Friends of Deer Creek Drawdown Report for 2007

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Introduction

The Lake Wildwood Association (LWWA) conducted a drawdown of the Lake Wildwood Reservoir beginning October 15th of 2007. Reservoir drawdowns are conducted as part of the reservoir sediment/vegetation management program. Sediment is removed that has been transported into the reservoir from upstream during winter flood events, and aquatic vegetation is removed that builds up during the summer months.

The drawdown is conducted in mid October and flows usually exceed the pre-dam October flows with respect to magnitude during the release period. . Flow measurements may occasionally be confounded by early season storms, such as occurred during the previous drawdown in 2004 (Cannon 2005, Fishery Foundation 2005). Ongoing monitoring has been conducted since 2001 to evaluate the impact of the drawdown on the creek environment; of special interest is the Fall Chinook Salmon run. The Salmon run occurs in the lower Yuba River and in some years in lower Deer Creek. Sediment loads produced by the release, especially fine sediments, can negatively impact salmon egg viability as well as negatively impact aquatic insect survival (Wood & Armitage 1997). Elevated temperatures, resulting from water releases from the epilimnion (upper portion of a stratified lake), can also negatively impact fish and aquatic macroinvertebrates and can kill salmon eggs at temperatures greater than 17^{o}C (Moyle 2002). A study of the 2003 drawdown conducted by The Fishery Foundation of California found that temperatures in Lower Deer creek during the peak flow of the release ranged from 17^{o}C to 20^{o}C however temperature fluctuations before the release ranged from 12^{o}C to 20^{o}C and after the release ranged from 8^{o}C to 17^{o}C. As a result of the release the Yuba River increased by about 1^{o}C in comparison to water temperatures before and after the release. Impacts were not as great on the Yuba River because of the mixing of Deer Creek water with the cooler water released from the bottom of Engelbright Dam.

Drawdown events have been conducted regularly in the month of October for the past 28 years but have only recently been monitored for water quality impacts on Lower Deer Creek. Friends of Deer Creek (FODC) has collected water chemistry data for the last 5 drawdown events in addition to the monitoring conducted by other agencies such as Fish and Game, The Fishery Foundation of California, and private consultants (i.e. Thomas Cannon). A history of Friends of Deer Creek monitoring is shown in Table 1 describing the location sites monitored, release points from the dam, release method, and constituents analyzed. Monitoring data have been used by the LWWA to modify the drawdown release mechanics, adjusting the release depth, magnitude, and duration in an effort to minimize potential turbidity and temperature impacts.

Table 1. Monitoring history of the Lake Wildwood Reservoir drawdown event. Numbered sites refer to FODC sampling sites, the weir is 200 ft below the outlet valve, and the Yuba is a site 3 miles below the Deer Creek Yuba River confluence. The release method is the number of days to reach peak flow. TR – turbidity, DO- dissolved oxygen, T- temperature, C- conductivity, TSS- total suspended solids, AI- aquatic insects.

Monitoring History

Organization	Year	Sites Locations	Release Point	Release Method	Analysis
FODC	2001	10	10 ft	3 day ramp	TR, DO, T, pH, C
FODC	2002	10	10 ft	3 day ramp	TR, DO, T, pH, C, TSS, FC
FODC	2003	Weir, 10	10 ft	3 day ramp	TR, DO, T, pH, C, TSS
FODC	2004a	Weir, 9	10 ft	8 day ramp	TR, DO, T, pH, C, TSS, AI
T. Cannon Aquatic Ecologist	2004b	Outlet, Camp, 10	10 ft	8 day ramp	TR, DO, T, TSS
FODC	2007	Weir, 8, 10, Yuba	10 & 32 ft	3 day ramp	TR, DO, T, pH, C, TSS, FC, AI

Previous findings for the LWW release have recorded turbidity concentrations as high as 348 NTU (Fish and Game result for the 2000 drawdown) however, results have been highly variable. Peak turbidity concentrations for 2002 and 2003, measured by FODC, were 43.3 and 4.5 NTU respectively suggesting that sampling in the past has not consistently captured the peak water chemistry related to suspended solids. For the 2007 drawdown event FODC implemented an intensive monitoring plan to capture the chemistry of the release at a higher resolution. The pulse release of water from the dam simulates a high flow storm event with no runoff inputs of suspended solids from the landscape. As a result in-channel sediment is flushed at the onset of high flows and is quickly exhausted (Henson et al. 2007; Petts et al. 1985). In order to capture peak water chemistry concentrations, especially constituents linked to suspended solids (ie turbidity, nutrients, and bacteria), sampling frequency should be high at the onset of the pulse flow. Automatic pump samplers were used to collect samples intensively to characterize chemistry variations during the release and to accurately predict total suspended solids (TSS) loading on the creek. This report summarizes and discusses the results of the 2007 LWW release data captured using the auto samplers. This report also includes a discussion on previous drawdown monitoring results and makes recommendations for future releases.

Sampling Sites

Lake Wildwood is a 300 acre, 4,000 acre-foot reservoir that was constructed on the lower reach of Deer Creek in 1970. Lower Deer Creek (below Lake Wildwood) is an ephemeral stream. Dry season flow is dominated by effluent from the Lake Wildwood Wastewater Treatment Plant. During the summer Nevada Irrigation District (NID) transfers water through the lake to provide water to a downstream irrigation ditch which is separate from the creek. In addition, Lake Wildwood purchases water from NID to replace evaporative loss in the lake. Depending on evaporative loss and irrigation demand, some of this flow may go over the spillway into the creek. During much of the dry season, however, little or no water flows over the dam.

Reservoir water quality parameters were provided by Bill Yanko on behalf of the Lake Wildwood Lake Committee to determine the water chemistry of the water being released. The samples were collected and analyses done by staff, with exception of some suspended solids and VSS analyses, which were done at the
Sanitation District Lab. Temperature and water chemistry measurements were taken at three sites on Lower Deer Creek (Figure 1) and temperature was also measured on the lower Yuba by FODC. Automatic pump samplers were set up at the Weir, Site 8, and Site 10 and HOBO temperature loggers were deployed at the Weir, Site 8, Site 10 and on the Yuba River.

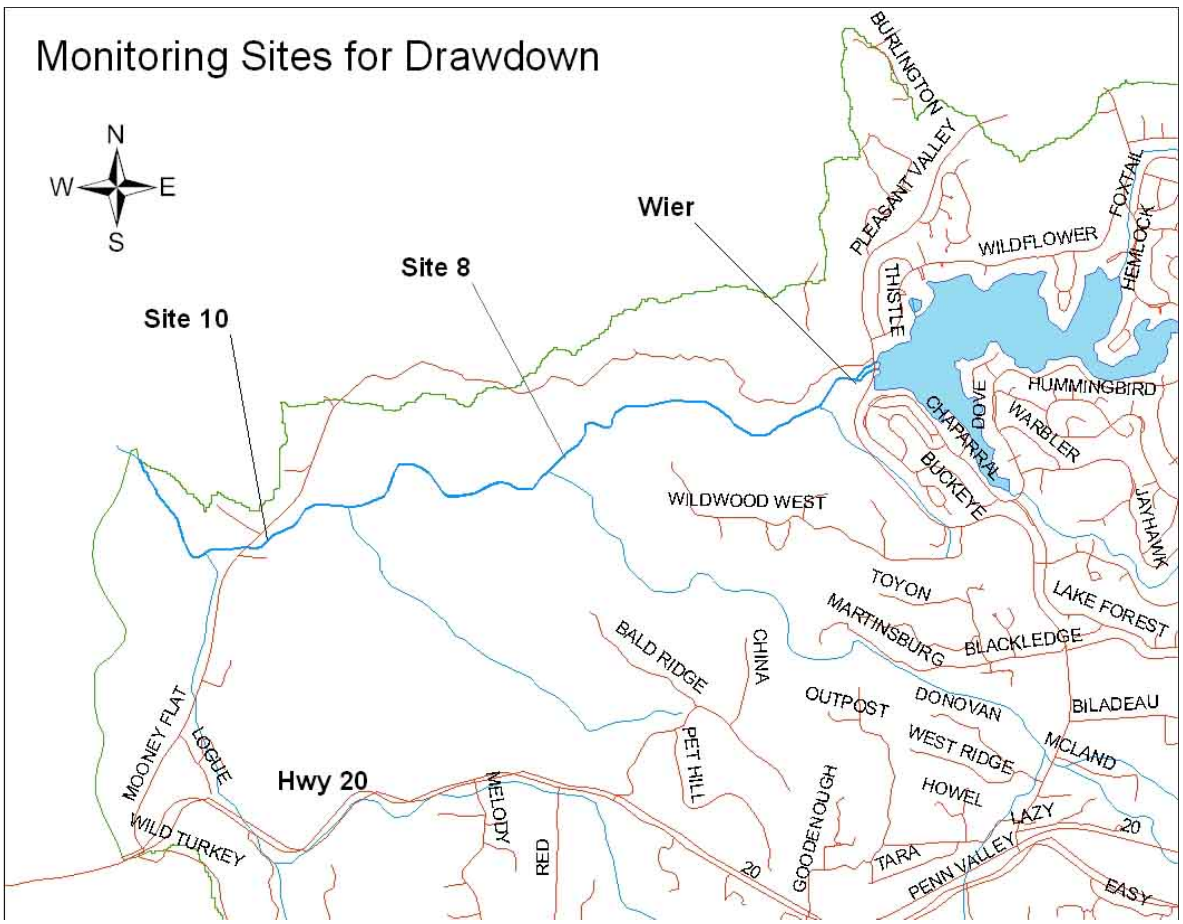

Figure 1. Map of water chemistry sampling locations for monitoring the Lake Wildwood drawdown event. The uppermost site was about 200 ft downstream of the release point at the NID weir, FODC sampling site 8 located 1.5 miles downstream of the release point, and FODC sampling site 10 located 3 miles downstream of the release point. The Yuba River sampling site is located 3 miles downstream of the Deer Creek-Yuba River confluence.

Methods

The data in this report were obtained using US Environmental Protection Agency (US EPA) approved methodology (described in the Sampling and Analysis Plan) with regulatory support from the California State Regional Water Quality Control Board (RWQCB). The quality of the data is maintained using a Quality Assurance Project Plan (QAPP) written and approved by the State Water Resources Control Board (SWRCB). A technical advisory committee or TAC committee, composed of scientists from northern California, meets quarterly to review and approve the data. An intercallibration session to check the accuracy of monitoring equipment is held every 6 months.

Pump Samplers: ISCO 6700 pump samplers were used to collect one-liter water samples during the 12 days of elevated flow. The intake tubes were staked near mid-channel and were a minimum of 10 centimeters (cm) above the streambed. Methods were consistent with standard USGS pump sampler procedures (Bent et. al 2001). Sampling frequencies during the period of increasing flow (the rising limb) were collected at 30 minute intervals at the onset of the pulse release to capture rapidly changing water quality conditions at greater resolution.

The Flood Flow Frequency Analysis Methodology that was used is based on USGS and U.S. Army Corps of Engineers (USACE) methods (http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf). Log Pearson type III method was used to conduct the flood flow frequency analysis. These guidelines and methods are regarded as the industry standard within government agencies (USGS, USACE) for performing flood flow frequency analysis. To perform flood flow frequency analysis the USACE HEC-Statistical Software Package was used which was developed by the Hydrologic Engineering Center (http://www.hec.usace.army.mil/). This program calculates flood flow frequencies based on Bulletin 17B guidelines.

Results and Discussion

Hydrology of the Release

The drawdown release from the Lake Wildwood Reservoir was initiated on the morning of October 15th and was returned to a base-flow on October 27th. Average flow 48 hours before the release was 8.3 cfs and 48 hours after the release was 4.1 cfs at the Smartville USGS gauge. The release was conducted using two discharge stages: 95 cfs stage and 196 cfs stage. The first stage had a duration of 48 hours with a discharge of about 95 cfs and was ramped up over a two hour period of time. The second stage had a duration of 6 days with a peak discharge of 196 cfs and was ramped up over a one hour period of time from the 95 cfs discharge. The entire release lasted 8 days. The initial 95 cfs pulse was released from a 26 inch valve located at a depth of 32 ft below the top of the spillway. The second 196 cfs pulse was a combination of discharges between the 26 inch (at 32 ft depth) valve which contributed about 95 cfs to the total discharge and the 48 inch (at 10 ft depth) valve which contributed the remaining 100 cfs. By blending the water from these two release points the goal was to combine the cooler deep water with the warmer shallow water to minimize downstream impacts of warm water temperatures.

The total volume of water discharged during the 2007 drawdown was about 2900 acre-feet to lower the reservoir 10 ft. On average, precipitation in December produces enough water volume to refill the LWW reservoir three times over (10,257 acre-feet). These calculations suggest that a longer release into November would still allow enough water volume to the LWW reservoir to fill before January. The LWW Lake Committee and Maintenance Supervisor are concerned, however, that if the release extends into November, there will not be adequate time to complete the sediment removal before the December rains begin.

Water Temperature of the Release

Temperature data are provided in Table 2. The maximum temperature measured during the 8 day release at the weir sampling point was 16.8 ^{o}C and the minimum temperature was around 13.9 ^{o}C. Initial temperatures at the beginning of the release (95 cfs) were between 13.9 and 15.8 ^{o}C during the first two days. Temperatures at the NID weir increased with the second stage of the release with a range of 15.3 to 16.8 ^{o}C (195 cfs), as warmer surface water was mixed in with the cooler deeper water (Figure 2). During the second stage of the release the temperatures gradually decreased from 16.8 ^{o}C to 15.3 ^{o}C most likely due to the change in the stratification of the reservoir due to the release. Downstream temperatures reached 17.7 ^{o}C at site 10 at Mooney Flat Rd during the release with a mean of 15.8 ^{o}C. Water released during the drawdown appeared to buffer downstream temperatures as noted at site 10 by the large variation in temperature before and after the drawdown event (11.2-19.7 ^{o}C) compared to the smaller variation in temperature during the drawdown (14.3-17.7 ^{o}C) (Figure 2). Temperatures in the Yuba River below the confluence of Deer Creek did not appear to be greatly impacted by the release however a small increase in temperature appears to correspond to the release of warmer water during the second stage of the release.

Table 2. Temperature summary for 4 sites during the eight day 2007 LWW drawdown.

Temperature				
	Weir ^{o}C	8 ^{o}C	10 ^{o}C	Yuba ^{o}C
Min	13.9	14.4	14.3	11.0
Max	16.8	18.0	17.7	13.8
Mean	15.8	15.9	15.8	12.1
Median	16.0	16.0	15.8	12.0

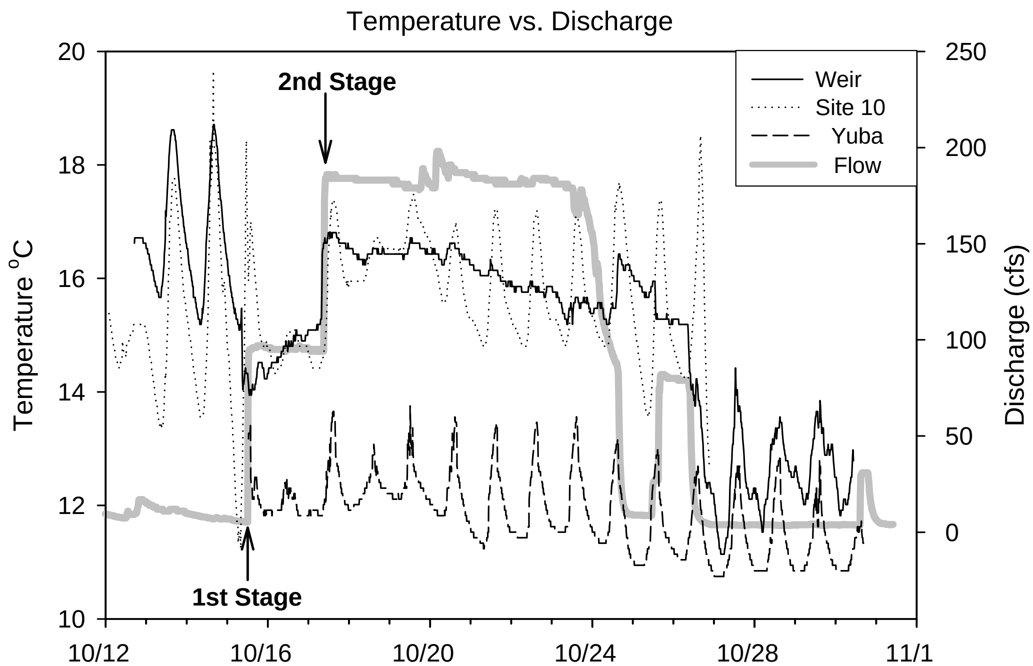

Figure 2: Temperatures at the Weir, Site 10 and on the Yuba with flow at the USGS gauge at Smartville. Stage 1 indicates an increase in flow from 5.5 cfs to 95 cfs and Stage 2 indicates an increase in flow from 95 cfs to 196 cfs.

Water Chemistry

A summary of the water quality data for the pulse release is in Table 3. Specific conductivity values and pH values were all within the range of background water quality levels for Lower Deer Creek and did not appear to be a concern, and are therefore not discussed in detail.

Table 3. Summary of the water quality including maximum, minimum, and mean during the LWW 2007 release.

Water Quality Summary Fall 2007 Release

	TSS (mg/L)	Turbidity (NTU)	pH	Sp Cond (us)	Ecoli (MPN)
Weir					
Mean	9.8	4.9	7.67	113	87
Max	34.3	17.0	8.21	126	649
Min	0.0	1.1	7.36	79	5
Site 8					
Mean	18.7	5.9	7.86	119	64
Max	239.7	65.0	8.21	174	276
Min	0.0	0.5	7.62	80	3
Site 10					
Mean	20.0	6.7	7.86	117	471
Max	218.7	72.1	9.98	171	2420
Min	0.0	0.4	7.34	92	21

Turbidity and Suspended Solids

The turbidity and total suspended solids (TSS) signature for the pulse release was distinct with peaks occurring at the onset of each stage increase and then quickly decreasing to baseline levels. These data strongly suggest that there is a finite supply of sediment in the channel and that the supply was exhausted quickly (Figure 3). The duration of the TSS and turbidity spike lasted between 3 and 4 hours at the weir before returning to base flow concentrations. Similar patterns were seen downstream at sites 8 and 10, however turbidity and TSS were between 4 and 6 times greater downstream than at the weir (Figures 4 and 5). Increased turbidity and TSS downstream are a result of a larger volume of sediment available as the distance from the outlet of the dam increases. Maximum turbidities of 17, 65, and 72.1 NTU for the weir, site 8, and site 10 respectively suggest that there are large transient increases in turbidity as a result of the initial pulse of flows of 95 cfs and greater. Volatile suspended solids (VSS) measurements taken on selected samples suggest that about 20% of the TSS concentrations were organic matter at the weir and downstream at sites 8 and 10 about 25% of the TSS concentrations were organic matter. It is not clear how much of this organic matter is composed of phytoplankton and how much is organic matter associated with the fine sediments. Further study is needed to determine the various source contributions to the organic matter.

Unfortunately data collected for the stage two pulse release at 195 cfs were compromised for sites 8 and 10. Samples collected during the onset of the second pulse at sites 8 and 10 were filled a second time by the pump sampler thus the highly turbid samples were diluted by water collected later in the release, compromising the samples. Although the timing of the turbidity peak is correct the concentration is an underestimate of the total (Figures 4 and 5). We were able to effectively quantify turbidity and TSS levels for stage one and for stage two pulse release at the weir. At the weir, TSS and turbidity concentrations were higher for the stage one 95 cfs release than the stage two 195 cfs release. These results suggest that a significant proportion of the sediment in the channel was exhausted by the 95 cfs release and that less sediment was available when the discharge was ramped up to 195 cfs. A potentially significant confounding factor was the tractor work conducted one week prior to the release in the outlet channel resulting in a large volume of unconsolidated soil less than 20 ft below the outlet valve. Peak turbidity and TSS concentrations were most likely largely influenced by the entrainment of these unconsolidated soils. The impact of these unconsolidated soils significantly affecting turbidity and TSS levels at downstream sites is less likely due to the greater peak concentrations observed at sites 8 and 10 during the first stage of release.

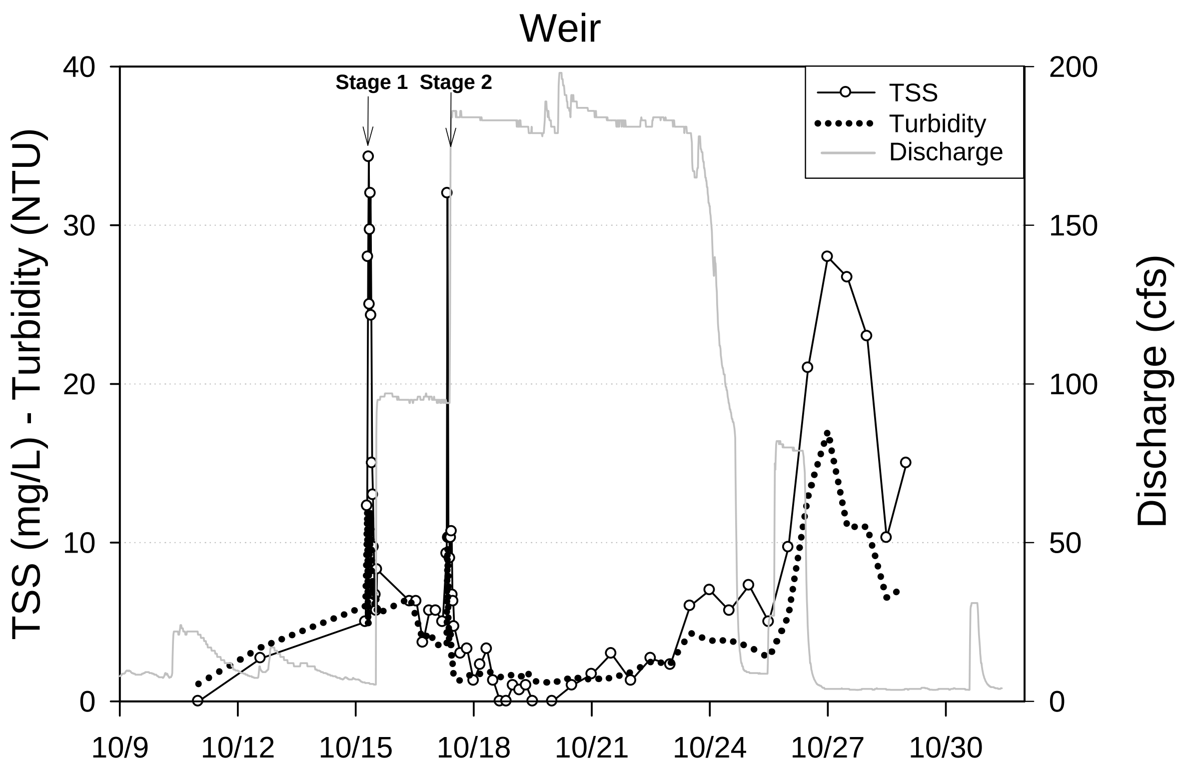

Figure 3. Total suspended solids and turbidity measured at the weir during the drawdown.

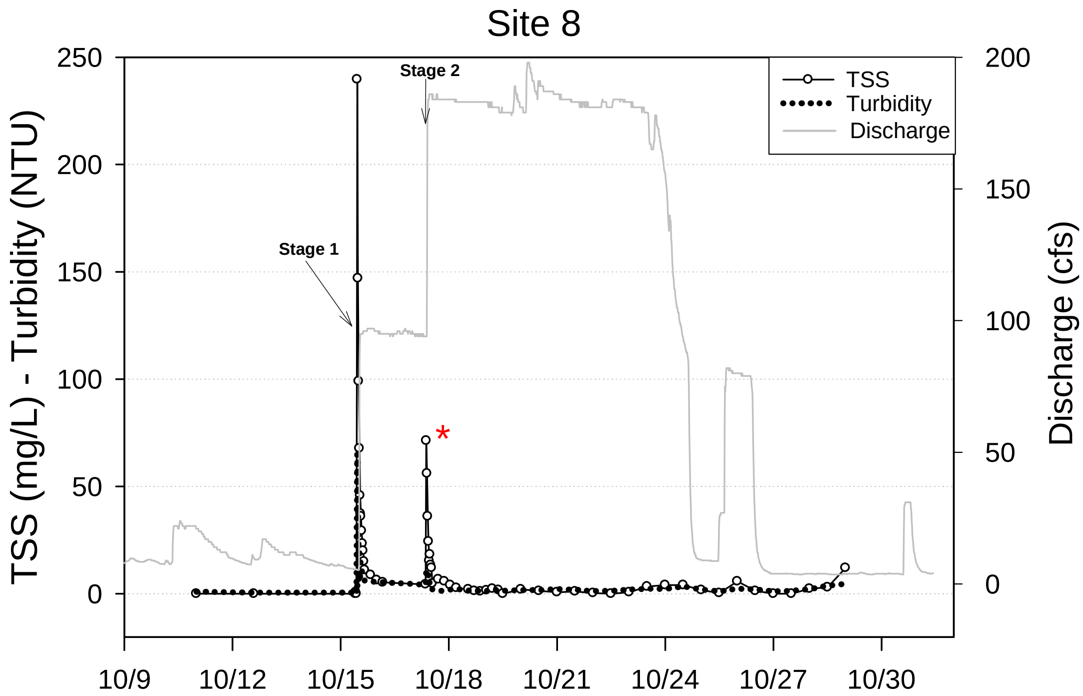

Figure 4. Total suspended solids and turbidity measured at FODC site 8 during the drawdown. The (*) denotes a sampling error during the peak concentration and does not accurately represent the peak concentration.

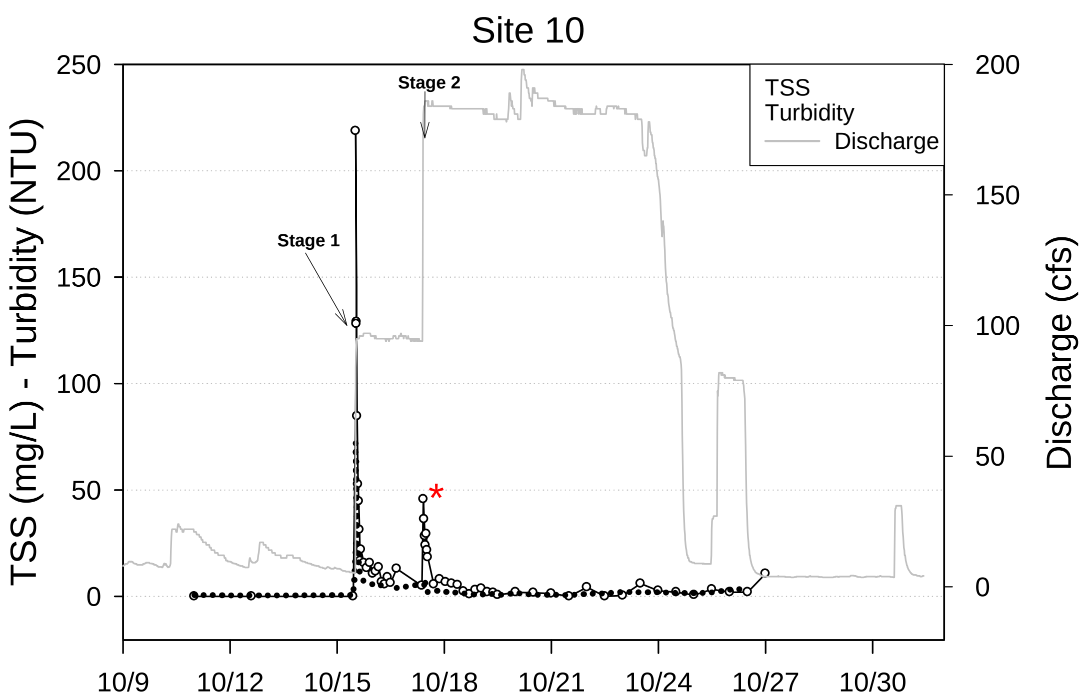

Figure 5. Total suspended solids and turbidity measured at FODC site 10 during the drawdown. The (*) denotes a sampling error during the peak concentration and does not accurately represent the peak concentration.

Also of concern is a TSS and turbidity peak at the tail end of the release that occurred at the weir on October 27th (Figure 3). The turbidity spike appears to correlate to a small pulse of water that begins on October 25th however it is not clear if the pulse of water actually caused the turbidity to increase or if it just happened to occur at the same time. Flow was stopped briefly due to vibrations occurring in tower structure. The flow was then restarted at 80 cfs to complete the drawdown. Even though the flow was minimal (80 cfs) compared to the 195 cfs, peak TSS reached 28 mg/L and turbidity reached 17 NTU. Unlike the turbidity and TSS spikes at the onset of the pulse release which were entraining (picking up) sediment as it left the outlet the turbidity peak that occurred on October 25 was from water released from the reservoir. Turbid water was observed immediately below the valve structure suggesting that the turbid water was released directly from the reservoir. This may be a result of turbulence within the reservoir caused by the drawdown of water, or the structure vibrations that were reported by LWW maintenance staff, as well as the release originating from the 32 ft depth release point. This late turbidity spike was only minimally observed downstream at Sites 8 and 10.

Table 4. The mass of sediment transported during the release. The table is tabulated by the two flow stages (95 and 196 cfs) and the overall sediment moved for the release (90 + 190 cfs).

Sediment Mass Entrained in kg at 95 and 196 cfs During the Release

	Mass @ 95cfs (kg)	Mass @ 196cfs (kg)	Total Mass (95cfs+196cfs) (kg)
Weir	917	2890	3807
Site 8	1629	*2711	*4339
Site 10	2726	*2934	*5660

* Denotes underestimates due to sampling error

The mass of the TSS transported past the weir, Site 8 and Site 10 for the release was 3807, 4339, and 5660 kg respectively (Table 4). Because of a sampling error at sites 8 and 10 the total sediment mass entrained during the entire release is an underestimate. Samples collected at sites 8 and 10 for the onset of the 190 cfs flow stage were unintentionally diluted leading to lower turbidity and TSS concentrations. This mass can be compared to future monitoring events.

Bacteria

During high discharge events *E. coli* often correlates strongly with turbidity and TSS (McDonald et al. 1982). At the weir, concentrations of *E. coli* remained under 50 MPN for the entirety of the release until the final sample collected on October 30th where the concentration increased to 648 MPN (Figure 6). Monitoring of E. coli concentrations just before the drawdown, at incrementing depths at the release point in the reservoir, yielded no violations of the single grab sample state standard of 235 MPN/ml standard of 6 samples collected suggesting that the water column is not the source of high fecal coliforms (unpublished data). The source of these bacteria is most likely from the sediments on the bottom of the reservoir near the 6 inch anaerobic valve. It is possible that this late peak is associated with the last turbidity peak observed at the weir, which was 4-days after the drawdown ended. As stated earlier the turbidity could be caused by the vibrations in the tower or by the turbulence caused by the release of water during the release. The 6-inch anaerobic valve was left open after the drawdown was completed to meet minimum downstream flow requirements per the lake Water Rights Agreement. On October 30th, divers were present to conduct the required annual inspection of the valve structures. The divers may have stirred up bottom sediments causing an increase in suspended solids going out the anaerobic valve. Also, light rains on the 29th and 30th of October may have contributed to the E. coli signature.

For downstream sites peak *E. coli* concentrations occurred at the onset of the stage one and stage two pulse flows, similar to that of the turbidity and TSS peaks (Figure 7). At site 10, concentrations increased above the USEPA *E. coli* standards of 126 MPN/ml (collected as a geometric mean of 5 samples over a 30 day period) and 235 MPN/ml (collected as a single grab sample) during the onset of the pulse flows but returned to base concentrations soon afterward suggesting that the peaks occurred quickly and then receded. Because peak concentrations receded quickly *E. coli* may not be a major water quality impact of the release.

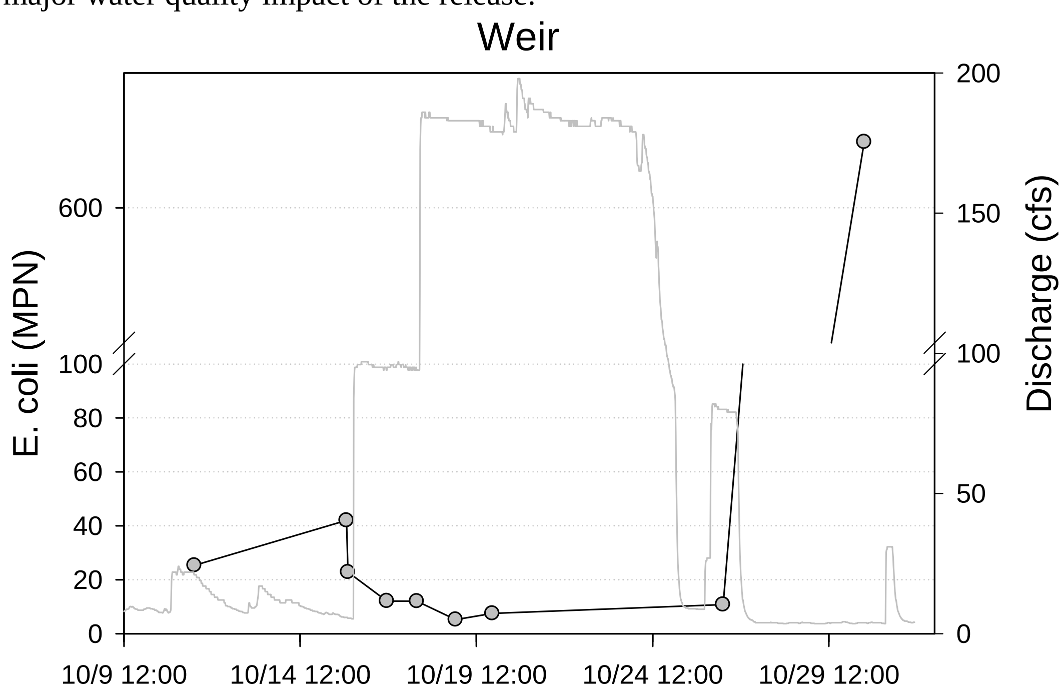

Figure 6. *E. coli* (MPN) for the drawdown at the weir.

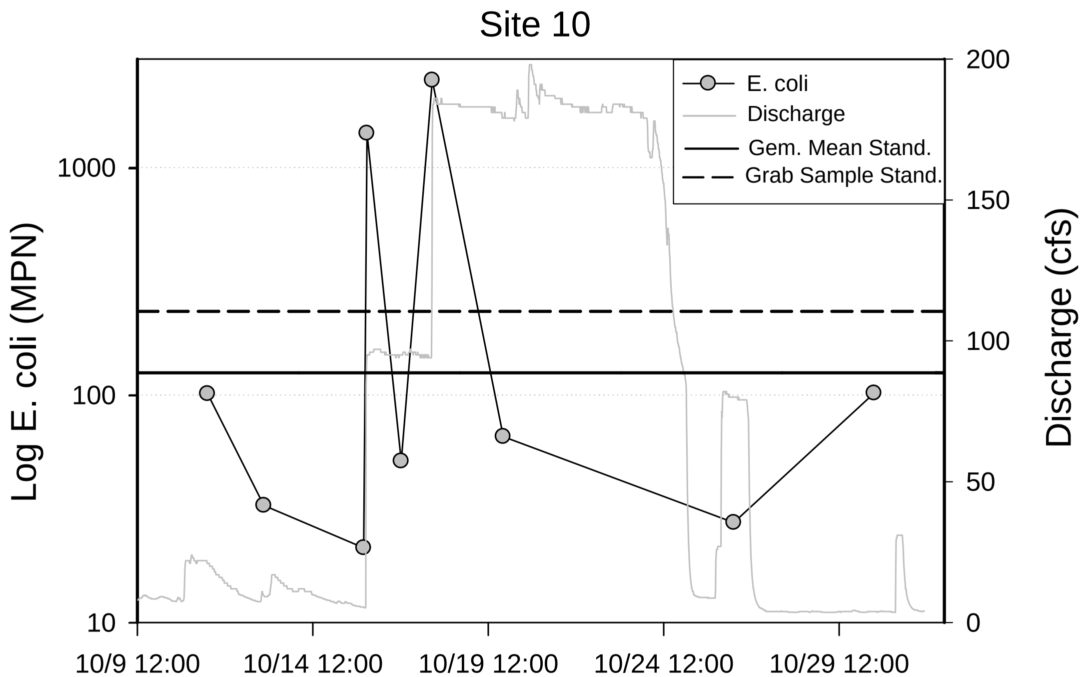

Figure 7. *E. coli* (MPN) for the drawdown at the weir. The solid line represents the USEPA standard of 126 MPN/100 ml collected as a geometric mean and the dashed line represents the standard for a single grab sample of 235 MPN/100 ml.

Summary of Past and Present Drawdown Data

Flow Regime

The flow regime of Lower Deer Creek for the month of October has been fundamentally changed by the Lake Wildwood Reservoir annual drawdown events since they began in 1978 (Figure 8). Lower Deer Creek experiences consistently higher flow magnitudes and durations in the month of October since the Lake Wildwood Dam was built. The return interval for a 302 cfs flow event before the Lake Wildwood Reservoir was built was every 18 years with a yearly occurrence probability of 5.6%. Since the dam was built the return interval for a 302 cfs flow event is only 3.3 years with a yearly occurrence probability of 30.8%. A list of the recurrence intervals for the 2, 5, 10, 20, 50, and 100 year flow events for pre and post dam construction can be found in Table 5.

October Flow Analysis

Return Interval (yrs)	Pre-LWW	Post-LWW
2	34	166
5	88	425
10	146	587
25	249	749
50	351	837
100	479	902

Table 5. Return interval for the month of October for the 2,5,10, 25, 50, and 100 year flows before Lake Wildwood was built (1936 to 1968) and after (1969 to 2007).

It is extremely difficult to quantify the impact that these flows have had on aquatic and terrestrial wildlife. It is known that fish, macroinvertebrates, and vegetation rely on life cycle triggers that include flow magnitude, duration, timing, as well as water temperature (Poff et al. 1997). Large releases of water in October can potentially have negative impacts on stream biota because flows of these magnitudes and durations would not occur naturally. A study by Novotney (1985) on a flood control dam in Kentucky compares macroinvertebrate populations above and below the reservoir. The study attributes major decreases in sensitive Ephemeroptera, Trichoptera, and Plecoptera below the dam to changes in the natural flow patterns. Because the drawdown has occurred almost every year for the past 30 years communities of fish and macroinvertebrates have most likely shifted to accommodate the highly unseasonal October flows. By reducing the discharge of the release it may be possible to restore hydrologic function to the October hydrograph and improve the conditions and habitat for macroinvertebrates and fish in Lower Deer Creek.

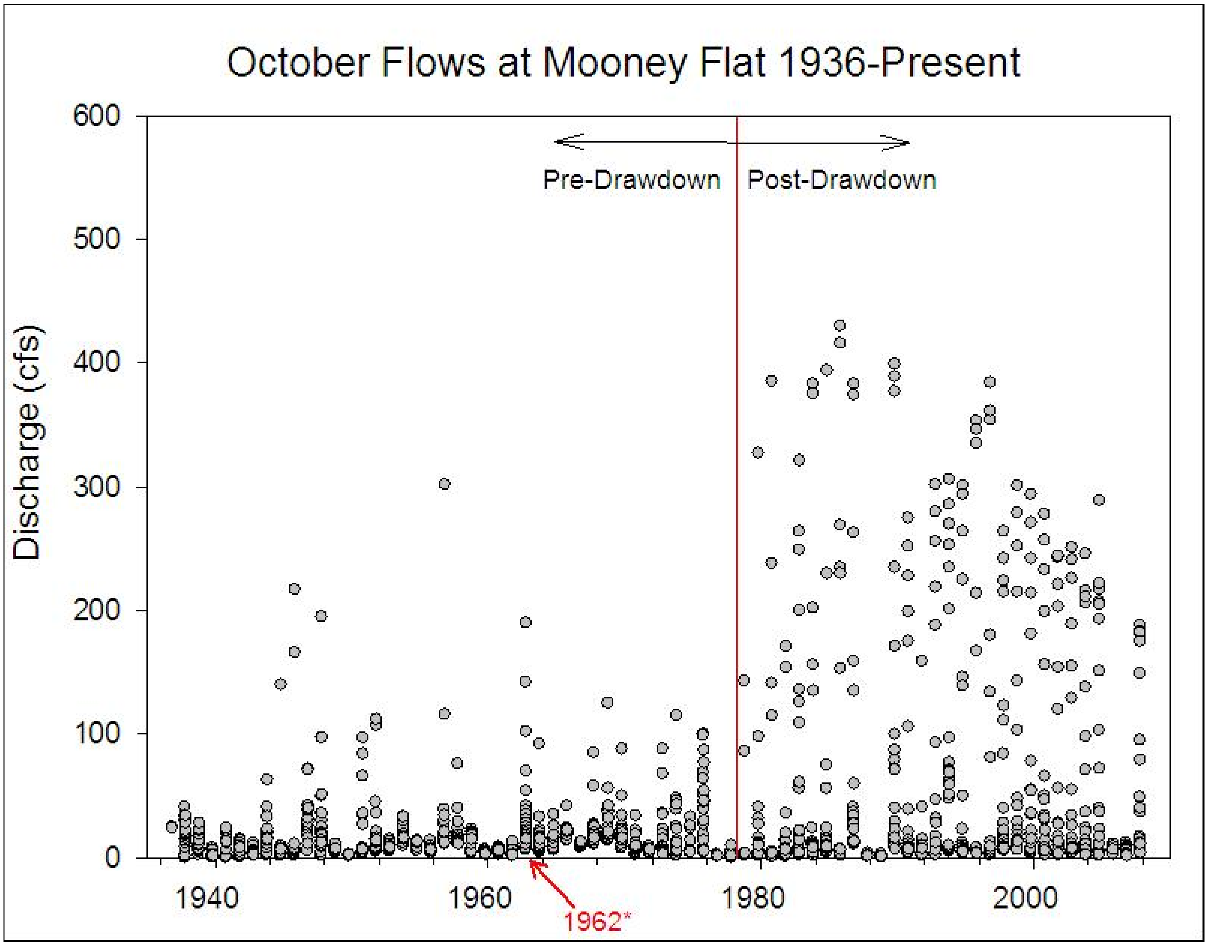

Figure 8. Historic flows for the USGS gauge at Smartville for the month of October from 1936 to present. Each column represents average daily flows for the month of October. Lake Wildwood Dam was built in 1969 and drawdown management began in 1978. 1962* was the largest storm on record for October and the third highest average daily flow recorded overall at 7370 cfs (data point not shown on the figure).

Water Quality

The clearest impacts on water quality of pulse releases are often observed during the onset of the pulse release. As the flow increases sediment stores are mobilized and quickly exhausted (Henson et al. 2007). This result could be seen in the high resolution sampling that was collected during the 2007 drawdown. Previous monitoring results of the drawdown have had various sampling frequencies and none had frequencies of less than 4 hours. Results from the 2007 drawdown suggest that the time it takes for turbidity and TSS to increase, peak, and decrease back to base levels takes about 4 hours. Capturing peak turbidity and TSS values of a pulse release at 4 hour intervals could provide large variability in results. Maximum turbidity and TSS concentrations for 2007 were the highest recorded in the five years that FODC has sampled even though the discharge of the drawdown was the lowest of the five years sampled (Table 6a). Reporting maximum water chemistry values is important for determining the greatest extent of the water quality impacts of the release on the system. Average water chemistry values display the consistent impacts that the system is being subjected to by the release. It is likely that in previous years, monitoring did not capture peak turbidity and TSS concentrations and that higher resolution sampling more effectively captures peak water chemistry.

Table 6a. Summary of maximum water chemistry values for the last 5 drawdown events for downstream sites. 2004a was monitoring conducted by FODC and 2004b was monitoring conducted by aquatic ecologist T. Cannon. All water chemistry measurements were taken at FODC sampling site 10 except for 2004a. The sampling interval is the highest frequency of samples collected during a given monitoring campaign.

Maximum Values

Year	Site	Sampling Interval (Hours)	Daily Discharge (cfs)	Max Turbidity (NTU)	Max TSS (mg/L)	Max Sp. Cond. Us/Cm	Max Temperature ^{o}C	Max *E. Coli* (MPN)
2001	10	2	244	23.3	NA	264	20.6	NA
2002	10	1	251	43.3	NA	304	18.6	300
2003	10	4	246	4.5	18	266	19.4	NA
2004a	8	6	289	8.1	10.5	362	17.2	NA
2004b	10	4	289	5.9	10	NA	17	NA
2007	10	0.5	188	72.1	218.7	171	18.4	2420

Table 6b. Summary of average water chemistry values for the last 5 drawdown events for downstream sites. 2004a was monitoring conducted by FODC and 2004b was monitoring conducted by aquatic ecologist T. Cannon. All water chemistry measurements were taken at FODC sampling site 10 except for 2004a. The sampling interval is the highest frequency of samples collected during a given monitoring campaign.

Average Values

Year	Site	Sampling Interval (Hours)	Daily Discharge (cfs)	Mean Turbidity (NTU)	Mean TSS (mg/L)	Mean Sp. Cond. Us/Cm	Mean Temperature °C	Mean *E. Coli* (MPN)
2001	10	2	244	4.9	NA	162	18.4	NA
2002	10	1	251	9.7	NA	169	17.2	270
2003	10	4	246	1.62	5.2	172	14.8	NA
2004a	8	6	289	2.4	9.4	158	15.5	NA
2004b	10	4	289	2.9	4.4	NA	15.9	NA
2007	10	0.5	188	6.7	20	171	15.7	471

Temperature

Maximum temperatures at FODC site 10 for 2007 were less than 2001, 2002, and 2003 but about 1°C higher than 2004. Median temperatures in 2007 were similar to 2003 and 2004 and nearly 3°C less than 2001. These results suggest that release temperatures have been effectively decreased over the last 5 drawdown events though it is questionable whether management has been the driver of this temperature change. Water temperature of past releases appears to be largely controlled by the ambient air temperature (Figure 9). The air temperature controls the temperature of the upper layer (epilimnion) of the reservoir, thus controlling the temperature of the water released from the valve located 10 feet below the spillway. The blending of colder deeper water from the 32 ft valve with warmer shallow water from the 10 ft valve for the 2007 release resulted in a buffering of water temperatures downstream. Despite this management, the water temp for 2007 appeared to remain consistent with the air temperature suggesting that warmer air temperatures could still lead to detrimental warm water releases during drawdown. Reducing peak temperatures should be a high priority as short exposure times to warm water temperatures can cause acute damage to salmon eggs as well as fish and macroinvertebrates.

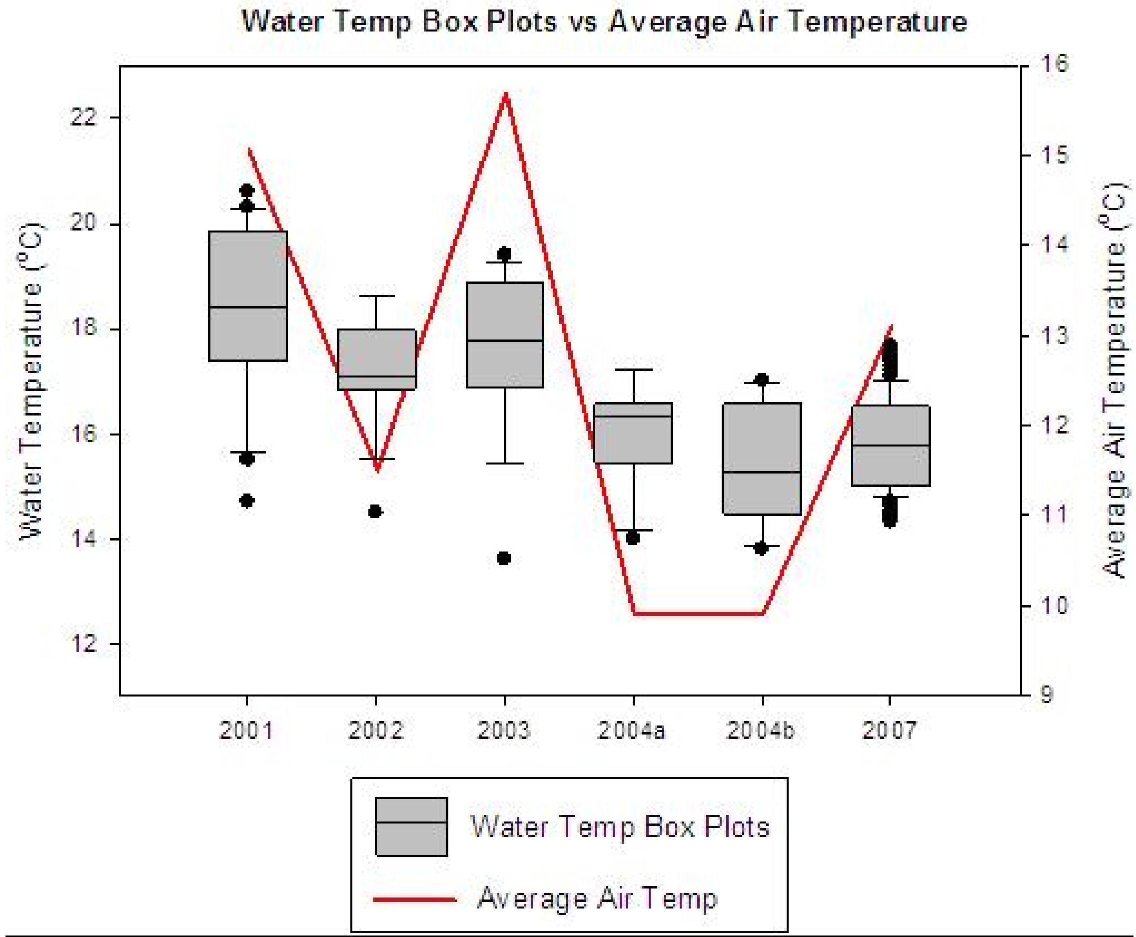

Figure 9. Water temperature box plots versus average air temperature during the Lake Wildwood drawdown events dating back to 2001 for site 10. Average air temperature measurements were taken for October 15th through the 31st. Box plots show the range of all temperature measurements taken during the release. Median temperatures are designated by the lines in the boxes. 2004a represents monitoring conducted by FODC and 2004b represents monitoring conducted by Thomas Cannon.

Friends of Deer Creek Recommendations

Recommendations for Future Monitoring

1) Monitoring in the future should incorporate a higher frequency of samples to accurately determine concentrations of constituents associated with particulates such as turbidity, TSS, and E. coli. Automatic pump samplers are the easiest way to accomplish collecting high resolution samples

2) Earlier coordination of meetings for the drawdown between the Lake Wildwood Lake Committee, Friends of Deer Creek, and Fish and Game will improve the management of the release. This will allow all concerns and input to be addressed before the drawdown management plan is begun.

Release Recommendations for Fall 2008

The Friends of Deer Creek Recommendation for the 2008 drawdown is as follows:

1) A release at 50 cfs from the lower cold water valve (32 ft depth) would take about 30 days to lower the Lake Wildwood Reservoir 10 ft. Releasing from the 32 ft valve would negate any temperature impacts of the release on aquatic organisms including the Chinook Salmon migration.

2) Ramping up to 50 cfs over at least a 6 hour period of time would reduce the impact of a sudden pulse of water on aquatic organisms (fish, aquatic insects...etc) and reduce peak turbidity levels. By extending the period of time of the release there would be a reduced impact of drawdown waters affecting fine sediment inputs and temperatures shifts in the Lower Yuba River.

Final Notes

Friends of Deer Creek is well aware that the impacts of pulse releases on stream health and function are still in the early stages of being understood by researchers. In many cases pulse releases are used to improve stream conditions and habitat for wildlife. However these releases are often on very large river and dam systems (ie Colorado and Mokelumne rivers) that have heavily manipulated flow regimes. In contrast, Deer Creek has retained, in large part, its natural flood frequency. The major reasons Deer Creek differs from the natural flow regime are the capturing of early season storm flows by the Scott's Flat Reservoir, the irrigation flows released in the summer by NID, and the Lake Wildwood drawdown release in the fall. Friends of Deer Creek also understands that any flow recommendations are an ongoing attempt to understand the dynamics of these releases and how they are impacting the stream and thus need to be monitored affectively. We believe strongly that large releases (over 50 cfs) from the dam have the ability to damage the aquatic ecosystem and harm the Fall Chinook Salmon Run. Our goal is to reach a collective agreement with the LWW Lake Committee and Fish and Game on a release that satisfies all parties.

Weather conditions are often cited as a primary concern with regard to the timing of the release and the removal of sediment from the LWW reservoir. On average November experiences about 12 days where flow at the Smartville gauge is below 10 cfs and 19 days where it is below 20 cfs (this includes flow from Squirrel Creek). On average December experiences 6 days where flow is below 10 cfs and 11 days where flow is below 20 cfs. Precipitation that results in a flow of less than 20 cfs should not greatly affect the loading and hauling of sediment from the lowered areas of the reservoir. These data suggest that after a one month drawdown there should still be windows of time, without precipitation, where sediment removal can occur. A better understanding of the timing and logistical requirements of sediment removal from the lake will greatly improve our ability to come to a consensus on a discharge rate.

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