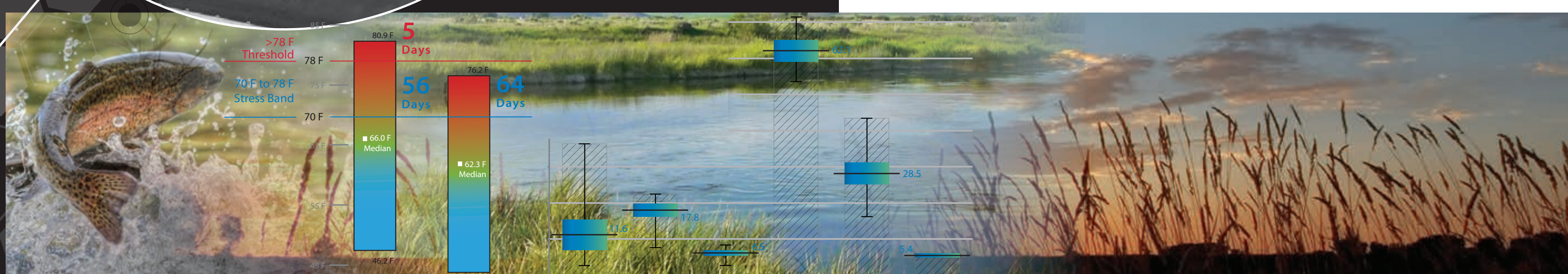
Silver Creek

Ten Year Edition

2011 - 2020

Annual Monitoring and Reporting



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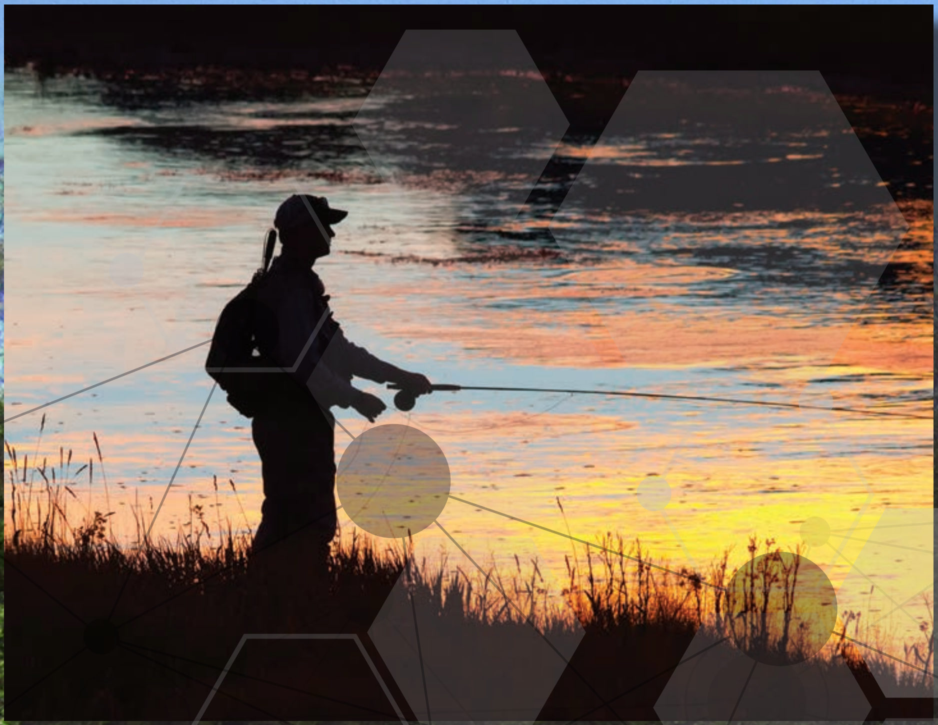


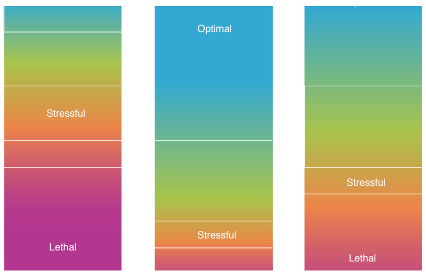
Ecosystem Sciences Foundation

Produced by: Ecosystem Sciences Foundation 202 N. 9th St Suite 400 Boise, Idaho 83702 Phone 208.383.0226

Silver Creek Watershed

2011-2020 / Ten Year Edition - Annual Monitoring / Reporting

Contents



Silver Creek Watershed

Ecosystem Sciences Foundation (ESF) has been working in the Silver Creek watershed since 2009, when it partnered with The Nature Conservancy to develop a Restoration and Enhancement Strategy for the watershed. The strategy identified numerous actions to be taken, including addressing data gaps on stream flow, temperature, and sediment conditions. To address these data gaps, ESF began its monitoring program in 2010 to increase our understanding of the Silver Creek system. This past year, ESF and its partners continued to gather critical data on stream flows, temperature, and dissolved oxygen. In addition, ESF conducted statistical analyses of temperature monitoring results and prepared an in-depth review of stream monitoring data over the last 10 years.

To date, the Silver Creek program has enjoyed support from numerous stakeholders. Most of the land within the watershed is privately owned; consequently, landowners in the watershed recognize the need to protect the ecological health of the watershed, as well as their rights as landowners. Our partners and stakeholders have been integral in helping us achieve our vision of providing direction for stewardship of the Silver Creek Watershed, and in designing and promoting appropriate stream restoration and enhancement actions.

The significant conclusions and findings from 2020 are:

- Silver Creek flows were below recent historical average discharge. The Big Wood Basin's weak snowpack resulted in lower-than-average stream volume in all stream tributaries.
- With some exceptions, temperatures in the Silver Creek system were similar to the temperatures experienced over the last several years. Some areas saw temperatures sustained above the stressful limit for fish for prolonged periods. The number days for which temperatures were above the 70°F stress band threshold increased slightly from 2019.
- Dissolved oxygen monitoring indicated that in some areas of Silver Creek concentrations have become so low that they stress all life stages of trout, especially in Butte Creek and Lower Silver Creek. However, these conditions are generally limited to early morning hours. In the afternoon, dissolved oxygen levels rise rapidly. Cold tributary creeks like Grove, and Upper Loving Creek maintained higher dissolved oxygen levels than Butte Creek and Lower Silver Creek.

For more details please visit: www.savesilvercreek.com

The information that is presented in this report reflects summarized analysis of all data. We are presenting the most important aspects of the past season's / last 10-year's work in a way that tells a story of the stream system and watershed. The information presented here is the result of detailed, scientifically rigorous analyses, and reflects a considerable amount of field work to collect. The website, which has been recently updated and redesigned, has additional information on programs in the watershed, including raw and tabulated data.

Snowpack & Runoff   Big Wood River Discharge   Irrigation Diversion & Delivery   Groundwater

Its About the Water

The Big Wood River / Silver Creek water system is a complex, interconnected hydrologic network. The network of canals, diversions, wells and springs have successfully served the needs of the valley since 1881. However, continued population expansion and changes in irrigation technology, crop selection, climate, and land use have altered the water resource. As a result, Silver Creek is experiencing inconsistent streamflow and the very existence of the habitat and fishery the creek supports is threatened.

Several droughts, during which runoff can average half of normal in the Big Wood River, have further aggravated the delicate water situation. Low flows during the heat of summer elevate water temperature and deplete dissolved oxygen levels, which result in stress to the fishery and raised concerns for potential fish kills.

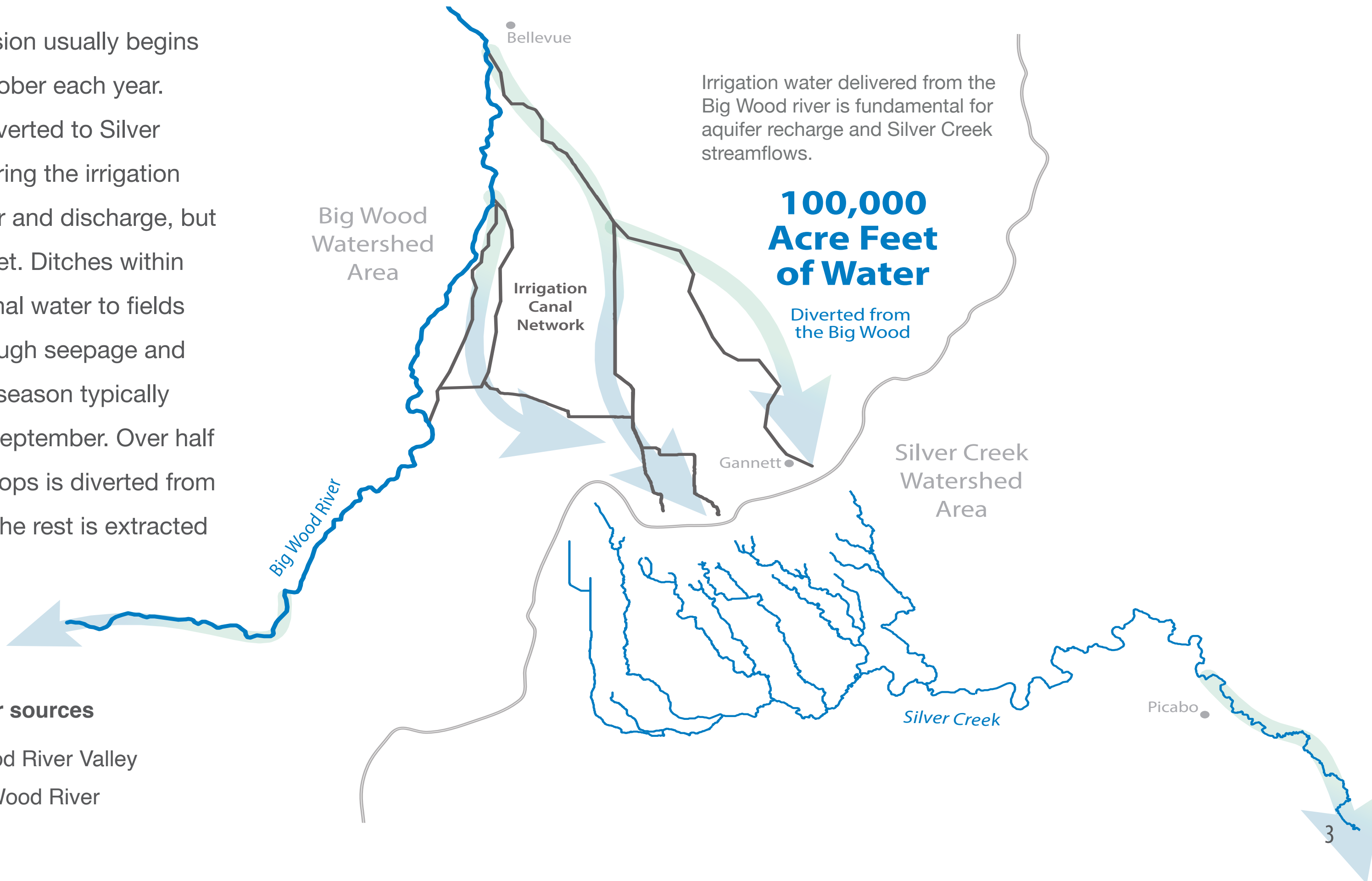
Silver Creek rises from a series of springs and flows eastward out of the basin. These springs are formed by application of irrigation water that exceed the consumptive use requirements of crops, and upwelling from the underlying aquifer system. Groundwater contributes to the spring flow by means of upwelling through the overlying sediments to the surface.

Since much of the flow of Silver Creek is the result of irrigation water recharging the groundwater system, the delivery of water from the Big Wood system is critical to the maintenance of Silver Creek streamflows. It is estimated that over 80% of the flows in Silver Creek come directly from upwelling springs in the aquifer system.

The major sources of recharge to the groundwater system are irrigation, snow melt, and precipitation. A significant contribution to groundwater recharge is due to the percolation of excess irrigation water applied to crops, leakage from canals and ditches, and seepage in the northern part of Big Wood River channel and tributary streams. Land owners also divert surplus canal water to designated ponds which recharge the aquifer.

Springs Silver Creek Streamflow Aquatic Health

The canal irrigation water diversion usually begins in April and continues through October each year. The total amount of canal water diverted to Silver Creek from the Big Wood River during the irrigation season is dependent on water year and discharge, but is typically around 100,000 acre feet. Ditches within the Bellevue Triangle that carry canal water to fields contribute to aquifer recharge through seepage and application to crops. The growing season typically occurs from May until the end of September. Over half of the irrigation water applied to crops is diverted from streams into irrigation canals and the rest is extracted by pumping groundwater.



Major Silver Creek water inflows or sources

1) Groundwater flowing from the Wood River Valley
2) Irrigation diversions from the Big Wood River
3) Precipitation and Snowmelt

Ten Years of Silver Creek Monitoring

This year marks the 10th year of the program and accumulating stream monitoring data. In particular, streamflow and temperature data from tributaries across the Silver Creek subbasin provide a detailed record from which to analyze change and conditions over the last decade.

Perennial steam temperature hot spots across all years of monitoring in the Silver Creek system include Silver Creek at Highway 93, Silver Creek at Susie Q, Silver Creek at Priest Bridge, Mid Mud Creek, Lower Mud Creek, and North Fork Loving Creek. Located further downstream within the monitoring array, these sites are most likely to experience elevated water temperatures.

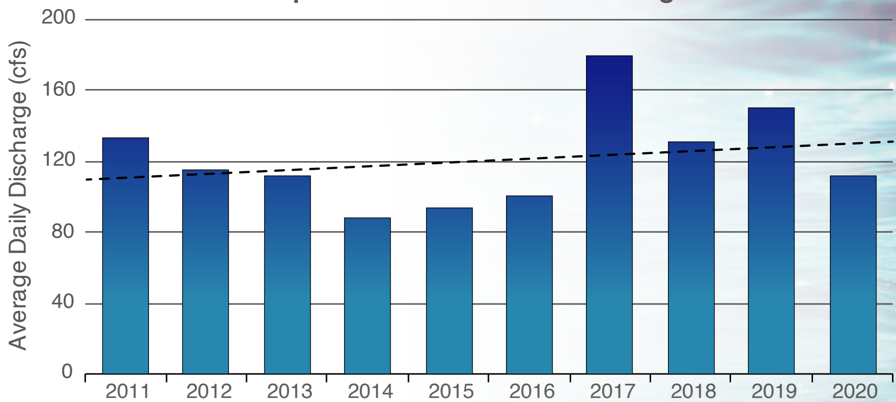
From 2011 to 2020, the monitoring data shows a decreasing trend in stream temperatures across the Silver Creek stream and tributary system, and a slightly increased trend in Silver Creek discharge as measured at the USGS gage at Sportsman's Access. In the first five years of temperature monitoring, from 2011-2015, daily median stream temperatures exceeded 70°F an average of 22.2 days. From 2016-2020, the average number of days that stream temperatures exceeded 70°F dropped to 11.4 days. The highest recorded average median temperatures have all occurred within the first five years of temperature monitoring, including a peak of 59°F in 2011. In the last four years, the average median temperature across all sites has hovered around 56.5°F.

In 2015, an analysis indicated that stream temperatures in the Silver Creek system are more closely related to streamflow than ambient air temperatures. Clearly, the relationship between streamflows and stream temperatures remains strong. The two years with the fewest average number of days that exceeded the 70°F temperature threshold during the period of record were 2017 and 2019, with 8 and 5.1 days, respectively. These occurred during years with above average streamflows in the Silver Creek and Big Wood River systems.

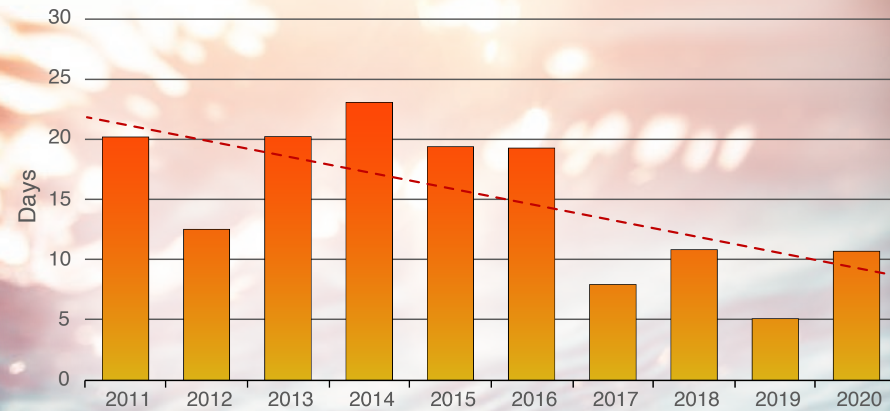
The 2017 water year was an historic event that saw far above normal winter snowpack, runoff, and streamflow discharge in the Big Wood and Silver Creek. Groundwater levels were also higher than average after the 2017 winter. This water year likely influenced conditions in Silver Creek for multiple years, with 2018 and 2019 also being normal to above normal water years.

The graphs displayed on this page show the 10-year change and trends in streamflow and stream temperatures. From 2011 through 2020 streamflow increased slightly. The historic high-water year of 2017 was followed by above average years in 2018 and 2019. The other three graphs illustrate changes in stream temperature for the 10-year period. The first shows that the average number of days that stream temperatures were above 70F across all sites in the watershed has reduced overall. The second shows that, median stream temperatures across all monitoring sites have decreased slightly over the same period. The third graph shows the year-to-year change in the average stream temperature of all sites in the watershed.

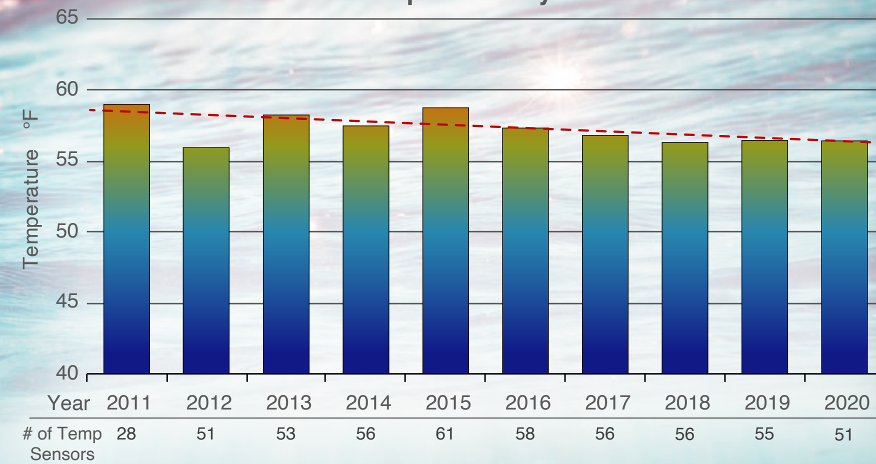
Average Daily Discharge (cfs)
Sportsman's Access USGS Gage



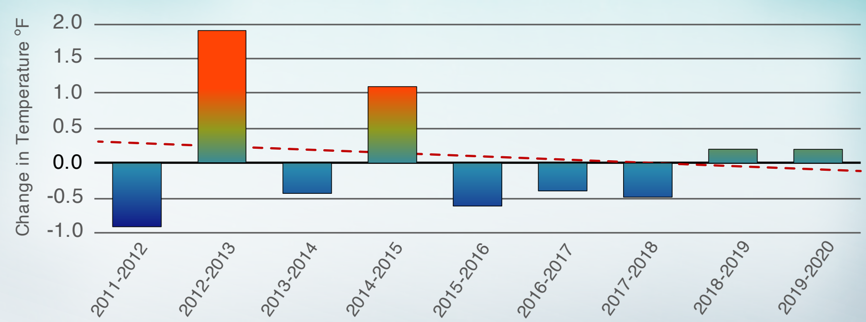
Average Number of Days > 70° F by Year for All Sites



Median Temperature by Year for All Sites



Average Temperature Change for All Sites

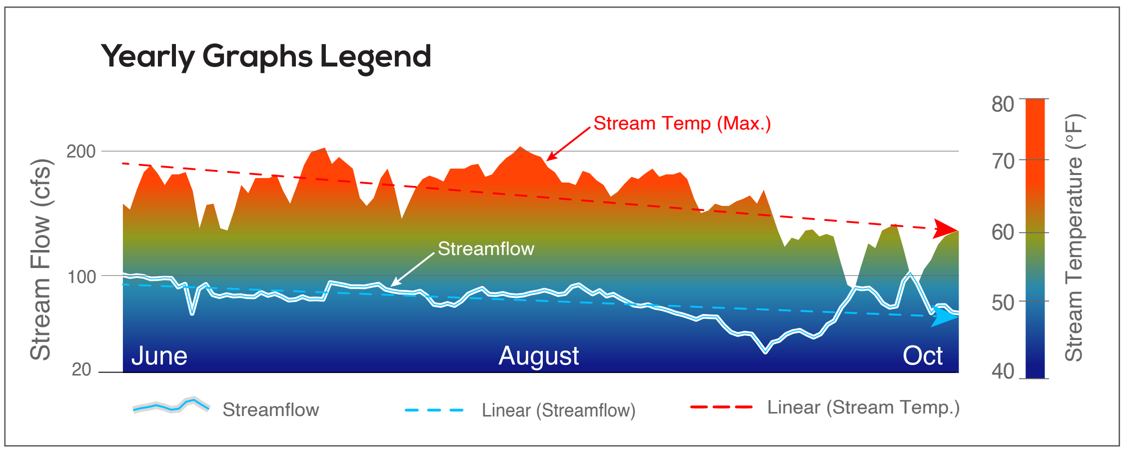


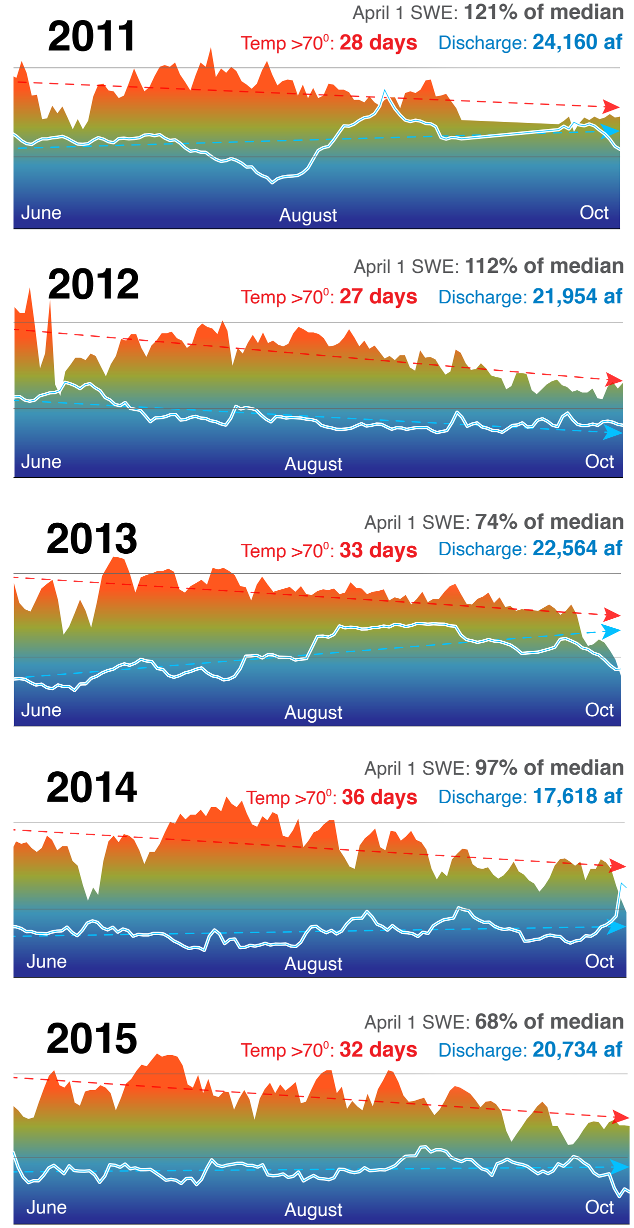
Silver Creek at Highway 20 Crossing

A Decade of Stream Temperature & Flow

With 10 years of data collected across the entire Silver Creek watershed, it is possible to look at longer term trends in stream temperature and streamflow (discharge). This page explores data from a key monitoring location in the center of the watershed - Silver Creek at Highway 20. Stream temperature data, collected continuously from June through early October of each year is compared and contrasted with streamflows continuously recorded at the USGS Sportsman's Access stream gage. These sites are adjacent to each other and allow for comparison over the 10-year period.

Presented here are the yearly graphs of stream temperatures and streamflows (cubic feet per second) to illustrate the relationship throughout each season. Also displayed are the number of days for which stream temperature exceeded 70F, the total stream discharge volume in acre feet, and the April 1 snow water equivalent (SWE) percentage for the monitoring season. These paired annual datasets provide critical insights into the relationship between streamflow and stream temperature. There are important inter-seasonal relationships that can be found by comparing each year's graph and





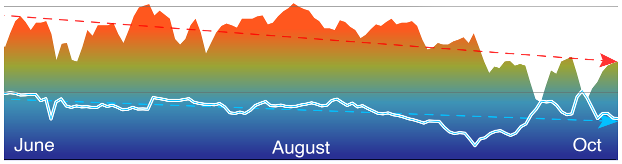
▲ Stream Temperature and Streamflow Graphs / Highway 20 Bridge and USGS Sportsman's Access - The above graphic depicts summarized stream temperature data for the summer season for the temperature monitoring site on Silver Creek at Highway 20 crossing. Referencing the legend above, each graph shows streamflow and temperature data for the summer season of June through October for each year; 2011-2020. The graph shows streamflow at the USGS Sportsman's Access gage, the linear trend of the streamflow, maximum daily stream temperature at Highway 20 and the linear trend in stream temperature.

associated data. Some specific examples to note are the relatively low streamflows in 2014 and 2015, and the relatively high stream temperatures and number of days above 70F. In contrast, 2017 and 2019 show notably higher streamflows, lower overall stream temperatures and a low number of days above the 70F threshold.

Below is a graph of the entire 10-year period at the Highway 20 site and USGS gage. Over this time frame, streamflow (cfs) has trended up, and temperatures have trended down at the Silver Creek at Highway 20 site. There is a clear relationship between the volume, timing and length of higher seasonal streamflow and the reaction of the stream temperatures. This site is representative of the watershed, but only illustrates the story of a particular point on the stream system. Analyzing the headwater creeks and contrasting them with the lower reaches of the stream system would exhibit a broader story of the system and how water volume and timing is a compelling driver of stream temperature and overall aquatic health in the Silver Creek ecosystem.

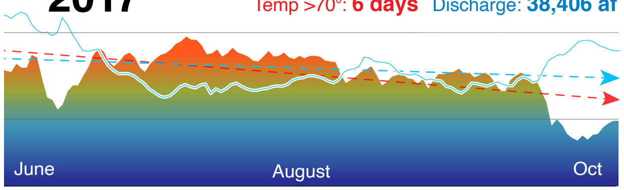
2016

April 1 SWE: **115% of median**
Temp >70°: **18 days** Discharge: **18,907 af**



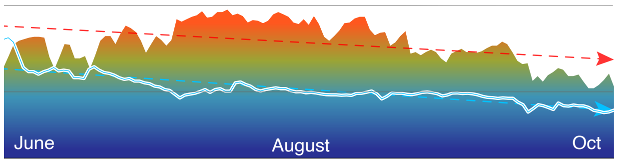
2017

April 1 SWE: **178% of median**
Temp >70°: **6 days** Discharge: **38,406 af**



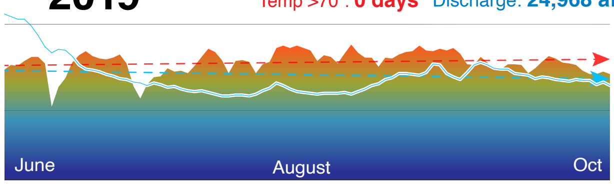
2018

April 1 SWE: **99% of median**
Temp >70°: **18 days** Discharge: **24,444 af**



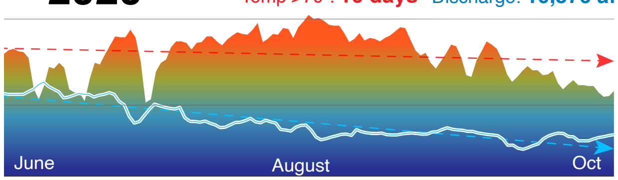
2019

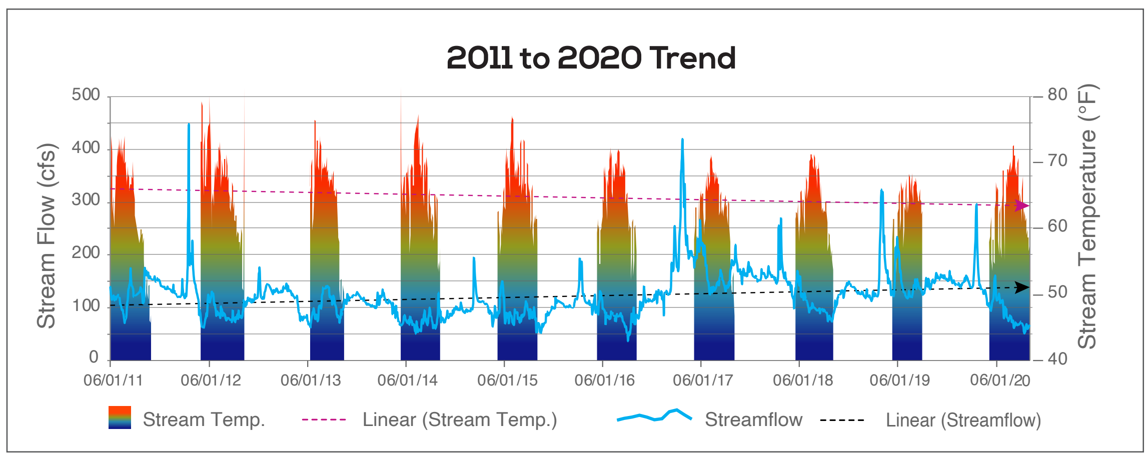
April 1 SWE: **115% of median**
Temp >70°: **0 days** Discharge: **24,968 af**



2020

April 1 SWE: **77% of median**
Temp >70°: **16 days** Discharge: **19,576 af**





Each year's graph also includes the April 1 snow water equivalent (SWE) for the basin from the NRCS, the total discharge (volume of water) of Silver Creek at the USGS Sportsman's Access gage for the June to October season in total acre feet, and the number of days the stream temperature was above 70F. The graph on the bottom left shows the 2011 to 2020 trend in stream temperature and stream flow, and the seasonal stream temperature at the Highway 20 site for comparison of change and overall trend.

Cycle of Drought

About a quarter of Idaho is currently experiencing some degree of drought, with Blaine County / Wood River Valley in extreme drought.

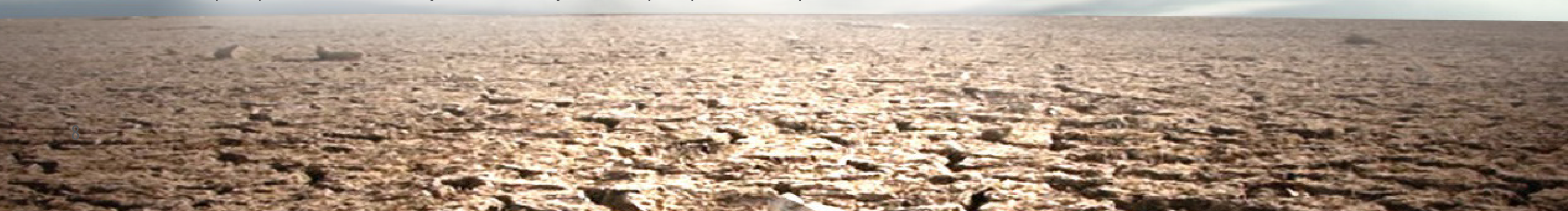
This is an ongoing, long-term drought that started in the fall of 2019. There has not been any kind of recovery yet, and the 2020 and 2021 water years are exacerbating the drought situation, which is part of a larger, longer-term drought across the Intermountain West.

The Silver Creek watershed is part of a complex geologic and hydrologic area. It is an area that has experienced numerous periods of drought in the last fifty years, in addition to periods of relatively high precipitation and above-average stream flows. The Silver Creek watershed exists within a semi-arid, high-desert climate that is characterized by relatively low rates of precipitation and humidity, and relatively high rates of evapotranspiration. Previous studies have shown that the Lower Wood River Valley, which the Silver Creek area is a part of, experiences considerable variability in precipitation, particularly in comparison to the upper reaches of the Big Wood and Little Wood River watersheds. Drought is a recurring issue in the arid west, and the historical data illustrates that it is a condition that happens with some frequency and will continue. It is important to understand and monitor climatological and hydrologic trends in the Silver Creek area to better protect the ecological health of the watershed.

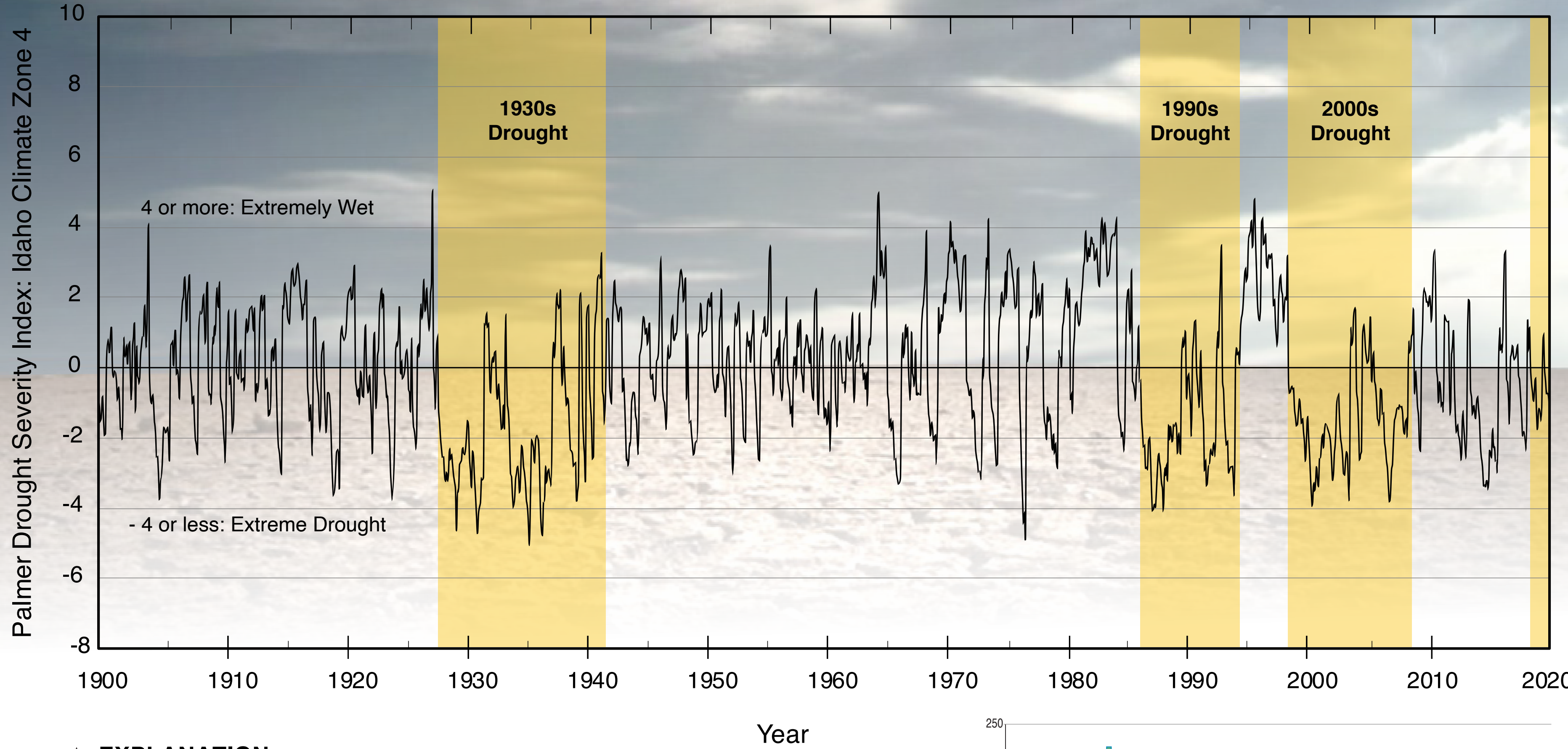
One way to assess climate conditions in an area is by looking at the Palmer Drought Severity Index (PDSI) as calculated by the National Climatic Data Center. The PDSI is a measure of long-term drought that uses precipitation, temperature, soil moisture, and other factors to generate a single value for a particular month in a given year. The index is useful because it accounts for long-term trends to define wet and dry periods. A value of 0 is defined as normal, negative numbers represent a drought, and positive numbers reflect above-normal precipitation.

Some of the worst periods of drought occurred in the 1930's for a prolonged period, and again in the early 1990's and 2000's. The current drought has not shown any signs of recovery yet.

In addition, precipitation records for the month of August over the last five years in Blaine County are below the historical average. 2017 was the wettest August in that 50-year timeframe; 2020 was well below normal.



Palmer Drought Severity Index: Idaho Climate Zone 4 from 1900 - 2020



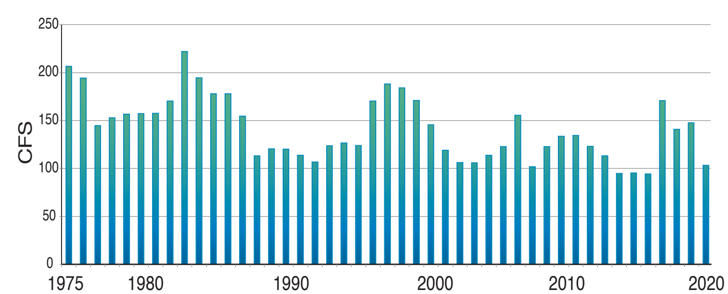
EXPLANATION

Palmer Drought Severity Index (PDSI) Value

- 4 or less: Extreme Drought
- 4 to - 3: Severe Drought
- 3 to -2: Moderate Drought
- 2 to - 1: Mild Drought

- 1 to - 0.5: Incipient Dry Spell
- 0.5 to 0.5: Near Normal
0.5 to 1: Incipient Wet Spell

1 to 2: Slightly Wet
2 to 3: Moderately Wet
3 to 4: Very Wet
4 or more: Extremely Wet

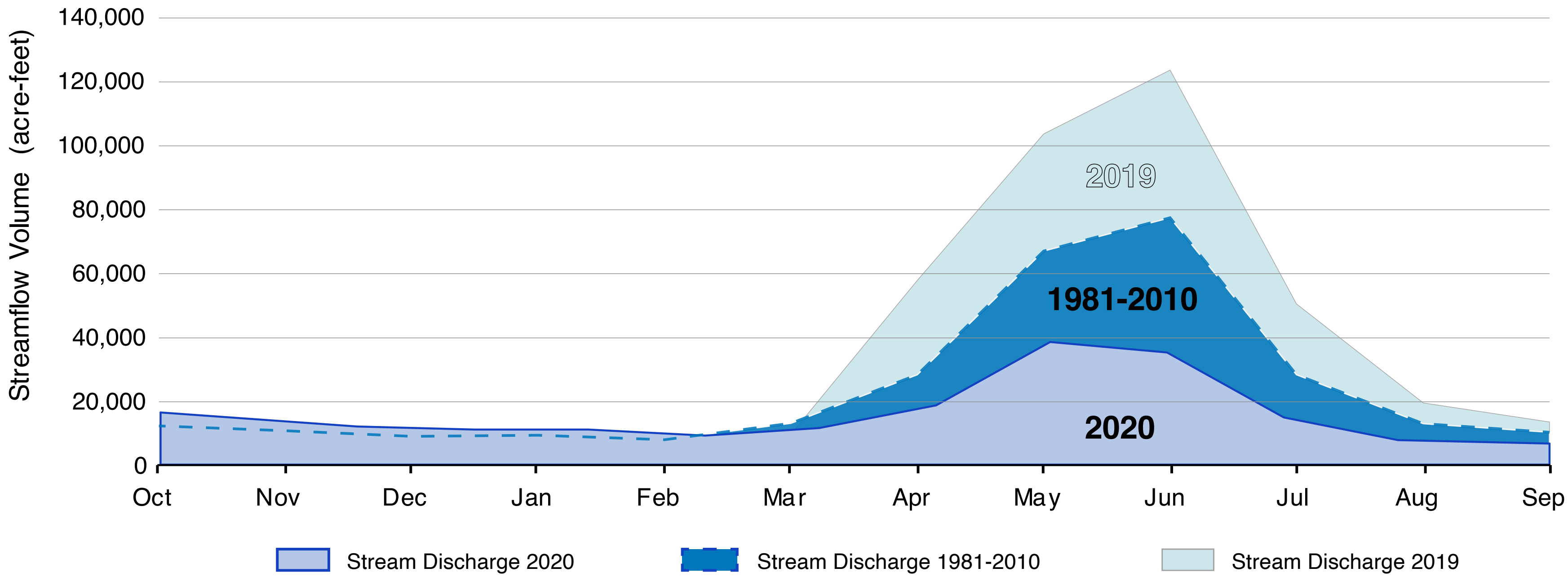


Silver Creek annual average streamflow (cfs) at USGS gage (Sportsmans Access) 1975 - 2020.

The water year for 2019-20 featured snow pack levels below the most recent 30-year average. In April 2020, snow water equivalent (SWE) levels within the Big Wood Basin were measured at 69% of median from those measured from 1981-2010. The total streamflow volume for the Big Wood River at Hailey (USGS gauge #13139510) was calculated at 66% of average from streamflow measured 1981-2010. This reality is unfortunate for the Silver Creek system, which relies almost entirely on groundwater levels within the Wood River Valley Aquifer system in which three quarters of inflow is received directly from tributaries and streamflow losses. As a spring-fed system, Silver Creek's water comes from groundwater upwelling at springheads and streambed groundwater inputs for consistent flow. In 2020, monitoring within Silver Creek's tributaries showed a decrease in spring and stream flows. Although none of the springs dried up entirely late in the season (a phenomena that has been observed in past low-water years). However, a few springheads saw elevated water temperatures indicating very low flow. Well water monitoring within the South Valley Groundwater District found that groundwater depths and artesian pressure were at or below average levels for most wells throughout the May to October 2020 timeframe. The inconsistent groundwater inputs throughout the summer months led to above average and maximum stream temperatures at most locations when compared to other monitoring years. This underscores the importance of groundwater as the ecological driver of the Silver Creek ecosystem.

Winter Snow + Water Year 2020

Photo: Ecosystem Sciences



▲ **Big Wood River stream flows (measured in acre-feet) for 2019 as compared to the 30 year mean (1981-2010).**

April 1, 2020

Idaho Water Supply Outlook Report

Big Wood Basin **69%** of median snowpack

Big Wood Basin **65%** of average precipitation

Streamflows up to **66%** of average

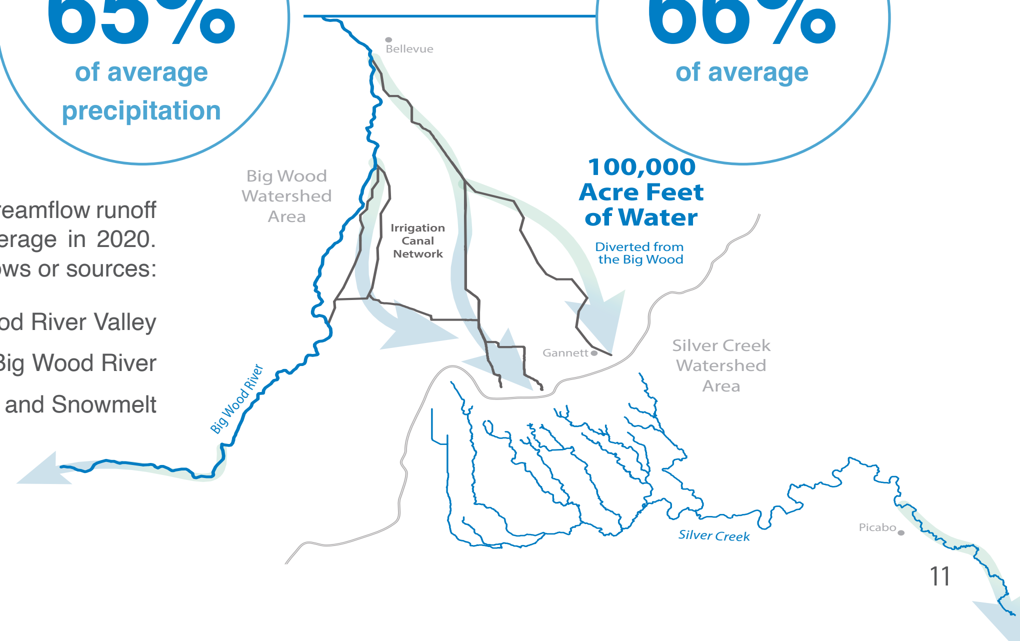
In 2020, the Big Wood Basin received below average precipitation between Oct 1 and April 1.

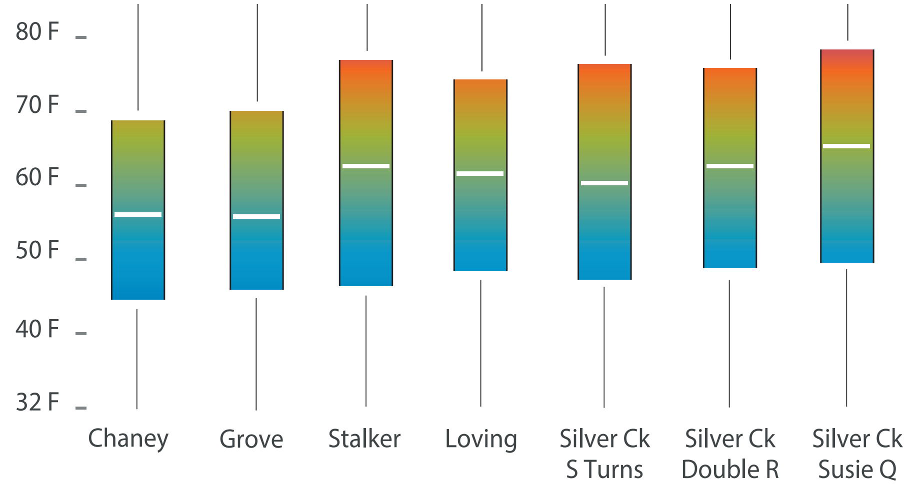
Snowpack conditions, forecast streamflow runoff and groundwater flows were average in 2020. Major Silver Creek water inflows or sources:

1) Groundwater inflows, Wood River Valley

2) Irrigation diversions from the Big Wood River

3) Precipitation and Snowmelt





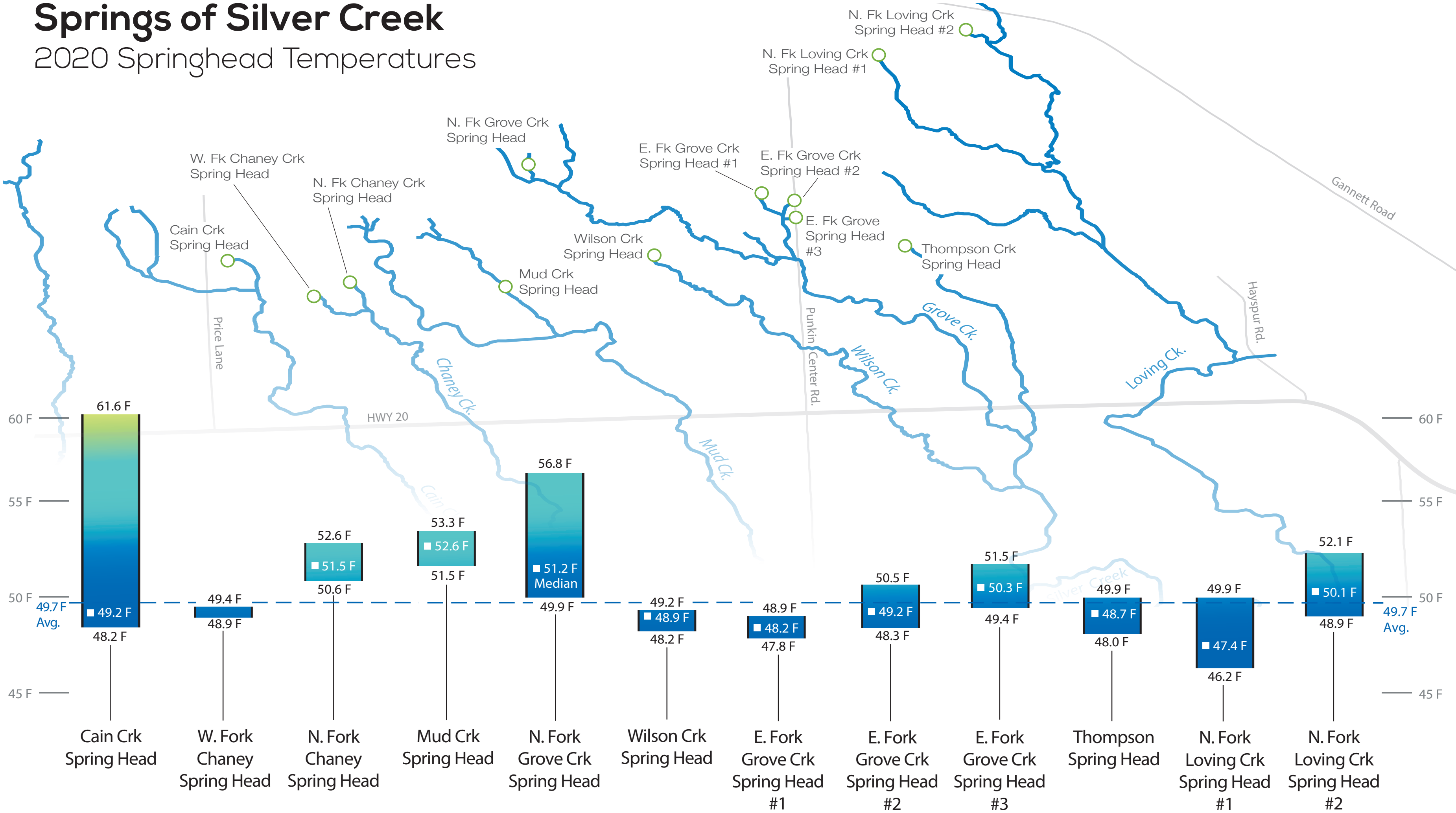
Summer Stream Temperatures: The graph above indicates the maximum, average and minimum summer water temperatures on selected areas of Silver Creek over a ten year period (2011-2020). This year, 39 stream temperature loggers and 12 springhead loggers were monitored throughout Silver Creek and on each tributary to record data and track changes in the system.

Stream Temperature

In 2020, 12 springhead and 39 stream temperature loggers were deployed in key locations throughout the Silver Creek Watershed. It is important to monitor the springs that feed Silver Creek because they are the primary source of water to the system and these springs provide consistent, cool water to Silver Creek's tributaries that can mitigate against changes in air temperature and climatic conditions. For the 12 springhead loggers, median temperatures stayed near 49.7°F throughout the summer of 2020. As opposed to some past years, no springheads dried up mid-summer, but low flows in some can be seen with elevated temperatures later in the season. The above-average 2019 water year carried over somewhat to the 2020 water year and helped to mitigate the below normal 2020 water year; however, groundwater levels did decline to below normal and led to both a shorter duration of high springhead flows and decreased extraction of groundwater for agricultural use. As a spring-driven system, these springs are critical to the health and persistence of Silver Creek.

Springs of Silver Creek

2020 Springhead Temperatures



Springhead Temperature Bands The above graphic depicts the summarized springhead temperature data for the entire summer season. The data were analyzed for the summer season to illustrate the spring temperatures that occurred for the period of June through September 2020. Each graph displays the total temperature range from June 1 to September 30; the absolute high and low temperatures are given, and the median water temperature is shown for that particular spring.

Temperature monitoring within Silver Creek and its tributaries found average and maximum stream temperatures relatively normal at most locations, with some exceptions. This illustrates the connection between the near-normal water-year, and carry-over from 2019, which led to a slight decrease in the duration and quantity of groundwater. The most notable decrease in temperature was measured in Chaney Creek, which remained below the stress band (70°F) for all but four days of the 2020 monitoring period and saw a decrease in median temperature of 3.5°F from 2019. Other tributaries that saw decreases in median temperatures from 2019 include Lower Mud Creek (2°F), Upper Stalker Creek (3°F), and Silver Creek at Kilpatrick Bridge (4°F).

Springhead Temperature Comparison

Heating Up

As a spring-driven system, temperatures within Silver Creek and its tributaries should remain relatively constant throughout the year and between years. For this reason, it is important to monitor temperatures over time to detect any major shifts in the system and to monitor the overall health of the Silver Creek Watershed. While median temperatures have remained relatively stable over the years of monitoring, there have been some increases at a few springheads worth noting. Monitoring indicated that three springheads experienced decreased flows. This left the remaining stagnant water to warm up by several degrees. Whether this is due to an overall decrease/ change in the groundwater system, or land use changes in near-surface water-bearing zones (e.g., a localized cone of depression resulting from groundwater extraction) is not yet clear. However, the decreased flow and higher temperature at the springheads exacerbates already high stream temperatures.

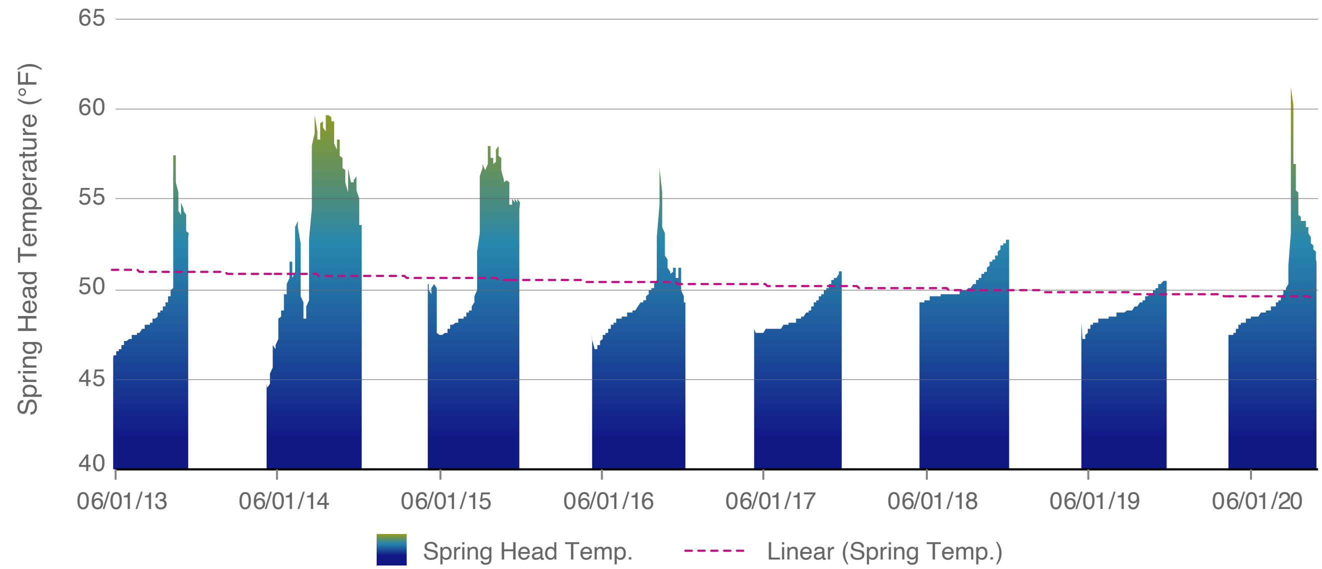
An increased understanding of the hydrogeologic relationship between surface water and groundwater in the Silver Creek watershed is needed in order to explain these changes in flow and temperature, and to develop appropriate strategies for future management and enhancement efforts. The following section outlines our current understanding of the groundwater system underlying Silver Creek.

It will be important to continue monitoring these springheads into the future to determine whether these noted changes are anomalies (one-to-two year occurrences) or a sign of a deteriorating groundwater, spring-fed stream system with consequences for the aquatic ecology of Silver Creek.

Cain Creek Springhead 2013 - 2020

The temperature comparison of the Cain Creek Springhead show the overall trend for the period of 2013 to 2020 and change between years. In low SWE or water years the springhead spikes in temperature later in the season. 2017 and 2019 lacked a temperature spike, while other years did experience spikes in temperature.. The temperature spikes likely mean that there was reduced flow and/or the springhead stopped running altogether. If the springs stop running, then Silver Creek's aquatic biota become stressed.

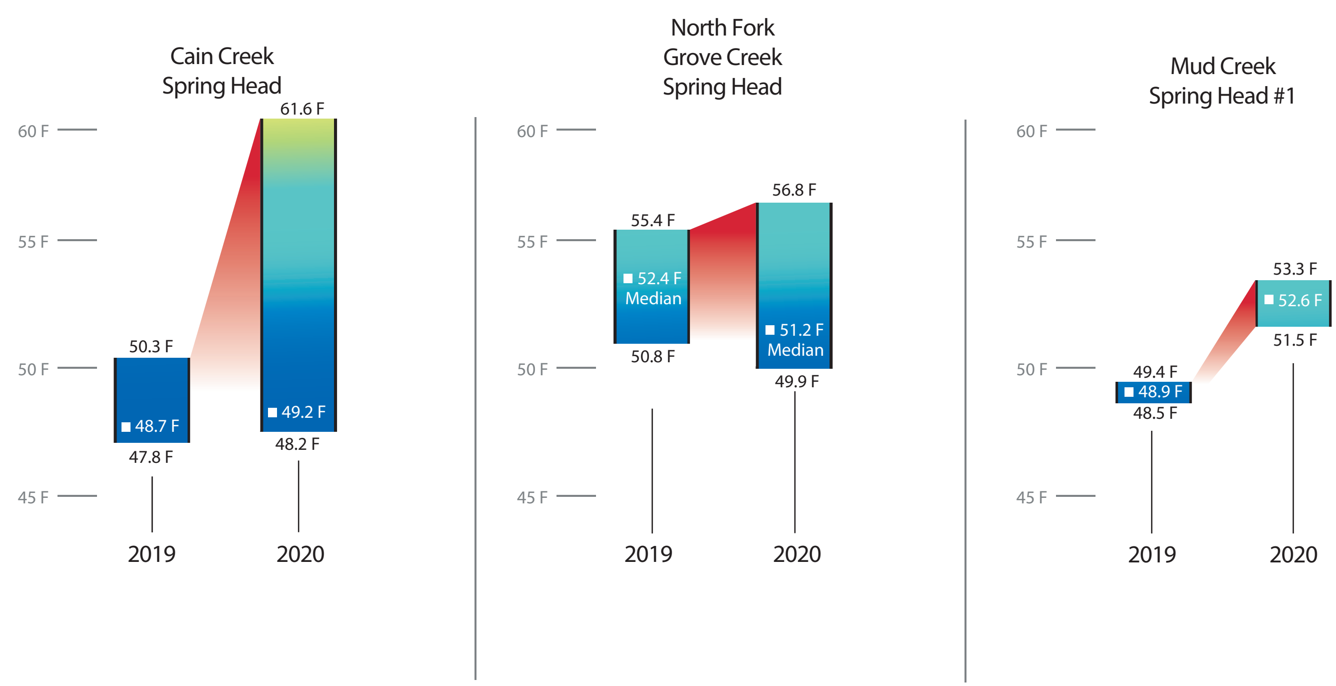
Cain Creek Spring Head: 2013 to 2020 Trend



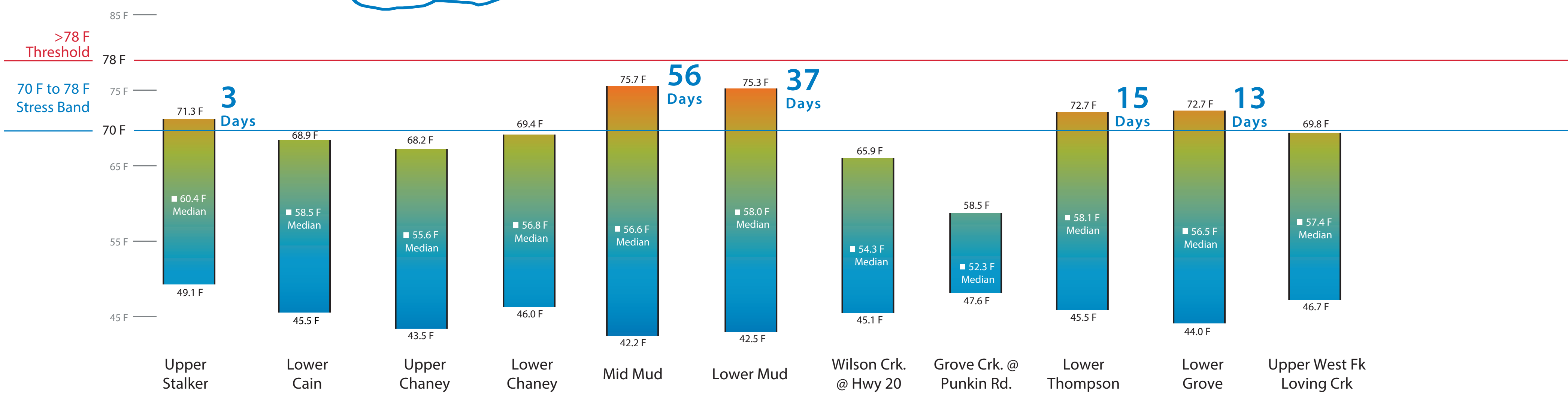
Temperature Spikes, 2019/2020

The temperature comparisons on this page display the temperature records of three springheads that indicate large changes or anomalies over the past two years. These three spring heads all had a dramatic increase in temperature in late August to early September - corresponding with a period of flows in the spring diminishing. Cain Creek is an "at-risk" or priority spring head that needs to be monitored closely. The significant spike in temperature is concerning and warrants continued observation, particularly in low water years.

2019 / 2020 Spring Head Temperatures Comparison



2020 Stream Temperatures Summary



▲ **Stream temperature bands** The above graphic depicts the summarized stream temperature data for the entire summer season for a selected group of data loggers and locations. The data were analyzed for the summer season to illustrate the high temperatures that occurred throughout the stream system for the period of June through the end of September 2020. Each graph displays the total temperature range for the period of record; the absolute high and low temperatures are given, and the median stream temperature is shown for that particular stream.

Locations of Stream Temperature Logger Array

This map illustrates the Silver Creek stream and tributary system along with the locations of the stream temperature loggers. The temperature loggers are expressed in two categories for discussion and analysis purposes:

Location of stream temperature loggers illustrated in bottom graphic of seasonal temperatures

Location of all other stream temperature loggers

Stream temperatures are logged continuously at one-hour intervals. The array of stream temperature loggers in the Silver Creek system is designed to capture temperature differences for each stream and tributary segment, from the spring source to Lower Silver Creek at the Highway 93 crossing.

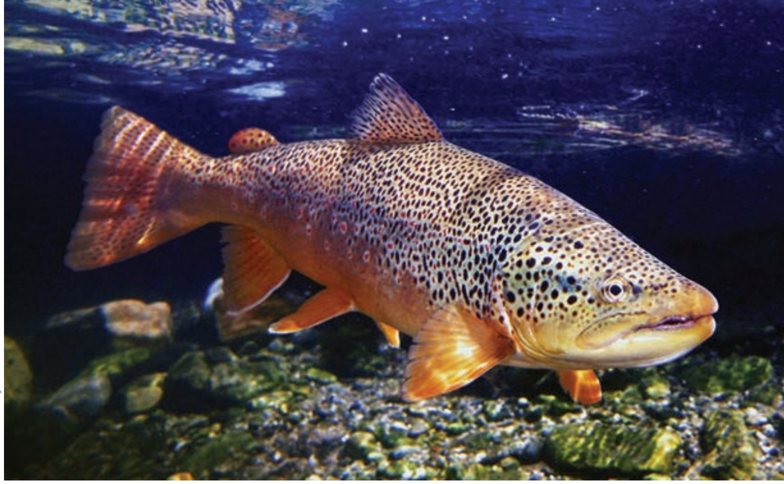
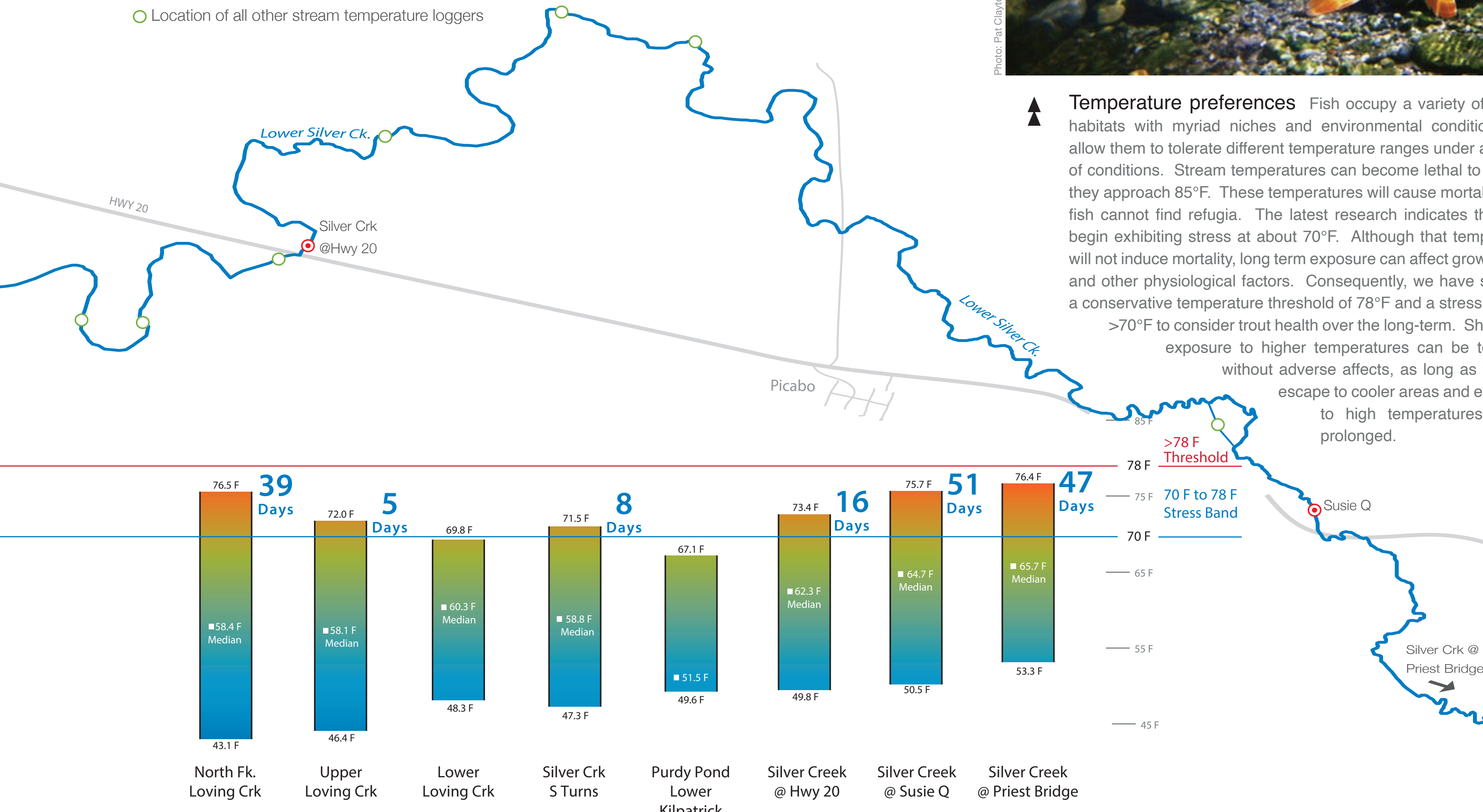


Photo: Pat Clayton

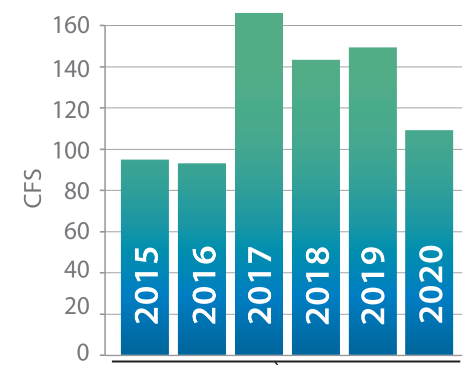
Temperature preferences Fish occupy a variety of stream habitats with myriad niches and environmental conditions that allow them to tolerate different temperature ranges under a variety of conditions. Stream temperatures can become lethal to trout as they approach 85°F. These temperatures will cause mortality if the fish cannot find refugia. The latest research indicates that trout begin exhibiting stress at about 70°F. Although that temperature will not induce mortality, long term exposure can affect growth rates and other physiological factors. Consequently, we have selected a conservative temperature threshold of 78°F and a stress band of >70°F to consider trout health over the long-term. Short-term exposure to higher temperatures can be tolerated without adverse affects, as long as fish can escape to cooler areas and exposure to high temperatures is not prolonged.

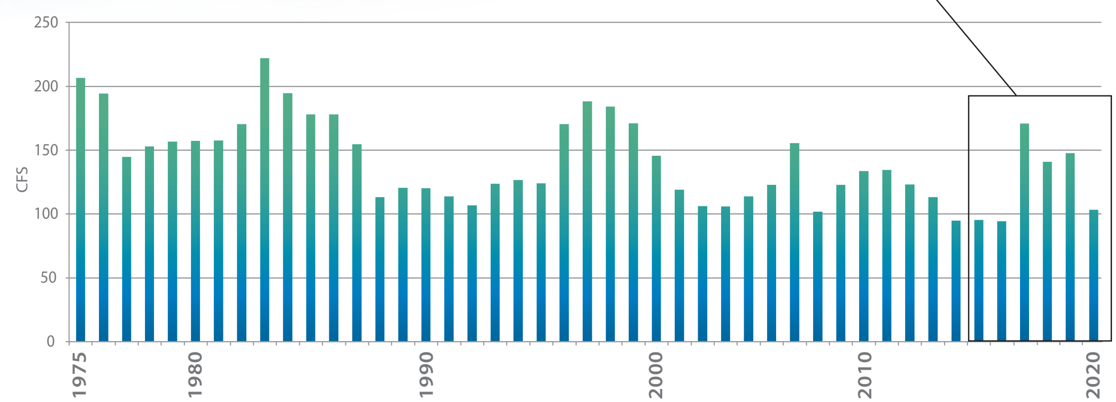


The overall median temperatures throughout the summer were within the preference range for trout (around 55-60 degrees) in Cain (58F), Chaney (56F), Mud (56-58F), Wilson (54F), Grove (56F), Thompson (58F), the upper reaches of Loving Creek (58-60F), and S-Turns at Silver Creek (59F). Stalker Creek and Lower Loving Creek and all had median temperatures at or above 60°F. The number of days that temperatures were within the stress band for trout (70°F-78°F) increased compared to measurements taken in 2019.

Stream Hydrology

Annual average streamflow (cfs) at USGS gage (Sportsmans Access) 1975 - 2020.





Silver Creek annual average streamflow (cfs) at USGS gage (Sportsmans Access) 1975 - 2020.

Monitoring streamflows is important, as it helps build our understanding of the volume and origin of water entering Silver Creek's tributaries and its potential influence on water temperature, dissolved oxygen and other water quality parameters.

Total annual discharge at Sportsman's Access in 2020 was near the 30-year average. Streamflows in Silver Creek's tributaries varied slightly, but in general were close to averages recorded since monitoring began in 2011. It was an average water year for Silver Creek and its tributaries. The Big Wood River had a below average annual discharge in 2020.

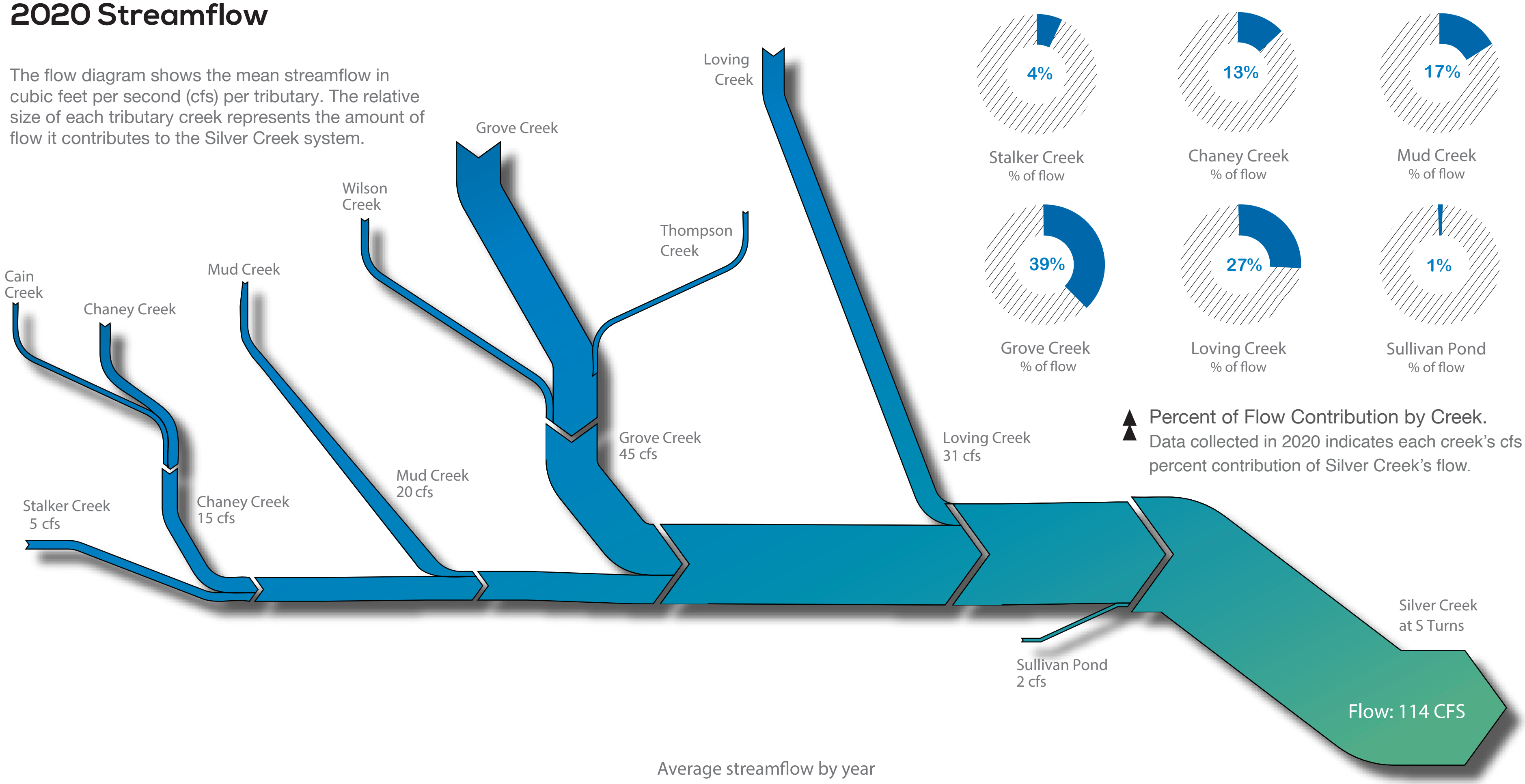
Big Wood River Average Annual Discharge at Hailey gage (cfs):

2015	311.5
2016	406.4
2017	1,003.0
2018	478.6
2019	598.9
2020	253.9

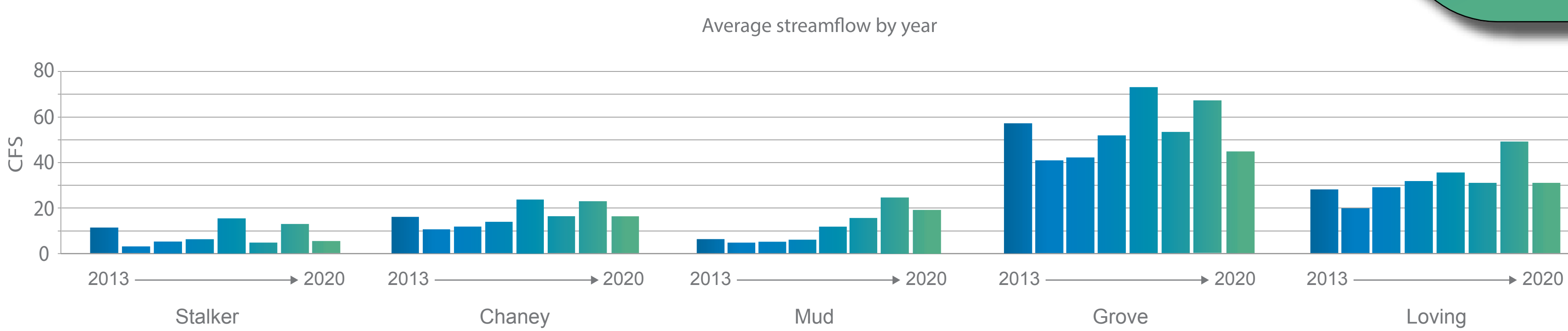
The 2020 water year resulted in below-average flows in the Wood River and average flows in Silver Creek and its tributaries. This is likely due to the historically low snowpack that the Big Wood Basin experienced in the winter of 2019-2020 combined with a rollover in groundwater levels from the 2018-2019 water year. In addition, a relatively wet spring and summer boosted streamflows and helped Silver Creek to approach average streamflows.

2020 Streamflow

The flow diagram shows the mean streamflow in cubic feet per second (cfs) per tributary. The relative size of each tributary creek represents the amount of flow it contributes to the Silver Creek system.



Percent of Flow Contribution by Creek. Data collected in 2020 indicates each creek's cfs and percent contribution of Silver Creek's flow.



Annual average streamflow by creek for 2013-2020. Data collected from 2013 - 2020 shows each creek's average flow. Recent increases in overall streamflow affects many critical components of the aquatic ecosystem. Measurements were not continuous, but were distributed throughout the spring, summer, and fall.

Dissolved Oxygen

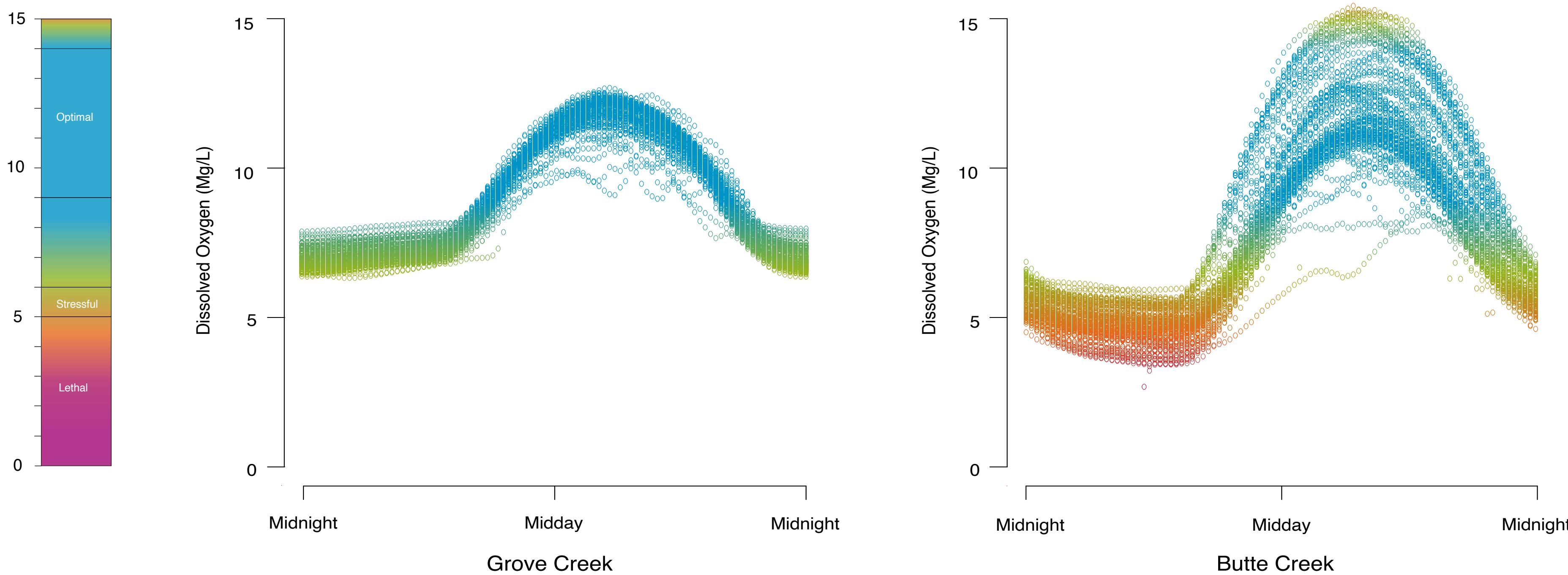
Since 2017, dissolved oxygen (DO) has been measured continuously from June through September at 7 sites. Data is recorded using optical sensors that record DO and temperature values every 15 minutes.

Similar to results from past years, the data indicated that not all of Silver Creek's waterways exhibit the same pattern of DO values and that DO levels stress fish in certain locations at certain times of the day. Seasonal fluctuations also occur, as changes in sunlight, temperature, flow and aquatic plant growth vary throughout the year.

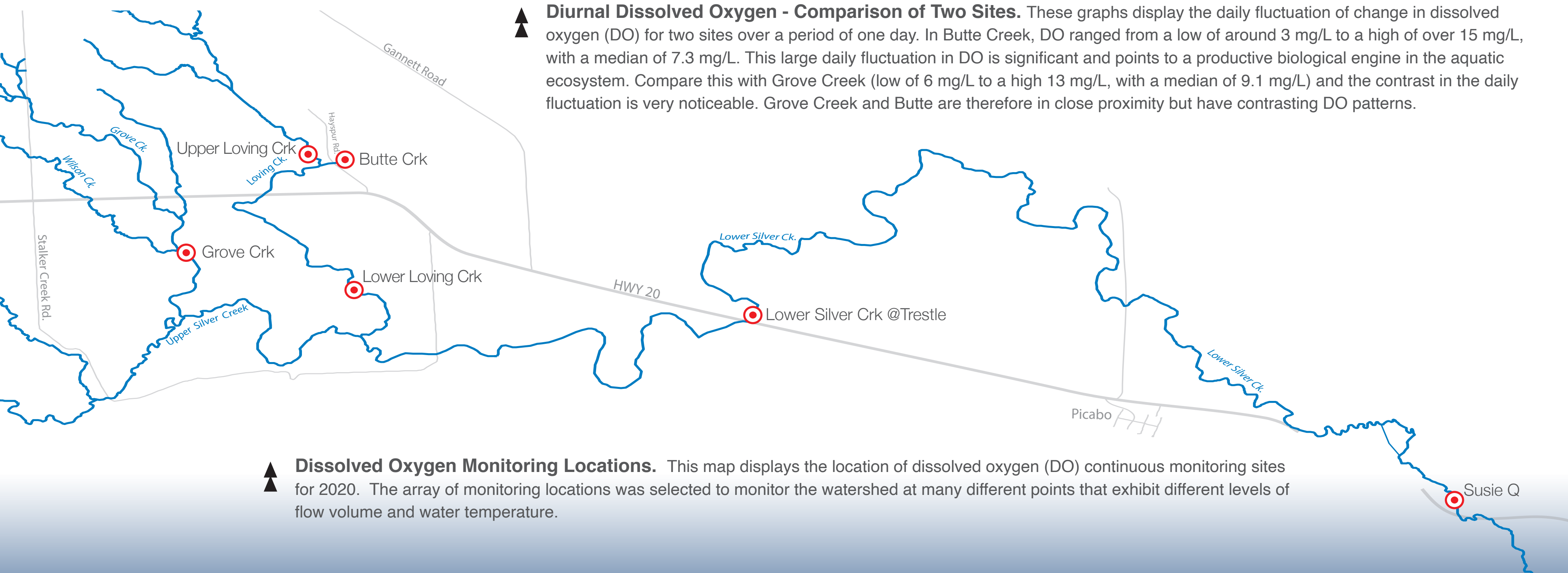
In many areas of the Silver Creek system, the daily fluctuations in DO are significant, which points to a productive biological engine in the aquatic ecosystem. As aquatic plant life within the stream utilizes photosynthesis to create energy, they produce oxygen. This process raises DO levels, which peak in the afternoon.

Overnight, plants continue to respire without photosynthesis, which requires oxygen (this demand is called biological oxygen demand) that is taken directly from the water. This daily process causes DO levels to be lowest just before dawn and highest in the afternoon; exhibiting a distinct diurnal cycle. As shown by the diurnal graphs presented, not all cycles are the same. The sensor placed at Grove Creek is in close proximity to the Butte Creek sensor location. Despite their close proximity in geographic space, their DO levels vary significantly (see diurnal plots on the facing page). This is due to a combination of factors, including streamflow volume, temperature, nutrient concentrations, and aquatic plant life, among others.

When DO readings fall into the stressful range for fish, they will seek refuge in areas that have higher DO concentrations. Fish eggs are buried in gravels and lack the mobility to escape low DO conditions. At the selected sites, 19% of all measurements made were between stressful to lethal levels for fish and their eggs (1st quartile at Suzie Q: 6.3 mg/L; Butte: 4.9 mg/L; Lower SC at the Trestle: 6.6 mg/L). The seasonal graphs present all data points taken during the 2020 season.

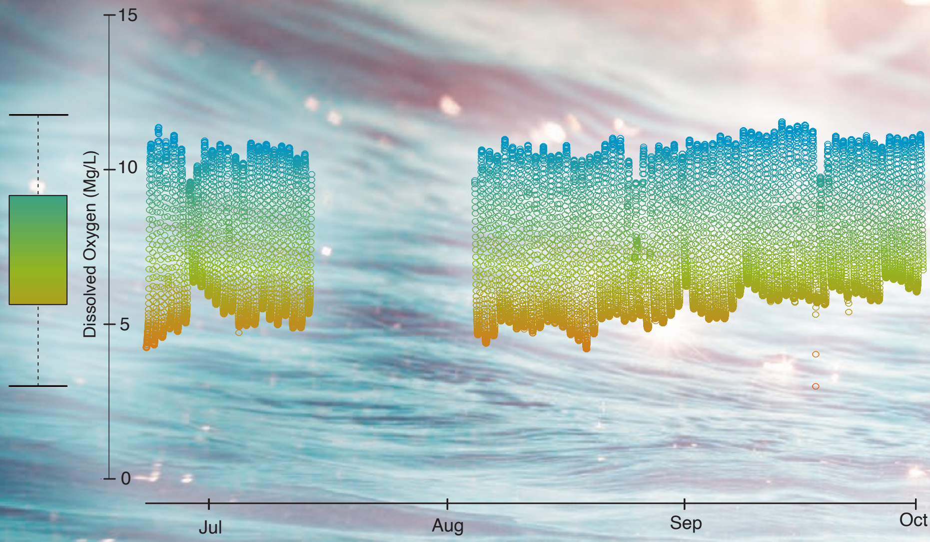


Diurnal Dissolved Oxygen - Comparison of Two Sites. These graphs display the daily fluctuation of change in dissolved oxygen (DO) for two sites over a period of one day. In Butte Creek, DO ranged from a low of around 3 mg/L to a high of over 15 mg/L, with a median of 7.3 mg/L. This large daily fluctuation in DO is significant and points to a productive biological engine in the aquatic ecosystem. Compare this with Grove Creek (low of 6 mg/L to a high 13 mg/L, with a median of 9.1 mg/L) and the contrast in the daily fluctuation is very noticeable. Grove Creek and Butte are therefore in close proximity but have contrasting DO patterns.

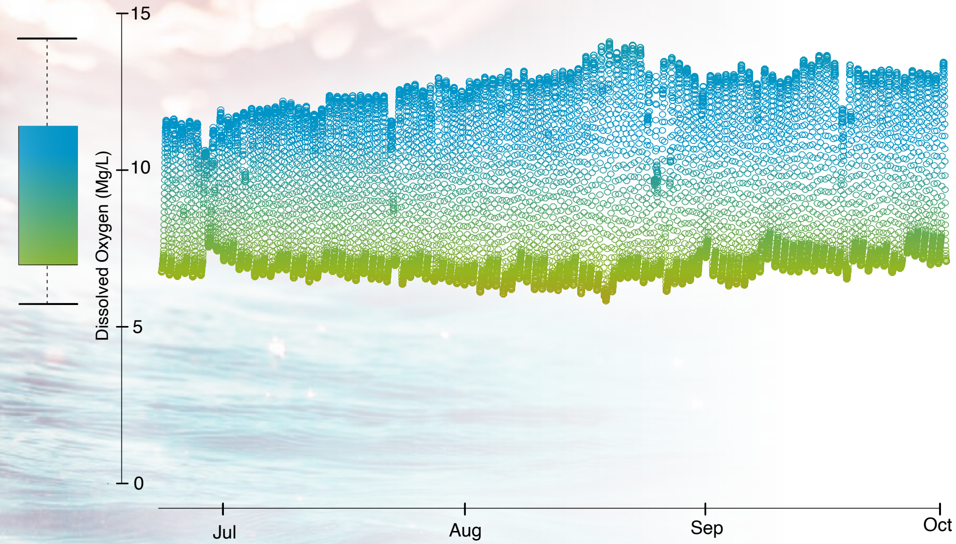


Dissolved Oxygen Monitoring Locations. This map displays the location of dissolved oxygen (DO) continuous monitoring sites for 2020. The array of monitoring locations was selected to monitor the watershed at many different points that exhibit different levels of flow volume and water temperature.

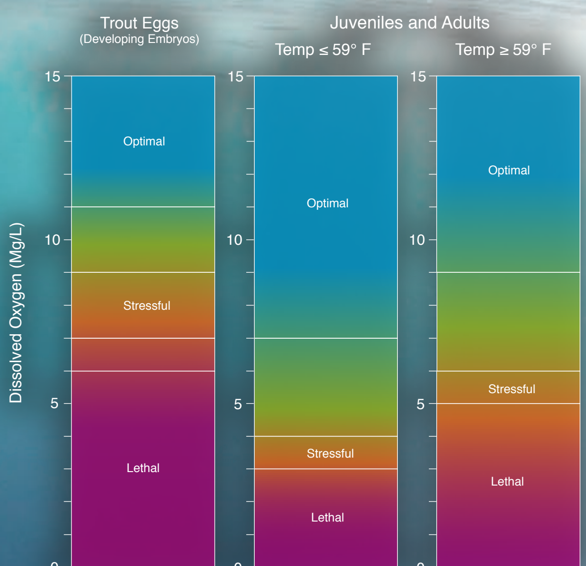
Dissolved Oxygen Results

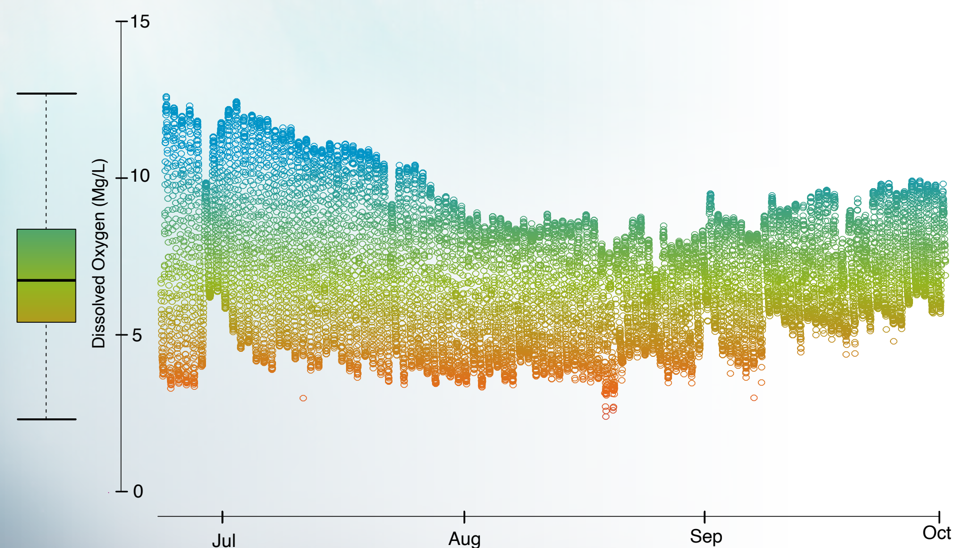


Upper Loving Creek



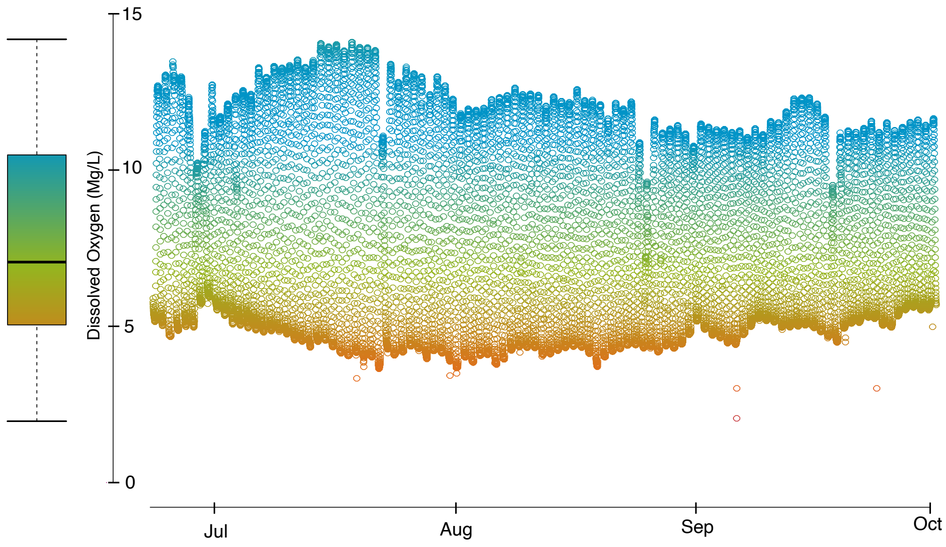
Grove Creek



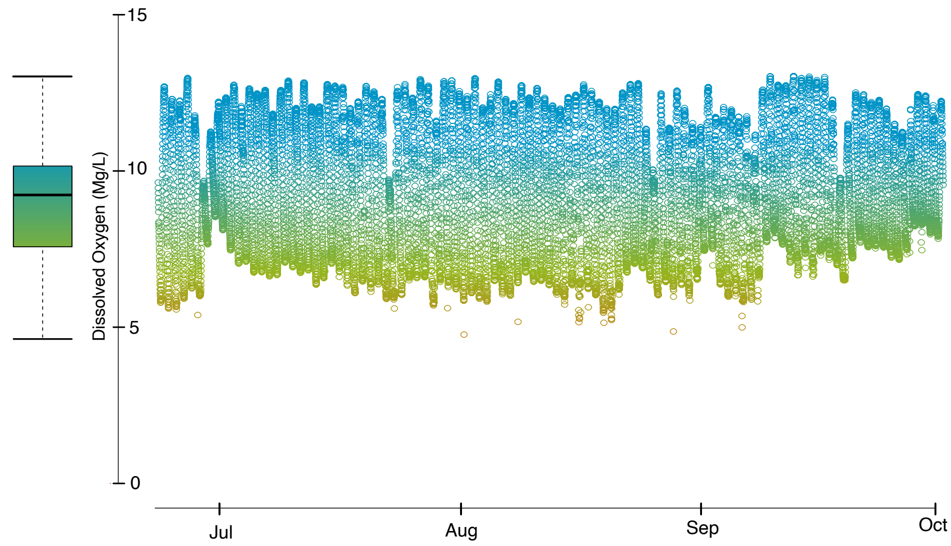


Lower Stalker Creek

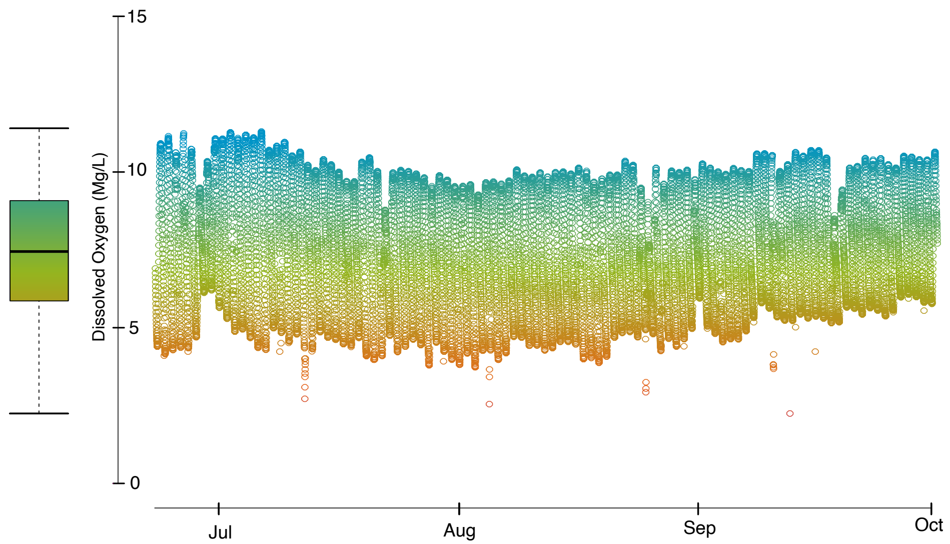
Average Dissolved Oxygen Requirements for Salmonids. Trout, depending on their particular life stage (egg, Juvenile, Adult), have differing requirements and thresholds for dissolved oxygen levels. Water temperature also plays a major role in dissolved oxygen levels. (Adapted from EPA's Chapman, 1986, and USFWS's Raleigh et al 1984, and Raleigh et al 1996).



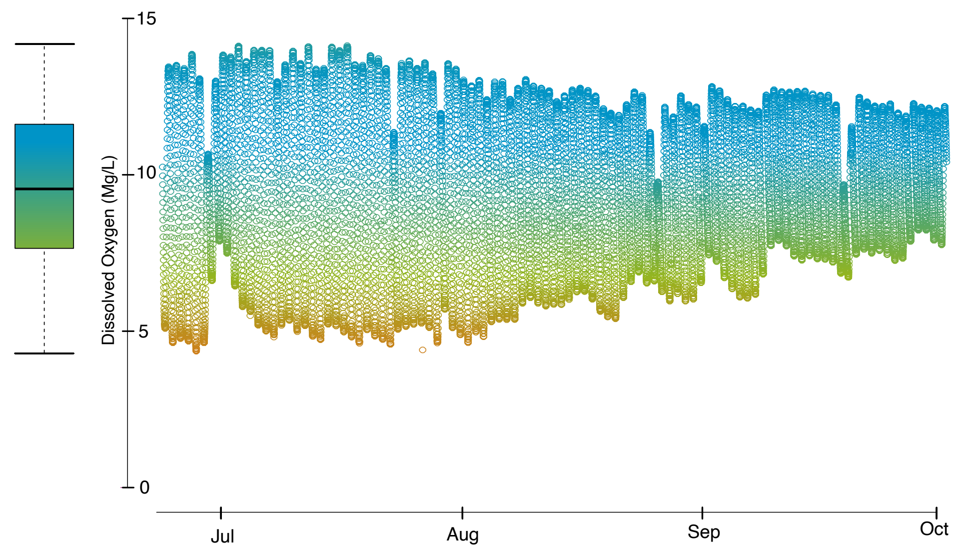
Butte Creek



Lower Silver Creek at Trestle



Lower Loving Creek



Susie Q

SILVER CREEK

RESTORATION AND GEOMORPHIC ASSESSMENT

A recently completed report provides an assessment for restoration planning and coordination in the Silver Creek Watershed. The report was completed for The Nature Conservancy (TNC) and the Silver Creek Alliance (SCA) and is intended to aid in the goal of creating habitat conditions that are suitable for sustaining a resilient wild trout spring creek fishery.

The streams in the Silver Creek watershed are spring-fed, and exhibit a relatively consistent hydrology. Other than human influence, Silver Creek functions like most other spring-fed streams that are highly stable and exhibit very slow rates of natural recovery. It is apparent that improving habitat conditions for wild trout in the foreseeable future will require active restoration actions including narrowing over-widened channel segments, adding woody debris and other forms of in-stream structure, creating more sinuous channels, and reducing fine sediment deposition. Implementation of any restoration action requires an understanding of the desired target conditions from which a restoration plan/design can be established.

GOAL: CREATE HABITAT CONDITIONS SUITABLE FOR A SUSTAINABLE, RESILIENT WILD TROUT SPRING CREEK FISHERY.

PURPOSE AND NEED

Silver Creek is biologically, culturally, historically, and economically relevant to Idaho and the West: Silver Creek is prized for its stunning clear waters, catch and release trout fishery, abundant wildlife, and vibrant history.

An assessment like this has not been done previously. Although many isolated investigations concentrating on one part of Silver Creek or on general conditions within the watershed have been performed, a geomorphically-based assessment at multiple scales of this type has not been performed.

The overall purpose of the assessment is to develop a report that is suitable for guiding approaches and implementation strategies for future restoration and enhancement projects.

SILVER CREEK WATERSHED

ASSESSMENT & RESTORATION DESIGN

PROJECT OVERVIEW

Conditions in the Silver Creek watershed have changed over the decades, resulting in many of the observed impacts that now adversely affect fish habitat.

The magnitude of impacts relative to the rates of “natural” recovery suggest that habitat is unlikely to be repaired by natural stream evolution within the foreseeable future (i.e., many decades). To restore the fishery’s high quality, accessible habitat for all life stages is needed: rearing habitats and refugia for juveniles; large pools for adults; and abundant, connected spawning and overwintering habitats. Channel restoration is therefore recommended to improve conditions by building new habitat (active restoration) and/or accelerating the stream’s ability to naturally repair itself and create new habitat (passive restoration).

GOALS OF THE ASSESSMENT

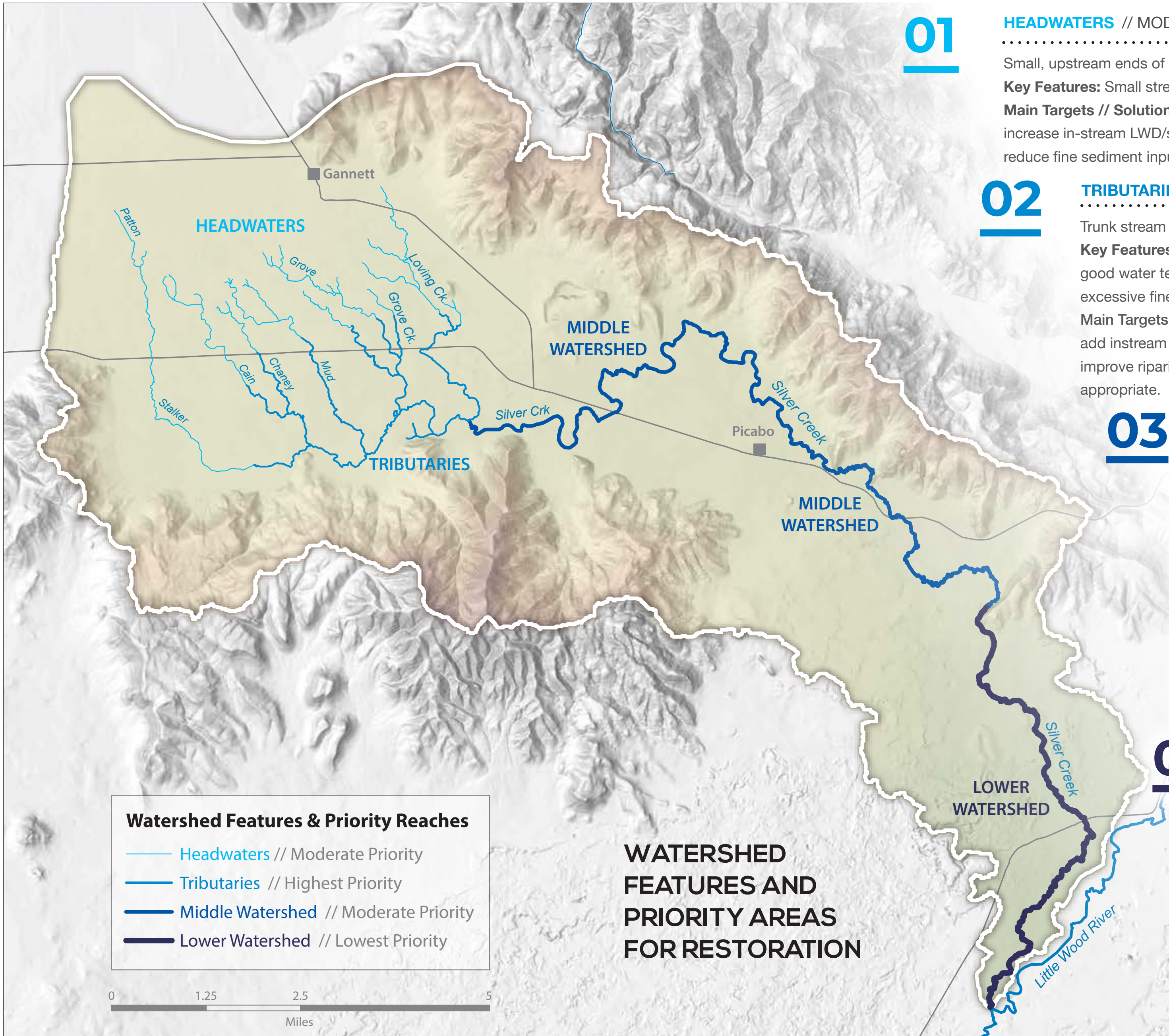
- Document past, existing (baseline), and potential target conditions.
- Identify potential actions for improving habitat relative to the Silver Creek goal that can be applied throughout the watershed.
- Provide a conceptual restoration plan for two priority reaches within the watershed.

WHERE TO FIND THE ASSESSMENT

The assessment was prepared as a collaborative joint effort by Rio ASE and Ecosystem Sciences, and was commissioned by the Silver Creek Alliance and The Nature Conservancy. The Assessment can be found at: SaveSilverCreek.com

The assessment is intended to be utilized by stakeholders, landowners, and other groups within the watershed to inform future restoration and enhancement efforts. It seeks to provide information on the geomorphic setting, and key parameters representing watershed and reach conditions.

WATERSHED FEATURES AND PRIORITY AREAS FOR RESTORATION



01 HEADWATERS // MODERATE PRIORITY

Small, upstream ends of headwater tributaries.

Key Features: Small streams with mixed habitat and fish use potential.

Main Targets // Solutions: Increase sinuosity, reduce width-to-depth ratio, increase in-stream LWD/structure forcing constrictions and pools with cover, reduce fine sediment inputs. Increase riparian vegetation.

02 TRIBUTARIES // HIGHEST PRIORITY

Trunk stream of tributaries and Silver Creek Preserve.

Key Features: Over-widened, single-threaded channel, generally good water temperatures, high habitat connectivity, few pools, excessive fine sediment.

Main Targets // Solutions: Reduce stream width, increase sinuosity, add instream LWD/structure forcing constrictions and pools, improve riparian vegetation, and use ponds as sediment traps where appropriate.

03 MIDDLE WATERSHED // MODERATE PRIORITY

Main-stem Silver Creek from Preserve downstream to Priest Road (roughly 1 miles south of Hwy 20)

Key Features: Over-widened, single-threaded channel, poor summer water temperatures, many disconnected side channels, poor floodplain connection, poor riparian habitat.

Main Targets // Solutions: Reconnect relic side channels and habitat, reduce stream width, add LWD/structure forcing constrictions and pools with cover, improve riparian vegetation, use ponds as sediment traps where appropriate.

04 LOWER WATERSHED // LOWEST PRIORITY

From Priest Road downstream to the confluence with the Little Wood River.

Key Features: Confined valley with poor floodplain connection, high summer water temperatures, poor habitat connectivity.

Main Targets // Solutions: Low restoration potential, poor benefit-to-cost ratio, opportunities should focus on improving riparian vegetation and adding in-stream LWD/structure within existing channel.

Restoration objectives should focus on a sustainable wild trout fishery by reducing over-widened and simplified channel forms, increasing in-stream hydraulic structural complexity, and improving riparian vegetation.

A SUSTAINABLE, RESILIENT WILD TROUT SPRING CREEK FISHERY

Next Steps

eDNA Monitoring

In partnership with the National Genomics Center for Wildlife and Fisheries Conservation, Ecosystem Sciences Foundation would like to conduct Environmental DNA (eDNA) sampling in Silver Creek and its tributaries in 2021-2022. The collection of eDNA has become a common tool among researchers to detect the presence of macrobial species (i.e. fishes, amphibians, mollusks, crustaceans, and insects) based on the presence of their DNA in air, water and soil. The use of eDNA sampling has been found to be a simple and efficient tool for determining a species' presence in an ecosystem and is often as effective at traditional sampling techniques. Of interest, eDNA can be used to detect species that are rare, difficult to find, or are in low densities within the ecosystem. For streams, conducting eDNA sampling is non-invasive and generally involves filtering several liters of water from the area of interest and then testing for DNA signatures. This permits rapid collection of large numbers of samples, each with a high probability of species detection. In the Silver Creek watershed, eDNA sampling would be used to estimate the abundance and distribution of rainbow trout, brown trout and other fish species. This study will provide in important information about Silver Creek's fish species for both conservation and recreational purposes. Please consider a donation to support this innovative project!

Fish Habitat Analysis and Mapping

Fish habitat features and redd counts were surveyed on nearly all the tributaries in Silver Creek in fall 2015 and spring 2016. However, due to lack of funding, the mainstem of Silver Creek has not been surveyed yet. ESF is seeking funds to conduct redd counts in the mainstem Silver Creek during the fall and spring seasons in 2021-2022. Our goal is to create a database with redd locations for brown trout and rainbow trout as well as a map that identifies redd locations and delineates habitat such as: spawning areas, early rearing and nursery areas, side channels, pools, undercut banks, resting and feeding zones, and streambank conditions.

Monitoring and Maintenance

Over the past 10 years, the Silver Creek Program has monitored stream hydrology, water temperature, sedimentation and dissolved oxygen. Combined, these parameters are indicators of ecosystem health much like checking our own body temperature and circulatory system. Monitoring is paramount to understanding ecological processes and relationships, identifying trends and establishing effective strategies for enhancement. However, monitoring is a long term scientific tool that must be done consistently over time; the more data collected, the more meaningful the results. As our monitoring program continues, it is necessary to periodically replace temperature sensors and redeploy DO sensors, which comes at a capital cost. We are seeking additional funding is needed to maintain our monitoring equipment to continue these important programs.

Funding

To continue our ongoing monitoring work and perform new analyses, as described above, our Silver Creek Program needs additional funding. Our program is heavily based on monitoring and data analysis; we have found that these activities alone are rarely funded through traditional grant programs. Please consider a donation to continue this important work. A substantial volunteer effort goes into the Silver Creek program each year and your donations directly support the Program. Thank you for your support!

Please send donations to:

Ecosystem Sciences Foundation
202 N 9th Suite 400
Boise, Idaho 83702

2011 - 2020

Silver Creek Annual Report

Ecosystem Sciences

Foundation

202 N 9th Suite 400

Boise, Idaho

83702

P: 208 383 0226

F: 208 368 0184