

Feather River Coordinated Resource Management Watershed Monitoring Program

2009 Report



Spanish Creek Continuous Recording Station at Dyrr Bank. May 2009

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Quincy, CA
Winter 2010

Introduction to FR-CRM Monitoring Program

2009 Monitoring Report Summary

This report tiers to Feather River Coordinated Resource Management (FR-CRM) group monitoring reports from 1999 through 2008. The 2009 Water Year (October 1, 2008- September 30, 2009) was the third year of the current drought in the Feather River Basin, with only 84% of normal historic rainfall. Last Chance Creek and Lights Creek continue to be the most temperature impaired streams in the Upper Feather River Watershed. Despite this impairment, the Feather River Coordinated Resource Management (FR-CRM) is detecting cooler water temperatures and augmented base flow on Last Chance Creek at Doyle Crossing. These water temperature improvements may be attributable to over ten miles of channel and approximately 1,500 acres of meadow that have been restored on Last Chance Creek upstream from Doyle Crossing. Water temperature improvements have also been seen on Red Clover Creek at Notson Bridge, downstream from the Red Clover/McReynolds Creek Restoration Project.

This year no maintenance was necessary on any of the Continuous Recording Stations (CRS). A crest-stage gage was installed on Sulphur Creek at Whitehawk, just downstream of the bridge. A gage plate was also installed on Wolf Creek at Ball Field Bridge

Most important findings in this monitoring report:

- Groundwater influence starting to be seen in late season water temperature and stream flow on Last Chance Creek at Doyle Crossing.
- Groundwater influence starting to be seen in late season water temperature on Red Clover Creek at Notson Bridge.
- A reduction in diurnal fluctuation of water temperature on Last Chance Creek at Doyle Crossing.

About the Feather River CRM

The FR-CRM group, a proactive consortium of 24 public agencies, private sector groups, and local landowners, was established in 1985 in response to widespread erosion and channel degradation in the Feather River watershed. One hundred and forty years of intensive resource use, including mining, grazing, timber harvesting, and railroad and road construction, have all contributed to a watershed-wide stream channel entrenchment process. FR-CRM was able to initiate systematized monitoring in the Feather River watershed in 1999 to establish baseline data for assessing long-term trends in watershed condition, and the potentially significant effects of restoration projects on watershed function. Most of the monitoring effort is concentrated in the Indian Creek subwatershed because of its highly degraded upper watershed condition, and high potential for benefit from restoration with many linear miles of alluvial channels. Monitoring site locations follow a nested approach. Please see the diagram at the end of the report that shows monitoring station locations with project locations.

Watershed Monitoring Program Background

Background information such as an overview of the watershed, monitoring program objectives, more detailed earlier data, and protocols can be found in the FR-CRM Watershed Monitoring Reports from 2001, 2004, and 2005. Reports (2005-07) can be found on the monitoring page of the FR-CRM website at www.feather-river-crm.org. The monitoring network was installed in 1999 and data have been collected from 2000-2009.

Initial funding for FR-CRM's monitoring program was provided by a Clean Water Act 319(h) grant (Aug 1998 to Dec 2000). Subsequent funding sources were: the California Surface Water Ambient Monitoring Program (SWAMP) from Oct 2000 to Dec 2003 and the Plumas Watershed Forum (2004 to 2006). Physical and biological surveys of FR-CRM's 20 Monitoring Reaches have not been conducted since 2003.

Monitoring Program Description

This report documents on-going monitoring data from the 2009 water year (October 1, 2008-September 30, 2009).

Three main subwatersheds of the Feather River are covered under this monitoring program:

- Indian Creek
 - Spanish Creek
 - Middle Fork Feather River
 - North Fork Feather River
- } **East Branch North Fork Feather**

Data Collected at the Continuous Recording Stations (CRS):

- **Stage** (calibrated to flow)
- **Water Temperature**
- **Air Temperature**
(except at Wolf Creek)
- **Turbidity** (NTU's)
(currently Indian Cr. at Taylorsville & Spanish Cr. 2001-06)

Much of the FR-CRM restoration efforts are concentrated on restoring the function of meadow floodplains in the watershed to store winter and spring precipitation, and release it later in the year. Two metrics that indicate restored floodplain function are summer baseflow levels and summer water temperatures. Increased summer baseflow with concurrent decreased summer water temperatures would indicate that winter and spring runoff stored in the meadow soils was being released as late season flow.

Stream flow stage, air and water temperature are recorded every 15 minutes by Campbell CR10X data loggers at the following FR-CRM monitoring stations: Red Clover Creek at Notson Bridge; Last Chance Creek at Doyle Crossing and at Million Dollar Bridge; Cottonwood Creek above and below Big Flat (not on map); Indian Creek at the DWR weir (above the confluence of Red Clover Creek), at the Flournoy Bridge (below the confluence of Red Clover Creek), and at the Taylorsville Bridge; Lights Creek at Deadfall Lane Br.; Wolf Creek at the Ball Field Bridge in Greenville; Spanish Creek at Dyr Bank near Gansner Park in Quincy; and on Sulphur Creek at the Highway 89 Bridge near Clio (temporarily disconnected).

The stage, air and water temperature readings are stored as hourly averages and then summarized into daily files at the end of each water year. To continuously record turbidity, an Analite 195 laser sensor (a nephelometric probe) was installed on Indian Creek at Taylorsville Bridge in 2001 and on Spanish Creek (2001-06). The data loggers are capable of storing up to six months of data. FRCRM staff and contract technicians download data monthly to ensure reliable station operation. Because of periodic channel shifts at most of the stations monthly calibration measurements are required. FRCRM staff are

also responsible for capturing discharge measurements over the range of flows experienced at each station in order to maintain/update the rating tables. Rating tables are reviewed and/or updated annually by Sagraves Environmental Services.

DWR Flow & Weather Stations

The California Department of Water Resources (DWR) maintains four Weather Stations and two continuous recording flow stations in the Feather River watershed to assist in managing the water resources. The two DWR flow stations are on Indian Creek below Indian Falls (ICR) and on the Middle Fork Feather River near Portola (MFP). Four weather stations installed by DWR in the Indian Creek watershed include Doyle Crossing (DOY) in 2000, Jordan Peak (JDP) in 2005, Thompson Valley (TVL) in 2006 and Taylorsville (TAY) in 2007. All of the DWR weather and flow stations are accessible on the DWR California Data Exchange Center (CDEC) website at cdec.water.ca.gov. Stream discharge and stage height are recorded at the DWR flow stations, while the DWR weather stations record rainfall, temperature, relative humidity, wind speed, wind direction, solar radiation and atmospheric pressure.

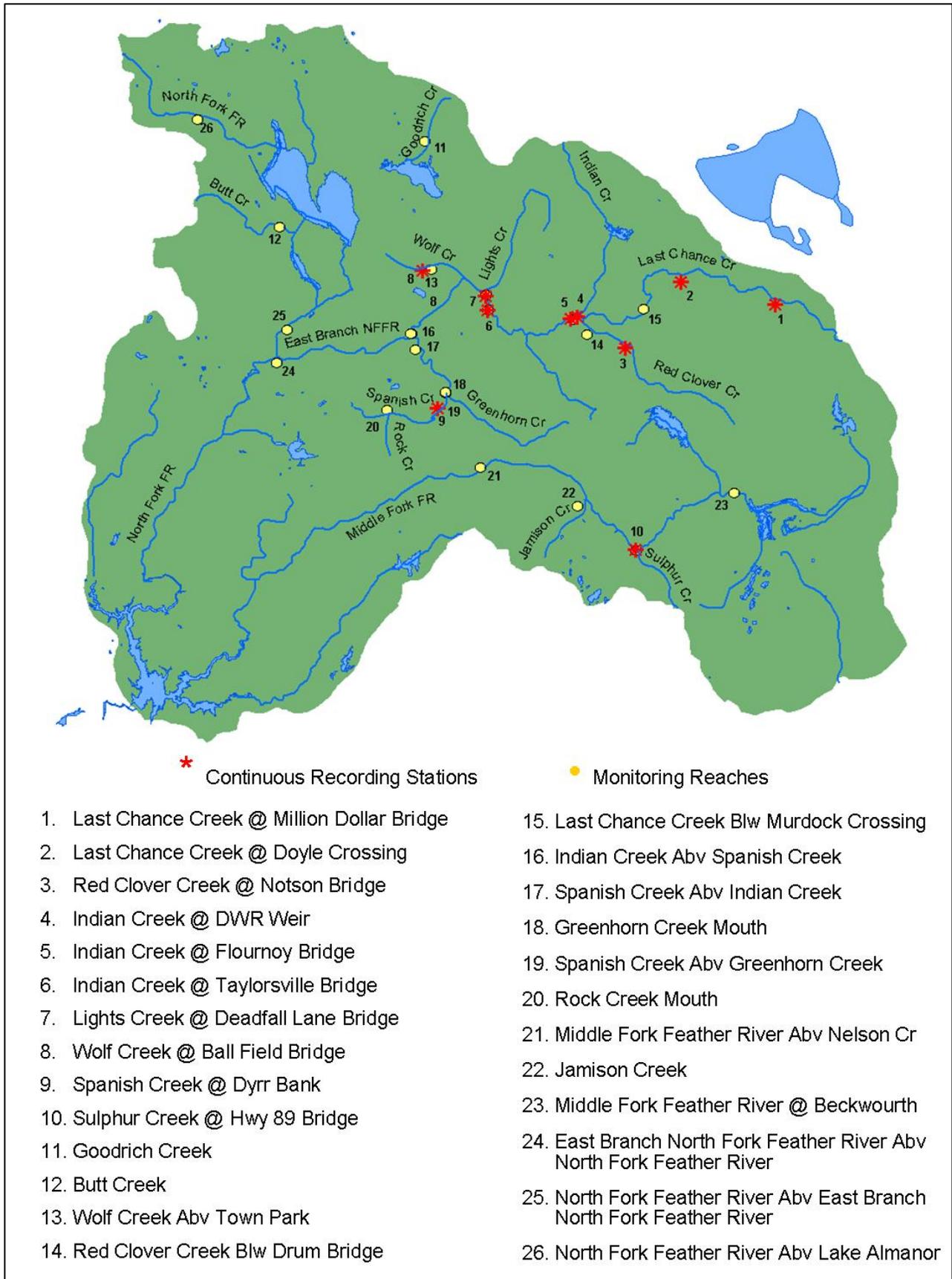


Figure 1. Feather River CRM Continuous Recording & Monitoring Reach Locations

Table 1. Upper Feather River Watershed Monitoring Sites and Parameters Recorded

Map #	Monitoring Site by Subwatershed	Monitoring Type
	North Fork Feather River (NFFR) watershed	
26	NFFR @ Domingo Springs (abv Lake Almanor)	MR [∞]
25	NFFR @ acw [†] East Branch NFFR	MR
12	Butt Cr (abv 307 Br)	MR
11	Goodrich Cr	MR discontinued
24	East Branch mouth (acw NFFR)	MR
17	Spanish mouth (acw Indian)	MR
	Spanish Creek @ Keddie abv Blackhawk Cr.	CRS (USGS)
19	Spanish Cr acw Greenhorn	MR
18	Greenhorn Cr mouth	MR
9	Spanish @ Gansner Park (Hwy 70)	CRS [‡]
20	Rock Cr mouth	MR
16	Indian Cr blw Indian Falls (acw Spanish Cr)	CRS (DWR)
13	Wolf Cr @ Town Park	MR
8	Wolf Cr @ Main St Bridge moved to Ball Field Br.	CRS
7	Lights Cr @ Deadfall Lane Br	MR & CRS
6	Indian Cr @ Taylorsville (TAY)	MR & CRS & Weather Station (DWR)
5	Indian Cr @ Flournoy (bcw [§] Red Clover)	MR & CRS
4	Indian Cr @ DWR weir (acw Red Clover)	MR & CRS
	Red Clover Cr @ Chase Bridge	MR
	Thompson Valley (TVL)	Weather Station (DWR)
14	Red Clover Cr @ Drum Bridge	MR
3	Red Clover @ Notson Bridge	CRS
15	Last Chance (LC) Cr @ Murdock	MR
2	Last Chance (LC) Cr @ Doyle Crossing (DOY)	CRS & Weather Station (DWR)
	McClellan Cr	MR (DWR)
	Cottonwood Cr @ Big Flat	CRS abv & blw Big Flat
	Little Stoney Cr	MR (DWR)
	Willow Cr	MR (DWR)
	LC @ Alkali Flat low water crossing	MR (DWR)
	Ferris Cr	MR (DWR)
1	LC @ Million Dollar Bridge	CRS
	LC @ Bird-Jordan	MR (DWR)
	Jordan Peak (JDP)	Weather Station (DWR)
	Middle Fork Feather River (MFFR) watershed	
21	MFFR abv Nelson Cr	MR
	MFFR @ Sloat	staff gage
22	Jamison Cr @ 23N37 Br	MR
10	Sulphur Cr @ Hwy 89 (Clio)	MR & CRS
	Boulder Cr	staff gage
	Barry Cr	staff gage
	Sulphur @ Lower Loop Bridge	staff gage
	Sulphur @ Upper Loop Bridge	staff gage
23	MFFR blw A23 Br (Beckwourth)	MR
	MFFR near Portola (MFP)	CRS (DWR)

[∞] Monitoring Reaches (MR) refers to those surveyed by FR-CRM unless otherwise noted in parentheses. Long term monitoring of these sites is expected to give watershed managers a better understanding of processes and long term trends in these subwatersheds. Data collected at Monitoring Reach sites can be found in the SWAMP final report, with details on protocols in Appendix A.

[†] “acw” means “above confluence with”

[‡] Continuous Recording Stations (CRS) are maintained and operated by FR-CRM unless otherwise noted in parentheses.

[§] “bcw” means “below confluence with”

2009 Monitoring Program Findings

FR-CRM is continuously collecting data throughout the Upper Feather River Watershed. The 2009 Water Year experienced the sixth lowest annual precipitation in the last decade with 84% of historic average annual precipitation for the Feather River Basin (see Table 2).

Table 2. Precipitation averages

Water Year (10/1-9/30)	Percent of Historic Average annual precip for the entire Feather River Basin from CDEC*	Total annual precip (inches) at Indian Cr in Genesee (Wilcox data) ⁺
1998	144%	
1999	99%	47.2
2000	101%	43.3
2001	56%	21.2
2002	77%	33.3
2003	111%	50.7
2004	83%	41.15
2005	109%	45.5
2006	154%	66.25
2007	60%	31.05
2008	68%	25.4
2009	84%	38.05
		44.31= Avg

* Averages derived by Ca. Dept. of Water Resources from the average of all reporting stations in the watershed. For 2004 there were 6/10 stations with averages (Sierraville, Vinton, Portola, Chester, Strawberry Valley, Brush Cr). For 2005, 9/10 stations were reporting (all of the above, plus Greenville, Quincy, and DeSabra). For 2006 data, 10 out of 10 stations were reporting. For 2007 8/10 stations were reporting averages (Plumas Eureka State Park, Sierraville, Vinton, Portola, Strawberry Valley, Greenville, Quincy, and DeSabra). For 2008 8/10 stations were reporting averages (Sierraville, Vinton, Portola, Chester, Strawberry Valley, Brush Creek, Quincy, and Nicolaus). For 2009 10/10 stations were reporting.

⁺ The values in the Indian Creek in Genesee Precip column are unrelated to the Percent of Historic Average Annual Precip values. The Percent Historic Average is an average of weather stations throughout the watershed, which is calculated by DWR. See above for which stations were reporting for each year.

****Please note that all bar charts are graphed with Summer Average Air Temperature and not Percent of Historic Average Annual Precipitation, as in previous reports. Air Temperature is an average of DWR weather stations at Antelope Lake, Doyle Crossing, Quincy, and Grizzly Ridge from June 1 through September 30.**

Water Temperature

Introduction

The Central Valley Regional Water Quality Control Board has identified water temperature as a water quality concern in the Feather River Watershed. A variety of water temperature parameters, which are a function of air temperature, duration of exposure to air temperature, volume of water, and surface exposure to insolation, were used to compare between sites and between years. Water temperatures were analyzed for seven continuous recording stations with usable low flow data (six in Indian Creek subwatershed, and one in Spanish Creek). Only 2004 through 2009 are represented in the following charts, to better display results. All data from 2000-2003 are available in previous Watershed Monitoring Reports, or on the FR-CRM website at www.feather-river-crm.org. When looking at these charts please keep in mind that the Wolf Creek station was moved from the Main St Bridge to the Ball Field Bridge in December 2008.

Data Issues

- The temperature sensor at Wolf Creek was buried in 2005 & 2006, and these years are not included.
- In 2007 Lights Creek and Indian Creek at Flournoy Bridge transducers were out of the water during low flows, so water temperature data was supplemented with data from HOBO temperature loggers placed in the stream near the station.
- Indian Creek at Taylorsville is not represented in the graphs, because the sensor was out of the water, only collecting high flow data, over the past six years.
- Spanish Creek transducer does not include data from 2007, due to high flows from winter 2006 burying the transducer. The transducer was moved to a new location in summer 2007 from the Highway 70 Bridge upstream to the Dyrr bank.
- Battery failure during high flow season on Indian Creek at Taylorsville Bridge during the 2009WY.

Maximum (Max) daily water temperature

Figure 2 graphs the highest one hour-long temperature that was recorded during the annual sampling period. The Department of Water Resources (DWR) weir, above the confluence of Red Clover Creek, is consistently one of the coolest stations in the Indian Creek subwatershed. This is most likely due to Indian Creek above this location being primarily fed by cold water from the bottom of Antelope Lake. Figure 2 also shows that Red Clover Creek has a visible warming influence on Indian Creek below the confluence (at Flournoy Br.). Most of the stations have reported a slight downward trend in the maximum daily water temperature over the past six years. 2009 temperatures cooled slightly from 2008, except at Doyle Crossing, despite being in the third year of a drought. The similarity in water temperature between 2007, 2008, and 2009 WY at Notson Bridge may be due to increased groundwater influence from restoration projects that occurred upstream. Three miles of channel were treated on Red Clover Creek in 2006. Indian Creek at DWR weir maintained the lowest recorded maximum daily temperature in 2009, due to its cold water source from the bottom of Antelope Lake.

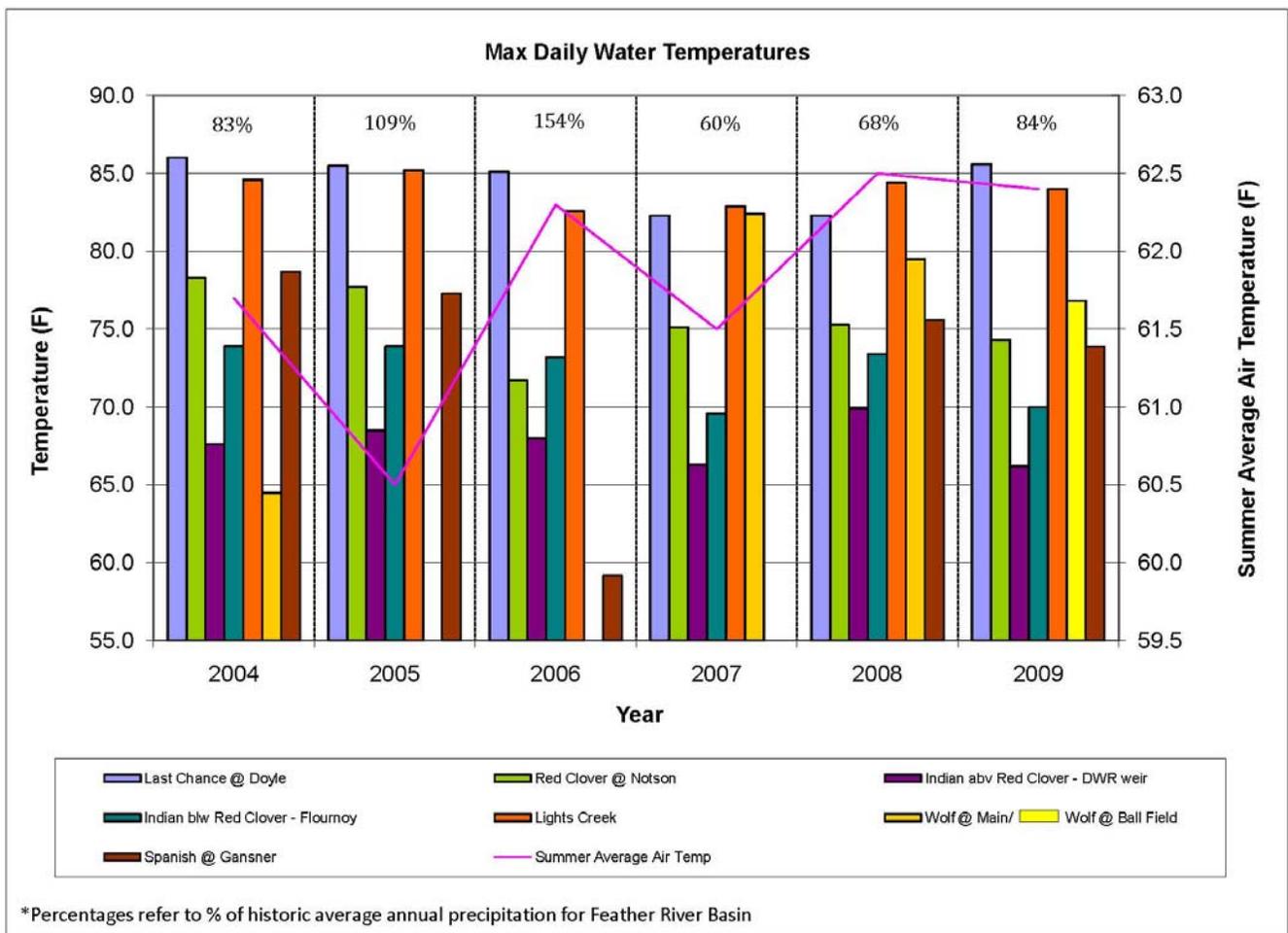


Figure 2. Maximum Daily Water Temperatures recorded 2004-2009

Maximum weekly average water temperature

Maximum (max) weekly average water temperature is calculated by taking a running seven day average of mean daily water temperature for the entire water year. Then, the maximum value of the averages is taken. Figure 3 shows that Lights and Last Chance Creeks are consistently the two warmest channels. Last Chance Creek at Doyle Crossing and Red Clover Creek at Notson Bridge both experienced max weekly average water temperatures for the third year in a row that were much lower than in the high flow 2006 water year. In dry years there is more influence on water temperature from groundwater, because there is less surface water. Perhaps this cooling at Notson Bridge and Doyle Crossing is due to the greater influence of stored groundwater, not only because there were three drought years following a wet year, but because of the restored channel/floodplain upstream from these stations. The effect of decreased water temperatures out of Red Clover Creek can be seen on Indian Creek at Flournoy Bridge, with a smaller change in water temperature on Indian Creek from above to below the confluence of Red Clover Creek. The decrease in Max Weekly Average Temperature on Last Chance Creek at Doyle Crossing from WY2006 may also be attributable to the ten miles of restoration upstream from Doyle Crossing.

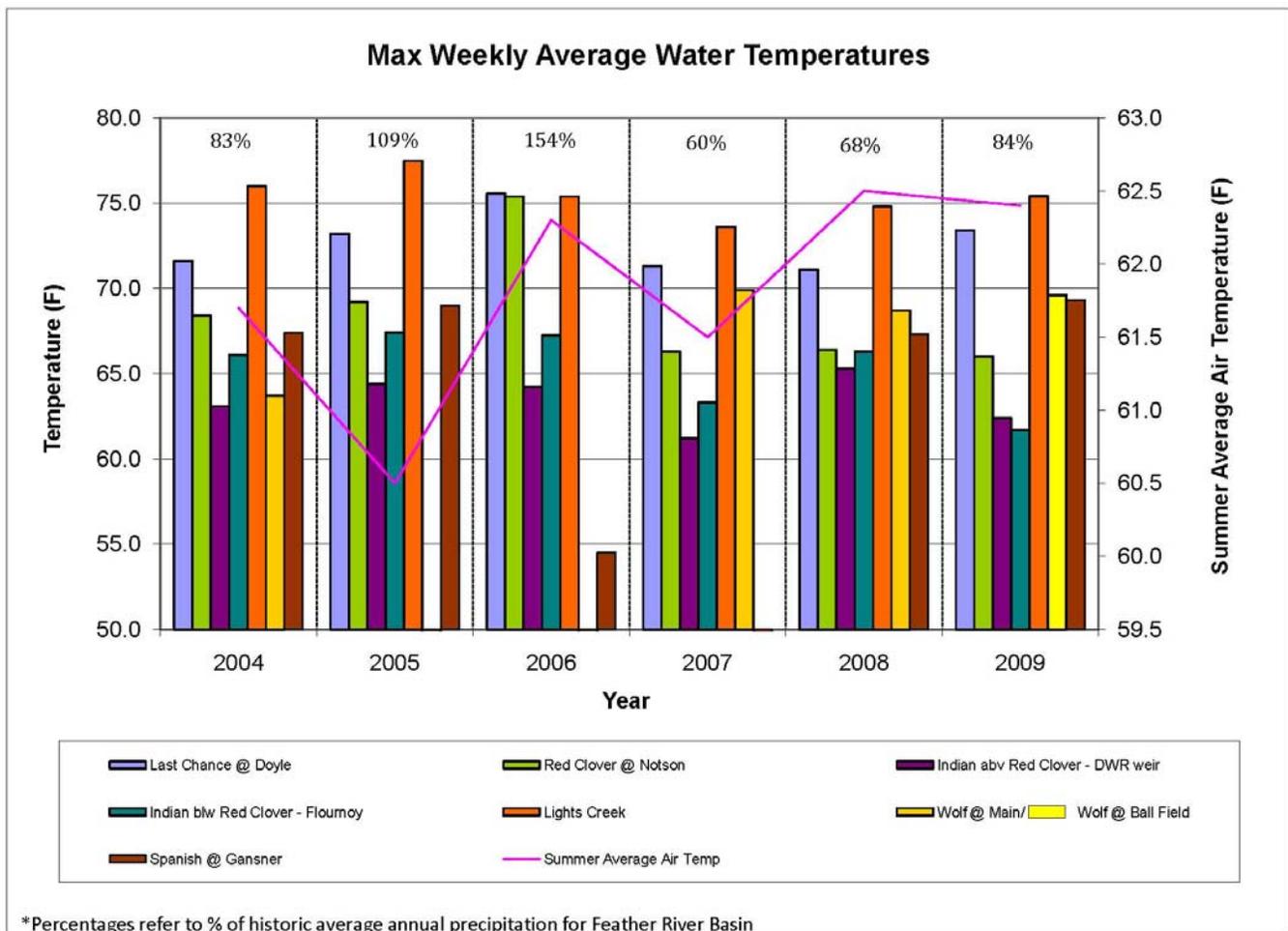


Figure 3. Maximum Weekly Average Water Temperatures 2004-2009 at Continuous Recording Stations

Daily Maximum Water Temperature >75°F

Figure 4 displays the number of days that had an absolute one-hour long temperature greater than 75°F among the seven continuous recording stations with usable low flow data from 2004-2009. A reading greater than 75°F can be lethal to coldwater fish species, even if it is just a short-term maximum temperature reading. Last Chance, Lights, and Wolf Creeks are the most impaired creeks monitored in the Indian Creek watershed over the last three years based on maximum water temperatures exceeding 75°F and maximum weekly average water temperatures greater than 66°F. Even though over 40 days were recorded on Last Chance Cr @ Doyle Crossing with maximum temperatures exceeding 75°F, the numbers have continued to show a downward trend since 2004, after the first phase of most of the channel/flooplain restoration work on Last Chance Creek was implemented. We will continue to monitor the change after Last Chance Phase II is implemented.

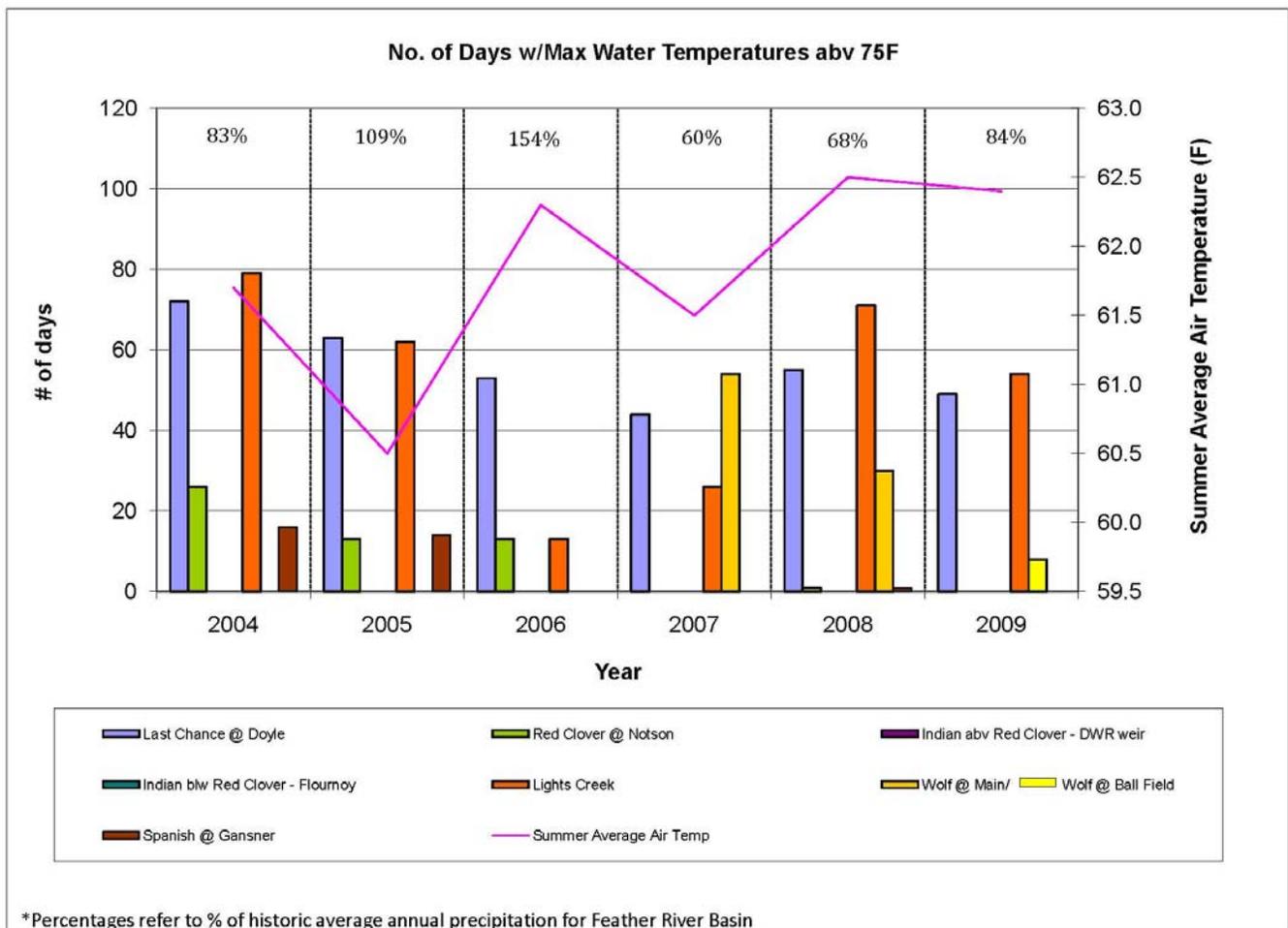


Figure 4. Number of days with maximum water temperature above 75F recorded from 2004-2009

Maximum summer diurnal water temperature fluctuation

Figure 5 and 6 display the maximum and average diurnal water temperature fluctuation, respectively. This is calculated by finding the difference between the maximum and the minimum water temperature in a 24-hour period (diurnal fluctuation). Then, a running seven day average of the diurnal fluctuation is calculated for the entire water year. Afterward the maximum value (Figure 5) and average value (Figure 6) of the averages is taken. This parameter is heavily dependent on air temperatures and insolation. In both the charts Last Chance Creek at Doyle Crossing shows smaller diurnal fluctuations in the past three years, which could be due to the completion of 10 miles of restoration in the upper Last Chance watershed.

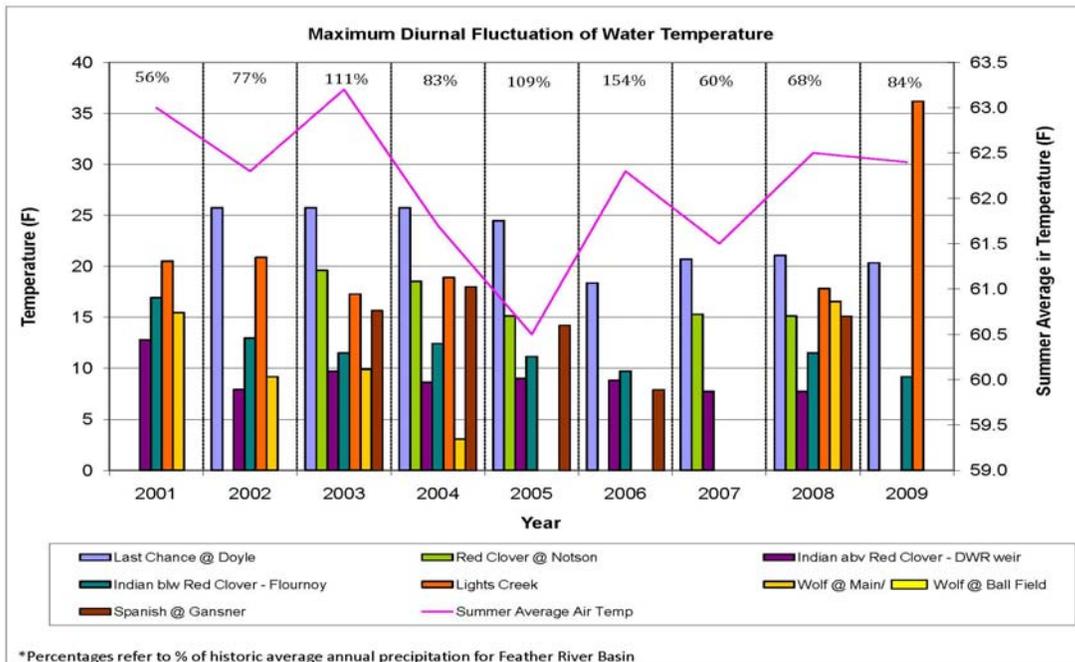


Figure 5. Maximum diurnal fluctuation of water temperature recorded from 2001-2009

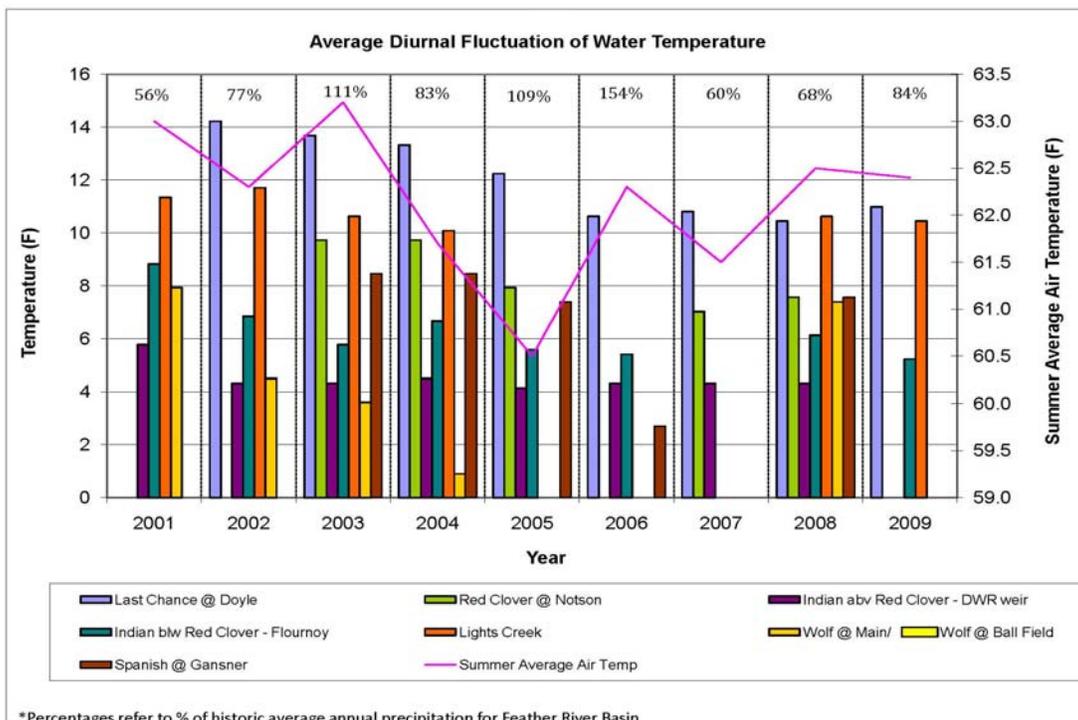


Figure 6. Average diurnal fluctuation of water temperature recorded from 2001-2009

Project Specific Water Temperature Data

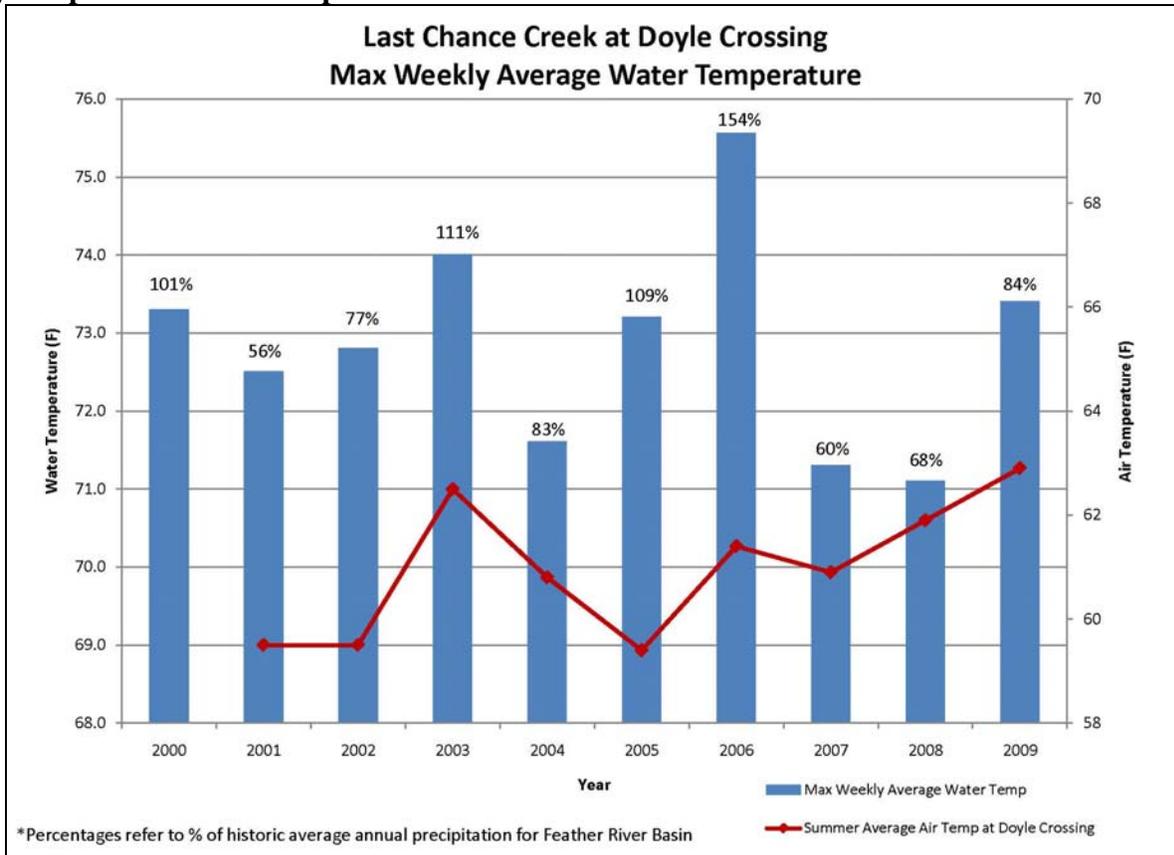


Figure 7: Maximum Weekly Average Water Temperature at Doyle Crossing for years 2000-2009

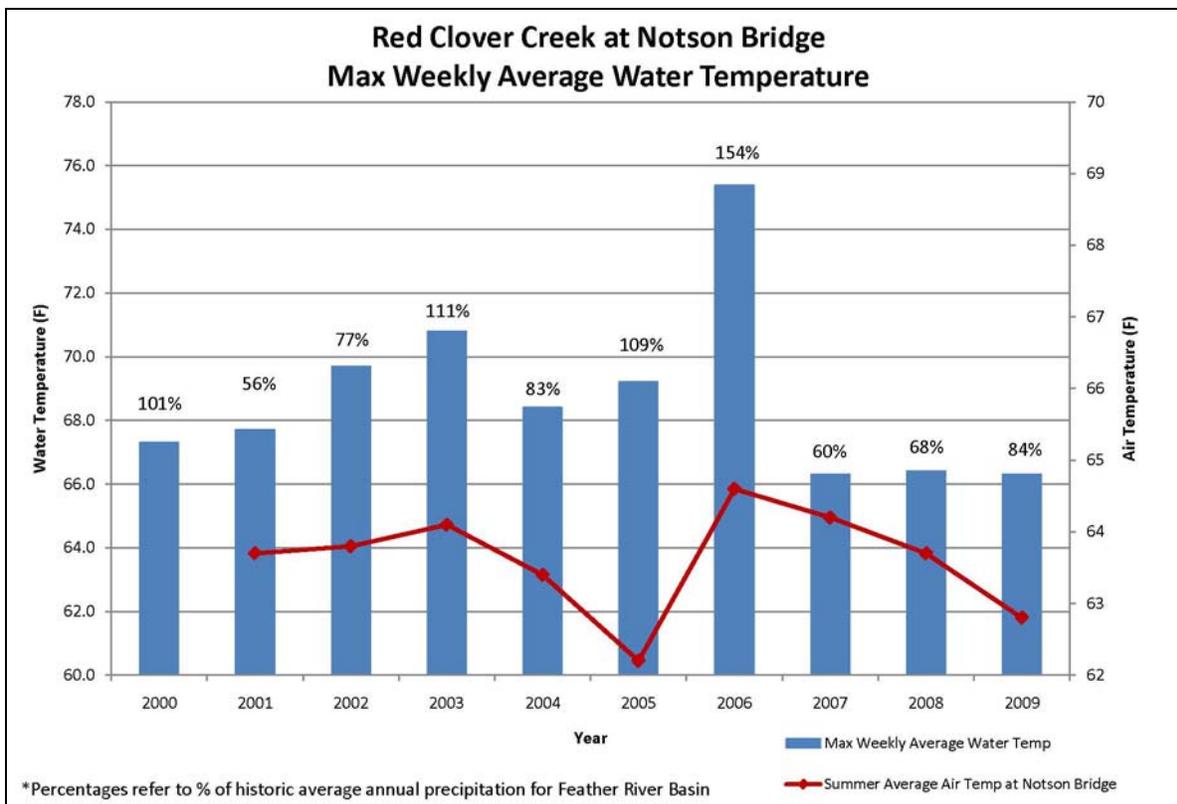


Figure 8: Maximum Weekly Average Water Temperature at Notson Bridge for years 2000-2009

Discussion

Last Chance Creek at Doyle Crossing and Lights Creek are consistently found to be the most heavily temperature impaired channels, followed by Wolf Creek, Red Clover Creek, and Spanish Creek. This temperature impairment of Red Clover, Wolf, Lights, and Spanish Creeks are assumed to be from the diminishment of groundwater recharge and release function of the watershed above these stations. The locally high temperature readings at Doyle Crossing on Last Chance Creek can be attributed to enhanced solar radiation from water sheeting over bedrock and a 400-foot long unshaded pool above the recording station. Although Red Clover Creek at Notson Bridge and Last Chance Creek at Doyle Crossing are still impaired channels, in the past three years there has been a noticeable decline in water temperatures, despite the low water years. This can be seen in Figures 7 and 8. Figure 7 displays maximum weekly average water temperature on Last Chance Creek at Doyle Crossing. In the Last Chance watershed the last major effort in restoration occurred in 2005, with the completion of Jordan Flat Supplemental and Dooley Creek restoration projects. The warmer water temperatures in the high precipitation year of 2006 may be due to high stream flows scouring out shade plants on the banks within the gullied channel; resulting in a high width to depth ratio, more insolation, and more surface water influence in the water temperatures. The warmer water temperatures in 2006 could also be due to meadows still filling after restoration. In 2007 and 2008 there is a significant decrease in water temperatures, despite about a 50% decrease in precipitation, and slightly warmer air temperatures. In 2009 the average summer air temperature is warmer than any other year in the ten year sampling period, yet we still see lower water temperatures than several years, including 2006. It could be suggested that this decline in water temperature may be attributed to more groundwater influence from the upstream project areas, versus more groundwater release in subsequent dry years. The same reasoning could pertain to Figure 8, which displays maximum weekly average water temperature on Red Clover Creek at Notson Bridge. The difference in water temperature at Notson Bridge 2007 through 2009, is even larger than the difference seen at Doyle Crossing. Notson Bridge is located nine miles downstream of the Red Clover/McReynolds Creek Restoration Project, which was completed in 2006.

Stream Flows

Many of the FR-CRM projects entail restoring the meadow/floodplain features in the watershed. This results in increasing the residence time of surface water in the landscape. This increased time, depending on season, results in increasing the opportunity for surface waters to infiltrate into shallow and deep aquifers while moving down-watershed. The groundwater pathways are complex and not readily understood. A portion of this groundwater is likely infiltrating into dispersed deep bedrock fractures. Another, possibly more important pathway, is the boundary zone between the meadow alluvium and bedrock. Groundwater may flow in a down-valley direction along this boundary zone down-valley to emerge as channel surface water well downstream of a project area. A primary purpose of the FR-CRM's nested network of streamflow stations is to detect hydrologic change at increasing watershed scales. We have been collecting data at these stations since 2000. Stations are located from ten to thirty miles downstream of the CRM's on-going project focus areas. The expectation is that surface and sub-surface base flow changes resulting from restoration could be detected down-watershed.

Figure 9 displays the weekly average minimum flows on Last Chance, Red Clover, and Indian Creeks. This is calculated by taking a running seven day average of the average daily water flow for the entire water year. Then, the minimum value of the averages is taken. Figure 9 shows what we believe may be early evidence of a measurable down-valley increase in flows from restoration project work. Figure 1 shows the location of the four stations. The Flournoy station (blue) is on Indian Creek, and is

downstream of the confluence of Indian Creek, Last Chance Creek and Red Clover Creek. The 378-acre Red Clover McReynolds project was completed in December 2006. Over 1,800 acres of meadow restoration has occurred in the Last Chance Creek watershed between 2001-07. The Notson station (green) is on Red Clover Creek, about six miles upstream of Flournoy station. The Doyle Crossing station (red) is on Last Chance Creek about ten miles upstream of Flournoy station. The DWR weir (purple) is on Indian above the confluence with Red Clover, and about ¼ mile upstream of the Flournoy station. In Figure 9, precipitation in 2001 and 2002 (pre-project) is fairly comparable to 2007, 2008, and 2009 (post-project). However, flows at Flournoy are dramatically higher in 2007-2009, and are also greater than the sum of the flows at the other three stations.

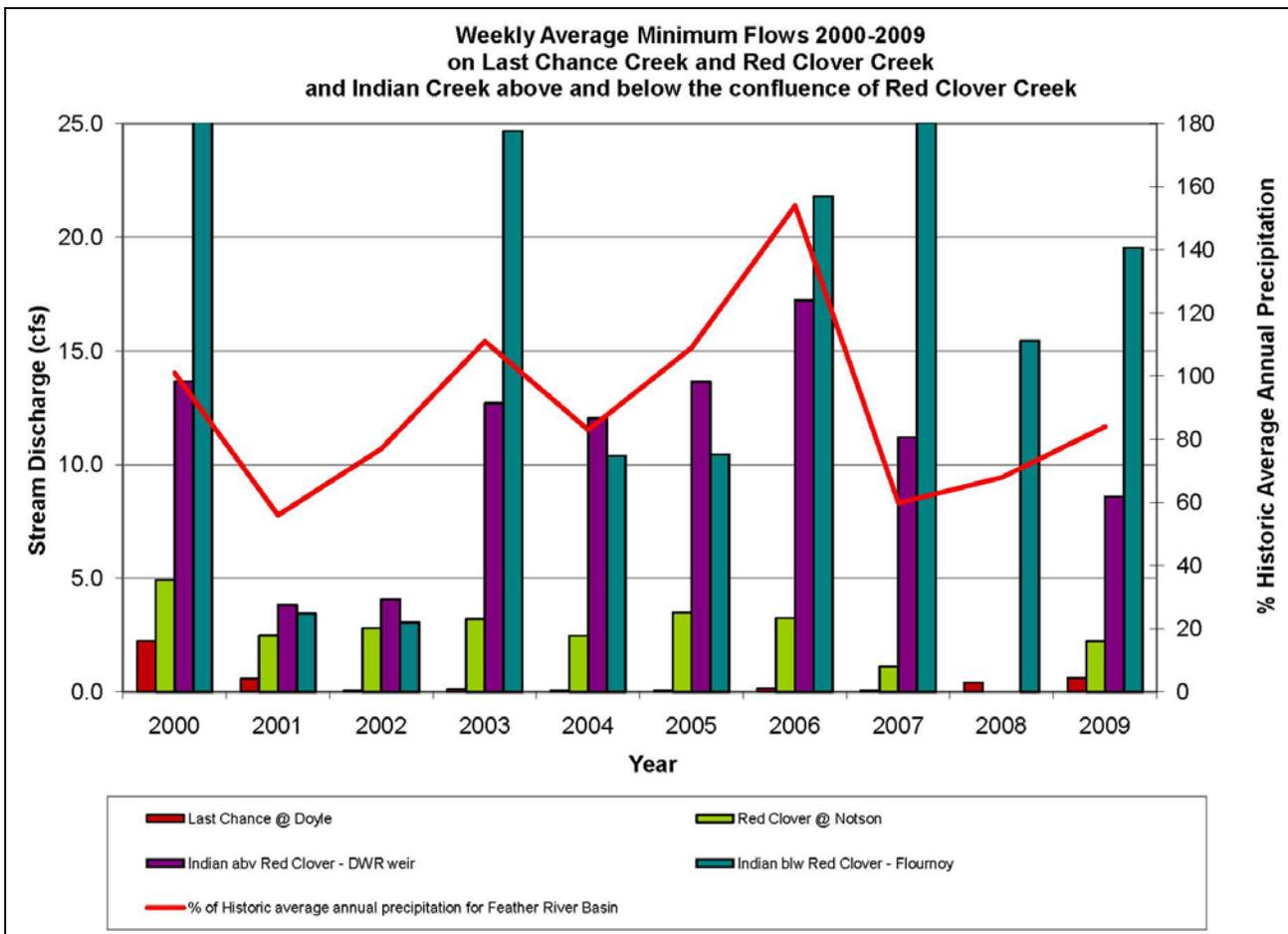


Figure 9. Weekly Average Minimum Flow from 2000-2009 on Last Chance Creek and Red Clover Creek and Indian Creek above and below the confluence of Red Clover Creek

Project Specific Flow Data

Figure 10 compares the spring hydrographs of Red Clover Creek at Notson Bridge from May 1 until September for 2002WY and 2009WY. 2002 was chosen for its similarity in precipitation during the water year to 2008 and 2009. 2002WY had a 77% of normal historic average annual precipitation for the Feather River Basin, while 2008WY had 68% and 2009 WY had 84%. Figure 11 compares the spring hydrographs of Last Chance Creek at Doyle Crossing from May 1 until September for 2002, 2008, and 2009. Figure 11 shows the base flows recorded on Last Chance Creek at Doyle Crossing in 2008 and 2009 are greater than that of 2002 from May through September. This base flow in 2008 at Doyle Crossing remains greater than that of 2002, despite the fact that the 2002WY had more precipitation later in the season than 2008 and 2009WYs. This augmented base

flow could be due to the restoration of ten miles of stream channel on Last Chance Creek upstream of Doyle Crossing, as well as the timing and intensity of precipitation.

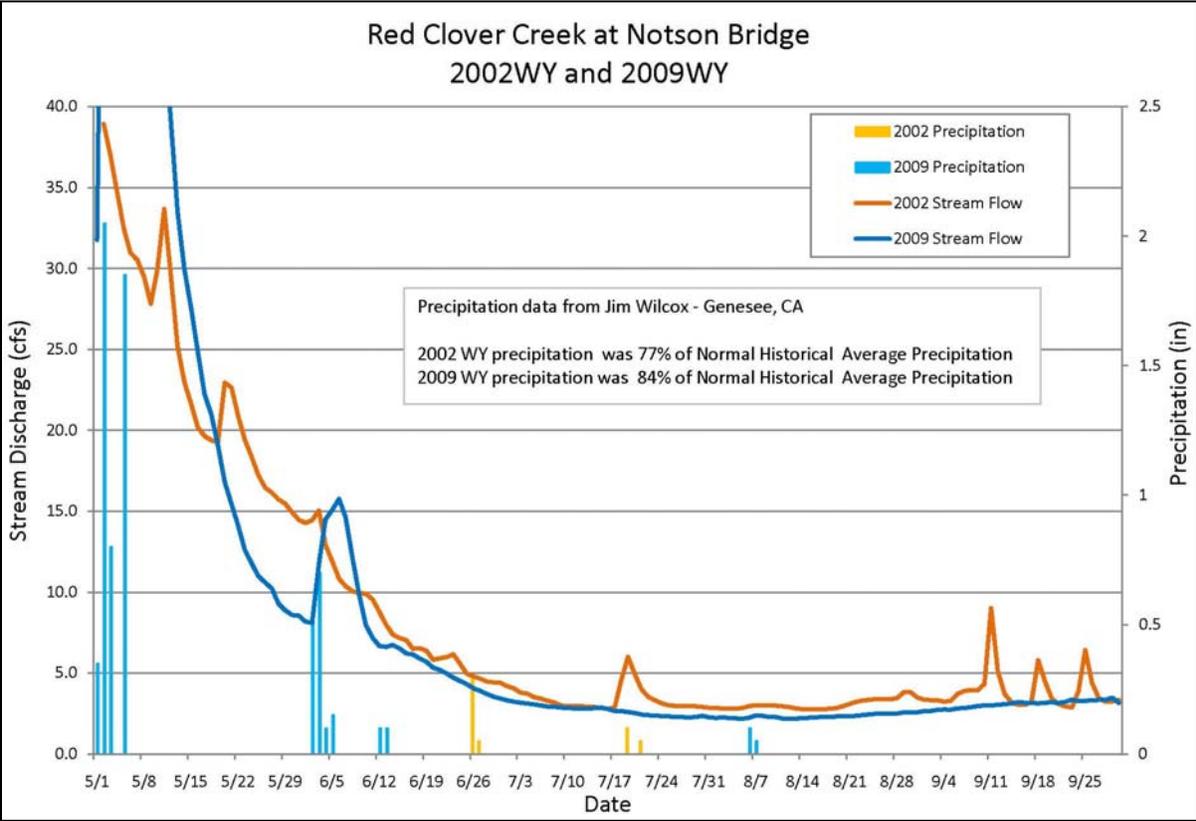


Figure 10: Spring recession stream flows in 2002WY and 2009WY at Notson Bridge

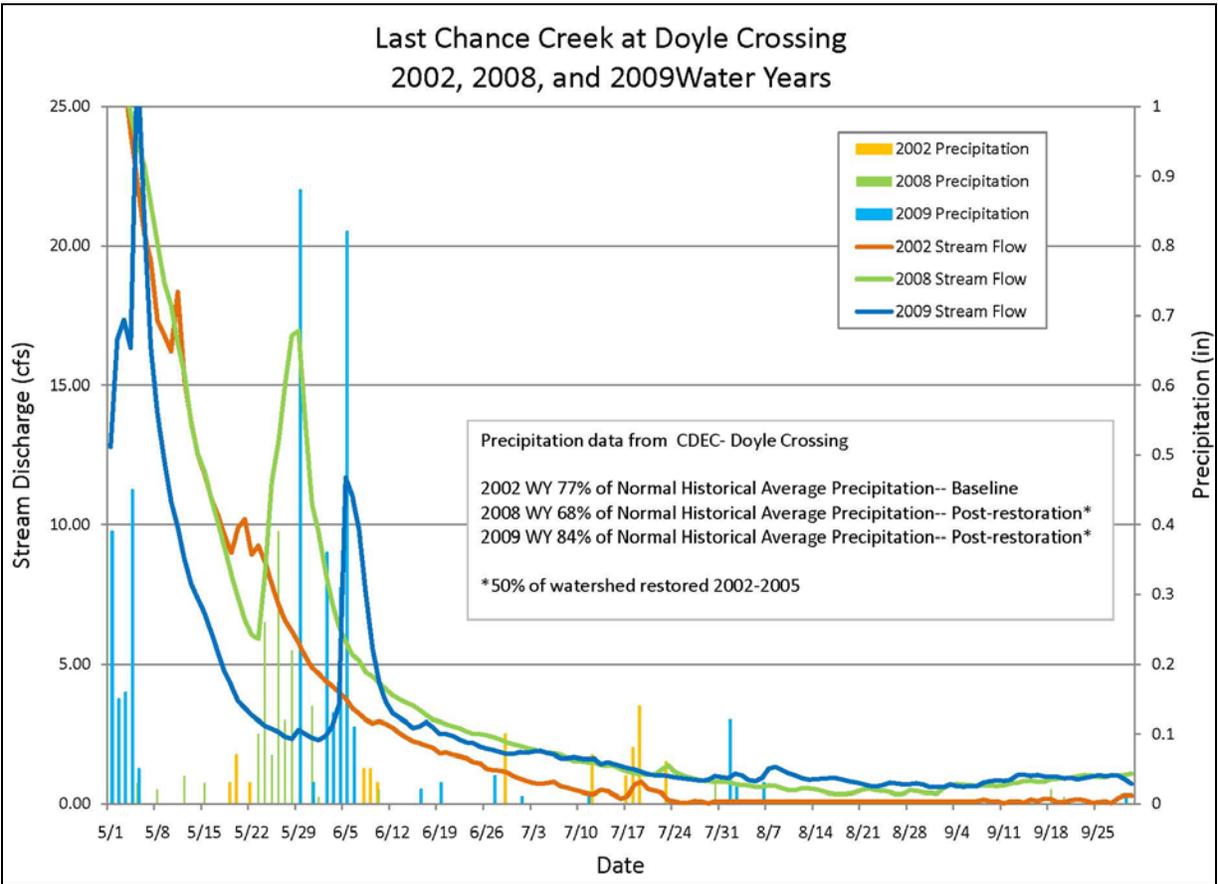
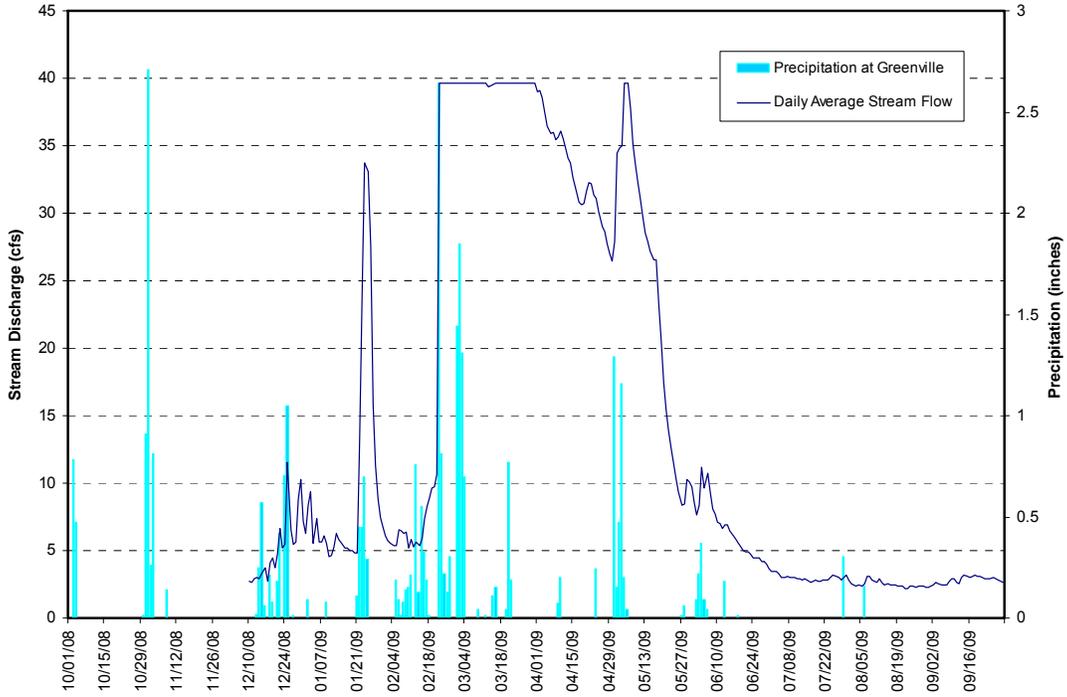


Figure 11: Spring recession stream flows in 2002, 2008, and 2009 Water Years at Doyle Crossing

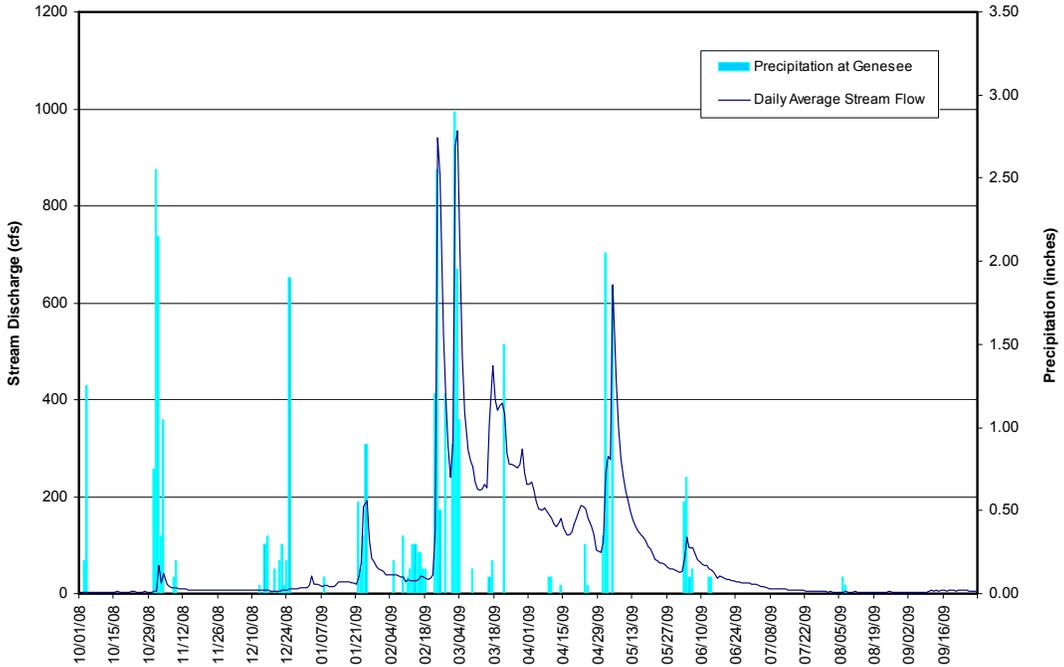
Watershed Hydrographs for continuous recording stations WY2010 (precipitation data taken at nearby weather stations)

The watershed hydrographs are starting to show differences between the Notson Bridge and Doyle Crossing late season flow peaks related to storms, versus the Wolf Creek and Lights Creek storm peaks. The restored reaches in the Red Clover and Last Chance watersheds appears to be starting to have an effect on downstream flow peaks.

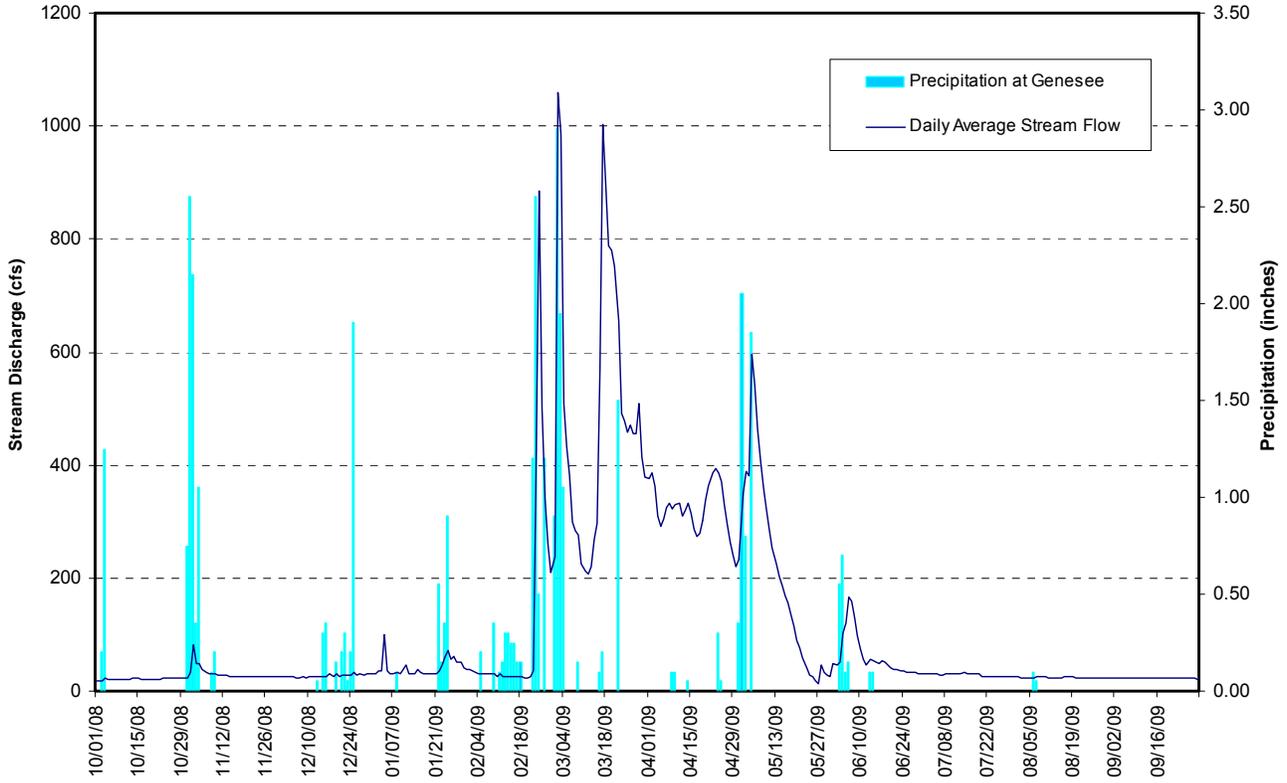
Wolf Creek at Ball Field Bridge - 2009



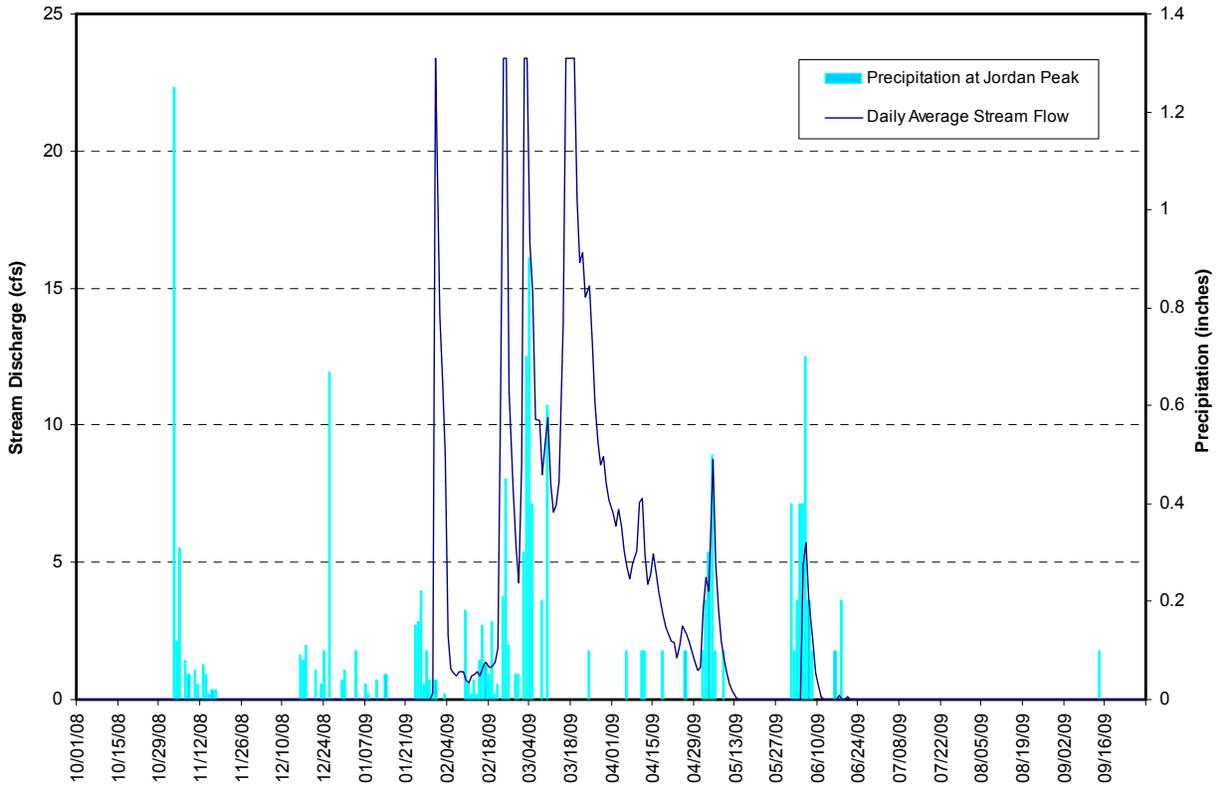
Lights Creek at Deadfall Lane Bridge - 2009



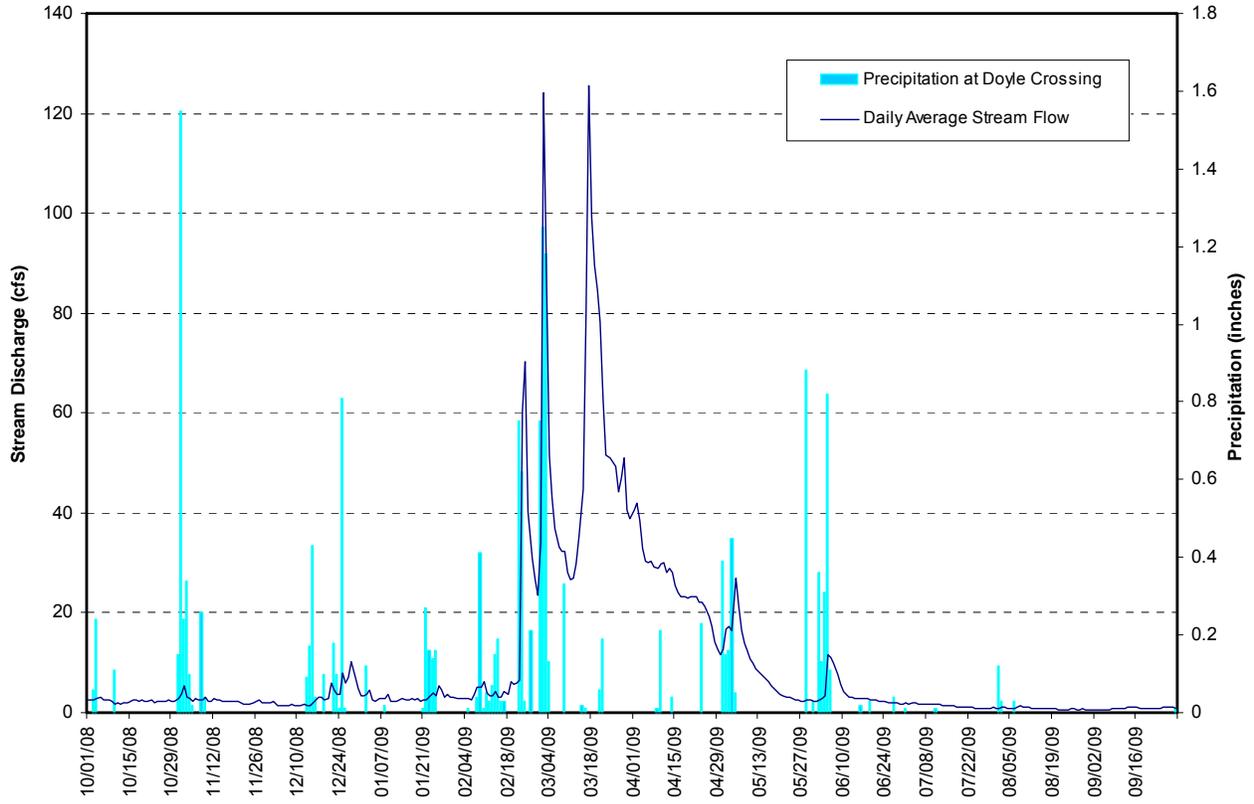
Indian Creek at Flournoy below Red Clover - 2009



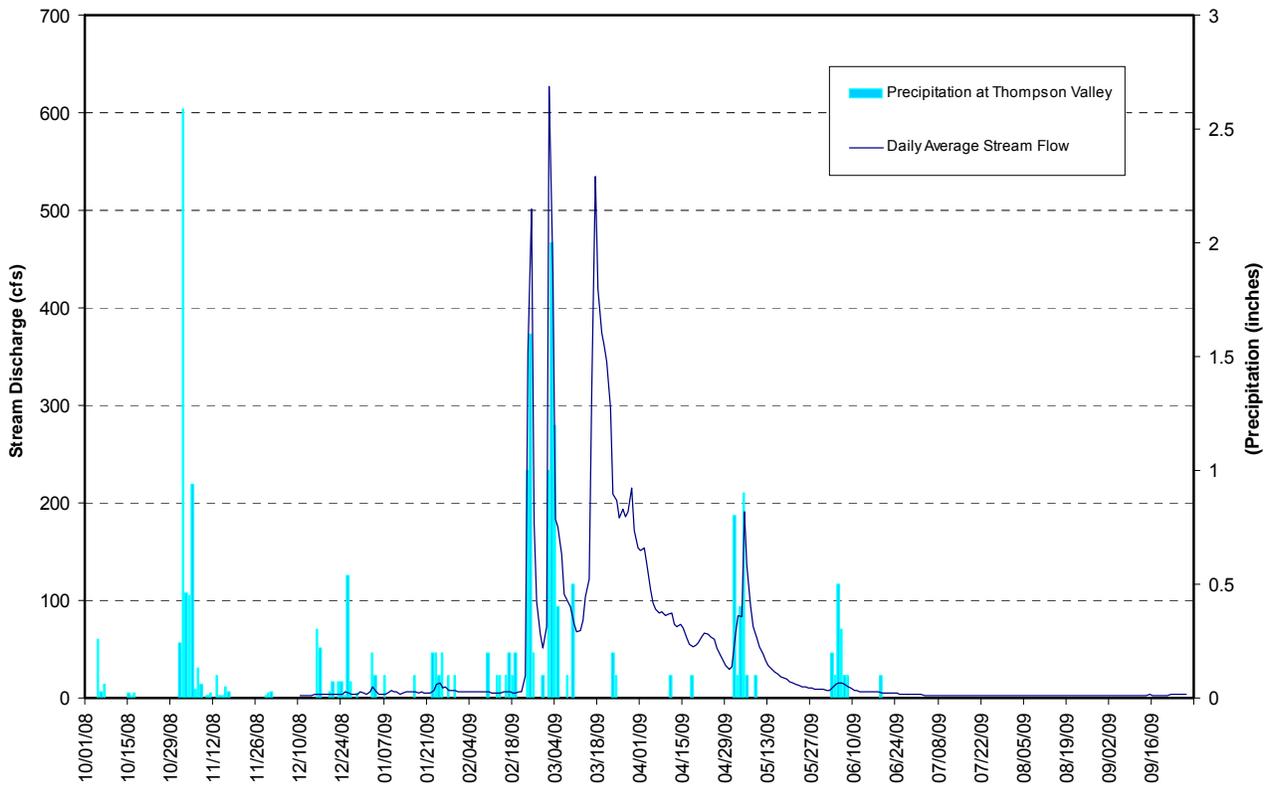
Last Chance Creek at Million Dollar Bridge - 2009



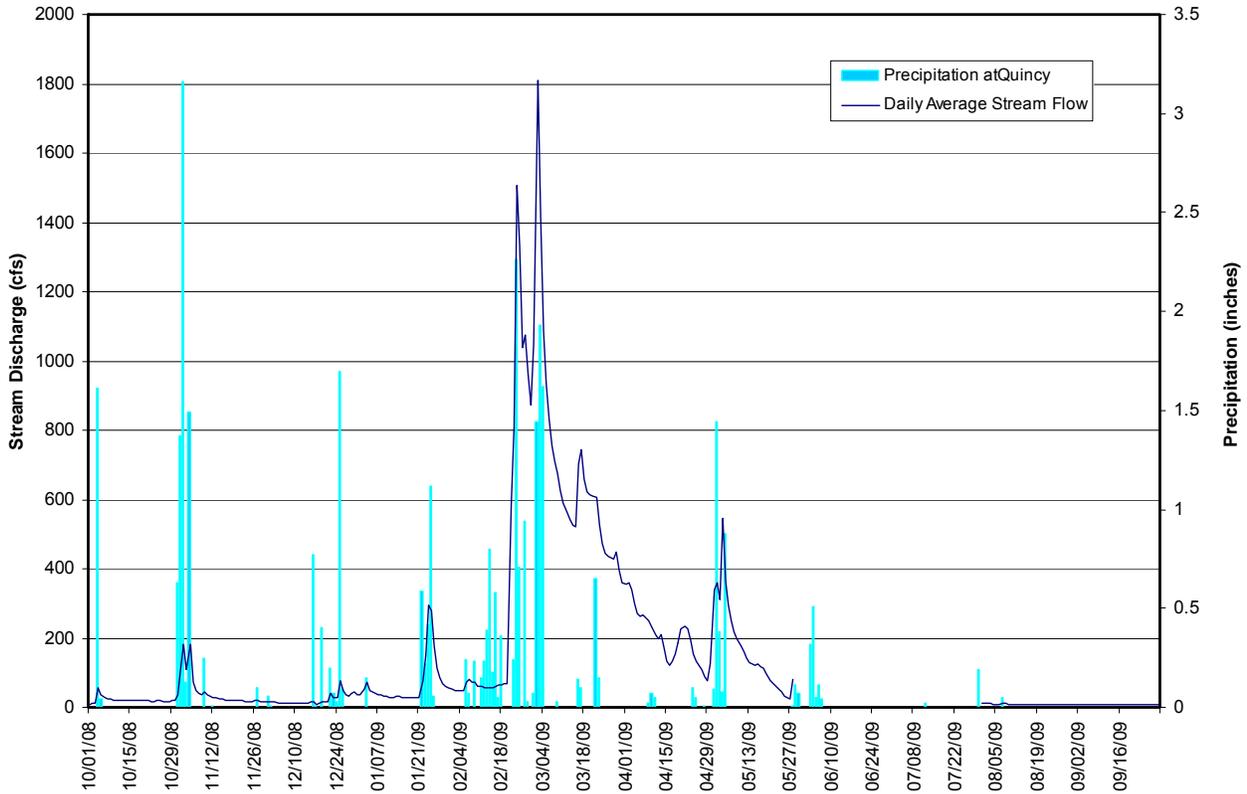
Last Chance Creek at Doyle Crossing - 2009



Red Clover Creek at Notson Bridge - 2009



Spanish Creek at Quincy Foot Bridge - 2009



Citizen Monitoring

During the 2009WY the Feather River CRM had the help of ten citizen monitors, who collected turbidity samples and water temperatures during storm events at 18 different locations throughout the watershed. Figure 12 shows different turbidity measurements taken in Indian Valley by citizen monitors during a storm event in May of 2009. Turbidity in this graph is measured in Nephelometric Turbidity Units (NTUs). High turbidity at Lights Creek is likely due to the Moonlight fire, as well as other watershed conditions.

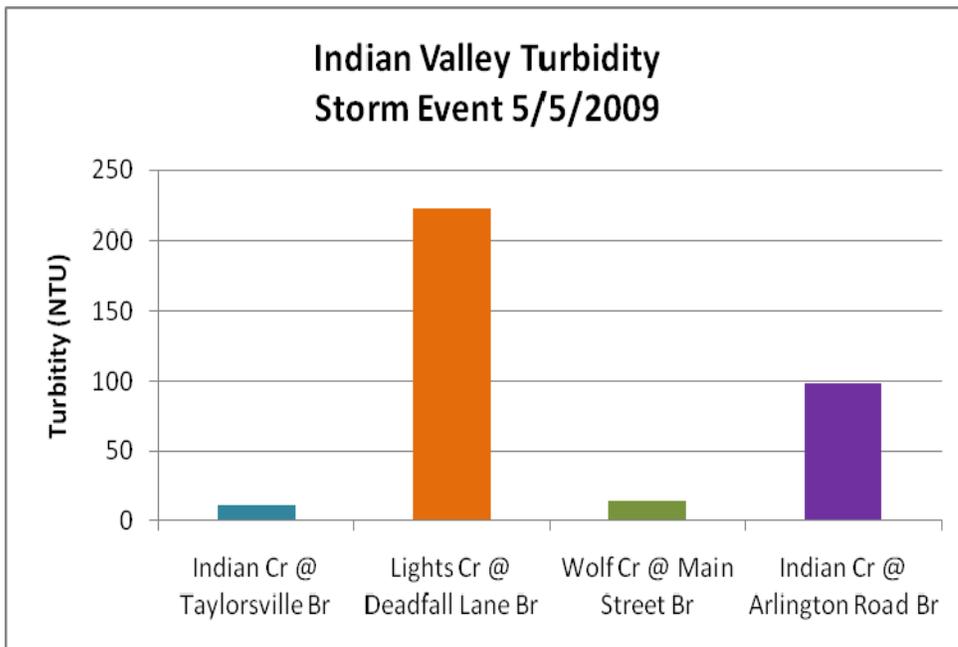


Figure 12: Indian Valley turbidity during a storm event on May 5, 2008. Data collected by citizen monitors.

Conclusion

The 2009 Water Year was the third year of a drought. With 84% of average historic precipitation falling in 2009, 68% in 2008, and 60% in 2007, this was a good water year for FR-CRM to analyze the response of the Feather River Watershed to low flows and summer temperatures. While Last Chance and Lights Creeks continued to be the most impaired streams for cold water fisheries that FR-CRM monitors, significant improvement in water temperatures were seen on Last Chance Creek at Doyle Crossing over the last three years of watershed monitoring data. Such water temperature improvements may be attributed to over 10 miles of channel and almost 1,500 acres of affected meadows that have been restored by FR-CRM on Last Chance Creek above Doyle Crossing. Eight more miles of restoration on Last Chance Creek above Doyle Crossing is planned for construction in 2011-2012 with Proposition 50 funds, and we hope to see more improvements in summer water temperatures and baseflow on Last Chance Creek at Doyle Crossing. There have also been improvements seen on Red Clover Creek at Notson Bridge in maximum weekly average water temperature and maximum summer water temperature diurnal fluctuation. These improvements may be due to the effect of the Red Clover/McReynolds Creek Restoration Project, which restored three miles of channel nine miles upstream of Notson Bridge.

Unlike the improvements on Last Chance Creek and Red Clover Creek, we foresee little improvement in summer water quality on Lights Creek, particularly with sediment contribution from fire and subsequent rehabilitation activities following the Moonlight fire in 2007. Wolf Creek water quality has improved since the first three phases of restoration, yet coldwater fisheries would benefit from more channel restoration upstream of Main Street between Setzer Road bridge and the Greenville Campground.

Feather River Watershed

North Fork Feather River

East Branch North Fork Feather River

Middle Fork Feather River

Indian Creek

Spanish Creek

Wolf Creek (1989 & 2002) 2.6 miles, 29 acres

Lights Creek (CRS)

Hossekus Creek (2002-2006) 1 mile, 60 acres

Ward Creek (1999) 1 mi./165 acres

Red Clover Creek

Last Chance Creek

@ Notson Bridge

Bagley (1996) .26 miles, 10 acres

Poco (1986) .23 miles, 20 acres

Red Clover McReynolds (2006) 4 miles, 350 acres

Red Clover Demonstration (1985) 1 mile, 70 acres

Noble (1990) .28 miles, 25 acres

Dixie Creek (2007) .38 miles, 12 acres

Dotta Canyon (1988) 5 miles, 50 acres

Boulder Creek (1997) .75 miles, 20 acres

Willow Creek (1996) .25 miles, 11 acres

Greenhorn Creek (1991 & 2001) .75 miles, 18 acres

@ Dyr Bank

Dyr Bank (2006) .11 miles

Elizabethtown (2002 & 2003) .3 miles, 7 acres

Kellet Bank (2008) .5 miles

Silver Creek (2008) .4 miles

Long Valley (2008) 2.1 mi/ 170 acres

Poplar Creek (1994 & 2003) .15 miles, 15 acres

Jamison Creek (1995 & 2005) .38 miles, 20 acres

Smith Creek (2007) .8 miles, 30 acres

Clark's Creek (2001) 1 mile, 56 acres

Big Flat (1995 & 2004) 1 miles, 47 acres

Above & Below Big Flat

Stone Dairy (2001) .5 miles, 20 acres

Little Stony Creek (1996) .15 miles, 2 acres

PNF (2003-07) 585 acres
multiple project reaches include:
Ferris Flat (2003)
Ferris Creek (2003)
Ferris Fields (2007)
Alkali Flat (2002)

Dooley (2005) 1 mile, 80 acres

Million \$ Bridge

PNF (2002-05) 350 acres
multiple project reaches include:
Jordan Flat + Supplemental (2002+05)
Artray (2002)
Bird-Jordan (2002)

Last Chance Charles-Matley (2004) .4 miles, 80 acres

Sulphur Creek (CRS)

Sulphur Bank Stabilization (2009) .1 miles

Rapp-Guidici (2007) .4 miles, 13 acres

Boulder Creek (2008) .6 miles, 17 acres

Humbug-Charles (2004) .5 miles, 60 acres

Carman (2001 & 2002) 2.5 miles, 245 acres

Little Last Chance (2007) 5 miles, 750 acres

Rowland (1997) 2 miles, 50 acres

Sulphur Cr.

@ 89 Br.

@ Bail Field Bridge

@ Deadfall Lane Br.

Taylorville Br.

@ Flournoy Bridge

@ DWR weir

● Continuous Recording Station (CRS)