POTW's Proposed AMP Framework for Montana

City of Billings' Water Reclamation Facility's recent $75M upgrade

Agenda

- Cities' work on improving surface water quality
- Cost-benefit analysis
- Common goal – supporting beneficial uses
- Region 8 States' approaches to interim limits
- Adaptive Management Plan flow charts
- Alt 5 TMDLs

Silver Bow Creek and Butte WWTP 1998 to present

1998
VNRP and nutrient TMDL

2005-2011
Planning for Butte WWTP Upgrade

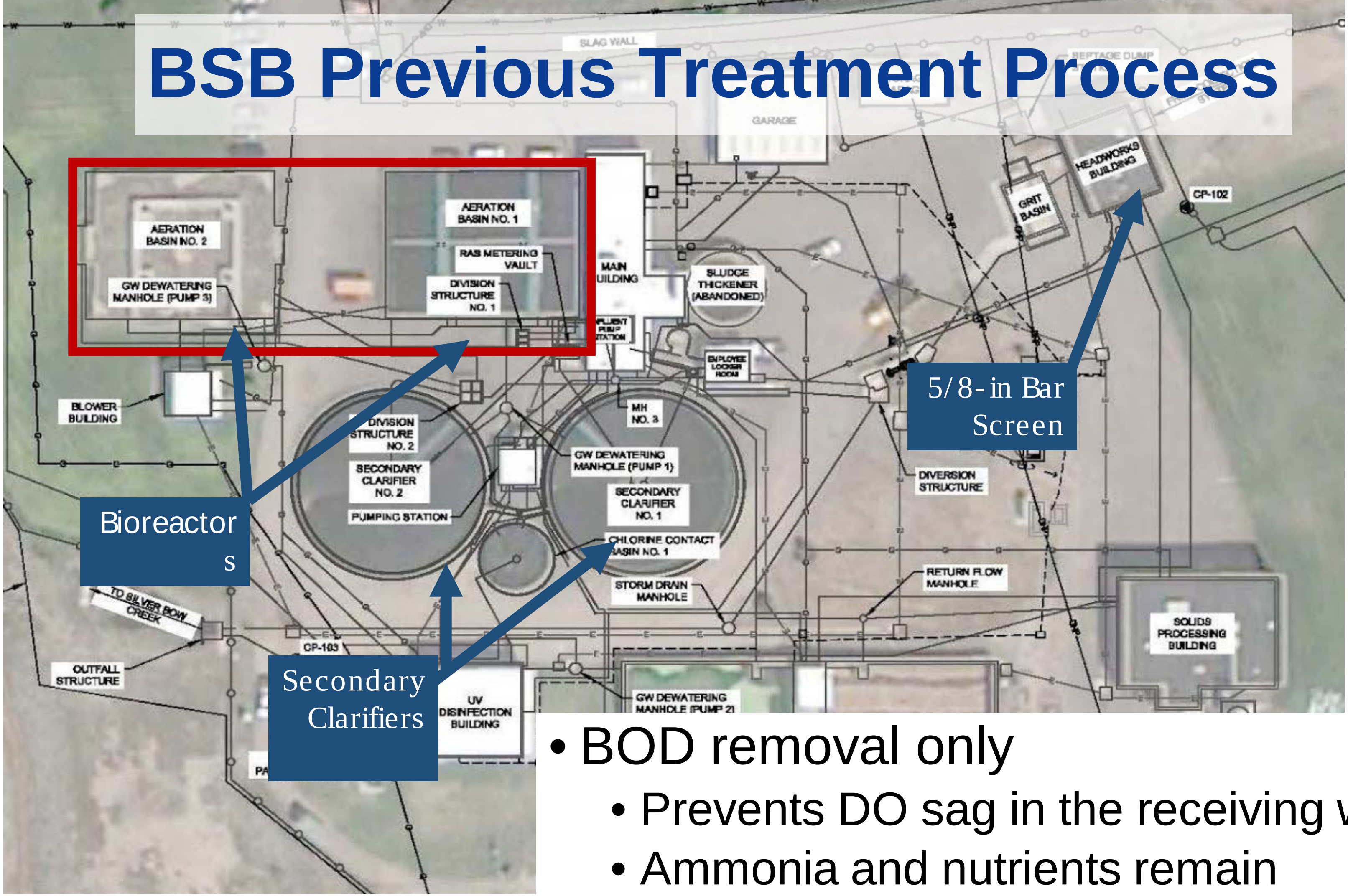
2012-2015
Design of Butte WWTP Upgrade

2014
New Upper Clark Fork Nutrient TMDL (upstream of Deer Lodge)

2016
Completion of Butte MBR (limits of technology nutrient removal)

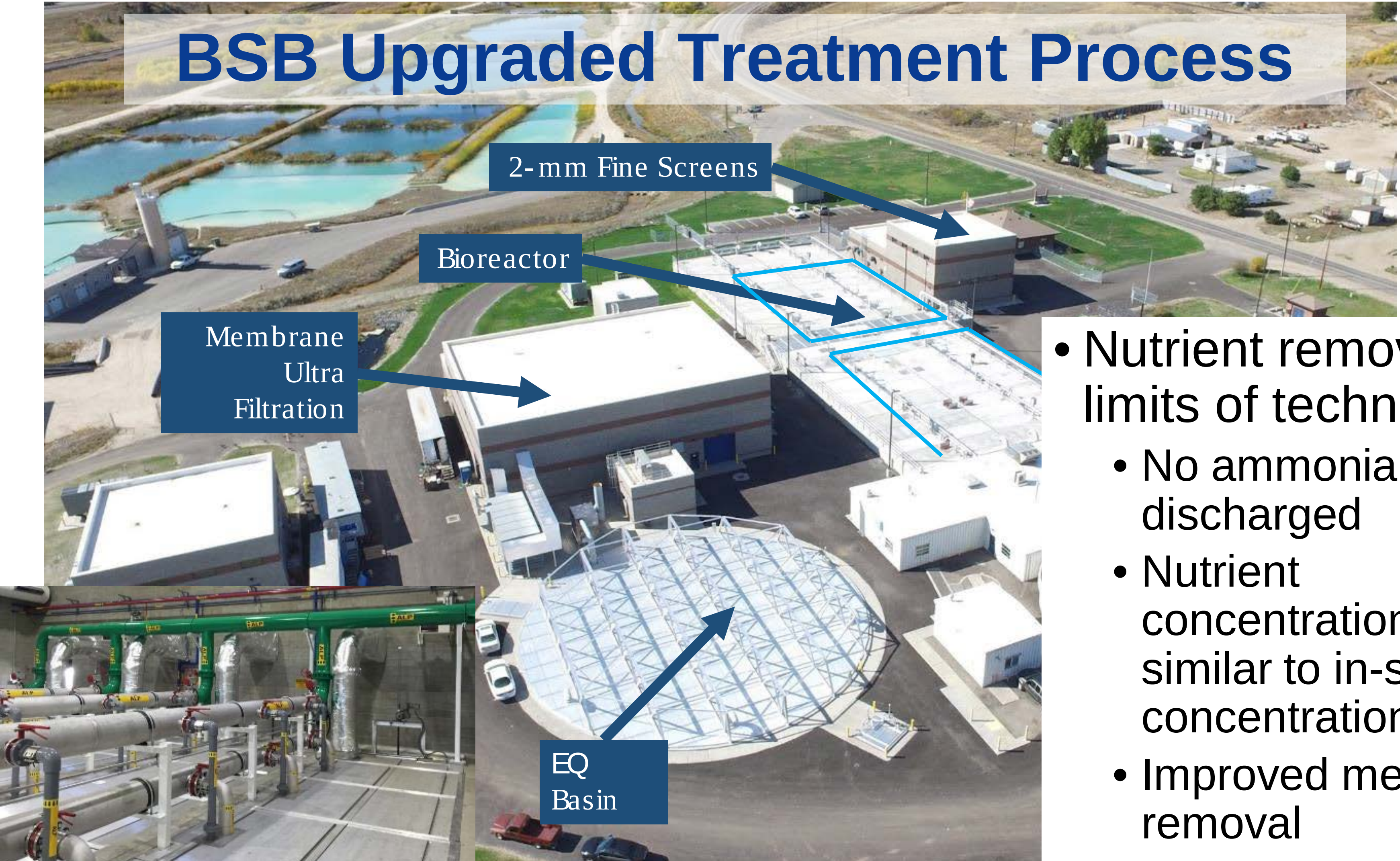
Ongoing
Stream Monitoring in Silver Bow Creek

BSB Previous Treatment Process



- BOD removal only
  - Prevents DO sag in the receiving water
  - Ammonia and nutrients remain

BSB Upgraded Treatment Process



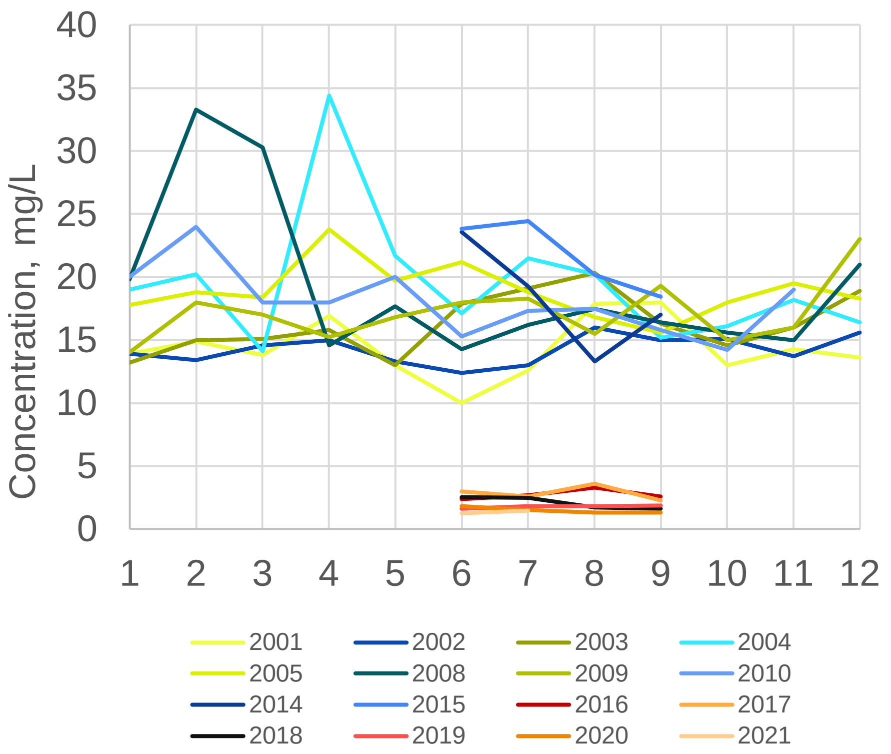
- Nutrient removal to limits of technology
  - No ammonia discharged
  - Nutrient concentrations similar to in-stream concentrations
  - Improved metals removal

Costs

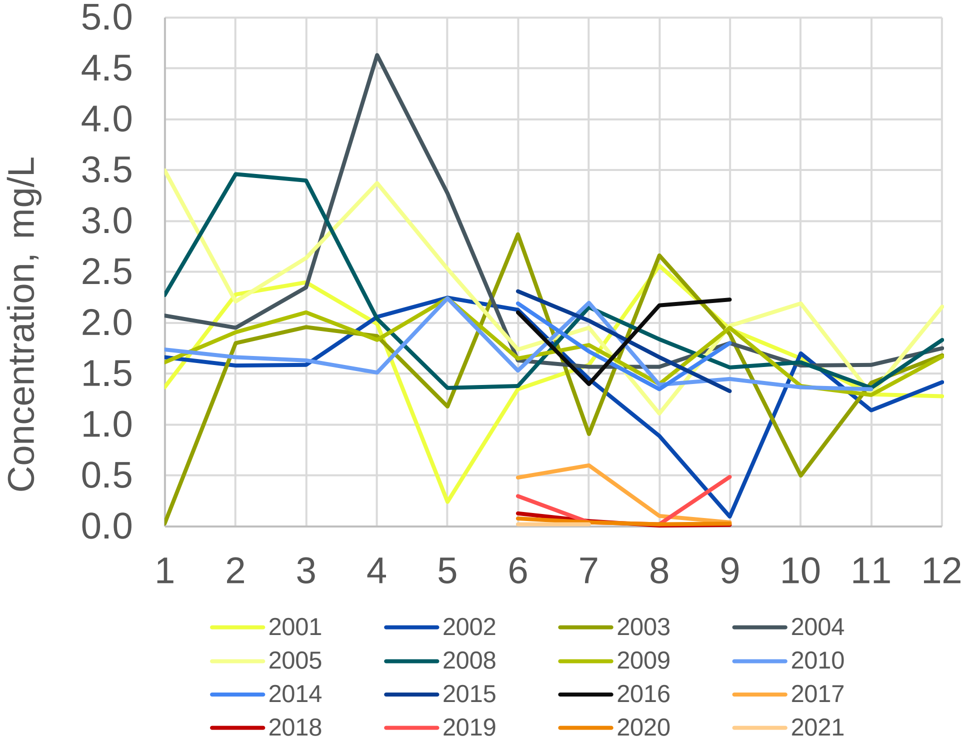
- Capital costs associated with upgrades for nutrient removal and better treatment in general:
  - $35,000,000

- Additional O&M Costs for higher level treatment:
  - $700,000 per year (total $4.2M)

Effluent TN



Effluent TP



Blue-green – Old Process

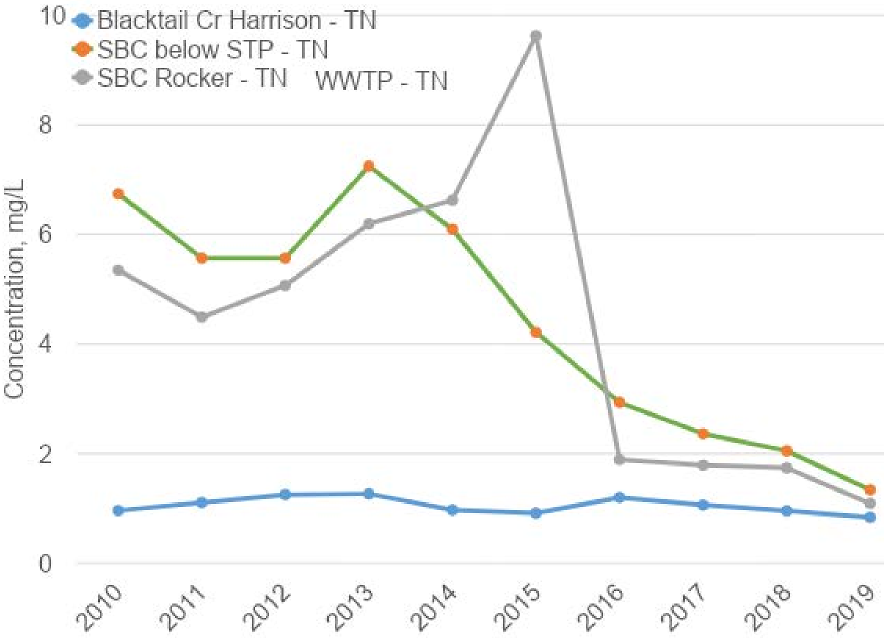
Yellow-red – New Process

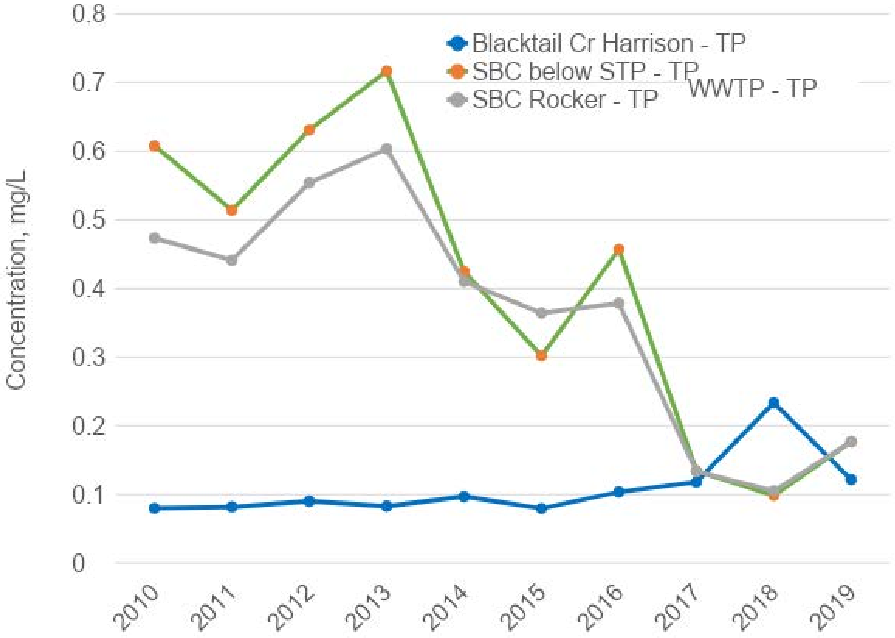
Nutrient Load to Silver Bow Creek

pounds per day (milligrams per liter)

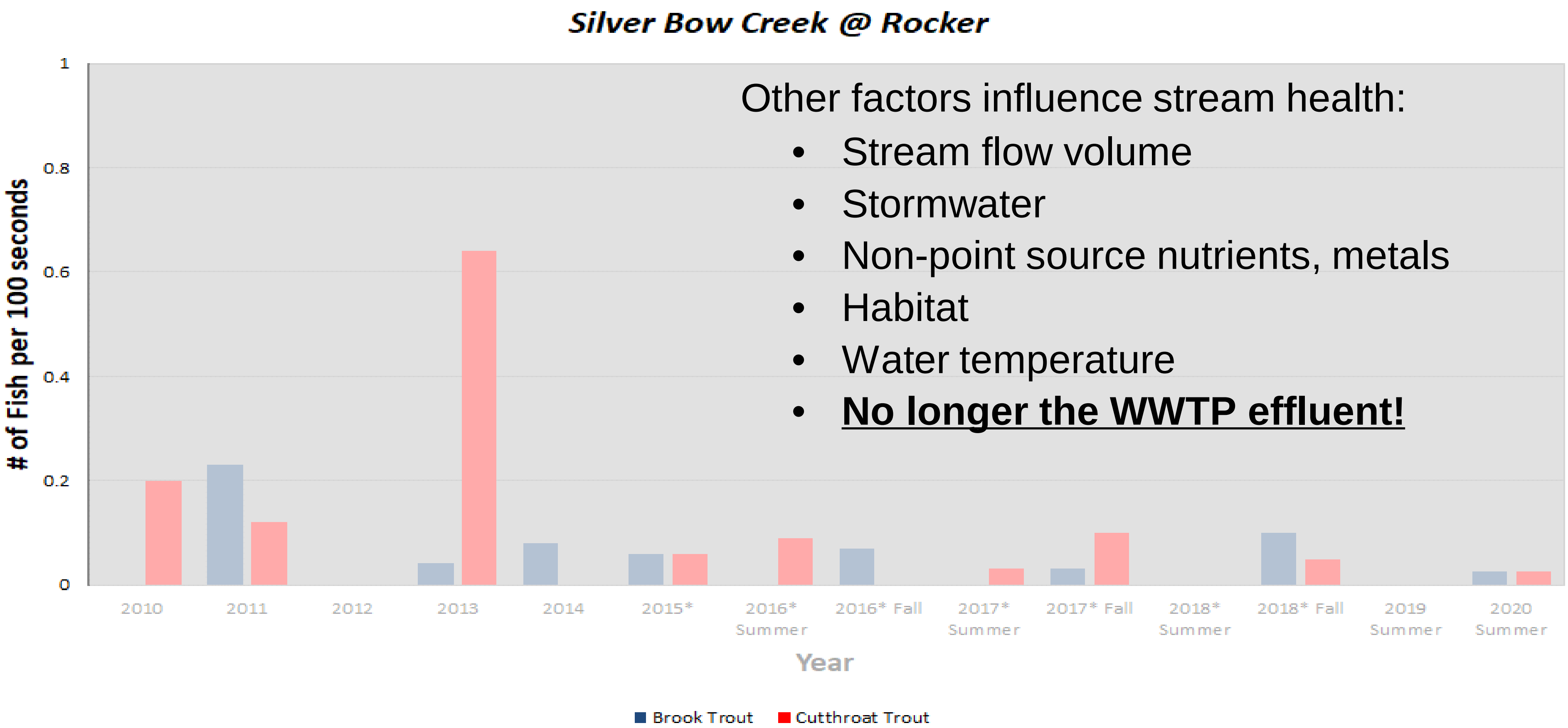
	Total Nitrogen	Total Phosphorous
Old Process, 2001-2015 Avg.	626 lb/d (17 mg/L)	57 lb/d (18 mg/L)
New, no chemical addition, 2016-2017 Avg.	91 lb/d (3.0 mg/L)	10 lb/d (0.3 mg/L)
New, process optimization, 2018-2019 Avg.	68 lb/d (194 mg/L)	4.7 lb/d (0.14 mg/L)
New, with chemical addition, 2020-2021 Avg.	27 lb/d (142 mg/L)	0.74 lb/d (0.03 mg/L)

Silver Bow Creek - Decreasing nutrient concentrations downstream of plant outfall…





… No increased fish population since 2010



Other factors influence stream health:

- Stream flow volume
- Stormwater
- Non-point source nutrients, metals
- Habitat
- Water temperature
- **No longer the WWTP effluent!**

Upper Clark Fork River and Deer Lodge Lagoon/WWTP - 1998 to present

1998

VNRP and nutrient TMDL

2000-2014

Deer Lodge Partial Effluent Land Application

Efforts to find more land for irrigation never successful

2009-2012

Planning for Lagoon Upgrades and Effluent Irrigation

2013-2015

Design of new Deer Lodge WWTP

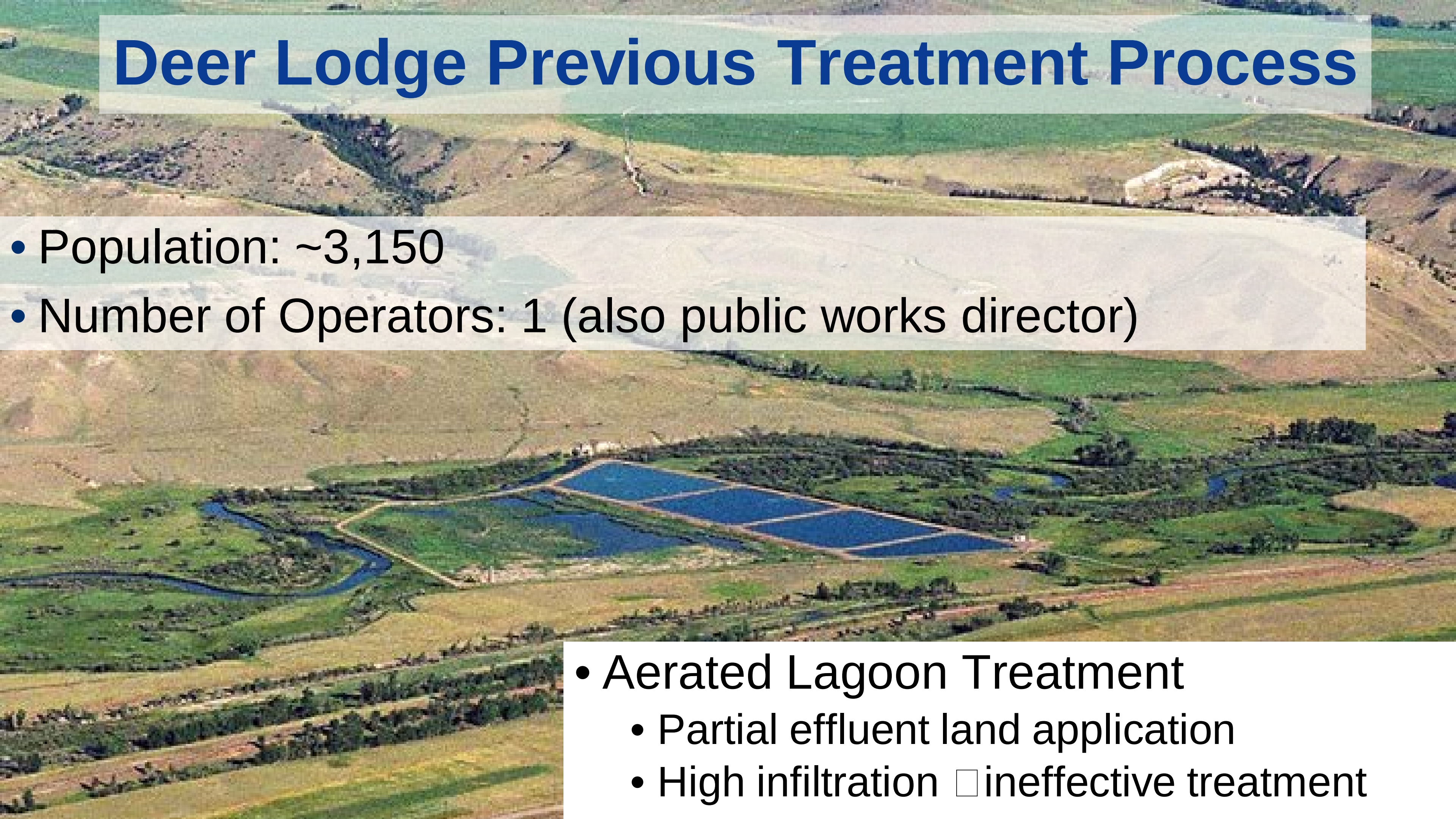
2017

Completion of Deer Lodge WWTP (nutrient removal)

Ongoing

Stream Monitoring in Clark Fork River

Deer Lodge Previous Treatment Process



- Population: ~3,150
- Number of Operators: 1 (also public works director)

- Aerated Lagoon Treatment
  - Partial effluent land application
  - High infiltration □ineffective treatment

Deer Lodge 2017 WWTP

- Population: ~2,900
- Number of Operators: 2 (public works superintendent plus backup)

- Bio-N removal (target effluent 8 mg/L)
- Chemical P-removal (target effluent 0.8 mg/L)
- Ongoing efforts to reduce infiltration will further improve WWTP nutrient removal

Costs

- Capital costs associated with upgrades for nutrient removal and better treatment in general:
  - $17,000,000

- Additional O&M Costs for higher level treatment with nutrient removal:
  - $200,000 per year (total of $300,000)

Further Reductions?

- Compliance with existing zero WLA has proved impossible
  - Sufficient land for land application could never be secured
  - Further reducing effluent nutrients is very costly for little gain
  - Decreasing rate payer base makes additional financial investments very costly
- More data is needed
  - Identify non-point nutrient sources
  - Identify best strategy for reducing nutrient sources with greatest impact

Great Falls WWTP

Missouri River

Large River, numeric criteria were not developed

Sampling in 2012, model not completed, complicated by dam and upstream impacts

B-2 water of the state

Not listed as impaired for nutrients in the stretch where the City discharges

Great Falls Facility Improvements & Missouri River Water Quality - 2000 to Present

Pre 2000
303(d) Impairment Listings Sun and other segments of Missouri

Pre 2000
Basic Secondary Treatment

2010 Facility Plan and Mixing Zone Study

2012
Wastewater Facility Upgrade Design

2012 – 2016
Construction 3-Stage MLE Upgrade

2017 Began establishing working relationships with local watershed stakeholders

2018
Updated Facilities Master Plan

2019-20 Began installing nutrient treatment optimization instrumentation

2015 - Present
Evaluating CIP and financial options for future $65M Biological Nutrient Removal (BNR)

Circa 2000 Great Falls WWTP Facility

Basic Secondary Treatment

10.5 MGD

Effluent Quality

- Phosphorus 5 mg/L
- Nitrogen 25 mg/L

Missouri River TMDL Status

Location	Miles	Causes of Impairment	Probable Sources
Headwaters To Toston Dam	22	Arsenic, **Nitrogen**, Sedimentation	Agriculture, **Municipal WW**, Natural
Toston Dam To Canyon Ferry Reservoir	22.6	Cadmium, Copper, Lead, Sediment	Agriculture, Resource
Holter Dam To Little Prickly Pear Creek	2.8	**Nitrogen, Phosphorous**, Sediment	Agriculture, Hydromod, **Municipal WW**, Natural
Little Prickly Pear Creek To Sheep Creek	20.9	Arsenic, **Nitrogen**, Sediment	Agriculture, Hydromod, Natural
Sheep Creek To Sun River	65.3	Sediment	Agriculture, Hydromod, Urban Storm, Natural
Sun River To Rainbow Dam	7	Chromium, Mercury, PCBs, Sediment, Selenium, Solids, Turbidity	Legacy, Hydromod, Industrial, Urban Storm, Agriculture
Rainbow Dam To Morony Dam	9.1	Arsenic, Copper, PCBs, Sediment, Temp, Turbidity	Legacy, Hydromos, Resource, Industrial, Natural
Morony Dam To Marias River	54.6	Aluminum, Arsenic, Cadmium, Chlorophyll, Copper, Iron, Lead, **Nitrogen, Phosphorous**, Sediment, Zinc	Agriculture, Hydromod, Industrial
(Sun) Muddy Creek to Mouth		**Nitrogen, Phosphorus,** Sediment, Total Suspended Solids, Other flow alterations	Agriculture, Irrigated Crop Production, Rangeland Grazing, Channelization

Great Falls Biological Nitrogen Removal Upgrade

$16M upgrade

MLE Nitrogen Removal Process with bonus phosphorus removal

13.3 MGD

Typical TN – 8 mg/L
77% Removal

Typical TP – 0.5 mg/L
85% Removal

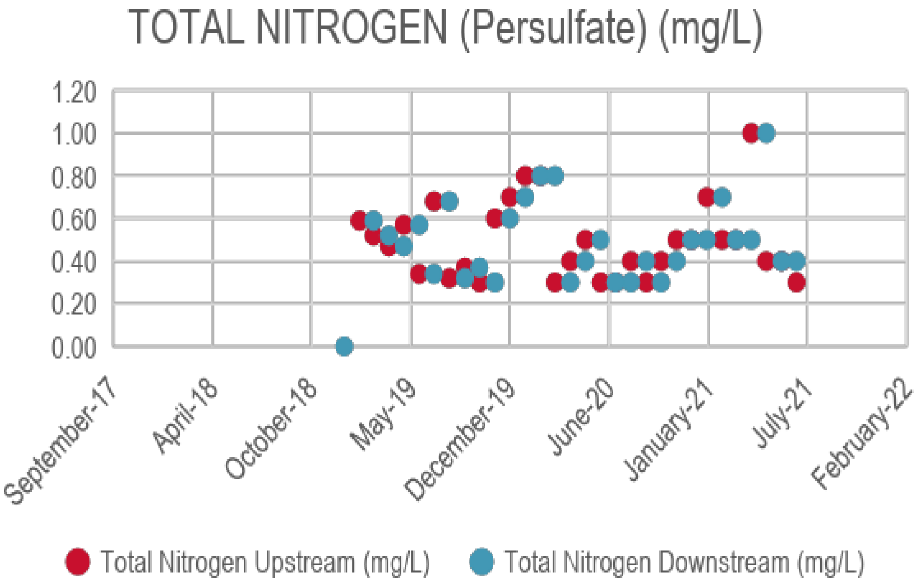
What it takes to do "more"

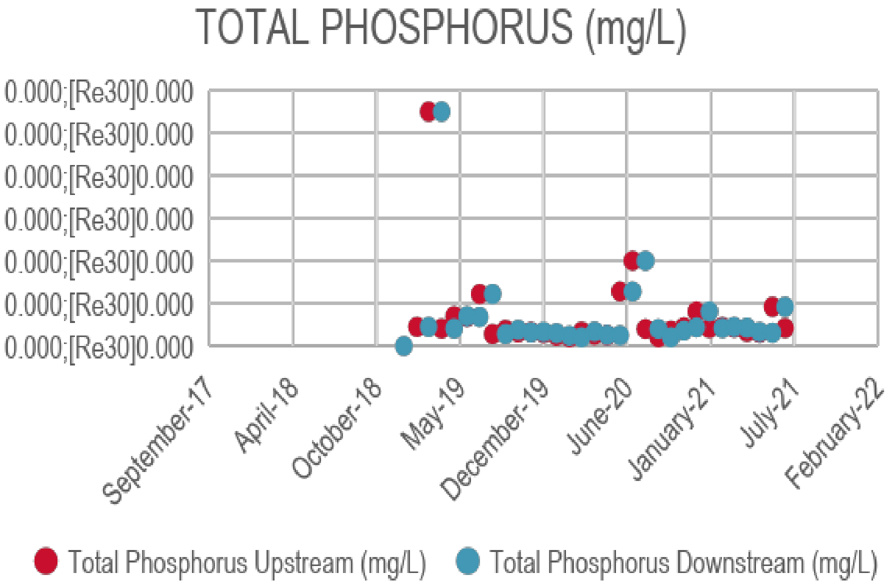
Nutrient treatment upgrades done *before* permit required

BNR = $65 M (in prepandemic 2018 $'s)

Great Falls Post Upgrade Monitoring

- Gathering monthly samples for nutrients
- Upstream to Downstream monitoring not statistically significant





Visual on Response Variables

Upstream Activities

Potentially harmful blue-green algae reported in Helena reservoirs, officials say

Tom Kuglin Aug 15, 2018 Updated Aug 20, 2018 0

1 of 3

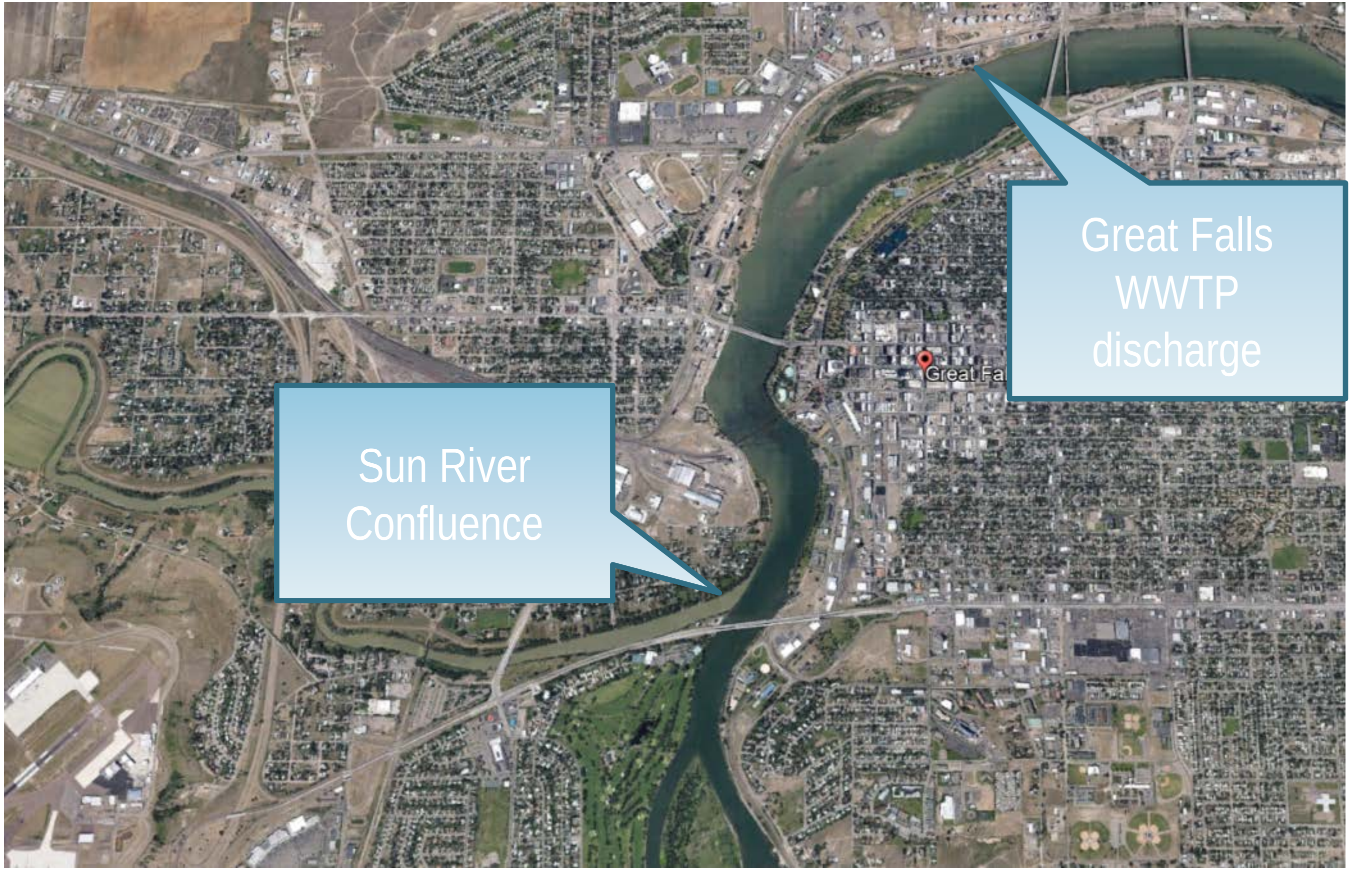
Missouri River Impacts

- Septics
  - Hardy Creek to Craig – relatively high density housing on septics
    Impaired Reach = Prickly Pear to Sheep Creek
  - Helena Valley septics
    Impaired Reach = Holter to Prickly Pear?
  - Fish Hatchery and Ag
    Impaired Reach = Morony to Marias?

- Improvements
  - Craig and Wolf Creek now have package plants
  - Both paid for improvements with resort taxes

Sun River Impacts

- Impaired for TN and TP at the confluence with Missouri
- Agriculture, Irrigated Crops, Grazing
- Small PS dischargers?



Summary

% point source removal without permit requirement

Discharge doesn't seem to impact the Missouri River

What next investment makes the most sense?

Impacts for other pollution sources nearby?

Collaboration

- Sun River Watershed Group
- Cascade Conservation District
- Cascade County

Kalispell's Efforts to Improve Water Quality in Ashley Creek

Kalispell Facility Improvements & Ashley Creek Water Quality: 1980s to Present

April 1984

Strategy for Limiting Phosphorus in Flathead Lake published by the Department of Health and Environmental Sciences Water Quality Bureau.

Recommended all PS get to 1.0 mg/L TP

October 1988

Issued Discharge Permit with 1.0 mg/L TP Limit

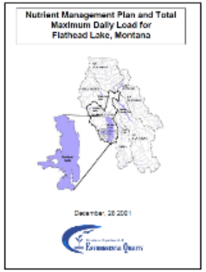
Parameter	Average Effluent Concentration mg/1 30-Day Average a/	7-Day Average a/
$CBOD_5$	10	15
TSS	10	15
Fecal Coliform #/100 ml c/	950	1900
Oil & Grease	10	N/A
Total Phosphorus – P	1.0	N/A

BNR Construction ($22 M)

1991-1992

December 2001

Flathead Lake TMDL Phase 1



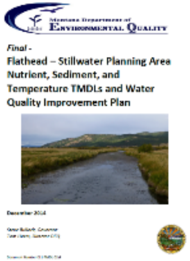
Wastewater Facility Upgrade

($24M)

2007-2008

December 2014

Flathead – Stillwater Planning Area TMDL



Temperature Monitoring on Ashley Creek

2016 – 2019

Optimization Study and Implementation

Facility Plan – Planning for Plant Treatment Upgrade/ Alternatives

2019 – 2021

Water Quality Sampling, Monitoring, & Modeling on Ashley Creek ($500K)

Flathead Lake TMDL Phase 2

(In progress)

Ashley Creek is NOT a Typical Western MT Wadeable Stream

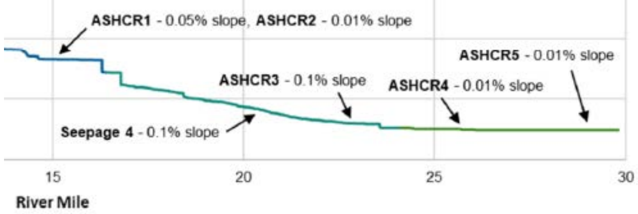
Natural Characteristics:

No gravel or potential for gravel recruitment

Low gradient and “U” shaped channel form

Very low flows in late summer and early fall

Backwater from Flathead River in lower reaches

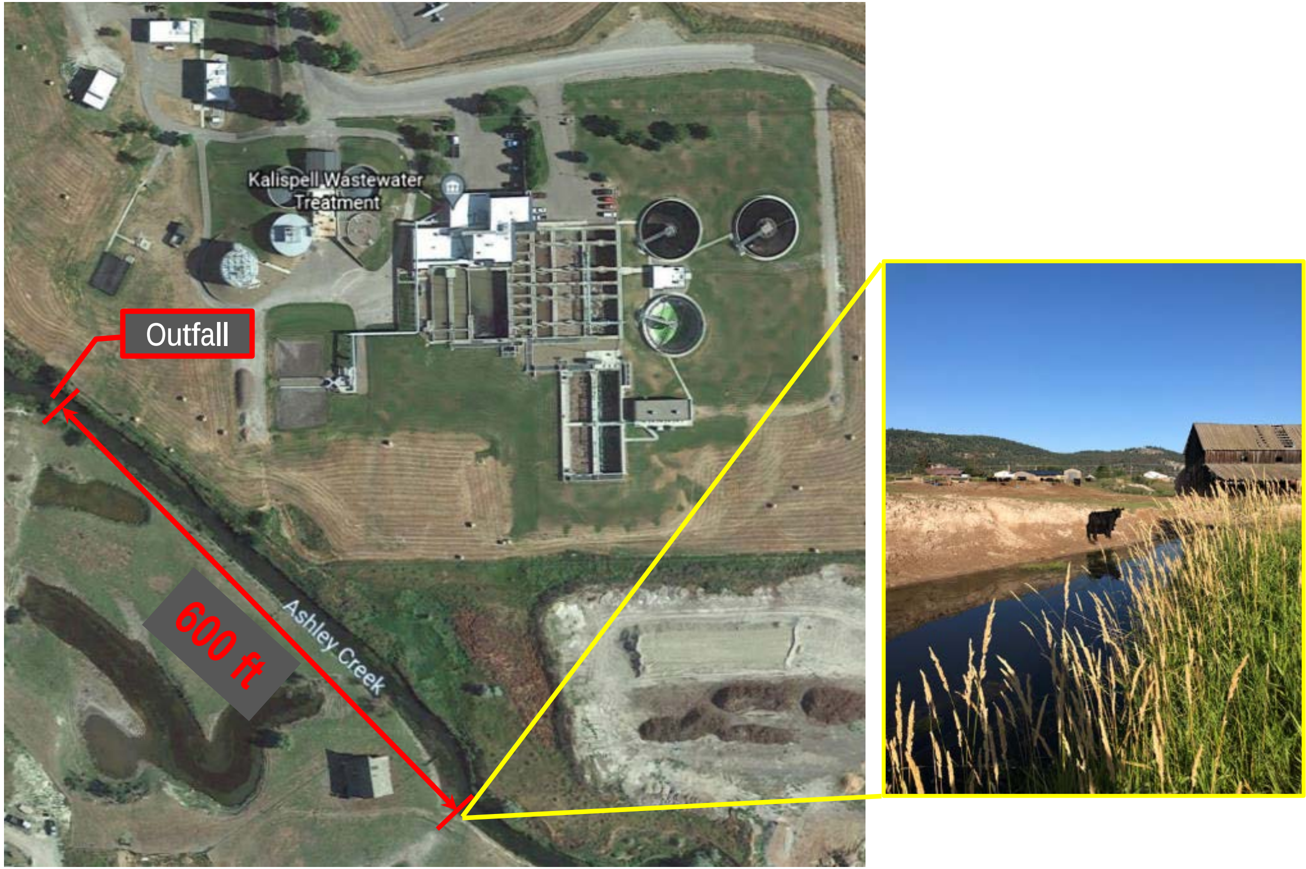


Award Winning Treatment Facility

- Two National 1st Place U.S EPA Clean Water Act Recognition Awards
- Advanced Nutrient Removal (Modified Johannesburg Process)
- Effluent Quality
  - Phosphorus = 0.13 mg/L

    ~ 97% Reduction
  - Nitrogen = 7.7 mg/L

    ~ 83% Reduction



Summary

- TMDLs have not considered improvements in water quality that have already occurred
- Important reductions in NPS loading have not occurred and should be addressed in the AMP
- General response/thresholds benchmarks for waterbodies should not be used when not applicable
- Significant investments already made to reduce PS nutrient loading to Ashley Creek


Fertilizer for Compost
Decomposed Contaminants
Energy (add 1300 lbs of Coal)
Chemicals
Time
Money
Brine (20% to Ocean)
H2O
.5 lbs P
20 lbs N
Billings WRF Every Hour (~2 ft)
Yellowstone River Every Hour (~106 ft) at 7Q10

Common Goal – Supporting Beneficial Uses

- Nutrients do not have direct toxic effects (like metals/arsenic)
- Simple dose-response relationships do not exist for nutrients
- Relationship between nutrients and biology is complicated:
  - Habitat issues (IBI)
  - Stream geometry (depth, width, shape, slope, bed, banks)
  - Flow alteration (dewatered for irrigation?)
  - Light penetration (canopy)
  - Temperature
  - Climate change

Simply reducing nutrients, without addressing these other issues, will not move toward supporting beneficial uses of our water bodies.

Region 8 Approaches to Interim Values

- Use Technology Based Effluent Limits (TBEL)
- Annual Median or Annual Average values for application to TBEL
- Delayed implementation of Nitrogen
- Incentives for early compliance

TBELs and incentives can be options for the glide path to water quality standards

Region 8 Eutrophication Regulation Status

Colorado

- Chla standards
- Interim TBELs at 15 mg/L TIN, 1 mg/L TP
- Numeric standards set for 2027
- Incentive program for early removal

Utah

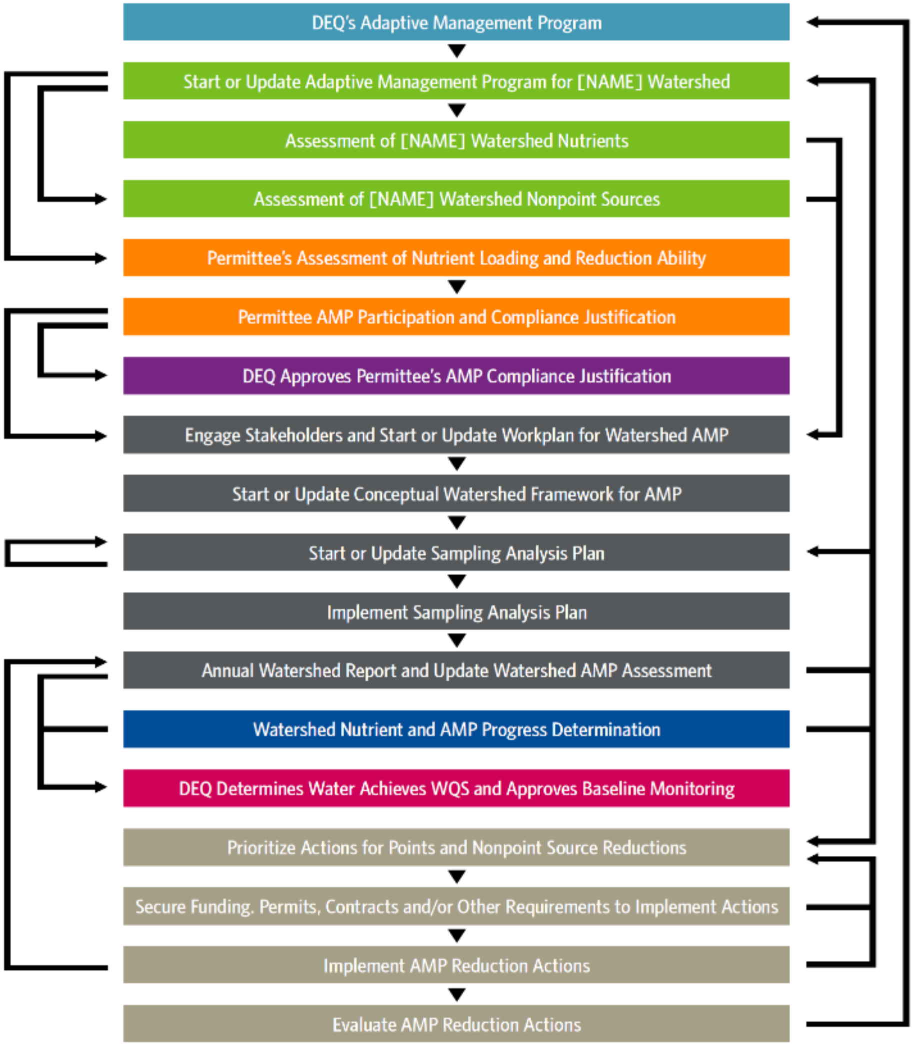
- “Start with P, Interim N Reductions Later”
- 1 mg/L Total P Technology Based Effluent Limit
- Percent cover rather than algae density

Wyoming/North Dakota/South Dakota

- WY-Working on an interpretation of the narrative standard for streams and lakes
- ND-Working on an interpretation of the narrative for lakes/reservoirs
- SD-specific regions have a clhl-a based approved for lakes/reservoirs

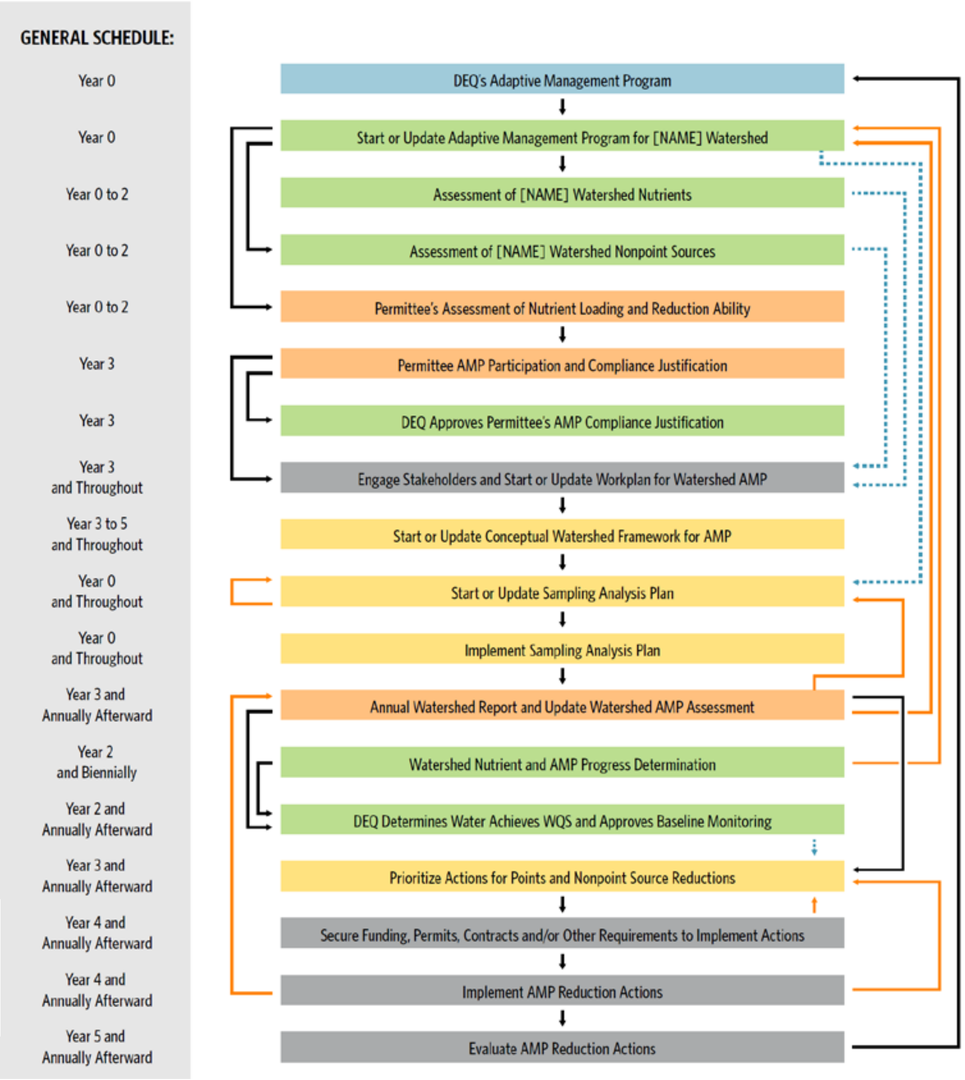
AMP Flowsheet

- Suggested improvement considerations
- Additional details to further define the process
- Feedback loops for modifications/updates
  - More realistically portray the iterative AMP process that incorporates mid-course adjustment and continues over an extended period of time (multiple permit cycles)
- Broader responsibilities for a SB358 Balanced Watershed Approach
- Potential for AMP prepared by Permittees, or DEQ, or an AMP Developer working on behalf of a group of stakeholders
- Conceptual Watershed Approach
  - Guideline for AMP development



Schedule & Timeframes

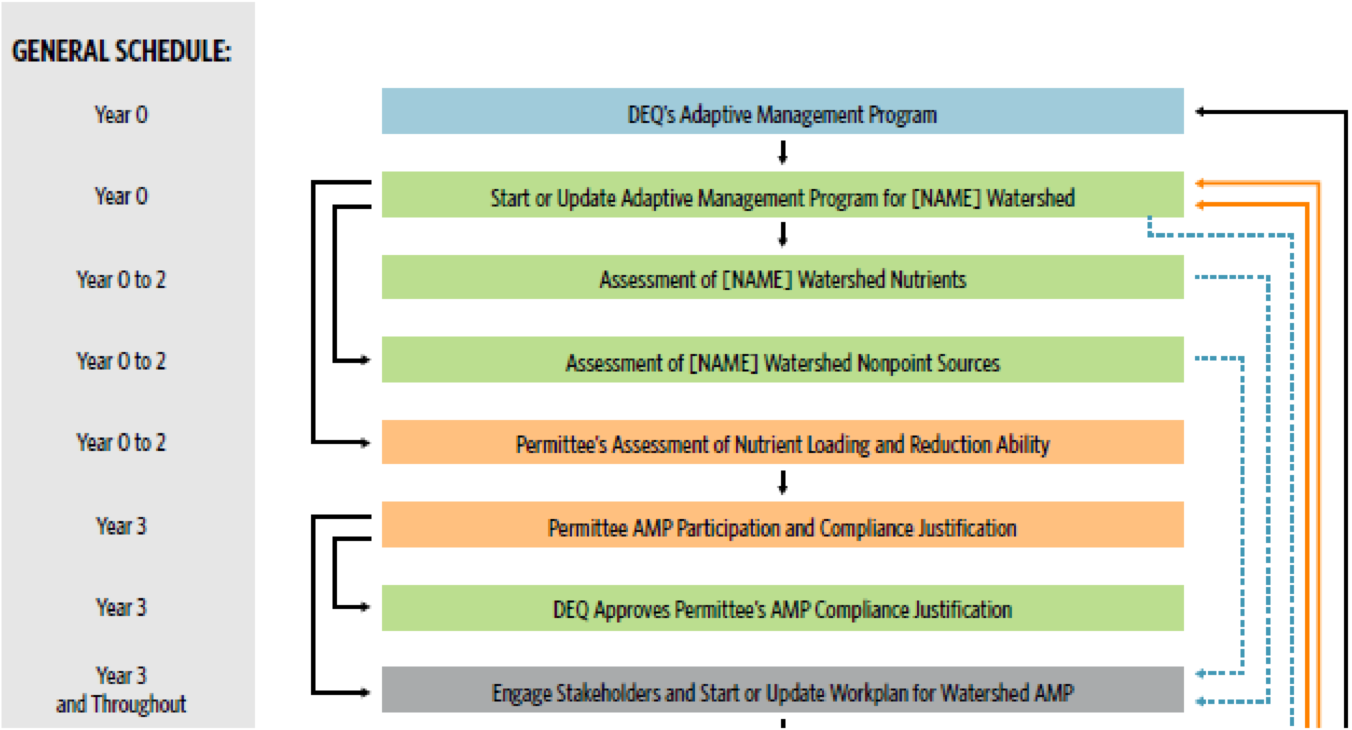
- Years 0 to 2: Initiate AMP Process
- Years 3 to 5: Engagement, Monitoring, Reporting
- Years 2 to 5 Beyond: Prioritize Management Actions, Implementation, Feedback, Re-prioritize



LEGEND: DEQ Program Action | Permitte Action | Group DEQ/Permittee/Other Action | DEQ Action | AMP Developer (likely Permittee or group of Permittees) Action | — Action or Step | --- Informs | — Adaptive or Update Step; Potentially Repeating

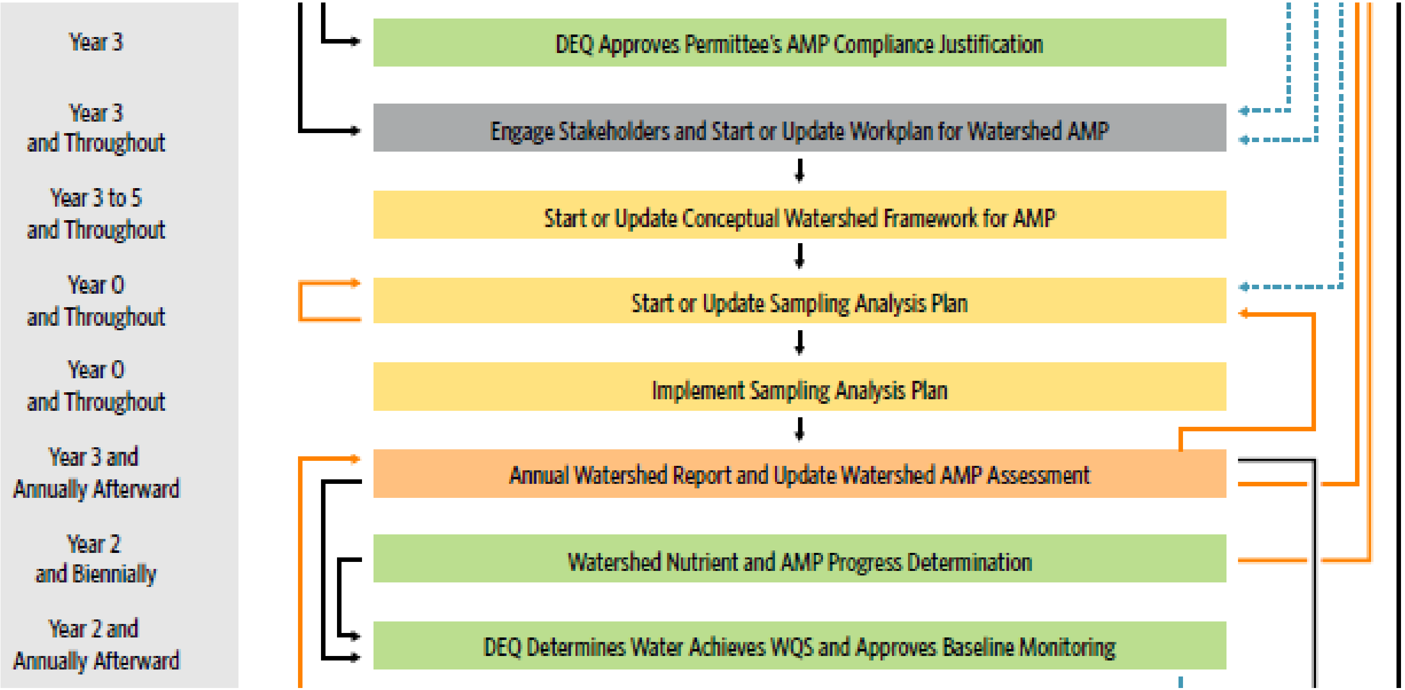
Years 0 to 2: Initiate AMP Process

- Watershed Assessment
- Loading Analysis
- Permittee Participation
  - Justification
  - DEQ Approval
- ID Stakeholders
  - Feed Forward



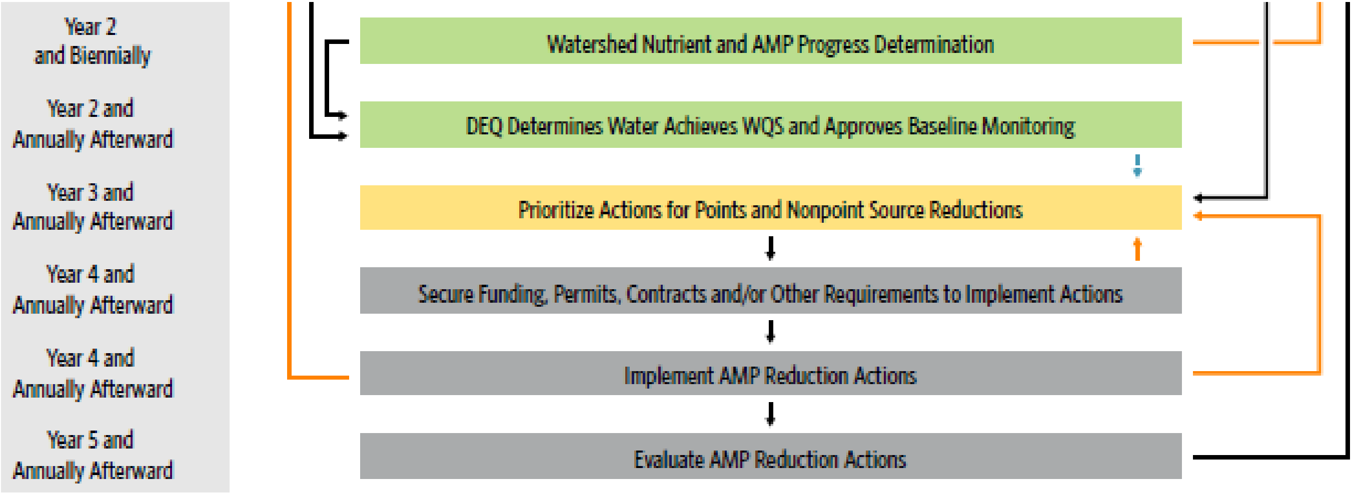
Years 3 to 5: Engagement, Monitoring, Reporting

- Engage Stakeholders
- Conceptual Watershed Approach
- Monitoring
  - Feedback Adjustments
- Annual Reporting

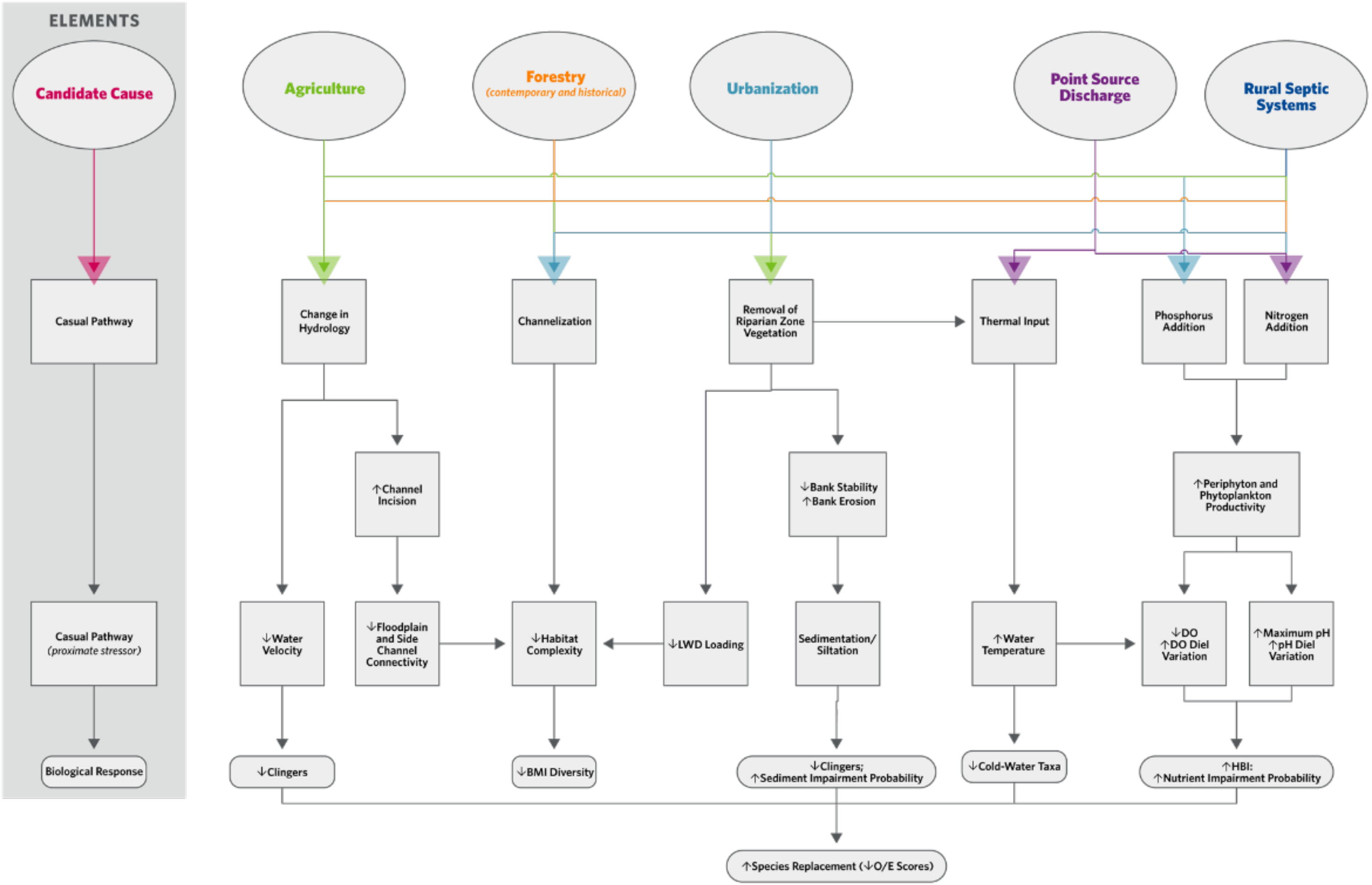


Years 2 to 5 Beyond: Prioritize Management Actions, Implementation, Feedback, Re-prioritize

- Candidate Management Actions
  - Point Source
  - Nonpoint Source
- Funding
  - ID Sources & Pursue
- Implementation
  - Prioritization
  - Trends Analysis
  - Evaluate AMP
  - Feedback
  - Re-prioritize
- Annual Reporting



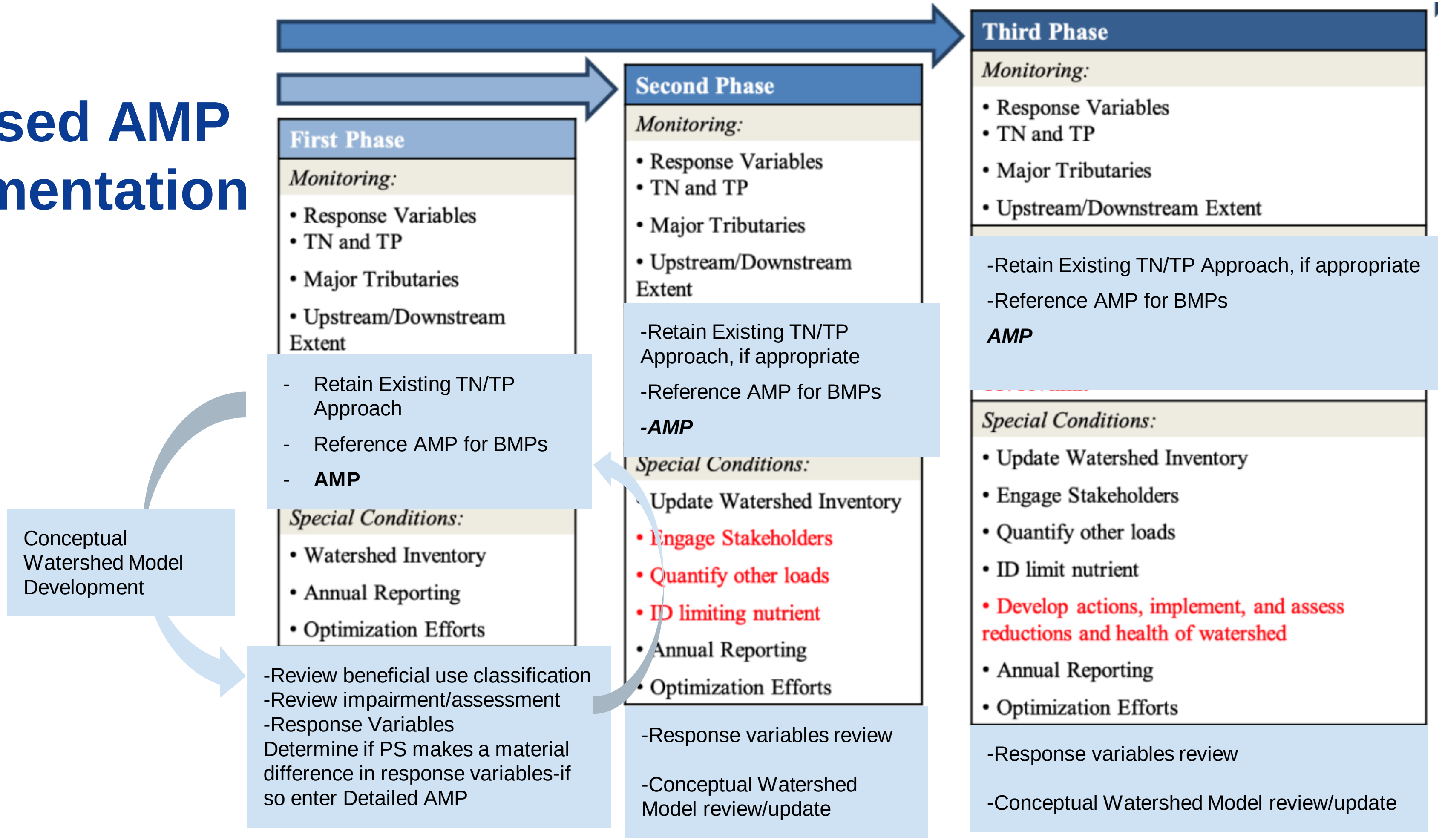
Conceptual Watershed Model



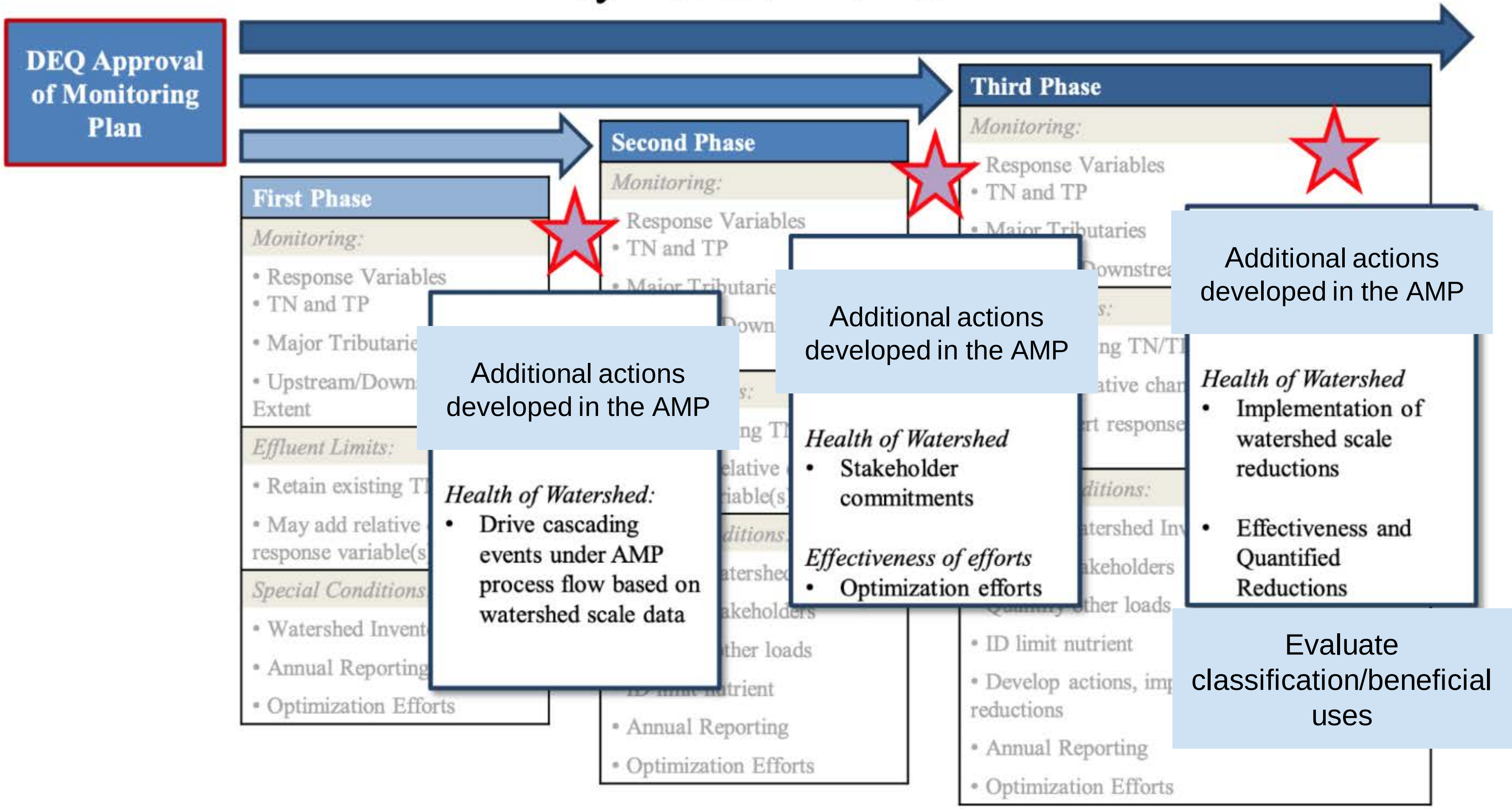
Effluent Limits in AMP

- AMP process evolves over time
  - Near term definition of numerical effluent limits infeasible
    - Existing permits vary: no effluent nutrient limits, existing effluent limits, administratively extended
- NPDES limits may be expressed as numeric or non-numeric discharge requirements
  - Federal regulations authorize non-numeric effluent limits in lieu of numeric limits where “Numeric effluent limitations are infeasible.” 40 CFR 122.44(k)(3)
- Non-numeric effluent limits based on Best Management Practices (BMP)
  - AMP = BMP

Proposed AMP Implementation



Key Decision Points



Adaptive Management Plan/TMDL Nexus

- How to reconcile TMDLs based on numeric values with new AMPs
- Consider alternative/iterative TMDL approaches
- EPA supported this idea in 2016 memo, also in Wisconsin
- Moving the response variable analysis into the AMP/TMDL has precedent and allows broader analysis than a permitting framework

Closing

- Point sources have invested heavily in capital, power, and chemical consumption to reduce point source loads
- Reached the point where new "cost-benefit analysis" needs to be done to make most effective decisions
  - Net environmental benefit needs to be considered
  - In many cases, further mechanical treatment often achieves little demonstrated benefit to the receiving water
  - Residents that pay for treatment have reached maximum capacity

Questions?