NAPA RIVER RUTHERFORD REACH RESTORATION PROJECT
2013 MONITORING REPORT

April 2014

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Introduction

The purpose of this document is to report on the results of the Monitoring Program for the Napa River Rutherford Reach Restoration Project (the Project) performed through December 2013.Napa County has conducted the monitoring program in accordance with the various Project permits as defined in the approved ***Monitoring Plan for the Rutherford Reach Restoration of the Napa River*** (2009, Rev 1/2011).The Monitoring Plan and associated Annual Monitoring Reports can be accessed online at the Napa County Watershed Information Center and Conservancy (WICC) document repository for the Rutherford Reach Restoration Project:

http://www.napawatersheds.org/app_folders/view/5502

The Monitoring Plan outlines a comprehensive monitoring framework and defines protocols for evaluating environmental parameters that provide measures of long term restoration effectiveness. Refer to the Monitoring Plan for specific field protocols, schedules, and field data sheets used to evaluate project effectiveness monitoring parameters.

This document is intended for review by resource agencies, the public, and members of the Rutherford Dust Restoration Team, which includes local landowners and/or their representatives, Napa County, and the Napa County Resource Conservation (RCD).

This report documents the Project elements implemented to date. This report also provides an executive summary of the progress that has been achieved towards meeting the performance standards set for each of the Project goals. The Project goals are organized into four categories:

- Sediment Load Reductions and Increased Channel Morphology Complexity
- Aquatic Habitat Enhancement
- Riparian Habitat Enhancement
- Ongoing Stakeholder Participation

The results of the individual monitoring studies supporting the assessment of whether the Project goals have been achieved, including all data, figures, graphs and photographs, are presented in the report Appendices.

Regulatory Compliance

The California Environmental Quality Act (CEQA) review was completed for the Project in 2008.The Project Initial Study/Mitigated Negative Notice of Determination is on file (State Clearing House No. 2008082086).

The regulatory permits acquired for the entire 4.5 mile Rutherford Reach Restoration Project include:

- USACE CWA 404 Permit (No. 2008-00366N), with construction phase reviews for updated wetland delineations and cultural resources.
- Project Biological Assessment: NMFS and USFWS biological opinions
- California Natural Diversity Database Record Search
- County Grading and Floodplain Management permit: the project has been determined to be in compliance with County grading and floodplain management ordinances through completion and submittal to FEMA of a Conditional Letter of Map Revision (CLOMR) in 2008.

The regulatory permits which are issued by restoration implementation (construction) phase include:

- RWQCB 401 Water Quality Certifications
- CDFG 1602 Streambed Alternation Permits

See **Appendix A. Regulatory Permit Summary** for detailed tables of information on existing Project permits and regulatory contact information

As of this report submittal, the Project has acquired all required permits to implement construction in Phases 1 through 4, encompassing Reaches 1-4, between the Zinfandel Lane and Rutherford Cross Road Bridges, and Reach 8 midway between the Rutherford and Oakville Cross Roads. Final design and permitting of Phase 5, Reaches 6,7 and 9 commenced in fall 2012. Phase 5 permits are expected to be obtained by April 2014 for construction in summer 2014. Construction of the entire Project is anticipated to be complete by December 2014 The implementation of the project should be complete by the end of 2017, following three years of vegetation establishment and maintenance in Phase 5. Beginning in 2018,longterm monitoring and maintenance of the channel will be conducted under the Napa River Rutherford Reach Special Benefit Zone Maintenance Assessment District, which is funded by all of the landowners with riverfront property between Zinfandel Lane and the Oakville Cross Road, and managed in association with Napa County Flood Control District staff.

Project Setting

The Napa River Rutherford Reach Restoration Project is being implemented along a 4.5-mile reach of the mainstem Napa River south of the City of Saint Helena between Zinfandel Lane and the Oakville Cross Road. This reach is comprised of approximately 40 parcels owned and managed by 29 different private entities. Historic changes in land use and management in the Napa River watershed have resulted in confinement of the river into a narrow channel, loss of riparian and wetland habitats, accelerated channel incision and bank erosion, and ongoing channel degradation. Properties along the Rutherford Reach have been subject to bank instability and failure leading to the loss of land, excessive sedimentation in the river and costly repairs.

The Napa River Rutherford Reach Restoration is a landowner-initiated project that aims to reduce existing bank erosion and enhance riparian and aquatic habitats using a suite of approaches, including: setting back earthen berms from the top of the river bank; creating vegetated buffers between the river and adjacent land uses; excavating and planting inset floodplain benches (1.5- to 2-year flood recurrence interval); creating backwater habitat to provide high-flow refugia for native fish; removing non-native invasive and Pierce's disease host species (e.g., Himalayan blackberry, periwinkle, giant reed, tree-of-heaven); planting native understory species; installing biotechnical bank stabilization to stabilize actively eroding banks; and, installing instream structures to improve aquatic habitat.

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 Pierces's Disease host plant removal; and, repairing (as needed) instream habitat structures and other constructed instream restoration features. All of this work is conducted on private land along the Project reach under the supervision of the Napa County Flood Control and Water Conservation District in concert with landowners and their representatives.

The Napa River is presently subject to a Clean Water Act Total Maximum Daily Load (TMDL) action due to excessive quantities of fine sediment degrading local water quality and beneficial uses. While sediment is a naturally-occurring input to the Napa River system, excessive amounts are considered a pollutant, and thus sediment load reductions mentioned in this report amount to 'pollutant reductions' in TMDL terms. The Rutherford Reach Restoration Project serves to support the TMDL objective of reducing fine sediment loads and as a result has been designated a regional priority by the San Francisco Bay Regional Water Quality Control Board responsible for TMDL development and implementation.

Restoration Goals and Objectives

For the purposes of monitoring Project success, restoration goals are organized into four categories:

- Sediment Load Reductions and Increased Channel Morphology Complexity
- Aquatic Habitat Enhancement
- Riparian Habitat Enhancement
- Ongoing Stakeholder Participation

These goals are described in detail below.

Sediment Load Reductions and Increased Channel Morphology Complexity

Existing (Pre-Project) Conditions

Changes in land use and land cover types, construction of earthen berms, and filling of historic distributary channels has resulted in increased flow volumes and velocities within the Rutherford Reach leading to channel incision, and streambank erosion and failure. In addition, inputs of fine sediments to the channel from eroding streambanks and other sources within the watershed has led to a reduction in the quality and quantity of instream habitat for salmonids and other native fish in the Rutherford Reach.

Desired Outcomes

The desired outcomes for this category focus on reducing contributions of fine sediment to the Napa River by reducing rates of channel bank erosion and bed incision and creating a more stable long term channel configuration.

The goals/desired outcomes for reducing fine sediment loads due to accelerated rates of channel bed and bank erosion and for improving channel morphology are as follows.

- Decrease the total amount of eroding streambanks.
- Reduce rates of bank retreat and stabilize severely eroding banks.
- Reduce rates of channel incision.
- Re-establish geomorphic and hydrologic processes to support a continuous and diverse native riparian corridor.
- Rehabilitate natural river/floodplain interactions where possible.
- Increase and enhance riverine, riparian, and floodplain habitat value and complexity, particularly to support increased quality and quantity of habitat for Chinook salmon, Steelhead trout and California freshwater shrimp.
- Create inset bankfull (1.5 year flood elevation) and mid-level terraces.
- Create sustainable geometries for setback channel banks and berms.
- Minimize the need for ongoing channel stabilization and maintenance work.

Aquatic Habitat Enhancement

Existing (Pre-Project) Conditions

The pre-restoration condition of aquatic habitat within the Rutherford Reach in 2009 consisted of long runs and glides, with fewer deep pools, and occasional riffles. Pool depths typically exceeded 3 feet and occasionally reached a maximum depth of approximately 9 feet. When present, cover in the pools consisted of deep water, undercut banks, instream woody material, and overhead cover in the form of low growing riparian vegetation. In general, less cover and fewer cover types were present in runs and riffles compared to pools. Cover in these habitats consisted of undercut banks, overhead cover from riparian vegetation, and instream woody material. The predominant substrate in the reach was gravel and sand-sized particles, although more sand than gravel was commonly present. Median particle size (D_{50}) on the bars and riffles sampled in 2005 varied from approximately 8mm to 50mm, with an average of 23mm.In comparison, preferred spawning habitat for Chinook salmon typically consists of bed material ranging from 25 to 102 mm in size. In summary, the diversity and abundance of native fish (including salmonids) in the Rutherford Reach was limited by a combination of factors including: the lack of winter and spring high flow refugia (low velocity flow areas); lack of suitable fall and winter spawning habitat (riffles and coarse gravel), lack of habitat complexity (pool, riffle, glide variability); a high percentage of predatory fish habitat (deep pools and glides); and lack of instream and overhead cover.

Desired Outcomes

The goals/desired outcomes for aquatic habitat quality on the Napa River Rutherford Reach are as follows:

Overall

- Protect existing high value riparian corridor habitat patches wherever possible.

- Re-establish geomorphic and hydrologic processes to support a continuous and diverse native riparian corridor.
- Increase and enhance riverine, riparian, and floodplain habitat value and complexity, particularly to support increased quality and quantity of habitat for Chinook salmon, Steelhead trout and California freshwater shrimp.
- Increase habitat velocity flow complexity by increasing variability in pool, riffle and glide habitats.
- Decrease percentage of deep pool and glide habitats that function as predatory fish habitat, and increase percentage of shallow pool and riffle habitat.

Steelhead and Chinook Rearing Habitat

- Increase summer rearing habitat and cover by inducing lateral pool scour associated with installed habitat structures (LWD).
- Increase and establish of high flow (>500 cfs) low velocity (<6 fps) bankfull refugia areas to increase fall and winter rearing habitat for 0-1+Steelhead, and immigrating/emigrating salmonids.

Steelhead and Chinook Spawning Habitat

- Increase of suitable fall and winter spawning habitat by increasing the frequency and length of riffle habitat, and increasing the recruitment of coarser spawning gravel by inducing sorting of bed and bar material, resulting in increased deposition of spawning-sized sediments and decreases in percentages of fines covering riffle crests / pool tails.
- Increase fall and winter spawning habitat and cover by inducing lateral pool scour associated with installed habitat structures (LWD).

Annual Steelhead 0-1+ Rearing

- Increase and establish of high flow (>500 cfs) low velocity (<6 fps) bankfull refugia areas to increase spring rearing habitat for 0+ Steelhead, and immigrating/emigrating salmonids.
- Increase quantity of high velocity feeding lanes, by creating relatively high velocity riffle habitat, and breaking up low velocity flat-water pool habitat. Induce local velocity accelerations and complexity and channel flow constrictions with installed habitat structures (LWD/Boulders).
- Enhance and encourage coarse sediment trapping for establishing riffle habitat and subsequent invertebrate production (i.e., create fish food habitat).

Spring Chinook Juvenile Rearing

- Increase and establish spring flow backwater pool habitat areas to increase spring rearing habitat for juvenile Chinook, and immigrating/emigrating salmonids.
- Increase summer rearing habitat by enhancing pool habitat complexity, depth, and shelter/canopy cover.

Riparian Habitat Enhancement

Existing (Pre-Project) Conditions

Regarding the pre-restoration condition of riparian habitat in 2009, the species composition and the width and extent of the riparian corridor varied considerably throughout the Rutherford Reach depending on channel width, bank steepness, and adjacent land uses. In general, Reaches 1, 2, 3, and 5 supported the largest intact stands of mature riparian vegetation. Valley oak (Quercus lobata), coast live oak (Quercus agrifolia), and California walnut (Juglans hindisi) were the dominant species in these reaches. Reaches 3, 5, 6 and 7, where the wider channel permits development of bars and inset floodplain benches, supported extensive stands of Fremont cottonwood (Populus fremontii), white alder (Alnus rhombifolia), red willow (Salix laevigata), arroyo willow (Salix lasiolepis), yellow willow (Salix lutea), and sandbar willow (Salix exigua). Overstory vegetation was relatively sparse in Reach 4 consisting of small stands or individual valley and coast live oaks. California bay (Umbellularia californica), blue elderberry (Sambucus mexicana), and California buckeye (Aesculus californica) were also found within the project area. The width of the riparian corridor (including vegetated areas along both banks) was greatest in Reach 1 (600 to 800 feet). The riparian corridor in Reaches 3, 5, 6, and 7 was also relatively wide, ranging from 250 to 400 feet in width. Reaches 2, 4, 8, and 9, which are confined by levees or adjacent land use, supported narrow bands of riparian vegetation (150 feet or less).

In many portions of the Rutherford Reach, the riparian understory was dominated by non-native species including Himalayan blackberry (Rubus discolor), periwinkle (Vinca major), and wild grape (Vitis sp.). Other non-native invasive species such as giant reed (Arundo donax) were also pervasive throughout the project area. However, other areas supported substantial patches of native understory species including snowberry (Symphoricarpos albus), Santa Barbara sedge (Carex barbarae), creeping wild rye (Leymus triticoides), and California rose (Rosa californica). In these reaches, it was not unusual to find areas dominated by native overstory and understory species. These areas of high native diversity were primarily a result of invasive species removal and revegetation projects implemented by local landowners to control Pierce's disease, and by the District to control giant reed.

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 prevents the establishment of inset floodplain benches and bars that would enable recruitment and establishment of riparian species. Additionally, channel incision has increased channel capacity and decreased the frequency of overtopping leading to the development of a more xeric mix of plant species (e.g., oaks) along the top of the river bank.

Relevant design criteria include: establish planting zones based on water surface elevations and distance from channel; establish a minimum 50' buffer to reduce disturbance to native wildlife and encourage migration; fill existing canopy gaps < 25' in length (VW-5); increase plant diversity and structure to improve quality for resident and migrant wildlife, especially riparian-dependent birds; obtain all plant material from Napa River watershed (VW-10); salvage native plant material for transplanting onto newly excavated benches and slopes (VW-11); irrigate all newly established plant material; stabilize exposed soils using a hydromulch consisting of a native (or sterile) seed mix.

Interruption of historic patterns of disturbance due to flooding has reduced riparian corridor width and interrupted succession processes critical to recruitment and survival of native riparian vegetation species and communities. Absent significant change in the geomorphic regime (outside the scope of this project), the riparian community will continue to decline as older trees die and recruitment is impaired due to numerous factors (lack of suitable geomorphic surfaces for colonization, competition with invasive plan species, seed/seedling predation by introduced species, etc).Artificial creation of inset flood terraces and bank setback and grading increases the area suitable for riparian recruitment. In particular in terms of created flood terraces, designing terraces for inundation at approximately the two-year return interval event creates new disturbance zones where future recruitment may be self-sustaining, assuming invasives continue to be controlled as part of project maintenance.

Desired Outcomes

The goals/desired outcomes for enhancing riparian habitat are as follows:

- Protect existing high value riparian corridor habitat patches wherever possible.
- Expand the native riparian buffer width and extent.
- Remove invasive non-native vegetation and replanting with native vegetation that will not promote Pierce's disease in vineyards.
- Re-establish geomorphic and hydrologic processes to support a continuous and diverse native riparian corridor.

Stakeholder Participation

Existing Conditions

The Preliminary Design for the Project was completed for all 28 properties in the Rutherford Reach. Participation in the Project is determined by individual landowners in separate final design and construction phases.

Desired Outcomes

- Ongoing access granted for team members, including Napa County Flood District and the Napa County Resource Conservation District, and contractors.
- Minimize piecemeal efforts at channel stabilization and berm construction on the part of landowners.
- Continued landowner leadership, as evidenced via the Landowner Advisory Committee.
- Remove invasive non-native vegetation and replanting with native vegetation that will not promote Pierce's disease in vineyards.
- Work closely with landowners to address their interests with regard to adjacent farmland and property.
- Rehabilitate the river in a way that facilitates permitting agency approval.

Project Implementation

The 4.5 mile project reach has been defined by a stream stationing system based on linear footage upstream from the Oakville Cross Road Bridge. The Rutherford Reach of the Napa River spans between river stations 0 and 24,857 feet, starting at the Oakville Cross Road Bridge and extending upstream to the Zinfandel Lane Bridge. The project reach has been divided into subreaches numbered from 1 to 9 starting from the Zinfandel Lane Bridge.

The Project is being constructed in phases contingent on available funding and landowner/District priorities with a target completion date of 2017.The Conceptual Design for the Rutherford Reach was completed in 2002, followed by the Preliminary Design in 2008.Final Designs are completed for each of the planned six construction phases. A copy of the preliminary design and final designs for each phase are available at the Watershed Information Center and Conservancy (WICC) of Napa County website at http://www.napawatersheds.org/app_folders/view/3577.

For each phase, the consulting engineer refines the preliminary design to a final design suitable for construction, based on more detailed topographic data, specific site conditions such as vegetation, current science, and consultations with landowners and permitting agency staff. Regulatory agency approval of the final design and remaining permits are obtained for each phase of construction implementation. Construction is overseen by a Project Team that includes the Napa County Program Manager, Napa County Department of Public Works Construction Managers, the Rutherford Dust Restoration Team Landowner Advisory Committee (LAC), with the benefit from input of a Project Strategy Team that includes technical experts and representatives from interested resource agencies.

See **Appendix B. Restoration Reaches, Phases, and Construction Schedule** for detailed tables of the locations of river reaches, and the timing and location of construction phases.

Phase 1a

Implementation construction began in 2009 with Phase 1a East Bank.

Phase 1a East Bank design was completed by ICF Jones & Stokes, with engineering subcontractors Riechers Spence & Associates, Inc. Phase 1a: Reaches 1 and 2 East Bank constructions took place in the summer of 2009. Phase 1a East Bank spans 6,254 feet, between river stations 24,857 - 18,600, on the Guggenhime and Quintessa properties. The construction contractor was Siteworks, and the revegetation contractor was Martinez Landscaping.

Phase 1b

Phase 1b design was completed by ICF Jones & Stokes, with engineering subcontractors and Northwest Hydraulic Consultants, with consultation input from Prunuske Chatham Inc. Phase 1b: Reaches 1 and 2 west bank construction took place in the summer of 2010. Phase 1b west bank spans 6,254 feet, between river stations 24,857 - 18,600, on the Ranch Winery/Sutter Home, Frogs Leap and Caymus properties. The construction contractor was Siteworks, with subcontractor Martinez Landscaping. The revegetation contractor was SMP Services.

Phase 2

Phase 2, Reach 3 final design was completed by ESA PWA (formerly Phil Williams Associates, Inc), with design sub-consultation by Restoration Resources and Cramer Fish Sciences. Phase 2: Reach 3 took place in the summer of 2010. Phase 2 spans 2,000 feet in the channel between river stations 18,000 - 16,000 on the Caymus property on the right (west) bank, and the Carpy-Conolly property on the left (east) bank. Phase 2 spans an additional 2,000 feet along the top of left (east) bank where the levee was setback on the Carpy-Conolly property, between river stations 16,000-14,000. The construction contractor was Team Ghilotti, Inc., with subcontractors, Atlas Tree Service and Prunuske Chatham. The revegetation contractor was SMP Services.

Phase 3a

Phase 3 final design was completed by ESA PWA (formerly Phil Williams Associates, Inc), with design sub-consultation by Restoration Resources and Cramer Fish Sciences.

Phase 3a: Reach 4 East Bank was completed in summer 2011.Phase 3 spans 4,000 feet between river stations 16,000 and 12,000 on the Carpy-Conolly, Honig and Round Pond East properties, completing left (east) bank construction between the Zinfandel Lane and Rutherford Cross Road Bridges. The construction contractor was Siteworks. The revegetation contractor was SMP Services.

Phase 3b

Phase 3b: Reach 4 west bank construction was completed in summer 2012, between river stations 16,000 and 12,000 on the Emmolo, Caymus (Mee prior to 2013), and Round Pond West properties, completing restoration construction on all properties between the Zinfandel Lane and Rutherford Cross Road Bridges, or 52% of the Project. The construction contractor was Team Ghilotti, Inc. The revegetation contractor was SMP Services.

Phase 4a

Phase 4a: Reach 8 north construction was planned for completion in summer 2012, between river stations 7,800and 5,800 on the Sawyer (Foley Johnson), Sequoia Grove, and Wilsey properties, located midway between the Rutherford Cross Road and Oakville Cross Road Bridges. The construction contractor was Siteworks. The revegetation contractor was Hanford ARC. All planned work was completed as scheduled with the exception of work on the Foley-Johnson property due to the delayed relocation of a PG&E power pole, which was located within the grading footprint. PG&E relocated the pole in winter 2013 when it fell after the December 2012 high flows. Siteworks then completed the bank stabilization work on Foley Johnson in summer 2013.

Ritz-Carlton Hotel Mitigation

The construction of the secondary channel on the Wilsey property as part of Phase 4a included the creation of a linear wetland to satisfy the Ritz Carlton Hotel Project mitigation requirements per the letter dated September 23, 2013 from the San Francisco Regional Water Quality Control Board to the Napa Valley Investment Property, Inc. c/o Land Plan Company, regarding the Conditional Water Quality Certification for the Ritz-Carlton Hotel, which references CIWQS Place No. 72762, and the project described as the Napa River Restoration Rutherford Reach 8 – Phase 4A in the letter dated April 30, 2012, and the agreement with Napa County dated August 6, 2013. Monitoring requirements for this project are being met by this report. The effectiveness monitoring studies for the overall Project include the results of any sites sampled at the linear wetland site. Although monitoring study results are not reported separately for the linear wetland mitigation site, a summary of the restoration elements, and any adaptive management measures taken specifically to maintain those features, are included in the applicable report sections on eroding banks, instream habitat structures and vegetation. See **Appendix. D Study XIV. Photomonitoring** for photographic documentation of the status of the linear wetland and a brief summary of the status of the linear wetland.

Phase 4bc

Phase 4bc: Reach 8 south construction was completed in summer 2013, between river stations 6,400 and 2,725 on the Davis (Frostfire), AJM Vineyard (McDowell), Glos, Cakebread, Nickel & Nickel, Gmelch, and Laird properties. The construction and revegetation contractor was Hanford ARC. Construction of Phase 4bc: Reach 8 south brings the project to 72% completion.

Phase 5

Phase 5: Reaches 6, 7 and 9 is scheduled for completion in summer 2014.Construction in Reaches 6 and 7 will occur on the Round Pond property on the east side between river stations 10,400 and 9,100 and on the Peju, St. Supery and Foley Johnson properties on the west side between river stations 9,375 and 7,925. Construction in Reach 9 spans between river stations 3,200 and 650, and will take place on east and west sides of the river on the Laird, United, Swanson, Nickel & Nickel, Spencer and Opus One properties. Vegetation management, but no construction, will take place on the Nickel & Nickel property downstream of the Bella Oaks Tributary, and on the Spencer property on the west side of the river between river stations 3,400 – 2,200. The implementation of the Project will be complete following construction and revegetation of Phase 5.

The restoration elements constructed in each construction phase (through Phase 4BC) are summarized in the following section and in **Appendix C. Restoration Elements**.

Restoration Actions and Treatment Elements

Restoration actions and treatments are summarized below according to the specific project goals that they address:

Sediment Load Reductions and Increased Channel Morphology Complexity

Restoration treatments to reduce sediment load and stabilize channel morphology include:

- Increased Riparian Buffer Width
- Setback Berms and Replacement
- Channel Reconfiguration
- Bank Stabilization
- Grade Control Boulders and Weirs

Aquatic Habitat Enhancement

Restoration treatments installed in-channel to improve aquatic habitat include:

- Large Woody Debris, Spider Logs, Low Profile Logs, and Toe Log-Boulder Structures
- Plant Material: Native Willow Cuttings, Off-Bench Branch Cover, Branch Bundles

- Constructed Riffles
- Backwater Alcoves on Created Instream Benches and Historic Secondary Channels
- Graded Instream Benches on Alternating Banks

Riparian Habitat Enhancement

Restoration treatments to improve riparian habitat include:

- Revegetation and Maintenance of Graded Areas with Native Under and Over Story Species
- Vegetation of Widened Riparian Corridor with Native Under and Over Story Species
- Removal and Management of Invasive Non-Native Species and Pierce Disease Host Plants

Stakeholder Participation

Methods to maintain stakeholder participation include:

- Conduct Landowner Advisory Committee Meetings
- Conduct Informational Outreach
- Manage Channel Maintenance and Monitoring Program

Restoration Element Construction Summary 2009-2013

See **Appendix C. Restoration Elements** for figures and tables of restoration elements and locations in each Phase of construction. Restoration elements, including graded structures, setback agricultural berms, and instream structures are depicted on aerial photos by construction phase. Tables list restoration feature by type, river station location, designer and year constructed by phase.

During the first five years of restoration construction from 2009-2013, 8,925 linear feet of inset floodplain benches, with a surface area of 14.5 acres, were constructed in Reaches 1,2,3,4 and 8. Side channel creation totaled 914 linear feet, with a surface area of 0.8 acres: 325 feet at Bench 3 in Reach 3, and 589 feet at Bench 1 in Reach 8A north. In Reach 8BC South, 552 feet of linear feet of channel and 2.1 acres of associated floodplain was restored along the Bella Oaks tributary with the creation of the alcove.

In Reaches 2-4, 13,435 linear feet of berms and bank stabilizations areas were setback from the stream to widen the river channel. Invasive species have been removed or managed, and riparian vegetation has been replanted on 26.3 acres including constructed benches, bank stabilization areas and widened riparian corridors where berms were setback. Eighty seven (87) instream habitat structures, including (66) large woody debris structures and twenty-ne (21) boulder clusters, were installed through 2012 and assessed for habitat function through 2013.In 2013,forty-four (44)instream habitat structures were installed in Reach 8 south. These structures will be assessed for actual versus intended habitat function in 2014.

Phase1a, Reaches 1-2 East Bank Restoration Elements

Graded Structures

Phase 1a was constructed in 2009 on the east bank of Reaches 1-2.Graded restoration elements in Phase 1a, Reaches 1-2 East Bank include: two (2) instream benches and a cut slope to stabilize the top of an eroding bedrock bank. The first bench spans 500 linear feet between river stations 23,950 –

23,450 on the Guggenhime property, at an average elevation of 168 feet, which is an approximately 10 feet above the level of the 2009 thalweg, and functions as a bankfull terrace. The second bench spans 600 linear feet between river stations 20,000-19,400 on the Quintessa property, at an average elevation of 160 feet, which is an approximately 10 feet above the level of the 2009 thalweg riffle crests, and function ns as a bankfull terrace. The top of bank grading spans 800 feet between river stations 19,400 and 18,600, at an elevation of 165 feet, approximately 16 feet above the level of the thalweg upslope above the exposed bedrock outcrop.

Instream Habitat Structures
Instream habitat structures included bench logs placed perpendicular to the channel to slow flow velocity and curb surface erosion of the instream benches. Fifteen (15) total bench logs were installed to slow channel flow velocities and prevent erosion of the newly graded terraces until vegetation become established to provide root strength and roughness: Eight (8) bench logs were installed on the Guggenhime bench, and seven (7) bench logs were installed on the Quintessa bench.

Restored Riparian Habitat
1.5acres of riparian habitat were restored in Phase 1a, Reaches 1-2 East Bank.

Phase1b, Reaches 1-2 West Bank Restoration Elements

Graded Structures
Phase 1b was constructed in 2010 on the west bank of Reaches 1-2.Graded restoration elements in Phase 1b, Reaches 1-2 West Bank include: one (1) tributary alcove, and three (3) instream benches on the right (west) bank. The alcove spans 325 linear feet between stations 22,225 – 21,900, and begins at the 2009 thalweg elevation on the Ranch Winery/Sutter Home property and functions as high flow backwater habitat. The first bankfull bench extends downstream from the alcove and spans 800 linear feet between river stations 21,900 – 21,625 on the Ranch Winery/Sutter Home property at elevation 165 feet, which averages 14 feet above the level of the 2009 thalweg riffle crests, and functions as edgewater habitat. The second bankfull bench spans 600 linear feet between river stations 19,900 - 19,100 on the Frogs Leap property at elevation of 159 feet, which averages 13 feet above the level of the 2009 thalweg riffle crests. The third bankfull bench spans 575 linear feet between river stations 18,600 – 18,025 on the Caymus property at elevation of 157 feet, which averages 13 feet above the level of the 2009 thalweg riffle crests, and functions as edgewater habitat.

Instream Habitat Structures
Eighteen (18)instream habitat structures were installed in Phase 1b, Reaches 1-2 West Bank, including twelve (12) bench logs placed perpendicular to the channel to slow flow velocity and curb surface erosion of the instream benches, three (3) spider logs, two (2) toe log structures, and one (1) boulder cluster. Five (5) bench logs were installed in the Ranch Winery/Sutter Home alcove, and one (1) on the Ranch Winery/Sutter Home terrace bench; three (3) bench logs were installed on the Frogs Leap bench, and three (3) bench logs were installed on the Caymus bench. Instream habitat structures were first installed in the low flow channel in 2011.In Phase 1 b: Reaches 1 and 2, three (3) spider log structures of triangular stacks of cabled together logs were anchored to the channel bed at right (west) bank river station 22,000, and left (east) bank river stations 21,900, and 21,670.Two (2) linear toe log structures were installed consisting of a linear assemblage of triangular log structures, cabled together, and cabled to boulders to anchor them in place along the base of the channel bank. The first

structure spans 50 feet between right (west) bank river stations 21,850 – 21,800 on the Ranch Winery/ Sutter Home property. This toe log structure is 14 feet below the graded bench surface, with the area between containing undisturbed riparian vegetation. The second toe log structure spans 75 linear feet between right (west) bank river stations 19,475-19,400 on the Frogs Leap property. This structure is located 12 feet below the graded bench surface, with only a pre-existing riparian tree remaining between the bench and the log structure after grading.

Restored Riparian Habitat
4.5 acres of riparian habitat were restored in Phase 1b, Reaches 1-2 West Bank.

Phase 2, Reach 3 Restoration Elements

Graded Structures
Phase 2 was constructed in 2010 on both banks of Reach 3.Graded restoration elements in Phase 2: Reach 3 includes five (5) instream benches. The first bench spans 275 linear feet between right (west) bank river stations 17,700 – 17,425 on the Caymus property, at an average elevation of 147 feet. Bench 1 functions as a 325 linear feet secondary channel with a mid channel bar and starts approximately 2 feet above the level of the 2009 thalweg at the upstream end of the bench, and ends at the channel grade where it renters the channel at the downstream end of the bench approximately 6 feet above the level of the 2009 thalweg riffle crests. Bench 2 spans 190 linear feet between right (west) bank river stations 17,350 – 17,160 on the Caymus property, at an average elevation of 146 to 145 feet, which averages 5 feet above the level of the 2009 thalweg riffle crests. Bench 2 functions as a backwater alcove. The third bench spans 300 linear feet between right (west) bank river stations 17,150 – 16,850 on the Caymus property, at an average elevation of 147 feet, which averages 4.5 feet above the level of the 2009 thalweg riffle crests. Bench 3 functions as edgewater habitat. The fourth bench spans 250 linear feet between left (east) bank river stations 16,725 – 16,475 on the Carpy-Conolly property, at an average elevation of 144 feet, which averages 3 feet above the level of the 2009 thalweg riffle crests. Bench 4 functions as edgewater habitat. The fifth bench spans 250 linear feet between left (east) bank river stations 16,350 – 16,100 on the Carpy-Conolly property, at an average elevation of 143 feet, which averages 4 feet above the level of the 2009 thalweg riffle crests Bench 5 functions as edgewater habitat.

Instream Habitat Structures
Seven (7) instream habitat structures were installed in Phase 2, Reach 3, including two (2) terrace logs on the Carpy-Conolly property, and five (5) root wad structures keyed into trenches in the upstream and/or downstream end of the graded benches in Reach 3 with root wads extending into the channel. The root wad structures are ballasted with 4 ton boulders, buried, and further stabilized with the addition of willow brush mattresses and gravel, which are then anchored with erosion control fabric. Four (4) root wads were installed on the right (west) bank at river stations 17,700, 17,425, 17,350, 17,225, and 16,900 on Benches 1-3, and one (1) root wad was installed at left (east) bank river station 16,125 at the downstream end of Bench 5.A 30 foot long buried rock grade control structure was installed in the channel between river stations16,180-16,150 to preclude against channel incision and undermining of restored elements upstream.

Restored Riparian Habitat
2.2 acres of riparian habitat were restored in Phase 2, Reach 3.

Phase 3a, Reach 4 East Bank Restoration Elements

Graded Structures

Phase 3a was constructed in 2011 on the east bank of Reach 4.Graded restoration elements in Phase 3a: Reach 4 East Bank include: four (4) instream benches and two (2) bank stabilization areas. Bench 7 spans 265 linear feet between left (east) bank river stations 15,840 – 15,575 on the Carpy-Conolly property. Bench 7 functions as edgewater habitat. Bank Stabilization Area 1 spans 150 linear feet between left (east) bank river stations 14,450 – 14,300 on the Carpy-Conolly property. Bank Stabilization Area 1 functions as edgewater habitat. Bank Stabilization Area 2 spans 75 linear feet between left (east) bank river stations 13,900-13,825 on the Honig property at the base of the confluence separating the Carpy-Conolly and Honig properties. Bank Stabilization Area 2 functions as high flow refugia. Bench 11 spans 230 linear feet between left (east) bank river stations 13,680 – 13,450 on the Honig property. Bench 11 functions as edgewater habitat. Bench 13 spans 425 linear feet between left (east) bank river stations 13,150 – 12,725 on the Honig property. Bench 13 functions as a secondary channel. Bench 14 spans 190 linear feet between left (east) bank river stations 12,580 – 12,390 on the Round Pond east bank property. Bench 14 functions as an edgewater habitat.

Instream Habitat Structures

Twelve (12) instream habitat structures were installed in Phase 3, Reach 4 east bank,: three (3) roots wads embedded in created instream benches, five (5) low profile log instream structures, and four (4) instream boulder clusters. The three (3) root wads, which have the trunk embedded in the bank and the root wad in the channel, were installed on the left (east) bank at river stations 13,070 on Bench 11, 12,800 on Bench 13, and 12,420 on Bench 14.The five (5) low profile logs, which have the root wad embedded in the bank and the canopy in the channel, were installed on the left (east) bank at river stations 13,650 and 13,590 on Bench 11, 12,990 and 12,850 on Bench 13, and 12,550 on Bench 14.The four (4) boulder clusters were installed in the river channel at river stations 13,050, 12,950, 12,825 and 12,400.

Restored Riparian Habitat

5.0 acres of riparian habitat were restored in Phase 3a: Reach 4 East Bank.

Phase 3b, Reach 4 West Bank Restoration Elements

Graded Structures

Phase 3b was constructed in 2012 on the west bank of Reach 4.Graded restoration elements in Phase 3a: Reach 4 West Bank include: five (5) instream benches and one (1) bank stabilization area. Bench 6 spans 325 linear feet between right (west) bank river stations 16,125-15,800 on the Emmolo property. Bench 6 functions as edgewater habitat. Bench 8 spans 200 linear feet between right (west) bank river stations 15,275-15,075 on the Emmolo property. Bench 8 functions as edgewater habitat. Bench 9 spans 70 linear feet between right (west) bank river stations 14,085-14,015 on the Caymus (Mee prior to 2013) property. Bench 9 functions as edgewater habitat. Bench 10 spans 415 linear feet between right (west) bank river stations 13,915-13,500 on the Caymus (Mee prior to 2013) property. Bench 10 functions as edgewater habitat. Bench 12 spans 200 linear feet between right (west) bank river stations 13,300-13,100 on the Round Pond west bank property. Bench 12 functions as edgewater habitat. Bank Stabilization Area 3 spans 260 linear feet between right (west) bank river stations

12,800-12,540 on the Round Pond west bank property. Bank Stabilization Area 3 functions to protect the Colinas Farming Shop building and as edgewater habitat.

Instream Habitat Structures

Fourteen (14) instream habitat structures were installed in Phase 3b, Reach 4 west bank in 2012: six (6) root wads embedded in created instream benches, two (2) low profile log instream structures, and five (5) instream boulder clusters, and one (1) boulder field. The six (6) root wads, which have the trunk embedded in the bank and the root wad in the channel, were installed on the right (west) bank at river stations 16,050 on Bench 6, 15,250 on Bench 8, 14,060 on Bench 9, 13,670 on Bench 10, 13,500 on Bench 10, and 13,290 on Bench 12.The two (2) low profile logs, which have the root wad embedded in the bank and the canopy in the channel, were installed on the right (west) bank at river stations 15,925 on Bench 6, and 13,210 on Bench 12.The five (5) boulder clusters were installed in the river channel at river stations 16,000, 15,910, 15,790, 15,275and 13,190. The boulder field was installed at station 13,980 upstream of the Honig east bank tributary confluence. The boulder field replaced a planned grade control structure starting at upstream river station 13,980, between floodplain Benches 9 and 10 upstream of the confluence with the return drainage on the east bank. The design plan was modified to accommodate site constraints and preservation of existing willows at the base of the channel bank.

Restored Riparian Habitat

5.2 acres of riparian habitat were restored in Phase 3a: Reach 4 West Bank.

Phase 4a, Reach 8 North Restoration Elements

Graded Structures

Phase 4a was constructed in 2012 on both sides of the channel at the north end of Reach 8.Graded restoration elements in Phase 4a: Reach 8 north include: one (1) instream bench, one (1) linear wetland secondary channel, and two (2) bank stabilization areas. Bench 1 spans 600 linear feet between left (east) bank river stations 7,100-6,500 on the Wilsey property. The bench contains a 589 feet long constructed linear wetland. The bench and wetland function as a secondary channel, backwater, and wetland habitat. Construction of Bank Stabilization Area 1 on the Foley (Sawyer prior to 2012) property commences in 2012 between right (west) bank stations 7,625-7,300, and was completed in 2013 following the delayed relocation of a PG&E power pole. Bank Stabilization Area 2 spans 300 linear feet between right (west) bank river stations 6,825-6,525 on the Sequoia Grove property. Bank Stabilization Area 2 functions as edgewater habitat. Bank Stabilization Area 3 spans separate nodes along 600 linear feet between left (east) bank river stations 6,400-5,800 feet on the Wilsey property.

Instream Habitat Structures

From 2012 – 2013, twenty-five (25) instream habitat structures were installed in Phase 4, Reach 8 north; including thirteen (13) boulder clusters and twelve (12) wood structures.

In 2012, twenty-one (21) instream habitat structures were installed in Phase 4, Reach 8 north; including ten (10) boulder clusters and eleven (11) wood structures. Five (5) boulder clusters were installed on the gravel bar along the base of Bank Stabilization Area 2 at river stations 6,760, 6,740, 6,710, 6,690, and 6,660. Five (5) boulder clusters were installed along the left edge of the channel at the outside of the meander bend along Bank Stabilization Area 3 at river stations 6,200, 6,160, 5,985, 5,905 and 5,875.

One (1) wood structure was integrated into the boulder cluster at river station 6,690 at the base of Bank Stabilization Area 2.

Three (3) root wads, which have the trunk embedded in the bank and the root wad in the channel, were installed on the left (east) bank along Bank Stabilization Area 3 at river stations 6,180, 6,100 and 5,880.

In 2013, (4) instream structures were installed at Bank Stabilization Area 1 at Foley Johnson (Previously Sawyer): three (3) boulder clusters at stations 7,530, 7,460 and 7,410; and (1) root wad at station 7,512.

Ritz-Carlton Hotel Mitigation Restoration Elements

Graded Structures
The linear wetland mitigation area included in the 589 feet long secondary channel constructed on Reach 8A Bench 1, which spans 600 linear feet between left (east) bank river stations 7,100-6,500 on the Wilsey property. The bench and wetland function as a secondary channel, backwater, and wetland habitat.

Instream Habitat Structures
One (1) large wood structure was installed mid way up the west bank of the mainstem Napa River at station 7,090 to deflect flows into the upstream end of the linear wetland secondary channel. Instream habitat structures installed along the linear wetland secondary channel include Six (6) wood structures were installed to direct flows along the newly graded secondary channel; three (3) log weirs at river stations 6,880, 6,610 and 6,530; two (2) low profile logs at river stations 6,740 and 6,670; and one (1) root wad at the downstream end of the secondary channel near the confluence with the mainstem at station 6,515.

Restored Riparian Habitat
2.3 acres of riparian habitat were restored in Phase 4a: Reach 8 north.

Phase 4bc, Reach 8 South Restoration Elements

Graded Structures
Phase 4bc was constructed in 2013 on both sides of the channel at the south end of Reach 8.Graded restoration elements in Phase 4bc: Reach 8 south include: three (3) instream benches, one (1) tributary alcove, and three (3) bank stabilization areas. Bench 1 spans 600 linear feet between right (west) bank river stations 6,300 – 5,700on the Davis (Frostfire) property. The base elevation of the backwater alcove on Bench 1 is 118 feet, which is the average level of the 2013 thalweg riffle crests. On the Laird property on the left (east) bank, Bench 2 spans 500linear feet between river stations 5,350-4,850. Bench 2 was originally designed to function as edgewater habitat. Due to the presence of a Swainson's hawk nest, the design was modified to retain the oak tree on an island. The revised design functions as a backwater alcove and high flow bypass channel around the island. The high flow channel elevation crests at 143 feet, which is approximately 26 feet above the level of the 2013

thalweg at the upstream end of the bench. The slope grades down to an elevation of 119 feet, which is one foot above the level of 2013 thalweg at the downstream end of the bench. Downstream on the Laird property, Bench 3 spans 350 linear feet between east bank river stations 4,250-3,900 at an average elevation of 119 feet, which averages 4 feet above the level of the thalweg riffle crests. Bench 3 functions as an edgewater habitat.

Bank Stabilization Area 1 spans 100 linear feet between right (west) bank river stations 5,450 – 5,350 on the Frostfire (Davis) and AJM Vineyards (McDowell) properties adjacent to Glos Lane. Bank Stabilization Area 1 was constructed to stabilize a steep sandy slope and preserve a heritage oak tree where a significant stand of Arundo was eradicated. Bank Stabilization Area 2 spans 225 linear feet between right (west) bank river stations 5,350-5,125 on the Cakebread property, between AJM Vineyards and the Glos house. Bank Stabilization Area 3 spans 250linear feet between right (west) bank river stations 4,550-4,300 on the Glos property. Bank Stabilization Area 3 functions as edgewater habitat at an elevation of 121 feet, which averages 5 feet above the level of the thalweg riffle crests. Bank Stabilization Area 3 also replaces an area that where Arundo had been eradicated. Additional bank stabilization was completed where Arundo had previously been eradicated on the east bank between Benches 2-3 on the Laird property.

Instream Habitat Structures

Two (2) 50 feet long buried rock grade control structure were installed in the channel between river stations 5,770 – 5,720and 5,375 – 5,350 to preclude against channel incision and undermining of res

Forty-four (44) instream habitat structures were installed in Phase 4bc, Reach 8 South in 2013: eleven (11) boulder clusters, and thirty-one (31) large wood structures. The eleven (11) boulder clusters were installed at the following river stations: One (1) toe log structure at river station 4,523; two (2) low profile logs in the channel at river stations 5,770 and 5,344; Eleven (11) single root wad snags, sometimes with an adjacent boulder, at river stations 6,163, 6,150, 6,108, 5,244, 5,243, 4,067, 4,054, 3,397, 3,367, 3,345, 3,326; and nineteen (19) root wad structures at river stations: 5,247, 5,094, 4,960, 4,293, 4,204, , 4,187, 3,999, 3,958, 3,500, 3,474, 3,400, 3,355, 3,333, 3,322 and 3,252.

Instream habitat structures installed in Phase 4bc: Reach 8 south will be evaluated in the next Annual Monitoring Report.

Restored Riparian Habitat

5.6 acres of riparian habitat were restored in Phase 4bc: Reach 8 south.

Monitoring Approach

The Monitoring Program framework links project objectives to proposed monitoring elements based on the understanding of process-based relationships between existing conditions and restoration techniques aimed at achieving desired outcomes. See **Appendix D. Monitoring Studies** for summary tables describing monitoring activities and monitoring frequency organized by resource category, and for monitoring protocols organized by frequency. Each desired outcome has defined specific performance indicators and standards. Project success will be evaluated by quantifying progress towards meeting performance standards over the life of the project. The monitoring components and schedule is described first and then existing conditions, restoration treatments, desired outcomes, monitoring indicators, and performance standards by monitoring category are addressed.

The Monitoring Program has four components: 1) an Annual Survey of the entire 4.5 mile reach, which is aimed at capturing both critical monitoring parameters and channel maintenance needs using rapid assessment formats; 2) seasonal evaluation of the performance of the instream habitat structures at representative seasonal flows; 3) repeat detailed channel transect and longitudinal profile surveys are conducted pre-construction and following significant flow events to capture long term habitat response, and, 4) phased vegetation surveys. These field survey elements are complemented with photo-monitoring at defined stations, detailed monitoring of revegetation sites conducted in phases as project areas are planted, and surveys of stakeholder participation. Refer to the Monitoring Protocols in the ***Monitoring Plan*** for a detailed description of the protocols that are to be conducted in each monitoring component.

A Before/After Control/Impact (BACI) approach is being applied for long term measuring change of geomorphic, aquatic and riparian habitat parameters (Roni 2005; Gerstein & Harris, 2005).Monitoring parameters have been chosen to measure changes in targeted resource categories in response to stream enhancements. Detailed transects complement the Annual Survey and are designed to balance the frequency and resolution of data collection in the most meaningful and yet cost-effective manner possible.

The Monitoring Program is designed to evaluate the success of the Rutherford Reach Restoration Project at meeting the objectives of reducing excessive channel bank and bed erosion, enhancing aquatic and riparian habitat, protecting property and maintaining stakeholder participation.

The Monitoring Program is similarly organized into the four categories of study to address progress towards meeting stated project goals with related parameters for measurement as described below:

Sediment Load Reductions and Increased Channel Morphology Complexity

The monitoring approach to assess reduction in sediment loads to the channel is to evaluate changes in basic stream channel geometry, bank condition, and resultant sediment loads in treated and untreated river reaches.

Performance Indicators

Performance indicators for sediment load reductions and channel morphology are listed below (units in parentheses):

- Length and/or surface area of actively eroding streambanks over the project reach (LxH or %L)
- Rates of bed deposition and scour at representative cross-sections (L or Vol/T)
- Bankfull width to depth ratio (W/D) at representative treatment cross-sections

Performance Standards

The performance standard for reducing sediment loads and improving channel morphology is:

- A 75% reduction in the length, or surface area, of actively eroding streambanks in the entire Project Reach.
- Positive trends in reductions of bed and bank erosion rates
- Positive trends in increases in bankfull channel width to depth ratios

Monitoring Protocols

Monitoring protocols for reducing sediment loads and improving channel morphology include:

- Stream Flow Measurements
- Eroding Streambank Survey
- Sediment Source Reduction Calculations
- Longitudinal Thalweg Surveys
- Cross Section Surveys

Aquatic Habitat Enhancement

The monitoring approach to assess enhancement of aquatic habitat is to evaluate changes in aquatic habitat quantity and quality associated with installed instream structures, including those aspects of active channel morphology that drive the creation and maintenance of habitat complexity.

Performance Indicators

Progress toward the goals/desired outcomes for aquatic habitat quality improvements will be based on (units in parentheses):

- Channel substrate size distribution (median statistic values for size frequency distribution, % fine sediment)
- Riffle length and frequency
- Residual pool depth
- Large woody debris structure persistence (# years, % persisting)
- Riparian/overhead cover (%)
- Area of high-flow refugia in constructed alcoves and bankfull instream benches (A)
- Flow velocities in constructed high-flow refugia areas (v)

Performance Standards

The performance standards for aquatic habitat quality are:

- A statistically significant increase in riffle median grain size (D50 mm)
- A statistically significant reduction in riffle substrate percentage of fines (<2mm)
- A 30% increase in riffle length or riffle frequency in treated locations
- A 25% increase in residual pool depth in treated locations

- A 75% persistence of installed instream habitat enhancement structures
- Creation of high flow refugia with (velocities less that 6 fps) for flows 500 cfs and above at constructed alcoves and instream bankfull benches
- A 40% increase in seasonal refugia cover

Monitoring Protocols

- Pebble Counts
- Spawning Gravel Permeability Studies by Napa RCD
- Channel Morphology Survey: Riffle, Glide, Pool Distribution Mapping
- Residual Pool Depth Survey associated with Installed Instream Habitat Structures
- Large Woody Debris Survey
- Seasonal Salmonid Habitat Velocity Surveys

Riparian Habitat Enhancement

The monitoring approach to assess enhancement of aquatic habitat is to evaluate increases in riparian habitat quantity and quality and planting survival in treated reaches, including the reduction in invasive plant species.

Performance Indicators

Progress toward the goals/desired outcomes for riparian habitat quality improvements will be based on (units in parentheses):

- Area successfully treated (acres)
- Plant survival at revegetation sites (%)
- Percent native vegetative cover: Absence/presence natural recruitment (no units)

Performance Standards

The performance standards for riparian habitat quality are:

- A minimum 20 acres over the life of the Rutherford Reach project (acres)
- An 80% survival of native plants at revegetation sites
- Greater than 90% native cover (less than 10% total non-native)
- Evidence of successful natural recruitment by year 5 at revegetation sites
- A 40% increase in seasonal refugia cover

Monitoring Protocols

- Vegetation Establishment Surveys
- Direct Count Plant Survival and Vigor Survey
- Area Mapping Percent Cover and Composition Survey
- Cross Section Transect Line Intercept Survey

Stakeholder Participation

The monitoring approach to assess stakeholder participation is to evaluate the success of stakeholder coordination in maintaining meaningful levels of participation.

Performance Indicators

The performance standards for stakeholder participation are:

- Landowner Participation in the Restoration Project
- Landowner adaptive monitoring and management
- Landowner Advisory Committee participation
- Performance Standards
- Continuation of at least 90% landowner participation in the project.
- Continued landowner leadership, as evidenced via the Landowner Advisory Committee (LAC) and willingness to fill offices (Chair, Vice-Chair, and Secretary).
- Ongoing access granted for team members, including Napa County Flood District and the Napa County Resource Conservation District.

Monitoring Protocols

- Records of Landowner Access Agreements
- Records of Landowner Maintenance Requests
- Landowner Advisory Committee Meetings Attendance Records

Ritz-Carlton Hotel Mitigation Monitoring

The linear wetland constructed in Phase 4A, Reach 8North to satisfy the Ritz-Carlton Hotel mitigation requirements is functioning as designed. The linear wetland is incorporated into the 589 feet long secondary channel constructed on Bench 1, which spans 600 linear feet between left (east) bank river stations 7,100-6,500 on the Wilsey property. The bench and wetland function as a secondary channel, backwater, and wetland habitat.

The effectiveness monitoring studies for the overall Project include the results of any sites sampled at the linear wetland mitigation site. Although monitoring study results are not reported separately for the linear wetland mitigation site, a summary of the restoration elements, and any adaptive management measures taken specifically to maintain those features, are included in the applicable report sections on eroding banks, instream habitat structures and vegetation establishment.

The long term monitoring cross section established at river station 6,750 includes data on channel substrate and topography at the linear wetland site. For example, the pebble count study conducted at river station 6,750 documents the median size of the gravel recruited iand the percentage of fines deposited at the sample site in the secondary channel.

The 2013 longitudinal profile thalweg survey study includes a plot of the elevation of the linear wetland following gravel recruitment and channel change caused by the December 2012 storm flows a month following the completion of construction. See **Appendix D. Study XIV. Photomonitoring** for photographs documenting the status of the mitigation wetland.

Summary of Monitoring Studies

Data, figures and tables from the thirteen individual monitoring studies are provided in **Appendix D**. This section summarizes findings to date and progress towards desired outcomes indicated by each monitoring study listed below.

I. Stream Flow Measurements
II. Eroding Streambank Survey
III. Sediment Source Reduction Calculations
IV. Longitudinal Thalweg Surveys
V. Cross Section Surveys
VI. Pebble Counts
VII. Spawning Gravel Permeability Measurements
VIII. Channel Morphology Survey: Riffle, Glide, Pool Distribution Mapping
IX. Residual Pool Depth Survey at Installed Instream Habitat Structures
X. Large Woody Debris Survey
XI. Seasonal Salmonid Habitat Velocity Surveys
XII. Vegetation Establishment Surveys
   - Direct Count Plant Survival and Vigor Survey
   - Area Mapping Percent Cover and Composition Survey
   - Cross Section Transect Line Intercept Survey
XIII. Stakeholder Participation Documentation

Instream Flow Measurements

See **Appendix D. Study I. Stream Flow Data** for a table and figure depicting the annual peak flows experienced in the Rutherford Reach from water years 2004 – 2013.

The channel flow capacity of the Rutherford Reach averages less than a ten year recurrence interval flood event. A 10 year recurrence interval flood discharge is approximately 13,000 cfs and 100 year recurrence interval flood discharge is 21,000 cfs.

At a peak discharge of 18,300 cfs, the New Year’s Flood of December 31, 2005 was the largest recorded flood on the Napa River Rutherford Reach. Ten (10) monitoring cross sections surveyed in 2004 were reoccupied and resurveyed following the flood from 2008-2009 to measure changes in channel geomorphology. For further discussion and graphed comparisons of channel change, refer to the 2012 Monitoring Report for the Napa River Rutherford Reach Restoration Project (March 2013)section on **Channel Transect Surveys** and **Appendix D. Study V. Channel Transect Surveys**, which are available online at the Napa County Watershed Information Center and Conservancy (http://www.napawatersheds.org/app_folders/view/5502).

Instream benches were first constructed in 2009.All instream benches were inundated at least once in the first winter following construction. The Napa County RCD first surveyed stream flow velocities on instream benches in winter 2011 in Reaches 1-3, and surveyed velocities on instream benches installed on the east bank of Reach 4 in winter 2012.The results of the velocity study are presented in the section on **Seasonal Salmonid Habitat Surveys** below and in **Appendix D. Study XI.**

High water mark and water surface elevation levels were surveyed in at the velocity measurement locations, and tabulated against the discharge and stage height at the stream gage at the Pope Street

Bridge upstream to provide baseline data to establish a stage discharge rating curve for the Rutherford Reach.

II. Eroding Streambank Survey

The Annual Survey is conducted within the entire length of the bankfull channel every year in order to evaluate the status of constructed features and to rapidly assess effects on fine sediment loading, channel morphology, and habitat features. (The Annual Survey also serves the Maintenance Plan objectives by identifying any emerging new areas of management concern along the channel due to debris deposition or bank instability—see *Final Maintenance Plan for the Napa River Rutherford Reach Restoration Project* (Napa County Resource Conservation District, August 2008) for details.) The Annual Stream Reach Survey is conducted each spring prior to the start of the summer construction season. The reduction of eroding bank length in a given construction phase is evaluated for the first time the following June, after one winter stream flow season. Stream maintenance and monitoring surveys commenced in summer 2009 and will continue annually through the 20-year duration of the River Maintenance District. The duration of the monitoring program is designed to coincide with the 20-year extent of the maintenance program.

Performance Standard

The desired outcome for eroding banks includes:

- A 75% reduction in the length, or surface area, of actively eroding streambanks in the entire Project Reach.

Progress Towards Standard

See **Appendix D. Study II. Eroding Stream Bank Survey** for figures and tables depicting the location and extent of eroding streambanks mapped during each annual survey.

The target goal is to reduce the surface area of eroding banks in the entire Rutherford Reach (Reaches 1-9) by 75%, which is measured annually under the channel monitoring survey conducted by Napa County each June. During the baseline survey in 2009, 14,674 feet of channel banks were eroding, or 30% of the channel bank length in the Rutherford Reach. To meet the sediment source reduction goal of the Project, 75% reduction in eroding bank length by 2017 would require that no more than 3,700 total linear feet of the 49,714 feet of left (east) and right (west) banks are eroding, or no more than 7.5% of the channel bank length in the Rutherford Reach.

In 2013, 5,200 feet of channel banks were mapped as eroding or unstable throughout the Rutherford Reach. This constitutes 15% of the channel bank length in the Rutherford Reach. This is a reduction of 65% compared to the 2009 baseline with 72% of the 4.5 mile Rutherford Reach Restoration Project complete.

A minimum further reduction of 1,500 linear feet in total eroding bank length is required to meet the project goal of 75% reduction of eroding banks since 2009.This goal is expected to be reached or exceeded upon the completion of the project in 2014.

III. Sediment Source Reduction Calculations

The Total Maximum Daily Load Target (TMDL) is to reduce fine sediment delivery from all Napa River mainstem channel incision and bank erosion sources by 19,000 metric tons/year. To measure the reduction in fine sediment source as result of the Project, the one-time removal of sediment available for delivery to the channel is measured and amortized over the life of the project (20 years).Added to this value is the estimated reduction in sediment delivery achieved through cessation of bank erosion that was proceeding at an average moderate rate of 750 metric tons/mile/year over the length of the unrestored channel. Sediment removed is assumed to be sandy clay loam with a bulk density of 1.6 metric tons/cubic meter.

Performance Standard

The desired outcome for fine sediment source reduction is:

- Up to 80% of the total target TMDL sediment load reduction on the mainstem Napa River.

Progress Towards Standard

See **Appendix D. Study III Sediment Source Reduction Calculations** for supporting data utilized to calculate the estimated reduction in sediment loading to the mainstem Napa River as a result of restoration Project implementation.

The implementation of Phases 1-4, in Reaches 1-4, and Reach 8, which constitutes 72% of the 4.5 mile Project Reach, from 2009-2013 reduced fine sediment source loading by an estimated 14,118 metric tons/year for the next 20 years, or 74% of the total TMDL target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources.

Completion of the final phase of construction implementation in 2014 is expected to exceed the standard, achieving an estimated reduction in excessive fine sediment loading of up to 86% from mainstem Napa River sources.

IV. Longitudinal Profile Thalweg Surveys

Longitudinal profile thalweg surveys provide detailed topographic data depicting channel morphology, habitat types, and changes in channel slope. Channel surface elevations are surveyed along the thalweg (the lowest flow path of the channel).Points are taken at all riffle crests, pool bottoms, transitions in channel surface substrate (Boulder, cobble, gravel, sand, silt, bedrock).Spacing between intermediate points is generally no more than 10 feet.

The baseline pre-project longitudinal thalweg survey was completed in 2009/2010. A subsequent survey was completed in fall 2013 following completion of restoration in the upstream half of the Project in Reaches 1-4, and in Reach 8 North., The 2013 survey of the Project reach was completed following restoration construction in Reaches 1-4, Reach 8 North, and the completion of the fish barrier removal at the Zinfandel Lane Bridge. .Thalweg surveys are to be conducted periodically approximately once every five years, or following large channel adjusting flood flow events to, evaluate changes in channel bed morphology in the Project reach. Sequential long profile elevations are compared to discern whether the average rate of channel incision is decreasing. The longitudinal thalweg elevations are tied into surveyed benchmarks established at monitoring cross sections along the Project reach.

Comparison of the pre-project 2009/2010 thalweg survey with the 1972 FEMA channel profile shows that the channel elevation remained essentially unchanged at upstream and downstream limits of the Project reach at the Zinfandel Lane and Oakville Cross Road Bridges, at 169 feet and 112 feet, respectively. Over this 37 year time period, the channel elevation decreased approximately one foot under the Rutherford Cross Road Bridge at the midpoint of the Project reach. The degree of channel incision varied greatly along the Project reach between the relatively fixed points of elevation at the three bridges. In the most confined channel sections upstream of the Rutherford Cross Road Bridge, in Project Reaches 1-4, the channel incised up to sixteen (16) feet, which equates to a maximum average rate of 0.4 feet per year.

Performance Standard

The desired outcomes for channel morphology measured by the longitudinal profile survey include:

- Positive trends in reductions in channel bed incision rates

Progress Towards Standard

See **Appendix D. Study IV. Longitudinal Profile Thalweg Surveys** for plots of the channel profiles from the 1972 FEMA study, the 2009/2010 pre-project baseline survey, and the 2013 survey. Detailed graphs depict the difference in bed elevation and substrate distribution along the thalweg 2013 versus 2009/2010. Figures depict locations of channel aggradation and incision relative to areas where the channel has been widened.

Comparison of the 2013 and 2009/2010 surveys reveals that the elevation of the channel is remaining has remained unchanged at the downstream end of the Project at Oakville Cross Road Bridge. At the upstream limit of the Project, the thalweg elevation decreased to 163 feet at the Zinfandel Lane Bridge, where the bridge apron was lowered by 6 feet to restore fish passage in 2011. Elevation differences varied by less than a foot under the Rutherford Cross Road Bridge.

In addition to remaining stable at the Zinfandel Lane, Rutherford Cross Road, and Oakville Cross Road Bridges, the channel elevation remained steady at various riffle crests in both restored and control sections. Some of these riffles have persisted since 2004, prior to the 80 year storm event in 2005. There are several other locations where the channel thalweg elevation remained stable with negligible change, most notably at the bedrock grade control at station 19,104 at the east bank stabilization area on Quintessa. The beaver dam at this location has persisted for several years. The number of beaver dams is increasing annually. At least three have persisted at other riffle crests where the channel elevation has remained stable for between 2009-2103. This indicates either that the beavers select relatively stable sites to construct the dams, or that the beaver dams are helping to stabilize the channel locations where they are constructed.

Aggradation and incision of the channel bed occurred between points that remained fixed in elevation along the entire Project reach following the December 2012 floods. Gravel has deposited locally in sections of the channel where flow velocities have been reduced through channel widening at instream benches, alcoves and created secondary channels. The length of the existing riffle in Reach 2 increased, extending downstream to the widened area of the channel at the constructed alcove in Reach 2. Channel bedload has also deposited where channel roughness has been increased. The installed boulder field between inset floodplain benches 9-10 in Reach 4 was completely buried in gravel despite the relatively steep slope and high confinement of the channel in this location. Sand is accumulating on the downstream end of willow baffles installed to reduce flow velocities on in stream benches.

While the elevation of the channel bed has remained unchanged at the limits of the Project reach, the baseline elevation of some points in the channel has been locally reduced. Caution should be taken when comparing differences in the lowest points of the thalweg between the 2009/2010 and 2013 surveys. Whereas the majority of the deepest pools in 2009/2010 were impassable and the distance to the maximum depth was estimated, in the historic drought year of 2013, most every pool was passable, and in fact some of the most persistent pools were completely dry. Thalweg elevations from the 2013 survey are therefore more reliable, but do not necessarily indicate that incision occurred at all of the coincident pool locations.

In general, a relatively high degree of channel scour occurred in between areas that had been widened to create floodplain benches in Reach 4. Prior to restoration, Reach 4 was the most narrow and confined section of the Project, and was characterized by a long, homogenous glide pool. Now relatively deeper pools separate longer and well-defined riffles, which were created by gravel deposition at benches. Historically low flow conditions allowed for a complete survey of Reach 8 at 9 at the downstream end of the project, portions of which were also previously impassable due to the depth of pools. Reoccupation of known points in the channel, indicate that the channel scoured locally up to eight feet in Reach 9, creating deep pools in previous riffle crest locations. These observations indicate that the channel bed is still subject to scour between fixed points of elevation. This may support the hypothesis that the channel has excess carrying capacity in relation to the bedload supply.

Some of these areas of local pool scour may be related to local reductions in bedload due to aggradation of the channel bed immediately upstream. For example, the aggradational area at Benches 10 and 11 in Reach 4 is followed immediately downstream scour pool. The channel aggraded along the length of Reaches 6, 7 and 8 from the confluence of Bale Slough to the downstream end of the newly constructed secondary channel. Channel adjustments in Reach 9 may be due to reduced amounts of bedload from upstream due to aggradation in of Reach 8. While the channel bed elevation remained relatively the same through the downstream half of Reach 8, the channel experienced downcutting from the Bella Oaks tributary confluence downstream through Reach 9. This may related to increased carrying capacity provided by the discharge from Bella Oaks.

Examination of the profiles demonstrate that sections of the channel in both widened and unrestored reaches experienced net incision. Furthermore, the Hydro Tools for Hydrology developed by Carl Renshaw at Dartmouth Earth Sciences includes an Excel add-in function called CompareXS() for determining the total areas of deposition and incision between two cross-sections (www.dartmouth.edu/~renshaw/hydrotoolbox/untitled_text_2/). Applying this function to the plots of the longitudinal profile surveys calculates that the Project reach sustained an overall maximum average decrease of 0.17 feet in thalweg channel elevation between 2009/2010 and 2013 following the flood flows in December 2012. Taking into account the error inherent in the inability to accurately survey the deepest pool elevations in Reaches 4, 8 and 9 during the 2009/2010, this estimate of net incision is high.

Although local areas of the channel are scouring, increased channel instability is unlikely to ensue if the natural and installed grade control structures continue to function to prevent channel incision from propagating upstream. Following the 2012 storms, the installed grade control in Reach 4 at Bench 5 was not exposed or undermined due to channel. This indicates that the installed structure is thus far functioning similarly to the natural bedrock grade control structure upstream in Reach 2 at the Quintessa Bank Stabilization Area to preclude upstream migration of channel knickpoints. Aggradation of the boulder field installed in Reach 4 between Benches 4-5immediately upstream of the scour pool associated with the confluence of the Honig ditch on the east bank suggests that channel stability and roughness has been sufficiently increased to preclude headward migration channel incision. Future storm flow events will serve to demonstrate whether the grade control structures installed in Reach 8BC South 2013 will also function as designed to hold the channel elevation, prevent channel incision, and preclude the isolation of newly created instream benches above the channel thalweg.

V. Channel Transect Surveys

Channel cross sections surveys allow evaluation of changes in channel geometry at spawning riffle crests in representative treatment and control locations throughout the Project, where the channel has been widened versus where it has not. Mapping of substrate and vegetation along the transects allows for evaluation of changes in patterns of sediment deposition and plant community distribution over time. Baseline surveys are conducted prior to construction and are re-occupied following construction.

Performance Standard

The desired outcome in channel morphology as measured by channel cross section surveys includes:

- Positive trends in increases in bankfull channel width to depth ratios

Progress Towards Standard

See **Appendix D. Study V. Channel Transect Surveys** for long term monitoring cross section locations in the Rutherford Reach. Results of cross sections surveys depicted changes of the unrestored channel from before and after the 2005 flood event were reported in the 2012 Monitoring Report.

In 2013, professional licensed land surveyors re-surveyed cross sections at all of the long term monitoring locations, and at additional locations previously surveyed in 2005 and 2007 to conduct hydraulic modeling and to create the baseline maps in support of the restoration design, in Reaches 1-4 of the Project between the Zinfandel Lane Bridge and the Rutherford Cross Road. These surveys will be used to conduct a CLOMR study to model post-construction flood flows in the restored upstream half of the project. The results from this study are forthcoming from Napa County.

The bankfull channel width to depth ratio has been directly increased along 25% of the Project reach, where the channel banks have been graded to construct 9,285 linear feet of inset floodplain benches and alcoves, and 3,235 linear feet of bank stabilization areas. Through 2013, 12,520 linear feet of channel banks have been stabilized with slope grading, constituting 35% of the total channel bank length in restored reaches. See **Appendix C. Restoration Elements** for tables of treated bank locations and length.

VI. Pebble Counts

To determine the grain size distribution of spawning substrate in the Rutherford Reach, pebble counts are conducted the closest riffle crest to each long term monitoring cross section survey location at the time of the survey. Cross sections are located in control and treatment areas in each construction phase. Most cross sections are originally located at a riffle crest. Migration of the riffle crest away from the monitoring cross section is recorded at the time of the pebble count survey, and the location of the survey is adjusted to capture the grain size distribution at the new location of the riffle crest for a more accurate comparison.

Performance Standard

The desired outcomes from the pebble count surveys studies include:

- A statistically significant increase in riffle median grain size (D50 mm).
- A statistically significant reduction in riffle substrate percentage of fines (<2mm).

Progress Towards Standard

See **Appendix D. Study VI. Pebble Counts** for a summary table of pebble counts conducted to date.

In fall 2013, the particle size distribution was sampled at thirty one (31) riffle crests at monitoring cross sections throughout the Project reach. Comparison of this data with previous pebble counts allows assessment of channel substrate changes subsequent to the 18,300 cfs flood of 2005, and the peak flow events of 9,628 cfs and 9,260 cfs in December 2012, in restored and unrestored sections of the Project. The 2013 data reflects the effects of the December flow events on restored areas in Reaches 1-4 between Zinfandel Lane and the Rutherford Cross Road, as well as in Reach 8 North where the linear wetland secondary channel was created opposite the Sequoia Grove bank stabilization area. See **Appendix D. Study IV. Longitudinal Profile Thalweg Elevation Surveys** to examine the results of the particle count data in context with the channel substrate and geometry mapped along the channel in tandem with the surveys conducted in 2009/2010 and in 2013.Locations of relative channel widening at restored locations are indicated on the long profile chart and in the pebble count summary table.

Pre- and Post-Restoration

The widening of the channel at restoration sites is contributing to the formation of gravel bars, the coarsening of the channel, and the reduction of percent fines in spawning riffle crests. Pebble counts conducted at riffle crests located adjacent to constructed inset floodplain benches show a bimodal distribution of particle size distribution. Pebble count data showing that median grain size on the floodplains is lower, and that the percentage of fine sediment is higher relevant to that in the adjacent low flow channel validates the field observation that sand is depositing differentially on the benches.

December 2012 Storm Flows

No definitive conclusions can be made regarding effect of restoration on changes in particle size based on a comparison of particle counts at sampled at locations in restored and unwidened sections of the channel from before and after the December 2012 storm events. The overall trend indicates that the median particle size at the majority of riffles sampled in the restored upstream half of the project became finer since they were last sampled between 2008-2011. Conversely, the median particle size at the majority of riffles sampled in the downstream half of the project stayed the same or became finer since they were last sampled between 2008-2011. Interestingly, median particle size remained unchanged across the cross section in Reach 8 where the newly created linear wetland and secondary channel had been created in 2012. No difference in median grain size was measured between the gravel recruited in the secondary channel and along the base of the bank stabilization area at Sequoia Grove.

18,300 cfs Annual Peak Flood Flow 2005

Particle counts taken before and after the 2005 flood in 2004 and 2005, and again in 2008 and 2009, showed no discernible trend in median particle size D50 in the narrow reach upstream of the Rutherford Cross Road in Reaches 1-4. Downstream of the Rutherford Cross Road, in Reach 5-9, the D50 generally increased, indicating a slight coursing of the stream channel. Comparison of the pebble counts taken in 2013, however, show an overall coarsening of the channel bed at 8 of the 10 locations surveyed in 2004. Of the two locations where the D50 particle size decreased relative to 2004, station 17,891 was located in a control reach, and station 15,950 was located at a restored bench. In the widened section of the channel, the particle size distribution was bimodal. Whereas the overall cross section was relatively finer compared to 2004 (D50 = 11 vs D50 = 16), the gravel in the riffle was coarser (D50 = 22 vs D50 = 16), and the sediment deposits on the newly constructed adjacent floodplain bench were much finer (D50= vs D50=16)

VII. Spawning Gravel Permeability

Spawning gravel permeability studies are complementary monitoring studies to the Project conducted with separate funding sources by the Napa County Resource Conservation District (Napa RCD) at sites throughout the Napa River watershed to characterize the quality of spawning habitat. The Project coordinates with the Napa RCD to obtain data collected at sites within the Rutherford Reach for evaluation of changes over time.

Performance Standard

The desired outcomes for spawning gravel permeability include:

- Increased gravel permeability at riffle crests
- Positive trends towards riffle crests with "good" rank

Progress Towards Standard

See **Appendix D. Study VII. Spawning Gravel Permeability** for the summarized results of the permeability analysis and the mortality index calculation performed by the Napa County Resource Conservation District for the riffle crest cross sections surveyed in 2004.

In 2004, the Napa RCD collected permeability data at the ten (10) baseline cross section transect survey locations, which were located at riffle crests in the Rutherford Reach. The results of the cross section transect surveys were reported in **Appendix D. Study V of the 2012 Monitoring Report.** In 2004, the results of the permeability and survival index surveys ranked one (1) of the ten (10) cross sections as good, while five (5) were ranked fair, and four (4) were ranked as poor.

In the winter of 2012-2013, the Napa County Resource Conservation District conducted repeat gravel permeability studies at two of the original 2004 sites in the Rutherford Reach as part of a larger study along the mainstem Napa River. The repeat measurements do not demonstrate a clear trend in spawning gravel permeability at the long-term monitoring sites in the Rutherford Reach. The RCD is working with Stillwater Sciences to determine the how much noise is present in the data, and the statistical significance of the results at multiple sites sampled along the Napa River. Repeat sampling will be conducted in summer 2014, and the results will be reported thereafter.

The results of the spawning gravel permeability and scour chain studies conducted in the Rutherford Reach can be compared against other sites on the Napa River throughout the watershed in the *Napa River Sediment TMDL Monitoring Program: Summary Report of Pilot Implementation* (September 2013), prepared by Stillwater Sciences for the Napa County Resource Conservation District and the State Water Quality Control Board. Napa River Pebble count data from these studies augmented the monitoring data collected for the Project. This report is available online: www.naparcd.org/documents/NapaTMDLPilotMon_TechMemo_2013_FINAL_30SEP2013.pdf.

VIII. Channel Morphology Survey: Riffle, Glide, Pool Distribution Mapping

The Rutherford Reach has experienced great simplification in channel morphology due to channel incision, with long sections of homogenous glides, and a reduction in the frequency and spatial extent of riffle spawning habitat. Mapping of the distribution of riffles, relative to intervening glides and pools, provides a way to spatially quantify channel morphology and habitat complexity. Long term monitoring locations are established at riffle crests in order to track changes in spawning habitat quality simultaneously with changes in channel geometry, hydraulics and sediment transport capacity. Spawning riffle crests are located at in the channel thalweg at the apex of gravel bars, where the channel flow velocity is greatest.

Three methods have been used to track trends in riffle crest distribution and density in treated or untreated locations throughout the Project reach. The first method was to map the spatial extent of gravel bar deposits along the channel. In 2005, Jones & Stokes mapped a total of 155 gravel bars in the Project reach from air photos. The results are depicted in the *Field Assessments Maps in the Final Basis of Design Report for the Napa River Rutherford Reach Restoration Project* (Jones & Stokes, October 2008). While the channel bar facies map displays the distribution of gravel deposition along the channel, it does not provide a means to track changes in the location distribution of riffle crests. Lacking an elevation component, the maps provide no means to measure changes in the relative depth of riffles, glides and pools, or to estimate changes in the volume of gravel deposition in the Project reach.

The second method used to measure long term change in riffle crest distribution is to survey the river channel profile elevation. Detailed longitudinal profile surveys of channel elevation and corresponding substrate the thalweg are conducted periodically. See **Appendix D. Study IV. Longitudinal Profile Thalweg Elevation Surveys** for the results of the longitudinal thalweg surveys, which document the channel geometry and substrate changes along the Project reach. The profiles from 2009-2010 and from 2013 clearly depict the riffles, pools and glides distributed along the channel. Riffle crests on the long profile are distinguished as relatively high points of elevation in the thalweg with gravel substrate.

The third method is rapid mapping of riffle crests along the channel during the annual spring channel survey. For annual field mapping along the channel, riffle crests are determined based on geomorphic attributes such as association with gravel point bars, and relatively high stream flow velocity, as well as by the determination of the fisheries biologist that the riffle crest presents a potential spawning location, or is located at an observed spawning location from the previous spawning season. Riffle crest distribution was mapped with a hand held GPS simultaneously with each of the long profile surveys conducted in 2013. The number and distribution of riffle crests mapped by hand was comparable to the number of high points indicated in the long profile surveys. This validates that the annual rapid mapping protocol serves as an efficient and cost effective proxy for tracking annual changes in riffle crest distribution in the years intervening longitudinal profile channel surveys.

According to Rocko Brown of ESA PWA, gravel deposits can generally be characterized as being "forced" or "free". In the first case, "forced bars" are locked in position by some structural element within the river corridor or by a relatively wide expansion. In the second case, "free bars" are transient features that represent an inability of the flow field to effectively route sediment through the course of sediment and water loading to the river corridor. Annual tracking of riffle crests is an efficient means to track the persistence of riffle crests at treated and untreated locations. To discern the mechanism that forces bars, the locations of the persistent riffle crests can be compared against the channel substrate and slopes mapped in the periodic longitudinal profile surveys, as well as in relationship to locations where the channel cross section has been widened to create inset floodplain benches.

The performance standard for the project is a 30% increase in riffle length or riffle frequency in treated locations. Increases in the length of riffle crests must be evaluated with air mapping or longitudinal profile surveys. Increased in the density of riffle crests can be evaluated with long profile surveys or field mapping. The 65 riffle crests mapped along the channel in June 2011 serve as the baseline against which to evaluate progress towards meeting the standard. To meet the target standard of a 30% increase in riffle frequency measured utilizing the annual field mapping protocol would require a total of 84 total riffle crests throughout the Project reach following the completion of the Project, and at least one channel forming 5 year recurrence interval event.

Performance Standard

The desired outcome for increased complexity in channel morphology includes:

- A 30% increase in riffle frequency or length in treated locations.

Progress Towards Standard

See **Appendix D. Study VIII. Channel Morphology Surveys** for tables and graphics depicting the changes in riffle bar density over time.

From 2011-2013 the number and corresponding density of riffle crests increased from 65 (14/mile) to 78 (17/mile) along the Project Reach. A comparison of restored Reaches 1-4 from 2011 – 2013, shows an increase in riffle crests from 37 to 42, which constitutes a 13% increase in density in the half of the Project that had been treated to date. Closer examination by river reach shows that a new riffle crest formed in association with the alcove constructed in Reach 2. Riffle crests, and associated pools became more evenly distributed throughout Reach 2. In Reach 3, where five (5) instream benches were constructed, riffle density increased by 30%, meeting the target. The six (6) riffle crests also became more evenly distributed along this restored reach. Riffle crests in Reach 4 remain have maintained the same density from 2011 to 2013 in restored and unrestored conditions. The distribution of riffle crests is uneven in Reach 4.

IX. Residual Pool Depth Survey Associated with Installed Instream Habitat Structures

Repeated measurements of residual pool depth in the vicinity of installed habitat structures will provide information regarding the effect of the installed structures on increasing channel bed and habitat complexity.

Performance Standard

The desired outcome for residual pool depth includes:

- A 25% increase in residual pool depth in treated locations.

Progress Towards Standard

See **Appendix D. Study IX. Residual Pool Depth Associated with Installed Instream Habitat Structures** for data on residual pool depth associated with installed instream habitat structures collected during the annual channel maintenance and monitoring survey. To date, baseline measurements of residual pool depth have taken been at installed structures. Trends in pool depth changes will be reported as long term data set is established. See **Appendix D. Study XI. Seasonal Salmonid Habitat Surveys** for the salmonid habitat functions provided by each installed structure per the assessments made by Napa County Resource Conservation Staff during one high flow, and one low flow event following installation.

X. Large Woody Debris Surveys

Seasonal evaluation of constructed instream habitat structures, including installed woody debris (LWD features), boulder clusters, riffle features, constructed alcoves and benches indicate whether the creation of high flow, low velocity, refugia habitat has been achieved as designed. Over the long term, the adopted management strategy to preserve naturally occurring LWD and the further addition of LWD through continued project implementation is expected to result in meeting overall Project goals

Performance Standard

The desired outcome for installed Large Woody Debris instream structures includes:

- A 75% persistence of installed instream habitat enhancement structures.
- A 40% increase in seasonal refugia cover for Salmonidsr

Progress Towards Standard

See **Appendix D. Study X. Large Woody Debris** Surveys for maps, figures and graphs summarizing the data collected on large woody debris, including additional discussion on the provision of geomorphic and salmonid habitat functions provided by installed LWD structures.

Installed Instream Habitat Structure Persistence

Instream structures were first installed in 2010. As of 2013, 98% of the installed large woody debris habitat enhancement structures have persisted, well exceeding the target of 75% persistence. One of low profile logs was buried and precluded assessment for salmonid habitat function. Eighteen (18) of the twenty-one (21), or 90% of the installed boulder clusters were located. Pool scour precluded some of the boulders from being found or evaluated. In some cases installed boulders were indistinguishable from pre-project rip rap. Finally, the boulder field in Reach 3 was nearly completely buried.

Instream Habitat Function

Whereas the percent of all documented LWD occurrences providing summer refugia has remained steady since 2010, the percent of summer refugia provided by installed LWD structures has increased from 10% to 25% of all occurrences. Naturally recruited LWD provided three times as much summer refugia as installed LWD in 2013, however, installed structures are providing a relatively greater percent of summer refugia summer compared to naturally recruited LWD versus 2011 when naturally recruited LWD provided nine times as much summer refugia compared to installed LWD.

No conclusive trends can be drawn regarding increases in winter refugia cover for salmonids provided by LWD, natural or installed. The total number and percent of installed and natural occurrences of LWD providing winter high flow refugia was relatively the same in 2013. This is in contrast to the prior three years when the percentages shifted markedly between types of LWD providing high flow refugia.

XI. Seasonal Salmonid Habitat Surveys

The Rutherford Reach has experienced up to 15 feet of channel incision since the 1970s, simplifying channel geomorphology and associated aquatic habitat, and significantly reducing high flow slow water habitat for salmonids, including special status Steelhead and Chinook salmon. Incision has also drastically reduced the amount of pool tail spawning habitat. A series of alcoves and floodplain flow expansion and contraction features are being installed in the Project reach which are designed to create flow refugia and complexity at a wide range of flows and salmonid life stages, and to set up the hydraulic conditions for riffle-pool persistence.

Performance Standard

The desired outcomes for high flow refugia for salmonids include:

- Creation of high flow refugia with velocities less than 6 fps for flows 500 cfs and above at constructed alcoves and instream bankfull benches.

Progress Towards Standard

See **Appendix D. Study XI. Seasonal Salmonid Habitat Surveys** for a summary report of target velocities and water depths for seasonal salmonid habitat, velocity measurements and high water mark surveys at constructed benches. The results detailing the functions of the instream habitat structures installed in Reaches 4 West and Reach 8 from 2012-2013, during one winter high flow and one spring low flow event will be included in the RCD report due to be completed in May 2014. A table of preliminary results for the Reach 8 instream structure function evaluation is presented in **Appendix D. Study XI. Seasonal Salmonid Habitat Surveys.**

To date, channel widening at constructed instream benches , alcoves and bank stabilization areas has created 12 acres of high flow slow water refuge for rearing salmonids.

From 2009-2011, one alcove and 10 instream benches were constructed in Reaches 1-4 (of 9 Total Project Reaches). Results from the velocity monitoring studies conducted by RCD staff during one winter event each in 2011 and 2012 demonstrate that the target water depths and velocity of less than 6 feet per second (FPS) for flows 500 cfs and above at the constructed alcove and all instream bankfull benches are being achieved in Reaches 1-3, and 4 east. The Project demonstrates that even in deeply incised river channels it is feasible to construct slow water refugia and geomorphic conditions for riffle persistence, creating critical habitat for various life stages of salmonids, including rearing habitat for Steelhead fry, small and large juveniles.

The two large flood events of December 2012, which were too large to allow safe access to the channel, coupled with the lack of rainfall runoff events for the remainder of the winter, precluded RCD staff from performing the high water velocity surveys in winter 2012-2013 at the benches that were constructed in 2012 in Phase 3B in Reach 4 West, and Phase 4A Reach 8 North. In spring 2013, RCD staff conducted the low flow instream habitat and snorkel surveys at these locations. During the following winter 2014, RCD staff conducted the high flow velocity monitoring surveys at the locations missed the prior year, as well as at the newly constructed benches in Phase 4BC Reach 8 South. RCD staff will complete instream habitat and snorkel surveys in Reach 8 South in April and May 2013.

XII. Vegetation Establishment Surveys

Vegetation installed in riparian restoration areas is monitored the first three establishment years by the contractor that installed the plants in each phase of the Project. Thereafter, vegetation monitoring and management in restored areas will be done by the Napa County Flood Control and Water Conservation District under the Maintenance Assessment District program. Photo monitoring will be incorporated into the annual stream reach survey, repeated cross section transect surveys, and phased vegetation establishment surveys. Photo monitoring of project progress will be conducted at least once every three years.

Performance Standard

The desired outcomes for enhanced riparian habitat include:

- A minimum 20 acres over the life of the Rutherford Reach project (acres)
- An 80% survival of native plants at revegetation sites
- Greater than 90% native cover (less than 10% total non-native)
- Evidence of successful natural recruitment by year 5 at revegetation sites
- A 40% increase in seasonal refugia cover

Progress Towards Standard

See **Appendix D. Study XII. Vegetation Establishment Surveys** for the results from the vegetation establishment surveys, which were first reported in the 2012 Monitoring Report. See **Appendix D. Study XIV Photomonitoring** for photographic documentation of vegetation establishment at restored sites throughout the Project reach**.**

To date, 26.3 acres of native riparian area have been restored in the Project in Reaches 1-4, and 8, exceeding the minimum target of 20 acres of riparian restoration. Revegetation of Reaches 1 - 2 began following restoration construction in 2009-2010, and in 2010 following construction in Reach 3. Revegetation of Reach 4 began following restoration construction on the east bank in 2011, and on the west bank in 2012. Revegetation of Reach 8A North, began following restoration construction in 2012 coincident with Reach 4 West Bank. While construction of Reach 8BC South was completed in 2013, revegetation did not begin until spring 2014 due to the drought and dry soil conditions.

Summary results from vegetation monitoring through 2013 of the 20.2 acres of area planted with riparian vegetation in Reaches 1 - 4, including direct count, percent vegetative cover and line intercept transect surveys, are presented herein.

Survey data from 2013 indicate overall vegetation survivorship to be greater than or equal to 81% in Reaches 1 and 2; 49% in Reach 3; 86% in Reach 4; and 91% in Reach 8A North. First year vegetation survivorship monitoring results for the Ritz-Carlton linear wetland mitigation area included in Reach 8A North is also 91%.. The Project goal and performance standard of 80% vegetation survivorship of installed native plants has been exceeded in all restored reaches with the exception of Reach 3, where vegetation survivorship has been low on east bank Benches 4-5. The Flood District is currently adaptively managing plantings on Reach 3 Benches 4-5 by adding soil amendments (mycorrhizae, etc.), mulching and increasing the watering duration to increase moisture retention with the goal of achieving 80% or greater vegetative plant cover at these locations over time.

Results from the 2013 line intercept surveys, indicate as they did in 2012, that complete vegetation coverage has been attained at monitoring sites in Reaches 1-4, which exceeds the 90% target for vegetation coverage. Results from the 2013 survey indicate that the vegetative coverage along surveys transects is comprised of approximately 70% herbaceous vegetation, 9% woody shrub vegetation and 21% woody tree vegetation. Field estimates and quadrant sampling along line transects indicate that approximately 20%-25% of the cover in restored areas is comprised of non-native vegetation while the remaining 75%-80% cover is native vegetation. Continued management of non-native plants will be continued to achieve the target goal of 90% native vegetation coverage in restored riparian areas. Whereas in 2012, approximately 20% of the installed and naturally recruited vegetation measured at transects was taller than three (3) feet high, in 2013 30% of the installed vegetation had grown to exceed that height.

Increases in both of these metrics, percent coverage and average vegetation height, represent a positive trend in vegetation establishment at the restored sites as installed vegetation becomes larger and more mature/complex providing greater habitat value. The installed vegetation is expected to increase at a normal trajectory under typical growing conditions. In conclusion, with site specific and general monitoring taking place at regular occurrences and informing adaptive management decisions at restoration sites, it is expected that the Project goals and performance measures will be achieved over the life of the Project.

Stakeholder Participation Documentation

The Rutherford Dust Restoration project is a landowner-initiated project. The leadership of the Rutherford Dust Restoration Team subcommittee of the Rutherford Dust Society, and the active participation in the Landowner Advisory Committee meetings has been central to the success of the restoration Project. Maintaining Landowner buy-in and active participation will remain a key element of project viability. Through community outreach, this private-public partnership can serve as a model for other communities. Documentation of participation levels will address the success of community engagement as the Project progresses.

Performance Standard

The desired outcomes for stakeholder participation include:

- Continuation of at least 90% landowner participation in the Project.
- Continued landowner leadership, as evidenced via the Landowner Advisory Committee (LAC) and willingness to fill offices (Chair, Vice-Chair, and Secretary).

Progress Towards Standard

See **Appendix D. Study XIII. Stakeholder Participation Documentation** for a table detailing landowner participation in the Project.

All 28 landowners who allowed for the creation of the Preliminary Design granted access for completion of the Final Design of the Project on their properties. Temporary Construction Easements and Maintenance Access Agreements have been signed or agreed to by 100 % of the landowners participating in the restoration Project in Phases 1-5, Reaches 1-9.Landowners who have undergone restoration construction since 2009 have continued to allow access for Project.

All 30 landowners included in the Channel Maintenance Assessment District receive annual reports of channel survey findings, and requests for channel maintenance. Records of landowner maintenance requests are maintained by the Napa County Flood Control and Water Conservation District. Annual maintenance activities are reported in a separate Annual Channel Maintenance and Monitoring Report for the Rutherford Reach of the Napa River produced by the Napa County Flood Control District.

Landowner Advisory Committee Meetings are held twice annually for landowners to confer with Flood District staff on the budget and workplan priorities for the implementation of the long term Channel Maintenance and Monitoring Plan. Sign-in sheets demonstrate that each meeting has been attended by representatives a minimum of one third of the 30 properties included in the Maintenance Assessment District. Each Annual Maintenance Workplan proposed by the District based on the annual maintenance and monitoring survey and landowner requests has been approved by a majority vote of the attending landowners each year.

Photomonitoring

Photomonitoring is conducted concurrently with the annual stream survey and at select locations pre- and post-construction. Photo-monitoring stations are established and re-occupied in the course of monitoring surveys to provide a visual record of progress. Site-specific monitoring of riparian revegetation sites will capture rates of survival and establishment and quantities of native relative to non-native vegetation. As air photos become available, and as the Project budget allows, the riparian buffer width and stream network will be assessed and incorporated in the spatial database.

Photo-monitoring data for each phase of construction is published in the final grant report for each phase of construction. Reports have been completed for Phases 1 and 2, and copies are available at the County.

Results of photomonitoring conducted at cross sections are available in **Appendix D. Study V.**

Complementary Monitoring

The project team coordinates with partner agencies responsible for complementary water quality, fish, and wildlife monitoring including the Water Board, RCD, and others and will encourage an active exchange of data and findings.

TMDL Studies

The Napa River Sediment TMDL Monitoring Program: Summary Report of Pilot Implementation (September 2013), prepared by Stillwater Sciences for the Napa County Resource Conservation District and the State Water Quality Control Board, presents the findings from studies to assess whether numeric targets for the attainment of water quality set forth by the State Water Board in the Sediment TMDL Plan are being met in the Napa River watershed. The report presents findings on spawning gravel embedednesss and scour chain surveys from previously sampled sites in the Rutherford Reach, along with other locations on the mainstem Napa River. Pebble count data from these studies augmented the monitoring data collected for the Project. This report is available online: www.naparcd.org/documents/NapaTMDLPilotMon_TechMemo_2013_FINAL_30SEP2013.pdf.

Salmonid Monitoring

The Napa County Resource Conservation District conducts annual salmonid spawning, rearing and outmigration surveys they conduct in the mainstem Napa River with selected sites in the Rutherford Reach. Their annual reports are posted to the WICC website.

Database Tracking

The Natural Resource Projects Inventory (NRPI) project survey form is completed for each Phase. It can be viewed at the following link: http://www.ice.ucdavis.edu/nrpi/project.asp?ProjectPK=12386.Napa County also uploads project data to Wetland Tracker for each Project phase at the following website: www.californiawetlands.net/tracker/. Each year, Napa County completes and submits the State Water Resources Control Board Annual Sediment Load Reduction Form, including BMPs implemented.

Discussion of Progress Towards Desired Outcomes

The monitoring of measurable performance indicators demonstrates that the majority of performance standard targets set for Napa River Restoration Project Rutherford to Oakville Reach are being met or exceeded to date. Analysis of these monitoring results demonstrates that progress is being made towards achieving the desired outcomes in the following four restoration categories:

- Sediment Load Reductions and Increased Channel Morphology Complexity
- Aquatic Habitat Enhancement
- Riparian Habitat Enhancement
- Ongoing Stakeholder Participation

Sediment Load Reductions and Increased Channel Morphology Complexity

Demonstrable progress is being made towards achieving the goals set forth in the sediment TMDL to reduce excessive sources of fine sediment delivery from bank erosion and bed incision sources along the Rutherford – Oakville Reach of the mainsteam Napa River. With four of five phases of project construction complete, the area of unstable streambanks has been reduced substantially, an overall reduction of 65% since 2009.

Stabilized bank slopes withstood testing by a pair of historically large storm events in December 2012. Graded areas have sustained little to no erosion even when subject to channel filling storm flows prior to the planting or establishment of riparian vegetation. Minimal areas have required for ongoing bank stabilization and revegetation. The restored areas that required installation of additional slope stabilization and erosion control measures after the storms of December 2012 were limited to transition areas between graded and ungraded sections of the channel; pockets of graded slopes that were comprised of relatively incompetent sandy substrate; and sandy slopes that were built slightly steeper than the design grade to preserve additional mature riparian trees at the top of the slope.

Repeat longitudinal profile surveys in 2009/2010 and 2013 indicate that the channel bed elevation has remained stable at the downstream and upstream limits of the of the Project. Areas of the channel bed incised and aggraded between points in the channel that remained fixed in elevation along the Project reach following the December 2012 floods. In addition to remaining stable at the Zinfandel Lane, Rutherford Cross Road, and Oakville Cross Road Bridges, the channel elevation remained steady at various riffle crests in both restored and control sections. Some of these riffles have persisted since 2004, prior to the 80 year storm event in 2005. Initial calculations show that the overall Project reach experienced up to 0.17 feet of average net incision along the thalweg from 2009-2013, however, inaccuracies stem from the fact that the lowest points in the baseline thalweg were estimated in deep pools. Gravel bars are forming and aggrading in areas where the river has been widened and where channel roughness has been increased by the installation of clusters of 4 ton boulders. Continued decreases in overall average channel bed elevation, by the increased scouring of pool depths between locations of fixed elevation, may indicate that the river channel bedload supply is limited. Gravel augmentation studies are currently underway for the mainstem Napa River.

Geomorphic and hydrologic processes are being re-established to support a continuous and diverse native riparian corridor. Where the channel has been widened to create inset benches flow velocities have been reduced. The constructed inset benches and secondary channel are providing floodplain functions allowing for deposition of sand and recruitment of riparian vegetation. Channel morphology in restored reaches is increasing in complexity, with previous homogenous glide pools evolving into sequences of distinct gravel bars, riffles, deeper pools and glides. Riparian vegetation is being recruited at the interface of the constructed benches and the low flow channel.

Aquatic Habitat Enhancement

The increased complexity in channel morphology is enhancing aquatic habitat. Channel flow velocities have been sufficiently reduced in constructed floodplain benches and alcoves to provide refuge habitat for rearing salmonids during winter storm flow events. Gravel is accumulating, and riffle length has locally increased in areas where the channel has been widened, providing increased spawning habitat. Pebble counts show that a greater percentage of fine sediments are depositing on the benches relative to adjacent spawning riffle crests, which may translate into improved spawning habitat for Chinook salmon and Steelhead trout.

High value riparian forest has been preserved and expanded. Where possible, riparian vegetation has been retained at the toe of graded slopes to provide cooling channel cover and to protect the banks from erosion. Two years following construction, the transition along graded areas in Reaches 1-3 has become nearly completely obscured from the view of the channel due to the recruitment and regeneration of riparian vegetation that is providing instream shade and cover. In some locations, growth has been especially vigorous. Riparian vegetation is quickly being recruited on benches subject to frequent inundation, and along the interface of the channel. The tributary alcove on the west bank of Reach 2 at the Ranch Winery, which has a near perennial spring, is functioning as a wetland. The large woody debris structures that were installed to provide stability to the graded slopes are completely obscured by vegetation growth. In addition, thinning of willows at the upstream edge of the base of Bench 4 in Reach 3 was necessary to facilitate continued high flow access to the created inset floodplain.

Installed woody debris structures are functioning to provide instream habitat for salmonids. Mature steelhead and juvenile Chinook salmon and steelhead trout have been observed taking cover under installed woody debris structures. Installed structures are providing an increased percentage of wood loading in the channel relative to natural recruited wood.

In some locations where boulder clusters have been installed, gravel has been recruitment and substrate sorting has been observed. The boulder field, which was installed to create hydraulic constriction, fast water habitat, and feeding lanes for salmonids, instead functioned to increase roughness to the degree which channel flood flow velocities were sufficiently reduced to induce gravel deposition to such a degree that the entire field of boulders was buried in gravel despite being located a confined section of the channel between benches. In other locations, installed boulders have had little discernible on channel morphology. Low profile logs have also been subject to burial by channel sediment, in lieu of providing intended habitat functions.

Riparian Habitat Enhancement

The extent and width of the riparian vegetation buffer has been significantly increased compared to pre-project conditions. Over 14 acres of vineyards have been voluntarily and permanently reconverted to riparian forest. Thus far, over twenty six (26.3) acres have been managed to remove invasive non-native vegetation and replanted with native vegetation that will not promote Pierce's disease in vineyards. The extent of arundo has been nearly eradicated with the removal of 3.25 acres from the Project reach.

Complete vegetation cover has been achieved three years following completion in the first two Phases of the Project. Vegetation establishment, growth and survival rates have been highest in areas of sufficient water supply and soil nutrients. Other locations are being adaptively managed. Natural vegetation recruitment is occurring on floodplain benches.

Stakeholder Participation

Cooperation and trust continues to be robust among the diverse Project stakeholders. All 28 landowners who allowed for the creation of the Preliminary Design granted access for completion of the Final Design of the Project on their properties. The private-public partnership established to implement and maintain the river restoration project for the long term remains strong. The landowners, the Napa County Flood Control and Water Conservation District, and the Napa County Resource Conservation District are successfully fulfilling their roles as prescribed in the Memorandum of Understanding that established the Rutherford Dust Restoration Team (RDRT).

This Project has provided the opportunity to aggregate piecemeal bank stabilization and streamline river management efforts into a comprehensive reach scale restoration effort, providing an economy of scale and greater aggregate economic and ecological benefits. The Project has not simply maintained regulatory compliance, but has worked in direct collaboration with regulatory agencies to improve the Project. Transparent dialogue and responsive to regulatory requests has facilitated Project cost effective and efficient permitting and has also helped to garner support for additional grant funding to continued implementation of the Project.

Landowners are continuing to demonstrate voluntary cooperation and leadership by continued active participation in the Landowner Advisory Committee meetings and communication with the Flood District on matters regarding channel monitoring and maintenance.

Conclusions

To date, monitoring results indicate that the restoration is meeting or is on target to meet the Project goals. It will take many years to evaluate whether some Project performance standards have been met, while other standards can be evaluated annually. Thus far, aquatic and terrestrial habitat has been improved along 3.4 stream miles, with direct treatment of 2.3 miles of streambanks. Creation of inset floodplain benches has succeeded in generating 14.5 acres of slower velocity flow areas to provide high flow refuge for rearing salmonids. An additional 2.9 acres of complex instream habitat has been created associated with the construction of 1,491 linear feet of wetlands.

To reduce sediment loading from channel bank erosion, 25% of the length of the channel banks have been stabilized with bank grading and revegetation or biotechnical treatments. Annual surveys show that eroding bank length has been reduced by 65% relative to 2009 baseline conditions. Channel substrate studies demonstrate that fine sediments are settling out on newly constructed bars, reducing the percent of fines in spawning gravels in the adjacent low flow channel relative to previously unrestored conditions. Gravel with a low percentage of fines relative to pre-project conditions is also being recruited in newly created side channels and along inset floodplain benches in restored areas of the mainstem Napa River. Long term monitoring will demonstrate whether the sediment load reduction target set for mainstem Napa River sources in Sediment TMDL have been met.

The success of salmonid habitat improvements will ultimately be determined by the rebound of fisheries populations in the watershed. Field measurements show increases in the quality and quantity of spawning and rearing habitat in the Rutherford Reach. Preliminary results indicate that channel complexity has increased from widening and reconfiguring of the channel. Long profile surveys indicate that widening of the channel, and the lowering of berms, have created pool riffle sequences where homogeneous glide pools previously existed in the most confined section of the channel in Reach 4 upstream of the Rutherford Cross Road. The creation of high flow refuge habitat has been verified by velocity monitoring surveys at constructed instream benches during winter high flow events. In recent low flow drought years, mature steelhead are spawning in riffles in the mainstem have been observed taking cover under nearby installed woody debris structures. Evaluation of installed habitat structures during low flow conditions in spring demonstrates that juvenile fish are utilizing the large woody debris structures.

Over 26 acres of riparian habitat has been successfully expanded and enhanced to date. Arundo has been removed from 3.25 acres, nearly totally eradicating this invasive weed throughout the Project reach, and native species have been planted where invasive species and Pierce Disease host plants have been removed. Short term revegetation monitoring demonstrates that restoration plantings are successfully establishing despite the historic drought conditions. Long term monitoring of re-vegetated areas that have been adaptively managed under the Channel Maintenance Assessment District will show how successful the Project is at managing invasive plant species and establishing a widened, more resilient, native riparian corridor with grass, understory and overstory species that provide aquatic and terrestrial habitat and improve long term bank stability.

The River Restoration Project has achieved unprecedented participation involving 100% of the properties within the project reach. Direct landowner participation in the channel maintenance and monitoring program continues to be robust. Utilizing this successful private-public partnership as a model, Napa County is expanding its efforts to partner with additional property owners throughout the watershed to manage riparian resources while protecting the productive uses of private property.

This Monitoring Report will be updated annually with results from studies conducted per the Project permits and the Monitoring Plan.

Appendices

NAPA RIVER RUTHERFORD REACH RESTORATION PROJECT

2012-2013 MONITORING REPORT

APPENDICES
Monitoring Studies and Project Summaries

April 2014

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XIV. PHOTOMONITORING

A. Regulatory Permit Summary

Regulatory Permit Summary

Permitting Agency	Agency Contact	Permit Number	Permit Expiration
Permits Obtained for Entire Project			
U.S. Army Corps of Engineers 1455 Market Street San Francisco CA 94103-1398	Sahrye Cohen (415) 503-6779 sahrye.e.cohen@usace.army.mil	2008-00366N Covers entire project	July 20, 2019: Extension may be granted if requested at least one month prior to expiration
U.S. Fish and Wildlife Service 2800 Cottage Way, Room W-2605 Sacramento CA 95825-1846	Ben Solvesky (916) 414-6600 ben_solvesky@fws.gov	81420-2009-F-0266-1 Biological Opinion for entire project: California freshwater shrimp California red-legged frog	Expires upon project completion.
NOAA-NMFS, Southwest Region 325 Sonoma Avenue, Room 325 Santa Rosa CA 95404-6515	Joshua Fuller (707) 575-6096 Joshua.fuller@noaa.gov	Tracking Number 2008/08010 Biological Opinion for entire project: Central California Coast steelhead	2019
Permits Obtained by Implementation Phase			
San Francisco Bay Regional Water Quality Control Board (RWQCB) 1515 Clay Street, Suite 1400 Oakland CA 94612	Ann Riley (510) 622-2420 alriley@waterboards.ca.gov	Phase 1: Reaches 1 and 2 Site No. 02-28-C0338 CIWQS Place No. 735511	2019
		Phase 2: Reach 3 Site No. 02-28-C0338 CIWQS Place No. 735511	2020
		Phase 3: Reach 4 Site No. 02-28-C0377 CIWQS Place No. 763994	2021
		Phase 4: Reach 8 CIWQS Place No. 7780033	2022
California Department of Fish and Game Walnut, Bay Delta Region PO Box 47, Yountville, CA 94599 7329 Silverado Trail, Napa, CA 94558	Suzanne Gilmore (707) 944-5536 Sgilmore@dfg.ca.gov	Phase 1: Reaches 1 and 2Notification No. 1600-2009-0206-3	December 31, 2013
		Phase 2: Reach 3 Notification No. 1600-2010-0021-R3	December 31, 2014
		Phase 3: Reach 4 Notification No. 1600-2011-0036-R3	December 31, 2014
		Phase 4: Reach 8 Notification No. 1600-2012-0074-R3	December 31, 2014

B. Restoration Reaches, Phases, and Construction Schedule

Restoration Reaches, Phases, and Construction Schedule

The Rutherford Reach of the Napa River spans 4.5 miles (24,857 feet) from the Zinfandel Lane Bridge downstream to the Oakville Cross Road. River stations are equal to the distance in feet upstream from the Oakville Cross Road Bridge. The Zinfandel Lane Bridge is located at River Station 24,857.

In 2002, the Rutherford Reach was subdivided into nine (9) subreaches based on differences in channel morphology and restoration needs observed at the time. Reach numbers progress from upstream to downstream Reaches 1 through 4 are located between Zinfandel Lane and Rutherford Cross Road. Reaches 5 through 9 are located between Rutherford Cross Road and Oakville Cross Road.

In 2004 a Conceptual Design was created for the entire Rutherford Reach Restoration Project. A Preliminary Engineering Design and Revegetation Plan was then developed, which went through California Environmental Quality Act (CEQA) review and was completed through a Initial Study Mitigated Negative Declaration (IS/MND) by Napa County in 2008.

For implementation, the Project was then into five final design and construction phases. Construction of these five design phases took place over six years between 2009 and 2014, and included eight (8) of the nine (9) reaches. The scope and sequencing of each design and construction was determined based on multiple factors such as restoration priority, funding limits, contiguous parcels, river bank, and landowner willingness.

Final Design & Construction Phase	River Reaches	River Stations	Construction Year
Zinfandel Lane Bridge	**Upstream Project Limit**	**24,857**	
Phase 1-East Bank	Reach 1 and 2	24,857 – 21,875 - 18,000	2009
Phase 1-West Bank	Reach 1 and 2	24,857 – 21,875 - 18,000	2010
Phase 2	Reach 3	18,000 - 16,000	2010
Phase 3A-East Bank	Reach 4	16,000 - 12,000	2011
Phase 3B-West Bank	Reach 4	16,000 - 12,000	2012
Rutherford Cross Road Bridge	**Mid Project Reach**	**12,000**	
Phase 4A-North	Reach 8	7,800 - 5,800	2012 - 2013
Phase 4BC-South	Reach 8	6,400 - 3,400	2013
Phase 5	Reach 6	11,000 – 9,200	2014
Phase 5	Reach 7	9,200 - 7,800	2014
Phase 5	Reach 9	3,400 - 0	2014
Oakville Cross Road Bridge	**Downstream Project Limit**	**0**	

C. Restoration Elements

Restoration Elements Summary Table

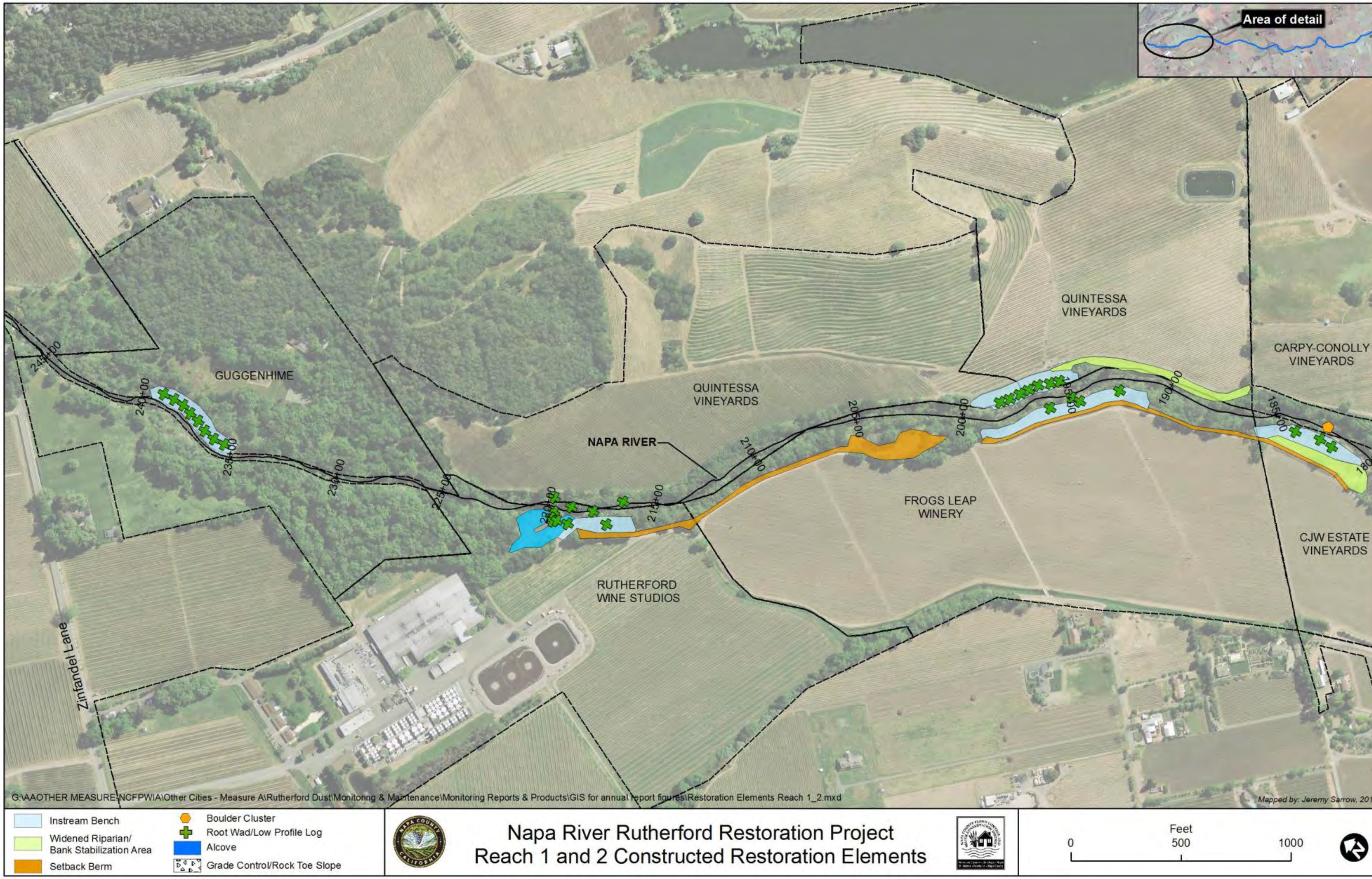
Napa River Rutherford Reach Restoration Project Elements Summary
Constructed Elements Summary
2009-2013

Construction Years:		**2009**	**2009-2010**	**2010-2011**	**2010-2012**	**2012**	**2013**	**2009-2013**
River Reaches (of 9 Total Reaches):		**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 8 North**	**Reach 8 South**	**Total**
River Stations (Feet upstream from Oakville Cross Road)		**24,857-21,875**	**21,875-18,000**	**18,000-16,000**	**16,000-12,000**	**7,800-5,800**	**5,800-3,400**	**24,857-5,800**
Floodplain Benches	Number	1	4	5	9	1	**3**	**23**
	Linear Feet	750	1,975	1,265	2,320	600	2,015	**8,925**
	Acres	0.8	3.1	1.7	5.6	1.2	2.1	**14.5**
Tributary Alcoves, Created Linear Wetlands and Side Channels	Number	1	-	-	-	1	1	**3**
	Linear Feet	350	-	-	-	589	552	**1,491**
	Acres	0.7	-	-	-	0.1	2.1	**2.9**
Bank Stabilization Areas	Number	-	1	-	3	3	**3**	**10**
	Linear Feet	-	800	-	485	1,225	**725**	**3,235**
Setback Berms	Linear Feet	-	3,565	1,205	8,665	-	-	**13,435**
Instream Habitat Structures: Large Woody Debris (LWD) & Boulder Clusters (BC)	LWD	15	17	7	16	11	33	**99**
	BC		1		10	10	11	**32**
	Total	15	18	7	26	21	44	**131**
Riparian Area Replanted* (Widened Riparian Area + Bank Stabilization Areas + Instream Benches)	Acres	1.5	4.5	2.2	10.2	2.3	5.6	**26.3**

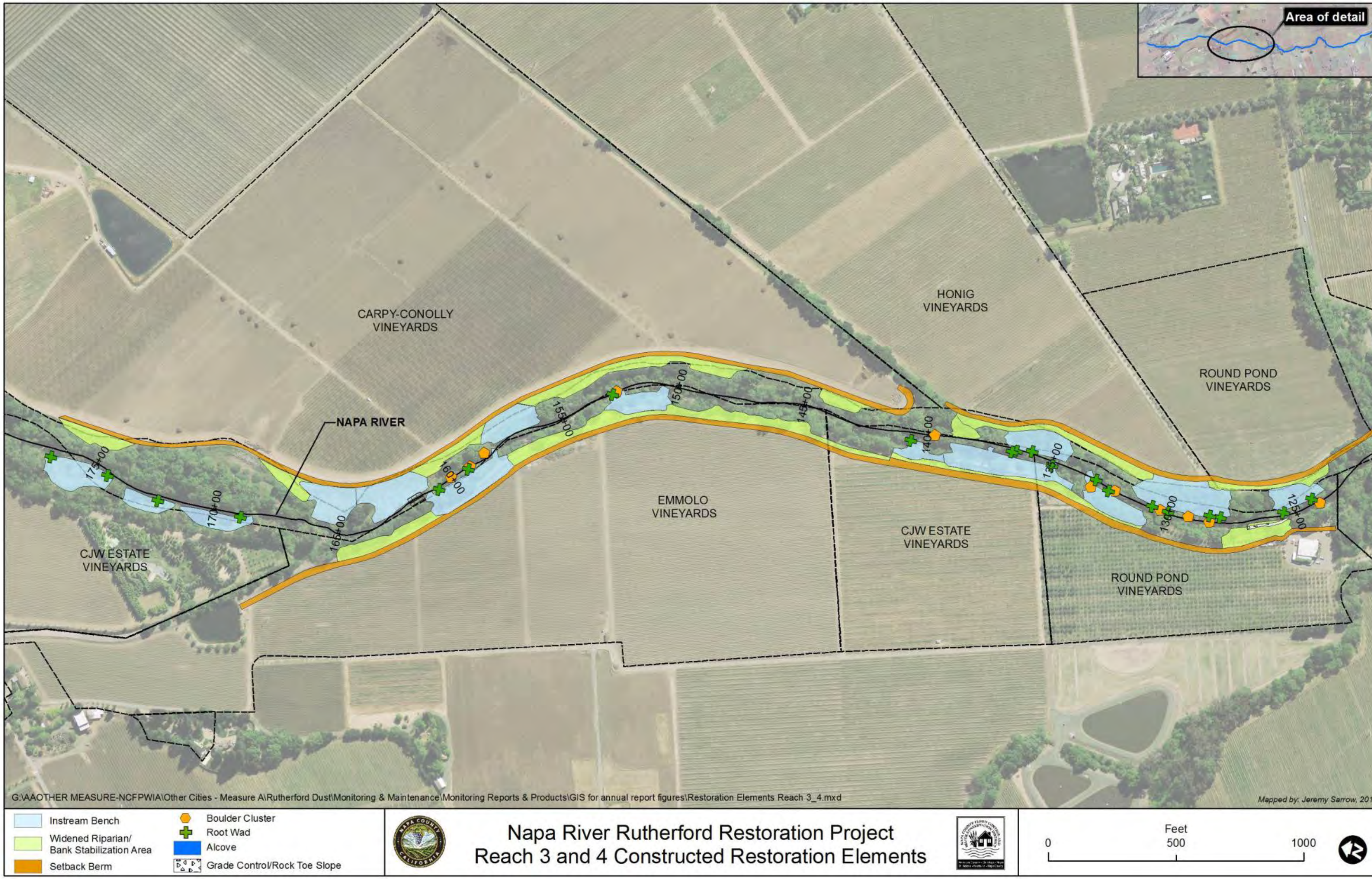
4/1/2014

.

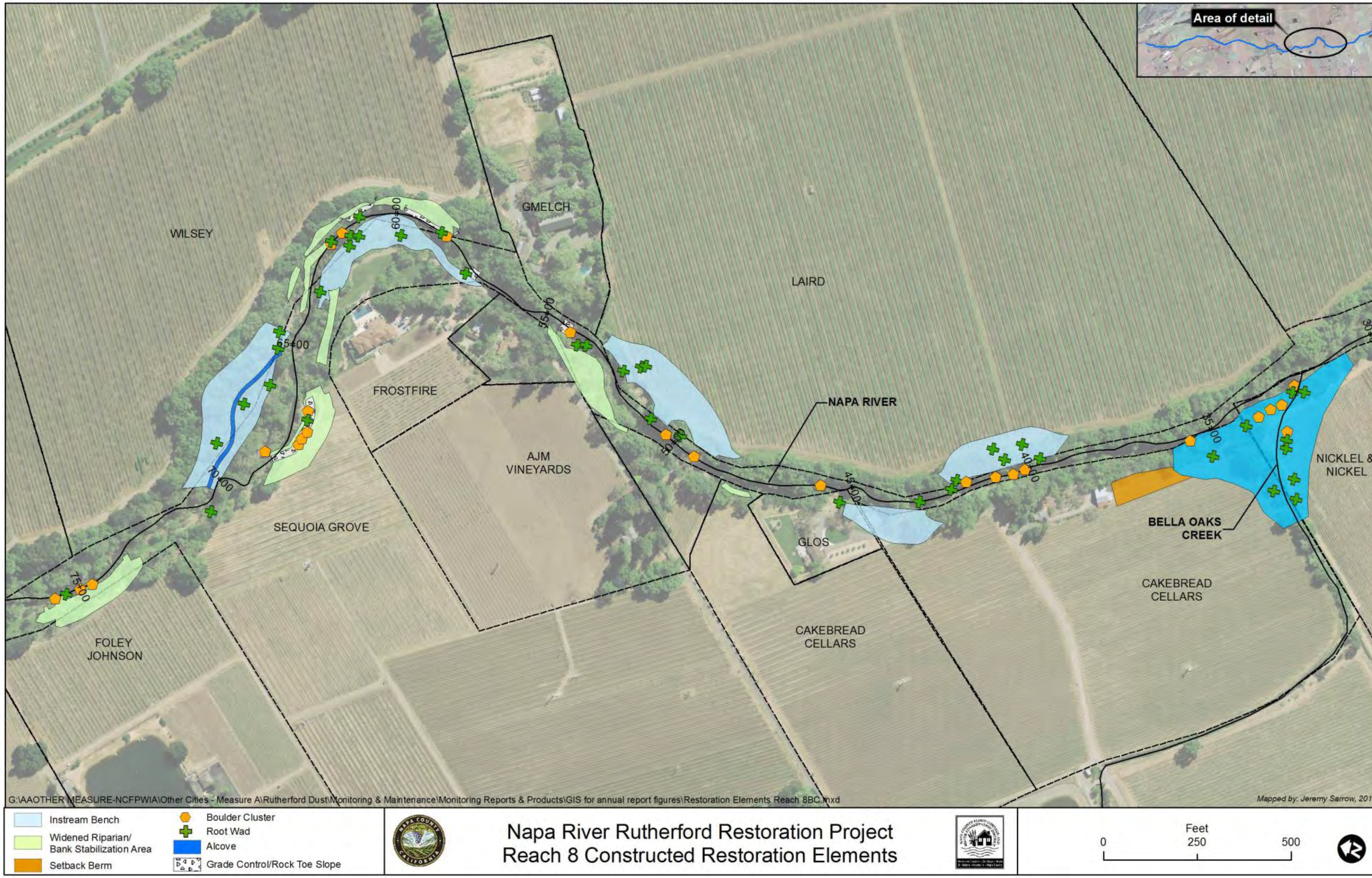
Restoration Elements Reaches 1 and 2



Restoration Elements
Reaches 3-4



Restoration Elements
Reach 8



Restoration Elements: Graded Habitat Features: Cumulative Channel Length Restored 2009 - 2010

Reach	Year	Design Phase	Subreach	Designer	Upstream River Station	Down Stream River Station	Channel Length by Phase	Channel Length Cumulative	Project Completion
		Graded Structure	**Parcel**	**Bank**	(feet)	(feet)	(feet)	(feet)	(%)
	2009	**Phase 1a**	**Reaches 1-2 East Bank**	**ICF JAS, RSA**	**24,857**	**18,000**	**6,857**	**6,857**	**28%**
1	2009	Bench 1	Guggenhime	Left / East	23,950	23,450			
2	2009	Bench 2	Quintessa	Left / East	20,000	19,400			
2	2009	Bank Stabilization 1	Quintessa	Left / East	19,400	18,600			
	2010	**Phase 1b**	**Reaches 1-2 West Bank**	**ICF JAS, NHC**	**24,857**	**18,000**	**6,857**	**6,857**	**28%**
1	2010	Tributary Alcove 1	Ranch /Sutter Home	Right / West	22,225	21,875			
2	2010	Bench 1	Ranch /Sutter Home	Right / West	21,875	21,625			
2	2010	Bench 2	Frogs Leap	Right / West	19,900	19,100			
2	2010	Bench 3	Caymus	Right / West	18,600	18,025			
	2010	**Phase 2**	**Reaches 1-3**	**ESA PWA**	**18,600**	**16,000**	**2,600**	**8,857**	**36%**
3	2010	Bench 1	Caymus	Right / West	17,700	17,425			
3	2010	Bench 2	Caymus	Right / West	17,350	17,160			
3	2010	Bench 3	Caymus	Right / West	17,150	16,850			
3	2010	Bench 4	Carpy Conolly	Left / East	16,725	16,475			
3	2010	Bench 5	Carpy Conolly	Left / East	16,350	16,100			

Restoration Elements: Graded Habitat Features: Cumulative Channel Length Restored 2009 - 2012

Reach	Year	Design Phase	Subreach	Designer	Upstream River Station	Down Stream River Station	Channel Length by Phase	Channel Length Cumulative	Project Completion
		Graded Structure	**Parcel**	**Bank**	(feet)	(feet)	(feet)	(feet)	(%)
	2011	**Phase 3a**	**Reach 4 East Bank**	**ESA PWA**	**16,000**	**12,000**	**4,000**	**12,857**	**52%**
4	2011	Bench 7	Carpy Conolly	Left / East	15,840	15,575	265		
4	2011	Bank Stabilization 1	Carpy Conolly	Left / East	14,450	14,300	150		
4	2011	Bank Stabilization 2	Honig	Left / East	13,900	13,825	75		
4	2011	Bench 11	Honig	Left / East	13,680	13,450	230		
4	2011	Bench 13	Honig	Left / East	13,150	12,725	425		
4	2011	Bench 14	Round PondSouth East	Left / East	12,580	12,390	190		
	2012	**Phase 3b**	**Reach 4 West Bank**	**ESA PWA**	**16,000**	**12,000**	**4,000**	**12,857**	**52%**
4	2012	Bench 6	Emmolo	Right / West	16,125	15,800	325		
4	2012	Bench 8	Emmolo	Right / West	15,275	15,075	200		
4	2012	Bench 9	Caymus (Mee)	Right / West	14,085	14,015	70		
4	2012	Bench 10	Caymus (Mee)	Right / West	13,915	13,500	415		
4	2012	Bench 12	Round Pond North West	Right / West	13,300	13,100	200		
4	2012	Bank Stabilization 3	Round Pond North West	Right / West	12,800	12,540	260		

Restoration Elements: Graded Habitat Features: Cumulative Channel Length Restored 2009 - 2013

Reach	Year	Design Phase	Subreach	Designer	Upstream River Station	Down Stream River Station	Channel Length by Phase	Channel Length Cumulative	Project Completion
		Graded Structure	**Parcel**	**Bank**	(feet)	(feet)	(feet)	(feet)	(%)
	2012	**Phase 4a**	**Reach 8 North**	**ESA PWA**	**7,800**	**5,800**	**2,000**	**14,857**	**60%**
8N	2013	Tributary	Foley Johnson (Sawyer)	Right / West	7,725	NA			
8N	2013	Bank Stabilization 1	Foley Johnson (Sawyer)	Right / West	7,625	7,300			
8N	2012	Bank Stabilization 2	Sequoia Grove	Right / West	6,825	6,525			
8N	2012	Bench 1	Wilsey	Left / East	7,100	6,500			
8N	2012	Linear Wetland	Wilsey	Left / East	7,000	6,411			
8N	2012	Bank Stablization 3	Wilsey	Left / East	6,400	5,800			
	2013	**Phase 4bc**	**Reach 8 South**	**ESA PWA**	**6,400**	**2,725**	**3,675**	**17,932**	**72%**
8S	2013	Bench 1	Frostfire Davis	Right / West	6,300	5,700			
8S	2013	Bench 1 - Alcove	Frostfire Davis	Right / West	6,150	5,950			
8S	2013	Bench 2	Laird	Left / East	5,350	4,850			
8S	2013	Bench 2 - Alcove	Laird	Left / East	5,300	4,925			
8S	2013	Bank Stablization 1	Frostfire Davis / AJM McDowell	Right / West	5,450	5,350			
8S	2013	Bank Stablization 2	Cakebread	Right / West	5,350	5,125			
8S	2013	Bank Stablization 3	Glos	Right / West	4,550	4,300			
8S	2013	Bench 3	Laird	Left / East	4,250	3,900			
8S	2013	Tributary Alcove 1A	Cakebread	Right / West	3,625	3,400			
8S			Bella Oaks Tributary	Right / West	3,260	3,250			
8S	2013	Tributary Alcove 1B	Nickel & Nickel	Right / West	3,400	3,050			

Restoration Elements: Graded Habitat Features: Cumulative Channel Length Restored 2009 – 2014 (Estimated)

Reach	Year	Design Phase	Subreach	Designer	Upstream River Station	Down Stream River Station	Channel Length by Phase	Channel Length Cumulative	Project Completion
		Graded Structure	**Parcel**	**Bank**	(feet)	(feet)	(feet)	(feet)	(%)
	2014	**Phase 5**	**Reaches 5,6,7**	**ESA PWA**	**12,000**	**7,800**	**4,200**	**22,132**	**89%**
6	2014	Secondary Channel	Round Pond Southeast	Left / East	10,400	9,100			
7	2014	Bank Stabilization 1	St Supery / Peju	Right / West	9,375	9,150			
7	2014	Bank Stabilization 2	St Supery/ Foley Johnson	Right / West	7,975	7,925			
	2014	**Phase 5**	**Reach 9**	**ESA PWA**	**2,725**	**-**	**2,725**	**24,857**	**100%**
9	2014	Bank Stabilization 3	Laird	Left / East	3,200	2,890			
9	2014	Bank Stabilization 4	United	Left / East	2,625	2,450			
9	2014	Bench 1	United	Left / East	2,300	1,925			
9	2014	Bench 2	Opus One	Right / West	900	750			
9	2014	Bench 3	Swanson	Left / East	975	650			
	2015	**TOTAL PROJECT**	**Reaches 1 - 9**		**24,857**	**0**	**24,857**	**24,857**	**100%**

Restoration Elements: Graded Habitat Features: Cumulative Bank Length Treated 2009 - 2010

Year	Design Phase Graded Structure	Subreach Parcel	Treated Bank Length by Phase (feet)	Total Bank Length by Phase (feet)	Treated Bank Length Cumulative (feet)	Total Bank Length Cumulative (feet)	Total Treated Bank length Cumulative (%)
2009	**Phase 1a**	**Reaches 1-2 East Bank**	**1,900**	**13,714**	**1,900**	**13,714**	**14%**
2009	Bench 1	Guggenhime	500				
2009	Bench 2	Quintessa	600				
2009	Bank Stabilization 1	Quintessa	800				
2010	**Phase 1b**	**Reaches 1-2 West Bank**	**1,975**	**13,714**	**3,875**	**13,714**	**28%**
2010	Tributary Alcove 1	Ranch /Sutter Home	350				
2010	Bench 1	Ranch /Sutter Home	250				
2010	Bench 2	Frogs Leap	800				
2010	Bench 3	Caymus	575				
2010	**Phase 2**	**Reaches 1-3**	**1,265**	**5,200**	**5,140**	**17,714**	**29%**
2010	Bench 1	Caymus	275				
2010	Bench 2	Caymus	190				
2010	Bench 3	Caymus	300				
2010	Bench 4	Carpy Conolly	250				
2010	Bench 5	Carpy Conolly	250				

Restoration Elements: Graded Habitat Features: Cumulative Bank Length Treated 2009 - 2012

Year	Design Phase	Subreach	Treated Bank Length by Phase	Total Bank Length by Phase	Treated Bank Length Cumulative	Total Bank Length Cumulative	Total Treated Bank length Cumulative
	Graded Structure	Parcel	(feet)	(feet)	(feet)	(feet)	(%)
2011	**Phase 3a**	**Reach 4 East Bank**	**1,335**	**8,000**	**6,475**	**25,714**	**25%**
2011	Bench 7	Carpy Conolly	265				
2011	Bank Stabilization 1	Carpy Conolly	150				
2011	Bank Stabilization 2	Honig	75				
2011	Bench 11	Honig	230				
2011	Bench 13	Honig	425				
2011	Bench 14	Round Pond East	190				
2012	**Phase 3b**	**Reach 4 West Bank**	**1,470**	**4,024**	**7,945**	**25,714**	**31%**
2012	Bench 6	Emmolo	325				
2012	Bench 8	Emmolo	200				
2012	Bench 9	Caymus (Mee)	70				
2012	Bench 10	Caymus (Mee)	415				
2012	Bench 12	Round Pond West	200				
2012	Bank Stabilization 3	Round Pond West	260				

Restoration Elements: Graded Habitat Features: Cumulative Bank Length Treated 2009 - 2013

Year	Design Phase	Subreach	Treated Bank Length by Phase	Total Bank Length by Phase	Treated Bank Length Cumulative	Total Bank Length Cumulative	Total Treated Bank length Cumulative
	Graded Structure	**Parcel**	(feet)	(feet)	(feet)	(feet)	(%)
2012	**Phase 4a**	**Reach 8 North**	**1,825**	**4,000**	**9,770**	**29,714**	**33%**
2013	Tributary	Foley Johnson (Sawyer)	NA				
2013	Bank Stabilization 1	Foley Johnson (Sawyer)	325				
2012	Bank Stabilization 2	Sequoia Grove	300				
2012	Bench 1	Wilsey	600				
2012	Linear Wetland	Wilsey	589				
2012	Bank Stablization 3	Wilsey	600				
2013	**Phase 4bc**	**Reach 8 South**	**2,750**	**7,350**	**12,520**	**35,864**	**35%**
2013	Bench 1	Frostfire Davis	600				
2013	Bench 1 - Alcove	Frostfire Davis	NA				
2013	Bench 2	Laird	500				
2013	Bench 2 - Alcove	Laird	NA				
2013	Bank Stablization 1	Frostfire Davis / AJM McDowell	225				
2013	Bank Stablization 2	Cakebread	250				
2013	Bank Stablization 3	Glos	250				
2013	Bench 3	Laird	350				
2013	Tributary Alcove 1A	Cakebread	225				
2013	Bella Oaks Tributary	Bella Oaks Tributary	340				
2013	Tributary Alcove 1B	Nickel & Nickel	350				

Restoration Elements: Graded Habitat Features: Cumulative Bank Length Treated 2009 – 2014 (Estimated)

Year	Design Phase	Subreach	Treated Bank Length by Phase	Total Bank Length by Phase	Treated Bank Length Cumulative	Total Bank Length Cumulative	Total Treated Bank length Cumulative
	Graded Structure	**Parcel**	(feet)	(feet)	(feet)	(feet)	(%)
2014	**Phase 5**	**Reaches 5,6,7**	4,200	**8,400**	**20,920**	**44,264**	**47%**
2014	Secondary Channel	Round Pond Southeast	1,300				
2014	Bank Stabilization 1	St Supery / Peju	225				
2014	Bank Stabilization 2	St Supery/ Foley Johnson	50				
2014	**Phase 5**	**Reach 9**	2,725	**5,450**	**26,370**	**49,714**	**53%**
2014	Bank Stabilization 3	Laird	310				
2014	Bank Stabilization 4	United	175				
2014	Bench 1	United	375				
2014	Bench 2	Opus One	150				
2014	Bench 3	Swanson	325				
2015	**TOTAL PROJECT**	**Reaches 1 - 9**	**26,370**	**49,714**	**26,370**	**49,714**	**47%**

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
23,920	WD-23920-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,880	WD-23880-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,830	WD-23830-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,780	WD-23780-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,730	WD-23730-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,680	WD-23680-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,620	WD-23620-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
23,560	WD-23560-L	Bench Log	Single > 18"		Left / East	Bench	Guggenhime
22,010	WD-22010-R	Bench Log	Single > 18"		Right / West	Alcove	Ranch Winery
22,000	WD-22000-R	Spider Log	Accumulation 2 < 9		Right / West	Alcove	Ranch Winery
21,950	WD-21950-R	Bench Log	Single > 18"		Right / West	Alcove	Ranch Winery
21,930	WD-21930-R	Bench Log	Single > 18"		Right / West	Alcove	Ranch Winery
21,910	WD-21910-R	Bench Log	Single > 18"		Right / West	Alcove	Ranch Winery
21,905	WD-21905-R	Bench Log	Single > 18"		Right / West	Alcove	Ranch Winery
21,900	WD-21900-L	Spider Log	Accumulation 2 < 9		Left / East	-	Quintessa
21,850	WD-21850-R	Toe Log	Jam > 10		Right / West	Bench	Ranch Winery
21,710	WD-21710-R	Bench Log	Single > 18"		Right / West	Bench	Ranch Winery
21,670	WD-21670-L	Spider Log	Accumulation 2 < 9		Left / East	-	Quintessa

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
19,780	WD-19780-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,730	WD-19730-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,685	WD-19685-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,650	WD-19650-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,610	WD-19610-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,560	WD-19560-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,505	WD-19505-L	Bench Log	Single > 18"		Left / East	Bench	Quintessa
19,650	WD-19650-R	Bench Log	Single > 18"		Right / West	Bench	Frogs Leap
19,475	WD-19475-R	Toe Log	Jam > 10		Right / West	Bench	Frogs Leap
19,440	WD-19440-R	Bench Log	Single > 18"		Right / West	Bench	Frogs Leap
19,200	WD-19200-R	Bench Log	Single > 18"		Right / West	Bench	Frogs Leap
18,350	WD-18350-R	Bench Log	Single > 18"		Right / West	Bench	Caymus
18,260	WD-18260-R	Bench Log	Single > 18"		Right / West	Bench	Caymus
18,250	BC-18250-M	Boulder Cluster	Accumulation 2 < 9		Mid	Bench	Caymus
18,200	WD-18200-R	Bench Log	Single > 18"		Right / West	Bench	Caymus
17,700	WD-17700-R	Root Wad	Accumulation 2 < 9		Right / West	Bench 1	Caymus
17,425	WD-17425-R	Root Wad	Accumulation 2 < 9		Right / West	Bench 1	Caymus
17,225	WD-17225-R	Root Wad	Accumulation 2 < 9		Right / West	Bench 2	Caymus
16,900	WD-16900-R	Root Wad	Accumulation 2 < 9		Right / West	Bench 3	Caymus

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
13,070	WD-13070-L	Root Wad	Accumulation 2 < 9		Left / East	Bench 13	Honig
13,050	BC-13050-L	Boulder Cluster	Boulder Cluster (4)	4	Left / East	Bench 13	Honig
12,990	WD-12990-L	Low Profile Log	Single > 18"		Left / East	Bench 13	Honig
12,950	BC-12950-M	Boulder Cluster	Accumulation 2 < 9	4	Mid	Bench 13	Honig
12,850	WD-12850-L	Low Profile Log	Single > 18"		Left / East	Bench 13	Honig
12,825	BC-12825-M	Boulder Cluster	Accumulation 2 < 9	5	Mid	Bench 13	Honig
12,800	WD-12800-L	Root Wad	Accumulation 2 < 9		Left / East	Bench 13	Honig
12,550	WD-12550-L	Low Profile Log	Single > 18"		Left / East	Bench 14	Round Pond E
12,420	WD-12420-L	Root Wad	Accumulation 2 < 9		Left / East	Bench 14	Round Pond E
12,400	BC-12400-L	Boulder Cluster	Accumulation 2 < 9	3	Left / East	Bench 14	Round Pond E
7,530	BC-7530-M	Boulder Cluster	Accumulation 2 < 9		Right / West	Stabilization 1	Foley (Sawyer)
7,512	WD-7512-R	Root Wad	Accumulation 2 < 9		Right / West	Stabilization 1	Foley (Sawyer)
7,460	BC-7460-M	Boulder Cluster	Accumulation 2 < 9		Right / West	Stabilization 1	Foley (Sawyer)
7,410	BC-7410-R	Boulder Cluster	Accumulation 2 < 9		Right / West	Stabilization 1	Foley (Sawyer)

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
7,090	WD-7090-R	Deflector	Accumulation 2 < 9		Right / West	Bank	Sequoia Grove
6,880	WD-6880-L	Log Weir	Accumulation 2 < 9		Left / East	Bench 1	Wilsey
6,740	WD-6740-L	Low Profile Log	Single > 18"		Left / East	Bench 1	Wilsey
6,670	WD-6670-L	Low Profile Log	Single > 18"		Left / East	Bench 1	Wilsey
6,610	WD-6610-L	Log Weir	Accumulation 2 < 9	2	Left / East	Bench 1	Wilsey
6,530	WD-6530-L	Log Weir	Accumulation 2 < 9	2	Left / East	Bench 1	Wilsey
6,515	WD-6515-L	Root Wad	Accumulation 2 < 9		Left / East	Bench 1	Wilsey
6,200	BC-6200-L	Boulder cluster	Single > 18"	1	Left / East	Stabilization 3	Wilsey
6,180	WD-6180-L	Root Wad	Single > 18"	1	Left / East	Stabilization 3	Wilsey
6,160	BC-6160-L	Boulder cluster	Accumulation 2 < 9	3	Left / East	Stabilization 3	Wilsey
6,100	WD-6100-L	Root Wad	Accumulation 2 < 9	4	Left / East	Stabilization 3	Wilsey
5,985	BC-5985-L	Boulder cluster	Accumulation 2 < 9	2	Left / East	Stabilization 3	Wilsey
5,905	BC-5905-L	Boulder cluster	Accumulation 2 < 9	3	Left / East	Stabilization 3	Wilsey
5,880	WD-5880-L	Revetment Key	Accumulation 2 < 9	2	Left / East	Stabilization 3	Wilsey
5,875	BC-5875-L	Boulder cluster	Accumulation 2 < 9	2	Left / East	Stabilization 3	Wilsey
6,760	BC-6760-R	Boulder cluster	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove
6,740	BC-6740-R	Boulder cluster	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove
6,710	BC-6710-R	Boulder cluster	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove
6,690	BC-6690-R	Boulder cluster	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove
6,690	WD-6690-R	LWD - Integrated	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove
6,660	BC-6660-R	Boulder cluster	Accumulation 2 < 9		Right / West	Stabilization 2	Sequoia Grove

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
6,349	WD-6349-R	Root Wad	Accumulation 2 < 9	5	Right / West	Bench 1	Frostfire Davis
6,163	WD-6163-R	Snag	Single > 18"	1	Right / West	Bench 1	Frostfire Davis
6,150	WD-6150-R	Snag	Single > 18"	1	Right / West	Bench 1	Frostfire Davis
6,108	WD-6108-R	Snag	Single > 18"	1	Right / West	Bench 1	Frostfire Davis
6,007	WD-6007-R	Root Wad	Single > 18"	1	Right / West	Bench 1	Frostfire Davis
5,770	R-5770-M	Grade Control	Jam >10	>10	Mid	Bench 1	Frostfire Davis
5,770	WD-5770-R	Low Profile Log	Single > 18"	1	Right / West	Bench 1	Frostfire Davis
5,400	BC-5400-M	Boulder Cluster	Accumulation 2 < 9	5	Mid	Stabilization 1	AJM McDowell
5,375	R-5375-M	Grade Control	Jam >10	>10	Mid	Stabilization 1	AJM McDowell
5,374	WD-5374-R	Root Wad	Accumulation 2 < 9	3	Right / West	Stabilization 1	AJM McDowell
5,344	WD-5344-R	Low Profile Log	Single > 18"	1	Left / East	Stabilization 1	AJM McDowell
5,247	WD-5247-L	Root Wad	Accumulation 2 < 9	3	Right / West	Bench 2	Laird
5,244	WD-5244-L	Snag	Single > 18"	1	Left / East	Bench 2	Laird
5,243	WD-5243-L	Snag	Single > 18"	1	Left / East	Bench 2	Laird
5,094	WD-5094-L	Root Wad	Accumulation 2 < 9	3	Left / East	Bench 2	Laird
4,980	BC-4980-L	Boulder Cluster	Accumulation 2 < 9	3	Left / East	Bench 2	Laird
4,960	WD-4960-L	Root Wad	Accumulation 2 < 9	4	Left / East	Bench 2	Laird
4,920	BC-4920-L	Boulder Cluster	Accumulation 2 < 9	9	Left / East	Bench 2	Laird

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
4,560	BC-4560-M	Boulder cluster	Accumulation 2 < 9	7	Mid	Stabilization 3	Glos
4,523	WD-4523-R	Toe Log	Accumulation 2 < 9	8	Right / West	Stabilization 3	Glos
4,293	WD-4293-R	Root Wad	Accumulation 2 < 9	4	Right / West	Stabilization 3	Glos
4,204	WD-4204-L	Root Wad	Accumulation 2 < 9	4	Left / East	Bench 3	Laird
4,187	WD-4187-L	Root Wad	Accumulation 2 < 9	3	Left / East	Bench 3	Laird
4,180	BC-4180-L	Boulder Cluster	Accumulation 2 < 9	3	Left / East	Bench 3	Laird
4,130	BC-4130-L	Boulder Cluster	Accumulation 2 < 9	5	Left / East	Bench 3	Laird
4,067	WD-4067-L	Snag	Single > 18"	1	Left / East	Bench 3	Laird
4,054	WD-4054-L	Snag	Single > 18"	1	Left / East	Bench 3	Laird
4,043	BC-4043-L	Boulder Cluster	Single > 18"	1	Left / East	Bench 3	Laird
4,000	BC-4000-L	Boulder Cluster	Accumulation 2 < 9	4	Left / East	Bench 3	Laird
3,999	WD-3999-L	Root Wad	Single > 18"	1	Left / East	Bench 3	Laird
3,958	WD-3958-L	Root Wad	Accumulation 2 < 9	4	Left / East	Bench 3	Laird

Restoration Elements: Instream Habitat Structures Installed

River Station	Structure Label	Habitat Structure	Configuration	#	Bank	Associated Graded Feature	Parcel
3,560	BC-3560-R	Boulder Cluster	Accumulation 2 < 9	7	Right / West	Tributary Alcove	Cakebread
3,500	WD-3500-R	Root Wad	Single > 18"	1	Right / West	Tributary Alcove	Cakebread
3,474	WD-3474-R	Root Wad	Accumulation 2 < 9	3	Right / West	Tributary Alcove	Cakebread
3,400	WD-3400-R	Root Wad	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,397	WD-3397-R	Snag + 1 Boulder	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,367	WD-3367-R	Snag + 1 Boulder	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,355	WD-3355-R	Root Wad	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,345	WD-3345-R	Snag + 1 Boulder	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,333	WD-3333-R	Root Wad	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,322	WD-3322-R	Root Wad	Accumulation 2 < 9	3	Right / West	Tributary Alcove	Nickel
3,321	BC-3321-R	Boulder Cluster	Accumulation 2 < 9	4	Right / West	Tributary Alcove	Nickel
3,316	WD-3316-R	Snag + 1 Boulder	Single > 18"	1	Right / West	Tributary Alcove	Nickel
3,260	T-3260-R	Confluence	-	-	Right / West	Bella Oaks Trib	Nickel
3,252	WD-3252-R	Root Wad	Accumulation 2 < 9	3	Right / West	Tributary Alcove	Nickel
3,250	BC-3250-R	Boulder Cluster	Accumulation 2 < 9	4	Right / West	Tributary Alcove	Nickel
3,238	WD-3238-R	Root Wad	Single > 18"	1	Right / West	Tributary Alcove	Nickel

D. Monitoring Studies

Monitoring Parameter Protocols, References, and Frequency by Category Table

Sediment Load Reductions and Channel Morphology

Monitoring Parameter	Protocols	Reference Sources	Frequency
Sediment Delivery to the Channel: Length and Height (Surface Area) of Actively Eroding Banks (Failing graded slopes, mass wasting, slumps, flows, etc)	Mapping and Measurement of Height and Length of Actively Eroding Streambanks, Photodocumentation	Gerstein and Harris (2005) Harrelson et al. (1994) Nossaman et al. (2007)	Annually
Channel Adjustment / Incision: Bed Deposition or Scour in Control Versus Treated Reaches	Cross Section Transects, Local Longitudinal Thalweg Survey, Photodocumentation	Flosi et al / CDFG. (1998) Gerstein (2005) Harrelson et al (1994) Gerstein (2005) Harrelson et al (1994)	Pre-and Post-Construction, and/or Post Significant Channel Forming Event
Bankfull Width to Depth Ratio: Entrenchment	Cross Section Transects	Fitzpatrick et al (1998) Rosgen (1996)	Pre-and Post-Construction, and/or Post Significant Channel Forming Event
Flood Stage / High Water Mark	Cross Section Transects	Fitzpatrick et al (1998)	Pre-and Post-Construction, and/or Post Significant Channel Forming Event
Bank Stability *(Rates of Widening at reference vs. restored cross sections)*	Cross Section Transects	Gerstein and Harris (2005) Nossaman et al. (2007)	Pre-and Post-Construction, and/or Post Significant Channel Forming Event
Channel Planform Network (Primary and Secondary Channels)	Photodocumentation of Constructed Alcoves Air Photo Analysis (As Available)	Fitzpatrick et al (1998)	Post Significant Channel Forming Event; As Available

Aquatic Habitat

Monitoring Parameter	Reference Sources	Protocols	Frequency
Large Woody Debris Logs and Jams (>12 inch diameter, or clump of >4 pieces)	Gerstein (2005) Flosi et al / CDFG. (1998)	Mapping and Categorization of LWD by geomorphic unit, salmonid habitat function, and risk to bank stability; Photodocumentation	Annually
Channel Geomorphic Heterogeneity: Riffle Habitat Frequency and Distribution		Mapping of Riffle Crests with GPS	Annually
Installed Habitat Structure (LWD/Boulder/Other) Affect on Increasing Pool Depth and Habitat Complexity	Lisle (1987)	Measurement of Residual Pool Depth at Locations of Installed Habitat Structures (LWD/Boulder/Other)	Annually
Installed Habitat Structure Persistence (LWD/Boulder/Other)	Lisle (1987)	Evaluation of Persistence and Status at Locations of Installed Habitat Structures	Annually
Areas requiring trash removal		Mapping, Photodocumentation	Annually
Channel Geomorphic Heterogeneity: Riffle, Pool and Glide Habitat Distribution	Flosi et al / CDFG (1998) Gerstein (2005) Harrelson et al. (1994); USDA R-5s Bulletin Number One	Cross Section Transects, Local Longitudinal Thalweg Survey or Habitat Unit Mapping at Locations of Installed Structures.	Pre-and Post-Construction, and Post Significant Channel Forming Event
Spawning Gravel Recruitment: Channel Substrate Size Distribution / Riffle Median Grain Size (D50)	Bunte & Abt (2001) Cover et al (2008) Fitzpatrick et al (1998) USDA (2003) Wolman (1954)	Modified Wolman Pebble Count, and/or Grid Pebble Count at Riffle Crests near Cross Section Transects	Pre-and Post-Construction, and Post Significant Channel Forming Event
Area of Low Velocity High Flow Refugia Within Bankfull at Constructed Alcoves and Bankfull Benches	USDA (2003) Gerstein (2005) Flosi et al / CDFG. (1998) Fisheries Biologist Expert Opinion	Habitat Unit Mapping and/or Sketch of River Flow Pattern; Description of Restoration Feature Affect on River Flow Pattern and Relative Velocity; Photodocumentation; Velocity Flow Measurements in Constructed High Flow Refugia Habitat	Representational Seasonal River Flow Stages (Winter and Spring)

Riparian Habitat

Monitoring Parameter	Protocols	Reference Sources	Frequency
Areas requiring weed control, including infestations of Pierce's disease host species	Mapping, Photodocumentation, Land Owner Request Forms	Harris (1999, 2005) Herrick et al (2005 a) Interagency Technical Reference (1996)	Annually
Areas requiring trash removal	Mapping, Photodocumentation		Annually
Riparian Vegetation Buffer Width	Cross Section Transects, Vegetation Surveys Air Photo Analysis (As Available)	Harris (1999, 2005)	Pre-and Post-Construction, and/or Post Significant Channel Forming Event
Riparian Vegetation Buffer Width for first five years after planting	As Built Surveys Air Photo Analysis (As Available)	Harris (1999, 2005)	Post Construction
Number of Pierce Disease Host Plant Infestations for first five years after planting	Area Mapping Vegetation Survey; Direct Count Vegetation Survey; Photodocumentation	Herrick et al (2005 a) Interagency Technical Reference (1996)	Establishment Years, 1,2,3 by contractor; Years 5 and 7 by Maintenance Assessment District
Restoration Planting Survival (80% in first five years after planting)	Cross Section Transect Vegetation Survey; Direct Count Vegetation Survey; Photodocumentation	Nossaman et al. (2007) Harris (1999, 2005) Gaffney (2008)	Establishment Years, 1,2,3 by contractor; Years 5 and 7 by Maintenance Assessment District

Stakeholder Participation

Monitoring Parameter	Protocols	Reference Sources	Frequency
Landowner participation in adaptive monitoring and management	Landowner maintenance requests and access agreements	FISRWP (2001)	As Events Occur
Landowner Advisory Committee (LAC) participation	Meeting minutes; Surveys of participation; Opinion surveys of effectiveness	FISRWP (2001)	As Events Occur

Monitoring Parameter Protocols, References, and Category by Frequency Table

Annual Stream Reach Survey

Monitoring Parameter	Protocols	Reference Sources	Category
Sediment Delivery to the Channel: Length and Height (Surface Area) of Actively Eroding Banks (Failing graded slopes, mass wasting, slumps, flows, etc)	Mapping and Measurement of Height and Length of Actively Eroding Streambanks, Photodocumentation	Gerstein and Harris (2005) Harrelson et al. (1994) Nossaman et al. (2007)	Sediment Load Reductions & Channel Morphology
Large Woody Debris Logs and Jams (>12 inch diameter, or clump of >4 pieces)	Mapping and Categorization of LWD by geomorphic unit, salmonid habitat function, and risk to bank stability; Photodocumentation	Gerstein (2005) Flosi et al / CDFG. (1998)	Aquatic Habitat Quality
Channel Geomorphic Heterogeneity: Riffle Habitat Frequency and Distribution	Mapping of Riffle Crests with GPS		Aquatic Habitat Quality
Installed Habitat Structure (LWD/Boulder/Other) Affect on Increasing Pool Depth and Habitat Complexity: Residual Pool Depth (Change in Pool Storage of Fines)	Measurement of Residual Pool Depth at Locations of Installed Habitat Structures (LWD/Boulder/Other)	Lisle (1987)	Aquatic Habitat Quality
Installed Habitat Structure Persistence (LWD/Boulder/Other)	Evaluation of Persistence and Status at Locations of Installed Habitat Structures	Lisle (1987)	Aquatic Habitat Quality
Areas requiring weed control, including infestations of Pierce's disease host species	Mapping, Photodocumentation, Land Owner Request Forms	Harris (1999, 2005) Herrick et al (2005 a) Interagency Technical Reference (1996)	Riparian / Floodplain Habitat Quality
Areas requiring trash removal	Mapping, Photodocumentation		Aquatic & Riparian Habitat Quality

Repeat Channel Transect Surveys and Local Longitudinal Profiles

Monitoring Parameter	Protocols	Reference Sources	Category
Channel Adjustment: Bed Deposition or Scour in Control Versus Treated Reaches	Cross Section Transects, Local Longitudinal Thalweg Survey, Photodocumentation	Flosi et al / CDFG. (1998) Gerstein (2005) Harrelson et al (1994) Gerstein (2005) Harrelson et al (1994)	Sediment Load Reductions & Channel Morphology
Bankfull Width to Depth Ratio: Entrenchment	Cross Section Transects	Fitzpatrick et al (1998) Rosgen (1996)	Sediment Load Reductions & Channel Morphology
Flood Stage / High Water Mark	Cross Section Transects	Fitzpatrick et al (1998)	Sediment Load Reductions & Channel Morphology
Bank Stability *(Rates of Widening at reference vs. restored cross sections)*	Cross Section Transects	Gerstein and Harris (2005) Nossaman et al. (2007)	Sediment Load Reductions & Channel Morphology
Channel Planform Network (Primary and Secondary Channels)	Photodocumentation of Constructed Alcoves, Local Longitudinal Thalweg Profile; Velocity Profile; Photodocumentation Air Photo Analysis (As Available)	Fitzpatrick et al (1998)	Sediment Load Reductions & Channel Morphology
Channel Geomorphic Heterogeneity: Riffle, Pool and Glide Habitat Distribution	Cross Section Transects, Local Longitudinal Thalweg Survey or Habitat Unit Mapping at Locations of Installed Structures.	Flosi et al / CDFG (1998) Gerstein (2005) Harrelson et al. (1994); USDA R-5s Bulletin Number One	Pre-and Post-Construction, and Post Significant Channel Forming Event
Spawning Gravel Recruitment: Channel Substrate Size Distribution / Riffle Median Grain Size (D50)	Modified Wolman Pebble Count, and/or Grid Pebble Count at Riffle Crests near Cross Section Transects	Bunte & Abt (2001) Cover et al (2008) Fitzpatrick et al (1998) USDA (2003) Wolman (1954)	Aquatic Habitat Quality

Riparian Vegetation Buffer Width	Cross Section Transects, Vegetation Surveys Air Photo Analysis (As Available)	Harris (1999, 2005)	Riparian / Floodplain Habitat Quality

Seasonal Aquatic Habitat Surveys of Constructed Alcoves and Bankfull Instream Benches

Monitoring Parameter	Protocols	Reference Sources	Category
Area of Low Velocity High Flow Refugia Within Bankfull at Constructed Alcoves and Bankfull Benches	Habitat Unit Mapping and/or Sketch of River Flow Pattern; Narrative Description of Restoration Feature Affect on River Flow Pattern and Relative Velocity; Photodocumentation; Velocity Flow Measurements in Accessible Areas of High Flow Refugia Habitat in Constructed Alcoves and Bankfull Benches	USDA (2003) Gerstein (2005) Flosi et al / CDFG. (1998) Fisheries Biologist Expert Opinion	Aquatic Habitat Quality

Phased Vegetation Establishment Years 1,2,3,5 and 7

Monitoring Parameter	Protocols	Reference Sources	Category
Riparian Vegetation Buffer Width for first five years after planting	As built survey; Air Photo Analysis (As Available)	Harris (1999, 2005)	Riparian / Floodplain Habitat Quality
Number of Pierce Disease Host Plant Infestations for first five years after planting	Area Mapping Vegetation Survey; Direct Count Vegetation Survey; Photodocumentation	Herrick et al (2005 a) Interagency Technical Reference (1996)	Riparian / Floodplain Habitat Quality
Restoration Planting Survival (80% in first five years after planting)	Cross Section Transect Vegetation Survey; Direct Count Vegetation Survey; Photodocumentation	Nossaman et al. (2007) Harris (1999, 2005) Gaffney (2008)	Riparian / Floodplain Habitat Quality

As Air Photos Become Available

Monitoring Parameter	Protocols	Reference Sources	Category
Channel Planform Network (Primary and Secondary Channels)	Photodocumentation of Constructed Alcoves Air Photo Analysis	Fitzpatrick et al (1998)	Stream Channel Geometry, Capacity, & Stability
Riparian Vegetation Buffer Width	Cross Section Transects, Vegetation Surveys Air Photo Analysis	Harris (1999, 2005)	Riparian / Floodplain Habitat Quality

As Events Occur

Monitoring Parameter	Protocols	Reference Sources	Category
Landowner participation in adaptive monitoring and management	Landowner maintenance requests and access agreements	FISRWP (2001)	Stakeholder Participation
Landowner Advisory Committee (LAC) participation	Meeting minutes; Surveys of participation; Opinion surveys of effectiveness	FISRWP (2001)	Stakeholder Participation

I. Stream Flow Measurements

Stream Flow Measurements

Annual Survey Results

Each water year begins on October 1st of one year and ends on September 30th of the next, and is designated by the year in which it ends. The beginning of the water year is essentially coincident with the end of each summer construction season. Restoration construction in the river channel is conducted between June and October each year, when stream levels and the probability of a rainfall event are lowest. So, for example, the 2010 water year began in October 2009 at the end of the 2009 construction season.

Photomonitoring is conducted during storm runoff events to assess whether newly constructed floodplain benches and alcoves are inundated at a given stream discharge and corresponding flood stage elevation. The peak discharge for each event is measured at the stream gage on the Napa River Near St. Helena (USGS 11456000), Napa County, California, at the Pope Street Bridge, which is located 2 miles upstream from Zinfandel Lane Bridge at the upstream end of the Project Reach.

The Napa County Resource Conservation District staff conducts velocity monitoring at each of the floodplain benches and alcoves during one high-flow storm event in the winter, and during one low-flow event in the spring following their construction. Stream flow velocities are measured to assess whether the intended target velocities for slow water fish habitat have been achieved. The RCD staff also survey in the water surface elevations, relative to existing project monuments, which have elevations surveyed relative to NAVD88. These flow elevation data are then correlated to the stage discharge data at the Napa River USGS 11456000 gauge so utilized to create a stage discharge rating curve for the Rutherford Reach. The velocity monitoring results are reported in **Appendix XI. Seasonal Salmonid Habitat Surveys**.

2010

Peak discharge in the winter of 2010 following the first season of project construction in 2009 in Phase 1a, Reaches 1-2 east bank was 2,800 cfs on January 20, 2010; which is between a 1.25 year recurrence interval flood. The bankfull instream benches on the Guggenhime and Quintessa properties inundated at the 1.25 year recurrence interval flood.

2011

Peak discharge in water year 2011 following the second season of project construction in 2010 in Phase 1b, Reaches 1-2 west bank, and Phase 2, Reach 3, occurred on March 20, 2011 and was 4,080 cfs, which is between a 1.5 year and 2 year recurrence interval flood. The benches constructed in 2009 in Phase 1a Reaches 1-2, and all of the benches constructed in 2010 in Phase 1b, Reaches 1-2, and Phase 2, Reach 3, were inundated several times during the winter of 2011.

2012

Peak discharge in water year 2012 following the third season of project construction in 2011 in Phase 3, Reach 4 east bank, occurred on March 14, 2012 and was 2,050 cfs, which is less than a 1.25 year recurrence interval flood. During this drought year, the benches constructed in 2010 in Phase 3a Reach 4 east bank each were inundated, whereas the benches in Phase 1a on Guggenhime, Quintessa, and Frog's Leap were not.

2013

In December 2012, two flow events came within a foot of overtopping the channel banks in the Rutherford Reach. The December 2, 2012 flow peaked at 9,260 cfs followed three weeks later by a 9,690 cfs peak flow event on December 23, 2012. The recurrence interval for flows of this magnitude is usually only once every 5-8 years on average. These storm flows ranked 21st and 18th largest, respectively, in magnitude among all annual peak flows for the Napa River Near St. Helena gage during the 83 years on record from 1929 - 2012. The newly constructed features in Reach 4 West and Reach 8 North held up well following the first storm, requiring only minor maintenance of erosion control matting and coir logs. Re-vegetation of Reach 4 West and Reach 8 North had not yet taken place at the time of the storm events. Lack of established vegetation cover, saturated soils, and the larger storm flow that occurred three weeks later on December 23, 2012, caused some localized slope failure in Reach 8 which required re-grading and stabilization. The localized failure occurred in sandy soils where the slope had been slightly steepened in relation to the plans in order to preserve additional riparian trees. Erosion control measures were also reinstalled throughout the Project.

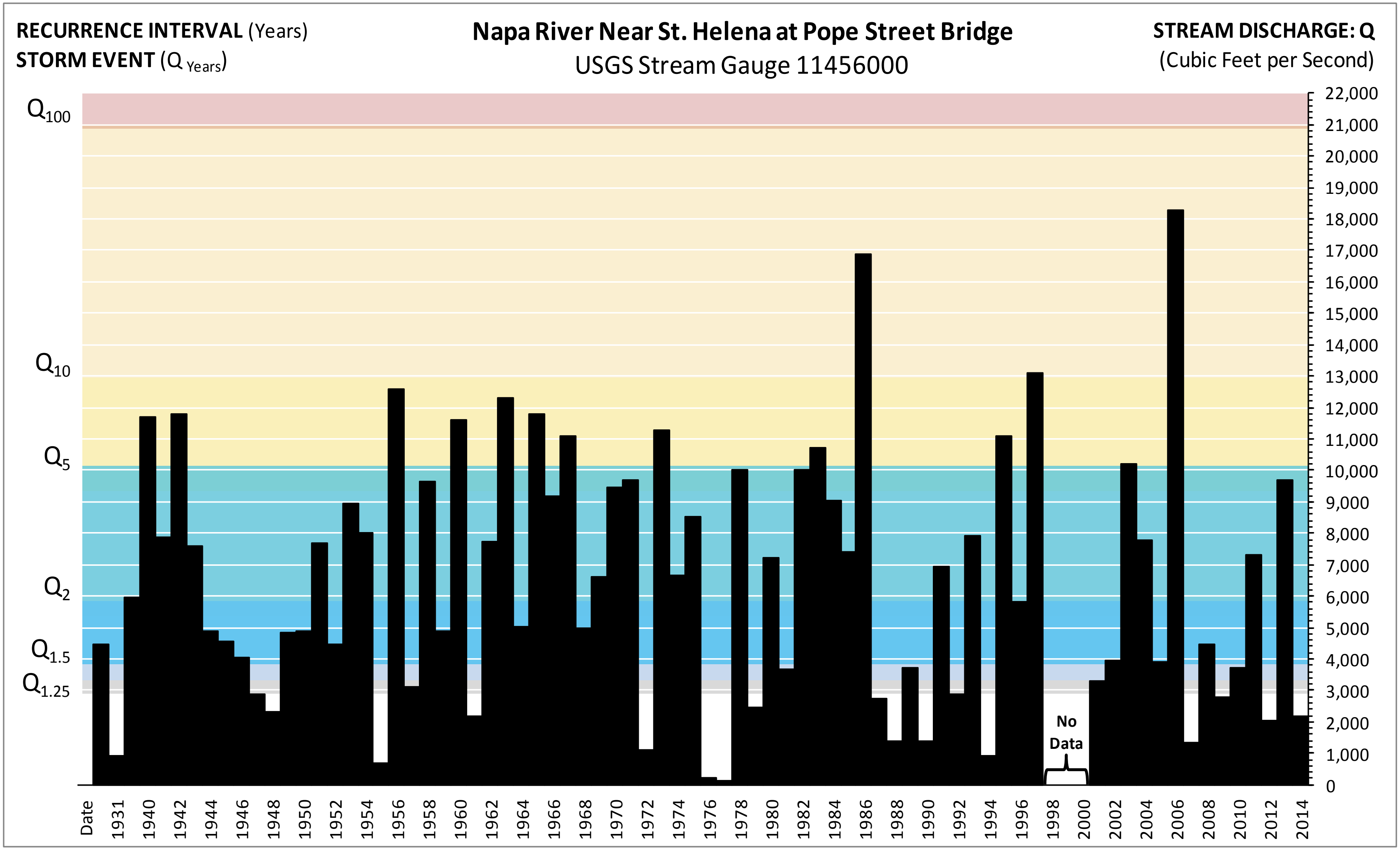
2014

An extended dry period followed the storms of December 2012, which is when the peak storm event occurred for the 2013 water year. By the beginning of the 2014 water year in October 2013, many of the usually perennial pools in the Rutherford Reach, some up to nine feet deep, were completely dry. When the long profile survey was conducted in November 2013, water flow was limited to Reaches 1-3, the deepest portions of Reach 4, the deepest portions of Reach 8, and all of Reach 9. Reaches 5-7 were completely devoid of flow.

Similar to two years prior in 2012, seasonal rains did not commence in water year 2014 until February 2014 inhibiting Chinook salmon from swimming upstream to spawn during the usual November to December timeframe. The newly constructed features in Reach 8 south, including the Bella Oaks Tributary alcove, were inundated during the first storm events on February 10, 2014, and February 28, which had peak discharges of 637 cfs and 642 cfs respectively. Revegetation of restored areas usually begins following the end of construction in November or December. Due to the low soil moisture and lack of rainfall, revegetation planting in did not commence until March 2014, after the February storms.

The peak discharge event following the fifth season of restoration construction in Phase 4BC, Reach 8 South, did not occur until April 1, 2014 and was 2,200 cfs. This was 150 cfs higher than the peak flow event in 2012. The recurrence interval for a flow of this magnitude is approximately one year.

Annual Peak Flows 1929-2014



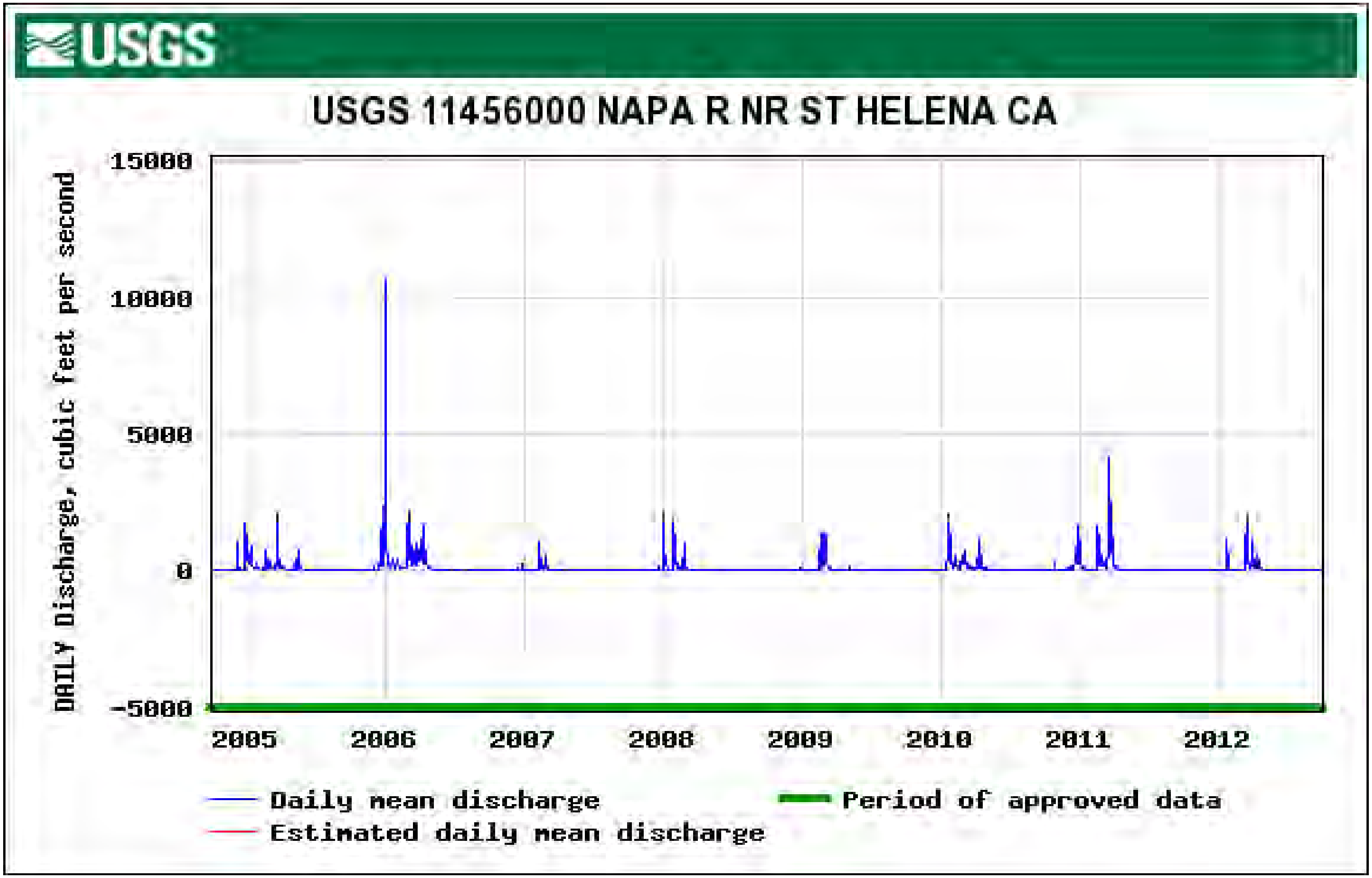
Hydrologic Unit Code 18050002 | Drainage Area 78.8 square miles | Gage Datum 193.21 feet above NGVD29

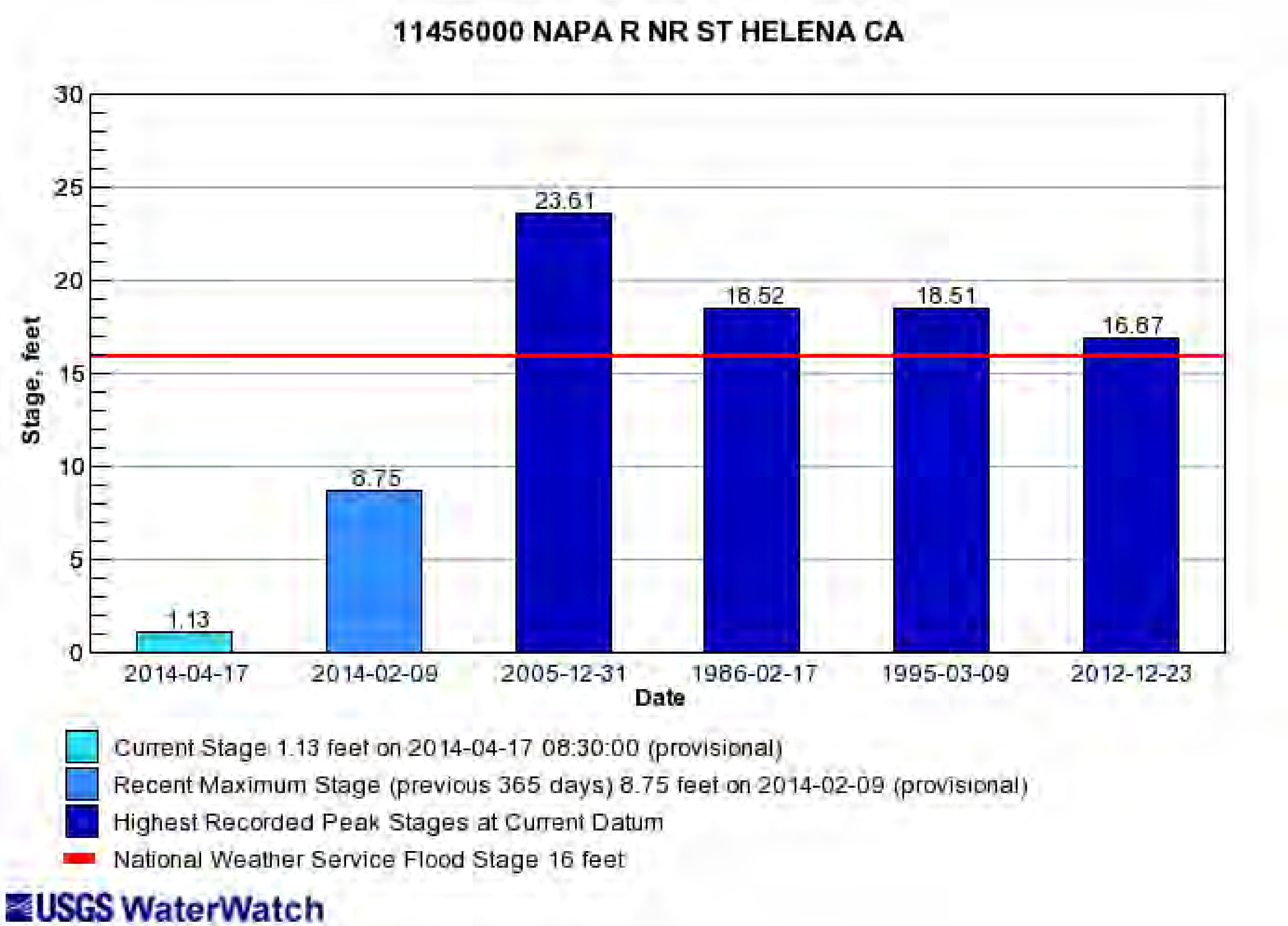
Latitude38°30'41", Longitude 122°27'17" NAD27

Annual Peak Flows 2004 - 2014

Water Year	Peak Discharge (cfs)	Peak Discharge Date	Gauge Height (feet)
2004	7,760	December 29, 2003	14.92
2005	3,890	March 22, 2005	10.80
2006	18,300	December 31, 2005	23.61
2007	1,350	December 26, 2006	6.87
2008	4,460	January 04, 2008	14.08
2009	2,800	February 22, 2009	11.06
2010	3,740	January 20, 2010	12.99
2011	7,330	March 20, 2011	14.99
2012	2,050	March 14, 2012	10.95
2013	9,260	December 2, 2012	16.60
2013	9,690	December 23, 2012	16.87
2014 Preliminary	2,200	February 9, 2014	8.75

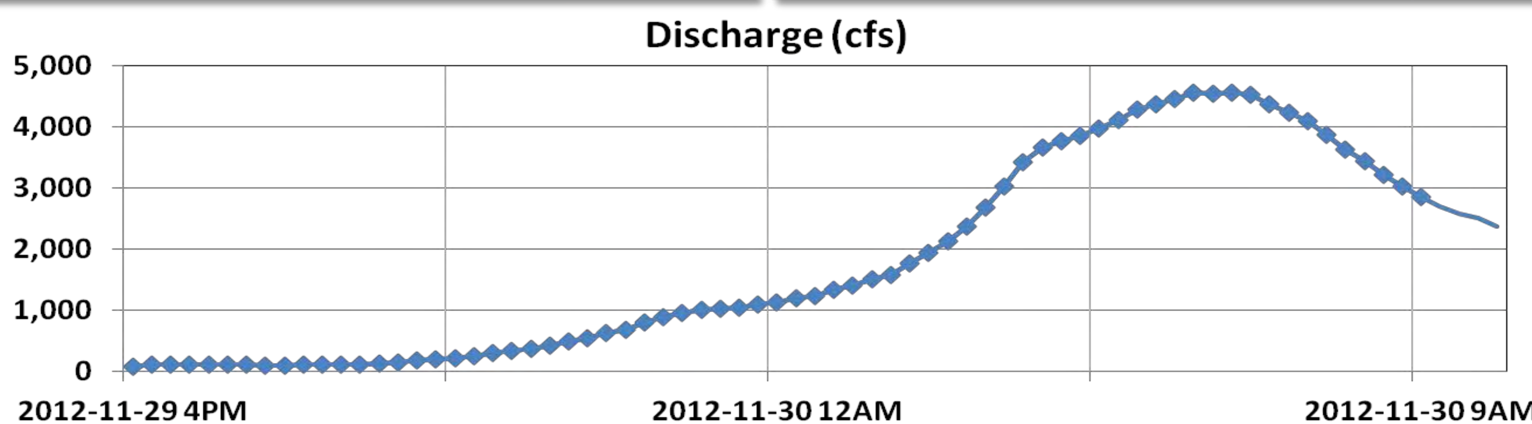
Recurrence Interval	Stream Discharge (Cubic Feet per Second)	Peak Flood Frequency	Depth of Flow	Effect in Napa River Rutherford – Oakville Reach
Q_{100}	21,000 cfs	Recurs About Once in a 100 Years	21 Feet	Disastrous Flooding Over Floodplain
Q_{10}	13,000 cfs	Recurs About Once in 10 Years	18.5 Feet	Flow Overtops Channel Banks
Q_5	10,100 cfs	Recurs About Once in 5 Years	17 Feet	Flow Near Top of Channel Banks
Q_2	5,790 cfs	Recurs About Every 2 Years	13.5 Feet	Typical Channel Forming Flow
$Q_{1.5}$	3,843 cfs	Recurs About Every 1.5 Years	11.5 Feet	Typical Flow to Inundate Gravel Bars
$Q_{1.25}$	2,870 cfs	Recurs About Every Year	10 Feet	Typical Annual Flow


USGS
USGS 11456000 NAPA R NR ST HELENA CA
DAILY Discharge, cubic feet per second
15000
10000
5000
0
-5000
2005
2006
2007
2008
2009
2010
2011
2012
Daily mean discharge
Period of approved data
Estimated daily mean discharge


11456000 NAPA R NR ST HELENA CA
30
25
20
15
10
5
0
Stage, feet
23.61
18.52
18.51
16.87
8.75
1.13
2014-04-17
2014-02-09
2005-12-31
1986-02-17
1995-03-09
2012-12-23
Date
Current Stage 1.13 feet on 2014-04-17 08:30:00 (provisional)
Recent Maximum Stage (previous 365 days) 8.75 feet on 2014-02-09 (provisional)
Highest Recorded Peak Stages at Current Datum
National Weather Service Flood Stage 16 feet
USGS WaterWatch

Rising Limb of Storm Flow

17 Hour Streamflow: November 29-20, 2012
Honig Bench 11: Downstream to Upstream
ESA Time Lapse Camera



High Water Mark and Water Surface Elevations for Velocity Monitoring of High Flow Refugia

2011

	Discharge Napa River Near St. Helena at Pope Street Bridge (cfs)	Water Surface Elevation (ft NAVD88)					
		Sutter Alcove	Frogs Leap Bench 1	Caymus Bench 0	Caymus Bench 1	Caymus Bench 2	Caymus Bench 3
River Station		21950	19680	18300	17500	17290	17050
HWM 2/16/2011	2,930		160.31	157.22	155.94	155.36	154.74
WSEL 2/16/2011 10:36	1,150	159.96					
WSEL 2/16/2011 11:03	1,120		156.13				
WSEL 2/16/2011 11:22	1,100			152.40			
WSEL 2/16/2011 11:42	1,070				150.18		
WSEL 2/16/2011 12:11	1,030						149.20
HWM 2/17/2011	3,160	165.38	160.92	157.89	156.81	156.30	155.75
WSEL 2/23/2011	228	155.52	151.61	148.34	145.49	145.52	144.76

2012

	Discharge Napa River Near St. Helena at Pope Street Bridge* (cfs)	Water Surface Elevation (ft NAVD88)					
		Bench 14: Round Pond	Bench 13: Honig	Bench 11: Honig	BSA 2: Honig	BSA 1: Carpy-Conolly	Bench 7: Carpy-Conolly
River Station		124.00	129.00	136.00	138.50	144.00	157.00
WSEL 1/23/2012 09:40	2,040	143.20					
WSEL 1/23/2012 10:00	2,060		143.99				
WSEL 1/23/2012 10:40	2,100			144.95			
WSEL 1/23/2012 10:50	2,100				145.73		
WSEL 1/23/2012 11:17	2,050					146.87	
WSEL 1/23/2012 11:30	1,970						149.81

*Provisional data provided by USGS, subject to revision

II. Eroding Streambank Survey

Eroding Streambanks

Approach

The Annual Stream Reach Survey is conducted each spring prior to the start of the summer construction season. The reduction of eroding bank length in a given construction phase is evaluated for the first time the following June, after one winter stream flow season. The target goal is to reduce the length of eroding banks in the entire Rutherford Reach (Reaches 1-9) by 75%, in comparison to the baseline survey measured in 2009. Eroding bank length is mapped annually under the channel monitoring survey conducted by Napa County each June. In 2009, 14,700 feet of channel banks were eroding, or 30% of the channel bank length in the Rutherford Reach (49,714 feet total length: left (east) and right (west) banks combined). To meet the sediment source reduction goal of the Project of a 75% reduction in eroding bank length by 2017 would require that no more than 7.5% of the channel bank length in the Rutherford Reach be unstable from erosion. This would require that no more than 3,700 total linear feet banks are unstable or eroding following implementation of the restoration.

Prior to the restoration Project, hard materials were dominantly used in bank protection efforts. In 2010, a baseline survey measured 4,800 linear feet of hardened banks in the Rutherford Reach. Hard bank stabilization treatments included rip rap, concrete, shotcrete, metal objects, trash or other infrastructure. Hardened bank structures are generally not utilized, effective, nor permitted to stabilize banks as part of the restoration Project with minor exceptions, as in the case where infrastructure must be protected. Instead, channel banks are stabilized through grading and biotechnical measures. Over the course of the Project, several segments of hard treatments will be removed where the banks are being setback, graded and re-vegetated to stabilize the bank. The length of hardened banks will be re-surveyed upon completion of the Project to compare reduction against the baseline measured in 2010.

Eroding Streambanks Table

Unstable or Potentially Unstable Banks (Linear Feet – Rounded to Nearest 100 Feet)						
Annual Summer Survey	**2009**	**2010**	**2011**	**2012**	**2013**	**TARGET**
Rutherford Reach	14,700	9,000	4,800	4,400	5,200	<3,700
Percent of Reach	59%	36%	19%	18%	21%	15%
Reduction Relative to 2009 Baseline	NA	39%	67%	70%	65%	75%

Hardened Banks (Linear Feet)
2010
4,800
19%
-

Annual Results

2009

Prior to the start of construction in 2009, the baseline survey conducted in June 2009 mapped approximately 14,700 linear feet of eroding banks throughout the Rutherford Reach: 8,538 linear feet on the left (east) bank, and 6,136 feet on the right (west) bank. Eroding bank sections ranged from 20 to 35 feet high. The longest contiguous sections of eroding bank on the right (west) bank spanned 140 feet between stations 21,500 - 21,360 (20 feet high) on the Guggenhime property; and 1,470 feet between stations 5,475 – 4,005 (20 feet high) on the Laird property, and on the left bank spanned 680 feet between stations 12,690 – 12,010 (35 feet high) on the Round Pond West property; and spanned a nearly contiguous stretch of 1,450 feet over three sections between stations 2,680 – 1,230 (feet high) on the Opus One property. The most rapidly eroding section of the river spanned 270 feet between right (east) bank river stations 6900 – 6,630 on the Sequoia Grove property. According to air photo analysis, and field observations since 2004, the 20 foot high bank at Sequoia Grove has been retreating at an average rate of 2 feet per year. This section of the channel is devoid of riparian vegetation buffer and is a high priority for restoration, to curb fine sediment delivery to the stream channel, and because rapid bank collapse is migrating downstream and threatening a residential home on the adjacent Frostfire/Davis (previously Mueller) property.

2010

Restoration construction was completed on the east left bank of Reaches 1in 2009. Restoration construction was completed through Reaches 1-3 in 2010. In June 2010, approximately 9,000 linear feet of eroding banks were mapped throughout the Rutherford Reach: 3,822 linear feet on the left (east) bank, and 5,210 feet on the right (west) bank constituting 18% of the channel bank length in the Rutherford Reach. This constitutes a reduction of 39% compared to the 2009 baseline. Eroding bank sections ranged from 10 to 30 feet high. Hardened banks, including rip rap and concrete, were mapped throughout the Rutherford Reach in 2010, and amounted to 4,800 linear feet of stream bank: 1,260 linear feet on the left (east) bank, and 5,210 linear feet on the right (west) bank constituting 19% of the channel bank length in the Rutherford Reach. Some of the hardened banks will be removed during the course of future restoration construction, with the exception of the bank revetments installed to protect the bridges at Zinfandel Lane, the Rutherford Cross and the Oakville Cross Roads.

2011

Restoration construction was completed through Reaches 1-3 in 2010. In June 2011, approximately 4,800 linear feet of eroding banks were mapped throughout the Rutherford Reach: 2,238 linear feet on the left (east) bank, and 2,513 linear feet on the right (west) bank constituting 19% of the channel bank length in the Rutherford Reach. This constitutes a reduction of 67% compared to the 2009 baseline.

2012

Restoration construction was completed through Reaches 1-3, and in Reach 4 east left bank in 2011. In June 2012, 4,400 linear feet of eroding banks were mapped throughout the Rutherford Reach: 1,725 linear feet on the left (east) bank, and 2,715 linear feet on the right (west) bank constituting 18% of the channel bank length in the Rutherford Reach. This constitutes a reduction of 70% compared to the 2009 baseline with 40% of the Rutherford Reach Restoration Project complete.

2013

Restoration construction was completed through Reaches 1-4, and in Reach 8 north in 2012. In June 2013, approximately 5,200 linear feet of eroding banks were mapped throughout the Rutherford Reach: 2,680 linear feet on the left (east) bank, and 2,477 linear feet on the right (west) bank constituting 21% of the channel bank length in the Rutherford Reach. This constitutes a reduction of 65% compared to the 2009 baseline with 72% of the Rutherford Reach restoration complete.

Summary

From 2009 to 2010, eroding bank length in the Rutherford Reach (Reaches 1-9) reduced by 38%, from 14,674 to 9,032 feet. Approximately 1,900 feet of this reduction was due to treatment of eroding banks by restoration construction in 2009 of Phase 1A: Reaches 1 and 2 east bank.

From 2010 to 2011, eroding bank length further reduced from 9,032 feet to 4,751 feet in the Rutherford Reach following construction in 2010 of Phase 1B: Reaches 1 and 2 west bank, and Phase 2: Reach 3.

With the Project nearly half complete following construction of Phases 1, 2 and 3a, in Reaches 1, 2, 3, and Reach 4 East bank upstream of the Rutherford Cross Road, by June 2012 eroding bank length had reduced by 70% compared to the 2009 baseline to 4,395 linear feet. All restored areas withstood the 3 year flood peak flow of 7,330 cfs on March 20, 2011 with only minor repairs required at some transition areas between newly graded and non-graded slopes and the downstream end of benches.

The following year, the slope stability in the newly graded areas in Reach 4 east and Reach 8 north were tested before they were revegetated by two high storms flows that occurred three weeks apart in December 2012. At peak discharges of 9,260 cfs and 9,698 cfs, and depths of nearly 17 feet, each at the upstream gage in St. Helena, each 5 year magnitude storm flow nearly filled the channel to the top of bank. When the December 2012 high flows occurred, the Project was fully constructed in Reaches 1-4 between Zinfandel Lane and the Rutherford Cross Road. The vertical failing bank at Sequoia Grove had also been stabilized as part of Phase 4a, and erosive pressure on the channel banks in Reach 8 north had been further alleviated by the construction of a secondary channel across from Sequoia Grove. The results of the June 2013 channel survey showed that following the high flows, the eroding bank length in the Project increased by 800-linear feet versus the previous year to 5,200 linear feet. Eroding bank length was 65% reduced compared to the 2009 baseline.

It is likely that the Project will be able to achieve target the 75% reduction in eroding bank length with the completion of the Project. To achieve a maximum of 3,700 linear feet of eroding banks in the Project reach, a minimum of 1,500 linear feet of the 5,200 linear feet of mapped eroding banks must be stabilized in 2013-2015. Approximately 1,700 linear feet of oversteepened high banks (315 feet), undercutting banks (1,280 feet), and slumped or fractured banks (100 feet) were mapped in previously treated areas, and will not be addressed with future grading. Some of the undercut banks may have been mapped for the first time because of the historically low flow level in the channel that allowed for the visual assessment of the base of bank for the first time since monitoring began, while other undercut banks may have been exposed due to scour from the 2012 storms.

Removing the areas that will not be treated with future grading from the total 5,200 linear feet of erosion mapped in the Reach mapped, leaves 3,500 feet of unstable banks in the Project reach that could be addressed to meet the minimum target reduction of 1,500 feet.

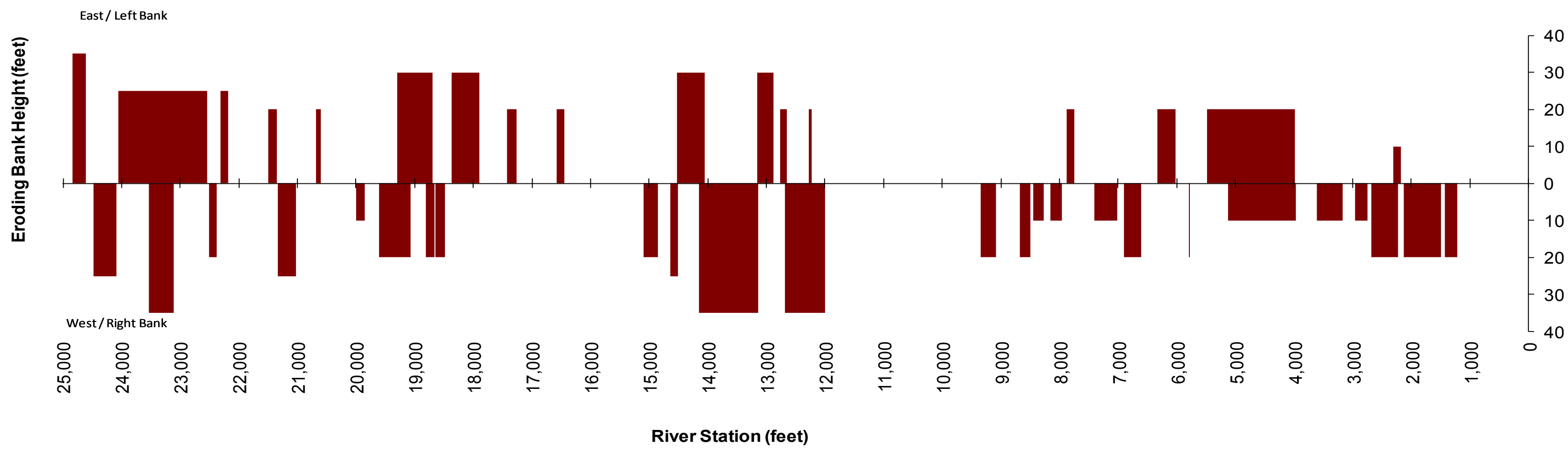
In 2013-2014, a minimum of 550 feet of eroding banks (250 feet of unstable banks and 300 feet of un-vegetated areas) will be graded and replanted as part of the restoration in Phases 4BC and 5, in Reaches 6-9. Stabilization of an additional 950 linear feet must occur to meet the target, which can be achieved by re-vegetating approximately half of the 2,150 feet of banks that were mapped as unstable due to lack of vegetation. Revegetation will not only take place during the final phase of the restoration, but will continue as necessary over the longterm through the Maintenance Assessment District.

		TOTAL		LEFT BANK		RIGHT BANK	
LENGTH	**2013-2012 CHANGE**	**717**	**feet**	**955**	**feet**	**(238)**	**feet**
TYPE OF INSTABILITY	High Bank	(105)	feet	90	feet	(195)	feet
	Slump-Fractured Bank	(110)	feet	20	feet	(130)	feet
	Undercutting	1,062	feet	690	feet	372	feet
	Un-Vegetated	(130)	feet	155	feet	(285)	feet
BANK LOCATION	Whole Bank	725	feet	685	feet	40	feet
	Top of Bank	(445)	feet	(165)	feet	(280)	feet
	Base of Bank	437	feet	435	feet	2	feet

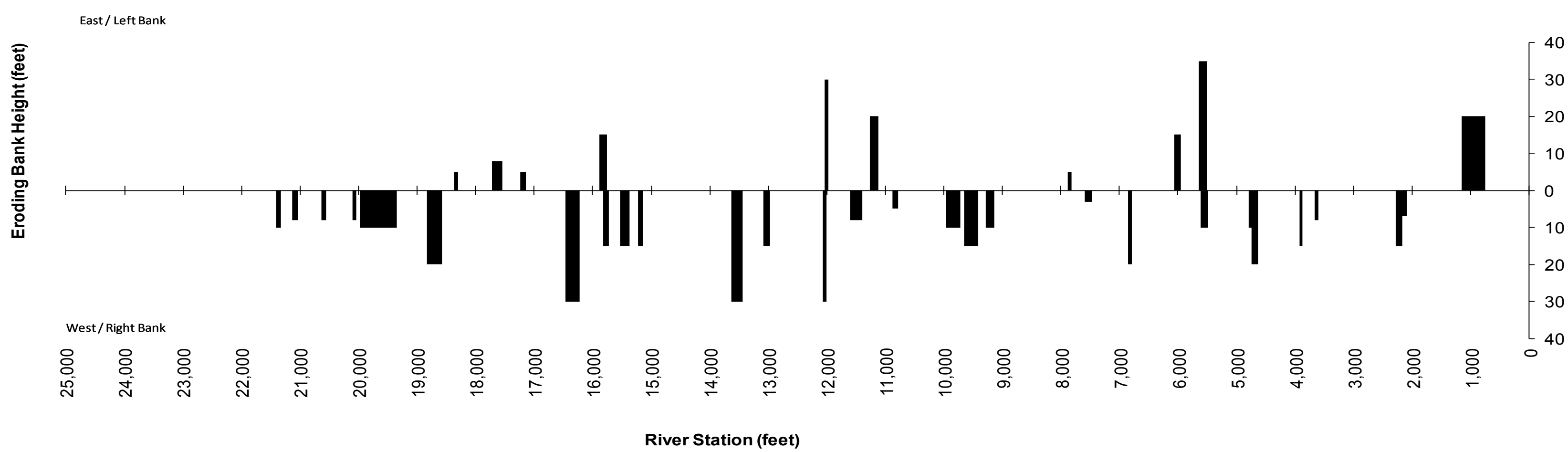
		TOTAL		LEFT BANK		RIGHT BANK	
LENGTH	**2013 TOTAL**	**5,157**	**100%**	**2,680**	**52%**	**2,477**	**48%**
TYPE OF INSTABILITY	High Bank	655	13%	370	14%	285	12%
	Slump-Fractured Bank	250	5%	75	3%	175	7%
	Undercutting	2,102	41%	810	30%	1,292	52%
	Un-Vegetated	2,150	42%	1,425	53%	725	29%
BANK LOCATION	Whole Bank	2,695	52%	1,360	51%	1,335	54%
	Top of Bank	985	19%	540	20%	445	18%
	Base of Bank	1,477	29%	780	29%	697	28%

		TOTAL		LEFT BANK		RIGHT BANK	
LENGTH	**2012 TOTAL**	**4,440**	**100%**	**1,725**	**39%**	**2,715**	**61%**
TYPE OF INSTABILITY	High Bank	760	17%	280	16%	480	18%
	Slump-Fractured Bank	360	8%	55	3%	305	11%
	Undercutting	1,040	23%	120	7%	920	34%
	Un-Vegetated	2,280	51%	1,270	74%	1,010	37%
BANK LOCATION	Whole Bank	1,970	44%	675	39%	1,295	48%
	Top of Bank	1,430	32%	705	41%	725	27%
	Base of Bank	1,040	23%	345	20%	695	26%

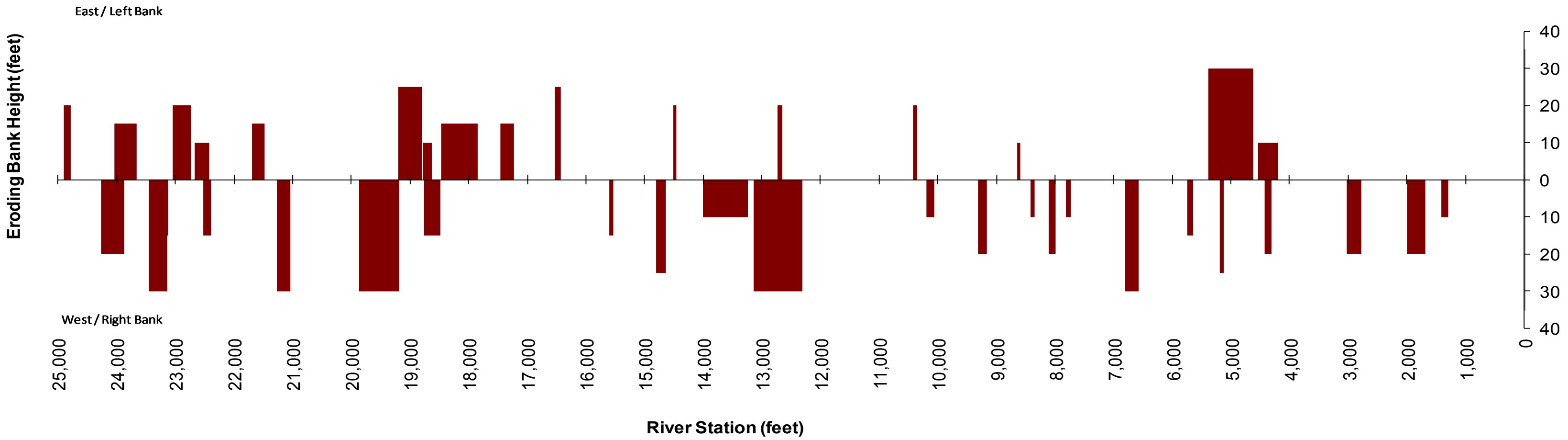
2009
Napa River Rutherford Reach
Eroding or Unstable Banks
14,700 Feet: 60%



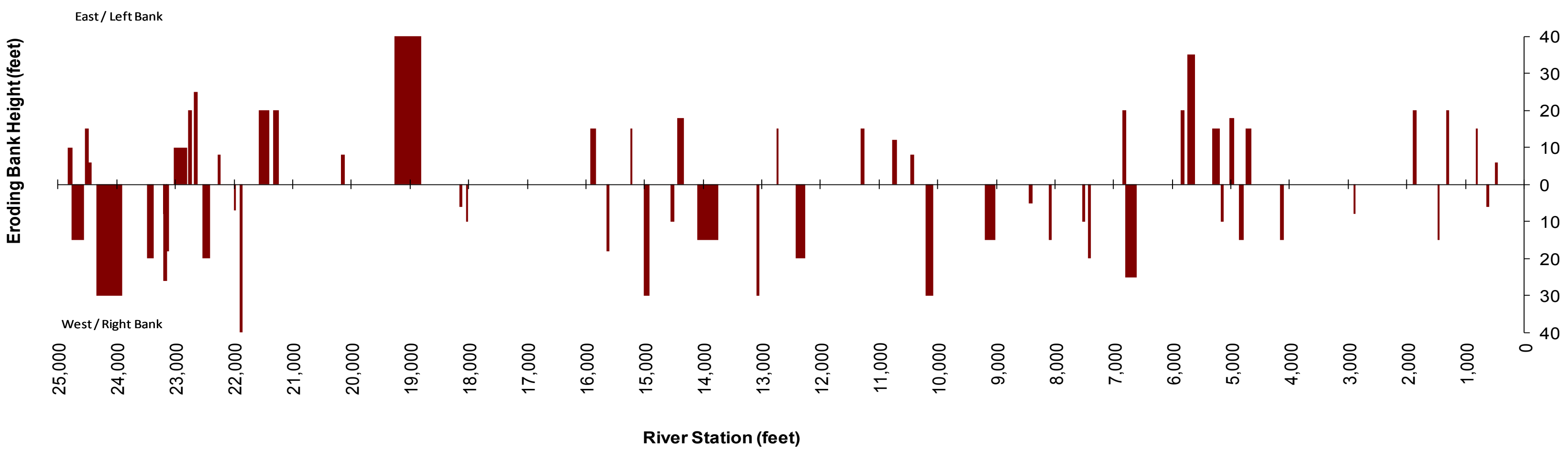
2010
Napa River Rutherford Reach
Hardened Banks
4,800 Feet: 19%



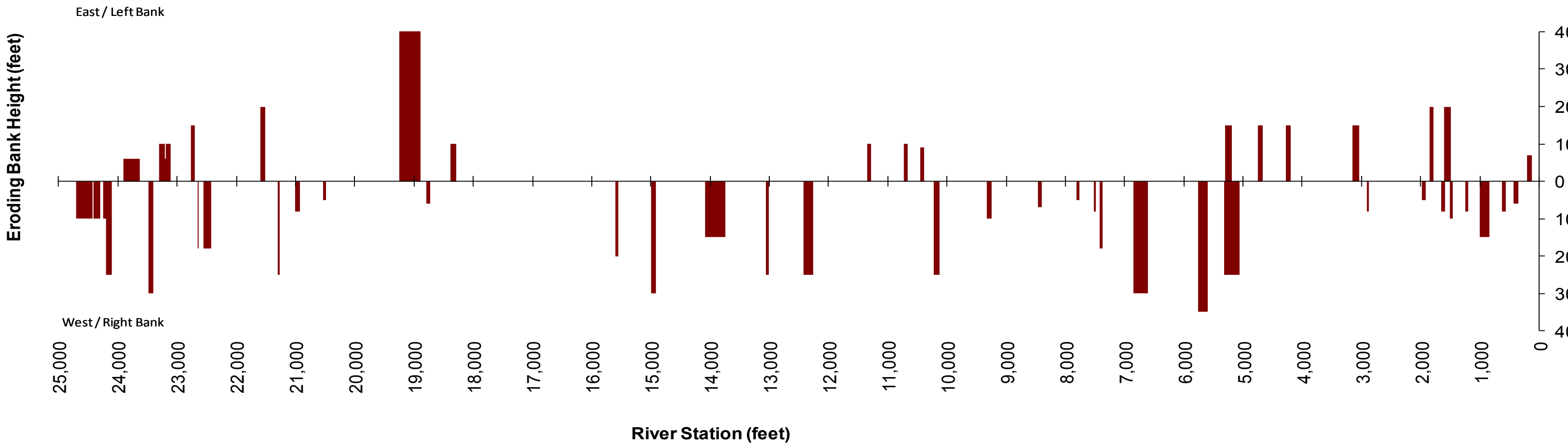
2010
Napa River Rutherford Reach
Eroding or Unstable Banks
9,000 Feet: 36%



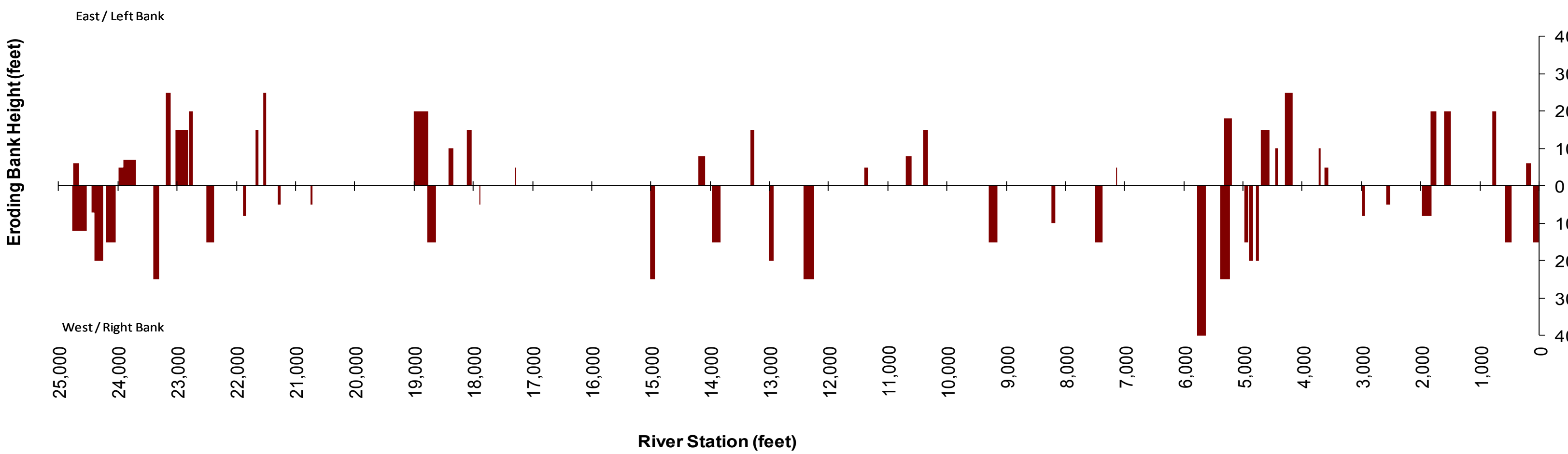
2011
Napa River Rutherford Reach
Eroding or Unstable Banks
4,800: Feet: %



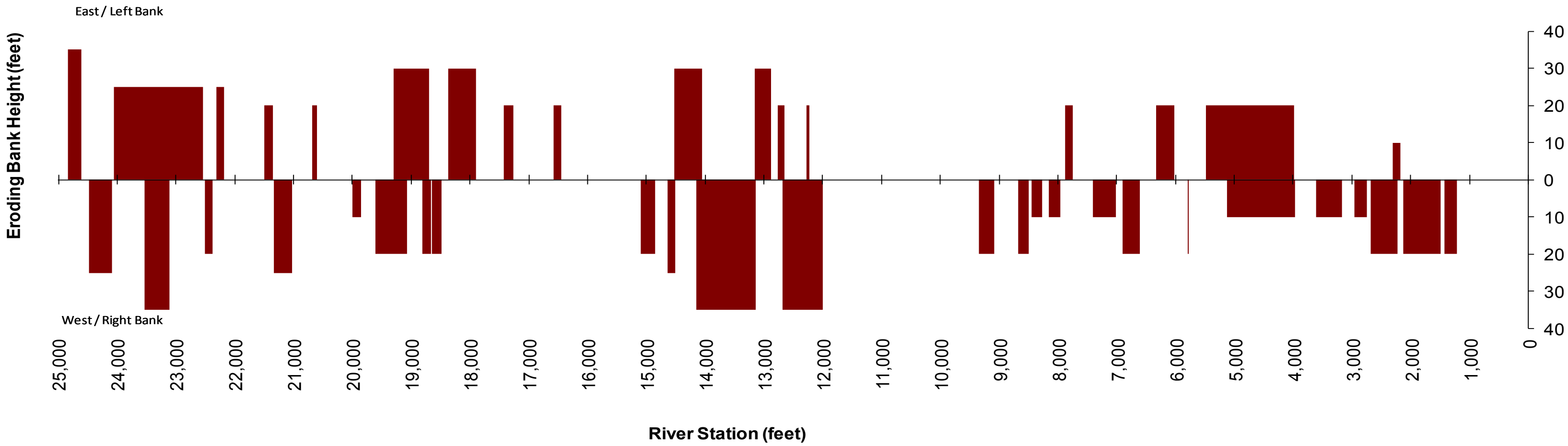
2012
Napa River Rutherford Reach
Eroding or Unstable Banks
4,400 Feet: 18%



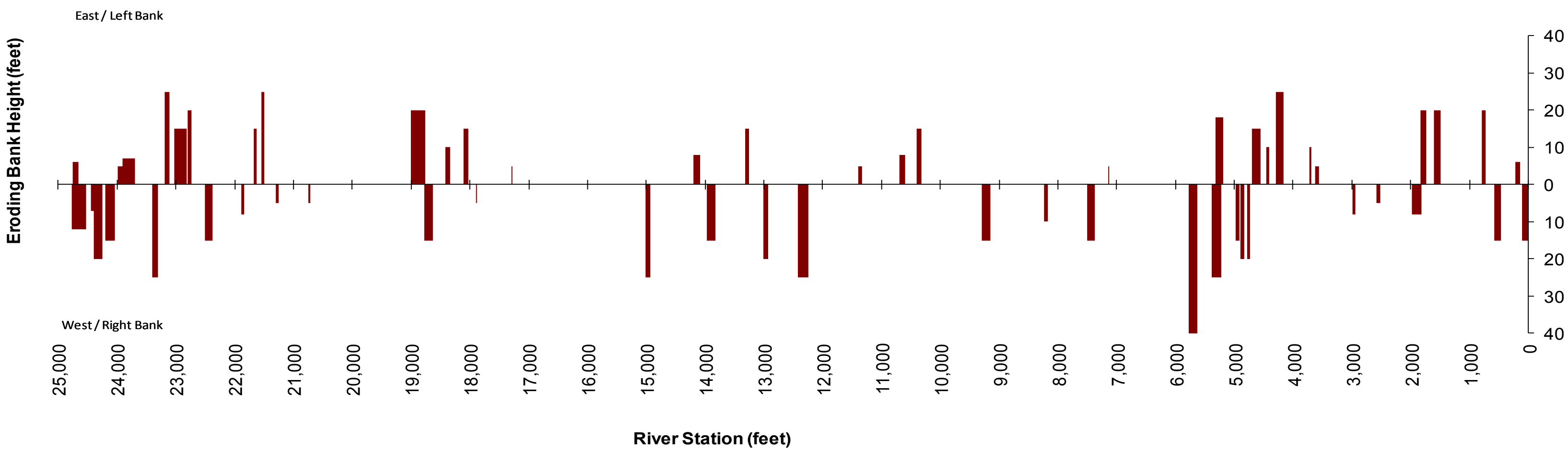
2013
Napa River Rutherford Reach
Eroding or Unstable Banks
5,200 Feet: 18%



2009
Napa River Rutherford Reach
Eroding or Unstable Banks
14,700 Feet: 60%



2013
Napa River Rutherford Reach
Eroding or Unstable Banks
5,200 Feet: 18%



Bank Stabilization at River Station 6750 at Sequoia Grove

6,750 6-5-2009

6,750 12-08-2011

6,750 06 -5--2013

III. Sediment Source Reduction Calculations

SEDIMENT SOURCE REDUCTION

Annual Results Summary

2010

Implementation of Phases 1-2: Reaches 1-3 combined, in 36% of the 4.5 mile Project reach, reduced fine sediment loading by 5,337 metric tons/year for twenty years, or 28% of the total target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources.

2011

Implementation of Phases 1-3A: Reaches 1-3, and 4 East combined, in 52% of the 4.5 mile Project reach, reduced fine sediment loading by 7,498 metric tons/year for twenty years, or 39% of the total target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources.

2012

Implementation of Phases 1-4A: Reaches 1- 4 and 8 North combined, in 60% of the 4.5 mile Project reach, reduced fine sediment loading by 10,342 metric tons/year for twenty years, or 54% of the total target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources.

2013

Implementation of Phases 1-4: Reaches 1- 4 and 8 combined, in 72% of the 4.5 mile Project reach, reduced fine sediment loading by 14,118 metric tons/year for twenty years, or 74% of the total target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources.

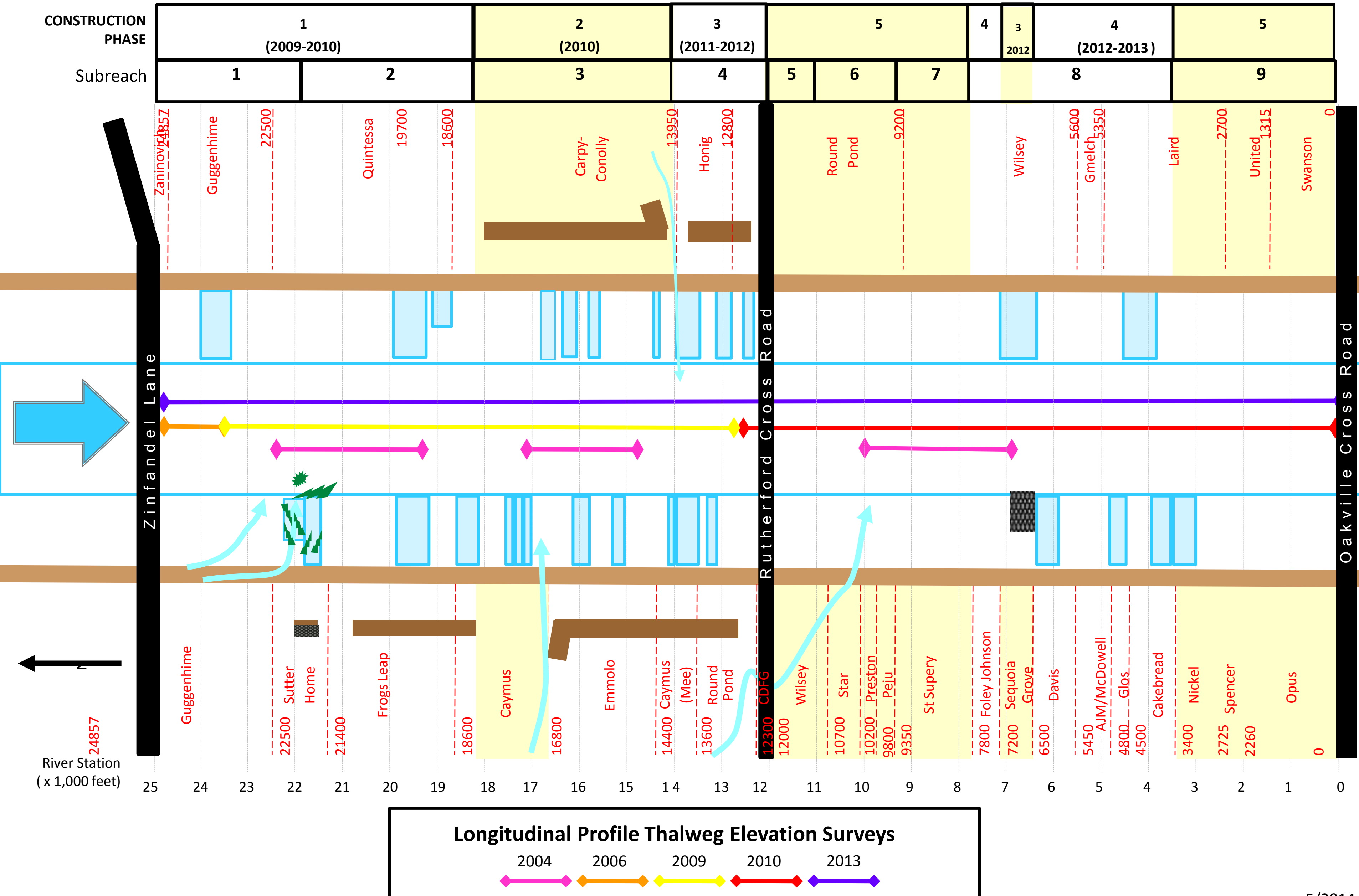
Annual Sediment Source Reduction Summary Table

Sediment Source Reduction Estimates	Project	River Station (Feet Upstream from Oakville Cross Road)		Sediment Removed	Sediment Removed	Reduction in Channel Bank Erosion Rates			
CONSTRUCTION PHASES	**Percent Complete**	**Upstream**	**Downstream**	**Metric Tons**	**Metric Tons/Year / 20 Years**	**MODERATE RATE 750 Metric Tons/ Mile/Year**	**Metric Tons/ Year**	**Year**	**%**
PHASE 1A: Reaches 1-2 East	**25%**	**24,857**	**18,600**	**20,552**	**1,028**	**237**	**1,916**	**2009**	**10%**
PHASE 1: Reaches 1-2		24,857	18,600	58,768	2,938	237	3,827	2010	20%
PHASE 2: Reach 3		18,600	16,000	22,801	1,140	98	1,509	2010	8%
PHASE 1B: Reaches 1-2 West; PHASE 2: Reach 3		24,857	16,000	61,016	3,051	335	4,309	2010	23%
PHASES 1 -2: Reaches 1-3	**36%**	**24,857**	**16,000**	**81,569**	**4,078**	**335**	**5,337**	**2010**	**28%**
PHASE 3A: Reach 4 East		16,000	12,000	31,865	1,593	152	2,161	2011	11%
PHASES 1 -3A: Reaches 1-3, 4 East	**52%**	**24,857**	**12,000**	**113,434**	**5,672**	**487**	**7,498**	**2011**	**39%**
PHASE 3B: Reach 4 West		16,000	12,000	39,694	1,985	Included in 3A	1,985	2012	10%
PHASE 4A: Reach 8 North		7,800	5,800	11,514	576	76	860	2012	5%
PHASE 3B: Reach 4 West; PHASE 4A: Reach 8 North				**51,208**	**2,560**	**76**	**3,414**	**2012**	**18%**
PHASES 1-4A	**60%**	**24,857**	**5,800**	**164,642**	**8,232**	**563**	**10,342**	**2012**	**54%**
PHASE 4BC: Reach 8 South		7,800	2,725	66,774	3,339	192	4,060	2013	21%
PHASES 1-4: Reaches 1-4, 8	**72%**	**24,857**	**2,725**	**231,417**	**11,571**	**679**	**14,118**	**2013**	**74%**
PHASE 5N: Reaches 5, 6,7 (Estimated)		12,000	7,800	11,972	599	159	1,195	2014	6%
PHASE 5S: Reach 9 (Estimated)		2,725	0	14,637	732	103	1,119	2014	6%
PHASE 5: Reaches 5,6,7,9 (Estimated)		**0**	**0**	**26,609**	**1,330**	**262**	**2,314**	**2014**	**12%**
PROJECT COMPLETION PHASES 1-5: Reaches 1-9 (Estimated)	**100%**	**24,857**	**0**	**258,026**	**12,901**	**942**	**16,432**	**2014**	**86%**

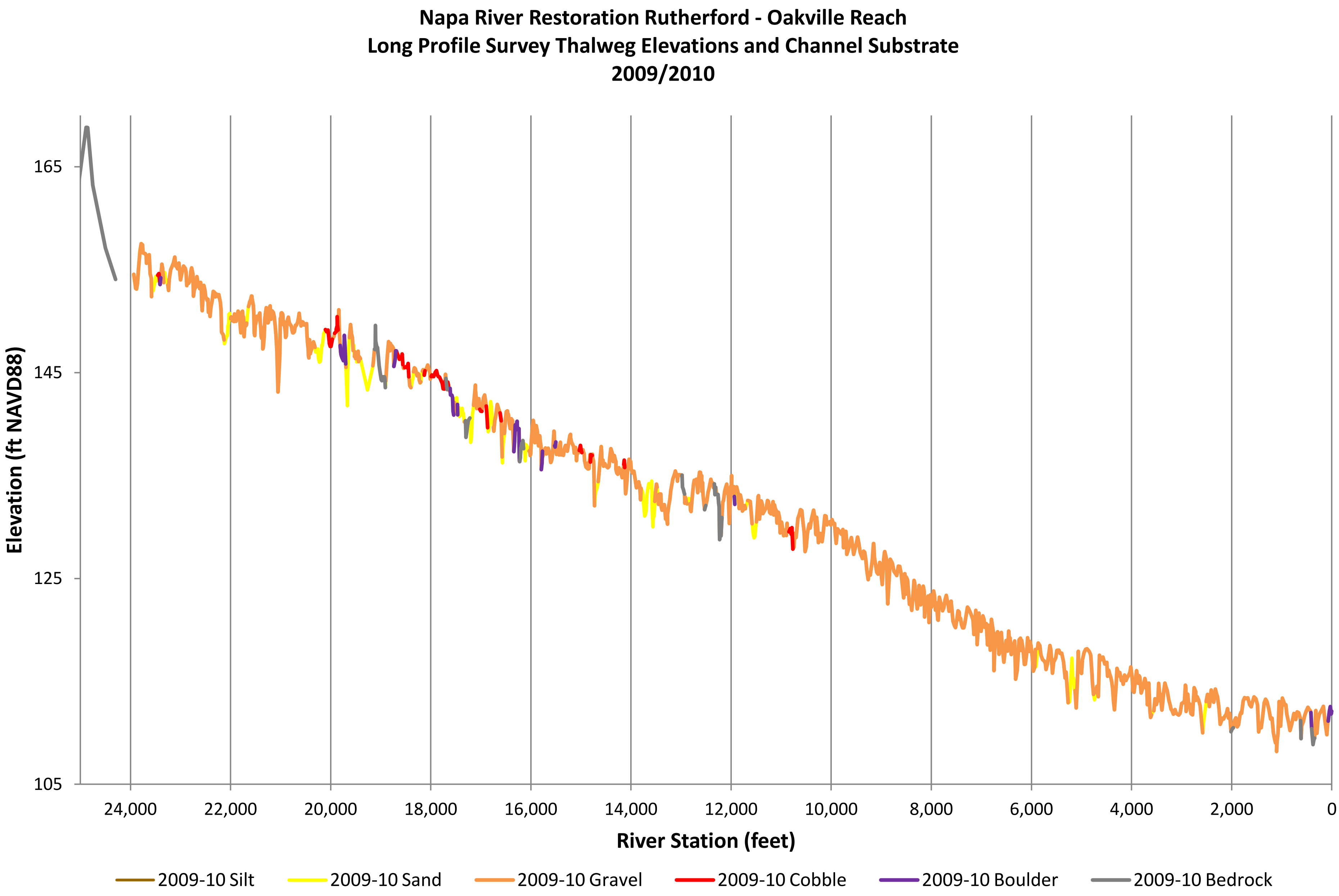
As of 12/09/2013

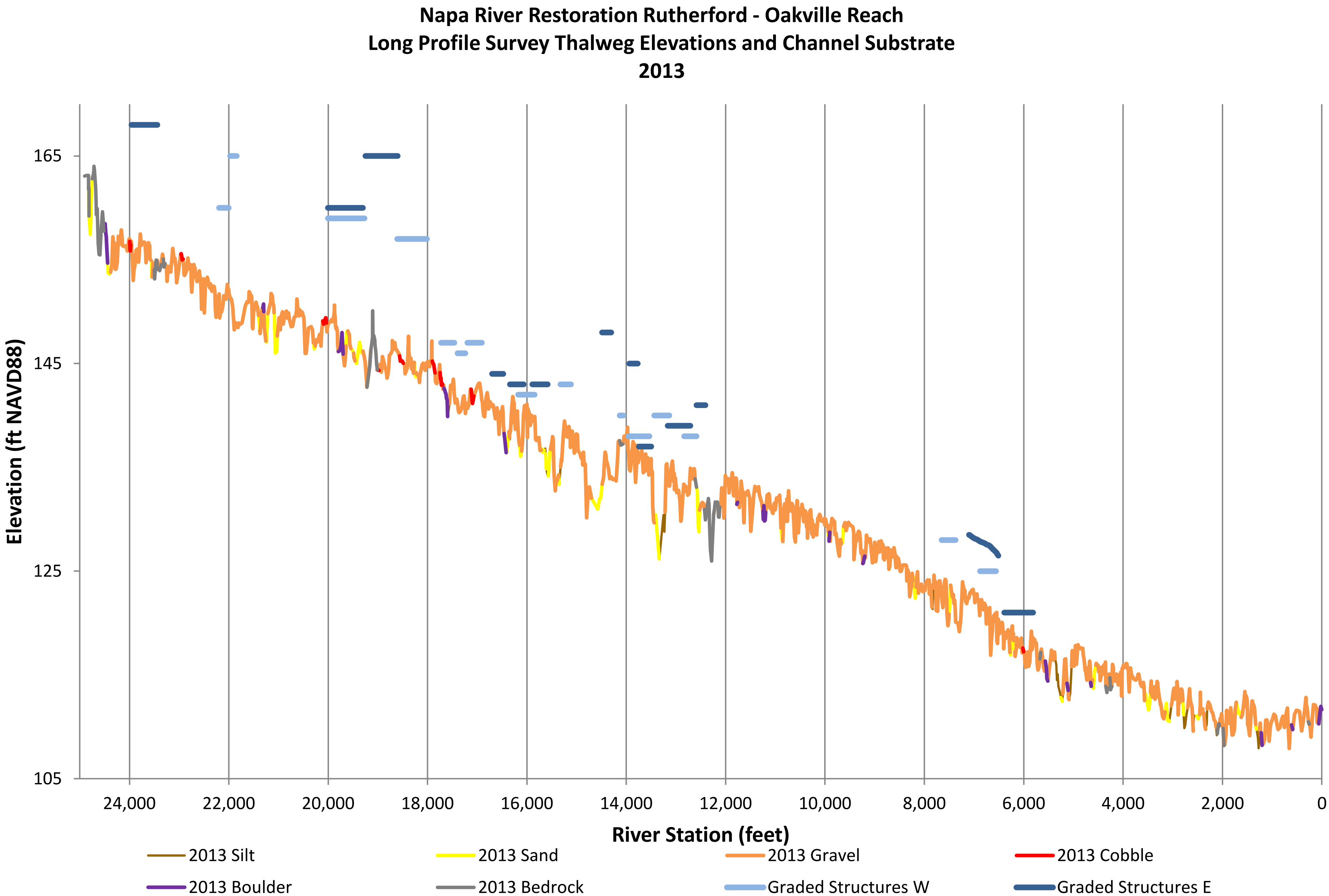
IV. Longitudinal Profile Thalweg Elevation Surveys

Napa River Rutherford Reach Restoration Project



5/2014


Napa River Restoration Rutherford - Oakville Reach
Long Profile Survey Thalweg Elevations and Channel Substrate
2009/2010
Elevation (ft NAVD88)
165
145
125
105
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
River Station (feet)
2009-10 Silt
2009-10 Sand
2009-10 Gravel
2009-10 Cobble
2009-10 Boulder
2009-10 Bedrock

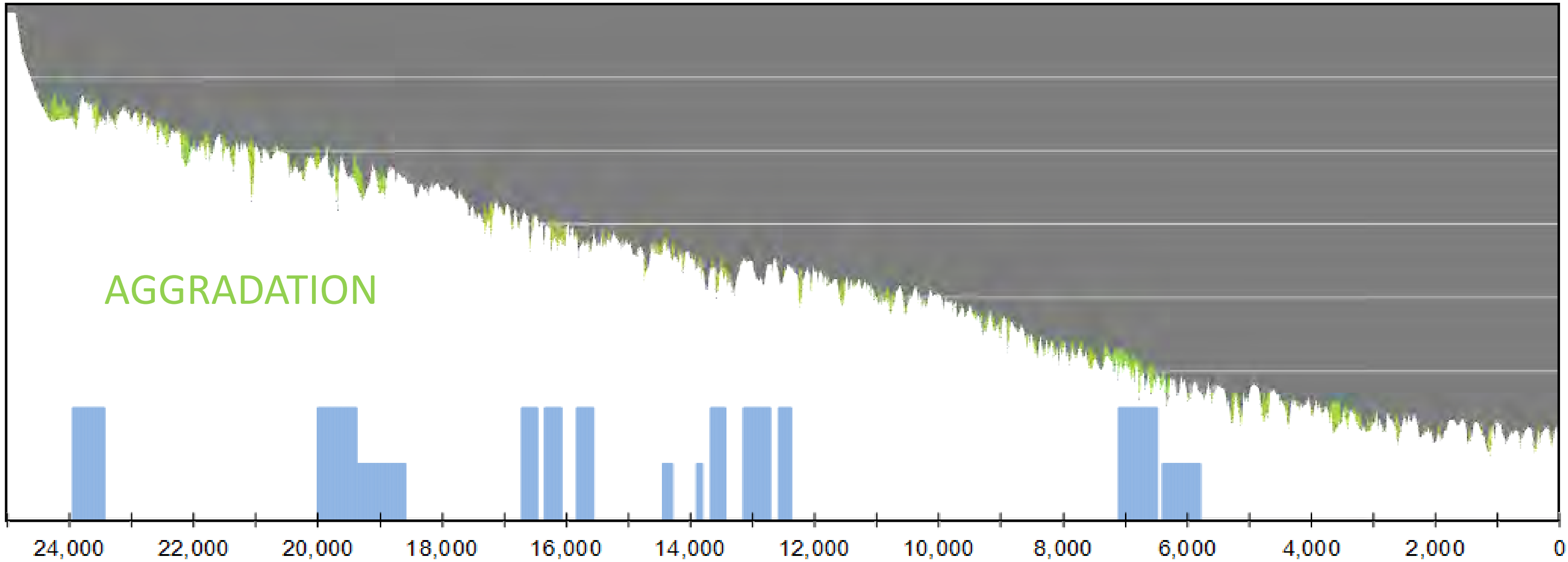

Napa River Restoration Rutherford - Oakville Reach
Long Profile Survey Thalweg Elevations and Channel Substrate
2013
Elevation (ft NAVD88)
165
145
125
105
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
River Station (feet)
2013 Silt
2013 Sand
2013 Gravel
2013 Cobble
2013 Boulder
2013 Bedrock
Graded Structures W
Graded Structures E

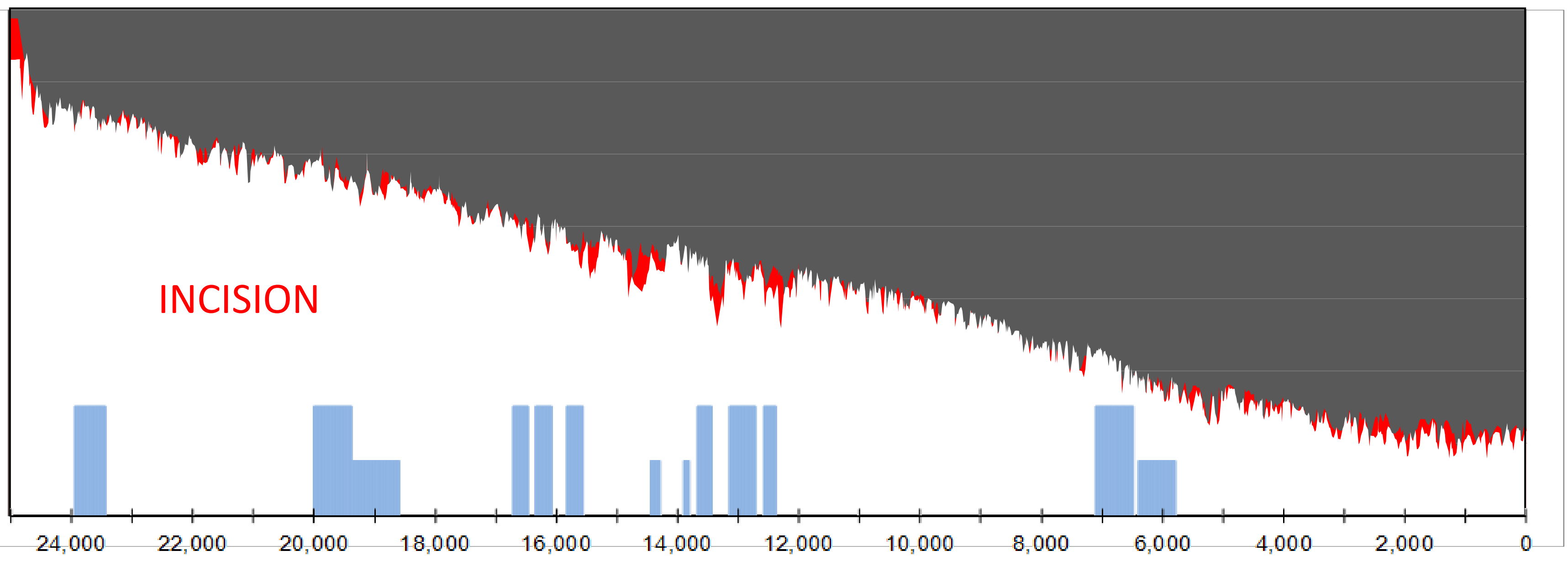
Substrate Key for Topographic Surveys

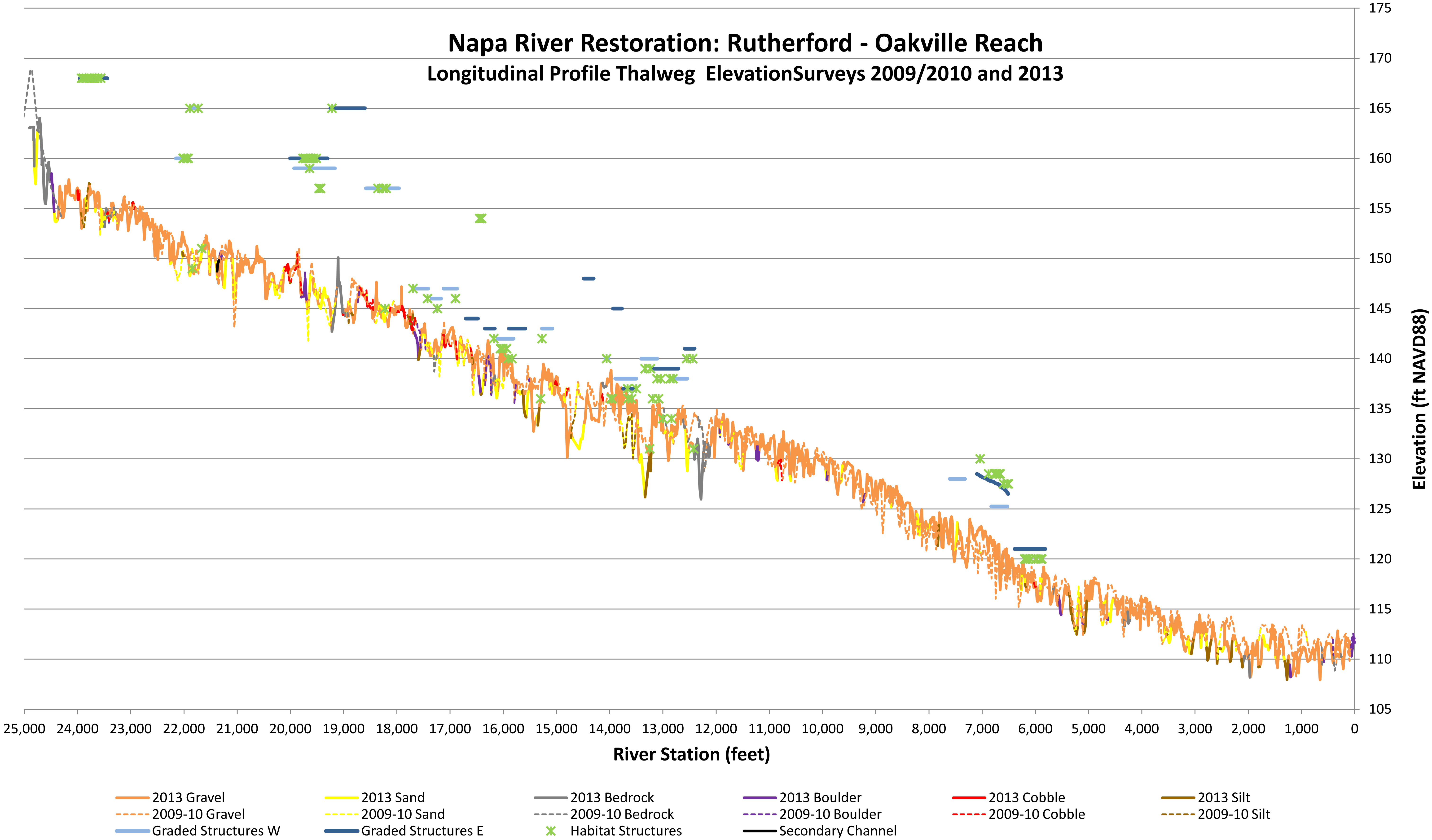
The distribution of substrate size classes along the longitudinal transects is indicated by color according to dominant relative gravel size determined by eye during the survey.

brown	silt, soil	(<.062mm median diameter)
yellow	sand	(.062-2 mm median diameter)
orange	gravel	(2-64 mm median diameter)
red	cobble	(>64 mm median diameter)
purple	Boulder / Rip Rap	(>128 mm median diameter)
grey	bedrock	
Black	rip rap or hardened banks	
green	Roots, Large Woody Debris	

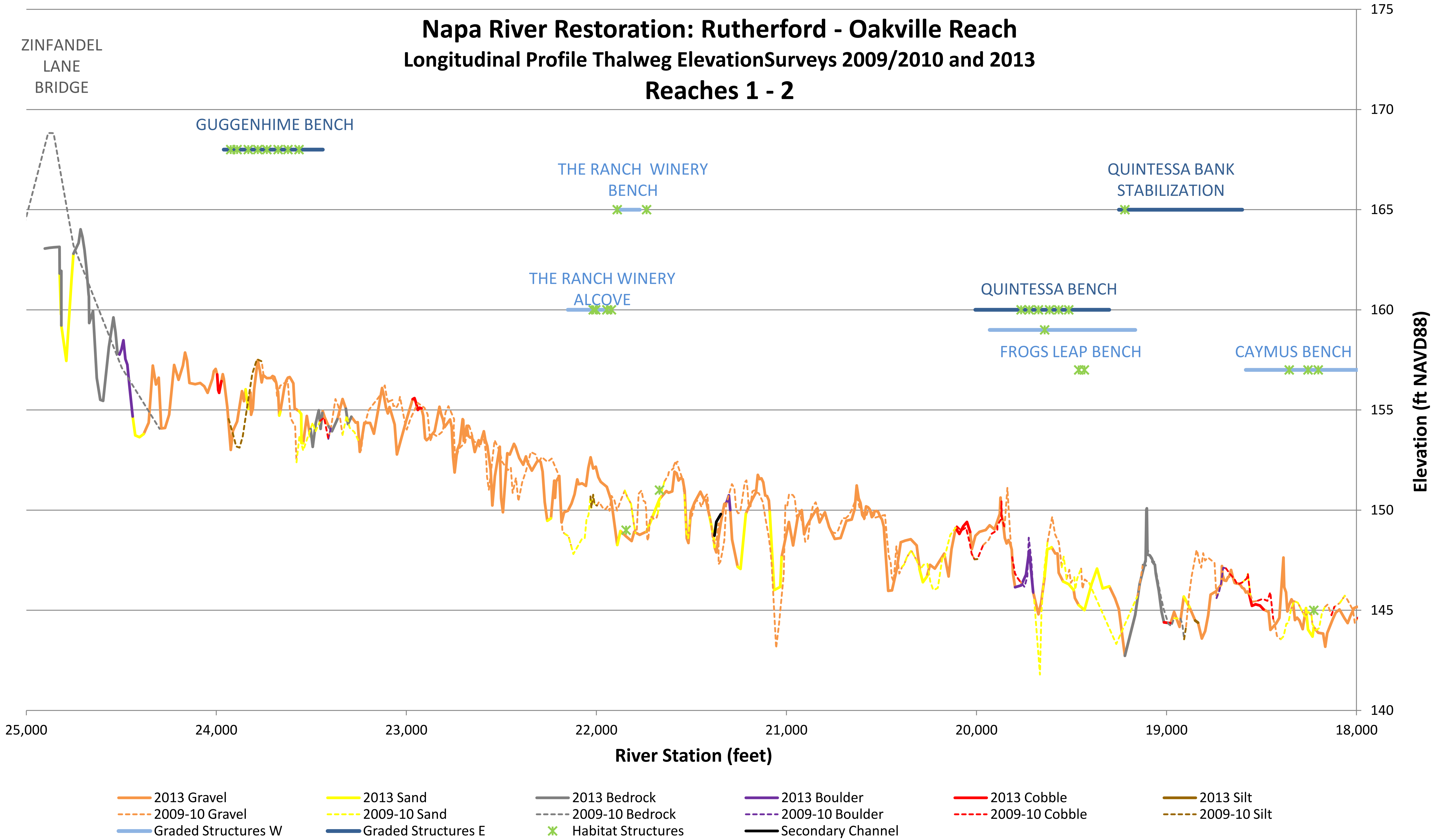
Channel Aggradation and Incision with Locations of Relative Channel Widening (2009 – 2013)



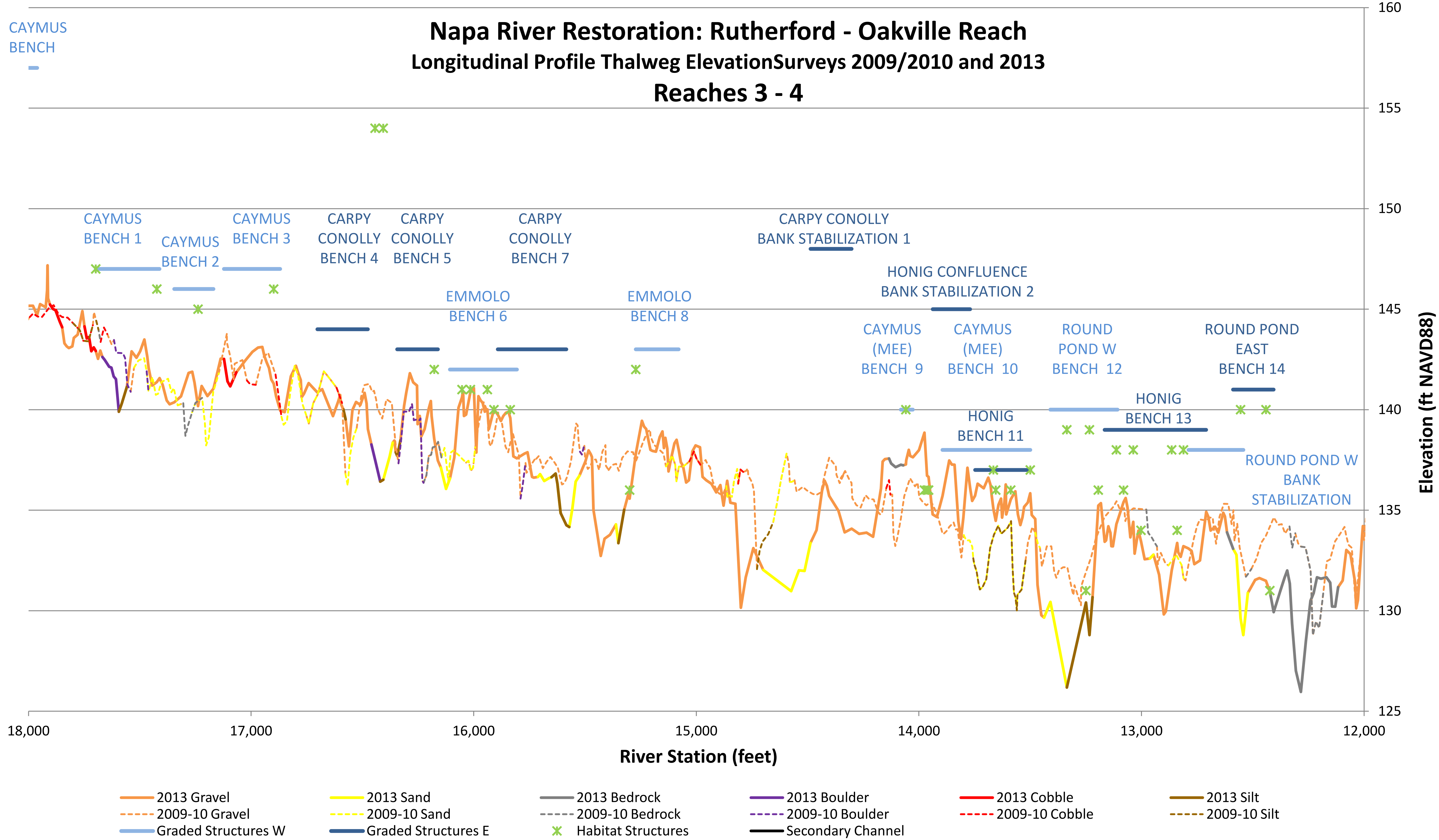


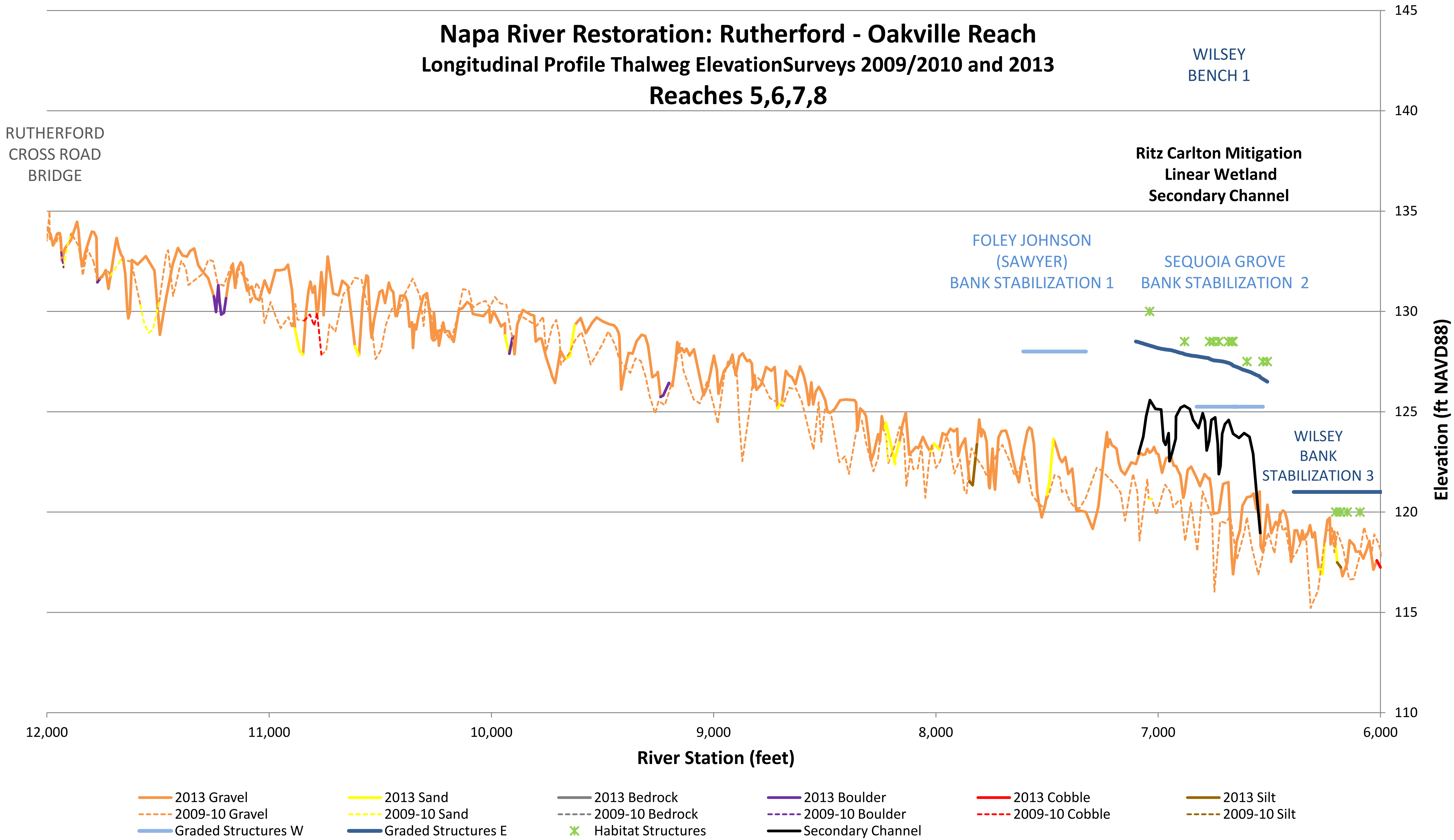


Napa River Restoration: Rutherford - Oakville Reach
Longitudinal Profile Thalweg ElevationSurveys 2009/2010 and 2013
Elevation (ft NAVD88)
175
170
165
160
155
150
145
140
135
130
125
120
115
110
105
River Station (feet)
25,000
24,000
23,000
22,000
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2013 Gravel
2013 Sand
2013 Bedrock
2013 Boulder
2013 Cobble
2013 Silt
2009-10 Gravel
2009-10 Sand
2009-10 Bedrock
2009-10 Boulder
2009-10 Cobble
2009-10 Silt
Graded Structures W
Graded Structures E
Habitat Structures
Secondary Channel

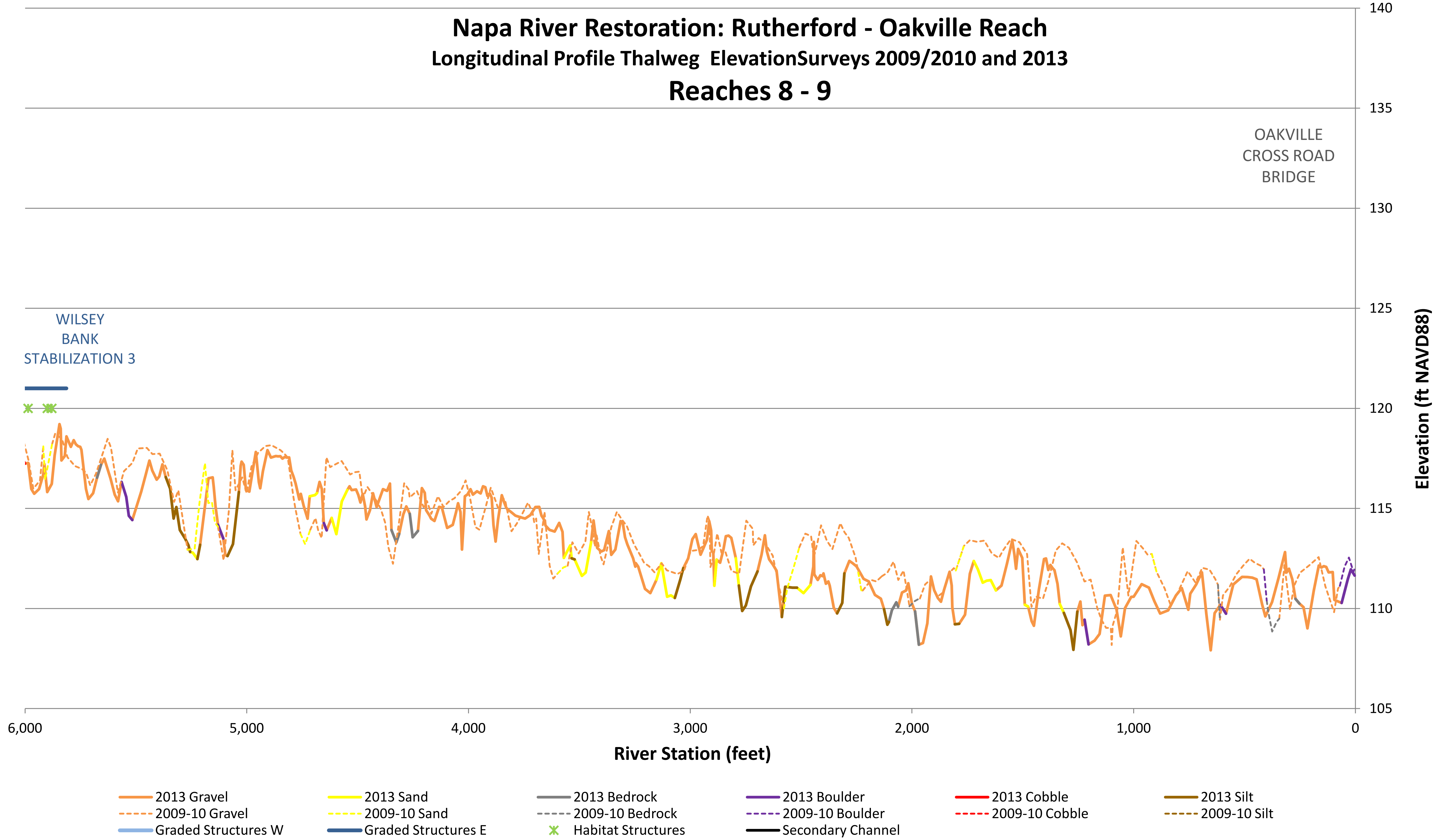


Napa River Restoration: Rutherford - Oakville Reach
Longitudinal Profile Thalweg ElevationSurveys 2009/2010 and 2013
Reaches 1 - 2
ZINFANDEL LANE BRIDGE
GUGGENHIME BENCH
THE RANCH WINERY BENCH
QUINTESSA BANK STABILIZATION
THE RANCH WINERY ALCOVE
QUINTESSA BENCH
FROGS LEAP BENCH
CAYMUS BENCH
175
170
165
160
155
150
145
140
Elevation (ft NAVD88)
25,000
24,000
23,000
22,000
21,000
20,000
19,000
18,000
River Station (feet)
2013 Gravel
2013 Sand
2013 Bedrock
2013 Boulder
2013 Cobble
2013 Silt
2009-10 Gravel
2009-10 Sand
2009-10 Bedrock
2009-10 Boulder
2009-10 Cobble
2009-10 Silt
Graded Structures W
Graded Structures E
Habitat Structures
Secondary Channel


Napa River Restoration: Rutherford - Oakville Reach
Longitudinal Profile Thalweg ElevationSurveys 2009/2010 and 2013
Reaches 3 - 4
CAYMUS BENCH
CAYMUS BENCH 1
CAYMUS BENCH 2
CAYMUS BENCH 3
CARPY CONOLLY BENCH 4
CARPY CONOLLY BENCH 5
CARPY CONOLLY BENCH 7
EMMOLO BENCH 6
EMMOLO BENCH 8
CARPY CONOLLY BANK STABILIZATION 1
HONIG CONFLUENCE BANK STABILIZATION 2
CAYMUS (MEE) BENCH 9
CAYMUS (MEE) BENCH 10
HONIG BENCH 11
ROUND POND W BENCH 12
HONIG BENCH 13
ROUND POND EAST BENCH 14
ROUND POND W BANK STABILIZATION
Elevation (ft NAVD88)
160
155
150
145
140
135
130
125
River Station (feet)
18,000
17,000
16,000
15,000
14,000
13,000
12,000
2013 Gravel
2009-10 Gravel
Graded Structures W
2013 Sand
2009-10 Sand
Graded Structures E
2013 Bedrock
2009-10 Bedrock
Habitat Structures
2013 Boulder
2009-10 Boulder
Secondary Channel
2013 Cobble
2009-10 Cobble
2013 Silt
2009-10 Silt



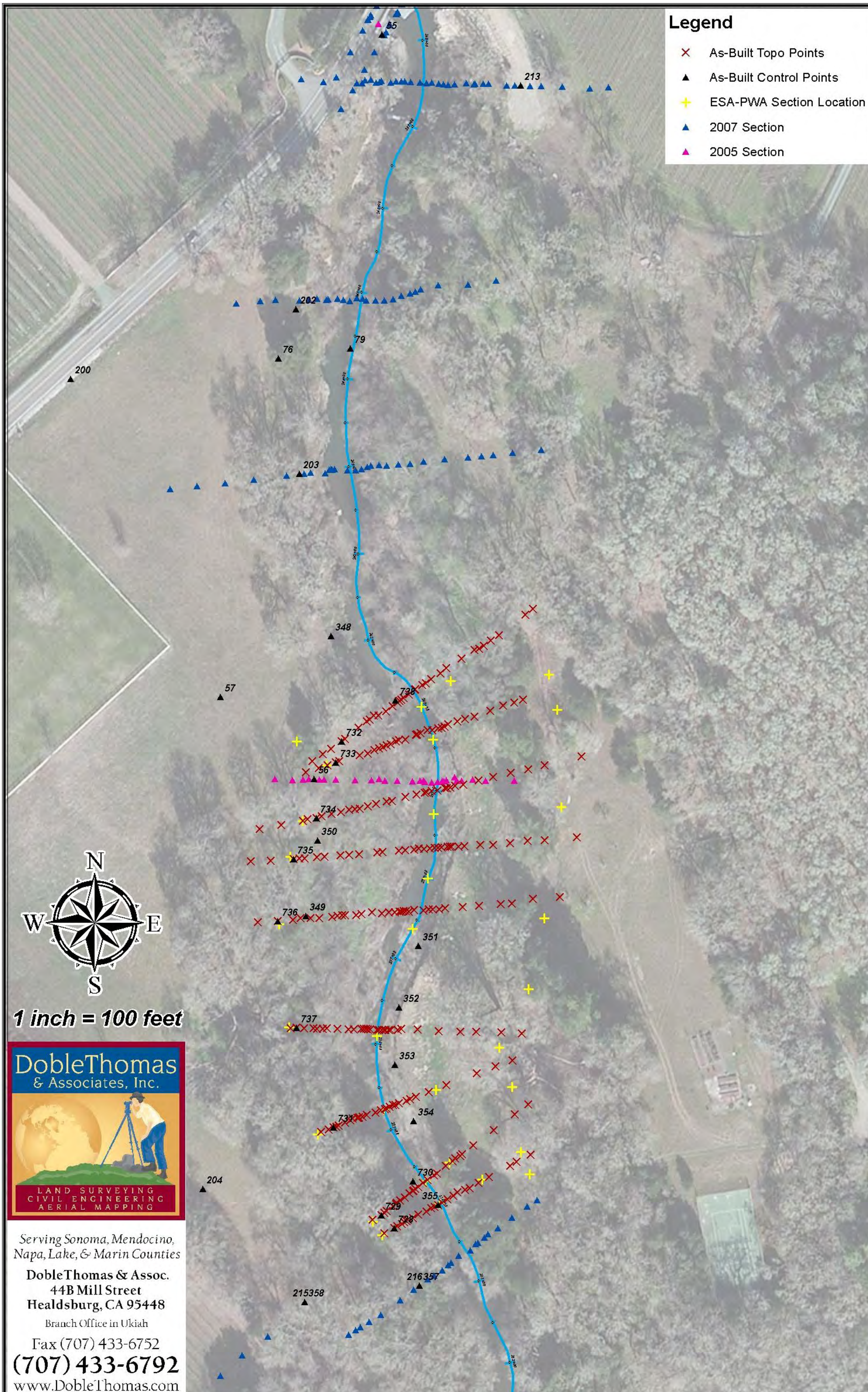
Napa River Restoration: Rutherford - Oakville Reach
Longitudinal Profile Thalweg ElevationSurveys 2009/2010 and 2013
Reaches 5,6,7,8
RUTHERFORD CROSS ROAD BRIDGE
WILSEY BENCH 1
Ritz Carlton Mitigation Linear Wetland Secondary Channel
FOLEY JOHNSON (SAWYER) BANK STABILIZATION 1
SEQUOIA GROVE BANK STABILIZATION 2
WILSEY BANK STABILIZATION 3
145
140
135
130
125
120
115
110
Elevation (ft NAVD88)
12,000
11,000
10,000
9,000
8,000
7,000
6,000
River Station (feet)
2013 Gravel
2009-10 Gravel
Graded Structures W
2013 Sand
2009-10 Sand
Graded Structures E
2013 Bedrock
2009-10 Bedrock
Habitat Structures
2013 Boulder
2009-10 Boulder
Secondary Channel
2013 Cobble
2009-10 Cobble
2013 Silt
2009-10 Silt



Napa River Restoration: Rutherford - Oakville Reach
Longitudinal Profile Thalweg ElevationSurveys 2009/2010 and 2013
Reaches 8 - 9
OAKVILLE CROSS ROAD BRIDGE
WILSEY BANK STABILIZATION 3
Elevation (ft NAVD88)
140
135
130
125
120
115
110
105
River Station (feet)
6,000
5,000
4,000
3,000
2,000
1,000
0
2013 Gravel
2013 Sand
2013 Bedrock
2013 Boulder
2013 Cobble
2013 Silt
2009-10 Gravel
2009-10 Sand
2009-10 Bedrock
2009-10 Boulder
2009-10 Cobble
2009-10 Silt
Graded Structures W
Graded Structures E
Habitat Structures
Secondary Channel

V. Channel Transect Surveys

Monitoring Cross Section Transect Survey Locations Surveyed in 2013


Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
55
213
202
79
76
200
203
348
57
738
732
733
56
734
350
735
736
349
351
352
737
353
731
354
730
204
355
729
728
216357
215358
N
S
E
W
1 inch = 100 feet
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Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
354
730
355
204
216357
215358
356
58
623
622
218
347
217
346
343
727
719
20
21
344
N
S
W
E
1 inch = 100 feet
220+27
Monitoring Section
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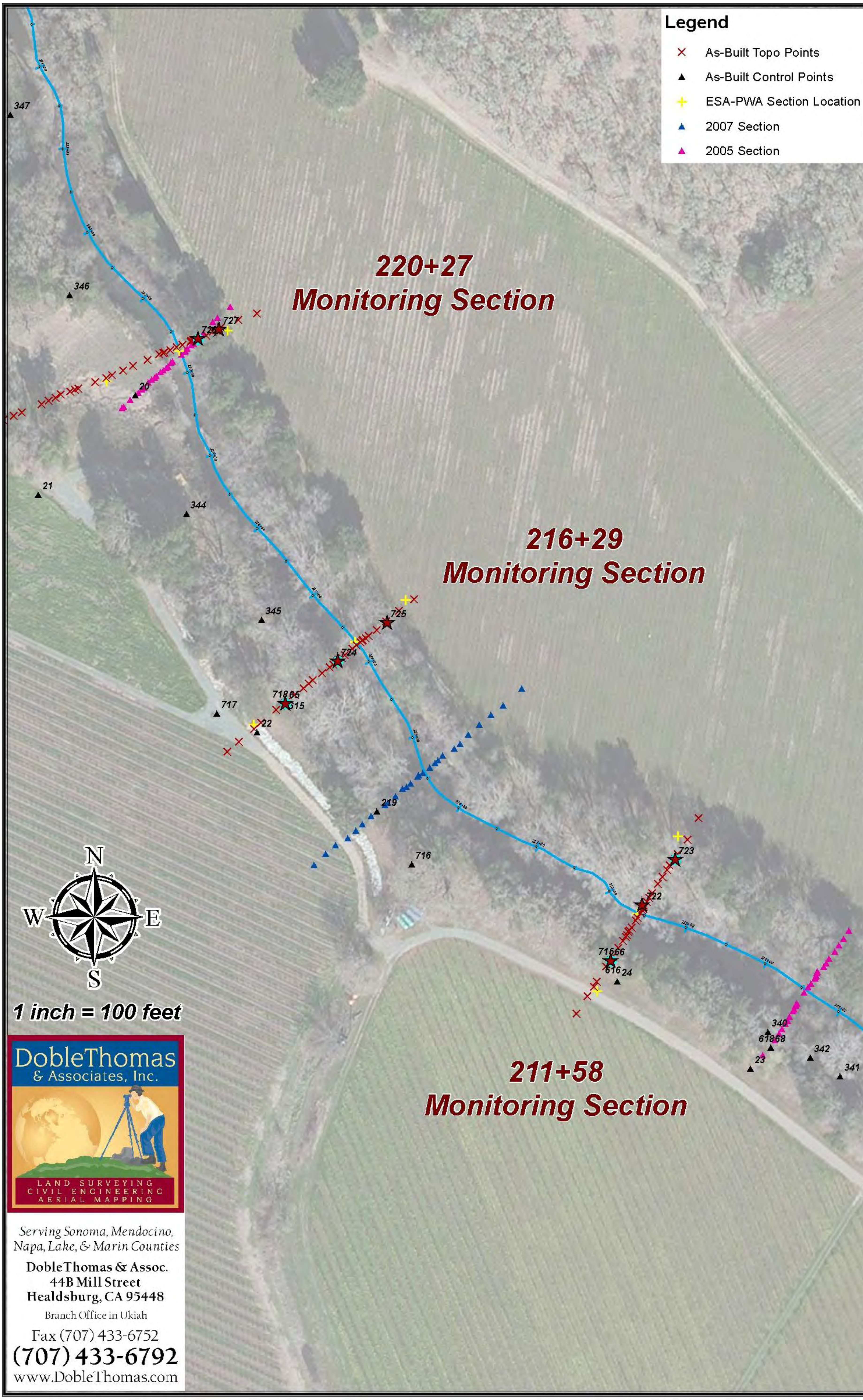
Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
220+27
Monitoring Section
216+29
Monitoring Section
211+58
Monitoring Section
347
346
20
21
344
345
717
22
219
716
727
725
724
723
722
24
340
342
341
23
N
S
W
E
1 inch = 100 feet
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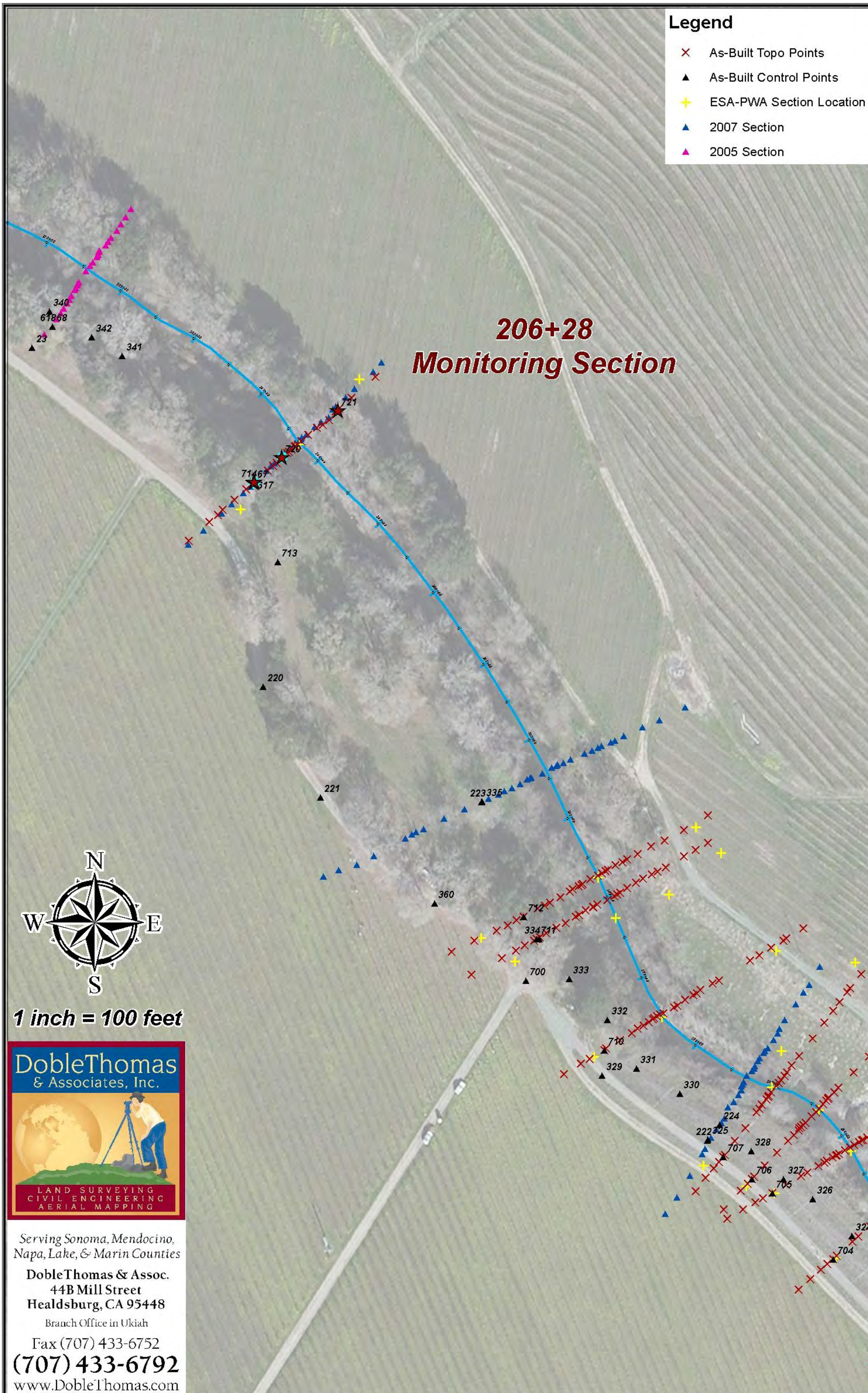

Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
206+28
Monitoring Section
N
S
E
W
1 inch = 100 feet
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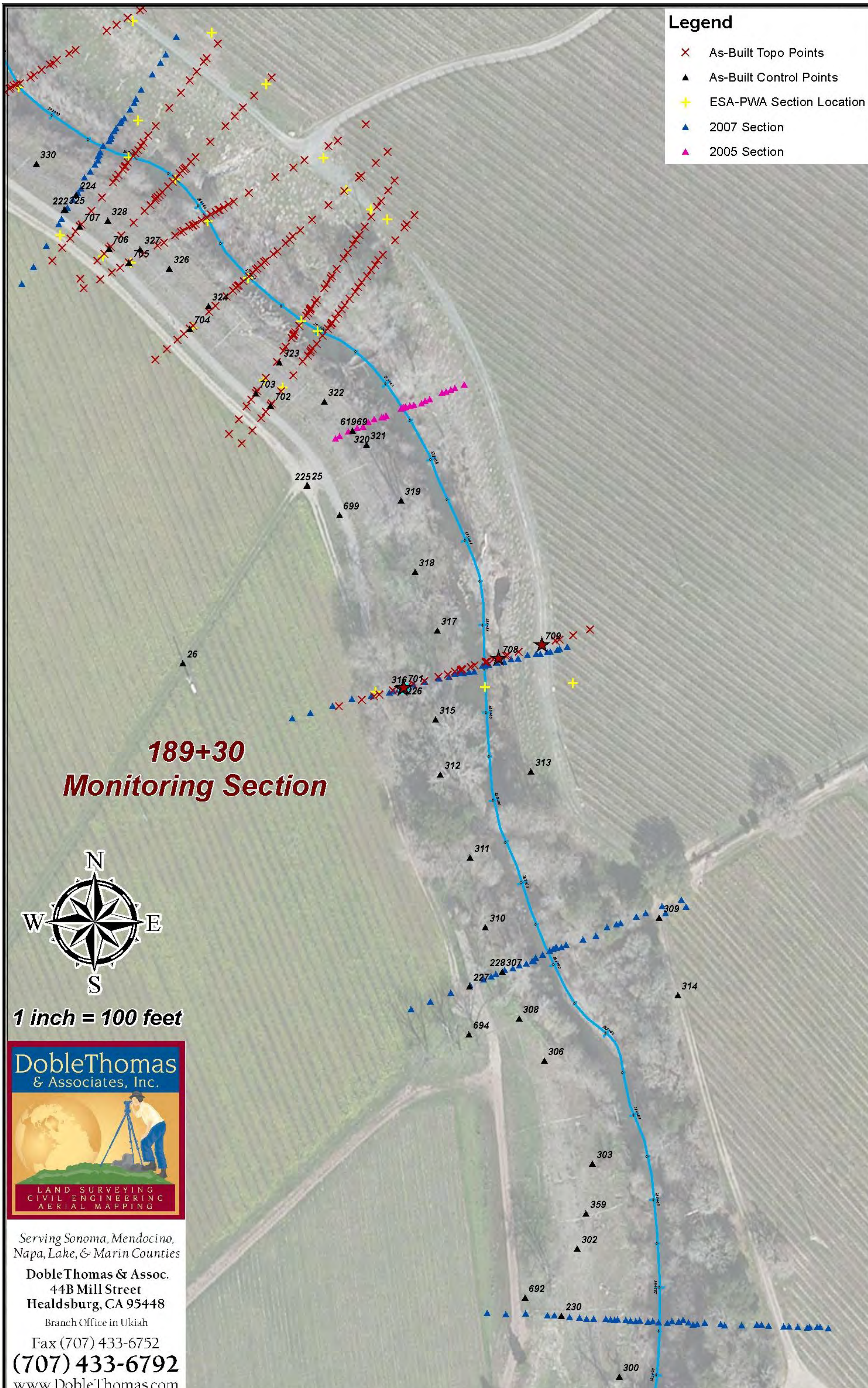
Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
189+30
Monitoring Section
N
S
E
W
1 inch = 100 feet
330
224
222325
707
328
706
327
705
326
324
704
323
703
702
322
61969
320
321
22525
699
319
318
317
26
709
708
316701
226
315
313
312
311
310
309
228307
227
314
308
694
306
303
359
302
692
230
300
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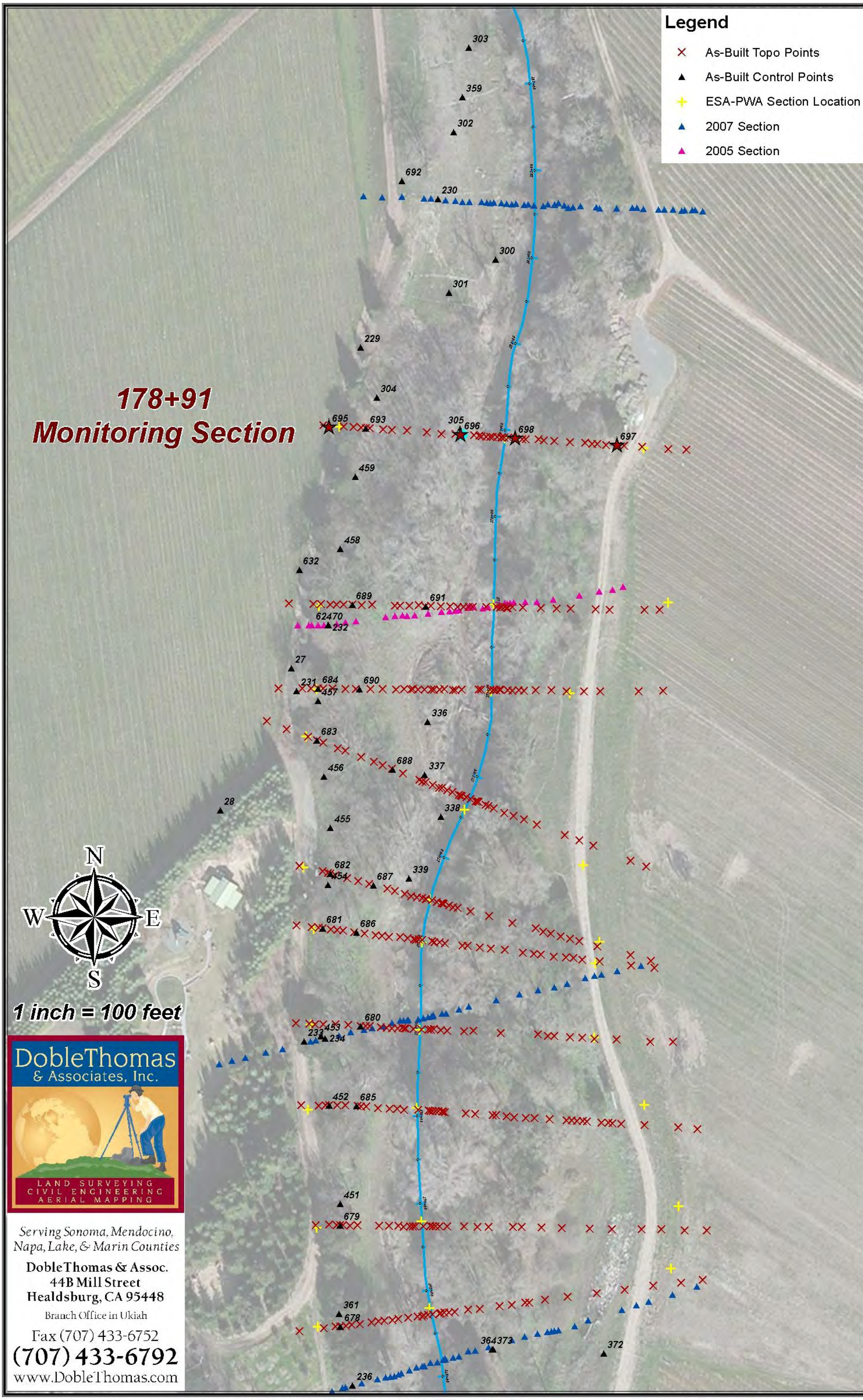
Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
178+91
Monitoring Section
N
S
E
W
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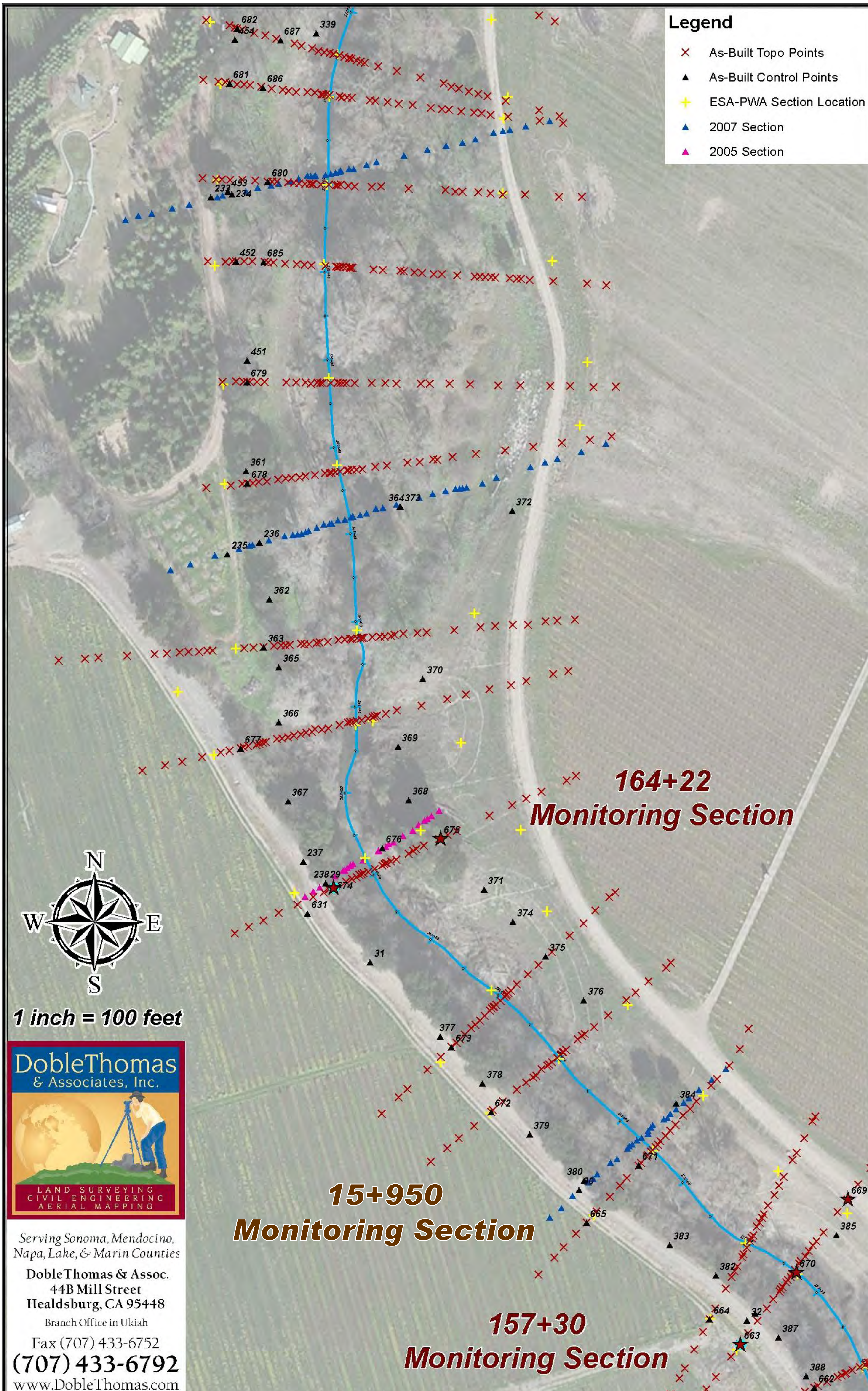

Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
164+22
Monitoring Section
15+950
Monitoring Section
157+30
Monitoring Section
N
E
S
W
1 inch = 100 feet
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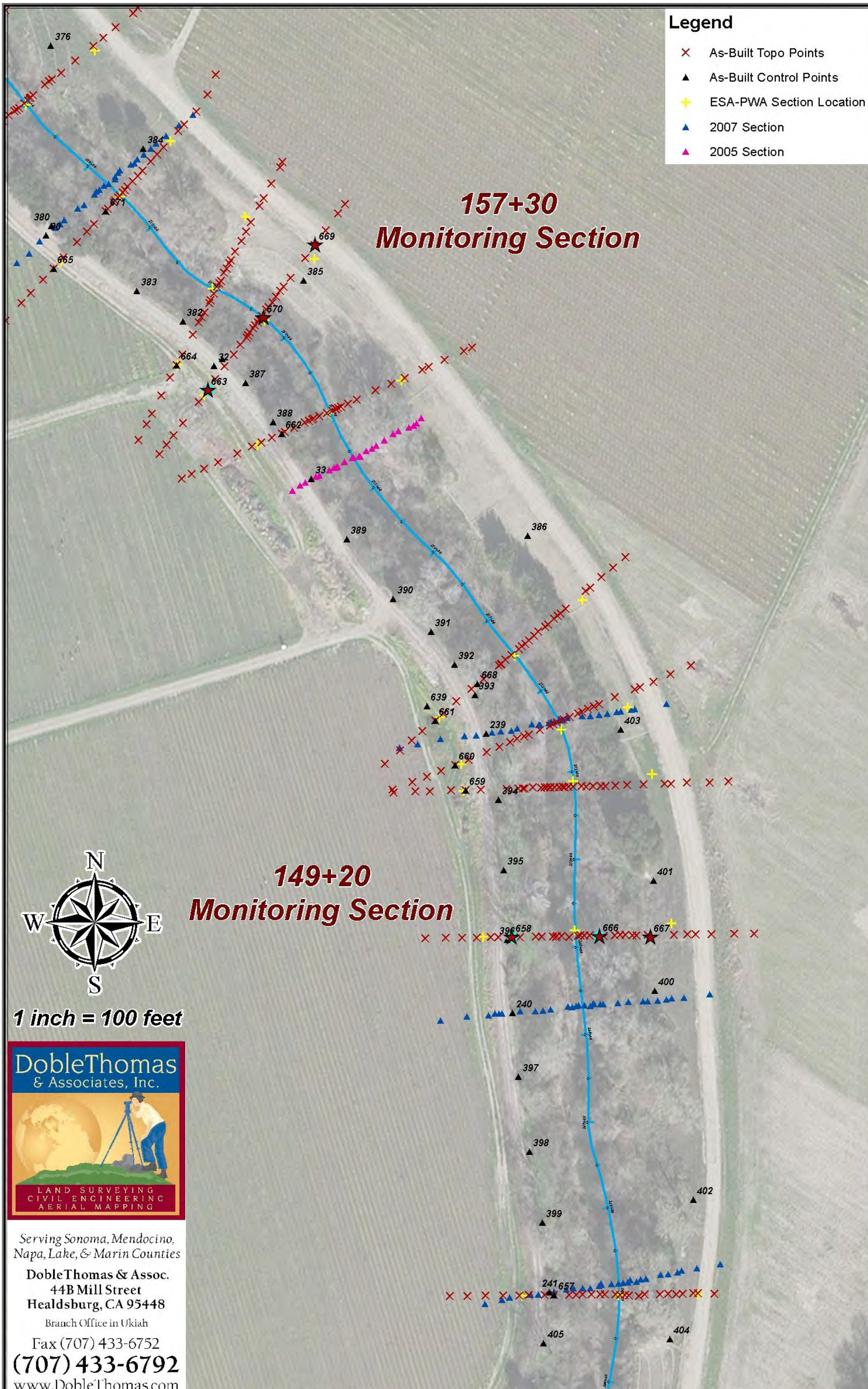

Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
157+30
Monitoring Section
149+20
Monitoring Section
N
W
E
S
1 inch = 100 feet
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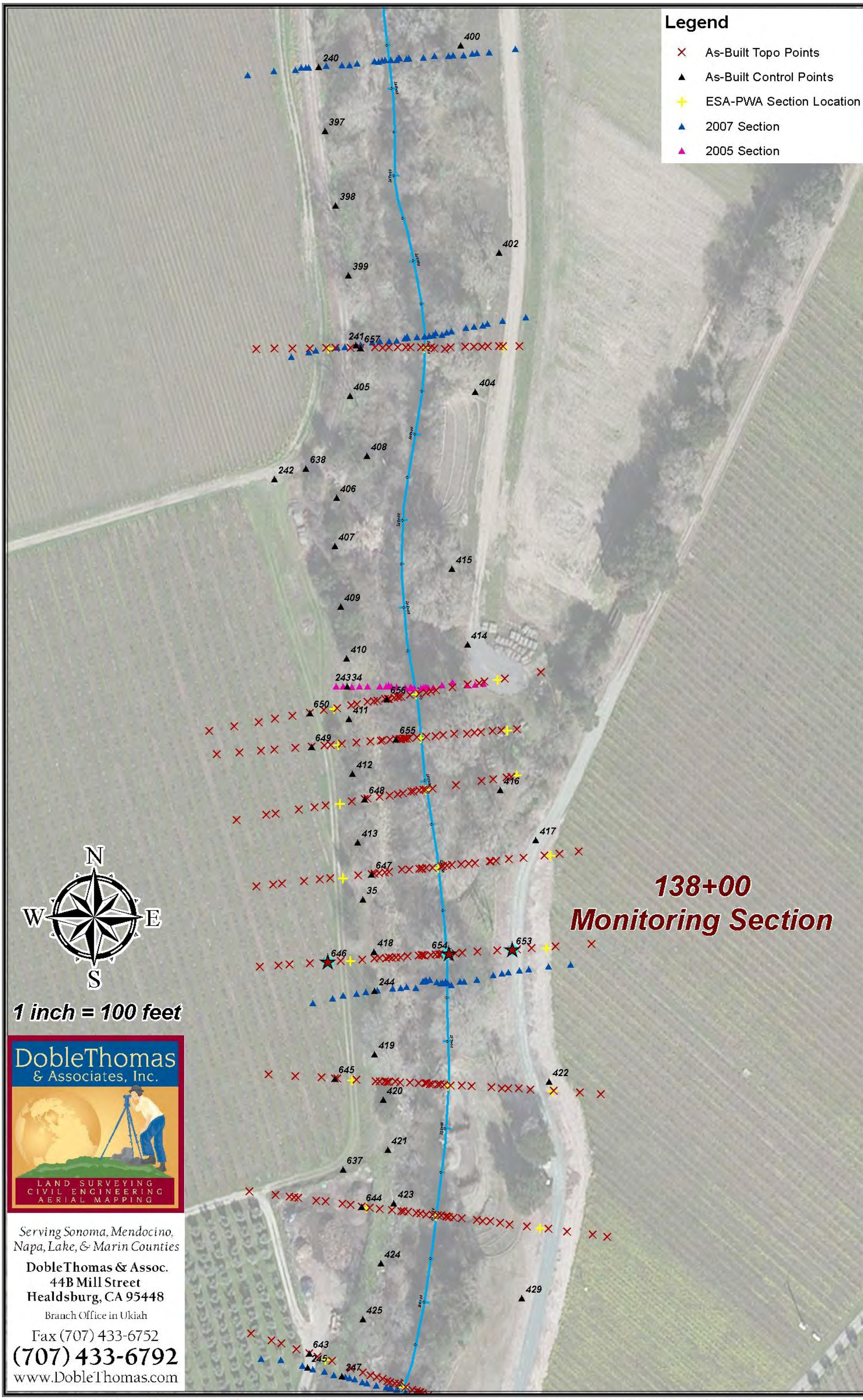
Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
138+00
Monitoring Section
N
S
E
W
1 inch = 100 feet
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400
240
397
398
402
399
241
657
405
404
408
638
242
406
407
415
409
414
410
24334
656
650
411
655
649
412
416
648
413
417
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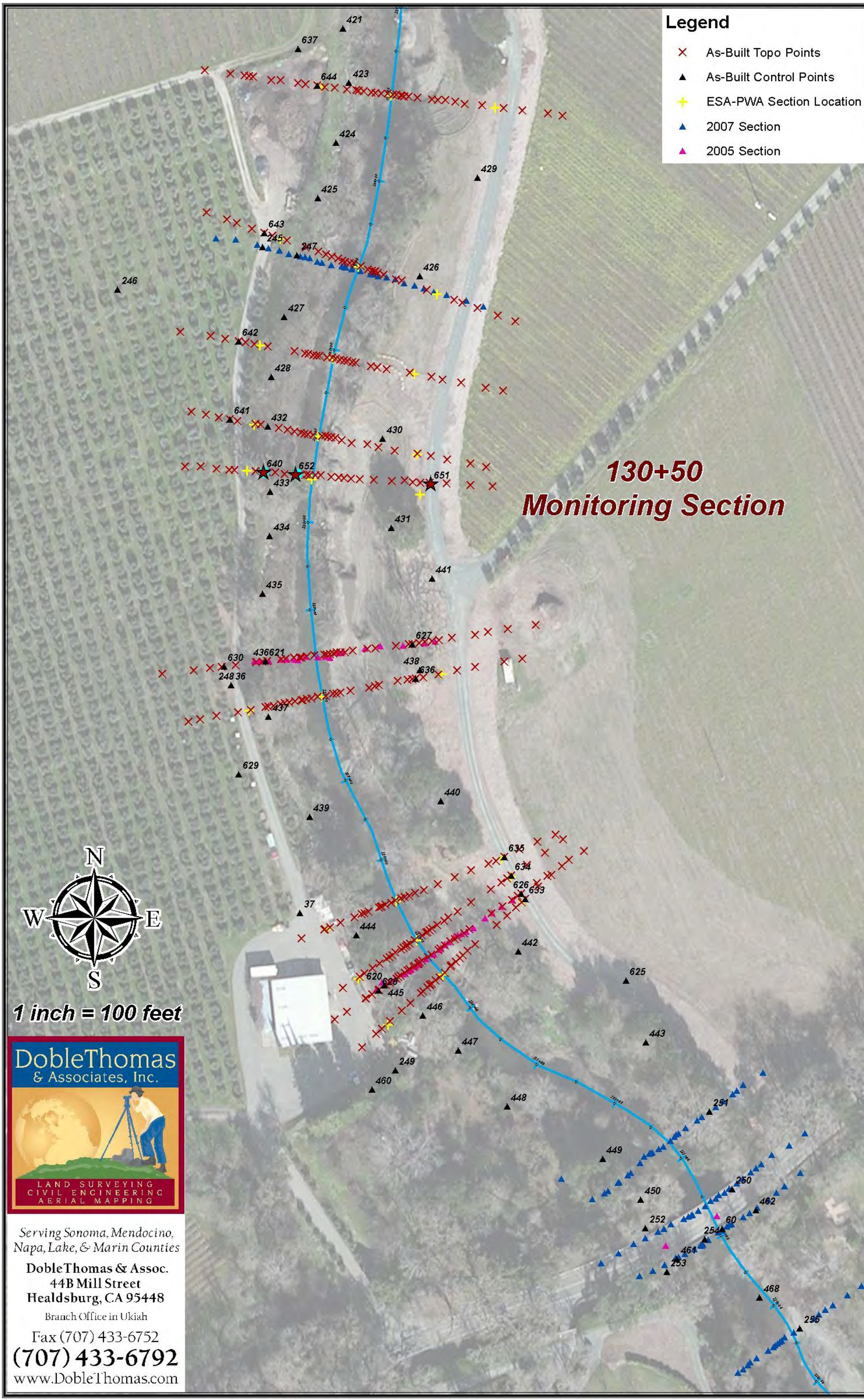
429
425
643
245
247


Legend
As-Built Topo Points
As-Built Control Points
ESA-PWA Section Location
2007 Section
2005 Section
130+50
Monitoring Section
N
W
E
S
1 inch = 100 feet
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VI. Pebble Counts

Pebble Counts

Pebble counts are taken concurrently with survey cross sections, which are located on riffle crests. Cross sections surveyed pre- and post-restoration construction, and are located in control and graded portions of each restoration reach. In addition to being used for hydraulic modeling for sediment transport, long term trends in particle count data can demonstrate transport of sediment through the system in response to flow events, and channel alterations, such as widening due to restoration.

Two sets of pebble count data provide the baseline for channel substrate conditions prior to the restoration construction. In 2004, pebble counts were performed at ten (10) long term monitoring cross sections in the Project reach. Pebble count data was taken at nine (11) additional locations in 2005 as part of the initial technical studies for the Project performed by ICF Jones & Stokes. Prior to the start of Project construction, in 2009, all of the ten (10) cross sections surveyed in 2004 were reoccupied to measure the change in channel substrate conditions following the 18,300 cfs peak flood event on December 31, 2005, the largest flood event ever measured since record keeping began in 1929. As the final design phases progressed, additional monitoring cross section locations were established, and associated pebble counts were conducted, in control and treatment locations in 2010, and 2011. In 2012, the Napa County Resource Conservation District also preformed pebble counts associated with embeddedness studies conducted at the 2004 cross section monitoring locations.

Following construction of 60% of the Project in Reaches 1-4, and the middle portion of Reach 8, two large channel filling flow events occurred two weeks apart in December 2012. At 9,698 cfs and 9,260 cfs, the December 23rd and December 12, 2012 floods respectively, were the 18th and 21st largest peak flood events in 80 years of recorded data.

In fall 2013, a total of thirty one (31) riffle crests were sampled to re-establish a baseline data set more evenly distributed throughout the Project reach. In October 2013, pebble counts were conducted at (29) riffle crests, the majority of which constituted re-occupation of riffle crests that had been surveyed at least once since 2004. Additional riffle crest locations were sampled where cross section survey data was available. Two riffles in Reach 9 were sampled on December 31, 2013. The 2013 data can be used to compare changes in channel substrate before and after the 2005, and following the 2012 flood events in restored versus unrestored reaches of the Project. Five riffle crests were sampled where the channel had been widened to create an inset floodplain bench in Reach 4 at river stations 15,950, 14,985, 13,800, 13,050 and in Reach 8 at river station 6,750.

The widening of the channel at restoration sites also appears to be a contributing factor to the coarsening of the channel cross section, and the reduction of fines in riffle crests throughout the Project reach. Comparison Pebble counts taken before and after the 2005 flood in 2004 and 2005, and again in 2008 and 2009, showed no discernible trend in median particle size D50 in the highly confined section of the river in Reaches 1-4 upstream of the Rutherford Cross Road. Downstream of the Rutherford Cross Road, in Reach 5-9, the D50 generally increased, indicating a slight coursing of the stream channel. Comparison of the D84 particle size, which is utilized to model sediment transport, pre- and post- flood, showed an overall coarsening of the channel in all reaches from 2004 to 2009.

Pebble count data take in 2012 demonstrates that the channel substrate in the restored Reaches 1-4 upstream of the Rutherford Cross Road became generally more fine compared to 2008 – 2011, whereas sampled locations in Reaches 5-9 were the same or coarser than prior to the 2012 flood flow events. In the three locations sampled where the channel was widened at stations 15,950 and 13,050 and 6,750, however, the riffle crest in the low flow channel remained the same or coarser, whether or not the overall cross section had become relatively finer in comparison to conditions in 2008 - 2011. This is because the fine sediment (<2 mm) is deposited non-uniformly across the cross section, with a greater proportion settling out in the slower velocity areas on the adjacent flood plain benches.

The pebble count data from 2013, however, demonstrates that the majority of the riffle crests at the eleven longterm monitoring cross sections throughout the Project in Reaches 1-9 are now coarser than they were in 2004. The D50 at 9 out of 11 of the monitoring cross sections surveyed in 2004 prior to the 2005 flood are coarser. Of the two that were finer in 2013 versus 2004, one is in the control site in Reach 3 at river station 17,891 where no channel widening occurred. The other is at river station 15,950 where the channel was widened in Reach 4 at Emmolo Bench 6. Whereas the new overall channel cross section is finer at the restored cross section 15,950 (2013 D50 = 11 vs. 2004 D50 = 16), the riffle crests in the low flow channel is coarser (2013 D50=22), and the newly created inset floodplain bench is significantly finer (D50 = 2). This further validates the field observations of differential sorting of channel substrate in the channel and on the constructed instream benches. The riffle crests in the low flow channel are dominated by gravel that is coarser than in 2004, and sand is accumulating in dunes on the floodplain benches.

The data on distribution of fines (sand and silt particles less than 2mm median diameter) at each monitoring cross section further validates the field observations that, where the channel has been widened to create slow water depositional areas, a larger percentage of sand is accumulating on the floodplains relative to the adjacent riffle crests. No data on percent fines is available for the cross sections from before the 2005 flood. A comparison of data from before and after the December 2012 flood events, shows that the percentage of fines generally increased in the newly restored Reaches 3 and 4, and decreased or stayed the same in the remaining including the restored section of Reach 8. The increase in percentage of fines on riffles in Reaches 3 and 4 in 2012 relative to 2011 may be attributable to a number of possible factors including a pulse of sediment delivered by the 2012 floods that previously would have been washed out of Reaches 3-4 when the channel was narrower and sustained higher velocity flows; local recruitment of fine sediment from newly graded areas where vegetation cover had not been fully established; or redistribution of fines from local channel bed scour that increased channel complexity, creating deep pools in previously glides.

Whereas the percentage of fines increased overall in Reaches 3-4, the percentage of fines in the riffle crest where the channel bed was widened decreased. The percent of fines increased the same two cross sections in Reach 3 and 4 discussed above, at river stations 17,891 and 15,950, and also at the control cross section at river station 16,422 between Carpy Bench 4 and 5 in Reach 4. Where the river channel had been widened at station 15,950 Emmolo Bench 6, however, as above, the riffle in the low flow channel had a large decrease in fines relative to the pre-widened channel (4% vs 15%), and the adjacent area on the new floodplain bench had more than twice as many percent fines as the pre-widened channel (46% vs. 15%). In Reach 8, where the secondary channel had been created across from the bank stabilization at Sequoia Grove, the percentage of fines decreased, and there was no discernible difference in the percent of fines in the channel relative to the adjacent bar.

Gravel Bar Formation

The widening of the channel at restoration sites also appears to be a contributing factor to the formation of new gravel bars, creating greater complexity in the channel. Comparison of pebble counts taken at monitoring cross sections in 2009 and 2011 pre- and post- construction of Phase 2: Reach 3 in 2010 demonstrate that a new gravel bar formed at river station 16,300 on the east bank opposite Carpy-Conolly Bench 5. The gravel bar that was sampled in 2009 at station 16,422 prior to construction of Carpy-Conolly Bench 4, constructed from east bank river stations 16,725-16,475, and Carpy-Conolly Bench 5, constructed from east bank river stations 16,350-16,100, no longer existed in 2011. It is likely that the widening of the channel at Bench 5 slowed velocities sufficiently to cause the gravel that was mobilized from the bar between the two benches 122 feet upstream, where the channel width was unchanged, to deposit as a new bar.

16,200-16,300 New Gravel Bar 2011

Sampling of the new downstream bar in 2011, which set up on the opposite west bank, shows that the median grain size increased from D50=16mm to D50=32mm, and the D84 increased from 32mm to 45mm following the 2011 peak flow event of 7,330 cfs. Significantly, not only did the gravel bed coarsen from 2009, but the percentage of fines in the new bar decreased from 17% to 1% of the sample. The reduction of fines in the gravel might be attributed to the fact that sand and finer sediments can now escape the incised low flow channel and deposit on the restored benches at relatively low flows (less than a 10 year recurrence interval). The sandbar, which accumulated on the new east bank Carpy-Conolly Bench 5, provides further evidence of this hypothesis that instream bench creation in serving to reduce the percent of fines in spawning gravel.

A new gravel bar also formed at station 13,050 on the east bank in 2012 following construction of Phase 3: Reach 4 East Bank Honig Bench 13 between stations 13,150-12,725 in 2011. The gravel in the bar was coarser and contained a lower percentage of fines than the gravel which existed previously in the glide that existed in the reach prior to restoration of the bench. Following the peak flow event of 7,330 in 2011, comparison of pebble counts from 2010 and 2011 show a coarsening of the bar at station 13,050, with an increase in the D50 from 11mm to 22mm, and an increase in the D84 from 32mm to 45mm. The percentage of fines in gravel on the bar decreased markedly from 30% to 2%. Like Bench 5 upstream, the new Honig Bench 13 on the east bank had also accumulated sand.

13,050 Glide Pre-Restoration 2011

13,050 Bar Post-East Bank Bench Construction 2012

Pebble Count Data 2013

River Reaches 1 - 3 Restoration Construction Completed 2009 - 2010

Cross Section	(<2 mm)	D50 Size Class	D84 Size Class	D90 Size Class	D50 Actual	D84 Actual	D90 Actual	DATE
River Station	%	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	mm/dd/yyyy
24,020	17	22	45	45	27	47	61	10/31/2013
23,796	3	16	32	32	20	39	45	10/31/2013
22,925	10	22	45	45	26	61	64	10/31/2013
22,589	8	22	45	45	30	54	64	10/31/2013
22,339	14	16	32	32	19	38	41	10/31/2013
22,027	28	6	16	22	6	19	25	10/17/2013
21,960	21	16	32	45	17	38	52	10/17/2013
21,629	17	16	45	45	16	47	63	10/17/2013
21,158	4	22	45	45	27	52	62	10/17/2013
20,534	6	22	45	45	29	51	62	10/17/2013
17,891	16	22	45	64	28	58	66	10/13/2013
16,422	45	2	8	16	3	11	17	10/12/2013

Pebble Count Data 2013

River Reach 4 Restoration Construction Completed 2011 - 2012

Cross Section	(<2 mm)	D50 Size Class	D84 Size Class	D90 Size Class	D50 Actual	D84 Actual	D90 Actual	DATE
River Station	(%)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm/dd/yyyy)
15,950	25	11	32	32	13	36	43	10/18/2013
Low Flow Channel	4	22	45	45	29	48	63	10/18/2013
Floodplain Bench	46	2	11	16	3	14	18	10/18/2013
15,730	37	8	22	32	10	27	36	10/18/2013
14,985	10	16	32	32	17	35	39	10/23/2013
Low Flow Channel	6	11	22	22	13	23	25	10/23/2013
Floodplain Bench	15	16	32	45	20	39	46	10/23/2013
14,920	45	4	11	16	4	14	21	10/23/2013
13,800	23	16	45	45	16	45	53	10/23/2013
Low Flow Channel	4	22	45	45	26	50	53	10/23/2013
Floodplain Bench	11	6	32	32	7	39	45	10/23/2013
13,100	8	22	32	45	24	44	51	10/23/2013
13,050	43	4	32	45	5	35	48	10/23/2013
Low Flow Channel	12	22	45	64	25	54	72	10/23/2013
Floodplain Bench	71	1	6	8	1	6	8	10/23/2013

Pebble Count Data 2013

River Reaches 5-9: Restoration Construction Completed in Reach 8 North Stations 7,800 - 6,400 in 2012

Cross Section	(<2 mm)	D50 Size Class	D84 Size Class	D90 Size Class	D50 Actual	D84 Actual	D90 Actual	DATE
River Station	(%)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm/dd/yyyy)
8,830	8	16	22	32	18	32	36	10/25/2013
8,630	12	16	32	45	17	38	52	10/25/2013
8,280	11	8	22	32	9	24	28	10/25/2013
7,830	12	16	32	45	20	42	50	10/25/2013
7,700	13	11	22	22	12	26	32	10/25/2013
6,750	19	11	32	32	14	34	42	10/24/2013
Low Flow Channel	18	11	22	32	12	30	39	10/24/2013
Floodplain Bench	20	11	32	32	15	37	44	10/24/2013
6,100	42	2	8	11	4	10	12	10/24/2013
6,050	10	22	45	45	24	48	60	10/24/2013
4,450	8	16	32	32	21	42	44	10/24/2013
3,450	15	16	32	45	21	44	59	10/24/2013
3,328	12	16	32	32	20	33	40	10/24/2013
2,390	3	16	32	32	20	42	40	12/31/2013
1,515	19	22	32	45	23	43	54	12/31/2013

D50 Particle Size Class (mm)

PROJECT REACH	1 & 2												3					
RIVER STATION	24,020	23,796	22,925	22,589	22,339	22,027	21,960	21,629	21,158	20,628	20,534	18,930	17,891	17,120	17,000	16,422	16,300	15,950
2004	-	-	-	-	-	-	-	8	16	16	-	-	-	-	-	-	-	16
3,890 cfs 22-Mar-2005																		
2005	-	-	-	-	-	-	-	-	-	-	-	-	45	-	16	-	-	-
18,300 cfs 31-Dec-2005																		
1,350 cfs 26-Dec-2006																		
4,460 cfs 4-Jan-2008																		
2008	-	-	-	-	-	11	-	22	11	22	-	22	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																		
2009	-	-	-	-	-	-	-				-	-	45		-	16	-	22
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	Coarser	Finer	Coarser	-	-	Same	-	-	-	-	Coarser
CONSTRUCTION 2009																		
3,740 cfs 20-Jan-2010																		
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																		
7,330 cfs 20-Mar-2011																		
2011	-	-	-	-	-	No Bar	-	22	32	16	-	-	-	32	-	No Bar	32	16
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	Same	Coarser	Finer	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																		
2,050 Cfs 14-Mar-2012																		
CONSTRUCTION 2012																		
9,260 cfs 2-Dec-2012																		
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																		
2013	22	16	22	22	16	6	16	16	22	-	22	-	22	-	-	2	-	11 22 CH / 2 Bench
POST 9698 cfs & 9,260 cfs CHANGE	-	-	-	-	-	Finer	-	Finer	Finer	Beaver Dam	Coarser	-	-	-	-	Finer	-	Finer Coarser Channel / Much Finer New Bench
CONSTRUCTION 2013																		
? cfs 2014																		
CONSTRUCTION 2014																		
? cfs 2014-2015																		
2004/2005 - 2013 CHANGE	-	-	-	-	-	-	-	Coarser	Coarser	Beaver Dam	Coarser	-	Finer	-	-	-	-	Finer Coarser Channel / Much Finer New Bench

D50 Particle Size Class (mm)

PROJECT REACH	4							5	6	7						
RIVER STATION	15,730	14,985	14,920	13,800	13,100	13,050	12,060	11,800	9,500	8,830	8,630	8,280	8,170	7,830	7,700	7,610
2004	8	-	-	-	-	-	-	-	-	16	8	8	-	8	8	-
3,890 cfs 22-Mar-2005																
2005	-	-	-	-	-	-	16	16	16	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																
1,350 cfs 26-Dec-2006																
4,460 cfs 4-Jan-2008																
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																
2009	4	-	-	-	-	-	-	-	-	11	16	16	-	22	8	-
POST 18,300 cfs CHANGE	Finer	-	-	-	-		-	-	-	Finer	Coarser	Coarser	-	Coarser	Same	-
CONSTRUCTION 2009																
3,740 cfs 20-Jan-2010																
2010	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																
7,330 cfs 20-Mar-2011																
2011	-	-	16	-	-	22	-	-	-	11	-	-	-	-	16	-
POST 7,330 cfs CHANGE	-	-	-	-	-	Coarser	-	-	-	Same	-	-	-	-	Coarser	-
CONSTRUCTION 2011																
2,050 Cfs 14-Mar-2012																
CONSTRUCTION 2012																
9,260 cfs 2-Dec-2012																
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	22	-	-	22	16	-	16
9,698 cfs 23-Dec-2012																
2013	8	16 11 CH / 16 Floodplain	4	16 22 CH / 6 Bench	22	4 22 CH / 1 Bench	-	-	-	16	16	8	-	16	11	-
POST 9698 cfs & 9,260 cfs CHANGE	-	- - / -	Finer	- - / -	-	Finer Same Channel / Much Finer New Bench	-	-	-	Coarser	-	-	-	-	Finer	-
CONSTRUCTION 2013																
? cfs 2014																
CONSTRUCTION 2014																
? cfs 2014-2015																
2004/2005 - 2013 CHANGE	Coarser	- - / -	-	- - / -	- -	- - / -	-	-	-	Same	Coarser	Same	-	Coarser	Coarser	-

D50 Particle Size Class (mm)

PROJECT REACH	8												9				
RIVER STATION	7,300	7,270	6,750	6,100	6,050	5,050	4,930	4,560	4,450	4,220	3,880	3,450	3,328	2,850	2,390	1,515	1,250
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																	
2005	22	-	-	-	-	16	-	-	-	-	-	-	-	11		-	8
18,300 cfs 31-Dec-2005																	
1,350 cfs 26-Dec-2006																	
4,460 cfs 4-Jan-2008																	
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																	
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2009																	
3,740 cfs 20-Jan-2010																	
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																	
7,330 cfs 20-Mar-2011																	
2011	-	-	11	-	16	-	-	-	16	-	-	16	-	-	-	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																	
2,050 Cfs 14-Mar-2012																	
CONSTRUCTION 2012																	
9,260 cfs 2-Dec-2012																	
2012 (RCD / Stillwater TMDL)	-	11	-	-	-	-	22	11	11	11	16	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																	
2013	-	-	11 11 / 11	2	22	-	-	-	16	-	-	16	16	-	16	22	-
POST 9698 cfs & 9,260 cfs CHANGE	-	-	Same Same Channel / Same LB Bench/CH	-	Coarser	-	-	-	Same	-	-	Same	-	-	-	-	-
CONSTRUCTION 2013																	
? cfs 2014																	
CONSTRUCTION 2014																	
? cfs 2014-2015																	
2004/2005 - 2013 CHANGE	-	-	- - / -	-	-	-	-	-	-	-	-	-	-	-	-	-	-

D84 Particle Size Class (mm)

PROJECT REACH	1 & 2												3					
RIVER STATION	24,020	23,796	22,925	22,589	22,339	22,027	21,960	21,629	21,158	20,628	20,534	18,930	17,891	17,120	17,000	16,422	16,300	15,950
2004	-	-	-	-	-	-	-	32	32	32	-	-	-	-	-	-	-	32
3,890 cfs 22-Mar-2005																		
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																		
1,350 cfs 26-Dec-2006																		
4,460 cfs 4-Jan-2008																		
2008	-	-	-	-	-	32	-	45	45	45	-	45	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																		
2009	-	-	-	-	-	-	-				-	-	90		-	32	-	45
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	Coarser	Coarser	Coarser	-	-	-	-	-	-	-	Coarser
CONSTRUCTION 2009																		
3,740 cfs 20-Jan-2010																		
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																		
7,330 cfs 20-Mar-2011																		
2011	-	-	-	-	-	No Bar	-	45	45	32	-	-	-	45	-	No Bar	45	32
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	Same	Same	Finer	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																		
2,050 Cfs 14-Mar-2012																		
CONSTRUCTION 2012																		
9,260 cfs 2-Dec-2012																		
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																		
2013	45	32	45	45	32	16	32	45	45	-	45	-	45	-	-	8	-	32 (45 CH / 11 Bench)
POST 9698 cfs & 9,260 cfs CHANGE	-	-	-	-	-	Finer	-	Same	Same	Beaver Dam	Coarser	-	-	-	-	Much Finer	-	Same (Coarser Channel / Finer Bench)
CONSTRUCTION 2013																		
? cfs 2014																		
CONSTRUCTION 2014																		
? cfs 2014-2015																		
2004/2005 - 2013 CHANGE	-	-	-	-	-	-	-	Coarser	Coarser	-	Coarser	-	-	-	-	-	-	Same (Coarser Channel / Finer Bench)

D84 Particle Size Class (mm)

PROJECT REACH	4										5	6	7						
RIVER STATION	15,730	14,985		14,920	13,800		13,100	13,050		12,060	11,800	9,500	8,830	8,630	8,280	8,170	7,830	7,700	7,610
2004	32	-		-	-		-	-		-	-	-	32	32	16	-	16	16	-
3,890 cfs 22-Mar-2005																			
2005	-	-		-	-		-	-		-	-	-	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																			
1,350 cfs 26-Dec-2006																			
4,460 cfs 4-Jan-2008																			
2008	-	-		-	-		-	-		-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																			
2009	11	-		-	-		-	-		-	-	-	32	32	32	-	45	22	-
POST 18,300 cfs CHANGE	Finer	-		-	-		-			-	-	-	Same	Same	Coarser	-	Coarser	Coarser	-
CONSTRUCTION 2009																			
3,740 cfs 20-Jan-2010																			
2010	-	-		-	-		-	32		-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																			
7,330 cfs 20-Mar-2011																			
2011	-	-		32	-		-	45		-	-	-	32	-	-	-	-	32	-
POST 7,330 cfs CHANGE	-	-		-	-		-	Coarser		-	-	-	Same	-	-	-	-	Same	-
CONSTRUCTION 2011																			
2,050 Cfs 14-Mar-2012																			
CONSTRUCTION 2012																			
9,260 cfs 2-Dec-2012																			
2012 (RCD / Stillwater TMDL)	-	-		-	-		-	-		-	-	-	45	-	-	45	32	-	32
9,698 cfs 23-Dec-2012																			
2013	22	32		11	45		32	32		-	-	-	22	22	22	-	32	22	
		22 CH	32 Floodplain		45 CH	32 Bench		45 CH	6 Bench										
POST 9698 cfs & 9,260 cfs CHANGE	-			Finer			-	Finer		-	-	-	Finer	-	-	-	-	Finer	-
		-	-		-	-		Coarser Channel	Much Finer New Bench										
CONSTRUCTION 2013																			
? cfs 2014																			
CONSTRUCTION 2014																			
? cfs 2014-2015																			
2004/2005 - 2013 CHANGE	Finer	-		-	-		-	-		-	-	-	Finer	Finer	Coarser	-	Coarser	Coarser	-
		-	-		-	-	-	-	-										

D84 Particle Size Class (mm)

PROJECT REACH	8												9				
RIVER STATION	7,300	7,270	6,750	6,100	6,050	5,050	4,930	4,560	4,450	4,220	3,880	3,450	3,328	2,850	2,390	1,515	1,250
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																	
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
18,300 cfs 31-Dec-2005																	
1,350 cfs 26-Dec-2006																	
4,460 cfs 4-Jan-2008																	
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																	
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2009																	
3,740 cfs 20-Jan-2010																	
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																	
7,330 cfs 20-Mar-2011																	
2011	-	-	32	-	45	-	-	-	32	-	-	32	-	-	-	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																	
2,050 Cfs 14-Mar-2012																	
CONSTRUCTION 2012																	
9,260 cfs 2-Dec-2012																	
2012 (RCD / Stillwater TMDL)	-	22	-	-	-	-	45	22	22	22	32	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																	
2013	-	-	32 (22 CH / 32 Bench/CH)	8	45	-	-	-	32	-	-	32	32	-	32	32	-
POST 9698 cfs & 9,260 cfs CHANGE	-	-	Same (Finer Channel / Same LB Bench/CH)	-	Same	-	-	-	Same	-	-	Same	-	-	-	-	-
CONSTRUCTION 2013																	
? cfs 2014																	
CONSTRUCTION 2014																	
? cfs 2014-2015																	
2004/2005 - 2013 CHANGE	-	-	- (- / -)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Percent Fines (< 2mm)

PROJECT REACH	1 & 2												3					
RIVER STATION	24,020	23,796	22,925	22,589	22,339	22,027	21,960	21,629	21,158	20,628	20,534	18,930	17,891	17,120	17,000	16,422	16,300	15,950
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																		
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																		
1,350 cfs 26-Dec-2006																		
4,460 cfs 4-Jan-2008																		
2008	-	-	-	-	-	22	-	16	23	11	-	12	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																		
2009	-	-	-	-	-	-	-				-	-	8		-	17	-	15
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-				-	-		-	-	-	-	
CONSTRUCTION 2009																		
3,740 cfs 20-Jan-2010																		
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																		
7,330 cfs 20-Mar-2011																		
2011	-	-	-	-	-	No Bar	-	6	3	23	-	-	-	2	-	No Bar	1	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	Fewer	Much Fewer	More	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																		
2,050 Cfs 14-Mar-2012																		
CONSTRUCTION 2012																		
9,260 cfs 2-Dec-2012																		
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																		
2013	17	3	10	8	14	28	21	17	4	-	6	-	16	-	-	45	-	25 (4 CH / 46 Bench)
POST 9698 cfs & 9,260 cfs CHANGE	-	-	-	-	-	Same	-	More	Same	-	-	-	-	-	-	More	-	- / -
CONSTRUCTION 2013																		
? cfs 2014																		
CONSTRUCTION 2014																		
? cfs 2014-2015																		
2008/2009 - 2013 CHANGE (No 2004-2005 Data on % Fines)	-	-	-	-	-	-	-	Same Fines	Much Fewer Fines	-	-	-	More Fines	-	-	More Fines	-	More Fines (Much Fewer CH / Much More Fines Bench)

Percent Fines (< 2mm)

PROJECT REACH	4							5	6	7						
RIVER STATION	15,730	14,985	14,920	13,800	13,100	13,050	12,060	11,800	9,500	8,830	8,630	8,280	8,170	7,830	7,700	7,610
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																
1,350 cfs 26-Dec-2006																
4,460 cfs 4-Jan-2008																
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																
2009	42	-	-	-	-	-	-	-	-	21	18	16	-	20	39	-
POST 18,300 cfs CHANGE		-	-	-	-		-	-	-				-			-
CONSTRUCTION 2009																
3,740 cfs 20-Jan-2010																
2010	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																
7,330 cfs 20-Mar-2011																
2011	-	-	4	-	-	2	-	-	-	21	-	-	-	-	12	-
POST 7,330 cfs CHANGE	-	-	-	-	-	Much Fewer	-	-	-	Same	-	-	-	-	Fewer	-
CONSTRUCTION 2011																
2,050 Cfs 14-Mar-2012																
CONSTRUCTION 2012																
9,260 cfs 2-Dec-2012																
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	0	-	-	0	1	-	0
9,698 cfs 23-Dec-2012																
2013	37	10 (6 CH; 15 Floodplain)	45	23 (4 CH; 11 Bench)	8	43 (12 CH; 71 Bench)	-	-	-	8	12	11	-	12	13	
POST 9698 cfs & 9,260 cfs CHANGE	-	(-; -)	Much More	(-; -)	-	Much More (Much More Channel; Much More Bench)	-	-	-	Fewer	-	-	-	-	Same	-
CONSTRUCTION 2013																
? cfs 2014																
CONSTRUCTION 2014																
? cfs 2014-2015																
2008/2009 - 2013 CHANGE (No 2004-2005 Data on % Fines)	Fewer Fines	- (-; -)	-	- (-; -)	-	- (-; -)	-	-	-	Fewer Fines	Fewer Fines	Fewer Fines	-	Fewer Fines	Fewer Fines	-

Percent Fines (< 2mm)

PROJECT REACH	8												9				
RIVER STATION	7,300	7,270	6,750	6,100	6,050	5,050	4,930	4,560	4,450	4,220	3,880	3,450	3,328	2,850	2,390	1,515	1,250
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																	
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
18,300 cfs 31-Dec-2005																	
1,350 cfs 26-Dec-2006																	
4,460 cfs 4-Jan-2008																	
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																	
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2009																	
3,740 cfs 20-Jan-2010																	
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																	
7,330 cfs 20-Mar-2011																	
2011	-	-	27	-	13	-	-	-	6	-	-	14	-	-	-	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																	
2,050 Cfs 14-Mar-2012																	
CONSTRUCTION 2012																	
9,260 cfs 2-Dec-2012																	
2012 (RCD / Stillwater TMDL)	-	0	-	-	-	-	0	0	1	0	0	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																	
2013	-	-	19 18 CH / 20 Bench/CH	42	10	-	-	-	8	-	-	15	12	-	3	19	-
POST 9698 cfs & 9,260 cfs CHANGE	-	-	Fewer Fewer Channel / Fewer Bench/CH	-	Same	-	-	-	More	-	-	Same	-	-	-	-	-
CONSTRUCTION 2013																	
? cfs 2014																	
CONSTRUCTION 2014																	
? cfs 2014-2015																	
2008/2009 - 2013 CHANGE (No 2004-2005 Data on % Fines)	-	-	- - / -	-	-	-	-	-	-	-	-	-	-	-	-	-	-

D90 Particle Size Class (mm)

PROJECT REACH	1 & 2												3					
RIVER STATION	24,020	23,796	22,925	22,589	22,339	22,027	21,960	21,629	21,158	20,628	20,534	18,930	17,891	17,120	17,000	16,422	16,300	15,950
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																		
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																		
1,350 cfs 26-Dec-2006																		
4,460 cfs 4-Jan-2008																		
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																		
2009	-	-	-	-	-	-	-				-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-				-	-		-	-	-	-	
CONSTRUCTION 2009																		
3,740 cfs 20-Jan-2010																		
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																		
7,330 cfs 20-Mar-2011																		
2011	-	-	-	-	-	No Bar	-	-	-	-	-	-	-	-	-	No Bar	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-				-	-	-	-	-	-	-	-
CONSTRUCTION 2011																		
2,050 Cfs 14-Mar-2012																		
CONSTRUCTION 2012																		
9,260 cfs 2-Dec-2012																		
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																		
2013	45	32	45	45	32	22	45	45	45	45	45	-	64	-	-	16	-	32 45 CH / 16 Bench
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	- - / -
CONSTRUCTION 2013																		
? cfs 2014																		
CONSTRUCTION 2014																		
? cfs 2014-2015																		
	-	-	-	-	-	-	-							-	-	-	-	

D90 Particle Size Class (mm)

PROJECT REACH	4							5	6	7						
RIVER STATION	15,730	14,985	14,920	13,800	13,100	13,050	12,060	11,800	9,500	8,830	8,630	8,280	8,170	7,830	7,700	7,610
2004	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	-
3,890 cfs 22-Mar-2005																
2005	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-
18,300 cfs 31-Dec-2005																
1,350 cfs 26-Dec-2006																
4,460 cfs 4-Jan-2008																
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE		-	-	-	-		-	-	-				-			-
CONSTRUCTION 2009																
3,740 cfs 20-Jan-2010																
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																
7,330 cfs 20-Mar-2011																
2011	-	-	-	-	-	- / -	-	-	-	-	-	-	-	-	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-		-	-	-		-	-	-	-		-
CONSTRUCTION 2011																
2,050 Cfs 14-Mar-2012																
CONSTRUCTION 2012																
9,260 cfs 2-Dec-2012																
2012 (RCD / Stillwater TMDL)	-	-	-	-	-	-	-	-	-	45	-	-	64	32	-	32
9,698 cfs 23-Dec-2012																
2013	32	32 22 CH / 45 Floodplain	16	45 45 CH / 32 Bench	45	45 64 CH / 8 Bench	-	-	-	32	45	32	-	45	22	-
	-	- - / -		- - / -	-	- Channel / Bench	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2013																
? cfs 2014																
CONSTRUCTION 2014																
? cfs 2014-2015																
		- - / -	-	- - / -	- / -	- - / -	-	-	-				-			-

D90 Particle Size Class (mm)

PROJECT REACH	8												9				
RIVER STATION	7,300	7,270	6,750	6,100	6,050	5,050	4,930	4,560	4,450	4,220	3,880	3,450	3,328	2,850	2,390	1,515	1,250
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,890 cfs 22-Mar-2005																	
2005	X	-	-	-	-	X	-	-	-	-	-	-	-	X		-	X
18,300 cfs 31-Dec-2005																	
1,350 cfs 26-Dec-2006																	
4,460 cfs 4-Jan-2008																	
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,800 cfs 22-Feb-2009																	
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 18,300 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2009																	
3,740 cfs 20-Jan-2010																	
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2010																	
7,330 cfs 20-Mar-2011																	
2011	-	-	- / -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POST 7,330 cfs CHANGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION 2011																	
2,050 Cfs 14-Mar-2012																	
CONSTRUCTION 2012																	
9,260 cfs 2-Dec-2012																	
2012 (RCD / Stillwater TMDL)	-	32	-	-	-	-	45	32	32	22	32	-	-	-	-	-	-
9,698 cfs 23-Dec-2012																	
2013	-	-	32 32 / 32	11	45	-	-	-	32	-	-	45	32	-	32	45	-
	-	-	- Channel / Bench/CH	-	-	-	-	-		-	-		-	-	-	-	-
CONSTRUCTION 2013																	
? cfs 2014																	
CONSTRUCTION 2014																	
? cfs 2014-2015																	
	-	-	- - / -	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pebble Count Data 2013

River Reaches 1 - 3 Restoration Construction Completed 2009 - 2010

Cross Section	(<2 mm)	D50 Size Class	D84 Size Class	D90 Size Class	D50 Actual	D84 Actual	D90 Actual	DATE
River Station	%	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	mm/dd/yyyy
24,020	17	22	45	45	27	47	61	10/31/2013
23,796	3	16	32	32	20	39	45	10/31/2013
22,925	10	22	45	45	26	61	64	10/31/2013
22,589	8	22	45	45	30	54	64	10/31/2013
22,339	14	16	32	32	19	38	41	10/31/2013
22,027	28	6	16	22	6	19	25	10/17/2013
21,960	21	16	32	45	17	38	52	10/17/2013
21,629	17	16	45	45	16	47	63	10/17/2013
21,158	4	22	45	45	27	52	62	10/17/2013
20,534	6	22	45	45	29	51	62	10/17/2013
17,891	16	22	45	64	28	58	66	10/13/2013
16,422	45	2	8	16	3	11	17	10/12/2013

Pebble Count Data 2013

River Reach 4 Restoration Construction Completed 2011 - 2012

15,950	25	11	32	32	13	36	43	10/18/2013
Low Flow Channel	4	22	45	45	29	48	63	10/18/2013
Floodplain Bench	46	2	11	16	3	14	18	10/18/2013
15,730	37	8	22	32	10	27	36	10/18/2013
14,985	10	16	32	32	17	35	39	10/23/2013
Low Flow Channel	6	11	22	22	13	23	25	10/23/2013
Floodplain Bench	15	16	32	45	20	39	46	10/23/2013
14,920	45	4	11	16	4	14	21	10/23/2013
13,800	23	16	45	45	16	45	53	10/23/2013
Low Flow Channel	4	22	45	45	26	50	53	10/23/2013
Floodplain Bench	11	6	32	32	7	39	45	10/23/2013
13,100	8	22	32	45	24	44	51	10/23/2013
13,050	43	4	32	45	5	35	48	10/23/2013
Low Flow Channel	12	22	45	64	25	54	72	10/23/2013
Floodplain Bench	71	1	6	8	1	6	8	10/23/2013

Pebble Count Data 2013

River Reaches 5-9 (Restoration Construction Completed in Reach 8 N (Stations 7,800 - 6,400 in 2012)

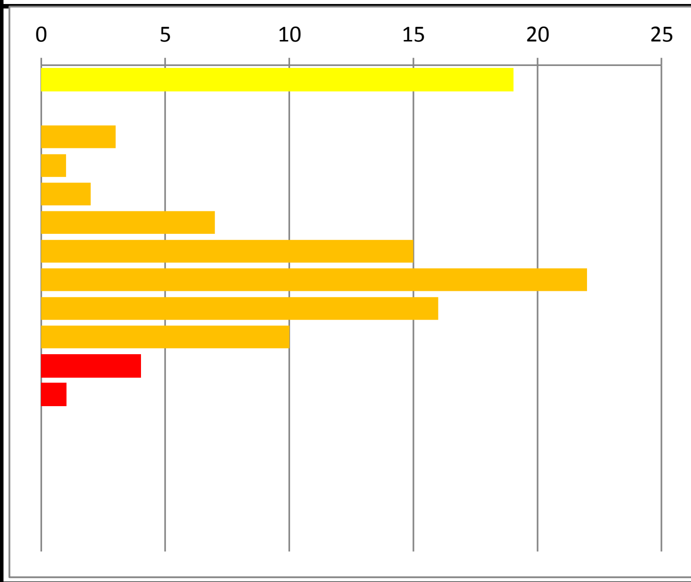
Cross Section	(<2 mm)	D50 Size Class	D84 Size Class	D90 Size Class	D50 Actual	D84 Actual	D90 Actual	DATE
River Station	%	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	mm/dd/yyyy
8,830	8	16	22	32	18	32	36	10/25/2013
8,630	12	16	32	45	17	38	52	10/25/2013
8,280	11	8	22	32	9	24	28	10/25/2013
7,830	12	16	32	45	20	42	50	10/25/2013
7,700	13	11	22	22	12	26	32	10/25/2013
6,750	19	11	32	32	14	34	42	10/24/2013
Low Flow Channel	18	11	22	32	12	30	39	10/24/2013
Floodplain Bench	20	11	32	32	15	37	44	10/24/2013
6,100	42	2	8	11	4	10	12	10/24/2013
6,050	10	22	45	45	24	48	60	10/24/2013
4,450	8	16	32	32	21	42	44	10/24/2013
3,450	15	16	32	45	21	44	59	10/24/2013
3,328	12	16	32	32	20	33	40	10/24/2013
2,390	3	16	32	32	20	42	40	12/31/2013
1,515	19	22	32	45	23	43	54	12/31/2013

Station: 1,515		Page: 2 of 2 Date: 12-31-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Ariadna Dang	
Sample Width: 36'	Sample Length: 66'	Bedform: MID CH BAR

GRID	1	2	3	4	5	6	7	8	9	10
1	1	15	54	42	13	23	30	26	65	8
2	18	28	20	16	24	35	34	31	1	1
3	1	33	31	18	57	19	1	39	35	12
4	1	30	19	43	36	1	1	40	32	57
5	50	23	1	20	30	15	20	18	25	42
6	15	1	1	41	18	21	58	1	27	23
7	90	47	30	1	1	33	17	19	13	1
8	10	74	30	65	12	51	30	32	28	27
9	28	1	5	5	60	38	54	53	23	40
10	6	19	1	1	22	28	5	20	66	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	19
Gravel	2		2-4	0
	4		4-5.8	3
	6		6-8	1
	8		8-11	2
	11		11-16	7
	16		16-22.6	15
	22		22-32	22
	32		32-45	16
	45		45-64	10
Cobble	64		64-90	4
	90		90-128	1
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	22	D50	23
D84	32	D84	42
D90	45	D90	54

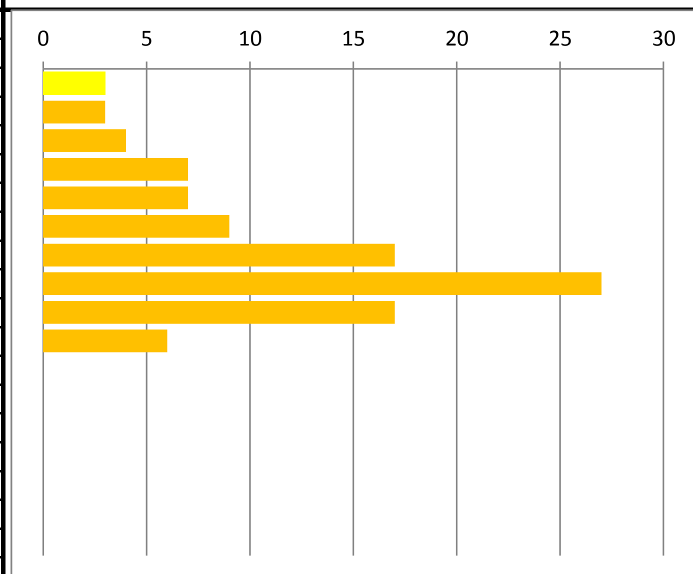
% Fines (<2 mm)
19

Station: 2,390 (DT548 LB 16 vinerows upstream from upstream edge of United lawn)		Page: 1 of 2 Date: 12-31-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Ariadna Dang	
Sample Width: 36'	Sample Length: 66'	Bedform: RB Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	20	55	57	34	13	35	10	27	34	15
2	13	41	22	22	55	45	6	24	5	11
3	4	37	28	40	20	10	32	7	6	17
4	30	20	10	3	1	27	31	25	32	20
5	27	35	6	1	6	57	15	17	22	11
6	19	8	23	22	16	25	30	1	36	14
7	24	28	25	38	2	9	18	15	30	20
8	42	23	42	17	6	40	6	30	11	20
9	19	25	9	27	5	20	5	45	10	16
10	31	30	32	25	3	20	32	29	19	42

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	3
Gravel	2	2-4	3
	4	4-5.8	4
	6	6-8	7
	8	8-11	7
	11	11-16	9
	16	16-22.6	17
	22	22-32	27
	32	32-45	17
	45	45-64	6
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	20
D84	32	D84	35
D90	32	D90	40

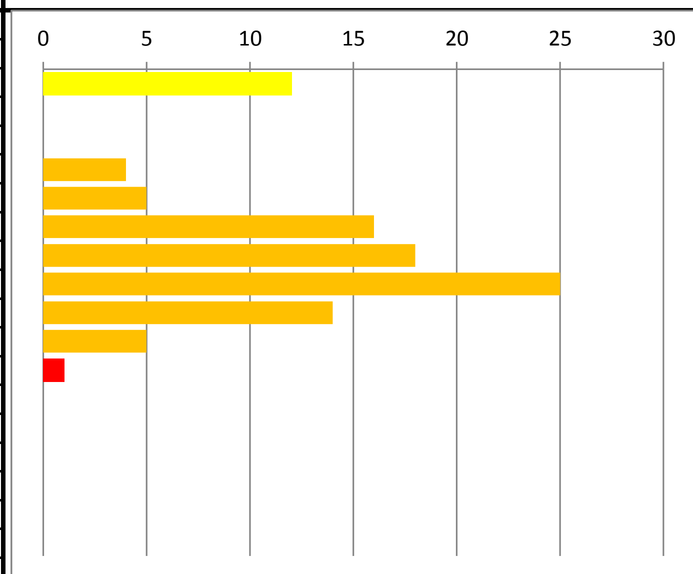
% Fines (<2 mm)
3

Station: 3,328 (47' US from new graded trib confluence)			Page: 6 of 7 Date: 10-24-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 30'	Sample Length: 30'		Bedform: DS Delta Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	20	51	21	13	11	1	1	1	38	1
2	1	25	29	45	1	1	11	31	21	14
3	8	11	32	41	8	10	10	1	13	7
4	16	30	23	1	12	21	6	1	24	11
5	15	31	22	20	16	35	1	32	28	1
6	6	84	14	44	19	20	18	12	14	29
7	11	33	47	27	15	25	34	19	27	18
8	9	31	43	17	31	30	26	57	39	24
9	18	24	6	40	37	27	25	18	25	27
10	11	11	61	40	28	18	33	25	17	20

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	12
Gravel	2	2-4	0
	4	4-5.8	0
	6	6-8	4
	8	8-11	5
	11	11-16	16
	16	16-22.6	18
	22	22-32	25
	32	32-45	14
	45	45-64	5
Cobble	64	64-90	1
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	20
D84	32	D84	33
D90	32	D90	40

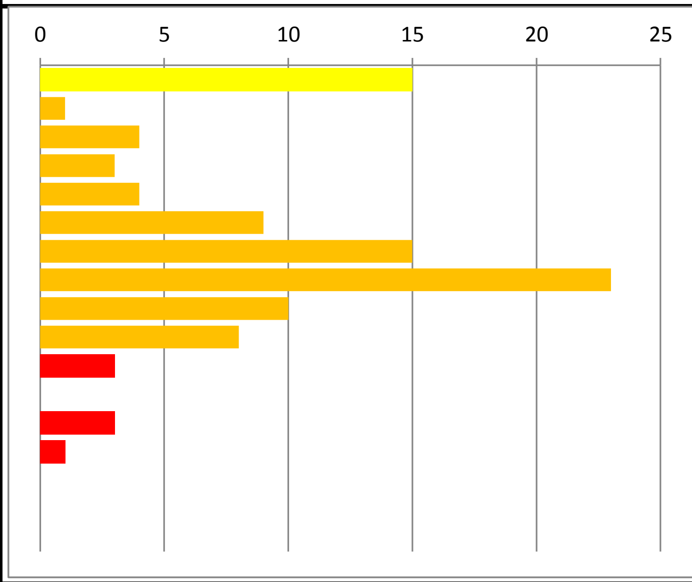
% Fines (<2 mm)
12

Station: 3,450			Page: 7 of 7
			Date: 10-24-13 C
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 37'	Sample Length: 37'		Bedform: Pool RB Delta Mid-conflu

GRID	1	2	3	4	5	6	7	8	9	10
1	1	13	8	30	45	14	11	21	5	34
2	1	4	31	43	31	44	26	24	9	39
3	19	10	17	28	16	59	24	18	4	1
4	1	1	16	40	26	175	6	31	15	26
5	21	30	25	140	65	1	21	8	31	650
6	24	30	21	26	13	11	19	42	190	30
7	41	25	61	21	25	75	51	175	6	62
8	1	15	1	1	18	18	4	57	16	29
9	21	1	13	22	12	1	1	55	55	77
10	34	22	1	36	1	30	6	3	34	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	15
Gravel	2	2-4	1
	4	4-5.8	4
	6	6-8	3
	8	8-11	4
	11	11-16	9
	16	16-22.6	15
	22	22-32	23
	32	32-45	10
	45	45-64	8
Cobble	64	64-90	3
	90	90-128	0
	128	128-180	3
	180	180-256	1
Boulder	256	256-512	0
	512	512-1024	1
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	21
D84	32	D84	44
D90	45	D90	59

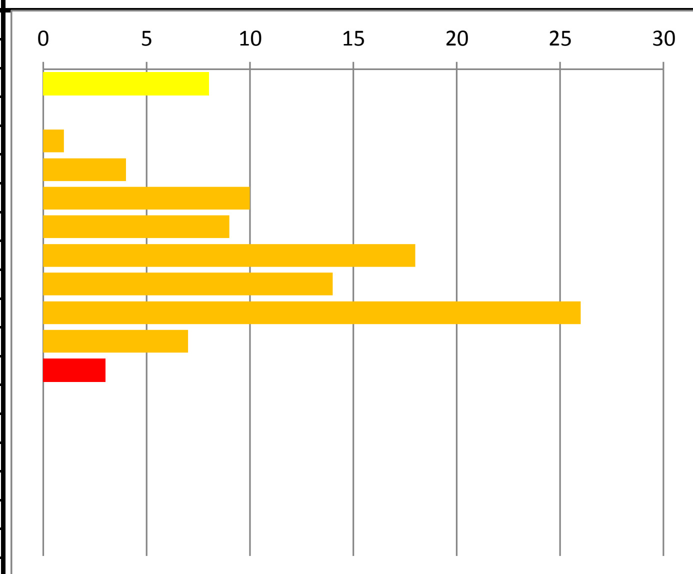
% Fines (<2 mm)
15

Station: 4,450 (4,450+20' US=4,470')		Page: 5 of 7 Date: 10-24-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 20'	Sample Length: 20'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	28	1	44	32	21	66	24	17	36	1
2	1	18	18	55	17	17	31	22	12	45
3	1	35	9	36	19	42	24	1	25	40
4	41	28	1	5	9	26	8	25	14	42
5	13	35	12	18	36	18	21	8	6	35
6	35	42	42	45	12	12	6	26	23	19
7	41	34	74	20	53	19	10	8	9	34
8	1	38	15	27	20	54	43	38	20	12
9	42	56	25	49	36	1	6	9	19	9
10	6	39	8	78	39	15	35	17	31	16

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	8
Gravel	2	2-4	0
	4	4-5.8	1
	6	6-8	4
	8	8-11	10
	11	11-16	9
	16	16-22.6	18
	22	22-32	14
	32	32-45	26
	45	45-64	7
Cobble	64	64-90	3
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	21
D84	32	D84	42
D90	32	D90	44

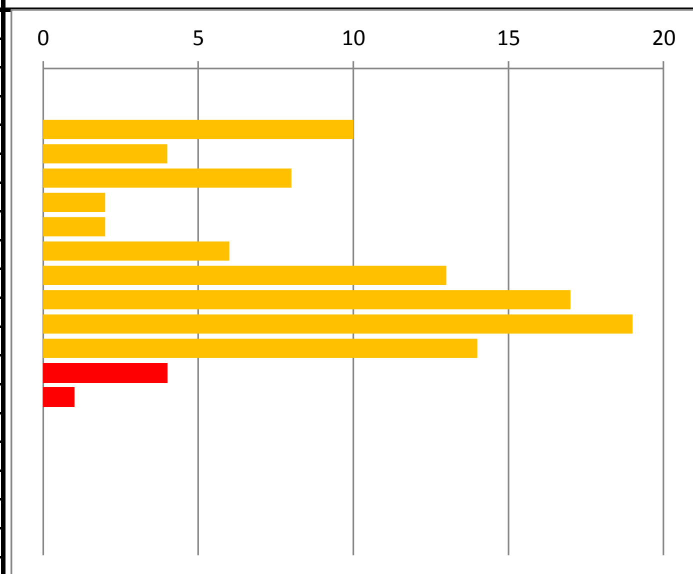
% Fines (<2 mm)
8

Station: 6,050		Page: 1 of 7
		Date: 10/24/13 D
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 15'	Sample Length: 30'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	16	12	10	21	30	27	22	17	24	21
2	4	13	17	23	62	14	1	32	1	34
3	8	6	25	40	51	48	26	43	57	19
4	21	35	2	57	60	72	5	30	35	21
5	32	12	25	55	61	41	3	71	27	26
6	41	42	42	41	45	44	1	63	17	46
7	29	21	16	35	60	25	1	1	1	20
8	22	7	51	23	71	100	4	1	84	40
9	24	3	11	4	1	5	3	40	29	60
10	33	5	4	13	4	1	1	42	38	20

Wet

Substrate	Size Class		Actual Measured B-Axis (mm)	Tally
Bedrock				
Silt			0.0062	
Sand			<2	10
Gravel	2		2-4	4
	4		4-5.8	8
	6		6-8	2
	8		8-11	2
	11		11-16	6
	16		16-22.6	13
	22		22-32	17
	32		32-45	19
	45		45-64	14
Cobble	64		64-90	4
	90		90-128	1
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	22	D50	24
D84	32	D84	48
D90	32	D90	60

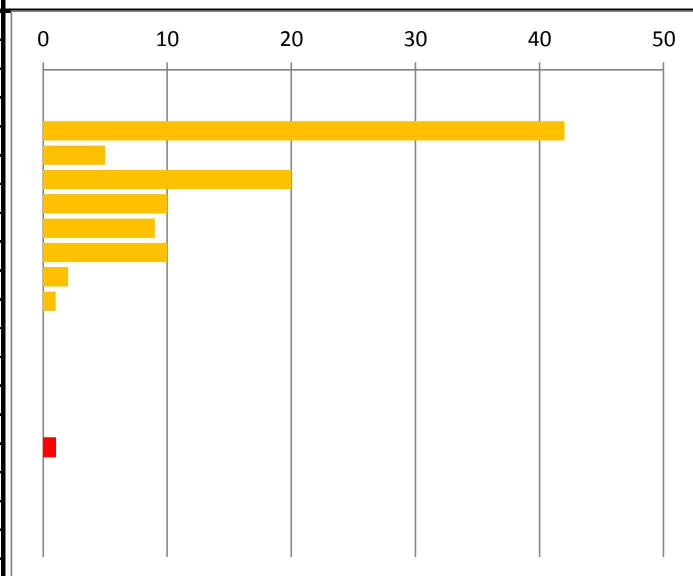
% Fines (<2 mm)
10

Station: 6,100 (6,100+26' US= 6,126)		Page: 2 of 7 / Date: 10/24/13 I
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 26'	Sample Length: 26'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	7	4	1	8	8	8	4	7
2	180	1	5	1	10	15	5	11	4	24
3	1	2	1	5	4	4	1	11	12	6
4	1	5	5	8	7	8	11	4	4	1
5	1	7	8	5	12	4	5	6	3	14
6	1	1	1	5	1	7	1	1	1	1
7	1	1	1	1	1	5	4	1	5	1
8	1	1	1	12	1	10	1	1	6	16
9	1	1	1	12	1	1	10	5	3	15
10	1	1	1	17	1	6	1	3	3	6

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	42
Gravel	2	2-4	5
	4	4-5.8	20
	6	6-8	10
	8	8-11	9
	11	11-16	10
	16	16-22.6	2
	22	22-32	1
	32	32-45	0
	45	45-64	0
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	0
	180	180-256	1
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	4	D50	4
D84	8	D84	10
D90	11	D90	12

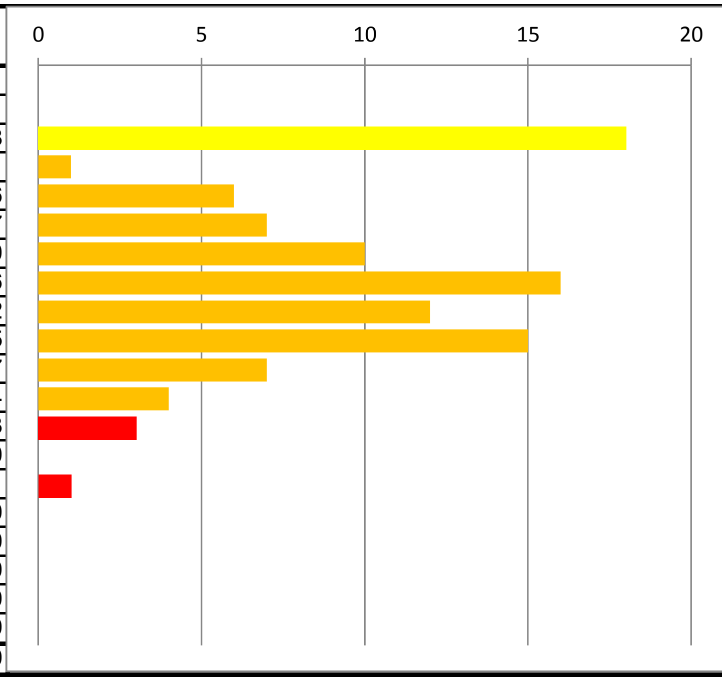
% Fines (<2 mm)
42

Station: 6,750 A: Low Flow Channel (6,750-40' DS-6,710)		Page: 3 of 7 Date: 10/24/13 F
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width:	Sample Length:	Bedform: Bar-Rb-Sequoia Grove

GRID	1	2	3	4	5	6	7	8	9	10
1	1	12	15	28	11	15	9	26	8	16
2	1	8	11	18	12	25	7	6	10	50
3	1	12	4	38	24	12	16	12	17	4
4	1	1	1	1	7	9	8	38	6	82
5	2	1	1	59	13	1	16	19	26	11
6	6	12	25	30	9	5	9	9	20	57
7	5	58	4	42	35	26	30	43	1	1
8	19	64	26	11	22	6	152	27	39	18
9	11	1	25	1	19	7	14	11	4	1
10	1	37	21	16	22	9	22	1	1	86

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	18
Gravel	2		2-4	1
	4		4-5.8	6
	6		6-8	7
	8		8-11	10
	11		11-16	16
	16		16-22.6	12
	22		22-32	15
	32		32-45	7
	45		45-64	4
Cobble	64		64-90	3
	90		90-128	0
	128		128-180	1
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	11	D50	12
D84	22	D84	30
D90	32	D90	39

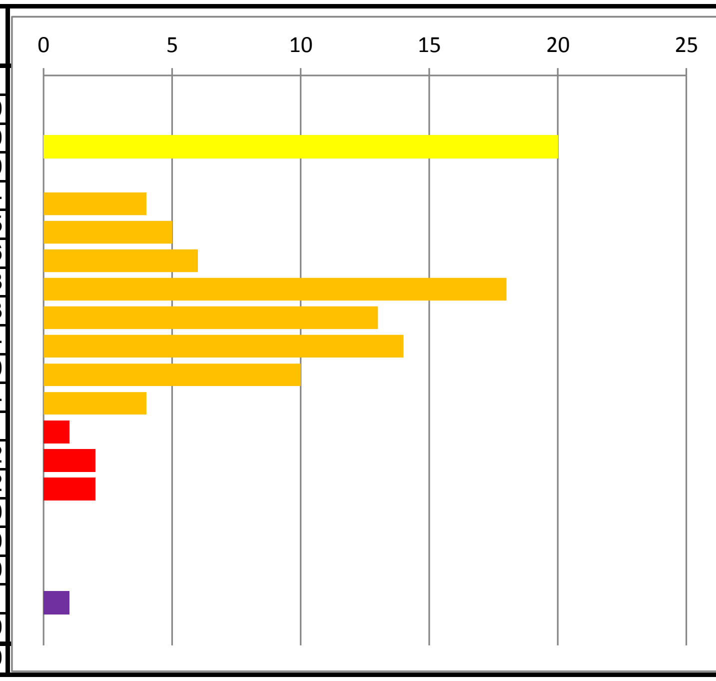
% Fines (<2 mm)
18

Station: 6,750 B: Bench/Secondary Channel (6,750-40' DS-6,710)		Page: 4 of 7 Date: 10/24/13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 30'	Sample Length: 40'	Bedform: Secondary Channel

GRID	1	2	3	4	5	6	7	8	9	10
1	1	11	42	25	19	45	8	7	42	14
2	1	16	10	32	15	14	16	30	1	1
3	1050	20	12	39	15	37	21	8	16	1
4	1	7	14	1	14	30	40	7	11	30
5	5	6	11	34	19	1	28	12	10	45
6	1	13	15	17	32	28	1	4	8	9
7	6	14	48	12	20	38	1	1	5	24
8	5	1	20	22	21	31	1	1	18	23
9	1	15	25	78	31	11	17	1	1	1
10	1	23	15	53	44	30	170	123	100	137

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	0
Sand		<2	20
Gravel	2	2-4	0
	4	4-5.8	4
	6	6-8	5
	8	8-11	6
	11	11-16	18
	16	16-22.6	13
	22	22-32	14
	32	32-45	10
	45	45-64	4
Cobble	64	64-90	1
	90	90-128	2
	128	128-180	2
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	1
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	11	D50	15
D84	32	D84	37
D90	32	D90	44

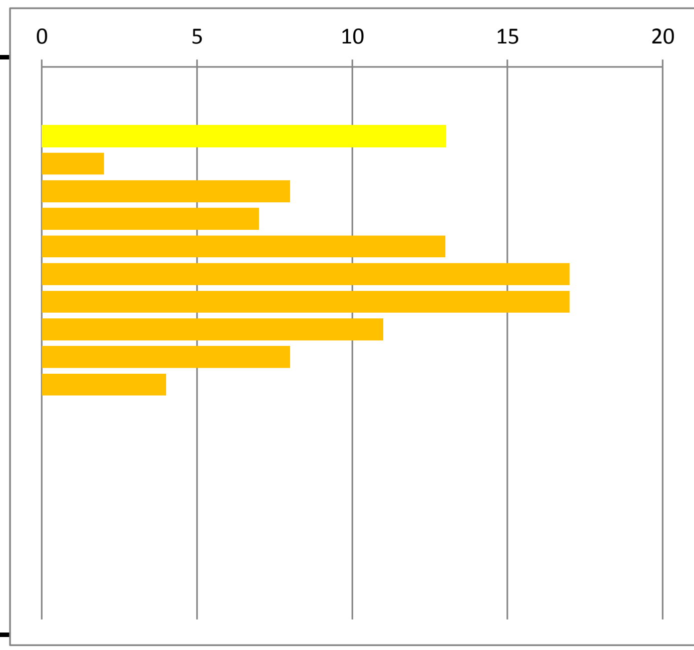
% Fines (<2 mm)
20

Station: 7,700 (7,720+26' US -7,726)			Page: 4 of 5 Date: 10/25/13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 26'	Sample Length: 26'		Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	32	21	23	8	5	15	9	14	28	1
2	12	13	24	12	11	19	1	7	12	4
3	18	12	31	45	32	43	22	19	7	5
4	1	11	41	53	9	6	8	40	20	6
5	1	9	26	13	8	20	19	12	21	4
6	1	12	8	16	17	12	15	5	10	1
7	1	26	38	14	46	17	10	5	8	7
8	1	21	31	5	12	2	35	1	9	2
9	39	23	17	26	16	7	17	1	21	8
10	26	8	12	1	47	17	7	1	1	5

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	13
Gravel	2	2-4	2
	4	4-5.8	8
	6	6-8	7
	8	8-11	13
	11	11-16	17
	16	16-22.6	17
	22	22-32	11
	32	32-45	8
	45	45-64	4
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	11	D50	12
D84	22	D84	26
D90	32	D90	32

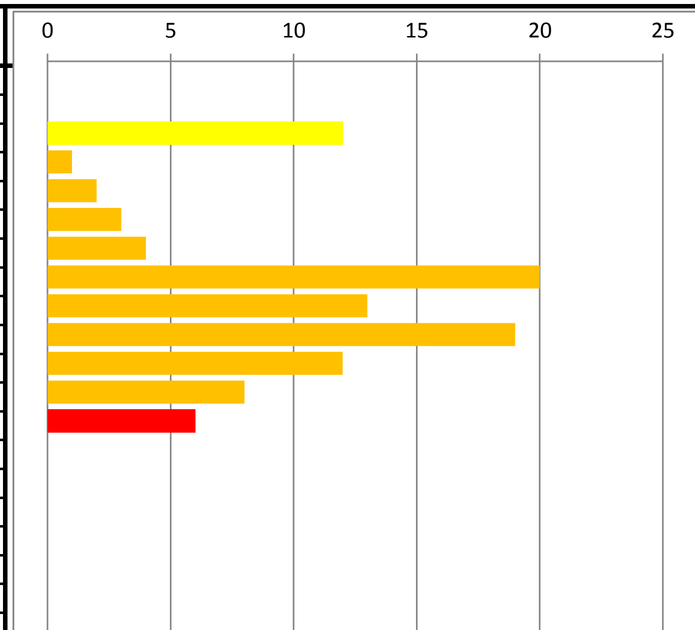
% Fines (<2 mm)
13

Station: 7,830 (7,819-XS-7,859 -11 DS 7830 +29' US)		Page: 5 of 5 Date: 10/25/13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 40'	Sample Length: 40'	Bedform: Bedform

GRID	1	2	3	4	5	6	7	8	9	10
1	56	25	11	39	21	20	28	41	25	51
2	71	14	35	28	45	14	14	44	6	11
3	13	43	55	49	28	39	83	35	13	42
4	35	1	1	23	65	30	15	24	26	77
5	1	64	14	16	31	16	35	17	37	50
6	1	46	17	20	13	21	30	8	14	23
7	1	1	10	25	53	14	28	17	15	19
8	1	8	1	31	25	11	35	14	77	12
9	1	1	10	13	14	24	21	11	5	7
10	1	3	1	29	5	12	28	20	16	7

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	12
Gravel	2		2-4	1
	4		4-5.8	2
	6		6-8	3
	8		8-11	4
	11		11-16	20
	16		16-22.6	13
	22		22-32	19
	32		32-45	12
	45		45-64	8
Cobble	64		64-90	6
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	16	D50	20
D84	32	D84	42
D90	45	D90	50

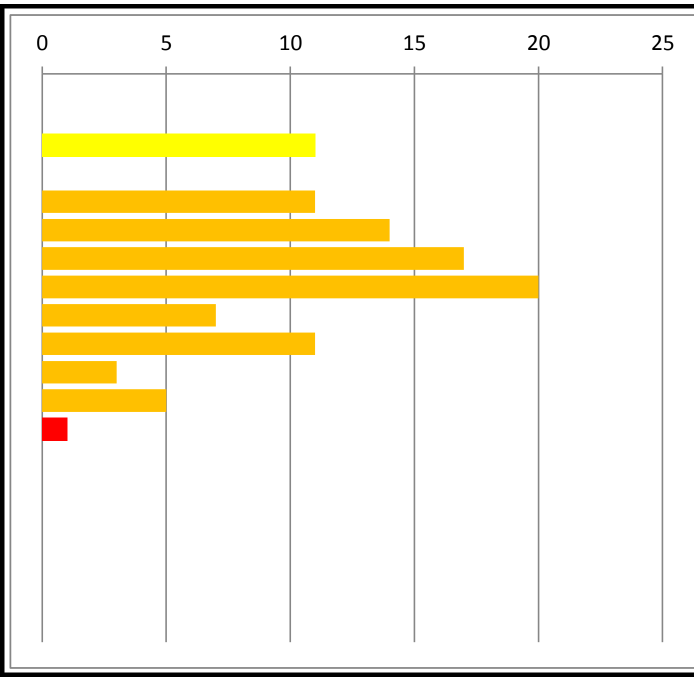
% Fines (<2 mm)
12

Station: 8,280		Page: 3 of 5
		Date: 10/25/13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 21'	Sample Length: 21'	Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	14	32	28	16	11	14	13	12	74	1
2	22	25	6	1	13	43	11	9	45	1
3	6	1	8	1	7	15	28	62	54	1
4	4	46	8	7	1	26	25	49	11	29
5	8	18	24	17	10	8	9	35	14	7
6	10	23	9	14	14	8	5	10	25	4
7	14	11	15	22	7	7	12	16	20	1
8	5	6	4	1	8	20	4	5	14	9
9	7	11	5	8	14	7	4	4	6	8
10	6	4	6	9	19	6	8	1	15	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	11
Gravel	2		2-4	0
	4		4-5.8	11
	6		6-8	14
	8		8-11	17
	11		11-16	20
	16		16-22.6	7
	22		22-32	11
	32		32-45	3
	45		45-64	5
Cobble	64		64-90	1
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	8	D50	9
D84	22	D84	24
D90	32	D90	28

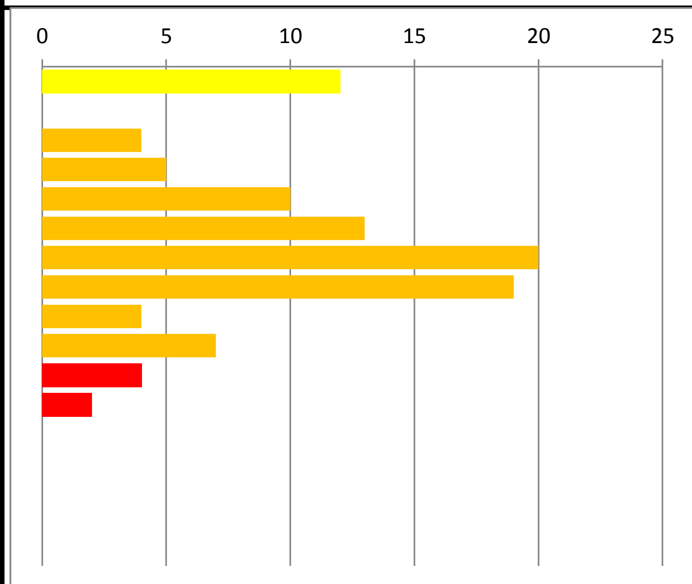
% Fines (<2 mm)
11

Station: 8,630			Page: 2 of 5
			Date: 10-25-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 40'	Sample Length: 40'		Bedform: Braided Ch.

GRID	1	2	3	4	5	6	7	8	9	10
1	8	40	66	56	52	28	15	4	12	18
2	14	15	57	49	31	21	10	13	7	16
3	31	16	20	78	71	39	30	19	4	48
4	24	59	91	12	43	1	17	5	21	9
5	20	13	11	92	54	8	1	4	25	24
6	13	6	25	17	16	25	25	16	1	1
7	21	22	17	19	10	23	6	1	1	6
8	12	38	6	28	1	9	24	1	10	1
9	21	22	21	10	8	14	11	27	16	1
10	31	23	65	1	18	17	14	8	31	1

Wet

Substrate	Size Class		Actual Measured B-Axis (mm)	Tally
Bedrock				
Silt			0.0062	
Sand			<2	12
Gravel	2		2-4	0
	4		4-5.8	4
	6		6-8	5
	8		8-11	10
	11		11-16	13
	16		16-22.6	20
	22		22-32	19
	32		32-45	4
	45		45-64	7
Cobble	64		64-90	4
	90		90-128	2
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	16	D50	17
D84	16	D84	38
D90	22	D90	52

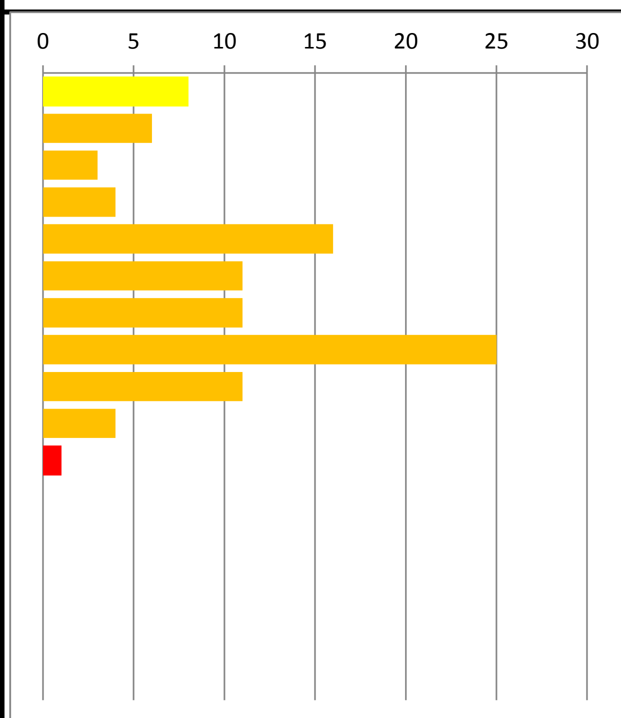
% Fines (<2 mm)
12

Station: 8,830 (8830-50 'DS)		Page: 1 of 5 Date: 10/25/13
Stream: Napa River	Project: Rutherford Reach (St. Supery)	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 50'	Sample Length: 50'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	10	11	35	11	27	14	73	32	36	48
2	24	9	22	55	22	28	44	22	34	11
3	44	23	18	24	9	24	27	1	29	27
4	32	37	23	15	19	29	20	45	33	12
5	30	25	14	31	4	34	12	6	13	1
6	15	28	5	14	11	10	2	64	20	1
7	18	27	26	23	11	29	1	5	26	1
8	9	20	6	14	10	60	1	29	7	4
9	11	12	3	11	24	10	2	11	21	1
10	7	12	4	43	19	16	4	27	33	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			0
Silt		0.0062	0
Sand		<2	8
Gravel	2	2-4	6
	4	4-5.8	3
	6	6-8	4
	8	8-11	16
	11	11-16	11
	16	16-22.6	11
	22	22-32	25
	32	32-45	11
	45	45-64	4
Cobble	64	64-90	1
	90	90-128	0
	128	128-180	0
	180	180-256	
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	18
D84	22	D84	32
D90	32	D90	36

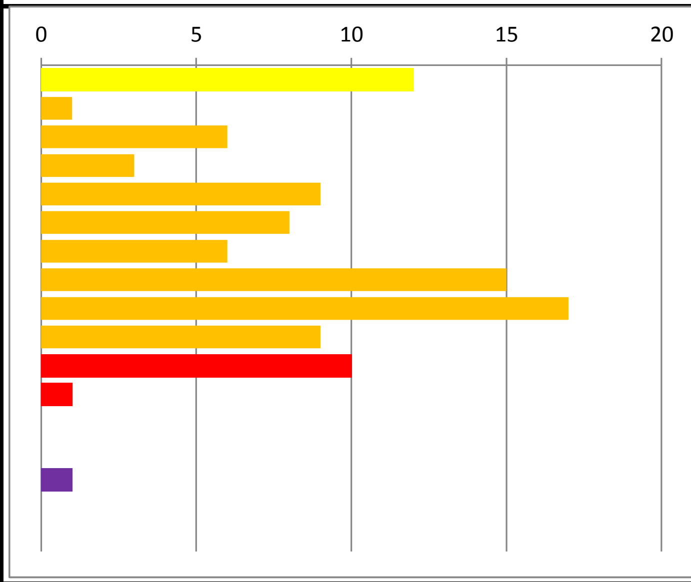
% Fines (<2 mm)
8

Station: 13,050 A: Low Flow Channel (13,050-13,010 DS RB)		Page: 6 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 40'	Sample Length: 40'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	1	21	41	31	48	20	45	9	81	45
2	1	4	4	32	22	31	36	44	50	70
3	1	7	1	13	38	25	25	69	1	7
4	10	4	1	85	42	27	74	35	41	26
5	1	1	1	11	33	25	14	14	100	79
6	22	13	25	32	8	1050	72	33	85	32
7	1	1	8	9	54	59	30	16	30	310
8	1	50	51	5	42	23	33	20	10	9
9	8	44	66	750	41	21	10	63	77	5
10	11	5	15	2	19	23	7	11	31	32

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	12
Gravel	2	2-4	1
	4	4-5.8	6
	6	6-8	3
	8	8-11	9
	11	11-16	8
	16	16-22.6	6
	22	22-32	15
	32	32-45	17
	45	45-64	9
Cobble	64	64-90	10
	90	90-128	1
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	1
	512	512-1024	1
	1024	1024-2048	1
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	25
D84	45	D84	54
D90	64	D90	72

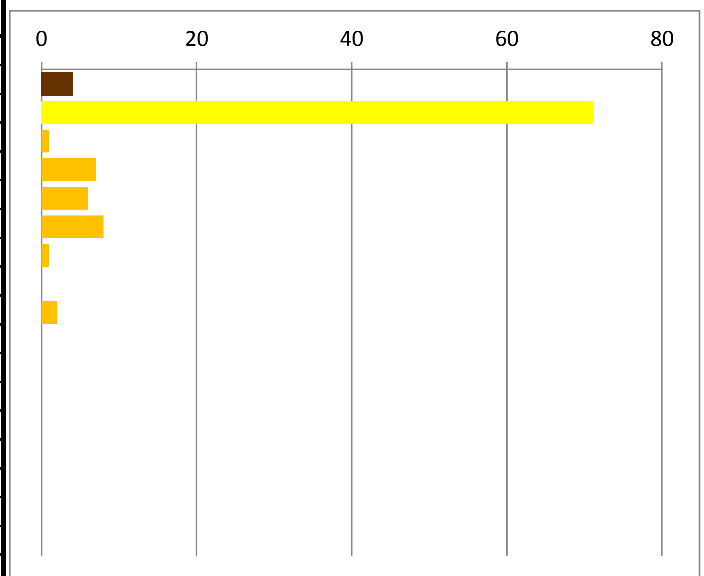
% Fines (<2 mm)
12

Station: 13,050 B: Bench 11 Honig LB (XS 13,050- 13,010)		Page: 7 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 50'	Sample Length: 40'	Bedform: Floodplain TerraceHonig

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	6	5	1	6	1	1	1	1
2	1	8	10	1	1	4	1	1	1	1
3	0	24	1	1	1	1	1	1	1	1
4	0	1	1	1	1	1	5	1	1	12
5	0	8	1	6	1	1	1	1	1	1
6	1	1	10	4	6	1	1	1	1	1
7	1	1	6	6	1	1	1	1	1	8
8	1	1	4	1	4	1	1	1	1	1
9	1	1	4	8	9	1	1	1	1	1
10	1	25	1	9	3	1	1	0	1	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	4
Sand		<2	71
Gravel	2	2-4	1
	4	4-5.8	7
	6	6-8	6
	8	8-11	8
	11	11-16	1
	16	16-22.6	0
	22	22-32	2
	32	32-45	0
	45	45-64	0
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	1	D50	1
D84	6	D84	6
D90	8	D90	8

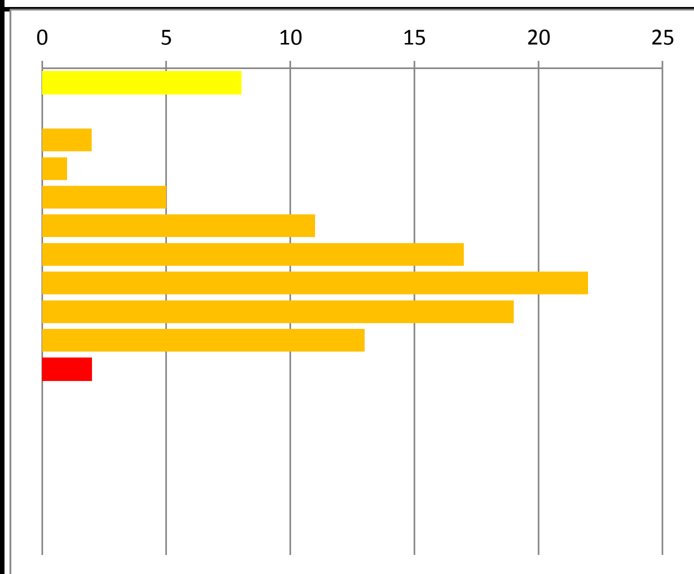
% Fines (<2 mm)
71

Station: 13,100 (Last for day but 2nd to last in Down Stream Stationing)		Page: 8 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 30'	Sample Length: 30'	Bedform: Bar Cross Channel

GRID	1	2	3	4	5	6	7	8	9	10
1	1	24	8	15	30	32	56	32	43	44
2	19	15	27	42	44	15	61	42	18	16
3	39	44	21	20	30	12	25	31	21	21
4	65	47	17	26	68	33	24	20	36	19
5	34	17	16	49	29	6	29	21	55	40
6	15	14	56	30	10	40	11	36	26	1
7	4	24	27	24	53	11	28	11	45	1
8	9	1	35	11	29	25	5	55	45	1
9	10	1	51	19	29	11	34	21	35	22
10	35	20	55	61	28	10	1	24	20	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	8
Gravel	2		2-4	0
	4		4-5.8	2
	6		6-8	1
	8		8-11	5
	11		11-16	11
	16		16-22.6	17
	22		22-32	22
	32		32-45	19
	45		45-64	13
Cobble	64		64-90	2
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	22	D50	24
D84	32	D84	44
D90	45	D90	51

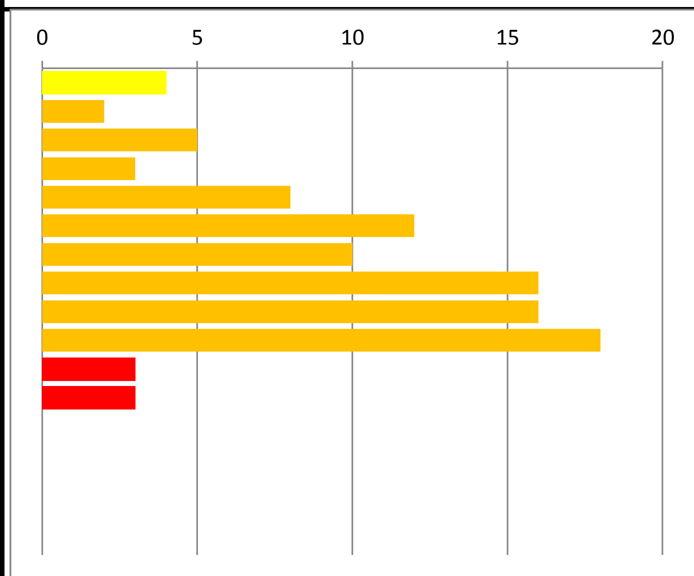
% Fines (<2 mm)
8

Station: 13,800 A: Low Flow Channel (XS 13,800 +25' US=13,825 (A) LB-Confluence@Honig RB-Emmolo Bench 8		Page: 4 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 25'	Sample Length: 25'	Bedform: Bar (DS- Apex US)

GRID	1	2	3	4	5	6	7	8	9	10
1	1	10	15	34	40	31	39	21	121	20
2	1	50	14	8	35	20	75	52	45	46
3	11	5	38	9	46	14	16	29	19	51
4	35	12	24	11	25	21	37	5	15	63
5	1	1	15	6	44	20	39	46	48	51
6	16	2	4	14	110	6	42	30	26	43
7	11	4	26	26	33	30	61	11	53	29
8	6	35	16	26	35	42	9	53	21	26
9	5	70	9	75	38	46	28	8	28	2
10	63	9	45	60	25	14	53	9	94	24

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	4
Gravel	2	2-4	2
	4	4-5.8	5
	6	6-8	3
	8	8-11	8
	11	11-16	12
	16	16-22.6	10
	22	22-32	16
	32	32-45	16
	45	45-64	18
Cobble	64	64-90	3
	90	90-128	3
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	26
D84	45	D84	50
D90	45	D90	53

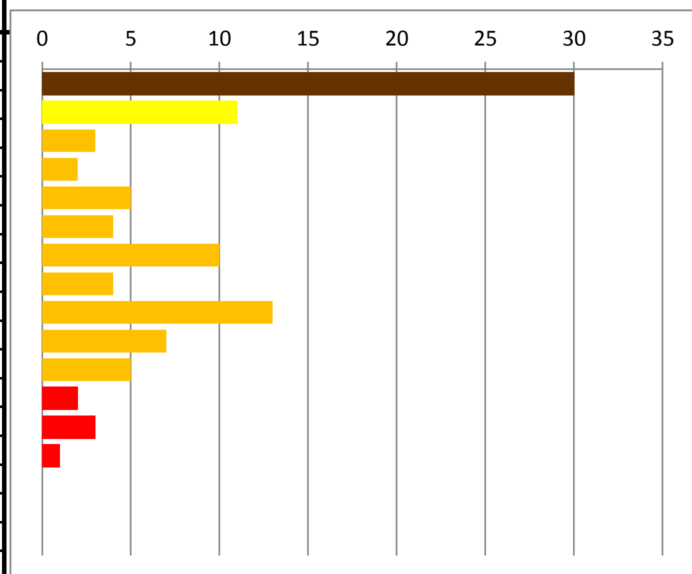
% Fines (<2 mm)
4

Station: 13,800 B: Bench 8 RB Emmolo (XS 13,800 +25" US=13,825) Across from Confluence on Honig LB		Page: 5 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 30'	Sample Length: 25'	Bedform: Floodplain Bench Emmo

GRID	1	2	3	4	5	6	7	8	9	10
1	0	70	30	10	13	11	12	0	0	0
2	0	13	26	8	0	16	7	0	0	0
3	1	6	22	4	0	16	12	0	0	0
4	1	40	30	12	1	8	7	0	27	120
5	24	45	82	44	1	3	0	0	0	0
6	58	24	21	28	22	13	0	10	0	96
7	63	15	42	1	1	18	1	33	0	90
8	14	4	13	24	1	0	1	1	53	154
9	27	2	1	3	51	7	23	0	0	0
10	39	6	40	30	39	0	0	0	0	0

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	30
Sand		<2	11
Gravel	2	2-4	3
	4	4-5.8	2
	6	6-8	5
	8	8-11	4
	11	11-16	10
	16	16-22.6	4
	22	22-32	13
	32	32-45	7
	45	45-64	5
Cobble	64	64-90	2
	90	90-128	3
	128	128-180	1
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	6	D50	7
D84	32	D84	39
D90	45	D90	45

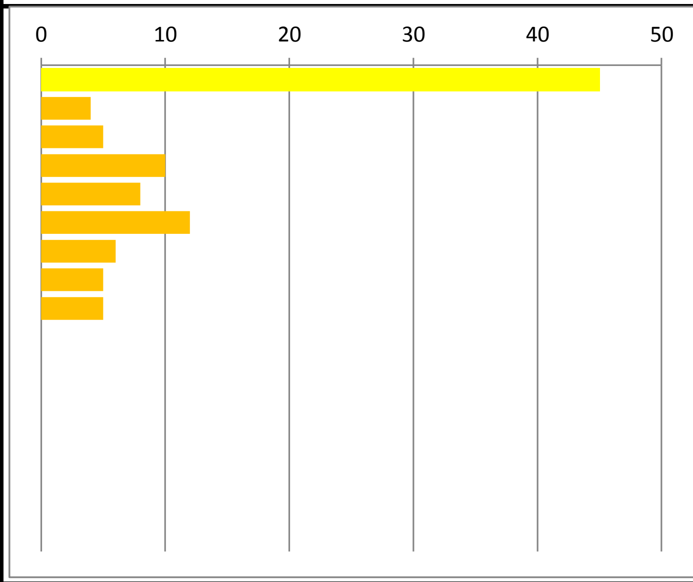
% Fines (<2 mm)
11

Station: 14,920 Low Flow Channel		Page: 3 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 25'	Sample Length: 25'	Bedform: Glide?

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	1	19	20	21	1	1	1	32
2	1	1	8	40	18	26	6	1	1	1
3	1	1	10	36	6	1	1	1	1	1
4	1	6	11	13	8	8	14	1	1	1
5	2	9	10	26	31	1	7	1	1	1
6	4	3	6	1	12	11	40	1	1	1
7	1	7	4	6	14	1	6	1	1	1
8	2	5	13	7	13	12	5	23	1	1
9	1	2	1	8	16	10	16	25	6	1
10	1	1	1	34	14	12	5	14	1	1

Wet

Substrate	Size Class		Actual Measured B-Axis (mm)	Tally
Bedrock				
Silt			0.0062	
Sand			<2	45
Gravel	2		2-4	4
	4		4-5.8	5
	6		6-8	10
	8		8-11	8
	11		11-16	12
	16		16-22.6	6
	22		22-32	5
	32		32-45	5
	45		45-64	0
Cobble	64		64-90	0
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	4	D50	4
D84	16	D84	14
D90	16	D90	21

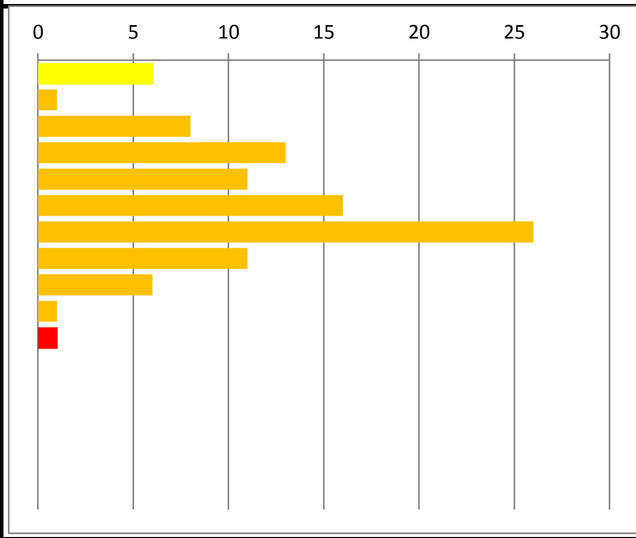
% Fines (<2 mm)
45

Station: 14,985 A: Low Flow Channel RB (14,985-14,965)		Page: 1 of 8 Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 20'	Sample Length: 20'	Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	12	18	4	6	12	11	16	18	37	1
2	24	8	15	5	9	27	12	8	1	1
3	4	9	11	4	48	3	17	7	38	11
4	17	1	21	9	10	5	16	23	19	6
5	20	8	18	7	16	17	30	25	18	4
6	19	13	10	1	18	23	7	4	35	21
7	11	7	9	15	25	7	20	23	33	19
8	5	16	9	13	15	22	6	22	20	7
9	6	16	18	19	20	7	41	12	70	18
10	1	12	9	6	15	40	6	19	25	11

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	6
Gravel	2	2-4	1
	4	4-5.8	8
	6	6-8	13
	8	8-11	11
	11	11-16	16
	16	16-22.6	26
	22	22-32	11
	32	32-45	6
	45	45-64	1
Cobble	64	64-90	1
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	11	D50	13
D84	22	D84	23
D90	22	D90	25

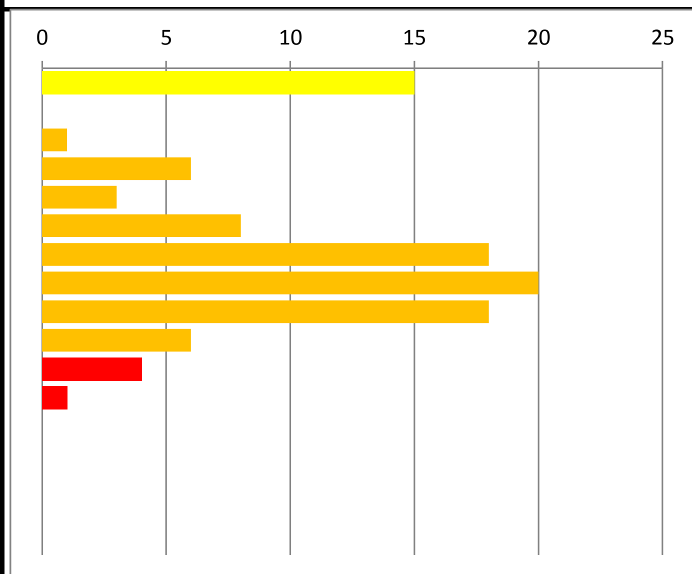
% Fines (<2 mm)
6

Station: 14,985 B: Floodplain Terrace (Natural) LB (14,985-14,965)		Page: 2 of 8 / Date: 10-23-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 50'	Sample Length: 20'	Bedform: LB Floodplain terrace

GRID	1	2	3	4	5	6	7	8	9	10
1	1	48	27	20	39	7	1	1	1	1
2	30	15	30	37	35	10	55	1	1	31
3	15	6	31	16	89	18	35	41	1	1
4	30	20	25	21	44	20	44	1	16	1
5	41	24	76	36	1	35	75	1	25	1
6	26	12	29	38	19	14	16	1	20	14
7	10	4	12	20	18	24	28	31	15	31
8	16	18	37	15	91	55	22	7	38	22
9	7	20	9	16	42	7	36	24	6	71
10	50	16	35	54	23	39	34	46	20	22

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	15
Gravel	2	2-4	0
	4	4-5.8	1
	6	6-8	6
	8	8-11	3
	11	11-16	8
	16	16-22.6	18
	22	22-32	20
	32	32-45	18
	45	45-64	6
Cobble	64	64-90	4
	90	90-128	1
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	20
D84	32	D84	39
D90	45	D90	46

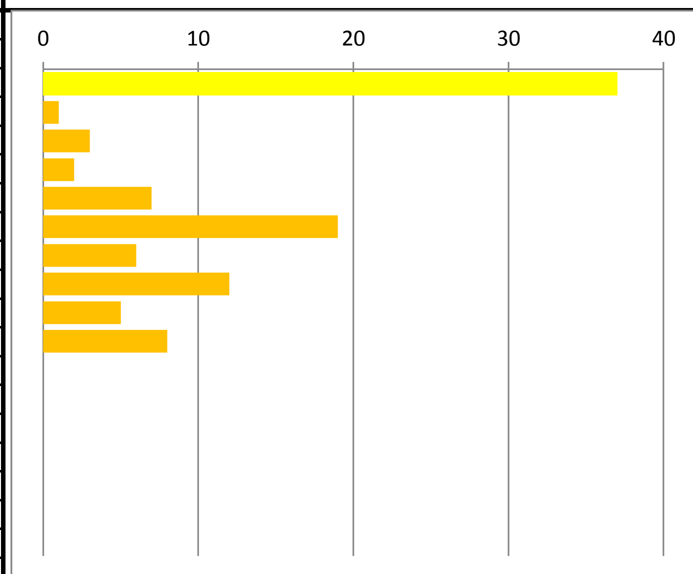
% Fines (<2 mm)
15

Station: 15,730 (15,730 + 30 US (15,730-15,760))		Page: 5 of 5 Date: 10-18-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 24'	Sample Length: 24'	Bedform: RB Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	15	1	1	1	1	21	11	5	8	1
2	25	26	1	1	3	11	18	10	9	1
3	14	19	1	1	9	26	10	14	11	1
4	26	14	1	1	1	22	34	7	15	1
5	11	49	1	1	1	11	50	17	46	14
6	24	13	1	1	1	51	1	48	20	1
7	13	4	1	1	1	55	36	18	26	14
8	60	24	1	1	1	14	38	12	34	1
9	29	9	1	1	1	11	1	14	1	31
10	27	7	1	4	1	10	36	55	29	13

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	37
Gravel	2		2-4	1
	4		4-5.8	3
	6		6-8	2
	8		8-11	7
	11		11-16	19
	16		16-22.6	6
	22		22-32	12
	32		32-45	5
	45		45-64	8
Cobble	64		64-90	0
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	8	D50	10
D84	22	D84	27
D90	32	D90	36

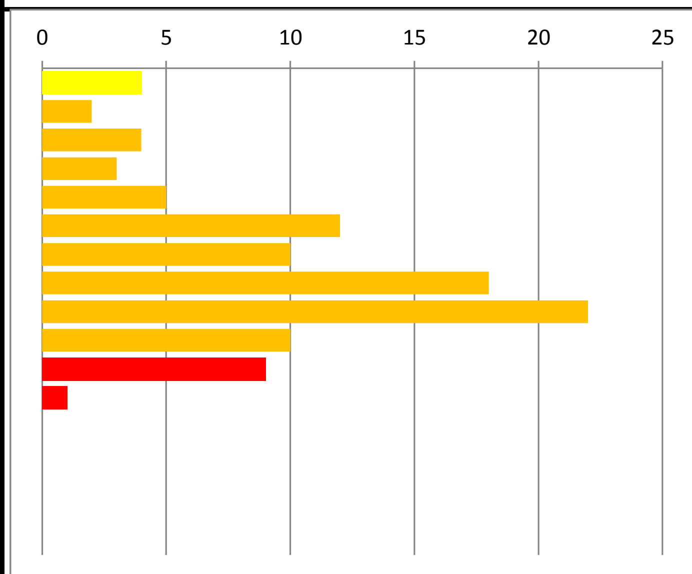
% Fines (<2 mm)
37

Station: 15,950 A: Low Flow Channel (15,964-15,928) DT XS Survey RB Stake		Page: 3 of 5 Date: 10-18-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 36'	Sample Length: 36'	Bedform: Full Ch. Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	20	26	12	2	72	14	46	5	67	61
2	16	4	35	48	56	21	36	8	31	9
3	32	7	15	20	71	38	38	31	16	7
4	38	4	38	24	56	63	35	64	99	69
5	6	31	9	67	35	23	70	38	33	13
6	13	13	26	65	35	13	45	14	1	23
7	15	15	14	38	32	51	52	22	37	41
8	1	42	45	42	21	27	29	16	29	10
9	19	15	39	29	22	43	73	3	30	31
10	33	30	36	28	20	10	1	1	5	19

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	4
Gravel	2	2-4	2
	4	4-5.8	4
	6	6-8	3
	8	8-11	5
	11	11-16	12
	16	16-22.6	10
	22	22-32	18
	32	32-45	22
	45	45-64	10
Cobble	64	64-90	9
	90	90-128	1
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	29
D84	45	D84	48
D90	45	D90	63

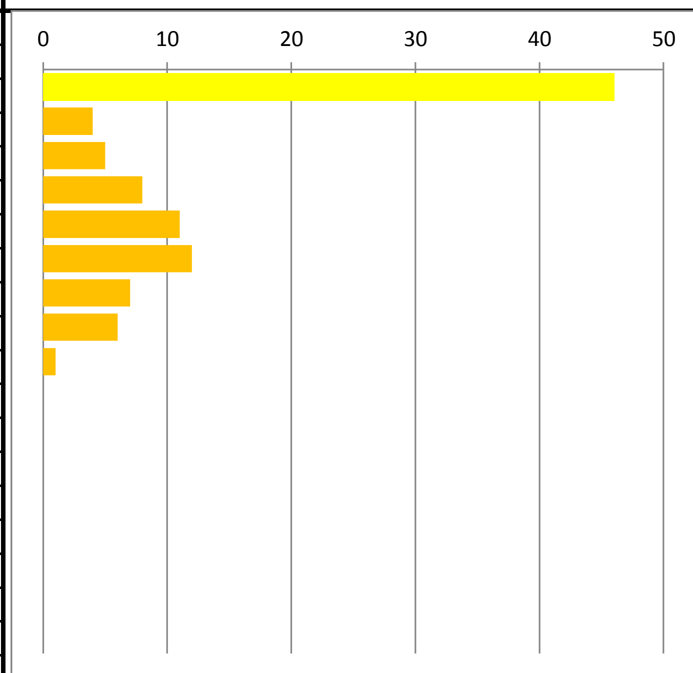
% Fines (<2 mm)
4

Station: 15,950 B: Bench (15,928-15,964)			Page: 4 of 5 Date: 10-18-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 36'	Sample Length: 36'		Bedform: Flood Plain Bench RB

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	1	1	1	1	12	1
2	1	1	1	1	1	1	1	9	7	13
3	1	1	1	1	1	1	2	1	29	11
4	1	7	4	7	1	4	8	18	10	1
5	14	6	3	13	5	1	1	1	3	28
6	1	19	12	1	10	16	8	10	1	15
7	7	9	1	22	8	27	12	2	16	1
8	1	1	6	14	15	6	13	23	16	24
9	20	1	1	1	1	12	1	18	10	35
10	1	1	1	1	5	10	7	4	10	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	46
Gravel	2	2-4	4
	4	4-5.8	5
	6	6-8	8
	8	8-11	11
	11	11-16	12
	16	16-22.6	7
	22	22-32	6
	32	32-45	1
	45	45-64	0
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	2	D50	3
D84	11	D84	14
D90	16	D90	18

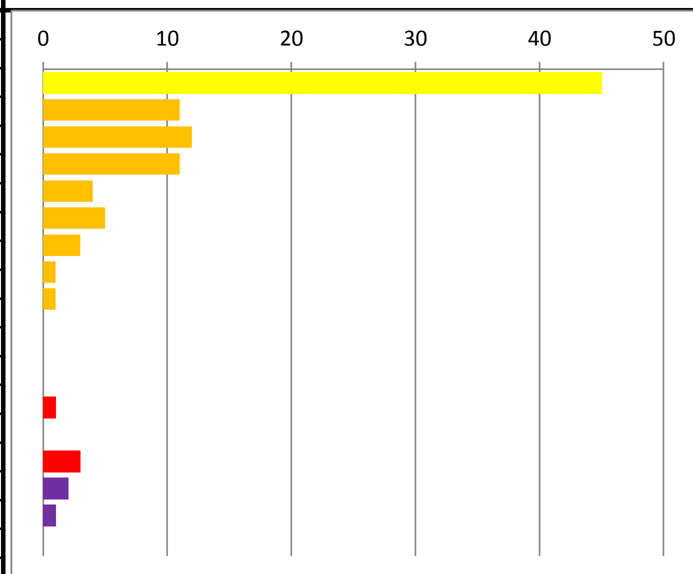
% Fines (<2 mm)
46

Station: 16,422 (16,437-16,417)		Page: 2 of 5
		Date: 10-18-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 30'	Sample Length: 30'	Bedform: Gravel Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	1	1	1	5	6	600
2	1	1	1	1	1	1	13	1	30	2000
3	1	1	1	1	1	1	1	3	1	7
4	1	3	1	1	1	4	1	4	6	1000
5	1	2	6	4	4	1	6	6	1	1
6	1	3	7	3	6	2	15	8	300	36
7	1	11	8	3	1	5	1	3	16	150
8	1	4	6	7	3	1	10	2	1	18
9	1	1	8	6	1	11	4	1	4	450
10	12	5	4	4	17	3	1	1	1	500

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	45
Gravel	2	2-4	11
	4	4-5.8	12
	6	6-8	11
	8	8-11	4
	11	11-16	5
	16	16-22.6	3
	22	22-32	1
	32	32-45	1
	45	45-64	0
Cobble	64	64-90	0
	90	90-128	0
	128	128-180	1
	180	180-256	0
Boulder	256	256-512	3
	512	512-1024	2
	1024	1024-2048	1
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	2	D50	3
D84	11	D84	11
D90	16	D90	17

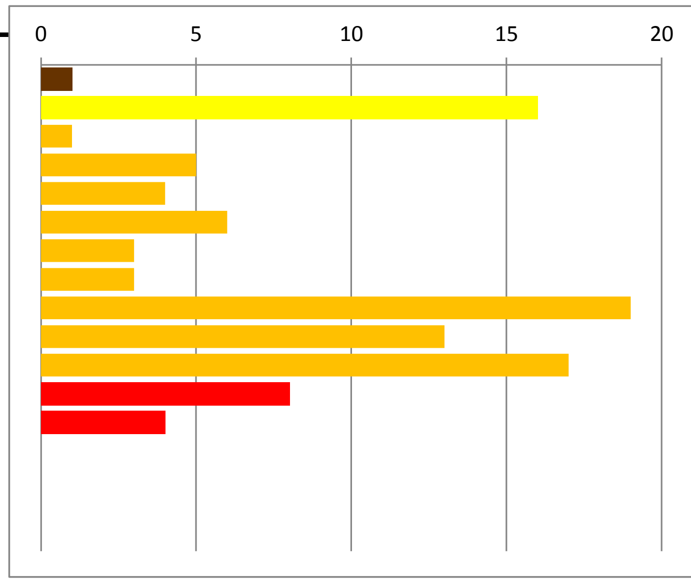
% Fines (<2 mm)
45

Station: 17,891 (17,891-US 50' Beaver Dam (17,941-17891))		Page: 1 of 5 Date: 10-18-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 40'	Sample Length: 40'	Bedform: Bar US of Beaver Dam

GRID	1	2	3	4	5	6	7	8	9	10
1	21	98	88	33	57	81	66	1	1	1
2	1	115	25	38	35	1	1	22	1	1
3	1	28	25	7	43	4	37	8	48	0
4	1	37	88	33	10	61	50	11	36	8
5	10	3	106	1	54	1	6	10	52	1
6	25	31	45	25	28	48	83	56	4	5
7	113	28	20	22	50	6	42	25	11	6
8	41	24	62	5	5	35	1	88	52	51
9	30	31	58	8	78	17	1	24	62	65
10	59	35	48	14	35	31	29	29	1	25

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	1
Sand		<2	16
Gravel	2	2-4	1
	4	4-5.8	5
	6	6-8	4
	8	8-11	6
	11	11-16	3
	16	16-22.6	3
	22	22-32	19
	32	32-45	13
	45	45-64	17
Cobble	64	64-90	8
	90	90-128	4
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	28
D84	45	D84	58
D90	64	D90	66

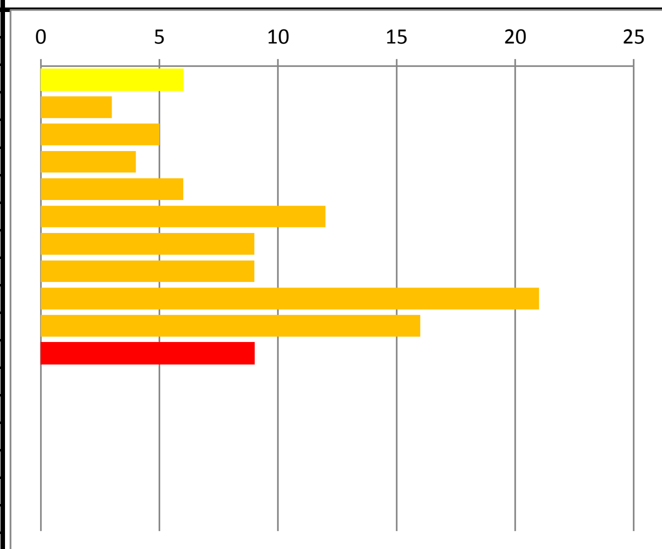
% Fines (<2 mm)
16

Station: 20,534 (20,628-94'= 20,534 (Moved DS because of Beaver Dam))			Page: 5 of 5 Date: 10-17-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Will Logsdon	Counter: Madeline Cooper		Counter: Connor McIntee
Sample Width: 46'	Sample Length: 46'		Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	11	40	38	19	8	37	34	68	5	11
2	12	6	13	53	21	56	16	85	11	8
3	3	16	25	62	10	49	9	1	2	10
4	1	6	15	36	50	50	29	44	4	15
5	34	37	17	40	31	45	39	42	51	5
6	46	50	44	70	55	65	31	65	18	11
7	14	11	7	21	63	51	5	44	4	1
8	35	40	25	44	53	72	19	43	15	11
9	23	31	20	56	40	33	38	49	32	1
10	71	6	3	28	70	1	68	30	10	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	6
Gravel	2	2-4	3
	4	4-5.8	5
	6	6-8	4
	8	8-11	6
	11	11-16	12
	16	16-22.6	9
	22	22-32	9
	32	32-45	21
	45	45-64	16
Cobble	64	64-90	9
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	29
D84	45	D84	51
D90	45	D90	62

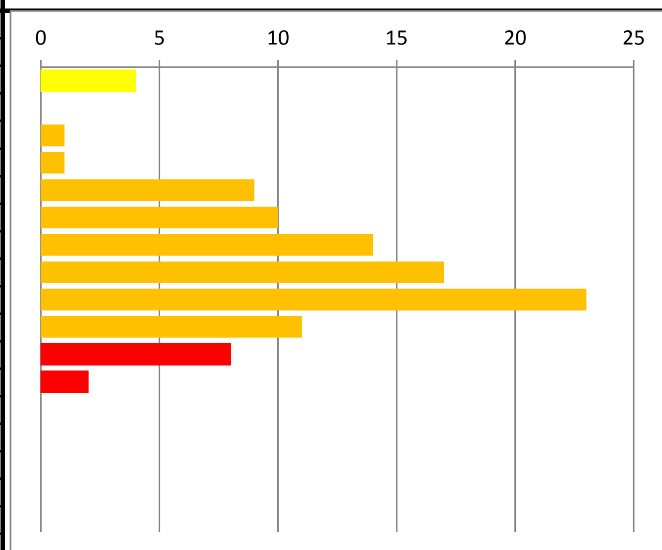
% Fines (<2 mm)
6

Station: 21,158			Page: 4 of 5 Date: 10-17-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Madeline Cooper	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 33'	Sample Length: 33'		Bedform: Gravel Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	1	33	41	52	49	32	22	16	42	44
2	15	1	75	36	19	41	35	59	94	44
3	9	44	77	8	65	33	31	31	27	8
4	62	33	56	24	20	6	40	14	15	24
5	59	16	33	69	20	31	64	21	11	11
6	21	14	34	24	1	8	30	27	22	10
7	36	10	35	26	34	93	12	17	29	16
8	9	9	28	57	19	37	40	14	11	18
9	52	23	32	81	68	16	58	69	22	34
10	8	13	4	17	18	27	45	48	1	42

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	4
Gravel	2	2-4	0
	4	4-5.8	1
	6	6-8	1
	8	8-11	9
	11	11-16	10
	16	16-22.6	14
	22	22-32	17
	32	32-45	23
	45	45-64	11
Cobble	64	64-90	8
	90	90-128	2
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	27
D84	45	D84	52
D90	45	D90	62

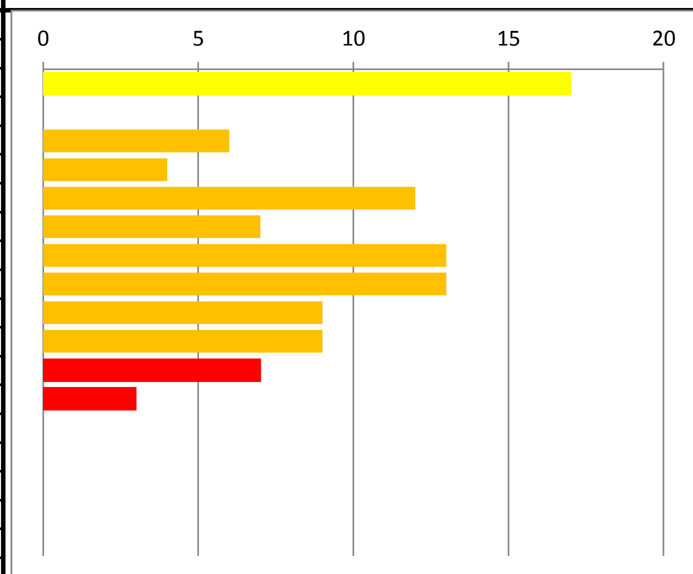
% Fines (<2 mm)
4

Station: 21,629			Page: 3 of 5
			Date: 10-17-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 37'	Sample Length: 37'		Bedform: Gravel Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	25	32	52	34	7	28	31	11	22	1
2	19	8	51	17	8	38	9	80	63	1
3	35	25	39	8	121	20	80	16	7	17
4	12	9	46	11	46	28	32	1	29	94
5	4	16	47	27	5	65	61	14	74	21
6	7	16	1	1	11	52	16	50	26	24
7	10	1	70	111	19	9	8	5	27	1
8	15	1	29	78	84	15	9	1	1	1
9	1	4	17	10	5	7	20	35	35	1
10	1	1	1	8	4	38	21	10	30	1

Wet

Substrate	Size Class		Actual Measured B-Axis (mm)	Tally
Bedrock				
Silt			0.0062	
Sand			<2	17
Gravel	2		2-4	0
	4		4-5.8	6
	6		6-8	4
	8		8-11	12
	11		11-16	7
	16		16-22.6	13
	22		22-32	13
	32		32-45	9
	45		45-64	9
Cobble	64		64-90	7
	90		90-128	3
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	16	D50	16
D84	45	D84	47
D90	45	D90	63

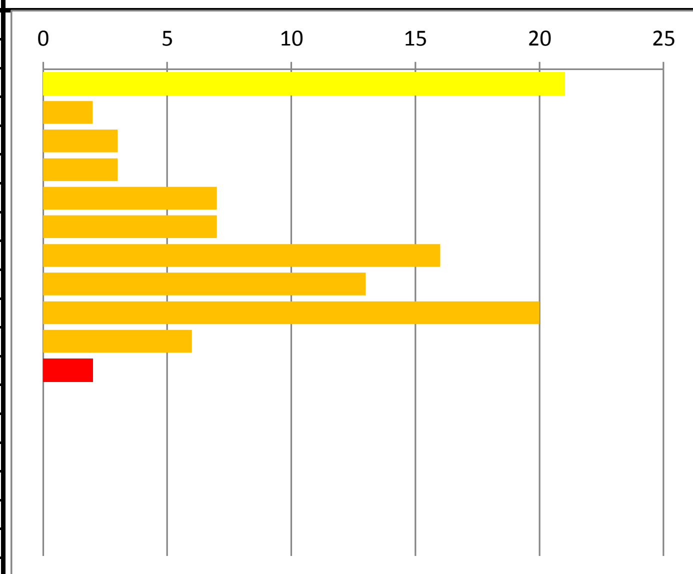
% Fines (<2 mm)
17

Station: 21,960 (22,027-67'		Page: 2 of 5 Date: 10-17-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Will Logsdon	Counter: Madeline Cooper	Counter: Connor McIntee
Sample Width: 34'	Sample Length: 34'	Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	18	1	37	1	25	14	4	1	1	1
2	30	7	13	27	33	18	21	3	1	1
3	16	41	10	54	17	4	36	18	10	1
4	50	14	42	21	36	20	41	7	1	1
5	20	1	1	14	31	3	45	21	22	1
6	15	17	28	54	21	70	29	25	38	14
7	40	34	36	35	36	9	25	8	1	1
8	1	21	34	17	40	6	29	1	23	1
9	1	8	19	1	45	1	70	11	24	10
10	31	4	20	46	42	37	44	44	39	8

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	21
Gravel	2		2-4	2
	4		4-5.8	3
	6		6-8	3
	8		8-11	7
	11		11-16	7
	16		16-22.6	16
	22		22-32	13
	32		32-45	20
	45		45-64	6
Cobble	64		64-90	2
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	16	D50	17
D84	32	D84	38
D90	45	D90	52

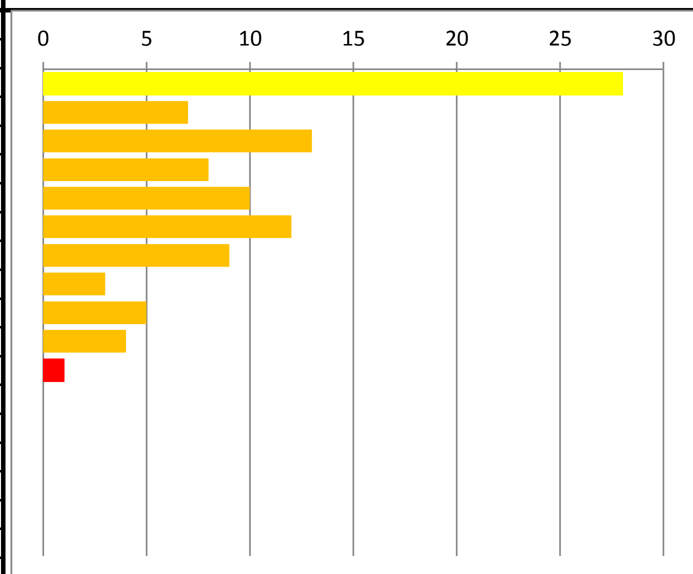
% Fines (<2 mm)
21

Station: 22,027			Page: 1 of 5
			Date: 10-17-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Madeline Cooper	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 24'	Sample Length: 24'		Bedform: Bar

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	6	11	8	34	6	1	10	21
2	1	1	3	7	5	1	19	13	52	14
3	1	3	11	1	6	44	1	16	17	9
4	1	5	5	14	8	6	5	4	14	49
5	1	3	4	5	15	12	1	24	47	38
6	1	4	1	5	2	42	21	1	65	10
7	1	7	1	4	11	2	1	1	19	5
8	1	8	1	1	17	5	9	44	8	6
9	1	21	1	3	7	1	19	8	23	2
10	9	1	1	11	13	4	25	59	13	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	28
Gravel	2	2-4	7
	4	4-5.8	13
	6	6-8	8
	8	8-11	10
	11	11-16	12
	16	16-22.6	9
	22	22-32	3
	32	32-45	5
	45	45-64	4
Cobble	64	64-90	1
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	6	D50	6
D84	16	D84	19
D90	22	D90	25

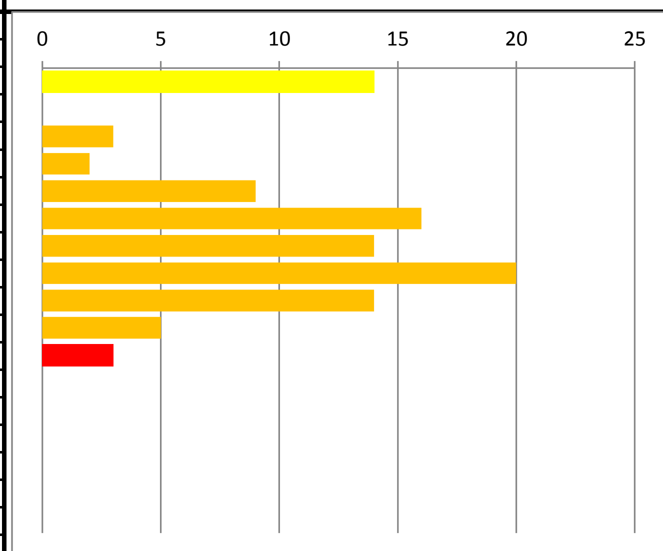
% Fines (<2 mm)
28

Station: 22,339 (Tape Station 48)		Page: 5 of 5 Date: 10-31-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Connor McIntee	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 30'	Sample Length: 30'	Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	19	26	8	41	68	8	38	8	11	1
2	14	45	1	54	17	38	23	24	5	1
3	9	1	1	15	17	19	29	12	4	5
4	23	15	51	1	27	23	36	26	14	1
5	14	1	1	19	15	41	23	37	19	40
6	1	41	27	38	11	6	20	41	31	46
7	13	1	75	9	7	31	23	8	27	12
8	1	46	1	27	11	9	19	34	65	38
9	1	40	13	25	25	18	30	21	16	32
10	20	26	19	10	16	24	10	12	12	12

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	14
Gravel	2	2-4	0
	4	4-5.8	3
	6	6-8	2
	8	8-11	9
	11	11-16	16
	16	16-22.6	14
	22	22-32	20
	32	32-45	14
	45	45-64	5
Cobble	64	64-90	3
	90	90-128	0
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	0
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	16	D50	19
D84	32	D84	38
D90	32	D90	41

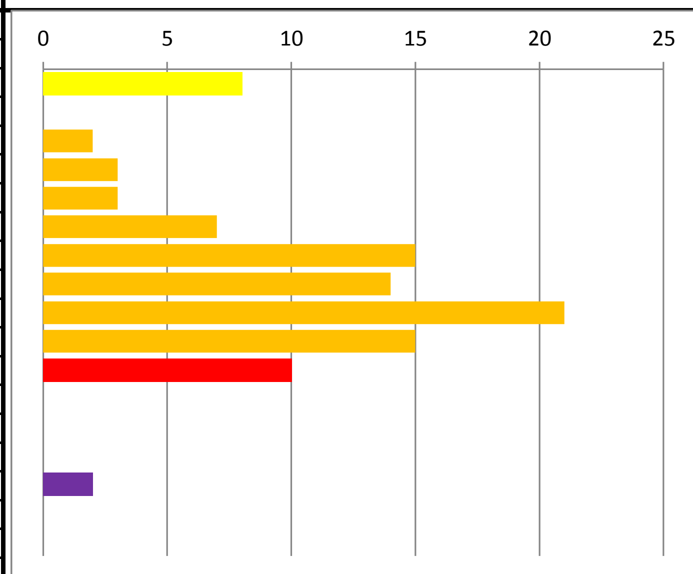
% Fines (<2 mm)
14

Station: 22,589			Page: 4 of 5
			Date: 10-31-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Connor McIntee	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 36'	Sample Length: 36'		Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	12	17	20	40	8	26	24	31	35	6
2	47	48	36	1	40	19	26	54	21	24
3	82	43	14	14	20	41	23	53	41	8
4	39	61	23	13	52	36	38	39	81	1
5	14	64	29	36	48	35	79	34	42	15
6	1	16	28	17	300	40	30	56	51	18
7	1	35	18	18	66	14	51	42	21	43
8	1	6	4	39	83	74	70	43	19	25
9	20	5	22	72	23	17	1	300	64	62
10	31	7	9	1	45	51	59	16	46	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	8
Gravel	2		2-4	0
	4		4-5.8	2
	6		6-8	3
	8		8-11	3
	11		11-16	7
	16		16-22.6	15
	22		22-32	14
	32		32-45	21
	45		45-64	15
Cobble	64		64-90	10
	90		90-128	0
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	2
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	22	D50	30
D84	45	D84	54
D90	64	D90	64

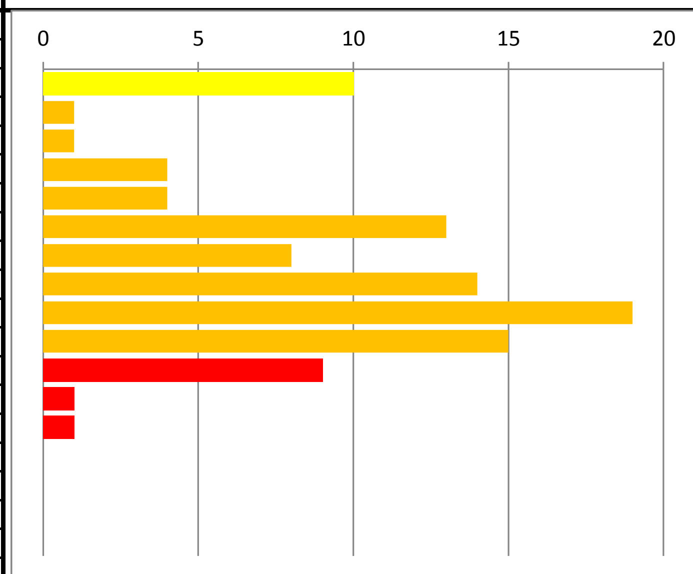
% Fines (<2 mm)
8

Station: 22,925			Page: 3 of 5
			Date: 10-31-13
Stream: Napa River		Project: Rutherford Reach	
Recorder: Will Logsdon	Counter: Willis Logsdon		Counter: Connor McIntee
Sample Width: 50'	Sample Length: 50'		Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	32	26	22	48	54	85	64	61	9	31
2	34	19	24	88	40	62	61	160	38	46
3	9	11	17	62	4	15	78	38	31	42
4	1	14	105	80	71	6	25	61	24	53
5	1	16	41	28	34	14	43	1	1	64
6	7	24	42	40	54	64	51	15	14	21
7	1	7	11	43	14	21	14	40	28	40
8	50	26	14	20	30	38	59	12	23	38
9	34	32	7	26	68	13	9	18	21	1
10	1	1	2	1	9	62	12	34	46	1

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	10
Gravel	2		2-4	1
	4		4-5.8	1
	6		6-8	4
	8		8-11	4
	11		11-16	13
	16		16-22.6	8
	22		22-32	14
	32		32-45	19
	45		45-64	15
Cobble	64		64-90	9
	90		90-128	1
	128		128-180	1
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	22	D50	26
D84	45	D84	61
D90	64	D90	45

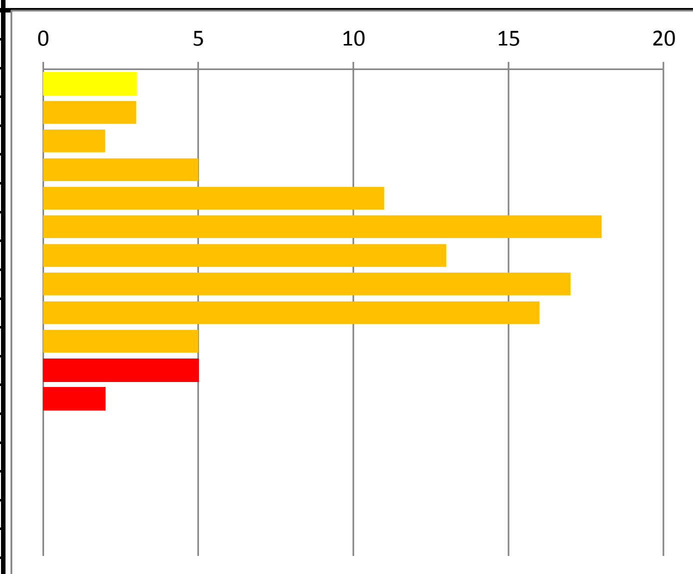
% Fines (<2 mm)
10

Station: 23,796 (if DT 730 is correct)		Page: 2 of 5 Date: 10-31-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Gretchen Hayes	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 34'	Sample Length: 34'	Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	31	39	39	45	10	20	20	100	33	15
2	15	29	61	38	9	22	32	19	35	10
3	28	31	72	4	36	78	31	27	40	5
4	35	71	15	34	16	57	1	26	20	9
5	20	8	7	14	11	38	28	40	12	2
6	53	7	10	8	20	45	19	31	19	1
7	11	12	6	24	31	18	14	33	15	1
8	95	8	11	34	28	29	26	21	13	12
9	65	13	7	11	25	44	41	8	15	3
10	65	12	6	18	13	19	25	10	8	2

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)		Tally
Bedrock				
Silt			0.0062	
Sand			<2	3
Gravel	2		2-4	3
	4		4-5.8	2
	6		6-8	5
	8		8-11	11
	11		11-16	18
	16		16-22.6	13
	22		22-32	17
	32		32-45	16
	45		45-64	5
Cobble	64		64-90	5
	90		90-128	2
	128		128-180	0
	180		180-256	0
Boulder	256		256-512	0
	512		512-1024	0
	1024		1024-2048	0
	2048		2048-4096	0
Total:				100



	Size Class		Actual (mm)
D50	16	D50	20
D84	32	D84	39
D90	45	D90	45

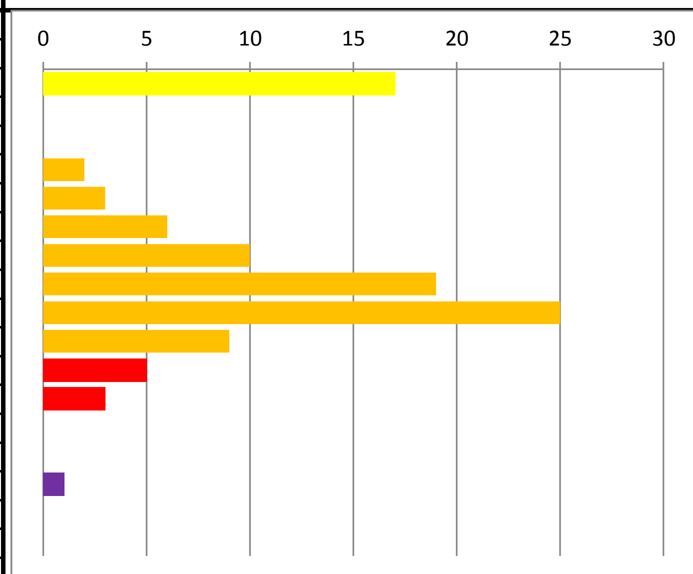
% Fines (<2 mm)
3

Station: 24,020 (DT 730 (check point to insure correctness of location) elevation 158.94)		Page: 1 of 5 Date: 10-31-13
Stream: Napa River	Project: Rutherford Reach	
Recorder: Connor McIntee	Counter: Willis Logsdon	Counter: Connor McIntee
Sample Width: 26'	Sample Length: 26'	Bedform:

GRID	1	2	3	4	5	6	7	8	9	10
1	1	1	13	31	17	39	50	103	23	10
2	1	18	14	26	40	42	29	47	71	18
3	1	1	21	270	87	20	30	56	39	40
4	1	11	60	40	58	31	25	10	27	32
5	1	14	27	31	41	43	80	26	51	19
6	1	12	16	26	31	35	41	40	45	39
7	28	1	35	10	40	38	23	7	22	44
8	1	1	13	73	100	32	41	61	25	71
9	1	1	1	62	32	25	40	6	21	35
10	1	1	1	97	16	26	42	37	16	36

Wet

Substrate	Size Class	Actual Measured B-Axis (mm)	Tally
Bedrock			
Silt		0.0062	
Sand		<2	17
Gravel	2	2-4	0
	4	4-5.8	0
	6	6-8	2
	8	8-11	3
	11	11-16	6
	16	16-22.6	10
	22	22-32	19
	32	32-45	25
	45	45-64	9
Cobble	64	64-90	5
	90	90-128	3
	128	128-180	0
	180	180-256	0
Boulder	256	256-512	1
	512	512-1024	0
	1024	1024-2048	0
	2048	2048-4096	0
Total:			100



	Size Class		Actual (mm)
D50	22	D50	27
D84	45	D84	47
D90	45	D90	61

% Fines (<2 mm)
17

VII. Spawning Gravel Permeability

Spawning Gravel Permeability

The TMDL target for spawning gravel permeability at riffle crests on the mainstem Napa River is >= 7,000 cm/hr (Napolitano et al. 2009). Higher rates of gravel permeability provides for greater survival to emergence of salmonid embryos. The summarized results of the permeability analysis and the mortality index calculation performed by the Napa County Resource Conservation District for the riffle crest cross sections surveyed in 2004 are given in the table below.

Spawning gravel permeability studies are complementary monitoring studies to the Project conducted with separate funding sources by the Napa County Resource Conservation District (Napa RCD) at sites throughout the Napa River watershed to characterize the quality of spawning habitat. The Project coordinates with the Napa RCD to obtain data collected at sites within the Rutherford Reach for evaluation of changes over time.

In 2004, the Napa RCD collected permeability data at the ten (10) baseline cross section transect survey locations, which were located at riffle crests in the Rutherford Reach. The results of the cross section transect surveys were reported in **Appendix D. Study V of the 2012 Monitoring Report.** In 2004, the results of the permeability and survival index surveys ranked one (1) of the ten (10) cross sections as good, while five (5) were ranked fair, and four (4) were ranked as poor.

In the winter of 2012-2013, the Napa County Resource Conservation District conducted repeat gravel permeability studies at two of the original 2004 sites in the Rutherford Reach as part of a larger study along the mainstem Napa River. The repeat measurements do not demonstrate a clear trend in spawning gravel permeability at the long-term monitoring sites in the Rutherford Reach. The RCD is working with Stillwater Sciences to determine the how much noise is present in the data, and the statistical significance of the results at multiple sites sampled along the Napa River. Repeat sampling will be conducted in summer 2014, and the results will be reported thereafter.

The results of the spawning gravel permeability and scour chain studies conducted in the Rutherford Reach can be compared against other sites on the Napa River throughout the watershed in the *Napa River Sediment TMDL Monitoring Program: Summary Report of Pilot Implementation* (September 2013), prepared by Stillwater Sciences for the Napa County Resource Conservation District and the State Water Quality Control Board. Napa River Pebble count data from these studies augmented the monitoring data collected for the Project. This report is available online: www.naparcd.org/documents/NapaTMDLPilotMon_TechMemo_2013_FINAL_30SEP2013.pdf.

River Station		SURVIVAL INDEX	SITE PERMEABILITY (Target >7,000 cm/hr)	RANK
2004	2012	2004	2004	2004
21,629		33%	2,290.5	poor
21,158		38%	3,240.0	fair
20,628		53%	9,292.5	good
15,950		44%	4,988.5	fair
15,730		45%	5,208.0	fair
8,830	8,810	36%	2,818.0	fair
8,630		31%	2,079.0	poor
8,280	8,170	26%	1,462.0	poor
7,830	7,810	38%	3,204.5	fair
7,700	7,610	35%	2,782.0	poor

Reach River Station Key for TMDL Studies Conducted in the Napa River Rutherford Reach

Napa River TMDL Study Sample Site*	Napa River Rutherford Reach River Station	Date Sampled	Napa River Rutherford Reach River Station	Date Sampled
M5-1	8,830	11/30/2004	8,810	12/10/2012
M5-2	8,280	12/1/2004	8,170	12/10/2012
M5-3	7,830	12/1/2004	7,810	12/10/2012
M5-4	7,700	12/1/2004	7,610	12/10/2012
M5-5	-	ND	7,270	12/10/2012
M6-1	-	ND	4,930	12/13/2012

**Napa River Sediment TMDL Monitoring Program: Summary Report of Pilot Implementation* (Stillwater Sciences, 2013)

IX. Residual Pool Depth Associated with Installed Instream Habitat Structures

Residual Pool Depth Associated with Instream Structures

Annual Survey Results

2011

Residual pool depth, shelter complex, and shelter cover associated with instream structures was measured for the first time in June 2011 during the annual stream survey when those structures, which were first installed in 2010 in Reaches 2-3, had experienced one year of winter flow. Bench logs installed on terraces and high benches were not assessed because they were not in the main flow channel. One boulder cluster was installed in 2010.

2012

Shelter complex, and shelter cover associated with instream structures was measured for the second time in June 2012 for those structures installed in 2010, and for the first time for those structures installed in Reach 4 west in 2011. Bench logs installed on terraces and high benches were not assessed because they were not in the main flow channel. Several more boulder clusters were installed in Phase 3 Reach 4 west. For those structures with two years worth of measurements, no discernible trend in shelter complex or shelter cover rating can be made.

Residual pool depth was measured only at those structures that had been installed in 2011, so no comparison of trends in changes in residual pool depths can yet be made.

2013

In June 2013, residual pool was measured at the majority of instream structures installed in Reaches 1-4, and in Reach 8 North.

Label	Type	Residual Pool Depth (feet)			Shelter Complex		Shelter Cover	
		6/2/2011	6/5-6/2012	6/4-5/2013	6/2/2011	6/5-6/2012	6/2/2011	6/5-6/2012
		20 cfs	6 cfs		20 cfs	6 cfs	20 cfs	6 cfs
WD-22200-R	Spider Log	1.1	NA	NA	1	2	5	20
WD-21900-L	Spider Log	1.4	NA	0.1	1	NA	10	NA
WD-21850-R	Toe Log	4.4	NA	3.7	2	2	30	25
WD-21670-L	Spider Log	1.9	NA	1.7	2	2	30	20
WD-19475-R	Toe Log	2.5	NA	4.5	2	NA	40	NA
BC-18250-M	Boulder Cluster	3.4	NA	1.1	1	NA	10	NA
WD-17700-R	Root Wad	NA	NA	NA	NA	NA	NA	NA
WD-17425-R	Root Wad	0.2	NA	0.6	1	2	25	30
WD-17225-R	Root Wad	2.2	NA	2.8	30	2	50	20
WD-16900-R	Root Wad	NA	NA	0.9	NA	2	NA	20
WD-16125-L	Root Wad	NA	2.6	3.5	3	2	40	40
BC-15910-R	Boulder Cluster	-	-	1.1				
BC-15790-R	Boulder Cluster	-	-	0.5				
BC-15275-R	Boulder Cluster	-	-	3.8				
WD-15250-R		-	-	2.6				
WD-14060-R		-	-	1.3				
BC-13980-M	Boulder Cluster	-	-	0.1				
WD-13650-L	Low Profile Log	-	1.3	NA				

Label	Type	Residual Pool Depth (feet)			Shelter Complex		Shelter Cover	
		6/2/2011	6/5-6/2012	6/4-5/2013	6/2/2011	6/5-6/2012	6/2/2011	6/5-6/2012
		20 cfs	6 cfs		20 cfs	6 cfs	20 cfs	6 cfs
WD-13590-L	Low Profile Log	-	1.6	NA	-	2	-	10
WD-13290-R		-	-	5.83	-	2	-	20
WD-13210-R		-	-	5.1				
BC-13190-R	Boulder Cluster	-	-	5.1				
WD-13070-L	Root Wad	-	NA	0.2	-	2	-	20
BC-13050-L	Boulder Cluster	-	NA	0.3	-	NA	-	NA
WD-12990-L	Low Profile Log	-	NA	Buried	-	NA	-	NA
BC-12930-L	Boulder Cluster	-	2.1	2.3	-	NA	-	NA
WD-12850-L	Low Profile Log	-	NA	1.9	-	NA	-	NA
BC-12825-L	Boulder Cluster	-	2.9	3.1	-	NA	-	NA
WD-12800-L	Root Wad	-	1.3	1.6	-	2	-	30
WD-12550-L	Low Profile Log	-	NA	NA	-	NA	-	NA
WD-12420-L	Root Wad	-	1.9	3.0	-	2	-	30
BC-12400-L	Boulder Cluster	-	2.1	3.7	-	1	-	10
WD-6100-L		-	-	1.5				
WD-5880-L		-	-	3.8				
BC-5875-L	Boulder Cluster	-	-	0.8				

X. Large Woody Debris Surveys

Annual Large Woody Debris Survey Results

Large Woody Debris (LWD) occurrences greater than one foot in diameter and six feet in length are mapped each June during the annual stream survey. Attributes such as fish habitat and geomorphic functions are recorded for each occurrence. The annual June LWD survey results can be compared to the results of the surveys of the habitat functions of installed structures assessed during a winter and a spring stream flow in the first year following installation, which are provided in the Seasonal Salmonid Habitat Survey Reports in Appendix D. Study IX.

2009

In 2009 154 occurrences of LWD were mapped, with 62% (95) being single pieces, 31% (47) being accumulations of between 2-9 pieces, and the remaining 8% (12) being jams of greater than 10 pieces. All wood was naturally recruited as no restoration installation had yet been installed.

2010

In 2010, 74% (148) of the 201 occurrences of LWD were single pieces, while 24% (49) were accumulations of 2-9 pieces, and the remaining 2% consisted of four (4) jam accumulations of greater than 10 pieces of wood. In 2010, there were about 50% more single pieces of LWD mapped in the channel versus 2009 (148 versus 96), while accumulations of 2-9 pieces remained relatively steady (49 versus 47). Jams of greater than 10 pieces of LWD reduced from 12 to 4 occurrences from 2009 to 2010 indicating that channel flows disseminated and dispersed some of the jams. In 2010, ninety percent (93%) of the debris were naturally recruited while 7% were restoration installations, all consisting of bench logs installed on terraces in Reaches 1-2 east bank, which function to provide bench stability and limited high flow refugia. About one-third of all mapped LWD functioned to provide winter high flow refugia (35%), while 13% of the LWD provided summer low flow refugia. About 6% of all LWD produced hydraulic constriction in the channel to produce increased flow velocities and feeding lane conditions for fish. Fifteen percent (15%) of all LWD caused pool scour; while 32% served to provide bank stability. The majority of LWD were nearly equally split between pools (36%) and terraces (31%), with the remaining 33% associated with other bedforms. Almost all (95%) of the LWD was dead, with 5% rooted and alive.

2011

In 2011, 77% (138) of the 179 occurrences of LWD were single pieces, while 20% (35) were accumulations of 2-9 pieces, and the remaining 3% consisted of five (5) jam accumulations of greater than 10 pieces of wood. One boulder cluster was installed as an instream structure that is evaluated for fish habitat and geomorphic function with the same attributes as installed LWD. In 2011, there were 14 fewer accumulations mapped versus 2010 (35 versus 49) continuing a downward trend in accumulations since 2009. One more jam of greater than 10 pieces of LWD was mapped in 2011 than 2010 (5 versus 4). In 2011, 78% of the LWD were naturally recruited while 22% (40) were restoration installations. About 19% of all mapped LWD functioned to provide winter high flow refugia, nearly half of the percent mapped in 2010: in 2010, 70 occurrences, versus 34 occurrences in 2011. This was true even though 76% of the mapped occurrences providing winter refugia were restoration installations. By contrast the percent of all LWD occurrences providing summer low flow refugia more than doubled from 13% in 2010 to 34% in 2011, from 26 in 2010 to 60 in 2011. Only 10% of all occurrences providing summer refugia were attributed to restoration installations. About 23% of all LWD produced hydraulic constriction in the channel to produce increased flow velocities and feeding lane conditions for fish. Twenty eight percent (28%) of all LWD caused pool scour; while 41% served to provide bank stability.

2012

In 2012, 83% (157) of the 189 occurrences of LWD were single pieces, while 15% (29) were accumulations of 2-9 pieces, and the remaining 3% consisted of three (3) jam accumulations of greater than 10 pieces of wood. Single pieces of wood as a percent of all LWD occurrences have remained relatively steady from 2010-2012, ranging from 74-81%. The percent of accumulations of 2-9 pieces of wood have trended downward between 2009-2012, from 31%, to 24%, to 20%, to 15%. Only 3 jams of greater than 10 pieces of LWD were mapped in 2012. Jams have remained consistently between 2-3% of all LWD occurrences mapped from 2010-2012. The lack of flood flows since 2010 2012 may account for the continuing downward trend in natural wood loading and associated accumulations of large pieces of wood.

The percent of LWD mapped attributed to restoration installations has increased each year. In 2012, the 52 LWD and boulder cluster installations installed between 2009-2011 accounted for 27% of all LWD occurrences mapped. In 2012, seventy five (75%) percent of the LWD were naturally recruited while 25% were restoration installations in Reaches 1-4 upstream of the Rutherford Cross Road. About 15% of all mapped LWD functioned to provide winter high flow refugia, relatively consistent with the previous year. LWD providing summer refugia also remained consistent at 38% of all occurrences versus 34% in 2011. This slight rise in percent of occurrences providing summer refugia can be attributed to installed structures. About 24% of all LWD produced hydraulic constriction in the channel to produce increased flow velocities and feeding lane conditions for fish, also consistent with 2011. In 2012 (29%) of all LWD caused pool scour versus 28% in 2011. In 2012; 33% served to provide bank stability. The consistency in results from 2011 could be attributed to the lack of change due to lack of channel flow during the preceding drought year.

The limited data set of two years of habitat and geomorphic assessment of installed LWD structures indicates that 6 of the 30, or 20%, of the installed LWD and boulder clusters were performing highly with consistent annual provision of summer refugia for fish, hydraulic constriction of streamflow to produce high velocity feeding lanes, and pool scour to create cover. This excludes the 22 bench and terrace logs that were installed and are functioning to prevent erosion of the surface of constructed benches and provide winter high flow refugia for fish until vegetation becomes established. Nine installations (30% of the total 30) provided limited fish habitat and geomorphic function. The boulder cluster installed in 2010 at station 18,250 used undersized rocks that did not affect streamflow. Boulder clusters installed in 2011-2012 increased the rock size to 3-4 tons each in order to increase the effect on channel hydraulics and promote gravel sorting and pool scour. LWD structures that silted in or whose root wads were suspended above the low flow channel also provided limited geomorphic and habitat function. For example, two of the three spider logs installed at stations 22,000 and 21,900 in association with the widening of the channel on the west bank at the alcove became buried. This may be attributed to the dropping out of sediment caused by the lowering of velocities due to the widening of the channel. All other installations provided some fish and geomorphic function as intended.

2013

By the end of construction 2012, a total of 66 LWD instream habitat structures had been installed in the Project reach. During the annual stream survey in June 2013, 65 of the structures were located and evaluated for geomorphic and salmonid habitat function. One of low profile logs was buried and precluded assessment for salmonid habitat function. Eighteen (18) of the twenty-one (21), or 90% of the installed boulder clusters were located. Pool scour precluded some of the boulders from being found or evaluated. In some cases installed boulders were indistinguishable from pre-project rip rap. Finally, the boulder field in Reach 3 was nearly completely buried.

In 2013, LWD installations constituted more than 1 out of every 3 LWD occurrences (66 of 180) documented throughout the Project reach. This represents an increase in the percentage of installed versus naturally recruited woody debris compared to the prior year survey in June 2012 survey, when 1 of every 4 LWD occurrences was an installed structure (47 of 189).

The results of the June 2013 LWD survey show that the percent of the 66 LWD installations providing the following fish habitat and geomorphic and salmonid habitat functions are as follows (in order of decreasing percentage): 46% bank stability, 40% winter high flow refugia, 25% summer refugia, 20% pool scour, 18% hydraulic channel constrictions creating swift water feeding lanes, 15% spawning gravel recruitment.

Bank Stability

Approximately half the installed LWD structures provided bank stability in 2013. In 2012; 31% of all LWD occurrences served to provide bank stability, remaining consistent with the majority of the survey years. Since 2011, the percent of LWD occurrences providing bank stability has been roughly equal between installed and natural occurrences.

Winter High Flow Refugia

About 40% the installed LWD structures provided winter high flow refugia 2013. The percentage of all LWD providing winter high flow refugia more than doubled from 2012-2013. About 34% of all mapped LWD functioned to provide winter high flow refugia, double that of 2012, but relatively consistent with 2010. In 2013, the percentage of installed versus recruited LWD providing high flow refugia was nearly 43% versus 57% respectively. These results may stem from the evaluation of more LWD that had been deposited at relatively higher locations in the channel due to the flood channel filling flood flows in December 2012.

Summer Low Flow Refugia

While the percentage of installed LWD is increasing relative to the total number of LWD occurrences documented, the percent of all occurrences providing summer refugia has remained steady since 2011. Overall, LWD providing summer refugia remained consistent at 36% of all occurrences. The percent of naturally recruited LWD providing summer refugia is several times that of installed LWD structures, however the difference is decreasing. The percent of the installed LWD structures providing summer refugia has increased each year, from 15% in 2011 to 25% in 2013. In 2011, 1of every 9 LWD providing summer refugia was an installed structure. By 2013, 1 of every 3 LWD occurrences providing summer refugia was an installed habitat structure.

Hydraulic Constrictions and High Velocity Feeding Lanes

Whereas the percent of all LWD occurrences producing hydraulic constriction to create feeding lanes decreased 2013 (18%) relative to 2011(23%) and 2012 (24%), the percentage of the installed LWD structures creating hydraulic constrictions and feeding lanes remained steady. This may indicate that the installed structures impinging on the channel are less subject to mobilization relative to unsecured wood when flow velocities increase.

In 2013 (25%) of all LWD caused pool scour versus 28% in 2011 and 2012. The majority of pool scouring LWD remains attributable to natural LWD (71% versus 29%). Adaptive design changes of installed LWD, including installation lower in elevation, closer to the thalweg, and farther out into the channel, may be the cause for the doubling of percent in the installed LWD causing pool scour and hydraulic constriction.

Pool Scour

The percentage of the installed LWD structures providing pool scour remained steady in 2013 compared to prior years.

Spawning Gravel Recruitment

Spawning gravel recruitment was attributed to 12% of all LWD occurrences, and is roughly equally attributed to installed and natural occurrences.

Interestingly, the distribution of installed and naturally recruited LWD relative to channel cross locations remained steady every year since 2010, despite variability in wood loading between 178 – 2011 occurrences, and steady increases in the percent of installed structures. Half of all LWD occurrences have been documented on the left/east side of the channel, while a third on the right/west, 12% in the middle, and remaining 6% spanning or suspended above the channel.

In 2013, 74% (132) of the 180 occurrences of LWD were single pieces a minimum of one foot in diameter and six feet in length, while 24% (43) were accumulations of 2-9 pieces, and the remaining 3% consisted of five (5) accumulations of greater than 10 pieces of wood. Two of these large accumulations are toe log structures installed at stations 21,850 and 19,475, to provide fish cover and protect the base of bank from erosion. The three remaining jams were flood deposited in Reach 8 at stations 7,700 (Right/West) at the outfall to the Foley Johnson swale; 6,800 (East/Left) on the mid channel bar at the upstream end of the Sequoia Grove Bank Stabilization and the Secondary Channel; and at 6,600 (Right/West) the downstream end of the Sequoia Grove Bank Stabilization. Previous annual surveys demonstrated that the LWD wracking has consistently occurred at station 7,700. In addition, five years of surveys have demonstrated that the largest percent of LWD in the Rutherford Reach has always accumulated in Reaches 8 between stations 8,800 and 6,300, between the St. Supery and Davis properties on the west and along the Wilsey property on the east. Unlike in previous years, the jams at stations 6,800 and 6,600 at the upstream and downstream end of the Sequoia Grove bank stabilization were localized, instead of dispersed throughout the mid channel bar and left floodplain. This is because of the slow water hydraulic conditions created by the widening of the channel through the bank setback at Sequoia Grove, and the creation of the secondary channel linear wetland on the opposite east bank along the Wilsey property. The channel filling flows of December 2012 delivered large amounts of wood to Reach 8, but instead of depositing throughout the channel, the wood floated into the slow water area created by setback bank at Sequoia Grove. The bifurcated channel created through the construction of the linear wetland secondary channel on the opposite east bank did not recruit appreciable numbers of LWD. The jam at station 6,600 was 200 feet wide and approximately 18 feet tall, consisting of several hundred pieces of debris that filled the west channel at the downstream end of the newly graded Sequoia Grove bank stabilization. The Flood District cleared this pile twice following the high flows, and mulched the debris jam to reduce flood risk, provide fish passage, and to augment restoration plantings with organic material.

Station 7,700 LWD Jam January 2013



Station 6,600 Sequoia Grove LWD Jam 1-2-2013

Stations 6,800 – 6,600 Sequoia Grove LWD Jams 1-16-2013

Station 6,800 LWD Jam June 2013

Large Woody Debris Structure Persistence (# years, % persisting)

Instream structures were first installed in the summer of 2010 as part of Phase 1b: Reaches 1-2 West, and Phase 2: Reach 3 construction. The maintenance status of Large Woody Debris (LWD) structures was assessed for the first time in June 2011. The performance standard is 75% persistence of installed instream habitat enhancement structures.

2012

As of June 2012, 100% of the large woody debris and boulder clusters installed in 2009-2011 had persisted with no need for maintenance.
In 2012, the survey field team also noted the multi-annual persistence of 18 occurrences (17 single pieces, 1 accumulation 2-9) of naturally occurring LWD. These persistent logs represent 13% of all naturally occurring LWD mapped in 2012. Several persistent occurrences had well-established colonies of nut sedge growing on them. One piece of wood at cross section 8,270 was known to have remained in place at least since 2004.

8,270 Cross Section LWD Persisting from prior to 2004 through 2013

2013

As of June 2013, 98% of the large woody debris installed in 2009-2011 had persisted with no need for maintenance. In 2013, the survey field team also noted the multi-annual persistence of 36 occurrences of naturally occurring LWD. These persistent logs represent 32% of all naturally occurring LWD mapped in 2013.

INSTREAM HABITAT STRUCTURE SUMMARY

LARGE WOODY DEBRIS (LWD)	**2009**	**2010**	**2011**	**2012**	**2013**
Installed per Year	15	24	8	19	0
Cumulative Installed		15	39	47	66
Evaluated / Found		15	39	47	65
Not Evaluated / Not Found	-	0	0	0	
Persisting			100%	100%	98%

BOULDER CLUSTERS (BC)	**2009**	**2010**	**2011**	**2012**	**2013**
Installed per Year	0	1	4	16	
Cumulative Installed		0	1	5	21
Evaluated / Found	-	-	1	5	19
Not Evaluated / Not Found	-	-	0	0	2
Persisting			100%	100%	90%

YEAR	**2009**	**2010**	**2011**	**2012**	**2013**
Total BC & LWD Occurrences	**154**	**201**	**179**	**194**	**199**
BOULDER CLUSTERS (BC)	0	0	1	5	19
LARGE WOODY DEBRIS (LWD)	**154**	**201**	**178**	**189**	**180**
Installed	0	15	39	47	65
Recruited	154	186	139	142	114

ALL LWD OCCURRENCES

Percent of All Large Wood Debris Occurrences

Total LWD Occurrences	**2009**	**2010**	**2011**	**2012**	**2013**
Installed	0%	7%	22%	25%	36%
Recruited	100%	93%	78%	75%	63%

BANK EROSION POTENTIAL	**2009**	**2010**	**2011**	**2012**	**2013**
Yes	7	14	11	2	0
No	147	187	168	184	0
TOTAL	**154**	**201**	**179**	**186**	**0**

LWD STATUS	**2009**	**2010**	**2011**	**2012**	**2013**
Dead	143	192	171	181	0
Live	11	9	7	5	0
Boulder Cluster	0	0	1	0	0
TOTAL	**154**	**201**	**179**	**186**	**0**

ALL LWD OCCURRENCES

Number of Large Wood Debris Occurrences

CONFIGURATION	**2009**	**2010**	**2011**	**2012**	**2013**
Total LWD Occurrences	**154**	**201**	**178**	**189**	**180**
Single	95	148	138	157	132
Accumulation 2 < 9	47	49	35	29	43
Jam > 10	12	4	5	3	5

RECRUITMENT MECHANISM	**2009**	**2010**	**2011**	**2012**	**2013**
Total LWD Occurrences	**154**	**201**	**178**	**189**	**179**
Installed	0	15	39	47	65
Recruited	154	186	139	142	114
Flood Deposited	118	182	134	126	96
Bank Erosion	26	0	0	0	0
Fallen in Place	10	4	5	16	13
Other	0	0	0	0	5

Percent of All Large Wood Debris Occurrences

	2009	**2010**	**2011**	**2012**	**2013**
Total LWD Occurrences	**100%**	**100%**	**100%**	**100%**	**100%**
Single	62%	74%	78%	83%	73%
Accumulation 2 < 9	31%	24%	20%	15%	24%
Jam > 10	8%	2%	3%	2%	3%

	2009	**2010**	**2011**	**2012**	**2013**
Total LWD Occurrences	**100%**	**100%**	**100%**	**100%**	**100%**
Installed	0%	7%	22%	25%	36%
Recruited	100%	93%	78%	75%	64%
Flood Deposited	77%	91%	75%	67%	54%
Bank Erosion	17%	0%	0%	0%	0%
Fallen in Place	6%	2%	3%	8%	7%
Other	0%	0%	0%	0%	3%

ALL LWD OCCURRENCES

Number of Large Wood Debris Occurrences / Percent of All Large Wood Debris Occurrences

BEDFORM ASSOCIATION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**154**	**201**	**178**	**189**	**180**	**100%**	**100%**	**100%**	**100%**	**100%**
Pool/Glide	102	73	54	74	56	66%	36%	30%	39%	31%
Riffle	8	6	14	11	6	5%	3%	8%	6%	3%
Gravel Bar	27	34	19	22	21	18%	17%	11%	12%	12%
Side Channel	0	2	9	0	13	0%	1%	5%	0%	7%
Tributary Channel	0	0	1	1	1	0%	0%	1%	1%	1%
Perched	0	0	0	0	15	0%	0%	0%	0%	8%
Bank	1	17	14	9	24	1%	8%	8%	5%	13%
Terrace	13	63	65	45	44	8%	31%	37%	24%	24%
Unspecified	3	6	2	27	0	2%	3%	1%	14%	0%

LOCATION IN CHANNEL	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**154**	**201**	**178**	**189**	**180**	**100%**	**100%**	**100%**	**100%**	**100%**
Left of Channel (East)	0	108	89	89	82	0%	54%	50%	47%	46%
Right of Channel (West)	0	66	58	62	68	0%	33%	33%	33%	38%
Middle of Channel	20	20	21	23	21	13%	10%	12%	12%	12%
Over / Above Channel	3	2	1	4	4	2%	1%	1%	2%	2%
Spanning Full Channel	6	4	8	7	4	4%	2%	4%	4%	2%
Island	0	1	0	0	1	0%	0%	0%	0%	1%
Unspecified	125	0	1	4	0	81%	0%	1%	2%	0%

ALL LWD OCCURRENCES

Number of Large Wood Debris Occurrences / Percent of All Large Wood Debris Occurrences

FISH HABITAT FUNCTION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Summer Refugia	NA	26	60	72	64	NA	13%	34%	38%	36%
Winter High Flow Refugia	NA	70	33	29	61	NA	35%	19%	15%	34%
Feeding Lane	NA	12	41	46	33	NA	6%	23%	24%	18%

GEOMORPHIC FUNCTION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Hydraulic Constriction	NA	12	41	46	33	NA	6%	23%	24%	18%
Pool Scour	60	30	49	52	45	39%	15%	28%	28%	25%
Spawning Gravel Recruitment	30	9	NA	NA	22	19%	4%	NA	NA	12%
Bank Stability	45	64	73	63	55	29%	32%	41%	33%	31%

LWD INSTALLATIONS

Number of Large Wood Debris Installations / Percent of Large Wood Debris Installations

FISH HABITAT FUNCTION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Summer Refugia	NA	0	6	9	16	NA	0%	15%	19%	25%
Winter High Flow Refugia	NA	15	26	4	26	NA	100%	67%	9%	40%
Feeding Lane	NA	0	5	8	12	NA	0%	13%	17%	18%

GEOMORPHIC FUNCTION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Hydraulic Constriction	NA	0	5	8	12	NA	0%	13%	17%	18%
Pool Scour	NA	0	5	10	13	NA	0%	13%	21%	20%
Spawning Gravel Recruitment	NA	0	NA	NA	10	NA	0%	NA	NA	15%
Bank Stability	NA	15	31	30	30	NA	100%	79%	64%	46%

FISH HABITAT FUNCTION

Number of Large Wood Debris Occurrences / Percent of All Large Wood Debris Occurrences

SUMMER REFUGIA	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**NA**	**26**	**60**	**72**	**64**	**NA**	**13%**	**34%**	**38%**	**36%**
Installed	NA	0	6	9	16	NA	0%	10%	13%	25%
Recruited	NA	26	54	63	48	NA	100%	90%	88%	75%

WINTER HIGH FLOW REFUGIA	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**NA**	**70**	**33**	**29**	**61**	**NA**	**35%**	**19%**	**15%**	**34%**
Installed	NA	15	26	4	26	NA	21%	79%	14%	43%
Recruited	NA	55	7	25	35	NA	79%	21%	86%	57%

FEEDING LANE	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**NA**	**12**	**41**	**46**	**33**	**NA**	**6%**	**23%**	**24%**	**18%**
Installed	NA	0	5	8	12	NA	0%	12%	17%	36%
Recruited	NA	12	36	38	21	NA	100%	88%	83%	64%

GEOMORPHIC FUNCTION

Number of Large Wood Debris Occurrences / Percent of All Large Wood Debris Occurrences

HYDRAULIC CONSTRICTION	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**NA**	**12**	**41**	**46**	**33**	**NA**	**6%**	**23%**	**24%**	**18%**
Installed	NA	0	5	8	12	NA	0%	12%	17%	36%
Recruited	NA	12	36	38	21	NA	100%	88%	83%	64%

POOL SCOUR	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**NA**	**26**	**60**	**72**	**45**	**NA**	**13%**	**34%**	**38%**	**25%**
Installed	NA	0	5	10	13	NA	0%	8%	14%	29%
Recruited	NA	26	55	62	32	NA	100%	92%	86%	71%

GRAVEL RECRUITMENT	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**30**	**9**	**NA**	**NA**	**22**	**19%**	**4%**	**NA**	**NA**	**12%**
Installed	NA	0	NA	NA	10	NA	0%	NA	NA	45%
Recruited	30	9	NA	NA	12	100%	100%	NA	NA	55%

BANK STABILITY	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Total LWD Occurrences	**45**	**64**	**73**	**63**	**55**	**29%**	**32%**	**41%**	**33%**	**31%**
Installed	NA	15	31	30	30	NA	23%	42%	48%	55%
Recruited	45	49	42	33	25	100%	77%	58%	52%	45%

XI. Seasonal Salmonid Habitat Surveys

Seasonal Salmonid Habitat Surveys

2011

In 2011, at the request of the Napa County Flood Control and Water Conservation District, Napa County Resource Conservation District (RCD) staff completed assessments of in-stream habitat features installed in 2010 in Reaches 1, 2, and 3 of the Napa River Rutherford Reach Restoration Project. on the Two assessments were completed: one at a winter flow high enough to inundate new bench cuts, and one at a low spring flow to evaluate new wood and rock habitat structures. The assessments included site sketches of surface flow patterns, collection of photographs, water velocity measurements, water-level elevation surveys, and evaluation of habitat function by a fisheries biologist.

High-Flow Assessment

On February 16, 2011, Jonathan Koehler, RCD fisheries biologist, and Paul Blank, RCD hydrologist, visited select newly-installed west-bank restoration features in Reaches 1, 2 and 3. These included the Sutter Home/Ranch Winery Alcove, the Frogs Leap bench cut, and the four Caymus bench cuts. According to data obtained from USGS stream gaging station 11456000, located approximately 2 miles upstream, streamflows peaked 7.5 hours prior to our visit at 3,350 cubic feet per second (cfs). During our visit flows receded from 1,110 cfs at 10:00 AM PST to 930 cfs at 12:15 PM PST

Average water velocity was measured at select locations within the newly-installed features using a USGS Price AA current meter with a wading rod and the six-tenths depth method. RCD flagged the current water surface elevations (WSEL) and February 16, 2011 high water marks (HWMs) for surveying at a later time.

RCD returned to the reach on February 23, 2011 with a theodolite and stadia rod and surveyed the previously-flagged WSELs and HWMs, the current WSELs, and HWMs from a higher peak flow on February 17, 2011. Water levels were surveyed relative to four existing top-of-bank monuments, two of which had previously been surveyed relative to NAVD88. RCD could not obtain elevation data for the other two monuments and on March 1, 2011, RCD returned to the field and surveyed those points relative to NAVD88.

Low-Flow Assessment

On June 2, 2011, RCD re-visited the newly-installed fish-habitat restoration features in Reach 1, 2, and 3. According to data obtained from USGS stream gaging station 11456000, located approximately 2 miles upstream, streamflow was 20 cfs during our visit. Average water velocity was measured at select locations near the newly-installed features using a USGS Price Pygmy current meter with a wading rod and the six-tenths depth method.

Snorkel Survey

On May 26, 2011 Jonathan Koehler and Paul Blank conducted an upstream snorkeling survey of the Rutherford Reach between Rutherford Road and Zinfandel Lane. The survey focused on presence/absence of juvenile salmonids throughout the reach and in the vicinity of each installed feature.

Results

Site sketches and photographs from each assessment were previously published and are available online at :

http://www.napawatersheds.org/files/managed/Document/5485/2011-2012%20Salmonid%20Habitat%20Surveys%20(Appendix%20XI).pdf

Water velocity measurements are noted on the site sketches. The results of water surface elevation surveying completed during the high-flow assessment are presented in the Table below.

Narrative evaluations of the performance of each assessed feature are provided in the Table below. The results of the snorkel survey showed relatively low abundances of juvenile Chinook salmon throughout the reach. No steelhead were observed during the survey. Juvenile Chinook salmon in the 80-100mm range were observed primarily in swift moving water associated with riffles and runs. No juvenile salmon were observed in the vicinity of the installed structures. Juvenile salmonids may utilize these structures at earlier life stages during the winter, but we did not assess this due to the limited visibility and potential danger associated with being in the channel during high flows.

2012

In 2012, at the request of the Napa County Flood Control and Water Conservation District, Napa County Resource Conservation District (RCD) staff completed assessments of recently-installed in-stream salmonid habitat features installed in 2011 in Reach 4 East bank of the Napa River Rutherford Reach Restoration Project. Reach 4 extends from the Rutherford Cross Road at river station 12,000, upstream 4,000 feet to river station 16,000. Restoration construction of the east bank took place in 2011. West bank construction is scheduled for summer 2012. Two assessments were completed: one at a winter flow high enough to inundate new bench cuts, and one at a low spring flow to evaluate new wood and rock habitat structures. The assessments included site sketches of surface flow patterns, collection of photographs, water velocity measurements, water-level elevation surveys, and evaluation of habitat function by a fisheries biologist. In addition, RCD conducted a snorkel survey to assess fish presence throughout the reach.

High-Flow Assessment

On January 23, 2012, Jonathan Koehler, RCD fisheries biologist, and Paul Blank, RCD hydrologist, visited select restoration features in Reach 4 installed in the summer and fall of 2011. These included Bench 7 and Bank Stabilization Area 1 on the Carpy-Conolly property, and Bank Stabilization Area 2, Bench 11, and Bench 13 on the Honig property, and Bench 14 on the Round Pond property. According to data obtained from USGS stream gaging station 11456000, located approximately 2 miles upstream, streamflows peaked 1.5 hours prior to our visit at 2,200 cubic feet per second (cfs). During our visit flows remained quite steady, varying from 1,970 to 2,100 cfs.

Average water velocity was measured at select locations within the newly-installed features using a USGS Price AA current meter with a wading rod and the six-tenths depth method. RCD flagged the current water surface elevations (WSEL) for surveying at a later time.

RCD returned to the reach on May 10, 2012 with a theodolite and stadia rod and surveyed the previously-flagged January 23, 2012 WSELs. Water levels were surveyed relative to three existing monuments which had previously been surveyed relative to NAVD88.

Low-Flow Assessment

On May 1, 2012, RCD re-visited the newly-installed fish-habitat restoration features in Reach 4 East. According to data obtained from USGS streamgaging station 11456000, located approximately 2 miles upstream, streamflow was 36 cfs during our visit. Average water velocity was measured at select locations near the newly-installed features using a USGS Price Pygmy current meter with a wading rod and the six-tenths depth method.

Snorkel Survey

On May 17, 2012, Jonathan Koehler and Paul Blank conducted an upstream snorkeling survey of the Rutherford Reach between the Rutherford Cross Road and Zinfandel Lane upstream. According to data obtained from USGS stream gaging station 11456000, located approximately 2 miles upstream, streamflow was 16 cfs during our visit. The survey focused on presence/absence of juvenile salmonids throughout the reach and in the vicinity of each installed feature.

Residual Pool Depth

Following the protocol in the Monitoring Plan for the Rutherford Reach Restoration of the Napa River, RCD measures the residual pool depth associated with installed instream habitat structures as part of the annual channel survey of the 4.5 mile Rutherford Reach each June. The trend in the residual pool depth is used to assess the impact of instream structures on pool structure, including the effectiveness of the structures on causing pool scour, reducing the deposition of fines in pools, and creating habitat complexity. RCD first measured residual pool depth in 2011 at instream habitat structures installed from 2009-2010 in Reaches 1-3, between Rutherford Reach river stations 16,000 – 24,857. Residual pool depth is the difference between maximum pool depth and pool tail depth.

Results

Site sketches and photographs from each assessment were previously published and are available online at :

http://www.napawatersheds.org/files/managed/Document/5485/2011-2012%20Salmonid%20Habitat%20Surveys%20(Appendix%20XI).pdf

Water velocity measurements are noted on the site sketches. The results of water surface elevation surveying completed during the high-flow assessment are presented in the Table below. Narrative evaluations of the performance of each assessed feature are provided in the Table below.

The results of the snorkel survey showed moderate abundances of juvenile steelhead throughout the reach. No juvenile Chinook salmon were observed during the survey. Juvenile steelhead ranging in length from approximately 80 – 100 mm were observed primarily in swift moving water associated with riffles and runs. No juvenile salmonids were observed in the immediate vicinity of the installed structures. Juvenile salmonids may utilize these structures during the winter, but we could not assess this due to limited visibility and potential danger associated with being in the channel during high flows.

Other fish species observed during the survey included California Roach (Lavinia symmetricus), Sacramento sucker (Catostomus occidentalis), Three-spine stickleback (Gasterosteus aculeatus), Sacramento pike minnow (Ptychocheilus grandis), tule perch (Hysterocarpus traski), and Pacific Lamprey (Entosphenus tridentatus). The adult Pacific lamprey was observed constructing a redd (spawning nest) just upstream of the tributary junction near BSA2: Honig Confluence. All fish species observed were native.

2013-2014

In 2013-2014, at the request of the Napa County Flood Control and Water Conservation District, Napa County Resource Conservation District (RCD) staff completed assessments of recently-installed in-stream salmonid habitat features installed in 2012-2013 in Reach 4 West and Reach 8 of the Napa River Rutherford Reach Restoration Project. The full results of the high-flow and low-flow assessments will be published in June 2014 following the spring snorkel survey. Preliminary Results from the low-flow assessments are provided in the Table below.

Flow Velocities in Constructed High-Flow Refugia Areas

The performance standard is high flow refugia with velocities less than 6 feet per second (FPS) for flows 500 cfs and above at constructed alcoves and instream bankfull benches, with specific target velocities for salmonid life stages as per the table below.

Target Salmonid Habitat Criteria

Species / Life Stage	*Depth (feet)*	*Substrate*	*Velocity (fps)*
Steelhead Fry	*0.0 – 1.5*	*substrate > sand* *organic cover*	*0.0 – 0.5*
Small Juvenile Steelhead	*0.5 – 1.5*	*tennis ball substrate* *deeper w/ organic cover*	*0.5 – 1.5*
Large Juvenile Steelhead	*> 1.5*		*1.0 - 2.5*
Adult Spawning	*0.5 – 2.0*		*1.0 - 2.5*
BMI-Riffle	*0.1 – 1.5*	*> golf ball substrate*	*> 1.5*

Source: NOAA/NMFS Criteria for MicroHabitat Mapping on Alameda Creek

High Water Mark and Water Surface Elevation for Velocity Monitoring of High Flow Refugia

2011

	Discharge Napa River Near St. Helena at Pope Street Bridge (cfs)	Water Surface Elevation (ft NAVD88)					
		Sutter Alcove	Frogs Leap Bench 1	Caymus Bench 0	Caymus Bench 1	Caymus Bench 2	Caymus Bench 3
River Station		21950	19680	18300	17500	17290	17050
HWM 2/16/2011	2,930		160.31	157.22	155.94	155.36	154.74
WSEL 2/16/2011 10:36	1,150	159.96					
WSEL 2/16/2011 11:03	1,120		156.13				
WSEL 2/16/2011 11:22	1,100			152.40			
WSEL 2/16/2011 11:42	1,070				150.18		
WSEL 2/16/2011 12:11	1,030						149.20
HWM 2/17/2011	3,160	165.38	160.92	157.89	156.81	156.30	155.75
WSEL 2/23/2011	228	155.52	151.61	148.34	145.49	145.52	144.76

2012

Water Surface Elevations at Constructed Instream Habitat Features During January 23, 2012 High-Flow Event

***Provisional data provided by USGS, subject to revision**

	Flow at Pope St* (cfs)	Water Surface Elevation (ft NAVD88)					
		Bench 14: Round Pond	Bench 13: Honig	Bench 11: Honig	BSA 2: Honig	BSA 1: Carpy-Conolly	Bench 7: Carpy-Conolly
River Station		12400-L	12900-L	13600-L	13850-L	14400-L	15700-L
WSEL 1/23/2012 0940	2,040	143.20					
WSEL 1/23/2012 1000	2,060		143.99				
WSEL 1/23/2012 1040	2,100			144.95			
WSEL 1/23/2012 1050	2,100				145.73		
WSEL 1/23/2012 1117	2,050					146.87	
WSEL 1/23/2012 1130	1,970						149.81

Rearing Habitat for 0-1+ Steelhead, and Immigrating/Emigrating Salmonids: 2011

Napa County Resource Conservation District Fisheries Biologist Evaluation of Performance of Each Assessed Instream Habitat Feature

Feature Name	River Station	Feature Type	Assessment	Fisheries Biologist Evaluation
Sutter Alcove	**21950-R**	Alcove	High-flow	The alcove appears to be functioning very well to provide off-channel refuge habitat for juvenile salmonids during high flow events. Areas of slack water were observed in this feature during a large winter storm event.
Frogs Leap Bench 1	**19680-R**	Bench Cut	High-flow	This bench is only inundated during large winter events, during which time it offers a limited amount of lower velocity refuge habitat for juvenile salmonids. However, it is only engaged for a very short period in any given season. The bench appears to drain well as flows recede and does not create a significant stranding hazard for young fish.
Caymus Bench 0	**18300-R**	Bench Cut	High-flow	This bench is only inundated during large winter events, during which time it offers a limited amount of lower velocity refuge habitat for juvenile salmonids. However, it is only engaged for a very short period in any given season. The bench appears to drain well as flows recede and does not create a significant stranding hazard for young fish.
Caymus Bench 1	**17500-R**	Bench Cut	High-flow	This bench is functioning well to provide off-channel refuge habitat for juvenile salmonids during high-flow events. During intermediate winter flows, velocities through the secondary channel may be prohibitively fast to provide much habitat for juvenile salmonid rearing.
Caymus Bench 2	**17290-R**	Bench Cut	High-flow	This bench is functioning very well to provide off-channel refuge habitat for juvenile salmonids during high flow events. Areas of slack water were observed in this feature during a large winter storm event.
Caymus Bench 3	**17050-R**	Bench Cut	High-flow	This bench is functioning well to provide off-channel refuge habitat for juvenile salmonids during high-flow events. During high winter flows, velocities through the secondary channel remained in the favorable range for juvenile salmonid rearing.

WD-16110-L	16110	Woody Debris	Low-flow	This feature is functioning very well to provide cover and increase water velocities around the structure to create feeding lanes for juvenile salmonids. It has also recruited naturally-downed wood, further increasing its habitat complexity and value. No juvenile salmonids were observed around the feature during a snorkel survey on May 26, 2011.
WD-17175-R	17175	Woody Debris	Low-flow	This feature is functioning well to provide cover and localized pool scour. The feature does not appear to be increasing water velocities, thereby creating feeding lanes for juvenile salmonids. No juvenile salmonids were observed around the feature during a snorkel survey on May 26, 2011.
WD-17425-R	17425	Woody Debris	Low-flow	This feature is functioning well to provide instream cover. The feature does not appear to be inducing pool scour nor is it increasing water velocities, thereby creating feeding lanes for juvenile salmonids. No juvenile salmonids were observed around the feature
WD-17700-R	17700	Woody Debris	Low-flow	Dry. Not assessed.
WD-19525-R	19525	Toe-Log Structure	Low-flow	At typical spring flows, this feature primarily provides instream cover. It is situated on the right bank of a deep, low velocity pool, which is not a habitat type that is likely to attract rearing salmonids seeking feeding opportunities. At higher flows, the structure may provide a velocity shelter for small fish, but this was not assessed. No juvenile salmonids were observed around the feature during a snorkel survey on May 26, 2011.
WD-21700-L	21700	Spider Log	Low-flow	This feature is functioning well to provide cover and localized pool scour. The feature does not appear to be increasing water velocities, thereby creating feeding lanes for juvenile salmonids. No juvenile salmonids were observed around the feature during a snorkel survey on May 26, 2011.

WD-21850-R	**21850**	Toe-Log Structure	Low-flow	This feature appears to primarily provide instream cover. It is situated on the right bank of a long, low velocity pool, which is not a habitat type that is likely to attract rearing salmonids seeking feeding opportunities. At higher flows, the structure may provide a velocity shelter for small fish, but this was not assessed. No juvenile salmonids were observed around the feature during a snorkel survey on May 26, 2011.
WD-21900-L	**21900**	Spider Log	Low-flow	Buried. Not assessed.
WD-22100-R	**22100**	Spider Log	Low-flow	Buried. Not assessed.

Rearing Habitat for 0-1+ Steelhead, and Immigrating/Emigrating Salmonids: 2012

Napa County Resource Conservation District Fisheries Biologist Evaluation of Performance of Each Assessed Instream Habitat Feature

Feature Name	River Station	Feature Type	Assessment	Fisheries Biologist Evaluation
Bench 14: Round Pond	**12500-L**	Bench Cut	High-flow	This bench appears to be functioning very well to provide off-channel refuge habitat for juvenile salmonids during high flow events. Areas of slack water were observed in this feature during a large winter storm event.
Bench 13: Honig	**13000-L**	Bench Cut	High-flow	This bench is functioning very well to provide off-channel refuge habitat for juvenile salmonids during high-flow events. Extensive slow and slack water areas were observed during a large winter storm event. This feature contained a favorable mix of slow resting habitat and swift feeding habitat.
Bench 11: Honig	**13600-L**	Bench Cut	High-flow	This bench is functioning very well to provide off-channel refuge habitat for juvenile salmonids during high-flow events. Extensive slow and slack water areas were observed during a large winter storm event. This feature contained a favorable mix of slow resting habitat and moderate to swift feeding habitat.
BSA 2: Honig Confluence	**13850-L**	Bank Stabilization Area	High-flow	This bank stabilization area and tributary channel junction appear to provide high flow refugia in the form of a backwater and partially inundated tree trunks. Water velocities were generally low during a large winter storm event.
BSA 1: Carpy Conolly	**14400-L**	Bank Stabilization Area	High-flow	This bank feature appears to provide high flow refugia, primarily from willows and other riparian vegetation, which were partially inundated at the time of observation. Although water velocities could not be measured in the heavily vegetated area due to limited access, surface currents appeared to be very slow or completely slack throughout most of the feature.
Bench 7: Carpy	**15700-L**	Bench	High-	This bench appears to be functioning very well to provide off-channel refuge habitat for juvenile salmonids during high flow events. Areas of slack water were observed in this

Conolly		Cut	flow	feature during a large winter storm event.
BC-12400	**12400**	Boulder Cluster	Low-flow	These three boulders appear to provide a relatively small but effective velocity shelter during low to moderate flows. Measured velocities were significantly slower within the cluster than the surrounding currents. No salmonids were observed around this feature during the snorkel survey. All boulders were covered heavily with filamentous algae.
WD-12410-L	**12410**	Root Wad	Low-flow	This rootwad appears to provide good refuge habitat during low to moderate flows. A deep scour hole has developed immediately around the feature, and water velocities measured just downstream of the rootwad were significantly lower than the surrounding currents. During the snorkel survey, no salmonids were present around this feature, but several other native fish species were observed.
WD-12600-L	**12600**	Root Wad	Low-flow	This rootwad is located at the left edge of a deep (>4 feet) pool and creates a slow backwater habitat. No fish were observed around this feature during the snorkel survey.
WD-12780-L	**12780**	Root Wad	Low-flow	This rootwad appears to provide good refuge habitat during low to moderate flows. A distinct scour hole has developed immediately around the feature, and a sand deposit was observed just downstream of the rootwad. During the snorkel survey, no salmonids were present around this feature, but several other native fish species were observed.
WD-12850-M	**12850**	Root Wad	Low-flow	This rootwad was partially buried in the streambed and did not appear to provide much instream habitat value during the low-flow assessment. No fish were observed around this feature during the snorkel survey.
BC-12850	**12850**	Boulder Cluster	Low-flow	This group of five boulders was completely submerged during our low-flow assessment and snorkel survey. The boulders appear to provide an effective velocity shelter during low to moderate flows. Measured velocities were significantly lower within the cluster than the surrounding currents; however the streambed at this location is relatively flat with little topographic complexity. No salmonids were observed around this feature during the snorkel survey. All boulders were covered heavily with filamentous algae.
BC-12930	**12930**	Boulder Cluster	Low-flow	This group of four boulders was completely submerged during our low-flow assessment and snorkel survey. The boulders appear to provide an effective velocity shelter during low to moderate flows. Measured velocities were lower within the cluster than the

				surrounding currents. No salmonids were observed around this feature during the snorkel survey. All boulders were covered with a moderate amount of filamentous algae.
WD-13010-M	**13010**	Low-profile Log	Low-flow	This log was partially buried in the streambed and did not appear to provide much instream habitat value during the low-flow assessment. No fish were observed around this feature during the snorkel survey.
BC-13040	**13040**	Boulder Cluster	Low-flow	This group of four boulders appears to provide excellent feeding and resting habitat for juvenile salmonids. Measured water velocities were significantly slower behind each boulder, while swift current habitat was created between the individual stones. Juvenile steelhead (~80-100 mm) was observed around the boulder cluster and in the surrounding riffle habitat during the snorkel survey. In addition, a gravel deposit with favorably-sized salmonid spawning substrate was observed near this boulder cluster, which appeared to be the result of hydraulic sorting.
WD-13080-L	**13080**	Root Wad	Low-flow	This rootwad appears to provide good refuge habitat during moderate to high flows. A relatively shallow scour hole has developed immediately around the feature. During the snorkel survey, no salmonids were present around this feature, but other native fish species were observed.
WD-13650-L	**13650**	Root Wad	Low-flow	This rootwad appears to provide good refuge habitat during low to moderate flows. A distinct scour hole has developed immediately around the feature and a small backwater was present just upstream of the feature at low flow. During the snorkel survey, no salmonids were present around this feature, but other native fish species were observed.

Rearing Habitat for 0-1+ Steelhead, and Immigrating/Emigrating Salmonids: 2014

Napa County Resource Conservation District Fisheries Biologist Evaluation of Performance of Each Assessed Instream Habitat Feature

RDRT Reach 8 Instream Habitat Structure Survey - Low Flow, April 29, 2014.

Napa County Resource Conservation District (Jonathan Koehler, Paul Blank)

Napa River flow = 13cfs at USGS Pope St. Gage

Key:
D = Designed function of structure
(yes/no) = does structure serve intended function?
X = additional functions provided by structure
[orange box] = Not found or river station needs verifying

Parcel	Structure Label	Installation	Bank	Associated Graded Feature	Summer Refugia	Winter Refugia	Hydraulic Constrict.	Pool Scour	Bank Stability	Gravel Recruit	Notes	Photos
Foley (Sawyer)	BC-7530-M	Boulder Cluster	Right / West	Bank Stabilization 1	D (yes)		D (yes)				fully submerged	106
Foley (Sawyer)	WD-7512-R	Root Wad	Right / West	Bank Stabilization 1	X	D (yes)		D (yes)			too low in channel to offer much winter refugia	105
Foley (Sawyer)	BC-7460-M	Boulder Cluster	Right / West	Bank Stabilization 1	D (yes)		D (yes)				mostly submerged - covered with filamentous algae	104
Foley (Sawyer)	BC-7410-R	Boulder Cluster	Right / West	Bank Stabilization 1	D (yes)		D (yes)	X			mostly submerged - covered with filamentous algae	103
Frostfire Davis	WD-6349-R	Root Wad	Right / West	Bench 1		X		D (yes?)			almost entirely out of water, so pool scour may not be directly associated with structure	102
Frostfire Davis	WD-6163-R	Snag	Right / West	Bench 1		D (yes)					dry - out of water	101
Frostfire Davis	WD-6150-R	Snag	Right / West	Bench 1		D					**NOT FOUND**	
Frostfire Davis	WD-6108-R	Snag	Right / West	Bench 1		D					**NOT FOUND - maybe buried**	
Frostfire Davis	WD-6007-R	Root Wad	Right / West	Bench 1				D (no)		X	dry on gravel bar, partially buried by fresh gravel. May offer some winter refugia	100
Frostfire Davis	R-5770-M	Grade Control Riffle	Mid	Bench 1	X		D (yes)					99
Frostfire Davis	WD-5770-R	Low Profile Log	Right / West	Bench 1	D						**NOT FOUND**	
AJM McDowell	BC-5400-M	Boulder Cluster	Mid	Bank Stabilization 1	D (yes)		D (yes)				mostly submerged - covered with filamentous algae	98
AJM McDowell	R-5375-M	Grade Control Riffle	Mid	Bank Stabilization 1			D (no)				**NOT FOUND -** assumed to be buried below grade	97
AJM McDowell	WD-5374-R	Root Wad	Right / West	Bank Stabilization 1	D (yes)		X					97
AJM McDowell	WD-5344-L	Low Profile Log	Left / East	Bank Stabilization 1	D (yes)		X					96
Laird	WD-5247-L	Root Wad	Right / West	Bench 2	D (yes)			D (yes?)			already deep pool at this site, so pool scour may not be directly associated with structure	94, 95
Laird	WD-5244-L	Snag	Left / East	Bench 2		X		D (no)			located near top of bank - high and dry	93
Laird	WD-5243-L	Snag	Left / East	Bench 2	D (no)	X	D (no)				located near top of bank - high and dry	93
Laird	WD-5094-L	Root Wad	Left / East	Bench 2	X			D (yes?)			already deep pool at this site, so pool scour may not be directly associated with structure	92
Laird	BC-4980-L	Boulder Cluster	Left / East	Bench 2	D (yes)		D (yes)				half submerged	91
Laird	WD-4960-L	Root Wad	Left / East	Bench 2	D (yes)		X				deep scour and small backwater associated with structure	89, 90
Laird	BC-4920-L	Boulder Cluster	Left / East	Bench 2	D (yes)		D (yes)	X			half submerged	88
Glos	BC-4560-M	Boulder cluster	Mid	Bank Stabilization 3	X			X			mostly submerged - covered with filamentous algae	87
Glos	WD-4523-R	Toe Log	Right / West	Bank Stabilization 3		X		D (no)	X		dry - out of water	86
Glos	WD-4293-R	Root Wad	Right / West	Bank Stabilization 3	X			D (no)			may provide slight bank stability for secondary channel	85
Laird	WD-4204-L	Root Wad	Left / East	Bench 3	X		X	D (yes)				83,84
Laird	WD-4187-L	Root Wad	Left / East	Bench 3	X		X	D (yes)				82
Laird	BC-4180-L	Boulder Cluster	Left / East	Bench 3	D (yes)		D (yes)				Mostly submerged	81
Laird	BC-4130-L	Boulder Cluster	Left / East	Bench 3	D (yes)		D (yes)	X			half submerged	80
Laird	WD-4067-L	Snag	Left / East	Bench 3		X		D (no)			dry - out of water	79

RDRT Reach 8 Instream Habitat Structure Survey - Low Flow, April 29, 2014.

Napa County Resource Conservation District (Jonathan Koehler, Paul Blank)

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Key:
D = Designed function of structure
(yes/no) = does structure serve intended function?
X = additional functions provided by structure
[orange box] = Not found or river station needs verifying

Parcel	Structure Label	Installation	Bank	Associated Graded Feature	Summer Refugia	Winter Refugia	Hydraulic Constrict.	Pool Scour	Bank Stability	Gravel Recruit	Notes	Photos
Laird	WD-4054-L	Snag	Left / East	Bench 3		X		D (no)			dry - out of water	78
Laird	BC-4043-L	Boulder Cluster	Left / East	Bench 3	D (no)		D (no)				Only one boulder found - up on LB bench	77
Laird	BC-4000-L	Boulder Cluster	Left / East	Bench 3	D (yes)		D (yes)	X			half submerged	76
Laird	WD-3999-L	Root Wad	Left / East	Bench 3		X		D (no)			dry - out of water, partially buried	75
Laird	WD-3958-L	Root Wad	Left / East	Bench 3	X		X	D (yes)				74
Cakebread	BC-3560-R	Boulder Cluster	Right / West	Tributary Alcove	D (yes)		D (yes)	X			partially submerged and covered with filamentous algae	73
Cakebread	WD-3500-R	Root Wad	Right / West	Tributary Alcove		D (yes)					dry - out of water	71
Cakebread	WD-3474-R	Root Wad	Right / West	Tributary Alcove		X		D (no)			dry - out of water. **River station 3,380**	63
Nickel	WD-3400-R	Root Wad	Right / West	Tributary Alcove		D (yes)					dry - out of water. **River station 3,360**	64
Nickel	WD-3397-R	Snag + 1 Boulder	Right / West	Tributary Alcove		D (yes)					dry - out of water. **River station 3,410**	70
Nickel	WD-3367-R	Snag + 1 Boulder	Right / West	Tributary Alcove		D (yes)					dry - out of water	70
Nickel	WD-3355-R	Root Wad	Right / West	Tributary Alcove		D (yes)					dry - out of water	64
Nickel	WD-3345-R	Snag + 1 Boulder	Right / West	Tributary Alcove		D (yes)					dry - out of water	70
Nickel	WD-3333-R	Root Wad	Right / West	Tributary Alcove		D (yes)					dry - out of water	65
Nickel	WD-3322-R	Root Wad	Right / West	Tributary Alcove		X		D (no)			dry - out of water	65
Nickel	BC-3321-R	Boulder Cluster	Right / West	Tributary Alcove	D		D				**NOT FOUND**	
Nickel	WD-3316-R	Snag + 1 Boulder	Right / West	Tributary Alcove		D (yes)					dry - out of water	72
Nickel	T-3260-R	Confluence	Right / West	Bella Oaks Tributary		D (yes)					flowing at time of survey	68
Nickel	WD-3252-R	Root Wad	Right / West	Tributary Alcove	X		X	D (yes)				68, 69
Nickel	BC-3250-R	Boulder Cluster	Right / West	Tributary Alcove	D (no)		D (no)				dry - out of water. Unable to determine function	67,68
Nickel	WD-3238-R	Root Wad	Right / West	Tributary Alcove		D (yes)					dry - out of water	66

XII. Vegetation Establishment Surveys

Vegetation Establishment Surveys

Napa River Rutherford Reach Restoration Project

1.0 Introduction

The Napa River Rutherford Reach Restoration Project (Project) is a comprehensive large scale river restoration project spanning 4.5 miles of the Napa River beginning at the Zinfandel Lane Bridge, just south of the town of St. Helena, and ending downstream at the Oakville Cross Road Bridge. The goals of the Project are many but primarily include the restoration of physical and biological processes of the Napa River including expanding and restoring riparian habitat. As part of the Project, re-vegetation plans and specifications are prepared by a design/ landscape consultant that specify the quantities and species of plants to be planted post construction. The vegetation plans also specify appropriate planting zones and invasive plant management strategies for the purpose of restoring riparian habitat in disturbed Project areas. Napa County vegetation management specialists review and approve the plans for consistency with known site conditions prior to putting the contract out for bid and ultimately oversee the contractor that is hired to install and maintain the vegetation. This report was prepared by the Napa County Flood Control and Water Conservation District (District) in order to evaluate and monitor restored riparian areas within the Project.

1.1 Site Preparation and Installation Methods

Preparation work for re-vegetation post construction includes the removal of select invasive non-native plant species. This is followed by field marking the location for native vegetation installation with landscaping flags throughout the Project site according to the species requirements and quantities specified in the re-vegetation plans. Next, a combination of under and overstory plant species ranging in size from container stock (1 gallon, treepot or depot), poles (3'-4' x 1/2"-3" diam.), small plugs and direct seed (1-3 seeds/planting hole depending on species) are installed following excavation of planting holes with a hand or chainsaw augur. Planting holes are amended with fertilizer packets prior to backfilling with native material or compost. Container stock and plugs are generally installed after the first major rain event during the period between October 15th and January 31st.

All re-vegetated Project areas are checked weekly during the irrigation season (April to October) and a minimum of once every month during the non-irrigation season (November to February) for the duration of the Project. During the irrigation season staff checks plant condition, weed growth, planting basin stability and assesses soil moisture around the plants to ensure that they are receiving sufficient water. Automated drip irrigation is installed for all planted areas within the Project. Watering schedules typically are as follows: for the first- three years irrigation begins on April 15th and continues through mid-fall/October. Plants are irrigated weekly and in general receive 4-8 gallons of water per application via drip emitters. The irrigation schedule is extended if hot, dry weather persists into the fall beyond October 15th. In general, plants will likely not be irrigated after the third year in an effort to have the installed plants adapt to the native hydrologic/precipitation cycle.

2.0 Riparian Restoration Goals and Success Criteria

The target restoration goals and success criteria for vegetation establishment set forth in the Monitoring Report and various project related permits include the following:

- A minimum of 20 acres of riparian habitat will be established over the life the Project (20 years)
- A minimum of 80% of native plants installed shall survive/establish at the re-vegetation sites within 3 years after being installed and will be in good health
- Greater than 90% native cover (less than 10% total non-native) will exist at any given planting site over the *life* of the Project
- Evidence of successful natural recruitment will be documented by year 5 at any given re-vegetation site

These target goals and success criteria are expected to be achieved over the life of the Project (20 years). Continued long-term monitoring will quantify and assess changes in vegetation and other ecological parameters through time to help further determine if the Project is achieving its goals and success criteria by the end of the monitoring period.

3.0 Methods

Below is a brief summary description of the monitoring methods utilized for the Vegetation Establishment Surveys conducted for the Project. Please refer to the reports listed in the reference section for a more detailed account of specific monitoring protocols and methods outline here.

3.1 Direct count and photo documentation

Direct count of installed plants in restored re-vegetated areas was conducted in order to determine the percent survivorship and qualitatively measure health and vigor of installed vegetation. As the name implies, this involves a direct count and assessment of each installed plant to determine whether it is dead or alive as well as the general vigor and health of the plant (Harris et al., 2005). For the first three years following plant installation, a contractor is responsible for the maintenance of native plants and conducting this survey such that at the end of the three year contractor maintenance period 80% or greater of installed plants are alive and growing well. Any area that does not demonstrate a minimum of 80% survivorship at the end of this three year period shall be replanted by the contractor under the direction of District staff. District staff was responsible for establishing photo monitoring sites and annually photographing each respective site.

3.2 Total area mapping/percent vegetative cover, invasive plant management

Each year, District staff map and report the total area of riparian habitat that has been planted in constructed restoration areas; the percentage of vegetative cover [i.e. replanted areas “covered” by herbaceous and/or woody plant species or un-vegetated ground “not covered”] at restored areas; and the total percent of “desirable native vs. targeted non-native invasive species cover in the restored areas (such as *vinca*, arundo, poison hemlock, red sesbania, Himalayan blackberry, etc).

The method utilized for mapping the total area of vegetative cover involves the use of GIS and multispectral/multi-band aerial imagery (ideally flown in the spring and at a resolution of 1 foot per pixel or less) in order to map the total vegetation of the Project area and perform a supervised image classification of vegetative cover class. District staff then performs field work to “ground truth” these surveyed areas to provide higher data resolution. Area mapping following this method is conducted as new aerial imagery is acquired by the County. The most recent mapping using this method was conducted in 2012 (see results for 2012 monitoring report) and is expected to be conducted again in 2014. Area mapping was not conducted in 2013 for this report as suitable aerial imagery was not available. It is expected that for survey year 2014 suitable imagery will be available to the County.

The location and extent of invasive plant species surveyed within the Project annually is mapped and entered into a GIS database. Areas treated are logged and reported in the annual maintenance and monitoring reports.

3.3 Line intercept transect surveys

Line intercept transect surveys and photo documentation of transect sites is conducted per the method outlined by Harris et al (2005). The surveys include establishing several transect lines for a given restoration area and measuring the height class of each plant species intersected by the transect line, categorizing the cover class and percentage of cover along the intercept line (i.e. herbaceous, woody, bare ground, etc.) and photographing each surveyed transect line. Transect lines are perpendicular to the channel in order to capture specific performance of planted species at a given river bank elevation or planting zone.

4.0 Results

The Project has been divided into nine reaches based on geomorphic characteristics, subsequent monitoring areas are also conducted along these reaches and further subdivided as necessary. Direct count surveys, photo documentation, area mapping, and line intercept surveys are conducted annually throughout constructed reaches of the Project.

4.1 Direct count and photo documentation

During the fall of 2013, District and contractor staff conducted annual direct count vegetation surveys of the restoration sites in Reaches 1-4 and Reach 8A; the location of these sites is shown in Figure 1. From 2009-2013, in reaches 1-4 and 8A, approximately 26.3 acres of restored area have been planted with native grasses, shrubs and trees. All areas in these reaches were surveyed to determine percent survivorship, vigor and qualitative health of installed vegetation. Tables 1-4 below presents the cumulative direct count and qualitative health assessment for reaches 1-4, and 8A. The direct count vegetation data is reported by survey year and includes: the species of the plant installed, the initial quantity of each species planted; the quantity live plants (including natural recruitment) at the time of the survey; the percent survival; and the general health of the vegetation. Re-vegetation contractors were responsible for plant establishment and monitoring in Reaches 1-3 from 2009-2012 as well as Reach 4 in 2012-2013 and Reach 8A in 2013. It should be noted that detailed monitoring information was not collected annually by the contractor responsible for maintaining reaches 1 and 2 east bank, however, District staff surveyed total plant survivorship for these areas in 2011, 2012, and 2013 and added it to the survey data below.

Survey data indicate overall survivorship for Reaches 1 and 2 to be 81% or greater for survey year 2013, while overall survivorship for Reach 3 was 49% or greater for survey year 2013. Overall survivorship for Reach 4 was 86% or greater for survey year 2013. Overall survivorship for Reach 8 was 91% or greater for survey year 2013. Several issues have arisen in Reach 3, on the east bank, that contributed to the low overall survivorship including low viability of seed material that was planted, inconsistent water availability from landowners during critical late summer irrigation months (particularly during the period of drought in 2013) and a high population of field mice/voles detected in the area that are burrowing beneath installed plant material and consuming roots. Representative photos of the sites are shown in Figures 2-5; additional photos of these sites can also be viewed in Appendix D. Study V of the Project Monitoring Report.

Table 1: Reach 1 and 2 Direct Count/Survivorship Survey

	2011			2012			2013			
Common Name	Qty Planted	Qty Alive	% Survival	Qty Planted	Qty Alive	% Survival	Qty Planted	Qty Alive	% Survival	Health
White alder	30	30	100%	30	30	100%	30	30	100%	Good
Big Leaf Maple	29	29	100%	29	26	90%	29	26	90%	Good
California buckeye	29	8	28%	29	12	41%	29	6	21%	Poor
Coyote brush	60	60	100%	60	88	147%	60	170	283%	Good
Western spice bush	241	241	100%	241	220	91%	241	183	76%	Good
Oregon Ash	100	91	91%	100	88	88%	100	49	49%	Good
Toyon	9	4	44%	9	9	100%	9	18	200%	Poor
CA black walnut	50	56	112%	50	55	110%	50	74	148%	Good
Honeysuckle	87	64	74%	87	64	74%	87	46	53%	Fair
Coast live oak	132	71	54%	132	48	36%	132	50	38%	Fair
Valley oak	90	49	54%	90	64	71%	90	50	56%	Fair
Fremont's cottonwood	136	97	71%	136	118	87%	136	112	82%	Fair
California wild rose	147	147	100%	147	140	95%	147	128	87%	Good
Red willow	136	142	104%	136	115	85%	136	90	66%	Good
Arroyo willow	136	95	70%	136	84	62%	136	104	76%	Fair
Snowberry	147	147	100%	147	155	105%	147	151	103%	Good
California bay	44	44	100%	44	39	89%	44	6	14%	Good
Total	**1603**	**1375**	**86%**	**1603**	**1355**	**85%**	**1603**	**1293**	**81%**	

*Planted fall 2009 and 2010, includes original planted stock and naturally recruited species.

**Acorns/seeds utilized during initial planting demonstrated low viability and thus were replaced with larger container stock on the second year.

Table 2: Reach 3 Direct Count/Survivorship Survey

	2011			2012			2013			
Common Name	Qty Planted	Qty Alive	% Survival	Qty Planted	Qty Alive	% Survival	Qty Planted	Qty Alive	% Survival	Health
Western Redbud	82	69	84%	82	68	83%	82	24	29%	Good
Silver Lupine	150	83	55%	150	57	38%	150	23	15%	Fair
Sticky Monkeyflower	57	20	35%	57	9	16%	57	12	21%	Poor
White Alder	10	4	40%	10	2	20%	10	6	60%	Poor
Oregon Ash	44	32	73%	44	45	102%	44	28	64%	Good
Fremont's Cottonwood	37	16	43%	37	32	86%	37	25	68%	Poor
Red Willow	24	29	121%	24	9	38%	24	28	117%	Good
Arroyo Willow	30	8	27%	30	21	70%	30	24	80%	Poor
Yellow Willow	28	20	71%	28	11	39%	28	11	39%	Good
Big Leaf Maple	10	5	50%	10	13	130%	10	11	110%	Fair
Box Elder	13	11	85%	13	0	0%	13	2	15%	Good
California Buckeye	44	0	0%	44	0	0%	44	3	7%	Poor
Black Walnut	65	42	65%	65	47	72%	65	46	71%	Fair
Valley Oak	128	14	11%	128	25	20%	128	38	30%	Poor
Coast Live Oak	58	0	0%	58	2	3%	58	32	55%	Poor
Bay Laurel	86	76	88%	86	52	60%	86	37	43%	Good
Blue Oak	28	0	0%	28	0	0%	28	0	0%	Poor
California Black Oak	3	0	0%	3	0	0%	3	0	0%	Poor
California Wild Rose	144	121	84%	144	122	85%	144	138	96%	Good
Snowberry	100	76	76%	100	64	64%	100	65	65%	Good
Coyote Bush	67	36	54%	67	44	66%	67	49	73%	Fair
Western Spice Bush	31	24	77%	31	23	74%	31	11	35%	Good
Toyon	59	29	49%	59	23	39%	59	17	29%	Poor
Twinberry	76	67	88%	76	59	78%	76	47	62%	Good
Honeysuckle	30	6	20%	30	9	30%	30	6	20%	Poor
Total	**1404**	**788**	**56%**	**1404**	**737**	**52%**	**1404**	**683**	**49%**	

*Planted fall 2010, includes original planted stock and naturally recruited species.

**Acorns/seeds utilized during initial planting demonstrated low viability and thus were replaced with larger container stock on the second year.

Table 3: Reach 4 Direct Count/Survivorship Survey

	2013			
Common Name	Qty Planted	Qty Alive	% Survival	Health
White Alder	16	15	94%	Good
Oregon Ash	128	134	105%	Good
Fremont's Cottonwood	83	22	27%	Poor
Red Willow	63	25	40%	Poor
Arroyo Willow	58	16	28%	Poor
Yellow Willow	9	6	67%	Fair
Big Leaf Maple	30	29	97%	Good
California Buckeye	126	86	68%	Fair
Black Walnut	201	139	69%	Fair
Valley Oak	196	252	129%	Good
Coast Live Oak	175	202	115%	Good
Bay Laurel	133	109	82%	Good
Blue Oak	73	37	51%	Poor
California Wild Rose	338	345	102%	Good
Snowberry	338	240	71%	Fair
Coyote Bush	201	231	115%	Good
Western Spice Bush	51	53	104%	Good
Toyon	100	52	52%	Poor
Deer grass	325	290	89%	Good
Honeysuckle	254	223	88%	Good
Total	**2898**	**2506**	**86%**	

*Planted fall 2012, includes original planted stock and naturally recruited species.

Table 4: Reach 8A Direct Count/Survivorship Survey

	2013			
Common Name	Qty Planted	Qty Alive	% Survival	Health
White Alder	16	16	100%	Good
Oregon Ash	79	65	82%	Fair
Fremont's Cottonwood	71	62	87%	Good
Red Willow	142	92	65%	Fair
Arroyo Willow	N/A	N/A	N/A	N/A
Toyon	20	17	85%	Good
Big Leaf Maple	14	14	100%	Poor
California Buckeye	29	5	17%	Poor
Black Walnut	9	26	289%	Good
Valley Oak	73	60	82%	Good
Coast Live Oak	37	30	81%	Good
Bay Laurel	16	9	56%	Fair
Yarrow	14	14	100%	Good
California Wild Rose	128	108	84%	Good
Snowberry	104	105	101%	Good
Coyote Bush	28	23	82%	Good
Western Spice Bush	8	8	100%	Good
Aster	512	512	100%	Good
Western Goldenrod	325	325	100%	Good
Honeysuckle	16	8	50%	Fair
Total	**1641**	**1499**	**91%**	

*Planted fall 2013, includes original planted stock and naturally recruited species.

4.2 Area mapping, percent cover and invasive plant management

As mentioned in section 3.2 above, due to the lack of availability of suitable 2013 year multispectral aerial imagery (i.e. infrared spectral bands 4, 3 and 2) percent vegetation cover type surveys using remote sensing methods (supervised classification) was not able to be conducted for monitoring year 2013. The County is in the process of acquiring suitable multispectral aerial imagery such that percent cover can be surveyed using remote sensing for monitoring year 2014.

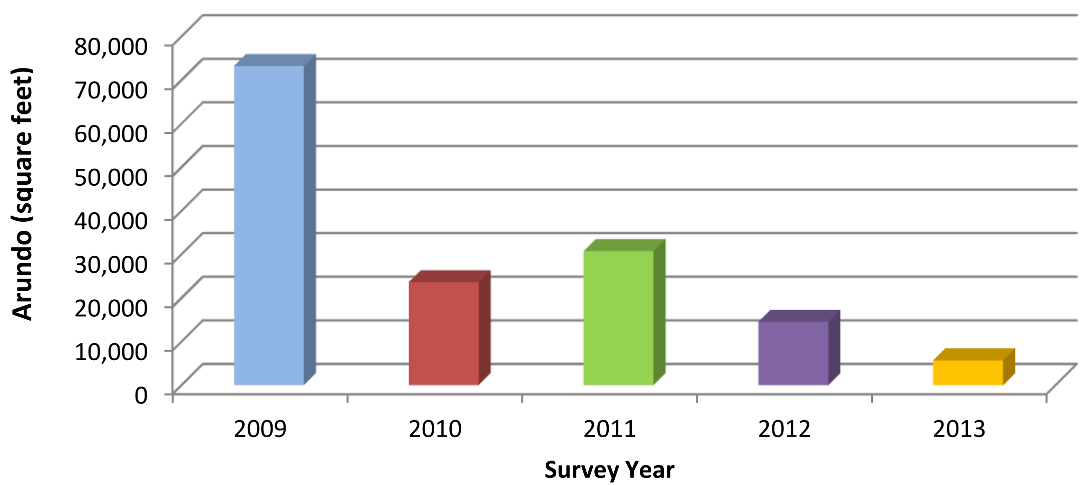
A total of 73,244 square feet (1.68 acres) of giant reed (*Arundo donax*), periwinkle (*Vinca major*), grape (*Vitis sp.*), Himalayan blackberry (*Rubus armeniacus*) and red sesbania (*Sesbania punicea*) were mapped and ultimately treated throughout the Project area during the summer and fall of 2013; see Table 5.

Table 5: Invasive Plant Species Mapped and Treated, 2009-2013

Invasive/Pierce host plant species treated (Square Feet)							
Survey Year	Giant Reed	Himalayan Blackberry	Periwinkle (*Vinca sp.*)	Poison Hemlock	CA Grape	Red Sesbania	Total Area Treated (Sqft)
2009	73,180	0	0	0	0	0	73,180
2010	23,599	952	17,389	17,424	0	86	68,923
2011	30,749	35,809	9,163	2,461	7,447	49,138	134,771
2012	14,502	2,668	6,951	6,423	N/A	17,636	48,180
2013	5,662	42,688	1,901	0	5,070	17,903	73,224
Total							398,278

Previous and ongoing efforts related to the Project designed to manage and remove giant reed (*Arundo*) have been successful in significantly reducing the amount of giant reed in the entire Project area. Chart 1 below depicts the general decline of Arundo throughout the Project area. Currently, only small or re-sprouting patches of giant reed require treatment under the Maintenance Assessment District (MAD).

Chart 1: Arundo mapped and treated (2009-2013)



4.3 Line intercept transect surveys

Line intercept transects were established at 5 locations in Reaches 1 and 2 in 2012 and 7 additional transects were established in Reaches 3 and 4 in 2013. Representative photos of each established transect line can be seen in Figure 5. The transect lines established thus far range between 42 to 111 feet in length. Figure 1 shows the name and location, by river station, of each transect line surveyed. Chart 2 below presents the average relative percent cover, by ground cover type, for all transect lines in Reaches 1 through 4 for survey years 2012 and 2013. As one can see from chart 2 whereas approximately 21% of the ground cover surveyed within the transects were classified as un-vegetated in 2012, in 2013 0% of the ground cover was un-vegetated. In 2012 approximately 53% cover was herbaceous, 6% shrub and 19% was classified as tree cover; the same transects measured in 2013 all showed an increase in respective vegetation cover type. This positive trend is to be expected as the installed vegetation establishes at each respective site and relative cover types increase.

Chart 2: Average percent cover by ground cover type for line transect surveys (2012-2013)

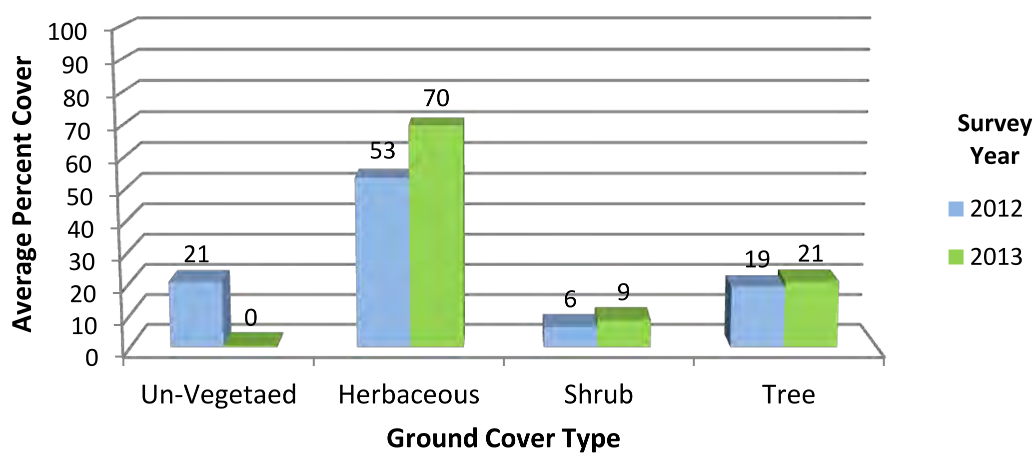
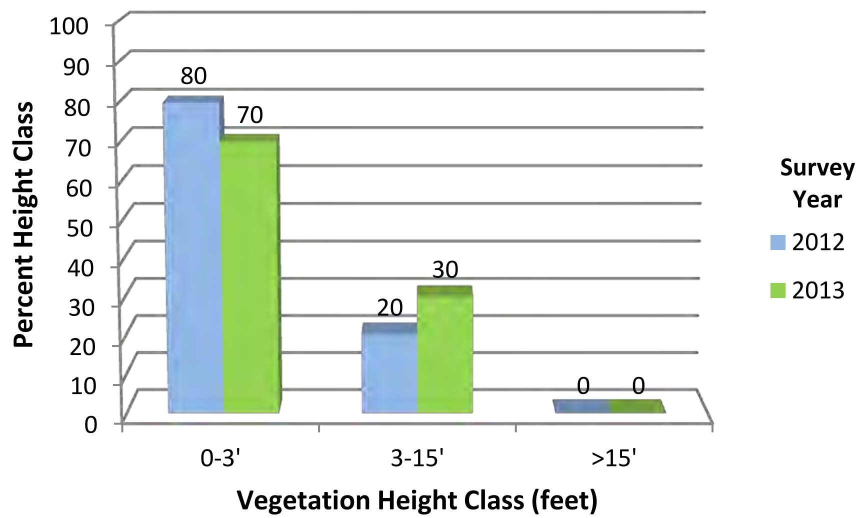


Chart 3 presents the average percent of cover of herbaceous and woody vegetation, by vegetation height class, for each transect line surveyed in 2012 and again in 2013. Approximately 70% of the vegetation measured in 2013 at a given transect is between 0 and 3 feet tall while approximately 30% of the vegetation measured in 2013 ranges between 3 and 15 feet height. This represents a significant increase in average vegetation height measured from survey year 2012, approximately 10% respectively. Representative photos of the transect sites are shown in Figures 2-5.

Chart 3: Average height class herbaceous and woody vegetation for line transect surveys (2012-2013)



5.0 Discussion and Conclusion

The results of the surveys indicate there is generally a positive trend for vegetation establishment, in terms of both coverage and average height measured, at newly constructed restoration areas. Survival of installed woody and herbaceous vegetation in reaches 1 through 2 is greater than 80%, which is consistent with the Project goals and performance standards for vegetation survivorship; however survivorship for Reach 3 remains low, 49%-56%. The reasons for low survivorship on reach 3 east bank are mentioned in section 4.2 above. The District is currently adaptively managing these sites by attempting to add soil amendments (mycorrhizae, etc.), increase cover and moisture retention at planting basins sites through the use of mulch and increasing the watering duration so that this area will attain 80% or greater over time. Results from line intercept surveys indicate that transects sites are covered with approximately 70% herbaceous vegetation, 21% woody tree vegetation and 9% woody shrub vegetation amounting to 100% vegetative cover at any given transect. Further, in 2013 approximately 70% of installed vegetation measured is between 0 and 3’ in height and the remaining 30% is approximately 3 to 15’ high. This represents approximately a 10% shift from 2012 to 2013 of the average height of the vegetation measured from 0-3’ to 3-15’. Both of these measurements, coverage and average height, represent a positive trend in vegetation establishment at restored sites as installed vegetation becomes larger and more mature/complex providing greater habitat value. The installed vegetation is expected to increase at a normal trajectory under typical growing conditions.

In conclusion, with site specific maintenance and monitoring taking place at regular occurrences and informing adaptive management decisions at restoration sites, it is expected that the Project goals and performance measures will be achieved over the life of the Project.

6.0 References

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, California.

Hayes, Gretchen E., et al. (2011) *Monitoring Plan for the Napa River Rutherford Reach Restoration Project*, Napa County Flood Control and Water Conservation District, Napa, California, 2009.

Herrick, J.E., J.W. Van Zee, K.M. Havstad, and W.G. Whitford. 2005. *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems*. USDA-ARS Jornada Experimental Range, Las Cruces, New Mexico.

Figure 1: Study area showing direct count, mapping, transect and photo monitoring locations

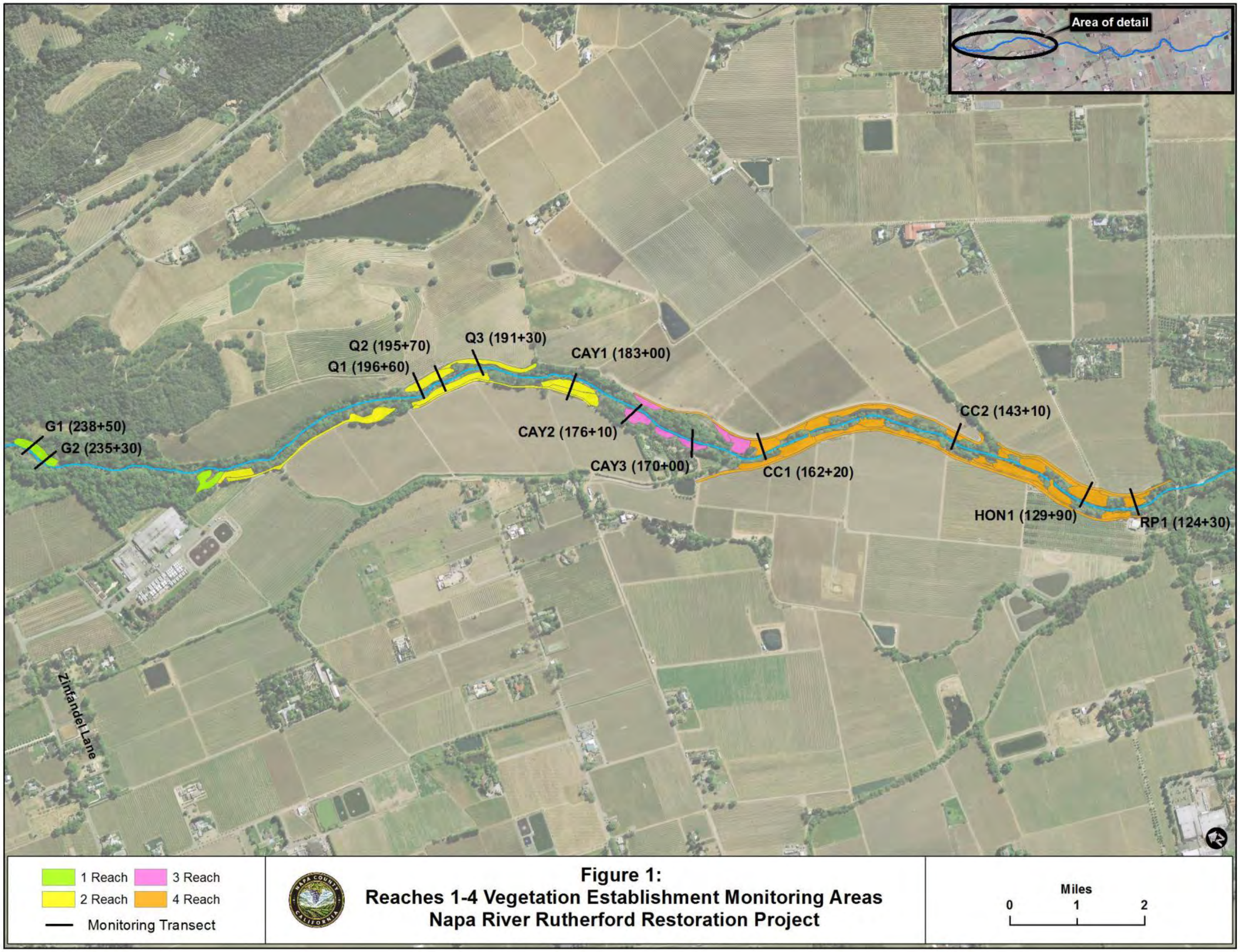


Figure 2: Representative photos of direct count and transect monitoring sites


Guggenhime Bench, Reach 1 (April 2014)


Quintessa Bench, Reach 2 (April 2014)


Frogs Leap Bench, Reach 2 (April 2014)


Caymus Bench, Reach 2 (April 2014)

Figure 3: Representative photos of direct count and transect monitoring sites

Carpy Conolly Bench 4, Reach 3 (April 2014)

Caymus Bench 2, Reach 3 (April 2014)

Honig Bench 11, Reach 4 (April 2014)

Round Pond East Bench 14, Reach 4 (April 2014)

Figure 4: Representative photos of direct count and transect monitoring sites

Sequoia Grove Bank Stabilization, Reach 8 North (April 2014)

Wilsey Bench 1, Linear Wetland, Reach 8 North (April 2014)

Wilsey Bench 1, Linear Wetland, Reach 8 North (April 2014)

Wilsey Bank Stabilization 3, Reach 8 North (April 2014)

Figure 5: Representative photos of direct count and transect monitoring sites


Transect G1/238+50 (July 2013)


Transect Q1/196+60 (July 2013)


Transect CC2/143+10 (July 2013)


Transect CAY/170+00 (July 2013)


Transect HON1/129+90 (July 2013)


Transect RP1/124+30 (July 2013)

XIII. Stakeholder Participation Documentation

Stakeholder Participation

Thirty one (31) property owners own forty one (41) parcels with river front property along the Rutherford Reach in Rutherford and Oakville. Thirty five (35) parcels owned by 26 property owners were included in the Napa River Rutherford Reach Restoration Project, and one in the Zinfandel Lane Fish Passage Project.

All forty one (41) parcels are included in the Napa River Special Benefit Zone Channel Maintenance Assessment District (MAD), which is funded by all thirty (30) property owners proportional to the linear footage of river front land they own. In addition to supporting routine channel maintenance measures, the MAD funds the long term monitoring and maintenance of the restoration construction project elements. To date, twenty-six (26) of the thirty one (31) landowners have signed long term access agreements authorizing Flood District staff to conduct channel and restoration project maintenance and monitoring under the MAD. Access to other properties has been authorized when requested.

The MAD is administered by the Napa County Flood Control and Water Conservation District in cooperation with the property owners through a Landowner Advisory Committee (LAC). The LAC began convening in 2009 coincident with the start of construction of the restoration project. From 2009 – 2011, the LAC convened three times a year. Landowners voted in 2012 to meet twice a year: once in July to review and comment on the results of the annual June channel survey and proposed channel maintenance workplan; and a second time in March to review and comment on the work done, the budget, and the prioritization of channel maintenance activities. Attendance at each LAC meeting has ranged between six (6) to eleven (11) people, representing of 20-30% of the properties in the MAD. The landowner liaison and the Napa County MAD representative are available via email and phone throughout the year, and have had communication with all of the landowners in the MAD.

Landowner Channel Maintenance Requests

Records of landowner channel maintenance requests are maintained by the Napa County Flood Control and Water Conservation District. The District reports annual maintenance activities in a separate Annual Channel Maintenance and Monitoring Report for the Rutherford Reach of the Napa River. These reports can be accessed online at the Napa County Watershed Information Center and Conservancy (WICC) in the Channel Maintenance folder of the Rutherford Reach Restoration Project document repository:

http://www.napawatersheds.org/app_folders/view/5501.

Landowner Restoration Construction Agreements

Parcel Name	Parcel No.	Bank	Reach									Design and Construction Phase	Temporary Construction Easement Signed	Construction Year
Marko B. Zaninovich	030-250-015-000	East	**1**									**Zinfandel Bridge**	2010	**2011**
David J. Guggenhime	030-250-016-000	West	**1**									**NA**	2009	**NA**
David J. Guggenhime	030-250-017-000	East	**1**									**1a**	2009	**2009**
The Ranch Winery	030-060-025-000	West	**1**	**2**								**1b**	2009	**2010**
Quintessa: Angaston LLC	030-060-049-000	East	**1**	**2**								**1a**	2010	**2009**
Quintessa: Clarevale LLC	030-060-059-000	East	**1**	**2**								**1a**	2010	**2009**
Frogs Leap Winery	030-060-021-000	West		**2**								**1b**	2010	**2010**
Caymus	030-230-013-000	West		**2**	**3**							**2**	2011	**2010**
Carpy Conolly LLC 1	030-090-002-000	East			**3**	**4**						**2**	2011	**2010**
Honig Vineyard and Winery	030-090-003-000	East				**4**						**3**	2011	**2011**
Round Pond Estate	030-140-004-000	East				**4**						**3**	2011	**2011**
Emmolo	030-230-019-000	West			**3**	**4**						**3**	2011	**2012**
Caymus	030-230-004-000	West				**4**						**3**	2010	**2012**
Round Pond Estate	030-230-021-000	West				**4**						**3**	2012	**2012**
CDFW	030-230-020-000	West				**4**						**NA**	NA	**NA**
Foley Johnson	030-190-004-000	West								**8**		**4a**	2012	**2012-2013**
Sequoia Grove	030-190-005-000	West								**8**		**4a**	2012	**2012**
Wilsey	030-140-019-000	East							**7**	**8**		**4a**	2012	**2012**
Wilsey	030-140-014-000	East							**7**	**8**		**4a**	2012	**2012**

Landowner Restoration Construction Agreements

Parcel Name	Parcel No.	Bank	Reach									Phase	Temporary Construction Easement Signed	Construction Year
Frostfire Vineyards LLC / Davis Estates	030-190-028-000	West								**8**		**4bc**	2012	**2013**
Frostfire Vineyards LLC / Davis Estates	030-190-029-000	West								**8**		**4bc**	2012	**2013**
AJM Vineyards / McDowell	030-190-012-000	West								**8**		**4bc**	2013	**2013**
AJM Vineyards / McDowell	031-010-005-000	West								**8**		**4bc**	2013	**2013**
Glos	031-010-006-000	West								**8**		**4bc**	2013	**2013**
Cakebread Properties LP1 @ River Ranch	031-010-009-000	West								**8**		**4bc**	2013	**2013**
Nickel & Nickel	031-010-003-000	West									**9**	**4bc**	2013	**2013**
El Encino LLC / Gmelch	031-030-014-000	East								**8**		**4bc**	2013	**2013**
Bayview Vineyards / Laird Estates	031-030-017-000	East								**8**	**9**	**4bc**	2013	**2013**
Bayview Vineyards / Laird Estates	031-030-018-000	East								**8**	**9**	**4bc**	2013	**2013**
Peju	030-150-011-000	West						**6**				**5**	2014	**2014**
Round Pond Estate	030-090-034-000	East						**6**				**5**	2014	**2014**
St. Supery	030-190-019-000	West							**7**			**5**	2014	**2014**
Foley Johnson	030-190-004-000	West							**7**			**5**	2014	**2014**
Bayview Vineyards / Laird Estates	031-030-018-000	East									**9**	**5**	2014	**2014**
Nickel & Nickel	031-010-003-000	West									**9**	**5**	2014	**2014**
United Wineries of America	031-040-027-000	East									**9**	**5**	2014	**2014**
Swanson	031-040-032-000	East									**9**	**5**	2014	**2014**
Swanson	031-040-033-000	East									**9**	**5**	2014	**2014**
Spencer Vineyards LLC	031-020-003-000	West									**9**	**5**	2014	**2014**
Opus One	031-020-007-000	West									**9**	**5**	2014	**2014**

Landowner Advisory Committee Meeting Attendance
Napa River Rutherford Reach Special Benefit Zone
River Channel Maintenance Assessment District (MAD)

Meeting Date	Landowner Attendees	Properties Represented (of 30)
6/18/2009	No Record	No Record
11/13/2009	No Record	No Record
4/10/2010	No Record	No Record
12/7/2010	No Record	No Record
4/22/2011	6	9
8/2/2011	10	9
12/6/2011	7	10
4/12/2012	9	10
7/24/2012	11	8
4/9/2013	8	7
7/25/2013	6	8
4/10/2014	11	15

XIV. Photomonitoring

XIV. Photomonitoring

Phase 1a
Reaches 1 and 2 East Bank

Constructed 2009

Guggenhime
Quintessa

River Station 23,800
Bench: Guggenhime
West Bank to East Bank

River Station 23,650
Bench: Guggenhime
Downstream to Upstream

June 2009

June 2011

River Station 23,650
Bench: Guggenhime
West Bank to East Bank

June 2009

June 2011

River Station 23,900
Bench: Guggenhime
East Bank to West Bank


June 2009


October 2009


June 2011


June 2009


April 2014

River Station 23,900
Bench: Guggenhime
East Bank Downstream


June 2009


April 2014


June 2011


April 2014

River Station 23,500
Bench: Guggenhime
East Bank to Upstream

June 2009

October 2009

June 2011

River Station 23,500
Bench: Guggenhime
East Bank to Upstream


June 2009


October 2009


June 2011


April 2014

River Station 23,500
Bench: Guggenhime
East Bank to Upstream

June 2009

October 2009

June 2011

April 2014

River Station 19,550
Benches: Quintessa & Frogs Leap
East Bank to West Bank

June 2009

September 2009

August 2011

River Station 19,550
Benches: Quintessa & Frogs Leap
East Bank to West Bank

September 2010

March 2011

March 2012

Phase 1b
Reaches 1 and 2 West Bank

Constructed 2010

The Ranch Winery & Trinchero Family Estates
Frog's Leap
Caymus

21, 950 River Station
Alcove: The Ranch Winery / Sutter Home
West Bank to Upstream

2010

March 2011

April 2014

River Station 20,800
Setback Berm: Frog's Leap
West Bank Vineyard to Channel

April 2010

January 2011

River Station 19,850
Bench: Frog's Leap
West Bank to Downstream


July 2010


August 2010


April 2011


May 2011

River Station 19,850
Bench: Frog's Leap
West Bank to Downstream

July 2010

April 2011

August 2010

April 2014

River Station 19,100
Frog's Leap Bench from Quintessa Road
East Bank to Upstream West Bank

March 2011

March 2012

River Station 18,100
Setback Berm: Caymus Bench
West Bank to Upstream

April 2010

December 2010

River Station 18,300
Bench: Caymus
West Bank to Upstream

April 2010

December 2010

April 2014

River Station 18,300
Bench: Caymus
West Bank to Upstream

April 2010

December 2010

Phase 2
Reach 3

Constructed 2010

Carpy Conolly with Pina Vineyard Mgmt
Caymus

River Station 17,650
Bench 1: Caymus
West Bank to Downstream

October 2010

December 2010

River Station 17,625
Bench 1: Caymus
West Bank to Channel

April 14, 2010

January 1, 2011

River Station 17,450
Bench 1: Caymus
Downstream to Upstream West Bank

June 2010

May 2011

River Station 17,450
Bench 1: Caymus
Downstream to Upstream

October 2010

May 2011

River Station 17,200
Bench 2: Caymus
Downstream to Upstream West Bank

October 2010

December 2010

May 2011

River Station 16,850
Bench 3: Caymus
Downstream to Upstream

October 2010

December 2010

River Station 17,130
Bench 3: Caymus
Upstream to Downstream

June 2010

June 2011

River Station 16,900
Caymus Bench 3
Downstream to Upstream

June 2010

June 2011

River Station 16,420
Bench 4: Carpy Conolly
East Bank to Upstream

April 2010

November 2011

April 2014

River Station 16,600
Bench 4: Carpy Conolly
East Bank to Channel

November 2010

November 2011

April 2014

River Station 16,125
Bench 5: Carpy Conolly
Downstream to Upstream

June 2010

November 2010

June 2011

River Station 16,200
Carpy Conolly Bench 5
East Bank to Upstream

November 2010

November 2011

April 2014

Phase 3a
Reach 4 East Bank

2011

Carpy-Conolly
Honig
Round Pond East Bank

Bench 7: Carpy-Conolly
East Bank to Downstream

April 2014

Bank Stabilization: Honig Confluence
East Bank to Upstream

April 2014

River Station 13,540
Honig Bench 11
East Bank to Upstream

July 2011

August 2011

November 2011

River Station 13,540
Bench 11: Honig
East Bank to Upstream

November 2011

March 2012

River Station 13,470
Bench 11: Honig
East Bank to Upstream


June 2011


November 2011


March 2012

River Station 13,650
Bench 11: Honig
Channel to East Bank

June 2011

November 2011

River Station 12,900
Berm Bench 13 Berm: Honig
East Bank to Upstream

May 2011

November 2011

River Station 13,050
Bench 13: Honig
East Bank to Downstream

July 2011

August 2011

March 2012

River Station 13,200
Bench 13: Honig
East Bank to Downstream

November 2011

March 2012

River Station 12,750
Bench 13: Honig
East Bank to Upstream

May 2011

November 2011

River Stations13,225 (8-30-11) 13,125 (3-30-12)
Bench 13: Honig Berm
East Bank to Upstream

River Station 13,050
Bench 13: Honig
Channel to East Bank

June 2011

November 2011

River Station 12,760
Bench 13: Honig
Channel to East Bank

June 2011

November 2011

River Station 12,425
Bench 14: Round Pond East
East Bank to Upstream

May 2011

November 2011

March 2012

April 2014

River Station 12,425
Bench 14: Round Pond East
East Bank to Upstream

May 2011

November 2011

River Station 12,490
Bench 14: Round Pond East
East Bank to Channel

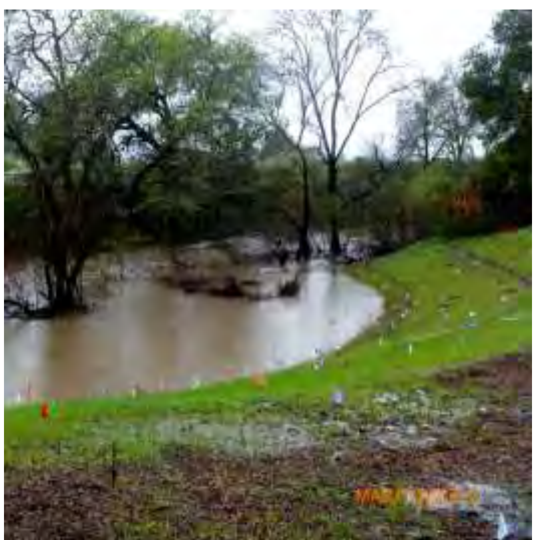
May 2011

November 2011

River Station 12,425
Bench 14: Round Pond East
East Bank to Upstream


August 2011


March 2012


March 2012


April 2014

River Station 12,500
Bench 14 Berm: Round Pond East
East Vineyard to Channel

August 2011

November 2011

River Station 12,060

Setback Berm: Round Pond East

East Bank to Upstream

May 2011

March 2012

Phase 3b
Reach 4 West Bank

Constructed 2012

Emmolo
Mee with Bettinelli Vineyard Management
Round Pond with Colinas Farming

River Station 16,110
Bench 6: Emmolo
West Bank to Downstream

May 2012

November 2012

River Station 16,110
Bench 6: Emmolo
West Bank to Downstream

May 2012

November 2012

April 2014

River Station 15,760
Bench 6: Emmolo
West Bank to Upstream

River Station 15,760
Bench 6: Emmolo
West Bank to Upstream

May 2012

November 2012

April 2014

River Station 15,290
Bench 8: Emmolo
West Bank to Downstream

River Station 15,290
Bench 8: Emmolo
West Bank to Downstream

May 2012

November 2012

April 2014

River Station 15,290
Bench 8: Emmolo
West Bank to Downstream

River Station 15,000
Bench 8: Emmolo
West Bank to Upstream

May 2012

November 2012

April 2014

River Station 15,000
Bench 8: Emmolo
West Bank to Upstream

May 2012

November 2012

River Station 14,100
Bench 9: Mee
West Bank to Downstream

August 2012

November 2012

River Station 14,100
Bench 9: Mee
West Bank to Downstream

August 2012

November 2012

River Station 14,050
Bench 9: Mee
West Bank to Downstream

May 2012

November 2012

April 2014

River Station 13,920
Bench 10: Caymus (Mee)
West Bank to Downstream

May 2012

November 2012

April 2014

River Station 13,920
Bench 10: Caymus (Mee)
West Bank to Downstream

May 2012

November 2012

River Station 13,560
Bench 10: Caymus (Mee)
West Bank to Upstream

May 2012

November 2012

River Station 13,560
Bench 10: Caymus (Mee)
West Bank to Upstream

May 2012

November 2012

April 2014

River Station 13,330
Bench 12: Round Pond West
West Bank to Downstream

May 2012

November 2012

April 2014

River Station 13,080
Bench 12: Round Pond West
West Bank to Upstream

May 2012

November 2012

April 2014

River Station 13,080
Bench 12: Round Pond West
West Bank to Upstream


May 2012


November 2012


December 2012


April 2014

River Station 12,780
Bank Stabilization 3: Round Pond West
West Bank to Downstream


May 2012


November2012


January 2013


December 2012


April 2014

River Station 12,780
Bank Stabilization 3: Round Pond West
West Bank to Downstream


May 2012


November 2012

River Station 12,600
Bank Stabilization 3: Round Pond West
West Bank to Upstream

May 2012

November 2012

December 2012

April 2014

River Station 12,660
Bank Stabilization 3: Round Pond West
West Bank to Upstream

May 2012

November 2012

Phase 4a
Reach 8 North

Constructed 2012

Foley Johnson (Previously Sawyer)
Sequoia Grove
Wilsey
Ritz Carlton Hotel Linear Wetland Mitigation
(Part of Secondary Channel on Bench 1 on Wilsey)

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Station 7,330 West Bank, Downstream to Upstream

May 2012

September 2013

December 2012

April 2013

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Station 7,330 West Bank, Downstream to Upstream

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Station 7,550 West Bank, Upstream to Downstream


Hayes 5-15-2012


Hayes 10-30-2012


Vicencio 12-12-2012


Hayes 4-25-2014

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Station 7,550 West Bank, Upstream to Downstream

5-15-2012 Hayes

Hayes 10-30-2012

Hayes 4-25-2014

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Boulder Cluster BC-7530-M

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Root Wad WD-7512-R

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Boulder Cluster BC-7460-M

Phase 4A
Reach 8 North, West Bank
Foley Johnson (Sawyer) Bank Stabilization
Boulder Cluster BC-7410-M

Ritz Carlton Hotel Linear Wetland Mitigation

Constructed 2012

Part of Phase 4a: Reach 8 North
Secondary Channel on Bench 1 on Wilsey

Ritz Carlton Hotel Linear Wetland Mitigation Site
Reach 8 North, Bench 1 Secondary Channel on Wilsey

The secondary channel constructed on Bench 1 on the Wilsey property in 2012 in Phase 4a Reach 8 North, included the creation of a 589 linear foot wetland to satisfy the mitigation requirements of the Ritz-Carlton Hotel.

Following construction in 2012, approximately 1.2 acres of graded area was revegetated in the secondary channel and on the adjacent instream bench with a mix of native riparian trees, shrubs and herbaceous plants. Photomonitoring of the site illustrates the progress of vegetation establishment at this site. Vegetation monitoring shows that first year vegetation survivorship on the Bench along the linear wetland was 91% or greater, which exceeds the requirement of 80% or greater plant survivorship. Field estimates and quadrant sampling within this area indicated that approximately 20%-25% of the vegetative cover is comprised of non-native vegetation while the remaining 75%-80% cover is native. Line intercept surveys for this area will be established in the summer of 2014

Ritz Carlton Hotel Linear Wetland Mitigation Site
Bench 1 Secondary Channel Inlet on Wilsey

The secondary channel constructed on Bench 1 on the Wilsey property in 2012 in Phase 4a Reach 8 North, included the creation of a 589 linear foot wetland to satisfy the mitigation requirements of the Ritz-Carlton Hotel.

Following a series of significant high flow events (5-10 year flows) in December of 2012, bio-engineered elements (vegetated soil lifts, pole planting etc.) along the secondary channel were damaged by storm flows that caused localized erosion and slumping. County staff surveyed the channel with design contractors after these events and developed a series of slope repair recommendations. The contractors repaired the slope by constructing vegetated soils lifts, installing an additional willow brush mattress and willow pole plantings, and re-hydroseeding the area. All repairs were successfully completed in April of 2013. As illustrated in the photomonitoring pairs, the slope repairs remained intact, and the slope remained stable during high flow events in February and March of 2014.

River Station 7,100
Bench 1 Secondary Channel Inlet: Wilsey
Channel to Downstream

June 2011

November 2012

January 2013

River Station 7,000
Bench 1 Secondary Channel Inlet: Wilsey
Channel to Downstream

November 2012

January 2013

River Station 7,000
Bench 1 Secondary Channel Inlet: Wilsey
East Bank to Channel

November 2013

December 2012

River Station 7,000
Bench 1 Secondary Channel: Wilsey
Channel to Downstream

November 2013

River Station 6,550
Bench 1: Wilsey
East Bank to Upstream


September 2012


November 2012


December 2012


January 2013

River Station 6,550
Bench 1: Wilsey
East Bank to Upstream

2012 Series

River Station 6,550

Bench 1 Secondary Channel: Wilsey

Downstream End Outlet to Upstream

November 2012

April 2012

January 2013

River Station 6,500
Bench 1 Secondary Channel: Wilsey
Downstream End Outlet to Downstream

November 2012

January 2013

River Stations 6,310 and 6,025
Bank Stabilization 3: Wilsey
East Bank

November 2012

6,310 to Downstream to Tree at 6,150

January 2013

6,025 to Upstream to Tree at 6,150

River Station 6,860
Bank Stabilization 2: Sequoia Grove
West Bank to Downstream

River Station 6,860
Bank Stabilization 2: Sequoia Grove
West Bank to Downstream

River Station 6,630
Bank Stabilization 2: Sequoia Grove
West Bank to Downstream

River Station 6,630
Bank Stabilization 2: Sequoia Grove
West Bank to Downstream

11-2012

12-2012

01-2013

River Station 6,630
Bank Stabilization 2: Sequoia Grove
West Bank to Downstream

May 2012

November 2012

December 2012

January 2013

River Station 6,630
Bank Stabilization 2: Sequoia Grove
West Bank to Upstream

May 2012

November 2012

December 2012

January 2013

Phase 4bc
Reach 8 South

Constructed 2013

El Encino (Gmelch)
Laird
Frostfire (Davis)
AJM Vineyards (McDowell)
Glos
Cakebread
Nickel & Nickel

Phase 4BC: Reach 8 South
Bench 1: Upstream to Downstream

Phase 4BC: Reach 8 South
Bench 1: Downstream to Upstream
Grade Control Structure

Phase 4BC: Reach 8 South
Bench 1: East Bank to West Bank Upstream

Tony Williams

Phase 4BC: Reach 8 South
Bench 1:

Vicencio 2-28-2104

Vicencio 2-28-2104

Vicencio 2-28-2104

Phase 4BC: Reach 8 South

Bank Stabilization 1: West Bank to East Bank

Phase 4BC: Reach 8 South
Bank Stabilization 1: Upstream to Downstream

Phase 4BC: Reach 8 South
Bank Stabilization 1: East Bank to West Bank

Hayes 6-11-2013

Tony Williams HARC 2013

Phase 4BC: Reach 8 South
Bank Stabilization 1: Upstream to Downstream

Vicencio 2-28-2104

Hayes 10-31-2012

Phase 4BC: Reach 8 South
Bank Stabilization 1: Downstream to Upstream

Hayes 6-6-2013

Phase 4BC: Reach 8 South
Bench 2: Upstream to Downstream

Tony Williams HARC 2013

John Vicencio Napa County 2-28-2014

Tony Williams HARC 2013

Phase 4BC: Reach 8 South
Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Hayes 2-3-2104

Tanaka 2-13-2014

Phase 4BC: Reach 8 South

Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Phase 4BC: Reach 8 South
Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Hayes 3-2104

Vicencio 2-28-2104

Phase 4BC: Reach 8 South
Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Phase 4BC: Reach 8 South

Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Phase 4BC: Reach 8 South
Bank Stabilization 3: Upstream to Downstream

Phase 4BC: Reach 8 South

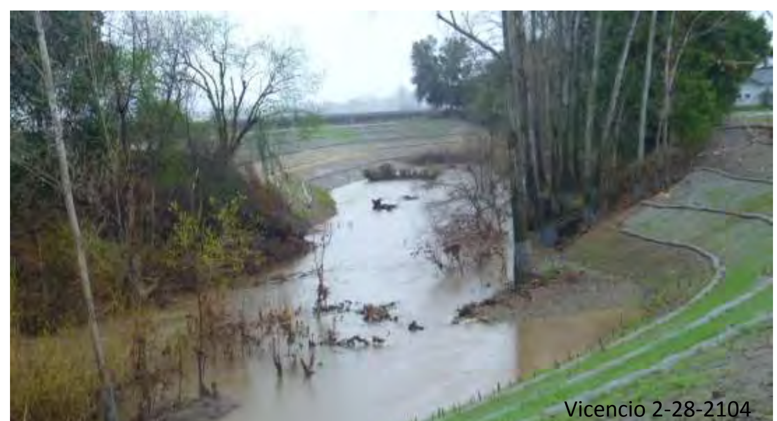
Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank


Hayes1 -7-2014


Pina 2-9-2104 AM


Hayes 2-3-2104


Tanaka 2-13-2104


Vicencio 2-28-2104

Phase 4BC: Reach 8 South
Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Hayes 2-3-2104

Tanaka 2-13-2014

Vicencio 2-28-2104

Phase 4BC: Reach 8 South
Bank Stabilization 3: Upstream to Downstream




Phase 4BC: Reach 8 South

Bank Stabilization 3 to Bench 3: Upstream to Downstream: West Bank to East Bank

Hayes 2-3-2104

Tanaka 2-13-2014

Phase 4BC: Reach 8 South
Bank Stabilization 3: Downstream to Upstream

Phase 4BC: Reach 8 South
Bank Stabilization 3: Downstream to Upstream

Phase 4BC: Reach 8 South Bank Stabilization 3

Phase 4BC

Reach 8 South

East Bank

Bench 3

Laird

Phase 4BC: Reach 8 South
Bench 3: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: East Bank to West Bank

Tony Williams HARC 2013

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South

Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South

Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South

Bella Oaks Tributary Alcove: Upstream to Downstream

Hayes 2/3/2014

Pina 2/9/2014

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Upstream to Downstream

Phase 4BC
Reach 8 South
West Bank
Bella Oaks Tributary Alcove
Nickel & Nickel

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Downstream to Upstream






Tony Williams HARC 4-1-2014

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Downstream to Upstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Downstream to Upstream









Tony Williams HARC 2013

HARC 4-1-2014

Phase 4BC: Reach 8 South
Bella Oaks Tributary Alcove: Downstream to Upstream

Hayes 5-28-2013

Hayes 11-22-2013

Phase 4BC
Reach 8 South
West Bank
Bella Oaks Tributary
Cakebread / Nickel & Nickel

Phase 4BC: Reach 8 South
Bella Oaks Tributary: East Bank Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary: East Bank Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary: Upstream to Downstream

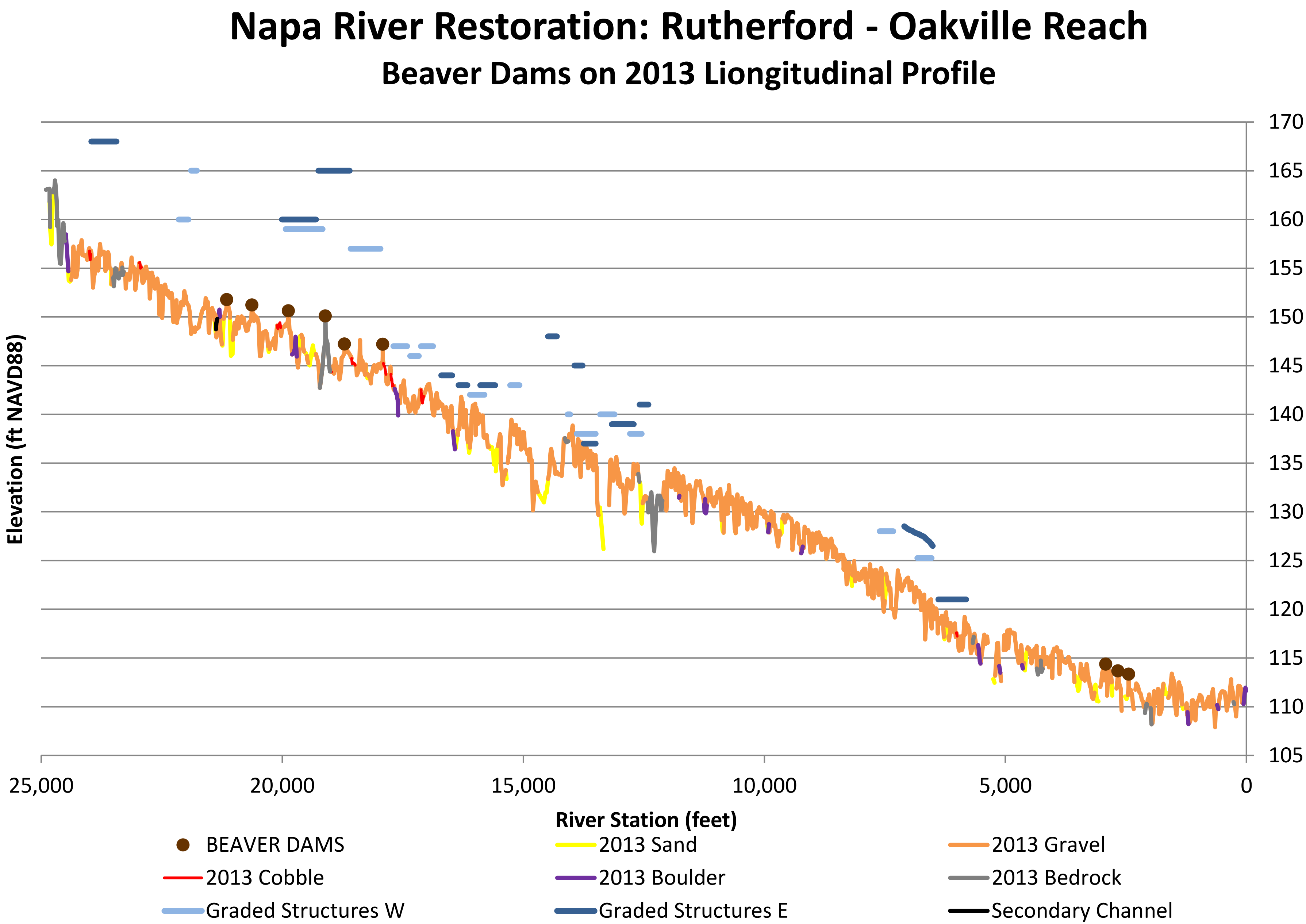
Phase 4BC: Reach 8 South
Bella Oaks Tributary: West Bank Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary: West Bank Upstream to Downstream

Phase 4BC: Reach 8 South
Bella Oaks Tributary: Downstream to Upstream

Napa River Rutherford Reach
Beaver
Dams and Activity

2013


Napa River Restoration: Rutherford - Oakville Reach
Beaver Dams on 2013 Liongitudinal Profile
Elevation (ft NAVD88)
170
165
160
155
150
145
140
135
130
125
120
115
110
105
25,000
20,000
15,000
10,000
5,000
0
River Station (feet)
BEAVER DAMS
2013 Sand
2013 Gravel
2013 Cobble
2013 Boulder
2013 Bedrock
Graded Structures W
Graded Structures E
Secondary Channel

Beaver Dams
Reaches 2 – 3
June 2013

Beaver Dam
Reach 9
November 2013

Beaver Activity and Management
Reach 8
September 2013