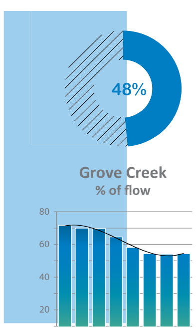
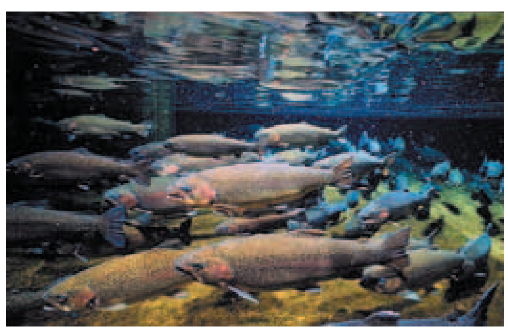
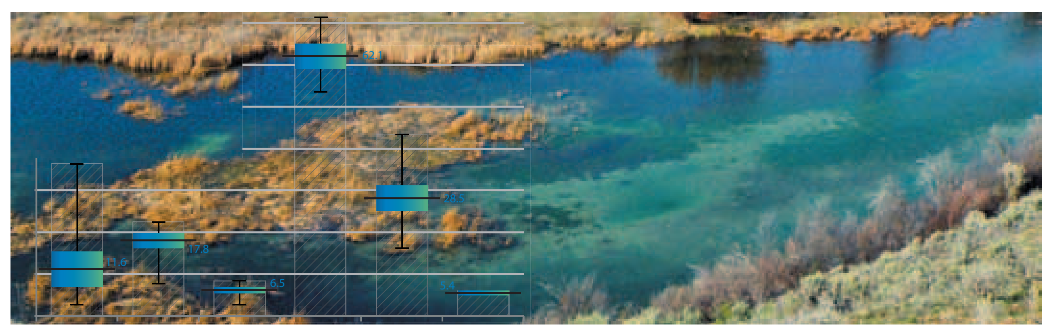
2012

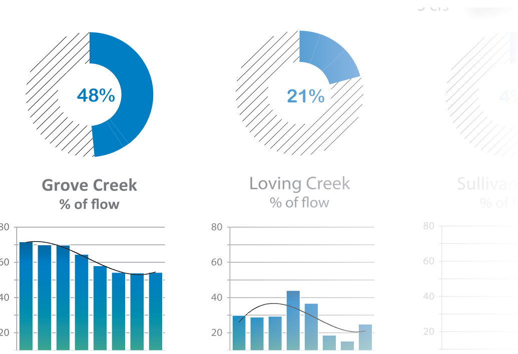
Silver Creek Annual Report

Silver Creek Alliance









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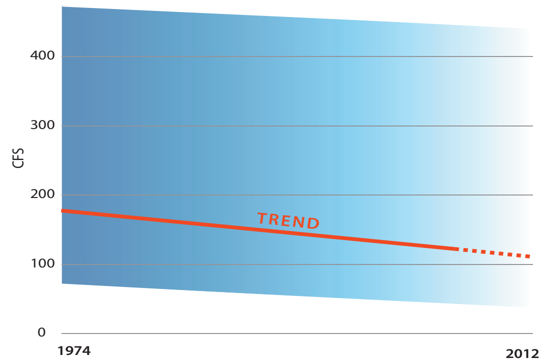

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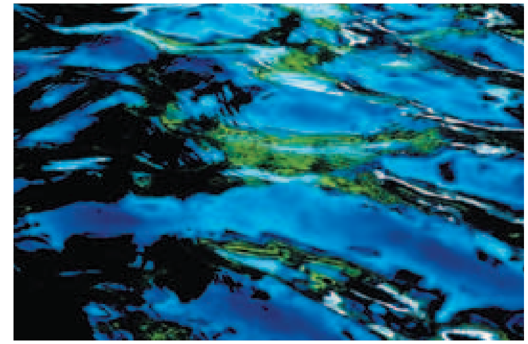

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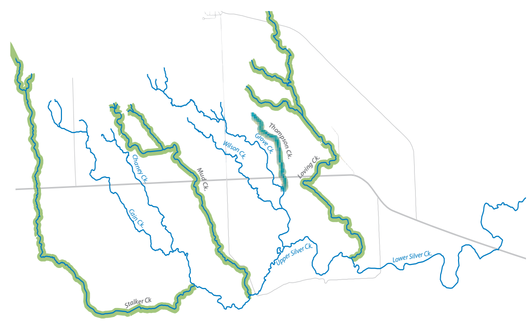

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www.silvercreekalliance.org

The Silver Creek Alliance is an association of conservationists working collaboratively to practice ecologically sound land and water management in the Silver Creek watershed of Idaho.

Silver Creek Watershed

2012 Report

In 2010, Ecosystem Sciences Foundation (ESF), in partnership with The Nature Conservancy (TNC), developed a restoration and enhancement strategy for the Silver Creek watershed. The strategy identified numerous actions to be taken including filling critical data gaps on stream flow, temperature, and sediment conditions.

A logical outcome of the *Silver Creek Watershed Enhancement Strategy* was to implement monitoring to better understand the creeks and then develop effective management and restoration tools. Many of the numerous stream restoration projects which have been performed throughout the watershed have been on private land using private funds. Landowners have a vested interest in encouraging the enhancement and restoration of streams for two principle reasons. First, landowners want stream reaches on their property to support good fisheries, be ecologically functional, and to ensure that restoration investments already made are sustained. Second, landowners recognize that all of the streams in the watershed are maintained primarily by spring flows and springs are maintained by the groundwater level and maintaining the groundwater level is paramount to sustaining Silver Creek.

What We Learned

This report summarizes data from 2012:

- **Stream Hydrology**
- **Stream Temperatures**
- **Hot Spots**

The significant conclusions and findings from 2012 are:

- The difference in the "flashiness" or the rise and fall in stream flow between the creeks, with Stalker Creek having the greatest range.
- Several creeks exhibited high temperatures above the threshold for very short durations. Otherwise, nearly all stream segments exhibited temperatures within the acceptable range for trout.
- Why are stream flows decreasing in Silver Creek? There are likely a number of reasons, but the simplest answer is: there is less groundwater.

For more details please visit: www.silvercreekalliance.org 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 work in way that tells a story of the stream system and watershed. The raw and tabulated data that is used as the basis for the information presented here is detailed, scientifically rigourous, and reflects a considerable amount of field work to collect this important data. The two websites have more detailed information on programs in the watershed.

Stream Hydrology

Understanding the hydrology of Silver Creek and its tributaries is fundamental to understanding how Silver Creek functions and what makes it such a special place. Before 2011, the flows in the major tributaries to Silver Creek had never been measured on a regular basis. In 2011, we initiated a surface flow monitoring program. After two seasons of hydrology data on the tributaries, the characteristics of each creek are becoming clearer. In 2012, five measurements were made on each of the major tributaries: Stalker, Chaney, Mud, Grove and Loving Creek. Access to the S-turns site on Silver Creek was hampered by a high stage (the stream can become so deep it becomes unsafe to measure in waders) and our desire not to disturb fishermen who were already utilizing the site prior to our arrival.

Spring Creeks – Similar but Different

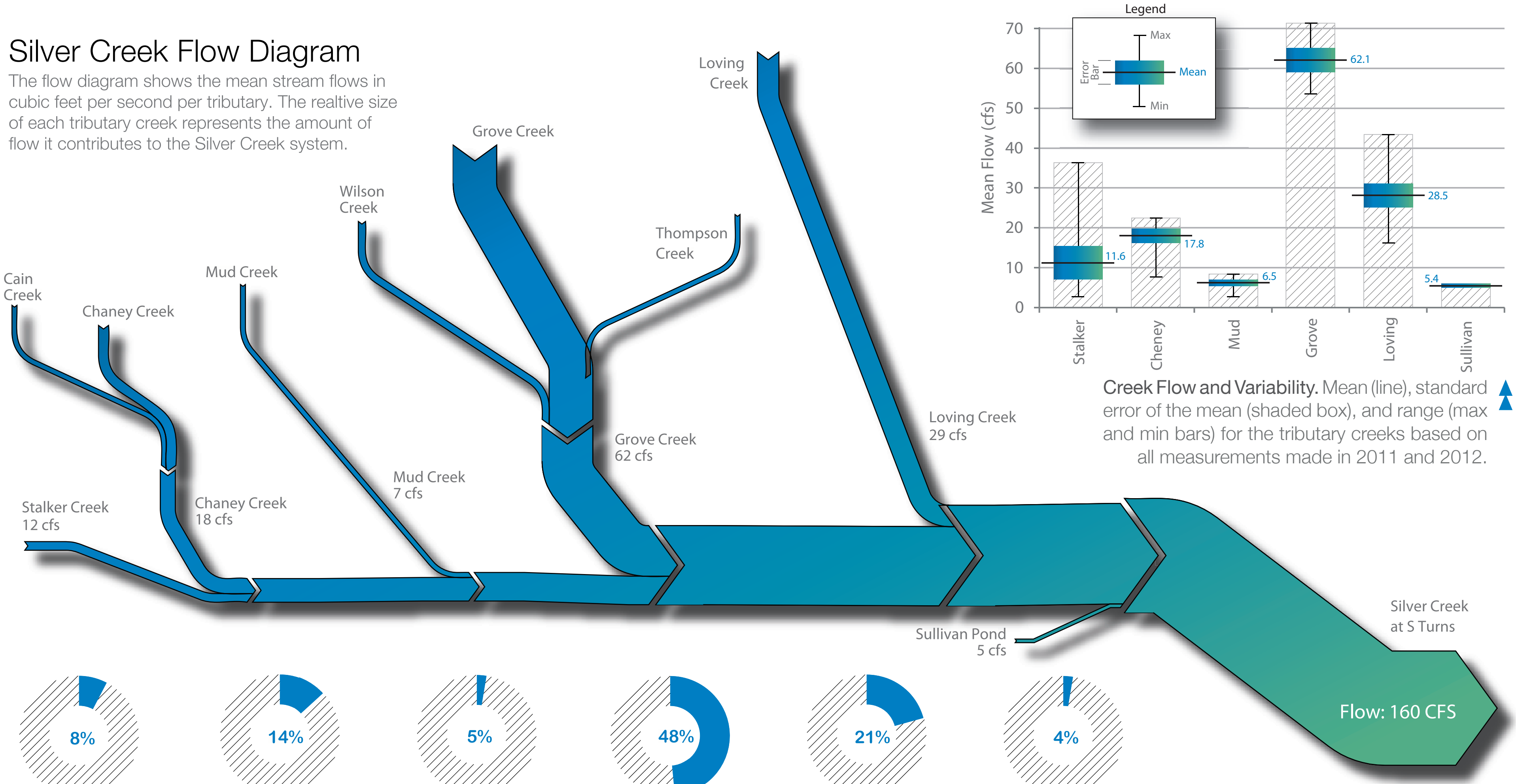
Silver Creek is famous for its spring creeks. They are known for their slowly meandering spring water, amazing trout fishery and scenic beauty. They are similar in many ways. However, the hydrology data collected over the past two years illustrates how different they are upon closer inspection.

After making five additional measurements on each of the tributary creeks in 2012 (see the graphics on the facing page) we can see in the graphic on the upper right of the facing page the difference in the "flashiness" between the creeks. Stalker is the 4th largest creek in terms of flow (11.6 mean cfs), but it has the highest standard error (measure of variability of the mean – 3.9), the largest range of flow measurements (3.9 to 33.3 cfs) and the largest standard error relative to the mean (SE/mean = 33.1). Loving Creek can be viewed as the second most variable creek (see graphic in the upper right of facing page). In contrast, Grove, Mud and Chaney are much less variable. Grove, the largest (62 cfs mean flow) had a range of 18 cfs and the smallest standard error relative to the mean (4.4) over the measurement period. Grove is the largest and the most constant. Stalker is much smaller and is the most variable in the system.

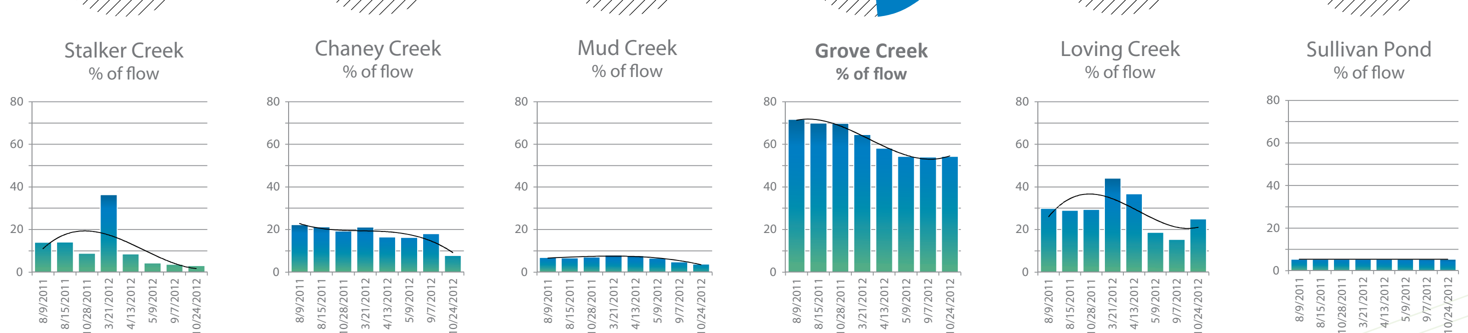
There are several factors that could explain these characteristics including watershed size, landcover, spring and groundwater influences, irrigation diversions and irrigation returns. We need to continue to monitor hydrology and identify the underlying causal factors to understand and protect this precious resource.

Silver Creek Flow Diagram

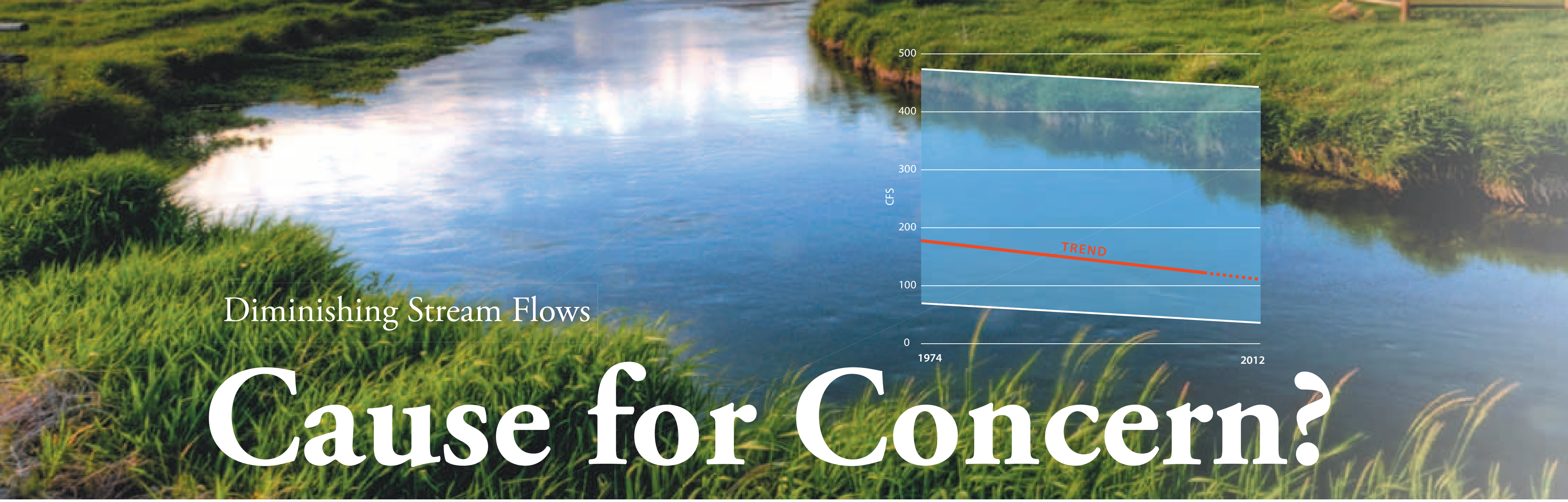
The flow diagram shows the mean stream flows in cubic feet per second per tributary. The realtive size of each tributary creek represents the amount of flow it contributes to the Silver Creek system.



Creek Flow and Variability. Mean (line), standard error of the mean (shaded box), and range (max and min bars) for the tributary creeks based on all measurements made in 2011 and 2012.



Percent of Flow Contribution by Creek. Data collected in 2011 and 2012 indicates each creek's cfs and percent contribution of Silver Creek's flow. The percentage calculations were made by calculating each creek's percentage of Silver Creek's flow on each day of measurement, then averaging all measurement days. The bar graphs indicate the cfs of each creek on each measurement day (note that the time intervals between measurements are not equal).



Diminishing Stream Flows

Cause for Concern?

The USGS has been recording stream flow data at Sportsman's Access since 1974. Over this period of record, there has been a significant decline in flows in Silver Creek. With lower flows come higher temperatures, less fish habitat, higher sediment and contaminant concentrations, and reduced scenic values.

Why are stream flows decreasing in Silver Creek? There are likely a number of reasons, but the simplest answer is: there is less groundwater. It is natural for groundwater levels to fluctuate. However, the decline in groundwater within the Big Wood Aquifer, especially the declines in the Bellevue fan, are not within the normal range of fluctuation.[1]

Big Wood River Flows and Groundwater Levels Declining

The springs that give life to Silver Creek are fed by the Big Wood Aquifer. The Big Wood Aquifer is a single unconfined aquifer that is fed mainly by snowmelt in the mountains surrounding Sun Valley, Ketchum, Hailey and Bellevue. The water flows underground out of the Wood River Valley and moves in two directions: towards Stanton Crossing and Picabo. It is the water that moves toward Picabo that emerges out of the springs that feed Silver Creek. This means that all of the water drawn from wells from the Wood River Valley to the Bellevue triangle all come from the Big Wood River Aquifer, and therefore, affect Silver Creek's flow.

The USGS performed a study in 2007 on the water resource trends in the Wood River Valley.[2] Their analysis showed decreasing water levels in groundwater wells, the Big Wood River, and in Silver Creek. They found decreasing trends in annual and mean monthly discharge for July through February and April from 1975-2005. They attribute an increase in March flows to an earlier snowmelt season due to climate change. They also found statistically significant

[1] Skinner, K.D., Bartolino, JR, and Tranmer, AW, 2007. Water-resource trends and comparisons between partial development and October 2006 hydrologic conditions, Wood River Valley, south-central Idaho: US Geological Survey Scientific Investigations Report 2007-5258, 30 p.

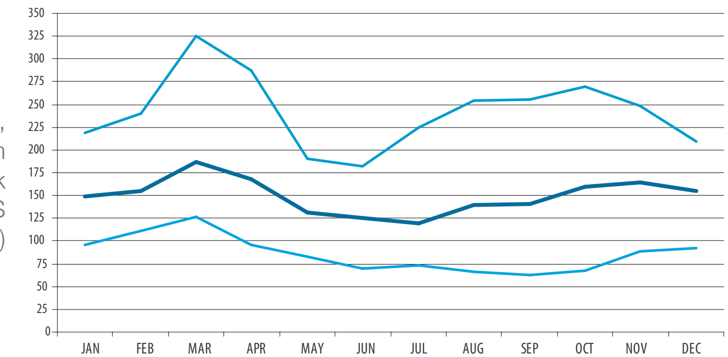
[2] Ibid.

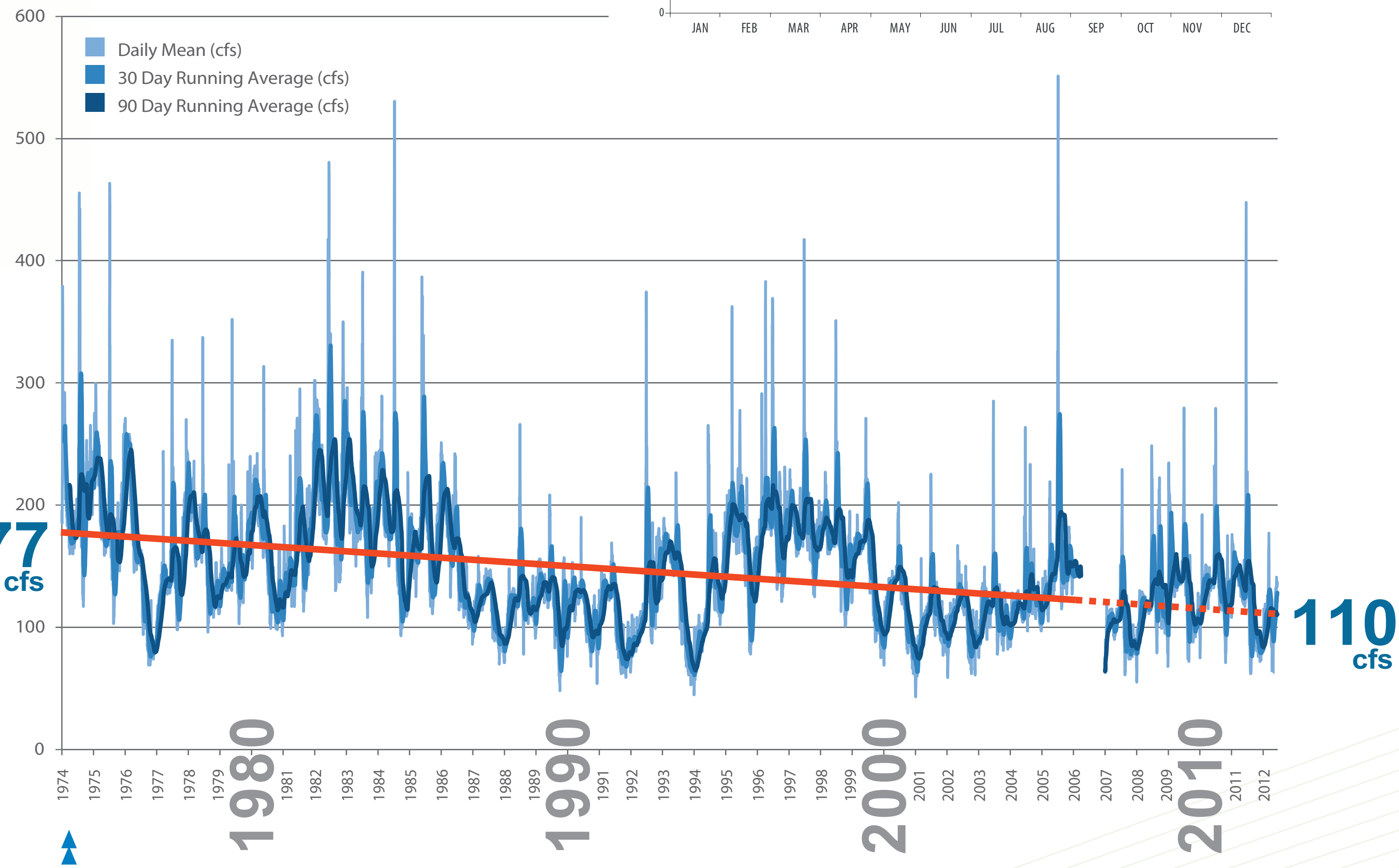
decreasing trends for the 7-day and 30-day low flows – meaning the low flows are getting lower.

Precipitation has varied over the last 35 years, with two notable drought periods. This affects the groundwater, and consequently the stream flow in Silver Creek. However, these fluctuations don't explain the declines in groundwater or surface water flows. More likely, the increasing consumptive use of water up gradient from Silver Creek is responsible.

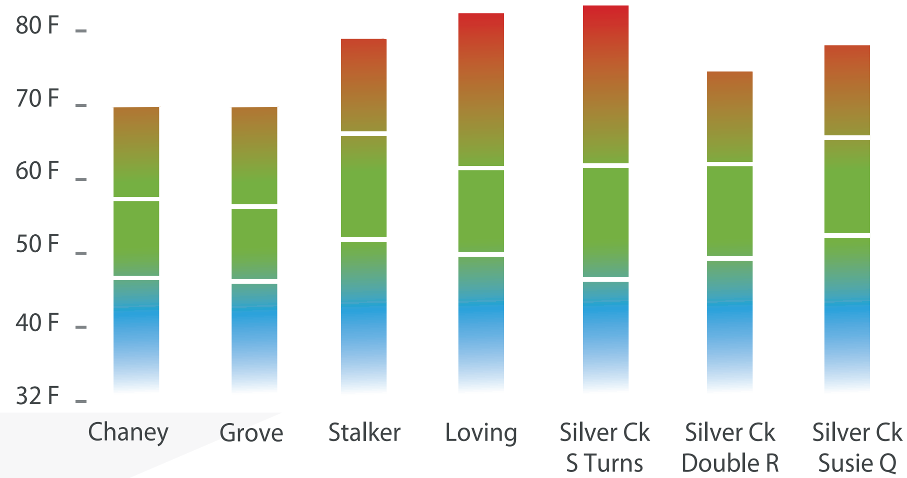
There have been many important restoration and enhancement efforts on Silver Creek in recent years. However, without the water supply to fill the creek and fuel the springs, this work will be meaningless. Monitoring surface and groundwater levels is critical to ensure the protection of Silver Creek for future generations.

Monthly average, maximum and minimum flows for Silver Creek from 1974-2012 (USGS measuring station)





38 years of Stream Flow Measurements on Silver Creek. The hydrograph above shows the daily mean (light blue) the 30 day running average (medium blue) and the 90 day running average (dark blue) for Silver Creek at the Sportsman's Access USGS stream gage. There was a gap in data from the stream gage in 2006. The red line is a simple linear regression run on 11,688 daily means between 1974 and 2006. The regression, the intercept and the x variable (day) were all highly significant (p=0), meaning that there is little or no chance that the regression line is purely due to random chance. The stream flows are declining. The data between 2007 and 2012 were not included in the analysis and therefore the regression was interpolated to extend it to today based on the 1974-2006 data. The regression predicts a decline of approximately 1.7 cfs/year over the analysis period.



Summer Stream Temperatures: 2006-2010 The graph above indicate the maximum, average and minimum summer water temperatures on selected areas of Silver Creek over a five year period. This year 50 stream temperature loggers were monitored throughout Silver Creek and each tributary to record critical information and track changes in the system.

Stream Temperature

The stream temperature monitoring program was continued in 2012. Additional loggers were installed throughout the Silver Creek watershed in 2011 and were maintained by Save Silver Creek and TNC. The monitoring array collects water temperature data for most springheads, every tributary stream within the Watershed, and Silver Creek itself. This year, 50 stream temperature loggers collected data, some year-round while others were deployed only during the summer months.

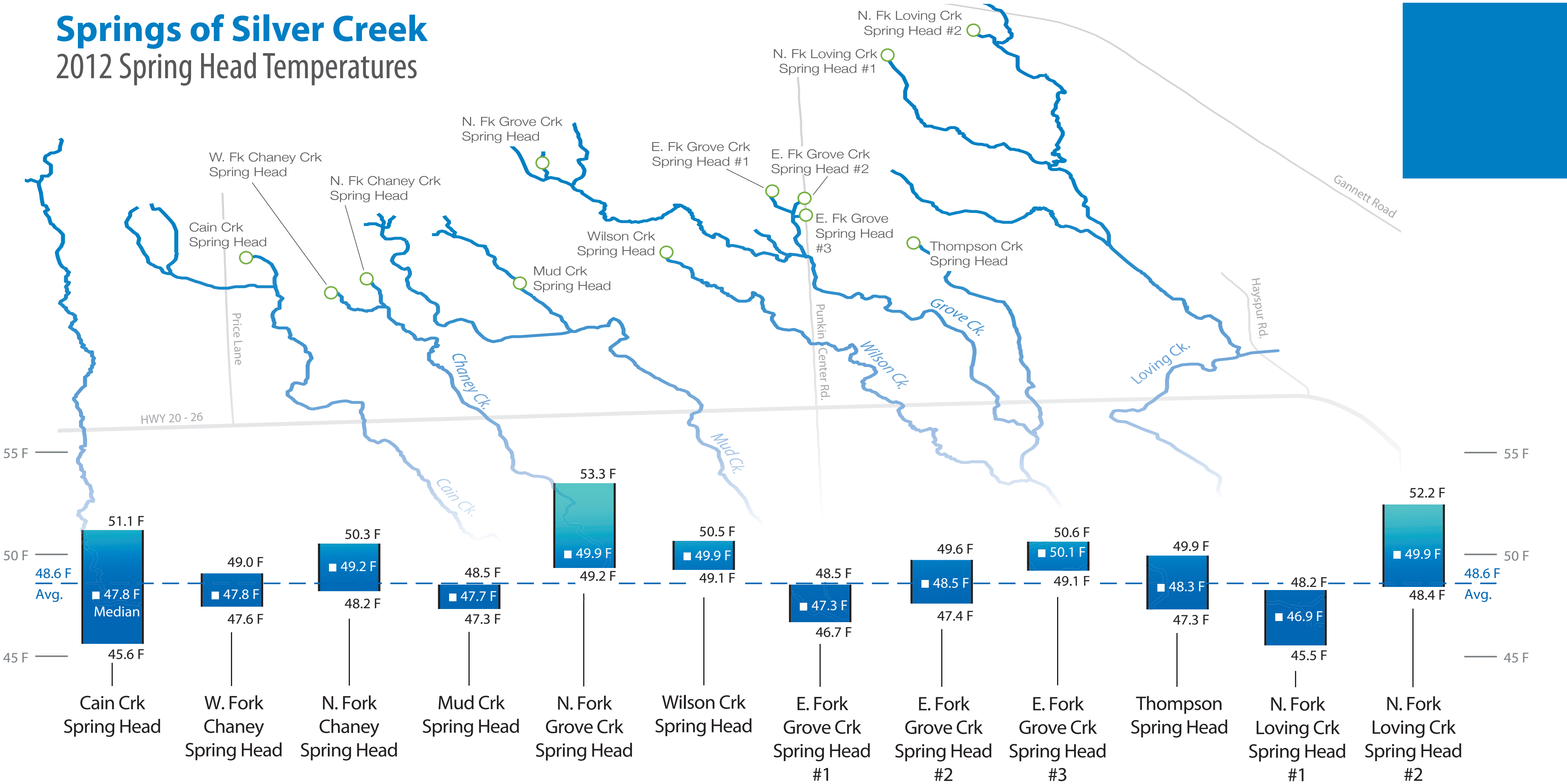
Temperature data is paramount to monitoring the overall health of the Silver Creek ecosystem. These data can aid in identifying potential reaches where elevated temperatures are problematic for fish and instream biota, or in assessing temperature responses to habitat restoration, changes in landuse, or recovery from wildfire.

Spring Driven Ecosystem

Stream temperatures in a spring driven system, such as Silver Creek, should

Springs of Silver Creek

2012 Spring Head Temperatures

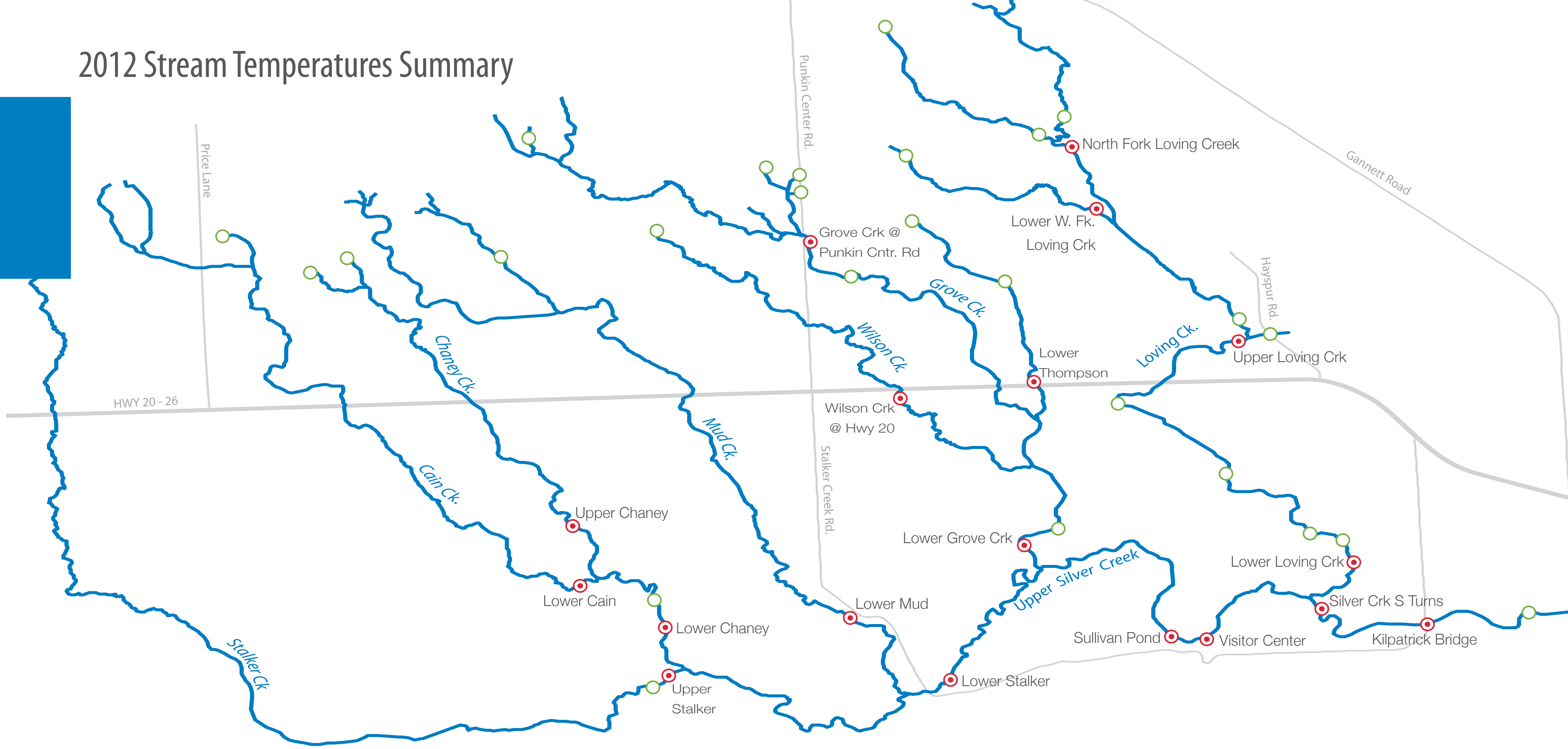


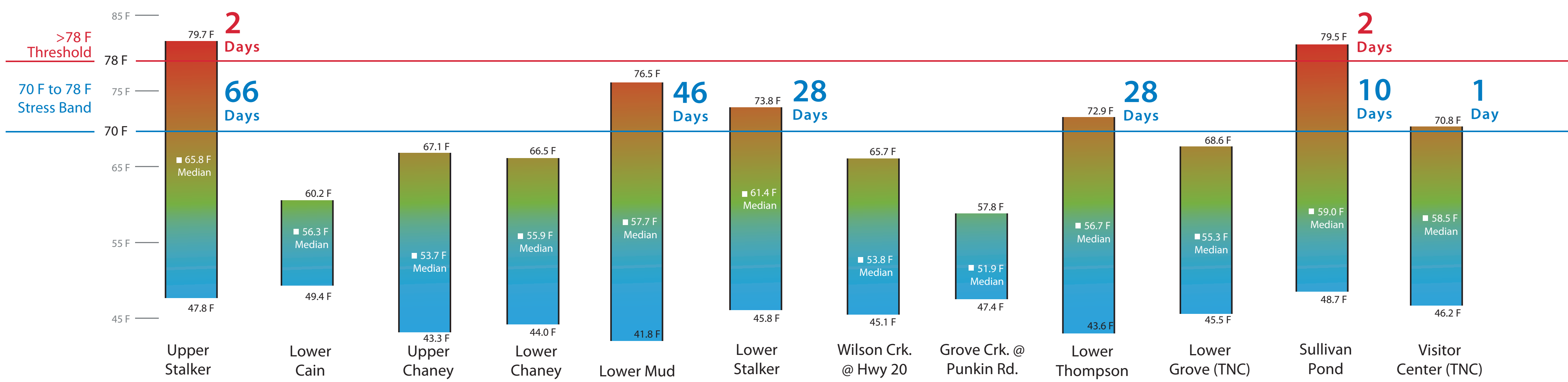
Stream temperature bands The above graphic depicts the summarized spring head temperature data for the entire summer season. The data was analyzed for the summer season to illustrate the spring temperatures that occurred for the period of May through mid-October, 2012. Each graph displays the total temperature range for the period of record; the absolute high and low temperatures are given and the median water temperature is shown for that particular spring.

be relatively constant and not fluctuate greatly with changes in air temperature or climatic conditions. Long periods of warm weather accompanied by clear sunny skies (high solar input) could elevate stream temperatures in a spring system. Like other spring driven systems, spring head temperatures in Silver Creek appear to remain relatively constant. In 2012, spring head temperature loggers were placed in 12 springs throughout the watershed. Monitoring data shows the average spring head temperature was 48F with a range between 45.5 to 53.3F •

Spring outflow on Silver Creek Tributary
Silver Creek watershed is dependent upon natural flowing springs from groundwater for its stream flows and stream temperature regulation.

2012 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, 2012. 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

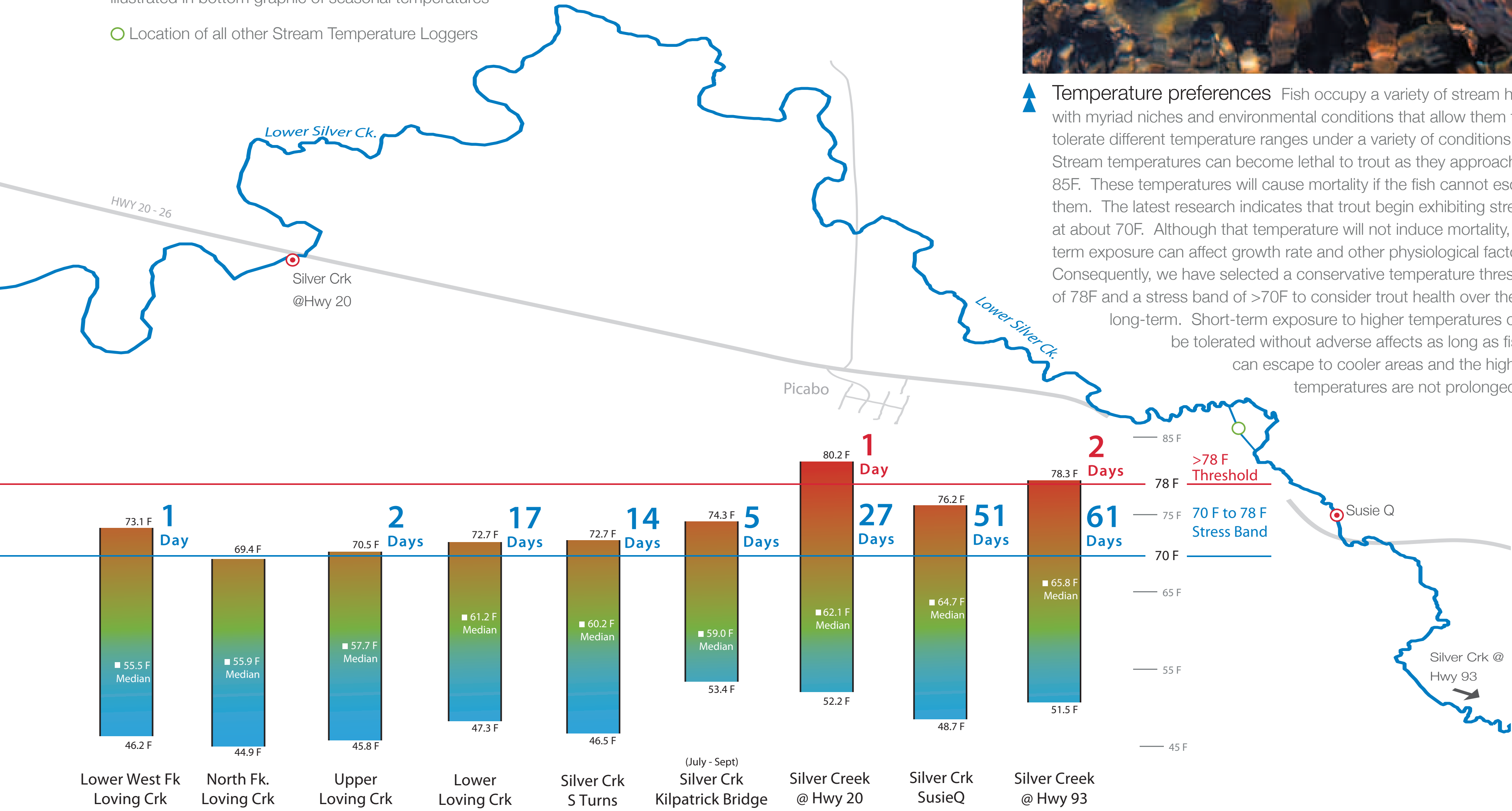
The map illustrates the Silver Creek stream and tributary system with the locations of the stream temperature loggers. The temperature loggers are expressed in two categories for discussion and analysis purposes:

⦿ Location of Stream Temperature Loggers illustrated in bottom graphic of seasonal temperatures

○ Location of all other Stream Temperature Loggers

Stream temperatures are logged at half-hour intervals over a twenty four hour period for as long as the logger is left in place. 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 through to Lower Silver Creek at the Highway 93 crossing.

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 85F. These temperatures will cause mortality if the fish cannot escape them. The latest research indicates that trout begin exhibiting stress at about 70F. Although that temperature will not induce mortality, long term exposure can affect growth rate and other physiological factors. Consequently, we have selected a conservative temperature threshold of 78F and a stress band of >70F 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 the high temperatures are not prolonged.



The overall average temperatures between night and day, throughout the summer, in all streams were well within the preference range for trout (around 55-60 degrees). Chaney, Grove, Wilson and Cain creeks' temperatures never entered the stress range. However, several streams did show temperatures exceeding the threshold of 78 degrees for several days (particularly Upper Stalker and Lower Silver Creek), and temperatures in most streams fell within the stress range for many days.

ArcHydro

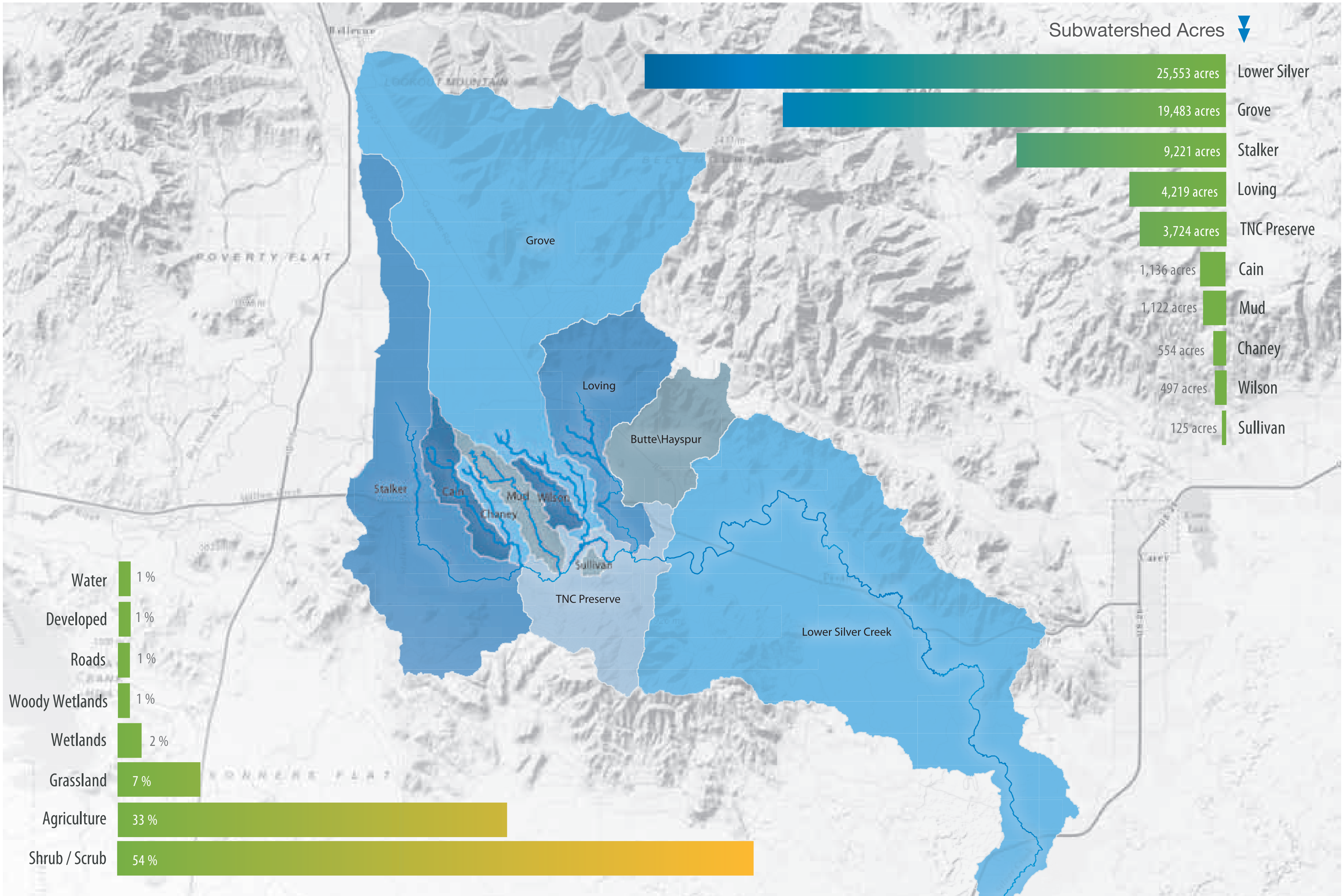
Watershed Delineation

The USGS defines watershed boundaries for most major streams in the US. They have done this for Silver Creek. However, prior to 2012, the sub-watersheds of Silver Creek's tributaries had not been defined.

In 2012, Ecosystem Sciences Foundation employed the ArcHydro data model, which is a suite of tools that work with ESRI's ArcGIS 10.1 (Geographic Information System - GIS), to derive the watershed and subwatersheds of Silver Creek. The work focused primarily on the main stem tributaries that feed Silver Creek - Stalker, Chaney, Cain, Grove, Mud, Wilson, Thompson and Loving. ArcHydro relies on two layers, a digital terrain model and a stream line (creek) layer, to derive watershed boundaries.

Eleven distinct subwatersheds were delineated for the Silver Creek system.

The graphics examine the differences and similarities of the land cover characteristic of each watershed. Overall, the Silver Creek Watershed encompasses 66,396 acres, with Grove Creek (19,483 acres) and Lower Silver Creek (23,553 acres) being the two largest subwatersheds. Agriculture is a dominant land cover type per subwatershed, ranging from 4% in the Sullivan Pond subwatershed to roughly 70% in Wilson and Chaney Creeks. Woody wetlands, an important land cover type for stream function and wildlife habitat, occupy only 1% of the total land area of the Silver Creek Watershed. The Wilson Creek subwatershed houses the greatest abundance of woody wetlands (13%) amongst the 10 delineated subwatersheds. Delineating watersheds allow managers and scientists to examine watershed characteristics and compare characteristics that may lead to deleterious conditions such as high stream temperatures or an abundance of sediment.



Landcover Types Within the Silver Creek Watershed

The landcover types **Shrub/Scrub** vegetation and **Agriculture** are the two most dominant conditions throughout the Silver Creek Watershed, representing **87%** of total ground landcover.

Hot Spots Analysis

The results of the 2012 Silver Creek Temperature Monitoring effort identified creeks within the Silver Creek Watershed that suffer from elevated summer stream temperatures, often occurring within the stress range for trout (> 70F). The creeks whose summer stream temperatures ranged into the stress band for trout are Stalker, Mud, Thompson, Sullivan Pond and Loving Creek. Some of the causes of high stream temperatures are apparent, like an abundance of open water, while other causes are less apparent. A GIS analysis was conducted to examine the potential causes of elevated stream temperatures. The analysis focused on several factors that have been known to contribute to elevated stream temperatures including; land cover types within a 100 foot buffer of each stream, number of wells per watershed, length of canals per watershed, percent of open water per watershed, solar inputs per watershed, sediment accumulation, and overall depth to groundwater derived by using well static depth detailed in the area's well records. Some variables show a positive relationship with temperature, while others show no relationship. The creeks described here each exhibit "at-risk" factors causing elevated stream temperatures, sediment accumulation and riparian tree cover dynamics that affect overall stream health.

Stalker Creek

Stalker Creek exhibits high summer temperatures, often achieving 80F. The reason for Stalker's elevated summer stream temperatures may be linked to a myriad of factors including; 1) its watershed contains the second largest network of canals and ditches (Lower Silver Creek has the most), 2) a high percentage (18.6%) of the 100 ft buffer is occupied by agriculture and only a small percentage (3.5%) of the buffer consists of woody wetlands which are known to shade streams and inhibit temperature gains, 3) a high volume of sediment relative to the other creeks in the Silver Creek Watershed (SCLA 2011), and 4) it contains large shallow wetlands that may create temperature issues. Sedimentation has been known to contribute to elevated stream temperatures (Poole and Berman 1999). Depth to groundwater may have an influence on Stalker Creek's stream temperatures as well. The depth to groundwater in the Stalker Creek Watershed is roughly 30 ft; compare that with Grove Creek which has a depth to groundwater of 14 ft. Stalker Creek may not have the groundwater/surface water interchange that Grove Creek has and this may cause stream temperatures to elevate as they travel from the cool springs that feed the Creek.

Mud Creek

Mud Creek exhibits elevated stream temperatures in the summer, frequently entering the stress band for trout, with some days reaching 76F. The potential factors causing high stream temperatures in Mud are not as evident as Stalker. For example, the Mud Creek Watershed's depth to groundwater is only 12ft, which is less than Grove and thus allows groundwater/surface water interchange throughout the Creek's length. Additionally, Mud's buffer strips are primarily grasslands (45%) as the land owner has ceded a portion of the agriculture fields adjacent to the stream as a buffer strip. Mud's high stream temperatures are an anomaly and may be influenced by the creeks shallow depth and low flow. Another potential issue is the existing buffer strip is not providing the benefits because of a lack of vegetation density and height (shading). Buffer strip improvement (more and taller vegetation) may provide some benefits towards reducing stream temperatures.

Sullivan Pond

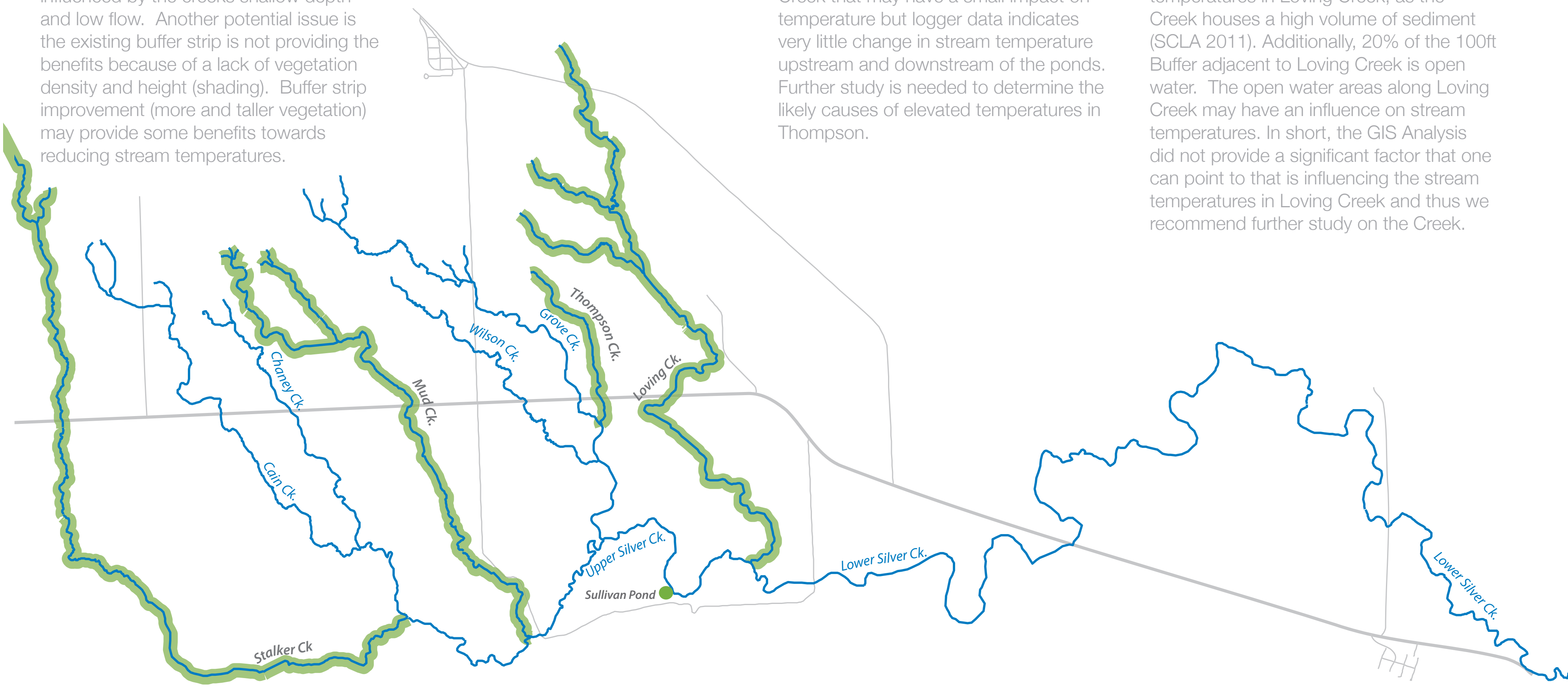
Sullivan Pond is an open water area adjacent to Silver Creek within the Preserve. Sullivan Pond is fed by springs to the east and north of the pond. Stream temperatures within the pond were in excess of 80F for several days during the summer 2012 monitoring period. Unlike Mud and Thompson, identifying the potential factors influencing elevated stream temperature in Sullivan Pond is fairly apparent. The name of the area implies the problem, the Pond, being un-shaded open water, is subject to high solar inputs and warm ambient air temperatures, causing water temperatures to increase throughout the long summer days.

Thompson Creek

Thompson Creek is a tributary to Grove Creek. Thompson Creek exhibited elevated stream temperatures in 2012 (73F). Similar to Mud Creek, the potential factors influencing elevated temperatures in Thompson Creek are not readily apparent, and will most likely entail further study. For example, woody wetlands occupy nearly 40% of the 100ft buffer around the creek. Woody wetlands are known to shade streams, reducing solar inputs and therefore help ameliorate stream temperature increases. Sedimentation in Thompson Creek is moderate and could be a factor influencing the stream temperatures. There are two large ponds along Thompson Creek that may have a small impact on temperature but logger data indicates very little change in stream temperature upstream and downstream of the ponds. Further study is needed to determine the likely causes of elevated temperatures in Thompson.

Loving Creek

Loving Creek experienced elevated stream temperatures during the summer of 2012. Multiple loggers within the Loving Creek Watershed recorded high stream temperatures including, #43 (North Fork Loving Creek below the Pond), #39 (also on the North Fork of Loving Creek) and #38 (upper main North Fork Loving Creek). This Creek needs to be assessed fully, including studying the influence that Butte Creek/Hayspur Hatchery has on Loving Creek's stream temperature. The GIS analysis performed for this report identified a few factors that are known to influence stream temperatures. Sedimentation may have a significant impact on stream temperatures in Loving Creek, as the Creek houses a high volume of sediment (SCLA 2011). Additionally, 20% of the 100ft Buffer adjacent to Loving Creek is open water. The open water areas along Loving Creek may have an influence on stream temperatures. In short, the GIS Analysis did not provide a significant factor that one can point to that is influencing the stream temperatures in Loving Creek and thus we recommend further study on the Creek.



Next Steps

Surface Hydrology and Temperature Monitoring

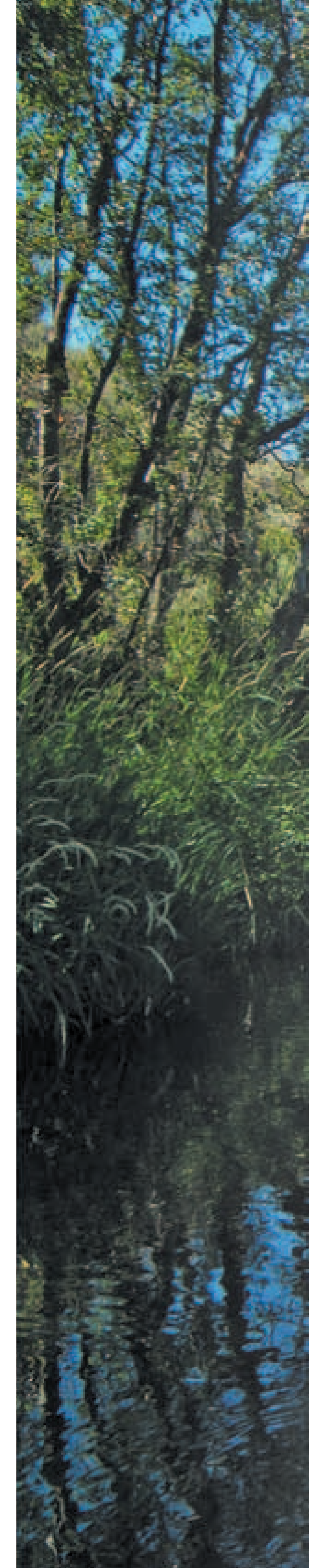
After our initial two years of monitoring, it is clear that the hydrology and temperature monitoring must continue on Silver Creek. As we build a database, we will continue to understand the system better and be able to detect data trends that indicate problems with the system. As an example, if flows decrease and temperatures rise, stress on fish will increase. Monitoring is a long-term scientific tool that must be done consistently over time. For this reason, we must find the resources to continue our existing monitoring efforts.

Buffers

Riparian buffers are streamside vegetation that “buffer” the stream from the upland landscape. They are critical ecosystem components that provide shade, sediment and nutrient filters, and habitat for fish and wildlife. However, not all buffers are created equal. Width, height and species composition all influence the functionality and value of a riparian buffer. We are seeking willing landowners to create a case study. We will evaluate the current riparian buffers on the property, assess the site specific conditions, and make recommendations as to how riparian buffers can be improved for temperature, sediment or erosion control. Proper stream buffers also provide important habitat components of the landscape, and will enhance wildlife values.

Groundwater Protection

All of the surface water in all of the tributaries to Silver Creek originates, for the most part, in headwater springs. Thus, groundwater is the ecological driver for the entire watershed. If groundwater levels drop such that spring flows are diminished or stopped, the ecosystem faces collapse. While temperature thresholds and sedimentation are critical parameters that influence the health of the ecosystem, it is groundwater which determines whether there is an ecosystem or not. Consequently, establishing a program to protect Silver Creek’s aquifer is of paramount importance. Before landowners can determine how the groundwater can be protected, we need to understand the fundamental dynamics of extraction versus recharge. Our current knowledge is that aquifers may be



recharged in wet years, and may be depleted in dry years. If these 'maybes' are correct, then a succession of dry years (drought periods) could result in the "mining" of the aquifers in which recharge is never able to replace what was lost. Severe drought could, in a short period of time, lead to the attenuation of spring flows with adverse ecological consequences to follow. Overdrafting of the aquifer as more groundwater wells go into production throughout the upper watershed can also result in mining.

A major action item to understand the groundwater dynamics within the system is to establish an array of piezometers (small groundwater monitoring installations) that will measure the change in depth to groundwater over time. Ideally, these piezometers will be spread systematically throughout the watershed. This is our long-term goal. In the short term, setting up piezometers along one or two creeks in select locations would set the foundation for our understanding of the groundwater dynamics. The Nature Conservancy supported a groundwater research effort which, we hope, will provide a foundation for linking stream temperature, groundwater flow, and groundwater recharge as a decision-making tool for stream and watershed management through time. This would provide an "early-warning system".

Fish Habitat Mapping

The Silver Creek watershed restoration and enhancement plan includes a detailed map of fish habitat from Stalker Creek to Kilpatrick Pond; primarily TNC's Preserve. The map delineated trout spawning areas, early rearing and nursery areas within Silver Creek and in side channels, pools (deep and shallow), undercut banks, resting and feeding zones, sediment conditions, beaver ponds, riparian vegetation and stream bank conditions, areas of reed canary grass growth, channel constrictions, and over-widened reaches. Users of the plan found the map so useful that we have been asked to continue this below Kilpatrick Pond to the confluence with the Little Wood River. Fish population sampling can be an important part of any monitoring program. How are fish populations responding to the current and future land and water resource management actions? The only way to know is to sample the fish populations – through snorkeling surveys, electrofishing surveys, or creel censuses. Fish are one of the treasured resources in Silver Creek and they should be understood and protected.

Watershed Health

The critical environmental issues throughout the Silver Creek Watershed are temperature, sediments, and flow. These parameters are indicators of the health of the watershed much like checking our own body temperature and circulatory system. Consequently it is important to maintain our temperature logger arrays throughout the streams and measure flows seasonally in all the streams to alert us to changes that indicate a serious issue with the functioning of the ecosystem. Sediment tracking requires less intensive work now that we have defined conditions for Silver Creek and the tributaries. A few sites will be selected from the data to set-up long-term tracking of sediment inputs and outputs. This will inform us as to whether the ecosystem is accumulating or exporting sediments or whether sediment inflow and outflow is pretty much in balance. This will also drive sediment removal actions like dredging or channel excavation at specific sites where such work will be beneficial and sustainable.

2012

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Don't hesitate. Get in touch!

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