Codornices Creek Restoration Project

2013 Supplemental Monitoring Report

Phase 3 Vegetation Monitoring
Phase 3 Geomorphic Monitoring

RWQCB Permit number: 02-01-C0763
USACOE Permit number: 28288-1S
DFG Notification Number: 1600-2006-0169-3

City of Albany / City of Berkeley

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Codornices Creek Monitoring 2013

1. Overview

This Supplemental Report presents the 2013 monitoring results for Phase 3 of the Codornices Creek Restoration Project and follows the December 2012 Monitoring Report that summarized the previous year's monitoring of Lower Codornices Creek.

To date, three phases of Codornices Creek restoration have been completed. Phase 1 was completed in 2005, Phase 2 in 2006 and Phase 3 in 2010. In 2013 geomorphic monitoring and vegetation monitoring occurred only in Phase 3.

The following is a calendar of scheduled monitoring activities for the three phases of the Codornices Creek Restoration Project for 2013. No BMI or Fish Survey work is scheduled for 2013. This work is scheduled for the following spring.

Table 1: Monitoring Calendar

Calendar Year 2013					
Phase	*Geomorphic Survey*	*Vegetation Survey*	*BMI Survey*	*Fish Survey*	*Report*
I	None (Yr. 9)	None (Yr. 9)	None	None	Supplement
II	None (Yr. 6)	None (Yr. 7)	None	None	
3	Summer 2013 (Yr. 3)	Summer 2013 (Yr. 3)	None	None	

In addition to the scheduled work, the City had four temperature data loggers installed in the creek to monitor stream temperatures within Phase 3 to address ongoing concerns about elevated stream temperatures and lack of vegetated cover along this reach.

2. Vegetation Monitoring Results (Phase 3 Only)

Year 3 / July 2013

2.1. METHODS:

The project monitoring was performed in accordance with the elements of the Monitoring and Mitigation Plan (MMP) prepared by FarWest Restoration Engineering (FRE) dated April 16, 2006. The MMP describes the project goals, monitoring questions, performance criteria and monitoring protocols required to evaluate the success of the restoration project towards achieving project objectives. The vegetation monitoring was broken down into four separate tasks. Monitoring for each task was conducted separately using distinct methods:

MMP Task 2.1: Task 2.1 monitors the soil bioengineering components of the project. For year 3, all poles with sprouts over 4-ft tall are counted.

Table 2: Soil Bioengineering Success Criteria

Year	Criteria
Year 1: 2011	Sprouts
Year 2: 2012	2-feet tall
Year 3: 2013	**4-feet tall**
Year 4: 2014	6-feet tall
Year 5: 2015	Evaluate entire canopy for percent cover
Year 10: 2020	Evaluate entire canopy for percent cover

MMP Task 2.2: This task evaluates the success of the live staking outside the active channel bank. For year 3, all stakes with sprouts over 1-ft tall are counted.

Table 3: Dogwood Stake Success Criteria

Year	Criteria
Year 1: 2011	Survival
Year 2: 2012	Survival
Year 3: 2013	**1-foot tall**
Year 4: 2014	2-feet tall
Year 5: 2015	Evaluate entire canopy for percent cover
Year 10: 2020	Evaluate entire canopy for percent cover

MMP Task 2.3: Container plants are monitored under this task. The entire site was surveyed and all living plants from the planting plan and additional plants installed by volunteers since the project completion were tallied and compiled on a per species basis. Dead plants were noted but not compiled.

MMP Task 2.4: The final task measures percent cover of native and non-native plants in 10 randomly sampled 3 foot by 3 foot plots using the Daubenmire method as detailed in the USFS Technical Reference: Sampling Vegetation Attributes, 1996.

2.2. RESULTS

2.2.1. MMP Tasks 2.1 and 2.2: Soil Bioengineering and Live Stakes

Soil Bioengineering and live stakes are performing well. Due to additional willow stake planting efforts in December 2012, it was difficult to quantify which stakes were planted with the original project planting vs. additional plantings. Therefore, all living willow stakes were counted; A total of 407 live willow stakes were noted within the project limits with >50% over 4-ft tall; 5 were noted to be volunteer seedlings outside the original willow planted areas. There were 19 dead willow cuttings. Dogwood staking also performed well between 2012 and 2013. 67 individuals (93%) survived through 2013.

2.2.2. MMP Task 2.3: Container Planting

Table 4: Phase 3 Container Planting Results

		2011 as-built		2012		2013	
Species	**Specified**	*#*	*% survival from previous period*	*#*	*% survival from previous period*	*#*	*% survival from previous period*
Acer macrophyllum	6	6	*100%*	7	*117%*	8	*114%*
Acer negundo	3	3	*100%*	3	*100%*	3	*100%*
Aesculus californica	18	17	*94%*	16	*94%*	17	*106%*
Alnus rhombifolia	40	37	*93%*	37	*100%*	36	*97%*
Heteromeles arbutifolia	18	15	*83%*	17	*113%*	20	*118%*
Mimulus aurantiacus	15	1	*7%*	3	*300%*	5	*167%*
Populus fremontii	20	18	*90%*	19	*106%*	21	*111%*
Quercus agrifolia	23	28	*122%*	29	*104%*	29	*100%*
Rhamnus californica	14	13	*93%*	22	*169%*	19	*86%*
Ribes sanguineum	8	8	*100%*	8	*100%*	9	*113%*
Rosa californica	11	8	*73%*	15	*188%*	16	*107%*
Sambucus mexicana	11	13	*NA*	14	*108%*	14	*100%*
TOTAL # OF INDIV.	**187**	**167**	*89%*	**190**	*114%*	**197**	*104%*

2.2.3. MMP Task 2.4: Percent Cover

The 2013 survey of percent cover indicates a decrease in bare soil. Native plant establishment on the Phase 3 floodplain is better than the previous two phases. *Leymus triticoides, Baccharis douglasii,* and *Equisetum* have successfully established and account for the majority of the native cover on the floodplain. Even with the limited initial container plant palette, ongoing maintenance by the City of Albany and maintenance / follow up planting by volunteer groups has been successful at adding further native cover and limiting the colonization of many of the invasive species typical of urban restoration areas.

Table 5: Percent Cover Results

2013		Species **Native**		Species **Exotic Forbs**		Species **Exotic Grasses**		Species **Bare Soil**	
Cover Class	Mid-point	Number	Product	Number	Product	Number	Product	Number	Product
1-5%	2.5	0	0	1	2.5	3	7.5	2	5
5-25%	15	0	0	2	30	3	45	3	45
26-50%	37.5	0	0	4	150	0	0	0	0
51-75%	62.5	4	250	1	62.5	0	0	0	0
76-95%	85	6	510	0	0	1	85	0	0
96-100%	97.5	0	0	0	0	0	0	0	0
Total Canopy			760		245		137.5		50
Number of Samples			10		10		10		10
% Canopy Cover			76%		25%		14%		5%
Species Composition			**57%**		**18%**		**10%**		**4%**
Frequency			100%		80%		70%		50%

2.3. DISCUSSION

2.3.1. MMP Task 2.1 and 2.2: Soil Bioengineering and Live Stakes

The willow used for soil bioengineering is healthy and growing, with a few willows approaching 10-ft tall. There are large areas of the channel receiving direct sunlight and watercress and cattails were noted. Due to the addition of the most recent willow pole planting in December of 2012, the overall number of individual willows has increased significantly. Dogwood stakes are establishing well within their planted areas. There is one meander at the upstream end of the project where the willow lacks vigor. This area was replanted with additional willow as part of the 2012 planting and should continue to be monitored.

2.3.2. MMP Task 2.3: Container Planting

More plants were observed in 2013 than in 2012. This is due in part to ongoing plantings by volunteers. Additionally some species are beginning to self-colonize. Two volunteer seedlings of Fremont poplar were observed on the floodplain. In certain areas, the horsetail was so robust that it likely blocked the view of some of the container plants. There were also recently planted containers of Big-leaf maple, Oregon ash and Ninebark noted during the survey.

The alders are struggling in some locations with one noted as dead but the remaining ones are showing sign of improvement. Overall the container plants are exceeding the 60% survival threshold.

2.3.3. MMP Task 2.4: Percent Cover

The goal for the third year of monitoring is to have less than 30% exotic species cover. There is currently 28% cover non-native species detected in the random selected sample plots. There were a few aggressive exotic species detected within the reach; acacia seedlings, bristly ox-tongue, fennel, pampas grass, curly dock, white clover, rye grass and wild oat are found scattered throughout the site and are continuing to be addressed through on-going maintenance. Additional effort should continue with removing these and other invasives.

The decrease in bare soil can be attributed in part to the establishment of the native seed mix on the floodplain and by self-colonization of species such as horsetail. The willows are establishing and will significantly increase the native over-story canopy in coming years.

2.4. General Notes

Overall the vegetation in Phase 3 is performing well. Site soil preparation and compaction mitigation was improved over techniques employed during the prior two phases, and the maintenance and irrigation programs have also been more consistent. The irrigation will likely be turned off after this growing season. Colonization of the site by invasive plant species continues to be an ongoing challenge. City maintenance and the additional planting and maintenance efforts by volunteers has played a significant role in getting native species to colonize this urban site, which in turn decreases invasive plant infestations.

2.5. Maintenance Recommendations

- 2.5.1. Locate and remove acacia seedlings, bristly ox-tongue, fennel, pampas grass, curly dock, Himalayan blackberry, bindweed, ivy and nasturtium.
- 2.5.2. Keep area around container plants/trees clear of weeds; mulch as often as possible around the base of the plants for weed suppression and water retention.
- 2.5.3. Check tree stakes and remove if not needed.
- 2.5.4. Hand weed in 6th Street Rain Gardens and prune vegetation back as needed.
- 2.5.5. Test irrigation system regularly and fix any issues promptly.
- 2.5.6. Empty trash cans on-site more frequently.

3. Geomorphic Survey

Phase 3 – Year 3

3.1. Methods

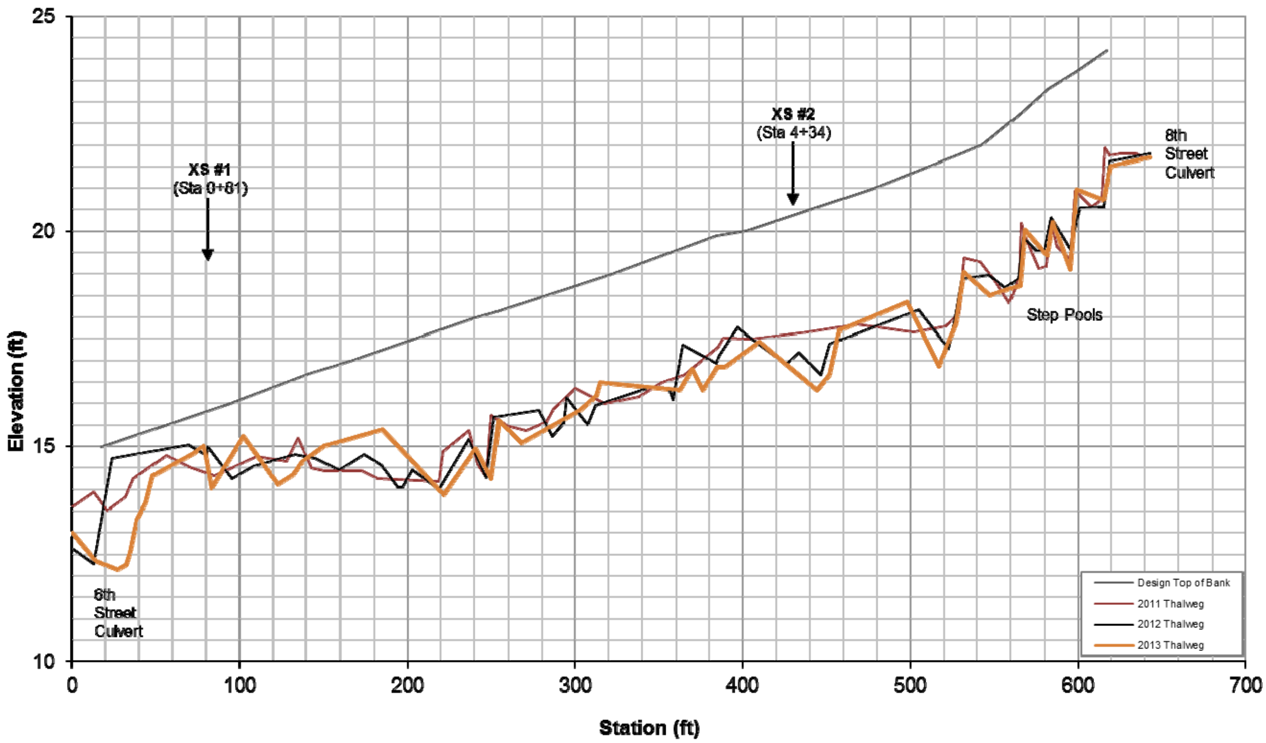
Profile and cross section surveys were repeated in 2013 in Phases 3 only. Cross sections are from established and monumented locations.

3.2. Results

3.2.1. Channel Profile Phase 3

Winter 2012/2013 saw similar adjustment and change as Winter 2011/2012 in Phase 3. Much of the bed has maintained a consistent elevation. The channel adjustments that occurred during the first winter upstream of the 6th street culvert have slowed and the channel has recreated a single threaded channel in this area. The upstream step pools have remained stable.

Riffle and pool morphology continue to develop within the channel with the exception of areas scoured to hardpan. The hardpan is hampering sediment deposition in these areas and limiting development of depositional feature such as point bars. Emergent vegetation was thick during the summer and led to minor sedimentation within the active channel.



Codornices Creek Phase III
Channel Profile

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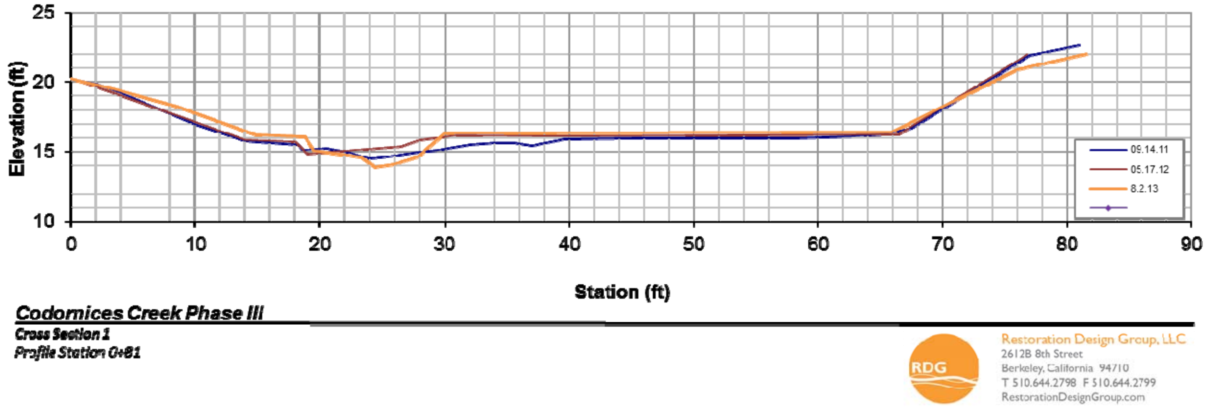
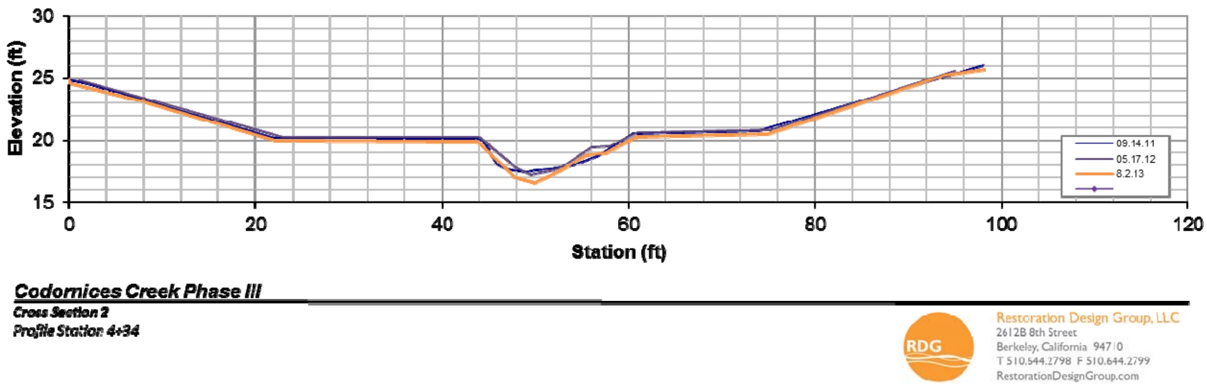
3.2.2. Cross Sections Phase 3

The two riffle cross sections were resurveyed in 2013. Cross section #1 is in the lower portion of the creek and is influenced by the culvert backwater. Cross section #2 is upstream in the location adjacent to the hardpan bed. Cross section 1 shows continued adjustment of the channel above the 6th street culvert. It continues to maintain the floodplain bench it established in 2012 (perhaps aggrading slightly), but the active channel has incised slightly. Cross section 2 has maintained its inner depositional bench formed in 2012 and incised its thalweg slightly, but otherwise remains similar to the 2011 and 2012 surveys.





3.3. Discussion

Phase 3 is performing well and does not need any adaptive management at this time. Overall the bed and banks remain stable.

The area immediately upstream of the 6th Street culvert has shown the most change since construction. The creek has abandoned the meander on the right and instead cut through the left point bar. The 2013 long profile show the original stationing through the design channel. The area immediately upstream of the culvert has experienced aggradation due to backwatering at the culvert during storm events. As in 2012, this backwater flooded the floodplain and lowered discharge velocities causing sediment deposition in the channel. This aggradation lowered the channel profile slope and further reduced the competency of the channel to pass sediment. There are indications that the deposition at the downstream end is working towards an equilibrium condition. The deposition has elevated the floodplain in this area and a low flow channel has recently reformed. No intervention is required at this time.

The exposed hardpan upstream continues to persist. This hardpan substrate excludes any opportunity for hyporheic flow and does not provide ideal habitat for benthos. This condition exists upstream of the project site as well, just below 9th street. Adding larger channel cobbles that would persist during large flows and begin to provide structure to capture sediment and build the channel on top of the hardpan clay can be considered as a tool for adaptive management. The material should be sized to be relatively immobile during flows greater than the 2-year event. This rock would not need to be keyed and could be designed as a threshold channel similar to what is often referred to as a "Newberry Riffle". It may be acceptable to delay this work to see if the channel may naturally begin to aggrade as roots of the riparian vegetation encroach on the channel, however adding the rock would offer immediate support for improved channel substrate therefore doing this work should be considered as an immediate adaptive management measure.

3.4. Maintenance Recommendations

3.4.1. Consider addressing the channel hardpan at the upper half of Phase 3 by adding rock to construct riffles that raise the channel grade back to the designed hydraulic geometry.

4. Stream Temperature Monitoring

Year 3 / September - October 2013

4.1. Methods

The intent of the stream temperature monitoring is to determine whether summertime stream temperatures within the newly restored reach of Codornices Creek are a concern for steelhead.

Four (4) HOBO U22-001 Temperature Data Loggers set to sample in 15 minute intervals were deployed in Codornices Creek on August 30th 2013 and retrieved on October 23rd 2013. The loggers were deployed in time for what was the second hottest day of the year (89 degrees on Sept 7th at the Oakland Airport). The hottest day was May 2nd at 92 degrees.

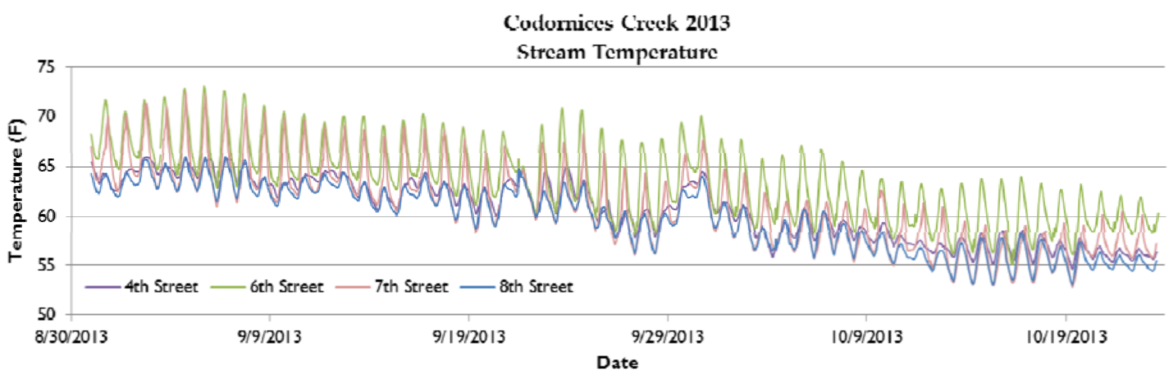
The loggers were positioned along the channel to observe the effects of Phase three on stream temperatures. The first logger was installed upstream of the project at 8th Street, the next logger was placed within Phase 3 (equivalent to 7th street) and the final two loggers were placed at 6th street and 4th street respectively. Phase 3 is bound by 6th and 8th streets. The 8th Street logger provides the baseline and incoming temperatures. The 7th and 6th Street loggers measure temperatures within and just below Phase 3 and the 4th Street logger is situated to capture the attenuation of temperatures downstream.

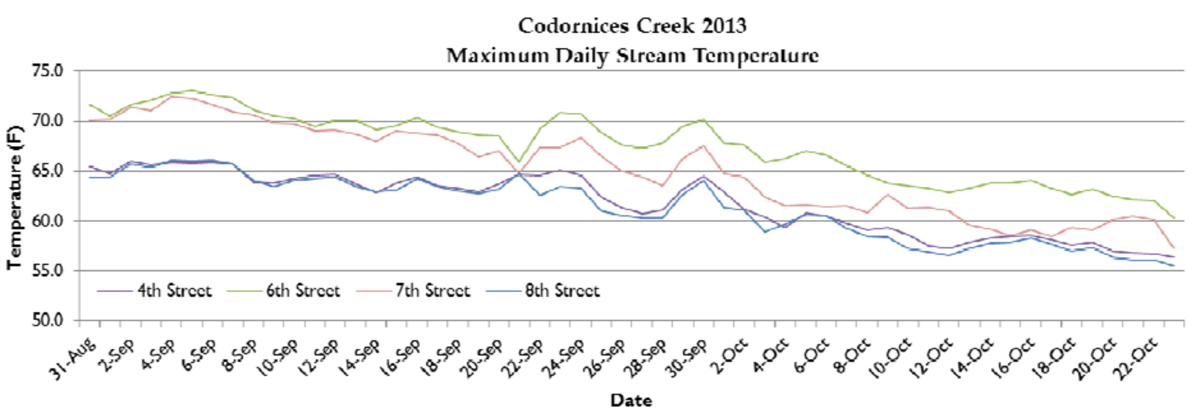
4.2. Results

Average and maximum stream temperatures are higher within and immediately downstream of the Phase 3 restoration project. Temperatures downstream of the project, at 4th Street, are largely similar to 8th street indicating that much of the warming that occurred within the Phase 3 is sufficiently dampened before reaching the 4th Street data logger.

Table 6: Summary of Temperature Monitoring Result

	8th	7th	6th	4th
Average Temp (F)	59.8	61.0	63.6	60.7
Max Temp (F)	66.0	72.5	73.1	66.0
Min Temp (F)	53.1	52.8	55.1	54.6





To further analyze the results we looked at the number of hours and percent time that the water temperatures were above certain temperature thresholds. Acknowledging substantial variation in reported values and no scientific consensus regarding suitable temperature ranges for central coast steelhead and rainbow trout we have attempted to select reasonable values for this analysis but don't suggest that these accurately reflect steelhead preferences in Codornices Creek. Sloat and Osterback (2013) showed that steelhead had a marked reduction in feeding and agonistic behavior between 75.2 – 77.0 F (24-25 c). Additionally this same study summarizes a series of other studies that attempt to derive the critical thermal maxima (CTM) for steelhead, which can be approximated as 86.0 F (30 c). Both of these thresholds are substantially higher than the 73.1 F (22.8) maximum temperature observed during the study period.

Using 70 and 64 F as more moderate thresholds for steelhead preferences one can begin to see a difference between the reaches of Codornices Creek.[1]

Table 7: Temperature Thresholds

	8th	7th	6th	4th
Hours Above 70 F (21.1 c)	0	14.25	65	0
Percent Time Above 70 F (21.1 c)	0.00%	1.10%	5.01%	0.00%
Hours Above 64 F (17.8 c)	98.5	294.75	594	215.75
Percent Time 64 F (17.8 c)	7.59%	22.72%	45.79%	16.63%

4.3. Discussion

Phase 3 was completed three years prior to this round of temperature monitoring. As is noted above, the vegetation has yet to mature and large portions of the channel receive direct sunlight. In addition, much of the upstream channel substrate is hard pan clay which limits subsurface flow which is known to reduce the effects of direct sunlight on stream temperatures.

Overtime stream temperatures are expected to reduce as vegetation along Phase 3 matures and begins to shade the channel. Monitoring during subsequent summers will reveal if this occurs. Although no goals regarding stream temperature were explicitly noted for the restoration, improving steelhead habitat is a goal. A fish survey is scheduled for the 2014 monitoring year which will provide an update to the qualitative review from previous years. This survey will directly address the steelhead habitat goal better than temperature monitoring alone.

The results of the monitoring indicate that Phase 3 does not currently provide desirable summertime rearing steelhead habitat; however conditions immediately downstream of

[1] Codornices Creek Biological Opinion States 64 F as an upper limit for rearing habitat. The Codornices Creek MND notes 70 F as a threshold for steelhead presence/absence.

Phase 3 appear to moderate the impacts of Phase 3 stream temperatures. As vegetation matures summer time temperature is expected to remain consistent between the restoration phases. Future monitoring will verify if this occurs.

4.4. Maintenance Recommendations

Immediate maintenance is not required. Although current temperatures are not ideal they are largely expected for a newly restored stream. Continued monitoring of vegetation and temperatures will provide a basis for future adaptive management strategies, including the need to add bankside vegetation. As noted above, there is a large portion of channel that has clay substrate and does not provide suitable habitat and likely contributes to the elevated stream temperatures seen within Phase 3. Addressing this condition should be considered if there is interest from the regulatory agencies.

5. References

Sloat, M. R., & Osterback, A. K. (2013). Maximum stream temperature and the occurrence, abundance, and behavior of steelhead trout (Oncorhynchus, *73*(October 2012), 64–73.