Madison Sediment and Temperature TMDLs

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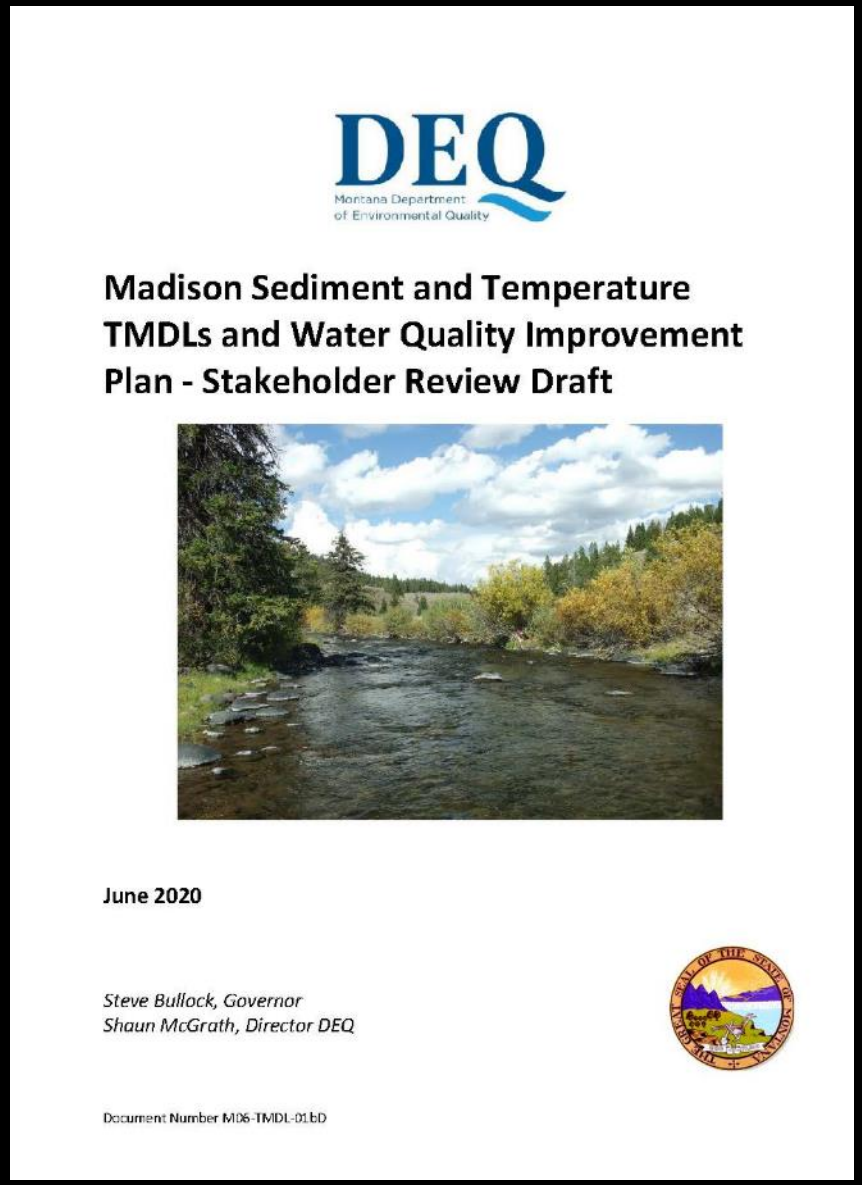
June 30, 2020

DEQ Montana Department of Environmental Quality



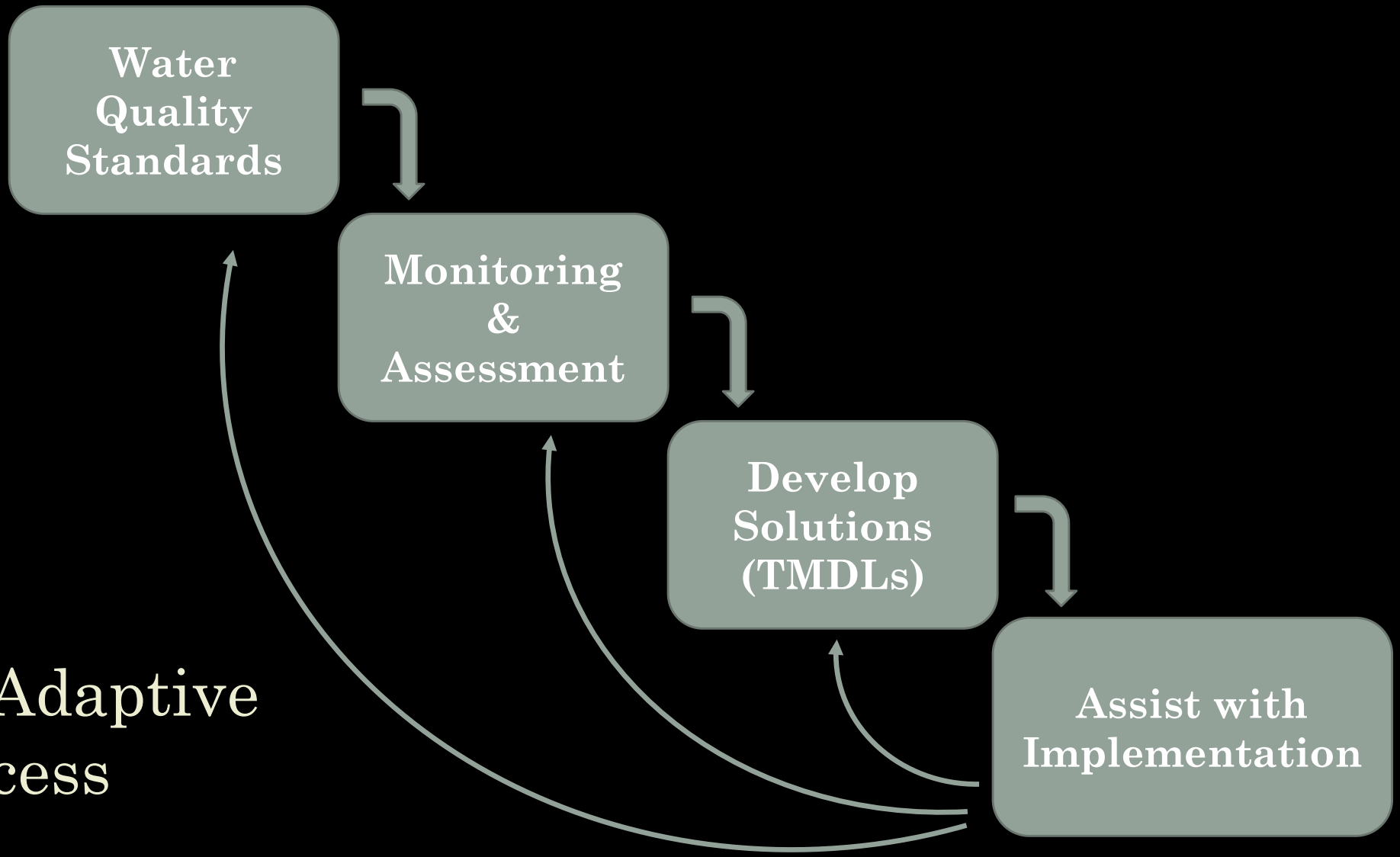
Meeting Purpose

Madison River Watershed Advisory Group meeting to discuss the stakeholder review version of a draft total maximum daily load (TMDL) document containing sediment and temperature TMDLs for tributaries of the Madison River

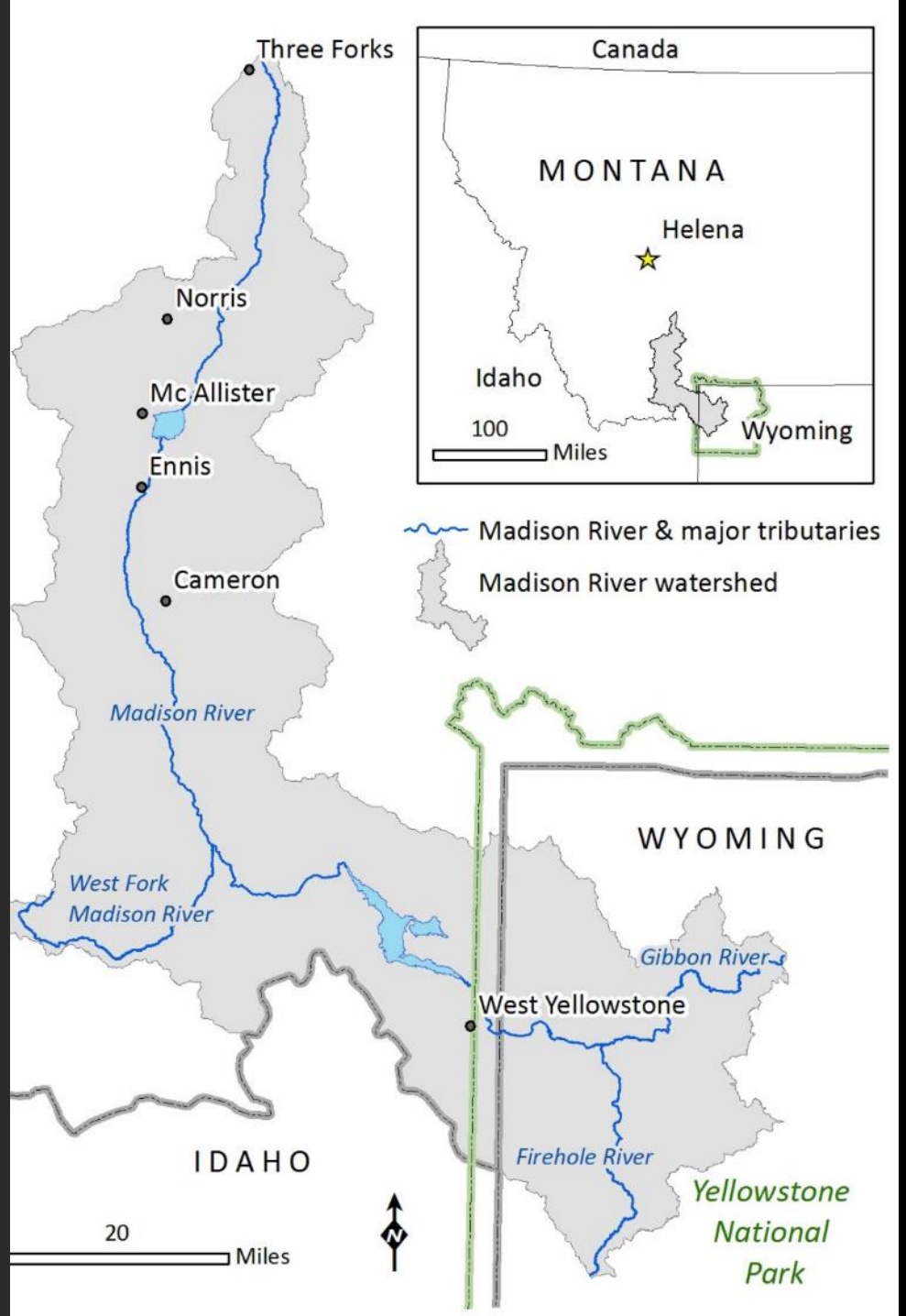
Presentation Outline

- Water quality planning process
- Project overview and history
- TMDL development process
- Sediment TMDLs
- Temperature TMDLs
- Next Steps & How to Comment

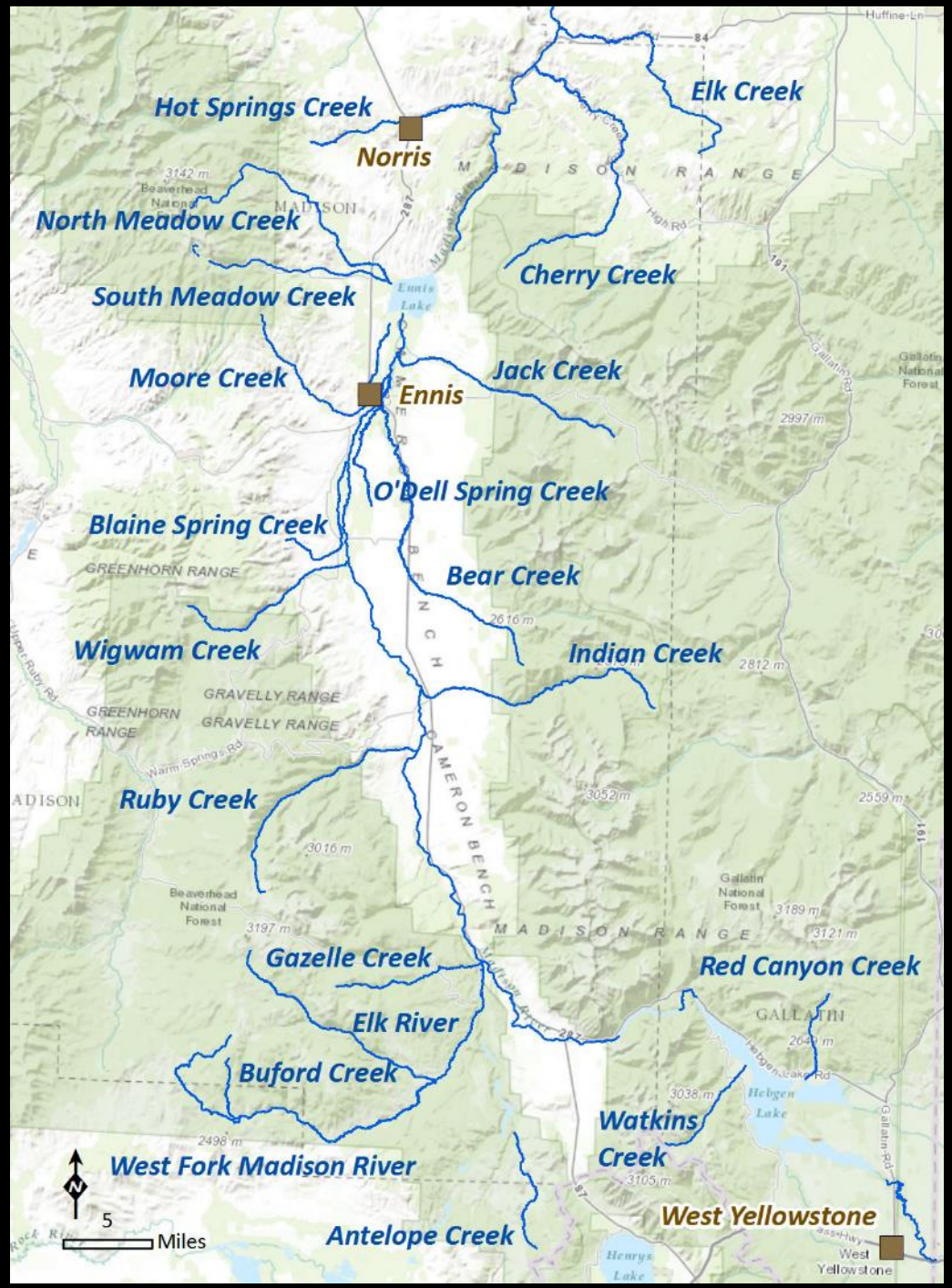
DEQ's Water Quality Planning Steps



An Adaptive Process

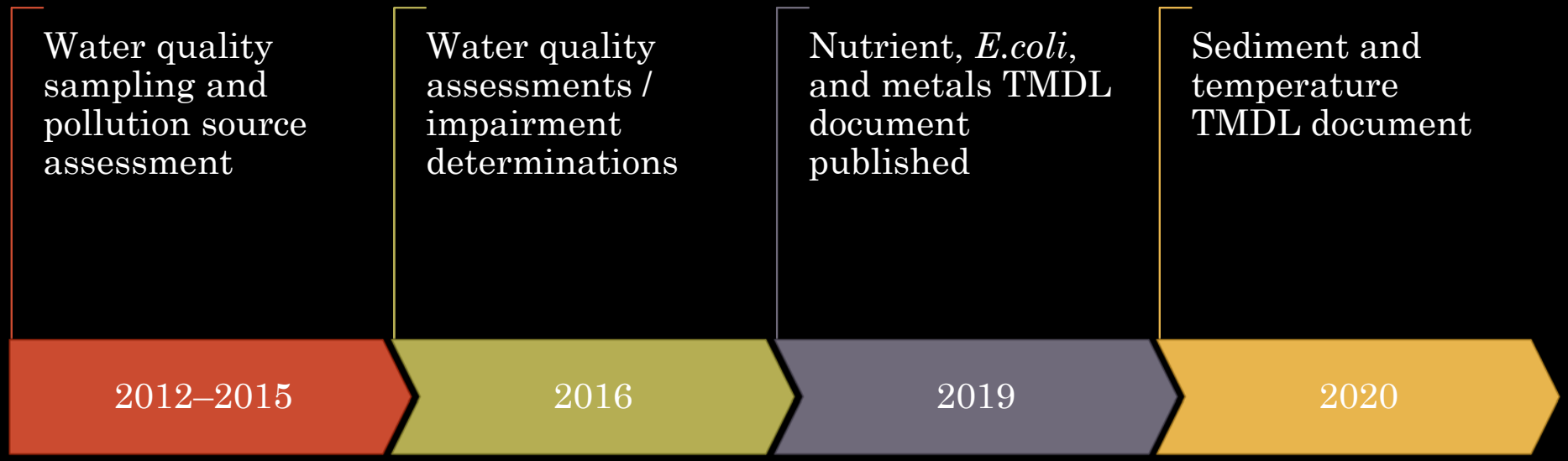


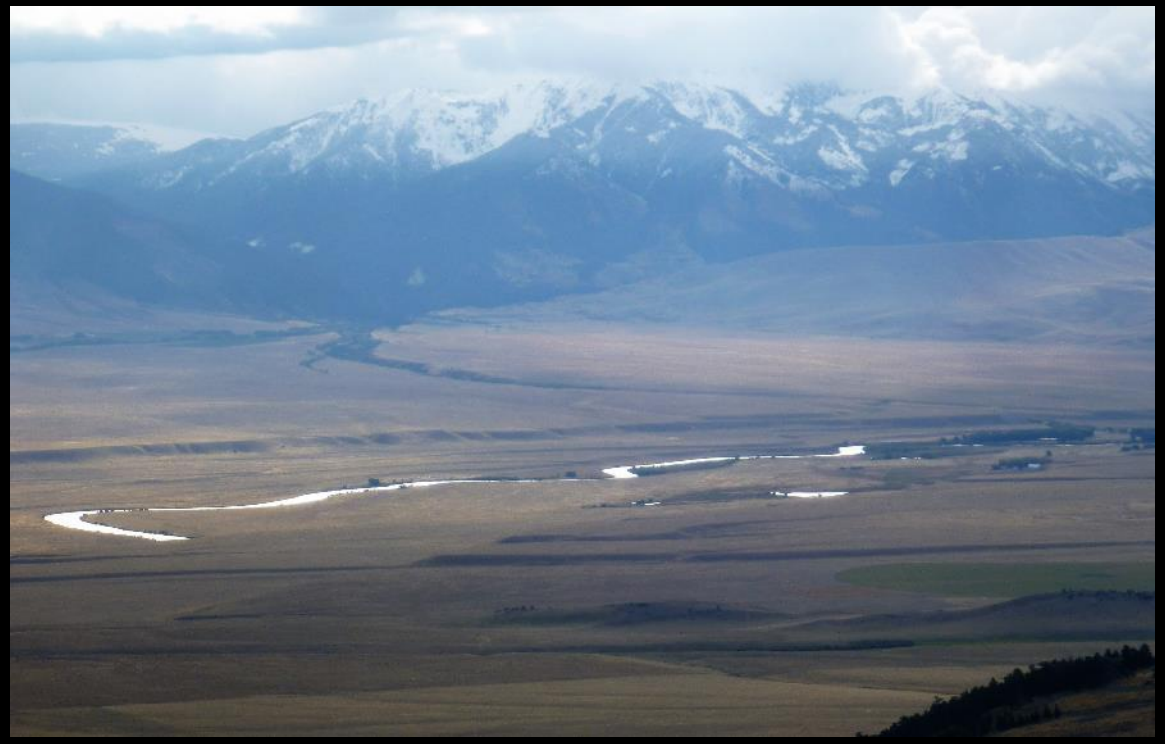
Madison River Watershed



Streams Addressed by this Project

Project History



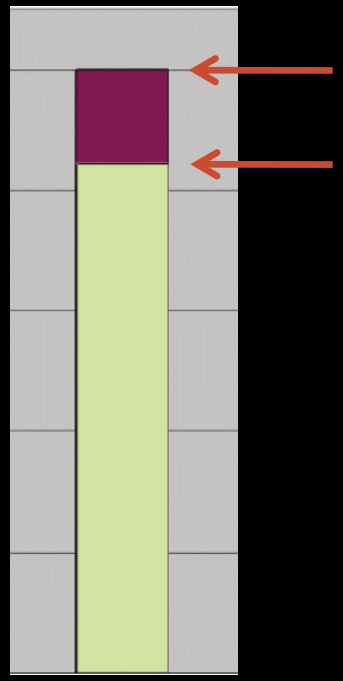


Project Goals

- Provide information that will help protect water quality in the Madison River watershed
- Provide water quality restoration suggestions
- To help achieve these goals, DEQ develops water quality improvement plans (TMDLs)

TMDL

- Total Maximum Daily Load is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards



Blaine Spring Creek Road Sediment Assessment

Madison TMDL Development Steps

1. Define the TMDL water quality targets
2. Define the TMDL (allowable loading rate)
3. Determine sources of pollutant loading
4. Determine the TMDL allocations
5. Develop water quality improvement recommendations

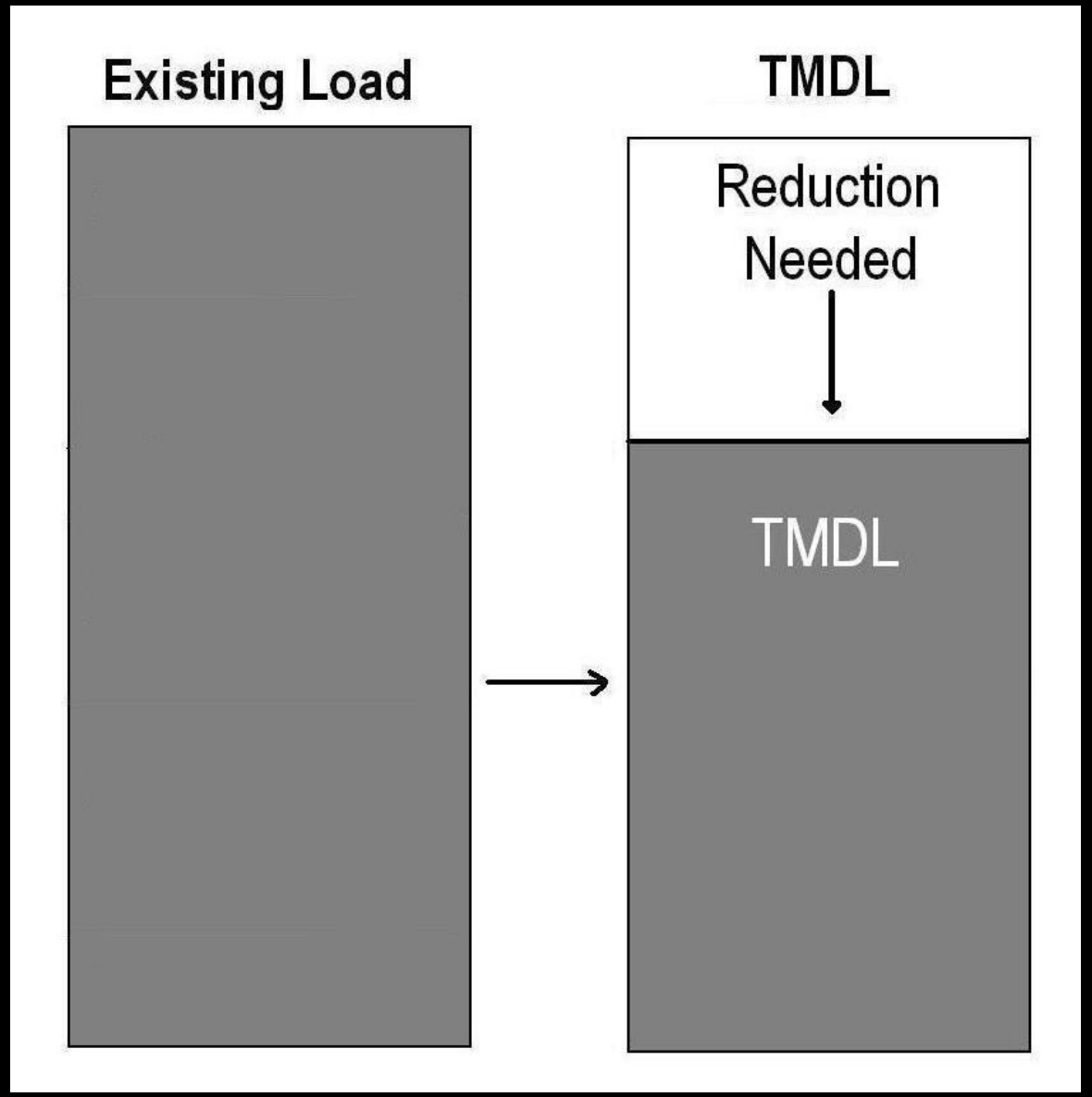

North Meadow Creek

1. Defining the Water Quality Target

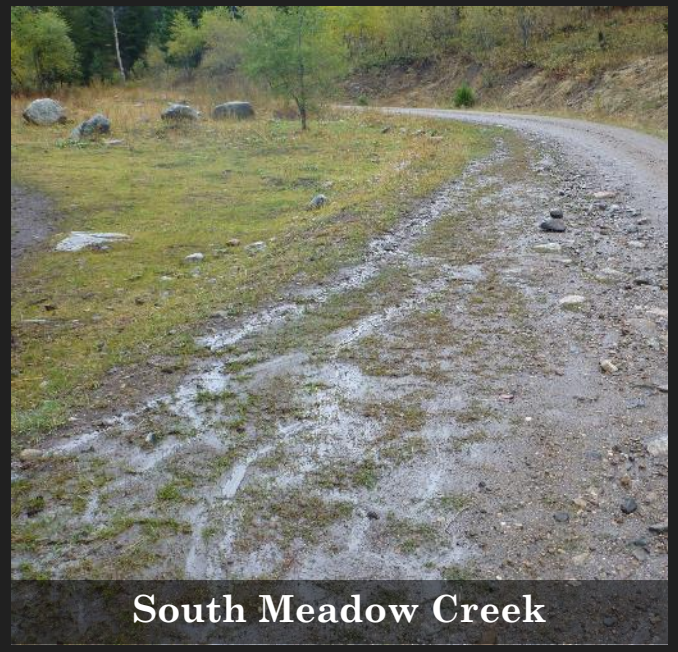
- TMDL targets represent conditions where the applicable water quality standards are achieved
- Where a numeric standard exists, the numeric standard typically becomes the target
- Where only narrative standards exist, DEQ develops targets that translate the standard

2. Defining the TMDL

- Varies by pollutant type
- Defined by a target value and streamflow



Cherry Creek

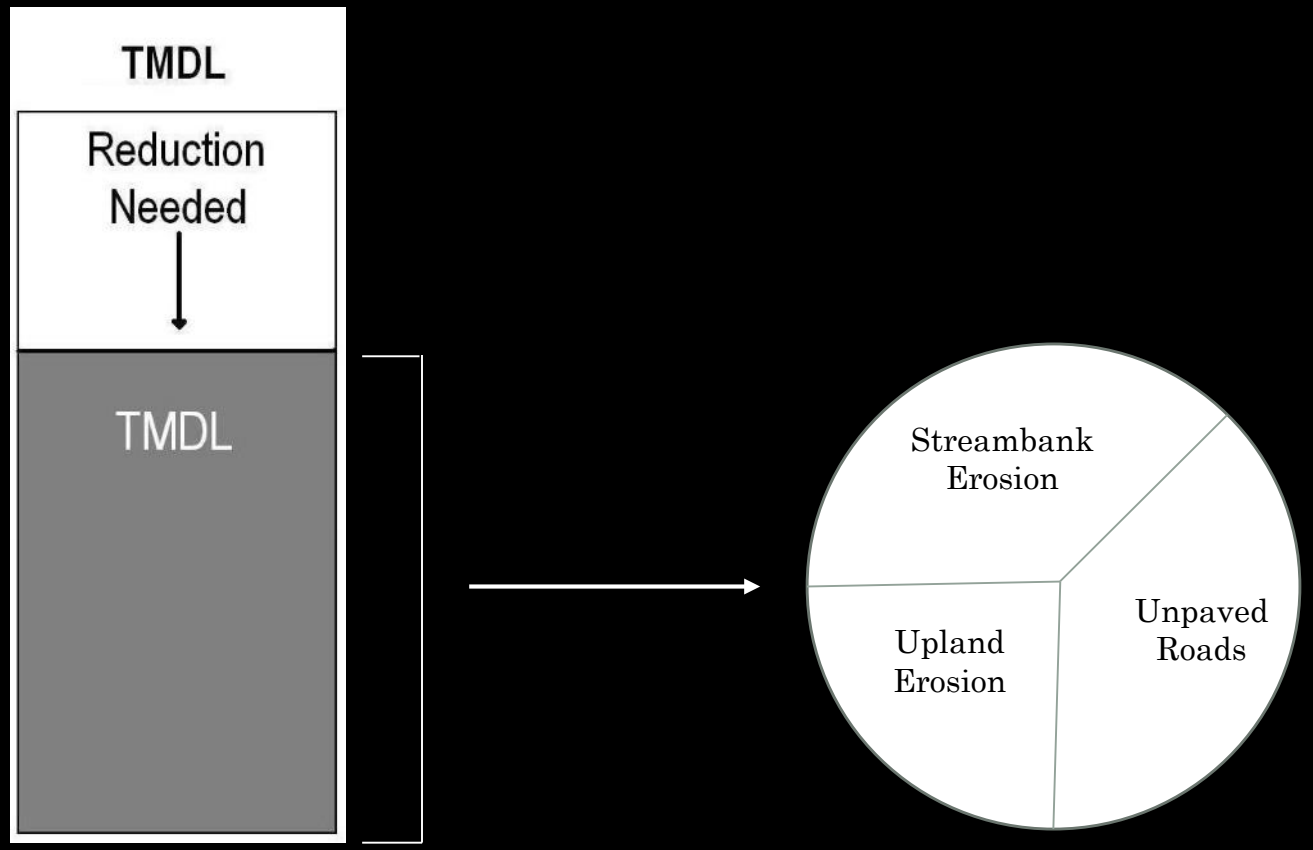


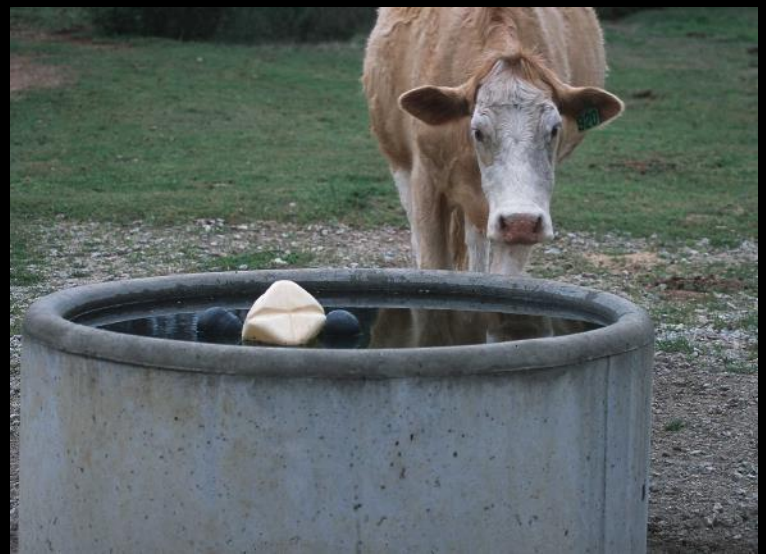
South Meadow Creek

3. Sources of Pollutant Loading

- What is the total existing load of the pollutant?
- What are the sources of the elevated loading?

4. TMDL Allocations: Conceptual Diagram





4. TMDL Allocations: Implementation

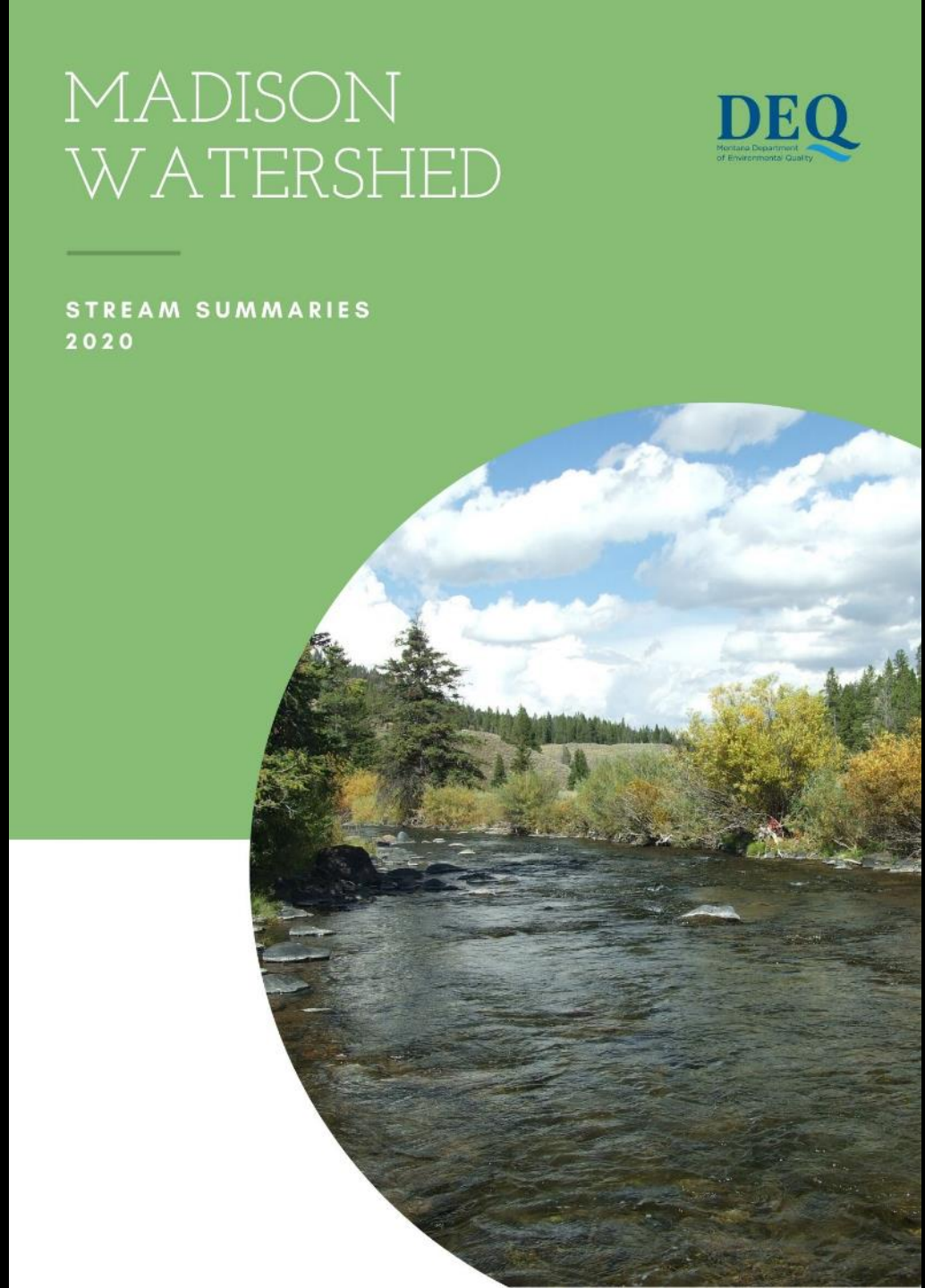
- Allocations to non-regulated sources, such as agricultural and water management practices, are predominately based on voluntary landowner actions
- Allocations can require changes to discharge limits for permitted facilities, although not the case for this project

5. Develop Water Quality Improvement Recommendations


Red Canyon Creek

- Section 9.0: Water Quality Improvement Plan
- Section 10.0: Monitoring for Effectiveness
- Improving riparian grazing management practices is the #1 factor that can improve stream health for most streams in the Madison
- Other practices:
  - Urban streamside vegetation management
  - Irrigation water management
  - Education on responsible streamside recreation

Supplemental to the TMDL Document



Contents

Contents

Antelope Creek

Location Description: Headwaters to junction with Cliff Lake

Impairments: Sediment, Flow Alteration, Alterations to Streamside Vegetation

Negatively Affects: Aquatic Life

Problem

The excess fine sediment loading at the upper DEQ-monitored site (ATLP 04-02) is linked to riparian grazing in the form of trampled streambanks and over-widened areas of the stream from cattle crossings.

Solutions

Riparian area improvements in the form of grazing best management practices could eventually result in reducing sediment loading enough to meet the water quality standard. The DEQ-monitored site on lower Antelope Creek (ATLP 10-01) demonstrated stable streambanks and a recovering riparian area due to a more recent fencing project and hardened stream crossing that has reduced livestock access to the stream.

Potential Restoration Project Locations

The project locations discussed in this section are directly linked to riparian grazing management or other riparian zone improvement BMPs that would subsequently result in reduced bank erosion and improvements in the stream's ability to transport sediment and provide aquatic habitat (channel form and function). Based on reviews of aerial photography, riparian areas generally appear healthy along the very upper reaches of Antelope Creek. Heavy grazing throughout the middle and lower portions of Antelope Creek is likely creating the same conditions seen at the DEQ-monitored site ATLP 04-02 (unstable streambanks and unhealthy riparian areas). Additionally, Antelope Creek runs dry during the summer months below ATLP 04-02 and projects to increase streamflow during hot summer months would prove beneficial to aquatic life as well as the riparian area for maintaining stable streambanks.

A trampled streambank from cattle access at monitoring site ATLP 04-02

Healthy riparian vegetation along Antelope Creek

Monitoring site ATLP 10-01 above Cliff Lake

Antelope Creek

WATERSHED RESTORATION PLAN INFORMATION

Antelope Creek WRP Elements

Waterbody / Assessment Unit ID: MT41F004_140

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.1, 5.5	5.6, 5.7.1	5.4.1	9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable

MONITORING LOCATIONS AND COLLECTED DATA

Legend

Sediment, Bank Erosion, and Greenline Sites

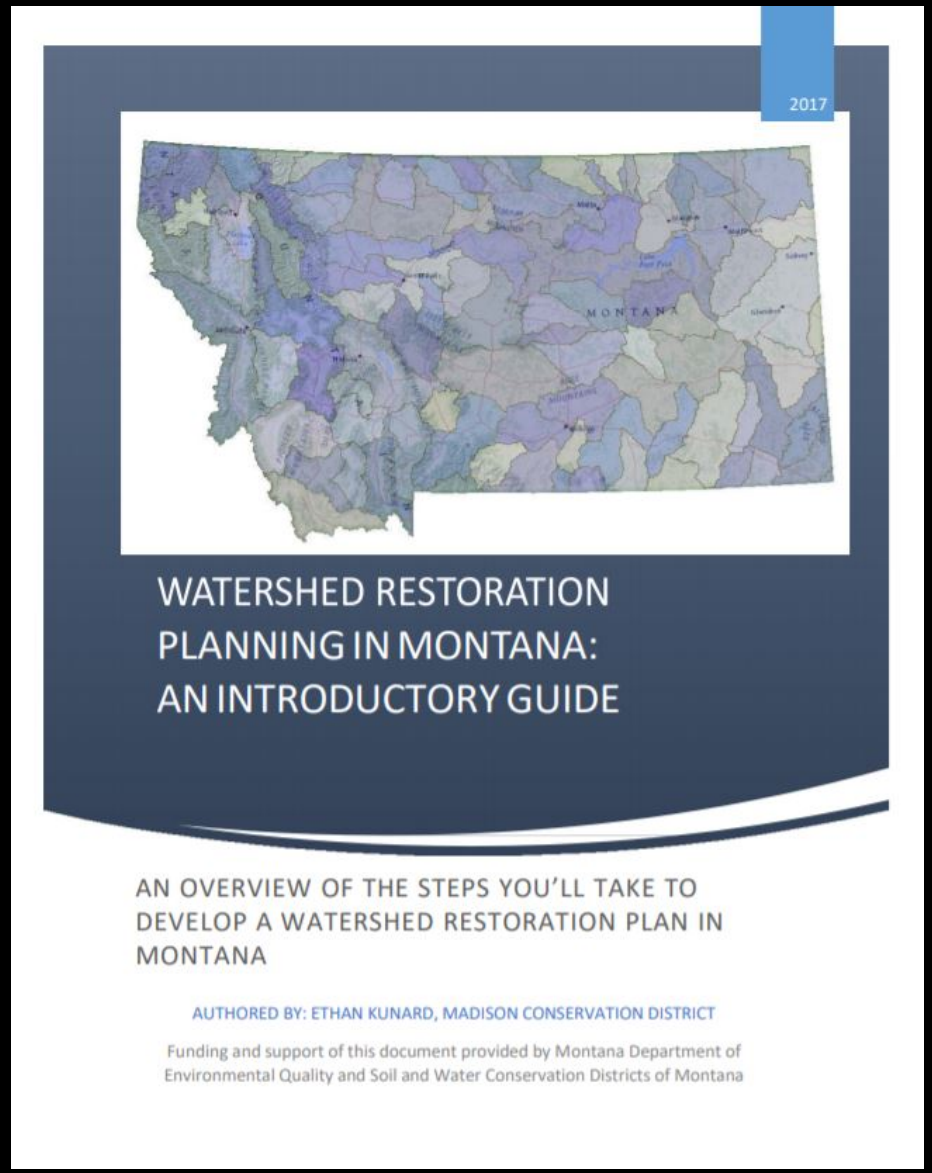
Study Stream

Antelope Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude[1]	Longitude[1]	Monitoring Parameters
ATLP 04-02 (M06ANTLC02)	DEQ	44.68141	-111.52829	Instream fine sediment[2] Instream habitat BEHI Greenline
ATLP 10-01 (M06ANTLC02)	DEQ	44.74677	-111.53753	Instream fine sediment[2] Instream habitat BEHI Greenline

[1] Latitude/longitudes are the downstream end of the sampling site

[2] Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses



Watershed Restoration Plan

- Locally developed
- DEQ-approved
- Opens up funding opportunities

North Meadow Creek

Sediment TMDLs

Christy Meredith

Sediment TMDLs

Sediment: naturally occurring component of healthy and stable stream ecosystems

Too much sediment :

- Changes composition of stream bottom
- Alters channel form and function
- Affects aquatic life

TMDL Process

Assessment:
Does it Exceed Targets?

Define Total Maximum Daily Load/Sources

Load Allocation:
What % Reduction is Recommended to Meet Targets?

Watershed Restoration Plan and Implementation

Sediment Standard

No increases in sediment above naturally occurring concentrations which will or are likely to create a nuisance or harm to beneficial uses.

Credit:USGS, J Armstrong

Water Quality Targets: Sediment

Targets are values that translate the narrative standard into something measurable. For sediment, we look at habitat and take measurements of certain stream features.

Water Quality Targets: Sediment

Targets are values that translate the narrative standard into something measurable. For sediment, we look at habitat and take measurements of certain stream features.

Reference Sites!

Field Investigations

Parameters of Interest

- Fine sediment
  (<6mm and <2mm in riffles and in pools)
- Channel form / stability
  (W/D ratio and entrenchment)
- Instream habitat
  (LWD, pools/mile, and pool depth)
- Riparian health
  (% understory shrub cover, % bare ground)
- Bank Erosion
  (Number of banks, loads, and associated causes and severity)

Parameters of interest are selected for their ability to display response to increases or decreases in sediment loading, and their linkage to effects upon aquatic life/cold water fish

Example Target

- No more than 15% of pool tails filled with fine sediment

Sediment Source Assessments: Categories

Natural erosion

Human influenced sediment/erosion

- Sediment from roads and road crossings
  - Non-"BMP'ed" roads and crossings
  - Culvert failure
- Streambank erosion
  - Streamside vegetation removal
  - Unnatural flow fluctuations
  - Livestock trampling
- Upland sediment
  - Grazing practices
  - Timber harvest
  - Streamside vegetation removal
  - Crop production
  - Development/construction

Load allocations
Expressed as percent reduction

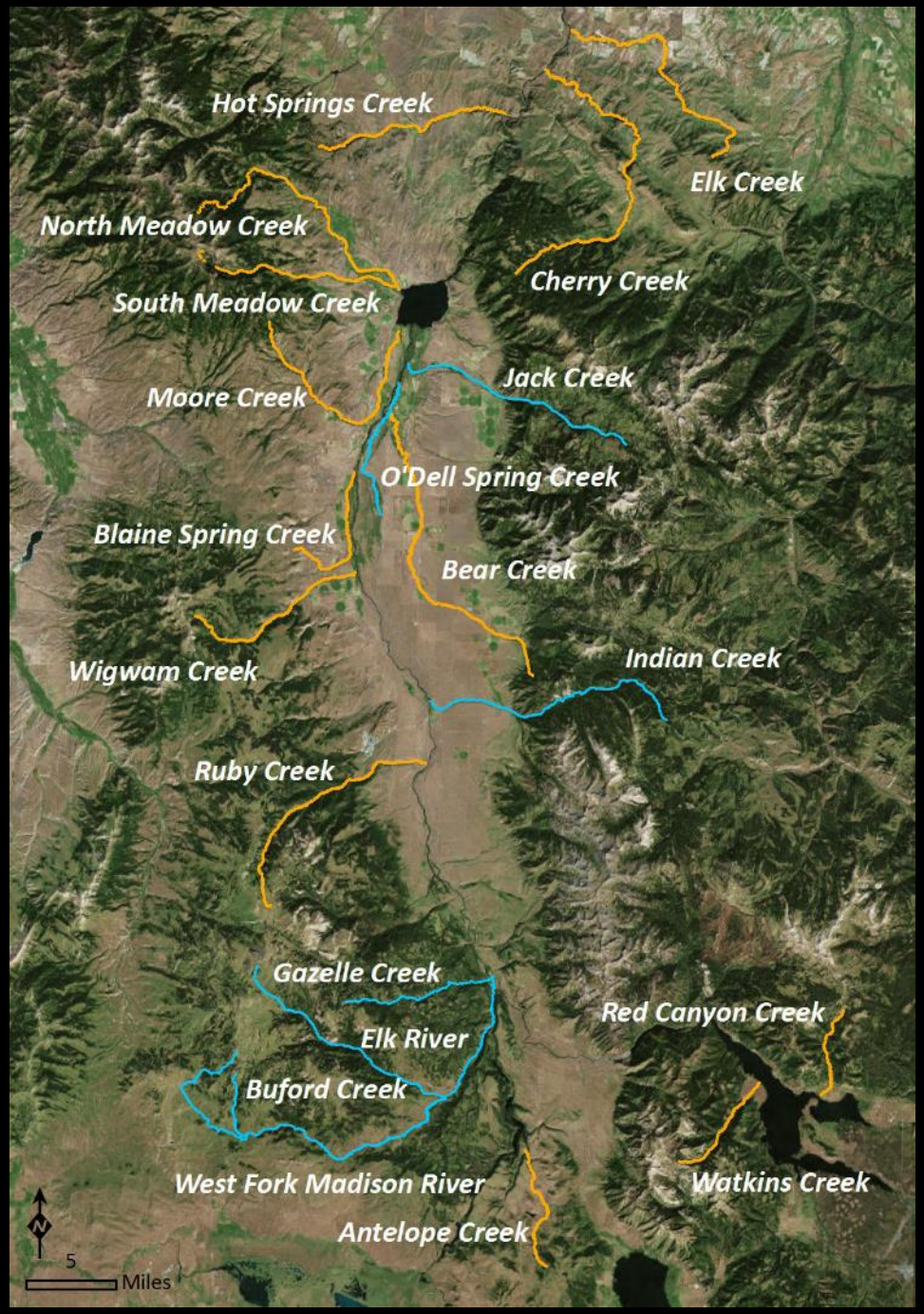
÷

= X

Desired condition

Existing condition

1-X*100 =
% reduction needed



Sediment TMDLs

- Antelope Creek
- Bear Creek
- Blaine Spring Creek
- Cherry Creek
- Elk Creek
- Hot Springs Creek
- Moore Creek
- North Meadow Creek
- South Meadow Creek
- Red Canyon Creek
- Ruby Creek
- Watkins Creek
- Wigwam Creek

Evaluated but No Sediment TMDL Needed

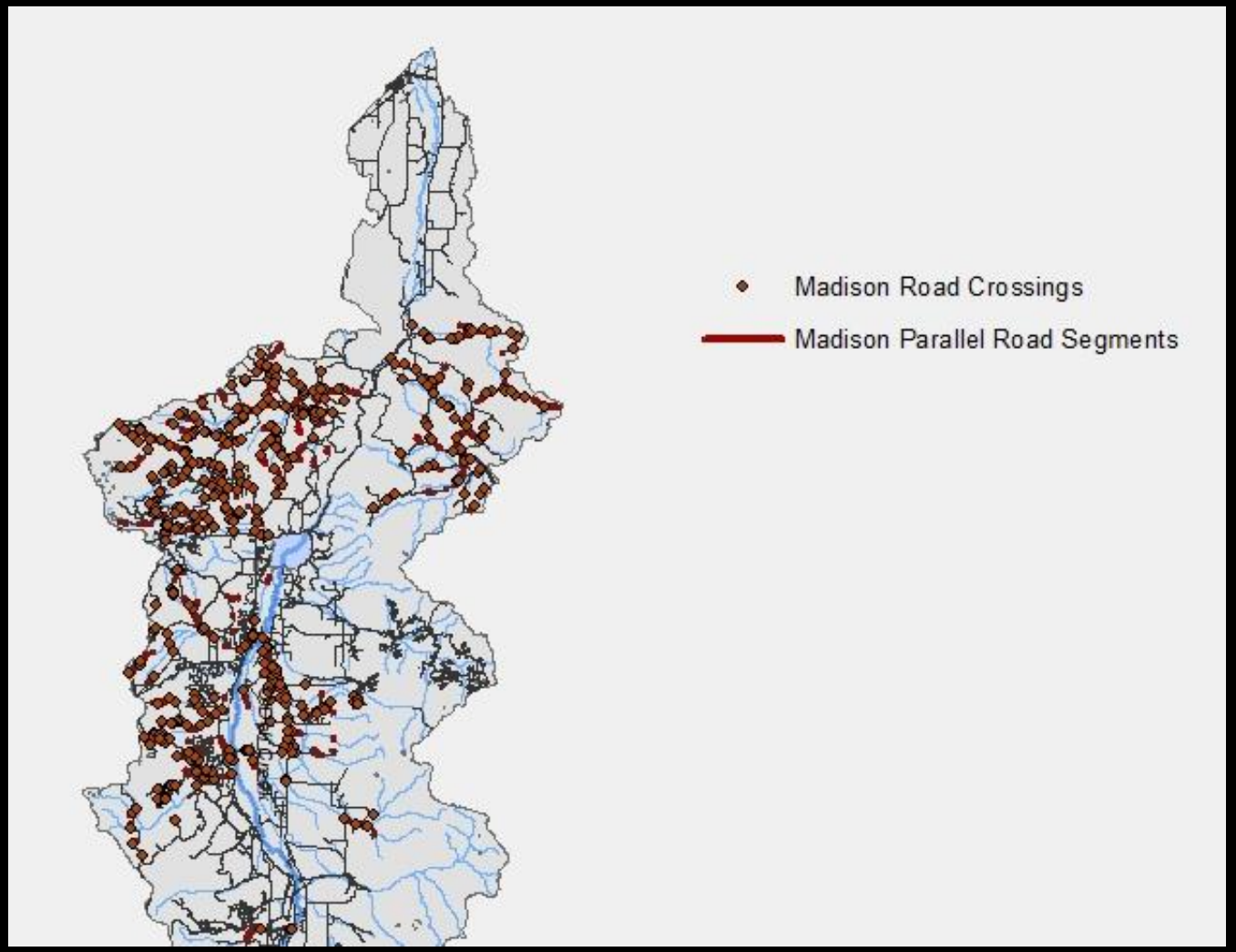
-Buford Creek
-Elk River
-Indian Creek
-Jack Creek
-O'Dell Spring Creek

Gravel Roads Assessment

Water Erosion Prediction Model:

- Survey crossings and parallel road segments
- Run model to estimate sediment run-off
- Re-Run model with BMPs
- Extrapolate results to similar crossings

Gravel Roads Distribution

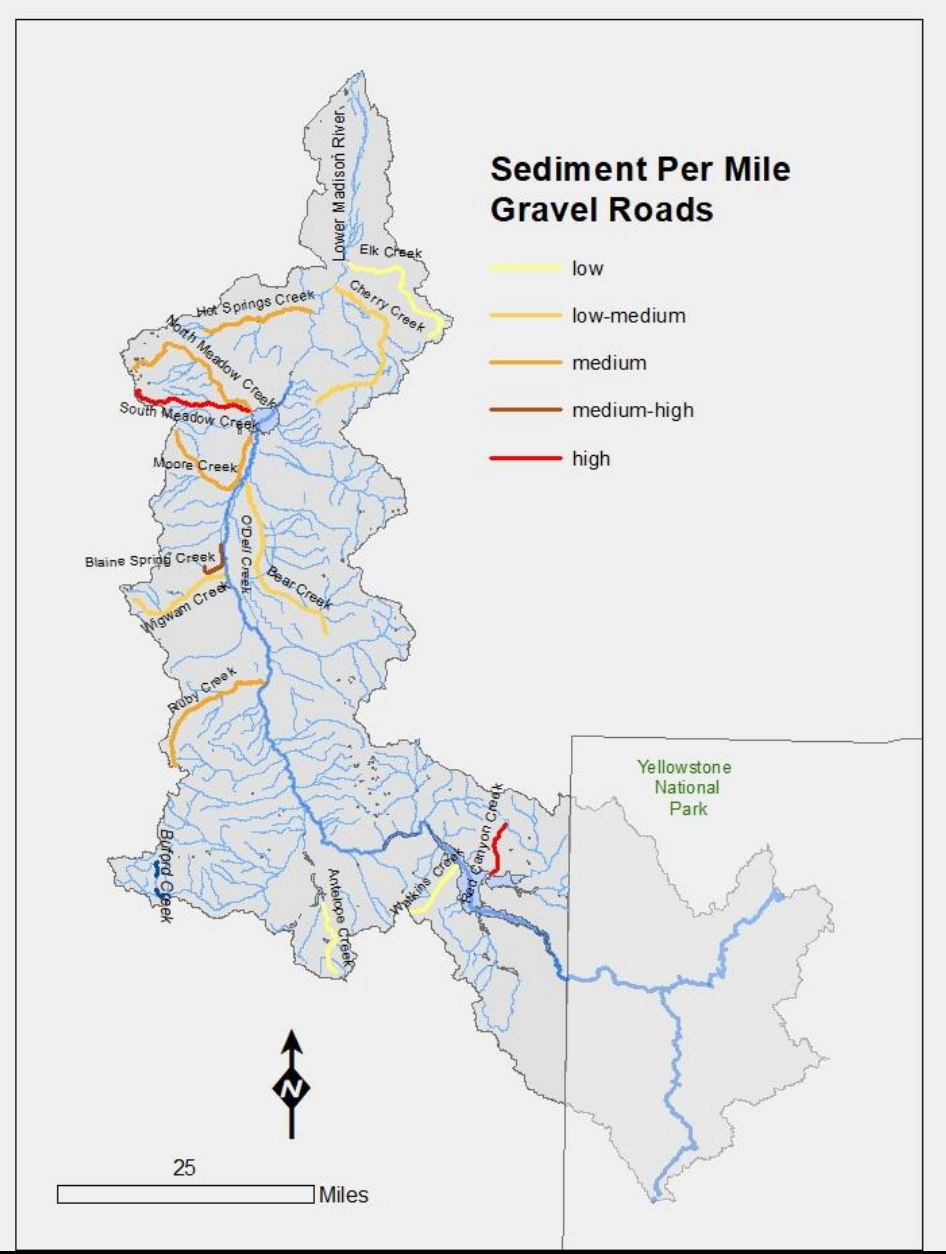


- 562 Gravel Crossings
- 992 Gravel Parallel Road Segments

- Crossing Types:

-High elevation public
-Low elevation public
-Low elevation private

Gravel Roads Assessment



Biggest Reduction Potential
(Tons per Stream Mile)

- South Meadow Creek
- Red Canyon Creek
- Blaine Spring Creek

Gravel Roads Assessment

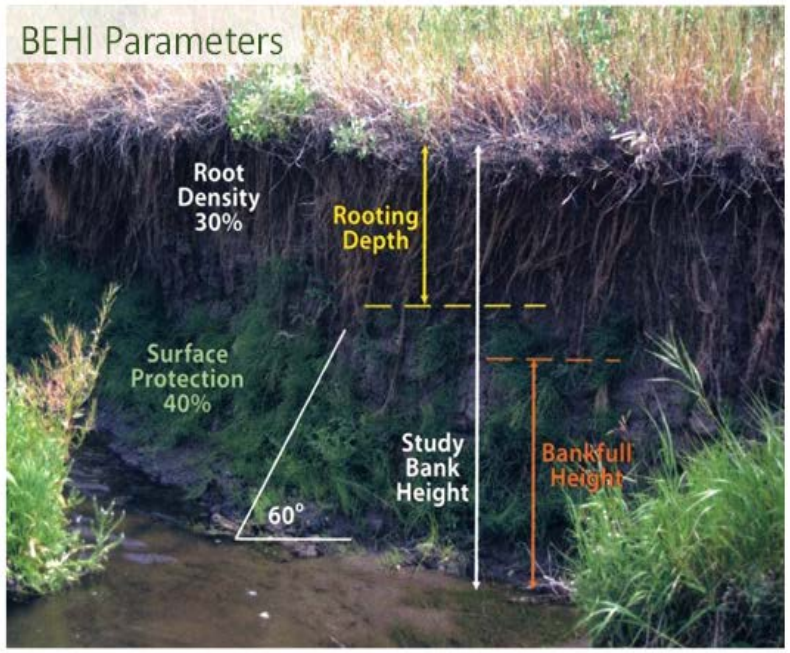
Highly Erodible Surface Type

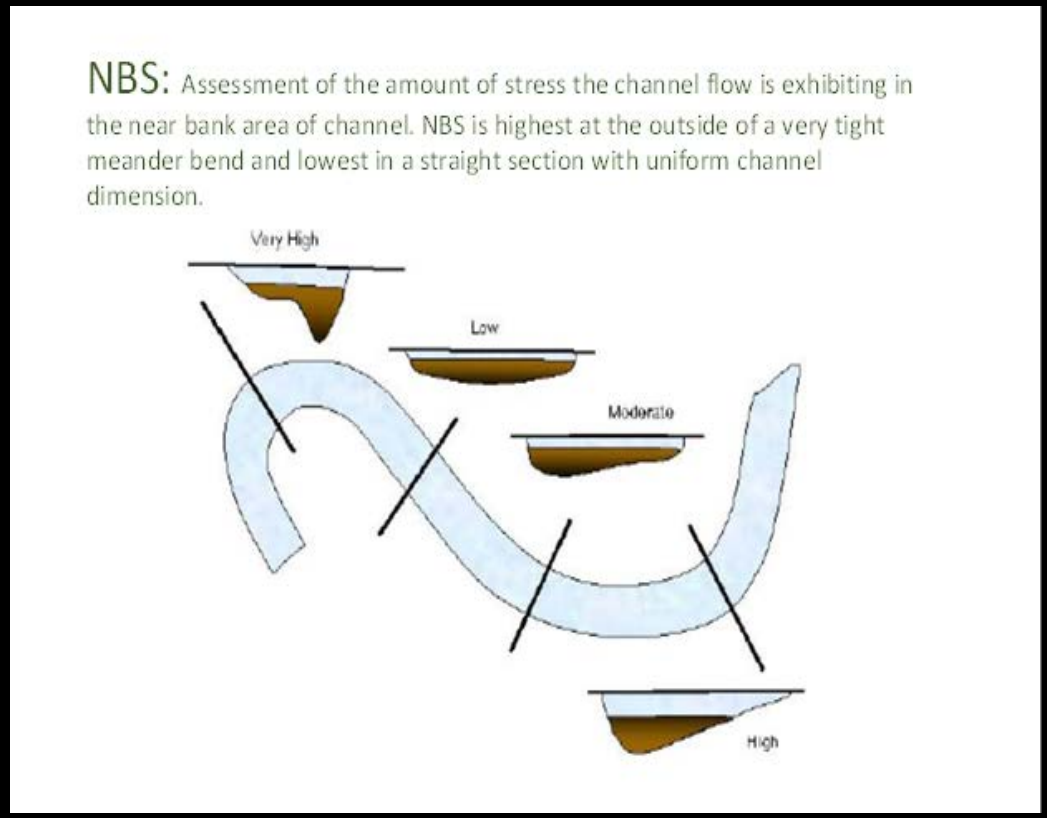
Absence of Water Bars

Bank Erosion

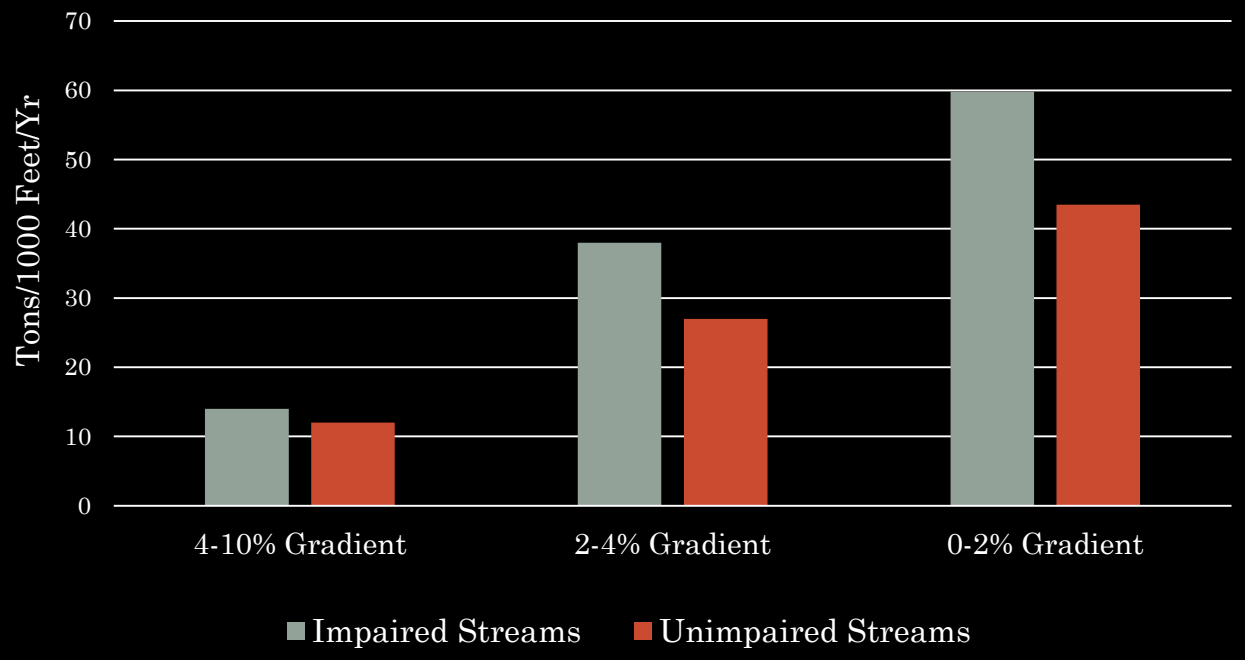
Bank Erosion Assessment

BANCS model: Comprised of Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) methods to estimate annual streambank erosion rates



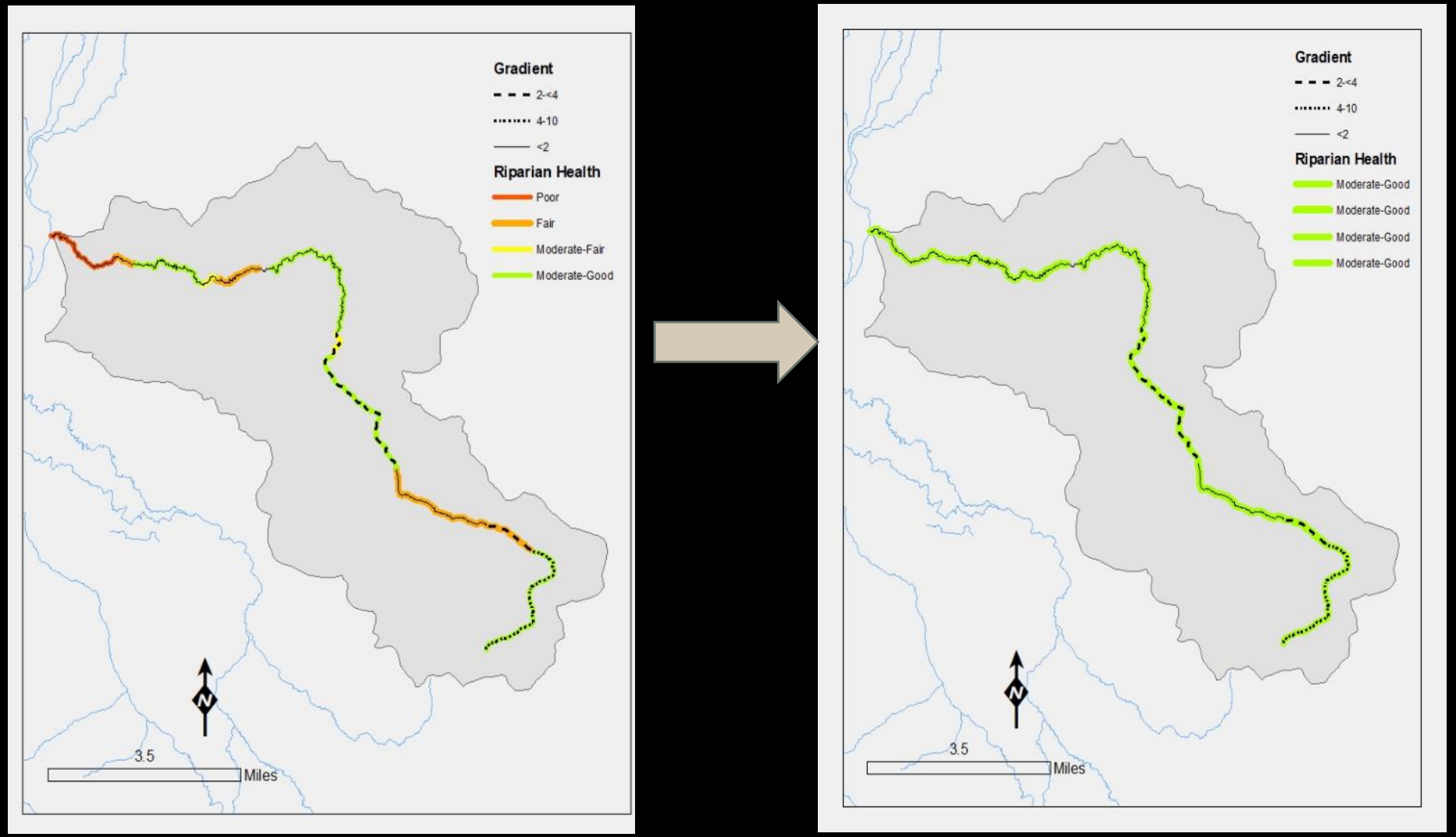


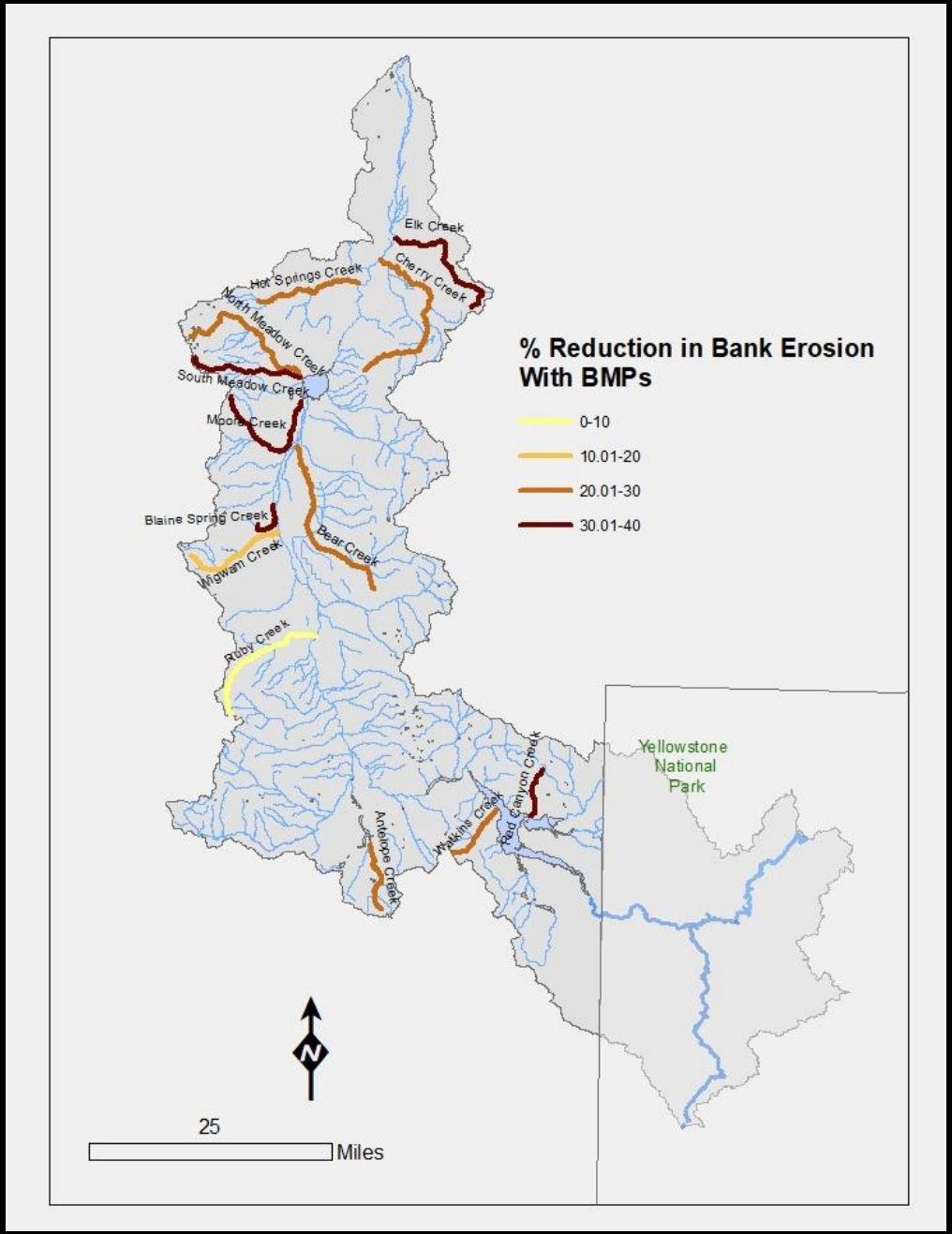
Effects of Gradient and Riparian Condition



- What did unimpaired stream have in common?
  -Average moderate to good riparian quality
  -75 % of riparian zone in “natural conditions”

Estimate Bank Erosion with BMP's





Bank Erosion Assessment

Biggest % Reduction With BMP's:

- Moore Creek
- South Meadow Creek
- Elk Creek
- Blaine Springs Creek
- Red Canyon Creek

Bank Erosion Surveys

Hummocking
Bear Creek

Bank Erosion
Cherry Creek

High Embeddedness
Elk Creek

Low Embeddedness
North Meadow Creek

Good Riparian Vegetation
Antelope Creek

Upland Erosion

- Most streams were found to have adequate upland conservation practices
- Exception: Elk Creek
- Universal Soil Loss Equation and Riparian Buffer

30% Reduction if BMP's Used

TMDLs and Allocations

- The TMDL is expressed as reduction in annual load

- Allocation (TMDL budget among sources)

Elk Creek Sediment TMDL

Sediment Source Assessment, Allocations and TMDL for Elk Creek			
Sediment Sources	**Current Estimated Load (Tons/Year)**	**Total Allowable Load (Tons/Year)**	**Load Allocations (% Reduction)**
Roads	9	5	43%
Eroding Banks	4840	3346	31%
Upland Erosion	14	9	30%
Total Sediment Load	**4862**	**3361**	**31%**

Temperature TMDLs

High thermal loading may increase water temperatures to levels that harm fish and other aquatic life.

In western Montana, temperature impairment listings are associated with fish and aquatic life beneficial uses.

Temperature TMDL Process

Assessment:
Does it Exceed Targets?

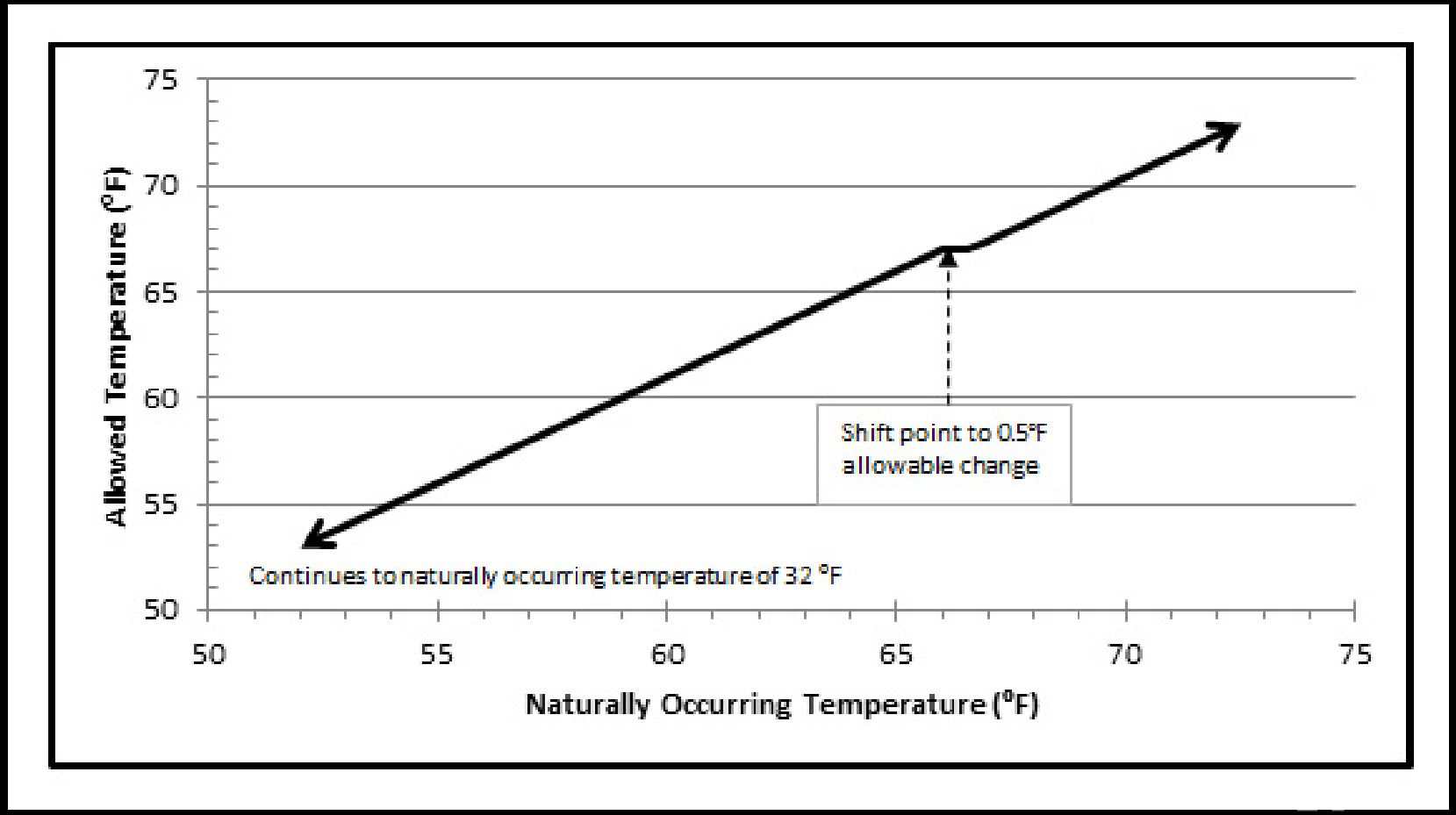
Define Total Maximum Daily Load/Sources

Load Allocation:
What % Reduction is Recommended to Meet Targets?

Watershed Restoration Plan and Implementation

Standard for Temperature

- 17.30.623(2)(e) A 1 ºF maximum increase above naturally occurring water temperature is allowed within the range of 32 ºF to 66 ºF; within the naturally occurring range of 66 to 66.5 ºF, no discharge is allowed which will cause the water temperature to exceed 67 ºF; and where the naturally occurring water temperature is 66.5 ºF or greater, the maximum allowable increase in water temperature is 0.5 ºF.

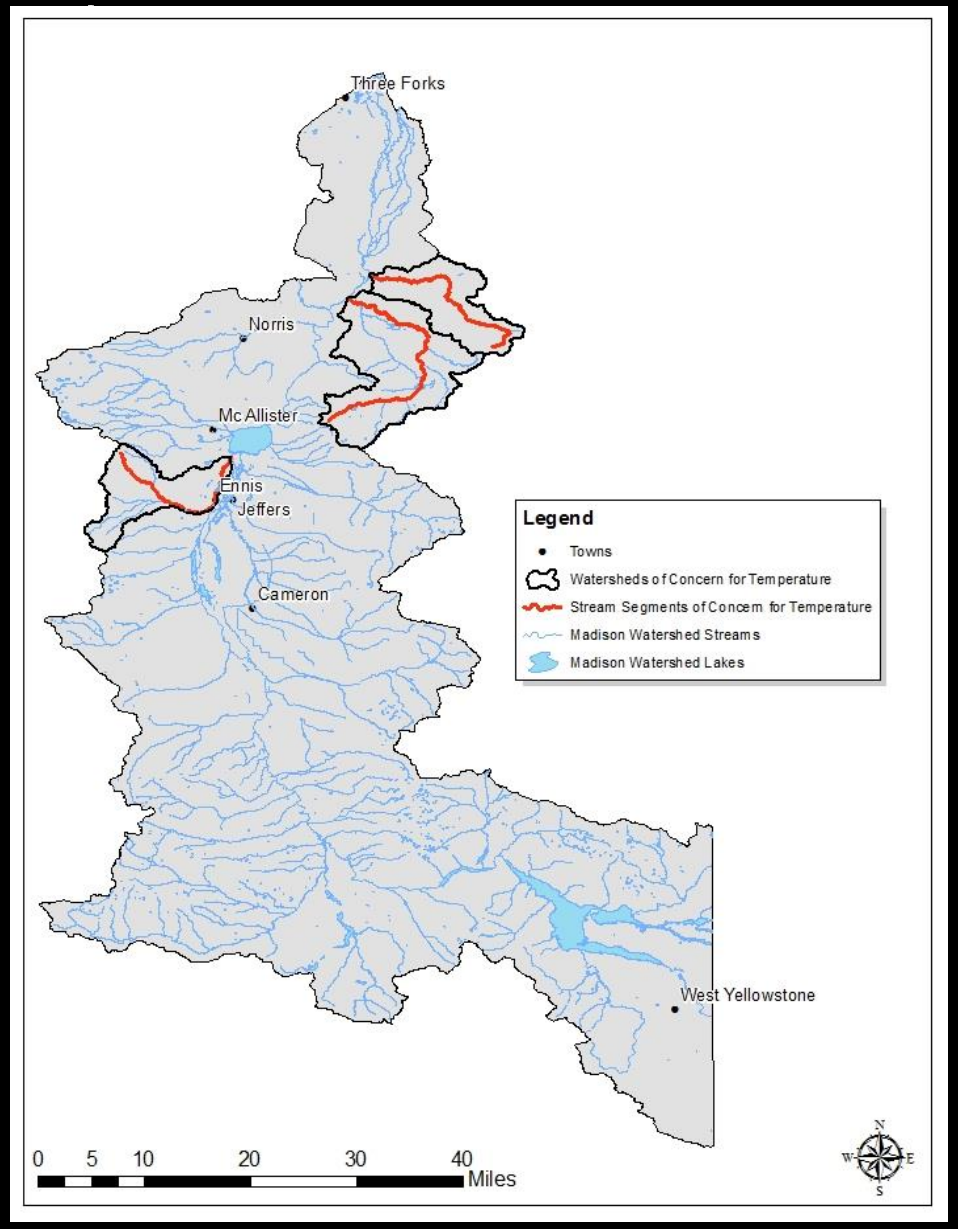


Temperature TMDLs and Allocations

In lieu of expressing allocations based on numeric temperatures or thermal loads, the TMDL and allocations are expressed via conditions that, if met, would comply with the temperature standard.

- Shade-Similar to “Natural” Conditions
- Width/depth ratio-Similar to Reference Range
- Streamflow-Increased 15%

Madison Temperature Streams



TMDL Developed

- **Cherry Creek**
- **Elk Creek**
- **Moore Creek**

Data Collected But No TMDL
West Fork Madison
Lower Madison

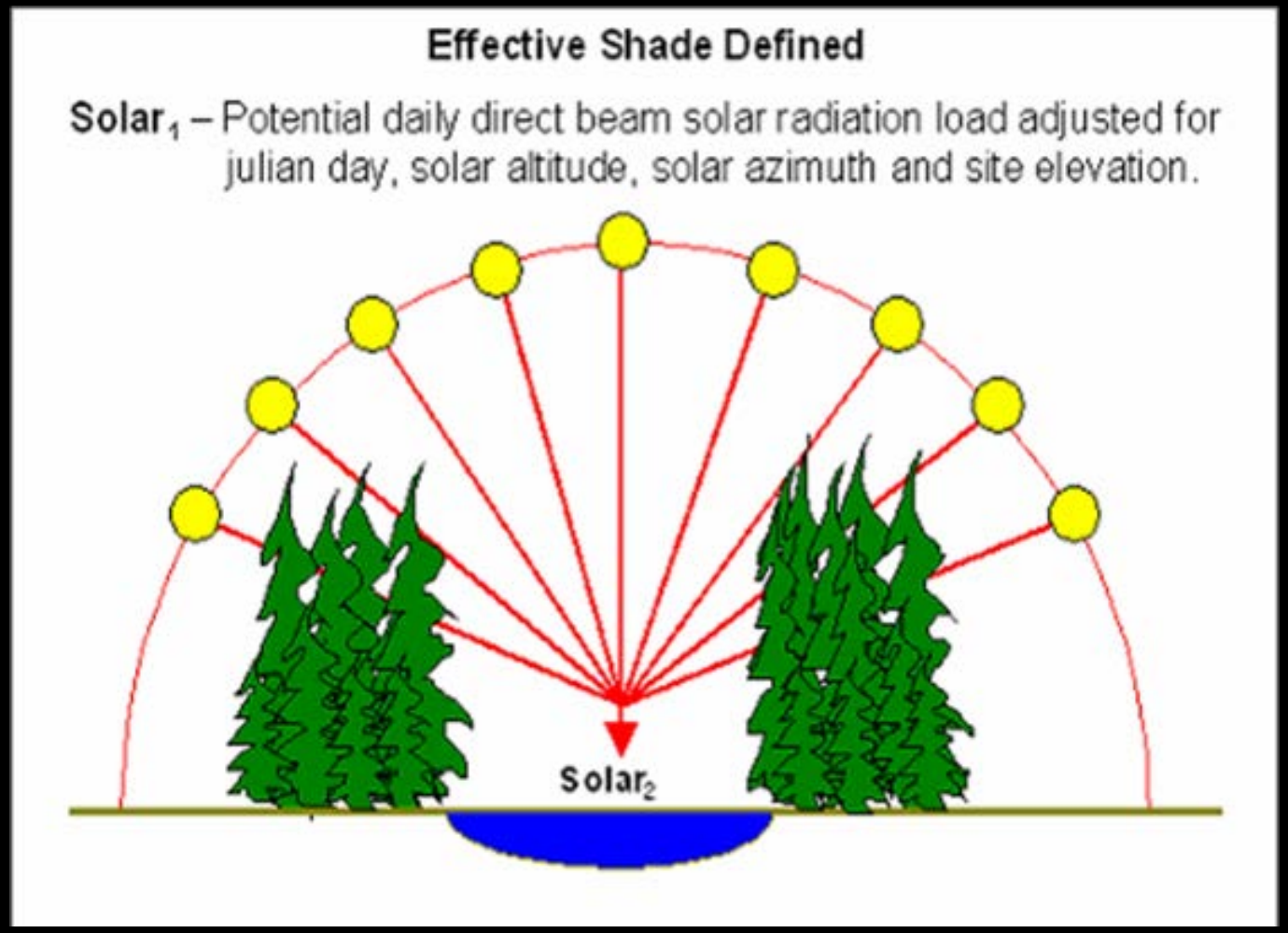
Field Data

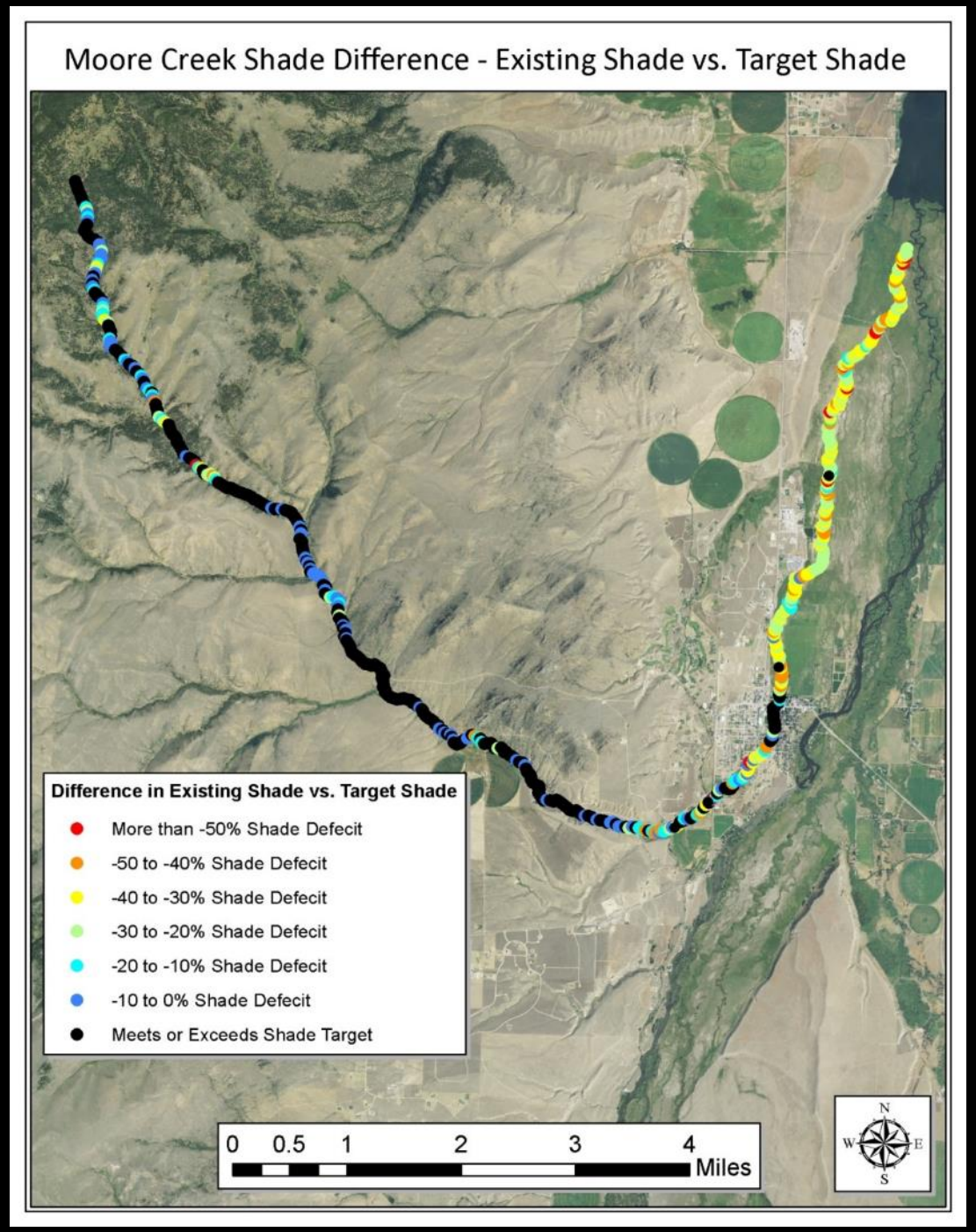
- Continuous Temperature Monitoring
- Stream Flow
- Shade

Field Data

- Continuous Temperature Monitoring
- Stream Flow
- Shade

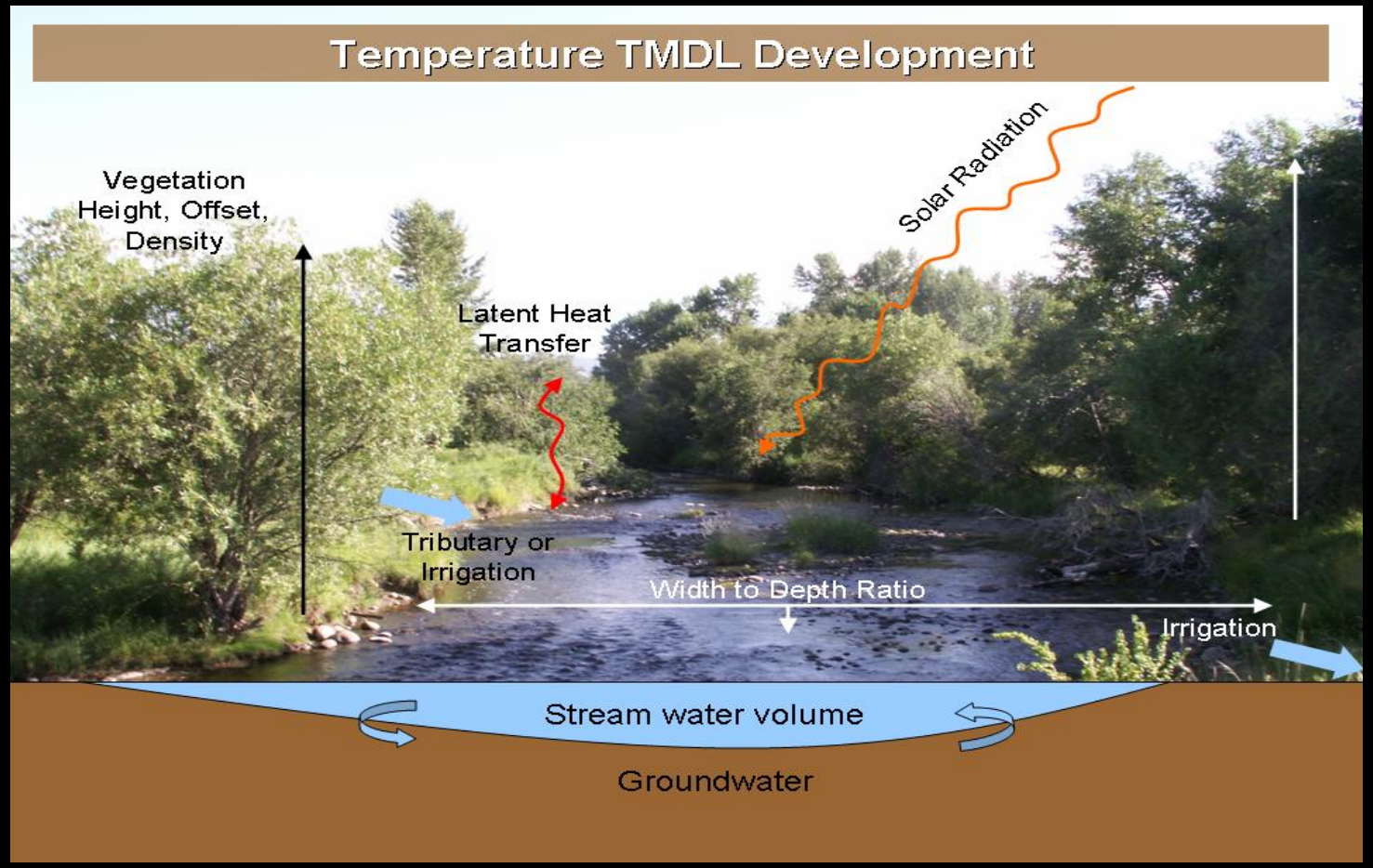
GIS-Derived Data





Washington State Department of Ecology. 2008. tTools for ArcGIS (tTools for ArcGIS 9.x (Build 7.5.3)).

Temperature Model TMDL Considerations



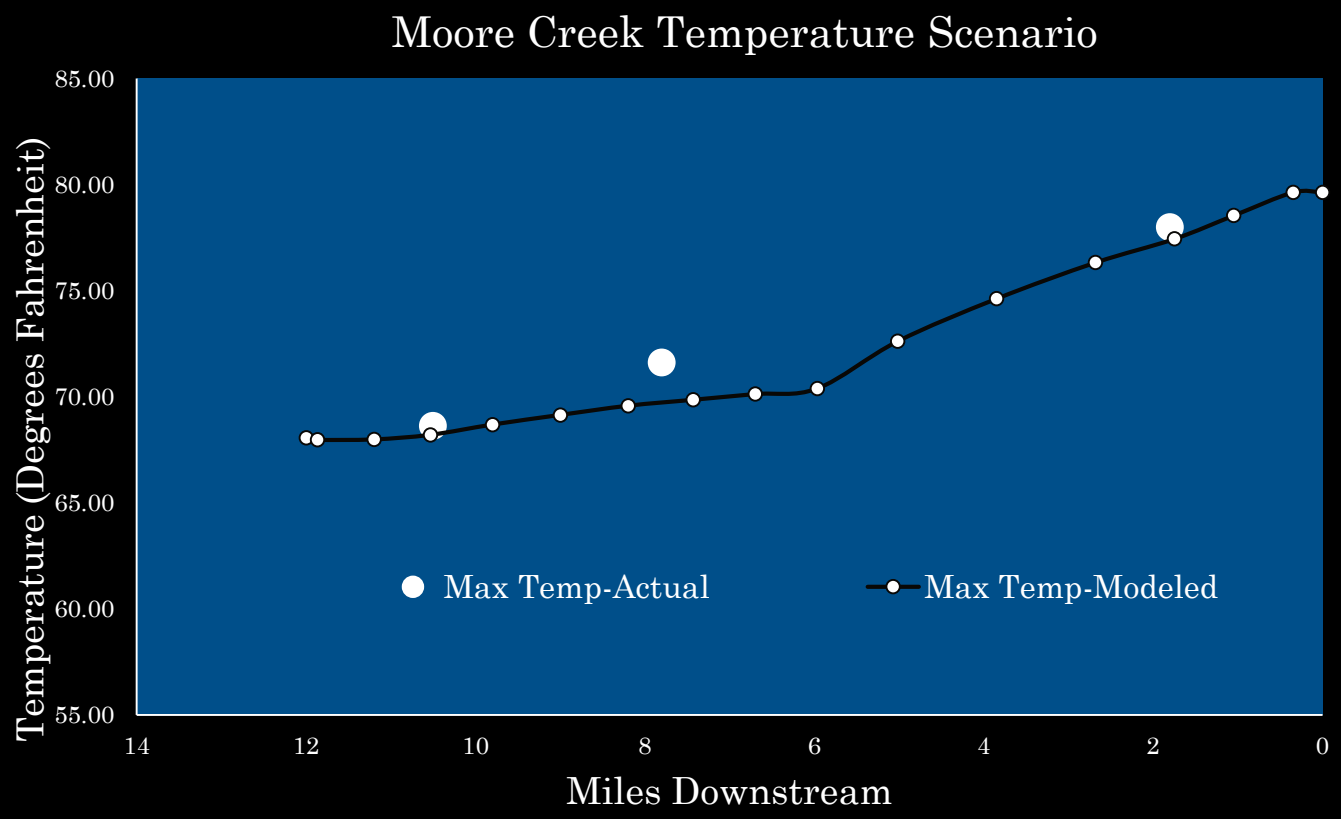
-Upstream Temperature

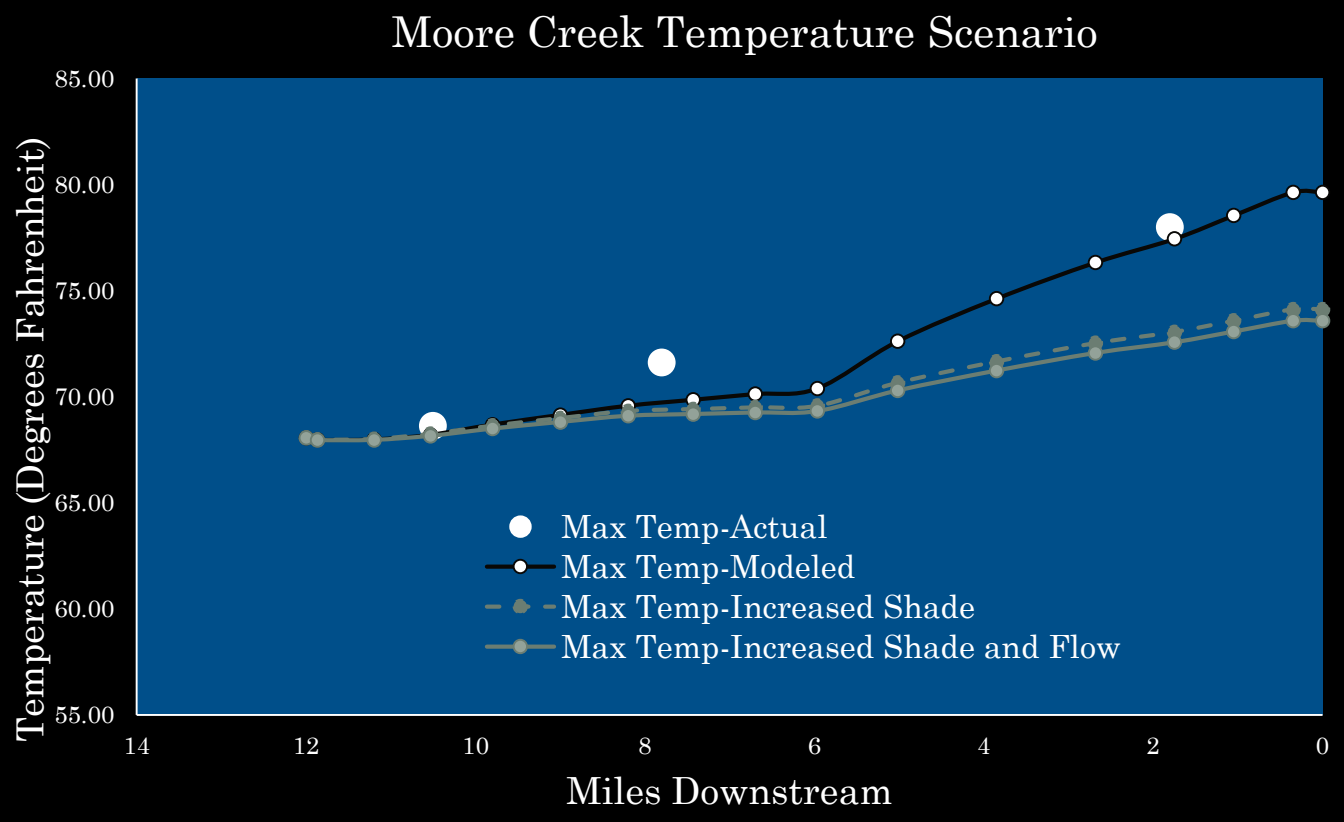
-Hourly Shade at each river mile and time of day

-Wetted Width

-Substrate

-Stream Flow


Moore Creek Temperature Scenario
Temperature (Degrees Fahrenheit)
85.00
80.00
75.00
70.00
65.00
60.00
55.00
14
12
10
8
6
4
2
0
Miles Downstream
Max Temp-Actual
Max Temp-Modeled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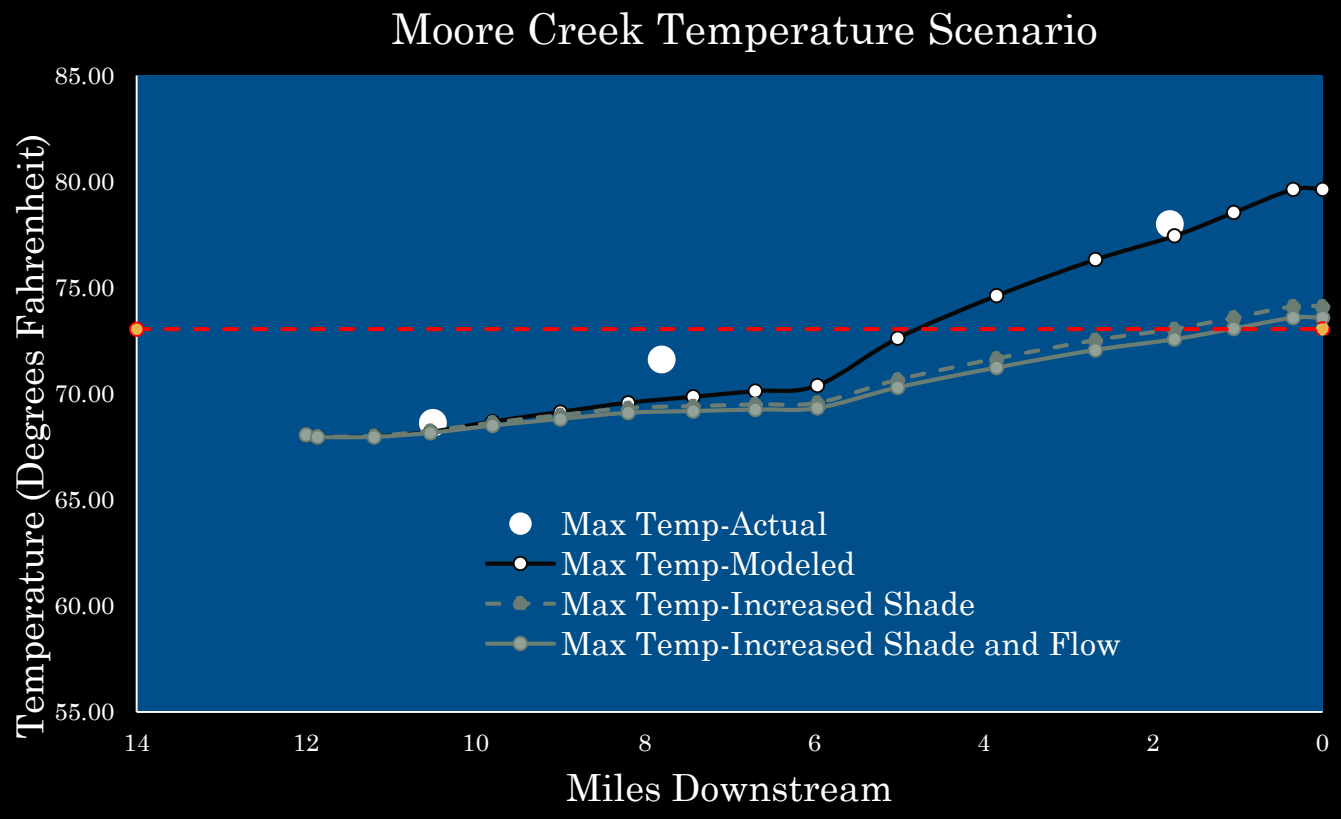
Miles Downstream
Max Temp-Actual
Max Temp-Modeled
Max Temp-Increased Shade
Max Temp-Increased Shade and Flow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14
12
10
8
6
4
2
0
Miles Downstream
Max Temp-Actual
Max Temp-Modeled
Max Temp-Increased Shade
Max Temp-Increased Shade and Flow

Sediment, Temperature, Habitat

- These impairments are commonly related
- Common factors include:
  -Stream form & function
  -Riparian health

	Alteration in Streamside Vegetation	Flow Regime Modification	Other Substrate Modification
Antelope Creek	x	x	
Blaine Spring Creek		x	
Elk Creek	x		
Hotsprings Creek		x	
Indian Creek	x	x	
Jack Creek	x	x	
Moore Creek	x		
North Meadow Creek		x	
O'Dell Spring Creek	x	x	x
Red Canyon Creek	x	x	
Ruby Creek		x	
Watkins Creek	x	x	

1 Recommendation

- Continued Riparian Restoration

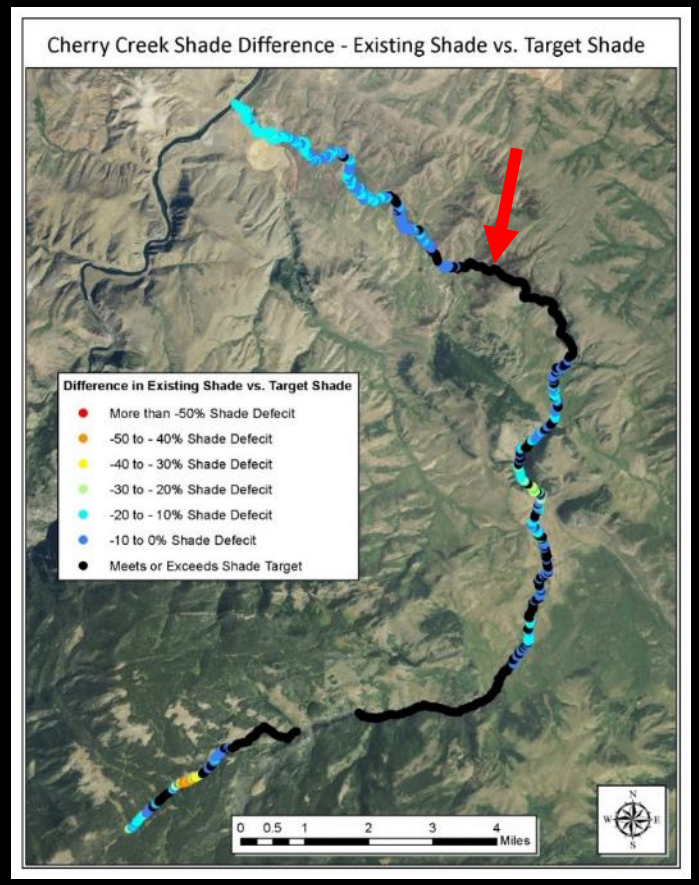
Volunteers on Jack Creek

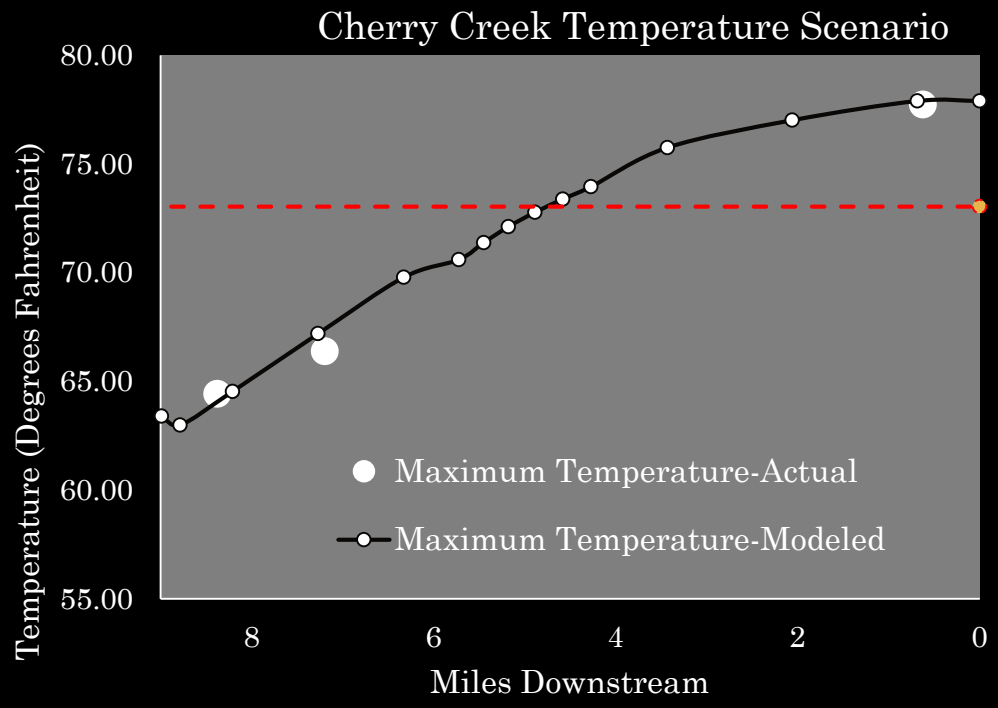
Additional Monitoring

- Continued riparian health prioritization
- Gravel roads prioritization
- Groundwater effects on temperature
- Irrigation efficiency studies
- Long-term monitoring of flow, temperature, bank and upland erosion

Questions?

Cherry Creek





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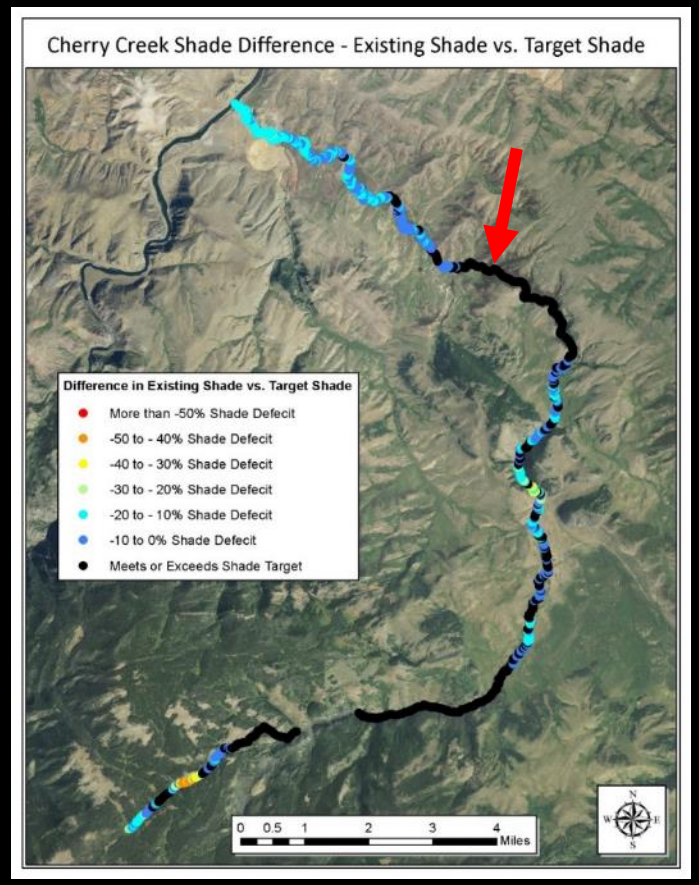
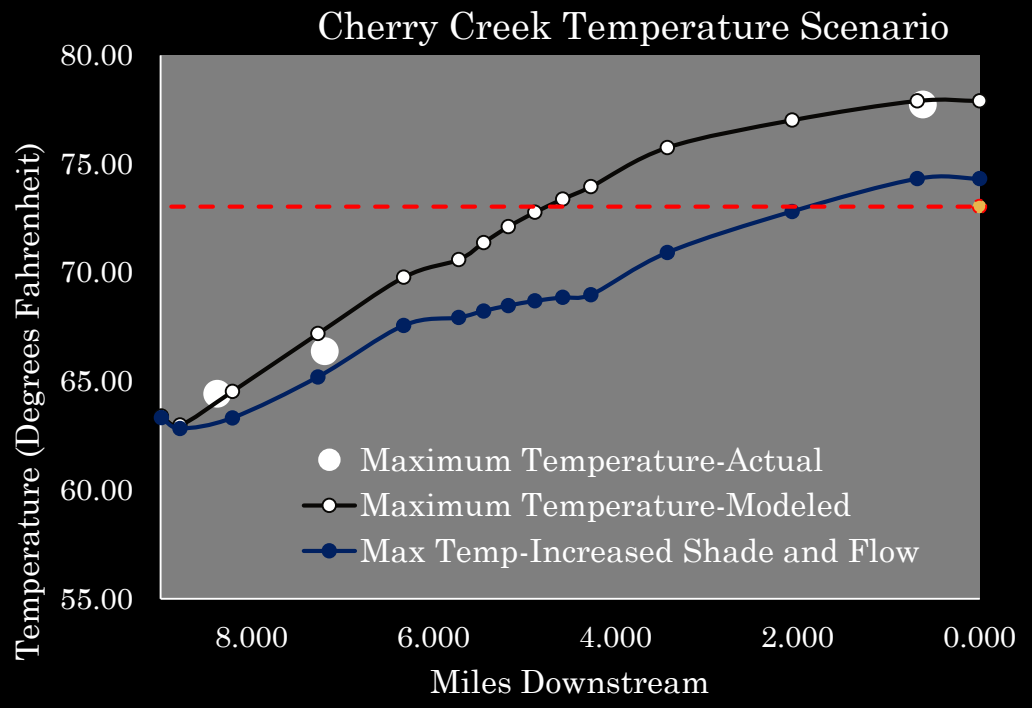
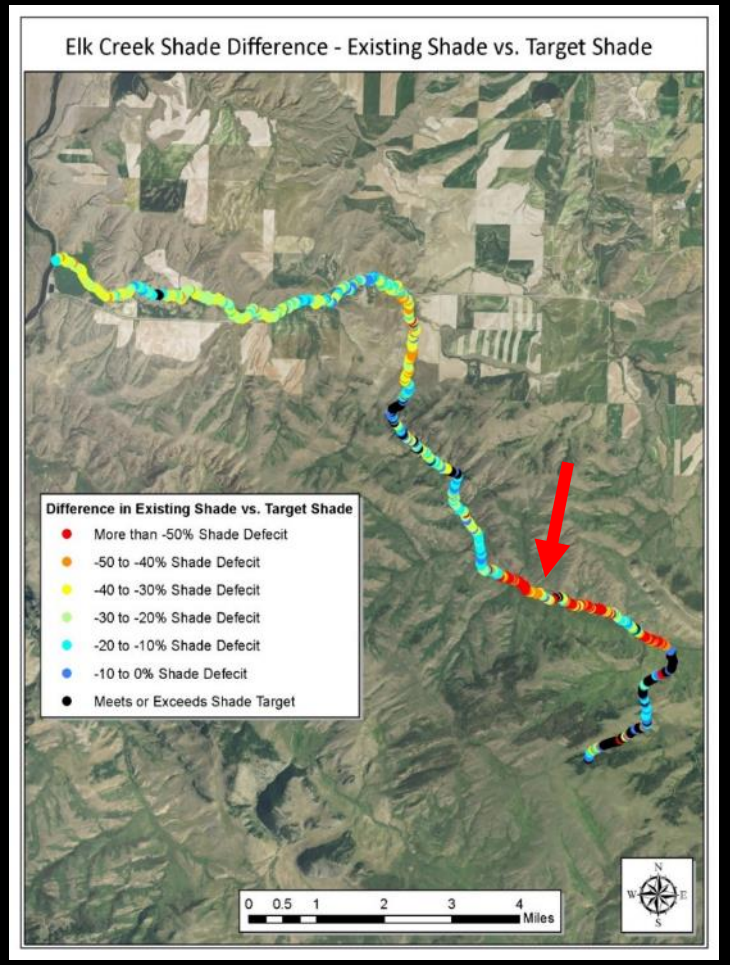
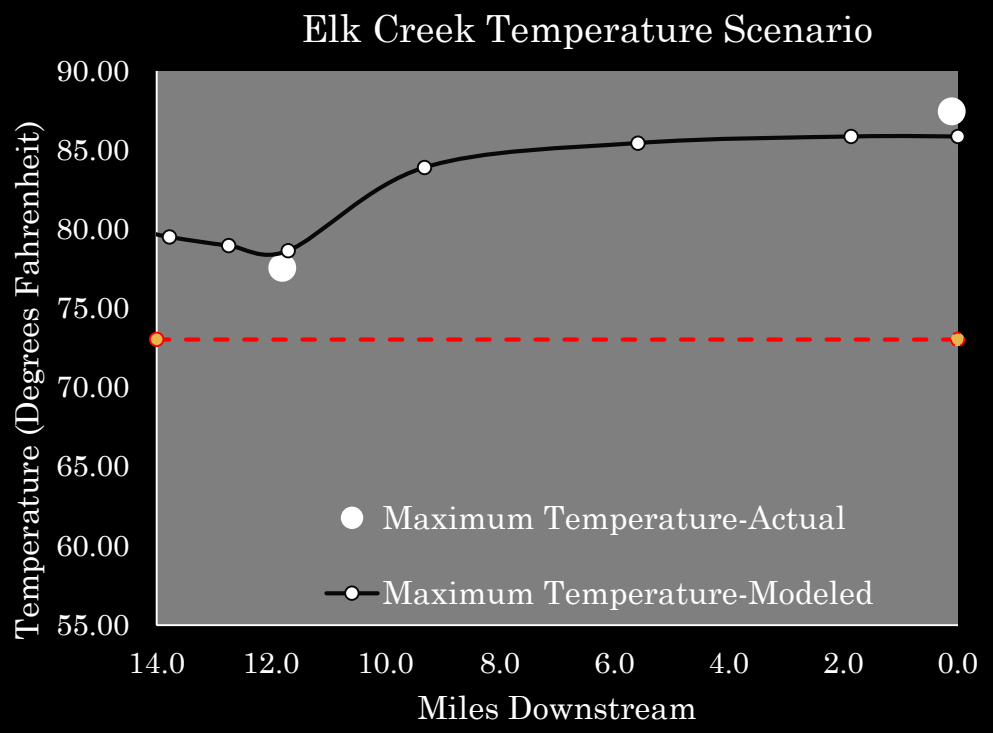


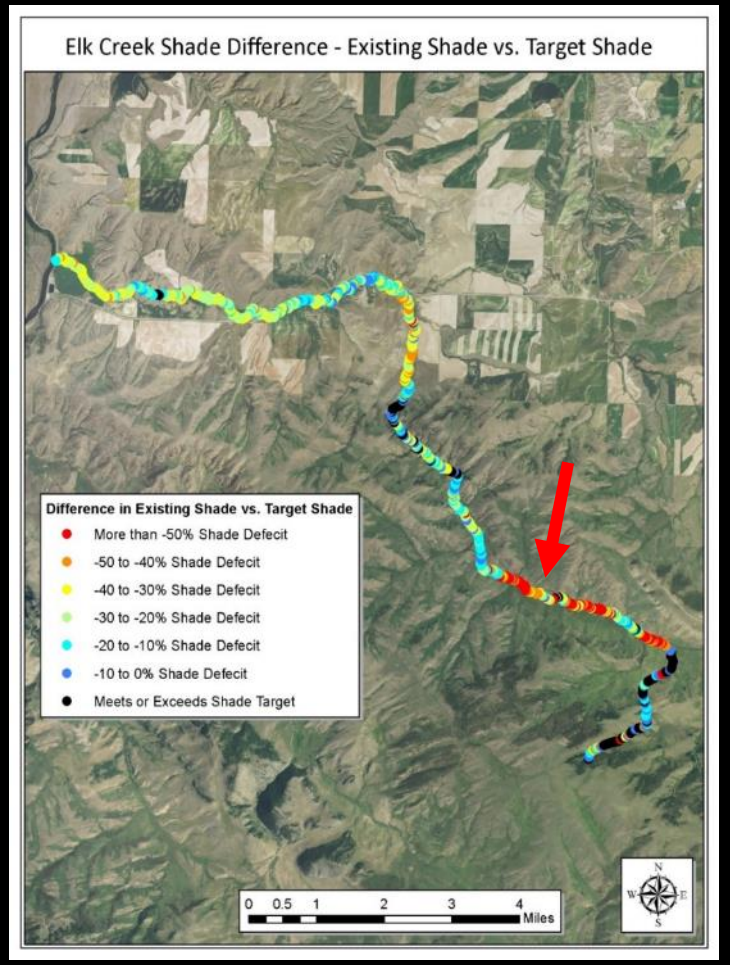


Elk Creek


Elk Creek Shade Difference - Existing Shade vs. Target Shade
Difference in Existing Shade vs. Target Shade
More than -50% Shade Defecit
-50 to -40% Shade Defecit
-40 to -30% Shade Defecit
-30 to -20% Shade Defecit
-20 to -10% Shade Defecit
-10 to 0% Shade Defecit
Meets or Exceeds Shade Target
0 0.5 1 2 3 4
Miles


Elk Creek Temperature Scenario
Temperature (Degrees Fahrenheit)
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Miles Downstream
Maximum Temperature-Actual
Maximum Temperature-Modeled

Elk Creek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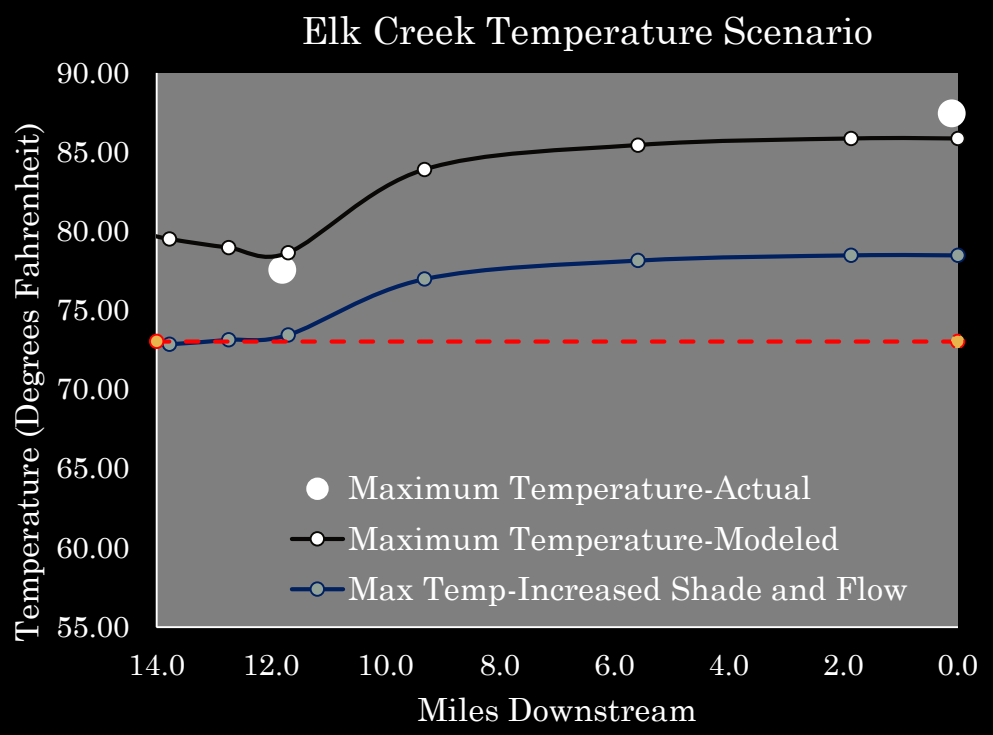
-10 to 0% Shade Defecit
Meets or Exceeds Shade Target
0 0.5 1 2 3 4
Miles


Elk Creek Temperature Scenario
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90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Miles Downstream
Maximum Temperature-Actual
Maximum Temperature-Modeled
Max Temp-Increased Shade and Flow

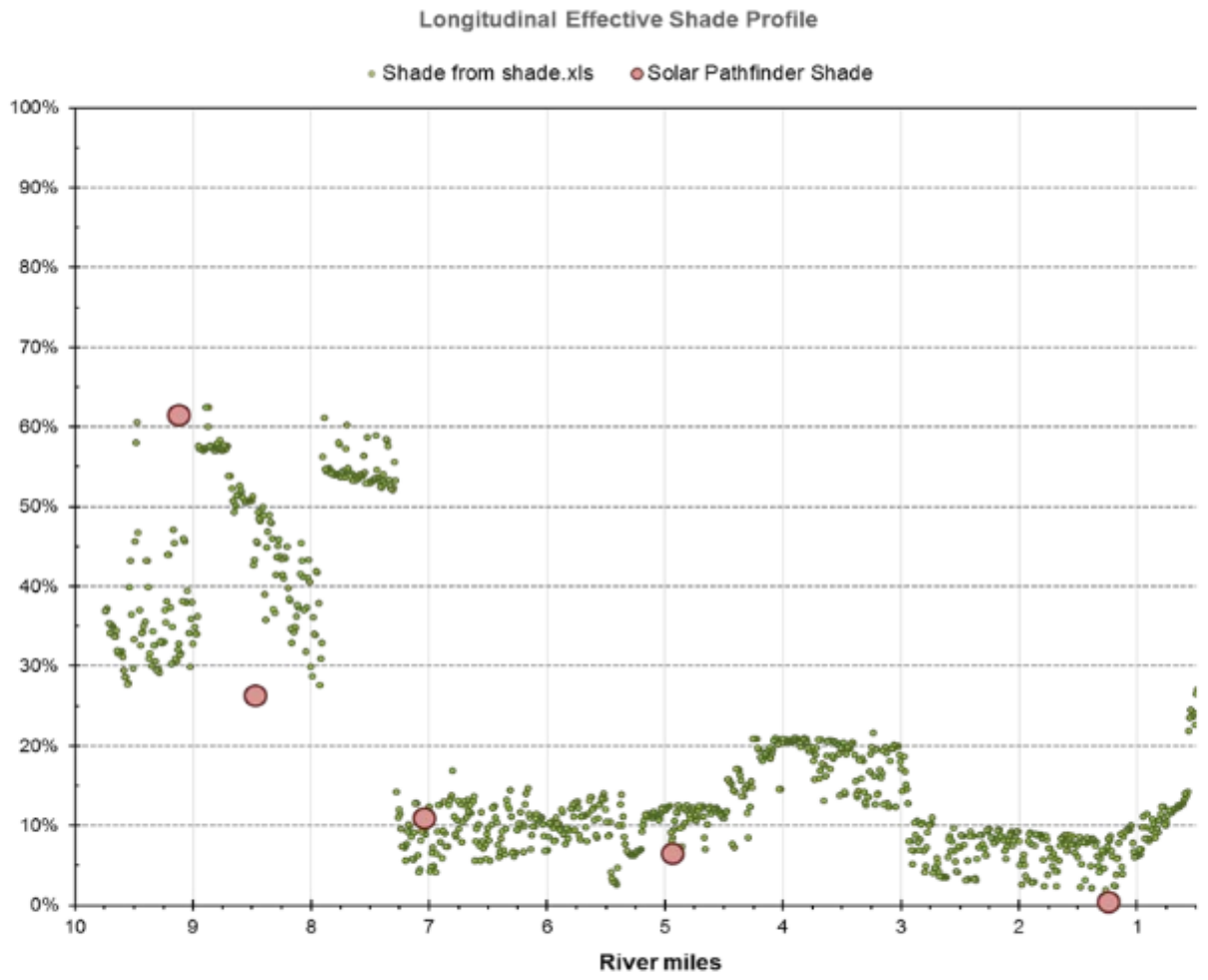


Figure 6-3. Effective shade output for EFRC from Shadev3.0.xls and Solar Pathfinder data

Westslope

Cutthroat

Trout

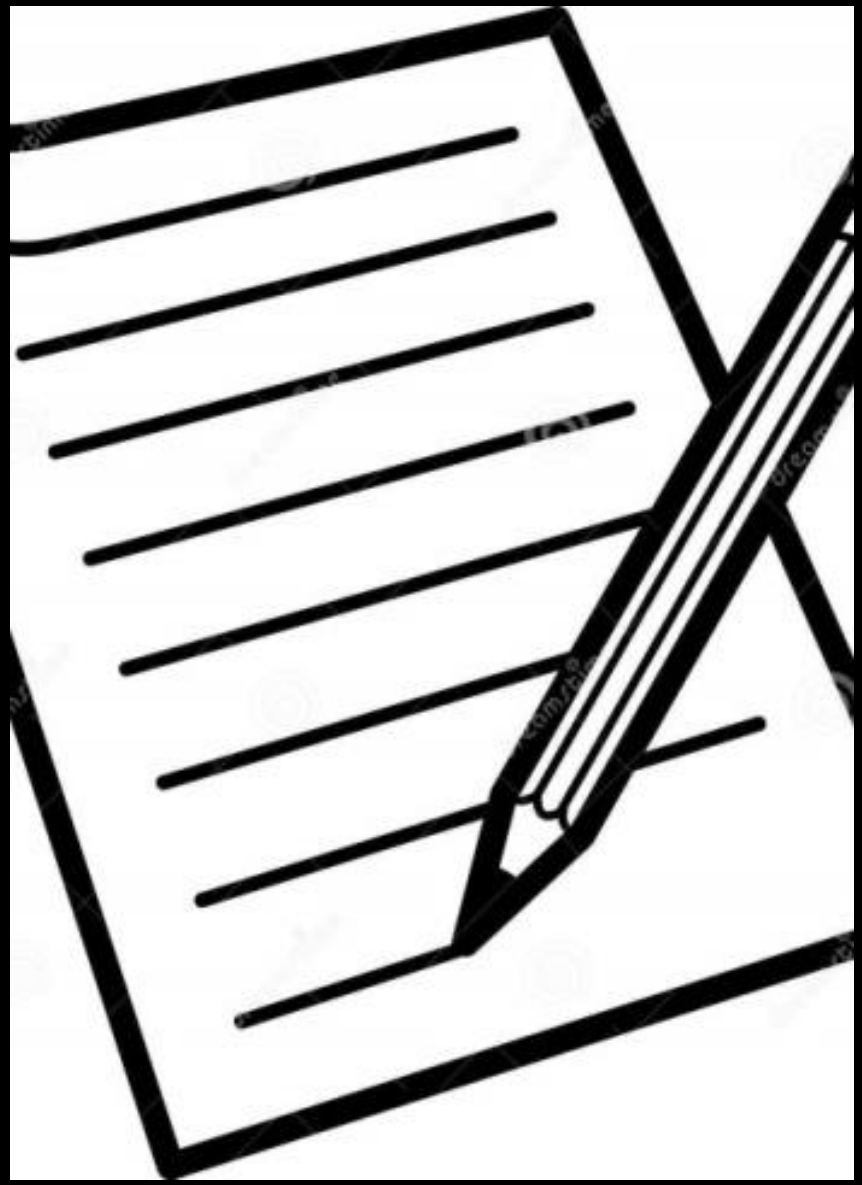
24-hour lethal temperature for 10% : 73

7-Day Upper Lethal Temperature for 50%: 75.4

Watkins Creek

Next Steps

Christina Staten



TMDL Document Completion Steps

- Watershed Advisory Group (stakeholder) review and comment
- Public comment period (typically 30 days)
- Public meeting during public comment period
- DEQ reviews comments, makes document edits, and writes responses to public comments
- Document submitted to U.S. EPA for approval
- Upon approval, final document is posted on DEQ's website

Contents of the TMDL Document

Part 1: Introductory Information	• 1.0 Project Overview • 2.0 Madison River TMDL Planning Area Description • 3.0 Montana Water Quality Standards • 4.0 Defining TMDLs and their Components
Part 2: TMDLs	• 5.0 Sediment TMDL Components • 6.0 Temperature TMDL Components • 7.0 Public Comments
Part 3: Water Quality Improvement Recommendations	• 8.0 Non-Pollutant Impairments • 9.0 Water Quality Improvement Plan • 10.0 Monitoring for Effectiveness
Stream Summaries Document	

How to Submit Comments

http://mtwaterqualityprojects.pbworks.com/

Send to: CStaten@mt.gov

Questions:

- Christina Staten: Project Coordinator
- Christy Meredith: Sediment and Temperature TMDLs Project Manager
  Christy.Meredith@mt.gov

DEQ Montana Department of Environmental Quality