


COALITION FOR THE POUDRE RIVER WATERSHED

State of the Upper Poudre River Watershed

A River Health Assessment

Stillwater Sciences

Johnson Environmental Consulting

Timberline Aquatics, Inc.

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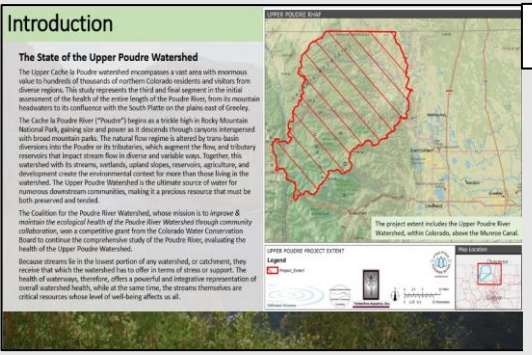
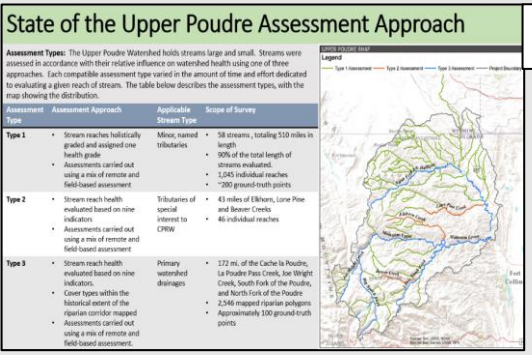


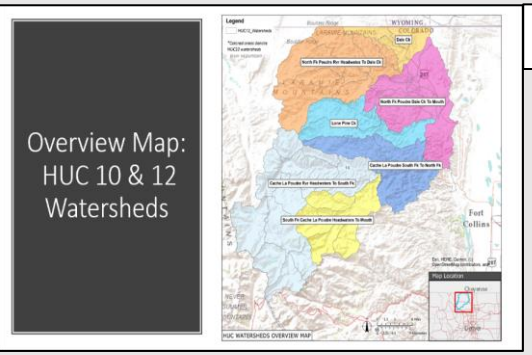
Sheets 2 – 9 Introduction & Methods

River health was assessed across the Upper Poudre River Watershed using remote and field surveys. The assessment provides a snapshot of watershed condition and environmental stressors causing impairment. Results will be used to identify opportunities for river health improvement, gauge wildfire recovery, and understand outcomes of recent forest management actions.



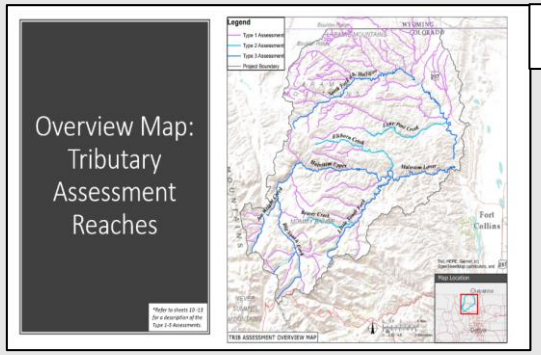
Sheets 10 – 15 Assessment & Analysis

The River Health Assessment Framework (RHAF) was customized for this project to assess river health in the Upper Poudre River Watershed. Three types of assessments were used for Upper Poudre perennial rivers based on their relative influence on watershed health.



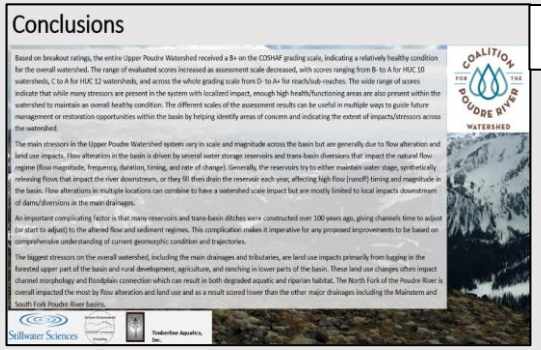
Sheets 16 – 20 Communicating Results

Health and condition grades are reported at several spatial scales. Stream reach grades were averaged to create a grade for each sub-watershed (HUC 12). Those grades were then averaged to produce watershed (HUC 10) grades, which were combined to create a health grade for the whole upper Poudre Sub-basin. The findings of detailed assessments of the main streams in each HUC 10 are provided on individual sheets.



Sheets 21 – 47 Results

Results are presented for all HUC 10 and HUC 12 primary river segments within the Upper Poudre River Watershed. Stressors to river health have been identified and presented along with the degree and extent of their impacts to watershed health.



Sheets 48 – 51 Conclusions & Opportunities

Overall, the Upper Poudre River Watershed is relatively healthy. The biggest stressors to health are flow alteration and land use changes. Potential opportunities to improve the overall watershed health and next steps are presented in these sheets.

South Fork of the Poudre near Pingree Park looking towards the Mummy Range

Introduction and Methods

The following seven sheets introduce the study area, project objectives, and the Upper Poudre River Health Assessment Framework.

Introduction

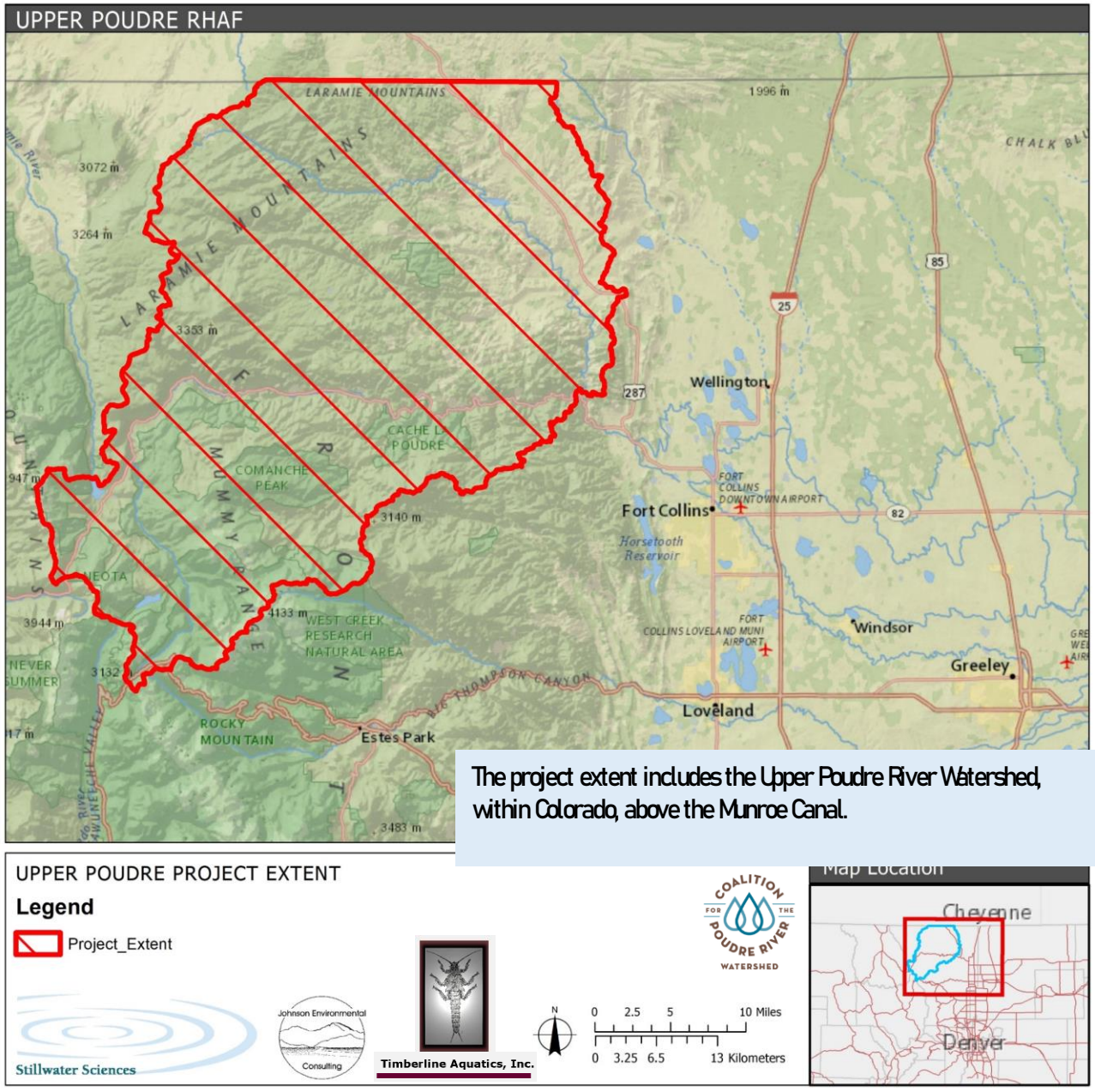
The State of the Upper Poudre Watershed

The Upper Cache la Poudre watershed encompasses a vast area with enormous value to hundreds of thousands of northern Colorado residents and visitors from diverse regions. This study represents the third and final segment in the initial assessment of the health of the entire length of the Poudre River, from its mountain headwaters to its confluence with the South Platte on the plains east of Greeley.

The Cache la Poudre River ("Poudre") begins as a trickle high in Rocky Mountain National Park, gaining size and power as it descends through canyons interspersed with broad mountain parks. The natural flow regime is altered by trans-basin diversions into the Poudre or its tributaries, which augment the flow, and tributary reservoirs that impact stream flow in diverse and variable ways. Together, this watershed with its streams, wetlands, upland slopes, reservoirs, agriculture, and development create the environmental context for more than just those living in the watershed. The Upper Poudre Watershed is the ultimate source of water for numerous downstream communities, making it a precious resource that must be both preserved and tended.

The Coalition for the Poudre River Watershed, whose mission is to *improve & maintain the ecological health of the Poudre River Watershed through community collaboration*, won a competitive grant from the Colorado Water Conservation Board to continue the comprehensive study of the Poudre River, evaluating the health of the Upper Poudre Watershed.

Because streams lie in the lowest portion of any watershed, or catchment, they receive that which the watershed has to offer in terms of stress or support. The health of waterways, therefore, offers a powerful and integrative representation of overall watershed health, while at the same time, the streams themselves are critical resources whose level of well-being affects us all.

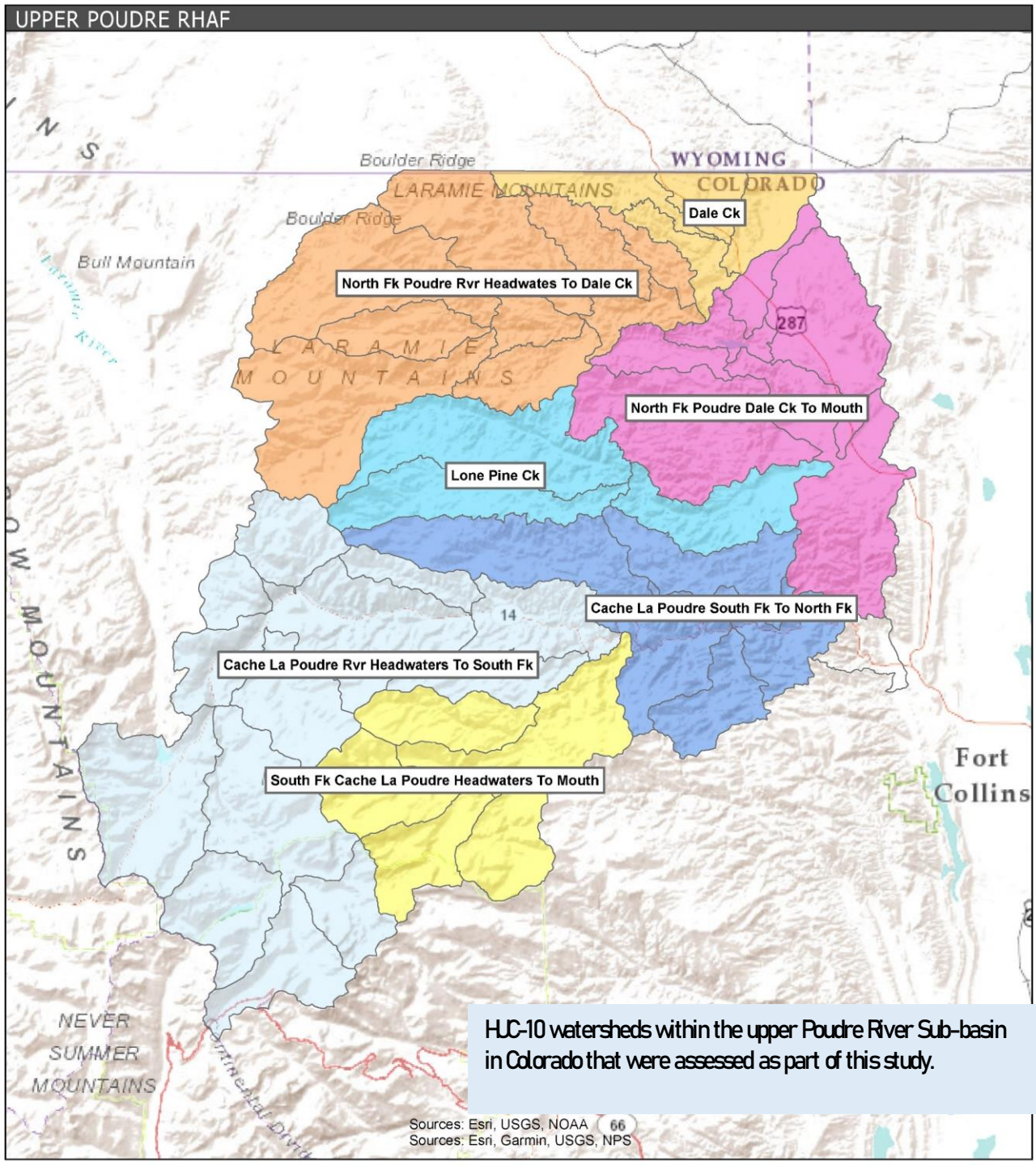


Project Objectives

Intent and Goals

The basic project objective was to carry out an extensive survey of stream health across the entire 951 square mile upper Poudre River Sub-basin, gathering information about each stream according to the waterway's relative contribution to overall watershed health. The sheer magnitude of the undertaking necessitated a strong reliance on expert judgement, supplemented by data resources, as available. The intent of this approach is to provide a sweeping picture of stream health patterns and causes of impairment across the watershed, which builds a broad-based platform from which to launch future targeted studies.

The information gathered by this study will have numerous applications, but it is particularly aimed at supporting future Stream Management Plan efforts needed in the Upper Poudre Watershed or elsewhere along the river. The study will also support the Coalition in meeting the goals articulated in its *Upper Poudre Watershed Resilience Plan* by providing basic information to help track the outcomes of forest health restoration treatments and to identify priority restoration needs and opportunities for the future.



HUC-10 watersheds within the upper Poudre River Sub-basin in Colorado that were assessed as part of this study.

The Region

Study Area

The study area covered 951 square miles of the Poudre River's upper watershed. Referred to as the "Upper Poudre Watershed", the study area began at the canyon mouth west of Fort Collins and included the entire watershed above that point. The study area was bounded to the North by the Wyoming border.

The Upper Poudre Watershed

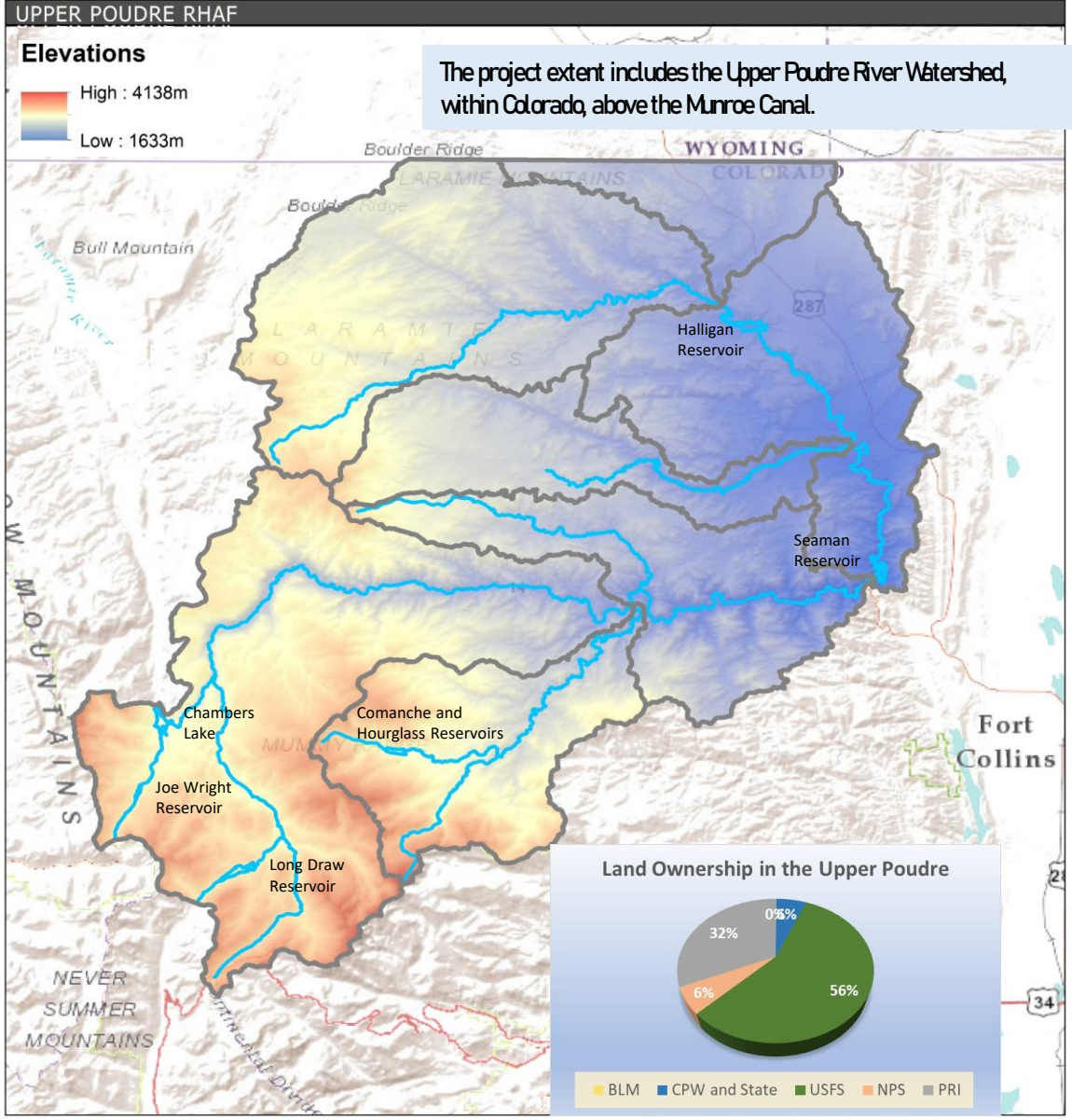
The Upper Poudre Watershed was broken into the seven watersheds listed below, following the USGS Hydrologic Unit Code (HUC) 10 boundaries. HUC 10 boundaries are shown in the map to the right.

- North Fork from the Headwaters to Dale Creek
- North Fork from Dale Creek to the Confluence with the Poudre
- Dale Creek
- Lone Pine Creek
- Cache la Poudre from the Headwaters to the South Fork
- Cache la Poudre from the South Fork to the North Fork (Munroe Diversion)
- South Fork from the Headwaters to the Confluence with the Poudre

Although specific patterns of land use vary across the watershed, the landscape is almost without exception rural. 56% of the watershed is managed by the United States Forest Service (USFS), including 136 square miles of federal Wilderness (14% of the watershed). Including all forms of public land – National Forest, National Park Service, and State – about 68% is managed as more or less wild lands. Ranching, commonly including haying, is the most prevalent land use occurring on private lands.

Ranging from 5,358 to 13,571 feet in elevation the watershed includes examples of the majority of Colorado's major ecozones – from high prairie in the north, to the lower montane at the canyon mouth, all the way to the high alpine on the summit of Hague's Peak, the region's tallest summit.

The watershed is bounded from south to north by the Mummy Range (south), the Never Summer Mountains (southwest), the Medicine Bow Mountains (west) and finally the Laramie Mountains (north).



Stream Health and its Assessment

Stream Health

Like the humans, animals, and plants that depend on streams for their survival, streams too have health that can be good or poor. If a river's health declines, the functions and ecosystem services it provides decline in step. This creates a multitude of problems for the organisms that rely on the river, including us humans. Many of the environmental challenges our society faces can be lessened or eliminated with healthy, functioning streams.

Stressor Assessment

The key diagnostic evidence used in stream health assessment is the presence and severity of stressors. Stressors are human created features or conditions that impair stream health and cause habitat to depart from its *Reference Standard,* or ideal condition. Stressors provide the single most significant insight into stream health, because stressors and their resultant impacts are more readily detectable than good health or proper habitat functioning on its own. That is**, it is easier for humans to identify human alterations to a natural system than it is to identify natural functioning apart from those anthropogenic cues.** Stressor-based assessment forges a direct link between the causes of impairment and their ramifications on ecological health and thereby imparts an additional advantage to those health surveys. Namely, stressors represent the agents of ecological health impairment and, therefore, point to the ways in which health can be improved through restoration activities.

Health Assessment

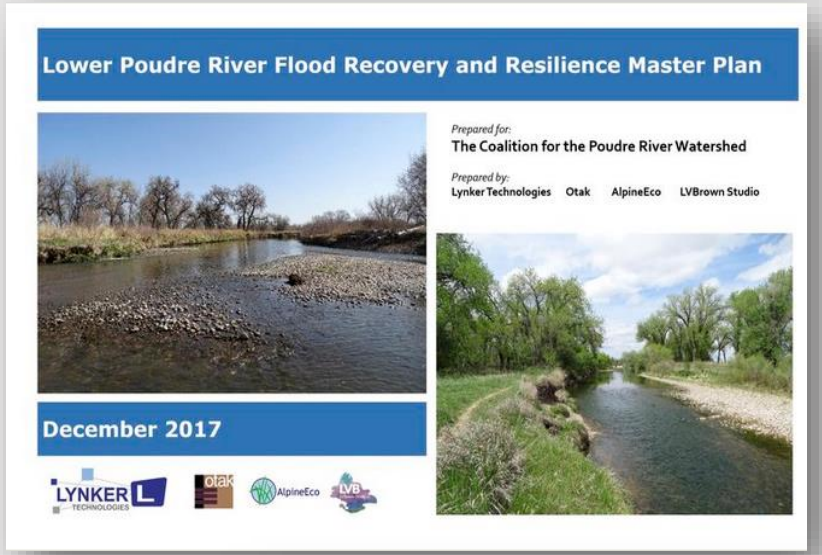
Stream health assessment is directly analogous to human health assessment. When you visit a doctor, he or she makes an assessment of your health. This assessment may be founded on basic observations of the things that make you tick, like your organs, glands and bones. The doctor's health assessment may be further supported by simple measurements, such as blood pressure, or by more complicated tests if initial observations warrant them.

Stream health assessment uses the same strategies as medical assessment. In stream assessment, the condition of the fundamental drivers, or **Indicators,** of stream health, such as water flow, sediment transport, and riparian condition, are considered to enable professionals to formulate and opinion on how well river health is being supported by existing conditions.

As in medical health assessment, stream assessment can employ a varying degree of analytical intensity in response to the study circumstances. Assessments can be done remotely using GIS and on-line tools or in the field using methods as rapid or intensive, as warranted by the information need.

Similarly, descriptions of stream health can vary in detail. A summary statement such as, "the subject is in good health!" can be as powerfully informative as it is concise. The relatively opaque rationale underlying the conclusion may be acceptable given study goals. If a clearer or more certain understanding of stream health is needed, the condition of the fundamental drivers of stream health, or **Indicators,** can be described and related to the presence and severity of the stressors.

State of the Upper Poudre Assessment



The Origins of the River and Watershed Assessment

The State of the Upper Poudre has at its core the *River Health Assessment Framework (RHAF)* that has been used on the two downstream reaches of the Poudre, through the City of Fort Collins and the Lower Poudre from I-25 to the confluence. These previous studies were conducted in 2016 and 2017 and laid the groundwork for this assessment. More than previous efforts, the State of the Upper Poudre sought to characterize the condition of the whole watershed rather than limiting the focus to the mainstem of the Poudre. Watershed characterization is needed more drastically in the headwaters, because in the headwaters, the river is its tributaries. See Appendix A for more detailed RHAF methodology.

Functional Assessment of Colorado Wetlands

A wetland and riparian health assessment developed for the federal Clean Water Act Program.

Functional Assessment of Colorado Streams

A stream health assessment developed for the federal Clean Water Act Program.

River Heath Assessment Framework (RHAF)

Stream and riparian assessment method crafted with the City of Fort Collins based on previous works and used to create the State of the Poudre Report Card and then the Lower Poudre Resilience Plan.

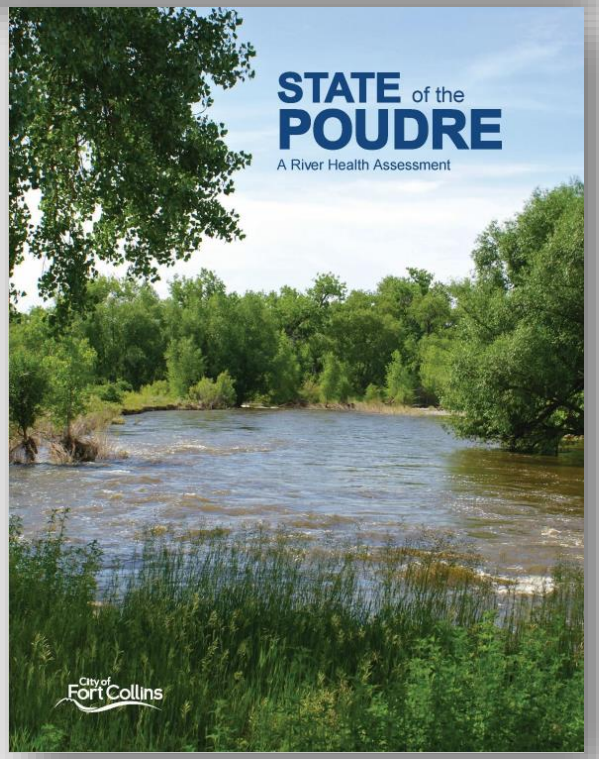
https://www.fcgov.com/naturalareas/pdf/river-health-report-final-appendix.pdf

https://www.poudrewatershed.org/lower-watershed-resilience-plan

Watershed Profiling

An approach to watershed condition assessment based on aquatic habitat health developed for the federal Clean Water Act https://nepis.epa.gov/Exe/ZyPDF.cgi/P10078WK.PDF?Dockey=P10078WK.PDF

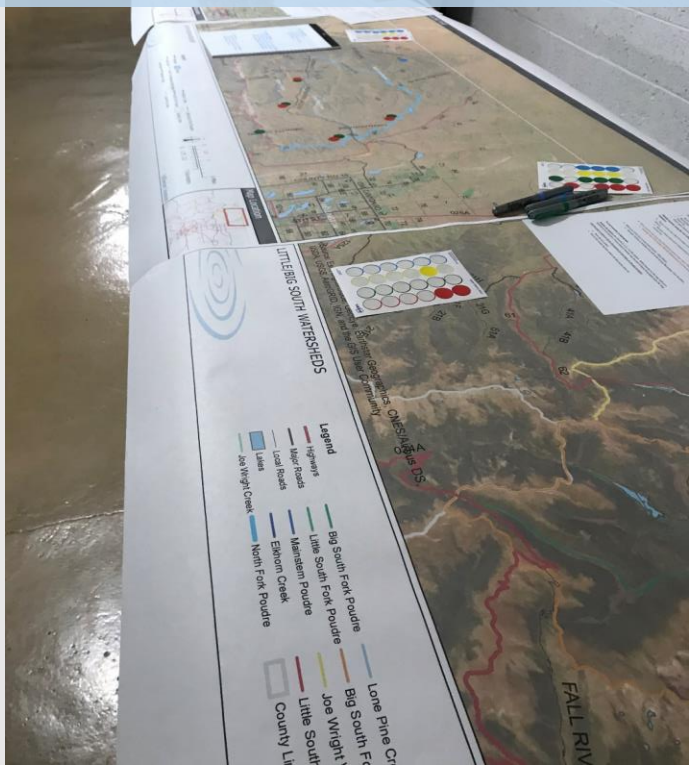
State of the Upper Poudre Assessment



Stakeholder Engagement

The project team worked with a monitoring sub-committee and CPRW stakeholder group throughout the project to help refine the indicators/metrics and to help determine the levels of assessment necessary to assess river health within the Upper Poudre River Watershed. Members of United States Forest Service, City of Fort Collins, Colorado State University, and Trout Unlimited served on the sub-committee and stakeholder group. Preliminary results were also presented to the stakeholders and at a community outreach event in Livermore.

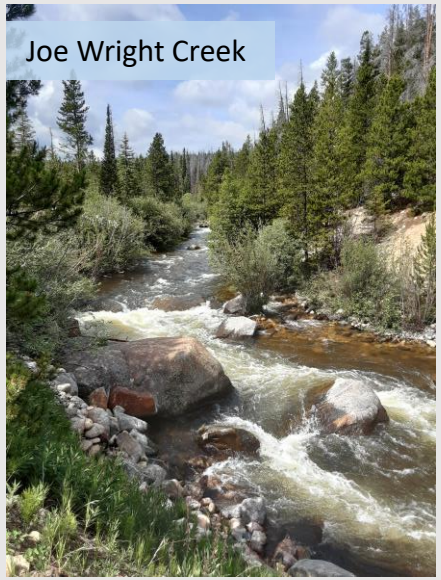
Preliminary results were presented to the community at the Livermore Community Center.

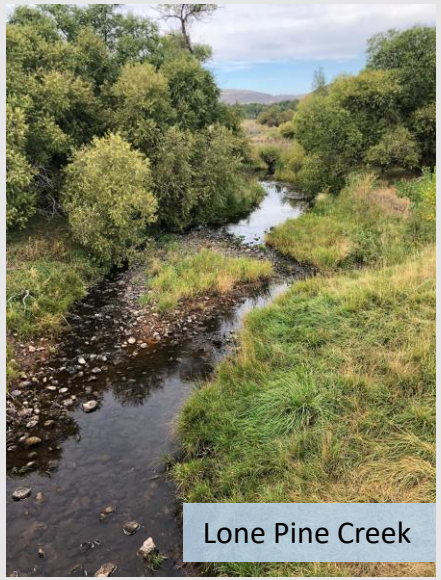


The Upper Poudre River Health Assessment Framework

Indicators of River Health

The Upper Poudre RHAF considers nine **Indicators** to describe stream health. Indicators may be individually described and graded, or they may be implicitly considered during rapid, summary assessments. Each Indicator may be further described by metrics that contribute substantially to the condition of the indicator. Indicators and metrics are considered in light of detectable stressors and the departure from **Reference Standard** conditions they cause (see table on slide 12). See Appendix A for more information on Indicators and Metrics and how they are scored.


Joe Wright Creek

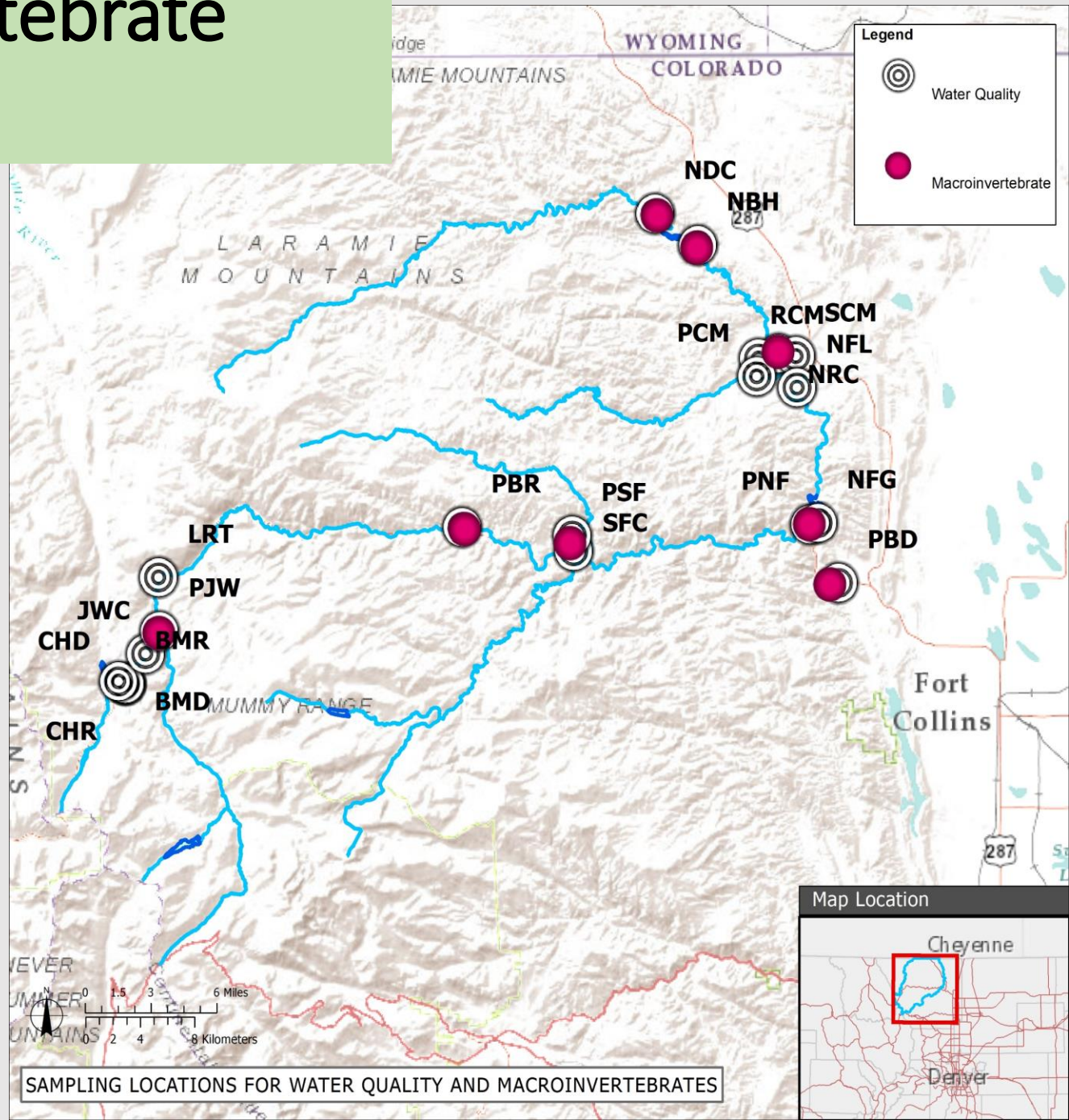

Lone Pine Creek

Indicators	Metrics	Data Source
Watershed		
Flow regime	Peak flows, base flows, variability, total volume	City of Fort Collins, City of Greeley, Colorado Division of Water Resources, United States Geological Survey (USGS)
Sediment regime	Land erosion, channel erosion, transport	Rapid Assessment
Water quality	Temperature, nutrients, pH, dissolved oxygen	City of Fort Collins Utilities, CPRW Citizen Science (see map slide 10)
Riparian		
Floodplain connectivity	Floodplain extent, Floodplain function	Rapid Assessment conducted by Stillwater
Riparian condition	Vegetation structure, complexity and extent	Rapid Assessment conducted by Johnson Environmental Consultants
In-channel		
River form	Planform, dimension, profile	Rapid Assessment conducted by Stillwater
Resilience	Dynamic equilibrium, recovery potential	Rapid Assessment conducted by Stillwater
Physical structure	Coarse scale, fine scale	Rapid Assessment conducted by Stillwater
Aquatic life	Aquatic insects	Macro-invertebrate Sampling (see map slide 10)

Water Quality and Macroinvertebrate sampling sites

Data from water quality and macroinvertebrate sampling locations enabled scoring the water quality and aquatic life indicators. Citizen Science (CitSci) was used to sample other tributaries in the upper watershed but those data will be incorporated into scoring in a future assessment effort.

Site Name	Stream Name
CHR	Joe Wright Creek
CHD	Joe Wright Creek
JWC	Joe Wright Creek
BMD	Joe Wright Creek
BMR	Joe Wright Creek
PJW	Big South
LRT	Cache la Poudre River
PBR	Cache la Poudre River
PSF	Cache la Poudre River
SFC	South Fork
NDC	North Fork
NBH	North Fork
PCM	Lone Pine Creek
RCM	Rabbit Creek
SCM	North Fork
NFL	North Fork
NRC	North Fork
NFG	North Fork
PNF	Cache la Poudre River
PBD	Cache la Poudre River



The Upper Poudre River Health Assessment Framework

Stream Health Grades and Grading Guidelines

The condition of Indicators, metrics, and overall stream condition is summarized with a letter grade assigned according to the academic grading scale. The guidelines associated with each grade calibrate evaluators and communicate to readers the magnitude of preservation or impairment warranting a given grade. Master grading guidelines, upon which all others were based, is included below. Indicator specific grading guidelines can be found in **Appendix A**.

Grade	Descriptor	Explanation
A	*Reference standard*	Condition of the variable is self-sustaining and supports functional characteristics appropriate to sustain river health. Little or no management is needed to sustain and protect this level of function against stressors.
B	*Highly functional*	Condition maintains essential qualities that support a high level of function, but there is some influence of stressors at a detectable, yet minor, level. Requires limited management to sustain and protect against stressors.
C	*Functional*	Condition is altered by stressors that substantially impair functionality, but basic natural river functions are still sustained. Periodic, and at times intensive, management is required to maintain the river's functional condition.
D	*Functionally impaired*	Condition is severely altered by stressors that impair basic natural river functions and the overall health of the river. Active management is required to maintain the river's functional role.
F	*Non- functional*	Condition is profoundly impaired by massive or overwhelming stressors that render it incapable of supporting basic natural river functions or it is otherwise unable to sustain biological river communities. Active management is required to return river functions.

Reference Standard

Reference Standard (A) can be interpreted as ideal conditions. Grades and guidelines are based on the departure of the target site from the Reference Standard. All three RHAFs completed to date use similar Reference Standard criteria based largely on the idea that a Reference Standard stream is one that is ideally adapted to its present circumstances and requires no human intervention to maintain health and functioning. This concept is key to understanding how stream health is assessed in altered systems that may look and function little like they did prior to European settlement. ***The reference standard stream is ideally adapted to its circumstances whether those circumstances result from natural or anthropogenic (human-caused) processes.*** In the Upper Poudre watershed, with its prevalence of public lands, including Wilderness and RMNP, Reference Standard streams commonly represent a natural, near-pristine condition.

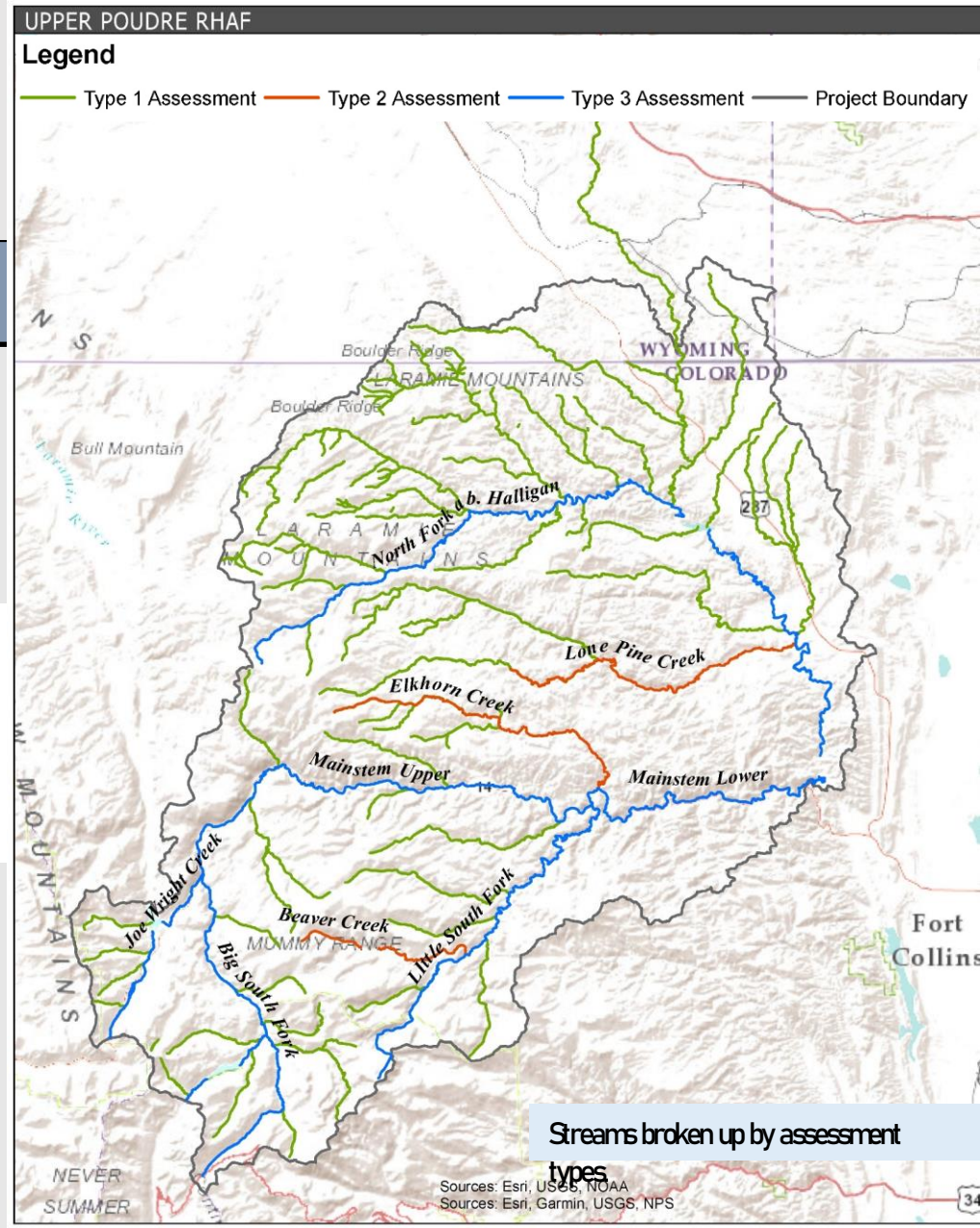
Assessment and Analysis

The following six sheets describe the collection and processing of stream health assessment information and the development of watershed condition scores

State of the Upper Poudre Assessment Approach

Assessment Types: The Upper Poudre Watershed holds streams large and small. Streams were assessed in accordance with their relative influence on watershed health using one of three approaches. Each compatible assessment type varied in the amount of time and effort dedicated to evaluating a given reach of stream. The table below describes the assessment types, with the map showing the distribution.

Assessment Type	Assessment Approach	Applicable Stream Type	Scope of Survey
Type 1	• Stream reaches holistically graded and assigned one health grade • Assessments carried out using a mix of remote and field-based assessment	Minor, named tributaries	• 58 streams , totaling 510 miles in length • 90% of the total length of streams evaluated. • 1,045 individual reaches • ~200 ground-truth points
Type 2	• Stream reach health evaluated based on nine indicators • Assessments carried out using a mix of remote and field-based assessment	Tributaries of special interest to CPRW	• 43 miles of Elkhorn, Lone Pine and Beaver Creeks • 46 individual reaches
Type 3	• Stream reach health evaluated based on nine indicators. • Cover types within the historical extent of the riparian corridor mapped • Assessments carried out using a mix of remote and field-based assessment.	Primary watershed drainages	• 172 mi. of the Cache la Poudre, La Poudre Pass Creek, Joe Wright Creek, South Fork of the Poudre, and North Fork of the Poudre • 2,546 mapped riparian polygons • Approximately 100 ground-truth points

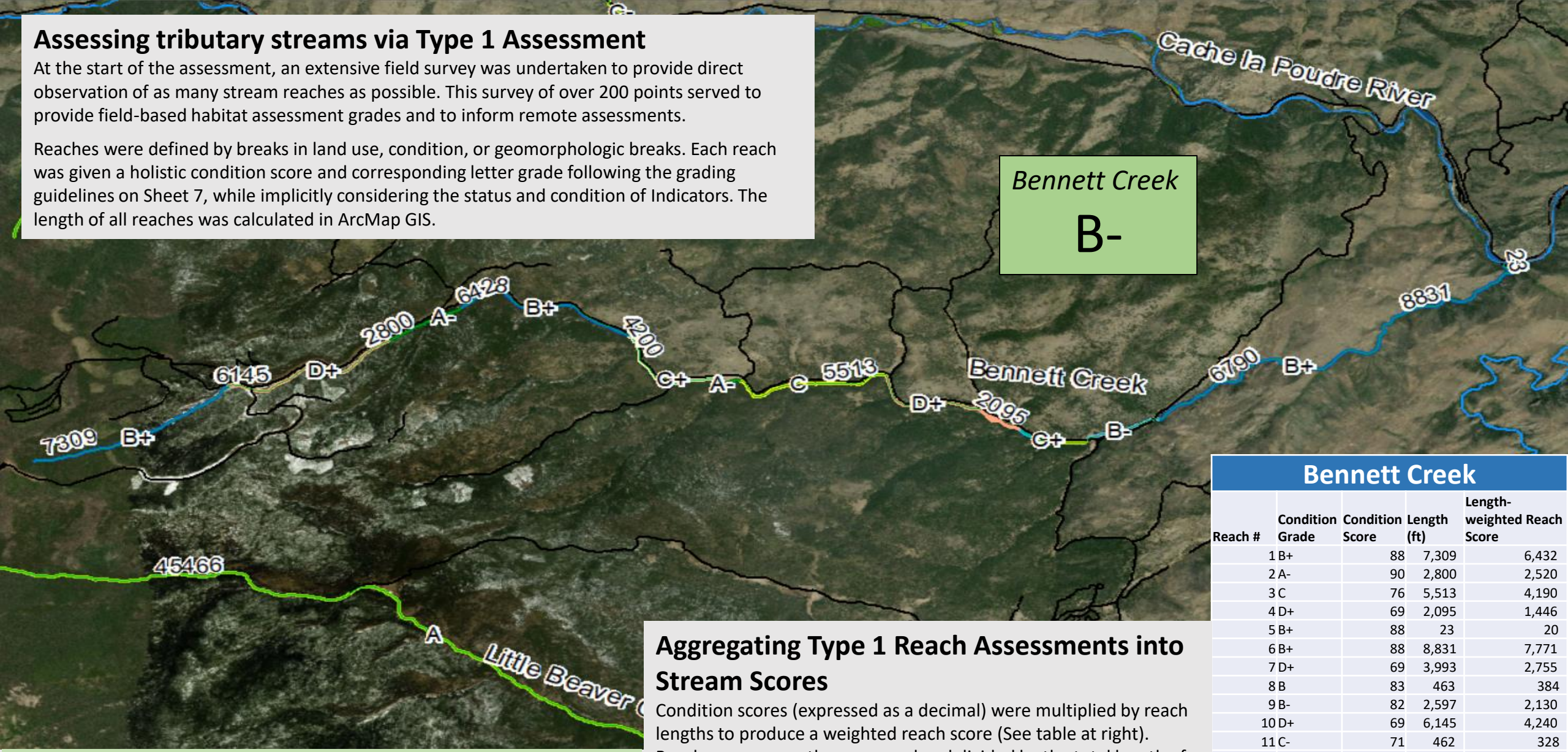


Streams broken up by assessment types

Assessing tributary streams via Type 1 Assessment

At the start of the assessment, an extensive field survey was undertaken to provide direct observation of as many stream reaches as possible. This survey of over 200 points served to provide field-based habitat assessment grades and to inform remote assessments.

Reaches were defined by breaks in land use, condition, or geomorphologic breaks. Each reach was given a holistic condition score and corresponding letter grade following the grading guidelines on Sheet 7, while implicitly considering the status and condition of Indicators. The length of all reaches was calculated in ArcMap GIS.



Type 1 Assessment

Minor Tributaries

Aggregating Type 1 Reach Assessments into Stream Scores

Condition scores (expressed as a decimal) were multiplied by reach lengths to produce a weighted reach score (See table at right). Reach scores were then summed and divided by the total length of the stream to arrive at a length-weighted average condition for the whole stream.

Bennett Creek is used here as an example minor tributary included in Type 1 assessment.

Bennett Creek

Reach #	Condition Grade	Condition Score	Length (ft)	Length-weighted Reach Score
1	B+	88	7,309	6,432
2	A-	90	2,800	2,520
3	C	76	5,513	4,190
4	D+	69	2,095	1,446
5	B+	88	23	20
6	B+	88	8,831	7,771
7	D+	69	3,993	2,755
8	B	83	463	384
9	B-	82	2,597	2,130
10	D+	69	6,145	4,240
11	C-	71	462	328
12	C+	78	4,200	3,276
13	A-	92	771	709
14	B+	88	6,428	5,657
15	B+	88	6,790	5,975
16	C-	70	421	295
17	C+	78	1,035	807
		Total	*59,876*	*48,935*

Waterbodies included in Type 2 Assessment:

- **Lone Pine Creek** and **Elkhorn Creek** were of special interest because CPRW has on-going forest health restoration treatments, such as prescribed fire and harvest, in these creeks. CPRW, along with USFS, is monitoring water quality pre- and post-treatment in these systems.
- **Beaver Creek** – included due to hydrologic alteration from high mountain reservoirs.

Lone Pine Cr. Reach #5

B-

Lone Pine Creek Reach #5

Indicator	Unconfined (RHAF)	Partially Confined	Confined
Flow regime	20	20	30
Sediment regime	5	10	5
Water quality	10	10	10
Floodplain connectivity	10	10	5
Riparian Condition	20	15	5
River Form	10	10	15
Resilience	10	10	10
Physical structure	10	10	15
Aquatic life	5	5	5

Type 2 Assessment

Special Interest Tributaries

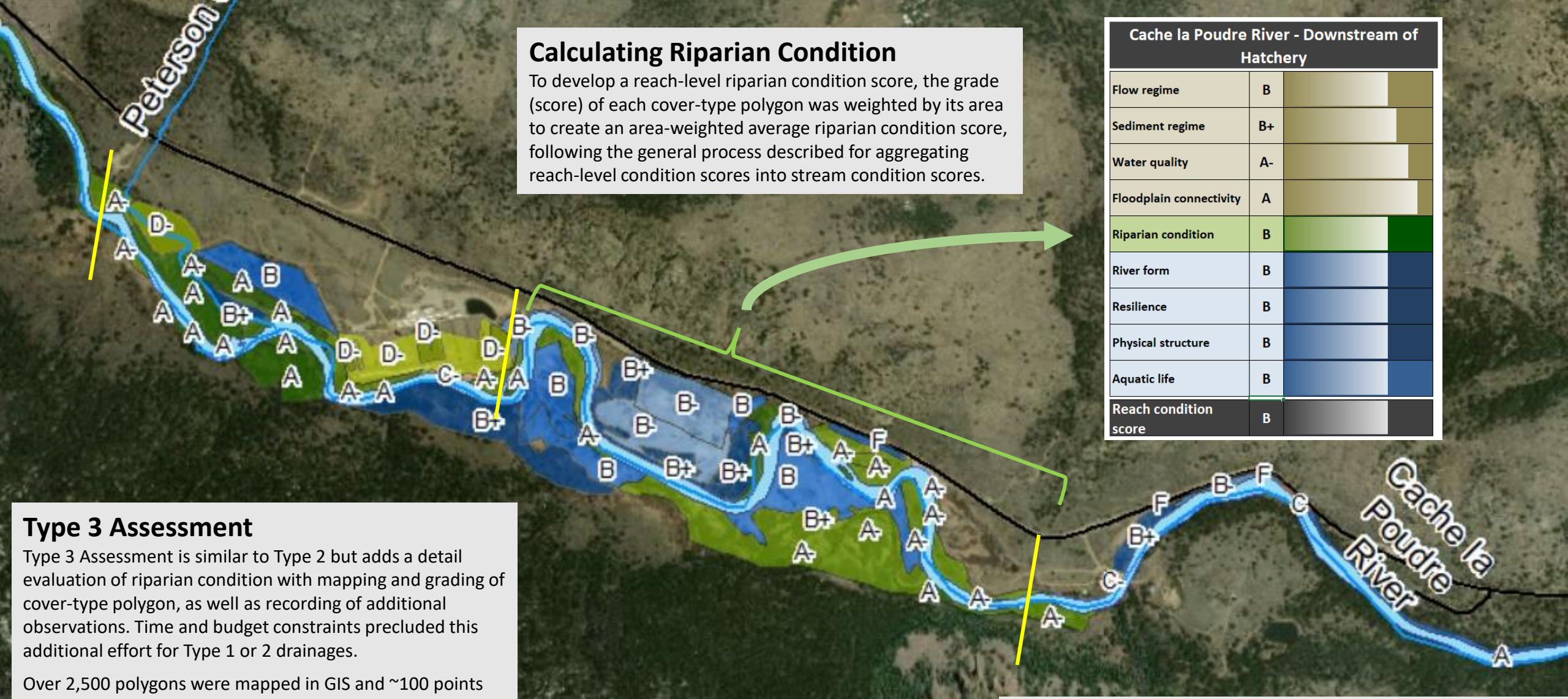
Lonepine Creek Reach #5		
Flow regime	A	95
Sediment regime	D+	68
Water quality	C	75
Floodplain connectivity	C+	78
Riparian condition	C-	72
River form	C	75
Resilience	B-	82
Physical structure	D-	62
Aquatic life	C-	72
Reach condition score	C	75

Type 2 Assessment

These streams were assessed in the field to the degree possible, along with the Type 1 tributaries. They were then broken into reaches based on geomorphology, land use, or condition. All nine indicators (see Sheet 9) were remotely evaluated at each reach. Indicator grades were weighted and summed to produce a weighted average of indicator scores that represents the overall ecological health of the stream reach.

The weights applied to indicator scores were based on the level of valley confinement using the Fort Collins RHAF weights as the basis. Different indicators become more important to overall river health depending on their valley type. For example, riparian condition would not play as large of a role in overall river health in a confined valley or canyon, where there is often only a small strip of riparian vegetation. In this situation, other indicators warrant heavier weighting depending on their influence on river health for that valley type. Weightings are provided in the table at left.

Reach grades were aggregated using the process described for Type 1 Assessment.



Calculating Riparian Condition

To develop a reach-level riparian condition score, the grade (score) of each cover-type polygon was weighted by its area to create an area-weighted average riparian condition score, following the general process described for aggregating reach-level condition scores into stream condition scores.

Cache la Poudre River - Downstream of Hatchery	
Flow regime	B
Sediment regime	B+
Water quality	A-
Floodplain connectivity	A
Riparian condition	B
River form	B
Resilience	B
Physical structure	B
Aquatic life	B
Reach condition score	B

Type 3 Assessment

Type 3 Assessment is similar to Type 2 but adds a detail evaluation of riparian condition with mapping and grading of cover-type polygon, as well as recording of additional observations. Time and budget constraints precluded this additional effort for Type 1 or 2 drainages.

Over 2,500 polygons were mapped in GIS and ~100 points were ground-truthed.

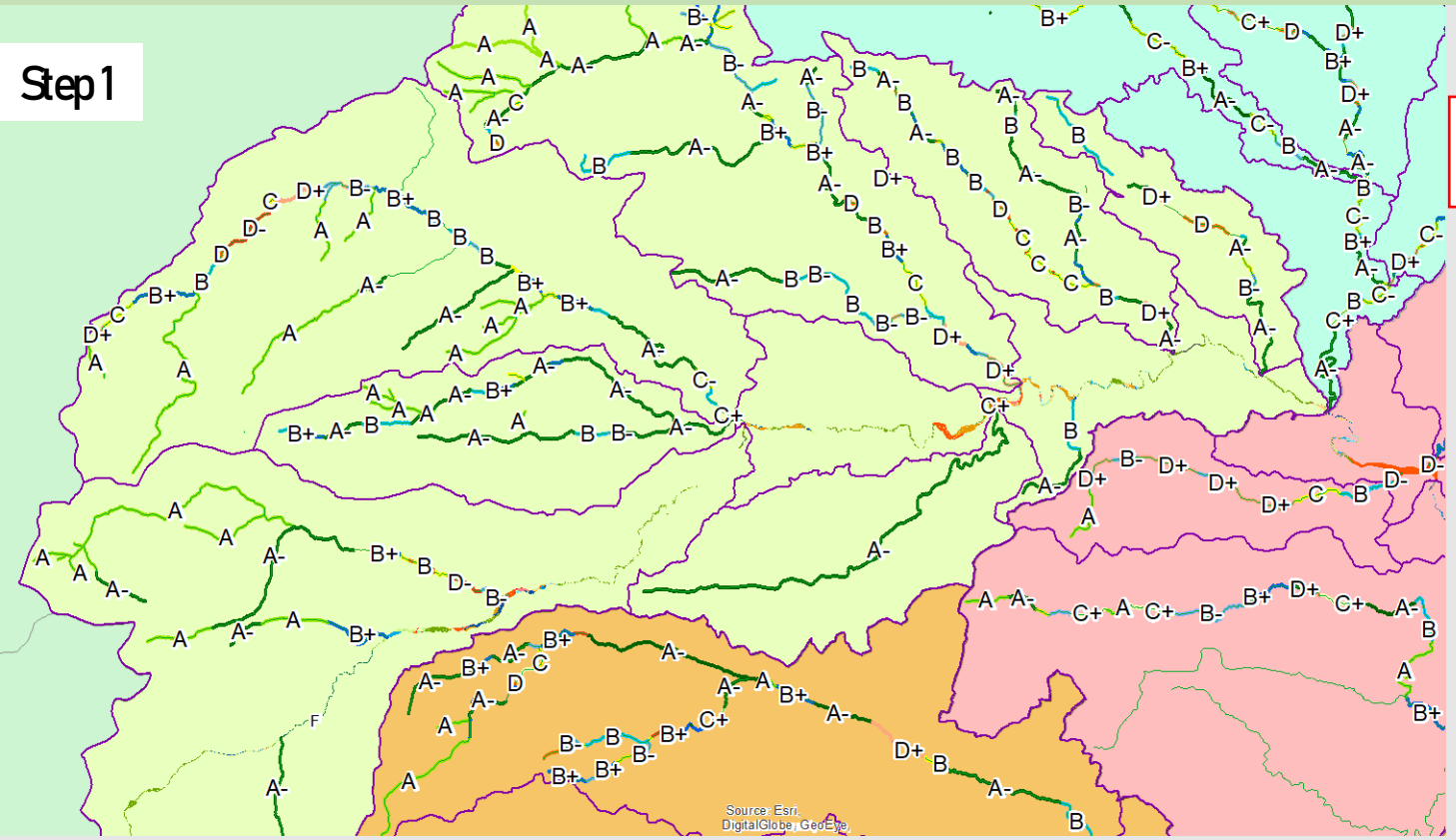
Type 3 Assessment

Main Watershed Drainages

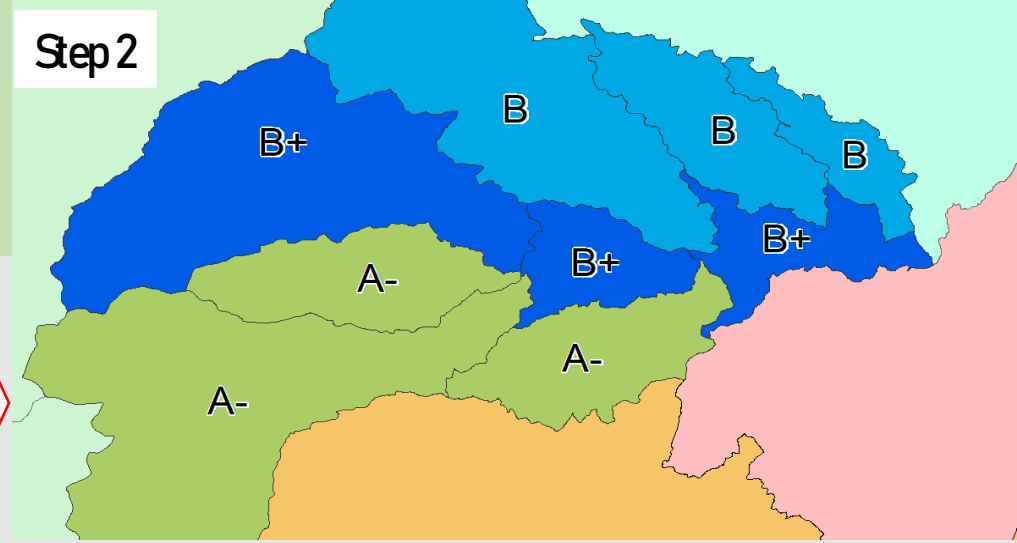
Waterbodies included in Type 3 Assessment:

- Mainstem Cache la Poudre
- Joe Wright Creek
- La Poudre Pass Creek
- South Fork Cache la Poudre
- North Fork Cache la Poudre

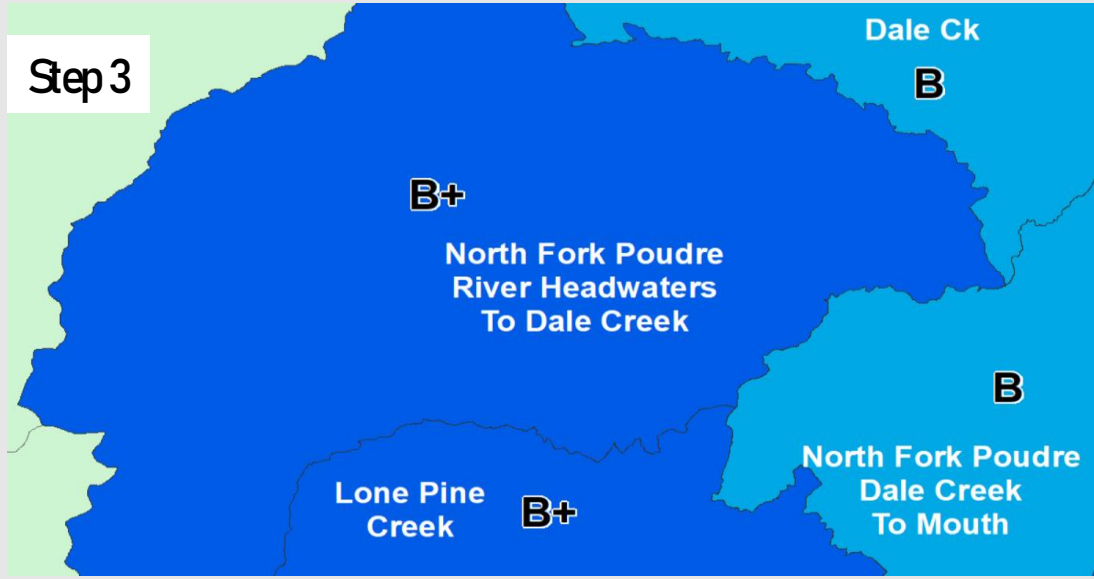
Putting it all together



Determining stream and then watershed health is a process of hierarchical aggregation, wherein a more and more expansive picture of condition is assembled from the building blocks of the landscape. In the Upper Poudre, stream reaches were first assembled to provide stream-level condition grades as described in the previous three sheets. These include all Type 1-3 assessments.



The next step up the assembly ladder was to merge all the stream-level grades (Types 1-3) into a length-weighted average condition score for each twelve-digit sub-watershed (HUC 12).

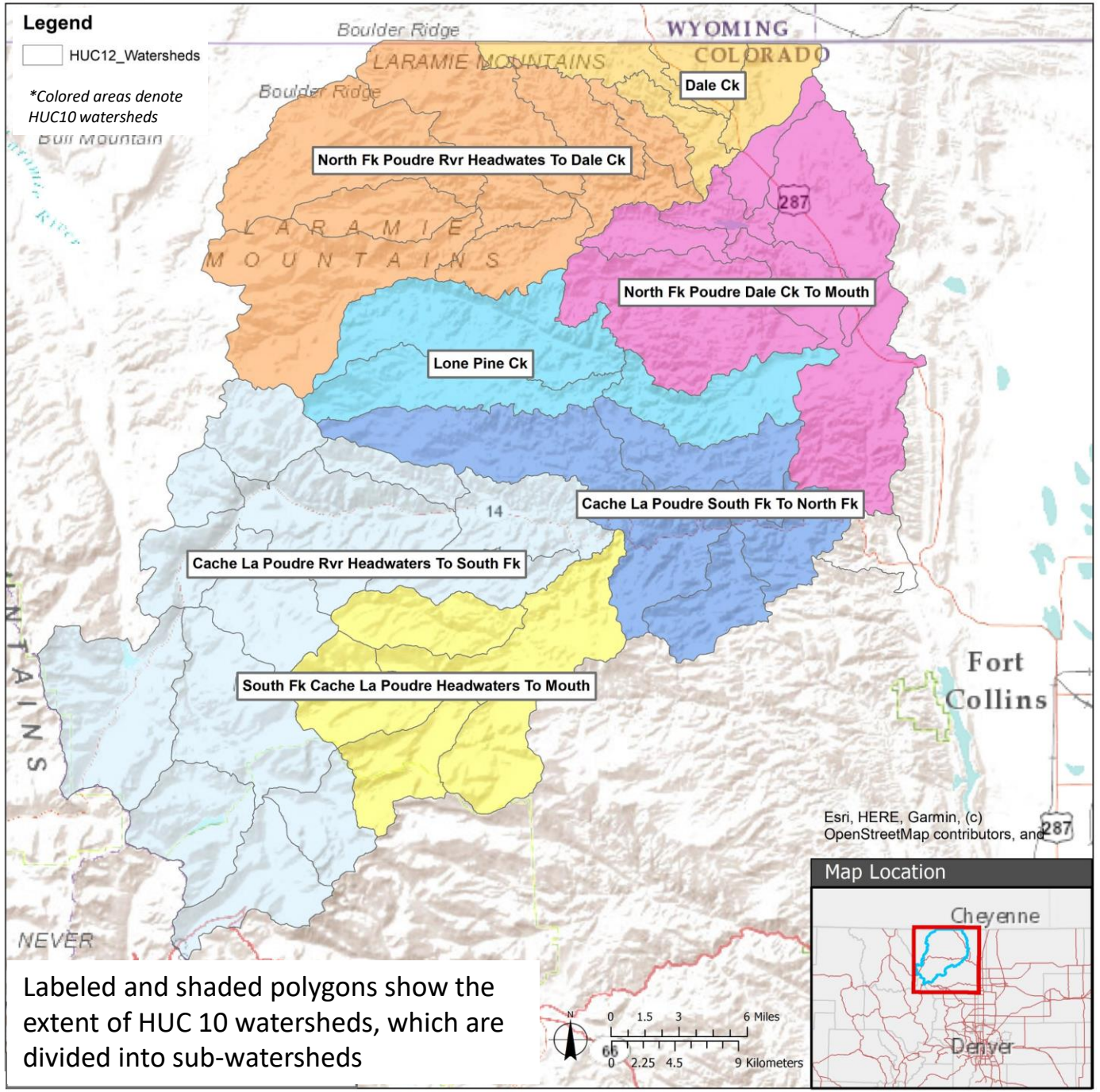


The final step in the watershed condition assessment was to aggregate the HUC 12 scores into single watershed condition scores for each of the six HUC 10 watersheds and then to combine those into one overall score for the entire Upper Poudre Watershed study area. This step followed the same basic process as described for previous levels.

Communicating Results

The following four sheets present graphics to clearly communicate the results of the stream health assessment

Overview Map: HUC 10 & 12 Watersheds



Labeled and shaded polygons show the extent of HUC 10 watersheds, which are divided into sub-watersheds

Communicating Results: HUC-10 Watershed

North Fork Watershed above Dale Creek

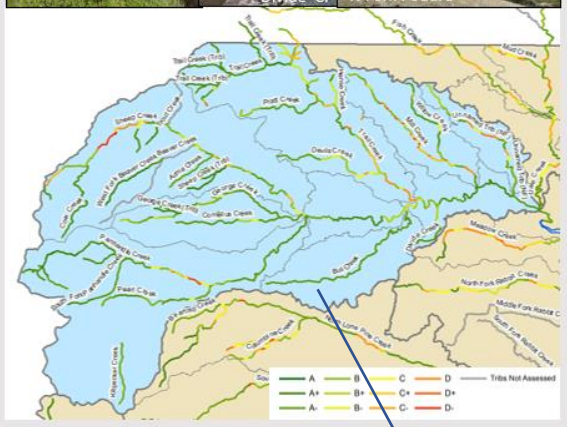
HUC-10 Watershed Grade
B+

Land cover and use

The North Fork Watershed begins in the in the forested Mountains, transitioning to open wood land and high prairie. With the change in land cover comes a change in the predominate land uses, from forest-based to range land and ranching. The rural settlement around Panhandle Reservoir is the most significant development.

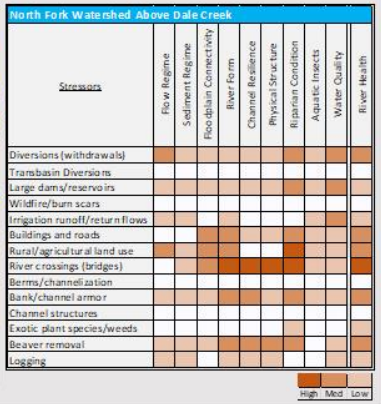
Statistics

Watershed size = 188 sq. mi.
Length of streams = 176 mi.
Elevation range = 6,391 – 10,974 ft.



Stressors

The stressors in the upper watershed are mainly logging, forest roads, associated crossings, and beaver removal. Two moderately large, tributary reservoirs affect hydrology in the headwaters. Lower in the watershed grazing, ranching, and haying increase in widespread effect.



21

Basic information about the watershed

Map of assessed streams color coded by reach condition

Brief summary of important stressors, or factors causing stream health impairment

Overall HUC 10 watershed health grade based on all the assessed stream reaches

Stressor matrix showing important stressors in the watershed and the indicators they affect. Darker colors indicate more negative effect

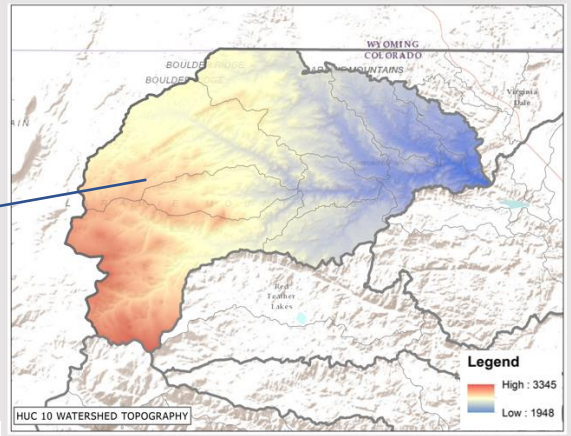
Map showing the overall scores for each HUC 12 watershed within the HUC 10 watershed. HUC-12 scores are based on all the assessed stream reaches.

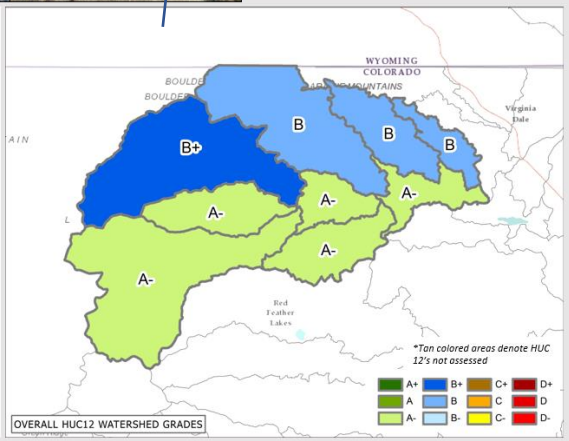
In the following slides, each HUC 10 watershed is described using two sheets. The first slide describes watershed conditions focusing on basic characteristics, broad trends in stream condition, predominant stressors, and land use alterations. The second slide presents overview maps showing the HUC 10 watershed elevation data and the HUC 12 sub-watershed scores within watershed. These scores include all the Type 1-3 assessment scores.

Elevation data for HUC 10 watershed (elevations in meters)

North Fork Watershed above Dale Creek

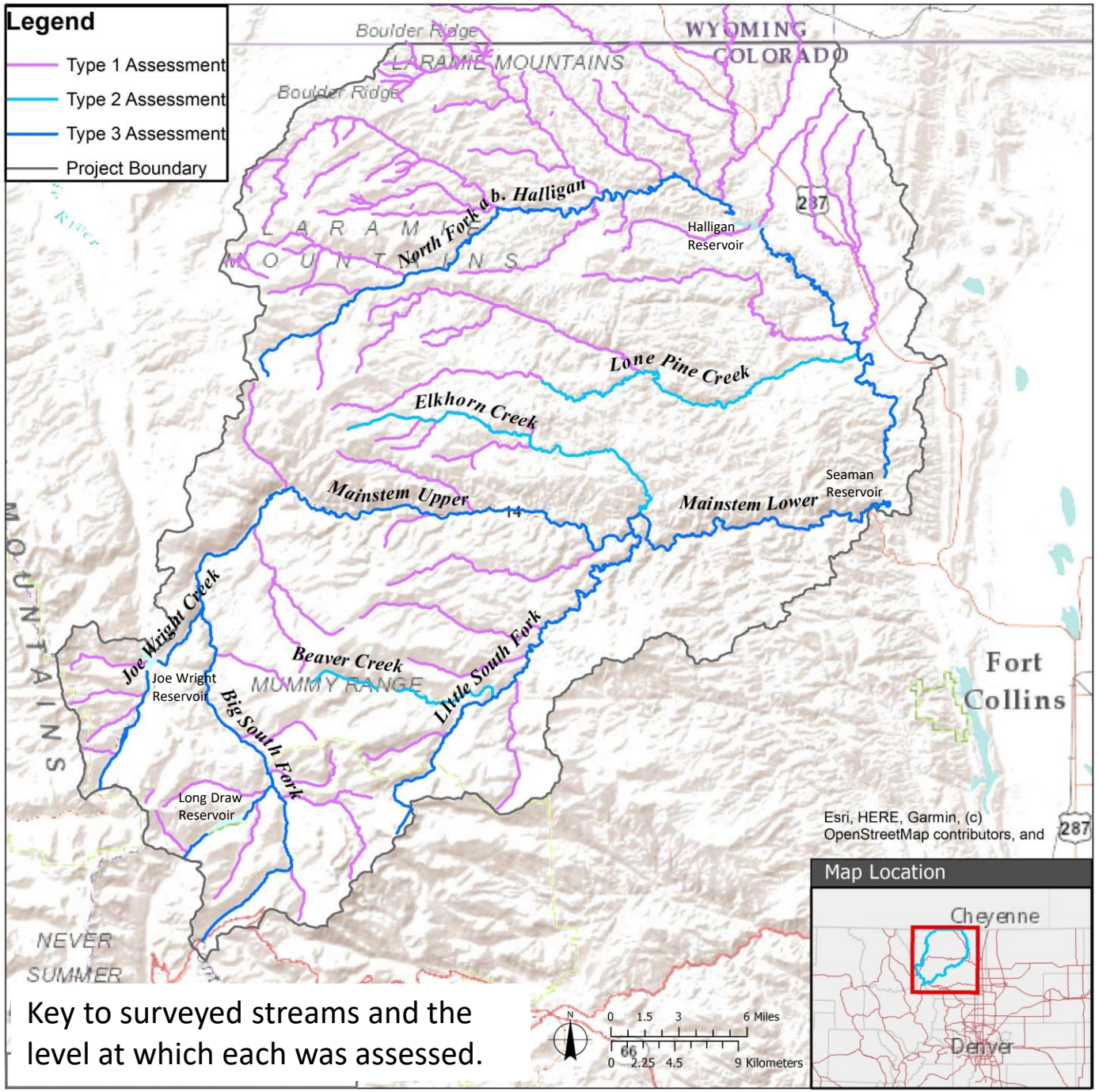
Watershed Grade
B+





Overview Map: Tributary Assessment Reaches

**Refer to sheets 11-14 for a description of the Type 1-3 Assessments.*



Key to surveyed streams and the level at which each was assessed.

Communicating Results: Type 2 & 3 Assessment Results

Summary of stressors to the overall indicator condition for the combined reach

Map showing the major river segment (North Fork of the Poudre River here) with reaches color coded according to condition

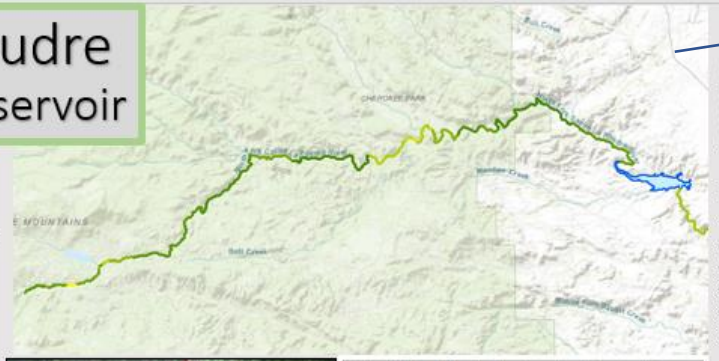
North Fork Poudre above Halligan Reservoir

Flow Regime
Eaton and Pan Handle Reservoirs and small diversions for flood irrigation are minimally impacting peak flow magnitude, frequency, and duration along the Upper North Fork of the Poudre. Base flows and flow variability would also be minimally altered from these stressors.

Sediment Regime
Agricultural land use and river crossings are slightly increasing sediment loads to the upper North Fork of the Poudre. Sediment transport continuity is relatively intact along the upper North Fork.

Water Quality
Agriculture, land use development, road crossings, and smaller reservoirs are slightly impacting temperature, phosphorus, and dissolved oxygen levels.

Riparian Condition
The riparian zone is typically narrow and intact. In a number of areas the valley bottom widens, and complex beaver habitat supports excellent health of the riverine system. Some areas where these habitats historically existed have been cleared for development, such as at Beaver Meadows Resort, or light agriculture



Above, the North Fork near its headwaters is in excellent condition. Below, despite the fairly remote location, portions of the North Fork have been cleared, ponded and channelized.

North Fork Cache la Poudre River - Above Halligan Reservoir	
Flow regime	A-
Sediment regime	A-
Floodplain connectivity	A-
River Form	A
Riparian condition	B+
Channel Resilience	A-
Physical Structure	A-
Aquatic Insects	A
Water Quality	B+
Reach condition score	A-

River Form
River crossings and land use changes are impacting the planform, channel dimension, and profile of the upper North Fork by encroaching upon the river. However, the spatial extent of these impacts is minimal.

Resilience
River crossings and land use changes (agriculture and development) are impacting channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal and most unaltered areas should be resilient.

Physical Structure
Land use changes and river crossings are impacting coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from agriculture, development, and river crossings is slightly impacting channel embeddedness.

Aquatic Life
Minimal stressors are present and do not appear to be negatively impacting to macro-invertebrate populations.

23

River Segment Grade

A-

Within each HUC 10 watershed, the main river segment was evaluated using the more detailed Type 2 and 3 assessments with nine indicator metrics. The results for the type 2 and 3 assessments are summarized on a single sheet. A description of the results for each indicator are summarized on the sheet.

Grades for individual metrics are distance weight averaged for the entire river segment.

Overall health grade for the main river segment. For example, this grade is just for the North Fork of the Poudre River channel and does not include any tributary scores.

Results

The seven major watersheds are described individually. For each major watershed, watershed condition and stressors are discussed on the first two sheets, followed by sheets describing the condition of the major stream(s) in the watershed. See Appendix B for the raw data from the watersheds and major streams.

North Fork Watershed above Dale Creek

HUC-10 Watershed Grade

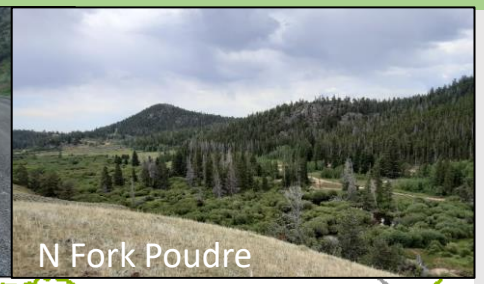
B+

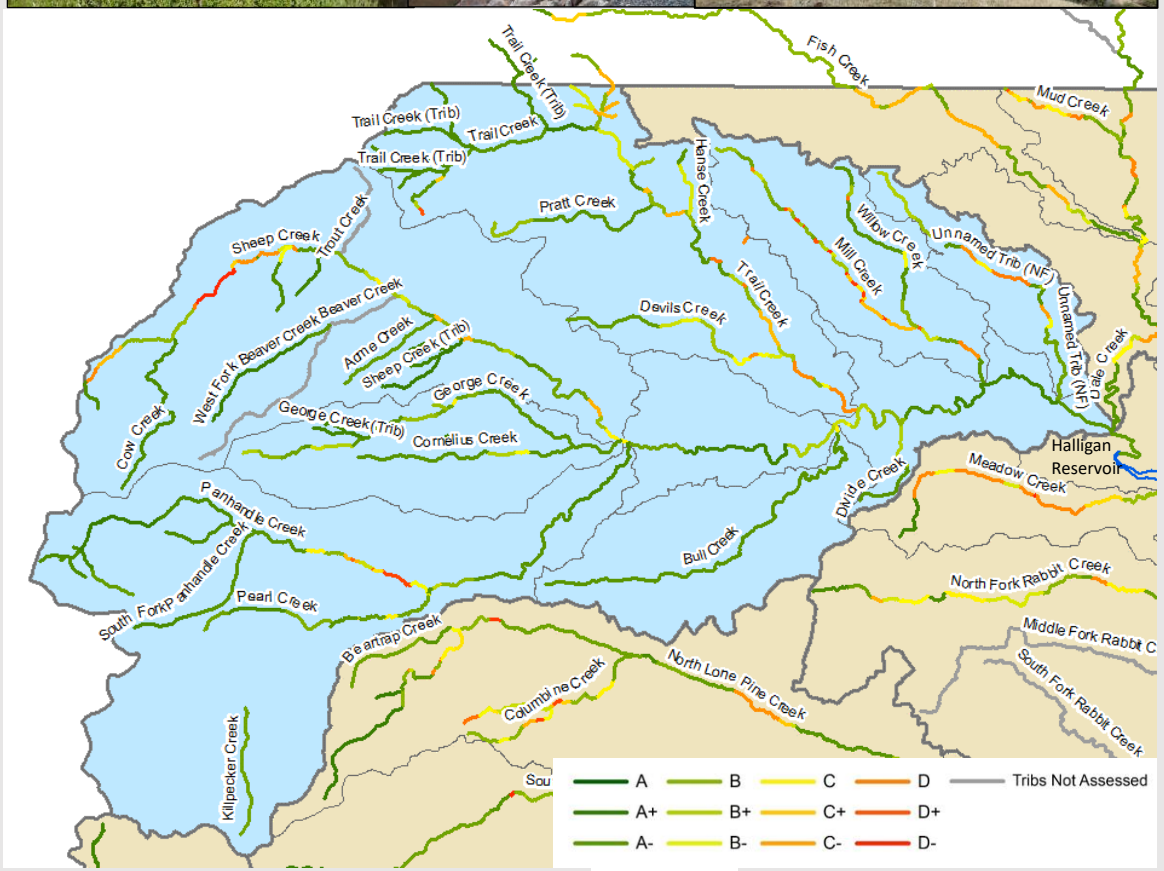
Land cover and use

The North Fork Watershed begins in the in the forested Mountains, transitioning to open wood land and high prairie. With the change in land cover comes a change in the predominate land uses, from forest-based to range land and ranching. The rural settlement around Panhandle Reservoir is the most significant development.

Statistics

Watershed size = 188 sq. mi.
Length of streams = 176 mi.
Elevation range = 6,391 – 10,974 ft.





Stressors

The stressors in the upper watershed are mainly logging, forest roads, associated crossings, and beaver removal. Two moderately large, tributary reservoirs affect hydrology in the headwaters. Lower in the watershed grazing, ranching, and haying increase in widespread effect.

North Fork Watershed Above Dale Creek

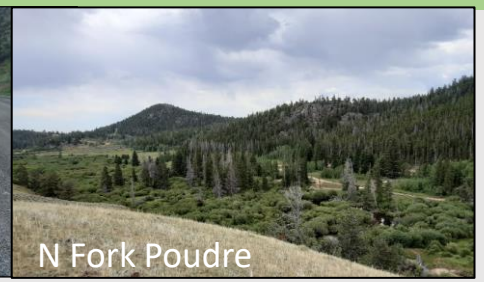
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions										
Large dams/reservoirs										
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads										
Rural/agricultural land use										
River crossings (bridges)										
Berms/channelization										
Bank/channel armor										
Channel structures										
Exotic plant species/weeds										
Beaver removal										
Logging										

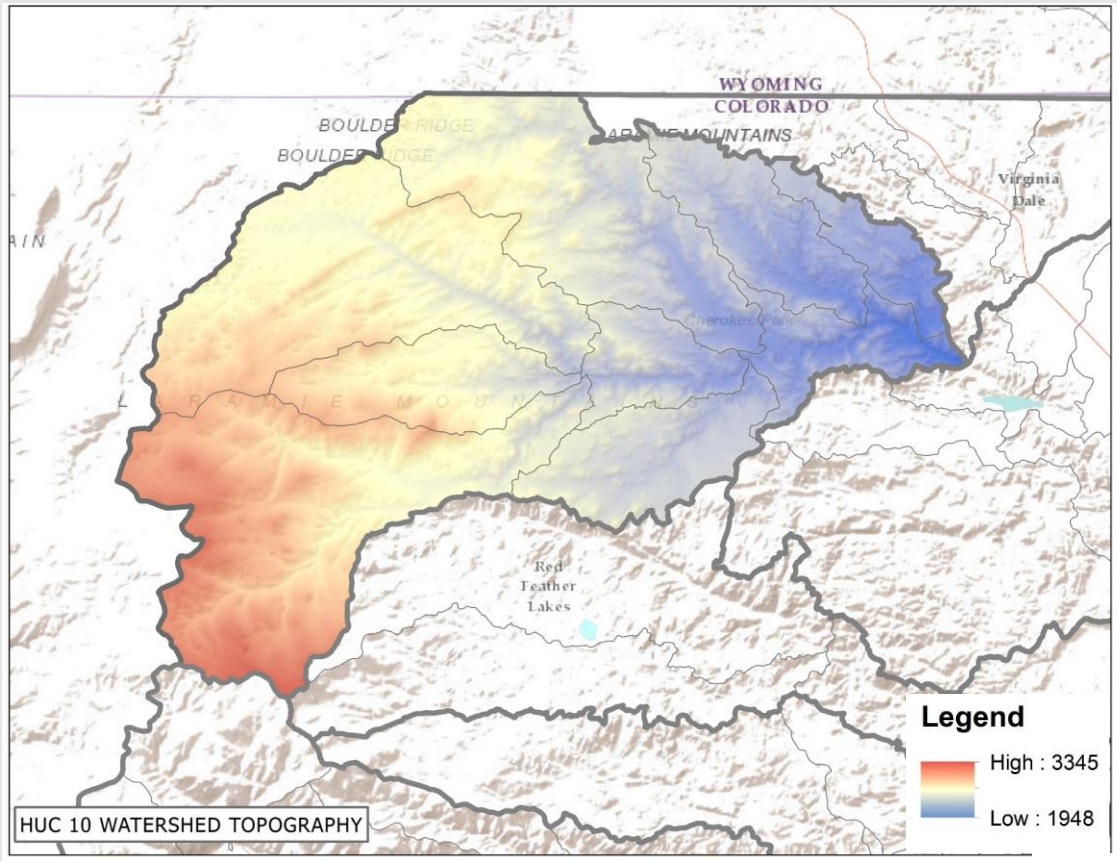
High Med Low

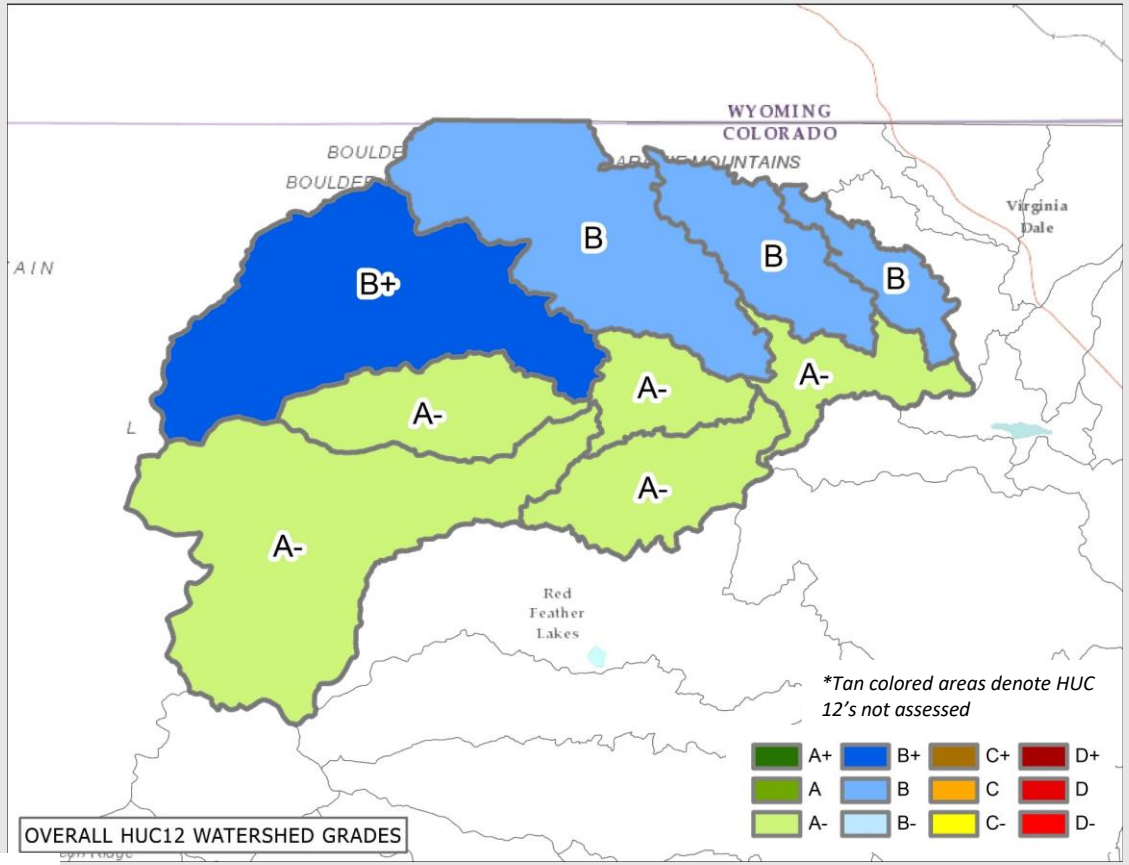
North Fork Watershed above Dale Creek

HUC-10 Watershed Grade

B+







North Fork Poudre above Halligan Reservoir

Flow Regime

Eaton and Pan Handle Reservoirs and small diversions for flood irrigation are minimally altering peak flow magnitude, frequency, and duration along the Upper North Fork of the Poudre. Base flows and flow variability would also be minimally altered from these stressors.

Sediment Regime

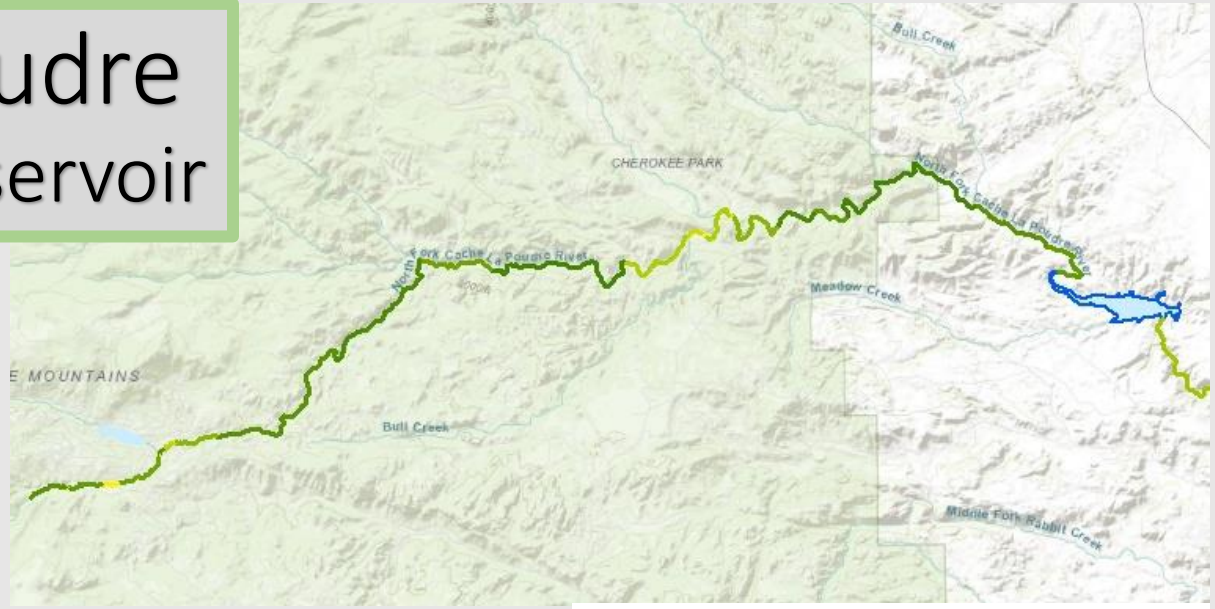
Agricultural land use and river crossings are minimally increasing sediment loads to the upper North Fork of the Poudre. Sediment transport continuity is relatively intact along the upper North Fork.

Water Quality

Agriculture, land use development, road crossings, and smaller reservoirs are causing minor impacts to temperature, phosphorus, and dissolved oxygen levels.

Riparian Condition

The riparian zone is typically narrow and intact. In several areas the valley bottom widens, and complex beaver habitat supports excellent health of the riverine system. Some areas where these habitats historically existed have been cleared for development, such as at Beaver Meadows Resort, or light agriculture.



Above, the North Fork near its headwaters is in excellent condition. Below, despite the fairly remote location, portions of the North Fork have been cleared, ponded and channelized.

North Fork Cache la Poudre River - Above Halligan Reservoir	
Flow regime	A-
Sediment regime	A-
Floodplain connectivity	A-
River Form	A
Riparian condition	B+
Channel Resilience	A-
Physical Structure	A-
Aquatic Insects	A
Water Quality	B+
Reach condition score	A-

River Form

River crossings and land use changes are altering the planform, channel dimension, and profile of the upper North Fork by encroaching upon the river. However, the spatial extent of these impacts is minimal.

Resilience

River crossings and land use changes (agriculture and development) are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal and most unaltered areas should be resilient.

Physical Structure

Land use changes and river crossings are altering coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from agriculture, development, and river crossings is altering channel embeddedness.

Aquatic Life

Minimal stressors are present and do not appear to be negatively impacting to macro-invertebrate populations.

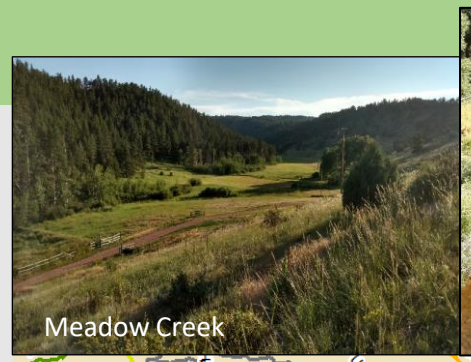
River Segment Grade

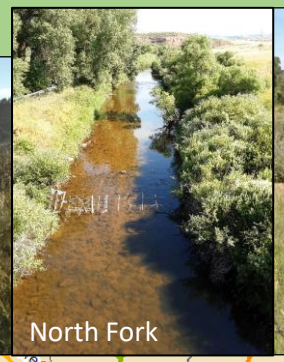
A-

North Fork Watershed below Halligan Reservoir

HUC-10 Watershed Grade

B-





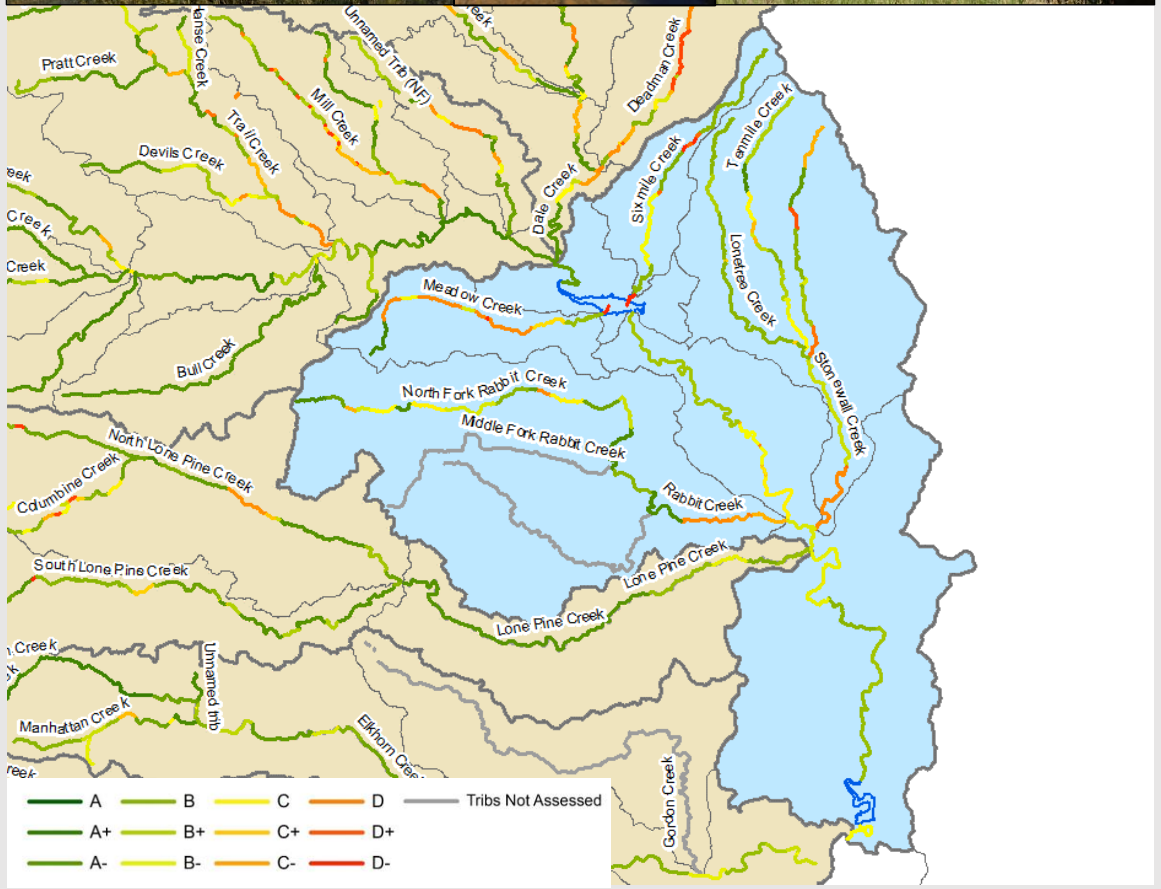
Land cover and use

Predominately private lands with notable State holdings throughout, and USFS lands on the north and south periphery. Natural landcover is predominately montane forests and woodland, and high plains. Light agriculture including haying and ranching are common in the valley bottoms.

With these land uses come alterations to the streams and riparian areas; willow clearing, channelization and beaver suppression are particularly common in this watershed. Stream condition tends to be punctuated with abrupt changes in condition following variation in land use or ownership.

Statistics

Watershed size = 149 sq. mi.
Length of streams = 85 mi.
Elevation range = 5,358 – 8,110 ft.



Stressors

Agriculture is the greatest stressor on streams in this watershed, not necessarily because of the local severity of impairment, but rather because of its ubiquity and the wide range of natural features it affects, including stream flow through diversions and irrigation, willow clearing, channelization and livestock impacts. While two major reservoirs exist in the watershed, they are both on North Fork and thus their impacts to the watershed as a whole are limited.

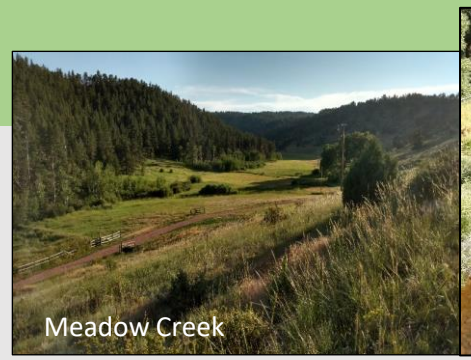
North Fork Watershed Below Halligan										
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)	High	High	High	High	High	High	High	High	High	High
Transbasin Diversions										
Large dams/reservoirs	High	High	High	High	Med	Med	High	Med	High	High
Wildfire/burn scars										
Irrigation runoff/return flows	Med	Med		Med				Med	High	Med
Buildings and roads			High	Med	Med		High		Med	High
Rural/agricultural land use	High	High	High	High	High	High	High	High	High	High
River crossings (bridges)		High	High	High	High	High	High	Med	Med	High
Berms/channelization										
Bank/channel armor	Med		Med	High	High	Med	High	Med	Med	High
Channel structures										
Exotic plant species/weeds							Med			Med
Beaver removal	Med	Med	Med	High	High	High	High		Med	High
Logging	Med	Med	Med	Med	Med	Med	Med		Med	Med

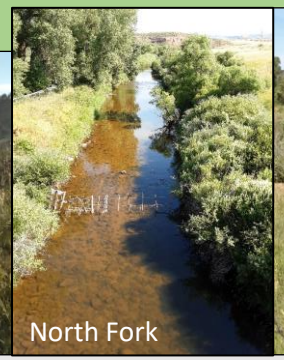
High Med Low

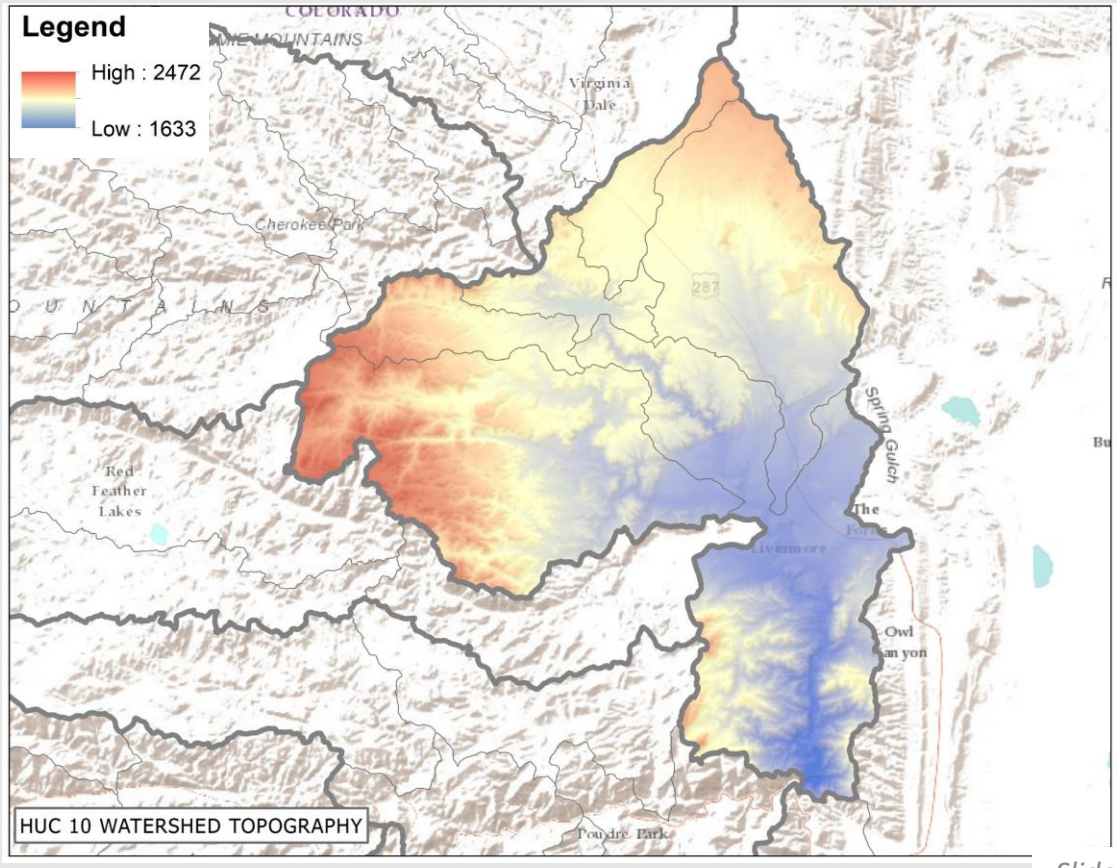
North Fork Watershed below Halligan Reservoir

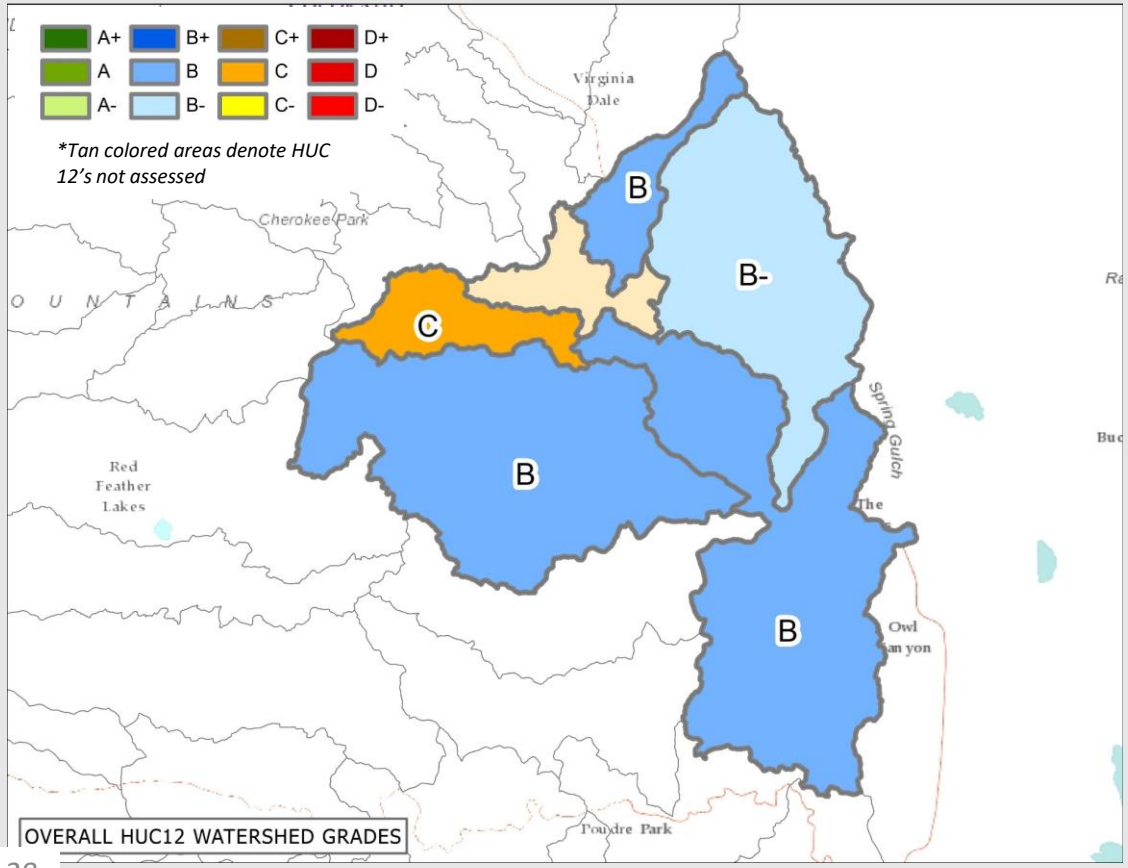
HUC-10 Watershed Grade

B-

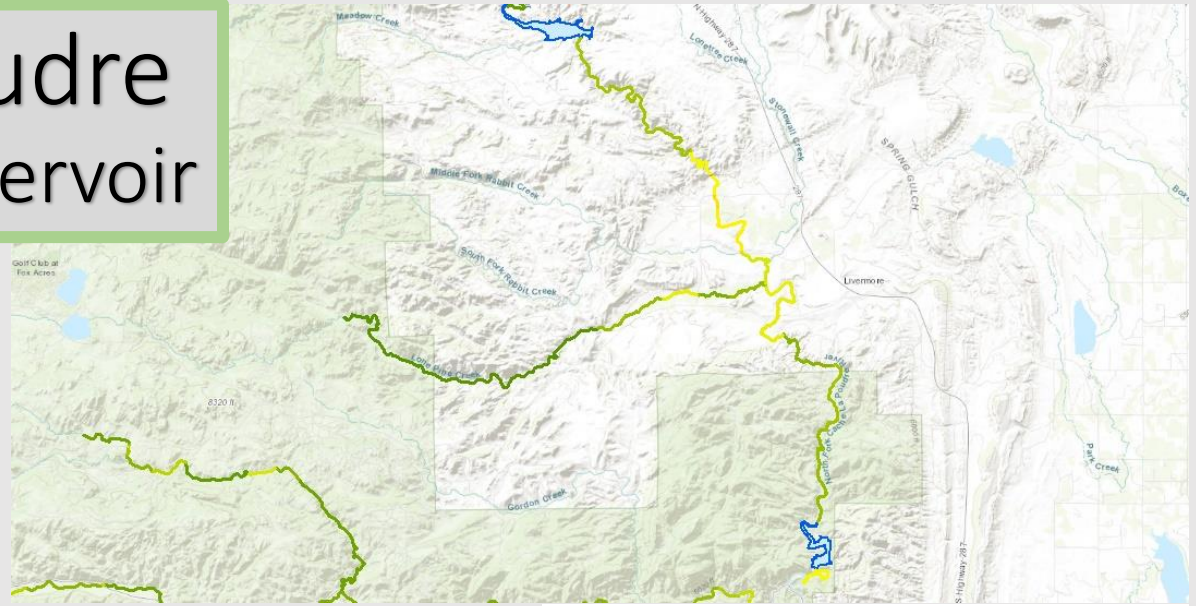








North Fork Poudre below Halligan Reservoir



Flow Regime

Halligan Reservoir, Seaman Reservoir, the North Poudre Canal, and numerous smaller diversions are severely altering peak flow magnitude, frequency, and duration along the North Fork of the Poudre. Base flows, water volume, and flow variability are also being altered by these stressors.

Sediment Regime

Agricultural land use and river crossings are increasing sediment loads to the North Fork of the Poudre. Sediment transport continuity is profoundly impaired by Halligan and Seaman Reservoirs.

Water Quality

The large reservoirs and their flow release operations are causing minor impacts to water temperatures along the North Fork.

Riparian Condition

There are three distinct reaches of the North Fork in this watershed that can be thought of as Phantom Canyon, Cherokee Park and Bonner Peak Canyon. The upper reach has narrow riparian zone with commonly excellent vegetation. Through Cherokee Park the riparian zone has been largely been converted to agriculture, however, a strip of riparian vegetation is usually maintained. Areas of wetland in this reach are commonly supported by irrigation return flows. In the Bonner Peak reach high quality habitat returns to the riparian zone. Most of the river below Halligan Reservoir is not publicly-accessible, however, numerous floodplain benches appear to have become isolated from the river through flow alterations. Agricultural practices exacerbate riparian zone losses.

North Fork Cache la Poudre River - Below Halligan Reservoir	
Flow regime	C
Sediment regime	B
Floodplain connectivity	B-
River Form	A-
Riparian condition	C
Channel Resilience	A-
Physical Structure	B
Aquatic Insects	A-
Water Quality	B
Reach condition score	B

River Form

River crossings and land use changes are altering the planform, channel dimension, and profile of the North Fork of the Poudre by encroaching upon the river. However, the spatial extent of these impacts is minimal. The channel form has adjusted over the past 110 years to its new flow and sediment regimes post-construction of Halligan Reservoir.

Resilience

River crossings and land use changes (agriculture and development) are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal.

Physical Structure

Land use changes and river crossings are altering coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from agriculture, development, and river crossings is minimally altering channel embeddedness.

Aquatic Life

Stressors are present but appear to be minimally altering to macro-invertebrate populations.

River Segment Grade

B

Dale Creek Watershed

HUC-10 Watershed Grade

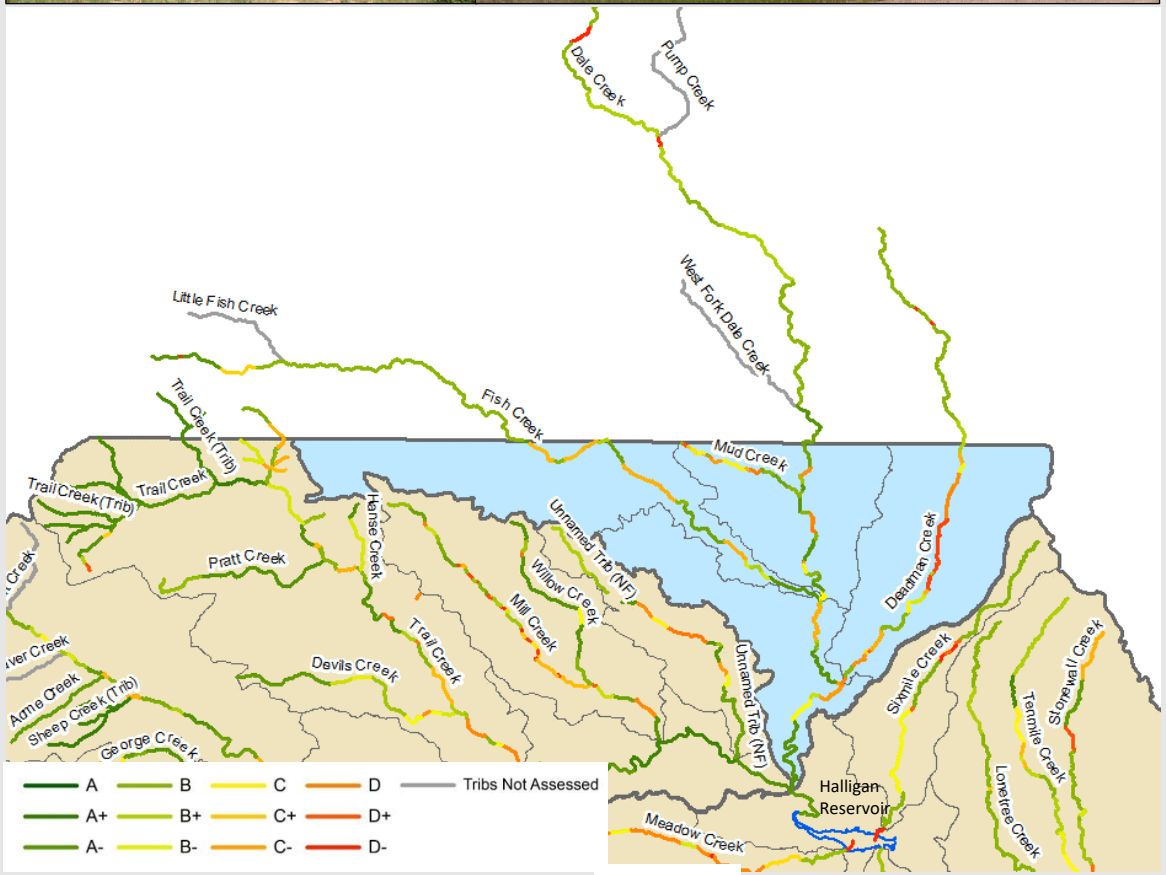
B

Land cover and use

Almost entirely privately held, the Dale Creek watershed has very little development and holds striking examples of high plains prairie and montane woodlands. Canyon reaches of the few streams generally hold excellent riparian and stream habitat. Where valley bottoms open, haying is the norm, but in most areas some riparian habitat is allowed to remain near the stream, helping to support aquatic health. Grazing occurs with little exception throughout the watershed.

Statistics

Watershed size = 42 sq. mi.
Length of streams = 65 mi.
Elevation range = 6,388 – 8,550 ft.



Stressors

Light agriculture and ranching are the predominate stressors on streams in the Dale Creek watershed. Although some locally severe agricultural/rural development impacts exist, most are moderate to light. Although none of the streams in the watershed are large, some are very well preserved.

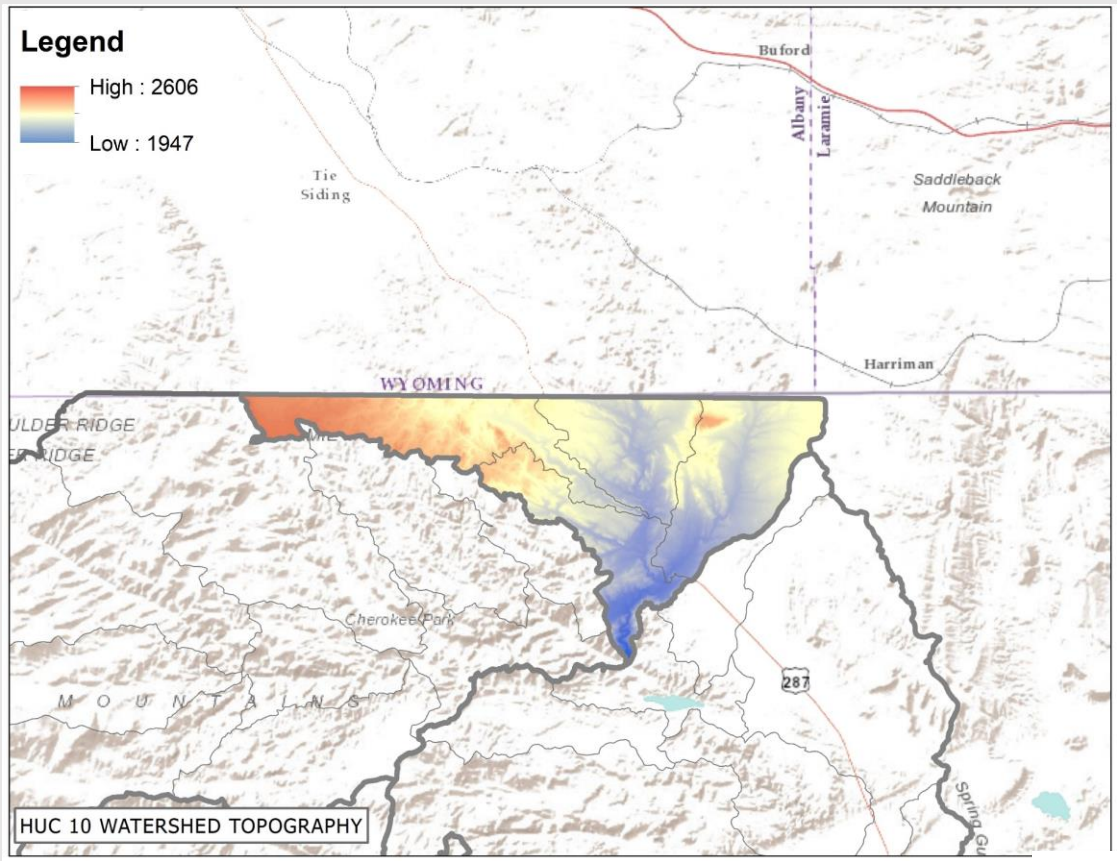
Dale Creek Watershed										
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions										
Large dams/reservoirs										
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads										
Rural/agricultural land use										
River crossings (bridges)										
Berms/channelization										
Bank/channel armor										
Channel structures										
Exotic plant species/weeds										
Beaver removal										
Logging										

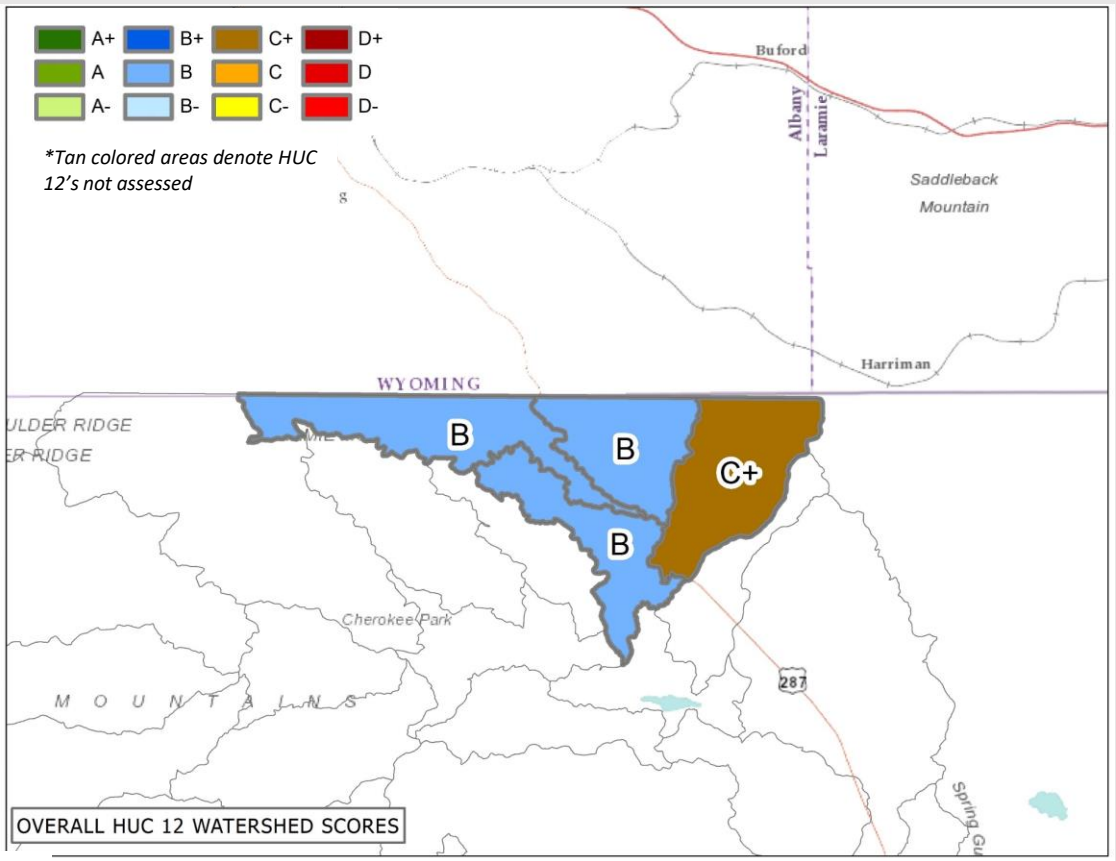
High Med Low

Dale Creek Watershed

HUC-10 Watershed Grade

B





Lone Pine Creek Watershed

HUC-10 Watershed Grade

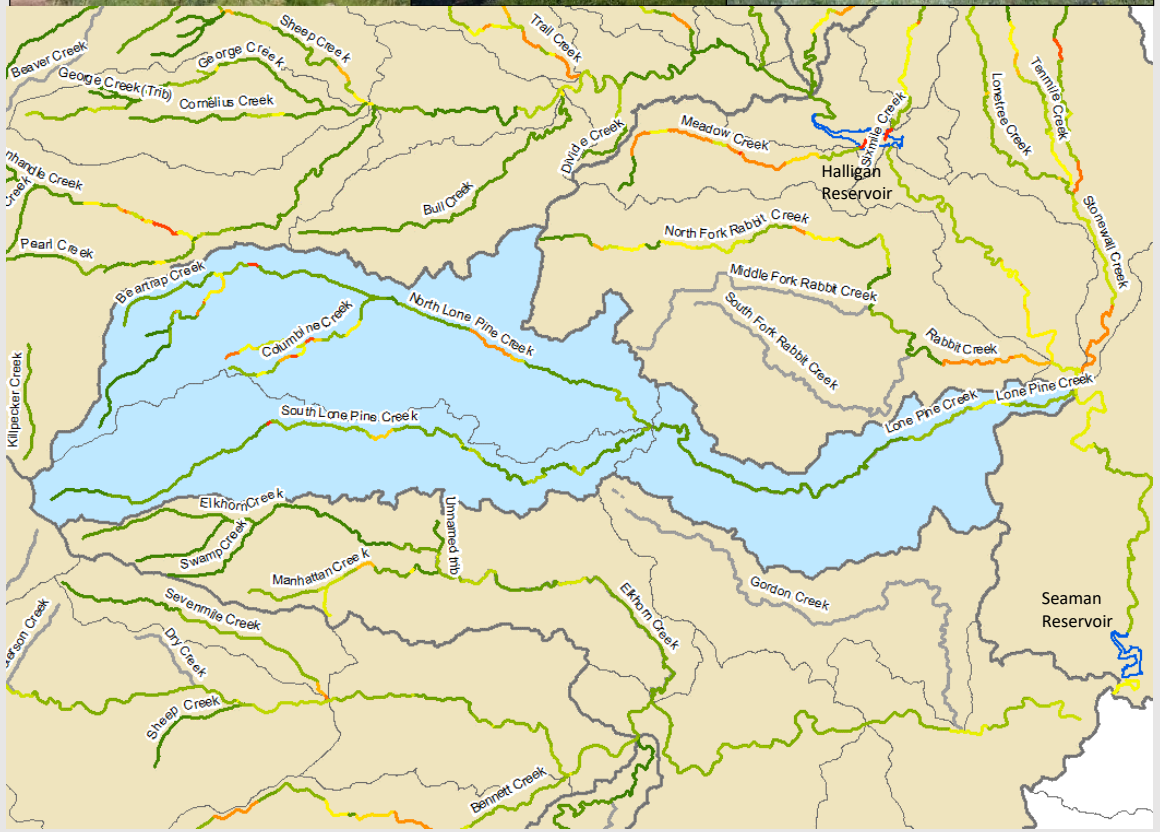
B+

Land cover and use

More that 50% of the Lone Pine watershed is managed by the USFS and much of that is in excellent condition. Other than the normal regional rural land uses including silviculture (mostly in the upper watershed), grazing and haying, the most notable land use alteration is the mountain settlement at Red Feather Lakes. In this area, modification of waterways is often severe, with a number of inline ponds and reservoirs along with clearing, channelization and hydrologic modification. At the lower end of the watershed much of the riparian corridor is being used for haying before joining the North Fork of the Poudre.

Statistics

Watershed size = 87 sq. mi.
Length of streams = 59 mi.
Elevation range = 5,761 – 11,001 ft.



Stressors

The main stressors in the upper part of the watershed are mainly from logging, while agricultural impacts are the predominant stressor in the lower part of the watershed near the confluence with the North Fork of the Poudre.

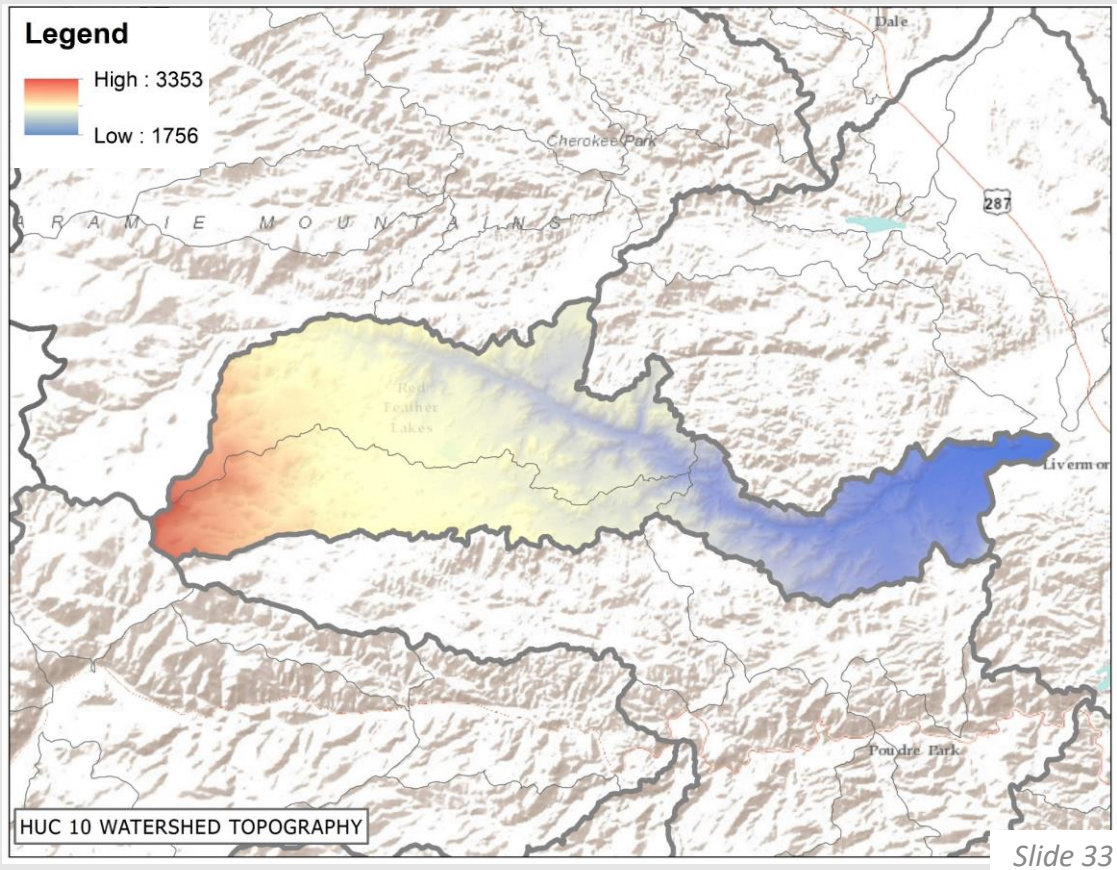
Lone Pine Creek Watershed										
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions										
Large dams/reservoirs										
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads										
Rural/agricultural land use										
River crossings (bridges)										
Berms/channelization										
Bank/channel armor										
Channel structures										
Exotic plant species/weeds										
Beaver removal										
Logging										

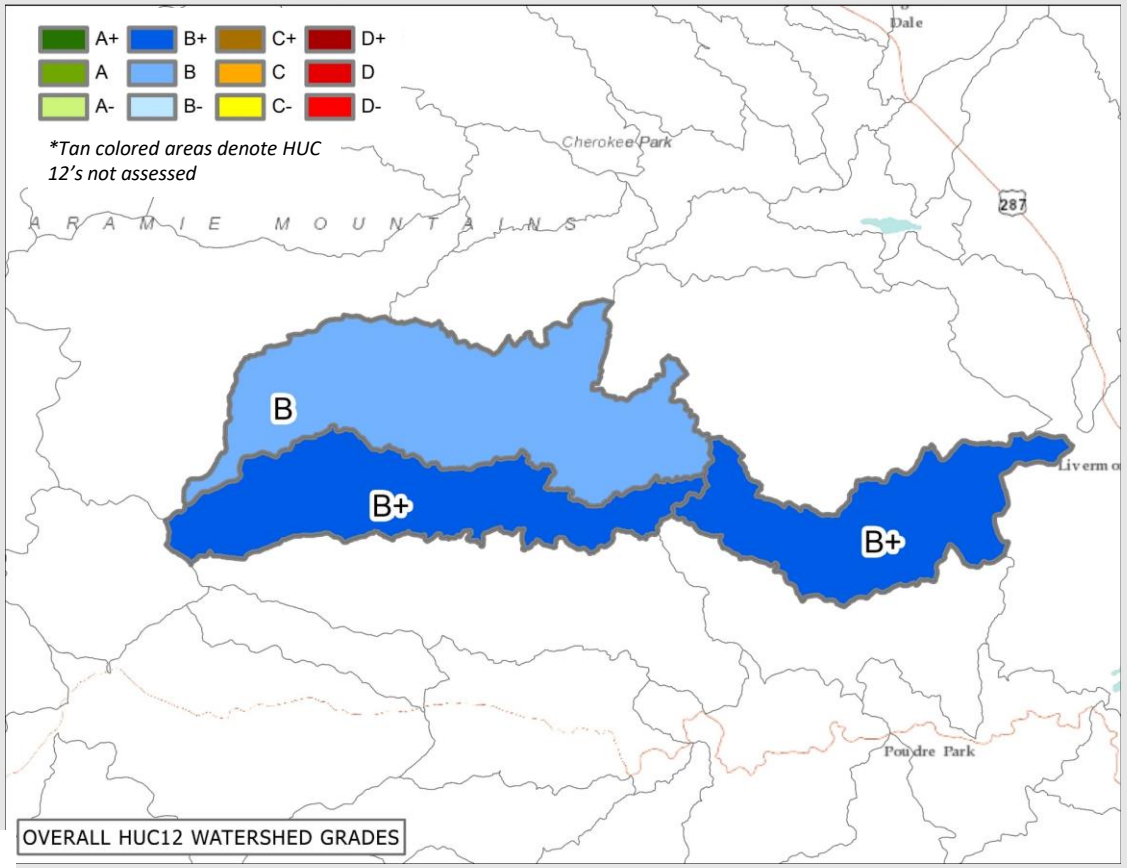
High Med Low

Lone Pine Creek Watershed

HUC-10 Watershed Grade

B+





Lone Pine Creek

Flow Regime

Small reservoirs and diversions for flood irrigation are minimally altering peak flow magnitude, frequency, and duration along the Upper North Fork of the Poudre. Base flows and flow variability would also be minimally altered from these stressors.

Sediment Regime

Agricultural land use and river crossings, including low water crossings, are increasing sediment loads to the Lone Pine Creek. Sediment transport continuity is relatively intact along Lone Pine Creek.

Water Quality

Land use and agriculture practices are negatively altering water temperature, dissolved oxygen, phosphorus, and nitrogen levels. Lone Pine Creek is on the Colorado Department of Public Health and Environment (CDPHE) Monitoring and Evaluation list for pH and Clean Water Act Section 303(d) for arsenic. More assessment is needed to determine the exact cause.

Riparian Condition

Riparian condition is largely very good. Below the confluence of the north and south forks, the stream is in excellent conditions. As it enters State land it passes through a cattle impacted reach, however these impacts diminish as the creek passes through the State Wildlife Area (SWA). Exiting the SWA, condition declines again as the stream enters private lands used for light agriculture.

Lone Pine Creek	
Flow regime	A
Sediment regime	A-
Floodplain connectivity	B+
River Form	B+
Riparian condition	B
Channel Resilience	B+
Physical Structure	A-
Aquatic Insects	A-
Water Quality	C
Reach condition score	B+

River Form

Agricultural land use is encroaching upon Lone Pine Creek in areas and is negatively altering the planform, channel dimension, and profile of the channel by altering streamside vegetation, local hydrology, and sediment input.

Resilience

River crossings and agricultural land use are minimally altering channel stability and the potential for the river to recover on its own after flood events.

Physical Structure

Land use changes and river crossings are altering coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from agriculture, development, and river crossings is minimally altering channel embeddedness.

Aquatic Life

Stressors are present but only appear to be minimally affecting macro-invertebrate populations.

River Segment Grade

B+

Cache la Poudre Watershed Headwaters to the South Fork

HUC-10 Watershed Grade

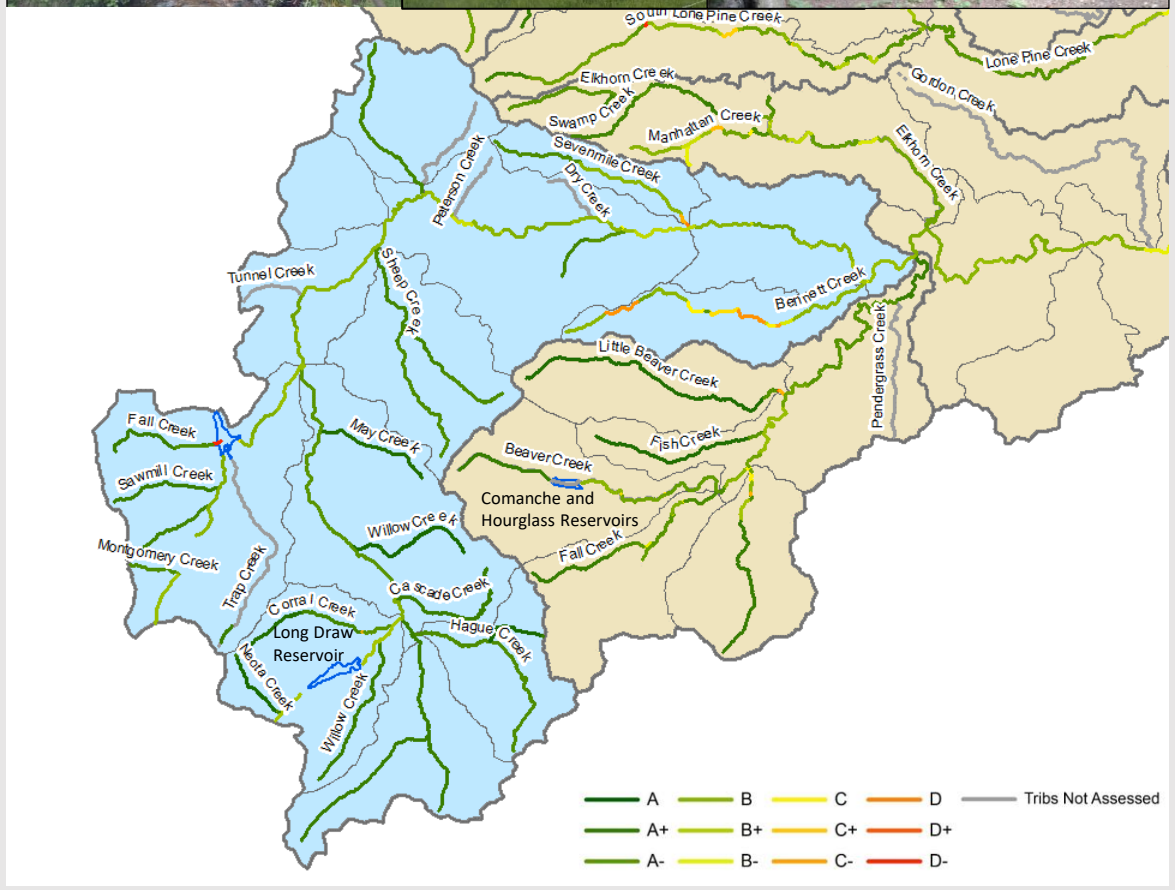
A-

Land cover and use

The Headwaters of the Poudre Watershed is a gem of Colorado. Beginning at the Continental Divide, the watershed is with small exceptions entirely managed by USFS or US NPS. This watershed also holds the majority of the Wilderness in the Poudre Sub-Basin. As such most of the watershed is managed as wildland covered by montane and subalpine forest. Recreation seems the most prevalent land use in the watershed although limited silviculture is present. Being a headwater watershed above major urban centers an important land use in the watershed is for water supply infrastructure and reservoirs. Colorado's oldest transbasin diversion, the Grand Ditch, connects to La Poudre Pass Creek, and four major reservoirs are located high in the watershed.

Statistics

Watershed size = 268 sq. mi.
Length of streams = 158 mi.
Elevation range = 6,552 – 13,571



Stressors

Stressors are unevenly distributed through the watershed. Some logging is certainly on going but its impacts are limited. Water supply reservoirs are an important impairment on several tributaries. In this watershed, recreation becomes an important stressor on some creeks. Bennett Cr has particularly suffered from heavy dispersed camping impacts.

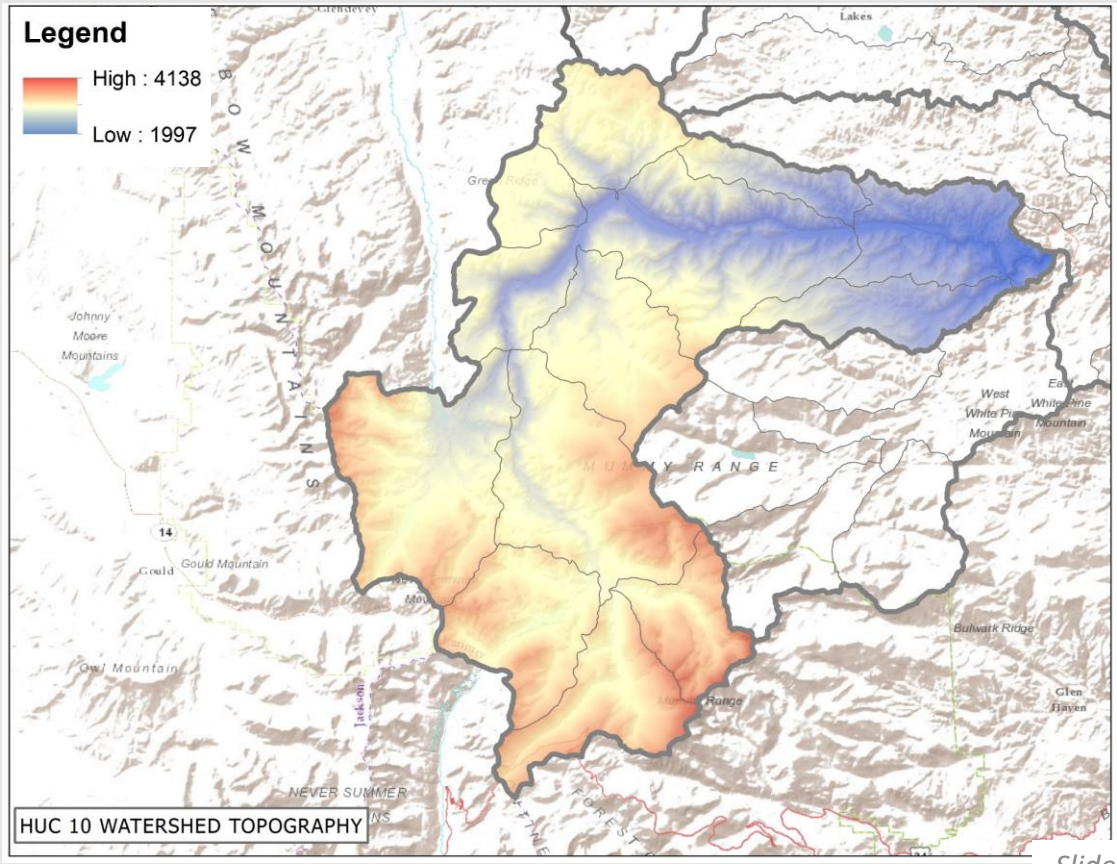
Cache la Poudre Watershed Headwaters to Little South Fork										
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions	High	High		High	Low					High
Large dams/reservoirs	High	High	High	Low	Low	Low	High	Low	Low	High
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads		Low	High	High	High		High			High
Rural/agricultural land use			High	High	High		High			High
River crossings (bridges)		High	High	High	High	High	High	Low	Low	High
Berms/channelization										
Bank/channel armor		High	High	High	High	Low	High		Low	High
Channel structures										
Exotic plant species/weeds							High			Low
Beaver removal	Low	Low	Low	Low	Low	Low	Low		Low	Low
Logging	Low	Low		Low	Low	Low			Low	Low

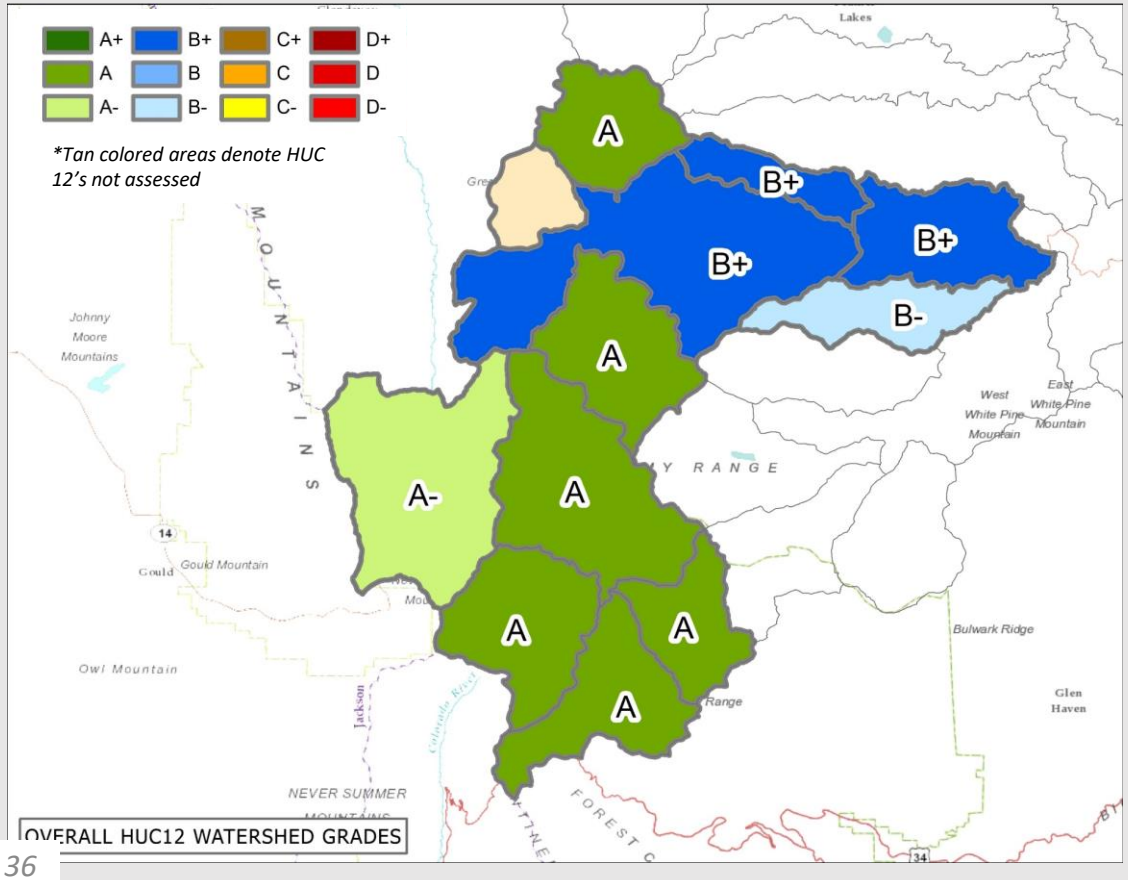
High Med Low

Cache la Poudre Watershed Headwaters to the South Fork

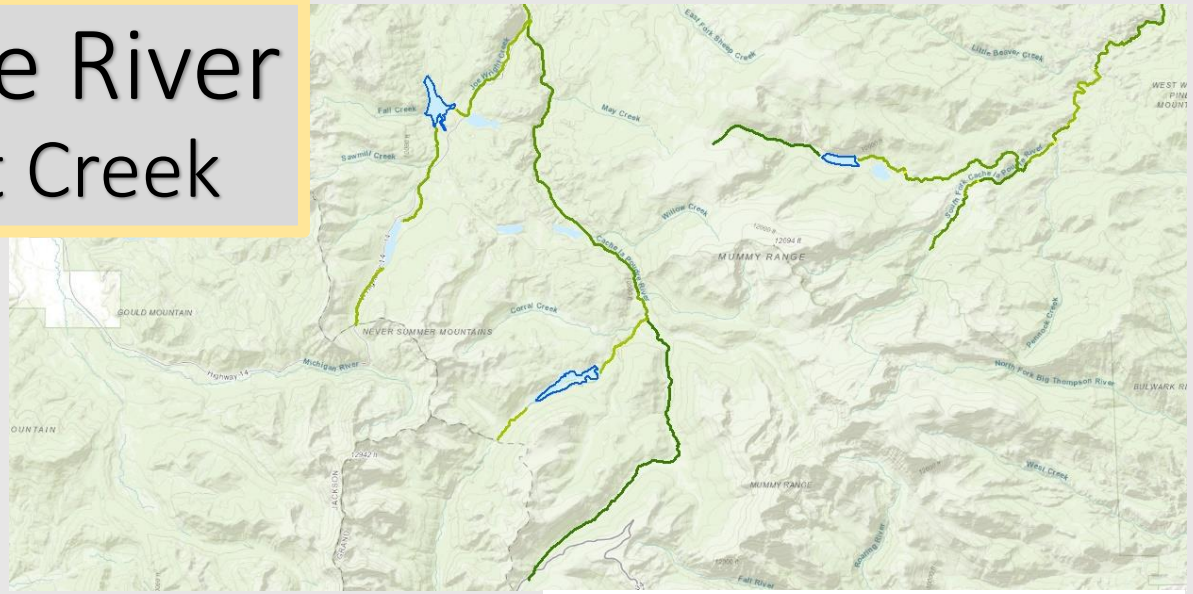
HUC-10 Watershed Grade

A-





Cache la Poudre River above Joe Wright Creek



Flow Regime

The Grand Ditch and Long Draw Reservoir are altering peak flow magnitude, frequency, and duration along the Upper Poudre River. Base flows and flow variability are also being altered from these stressors. The Poudre above these stressors is relatively unaltered and makes up more than half of the final score.

Sediment Regime

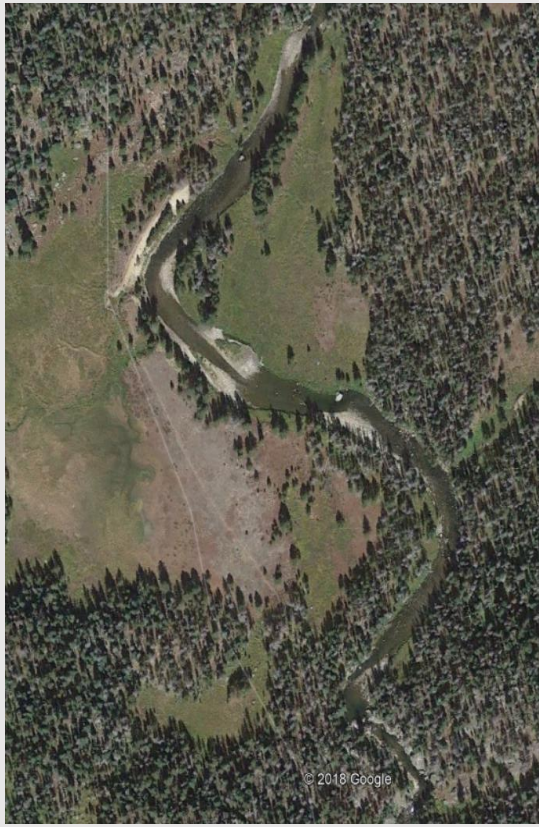
Land erosion, channel erosion, and sediment continuity is relatively unaltered along the Upper Poudre River.

Water Quality

Reservoir operations and flow augmentation in the watershed upstream are minimally altering water temperatures along the Poudre River here.

Riparian Condition

This reach of the river includes its headwaters in RMNP, which is managed as Wilderness, followed by a long reach through the Comanche Wilderness. Other that minor, near-stream recreational impacts, the riparian habitat appears intact and in largely outstanding condition.



Cache la Poudre River above Joe Wright Creek	
Flow regime	A-
Sediment regime	A
Floodplain connectivity	A
River Form	A
Riparian condition	A
Channel Resilience	A
Physical Structure	A
Aquatic Insects	B+
Water Quality	A-
Reach condition score	A

River Form

Besides the HWY 14 river crossing, channel planform, dimension, and profile are relatively unaltered along the Upper Poudre River.

Resilience

Channel stability and recovery are relatively unaltered along the Upper Poudre River.

Physical Structure

Increased sediment delivery to the river from old beaver meadow complexes are minimally altering channel embeddedness. Coarse structure is also minimally impacted by more homogenous habitat in these areas where old beaver dams have blown out .

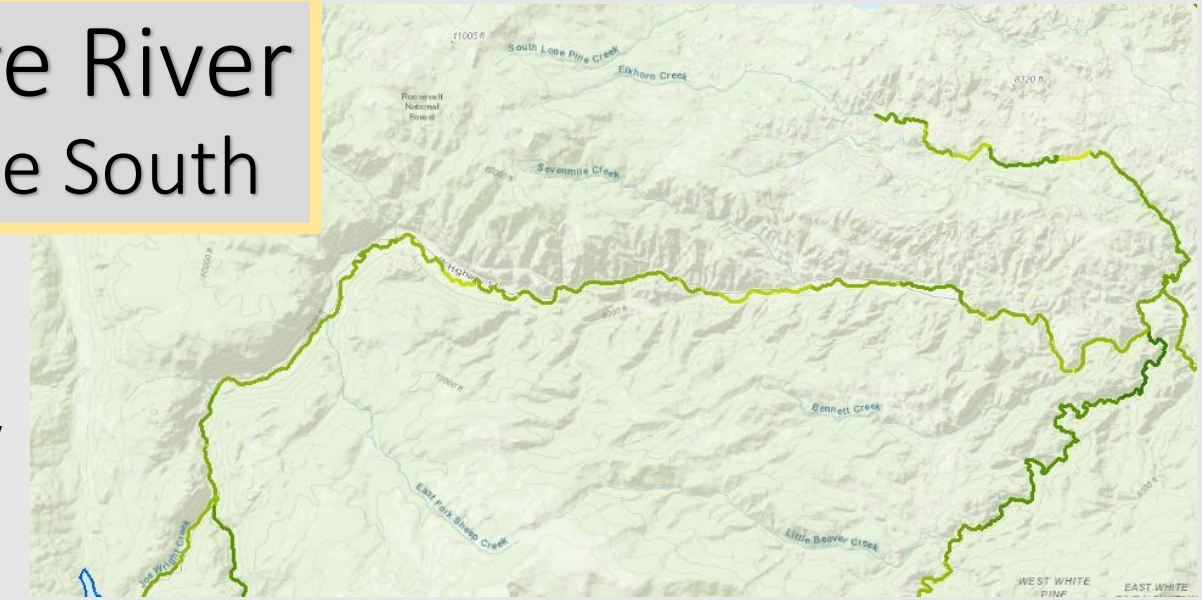
Aquatic Life

Minimal stressors are present, but it does appear that macro-invertebrate populations are being minimally impacted. More investigation is needed.

River Segment Grade

A

Cache la Poudre River
Joe Wright to Little South



Flow Regime
Large Reservoirs and trans-basin diversions in the upper watershed are altering peak flow magnitude, frequency, and duration along the Poudre River here. Base flows and flow variability are also being altered by these stressors.

Sediment Regime
Sediment transport continuity is altered by numerous large reservoirs cutting off sediment supply. River crossings are increasing sediment delivery to the channel, but the surrounding land erosion is relatively unaltered.

Water Quality
Reservoir operations and flow augmentation in the watershed upstream are minimally altering water temperatures along the Poudre River here.

Riparian Condition
Riparian through this habitat is generally quite narrow throughout this reach, with the notable exception of the stretch near the CPW fish hatchery. Ironically, this management facility was placed in what was probably the largest headwater wetland complex along the mainstem of the Poudre. Despite the impact, some high-quality habitats remain in the area. Highway 14 is no doubt the greatest impact on Poudre River riparian habitats in this reach.


Near Sportman's Lodge


Above the hatchery

Cache la Poudre River - Joe Wright Creek to Little South Fork	
Flow regime	B
Sediment regime	A-
Floodplain connectivity	B+
River Form	B+
Riparian condition	B
Channel Resilience	B+
Physical Structure	B+
Aquatic Insects	B
Water Quality	A-
Reach condition score	B+

River Form
Bank armoring, land use development, and river crossings are negatively altering the planform, channel dimension, and profile of the Poudre River here. However, the spatial extent of these impacts is relatively small.

Resilience
Bank armoring, river crossings, and land use development limit the channel adjustment, floodplain connection, and vegetation needed for the river to recover on its own after flood events. The channel is generally stable or has bank armoring in place to slow erosion.

Physical Structure
Bank armor, land use development, and river crossings are altering coarse channel structure by creating more homogenous areas of river channel and decreasing wood supply into the channel. Removal of large boulders from the river channel for use as bank armor has also simplified aquatic habitat.

Aquatic Life
Minimal stressors are present, but it does appear that macro-invertebrate populations are being minimally impacted by something.

River Segment Grade

B+

Joe Wright Creek

Flow Regime

Numerous large reservoirs and trans-basin diversions are altering peak flow magnitude, frequency, and duration along Joe Wright Creek. Base flows and flow variability are also altered from these stressors.

Sediment Regime

Large reservoirs and river crossings are negatively altering sediment transport continuity. Flow augmentation and alteration has led to minimal channel erosion. Land erosion is relatively unaltered.

Water Quality

Reservoir operations and flow augmentation in the watershed upstream are minimally altering dissolved oxygen levels along the Poudre River here.

Riparian Condition

The riparian zone along Joe Wright Cr is generally narrow or non-existent. Flow regime alteration has no doubt had some effect on riparian condition, but those effects a minimal or otherwise difficult to detect. Highway 14 and associated fill is the major impact to this stream's riparian area.


Michigan Ditch


Above Joe Wright Reservoir

Joe Wright Creek		
Flow regime	C	
Sediment regime	A-	
Floodplain connectivity	A	
River Form	A-	
Riparian condition	B+	
Channel Resilience	A-	
Physical Structure	A-	
Aquatic Insects	B	
Water Quality	A-	
Reach condition score	B	

River Form

River crossings are altering the planform, channel dimension, and profile of Joe Wright Creek. However, the spatial extent of these impacts is minimal.

Resilience

River crossings and the Highway 14 are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal and most unaltered areas should be resilient.

Physical Structure

River crossings and flow alteration are altering coarse channel structure by creating more homogenous areas of river channel. Slight increase of sediment delivery to the river from river crossings is minimally altering channel embeddedness.

Aquatic Life

Minimal stressors are present and are only minimally altering macro-invertebrate populations.

River Segment Grade

B

La Poudre Pass Creek

Flow Regime

The Grand Ditch and Long Draw Reservoir are altering peak flow magnitude, frequency, and duration along the La Poudre Pass Creek. Base flows and flow variability are also being altered from these stressors.

Sediment Regime

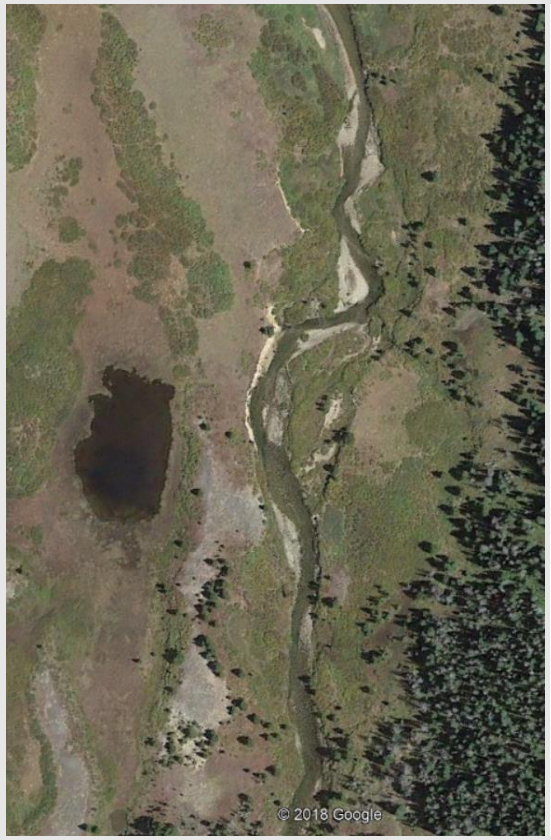
Long Draw Reservoir and the Grand Ditch are negatively altering sediment continuity and channel erosion. Land erosion is relatively unaltered.

Water Quality

Water quality is relatively unaltered along La Poudre Pass Creek.

Riparian Condition

Despite its remote location, the riparian habitats along La Poudre Pass Creek have suffered from water management infrastructure and practices, as well as pockets of substantial recreational impacts.



La Poudre Pass Creek	
Flow regime	C
Sediment regime	B+
Floodplain connectivity	A-
River Form	B+
Riparian condition	B-
Channel Resilience	A-
Physical Structure	B
Aquatic Insects	A-
Water Quality	A
Reach condition score	B

River Form

The altered flow and sediment regimes have impacted channel dimension, planform, and profile. This is especially true upstream of Long Draw Reservoir.

Resilience

The altered flow and sediment regimes have impacted channel stability. The ability for the channel to recover after large flood events is relatively unaltered.

Physical Structure

The altered flow and sediment regimes are altering coarse channel structure by increasing sediment levels to the channel from bank erosion which is creating more over-widened and homogenous areas of river channel. Increased sediment delivery from the bank erosion is altering channel embeddedness.

Aquatic Life

Minimal stressors are present and only appear to be minimally altering macro-invertebrate populations.

River Segment Grade

B

Cache la Poudre Watershed – S Fork to N Fork

HUC-10 Watershed Grade

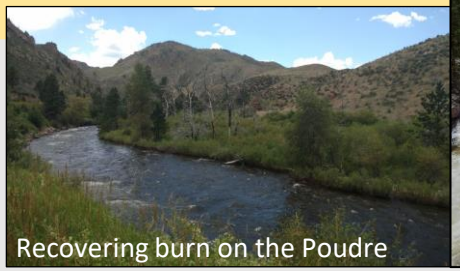
B+

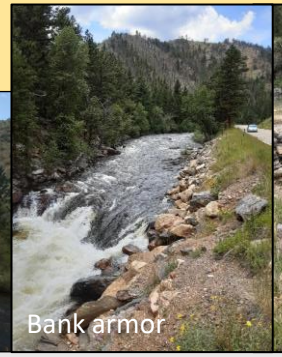
Land cover and use

More than 50% of this watershed is managed by USFS and land cover is predominately montane to subalpine forest and woodland. Most of the land is managed as wildland and the high quality of many riverine habitats reflects this. Scattered rural developments particularly the Poudre and Gordon Creek seem to be the most prevalent land cover change occurring in the watershed. Most of the watershed is used as rangeland, but in most areas the grazing appears well managed. Some areas of concentrated grazing on private lands cause local or cumulative impacts to affected tributaries.

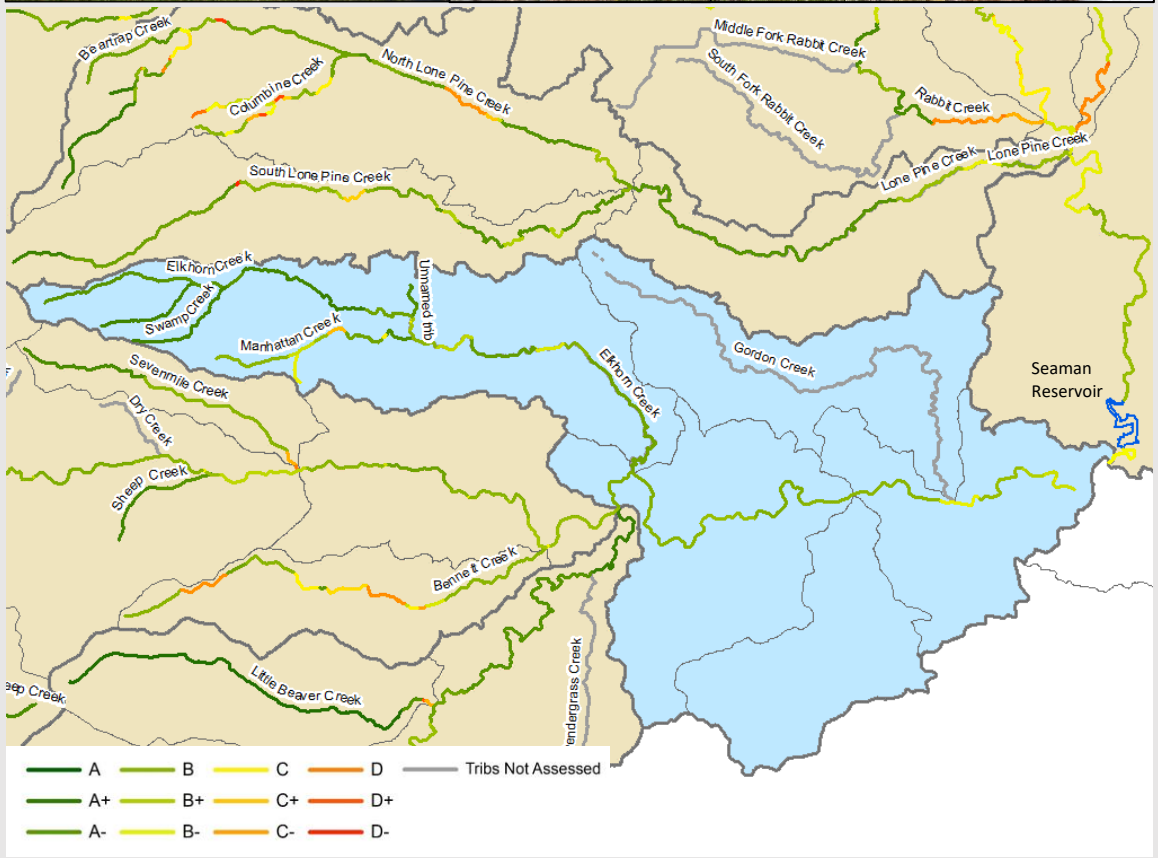
Statistics

Watershed size = 113 sq. mi.
Length of streams = 36 mi.
Elevation range = 5,361 – 10,978


Recovering burn on the Poudre


Bank armor


Bridge crossing



Stressors

The most notable stress occurring in this watershed in recent history were the Hewlett Gulch and High Park wildfires. Although severe events, lingering stress on streams riparian areas was scarcely observed, although it may still occur on some un-surveyed streams. Highway 14 is the most significant stressor on the mainstem in this reach.

Cache la Poudre Watershed Little South Fork to North Fork

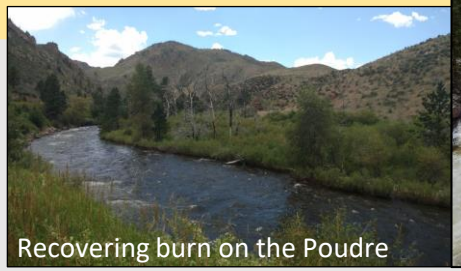
Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions										
Large dams/reservoirs										
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads										
Rural/agricultural land use										
River crossings (bridges)										
Berms/channelization										
Bank/channel armor										
Channel structures										
Exotic plant species/weeds										
Beaver removal										
Logging										

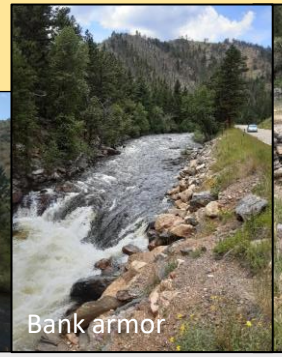
High Med Low

Cache la Poudre Watershed – S Fork to N Fork

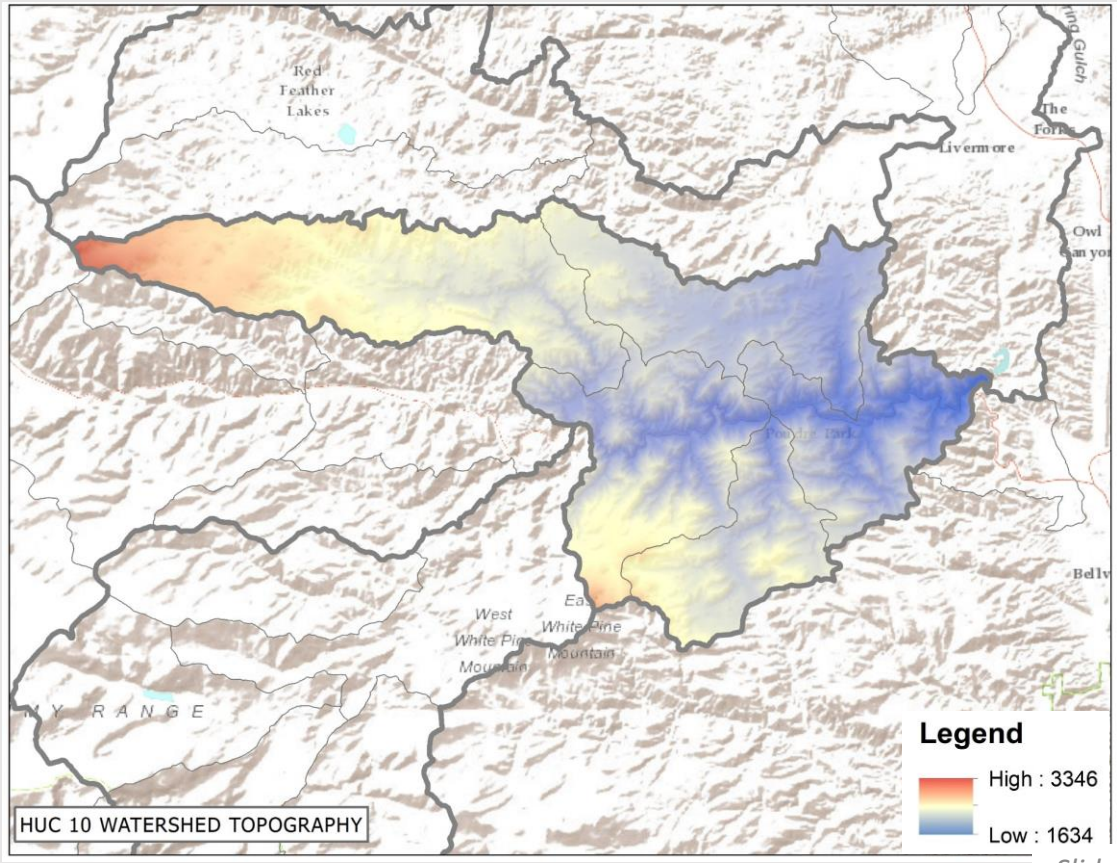
HUC-10 Watershed Grade

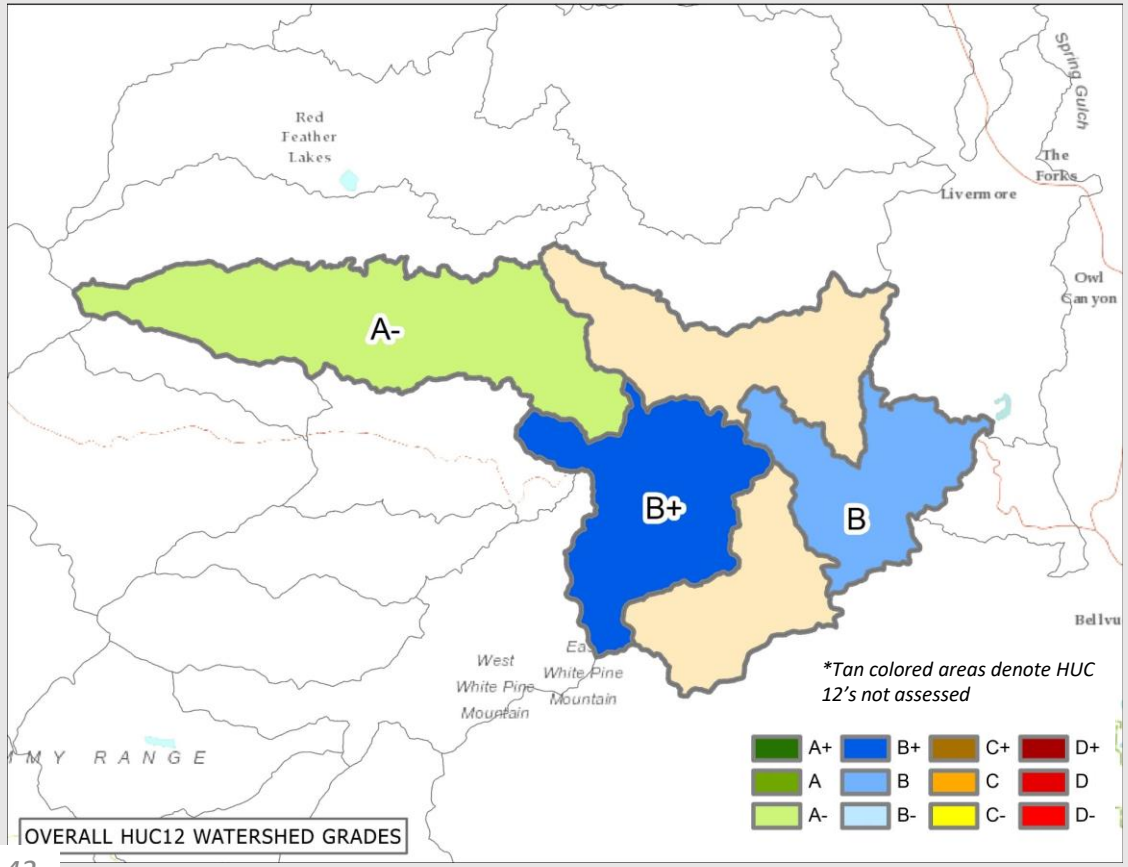
B+


Recovering burn on the Poudre

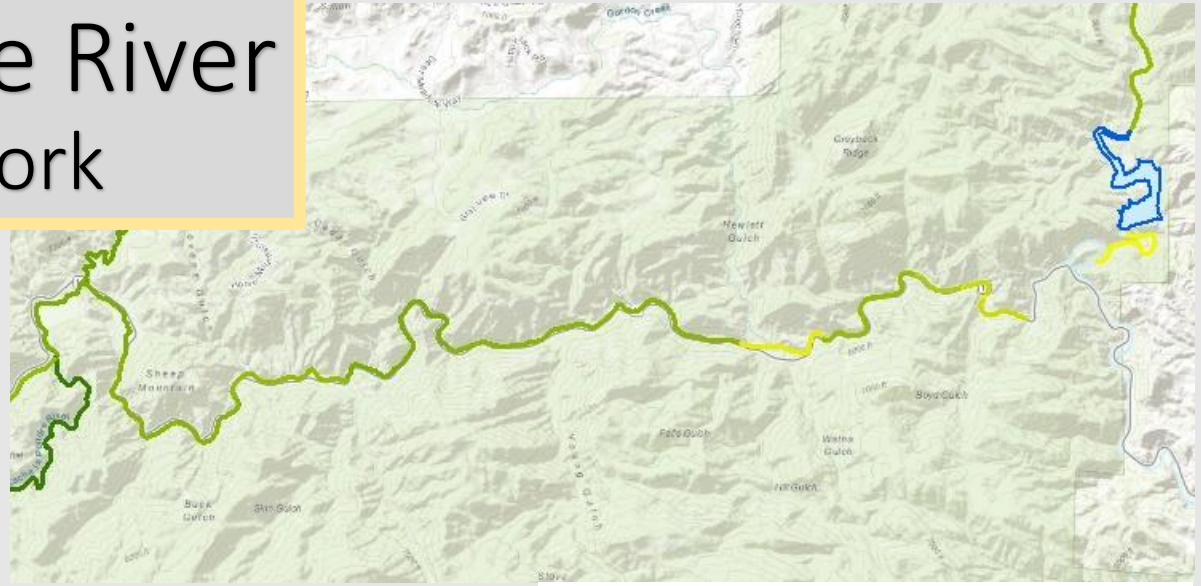

Bank armor


Bridge crossing





Cache la Poudre River
S. Fork to N. Fork



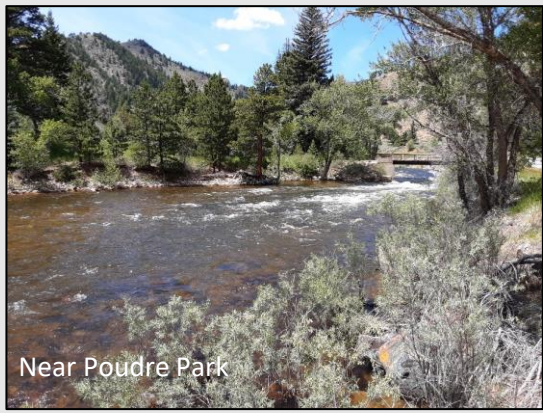
Flow Regime
Multiple large reservoirs and trans-basin diversions in the upstream watershed are altering peak flow magnitude, frequency, and duration. Base flows and flow variability are also altered from these stressors.

Sediment Regime
Land use development and Highway 14 are altering sediment delivery to the channel. Sediment transport continuity is relatively intact along this section of the river.

Water Quality
Flow alteration and augmentation from reservoirs and trans-basin diversion are negatively altering water temperature and dissolved oxygen levels along the Poudre here. On a smaller scale land use development and infrastructure are minimally affecting water quality.

Riparian Condition
The riparian habitat along this reach of the naturally narrow or non-existent (see pictures). In general, remaining habitat is in good to excellent condition but much of the riparian habitat on the road-ward side has been destroyed by the construction of the road. The habitat on the bank opposite the road is almost uniformly in reference standard condition


Near Hewlett Gulch


Near Poudre Park

Cache la Poudre River - South Fork to North Fork	
Flow regime	B+
Sediment regime	A-
Floodplain connectivity	B
River Form	B
Riparian condition	B-
Channel Resilience	B
Physical Structure	B
Aquatic Insects	A-
Water Quality	B+
Reach condition score	B

River Form
Bank armoring, road fill, and river crossings are negatively altering the planform, channel dimension, and profile of the Poudre River here. However, the spatial extent of these impacts is relatively small.

Resilience
Bank armoring, road fill, and river crossings limit the channel adjustment, floodplain connection, and vegetation needed for the river to recover on its own after flood events. The channel is generally stable or has bank armoring in place to slow erosion.

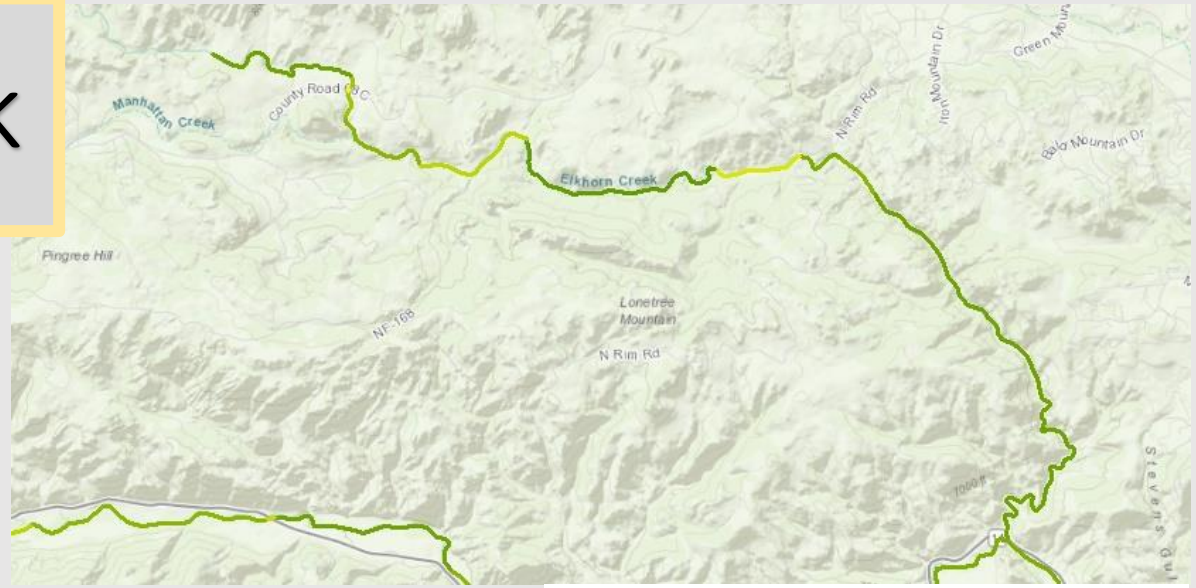
Physical Structure
Bank armor, land use development, and river crossings are altering coarse channel structure by creating more homogenous areas of river channel and decreasing wood supply into the channel. Removal of large boulders from the river channel for use as bank armor has also simplified aquatic habitat.

Aquatic Life
Stressors are present but only appear to be minimally altering macro-invertebrate populations.

River Segment Grade

B

Elkhorn Creek



Flow Regime

Numerous small reservoirs and diversions for flood irrigation are altering peak flow magnitude, frequency, and duration along the Elkhorn Creek. Base flows and flow variability are also being altered by these stressors.

Sediment Regime

Agricultural land use and numerous gravel road crossings are increasing sediment loads to Elkhorn Creek. Sediment transport continuity is minimally impacted by the diversions

Water Quality

Flow alteration from small reservoirs and flood irrigation diversions, land use and agriculture practices, and gravel road crossings are minimally affecting water quality along Elkhorn Creek.

Riparian Condition

The majority of Elkhorn Creek is in excellent to outstanding condition. Pockets of isolated rural development, small inline ponds and some haying constitute the main detectable impacts to these habitats.

Elkhorn Creek	
Flow regime	B
Sediment regime	B+
Floodplain connectivity	A-
River Form	A-
Riparian condition	B+
Channel Resilience	A-
Physical Structure	B+
Aquatic Insects	A-
Water Quality	B+
Reach condition score	B+

River Form

Agricultural land use and river crossings and are altering the planform, channel dimension, and profile of Elkhorn creek by encroaching upon the river and altering streamside vegetation, local hydrology, and sediment input.

Resilience

River crossings and land use changes (agriculture and development) are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal and most unaltered areas should be resilient.

Physical Structure

Agricultural land use and river crossings are altering coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from agriculture, development, and river crossings are altering channel embeddedness.

Aquatic Life

Stressors are present but only appear to be minimally altering macro-invertebrate populations.

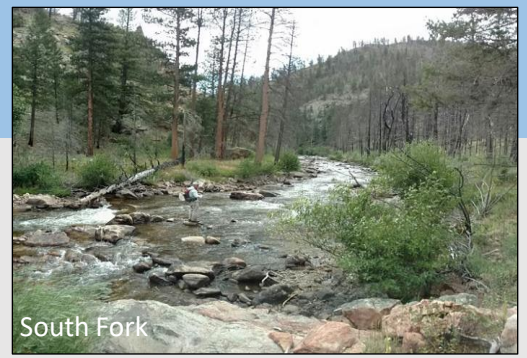
River Segment Grade

B+

South Fork Watershed

HUC-10 Watershed Grade

A-


South Fork

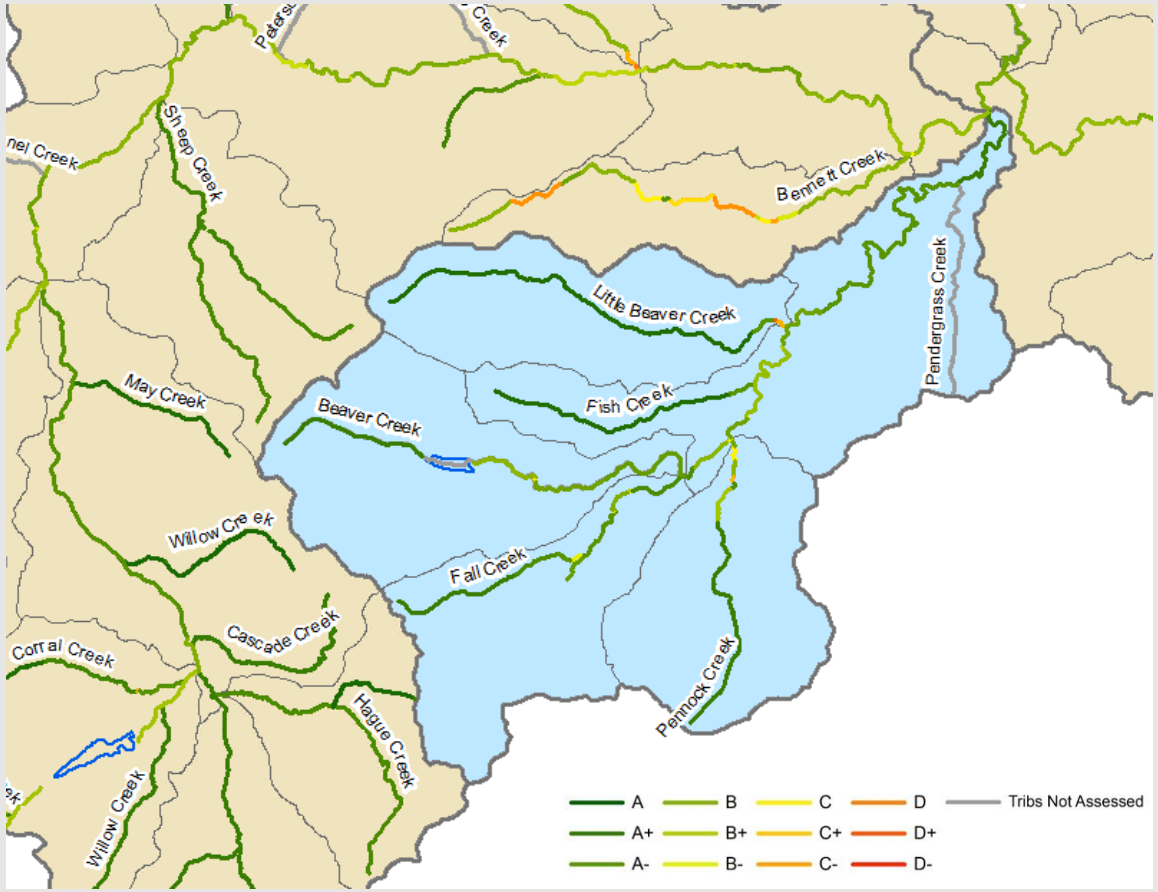

High Park fire at Pingree

Land cover and use

The vast majority of the South Fork watershed is managed by USFS, with most of the major tributaries beginning in or flowing through Comanche Peaks Wilderness Area. As such, most of the watershed is covered by montane and subalpine habitats, although much of the watershed burned.

Statistics

Watershed size = 104 sq. mi.
Length of streams = 58 mi.
Elevation range = 6,552 – 13,392



Stressors

The best-known stress occurring in this watershed in recent history High Park fire. Although a severe event, lingering stress on streams and riparian areas was scarcely observed, although it may still occur on some un-surveyed streams. The CSU Mountain campus is a notable stressor on Fall Creek, while Comanche and Hourglass Reservoirs affects flows on Beaver Creek and therefore the South Fork.

Little South Fork Watershed

Stressors	Flow Regime	Sediment Regime	Floodplain Connectivity	River Form	Channel Resilience	Physical Structure	Riparian Condition	Aquatic Insects	Water Quality	River Health
Diversions (withdrawals)										
Transbasin Diversions										
Large dams/reservoirs										
Wildfire/burn scars										
Irrigation runoff/return flows										
Buildings and roads										
Rural/agricultural land use										
River crossings (bridges)										
Berms/channelization										
Bank/channel armor										
Channel structures										
Exotic plant species/weeds										
Beaver removal										
Logging										

High Med Low

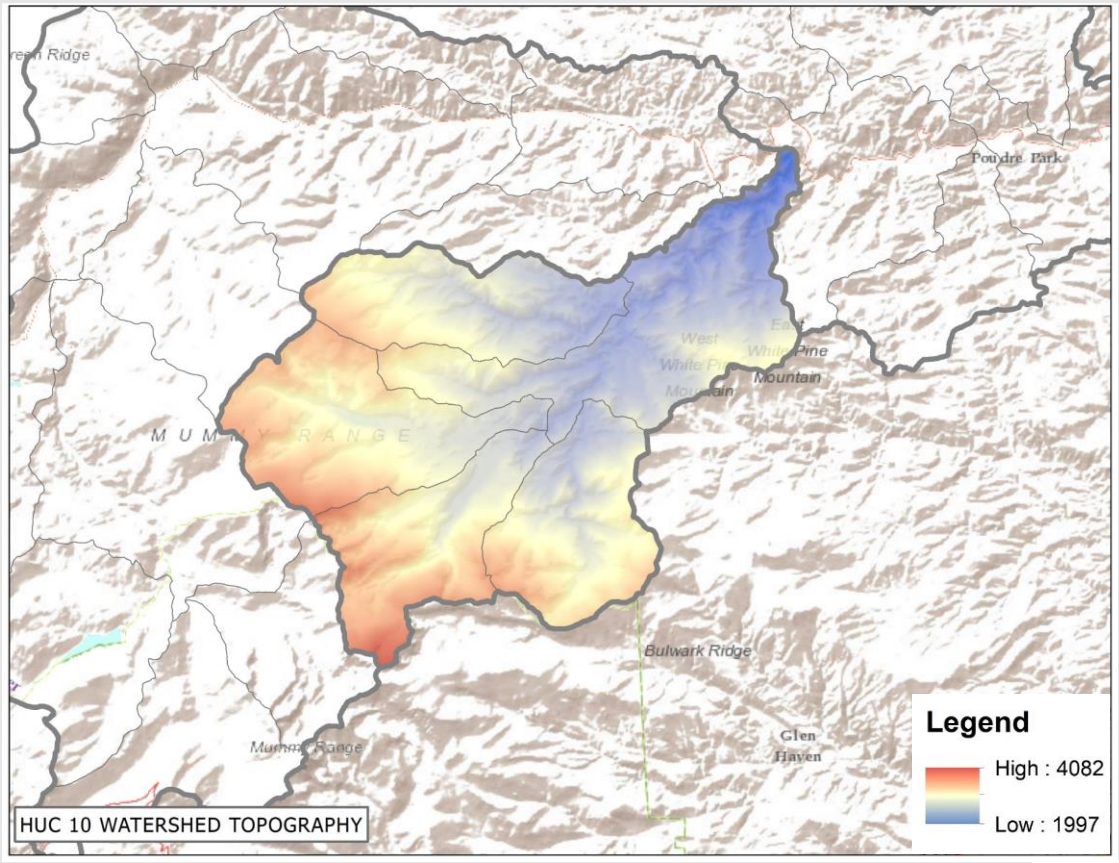
South Fork Watershed

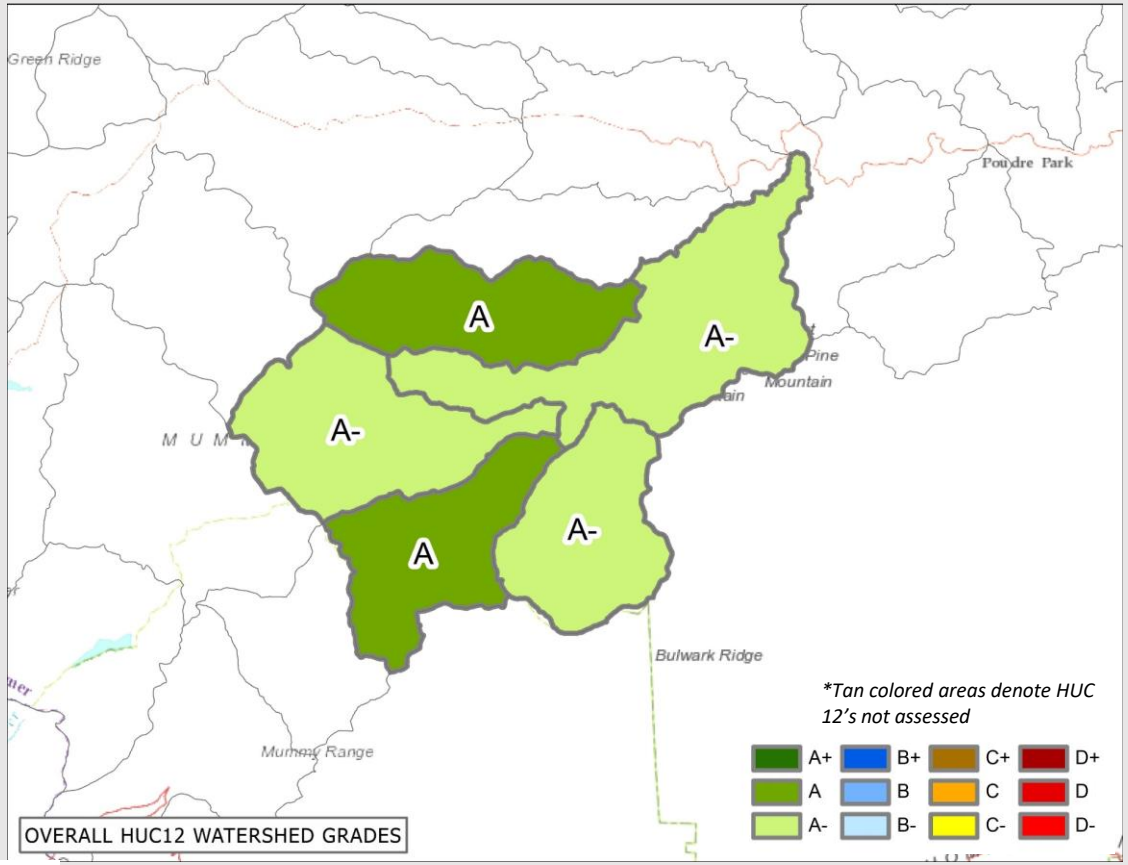
HUC-10 Watershed Grade

A-


South Fork


High Park fire at Pingree





South Fork of the Poudre

Flow Regime

Hourglass and Comanche Reservoirs in the upper watershed are minimally altering peak flow magnitude, frequency, and duration along the Little South Fork of the Poudre. Base flows and flow variability are also being minimally altered from these stressors.

Sediment Regime

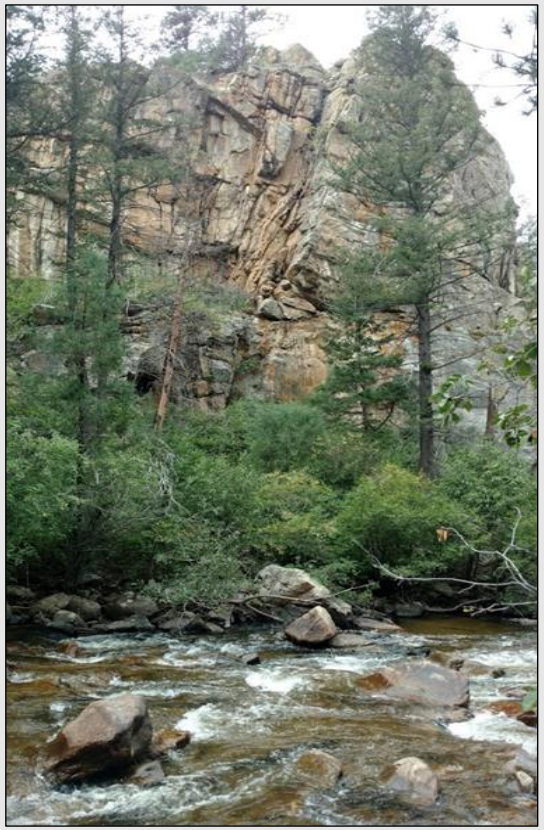
The close proximity of the road to the river, river crossings, and old beaver meadows are increasing sediment loads to the Little South Fork of the Poudre.

Water Quality

The high mountain reservoirs and agricultural land use are minimally altering water temperature and dissolved oxygen levels along the Little South Fork of the Poudre.

Riparian Condition

Most of the South Fork naturally has a very narrow riparian zone. Much of that riparian habitat is in excellent to outstanding condition. One canyon reach through which the Pingree Park Road was built, suffered a large percentage loss of riparian habitat on the road-ward side of the river, but in absolute terms the loss may have been only a few feet in width.



Little South Fork of the Poudre	
Flow regime	B+
Sediment regime	B+
Floodplain connectivity	A-
River Form	A-
Riparian condition	B+
Channel Resilience	A
Physical Structure	A-
Aquatic Insects	A
Water Quality	A-
Reach condition score	A-

River Form

Bank armoring, river crossings and land use changes are altering the planform, channel dimension, and profile of the Little South Fork. However, the spatial extent of these impacts is minimal.

Resilience

Bank armoring, river crossings and land use changes are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is very minimal and most unaltered areas should be resilient.

Physical Structure

Land use changes and river crossings are altering coarse channel structure by creating more homogenous areas of river channel, decreasing wood supply into the channel, and reducing areas where beaver would potentially be present. Increased sediment delivery to the river from the close proximity of the gravel road and river crossings are altering channel embeddedness.

Aquatic Life

Minimal stressors are present and do not appear to be negatively altering to macro-invertebrate populations.

River Segment Grade

A-

Beaver Creek

Flow Regime

Hourglass and Comanche Reservoirs are altering peak flow magnitude, frequency, and duration along Beaver Creek. Base flows and flow variability are also being minimally altered from these stressors.

Sediment Regime

Comanche Reservoir is altering sediment continuity along Beaver Creek. Land erosion is relatively unaltered and channel erosion is impacted by the altered flow and sediment regimes.

Water Quality

The high mountain reservoirs are minimally altering water quality along Beaver Creek.

Riparian Condition

Beaver Creek begins as an essentially pristine riverine habitat in the Comanche Peaks wilderness but was converted to reservoir right outside of what is now wilderness. Below the reservoirs the riparian habitat quickly improves in condition. In the lower, strongly confined reaches of the creek reservoir impacts on riparian habitats are likely trivial or otherwise difficult to detect.

Beaver Creek		
Flow regime	B	
Sediment regime	A	
Floodplain connectivity	A	
River Form	A	
Riparian condition	A	
Channel Resilience	A	
Physical Structure	A	
Aquatic Insects	A-	
Water Quality	A-	
Reach condition score	A-	

River Form

River crossings are altering the planform, channel dimension, and profile of Beaver Creek. However, the spatial extent of these impacts is minimal.

Resilience

River crossings are altering channel stability and the potential for the river to recover on its own after flood events. However, the spatial extent of these impacts is minimal and most unaltered areas should be resilient.

Physical Structure

River crossings are altering coarse channel structure by creating more homogenous areas of river channel. Increased sediment delivery to the river from accelerated bank erosion and river crossings is altering channel embeddedness. The spatial extent of these stressors is minimal.

Aquatic Life

Minimal stressors are present and only appear to be minimally altering macro-invertebrate populations.

River Segment Grade

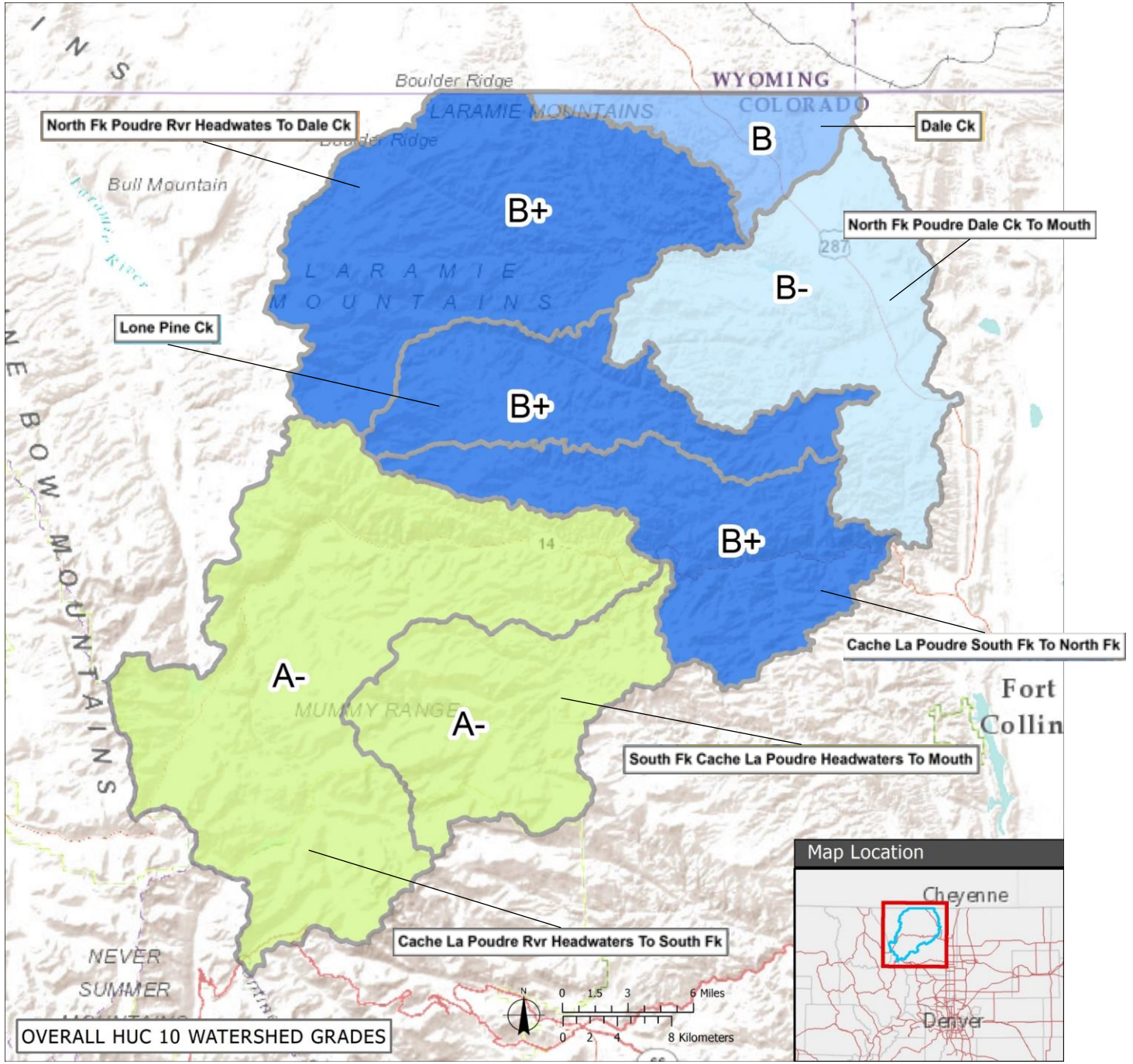
A-

HUC 10 Watershed Grades

Upper Poudre River Sub-basin Grade

B+

The map shows health grades for the seven watersheds within the upper Poudre River Sub-basin. Overall the upper sub-basin received a B+ when watershed scores were combined, indicating relatively good ecological health. In general, health of streams and landscapes decreases with elevation in the sub-basin. The Poudre Headwaters and the South Fork watersheds, with their high proportion of lands managed as wilderness, particularly help support watershed health.



Conclusions & Opportunities

Conclusions

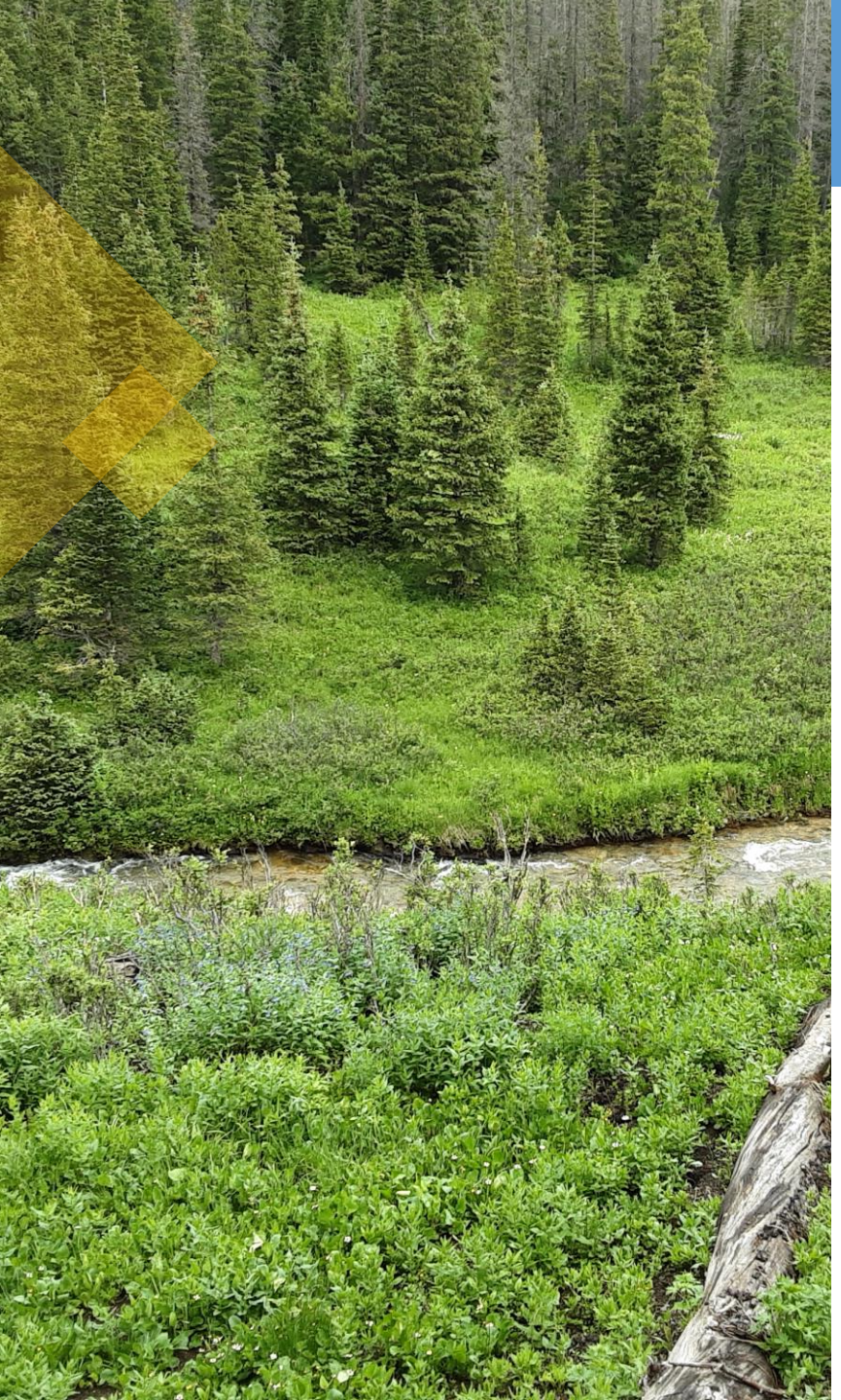
The Upper Poudre River watershed received a B+ on the RHAF grading scale, indicating the condition maintains essential qualities that support a high level of function, but there is some influence of stressors at a detectable, although minor, level.

The range of evaluated scores increased as assessment scale decreased, with scores ranging from B- to A for HUC 10 watersheds, C to A for HUC 12 sub-watersheds, and across the whole grading scale from D- to A+ for reach/sub-reaches. The wide range of scores indicate that, while many stressors are present in the system with localized impact, enough high health/functioning areas are also present within the watershed to maintain an overall healthy condition. The different scales of the assessment results can be useful in multiple ways to guide future management or restoration opportunities within the basin by helping identify areas of concern and indicating the extent of impacts/stressors across the watershed.

Stressors in the Upper Poudre watershed vary in severity and extent across the landscape but are generally related to flow alteration and land use. Flow alteration in the basin is driven by several water storage reservoirs and trans-basin diversions that impact the natural flow regime (flow magnitude, frequency, duration, timing, and rate of change).

Reservoirs are either managed to maintain water stage, or they are filled and drained each year. In the former case, peak flows are commonly less affected but baseflows can suffer greatly. Fill-and-drain management knocks the top of critical peak of the hydrograph but may allow healthier baseflows later in the summer. The effects of baseflow augmentation on Upper Poudre stream habitats are not well understood.

A factor that complicated interpretation in this study is that many reservoirs and trans-basin ditches were constructed over 100 years ago, which has given channels time to adjust to the altered flow and sediment regimes. The response of natural systems to long-term artificial management makes it imperative that plans aiming to actively improve stream health be based on comprehensive understanding of current conditions and system trajectories, as these often differ from wholly natural systems.



Conclusions

In addition to flow alteration, land use impact is a leading stressor in the Upper Poudre watershed.

The biggest stressors on the overall watershed, including the main drainages and tributaries, are logging and roads in the forested upper part of the basin and rural development, agriculture, and ranching in the middle and lower parts of the basin.

Historical and active beaver suppression is a cause of on-going impairment throughout the region. Roads traveling in the floodplain and/or making multiple crossings constitute a pervasive and long-standing impact, most notable along the main stem of the Poudre River. These land use changes cause direct alteration of habitats, but also trigger any number of complex feedbacks between hydrology, geomorphology and biology that generally result in systemic degradation.

The lower North Fork of the Poudre watershed was found to be the most impacted under current conditions. Despite impacts, it received an encouraging B- grade, indicating that conditions are maintaining essential qualities that support a high level of function, even though conditions are notably altered by stressors that substantially impair functionality.

On the highest level, stressors that are present in the upper Poudre River watershed are altering river health, but generally the spatial extent of these impacts is relatively small compared to the large size of the watershed - and conditions are aided by the large proportion of land that is managed as national forest, wilderness, or other wildland.

Future stressors that could potentially impact river health in the upper watershed include climate change, water development projects, land use changes, and increased infrastructure including road crossings.

Restoration Opportunities

Resulting scores from this river health assessment can be used to identify areas for best potential investment of future restoration funding and efforts. Results from the *Upper Poudre Watershed Resilience Plan* should be integrated with results of this study to identify the restoration efforts with maximum potential to benefit the riparian and the upland habitat within the watershed.

Based on results of this study, examples of restoration efforts that have strong potential to make meaningful improvements to river health in the Upper Poudre Watershed include:

- improving river crossings to allow the river to adjust as necessary, improve sediment continuity, and increase fish passage;
- increasing riparian health by fencing of livestock, increasing buffers around rivers from agriculture land use, and removing invasive species;
- reintroducing beavers into appropriate areas to increase habitat diversity, improve riparian and geomorphic condition, provide water quality and quantity benefits, and increase resilience to future fires; and
- changing flow management at reservoirs to better mimic natural flow regime and reduce impacts to peak flow magnitude, duration, and timing.

The broad-based platform of ecologic and geomorphic information provided by this study will support the Coalition and others with next steps for improving and/or conserving and protecting conditions in the Upper Poudre Watershed.

Future targeted studies, including Stream Management Plan efforts, can use this study to help identify potential restoration projects. A diverse stakeholder group should then work together on mutual goals and ranking criteria that allow prioritization of potential projects based on potential ecological uplift, geomorphic stability improvement, cost, feasibility, ecosystem service enhancement, and other important criteria.

A robust prioritization process is critical to ensure investments in restoration are transparent and defensible and will deliver the greatest benefits to the Upper Poudre Watershed.

Coalition for the Poudre River Watershed

Stillwater Sciences

Johnson Environmental Consulting

Timberline Aquatics, Inc.

Next Steps

- CPRW is working with stakeholders from the Cities of Fort Collins and Greeley to align all three RHAF assessments and develop a basin-wide protocol and assessment plan to guide restoration and management actions for the whole basin
- Refine standard operating procedures, identify long-term assessment reaches, and prioritize reaches for restoration, protection and/or management
- Implement a constraints and opportunities analysis that incorporates existing data on legal, recreational, social and economic values to clarify and refine the prioritization and project development
- Create data management tools and a web-based platform for stakeholders to track, access and communicate measurable outcomes toward river health goals

CPRW's end goal is to have a science-based, stakeholder driven, basin-wide RHAF implementation plan and a prioritized list of reaches to guide restoration in the watershed.

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- United States Geological Survey, 2019. Streamflow data from sites within the Cache la Poudre River Watershed.

Appendices

- **Appendix A-** *RHAF Cache La Poudre River Health Assessment Framework, 2019 Methods and Application*
- **Appendix B**- *State of the Upper Poudre Final Scores*