NAPA RIVER OAKVILLE TO OAK KNOLL REACH RESTORATION PROJECT
ANNUAL MONITORING REPORT - 2019




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1. Introduction

The purpose of this document is to report on the results of surveys performed during calendar year 2019 related to the monitoring program for the Napa River Oakville to Oak Knoll Restoration Project (Project). Napa County, in partnership with the Napa County Resource Conservation District (RCD), conducts the monitoring in accordance with Project permits and as defined by the Monitoring Plan (Sarrow, J., Blank, P., Koehler, J., 2015) approved for the Project. The Monitoring Plan outlines the monitoring framework and defines survey protocols utilized for collecting data to measure the response and evaluate the effectiveness of restoration actions related to implementation of the Project.

This annual monitoring report and future reports, in addition to the Monitoring Plan, can be accessed online at the Napa County Watershed Information Center and Conservancy (WICC) document repository for the Oakville to Oak Knoll Restoration Project: https://www.napawatersheds.org/app_folders/view/10078.

1.1 Project Description

The Project includes 4.8 miles of active channel restoration activities along 9 miles of the mainstem Napa River between the Oakville Cross Road Bridge and the Oak Knoll Avenue Bridge. The Project consists of 23 individual sites (Restoration Sites) grouped together into four distinct areas (Construction Groups), based on funding, construction, and monitoring considerations. These areas are labeled Group A, Group B, Group C, and Group D (**Figure 1)**.

The Project encompasses 108 acres in total and includes approximately 83 acres of grading in order to create and restore floodplain and riparian areas, stabilize eroding streambanks, and install instream habitat features. The Project includes removal of approximately 36 acres of vineyards, and restoration of 84 acres of transitional riparian and riverine habitat.

The overarching goals of the Project are to restore and enhance long-term river and floodplain function, improve the quality and resilience of aquatic and terrestrial riparian habitat, and reduce property damage and sediment delivery associated with ongoing bank erosion processes. Restoration elements include bank stabilization, channel widening, instream habitat improvement, spawning gravel improvement, floodplain restoration, re-vegetation, and managed retreat.

The Project also includes an annual maintenance program funded by landowner assessments to proactively address debris, bank erosion, and inputs of fine sediments and to maintain the functions of the restoration features. Maintenance activities include debris removal; downed tree stabilization/relocation; in-channel vegetation management; planting native vegetation; invasive and Pierce's Disease host plant removal; and repairing (as needed) instream habitat structures and other constructed instream restoration features. This work is conducted under the supervision of the Napa County Flood Control and Water Conservation District (District) in concert with landowners and their representatives.

The Project has strong landowner participation and includes landowner advisory committees (LAC) established to guide adaptive management needs within the respective Project areas. Additional

detailed descriptions for the Project can be found in the Initial Study/Mitigated Negative Declaration (IS/MND) that was prepared as a requirement for review under the California Environmental Quality Act (CEQA). The IS/MND for the Project is available for viewing and download on WICC: https://www.napawatersheds.org/app_folders/view/10078.

1.2 Project Status, Implementation, and Funding

As of December 2019, restoration construction and revegetation activities have been completed for Group A (Sites 21, 22, and 23), Group C (Sites 12, 13 and 14) and Group B (Sites 15, 17, 18, 19, 20 and 20W). Full implementation and construction of the entire Project (all 23 Restoration Sites) is expected by fall 2021. **Table 1** provides a summary of funding sources and actual or estimated construction dates for each Construction Group.

Table 1: Funding source and construction year for each Construction Group

Fund Source	Amount Awarded	Measure A Match	Construction Group	Construction Year
EPA 2013-W9-99T07301	$1,271,350	$1,246,350	Group A-Construction	2015-2016
EPA 2012-W9-00T95301	$659,587	$659,587	Group C-Site 14 Construction	2017-2018
EPA 2014 W9-99T24201	$894,324	$894,324	Group C-Site 14 Construction	2017-2018
EPA 2018 W9-99T70901	$822,000		Group C-Revegetation, Group B Design, Group B Construction	2017-2019
Coastal Conservancy 16-054	$850,000		Group C-Site 13 Construction	2017-2018
Coastal Conservancy 18-024	$450,000		Group B Construction	2019
SWRCB 319-2017 NO-D1613202	$750,000	$250,000	Group C-Site 13 Construction	2017-2018
SWRCB 319-2018	$750,000		Group B-Construction	2019
CDFW-2017 P1696017	$1,000,000		Site 12 and 13 Construction and 12, 13, 14 revegetation	2017-2018
CDFW-2018 P1796036	$750,000		Group B & D-Design	2019-2020
WCB Prop 1-2018	$2,500,000		Group B & D-Construction and revegetation	2019-2021
EPA 2019 W9-99T87101	$740,000		Group D-Construction	2020-2021
Coastal Conservancy 2019	$1,700,000		Group D-Construction, project and biological monitoring	2020-2021
		$2,300,000	Group D-Implementation	2020-2021
Total	**$13,137,261**	**$5,350,261**		

1.3 Description of Restoration Activities Completed

A summary of specific restoration features constructed to date in Construction Groups A and C is provided in **Table 2**. This table will be expanded in subsequent monitoring reports as additional Restoration Groups and Sites are constructed. Brief summaries of completed Restoration Sites are presented below. For additional details and descriptions of all proposed and completed Construction Groups and Restoration Sites, please refer to the *Basis of Design Report* developed by Environmental Science Associates (ESA, 2019), and the *Napa River Restoration: Oakville to Oak Knoll Final Concept Plan* developed by the California Land Stewardship Institute (CLSI, 2011).

Table 2: Constructed restoration features in Groups A and C

Restoration Feature		Group A	Group C	Group B	Group D	Total
Floodplain Benches	Acres	1.48	5.46	1.76	N/A	8.7 Ac
Riparian Areas	Acres	2.68	11.1	9.88	N/A	23.66 Ac
Seasonal Wetlands	Acres	0	1.22	2.42	N/A	3.64 Ac
Side Channels	Linear Feet	724	340	0	N/A	1,064 Lf
Instream Habitat Structures	Large Wood	24	21	10	N/A	55
	Boulder Clusters	17	37	8	N/A	62
Setback Berms	Linear Feet	0	2,872	3,339	N/A	6,211 Lf
Construction Year		**2015 -2016**	**2016 -2018**	**2018-2019**	**Pending**	

Summary of Restoration Sites 21, 22 and 23 (Group A)

Construction took place during the summers of 2015 and 2016. A total of 4.16 acres of riparian, upland, and vineyard areas were re-graded and enhanced to create and restore floodplain and upland riparian habitat through conversion of vineyard lands. Additionally, two side channel features were created totaling 724 linear feet at Sites 22 and 23.

Selective bench creation and bank stabilization was implemented over approximately 1,850 linear feet of over-steepened and actively eroding stream banks. In addition to channel widening and floodplain grading, a total of 41 in-channel habitat structures (17 boulder clusters and 24 large wood structures) were installed at Sites 21, 22, and 23. The Project also included approximately 6.5 acres of invasive vegetation management. All disturbed areas within the vegetation management zones were seeded with a native seed mix or covered with mulch. A total of 2 acres, within the 6.5 acres invasive

management areas, were revegetated to support establishment of a more complex mix of appropriate native riparian plant species.

The Project reused as much material as possible on-site. Trees removed from the Project area were used to create the large wood structures. An estimated 29,522 cubic yards (CY) of earthen material and existing riprap debris (concrete and other anthropogenic materials) were excavated and disposed of off-site. All work was completed in accordance with permits and the construction plans and drawings prepared for the Project.

Summary of Restoration Sites 12, 13, and 14 (Group C)

Construction took place during the summer from 2016 - 2018. A total of 17.8 acres of riparian, upland, and vineyard areas were re-graded and enhanced to create and restore floodplain, seasonal wetland and upland riparian habitat through conversion of vineyard lands. Additionally, a 340 linear foot side channel feature was created at Site 12.

Selective floodplain bench creation and bank stabilization was implemented over approximately 4,550 linear feet of over-steepened and actively eroding stream banks. In addition to channel widening and floodplain grading, a total of 58 in-channel habitat structures (37 boulder clusters and 21 large wood structures) were installed at Sites 12, 13, and 14. A total of 42 bio-technical features including willow baffles, brush mattresses, etc. were installed. The Project also included approximately 3.3 acres of invasive vegetation management. All disturbed areas within the vegetation management zones were seeded with a native seed mix or covered with mulch and revegetated to support establishment of a more complex mix of appropriate native riparian plant species.

Similar to Restoration Sites 21, 22, and 23, soil and woody material was reused on-site whenever possible. Trees removed during construction were repurposed to create the large wood structures. An estimated 65,410 CY of earthen material and existing riprap debris (concrete and other anthropogenic materials) were excavated and reused on site or disposed of off-site. All work was completed in accordance with permits and the construction plans and drawings prepared for the Project.

Summary of Restoration Sites 15, 17, 18, 19, 20 and 20W (Group B)

Construction took place during the summer of 2019. A total of 10.42 acres of riparian, upland, vineyard and in-channel areas were re-graded and enhanced to create and restore floodplain benches, seasonal depressional wetlands and riparian habitat.

Selective bench creation, bank stabilization and riparian corridor enhancement was implemented over approximately 3,070 linear feet of river channel.

The newly graded floodplains include 4 channel expansion areas as well as a 1,500 linear foot seasonal depressional wetland features that functions as a high flow swale with multiple returns to the main channel. In addition to channel widening and seasonal wetland creation, a total of 36 in-channel habitat structures (8 boulder clusters, 10 large wood structures, and 18 live wood habitat structures) were installed at Sites 17, 19, and 20.

The Project also includes 5 acres of native plant revegetation that was completed in the fall of 2019. All graded areas were revegetated with 31,205 container plants composed of native trees, shrubs, vines and herbaceous species. The plant palette included over story trees such as valley oak (Quercus lobata), coast live oak, (Quercus agrifolia), and Big leaf maple (Acer macrophyllum) to initiate the long term establishment of species that will provide riparian canopy cover and structural complexity. In addition, numerous pioneer species such as Fremont's cottonwood (Populus fremontii) and coyote bush (Baccharis pilularis) were included to provide initial cover and diversity. The restoration sites were all planted with a matrix of hardy understory species including Santa Barbara sedge (Carex barbarae) and creeping wild rye (Elymus triticoides), as well as spreading shrub species such as CA wild rose (Rosa californica) and creeping snowberry (Symphoricarpos albus). The revegetation effort also includes up to 5.6 acres of invasive vegetation management in sites adjacent to the graded areas which will be initiated in 2020.

All disturbed areas were either replanted with native vegetation and/or seeded with a native seed mix and covered with mulch. All work was completed in accordance with permits and the construction plans and drawings prepared for the Project.

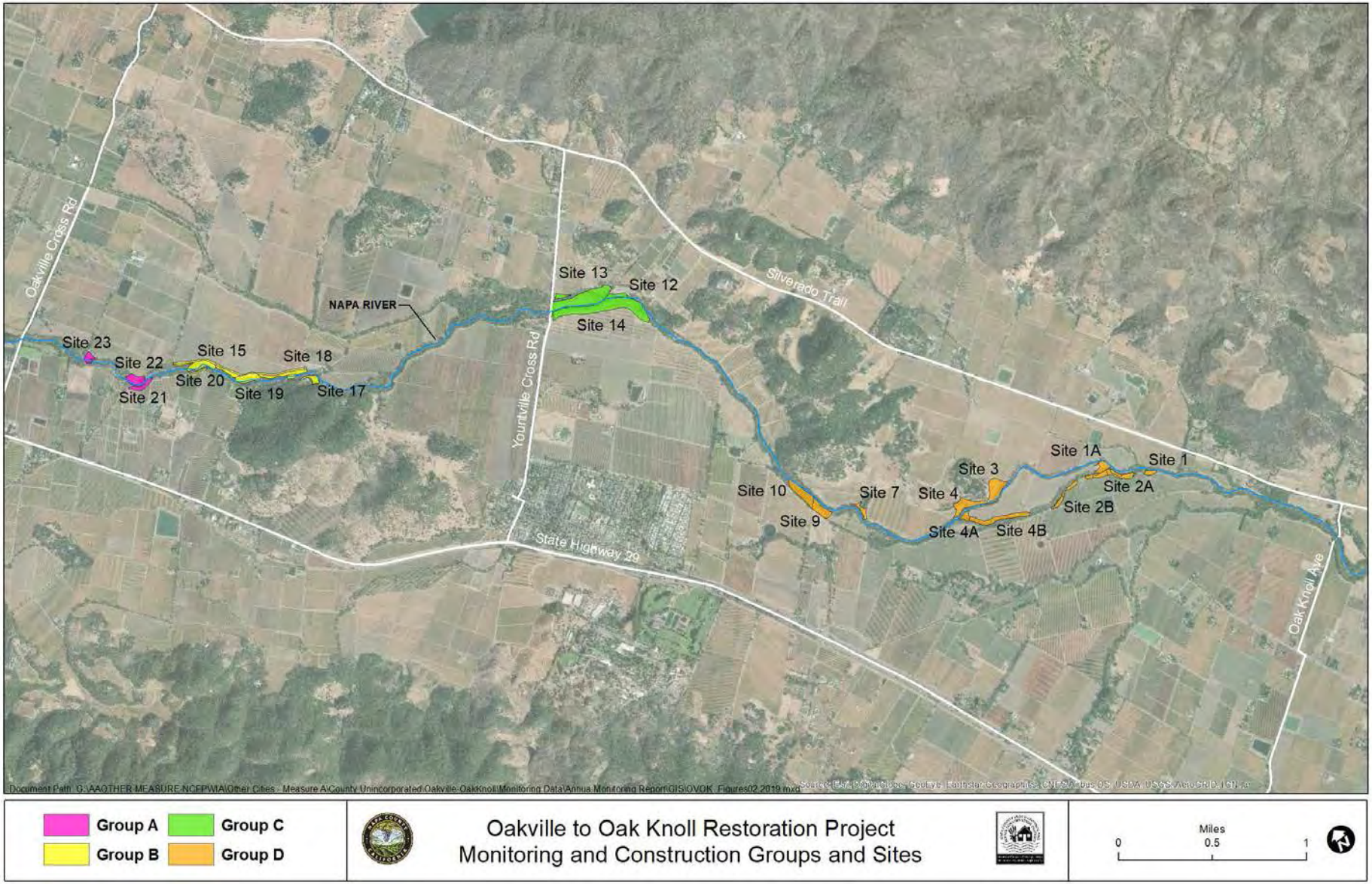


Figure 1: Construction Group and Restoration Site location map.

2.0 Restoration Goals and Desired Outcomes

Changes in land use, construction of earthen berms, and filling of historic channels has resulted in increased flow volumes and velocities within the Napa River leading to channel incision and streambank erosion and failure. In addition, inputs of fine sediments to the channel from eroding stream banks and other sources throughout the watershed has led to a reduction in the quality and quantity of instream habitat for salmonids and other native fishes within the Project reach.

The pre-restoration condition for aquatic habitat within the Project reach generally consisted of long homogenous glides and pools, with relatively few riffles and runs. In general, these pool/glide habitats offered less cover and feeding opportunities for salmonids. The predominant substrate in the reach was gravel and sand-sized particles. The pre-project condition of riparian habitat varied considerably throughout the Project reach, depending on channel width, bank steepness, and adjacent land uses. In general, the extent and diversity of riparian habitat found within the Project area was limited by the morphology of the channel. In most reaches, the confined nature of the channel prevented the establishment of inset floodplain benches and bars that would enable recruitment and establishment of riparian species.

In order to address these pre-project conditions and restore instream and riparian habitat, the following restoration goals and desired outcomes were developed in the Monitoring Plan as well as in the regulatory permits issued for the Project. These include generally:

- Minimizing the need for ongoing channel stabilization and repair work by establishing a more self-sustaining channel design which reduces maintenance needs;
- Enhancing geomorphic channel forms and processes to support a more diverse and complex instream condition;
- Increasing river and floodplain interactions where possible;
- Increasing and enhancing riverine, riparian, and floodplain habitat functions, with a focus to improve habitat for fish and wildlife;
- Removing and managing invasive nonnative vegetation and replanting native vegetation that will not promote Pierce's disease in vineyards while enhancing the complexity and width of the riparian corridor;
- Supporting the sediment reduction and habitat enhancement goals of the Napa River TMDL

3.0 Monitoring Protocols, Indicators and Performance Standards

Performance standards have been developed for the Project goals; success of the Project will be evaluated by quantifying progress towards meeting these standards over the life of the Project. The monitoring protocols, frequency of surveys and performance standards are summarized below and described in further detail in the Monitoring Plan.

Monitoring protocols and indicators developed for the Project include the following:

1. Annual reconnaissance of the entire Project reach to observe current Project conditions and identify if any immediate adaptive management (bank erosion, etc.) actions are needed;
2. Topographic cross sections survey of post construction cross sections to provide a basis to evaluate how instream habitat structures are performing at representative high- and low-flow events;
3. Detailed channel transect and longitudinal profile surveys designed to characterize the long term physical channel response to changing conditions based on flow variation and vegetation establishment;
4. Seasonal high-flow surveys and instream habitat assessment (snorkel surveys) at restoration sites designed to evaluate salmonid utilization of created habitat features and restoration area;
5. Phased vegetation establishment surveys to track plant establishment and guide adaptive management of re-vegetated areas; and
6. Photo-monitoring at defined stations to capture changes over time.

A Before/After approach is being applied to document long-term changes in geomorphic and aquatic and riparian habitat parameters (Gerstein & Harris, 2005). Monitoring indicators and protocols have also been chosen to balance the frequency and resolution of data collection in a meaningful and yet cost-effective manner, while ultimately evaluating the success of each restoration site within the Project reach. **Table 3** provides a summary of the monitoring indicators, protocols and performance standards.

Table 3. Monitoring indicators, protocols, and performance standards for the Project

Monitoring Indicator	Monitoring Protocol	Performance Standard
Changes in bed deposition, scour and lateral migration	Cross section and thalweg surveys	Reduction in bed and bank erosion sites, vertical channel adjustment
Channel width-to-depth ratio at surveyed cross-sections	Cross section surveys	Increase in channel width to depth ratios
Channel substrate size distribution (median size frequency distribution, % fine sediment) and gravel recruitment	Pebble counts at cross sections	Statistically significant increase in riffle median grain size (D50 mm) and reduction in riffle substrate percentage of fines (<2mm)
Riffle length and frequency	Thalweg surveys	Increase in riffle length or riffle frequency, and increase in habitat type diversity

Monitoring Indicator	Monitoring Protocol	Performance Standard
Water velocities in constructed high-flow refugia areas	Seasonal high-flow surveys	Creation of high-flow refugia (less than 6 fps) at flows of 500 cfs and greater at constructed features
Instream habitat utilization of installed structures under low-flow conditions	Seasonal low-flow and snorkel surveys	Presence of juvenile salmonids utilizing installed instream habitat structures
Vegetation communities and riparian buffer width	Cross section surveys	Positive trends in riparian vegetation buffer width
Plant survival at revegetation sites (%)	Vegetation establishment and annual maintenance surveys	70% survival of native plants at revegetation sites at years 3, 5 post-installation
Percent native vegetative cover: Absence/presence natural recruitment	Vegetation establishment and annual maintenance surveys	70% or greater native cover and evidence of natural recruitment by year 5 at revegetation sites
Documentation of change at restoration sites	Photo monitoring	Evidence of vegetation establishment, persistence of restoration features and increases in channel complexity

4.0 Results and Discussion

4.1 Hydrologic Conditions

Tracking and analyzing streamflow in the Napa River Oakville-to-Oak Knoll (OVOK) Restoration Reach is key to identifying channel-forming flows and evaluating changes in stream geometry, bank condition, and sediment load, as well as guiding monitoring activities. Channel-forming flows are flow events that are sufficiently large to move all the mass and sizes of alluvial sediment supplied to the channel and include a range of intermediate high flows. The most effective channel-forming flow is often associated with the bank full discharge, which is in turn often associated with a 1.5-year recurrence interval. Although only a rule of thumb, the 1.5-year peak flow is used in this monitoring effort as a threshold to define a channel-forming flow.

Streamflow in the OVOK reach is measured at USGS Station 11458000 NAPA R NR NAPA, located at Oak Knoll Avenue Bridge, at the downstream extent of the reach. Real-time and historical stage and flow data for the station are available at waterdata.usgs.gov. Several tributary streams (To Kalon, Yount Mill, Conn, Chase, and Dry Creeks) join the Napa River within the project reach, more than doubling the watershed area from approximately 99 square miles at the top of the reach to approximately 219 square miles at the bottom. A large portion of this increase is due to Conn Creek, which is regulated by Lake Hennessey and Rector Reservoir. Under any conditions, streamflow entering the upstream extent of the

OVOK reach will be significantly less than measured at Station 11458000 and can be estimated as approximately half when the reservoirs are spilling.

Station 11458000 has been in continuous operation since 1959 and USGS provides peak flow statistics at streamstats.usgs.gov. The calculated peak flows for the 1-, 2-, 5-, 10-, 25-, 50- and 100-year floods are summarized in **Table 4**. USGS does not provide a peak flow statistic for the 1.5-year flood, but it is estimated for the purposes of this monitoring effort at 6,500 cfs.

Table 4. Peak flow statistics for USGS Station 11458000.

Peak Flood	Discharge (cfs)
Mean Annual (1-Year)	4,520
2-Year	8,470
5-Year	15,300
10-Year	20,700
25-Year	28,100
50-Year	34,100
100-Year	40,400

The last rare flooding event occurred on December 31, 2005, prior to construction of the project, when a peak flow of 29,600 cfs was recorded at Station 11458000, making it an approximate 30-year flood. Since that time, two peak flow events (15,900 cfs on January 8, 2017 and 16,600 cfs on February 27, 2019) have exceeded the 5-year flood. Flow events with peak discharges greater than the 1.5-year flood that have occurred since initiation of construction in 2015 are listed in **Table 5.** These events can be expected to have significantly altered the streambed, promoted further erosion of eroding streambank areas, and tested the stability of graded restoration areas.

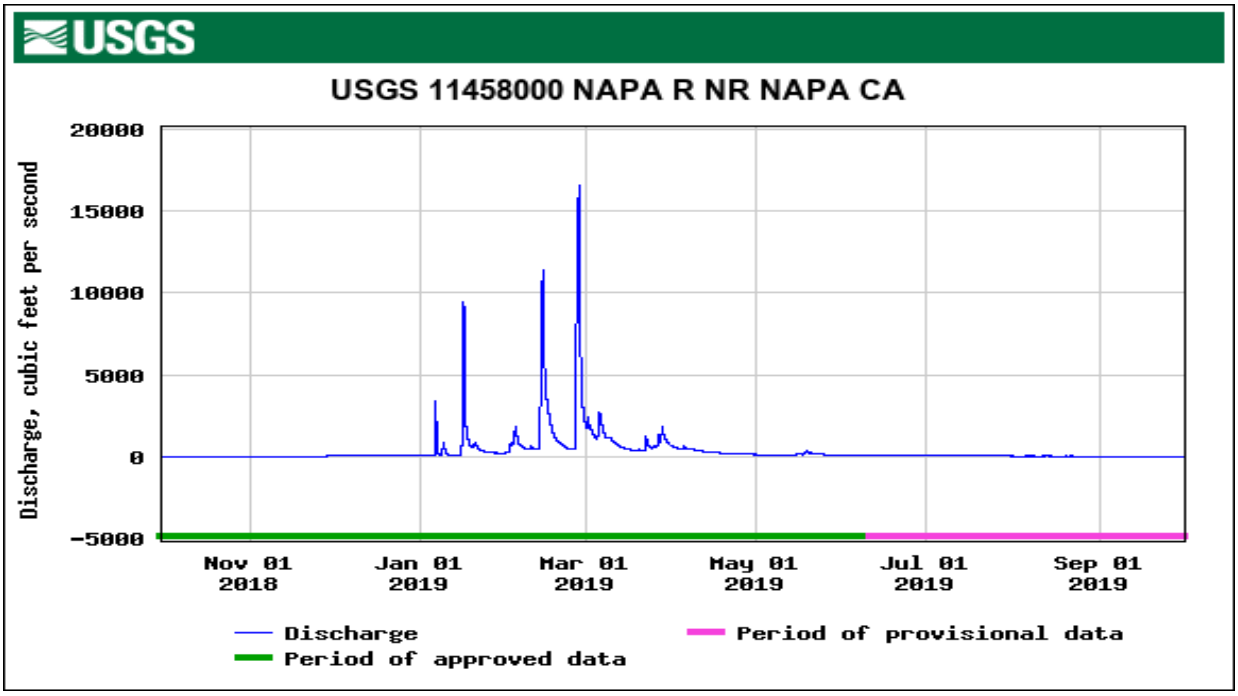
Table 5. High-flow events and peak discharges greater than 1.5-year flood since initiation of Project construction.

Water Year	Date	Peak Discharge (cfs)
2014-15	Dec 11, 2014	10,400
2015-16	Mar 6, 2016	7,380
2016-17	Dec 15, 2016	8,570
2016-17	Jan 8, 2017	15,900
2016-17	Jan 11, 2017	14,500
2016-17	Jan 22, 2017	7,160
2016-17	Feb 7, 2017	14,400
2016-17	Feb 9, 2017	9,580
2016-17	Feb 20, 2017	7,570
2018-19	Jan 17, 2019	9,500
2018-19	Feb 14, 2019	11,400
2018-19	Feb 27, 2019	16,600

During the 2018-19 water year (October 1, 2018 through September 30, 2019), measurable streamflow began at Station 11458000 on November 29, 2018 and continued through late August 2019. The peak flow of the season occurred on February 27, 2019, and was measured to be 16,600 cfs, an approximate

5.4-year flood. Following the last significant stormflow of the season on March 29, 2019, flows in the river receded until streamflow ended on August 29, 2019. A plot of streamflow measured at Station 11458000 during the 2018-19 water year is included as **Figure 2**.

Figure 2. 2018-19 streamflow, Napa River Oakville-to-Oak Knoll Restoration Reach, USGS Station 11458000.



The reporting period for this monitoring effort includes the start of the 2019-20 water year (October 1, 2019 through September 30, 2020), and measurable flows in the reach began on December 1, 2019. As of mid-January, no flow events have exceeded the 1.5-year peak flow with the largest peak flow provisionally estimated at 805 cfs. The streamflow data for the entire 2019-20 water year will be presented in the next annual monitoring report.

During the dry season, Napa River flow at Station 11458000 typically subsides in July or August and begins again in October or November, according to historical data. Rarely, the river will flow perennially or remain dry well into winter, depending on rainfall timing and magnitude. During the dry period, conditions in the OVOK Reach vary, with sub-reach conditions ranging from completely dry, to isolated pools, to trickling. Dry-season streamflow data for Station 11458000, including mean monthly discharge statistics, can be found at waterdata.usgs.gov.

4.2 Longitudinal Profile Thalweg Surveys

Channel thalweg surveying provides a means of measuring changes in streambed complexity. Indications of progress include increases in riffle frequency and corresponding decreases in mean riffle height, increases in riffle length and corresponding decreases in pool length, and increases in total and mean residual pool depth.

Three distinct subreaches with a combined length of approximately 4.5 miles of the 8.4-mile OVOK restoration reach were selected for post-project channel longitudinal profile surveying. The subreaches

encompass all completed and planned restoration sites and groups. The first post-construction survey is currently expected to be completed in 2021 pending completion of construction for the entire Project, Groups A through D.

Pre-project (baseline) channel thalweg surveys were completed for 2 of the 3 subreaches covering Groups A through C and will be completed for Group D in the fall of 2020. Group A through C surveys were conducted by the California Land Stewardship Institute (CLSI) in partnership with RCD in 2012 as part of the design phase of the Project. The pre-construction baseline Group A through C surveys were analyzed in the previous year's (2018) monitoring report, please refer to the 2018 report for analysis including riffle count, riffle length, pool length, and residual pool depth regarding these surveys.

4.3 Channel Cross Section Surveys

Channel cross section surveying provides a means of measuring channel adjustment in response to restoration, including changes in channel width, depth, and area, streambed deposition or scour, and streambank erosion. Twenty two cross section survey transects (including two "control" cross-sections located in areas not graded) were selected for post-project restoration monitoring; **Figure 3**. The first post-construction survey is scheduled to occur in 2022 following completion of the entire Project construction which is currently expected in 2021. The cross-section surveys will be completed in accordance with a methodology specific to restoration monitoring that includes selected survey points, floodplain elevations, collection of vegetation and substrate data (pebble counts), and installation of permanent survey monuments. The monuments will allow future re-occupation of the lines-of-section. Re-surveying of the cross sections allows evaluation of changes in channel conditions in response to restoration and will occur at 5-year intervals following the first post-construction survey after completion of the Project.

While pre-project (baseline) surveys of the twenty-two monitoring cross sections were established in 2012 as part of the design phase of the Project, they were not surveyed to the monitoring standards previously outlined. The locations of these baseline cross sections were not permanently monumented and therefore cannot be precisely re-occupied; however, they were surveyed with a total station and therefore accurately mapped. Therefore locating and re-surveying the cross sections to an adequate degree of accuracy is feasible. The previous surveys captured channel geometry only, so although analysis will include pre- and post-project comparison of channel dimension metrics, similar comparisons of vegetation and substrate data at the cross sections will not be possible. Air photo analysis will be used to estimate pre-project riparian vegetation widths, otherwise vegetation and substrate changes at the cross sections will be monitored through time beginning after completion of construction activities.

However, the 2012 survey data, collected for restoration design, was re-processed from XYZ coordinate data to two-dimensional channel sections and analyzed for maximum depth, top width, cross-sectional area, width-to-depth ratio and riparian vegetation width. Please refer to the 2018 monitoring report for the completed analysis of the 2012 cross section survey data.

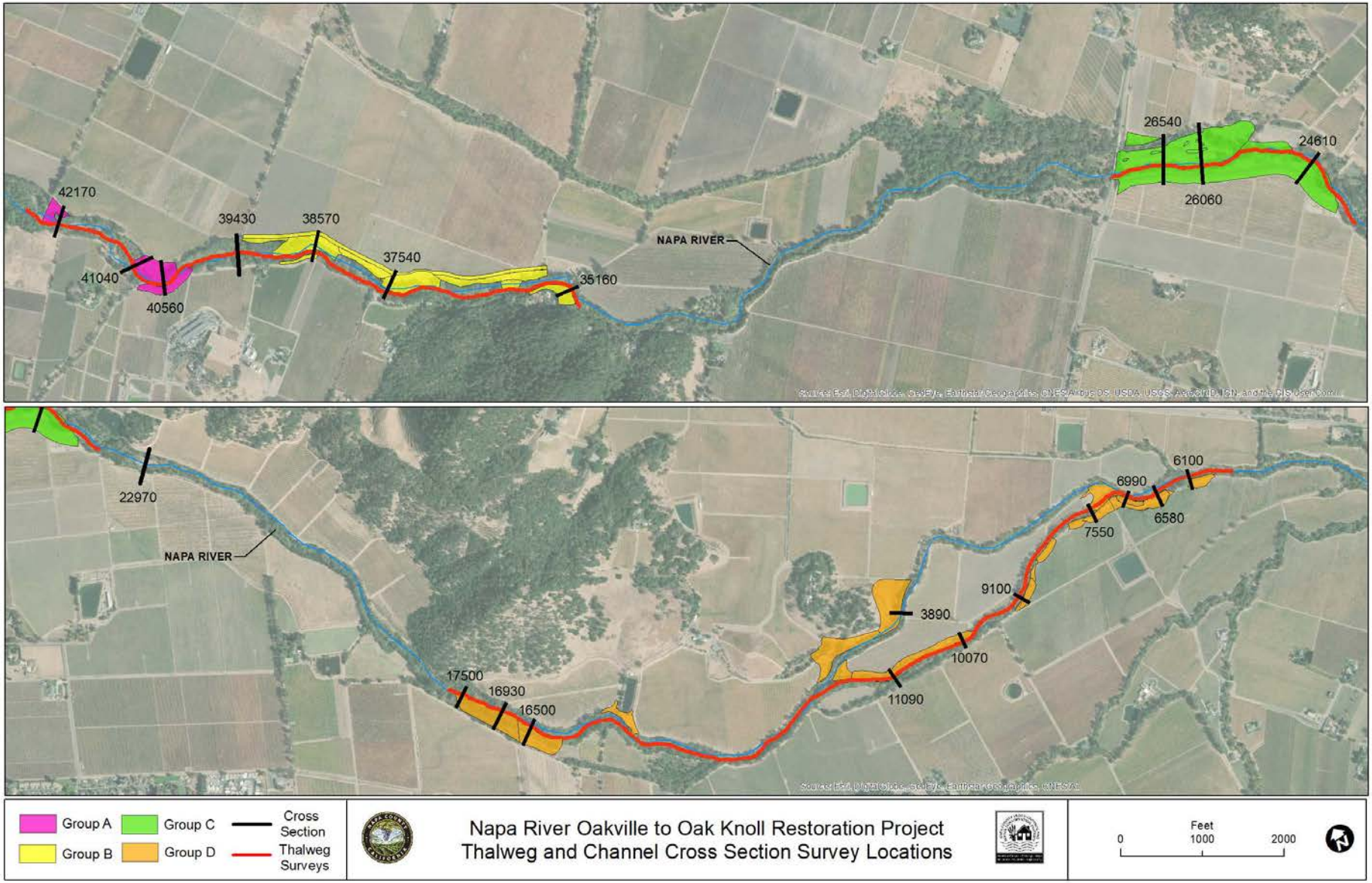


Figure 3: Location of monitoring thalweg and channel cross section surveys

4.4 Vegetation Establishment Surveys

Vegetation establishment surveys are conducted for the first 3 years following plant installation and thereafter during years 5 and 10 post-installation. Non-native invasive vegetation is also managed and documented during routine maintenance activities and surveys throughout the year. The target restoration goals and success criteria for vegetation establishment and long-term maintenance include:

- Minimum survivorship of 70% for all native plants installed at re-vegetation sites within 3 years after being installed, and at years 5 and 10 should be in good health
- Greater than 70% native vegetative cover will exist at any given re-vegetation site over the *life* of the Project and evidence of natural recruitment will be documented after year 5 at any given site

Plant and irrigation installation at Group A (Sites 21, 22, and 23) was completed in late spring of 2017, plant and irrigation installation for Group C (Sites 12, 13 and 14) was completed in the fall of 2018 resulting in a total of 20.3 acres of restored and enhanced in-channel, riparian, and upland habitat between both construction groups. A summary of the results from annual vegetation surveys for years 1 and 2 conducted by the revegetation maintenance contractors (Handford ARC) at Group A, including direct count, percent vegetative cover, and invasive plant management is presented herein. **Figure 4** below shows the location of each Restoration Sites surveyed. The first year vegetation surveys for Group C were conducted during the spring and fall of 2019.

Direct Count Vegetation Surveys

During the fall of 2019, contractor staff surveyed all planted Restoration Sites in Group A and C to determine percent survivorship, cover, and qualitative health of installed and naturally recruited vegetation. Further, within each Restoration Site, plants were installed within 5 different habitat planting zones: river wet edge, lower floodplain bench, lower and upper riparian slope, and transitional upland oak woodland. Percent survivorship survey results range widely, from 5% to 225%, and very by Site, species planted and habitat planting zone; in general overall plant establishment in Group A is performing better than in Group C.

In Group A black walnut (*Juglans californica*), big-leaf maple (*Acer macrophyllum*), valley oak (*Quercus lobata*), yarrow (*Achillea millefolium*), foothill penstemon (*Penstemon heteropyllus*), California wild rose (*Rosa californica*), snowberry (*Symphoricarpus albus*), and rushes (*Juncus* spp.) were among the best performing species in regards to survivorship and volunteer recruitment. **Table 6** below presents a summary of percent survivorship by habitat planting zone for Group A, Sites 21, 22, and 23 for monitoring year 2019.

Table 6: Group A woody vegetation direct count/survivorship survey by habitat zone and Site - 2019

Habitat Planting Zone	Site 21		Site 22		Site 23	
	Total Planted	Total % Survived	Total Planted	Total % Survived	Total Planted	Total % Survived
River Wet Edge	Not Applicable		578	91.1%	248	94.4%
Lower Floodplain Bench			640	93.9%	116	92.2%
Lower Riparian Slope	783	100.0%	1979	99.6%	1365	99.9%
Upper Riparian Slope	1785	99.7%	2906	99.7%	1246	99.7%
Transitional Upland Oak Woodland	Not Applicable		442	98.2%	658	99.1%

* Includes original planted stock and naturally recruited species.

Observations for Group C included the following "Overall the species that were counted were in good health and vigor and it was easy to distinguish between dead and thriving plants. Across all three sites the overall percent survivorship, comparing those counted to the specifications, was 79%. When looking at the overall survivorship for each site, site 12 had a 103% survivorship, site 13 had a 100% survivorship, while site 14 had 63% survivorship. This may be in part due to site 14 having a large amount of soil that was moved during flooding and also a lower number of volunteers compared to the other two sites." More likely, the difference in survivorship reflects the decision to shift some of the woody plants originally planned for Site 14 over to Sites 12 and 13. This decision accounted for field conditions during planting. For example, certain lower portions of Site 14 exhibited high natural recruitment of willows, cottonwoods and several native herbaceous species. Other areas also featured recent gravel deposits and did not appear suitable for active planting. Lastly, the grading plan at site 14 retained numerous large, mature valley oak trees that are likely to produce volunteer oak seedlings over a significant portion of the project site. **Table 7** below presents a summary of percent survivorship by habitat planting zone for Group A, Sites 12, 13 and 14 for monitoring year 2019. Representative photographs of revegetation sites surveyed and additional details, including species specific survivorship counts, are provided in **Appendix A** and **B**.

Table 7: Group C woody vegetation direct count/survivorship survey by habitat zone - 2019

Habitat Planting Zone	Sites 12, 13 and 14		
	Total Planted	Plant count 2019	Total % Survived
Invasive Vegetation Management	620	567	91%
Lower Floodplain Slope	6	0	0.0%
Lower Floodplain Bench	354	255	72.0%
Lower Riparian Slope	1,354	629	46%
Upper Riparian Slope	2,960	2,769	94.0%
Transitional Upland Oak Woodland	165	108	65.0%

Vegetative Percent Cover Surveys

Percent cover of non-native vs. native herbaceous vegetation and percent bare ground was estimated for each habitat planting zone for all Sites within Group A and C. **Table 8** below presents a summary of the percent cover by habitat planting zone for Group A, Sites 21, 22, and 23 for monitoring year 2019. Herbaceous cover at the three sites was primarily native-dominated, especially by perennial grasses, foothill penstemon, and poppies. Bare areas were minimal in most planting zones ranging from 5%-10%.

Table 8: Group A, Sites 21, 22 and 23 vegetative cover estimation survey results 2019

Habitat Planting Zone	Site 21			Site 22			Site 23		
	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE
River Wet Edge	Not Applicable			75	20	5	80	15	5
Lower Floodplain Bench				80	15	5	85	10	5
Lower Riparian Slope	80	15	5	70	25	5	85	10	5
Upper Riparian Slope	70	20	10	70	25	5	80	15	5
Transitional Upland Oak Woodland	Not Applicable			65	30	5	85	10	5

Table 9 below presents a summary of the percent cover by habitat planting zone for Group C, Sites 12, 13, and 14 for monitoring year 2019. The primary cover at all three sites was bare soil followed by non-native cover and then native cover. This is not surprising given the drastic flooding the site endured during the 2018/2019 winter which washed out some of the site including some seed. While the percent cover was not dominated by native plants there was a large number of smaller native plants present and given time they should fill in and give good coverage in future years. Representative photographs of percent cover at the revegetation sites surveyed along with additional details, including dominate native and non-native species, can be found in **Appendix A** and **B**.

Table 9: Group C, Sites 12, 13 and 14 vegetative cover estimation survey results 2019

Habitat Planting Zone	Site 12			Site 13			Site 14		
	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE
River Wet Edge	9	6	85	15	.8	84.2	10.5	2.2	87.3
Lower Floodplain Bench	Not Applicable			12	10.5	77.5	23.3	6.7	70
Lower Riparian Slope	4.3	5.7	90	6.7	21.2	72.2	20.4	12.9	66.7
Upper Riparian Slope	5.7	34.3	60	6.8	25	68.2	15.3	19.3	65.5
Lower Floodplain Slope	12	3	85	Not Applicable			5	10	85
Transitional Upland Oak Woodland	Not Applicable			5.5	33.7	60.8	Not Applicable		
Seasonal Wetland				10.8	8.4	80.8			
Invasive Vegetation Management	9.4	64.6	26	3.1	29.3	67.6	17.6	56.9	25.5

As this is the second monitoring year for vegetation establishment of Group A and the first monitoring year for Group C, results vary for the respective two Groups and Sites based on the time of establishment. In general overall percent survivorship for installed vegetation in Group A (Sites 21, 22, and 23) is very good to excellent while overall survivorship in Group C (Sites 12, 13 and 14) varies widely ranging from 0% to 94% depending on the plant species and habitat planting zone. Similarly, native vegetation cover estimates for Groups A and C vary widely with Sites in Group A ranging from 70%-80% while Sites in Group C ranged from 4.3% to 23.3%. In general, with proper management of non-native weeds and regular irrigation of installed vegetation the respective restoration Sites at both Groups A and C can be expected to establish successfully. In addition, natural recruitment is expected to further add habitat value to the Restoration Sites over time.

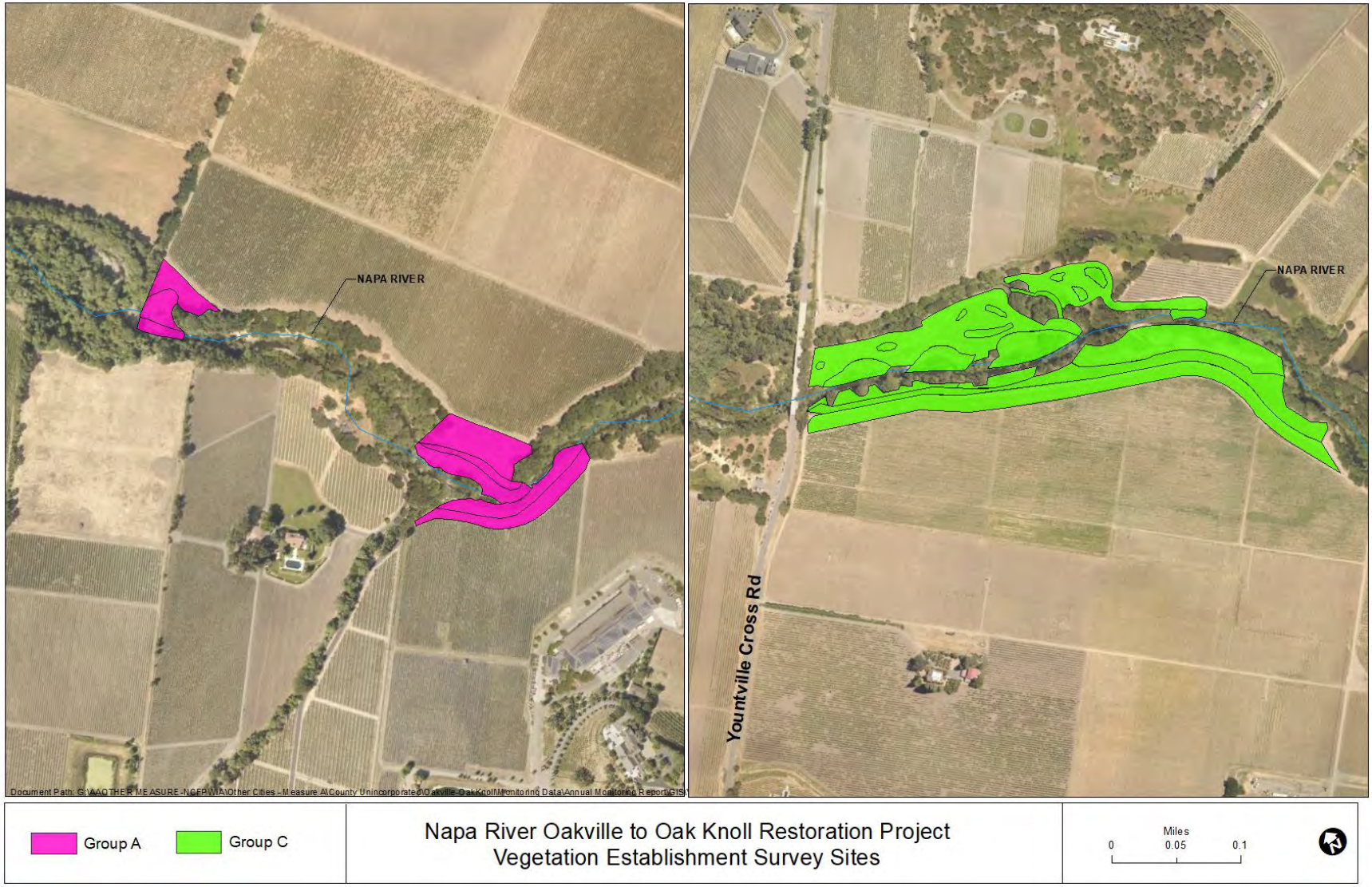


Figure 4: Location of direct count and percent cover vegetation surveys

Invasive Plant Management

A total of 5.5 acres of non-native invasive and Pierce host vegetation was removed or treated in 2019 throughout Sites 21, 22, and 23 (Group A) and Sites 12, 13, and 14 (Group C). The combined acreage of invasive plant management areas to be maintained in both construction groups is 21.75 acres. Both mechanical and chemical methods were used to remove/treat tree of heaven (*Alianthus altissima*), giant reed grass (*Arundo donax*), Himalayan blackberry (*Rubus armeniacus*), big-leaf periwinkle (*Vinca major*), California wild grape (*Vitis californica*), red sesbania (*Sesbania punicea*), poison hemlock (*Conium maculatum*), and American pokeweed (*Phytolacca americana*).

Previous and ongoing efforts to manage and remove Arundo under the CFD have been successful in significantly reducing the quantity within the Project area; to date 4.96 acres of Arundo have been controlled and show no signs of resprouting. Ongoing treatment of an additional 1.3 acres of Arundo within the project reach also shows signs of success with only minor annual follow-up treatment required in recent years.

4.5 Photo Monitoring

Top-of-bank and in-channel photo monitoring is conducted annually at established monitoring locations within Restoration Sites to document change over time. Photos are also taken opportunistically during periodic high-flow events to document hydraulics and Project performance. Photo monitoring of Restoration Sites creates a visual record of vegetation establishment and seasonal change year over year. As aerial photography becomes available, and as the Project budget allows, the riparian buffer width and stream network are also assessed and incorporated into a spatial database (GIS). Results of annual photo monitoring for Groups A, B and C for monitoring year 2019 can be found in **Appendix B** as well as additional photos of Groups A and C in **Appendix A.**

4.6 Spawner Surveys

The Napa County Resource Conservation District (RCD) conducts annual surveys for adult Chinook salmon during the fall and winter spawning season (November - January). In addition, the RCD operates a juvenile salmon and steelhead trapping and tagging program in the lower Napa River each spring (March - June), as smolts migrate out to sea. These monitoring efforts are intended to help gauge the success of ongoing river restoration, provide estimates of salmonid abundance and spawning distributions from one year to the next, and improve our understanding of life history details of salmonids and other native fishes of the Napa River watershed.

During the 2019-2020 spawning season, RCD conducted five kayak surveys in the Napa River spanning 40.2 km (24.9 miles) from Calistoga to Oak Knoll Avenue. The Oakville to Oak Knoll (OVOK) project reach was surveyed on December 19, 2019 and January 9, 2020 as part of this broader effort. Surveys were conducted according to methodology described in the California Salmonid Stream Habitat Restoration Manual published by the California Department of Fish and Wildlife (CDFW 1998). Throughout the surveys, the crew continuously scanned the river for live salmon, spawning redds (nests), and salmon carcasses. The following data, along with geographic coordinates of each observation, were recorded using a field tablet computer:

- Salmon (live) - total count, species, sex
- Salmon (carcass) - total count, species, sex, length, presence/absence of adipose fin, condition
- Redd - total count, species, area, habitat type, occupied/not occupied

The results of the two surveys covering the OVOK project reach are shown in **Table 10**. A total of one live adult Chinook salmon and 10 redds were observed throughout the reach, see **Figure 5** below. Of the ten redds, eight were constructed at riffle crests and two were constructed in runs. The one live fish observed was a female sitting on a fully constructed redd. Based on observations throughout the watershed, it appears that most Chinook spawning activity took place as soon as flow in the Napa River was sufficient to allow for upstream migration. In the 2019-20 spawning season, this likely occurred immediately following storms on December 2nd and 7th.

No Chinook salmon carcasses or partial skeletons were found in the OVOK project reach. Additionally, no carcasses were found in any of the other surveyed reaches of the Napa River during the 2019-20 spawning season. Given the relatively high number of redds and live fish observed this year, the complete absence of carcasses was unusual. The exact reason for the lack of carcasses is unknown but can likely be attributed to some combination of predation, poaching, and lack of detectability due to low water clarity. Additional details and results from the RCD's monitoring program, including smolt trapping and tagging results, will be provided in the 2020 annual report. Previous reports are available on the RCD and WICC websites.

Table 10. Survey details and summarized results of Chinook salmon spawner surveys in the OVOK project reach during the 2019-2020 spawning season.

Survey Dates	December 19, 2019, January 9, 2020
Surveyed Reach Length	13.6 Km (8.4 miles)
Survey Extent	Oakville Cross Road Bridge to Oak Knoll Avenue Bridge
Streamflow Range	76 - 49 CFS*
Live Chinook Salmon Count	1
Chinook Salmon Redd Count	10
Chinook Salmon Carcass Count	0

*Provisional data at time of survey (USGS Gage 11458000, Napa River, Napa)

Figure 5: Redd and live adult survey observation locations

5.0 Summary and Conclusions

Results for monitoring year 2019 indicate that restoration elements implemented thus far (floodplain grading, installed instream habitat strictures, etc.) within Groups A and C are performing as designed. Results of post construction high and low flow monitoring has indicated in-channel restoration areas and features are providing high-flow refuge, instream habitat for various life stage of salmonids, suitable spawning areas and increased ecological and hydraulic function relative to pre-Project conditions.

In general overall percent survivorship for installed vegetation in Group A (Sites 21, 22, and 23) was very good to excellent while overall survivorship in Group C (Sites 12, 13 and 14) varied widely ranging from 0% to 94% depending on the plant species and habitat planting zone. Similarly, native vegetation cover estimates for Groups A and C vary widely with Sites in Group A ranging from 70%-80% while Sites in Group C ranged from 4.3% to 23.3% which should be expected as these Sites were planted in the fall of 2018 and are still establishing. Overall, the Project is providing important foraging and rearing areas for native aquatic and terrestrial wildlife through the creation and enhancement instream, floodplain, and riparian habitat areas.

6.0 References

California Department of Fish and Wildlife (CDFW). 1998. California Salmonid Stream Habitat Restoration Manual. http://www.dfg.ca.gov/fish/Resources/HabitatManual.asp.

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Harris, R.R., S.D. Kocher, J.M. Gerstein and C. Olson. (2005) *Monitoring the Effectiveness of Riparian Vegetation Restoration*. University of California, Center for Forestry, Berkeley, CA. http://forestry.berkeley.edu/comp_proj/DFG/Monitoring%20the%20Effectiveness%20of%20Riparian%20Vegetation%20Restorat.pdf

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Appendix A

Vegetation Establishment Surveys

July 29, 2019

Napa County Flood Control and Water Conservation District
804 First St
Napa, CA, 94559
Attention: MIke Gordon & Andrew Butler

Sent via email:michael.gordon@countyofnapa.org

Subject: OVOK Group A Revegetation Spring 2019 Monitoring Report

Mike,

Attached is the annual monitoring report for OVOK Group A revegetation project. This report covers the first half of the second year of our 3-year maintenance period.

Sincerely,

Will Johnson | Hanford

Napa River Restoration Project
OVOK Group A Sites
Re-Vegetation Project Maintenance and Monitoring
2019 Annual Report Establishment Year 2

I. Discussion of Maintenance Activities

OVOK Group A sites were planted and irrigation installed in late spring 2017. Once the plants and irrigation were installed, Hanford Applied Restoration and Conservation (Hanford) began the first year of plant establishment and maintenance. This report discusses the work that was completed during the first half of the second year of plant establishment and maintenance year as well as the third monitoring event results.

Irrigation

All of the OVOK Group A sites irrigation systems have water provided by adjacent private landowners either by tying directly into their existing irrigation system such as at sites 22 or 23 or via a water tank that is filled with water provided by the vineyard at site 21.

All of the sites have a combination of overhead spray irrigation for seeded areas, and drip irrigation for container plants. These systems were generally installed according to plans. Some field adjustments were made with approval from the County. One adjustment that was made was to use perforated spaghetti around the smaller plug plants such as *Elymus triticoides*. Another alteration was to an erosive slump at site 21 that was re-graded and seeded. This area was added to the irrigation system via the overhead spray irrigation.

Watering events are scheduled as noted in notes 12 and 14 on page R02 of the project plans. Per Hanford's observations no adjustments to the timing and quantity of water were needed in the 2018 water season, however the significant storm season for the winter of 2018-2019 did cause some damage to the irrigation system. Hanford repaired these issues in the Spring of 2019.

Invasive Plant Management

Non-native invasive plants, both listed within the specifications and those that are problematic to the success of natives, were routinely removed from the planting sites. The most intensive non-native removal efforts occur in the early part of the year, between March and May. This is the period of rapid growth and pre-flowering/pre-seed formation stages of plant development. Removed biomass is disposed of away from native plantings and is adequately uprooted so as to prevent re-establishment.

The Vegetation Management Zones were managed in accordance with the timeline provided in General Considerations, Management and Removal Guidelines (Sheet RO2 from the Plans and per sections 21-29 of the technical specifications), first with the objective of eradicating all non-native invasive plant species and second with allowing for establishment of natives. In many cases the areas were treated with herbicide or cleared by hand in order to adequately control non- natives. Over the plant establishment period, the non-native population will be controlled and re-growth of a much smaller distribution is expected leading to a reduction in re-treated plants.

The Invasive Vegetation Management (IVM) Zones A and B were managed in accordance with the General Revegetation notes in the plans on R02, and the Pierce' disease host plant treatment recommendations on R03 of the plans. The host plants identified for removal are tree of heaven (*Alianthus altissima*), giant reed grass (*Arundo donax*), Himalayan blackberry (*Rubus armeniacus*), big-leaf periwinkle (*Vinca major*), California wild grape (*Vitis californica*), red sesbania (*Sesbania punicea*), poison hemlock (*Conium maculatum*), and American pokeweed (*Phytolacca americana*). Hanford did not observe giant reed grass in the invasive and planting vegetation

management zones. In fact, the level of invasive and host plants cover in the IVM zones was less than anticipated. Under the direction of the County, Hanford applied the Year-2 Maintenance Wildflower seeding mix that was left over from spraying the IVM zones to bare areas within the planting sites.

The 2017-18 maintenance season was successful at reducing populations of the species described above. 2018-2019 maintenance visits have consisted of primarily hand weeding that targeted red sesbania. A new spcies was observed by the County and Hanford, black locust (*Robinia psudoacacia*), and was added to the species to control list. Hanford primarily controlled invasive plants via mechanical mowing and hand removal. Hanford visited the sites one to two occasions a month to control species before seed was released in order to reduce non-native plant species populations.

Additionally, the County worked with Hanford under a change order to remove a large patch of prickly pear cactus (*Opuntia spp.*) located along the vineyard road between sites 22 and 23. Hanford removed the large cactus patch via a mini excavator and skid steer to dig out the vegetation and stockpile it a location adjacent to the site. The removal area was seeded and planted with a mixture of snowberry and native rose container plants.

Herbicide applications are a last resort measure and always conducted by personnel with experience in handling and applying chemicals, knowledge of flora in Northern California, and experience in invasive plant management. Only personnel who are qualified applicators as certified by the California Department of Pesticide Regulation conduct or oversee herbicide applications.

In 2017, after the initial mechanical removal of Peirce's disease host and invasive plant species, two herbicide spot treatment events occurred. The primary species that require herbicide spot treatments were periwinkle (*Vinca major*), Himalayan blackberry (*Rubus armeniacus*), poison hemlock (*Conium maculatum*), and crabgrass (*Digitaria ischaemum*) were targeted with herbicide applications. Overall there were less observed invasive species identified in the area. The 2016 – 2017 targeted treatments have succeeded in reducing these target species populations. Hanford has observed a few patches of Himalayan blackberry and periwinkle that will be spot foliar treated later this summer. Additionally, there is a patch of giant reed grass observed between sites 21 and 22. These patches will be treated via cut stump method as described in the project specifications.

Himalayan blackberry and periwinkle will be treated with Roundup Custom®. This chemical is an aquatic formulation of glyphosate without surfactants. Glyphosate is applied at 3%. Spray mix includes an indicator dye (at 1% solution) and non-ionic vegetable oil surfactant (at 1.5%). Water for dilution was sourced from the irrigation system via quick coupler. The giant reed grass will be treated via a solution of full concentration Garlon (triclopyr) applied via cut-stump method.

Monthly Establishment Records

Maintenance is ongoing and is conducted between March and October per Establishment Year. Maintenance activities consisted of:

- Hand removing weeds from the direct vicinity of native plant basins to reduce competition.
- Running irrigation systems. Calling private landowners, coordinating with winery personnel, opening and closing station/gate valves, and checking for functionality across entire system.
- Hand watering willow benches and sections using supplemental overhead sprinklers or hose.
- Fixing line breaks or replacing clogged drip emitters in irrigation systems.
- Applying herbicide to specific stands of non-native plants within Vegetation Management Zones.
- Monitoring (plant counts, photo points, surveys).
- Winterizing (capping) the overhead sprinkler system.

II. Monitoring Results – All Sites

On June 17, 2019 the third vegetation monitoring survey of the three primary sites and the riparian enhancement zone (REZ) was completed. Hanford observed that the herbaceous cover at the three sites is primarily native-dominated, especially by perennial grasses, foothill penstemon, and poppies. Bare areas were minimal in most zones; however, the lower riparian slope zone have the most spots with bare areas. See Appendix A for the photo monitoring points. See Appendix B for a summary table of the results of the monitoring visit. Also included with this report is the excel spreadsheet of the results.

Progress toward Plant Establishment

The four planting sites, Site 21-23 and the REZ, were planted in April-May of 2017. The five planting zones were installed per plan except for the River Wet Edge and the Lower Floodplain Bench. These zones were combined after the 2016-2017 winter season greatly transformed the gravel bars in this stretch of the river.

Monitoring results indicate that the majority of installed native plants are surviving and thriving. Black walnut (*Juglans californica*), big-leaf maple (*Acer macrophyllum*), valley oak (*Quercus lobata*), yarrow (*Achillea millefolium*), foothill penstemon (*Penstemon heteropyllus*), (*Rosa californica*), snowberry (*Symphoricarpus albus*), and rushes (*Juncus* spp.) are among the best performing species in regards to survivorship and volunteer recruitment at the site. The 2019 monitoring event confirms that the sites continue to perform well.

Adaptive management to facilitate the recruitment of volunteer species and success of installed plants is ongoing and includes:

- Minimizing large-scale disturbance events (clearing, grading) to the site, as this typically facilitates the establishment and spread of non-native invasive plants.
- Maximizing the amount of water provided directly to natives (minimizing run-off to non-target plants).
- Maximizing water retention by replenishing/refreshing wood chip mulch around plantings or by reconstructing berms and plant basins on slopes.
- Focusing weed abatement efforts on target list species only with secondary priorities on problematic invasive plant species that have the tendency to spread.
- Reducing populations of non-native invasive plant species by trimming/cutting flowering or aboveground structures when they cannot be fully eradicated – by temporarily reducing the ability to spread and/or reproduce, or by continually stressing these plant species, it increases the chances of later controlling them fully.

Plant Replacements

The County initiated a change order for installing additional container plants in the Spring of 2018. These plants are not considered replacement plants and were used to infill some locations at Sites 21 and 22. Hanford installed an additional 25 10-gallon oak trees along the tops of the river banks at vineyard road at site 21. Hanford installed 4,405 additional plants throughout the sites. See Appendix C for a summary of the species planted.

These plants were not easily distinguished from those planted in 2017 by the monitor so some of these plants were likely included in the counts for the June 2019 monitoring visit.

APPENDIX A

OVOK Group A Sites Revegetation

May 2019 Photo Monitoring

Riparian Enhancement Zone (REZ) - Photo Point 1 TOP: May 9, 2018 BOTTOM: June 17, 2019

Riparian Enhancement Zone (REZ) - Photo Point 2 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 21 - Photo Point 1 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 21 - Photo Point 2 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 21 - Photo Point 3 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 22 - Photo 1 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 22 - Photo Point 2 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 22 - Photo Point 3 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 22 - Photo Point 4

TOP: May 9, 2018

BOTTOM: June 17, 2019

Site 23 - Photo Point 1 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 23 - Photo Point 2 TOP: May 9, 2018 BOTTOM: June 17, 2019

Site 23 - Photo Point 3

TOP: May 9, 2018

BOTTOM: June 17, 2019

Site 23 - Photo Point 4 TOP: May 9, 2018 BOTTOM: June 17, 2019

APPENDIX B

OVOK Group A Sites Revegetation

2019 Monitoring Results Table

Table 1.0 – June 2019 Monitoring Event – Percent Cover Results

HABITAT	SITE 21 - % COVER			SITE 22 - % COVER			SITE 23 - % COVER			REZ - % COVER		
	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE	NATIVE	NON-NATIVE	BARE
River Wet Edge	Not Applicable			75	20	5	80	15	5	Not Applicable		
Lower Floodplain Bench				80	15	5	85	10	5			
Lower Riparian Slope	80	15	5	70	25	5	85	10	5			
Upper Riparian Slope	70	20	10	70	25	5	80	15	5			
Transitional Upland Oak Woodland	Not Applicable			65	30	5	85	10	5	85	10	5

Table 2.0 – June 2019 Monitoring Event – Total Survivorship Per Site and Habitat Type

HABITAT	SITE 21		SITE 22		SITE 23		REZ	
	Total Planted	Total % Survived	Total Planted	Total % Survived	Total Planted	Total % Survived	Total Planted	Total % Survived
River Wet Edge	Not Applicable		578	91.9%	248	94.4%	Not Applicable	
Lower Floodplain Bench			640	93.9%	116	92.2%		
Lower Riparian Slope	783	100.0%	1979	99.6%	1365	99.9%		
Upper Riparian Slope	1785	99.7%	2906	99.7%	1246	99.7%		
Transitional Upland Oak Woodland	Not Applicable		442	98.2%	658	99.1%	593	100%

APPENDIX B

OVOK Group A Sites Revegetation

2019 Change Order # 8 Additional Plant List

APPENDIX C

OVOK GROUP A - CHANGE ORDER # 8- PLANT LIST			
Common Name	Scientific	Size	Quantity
Coast Live Oak	*Quercus agrifolia*	1 gallon	10
Valley Oak	*Quercus lobota*	1 gallon	5
California lilac	*Ceanothus* 'Concha'	1 gallon	20
Bush Monkey Flower	*Mimulus aurantiacus*	1 gallon	55
Silver Bush lupine	*Lupinus albifrons*	1 gallon	55
California Buckwheat	*Eriogonum fasciculatum*	1 gallon	55
Foothil Penstemon	*Penstemon heterophyllus*	1 gallon	40
California Fuchsia	*Epilobium canum*	1 gallon	30
Brown Dogwood	*Cornus glabrata*	1 gallon	20
California Rose	*Rosa californica*	1 gallon	30
Snowberry	*Symphoricarpos mollis*	1 gallon	15
Coyote Brush	*Baccharis pilularis*	1 gallon	25
Cottonwood	*Populus fremontii*	1 gallon	35
Oregon Ash	*Fraxinus latifolia*	1 gallon	10
Coast Live Oak	*Quercus agrifolia*	10 gallon*	15
Valley Oak	*Quercus lobota*	10 gallon*	10
Santa Barbara Sedge	*Carex barbarae*	Liner**	3,000
Creeping Wild Rye	*Elymus triticoides*	Liner**	1,000
Total			**4,430**

* This size of oak was planted along the top of bank and along the vineyard road at site 21

** These species were planted along the creek at site 22 in wetland elevations.

*** Unless noted otherwise, these plants we installed primarily at site 21

October 18th, 2019

Napa County Flood Control & Water Conservation District
804 1st St. Napa, CA
Attention: Mike Gordon and Andrew Butler
Sent via email

Subject: OVOK Group C Revegetation – 2019 Annual Report

Mike,

Please see enclosed report. Let me know if you have any questions or comments.

Best,

Will Johnson
Project Manager
Hanford ARC
(707) 766-4905

GROUP C REVEGETATION – OAKVILLE TO OAK KNOLL
2019 ANNUAL REPORT






DISCUSSION OF MAINTENANCE ACTIVITIES & INVASIVE WEED MANAGEMENT

Maintenance is ongoing and is conducted between March and October. Maintenance activities consist of:

- Hand removing weeds from the direct vicinity of native plant basins to reduce competition.
- Running irrigation systems, calling private landowners, coordinating with winery personnel, opening and closing station/gate valves, and checking for functionality across systems.
- Hand watering willow benches and sections using supplemental overhead sprinklers or hoses.
- Fixing line breaks or replacing clogged drip emitters in irrigation systems.
- Applying herbicide to specific stands of non-native plants within Vegetation Management Zones.
- Monitoring (plant counts, photo points, surveys).
- Winterizing (capping) the overhead sprinkler system.

Intensive non-native and invasive plant management occurred in the early part of the growing season (March – May). This is the period of rapid growth and pre-flowering/pre-seed formation stage of weeds. Crews used a combination of hand tools and gasoline-powered equipment (brush-cutters, weedwhackers) to control weeds in and around planted areas. Cut or pulled material was typically piled away from natives in open/bare areas. As of October 2019, crews are currently performing late season mowing/clearing of annuals and sweet clover/mustard site-wide.

Crews spent significant time in the early spring (February 2019) repairing and retrofitting irrigation system components that were damaged during high flows.

DISCUSSION OF MONITORING RESULTS

Spring surveys, including photo monitoring and herbaceous cover, were performed in late April and early May 2019. Fall surveys (including photo monitoring and a complete census of trees, shrubs, and vines) were performed in early September 2019.

Appendix A includes photo comparisons from spring and fall 2019 for 28 photo points across the sites. Most of the photos show an increase in vegetation although some, where annuals were dominant, are sparser as germinating fall rains had not happened before the fall photos were taken.

Appendix B is a summary table of the results of the spring vegetation monitoring visits. These surveys were performed on May 2nd, 6th, and 9th of 2019 across the three sites. For each site and habitat type an average percent cover of native, non-native and bare dirt are presented along with the dominate native and non-native species for each site and habitat type. The method for sampling for each site included choosing a random direction within each habitat type and walking a random number of steps then using a meter square and CNPS percent cover diagrams to estimate percent cover by natives and non-natives within each plot as well as noting the dominate species within each plot. In total 146 plots were measured with 13 plots completed on site 12, the smallest site; 75 plots completed for site 13, the largest site; and 58 plots completed on site 14. Around five and seven plots were measured per acre to provide an estimate of percent coverage across the entire site. The primary cover at all three sites was bare soil followed by non-native cover and then native cover. This is not surprising given the drastic flooding the site endured during the 2018/2019 winter which washed out some of the site including some seed. While the percent cover was not dominated by native plants there was a large number of smaller native plants present and given time they should fill in and give good coverage in future years.

Appendix C provides the data from a complete census of all trees, shrubs, and vines (as labeled in the specifications) by habitat type across the project as compared to the original specifications. The census was completed on September 3rd, 4th, 6th, 10th, 11th, and 12th. Overall the species that were counted were in good health and vigor and it was easy to distinguish between dead and thriving plants. There were two species in the specifications which were not delivered to the project at all, the *Ribes californicum* (California gooseberry) and *Aristolochia californica* (pipe vine), so these show a 0% survivorship rate although they were never planted. *Salix lasiolepis* (arroyo willow) was also delivered and planted although not in the original specification. Some species had unusually low percent survival including *Alnus rhombifolia* (white alder) which could be because it was either hidden or overwhelmed by the thicket of *Populus fremontii* (Fremont's cottonwood) along the river's edge. Other species that had low percent survival rates include *Ceanothus cuneatus* (buck brush), *Umbellularia californica* (bay laurel), *Lonicera hispidula* (honeysuckle), and *Aesculus californica* (California buckeye). There were several dead buck brush found in the census and *Ceanothus* sp. can be very particular about site conditions which may have been challenging for this species. The honeysuckle is a low growing vine and in areas with a lot of weed cover, especially areas with *Kickxia* sp. (fluellin), it was hard to detect surviving honeysuckle. The survey was done in early September as the specifications require but it was found that the California buckeye trees had already all lost their leaves and were hard to find and determine if they were dead or alive so next year, 2020, the survey will be done earlier, in August, to see if this can more adequately capture the survivorship of this species. Some species did very well and the percent counted is above the number of plants on the specification and this is due to prolific volunteers. Fremont's cottonwood, *Baccharis pilularis* (coyote bush), *Juglans californica* (California black walnut) and *Quercus lobata* (valley oak) in particular had a large number of volunteers that were found. Across all three sites the overall percent survivorship, comparing those counted to the specifications, was 79%. When looking at the overall survivorship for each site, site 12 had a 103% survivorship, site 13 had a 100% survivorship, while site 14 had 63% survivorship. This may be in part due to site 14 having a large amount of soil that was moved during flooding and also a lower number of volunteers compared to the other two sites.

SUGGESTED ADAPTIVE MANAGEMENT

Adaptive management to facilitate the recruitment of volunteer species and success of installed plants is ongoing and includes:

- Minimizing large-scale disturbance events (clearing, grading) to the site, as this typically facilitates the establishment and spread of non-native invasive plants.
- Maximizing the amount of water provided directly to natives (minimizing run-off to non-target plants).
- Maximizing water retention by replenishing/refreshing wood chip mulch around plantings or by reconstructing berms and plant basins on slopes.
- Focusing weed abatement efforts on target list species only with secondary priorities on problematic invasive plant species that have the tendency to spread.
- Reducing populations of non-native invasive plant species by trimming/cutting flowering or aboveground structures when they cannot be fully eradicated – by temporarily reducing the ability to spread and/or reproduce, or by continually stressing these plant species, it increases the chances of later controlling them fully.

Upcoming work (as of October 2019) includes:

- Seeding in gaps and bare areas. Hanford will hand-broadcast seed into bare or weed thatch covered areas this fall.

- Crews will rake/clear thatch from small “island” areas within larger thatch areas. These islands will be prepped and seeded. The islands will act as native vegetation stands.
- The intended effect is a small source population of native plants within a larger weedy-dominated area. This same process will be repeated in October 2020.
- Seed will be transitional oak woodland/upper slope mix.
- Adjustment of irrigation to well established native herbaceous species (wild rye, deergrass) based on their growth/size, to promote lateral spread and reduce weed establishment.
- Crews will remove emitters and/or discontinue irrigation to these areas/plants as feasible.
- Crews will perform 2/3 mow on native grass stands this fall in order to stimulate growth and to spread/distribute native seed heads.
- Crews will install native plants in blackberry removal area, especially at the downstream end, and will seed passively in the entire area.
- Plant list/quantity previously provided to Hanford below:

Plant name	Size	FCD requested amounts/quantity
Buckeye	Treepot 4	10
Live oak	Treepot 4	10
Valley oak	Treepot 4	10
Coyotebrush	Deepot 40	20
Snowberry	Gallon	150
Santa barbara sedge	Liner	200

MAINTENANCE RECORDS/HOURS

Attached is a summary of crew hours on-site, split by task type.

Appendix A

Photo Monitoring 2019

PP 1 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 2 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 3 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 4 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 5 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 6 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 7 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 8 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 9 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 10 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 11 TOP: April 23, 2019 BOTTOM: September 11, 2019

PP 12 TOP: April 23, 2019 BOTTOM: September 12, 2019

PP 13 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 14 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 15 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 16 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 17 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 18 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 19 TOP: April 23, 2019 BOTTOM: September 6, 2019

PP 20 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 21 TOP: April 23, 2019 BOTTOM: September 6, 2019

PP 22 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 23 (Top: Facing S towards River, Bottom: Facing N away from river) TOP (both): April 23, 2019 BOTTOM: S

PP 24 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 25 (Top: Facing E, Bottom: Facing S towards the river) TOP (both): April 23, 2019

PP 26 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 27 TOP: April 23, 2019 BOTTOM: September 3, 2019

PP 28 TOP: April 23, 2019 BOTTOM: September 3, 2109

Appendix A1

Photo Point Map 2019


Hanford Napa River Oak Reach Map
Photo Monitoring Photo Point Map
Legend
Photo Points
pp 16
PP 19
pp 18
pp 17
PP 13
pp 15
pp 14
PP 25
PP 22
PP 12
PP 21
PP 4
PP 3
PP 20
PP 23
PP 2
PP 5
PP 24
PP 27
PP 11
PP 26
PP 6
PP 7
PP 1
PP 28
PP 8
PP 9
PP 10
Yountville Cross Rd
Google Earth
© 2018 Google
1000 ft
N

Appendix B

Vegetation
Composition and
Percent Cover Data

Appendix B - Spring 2019 Monitoring Event- Percent Cover Results

Habitat	Site 12					Site 13					Site 14				
	% Cover					% Cover					% Cover				
	Native	Non-Native	Bare	Dominate Native	Dominate Non-Native	Native	Non-Native	Bare	Dominate Native	Dominate Non-Native	Native	Non-Native	Bare	Dominate Native	Dominate Non-Native
Invasive Vegetation Management	9.4	64.6	26.0	*Carex barbarae, Rosa californica*	*Brassica sp., Carduus pycnocephalus*	3.1	29.3	67.6	Diverse: *Bromus hordeaceus, Hordeum murinum, Festuca perennis*	*Elymus triticoides, Cyperus sp.*	17.6	56.9	25.5	*Brodiaea sp., Artemisia douglasiana*	*Festuca perennis, Bromus hordeaceus, Medicago polymorpha*
Lower Floodplain Bench	Not Applicable					12.0	10.5	77.5	*Cyperus sp., Sisyrinchium bellum*	*Medicago polymorpha*	23.3	6.7	70.0	*Carex Barbarae, Elymus triticoides, Hordeum brachyantherum*	*Bromus hordeaceus, Festuca perennis*
Lower Floodplain Slope	12.0	3.0	85.0	*Salix sp., Cyperus sp.*	*Portulaca oleracea*	Not Applicable					5.0	10.0	85.0	*Salix sp., Carex barbarae*	*Bromus hordeaceus, Helminthotheca echioides*
Lower Riparian Slope	4.3	5.7	90.0	*Carex barbarae, Festuca idahoensis*	*Hordeum murinum, Medicago polymorpha*	6.7	21.2	72.2	*Layia platyglossa, Euthamia occidentalis*	*Bromus hordeaceus, Medicago polymorpha*	20.4	12.9	66.7	Diverse: *Lupinus bicolor, Festuca idahoensis, Elymus triticoides*	*Bromus hordeaceus, Vicia sp., Festuca perennis*
River Wet Edge	9.0	6.0	85.0	*Salix sp., Xanthium strumarium*	*Medicago polymorpha*	15.0	0.8	84.2	*Salix sp.*	*Medicago polymorpha*	10.5	2.2	87.3	*Cyperus sp., Xanthium strumarium*	*Medicago polymorpha*
Seasonal Wetland	Not Applicable					10.8	8.4	80.8	*Cyperus sp.*	*Medicago polymorpha*	Not Applicable				
Transitional Oak Woodland						5.5	33.7	60.8	*Juncus sp., Elymus glaucus*	*Medicago polymorpha, Bromus hordeaceus*					
Upper Riparian Slope	5.7	34.3	60.0	*Carex barbarae*	*Bromus hordeaceus, Hordeum murinum*	6.8	25.0	68.2	Diverse: *Festuca idahoensis, Euthamia sp., Hordeum brachyantherum*	*Medicago polymorpha, Hordeum murinum*	15.3	19.2	65.5	Diverse: *Elymus glaucus, Festuca idahoensis, Penstemon heterophyllus, Achillea millefolium*	*Helminthotheca echioides, Festuca arundinacea, Medicago polymorpha.*

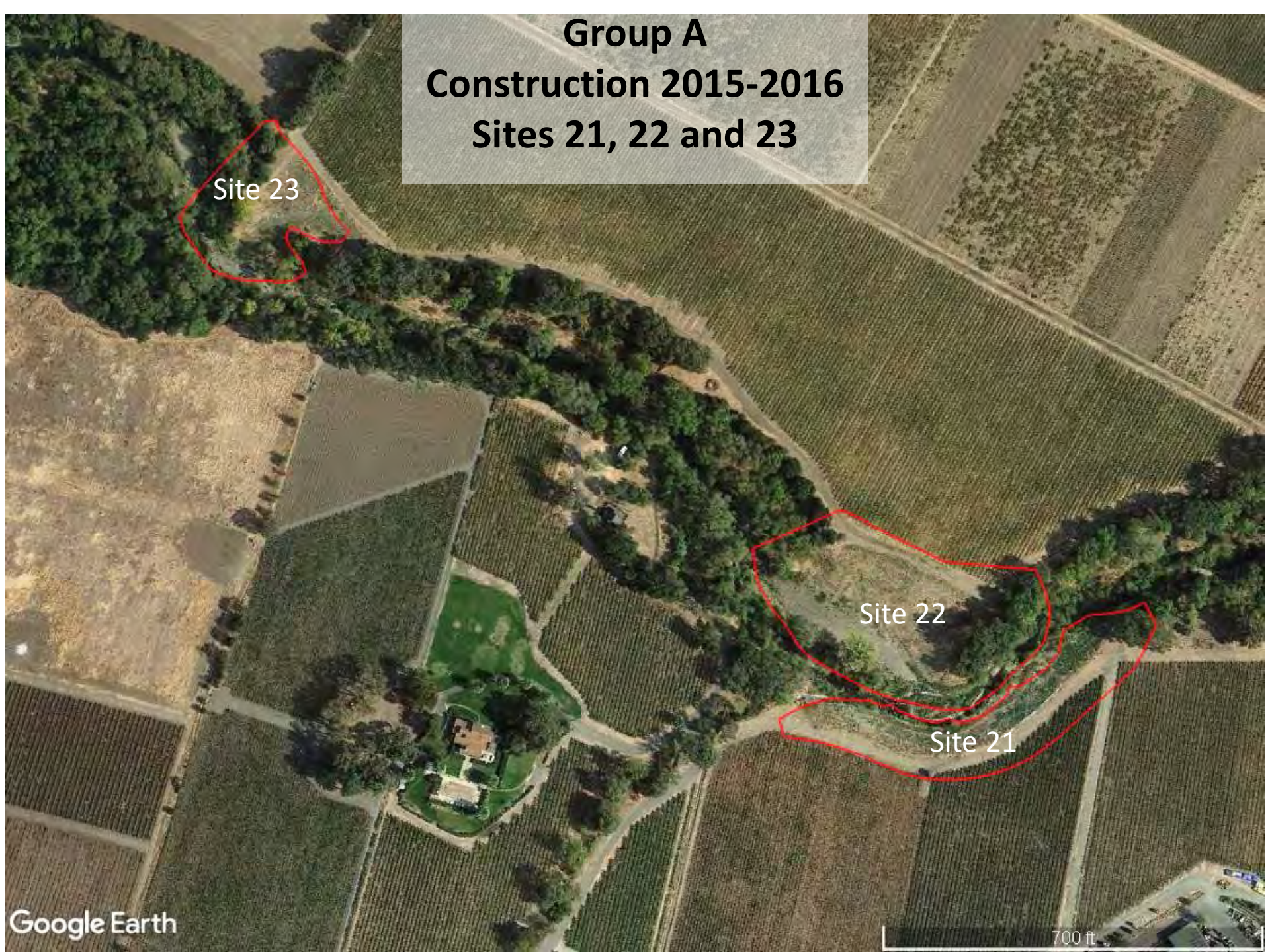
Appendix C

Census by Habitat
Type Data

SPECIES	TYPE	TOTAL INVASIVE PLANT MANAGEMENT IN PLAN	TOTAL INVASIVE PLANT MANAGEMENT COUNTED	% SURVIVORSHIP IN INVASIVE PLANT MANAGEMENT	TOTAL LOWER FLOODPLAIN SLOPE IN PLAN	TOTAL LOWER FLOODPLAIN SLOPE COUNTED	% SURVIVORSHIP IN LOWER FLOODPLAIN SLOPE	TOTAL LOWER FLOODPLAIN BENCH IN PLAN	TOTAL LOWER FLOODPLAIN BENCH COUNTED	% SURVIVORSHIP IN LOWER FLOODPLAIN BENCH	TOTAL LOWER RIPARIAN SLOPE IN PLAN	TOTAL LOWER RIPARIAN SLOPE COUNTED	% SURVIVORSHIP IN LOWER RIPARIAN SLOPE	TOTAL UPPER RIPARIAN SLOPE IN PLAN	TOTAL UPPER RIPARIAN SLOPE COUNTED	% SURVIVORSHIP IN UPPER RIPARIAN SLOPE	TOTAL TRANSITIONAL OAK WOODLAND IN PLAN	TOTAL TRANSITIONAL OAK WOODLAND COUNTED	% SURVIVORSHIP IN TRANSITIONAL OAK WOODLAND
Acer macrophyllum big leaf maple	tree	0	5	N/A	0	0		0	0		0	1	N/A	157	46	29%	0	0	
Aesculus californica CA buckeye	tree	54	9	17%	0	0		0	0		0	0		139	41	29%	9	0	0%
Alnus rhombifolia white alder	tree	0	1	N/A	6	0	0%	148	20	14%	255	12	5%	2	0	0%	0	0	
Fraxinus latifolia OR ash	tree	0	0		0	0		20	13	65%	93	95	102%	117	114	97%	0	0	
Juglans californica CA black walnut	tree	5	4	80%	0	0		0	0		0	2	N/A	7	10	143%	0	0	
Populus fremontii Fremont's cottonwood	tree	0	0		0	0		59	197	334%	246	254	103%	76	120	158%	0	0	
Quercus agrifolia coast live oak	tree	52	23	44%	0	0		0	0		11	6	55%	103	74	72%	14	3	21%
Quercus lobata valley oak	tree	52	22	42%	0	0		0	0		50	9	18%	112	217	194%	14	2	14%
Salix lasiolepis arroyo willow	tree	0	0	N/A	0	0		0	0		0	1	N/A	0	9	N/A	0	0	
Umbellularia californica bay laurel	tree	0	1	N/A	0	0		0	0		0	0		37	7	19%	0	0	
Achillea millefolium yarrow	shrub	69	75	109%	0	0		0	0		0	18	N/A	312	286	92%	27	13	48%
Baccharis pilularis coyote bush	shrub	131	137	105%	0	0		0	7	N/A	113	46	41%	172	387	225%	0	25	N/A

SPECIES	TYPE	TOTAL INVASIVE PLANT MANAGEMENT IN PLAN	TOTAL INVASIVE PLANT MANAGEMENT COUNTED	% SURVIVORSHIP IN INVASIVE PLANT MANAGEMENT	TOTAL LOWER FLOODPLAIN SLOPE IN PLAN	TOTAL LOWER FLOODPLAIN SLOPE COUNTED	% SURVIVORSHIP IN LOWER FLOODPLAIN SLOPE	TOTAL LOWER FLOODPLAIN BENCH IN PLAN	TOTAL LOWER FLOODPLAIN BENCH COUNTED	% SURVIVORSHIP IN LOWER FLOODPLAIN BENCH	TOTAL LOWER RIPARIAN SLOPE IN PLAN	TOTAL LOWER RIPARIAN SLOPE COUNTED	% SURVIVORSHIP IN LOWER RIPARIAN SLOPE	TOTAL UPPER RIPARIAN SLOPE IN PLAN	TOTAL UPPER RIPARIAN SLOPE COUNTED	% SURVIVORSHIP IN UPPER RIPARIAN SLOPE	TOTAL TRANSITIONAL OAK WOODLAND IN PLAN	TOTAL TRANSITIONAL OAK WOODLAND COUNTED	% SURVIVORSHIP IN TRANSITIONAL OAK WOODLAND
Baccharis salicifolia mule fat	shrub	0	7	N/A	0	0		40	0	0%	0	3	N/A	0	1	N/A	0	21	N/A
Calycanthus occidentalis Western spice bush	shrub	0	33	N/A	0	0		0	0		0	0		170	111	65%	14	12	86%
Ceanothus cuneatus buck brush	shrub	0	3	N/A	0	0		0	0		0	0		0	11	N/A	67	0	0%
Heteromeles arbutifolia toyon	shrub	54	9	17%	0	0		0	0		0	0		120	108	90%	10	2	20%
Physocarpus capitatus ninebark	shrub	0	24	N/A	0	0		0	0		88	22	25%	117	152	130%	0	0	
Ribes californicum CA gooseberry	shrub	0	0		0	0		0	0		0	0		74	0	0%	0	0	
Rosa californica CA wild rose	shrub	203	121	60%	0	0		47	6	13%	194	66	34%	372	573	154%	10	15	150%
Sambucus nigra ssp. caerulea elderberry	shrub	0	92	N/A	0	0		0	0		14	1	7%	190	33	17%	0	14	N/A
Symphoricarpos albus snowberry	shrub	0	4	N/A	0	0		40	12	30%	290	93	32%	409	446	109%	0	0	
Aristolochia californica pipe vine	vine	0	0		0	0		0	0		0	0		157	0	0%	0	0	
Lonicera hispidula honeysuckle	vine	0	2	N/A	0	0		0	0		0	0		117	23	20%	0	1	N/A
		620	**567**	**91%**	**6**	**0**	**0%**	**354**	**255**	**72%**	**1,354**	**629**	**46%**	**2,960**	**2,769**	**94%**	**165**	**108**	**65%**

Appendix B
Photographic Monitoring
2019


Group A
Construction 2015-2016
Sites 21, 22 and 23
Site 23
Site 22
Site 21
Google Earth
700 ft

Group A, Site 21

July 2016

January 2017

May 2018

March 2019

Group A, Site 21

July 2016

January 2017

May 2018

March 2019

Group A, Site 22

July 2016

March 2017

September 2019

Low flow channel - September 2016

Group A, Site 22

September 2016

January 2017

September 2019

Group A, Site 22

July 2016

January 2017

September 2018

September 2019

Group A, Site 23

May 2016

July 2017

September 2019

In channel perspective - September 2017

Group A, Site 23

May 2017

September 2017

September 2018


Group C
Construction 2017-2018
Sites 12, 13 and 14
Site 13
Site 12
Site 14
Google Earth
1000 ft

Group C, Site 12 and 13

September 2017

November 2017

April 2018

March 2019

Group C, Site 13

September 2017

November 2017

April 2018

March 2019

Group C, Site 13

September 2017

April 2018

April 2018

May 2019

Group C - Site 13

Backwater/secondary channel

October 2017

Wetland feature – May 2019

March 2019

Group C, Site 14

September 2016

November 2017

May 2017

March 2019

Group C, Site 14

September 2016

September 2017

March 2019

Group C, Site 14

November 2016

April 2018

March 2019

March 2019

Group C, Site 14

November 2016

April 2017

April 2018

March 2019

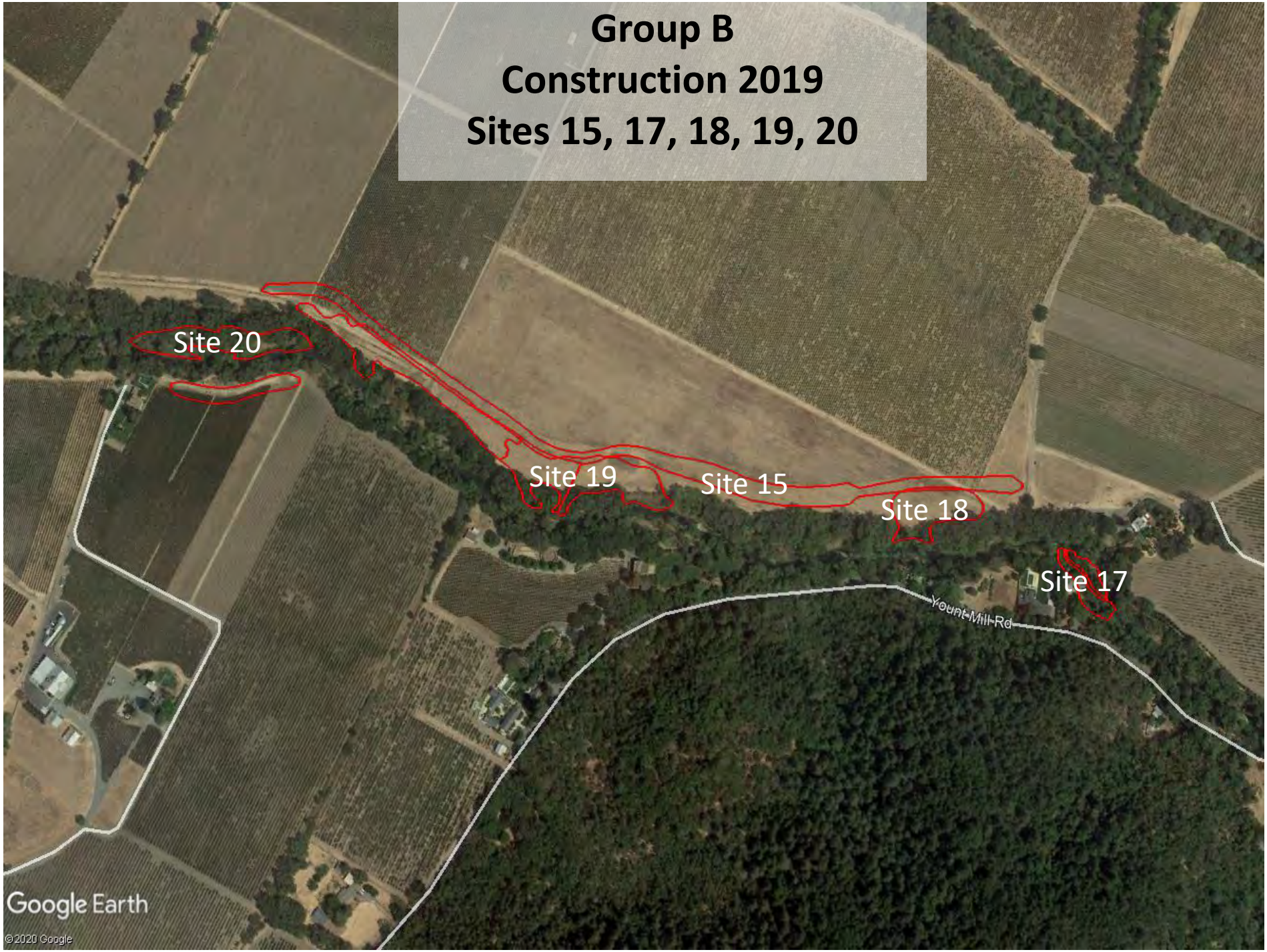
Group C, Site 14

November 2016

April 2017

August 2018

March 2019


Group B
Construction 2019
Sites 15, 17, 18, 19, 20
Site 20
Site 19
Site 15
Site 18
Site 17
Yount Mill Rd
Google Earth
©2020 Google

Group B - Site 15

November 2017

November 2019

November 2017

November 2019

Group B - Site 15

November 2017

November 2019

November 2017

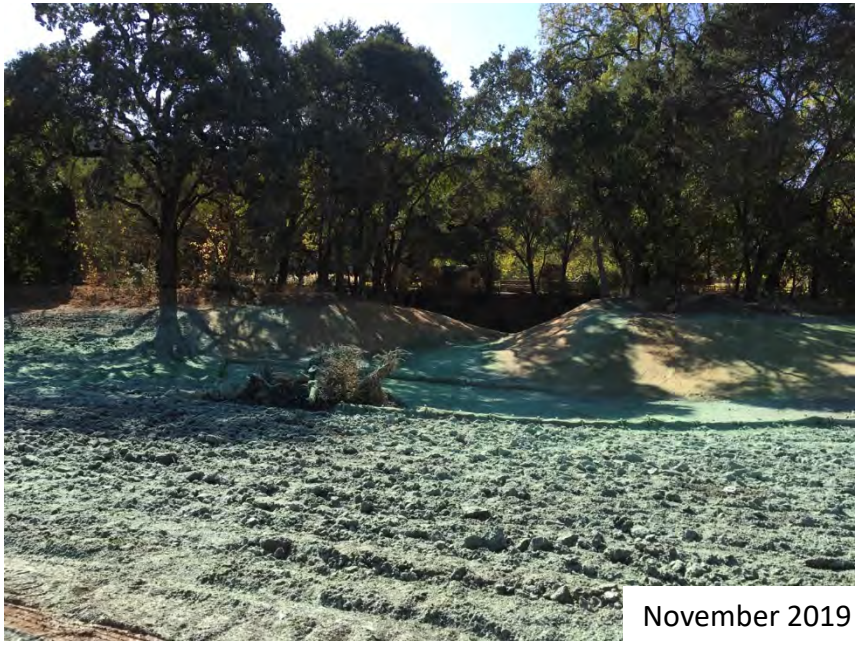
November 2019

Group B - Site 15

November 2017

November 2019

November 2017



November 2019

Group B - Site 17

November 2019

Group B - Site 18

November 2017

November 2019

November 2017

November 2019

Group B - Site 18

November 2017

November 2019

November 2017

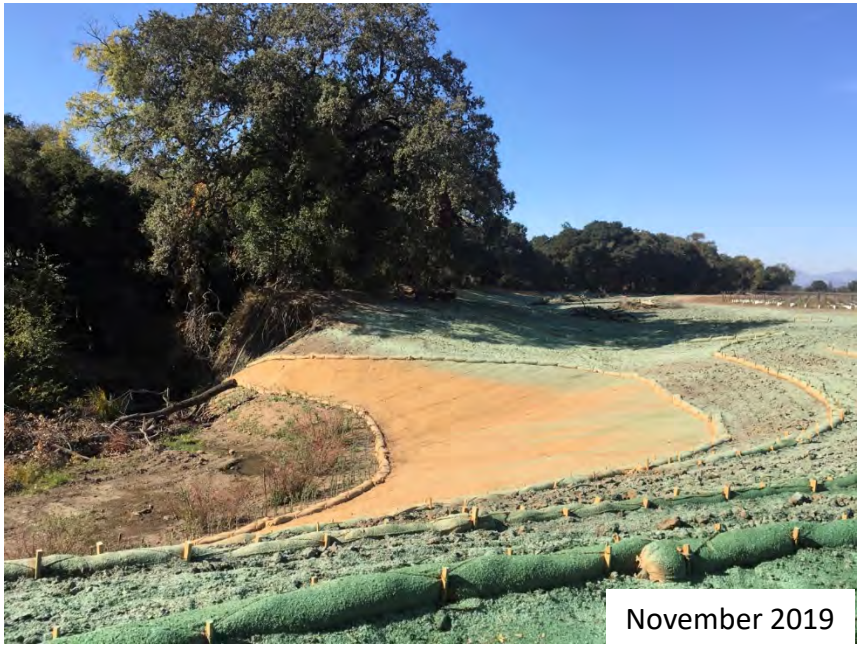
November 2019

Group B - Site 19

November 2017

November 2019

November 2017



November 2019

Group B - Site 20

November 2017

November 2019

November 2017

November 2019

Group B - Site 20

November 2017

November 2019

November 2017

November 2019

Group B - Site 20

November 2017

November 2019

November 2019