Codornices Creek Restoration Project

2020 Monitoring Report

Phase 3 Vegetation Monitoring
Phase 3 Geomorphic Monitoring
Phase 1-3 Benthic Macro Invertebrate Sampling
Phase 1-3 Stream Habitat Condition Survey

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

City of Albany / City of Berkeley

Appendices:
Appendix A: *Habitat Survey*
Appendix B: *Phase 3 Cross Section Locations*
Appendix C: *Photopoint Locations*
Appendix D: *2020 Site Images*

Prepared By:
Restoration Design Group
2332 5th Street, Suite C
Berkeley, California 94710

Codornices Creek Monitoring 2020

1. Overview

This report presents the 2020 (year 10) monitoring results for Phase 3 of the Codornices Creek Restoration Project and follows the December 2019 Monitoring Supplemental Report that summarized that year's monitoring of Lower Codornices Creek. This is the final year of monitoring for Phase 3.

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. Table 1 below is a calendar of scheduled monitoring activities for phase III of the Codornices Creek Restoration Project for 2020. Vegetation, geomorphic, BMI and fish surveys were completed for Phase 3. Monitoring activities for phases I, II and III are now complete.

Table 1: Monitoring Calendar

Calendar Year 2020				
Phase	*Geomorphic Survey*	*Vegetation Survey*	*BMI Survey*	*Fish Survey*
I	Complete	Complete	Complete	Complete
II	Complete	Complete	Complete	Complete
III	Winter 2020 (Yr. 10)	Spring 2020 (Yr. 10)	Fall (Yr. 10)	Fall (Yr. 10)

2. Vegetation Monitoring Results (Phase 3 Only)

Year 10 / Spring 2020

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. Table 2 below summarizes the monitoring criteria for the soil bioengineering by year. For year 10, the entire riparian canopy is evaluated for percent cover using the same methodology as in year 5. This was done using the Line Intercept Transect Along Banks method (Center for Forestry, UC Berkeley, 2005). Both sides of the creek (along bankfull channel) within the project area were

measured in a linear fashion for gaps 1-foot or more in riparian cover. Total gaps were compared to total project area reach length (both sides) to quantify a percent of riparian canopy cover.

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 of dogwood outside the active channel bank. See Table 3 below for success criteria of the live staking. For year 10, the entire riparian canopy is evaluated for percent cover. See Task 2.1 for method of measurement.

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 original list of species planted, including additional plants installed by volunteers since the project completion, were tallied and compiled on a per species basis. Native species planted by volunteers or growing as volunteers but not on the original plant list were not tallied. 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 covering the entire channel and much of the floodplain. Along both banks of the project area, there were no measurable gaps in riparian cover. Compared to 1,260 linear feet of channel (along both banks), the total measures 100% riparian cover.

2.2.1.MMP Task 2.3: Container Planting

Table 4: Phase 3 Container Planting Results

	2011 as-built			2012		2013		2014		2015		2016		2018		2020	
Species	**Spec'd**	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*
Acer macrophyllum	6	6	*100%*	7	*117%*	8	*114%*	7	*88%*	4	*57%*	6	150%	9	*150%*	*9*	*100%*
Acer negundo	3	3	*100%*	3	*100%*	3	*100%*	3	*100%*	2	*67%*	4	200%	2	*50%*	*2*	*100%*
Aesculus californica	18	17	*94%*	16	*94%*	17	*106%*	17	*100%*	13	*76%*	14	108%	15	*107%*	*15*	*100%*
Alnus rhombifolia	40	37	*93%*	37	*100%*	36	*97%*	33	*92%*	24	*73%*	26	108%	15	*58%*	*17*	*113%*
Heteromeles arbutifolia	18	15	*83%*	17	*113%*	20	*118%*	19	*95%*	18	*95%*	15	83%	16	*107%*	*22*	*136%*
Mimulus aurantiacus	15	1	*7%*	3	*300%*	5	*167%*	3	*60%*	0	*0%*	1	NA	1	*100%*	*1*	*100%*
Populus fremontii	20	18	*90%*	19	*106%*	21	*111%*	18	*86%*	20	*111%*	15	75%	22	*147%*	*21*	*95%*
Quercus agrifolia	23	28	*122%*	29	*104%*	29	*100%*	34	*117%*	28	*82%*	28	100%	29	*104%*	*28*	*96%*
Rhamnus californica	14	13	*93%*	22	*169%*	19	*86%*	21	*111%*	18	*86%*	11	61%	9	*82%*	*10*	*111%*
Ribes sanguineum	8	8	*100%*	8	*100%*	9	*113%*	3	*33%*	1	*33%*	1	100%	2	*200%*	*4*	*200%*
Rosa californica	11	8	*73%*	15	*188%*	16	*107%*	14	*88%*	9	*64%*	8	89%	11	*138%*	*25*	*625%*
Sambucus mexicana	11	13	*NA*	14	*108%*	14	*100%*	12	*86%*	7	*58%*	7	100%	6	*86%*	*6*	*100%*
TOTAL # OF INDIV.	**187**	**167**	*89%*	**190**	*114%*	**197**	*104%*	**184**	*93%*	**144**	*78%*	**136**	**94%**	**137**	*101%*	*160*	*116%*

2.2.2. MMP Task 2.4: Percent Cover

The 2020 survey percent cover survey shows native riparian species continue to grow and self seed on-site. Dominant native plant species contributing to 75% absolute canopy cover include,

Salix spp (Willow), *Cornus sericea* (Dogwood), *Physocarpus capitatus* (Ninebark), *Alnus rhombifolia* (White Alder) and *Fraxinus latifolia* (Oregon Ash). However, trailing closely behind, exotic forbes continue to thrive at 69% absolute cover. These invasive species often limit native annual and perennial forbs from establishing. Because of this, we see the majority of native cover from large shrubs and trees. The ground plane, especially during the spring growing season, is primarily exotic forbes and grasses. Overall, native canopy cover is performing well and providing habitat and abundant shade over the creek.

Table 5: Percent Cover Results using Daubenmire Method

2020		Species		Species		Species		Species	
		Native		Exotic Forbs		Exotic Grasses		Bare Soil	
Cover Class	Mid-point	Number	Product	Number	Product	Number	Product	Number	Product
1-5%	2.5	0	0	0	0	7	17.5	0	3
5-25%	15	1	15	0	0	2	30	2	30
25-50%	37.5	0	0	1	37.5	0	0	3	0
50-75%	62.5	3	187.5	5	312.5	0	0	0	0
75-95%	85	3	255	4	340	0	0	0	0
95-100%	97.5	3	292.5	0	0	0	0	0	0
Total Canopy			750		690		47.5		33
Number of Samples			10		10		10		10
% Canopy Cover			75%		69%		5%		3%
Species Composition			**56%**		**52%**		**4%**		**2%**
Frequency			100%		100%		90%		50%

2.3. DISCUSSION

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

The riparian canopy is providing 100% cover to the creek and most of the floodplain. Willow and Dogwood stakes are establishing well and have formed thickets in various areas.

2.3.2. MMP Task 2.3: Container Planting

As summarized in Table 4 above, more container plants (116%) were observed in 2020 than in 2018. Additionally, there are many other native species flourishing that were planted by volunteers or self seeded from the upper watershed. Specimens of Oregon ash, California Sagebrush, Mugwort, Bee plant, Wild Strawberry, Douglas Iris, Ocean-spray, Coyote Brush, Ceanothus and Ninebark were noted during the survey. *Physocarpus capitatus* (Ninebark),

Fraxinus latifolia (Oregon Ash) and *Baccharis pilularis* (Coyote Brush) are self-colonizing aggressively and have appeared throughout the site. In particular, Organ ash saplings are emerging in large numbers all throughout the site. Two volunteer Alder were observed in the channel. Overall, the dense cover of vegetation made locating all of the container plants challenging.

Only two species (Live Oak and Fremont Poplar) saw a decline in numbers, and both were insignificant. Overall the container plants are exceeding the 60% survival threshold.

2.3.3. MMP Task 2.4: Percent Cover

The percent cover of non-native species (average of exotic forbs and exotic grasses) has stabilized around 37% since 2018. Multiple aggressive exotic species are still colonizing within the Phase 3 reach. Acacia seedlings, bristly ox-tongue, fennel, pampas grass, curly dock, bindweed, and wild onion are found scattered throughout the site and should continue to be addressed through on-going maintenance. Additional effort should continue with removing these and other invasives.

Canopy cover is made up of nearly 100% native vegetation.

2.4. General Notes

Overall the vegetation in Phase 3 has matured and is performing well. 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. Mulch: Hand weed area around container plants/trees and mulch around the base of the plants for weed suppression and water retention.
- 2.5.2. Weed: Locate and remove acacia seedlings/small trees, pampas grass, bristly ox-tongue, fennel, curly dock, Himalayan blackberry, bindweed, ivy, ripgut brome, wild oat grass and nasturtium.
- 2.5.3. Prune: Selectively prune willows and other vegetation that are growing into the multi-use path and sidewalk areas to allow for general safety of trail users as well as aesthetics. Perform structural and aesthetic pruning on oak and other trees near public use areas to ensure healthy ongoing growth.
- 2.5.4. Trailside Vegetation Maintenance: Maintain trailside vegetation to keep plants from encroaching on and undermining the trail.

2.5.5. Weed 6th Street Rain Gardens: Remove Fennel and bristly ox-tongue and other invasive species. One of the rain garden planters on the east side of 6th street has had the vegetation completely removed: replant per original plans.
2.5.6. Remove and dispose of sediment from Rain Garden entry points.
2.5.7. Pick up trash from site.
2.5.8. Prune roses in Rain Garden.
2.5.9. Test rain garden irrigation system regularly and fix any issues promptly. Turn off the irrigation for all areas except for the rain gardens and monitor the health of the trees and shrubs.
2.5.10. Empty trash cans on-site more frequently.
2.5.11. Clean or paint over graffiti on USPS wall along multi-use trail.

3. Geomorphic Survey

Phase 3 – Year 10

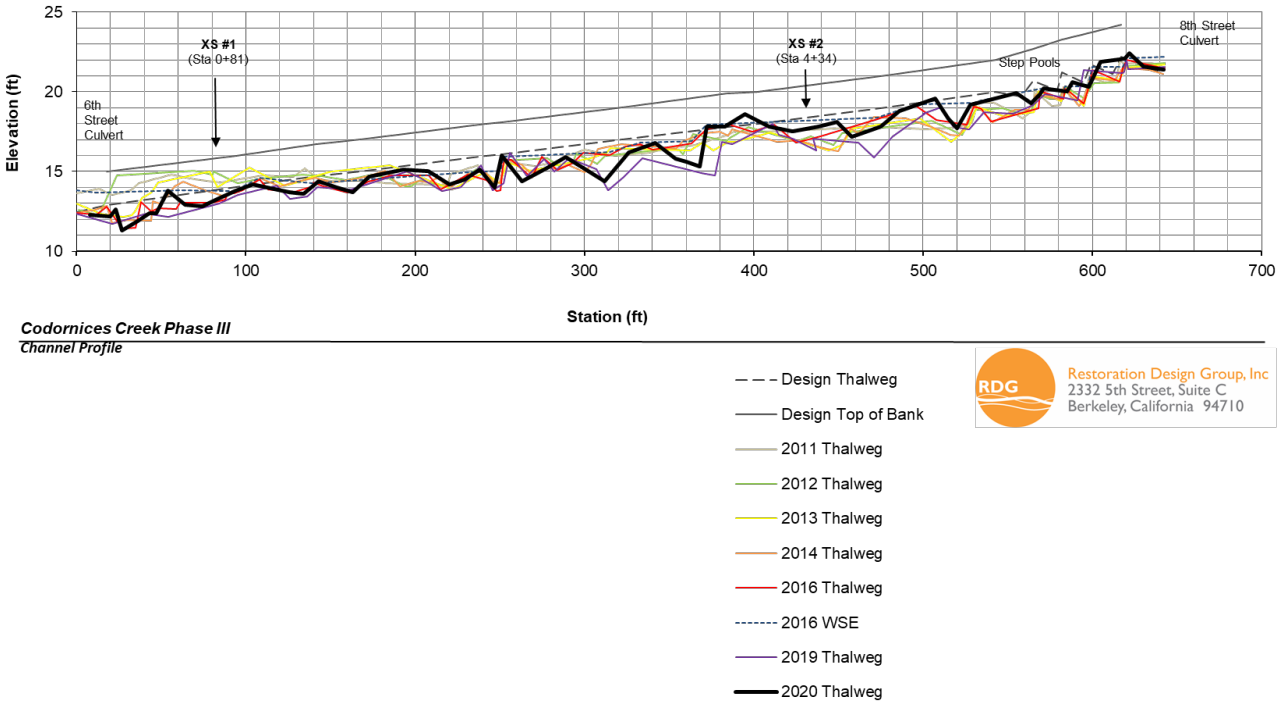
3.1. Methods

Profile and cross section surveys were completed in 2020 for Phases 3 to complete year 10 monitoring. Cross sections are from established and monumented locations.

3.2. Results

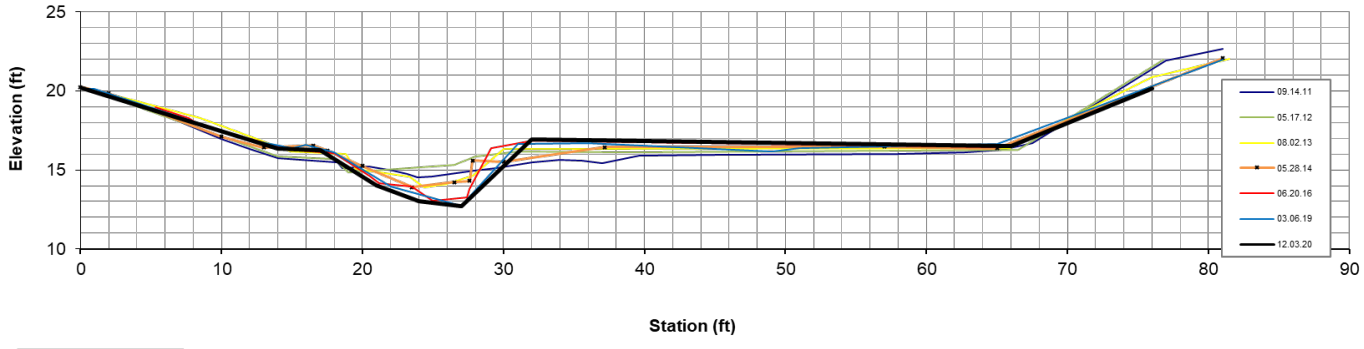
3.2.1. Channel Profile Phase 3

Riffle and pool morphology continue to develop within the channel as seen in the long profile surveyed in 2020. Woody debris in channel has helped accumulate course sediment and reduce scour in some areas. However, hardpan continues to reduce sediment retention and disrupt the formation of point bars. There continues to be some areas of concern where channel degradation has occurred near where the hardpan has been exposed. However, some deeply scoured pools have remained stable or filled in with sediment showing some improvement since 2019.



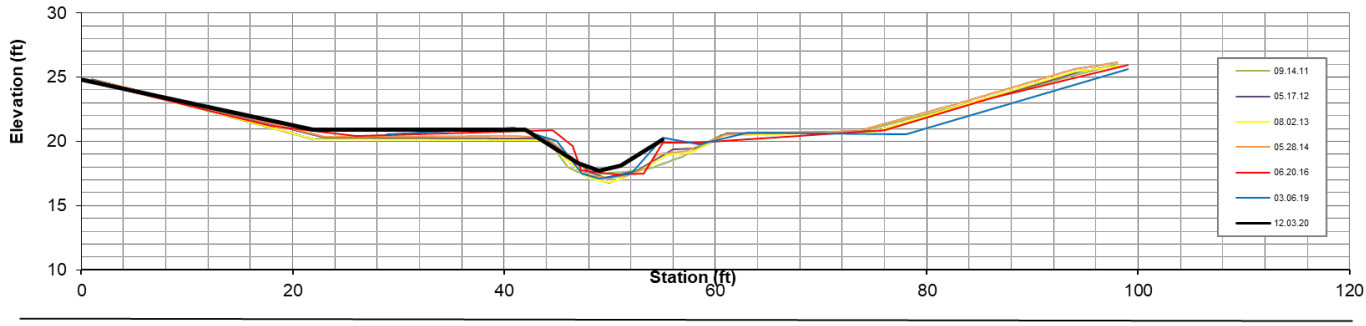
3.2.2. Cross Sections Phase 3

The two riffle cross sections were resurveyed in 2020. 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 has remained stable after narrowing the first four year after construction. Cross section 2 has also remained stable after building an inner depositional bench the first four years after construction. The thalweg has maintained a consistent elevation for the duration of the monitoring period.



Codornices Creek Phase III
Cross Section 1
Profile Station 0+81

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710



Codornices Creek Phase III
Cross Section 2
Profile Station 4+34

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

3.3. Discussion

Phase 3 continues to mature. We have been monitoring the upper half of the restoration reach, where the channel has exposed hardpan and significant channel degradation.

The exposed hardpan upstream continues to persist but has begun to be buried by sediment being trapped behind woody debris crossing the channel. The long profile shows between 6" and 1' of aggradation above STA 3+00 which is a significant improvement from the survey in early 2019. Willow branches and other woody plant matter should continue to be encouraged to build-up in the channel. This technique, often referred to as a Beaver Dam Analog (BDA), will increase sediment deposition and create connection between the channel and floodplain by dispersing flow horizontally.

Maintenance Recommendations

3.3.1. Allow vegetation to remain in the channel to encourage minor debris jams and backwatered pool habitat. Use small limbs pruned off willows and place downstream of pools perpendicular to channel.

3.3.2. Consider actively installing woody debris jams similar to Beaver Dam Analogs to accelerate deposition within this reach.

4. Benthic Macroinvertebrate Survey

4.1. Methods

The Watershed Project and RDG collected benthic macroinvertebrates following the California Stream Bioassessment Procedure in October 2020. This protocol is consistent with past sampling conducted by Kier Associates in 2006 and RDG in 2012 and 2014. Each of the three phases of restoration were sampled separately and were composed of three randomly selected riffle locations for a total of nine (9) collection sites. Each of the three samples was evaluated in the laboratory by Tom King of BioAssessment Services, Folsom, Ca.

Table 6: BMI Survey Results[1]

Metrics	2020			2016			2014			2012		
	Phase I	Phase II	Phase III	Phase I	Phase II	Phase III	Phase I	Phase II	Phase III	Phase I	Phase II	Phase III
Richness:												
Taxonomic	15	16	18	16	19	20	21	18	23	17	17	16
EPT	1	2	2	3	2	2	2	3	4	2	1	2
Composition:												
EPT Index (%)	8.0	2.1	1.1	2.1	4.0	0.4	3.4	5.7	8.8	14	1.3	2.0
Sensitive EPT Index (%)	8.0	1.9	1.1	1.9	4.0	0.2	3.1	3.3	3.1	14	1.3	0.7
Shannon Diversity	1.46	1.21	1.88	1.8	2.1	1.7	2.2	2.0	2.1	2.3	2.0	2.2
Dominant Taxon (%)	59	70	39	31	24	52	23	39	43	23	24	29
Non-Insect Taxa (%)	67	56	61	44	53	45	43	44	43	47	59	50
Tolerance:												
Tolerance Value	6.9	7.3	7.2	4.6	5.2	4.8	5.4	5.6	5.6	5.5	6.2	5.8
Intolerant Organisms (%)	8.0	2.1	1.1	2.1	4.0	0.4	3.1	3.3	3.1	14	1.3	0.7
Intolerant Taxa (%)	6.7	13	10	19	11	10	4.8	11	13	12	5.9	6.3

[1] Metrics based on SAFIT level I standard taxonomic effort except chironomids identified to subfamily/ tribe. Standard taxonomic effort source: Southwest Association of Freshwater Invertebrate Taxonomists (http://www.waterboards.ca.gov/swamp/docs/safit/ste_list.pdf).

Tolerant Organisms (%)	74	79	70	3.9	6.7	3.0	19	9.6	12	28	24	21
Tolerant Taxa (%)	27	25	39	13	26	25	19	22	26	29	29	31
Functional Feeding Groups:												
Collector-Gatherers (%)	15	14	12	38	29	65	64	66	69	46	46	64
Collector-Filterers (%)	12	4.0	5.5	0.7	2.0	2.3	10	1.7	1.0	1.3	2.2	1.4
Scrapers (%)	63	75	64	35	27	15	12	5.2	10	25	23	11
Predators (%)	2.6	4.4	16	24	38	18	11	24	14	15	27	22
Shredders (%)	8.0	1.9	1.3	1.9	4.0	0.2	3.3	3.3	3.1	14	1.3	0.7
Other (%)	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.0	3.1	0.0	0.0	1.4
Estimated Abundance:	8,362	3,600	3,417	1068	506	845	697	2168	1360			

4.2. **Results**

The results show an unchanged taxonomic richness, a slight increase of intolerant organisms especially in phase 1 and 3, and a large increase in tolerant organisms in all three phases. The abundance of BMI has increased steadily over time. Additionally, the EPT index percentage increased from 2016. The three samples contained a total of 25 discrete taxa, up from 22 in 2012 and down from 30 in 2014.

4.3. **Discussion**

The 2020 results show that stream health has increased slightly overtime since 2014. All surveys indicate that Codornices Creek remains somewhat impaired and few trends can be discerned from the survey; however, this collection of BMI surveys now offers a robust snapshot of existing stream health through the restoration reach and provide a baseline for continued measurement of stream health as Berkeley and Albany continue to implement green infrastructure projects within Codornices Creek Watershed.

4.4. **Maintenance Recommendations**

Elevated stream temperatures have posed as an issue to ideal habitat for benthic macroinvertebrates in Phase 3. Channel aggradation observed in the 2020 geomorphic survey indicates the amount of exposed hardpan clay substrate may continue to decrease over time, which will provide a more suitable environment for benthic macroinvertebrates and lower stream temperatures. RDG recommends continued informal monitoring to ensure an upward trend is occurring. Future improvement may be considered in the case that persistent aggradation does not occur.

Hagar Environmental Science

Technical Memorandum

Prepared for: **Restoration Design Group**

Prepared by: **Hagar Environmental Science**

Codornices Creek Phase 3 (6th Street to 8th Street) Post-Project Habitat Reconnaissance 2020

The Phase 3 reach of Codornices Creek was surveyed on October 6, 2020 to assess the general stream habitat condition following the stream restoration project completed in 2010. Habitat assessments were also conducted for the reach in 2012 (HES 2012), 2014 (HES 2014), and 2016 (HES 2016). The habitat reconnaissance was conducted with the following objectives:

- estimate the frequency and relative extent of pool and riffle habitat types in the study reach and measure pool depths;
- evaluate the extent of cover in the study reach and characterize the habitat in terms of ability to support steelhead (*Oncorhynchus mykiss*) in comparison to other Central Coast streams;
- note the presence of any fish migration passage obstacles;
- provide a qualitative assessment of macro-invertebrate populations that are visible at the time of the survey; and
- record any observations of trout or steelhead (*O. mykiss*), California red-legged frog (CRLF), or other aquatic life visible during the time of the survey

The Phase 3 reach appears to have reached an equilibrium since the restoration project was completed in 2010. Significant changes in instream habitat features were observed during previous surveys in 2012, 2014, and 2016 but conditions in 2020 were similar to those observed in 2016.

Previous Survey Results

Restoration work was completed in this reach during the summer and fall of 2010. During the survey in August 2012, the project was still in the early stages of recovery (HES 2012). Riparian plantings were still small and there was very little shade along the stream.

Watercress and other emergent aquatic plants were established in the stream channel to the extent that open water was not visible in much of the project. Most of the project was characterized as "marsh" (496 out of 596 total feet or 83% of the project length). The remaining habitat consisted of small pockets of glide (13%) and run (3%) type habitat (Table 1).

By 2014, there had been some growth of the willows and other riparian vegetation providing additional shading (Table 1). Although still present in some areas, the extensive growth of emergent aquatic vegetation had been reduced and a defined channel was present through most of the reach (HES 2014). The channel had cut down through the wedge of sediment upstream of the 6th Street culvert, noted in the 2012 survey, improving passage through this section.

Table 1. Comparison of macrohabitat characteristics in the Phase 3 reach during post-restoration habitat surveys.

Survey Year	Pool (%)	Riffle (%)	Glide (%)	Run (%)	Average Canopy (%)	Mean of Maximum Pool Depth (ft)
2012	-	-	13	3	<10	-
2014	37	11	37	15	27	1.4
2016	48	25	14	13	63	1.8
2020	44	24	32	0	95	1.8

In 2016, riparian vegetation had matured further and most of the reach had good canopy. Average percent canopy increased from 27% in 2014 to 63% in 2016 (HES 2016). Floating and emergent vegetation was present along the channel margins in places but the channel was well defined.

Macrohabitat features shifted significantly between 2014 and 2016 (Table 1). In 2014 the reach consisted of pools and glides (each at 37% of the total by length) with smaller amounts of run (15% by length) and riffle (11% by length). In 2016, the extent of pools had increased to 48% by length and riffles were the next most extensive habitat type at 25%. Glides and runs comprised 14% and 13% of habitat by length, respectively. Pools below the rock weirs in the upper part of the reach had increased in depth and areal extent and provided improved habitat. This was reflected by an increase in depth of pools to an average depth of 1.8 feet in 2016 (range 1.3 ft. to 3.2 ft.) compared to 1.4 feet in 2014 (range 1.2 ft. to 1.9 ft). Glides and runs were deep enough to provide rearing habitat for younger *O. mykiss* with maximum depths averaging 0.65 and 1.1 feet, respectively. The substrate was dominated by silt and clay in much of the reach. A hard pan of clay was exposed in many areas in this reach. Gravel had been deposited in a few areas.

2020 Survey Results

A habitat survey was conducted on October 6, 2020. Streamflow at the time of the survey was low, reflecting relatively low precipitation during the preceding winter. The canopy had grown in almost completely (95%) since the original restoration project and was composed primarily of willow. Macrohabitat types consisted of pool (44%), glide (32%), and riffle (24%). No run type habitat was identified in 2020, possibly a result of the low flow and corresponding shallow depths that may have resulted in classification of some habitats as glide rather than run as in previous surveys. Proportion of pool and riffle habitat was similar to the last survey in 2016 and any difference is within the level of accuracy of the survey (Table 1).

The average of pool maximum depths was 1.8 feet, the same as 2016. Pool maximum depth ranged from 1.1 feet to 2.8 feet. In general, the pools had extensive to moderate cover provided primarily by undercut banks, root mass, and small woody debris with some contribution from overhanging tree branches and occasional boulders. The depth of pools, in conjunction with the levels of cover observed, provide suitable habitat for *O. mykiss* in a relatively small stream such as Codornices Creek in the vicinity of the project. Accumulation of gravel was noted in the transitions from pool to riffle in some areas. Some of these accumulations provided potential spawning sites for *O. mykiss*

There were a series of four rock weirs in the upper part of the reach and one near the lower end. Habitat below these weirs had previously been classified as pools but was classified as glide in 2020. This may have been a result of low streamflow the preceding winter that would have resulted in more deposition of sediment below these structures rather than scouring of sediment to form pools under higher flow conditions. The rock weirs, as well as many of the riffles, had shallow depth that would preclude movement of *O. mykiss* at the level of flow occurring during the survey. These obstacles would likely be minimized at higher flows occurring during the wet season. The culvert at 6th St. had a pool extending from downstream of the culvert to upstream of the culvert and presented no obstacle to passage.

Aquatic life observed during the survey included threespine stickleback (*Gasterosteus aculeatus*, pond skaters (family Gerridae), and evidence of crayfish in the form of detached appendages (apparently from *Faxonius rusticus*, an invasive species). No *O. mykiss* or CRLF were seen. Conditions for observing *O. mykiss* were not ideal due to the streams small size, extensive cover, poor lighting due to extensive canopy, and lower fish activity levels due to seasonally reduced temperature. Readily observed benthic macro-invertebrates such as insect larval stages on stream cobbles were not seen in cursory examination of the stream bed. The only macro-invertebrates observed were small aquatic snails.

Conclusions

The Phase 3 reach appears to have reached a relatively stable equilibrium condition in terms of riparian and aquatic habitat. The canopy is monotypic (mostly willow) relatively dense, and may somewhat limit aquatic productivity due to lack of sunlight. Habitat conditions are suitable for trout and rearing juvenile steelhead. Potential rearing and spawning habitat are both present in the reach. The quality of habitat may benefit from a few scattered areas with open canopy that allow greater insolation and enhance aquatic productivity. Previous monitoring has indicated that high temperature is not likely to be a problem in this reach (HES 2014). Maturation of riparian vegetation including developing root masses and interaction with higher winter flows should result in continuing development of pools and undercut banks. The rock weirs should also be instrumental in these processes, particularly in higher flow years. The pan of clay substrate in many areas of the reach may be the biggest limiting factor for *O. mykiss*, although this reach supported a relatively abundant population before the project and certainly has that potential now (HES 2010). More gravel appears to be deposited in the reach compared to previous surveys.

Water quality is likely a major limiting factor as well. Release of retardant foam to the creek during fire-fighting activity in April 2019 and the resulting fish-kill is a recent, well-reported incident (San Francisco Chronicle, April 4, 2019, https://www.sfchronicle.com/bayarea/article/Hordes-of-fish-killed-in-Berkeley-by-firefighting-13743502.php). There are likely numerous other accidental and intentional releases of toxic substances to the creek from the densely populated urban residential and commercial watershed. Water quality degradation may have direct effects on fish and other aquatic species, such as the retardant spill, or more indirect effects on productivity of the aquatic ecosystem.

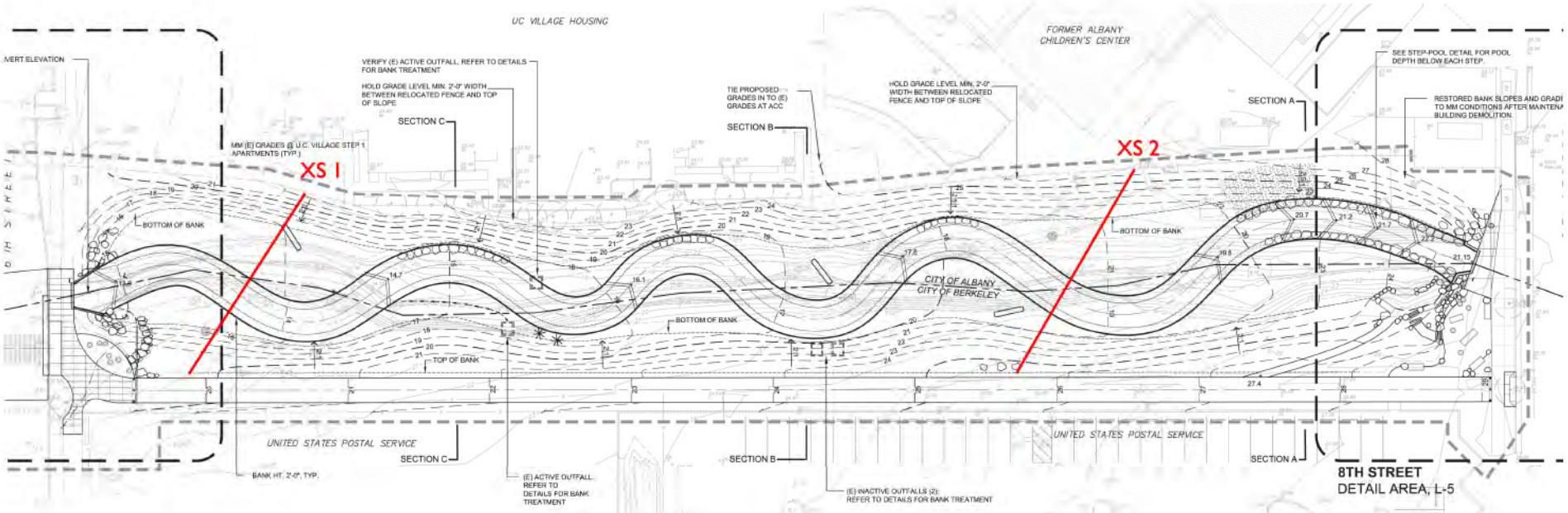
References

Hagar Environmental Science (HES). 2010. Codornices Creek Restoration Phase III: 6th to 8th Street Creek Modifications Fish Relocation Activities, July 2010. Technical Report prepared for City of Albany. September 21, 2010. 7 pp.

Hagar Environmental Science (HES). 2012. Codornices Creek Post-Project Habitat Reconnaissance. Technical Report prepared for Restoration Design Group. October 2, 2012. 8 pp.

Hagar Environmental Science (HES). 2014. Codornices Creek Post-Project Habitat Reconnaissance, UPRR to 8th Street. Technical Report prepared for Restoration Design Group. October 17, 2014. 9 pp.

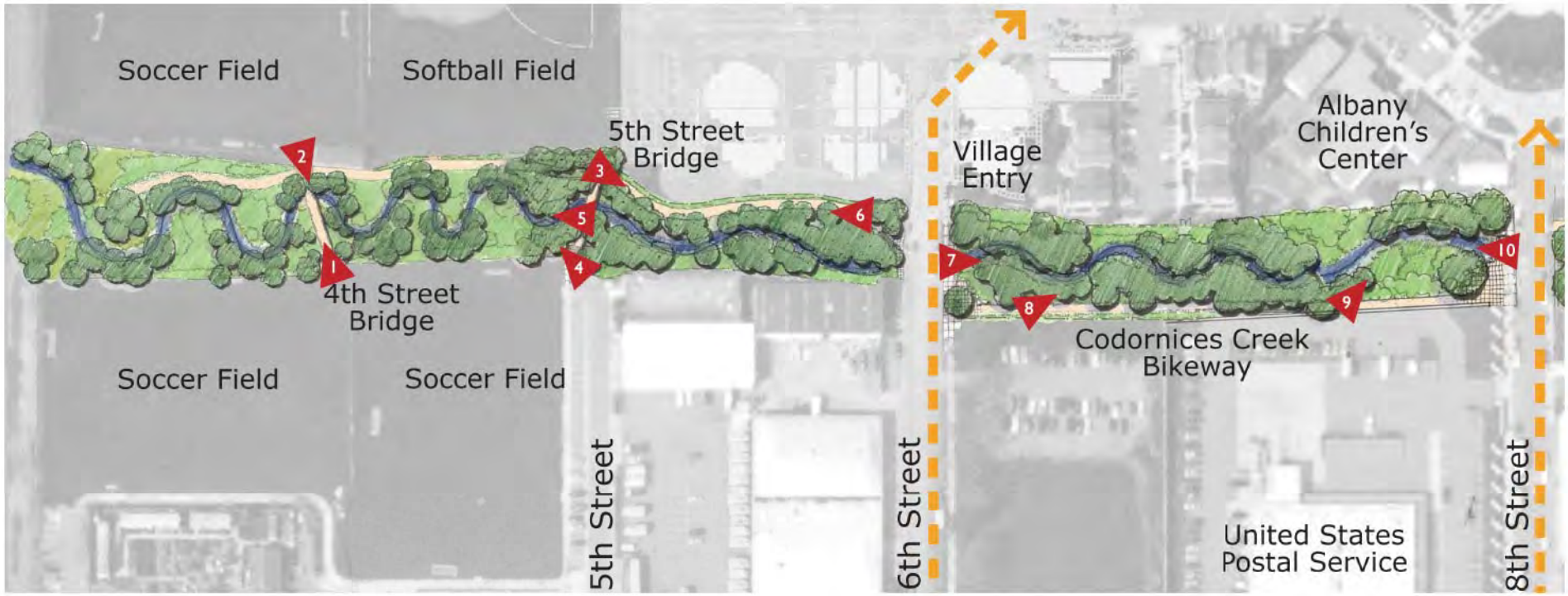
Hagar Environmental Science (HES). 2016. Hagar Environmental Science (HES). 2016 Codornices Creek Post-Project Habitat Reconnaissance, UPRR to 8th Street. Technical Report prepared for Restoration Design Group. November 23, 2016. 7pp.



Codornices Creek Phase III

Cross Section Locations

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com



Codornices Creek Phase III

Photo Point Locations

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

4/20/2006

8/4/2009

11/8/2016

10/1/2020

Codornices Creek Phase 1

Photo Point #1

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

7/12/2007

8/4/2009

12/14/2012

10/01/2020

Codornices Creek Phase 1

Photo Point #2

RDG
Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

10/9/2008

8/4/2009

12/14/2012

10/1/2020

Codornices Creek Phase 2

Photo Point #3

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

9/27/2007

7/31/2009

9/25/2013

10/1/2020

Codornices Creek Phase 2

Photo Point #4

RDG
Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

7/02/2007

7/31/2009

12/14/2012

10/1/2020

Codornices Creek Phase 2

Photo Point #5

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

10/9/2008

12/14/2012

4/18/2014

10/1/2020

Codornices Creek Phase 2

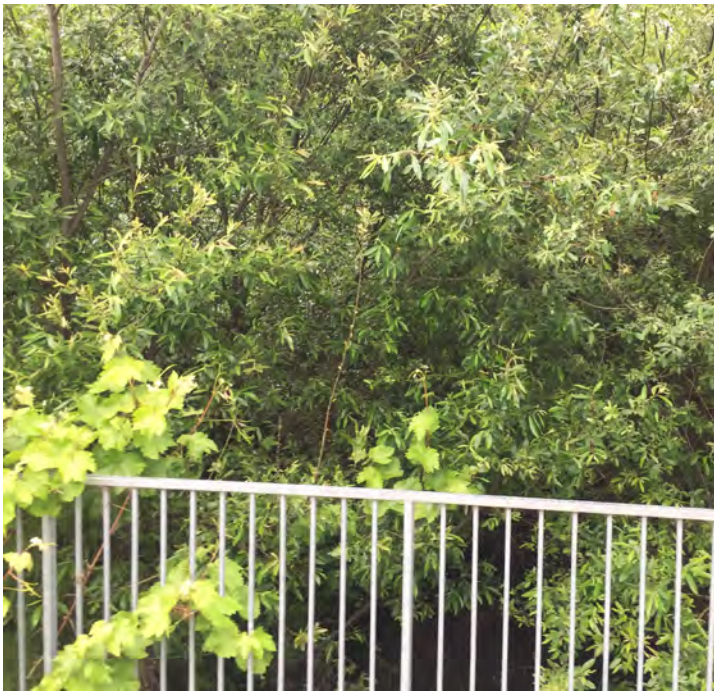
Photo Point #6

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

2/17/2011

2/21/2011

10/22/2012



10/1/2020

Codornices Creek Phase 3

Photo Point #7

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

2/17/2011

3/7/2012

11/8/2016

10/1/2020

Codornices Creek Phase 3

Photo Point #8

Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

1/23/2012

3/7/2012

12/14/2014

10/1/2020

Codornices Creek Phase 3

Photo Point #9

RDG
Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710

2/17/2011

3/7/2012

12/14/2014

10/1/2020

Codornices Creek Phase 3

Photo Point #10

RDG
Restoration Design Group, Inc
2332 5th Street, Suite C
Berkeley, California 94710