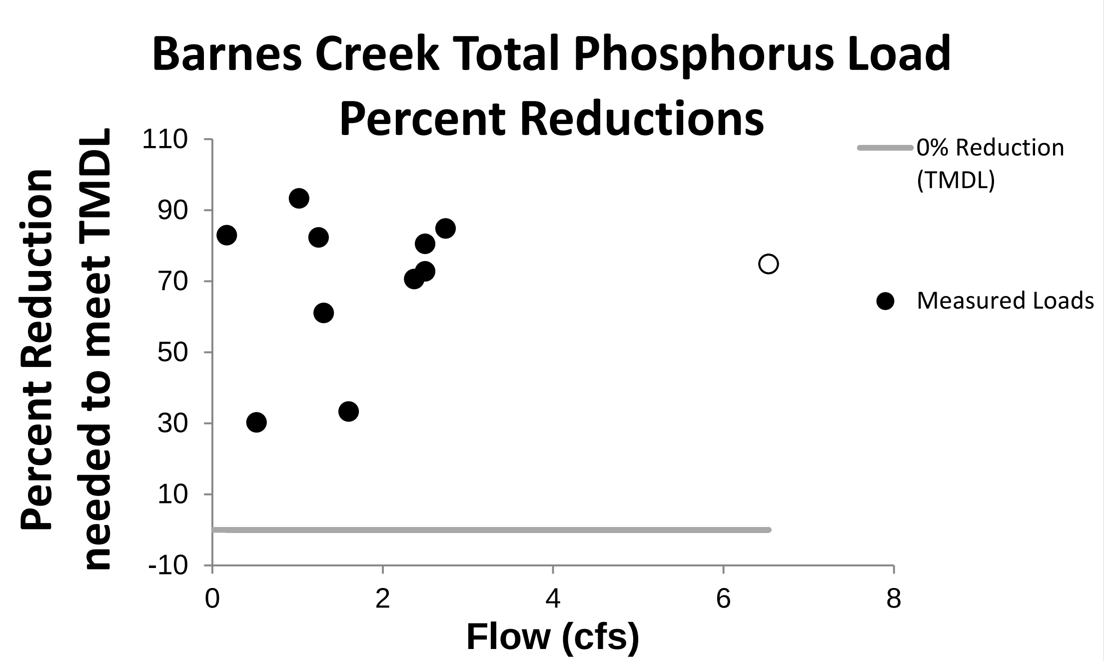
Source Category	Allocation & TMDL (lbs/day)[1]	Existing Load (lbs/day)[1]
Composite Load	28.26	19.96
Wasteload (Philipsburg WWTP)	0.06	2.7[2]
	TMDL = 28.32	**Total = 22.66**

[1] Based on a median growing season flow of 174.84 cfs

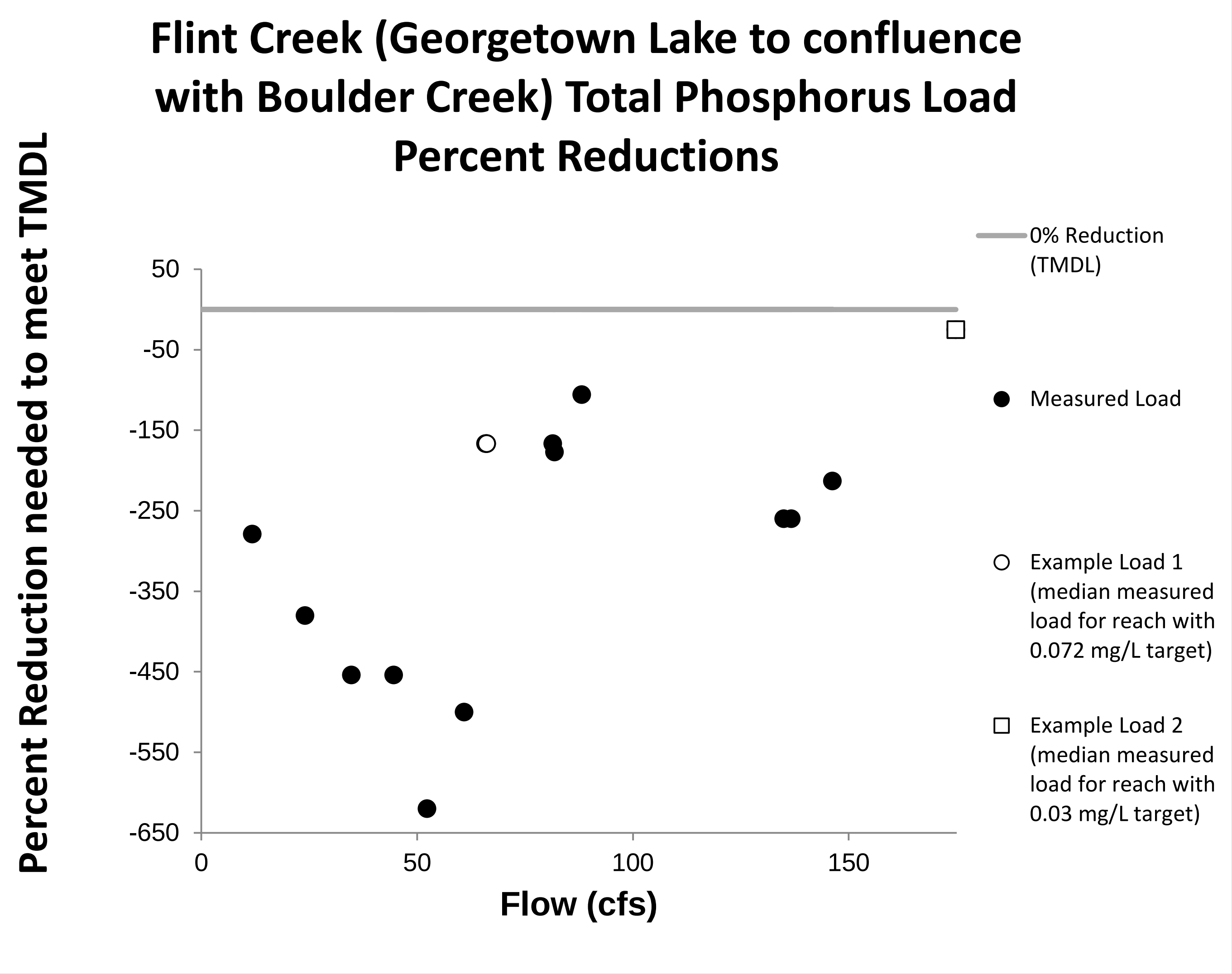
[2] Based on summer growing season monthly averages from the Philipsburg WWTP

Reductions


Barnes Creek Total Nitrogen Load
Percent Reductions
0% Reduction (TMDL)
Measured Loads
Percent Reduction needed to meet TMDL
100
80
60
40
20
0
-20
-40
0
2
4
6
8
Flow (cfs)


Barnes Creek Total Phosphorus Load
Percent Reductions
0% Reduction (TMDL)
Measured Loads
Percent Reduction needed to meet TMDL
110
90
70
50
30
10
-10
0
2
4
6
8
Flow (cfs)

Reductions



Based on concentration data with no associated flow, reductions of 1% to 55% are required

Potential Solutions:

Best Management Practices (BMPs):

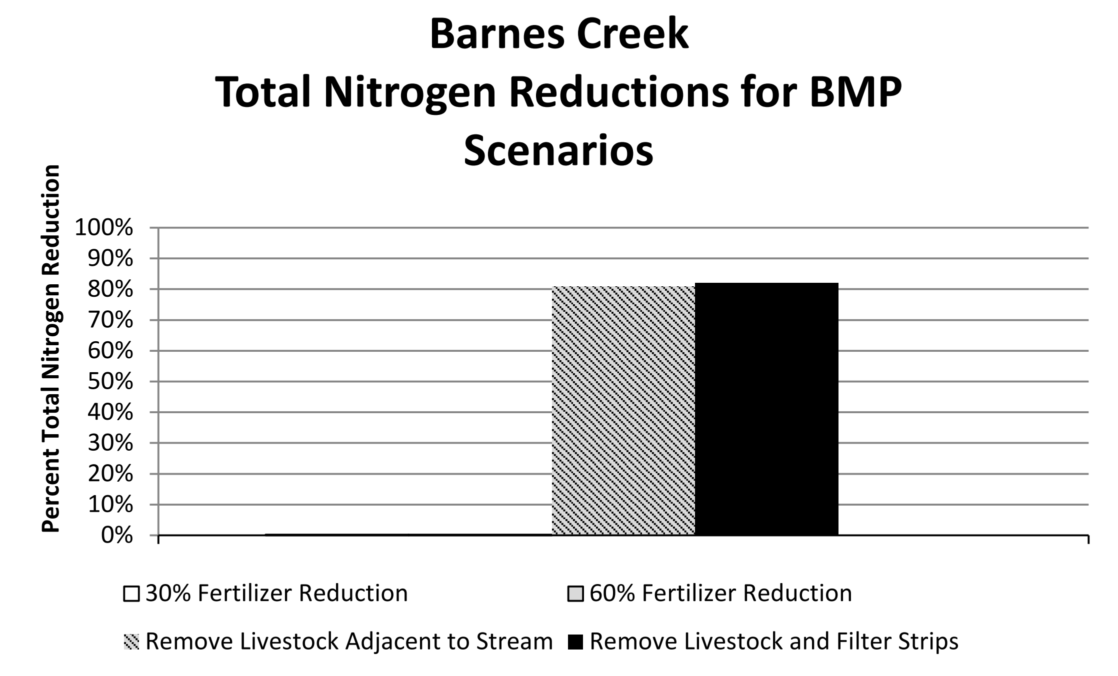
In some cases landowners are already implementing BMPs and may only need to continue with current practices

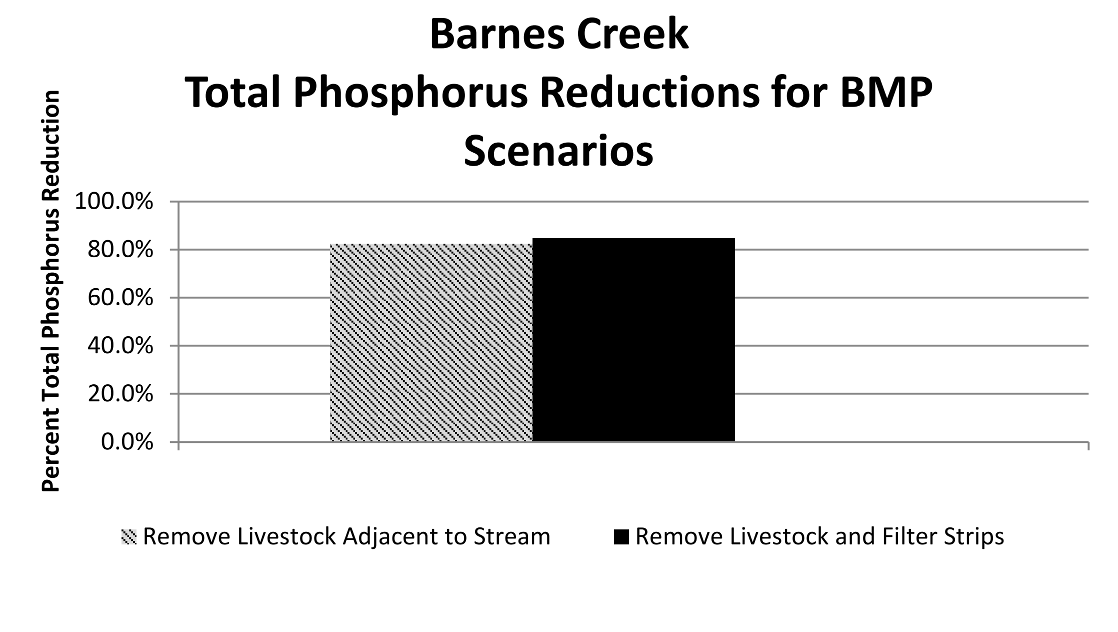
Livestock – riparian buffer strips, off stream water tanks, manure management, rotational grazing, water gaps

Timber harvest activities – streamside management zone, appropriate road building, grading, and maintenance

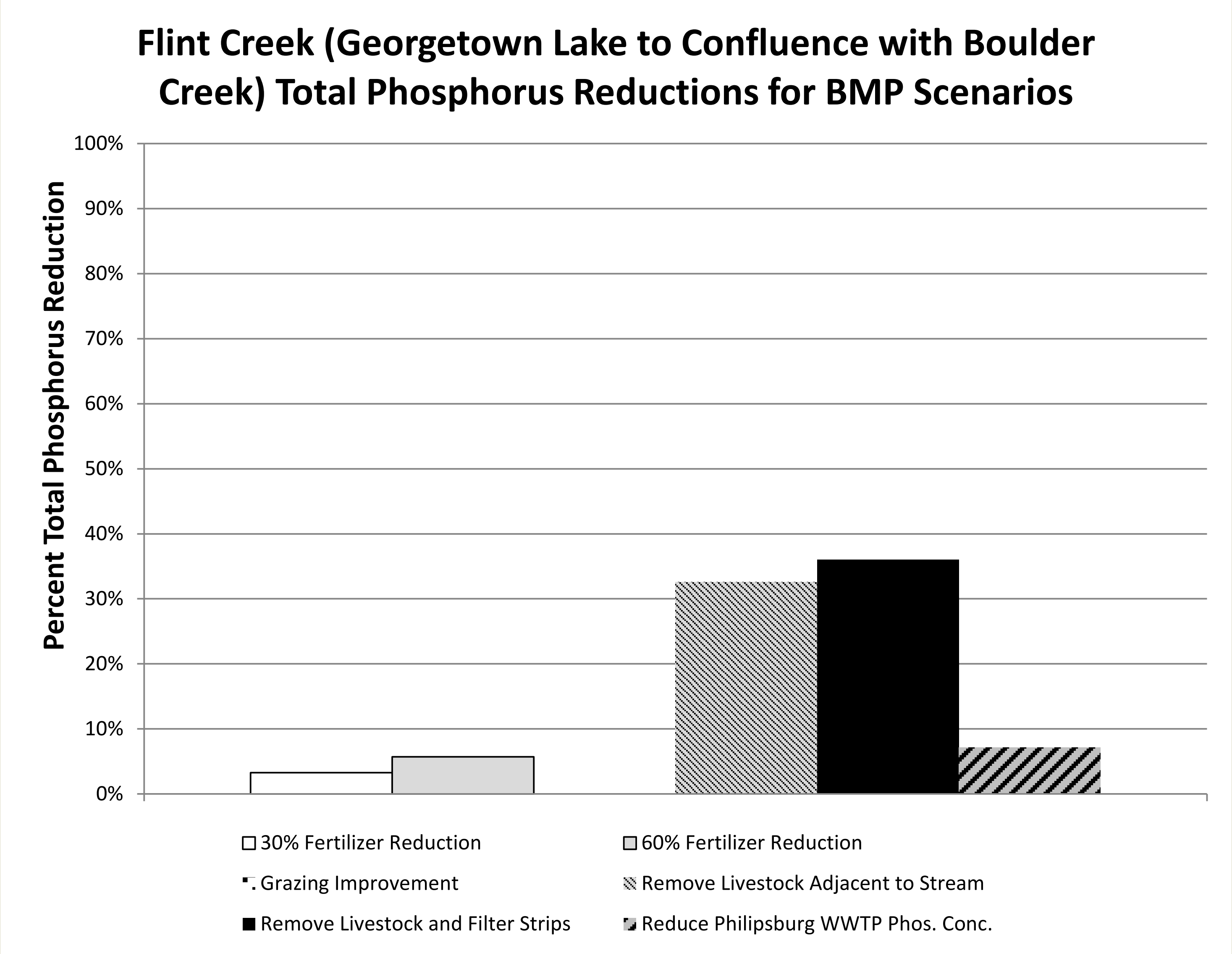
Septic – BMPs are used in installation, may want to look into potential effects of future growth (adding septic systems)

Reduction Scenarios





Reduction Scenarios



Potential Solutions:

We recognize that:

- These are small streams and therefore sensitive to impacts
- Adaptive management will be necessary to evaluate BMP effectiveness and determine what reductions are attainable

Implementing Solutions and Monitoring Progress and Success: The Next Steps

Develop a Watershed Restoration Plan that:

1) Identifies specific conditions under which BMPs may be implemented

2) Identifies what specific BMPs will be used

3) Contains a plan for monitoring the progress and success that results

Contacts:

Paul Kusnierz, Nutrients Project Manager, pkusnierz@mt.gov, (406) 444-4205

Eric Regensburger, Water Quality Modeler, eregensburger@mt.gov (406) 444-6714

Laura Anderson, Watershed Protection Section, landersen3@mt.gov, (406) 444-0549

Additional Information:

http://montanatmdlflathead.pbworks.com/