Riparian Zone Monitoring Plan

Prepared for:

Marin Resource Conservation District
P.O. Box 1146, Point Reyes Station CA 94956
(415) 663-1170, http://www.marinrcd.org/

Prepared by:

University of California Cooperative Extension
1682 Novato Boulevard Suite 150-B, Novato CA 94947
(415) 499-4204, http://cemarin.ucdavis.edu/

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Contributors

This plan was the result of contributions from numerous local professionals. Specifically, the following partnering organizations helped to produce this document:

- USDA Natural Resources Conservation Service
- The Bay Institute's Students & Teachers Restoring A Watershed
- Point Reyes Bird Observatory Conservation Science
- Prunuske Chatham, Inc.
- Jeff Creque, Certified Rangeland Manager
- Marin Agricultural Land Trust
- San Francisco Bay Regional Water Quality Control Board
- Southern Sonoma County Resource Conservation District
- California Department of Fish and Game
- Point Reyes National Seashore
- Marin Municipal Water District
- The Nature Conservancy

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Project Summary

The conservation of natural resources and agricultural viability has been the focus of the Marin Resource Conservation District (RCD) for 50 years. Delivering financial and technical support with partnering organizations to landowners has evolved over the last half century in the face of increased demand for stream restoration and locally produced food. Responding to societal needs and explaining the long-term outcomes from natural resource enhancement efforts has continued to be a challenge for agriculture.

Assisting landowners to meet their needs has changed as watershed and creek management issues, such as water quality, are increasingly problematic. Solutions for controlling erosion and managing the corridor along streams have improved since the 1970's. Marin RCD and its partners have pioneered advances in riparian restoration technology and now provide concise, scientific approaches to watershed restoration based on site conditions.

This Riparian Zone Monitoring Plan (RZMP) is for conservation projects implemented in riparian areas targeted in watershed recovery efforts to control erosion and sedimentation, increase aquatic, riparian, and upland habitat and stabilize eroding stream channels. The RZMP applies to any stream from headwater creeks or gullies to large streams or small rivers. Its goal is to provide funding and permitting agencies the confidence that projects are systematically monitored while guiding Marin RCD staff and partners to efficiently collect and report monitoring results for integration with the Permit Coordination Program (MRCD 2004).

Overall, the RZMP provides a science-based guide to organize post-project monitoring based on site-specific objectives to further understand agricultural sustainability and ecosystem services. It standardizes monitoring protocols and prioritizes questions for periodic evaluation. Consistent and systematic monitoring of project outcomes will continue to improve conservation practices while maintaining landowner confidentiality. Marin RCD's watershed restoration program is built upon the hard work by community residents, landowners, ranchers, farmers, consultants, restoration practitioners, agencies, scientists, oyster growers, and other stakeholders.

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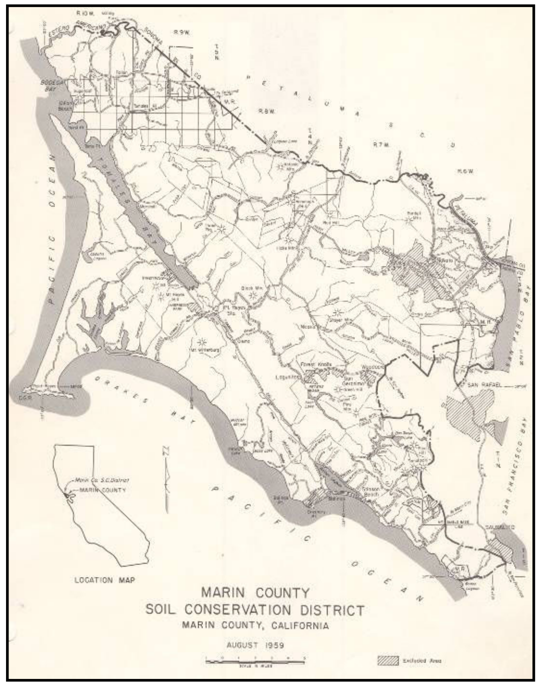
INTRODUCTION



The mission of the Marin RCD is to conserve and enhance Marin County's natural resources, including its soil, water, vegetation, and wildlife. The RCD has administered approximately $12 million of government and private foundation grants since its inception in 1959 while providing technical and other financial resources. Today, the RCD continues to bring together state, federal, and local agencies with private landowners to conserve soil and water resources. Conservation projects focus on:

- Control of soil erosion
- Riparian habitat restoration
- Protection and improvement of water quality
- Education and outreach
- Conservation of rangeland, cropland, and forestland
- Active support of the district's agricultural economy and heritage

The purpose of riparian enhancement and watershed conservation is to implement management practices that improve water quality by reducing sediment, pathogen or nutrient levels in storm runoff and increase habitat for wildlife, birds or fish. The links between streambank erosion, water quality, and fish and wildlife habitat are a concern for agricultural production and environmental conservation. The RCD seeks to improve natural resources, minimize non-point source pollution such as the erosion of topsoil or fine sediment, and implement healthy land management practices on Marin County farms.

The need to monitor conservation and restoration project outcomes has received increased critical attention in recent years from both the popular press (Dean 2008) and the scientific literature (Christian-Smith and Merenlender 2010). This is partly because few long-term assessments have been completed. Riparian and watershed enhancement practices in particular have received minimal documentation considering over $2 billion has been spent on these efforts in the United States (Bernhardt et al. 2005, 2007). As a result, numerous researchers have questioned project success (Dean 2008, Palmer et al. 2005), while others have produced monitoring methods or guidance (Harris et al. 2005a, Harris et al. 2005b, Thayer et al. 2005, Kondolf and Micheli 1995), and evaluated project outcomes (Lennox et al. 2011, Tompkins and Kondolf 2007, Opperman and Merenlender 2004).

Multiple grant opportunities currently require some degree of project monitoring; however, few funding opportunities offer long-term contract agreements to implement project monitoring over five years (Reeve et al. 2006, Reeve and Towey 2007). Securing adequate funding will be an ongoing challenge to complete the specifics detailed in the following plan. As a result, fast assessments efficiently evaluate all project sites and intensive, quantitative protocols follow a subset of project sites depending on available funding.

The objective of this Riparian Zone Monitoring Plan (RZMP) is to organize and standardize an efficient process to document short and long-term project outcomes in order to evaluate and improve the management practices utilized by Marin RCD. The plan focuses on the following fundamental questions:

1) Are projects performing as planned and satisfying landowner concerns?
2) Are long-term project objectives being accomplished?
3) How can project planning, design, implementation, maintenance, and adaptive management be improved to ensure success at each site?
4) How can monitoring data be efficiently shared between RCD partners and reported to funders while maintaining client confidentiality and educating the public about conservation practices?

Landowner observations and permission to monitor sites are critical to understand project outcomes over multiple decades (Figure 1). The greatest benefit resulting from monitoring is having a jump-start on adaptive management needs which leads to greater project success. Project evaluations may also be included in Ranch Water Quality Plans to meet regulatory requirements (SFBRWQCB 2009). Incorporating the lessons learned from previous projects has helped to fine-tune future projects for permit, funder and landowner requirements. This has become an incentive for landowners and increased participation in natural resource conservation and stewardship (MRCD 2004). A well planned and coordinated monitoring program provides for numerous other opportunities, such as greater power to leverage grant funds for implementing more conservation projects, assessing landowners' satisfaction, and educating the public. The RZMP formalizes this feedback loop by documenting how design, installation and maintenance leads to effective projects on the ground.

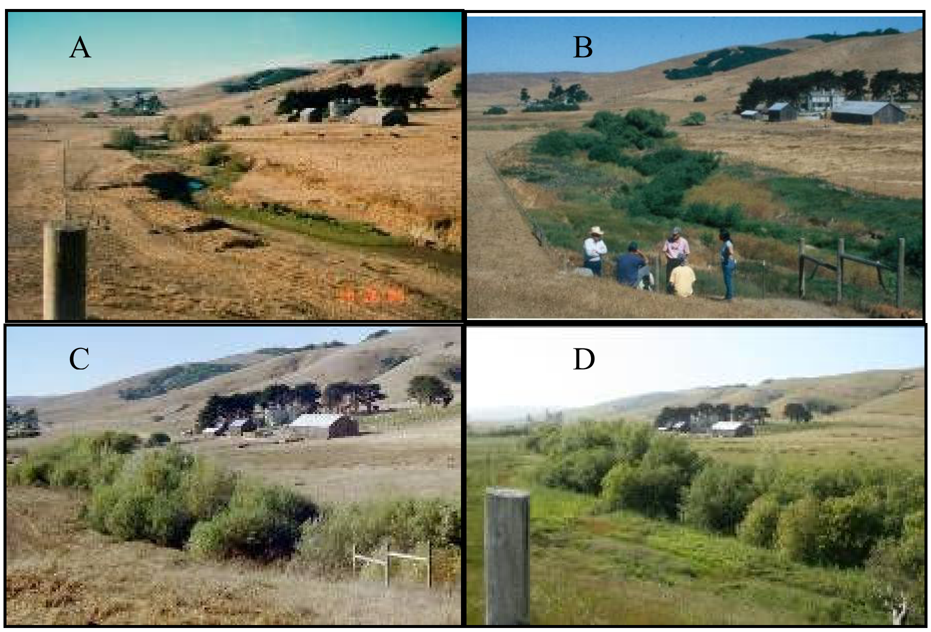


Figure 1: Photo-point sequence of riparian revegetation project site at a tributary to Walker Creek documents the vegetation response at zero (A), two (B), eight (C), and twelve years (D) since project implementation.

The following plan lays out a step-by-step process for data collection, analysis and reporting that begins before project implementation. This allows Marin RCD and its partners the capacity to lead how project effectiveness is measured in order to provide consistency over time for useful and meaningful results. The methods were compiled from the scientific literature and grant funders can have greater confidence in Marin RCD's restoration program to document expected and unintended outcomes beyond the contract period.

This document provides a guide to organize project monitoring based on site-specific objectives by focusing on the commonly utilized conservation practices and those outlined in the Marin Coastal Watershed Permit Coordination Program (PCI 2010). The RZMP components were a collaborative effort among Marin RCD partners with field-testing conducted at numerous project sites from 2008 to 2010. Overall, the RZMP standardizes monitoring protocols, streamlines the reporting process among partners and prioritizes questions for periodic evaluation and analysis.

CONSERVATION PRACTICES, PROJECT OBJECTIVES & MONITORING TYPES

Partners & Collaboration

The Marin RCD collaborates with numerous local natural resource professionals to provide landowners a broad base of expertise, skills and experience when implementing conservation projects. Marin RCD partners use a watershed approach to conservation by integrating ecology, sociology and geology to evaluate the aggregate effects of current and historic land use. The goal is to provide an objective and scientific basis to treat the underlying causes of environmental problems instead of the symptoms.

Landowner participation is important for the success of each project and for restoration to succeed in privately owned watersheds overall. Conservation projects start with an interested landowner that contacts Marin RCD staff to request assistance in addressing environmental concerns or implementing specific practices. The planning and design of specific project practices follows the guidance of locally experienced restoration professionals (MRCD 2004). Landowner interest, participation and satisfaction have been found to be critical for Marin RCD projects to be successful. When a landowner is willing and dedicated to project stewardship, they can make it a success through sheer determination. Basically, investment equals outcome. Marin RCD and partners build upon this land stewardship ethic to focus time and resources because of landowners' critical role in conservation. Aldo Leopold explained the philosophy of conservation over 70 years ago in Sand County Almanac.

> *"The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.... In short, a land ethic changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such."* (Leopold 1949)

Multiple roles are filled among Marin RCD partners to plan, implement and monitor each conservation project. The partnership with the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) offers technical and financial assistance to help solve natural resource challenges, which often maintains or improves long-term economic viability. The technical support provided by the NRCS to agricultural operators is based on conservation systems and plans designed to sustain and improve soil and water quality (MRCD 2004, 2009).

Other Marin RCD partners provide numerous benefits to conservation and land management in the County. Consulting firms prioritize sediment reduction opportunities, obtain permits, design projects, engineer specifications, and conduct construction monitoring for Marin RCD. The Bay Institute's Students And Teachers Restoring A Watershed (STRAW) educates hundreds of students about agricultural viability and watershed ecology while installing thousands of native plants each year (Figure 2). STRAW monitors the survival and establishment of their plantings. Point Reyes Bird Observatory (PRBO) assesses bird populations at stream restoration sites over time and shares their results with participating landowners. The University of California Cooperative Extension (UCCE) conducts monitoring research while providing publications and workshops. These groups collaborate to offer resources to local agriculture along with other government and private organizations such as the Marin County Agricultural Commissioner, Marin Agricultural Land Trust and Farm Bureau.

Figure 2: A gully site pre-project (left) and the STRAW revegetation day implementing critical area planting practice (right) following spring development and grade stabilization structures. Control fencing was constructed after the planting was completed.

Water quality monitoring of Marin County streams has been conducted by numerous agencies and groups over the years including California Department of Fish and Game, Regional Water Quality Control Board (RWQCB) and others. The Sonoma-Marin Farm Bureau's Animal Resource Management Committee provides a water quality monitoring service for dairy operations assessing nutrients. Currently, the Tomales Bay Watershed Council conducts long-term monitoring for pathogens in streams flowing to Tomales Bay (TBWC 2003). NRCS, UCCE, Marin RCD and Southern Sonoma County RCD collaborated to monitor nutrient and sediment concentrations during storms from 2004-2006 for evaluating the effectiveness of conservation practices on water quality in the Stemple Creek Watershed (USDA 2005). The large-spatial and temporal variations in water quality dictate such monitoring be conducted intensively and systematically across numerous sites.

Since water quality and fisheries of the Tomales Bay Watershed are being evaluated by other organizations, the RCD monitoring program focuses on the effectiveness of projects at the site or ranch scale. Such effectiveness monitoring of beneficial or Best Management Practices (BMP) is the type of evaluation required by the RWQCB's Conditional Grazing Waiver for Tomales Bay (SFBRWQCB 2009), provides feedback to improve practices, identifies the need for future projects, and offers education opportunities. Though the RCD does not regularly monitor water quality, exceptions have been made to measure the quantity of flow from spring developments or for other project-specific reasons and hydrology professionals will continue to be consulted. Given the large amount of scientific research documenting how vegetation affects storm water runoff, this RZMP details how vegetation will be monitored at a project site to document expected water quality improvements for sediment, nutrient and pathogen pollutants.

Permit Coordination & Conservation Practices

The Marin RCD steadily works with private landowners to implement conservation projects has been shown by their steady and consistent participation. A growing number of landowners in the coastal watersheds of Marin County are interested in restoring streams or enhancing other natural resources on their property (Prunuske et al. 1994, PCI 2001, MRCD 2004). However, the regulatory review processes that were intended to protect natural resources has acted as a disincentive to voluntary efforts reducing nonpoint source pollution and enhancing habitat. As a result, the Marin RCD created the Marin Coastal Watershed Permit Coordination Program (PCP) (MRCD 2004), conducted a five year review (MRCD 2009), and is currently updating the PCP (PCI 2010).

The Permit Coordination Program (PCP) provides the catalyst for high quality erosion control and habitat restoration throughout the Tomales Bay watershed. It is based on a model of coordinated, multi-agency project oversight and review that ensures the integrity of agency mandates but makes permitting for stream enhancement accessible to farmers and ranchers. Through the PCP, Marin RCD and partners work directly with landowners to promote voluntary actions that will improve water quality and wildlife habitat values in the Stemple, Walker, and Tomales Bay watersheds (Figure 3).

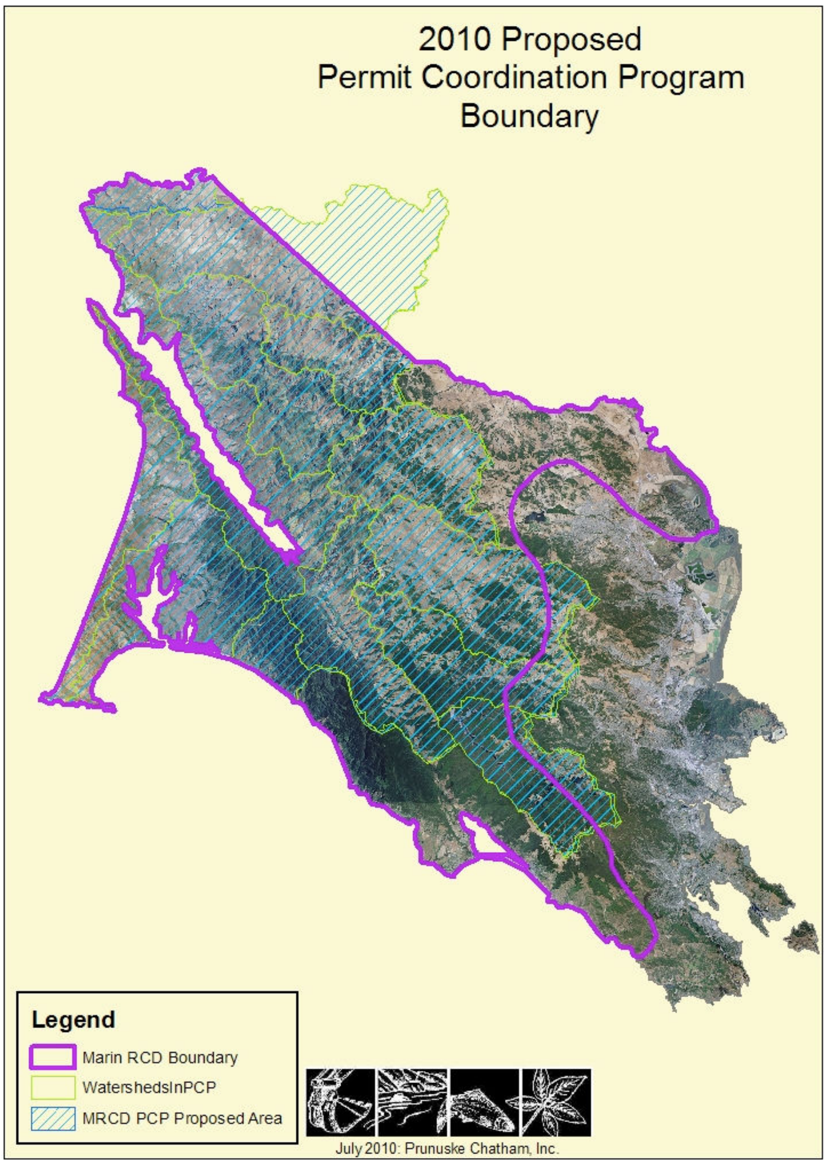


Figure 3: Map of previous (2004) and proposed (2010) Permit Coordination Program (PCP) area.

The PCP applies to the conservation practices that require more intensive permit review. The following 17 conservation practices were modified to fit local conditions for use by Marin RCD and its partners with detailed specifications available in the PCP (PCI 2010):

1) Access road,
2) Animal trail & walkway,
3) Critical area planting,
4) Filter strip,
5) Fish passage,
6) Stream habitat improvement & mngt.,
7) Grade stabilization structure,
8) Grassed waterway,
9) Lined waterway,
10) Pipeline,
11) Sediment basin,
12) Spring development,
13) Streambank protection,
14) Stream channel stabilization,
15) Structure for water control,
16) Underground outlet,
17) Water & sediment control basin,

Multiple practices are often combined at a single project site. For example, a riparian revegetation project may include critical area planting, stream bank protection and stream channel stabilization practices. Three additional practices are commonly used:

18) Fencing, http://efotg.nrcs.usda.gov/references/public/CA/382std-04-07.pdf
19) Watering facility, http://efotg.nrcs.usda.gov/references/public/CA/614std-09-07.pdf
20) Prescribed grazing, http://efotg.nrcs.usda.gov/references/public/CA/528std-6-08.pdf

NRCS technical standards, specifications, and operations/ maintenance documents for these and other conservation practices are available from the office in Petaluma and on the internet (http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=CA). To download the information, use the map to select the county, wait for a few seconds, go to Section IV-B of the electronic Field Office Technical Guide, and choose the practice desired (USDA 2010a).

Monitoring Types & Project Objectives

The monitoring conducted for each project depends on the specific objectives and expected changes at the site; however, certain types of monitoring are done at all project sites. Numerous documents describe methodologies and three types of post-project monitoring are common (Lewis et al. 2009, Roni 2005). The common project objectives used by Marin RCD are described below to facilitate a systematic planning process for how to monitor each project site.

Project Planning is the start of the monitoring process in order to have the resources and time available to collect data before the project is installed. During planning, documentation of current site conditions occurs to support project selection, objectives, design, and funding. The most important step in monitoring conservation project is to document objectives on a site-by-site basis. This guides the attributes monitored for quantitative effectiveness purposes, and needs to begin prior to project implementation. For example, project objectives may include the success of plantings, aquatic habitat condition, native tree cover, and all three are often combined. Refer to the PCP for detailed information about the planning process (PCI 2010).

The first post-project monitoring type is Implementation Monitoring to confirm *what was done, where is it located, did it live, and is the landowner satisfied?* Marin RCD's Construction Monitoring coordinates design engineers with field inspectors to facilitate proper project implementation and address contractors' concerns or questions immediately (MRCD 2009, PCI 2010). This ensures that the project was installed according to the approved designs, plans, permits and landowner agreements. Common implementation monitoring objectives include:

1) *Completed practices location* – Document the extent and location of practices at each site.
2) *Satisfy landowner concern* – The landowner's reasons to implement the project are satisfied.
3) *Revegetation survival* – Survivorship of planted vegetation meets the target for the project site or replanting is done.

Second is Effectiveness Monitoring, which assesses changes in site conditions over time to document outcomes resulting from the implemented project. *Did attributes or components at the project site change in magnitude as expected over the appropriate time frame?* The qualitative methods provide a broad assessment of project site conditions, but the data is less comparable following 10 to 20 years (Kocher and Harris 2005). Qualitative monitoring is able to rapidly identify a range of concerns at each project site that might not be detected by a more narrowly focused quantitative approach (Kocher and Harris 2005). Qualitative monitoring uses photographs, interviews, counts, and effectiveness ratings (excellent, good, fair, poor, or fail) at the majority of project sites. For example, the Project Assessment Checklist combines implementation and effectiveness evaluations in a two-page form (Appendix B). The most common qualitative tool is photo-point monitoring (Figures 1 and 2). Survivorship monitoring is considered semi-quantitative (Harris et al. 2005b) and is organized with the qualitative protocols in Appendix B.

Qualitative and quantitative monitoring attributes each have their purpose and compliment each other in Marin RCD's monitoring program. Quantitative monitoring approaches often use transects with a tape measure, hip chain, or other means to systematically assess change in project site characteristics (Figure 4). It provides objective data that is less subject to varying interpretations of project outcomes, but more time is necessary to survey transects repeatedly. Quantitative approaches include estimates of sediment saved at 100% of relevant projects and formal transects on a subset of project sites (25%) often include canopy cover or streambank stability over 10-20 years. They are surveyed before and after project implementation to document a trajectory for when targets are reached. Quantitative methods are also used to calibrate qualitative approaches by statistically correlating the two and comparing the change over time with trend and trajectory analysis.

Common effectiveness monitoring objectives include:

1) *Benefit ranch/farm viability and/or productivity*:
   a. *Improve/preserve farm field productivity* – The production from pasture, agricultural field, or ranch/farm system is improved or maintained.
   b. *Improve livestock management* – The moving/handling or welfare/health of livestock is improved or maintained.
   c. *Conserve on-farm water use* – Less water is used in farm/ranch operations.
2) *Reduce/prevent sediment erosion/ delivery* – Soil/fine sediment is stabilized and erosion is controlled as indicated by reducing sediment loads and increasing streambank stability/ground cover. Mercury pollution control is linked to erosion control of Walker Creek floodplain sediments, and effectiveness monitoring is the same for both objectives.

3) *Reduce/prevent pathogen or nutrient delivery* – Sources of nutrients or pathogens are prevented from entering the stream as indicated by increasing ground cover and Residual Dry Matter (RDM) at a site.

4) *Improve/preserve riparian habitat* – Increase or protect native woody or herbaceous vegetation cover and diversity along the stream while controlling or reducing invasive exotic plant species.

5) *Improve/preserve aquatic habitat* – The habitat available for aquatic species in the stream (fish, amphibians, invertebrates) is improved or protected as indicated by increasing pool depth, stream shade, woody debris, upstream access, etc.

Figure 4: Quantitative monitoring along transects for vegetation and bank/channel stability cover using tape measure (left), aquatic habitat survey using hip chain, (middle), and cross-section channel dimensions stadia rod/line level/tape measure (right).

The third post-project monitoring type is Validation Monitoring to confirm the cause and effect relationship between the project and biotic (fish or wildlife) or physical (water quantity or quality) response. For example, this includes the change in habitat use, presence, or abundance of migratory songbirds or salmon and steelhead trout at the project site. These attributes are often controlled by landscape-scale factors such as upstream land use or the proximity of desired wildlife to the project site. Validation monitoring is coordinated with effectiveness efforts at the same project sites and needs to occur over a sufficient period of time for wildlife use or water quality to change as a result of the conservation practices. *Did wildlife (e.g. birds), fish, or water (e.g. temperature) respond to the changes in physical or biological attributes brought about by the project?* Common Marin RCD validation monitoring objectives include:

1) *Increase/ preserve terrestrial wildlife abundance/ diversity* – The habitat use by terrestrial wildlife, such as native birds, is greater or preserved as a result of the project(s) indicated by population abundance or diversity.

2) *Increase/ preserve aquatic species abundance/ diversity* – The habitat use by native aquatic fauna (fish, amphibians, invertebrates) is greater or preserved as a result of the project(s) indicated by population abundance, presence or diversity.

3) *Improve/ preserve water quantity/ quality* – The amount or condition of water such as storm runoff, waste water, spring development, or stream flow is improved or preserved as a result of the project(s).

Similar across all monitoring types is an opportunity to identify and address threats to project success at the site into the future. In addition, some objectives pertain to all practices while others are specific to certain practices (Table 1).

Table 1: NRCS conservation practices most commonly used by Marin RCD matched with potential project objectives (shaded). Other objectives may be added.

Conservation Practice (NRCS code)	**Project Objective**										
	Completed practices location	Landowner concern satisfied	Reveg. survival	Benefit/ sustain farm viability/ productivity	Reduce/ prevent sediment erosion/ delivery	Reduce/ prevent pathogen or nutrient delivery	Improve/ preserve riparian habitat	Improve/ preserve aquatic habitat	Increase/ preserve terrestrial wildlife abundance/ diversity	Increase/ preserve aquatic species abundance/ diversity	Improve/ preserve water quantity/ quality
	Implementation			Effectiveness					Validation		
Access road (560)	■	■		■							
Animal trail/ walkway (575)	■	■		■							
Critical area planting (342)	■	■	■		■	■	■	■	■	■	■
Fencing (382)	■	■		■	■	■	■	■	■	■	■
Filter strip (393)	■	■	■	■	■	■					
Fish passage (396)	■	■			■						
Stream habitat improvement/ mngt. (395)	■	■	■		■	■	■	■	■	■	■
Grade stabilization structure (410)	■	■	■	■	■		■	■	■	■	
Grassed waterway (412)	■	■	■	■	■						
Lined waterway/ outlet (468)	■	■		■	■						
Pipeline (516)	■	■		■		■					
Prescribed Grazing (528)	■	■		■	■	■	■	■	■	■	■
Sediment basin (350)	■	■			■			■			■
Spring development (574)	■	■		■			■	■			
Stream channel stabilization (584)	■	■	■	■	■	■	■	■	■	■	■
Streambank protection (580)	■	■	■	■	■	■	■	■	■	■	■
Structure for water control (587)	■	■		■	■	■		■			
Underground outlet (620)	■	■		■	■	■					
Water & sediment control basin (638)	■	■			■	■		■	■	■	■
Watering facility (614)	■	■		■	■	■	■	■	■	■	■

MONITORING COMPONENTS & STRUCTURE

This section provides specific detail on how riparian enhancement project sites and associated conservation practices are monitored by Marin RCD and its partners using existing scientific protocols. Information is gathered from participating individuals and landowners to ascertain how projects positively or negatively impacted ranch operations and viability. The timing of monitoring visits, coordination, data management, reporting, and required resources are also covered in this section.

Monitoring Attributes, Targets & Protocols

The attributes monitored depend on the specific objectives at each site. As a result, monitoring begins during project planning before implementation by organizing project objectives, prioritizing their importance, and estimating the time expected to reach target values. The target values included represent biologically significant thresholds based on the scientific literature that indicate the improved habitat conditions will benefit fish, wildlife, water quality, or all three. The targets should be reviewed with the PCP in five years to assess their importance and achievability. The targets are not mandatory programmatic goals and offer working expectations, or hypotheses, for RCD partners to discuss further. Implementation and effectiveness monitoring are the focus for RCD staff with specific forms provided in the appendices. Validation monitoring is being conducted by RCD partners.

Project Planning

Pre-project site evaluations provide information for objectives, project selection, budget estimates and permit needs. A few organizational steps begin before conservation projects are implemented that guide and facilitate the post-project monitoring for each site. The Permit Coordination Program (PCP) describes this process in detail (PCI 2010).

An easy and fast tool to help landowners prioritize project sites within a ranch is available for ranches in west Marin. The Ranch Water Quality Plan Template (SFWQCB 2009) was the product of collaboration among multiple agencies (California Cattelmen's Association, Marin Farm Bureau, Western United Dairymen, Marin RCD, NRCS, MALT, RWQCB, Point Reyes National Seashore and Marin Organic) to comply with Conditional Grazing Waiver regulations related to the Tomales Bay Total Maximum Daily Load (TMDL). The Ranch Plan Template provides pasture and stream checklists to identify areas on the ranch to work on and potential conservation practices needed, which helps to secure funding for fixing historic and legacy sites. The better a landowner is able to describe their needs and ranch plans the better their chances when competing for limited financial resources from NRCS, RCD, or other groups.

The first and most important step in project monitoring is to document objectives on a site-by-site basis once the project has been approved by the RCD Board of Directors. The commonly used objectives listed in Table 1 offer a guide to completing the Project Objectives form in Appendix A, but site-specific potential and limiting factors need to be considered. Project objectives may include the success of plantings (implementation monitoring), the attainment of certain habitat conditions (effectiveness monitoring), or both, and data collection at the project site is conducted accordingly. Note the priority of each compared to the other objectives selected. Also, estimate the target value if applicable and how long (# of years) until each target is expected to be achieved using the professional judgment of RCD partners and restoration trajectory research such as Lennox et al. (2011). Try to keep the targets both realistic and meaningful with periodic evaluations during PCP and programmatic reviews. Keep in mind validation monitoring objectives require significantly greater expertise and resources.

The Monitoring Plan Checklist form is an organizational guide that begins once the project objectives are set (Appendix A). Potential monitoring forms are listed based on when each is used in the project timeline – pre-project, post-project for grant reports, and long-term quantitative protocols (Table 2). The frequency that each protocol is used, a summary of each, and space for noting when monitoring was done are included on the Checklist.

Table 2: Monitoring forms listed according to common project objective to facilitate developing the monitoring plan for each project site. The phase in the project timeline when to use each form and the goal for percent of project sites are included.

Monitoring Form/ Protocol (with location)	Project Objective											Percent of Project Sites
	Completed practices location	Landowner concern satisfied	Reveg. survival	Benefit/ sustain farm viability/ productivity	Reduce/ prevent sediment erosion/ delivery	Reduce/ prevent pathogen or nutrient delivery	Improve/ preserve riparian habitat	Improve/ preserve aquatic habitat	Increase/ preserve terrestrial wildlife abundance/ diversity	Increase/ preserve aquatic species abundance/ diversity	Improve/ preserve water quantity/ quality	
	Implementation			Effectiveness					Validation			
Pre-project:												
Objectives/ Targets (Appx. A)	■	■	■	■	■	■	■	■	■	■	■	100%
Monitoring Plan Checklist (Appx. A)	■	■	■	■	■	■	■	■	■	■	■	100%
Post-project completed for grant reports (2-3 years):												
Map/ Site Sketch (Appx. A)	■											100%
Revegetation Data (Appx. A)	■		■									100%
Project Assessment Checklist (Appx. B)	■		■	■	■	■	■	■				100%
Landowner Questionnaire (Appx. B)		■		■								100%
Revegetation Survival (Appx. B)			■									100%
Pre-project, post-project, for grant reports & repeated over time as funding allows:												
Photo-points (Appx. A)	■	■	■		■	■	■	■	■	■		100%
Sediment Load Estimates (Appx. C)					■		■	■				100%
Streambank Stability Line Intercept Transect (Appx. C)					■	■	■	■				25%
Riparian Line Intercept Transect (Appx. C)					■		■					25%
Aquatic Habitat (Appx. C)					■		■	■		■		25%
Stream Shade (Appx. C)							■	■	■	■		25%
Tag Lines (Weaver et al. 2005 - p. 40)								■				25%
Bird Populations (Ralph et al. 1993, 1995)									■			25%
As needed for certain projects (pre-project, post-project, & repeated):												
Channel Dimensions: cross-sections, long. profile (Appx. C)					■			■				5%
Maintenance & Event (Weaver et al. 2005 - p. 79)					■							5%
Water Quantity/ Quality (SWRCB 2001, MacDonald et al. 1991)					■	■		■			■	5%
Fish Passage (Collins 2009, Stockard and Harris 2005)								■		■		5%
Fish Populations (Duffy 2005, Dolloff et al. 1993)							■	■		■		5%
Freshwater Shrimp (Fong and Vandenberg 1998)							■	■		■		5%
Red-legged Frog (USFWS 2005, 2002)							■	■		■		5%

As the saying goes, pictures are "worth a thousand words" and are particularly valuable when sharing project results with the public or other landowners. Use the Photo-Point Monitoring form to help standardize the process (Appendix A). It is important to locate photo-points so that they capture a representative area of the field or a limiting factor at the site such as an eroding streambank. The photo-point location must allow for repeated unobstructed photos once trees become tall similar to Figure 1 and place points on the project map or site sketch. Detailed notes on the precise location and direction of photo points are written on the Photo-Point Monitoring form (Appendix B). The first photos are taken prior to installation of practices before grading is conducted, during installation (Figure 2) and post-project as explained by Gerstein and Kocher (2005). These are shared with landowners so they can be incorporated into ranch plans. For further information, refer to McDougald et al. (2003), Ward et al. (2003a), Herrick et al. (2005a), and Wildland Solutions (2008).

Collecting information regarding project design, layout and location on a Site Map (Figure 5) is important to organize and guide monitoring at the project site. Site maps facilitate communication between RCD partners for project planning, implementation and pre-project baseline quantitative effectiveness monitoring. Monitoring sub-sections within the site are delineated for collecting and managing quantitative effectiveness data. They are based on channel and streambank stability, existing vegetation, or conservation practices implemented such as bank stabilization and revegetation zones similar to Figure 5.

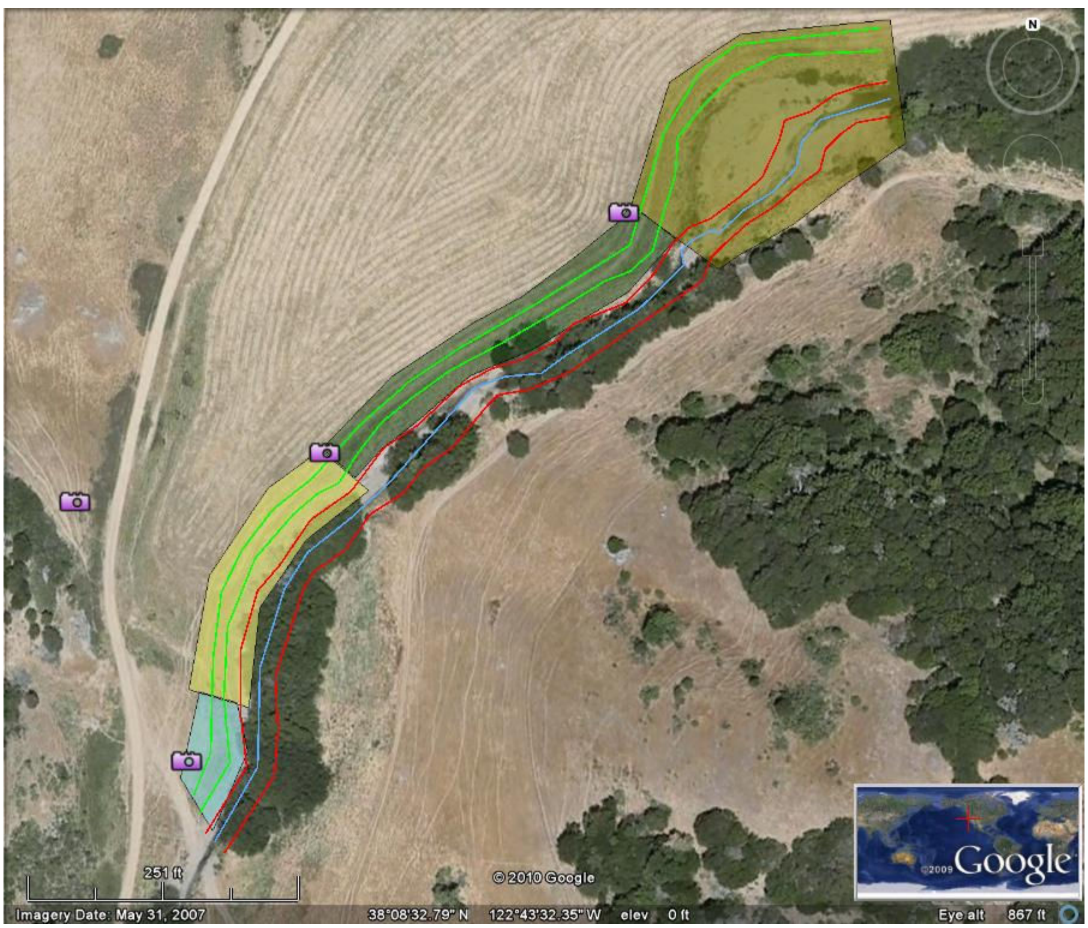


Figure 5: Example of a riparian revegetation project site with sub-sections, transects and photo-points overlayed on site map. The polygons delineate the four separate sections of the site monitored individually over time based on the planting design and site conditions. Quantitative monitoring includes Streambank Stability Line Intercept Transects (red lines), Aquatic Habitat Transect (blue line), and Riparian Line Intercept Transects (green lines). Photo-points are marked with camera icons.

The data from each sub-section is tracked individually over time for sediment load estimates, bank stability, vegetation and aquatic habitat changes. The boundaries between each subsection are marked in the field with T-posts or other permanent identifying feature depending on landowner preferences and the area of each section is measured in acres. The site map may be from various sources with appropriate detail for each conservation practice planned including Site Sketch form (Appendix A), GIS, Google, AutoDesk, or other mapping software. Large sites or complex projects may have both site maps and an AutoCAD as-built (Figure 6).

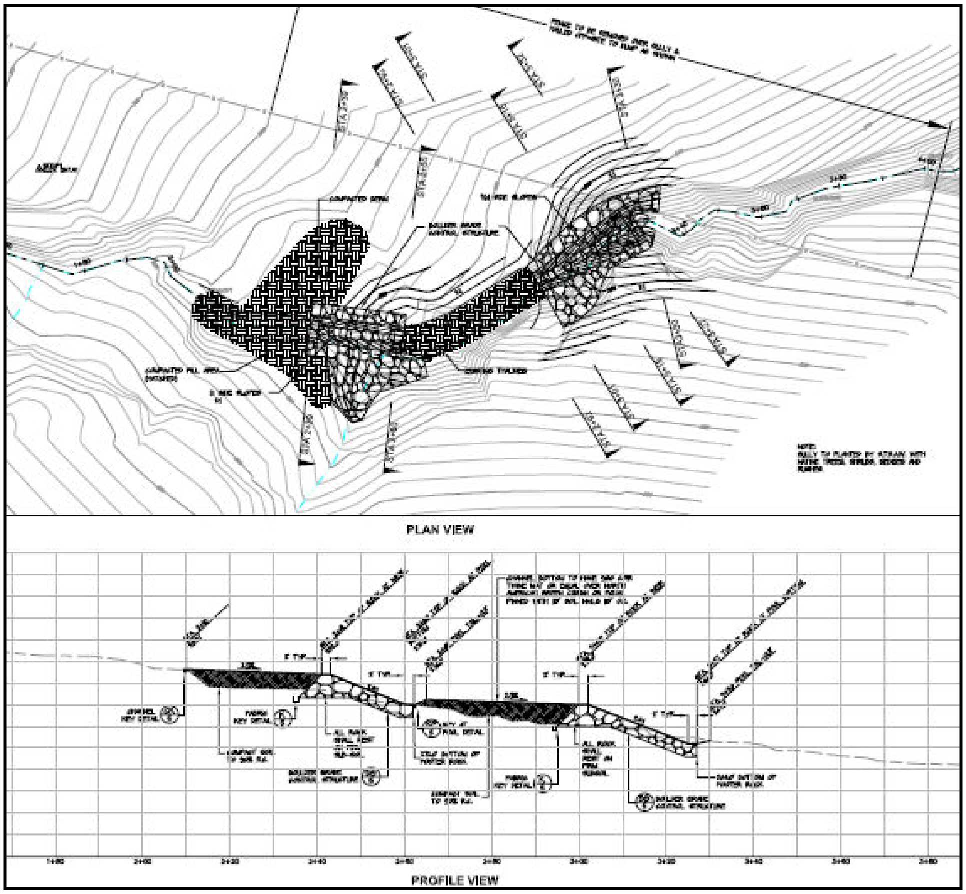


Figure 6: An example of a pre-project as-built for grade stabilization practice at the site in Figure 2 depicting two grade stabilization structures in a plan view (top) and profile view (bottom). Image courtesy of Prunuske Chatham, Inc.

Implementation Monitoring

Marin RCD's implementation monitoring includes the location, extent, concerns, and maintenance needs of each practice for every project site. Project success often depends on adaptively responding to unforeseen circumstances at the site. Similar to the construction monitoring process that provides quality control during installation, adapting and responding to maintenance needs is the primary purpose of Marin RCD's implementation monitoring. Landowner feedback and participation is critical to finding and solving potential problems Table 2 summarizes the attributes, targets and protocols for each implementation project objective. The timeline to complete these tasks does not include pre-project data and generally ends about three years after project completion so the results may be included in final project reports.

After the project is implemented, update or redo the site map or sketch with accurate locations or changes in extent of practices such as revegetation zones, fences, structures, water troughs, etc.

Repeat photo-points immediately after construction and be sure the location is accurate on the site map. Also, collect project statistics including the total distance of stream treated with conservation practices, distance fenced, size area of each section within the site, etc. The Revegetation Data form summarizes distance of stream planted, number of each species planted, distance of biotechnical repairs, area of invasive plants removed, and student/ volunteer participation (Appendix B). These steps set the foundation to conduct the more intensive project monitoring components because qualitative and quantitative effectiveness monitoring depends on the documentation of project location, as explained in Gerstein et al. (2005a) and Collins (2009).

Table 2: Implementation monitoring attributes (with target value) and protocols organized by project objective.

Project Objective	Completed Practices Location	Landowner Concern	Revegetation Survival
Measured Attribute (Target)	extent of each practice, as-built changes, delineate reveg. zones, # of each species planted/ area seeded, etc. (95%)	landowner satisfied (80%), problems fixed (90%)	survivorship (80%), establishment (40%)
Form/ Protocol	Site Map/ Sketch, Photo-points, Reveg. Data, Project Assessment Checklist	Landowner Questionnaire, Project Assessment Checklist, Maintenance/Event	Revegetation Survival

The Project Assessment Checklist (PAC) offers an important tool to systematically assess implementation, maintenance and landowner needs at the site following project installation (Appendix B). It is adapted from an existing Marin RCD checklist with questions to identify responsibility for adaptive management needs at the site and includes both implementation and effectiveness monitoring types. This qualitative assessment evaluates repair needs for fences, structures, water troughs, pipelines springs, crossings, roads, plantings, streambanks, livestock grazing, etc. during the critical three years after installation. As a result, RCD monitoring is designed to find potential problems and fix them before they undermine project success instead of documenting implementation mistakes.

The Landowner Questionnaire assesses landowner or land manager opinion regarding project success and how this perception may change over time (Appendix B). The intent is to assess landowner satisfaction, ranch viability/ productivity, landowner confusion during planning/ implementation, and unintended side effects from the conservation project in order to reduce potential miscommunication and future problems. The questionnaire is completed for most Marin RCD projects less than three years after installation for summary in grant reports, depending on landowner availability. The answers are quantified in a trend detection approach using a 1 – 5 rating system (Dillman 2000). The questionnaire is designed to guide a personal interview with each landowner in a systematic process.

Survival of planted trees, shrubs and herbaceous plugs is monitored to ensure adequate establishment and growth at revegetation projects. The Revegetation Survival form (Appendix B) was the result of a collaborative effort between the STRAW program and Prunuske Chatham, Inc. This protocol quantifies survival and establishment in a direct count census approach based on the vigor status (systemic stress vs. healthy new growth) and height (more or less than three feet tall) of each individual plant (Harris et al. 2005). Project sites are subdivided into revegetation zones based on conservation practices, left/right streambank, bioengineering structure or other project design component. This permits collection of survival data using the site sketch or other map. These revegetation zones, or subsections, allow for incorporation of these factors into data analysis, allowing greater accuracy of data collection and correlation with Line Intercept Transect data. At each site, browse pressure, causes of mortality (gopher, mowed, mis-planted, buried, erosion, livestock, irrigation, rodent, etc.) and weed populations are characterized. Invasive weed populations encountered will be reported to RCD staff and the landowner. Survival data is collected annually for three years and replanting is usually done if the survival rate is less than 80%.

The Maintenance & Event Monitoring form is designed to document actions taken to fix eroded and eroding soil, fill or sedimentation usually related to roads or stream crossings (Weaver et al. 2005, p. 79). This form provides a means to record the volume of soil that moved in cubic yards, the location, and when it occurred. Though often obvious at the time erosion occurred, add the eroded volume to Sediment Load Estimates for quantitative effectiveness monitoring instead of relying on personal memory. In addition to reducing sediment delivery in a watershed, it is often expected that conservation practices will reduce maintenance needs for landowners. Therefore, one important measure of project success is the frequency at which maintenance activities occur before and after restoration. Typical events monitored include frequency of culvert plugging and occurrence of drainage facility-related erosion. (Weaver et al. 2005)

For further information regarding implementation monitoring, refer to Collins (2009) for updated forms and protocols from the California Department of Fish and Game's (CDFG) Coastal Monitoring and Evaluation Program. CDFG collaborated with the University of California Berkeley Center for Forestry to provide protocols and guidance regarding Photo Description (Gerstein and Kocher 2005), Project Site Sketch, Site Access/ Location, Project Site Navigation, and (Gerstein et al. 2005) and the pertinent tools have been integrated with this plan where relevant to the RCD. Specific implementation monitoring protocols tailored to certain types of restoration projects (Kocher and Harris 2005) may be referred to in the future for evaluating certain RCD practices such as stream crossings, instream habitat, and fish passage from Collins (2009). Not all the implementation monitoring methods used by CDFG pertain to the RCD restoration program.

Effectiveness Monitoring

RCD effectiveness monitoring includes both qualitative and quantitative approaches to balance intensive measurement of specific attributes with a broad overview of each project over time. Thus, a subset (10-25%) of projects are evaluated using the quantitative protocols and the attributes selected for monitoring depend on site objectives (Table 3) with realistic targets that indicate water quality (Lewis et al. 2011, 2010, Singer et al. 1982) and habitat improvements (Lennox et al. 2011, Gardali et al. 2006). Before revisiting project sites for field data collection, review the project objectives, site map, and previously collected data.

The objectives that benefit ranch/ farm viability (pasture productivity, livestock management, water use, etc.) are primarily assessed by completing the Landowner Questionnaire (Appendix B). It may be used in situations where there is a concern that the project may unintentionally reduce pasture productivity or complicate livestock management. The Questionnaire can be completed at the end of grant funding and potentially every five or ten years to monitor the long-term affects of projects over multiple decades. Landowner needs often change over time so the Questionnaire and Project Assessment Checklist offer RCD staff tools to document those changes, along with impacts to ranch productivity or management, such as broken fences and invasive weed populations.

Table 3: Effectiveness monitoring attributes (with target value) and protocols organized by project objective.

Project Objective	Benefit ranch viability/ productivity	Reduce/ prevent sediment delivery/ erosion	Reduce/ prevent pathogen or nutrient delivery	Improve/ preserve riparian habitat	Improve/ preserve aquatic habitat
Measured Attribute (Target)	landowner observations, electric/ vet./ water bill, RDM	Eff. ratings (80%), RDM (1000 lb/ac), eff. rating (80%), groundcover (90%), bank stability (75%)	RDM (1000 lb/ac), groundcover (90%)	Eff. rating (80%), Cover of native tree (60%) shrub (30%) inv. exotic weeds (<30%), & species #	shelter rating (80), shade (90%), LWD (2/100ft), max. pool depth (1m), bankfull W:D (<3:1)
Form/ Protocol	Landowner Questionnaire, Project Assessment Checklist, Sediment Load Estimates	Project Assessment Checklist, Sediment Load Estimates, Streambank Stability Line Intercept, Cross-sections	Project Assessment Checklist, Streambank/ Riparian Line Intercept	Project Assessment Checklist, Streambank/ Riparian Line Intercept	Project Assessment Checklist, Aquatic Habitat, Stream Shade, Tag Lines, Resurvey Site

The Project Assessment Checklist (PAC) offers a qualitative monitoring tool to rapidly assess natural resource conditions for rating practice effectiveness and project success (Appendix B). In addition, the PAC incorporates current science-based approaches to visually estimate *residual dry matter (RDM)* (Wildland Solutions 2008), *riparian vegetation* (Ward et al. 2003a, Ward et al. 2003b, USDA 1998), *stability* (Ward et al. 2003a, Ward et al. 2003b, USDA 1998), *invasive plants* (NPS 2010, Cal-IPC 2006, Rew et al. 2006), and *instream habitat* (Collins 2009, Flosi et al. 1998) including fish passage (NOAA 2001). The qualitative effectiveness ratings in the Checklist have been field tested by CDFG's Coastal Monitoring and Evaluation Program (Collins 2009, Harris et al. 2005a, Kocher and Harris 2005). The visual estimation of RDM requires calibration from local rangeland professionals with experience weighing biomass from the coastal prairie and annual rangelands of Marin County. For setting objectives or interpreting

RDM data, refer to Bartolome et al. (2006) and Guenther (2007). Invasive plant monitoring collaborates with the Bay Area Early Detection Rapid Response (EDRR) program and Marin-Sonoma Weed Management Area (WMA) to prioritize species for removal and control on private land given the succession of problem species over time (Figure 7, Lennox et al. 2010). The accompanying Project Assessment Checklist Guide provides definitions for the categorical effectiveness ratings and site condition assessments (Appendix B).

Figure 7: Milk thistle within the fenced area around a gully one year after grade stabilization/tree planting (left), and Himalaya blackberry under willow 30 years after control fencing along a stream (right).

The timeline to complete quantitative monitoring tasks begins before project installation and ideally includes three site visits for data collection (pre-project baseline, year 1, year 2 or 3) before final project reports are completed. However, at a minimum, two site visits are needed at a site receiving quantitative monitoring (one pre-project and one post-project) before project reports are completed. Quantitative monitoring will continue with site visits every 3-5 years for about 20 years or until the objectives are achieved, depending on landowner permission. Data is collected and organized based on the subsections zones delineated on the site map or sketch. The qualitative monitoring protocols are not completed as often – years 1 and 2 or 3, in general.

Reduction in fine sediment erosion and delivery is a common, high priority objective for Marin RCD conservation projects. Sediment Load Estimates (Appendix C) are used to quantify *streambank and gully erosion* by quantifying the volume of potential erosion at the project site based on Lewis et al. (2000, 2001). Similar methods were used by Weaver et al. (2005) and Klein (2003). The deliverable fine sediment saved by each project is the sum of each section within the site and calculated by subtracting the post-project value from the pre-project results. Unstable streambanks and channels are generally identified by the following morphological features (Overton et al. 1997, Rosgen 2001, Gerstein and Harris 2005):

1. breakdown if clumps of bank are broken away and banks are unvegetated,
2. slumping if banks have slipped down recently,
3. tension cracks or fracture if a crack is visible on the bank, or
4. vertical and eroding if the bank is mostly uncovered, in other words, less than 50 percent covered by perennial vegetation, roots, rocks of cobble size or larger, or logs of 0.1 meter in diameter or larger, and the bank angle is steeper than 80 degrees from the horizontal.

Streambanks with an angle >80 degrees from horizontal are generally considered unstable, 45-80 degrees may be at risk of instability and banks that are at an angle of less than 45 degrees (1:1) are stable. However, in some geologic settings of Marin County, vertical and unvegetated streambanks may be stable for decades and headcuts may be armored where impervious bedrock material is available (Figure 8). Undercut banks are considered stable unless tension fractures show on the ground surface at the back of the undercut (Weaver et al. 2005, Klein 2003).

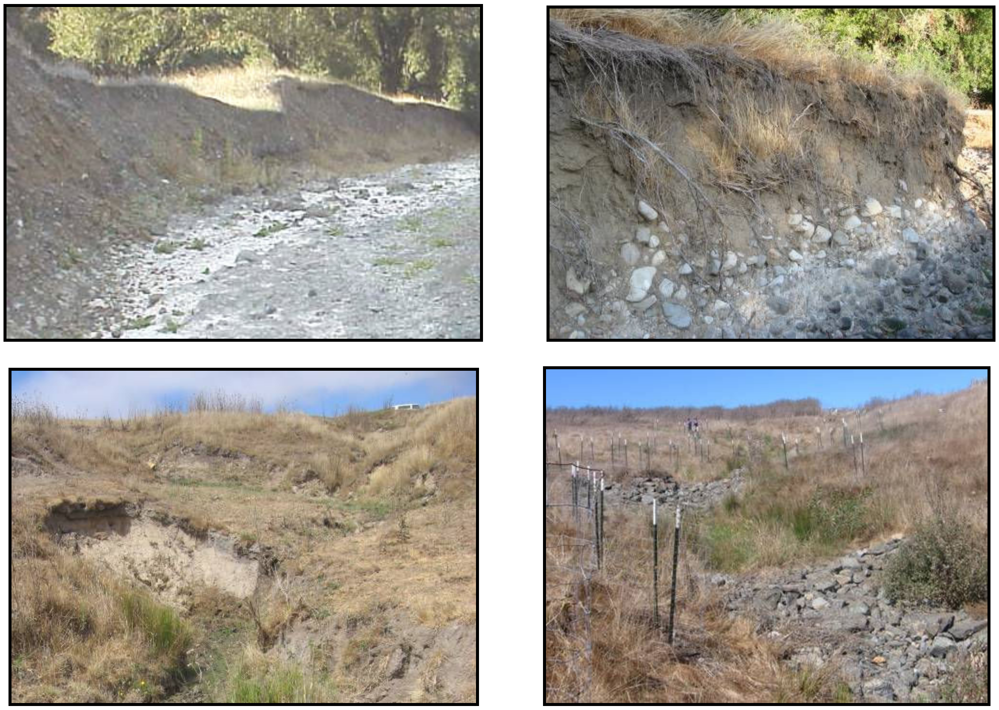


Figure 8: Typical streambank erosion (top left), a similarly barren but more stable streambank (top right), combined gully and bank erosion before project (bottom left), and after grade control structures and planting is completed (bottom right).

For estimating *sheet and rill erosion*, models have evolved since the 1940s (Spaeth et al. 2003). For grazed watersheds, the Rangeland Hydrology and Erosion Model (RHEM) is available on the internet at http://apps.tucson.ars.ag.gov/rhem/ (Wei et al. 2009) and the Sediment Load Estimates form provides a guide to field data collection (Appendix C). Though most sediment controlled is from streambank or gully erosion types, conservation projects that increase vegetation cover often reduce rates of sheet and rill erosion. The RHEM is used pre-project and about two or three years post-project for streambanks and gullies to estimate sediment yield and soil loss. Field data is collected with the Sediment Load Estimates form in Appendix C. It assumes no concentrated flow using slope lengths less than 50 meters and is based on canopy, basal and litter cover as well as slope, precipitation and soil texture factors. Internet based access to soil information is available from NRCS (http://websoilsurvey.nrcs.usda.gov/app/) and UC Davis (http://casoilresource.lawr.ucdavis.edu/drupal/node/902). RHEM does not quantify the filtering capacity of overland flow entering riparian buffers and this will be investigated further.

Previous models were intended for prioritizing and selecting future projects, such as the Universal Soil Loss Equation (USLE), or based on row crop data, such as Revised USLE (RUSLE), and have been found to over and under estimate actual erosion rates on rangeland, respectively (Spaeth et al. 2003, Tiwari et al. 2000). For large-scale basin and watershed models, the Automated Geospatial Watershed Assessment (http://www.tucson.ars.ag.gov/agwa/) is available (Goodrich et al. 2006).

Quantitative effectiveness assessment of riparian habitat at streambank and gully erosion control projects use the Streambank Stability Line Intercept Transect (Appendix C) at the toe of the bank near bankfull, following Gerstein and Harris (2005). This protocol also collects ground cover and plant diversity data along each transect, with the cover of each species grouped in three height classes (0-3, 3-15, 15+ feet). Monitoring stability and riparian vegetation in one transect located at the most sensitive location along the stream (i.e. bankfull) offers an efficient tool to assess site change over time, similar to the "greenline" (Winward 2000, Gerstein and Harris 2005, Herrick et al. 2005b). This protocol is used for most riparian improvement practices, including control fencing of the riparian corridor, planting of woody species, and other practices intending to reduce erosion or increase the filtering potential of riparian areas (Pearce et al. 1998). Examples include modifying upland management, groundcover and stability improvement and providing alternative water sources for livestock, with or without riparian fencing (Prunuske et al. 1994, George et al. 2007).

Cross-section analysis occurs on a subset of quantitative monitoring sites where gully erosion and stream bed down-cutting may occur and jeopardize project success or sedimentation may cause erosion or localized flooding (Gerstein and Harris 2005, Harrelson et al. 1994). The Channel Dimensions form is in Appendix C (Gerstein and Harris 2005) or the Tag Lines form is used at gullies (Weaver et al. 2005, p. 40). Resurveying and mapping the entire site with post-project contour lines will be investigated further to estimate total eroded soil similar to displacement surveys described by Weaver et al. (2005).

Pathogen and nutrient fate and delivery complex to document at the watershed scale. However, numerous research studies have documented significant reductions in nutrient concentrations, pathogen indicators, and specific pathogenic organisms resulting from greater amounts of herbaceous vegetation (e.g. negative correlations) at the site and ranch scale. Thus, groundcover and residual dry matter (RDM) changes at the project site indicate reductions in pathogen and nutrient delivery. Recent studies in Marin County have found decreased pathogens in runoff as groundcover increased, including fecal coliform (Lewis et al. 2011, Lewis et al. 2010, Lennox et al. 2007), *Giardia* (Miller et al. 2007) and *Cryptosporidium* (Miller et al. 2008). Similarly, increasing RDM reduced *E. coli* in an intensive field study of vegetated buffers in the Sierra Nevada foothills (Tate et al. 2006) and reduced *C. parvum* in a controlled study (Tate et al. 2004). Concentrations of phosphorus and nitrogen, in runoff are reduced with more vegetation to uptake excess nutrients or filter through the soil until the build up of litter and decadent plant material may release nutrients (Dosskey et al 2007). Plus, restored floodplains have been documented to function as nitrate sinks (Sheibley et al. 2006) and the greater extent of riparian vegetation has correlated to less nutrients in runoff (Houlahan and Findlay 2004). Overall, pathogen and nutrient delivery to streams decreases and the filtering capacity of the stream increases as groundcover along the stream increases. Groundcover is assessed using the Streambank Stability and/or Riparian Line Intercept Transects with an adapted gap intercept approach to quantify the amount of bare ground along the transect over time (Herrick et al. 2005b.

Riparian habitat improvement objectives commonly involve increasing the abundance and diversity of native woody vegetation along streams at historically grazed project sites in Marin County. Harris et al. (2005) consolidated existing protocols into an efficient method to assess plant species cover over time since project installation at California riparian restoration sites using the Riparian Line Intercept Transect (Appendix C). This method is used for any practice intended to improve or protect riparian vegetation, such as exclusionary fencing and other indirect passive approaches, in addition to direct planting. The vegetation data collected is the same as the Streambank Stability Line Intercept Transect, with species cover organized by three height classes (0-3, 3-15, 15+ feet). Transects are placed where riparian vegetation is expected to change as a result of the project. A typical revegetation project site may have two Riparian Line Intercept Transects on each bank parallel to the stream with one below the top-of-bank (i.e. hydrologic floodplain) and one on the upper bank (i.e. topographic floodplain), in addition to the Streambank Stability Transect at bankfull (Figure 9). If the distance between transects is less than 20 feet, one Riparian Transect on the upper bank is sufficient. For projects without an objective to change or preserve upper bank vegetation, a Riparian Transect is not needed and the Streambank Stability Transect suffices. The Riparian Transect may also be placed in any location to survey and monitor isolated revegetation zones or species of interest such as native grass patches, sedges (*Carex spp.*), or western dog violet (*Viola adunca*) which is the larval host plant for Myrtle's Silverspot butterfly (NPS 2007). Herbaceous species cover and composition are assessed in the same transect as the woody species by adapting the gap intercept approach of Herrick et al. (2005b).

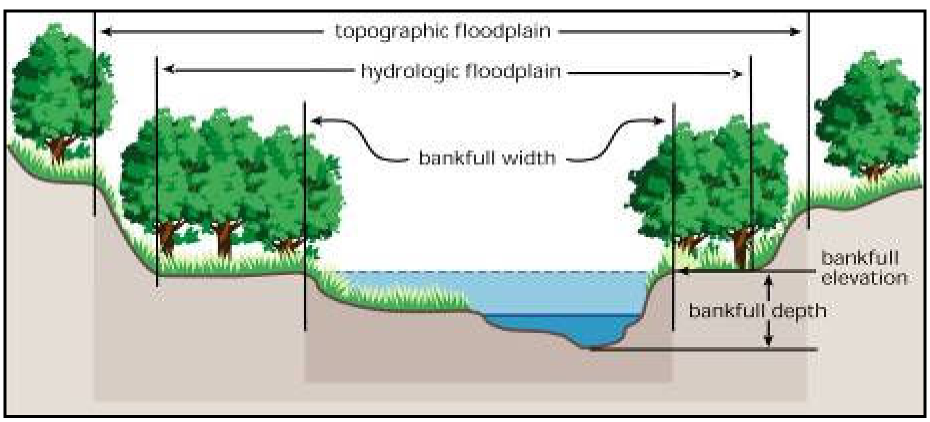


Figure 9: Example cross-section of a small stream showing bankfull channel and riparian floodplains (FISRWG 1998).

The extent of each transect depends on the revegetation zones and other subsections within each project site, using the site map or sketch as previously discussed. For each transect surveyed, the field data is collected and entered in the database according to the subsection zones to allow for correlation to survival, aquatic habitat, or other data. Plant species identification will follow the nomenclature in the NRCS PLANTS Database (USDA 2010b), while also utilizing local field guides and professionals. This method may be integrated with specific case studies or research projects to investigate the efficacy of weed removal techniques, planted versus colonized plants, or how individual trees grow over time (Harris et al. 2005).

Aquatic habitat improvements often target factors that may be limiting to specific populations in the area, such as water depth, cover, shade, etc. These objectives often apply to riparian control fencing practices, which indirectly affect aquatic habitat by allowing woody vegetation to colonize passively, in addition to practices directly improving the stream channel (Lennox et al. 2011). Similar to the previous discussed methodologies, aquatic habitat data are collected, recorded and analyzed by subsection zones based on the project site map. Cover values and shelter ratings (Flosi et al. 1998) are calculated using the Project Assessment Checklist's qualitative visual estimation (Appendix B) and the Aquatic Habitat form (Appendix C) quantitative transect of the channel thalweg, the deepest point in cross-section (Gerstein 2005). The Aquatic Habitat survey also assesses habitat type (Flosi et al. 1998), residual pool depth (Lisle 1987), stream width and woody debris (adapted from Gerstein, 2005). The Channel Dimensions form (Appendix C) is also used for longitudinal profiles to calibrate residual pool depth results from Aquatic Habitat surveys (Gerstein 2005, Harrelson et al. 1994).

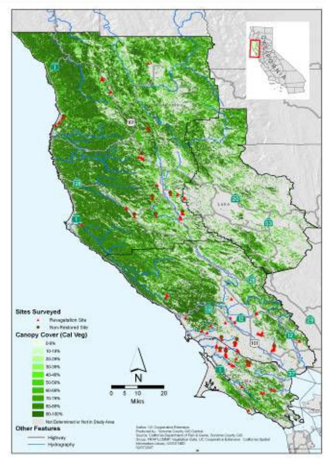
Shade over the stream has been found to reduce stream temperature (Brown 1969). It is quantified at project sites as canopy density from the thalweg using a Densiometer, following Flosi et al. (1998) and the Stream Shade form adapted from Harris et al. (2005) (Appendix C). Shade is measured at a minimum of three locations, stratified within each subsection of a project site, but not less than 30-50 feet apart. Try to place these on riffles so the same location also receives an assessment of bankfull channel width-to-depth ratio using the Tag Lines form for small streams and gullies (Weaver et al. 2005, p. 40) or the Channel Dimensions form for rivers and permanent cross-sections (Appendix C, Gerstein 2005, Gerstein and Harris 2005). Tag Lines offer a time-efficient approach by confining measurements to the bankfull channel (Figure 10) and avoiding permanent markers (Herrick et al. 2005b, Rosgen 1996). Permanent cross-sections will calibrate the channel width-to-depth ratio results from Tag Line surveys. Three dimensional surveys to efficiently map the project site will be investigated for future applicability to project monitoring. For stream substrate monitoring, consult Gerstein et al. (2005b) and Hilton and Lisle (1993).

Figure 10: Tag Line measuring bankfull channel width and average depth for width:depth ratio.

Fish passage projects are expensive and often need detailed engineering specifications. Effectiveness monitoring uses both qualitative (Collins 2009, NMFS 2001) and quantitative (Stockard and Harris 2005) assessments. Fish passage project database and updated monitoring protocols are available on the internet at the California Fish Passage Assessment Database (CDFG 2010).

Control and reference sites have been recommended for confirming that the quantified changes in site conditions resulted from the conservation project and associated practices implemented. However, Marin RCD's monitoring program focuses on systematically collecting pre-project baseline data. Appropriately comparable control sites have not been located for the sites monitored to date and monitoring them is an inefficient use of time compared to the usefulness of pre-project data. The magnitude of change for the site conditions monitored is expected to be statistically significant without comparisons to other sites (Lewis et al. 2009, Lennox et al. 2011). Thus, Marin RCD's monitoring program does not utilize control sites for effectiveness monitoring purposes. Reference sites may be considered for specific purposes in the future.

The focus of this plan is on site, or reach, scale effectiveness monitoring; however, remote sensing options such as Geographic Information Systems (GIS) with aerial photography (Wehren et al. 2002) and infrared imagery can be applied to effectiveness monitoring at the landscape scale (Roni 2005). Information collected from such a broad scale can be used to help interpret the variability of data collected at a finer scale similar to studies by Opperman et al. (2005) and Lennox (2007). For further information on specific methods, refer to Roni (2005) and Schilling et al. (2005). Essential to making this possible is documenting project location with GIS or other mapping software. The scale of maps produced will be large enough to not identify individual properties and the accompanying data will remain confidential among Marin RCD partners.



Residual dry matter (RDM) is assessed for refining grazing plans in pastures with streams, riparian pastures or for targeted grazing within "riparian exclosures". This may be done rapidly using the visual estimation protocol in the Project Assessment Checklist (Wildland Solutions 2008). A more accurate and quantitative alternative uses a "double sampling" approach to combine the accuracy of directly harvesting biomass with the speed of estimation (USDA 1997 Ch. 4, Herrick et al. 2005b). This double sampling transect may replace the Riparian Line Intercept Transect's assessment of groundcover and herbaceous species composition where grazing will be used for vegetation management. To document grazing schedules, efficient methods have been provided for range managers by California NRCS (USDA 2009) and for landowners by UCCE (Ward et al. 2003a). The NRCS Prescribed Grazing Support Tool assesses pasture specific management, the timing of livestock use and the constraints to productivity (water troughs, erosion, compaction, water quality) using Animal Unit Days (AUD) for planning rest periods and conservation alternatives.

For further information regarding qualitative effectiveness monitoring, refer to Collins (2009). The forms and instructions are currently being used to assess projects funded through the CDFG Fisheries Restoration Grant Program. Specific checklists that apply to RCD riparian enhancement projects include *Revegetation Treatments, Vegetation Control & Removal, Stream*

Crossings, Fish Passage, Instream Habitat & Bank Restoration and *Land Use Treatments & Exclusion Fencing*. These forms and instructions are available online (see References section).

Validation Monitoring

Habitat use of restored streams by terrestrial wildlife (birds, deer, rodents, etc.) or aquatic species (fish, amphibians, etc.) shows how, when, where and/or who is using the project site conditions previously documented by effectiveness monitoring. Table 4 outlines a few of the many validation monitoring opportunities. Field data collected is recorded by subsection zones within the project site as much as possible in order to correlate habitat conditions with the habitat use data.

Table 4: Validation monitoring attributes and protocols organized by project objective.

Project Objective	Increase/ preserve terrestrial wildlife abundance/ diversity	Increase/ preserve aquatic species abundance/ diversity	Improve/ preserve water quantity/ quality
Measured Attribute	species #, species of interest	Fish/amphibian/shrimp density, presence, species #	Spring/ summer stream temp
Protocol	Area search, Point-count survey	Snorkel/ visual surveys	Data loggers

Bird use of restored riparian habitat has been documented along the Sacramento River (Gardali et al. 2006) and in Marin County (Kreitinger and Gardali 2006). PRBO has also led the effort in validation monitoring of bird diversity and abundance at Marin RCD project sites using area search and point-count methodologies following the standardized protocols of Ralph et al. (1993, 1995). The timeline for terrestrial habitat use monitoring tasks is the same as the quantitative effectiveness monitoring components and begins before project implementation, especially if grading or other earthwork occurs at the site. Validation monitoring of other wildlife species has also been conducted at the Sacramento River in California (Golet et al. 2008) and will be further investigated for Marin RCD project sites using an appropriate research design (Morrison et al. 1994).

Fisheries monitoring is an intensive undertaking spanning over multiple years. Marin RCD strategically collaborates with its partners who undertake watershed scale monitoring programs to validate aquatic habitat use from its conservation projects. Basin-wide surveys beyond the project site (Dolloff et al. 1993) are combined with systematic site-scale data (Duffy 2005) to integrate landscape connectivity and metapopulations dynamics. Fish populations are monitored in the majority of Tomales Bay watersheds at previously restored stream sites by partnering agencies such as:

- ✓ Walker Creek – CDFG, Marin Municipal Water District (MMWD)
- ✓ Lagunitas Creek – MMWD, Salmon Protection and Watershed Network (SPAWN)
- ✓ Olema Creek and other coastal streams – Point Reyes National Seashore (PRNS)

Marin RCD has led limiting factors investigations, implements fish habitat improvement project where needed, seeks funding and assists with landowner access for partners to conduct monitoring. The 30 years of perfecting instream enhancement practices is an example of how Marin RCD monitoring documented unsuccessful projects (Kelley 1989) and collaborated to refine restoration techniques which are now showing the intended results of more fish (Ferguson 2005). Project partners monitor fish at stream sites previously restored by Marin RCD. Conservation projects have evolved to now focus resources on winter habitat for juvenile salmon because of Marin RCD's research (Stillwater Sciences 2008). As restored habitats connect and watershed functions improve, validation monitoring is in place to document overall improvement in native fish populations resulting from Marin RCD and partners' conservation practices (Andrew et al. 2010, MMWD 2010).

California freshwater shrimp (*Syncaris pacifica*) are monitored by the Nature Conservancy at a few stream restoration project sites where populations were known to already exist such as Stemple Creek. By increasing streamside vegetation and riparian forests, it is likely that the shrimp are more abundant (Fong and Vandenberg 1998). It is not known if conservation practices have increased the range into new habitat such as Walker or Chileno creeks (Serpa 2010) and this may be investigated further depending on landowner permission.

Amphibian validation monitoring for frogs (Bulger et al. 2006, USFWS 2005, USFWS 2002) and newts using a cross-sectional approach to assess aquatic habitat use at previously installed riparian and upland project sites is considered in conjunction with studies of native fish. The abundance of stock ponds across the landscape of west Marin County may have contributed to the continued presence of red-legged frogs in the county; however, the effect of conservation practices and watershed restoration on amphibian abundance has not been documented. Benthic macro-invertebrates (BMI) have been used as an indicator to monitor the quality of stream habitat and as an index for long-term water quality (Barbour et al. 1999). The data analysis for BMI's and other aquatic fauna requires dedicated staff resources and a financial commitment. Plus, controlling for the numerous environmental factors affecting populations, such as stream substrate, requires a rigorous research design that incorporates a water quality monitoring component.

Water quality and quantity monitoring is conducted at site, ranch, and watershed scales by Marin RCD and its partners. Objectives are wide ranging and include conservation practices related to water development, springs, troughs, tanks, irrigation, ponds, regulations, and increasing stream flow available. Stream temperature monitoring (Tate et al. 2005a, Tate et al. 2005b, SWRCB 2001, MacDonald et al. 1991) or other water quality assessments concurrently quantify stream flow (CARCD 2001, Tate 1995a, Tate 1995b). Projects that increase canopy cover and stream shade reduce solar radiation and most likely stream temperature. Confirming this occurred as a result of the project is an intensive undertaking that requires financial resources, staff time, particular skills and equipment over multiple years of monitoring. Plus, the factors that drive stream temperature and other water quality parameters often operate at a scale that is larger than the project site. Various upstream conditions may hinder the ability of a monitoring program to detect a difference in water quality over time or above and below a particular project site. Thus, validation monitoring of stream temperature, turbidity, pathogens, and/ or flow at riparian restoration project sites is assessed in a multidisciplinary approach with partnering organizations. The Automated Geospatial Watershed Assessment (AGWA) software previously discussed may be an applicable modeling tool for assessing conservation's ability to improve water quality in Tomales Bay watersheds and this will be investigated further.

As riparian buffer connect and watershed functions improve, validation monitoring is being conducted to document improvement in water quality resulting from Marin RCD's conservation practices. Currently, Marin RCD strategically collaborates with its partners to validate water quality improvements at a watershed scale from its conservation projects such as:

- ✓ Walker Creek – Tomales Bay Watershed Council (TBWC), MMWD, RWQCB
- ✓ Lagunitas/ Olema Creeks – TBWC, MMWD, RWQCB, PRNS
- ✓ Tomales Bay – TBWC, RWQCB, CDFG, Department of Health Services (DHS)

Given the difficulty of documenting changes in validation monitoring parameters resulting from conservation projects, study designs incorporate some type of control site or measure of annual variation for the species observed. If an increase in a desired population is measured at the project site, how do we know it was caused by the project and not the result of annual, climatic or ocean conditions? One approach utilized by PRBO incorporates results from Audubon's Christmas Bird Count to ascertain if the population changed on a large scale independent of the project site conditions (Gardali et al. 2006). For aquatic species and water quality studies, a nearby control watershed or subwatershed is utilized.

Monitoring Tasks, Timing & Partner Roles

When to collect monitoring data is standardized in order to respond to needs at the project site and compare results over time such as pooling the data from numerous project sites for periodic programmatic evaluations. As mentioned, implementation monitoring occurs post-project and generally within three years after project implementation to summarize results for grant reports. Late summer and early fall are ideal monitoring seasons to evaluate groundcover as an indicator for water quality and fix potential problems before the next winter begins. The Project Assessment Checklist (PAC) and Landowner Questionnaire may be repeated to check on particular project sites if the project effectiveness rating was low (i.e. poor or fail) for any reason during the initial evaluation and changes were made to fix problems at the site.

In contrast, pre-project baseline data for quantified effectiveness monitoring and terrestrial habitat use is collected before the project begins or immediately following the completion of a practice, such as within a few weeks following the construction of a riparian fence (Table 2 & 5). This demands coordination during project planning and installation to avoid conflicts with construction activities and collect field data when the plants are identifiable and intermittent streams are flowing. Vegetation and bank stability data is collected in late summer or early fall while aquatic habitat surveys are conducted in early summer when streams are still flowing.

The monitoring tasks are designed to be completed by the appropriate responsible partnering organization data collection roles (Table 5). The coordination of partners to monitor project sites is ultimately the responsibility of Marin RCD. Sharing the workload among partners based upon their expertise, interest and availability has been crucial to Marin RCD's success. Organization and coordination among partners is important to maintain an efficient monitoring program. This is especially critical for the site map and photo-point monitoring so these tasks are not accidentally repeated and deadlines are met on time. Data management is a shared task among partners to consolidate results for reporting requirements. Marin RCD is responsible for reports to both landowners and funders. The raw data from monitoring will be pooled together for analysis to conduct periodic programmatic reviews and is the shared responsibility of Marin RCD and its partners.

Table 5: Monitoring tasks listed based on the monitoring form name (in Appendices or References), organized by the timeline and who is responsible for conducting each task. The percent of relevant projects to be monitored with each form is included.

Task (monitoring form)	Timeline	Data Collection Responsibility	% of Projects
Monitoring Plan Checklist	Pre-project	Project Manager	90-100%
Objectives/ Targets		Project Planner, Manager	90-100%
Map/ Site Sketch	Post-project completed < 3 years and for grants reports	Project Planner, Manager	90-100%
Revegetation Data		Consultant, Contractor, Manager	90-100%
Project Assessment Checklist		Project Manager, Consultant	90-100%
Landowner Questionnaire		Project Manager	90-100%
Revegetation Survival		Consultant, Contractor, Manager	90-100%
Photo-points	Pre-project, post-project, for reports, & repeated over time as funding allows	Project Manager, Planner, Consultant	90-100%
Sediment Load Estimates		Project Manager, Planner, Consultant	90-100%
Streambank Stability Line Intercept Transect		Consultant, Contractor	10-25%
Riparian Line Intercept Transect		Consultant, Contractor	10-25%
Aquatic Habitat		Consultant, Contractor	10-25%
Stream Shade		Consultant, Contractor	10-25%
Tag Lines		Consultant, Contractor	10-25%
Bird Surveys		Consultant (PRBO)	10-25%

The duration of effectiveness monitoring depends upon the amount of time required to reasonably ascertain whether project objectives have been met. In other words, the monitoring timeline depends on when target values are expected to be achieved as a result of the project and should reflect the time necessary for identified attributes to change. For example, streambank stability may be expected to improve within three years after project installation (Figure 11), while native tree canopy may take 10 years and residual pool depth may take multiple decades to manifest (Lennox et al. 2011). Therefore, subsequent visits to resurvey projects are repeated between one and five years or following large floods to document trends and changes in trajectory (Reeve et al. 2006, Lewis et al. 2009).

One of the primary problems encountered when monitoring revegetation survival at riparian planting projects over time is how to find the planted trees and shrubs among naturally colonizing vegetation (Harris et al. 2005b, Lewis et al. 2009). Conditions become particularly obscured along the edge of channels where alder (*Alnus spp.*), willow (*Salix spp.*) and cottonwood (*Populus spp.*) are planted in high densities with no protective hardware or marking. These trees may be washed out, buried by flood deposits, produce numerous sprouts, or natural colonization may occur among the planted individuals. This is particularly true for shrub willow species that propagate vegetatively, such as arroyo and narrow-leaved willow (*Salix lasiolepis* and *S. exigua*). Interpreting the origin of low sprouting regrowth often becomes impractical 10 to 20 years after project implementation. Therefore, cover is measured using the Line Intercept Transects for long-term effectiveness monitoring to systematically compare results over multiple decades. Establishment of planted trees and shrubs may be assessed up to 10 years post-project using the Revegetation Survival Form but this will depend on funding availability.

Figure 11: Photo-point sequence at a streambank stabilization project site pre-project (left) and during construction with installation of willow wattles following grading (right).

Certain aquatic habitat attributes have been shown to improve 20 to 30 years following riparian revegetation (Opperman and Merenlender 2004, Lennox et al. 2011). Documenting the habitat available to aquatic species is a lot easier than intensively validating habitat use by fish or amphibians, so more project sites can be evaluated in a relative and consistent manner over time. The interaction of woody vegetation and watershed hydrology during flood events may alter stream channel morphology and habitat complexity at certain sites. As trees grow, stream shade can rapidly increase while woody debris recruitment may be slower, and changes to the stream channel are the slowest. Monitoring these attributes should take this into consideration, being careful to select revegetation sites where these potential changes may occur and these objectives were clearly identified with the landowner during project implementation.

As previously discussed, effectiveness monitoring for 20 years or more is ideal in order to document when objectives are met, successional changes in vegetation (Lennox 2007), indirect improvements in aquatic habitat as a result of tree establishment, and unintended changes such as weeds (Lennox et al. 2011). However, this is longer than funding for projects will allow because most restoration contracts last about three years and may not fund monitoring. One notable exception is the Booneville Environmental Foundation, which has watershed restoration grants available for ten year funding cycles which include and require on well developed monitoring programs (Reeve et al. 2006). The RZMP enables Marin RCD to now compete for such opportunities.

Site conditions two to five years post implementation offer reasonable indicators of whether the conservation practices installed are likely to have the desired effects even if the duration of monitoring is insufficient to ascertain a direct response and thorough achievement of project objectives. The PAC provides a systematic tool for this important need. Environmental stresses, project maintenance, site management and seasonal factors are considered when planning and interpreting monitoring data because of their potential to influence results. For example, fences are a common tool and the success of numerous other practices depends on their integrity such as revegetation and channel stabilization. If a PAC survey finds an access point through a fence, the database would have a low effectiveness rating for the fence practice at the site for the monitoring date that may or may not slow the attainment of other objectives. Plus, the landowner or manager is contacted to discuss options for remedial action and future PAC surveys should observe higher effectiveness ratings. Other practices such as fish habitat, streambank protection, sediment traps, filter strips, and floodplain plantings are assessed after high flow events to determine site stability following extreme physical conditions and to plan repairs if problems are encountered.

Data Management & Reporting

Similar to collecting field data, managing data with foresight of the end products will provide an efficient process for reporting and collaborating among partners. Three types of reporting are conducted for Marin RCD conservation projects:

1. Landowner reports offer important information to maintain project success and respond to problems at the site while providing project details for incorporation into the landowner’s ranch plan. Lessons learned from each project site are used to improve future practices implemented.
2. Grant reports to funders summarize monitoring results from sites appropriate to each funding source and deadlines need to be accommodated within one to three years.
3. Programmatic reviews of Marin RCD’s restoration program include five-year PCP reviews (MRCD 2009) and compilations all of monitoring data available at the time. These further help to understand the long-term outcomes of conservation practices and offer recommendations for how to improve restoration efforts.

Privacy

As discussed, the participation of landowners is critical to watershed restoration in privately owned landscapes. A common limiting factor to landowner involvement in government conservation programs and grants are issues regarding data management and reporting information back to regulatory agencies. Marin RCD staff, partners and board of directors give this issue close attention in order to communicate clearly with interested landowners about what is considered public information.

Landowner Reports

The first phase of landowner reporting is informal and involves communicating maintenance needs encountered during monitoring visits back to the landowner or land manager in a timely manner so corrective action may be taken as soon as possible from year one to two.

The second phase includes formal summaries of monitoring results similar to the information included in the reports to funders. This allows for feedback and internal review of the effectiveness ratings from the Project Assessment Checklist. Fundamental attributes quantified (e.g. streambank stability, volume erodible sediment saved, native tree cover, stream shade, etc.) related to the project objectives, comparing pre-project and post project conditions, may also be included. Landowners with grazing operations can add these reports to their ranch water quality plan.

Reports to Funders

Grant reports focus on documenting implementation and qualitative effectiveness monitoring results for the appropriate project sites funded. The project effectiveness ratings and photographs offer insight regarding how, when and what was done with the funding regarding preliminary project success. The landowner survey and quantitative effectiveness results may also be included if appropriate.

Programmatic Review

A programmatic review of the RCD's conservation projects is an opportunity to document broad accomplishments across multiple grant projects and evaluate project success to enhance riparian resources every five to ten years. Examples of such review include those completed for Mendocino County RCD's bioengineering projects (Wehren et al. 2002) and NRCS's bibliography reviews (USDA 2008a, b), as well as for specific regions such as the Russian River Watershed (Christian-Smith and Merenlender 2010), California (Kondolf et al. 2007) and across the United States (Bernhardt et al. 2007).

The Marin RCD programmatic review systematically documents conservation achievements and lessons which may be used in future grant applications. They summarize project number and practices within each watershed, project effectiveness, landowner satisfaction, plant survival and establishment, long-term project outcomes with effectiveness monitoring results and any habitat use documented. Landowner information and privacy continues to be preserved unless specific permission is given to the RCD to highlight certain projects as case studies. Geographic Information System (GIS) or other mapping software will be utilized to document what was done where at a broad scale so the specific location on any one ranch is not revealed. Basically, all monitoring data will be utilized and the RZMP will be reevaluated in the programmatic review.

A combination of practical and theoretical topics may be assessed in the programmatic review. Important questions to be answered include which project objectives were accomplished and how many landowner goals were satisfied? Also, were target values achieved in the expected amount of time following project implementation? Which plants established and which did not survive where? Do the species planted relate to species present? Does the number of plant species, total cover of all species or landscape position affect bird abundance at restored stream sites?

Monitoring Resources Required

Technical expertise and field experience needed to complete surveys is minimal for some attributes and high for others such as validation monitoring. All monitoring methods require detailed notes regarding transect location so someone else could repeat the survey in the future or if the site becomes overgrown by woody vegetation or fences are removed. Implementation monitoring requires organizational skills and an understanding of NRCS conservation practices. Plant identification skills and a familiarity with the project site are necessary to conduct revegetation survival surveys.

The resources required to conduct effectiveness monitoring depend on the specific protocol used. The qualitative visual monitoring using the Project Assessment Checklist can be picked up after minimal training with RCD partners or local rangeland managers to learn terminology, estimate RDM and identify common invasive weeds. Quantitative monitoring requires experience identifying plants and interpreting stream geomorphology. Equipment needs include:

- ✓ Clipboard, field sheets and sharp pencils
- ✓ Camera
- ✓ 100+ foot tape measuring in tenths of a foot (1.25') instead of inches (1'3")
- ✓ GPS unit
- ✓ Clinometer
- ✓ Spray bottle
- ✓ Shovel
- ✓ Site map and topographic map
- ✓ Stadia rod (also tenths of a foot)
- ✓ Flagging with felt pens
- ✓ T-posts or other permanent markers

Transect surveys require an additional 300 foot tape measure, Densiometer (Flosi et al. 1998), hip chain with extra string, bubble level with a wind-out role of string (for Tag Lines), transit, stakes, and hammer. The data entry and analysis of transect data takes considerably more time to complete.

The validation monitoring resources to document habitat use or estimate populations generally require species identification skills as well as monitoring program design expertise. The aquatic species also require special agency permits for electrofishing and handling, so dive surveys using snorkel observations are a potential efficient long-term monitoring technique. Dive surveys require two staff highly skilled in the method and minimal equipment (dry or wet suits,

underwater flashlights, small write in the rain notebook, rubber gloves). In contrast, electrofishing requires three to five staff and more permits and gear (electrofishers, dip nets, block nets, rubber gloves, five gallon buckets, thermometer, specific conductance meter, chest waders, anesthetic, measuring board, portable electronic balance). Marin RCD is thankful of its partners and relies on them to deliver the details of this RZMP over the next ten years.

The field testing phase of the RZMP streamlined the field work and focused the reporting components. The budget needs depend on the staff time to do each survey, which improves over time. The references for each protocol will be reviewed annually prior to summer data collection. Though the RZMP protocols are compiled from commonly used methods by natural resource professionals, the monitoring data collected is evaluated for accuracy and calibration needs. Data analysis will be done specific to the three reporting phases and statistical software will be necessary for programmatic reviews.

SUMMARY

Marin RCD staff and partners have the skill and experience to accomplish the monitoring goals detailed in this plan. The protocols included offer the ability to systematically document the performance of commonly used practices and should be applicable to other RCDs in California. Since the primary focus of Marin RCD is to provide landowners quality conservation projects, monitoring tasks and coordination have been woven into the project planning and maintenance activities so as to not add unnecessary tasks for the people designing and installing projects. However, additional economic resources will be necessary to continue the data collection, management and analysis tasks outlined in this plan. Plus, it is critical during this process to maintain landowner privacy and be clear how project site information will be shared with funding agencies.

The information obtained through monitoring provides useful feedback to future project participants and grantors as restoration professionals continue to decipher the reasons behind project successes and failures and apply those lessons to their practice. When project outcomes and the resulting conservation lessons are shared with the community at large, overall knowledge increases to form a common understanding while guiding the sciences of agricultural sustainability and ecological restoration. Even “unsuccessful” projects that fail to meet their objectives or target values can contribute useful information to this process. As stated by Palmer et al. (2005), “Assessment is a critical component of all restoration projects but achieving stated goals is not a prerequisite to a valuable project. Indeed, well-documented projects that fall short of initial objectives may contribute more to the future health of our waterways than projects that fulfill predictions.”

The structure of this RZMP is based on the development of realistic, measurable project objectives and collecting pre-project baseline data to determine how the project affected site conditions. The protocols used in the field to assess project outcomes for decades into the future depend on the clarity of objectives documented before project installation. In addition to documenting the intended objectives, consistent and systematic monitoring also allows for inadvertent outcomes to be documented and responded to, such as the encroachment by exotic species over time. Though the project may officially end after three years when the grant terminates, this plan sets up a long-term process to manage project sites and respond to landowners’ needs over multiple decades while learning more about the ability for riparian vegetation to improve watersheds and sustain ecosystem services in Marin County for generations to come.

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APPENDIX A: PROJECT PLANNING & IMPLEMENTATION FORMS

Project Objectives & Targets

Property/ Project Location: ____ Date: ___________

Landowner objective (paraphrase concern or reason for doing project):______________________

____

____

Check any appropriate objectives. 1) Note the priority of each compared to the other objectives selected. 2) Estimate target value if applicable. 3) Decide how long (# of years) until the target is expected to be achieved. Refer to pages 8 – 10 of the RZMP.

Implementation

- ☐ _____ Landowner concern satisfied – ____
  ____ Expected in ________ years
- ☐ _____ Revegetation survival (50 – 100%) – ____
  (for each zone) ____
  ____ Expected in ________ years

Effectiveness

- ☐ _____ Benefit ranch/ farm viability/ productivity:
  - ☐ Improve/ preserve pasture or field production – ____________________________
    ____ Expected in ________ years
  - ☐ Improve livestock management – ____
    ____ Expected in ________ years
  - ☐ Conserve water use – ____
    ____ Expected in ________ years
- ☐ _____ Reduce or prevent sediment delivery (% stable bank, RDM) – ____________________
  ____ Expected in ________ years
- ☐ _____ Reduce or prevent pathogens/ nutrients (% groundcover, RDM) – ________________
  ____ Expected in ________ years
- ☐ _____ Improve or preserve riparian habitat (extent, % tree/shrub/sp cover) – ______________
  ____ Expected in ________ years
- ☐ _____ Improve or preserve aquatic habitat (water depth, shade, LWD)– _________________
  ____ Expected in ________ years

Validation

- ☐ _____ Increase or preserve terrestrial wildlife abundance/ diversity – ____________________
  ____ Expected in ________ years
- ☐ _____ Increase or preserve aquatic species abundance/ diversity – _______________________
  ____ Expected in ________ years
- ☐ _____ Improve or preserve water quantity/ quality – ________________________________
  ____ Expected in ________ years

- ☐ _____ Other:____
  ____ Expected in ________ years

Monitoring Plan Checklist

Property/ Project Location: ____ Date: ___________

Monitoring Form/ Protocol (Location)	Monitoring Plan		Date Completed, Who Completed, & Project Feedback Notes
	Frequency	Summary	
Pre-project:			
☐ Objectives/ Targets (Appx. A)	1x	prioritize objectives and set targets	
Post-project completed for grant reports (2-3 years):			
☐ Map/ Site Sketch (Appx. A)	1x ____	update/ redo project map with location of practices	
☐ Revegetation Data (Appx. A)	1x + ____	more site visits if replanting is needed	
☐ Project Assessment Checklist (Appx. B)	2x + ____	1st & 2nd summer	
☐ Landowner Questionnaire (Appx. B)	1x ____	2nd summer	
☐ Revegetation Survival (Appx. B)	2x ____	1st & 2nd summer (replant if survival < 80%)	
Pre-project, post-project, for grant reports & repeated over time as funding allows:			
☐ Photo-points (Appx. A)	3x ____	locate each on the site map	
☐ Sediment Load Estimates (Appx. C)	2x ____	surveys potential bank/gully & models sheet/rill erosion	
☐ Streambank Stability Line Intercept Transect (Appx. C)	2x ____	stability and vegetation cover along stream (bankful)	
☐ Riparian Line Intercept Transect (Appx. C)	2x ____	vegetation cover along top-of-bank or other direction	
☐ Aquatic Habitat (Appx. C)	1x ____	thalweg transect - pool depth, instream habitat, LWD	
☐ Stream Shade (Appx. C)	1x ____	Densiometer - 3 per site subsection at Tag Lines	
☐ Tag Lines (Weaver et al. 2005 - p. 40)	1x ____	channel width:depth ratio measured in riffles	
☐ Bird Populations (Ralph et al. 1995, 1993)	1x ____	collect data for each subsection of the site	
As needed for certain projects (pre-project, post-project, & repeated):			
☐ Channel Dimensions (Appx. C)	1x ____	x-sections or long. profile to calibrate Tag Lines/ Sediment Loads or Aquatic Habitat	
☐ Maintenance & Event (Weaver et al. 2005 - p. 79)	1x + ____	during road maintenance, estimate eroded volume	
☐ Water Quantity/ Quality (SWRCB 2001, MacDonald et al. 1991)	3x + ____	automated sampling systems preferred	
☐ Fish Passage (Collins 2009, Stockard and Harris 2005, NMFS 2001)	2x ____	qualitative and quantitative protocols used	
☐ Fish Populations (Duffy 2005, Dolloff et al. 1993)	3x + ____	consult partner agencies and local experts	
☐ Freshwater Shrimp (Fong and Vandenberg 1998)	3x + ____	consult partner agencies and local experts	
☐ Red-legged Frog (USFWS 2005, 2002)	3x + ____	consult partner agencies and local experts	

Frequency: the # of visits planned to collect monitoring data over the duration of a typical grant funding riparian restoration for a 3-year contract period. Make changes to represent site plans and needs.

Notes:

Photo-Point Monitoring (STRAW 2008)

Site:____________________________________ Date: __________

Photo Point #: ____ Bearing:___________ Zoom: ______ Coordinate:____________________________________

	Directions to Photo Point Marker:
	Subject Description:
	Comments:

Photo Point #: ____ Bearing:___________ Zoom: ______ Coordinate:____________________________________

	Directions to Photo Point Marker:
	Subject Description:
	Comments:

Photo Point #: ____ Bearing:___________ Zoom: ______ Coordinate:____________________________________

	Directions to Photo Point Marker:
	Subject Description:
	Comments:

Project Site Sketch (Collins 2009)

Property/ Project Location: ____ Date: ___________

North Arrow

Magnetic or True

Revegetation Data (STRAW 2008)

Site______________ **Funder**____________________ **Creek**___________________ **Date**____________

Watershed_____________________ **Width**________________ **Linear Feet**__________________

School	Teacher	Students	Grade	Parents

Volunteers

Container Plants

	Brought	Planted	color		Brought	Planted	Color
big leaf maple				Onion grass			
box elder				Oregon ash			
buckeye				red Osier dogwood			
CA rose				Snowberry			
Carex sedge				spicebush			
coffeeberry				thimbleberry			
coyote bush				toyon			
currant				valley oak			
douglas fir				walnut			
dutchman's pipe				wax myrtle			
elderberry				white alder			
grape				CA fescue			
hawthorn				Molate fescue			
hazelnut				western fescue			
honey suckle							
Juncus rush							
live oak							
native black berry							
				TOTAL			

Invasives

Type/ yd^3 Removed

Willows

Groundcover

Seeding SF_________
Blanket SF_________
Mulching SF________

Biotech

willow wall 1 LF_____________	Willow Wattle 1 LF________
willow wall 2 LF_____________	Willow Wattle 2 LF________
willow wall 3 LF_____________	Willow Wattle 3 LF________
willow wall 4 LF_____________	Willow Wattle 4 LF________

Brush Checkdams___________

Other

Restoration comments:

APPENDIX B: QUALITATIVE MONITORING FORMS

Project Assessment Checklist

Property/Project Location: ____ Project Year: ______________

I) **Notify** landowner for permission in advance of site visit.
II) **Take** camera and project folder (with plans, objectives, photos, LA, project history, monitoring, etc.).
III) **Repeat photograph** (relocate photo point as precisely as possible based on original photo and data).

Evaluation completed by:

____

Date: __________________

1) Fences	**Yes**	**No**	**N/A**
H-Braces sound			
Wire is tight			
Broken or missing posts			
Evidence of excessive livestock pressure			
Evidence of livestock in enclosure area			
Gates open			
If fence is electrical, is it working			
Electrical fence line clear of vegetation			
Flood gates closed or replaced after winter			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)
Comments:____

2) Troughs & Springs	**Yes**	**No**	**N/A**
Does trough have water			
Does the float valve work			
If trough is not working, does the spring have water			
Pipe plugged or broken			
Is there a fence around the spring to keep cows out			
Is there a mud hole at spring of trough			
Is trough poring enough water for the herd			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)
Comments:____

3) Roads & Animal Trails	**Yes**	**No**	**N/A**
Sheet/rill erosion			
Culverts plugged/smashed/rusted out			
Visible erosion in road/ trail ditch or on fill			
Rolling dips/water bars functioning as planned			
Evidence of short-cut use that causes additional erosion			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)
Comments:____

4) Plantings & Woody Vegetation	**Yes**	**No**	**N/A**
Evidence of livestock damage			
Evidence of water deficiency			
Water system working			
Weed control adequate			
Wildlife protection working			
Survival of plantings adequate (no replanting?)			
Natural regen. (list tree/ shrub seedlings below)			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)
Riparian Vegetation (see Guide): NA Great Good Fair Poor (circle one)
Comments:____

5) Grazing & Herbaceous Vegetation (see grazing plan)

	Yes	No	N/A
Is grazing being managed as per grazing plan (see LA)			
Is crossing for livestock stable			

Estimate RDM (lb/ac): NA <200 200-350 350-700 700-1000 1000-1500 >1500

Comments & **list invasive plant species** present (estimate patch size area or % of site for each):

____

6**) Water and Sediment Detention Structures**

	Yes	No	N/A
Basin has capacity			
Structures secure			
Evidence of rilling			
Erosion on embankment			
Erosion present at energy dissipating structure			
Other erosion present (if yes, describe below)			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)

Structure Stability (see Guide): NA Great Good Fair Poor (circle one)

Comments: ____

7) Erosion Control Repairs & Structures

	Yes	No	N/A
Toe or footer rocks secure			
Evidence of toe scour			
Weir rock secure			
Has rock moved			
Evidence of piping above weir rock			
Evidence of down cutting upstream of the weir rock			
Evidence of soil piping through or under rock structure			
Is fabric key upstream of the weir rock secure			
Fabric visible			
Evidence of bank erosion or scour around the rock structure			
Upstream and down stream keys holding			
Biotechnical repairs holding			
Other erosion present (if yes, describe below)			

Effectiveness Rating (see Guide): NA Excellent Good Fair Poor Fail (circle one)

Stability (see Guide): NA Great Good Fair Poor (circle one)

Comments: ____

____

8) Instream Habitat

Estimate instream shelter value (0-3):________________________ (see definitions in Guide)

Estimate % site covered by shelter:__________ Calculate instream shelter rating (value X %):___________

Fish passage – 1) upstream jumps < ½ foot tall? Yes No 2) Flow connectivity adequate? Yes No

Comments:____

9) Overall

	Yes	No	N/A
Is the project being managed per LA			
Remedial action needed			
Inform RCD			
Call landowner			
Inform project designer (NRCS, PCI, etc.)			
Inform contractor (STRAW, etc.)			

Overall Effectiveness Rating (circle one): NA Excellent Good Fair Poor Fail

Comments (determine responsibility, describe action taken, & record dates): ________________________

____

Project Assessment Checklist Guide

Effectiveness Rating (Collins 2009)

RATING	OBJECTIVES	TARGETS	UNINTENDED EFFECTS	STRUCTURAL CONDITION
Excellent	Achieved all stated objectives.	Met or exceeded targeted values.	No negative unintended effects. Unintended positive effects may outweigh failure to achieve a target value.	Excellent to Good. Has the intended functional value.
Good	Achieved most stated objectives.	Did not quite meet all targeted values. Or, if no targets were specified, maximum rating is Good.	Nonnegative unintended effects.	Excellent to Fair. Has the intended functional value.
Fair	Partially achieved most objectives, or objectives not achieved were outside the control of practice.	May or may not meet all targeted values.	May have minor unintended negative effects that partially offset objectives.	Excellent to Fair. Has functional value.
Poor	Achieved at least 1 objective – those not achieved were the fault of the practice.	May or may not meet all targeted values.	May have minor or major unintended negative effects that offsets or negates a targeted gain.	Excellent to Poor. Has some functional value.
Fail	Achieved no objectives – practice may be completely gone.	Did not meet targeted values.	May have unintended negative effects that are degrading the habitat and outweigh achieved objectives.	Excellent to Fail. Has no functional value.

Riparian Vegetation (Ward et al. 2003b, Ward et al. 2003c, USDA 1998)

Excellent = 'natural veg' at least 2 active channel widths (native perennials - rush, shrubs, trees, etc. - OR annual grass at intermittent streams) with all age classes of woody species or point bars regenerating

Good = 'natural veg' 1 active channel width – covers floodplain (bare spots common at intermittent streams)

Fair = 'natural veg' ½ active channel width – bare spots common or filtering function slightly compromised

Poor = 'natural veg' < ½ active channel width – bare spots common or lack of regeneration or filtering function severely compromised

Invasive Plants

Refer to species lists provided by the Bay Area Weed Watchers Volunteer Program (NPS 2010) or create one for a specific site using a combination of CW & NW Floristic Provinces (Cal-IPC 2006). Assistance identifying species is available from UC IPM (http://www.ipm.ucdavis.edu/PMG/weeds_intro.html).

Stability (Ward et al. 2003b, Ward et al. 2003c, USDA 1998)

Excellent = banks and channel are stable with outside bends protected by vegetation

Good = moderately stable with infrequent, small areas of erosion – mostly healed over

Fair = moderately unstable with outside bends actively eroding – steep bare soil with high erosion potential

Poor = banks are unstable with active erosion frequent at site

Residual Dry Matter (RDM) (Wildland Solutions 2008)

<200 lb/ac	200-350 lb/ac	350-700 lb/ac
Evidence of total use	Extensive grazing use	Extensive grazing use
<1" tall – "blitzed" or "nuked"	Most 1" tall, some 3-5"	Patchy areas 1"-5" tall
Considerable bare soil apparent	Ground cover sparse, clumpy	Some bare soil patches

700-1000 lb/ac	1000-1500 lb/ac	>1500 lb/ac
Clear signs of grazing use	May have considerable use	May have signs of grazing
Patches of seed stalks	Numerous seed stalks	Dry grass may lay flat
Random bare soil seen at 20'	Bare soil from gophers or trails	Litter may be thick

Instream Shelter (Collins 2009, Flosi et al. 1998)

Value 0: no shelter present

Value 1: 1-5 boulders, bare undercut bank/ bedrock ledge, **OR** a single LWD (>12" dia. & 6' long)

Value 2: 1-2 pieces of LWD associated with any amount of Small WD, 6 or more boulders per 50', stable undercut bank (<12" undercut) with root mass, a single root wad lacking complexity, branches in or near the water, limited submersed vegetative fish cover, **OR** a bubble curtain

Value 3: MUST have a combination of **at least 2** of the following cover types:

- LWD (large woody debris)/ boulders/ root wads,
- 3 or more pieces of LWD combined with SWD,
- 3 or more boulders combined with LWD/ SWD,
- bubble curtain combined with LWD or boulders,
- stable undercut bank with >12" undercut associated with root mass or LWD,
- extensive submerged vegetative fish cover

Fish Passage –*flow connectivity* refers to adequate stream flow between pools for downstream and upstream migration to occur given the annual timing and variability of flow at the site (CDFG 2010, Stockard and Harris 2005, NMFS 2001)

Landowner Questionnaire

Completed by: ____________________________ Date: __________

Rank Descriptions

1 = definitely not, or never
2 = no, or probably not
3 = not sure, or no opinion
4 = yes, or probably so
5 = definitely yes, without a doubt

The intent of this questionnaire is to summarize your thoughts, any confusion you may have had, and unintended side effects resulting from your conservation project in order to reduce future problems and miscommunication. Please answer the following questions using the 1-5 (no-yes) ranks in the box. Thank you again for working with Marin Resource Conservation District.

Landowner/ Manager Interviewed: ________________________________ Project Year: ______________

Project Description/ Location: ____

1) Was the project successful meeting your intended goal(s)?

1 2 3 4 5 NA

Comments:____

____

2) Could Marin RCD improve any phase in the process (please circle any that apply)?

1 2 3 4 5 NA

Selection Design Construction Maintenance Monitoring Your Time

Other/Comments:____

____

3) Was any phase in the process confusing (please circle any that apply)?

1 2 3 4 5 NA

Selection Design Funding Sources Construction Maintenance Monitoring

Other/Comments:____

____

4) Will you continue to participate in Marin RCD projects?

1 2 3 4 5 NA

Comments:____

____

5) Would you recommend participation in Marin RCD projects?

1 2 3 4 5 NA

Comments:____

____

6) Did the project help you conserve or reduce water used for your farm/ ranch?

1 2 3 4 5 NA

Comments:____

____

7) Did the project improve your management of a pasture or farm field?

1 2 3 4 5 NA

Comments:____

____

8) Did the project help improve the productivity of a pasture or farm field?

1 2 3 4 5 NA

Comments:____

____

9) Did the project improve livestock health?

1 2 3 4 5 NA

Comments:____

____

10) Have you implemented similar or other conservation practices on your own?

1 2 3 4 5 NA

Describe/Comments:____

____

11) Did the project <u>reduce</u> any agricultural expenses (please circle any that apply)?

1 2 3 4 5 NA

Water Feed Electricity Time Fuel Labor

Other/Comments:____

____

12) Did the project <u>increase</u> any agricultural expenses (please circle any that apply)?

1 2 3 4 5 NA

Water Feed Electricity Time Fuel Labor

Other/Comments:____

____

13) Has the project helped to reduce any stress from natural resource concerns?

1 2 3 4 5 NA

Comments:____

____

14) Has the project improved water quality?

1 2 3 4 5 NA

Comments:____

____

15) Has the project improved wildlife habitat?

1 2 3 4 5 NA

Comments:____

____

Revegetation Survival (STRAW 2008, adapted from Harris 2005)

Page ___ of ___

Site Name__________________ **Staff**_______________ **Bank/ Zone**____
(Looking Downstream)

Plant Species	# Planted	<3ft - LV	<3ft - HV	>3ft - LV	>3ft - HV

Date Monitored_____________

Date(s) Planted______________

Mortality	
Cause (Use Comments)	**Percent**
_______________	______%
_______________	______%
_______________	______%
_______________	______%
_______________	______%
_______________	______%
	100%

Dominant Weeds and Colonizers

General Browse (Circle One)

None Low High

Densiometer Data Needed?

YES NO

If Yes, use form on back

General Notes / Comments

Overall appearance?

Vandalism?

Gophers?

Livestock?

Herbivores?

Girdling?

Watering?

Weeds?

Fencing?

Erosion?

Other?

Wildlife?

LV = Low Vigor (systemic stress)

HV = High Vigor (healthy new growth)

APPENDIX C: QUANTITATIVE EFFECTIVENESS MONITORING FORMS

Sediment Load Estimates

Property/Project(s) Location: ___________________________________ Project Year: ___________
Evaluation Completed by: _____________________________________ Date: _________________

Streambank & Gully Erosion

Locate the erosion sites caused by potential bank failures or channel incision from gullying (Lewis et al. 2000) and record their Length, Width, and Depth (ft) noting the subsection in the site, % deliverable and % fines. Minimum and maximum values are acceptable – use both for the section calculations to produce a range in the site's sediment estimates. Focus on the potential future erosion, but also document recently eroded areas if it occurred since the last survey.

Location (site, section)	Type (bank or gully)	Potential or Eroded	Length	Width	Depth	% Deliv-erable	% Fines

Notes:

Sheet & Rill Erosion

Collect the following field data from each section of the project site to run the Rangeland Hydrology and Erosion Model (RHEM). For any attribute that is too variable for rapid measurement (i.e. % slope and cover), provide minimum and maximum values – input both into the model to produce a range in the final sediment estimates for each section and site. If more subsections are needed, delineate them on a site map or sketch and explain below.

Location (site, section)	Soil Texture	Slope Length	Slope Shape	% Steep-ness	Dominant Plant Growth	Canopy Cover %	Basal Cover %	Rock Cover %	Litter Cover %

Notes:

Sediment Load Estimates Guide

Streambank & Gully Erosion

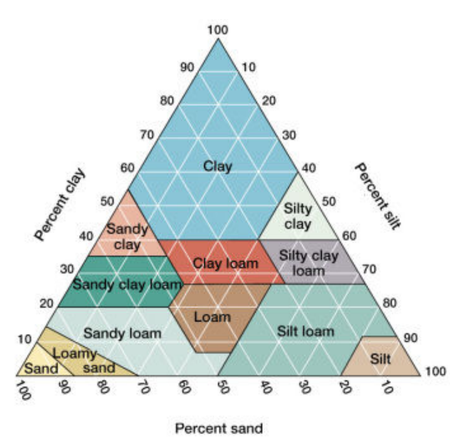
Erosion: the detachment, transport, and deposition of soil particles by wind, raindrops, or water flow
Gully: an erosion channel formed by concentrated surface runoff: larger then 1 ft deep & 1 ft wide
Streambank Erosion: the removal of soil by the direct action of stream flow during high flow
Length: distance parallel to stream of unstable channel
Width: perpendicular to Length measurement up the bank on the slope or of the gullying channel
Depth: perpendicular to Width measurement into the ground
% Deliverable: sediment that is delivered to a watercourse (±30%) of potential erodible volume
% Fines: estimate the proportion of fine sediment (not gravel or cobble) that would erode
Potential Volume: estimated volume of sediment that is potentially deliverable
Eroded Volume: estimated volume of previously eroded sediment from a site

Refer to Lewis et al. (2000) before field work and consult other literature. Enter raw data collected in the field directly into an excel spreadsheet and 1) calculate the total sediment yield volume for each row above including the percent deliverable; 2) sum the potential erodible volume in each section of the site for streambank and gully erosion types separately and divide by 27 to convert to cubic yards (CY); 3) total the potential streambank and gully erosion separately for the site; 4) sum these two for a total estimate of the site; and 5) total sediment saved = preproject potential erodible sediment – postproject eroded sediment – postproject potential erodible sediment.

Sheet & Rill Erosion

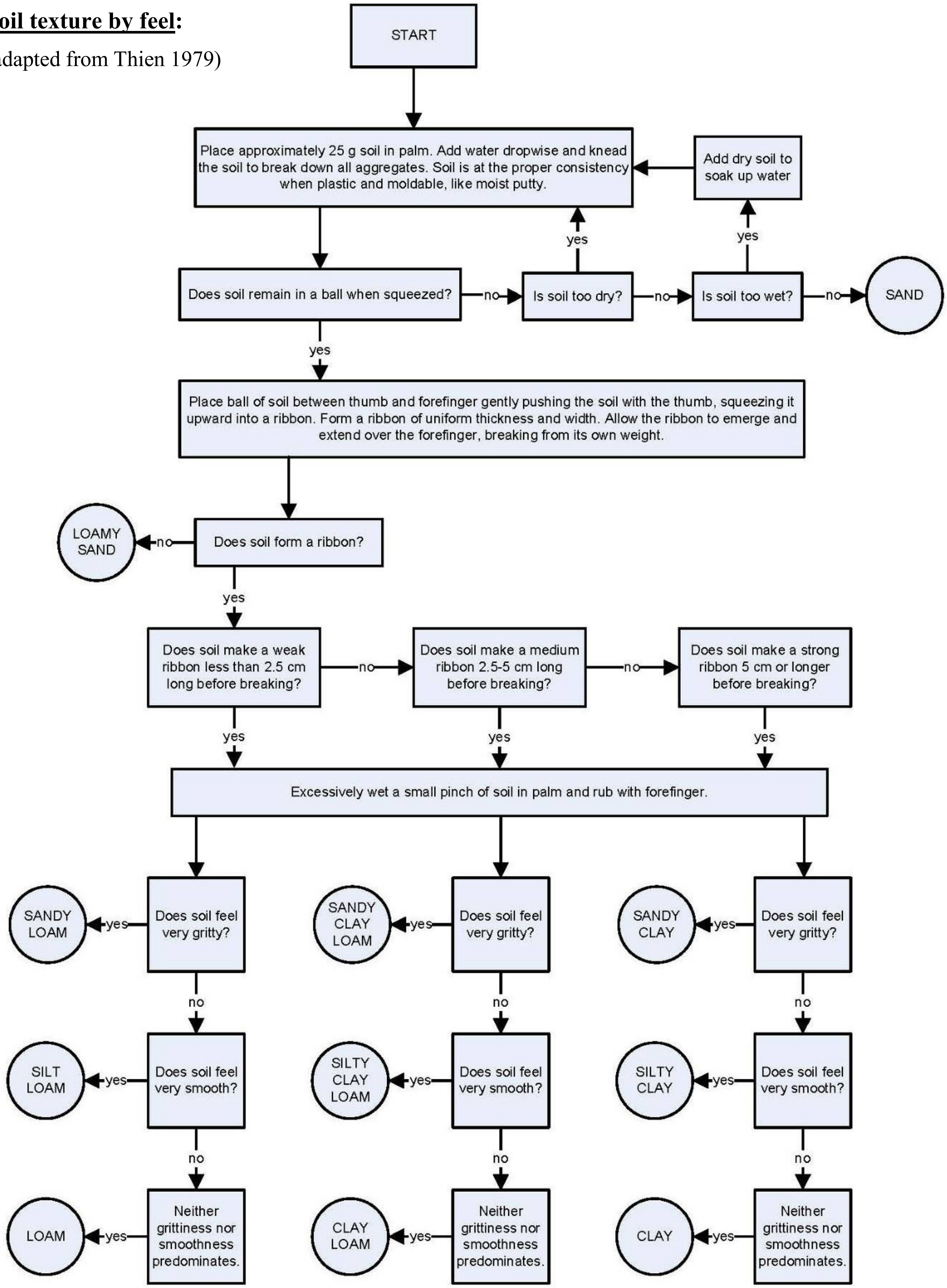
Soil Texture: at < 2"depth, may be Sand, Loamy sand, Sandy loam, Loam, Silt loam, Silt, Sandy clay loam, Clay loam, Silty clay loam, Sandy clay, Silty clay, or Clay (see Marin County Soil Survey or http://casoilresource.lawr.ucdavis.edu/drupal/node/902 to find soil type(s) and use the flow chart on p. 69 at the site to cross-check with expected texture from the table on p. 70-72)
Slope Length: horizontal distance from upper bank (at fence) to waters edge (< 50 meters)
Slope Shape: may be Uniform , Convex , Concave , or S-shaped from upper bank
% Steepness: the percent slope from upper bank to waters edge (rise/run, or clinometer)
Dominant Plant Growth Form: top canopy may be shrubs or perennial grass or annual (='other')
Canopy Cover: % of total vegetation living or dead for woody and herbaceous (USDA 2007)
Basal Plant Canopy Cover: % intersection of plant and soil surface for groundcover layer only
Rock & Litter Cover: % of rocks and litter respectively, for groundcover layer only

After collecting field data, go to http://dss.tucson.ars.ag.gov/rhem/ and enter field data directly into the program. 1) Name each model run (by site and section # within the site) and select English units; 2) select the Kentfield climate station (next closest is Graton); 3) input the field data collected from each section of the project site; 4) record sediment yield and soil loss (tons/ac/yr) for average, 50 year and 100 year storms from each section of the site; 5) multiply by the size of the section (ac) and divide by 1.35 to convert to cubic yards per year; 5) sum all section outputs for totals of the project site; 6) multiply by the number of years since project implementation for both pre and post project surveys; and 7) subtract the post-project value from the pre-project to give total sediment saved.



Soil texture by feel:

(adapted from Thien 1979)



Map Unit #	Map Unit Name	Texture	T Factor (tons/ac/yr)	Erosion Hazard - off road, off trail	Erosion Hazard - road, trail	Range Prod. - normal (lb/ac/yr)	Range Prod. - low (lb/ac/yr)	Range Prod. - high (lb/ac/yr)	Seedling Mortality Potential	Acres	% of County
101	BALLARD GRAVELLY, LOAM 2 TO 9 PERCENT SLOPES	gravelly loam	5	Slight	Moderate	1,700	1,020	2,210	Low	1,768	0.5%
102	BALLARD-URBAN LAND COMPLEX, 0 TO 9 PERCENT SLOPES	gravelly loam	5	Slight	Moderate				Low	856	0.2%
103	BARNABE VERY GRAVELLY LOAM, 30 TO 50 PERCENT SLOPES	very gravelly loam	1	Severe	Severe				Low	821	0.2%
104	BEACHES			Not rated	Not rated				Not rated	1,599	0.4%
105	BLUCHER-COLE COMPLEX, 2 TO 5 PERCENT SLOPES	clay loam	5	Slight	Moderate	1,750	1,050	2,100	High	10,390	2.7%
106	BONNYDOON GRAVELLY LOAM, 15 TO 30 PERCENT SLOPES	gravelly loam	2	Moderate	Severe	2,720	1,870	3,230	Low	516	0.1%
107	BONNYDOON GRAVELLY LOAM, 30 TO 75 PERCENT SLOPES	gravelly loam	2	Very severe	Severe	2,720	1,870	3,230	Low	4,107	1.1%
108	BONNYDOON VARIANT-GILROY-GILROY VARIANT LOAMS, 50 TO 75 PERCENT SLOPES	loam	1	Very severe	Severe	1,535	855	2,035	Low	2,933	0.8%
109	BRESSA VARIANT-MCMULLIN VARIANT COMPLEX, 30 TO 50 PERCENT SLOPES	gravelly loam	3	Severe	Severe				Low	1,510	0.4%
110	CENTISSIMA-BARNABE COMPLEX, 15 TO 30 PERCENT SLOPES	loam	3	Moderate	Severe				Low	785	0.2%
111	CENTISSIMA-BARNABE COMPLEX, 30 TO 50 PERCENT SLOPES	loam	3	Severe	Severe				Low	2,663	0.7%
112	CENTISSIMA-BARNABE COMPLEX, 50 TO 75 PERCENT SLOPES	loam	3	Very severe	Severe				Low	4,851	1.2%
113	CLEAR LAKE CLAY	clay	5	Slight	Slight	1,350	1,215	1,530	High	1,098	0.3%
114	CORTINA GRAVELLY SANDY LOAM, 0 TO 5 PERCENT SLOPES	gravelly sandy loam	4	Slight	Slight	680	340	850	Low	874	0.2%
115	CRONKHITE-BARNABE COMPLEX, 9 TO 15 PERCENT SLOPES	loam	4	Moderate	Severe	1,200	900	1,400	Low	2,261	0.6%
116	CRONKHITE-BARNABE COMPLEX, 15 TO 30 PERCENT SLOPES	loam	4	Moderate	Severe	1,200	900	1,400	Low	2,953	0.8%
117	CRONKHITE-BARNABE COMPLEX, 30 TO 50 PERCENT SLOPES	loam	4	Severe	Severe	960	720	1,120	Low	3,923	1.0%
118	CRONKHITE-BARNABE COMPLEX, 50 TO 75 PERCENT SLOPES	loam	4	Very severe	Severe	960	720	1,120	Low	2,504	0.6%
119	DIPSEA-BARNABE VERY GRAVELLY LOAMS, 30 TO 50 PERCENT SLOPES	very gravelly loam	4	Severe	Severe				Low	2,311	0.6%
120	DIPSEA-BARNABE VERY GRAVELLY LOAMS, 50 TO 75 PERCENT SLOPES	very gravelly loam	4	Very severe	Severe				Low	9,146	2.3%
121	DIPSEA-URBAN LAND-BARNABE COMPLEX, 30 TO 50 PERCENT SLOPES	very gravelly loam	4	Severe	Severe				Low	548	0.1%
122	DUNE LAND			Not rated	Not rated				Not rated	3,552	0.9%
123	FELTON VARIANT-SOULAJULE COMPLEX, 9 TO 15 PERCENT SLOPES	clay loam	3	Moderate	Severe	1,840	1,080	2,080	Low	719	0.2%
124	FELTON VARIANT-SOULAJULE COMPLEX, 15 TO 30 PERCENT SLOPES	clay loam	3	Moderate	Severe	1,840	1,080	2,080	Low	949	0.2%
125	FELTON VARIANT-SOULAJULE COMPLEX, 30 TO 50 PERCENT SLOPES	clay loam	4	Severe	Severe	2,080	1,230	2,360	Low	2,352	0.6%
126	FELTON VARIANT-SOULAJULE COMPLEX, 50 TO 75 PERCENT SLOPES	clay loam	4	Very severe	Severe	2,080	1,230	2,360	Low	1,007	0.3%
127	FLUVENTS, CHANNELED	stratified cobbly sand to silt loam		Slight	Moderate				Not rated	930	0.2%
128	GILROY-GILROY VARIANT-BONNYDOON VARIANT LOAMS, 30 TO 50 PERCENT SLOPES	loam	2	Severe	Severe	1,689	1,005	2,250	Low	3,257	0.8%
129	HENNEKE STONY CLAY LOAM, 15 TO 50 PERCENT SLOPES	stony clay loam	1	Severe	Severe	510	425	680	Low	3,396	0.9%
130	HUMAQUEPTS, SEEPED	peat	5	Slight	Moderate				Not rated	571	0.1%
131	HYDRAQUENTS, SALINE	stratified peat to silt to clay		Slight	Slight				Not rated	2,041	0.5%
132	INVERNESS LOAM, 9 TO 15 PERCENT	loam	4	Slight	Severe				Low	756	0.2%
133	INVERNESS LOAM, 15 TO 30 PERCENT	loam	4	Moderate	Severe				Low	817	0.2%
134	INVERNESS LOAM, 30 TO 50 PERCENT	loam	4	Severe	Severe				Low	638	0.2%
135	INVERNESS LOAM, 50 TO 75 PERCENT SLOPES	loam	4	Very severe	Severe				Low	3,923	1.0%
136	KEHOE LOAM, 9 TO 15 PERCENT SLOPES	loam	3	Moderate	Severe	2,465	2,125	2,975	Low	915	0.2%
137	KEHOE LOAM, 15 TO 50 PERCENT SLOPES	loam	3	Severe	Severe	2,465	2,125	2,975	Low	993	0.3%

Map Unit #	Map Unit Name	Texture	T Factor (tons/ac/yr)	Erosion Hazard - off road, off trail	Erosion Hazard - road, trail	Range Prod. - normal (lb/ac/yr)	Range Prod. - low (lb/ac/yr)	Range Prod. - high (lb/ac/yr)	Seedling Mortality Potential	Acres	% of County
138	KEHOE VARIANT COARSE SANDY LOAM, 9 TO 15 PERCENT SLOPES	coarse sandy loam	4	Slight	Severe	2,975	2,210	3,400	Low	489	0.1%
139	KEHOE VARIANT COARSE SANDY LOAM, 15 TO 50 PERCENT SLOPES	coarse sandy loam	4	Moderate	Severe	2,975	1,768	3,081	Low	2,712	0.7%
140	LOS OSOS-BONNYDOON COMPLEX, 5 TO 15 PERCENT SLOPES	gravelly loam	3	Moderate	Severe	2,626	1,691	2,948	Low	2,722	0.7%
141	LOS OSOS-BONNYDOON COMPLEX, 15 TO 30 PERCENT SLOPES	gravelly loam	3	Moderate	Severe	2,515	1,640	2,860	Low	5,972	1.5%
142	LOS OSOS-BONNYDOON COMPLEX, 30 TO 50 PERCENT SLOPES	gravelly loam	3	Severe	Severe	2,440			Low	13,688	3.5%
143	LOS OSOS-URBAN LAND-BONNYDOON COMPLEX, 15 TO 30 PERCENT SLOPES	gravelly loam		Moderate	Severe				Low	652	0.2%
144	LOS OSOS-URBAN LAND-BONNYDOON COMPLEX, 30 TO 50 PERCENT SLOPES	gravelly loam	3	Severe	Severe		571	1,857	Low	535	0.1%
145	MAYMEN-MAYMEN VARIANT GRAVELLY LOAMS, 30 TO 75 PERCENT SLOPES	gravelly loam	1	Very severe	Severe	1,714	537	1,253	Low	7,119	1.8%
146	MONTARA CLAY LOAM, 15 TO 30 PERCENT SLOPES	clay loam	1	Moderate	Severe	805			High	273	0.1%
147	NOVATO CLAY	clay	5	Slight	Slight		1,530	2,550	High	3,113	0.8%
148	OLOMPALI LOAM, 2 TO 9 PERCENT SLOPES	loam	3	Slight	Moderate	2,125	1,530	2,550	High	1,232	0.3%
149	OLOMPALI LOAM, 9 TO 15 PERCENT SLOPES	loam	3	Moderate	Severe	2,125	1,545	2,576	High	3,357	0.9%
150	OLOMPALI LOAM, 15 TO 30 PERCENT SLOPES	loam	3	Moderate	Severe	2,146	1,212	1,818	Low	1,921	0.5%
151	PABLO-BAYVIEW COMPLEX, 15 TO 50 PERCENT SLOPES	loam	1	Moderate	Severe	1,556	1,212	1,818	Low	3,080	0.8%
152	PABLO-BAYVIEW COMPLEX, 50 TO 75 PERCENT SLOPES	loam	1	Very severe	Severe	1,556			Low	2,978	0.8%
153	PALOMARIN-WITTENBERG COMPLEX, 9 TO 15 PERCENT SLOPES	loam	3	Slight	Severe				Low	585	0.1%
154	PALOMARIN-WITTENBERG COMPLEX, 15 TO 30 PERCENT SLOPES	loam	3	Moderate	Severe				Low	2,345	0.6%
155	PALOMARIN-WITTENBERG COMPLEX, 30 TO 50 PERCENT SLOPES	loam	3	Severe	Severe				Low	3,004	0.8%
156	PALOMARIN-WITTENBERG COMPLEX, 50 TO 75 PERCENT SLOPES	loam	3	Very severe	Severe				Not rated	7,742	2.0%
157	PITS, QUARRIES			Not rated	Not rated		900	1,800	High	342	0.1%
158	REYES CLAY	clay	5	Slight	Slight	1,350			Not rated	7,967	2.0%
159	ROCK OUTCROP-XERORTHENTS COMPLEX, 50 TO 75 PERCENT SLOPES			Not rated	Not rated		2,273	3,636	High	1,792	0.5%
160	RODEO CLAY LOAM, 2 TO 15 PERCENT SLOPES	clay loam	5	Slight	Severe	2,727	1,660	3,140	Low	3,808	1.0%
161	SAURIN-BONNYDOON COMPLEX, 2 TO 15 PERCENT SLOPES	clay loam	3	Slight	Severe	2,460	1,553	2,915	Low	995	0.3%
162	SAURIN-BONNYDOON COMPLEX, 15 TO 30 PERCENT SLOPES	clay loam	3	Moderate	Severe	2,298	1,918	3,592	Low	2,719	0.7%
163	SAURIN-BONNYDOON COMPLEX, 30 TO 50 PERCENT SLOPES	clay loam	3	Severe	Severe	2,837	1,918	3,592	Low	5,878	1.5%
164	SAURIN-BONNYDOON COMPLEX, 50 TO 75 PERCENT SLOPES	clay loam	3	Very severe	Severe	2,837			Low	4,769	1.2%
165	SAURIN-URBAN LAND-BONNYDOON COMPLEX, 15 TO 30 PERCENT SLOPES	clay loam		Moderate	Severe				Low	605	0.2%
166	SAURIN-URBAN LAND-BONNYDOON COMPLEX, 30 TO 50 PERCENT SLOPES	clay loam		Severe	Severe				Low	1,364	0.3%
167	SHERIDAN VARIANT COARSE SANDY LOAM, 9 TO 30 PERCENT SLOPES	coarse sandy loam	3	Moderate	Severe				Low	1,245	0.3%
168	SHERIDAN VARIANT COARSE SANDY LOAM, 30 TO 50 PERCENT SLOPES	coarse sandy loam	3	Severe	Severe				Low	1,261	0.3%
169	SHERIDAN VARIANT COARSE SANDY LOAM, 50 TO 75 PERCENT SLOPES	coarse sandy loam	3	Very severe	Severe		1,653	2,480	Low	1,378	0.4%
170	SIRDRAK SAND, 2 TO 15 PERCENT SLOPES	sand	5	Slight	Moderate	2,204	1,636	2,455	Low	2,106	0.5%
171	SIRDRAK SAND, 15 TO 50 PERCENT SLOPES	sand	5	Moderate	Severe	2,182	1,800	2,520	High	575	0.1%
172	SIRDRAK VARIANT SAND, 0 TO 5 PERCENT SLOPES	sand	4	Slight	Slight	2,160	1,561	2,602	Low	1,710	0.4%
173	SOBEGA LOAM, 9 TO 15 PERCENT SLOPES	loam	3	Slight	Severe	2,168	1,561	2,602	Low	2,344	0.6%
174	SOBEGA LOAM, 15 TO 30 PERCENT SLOPES	loam	3	Moderate	Severe	2,168	680	1,763	Low	503	0.1%

Map Unit #	Map Unit Name	Texture	T Factor (tons/ac/yr)	Erosion Hazard - off road, off trail	Erosion Hazard - road, trail	Range Prod. - normal (lb/ac/yr)	Range Prod. - low (lb/ac/yr)	Range Prod. - high (lb/ac/yr)	Seedling Mortality Potential	Acres	% of County
175	TAMALPAIS-BARNABE VARIANT VERY GRAVELLY LOAMS, 15 TO 30 PERCENT SLOPES	very gravelly loam	2	Moderate	Severe	1,330	600	1,547	Low	537	0.1%
176	TAMALPAIS-BARNABE VARIANT VERY GRAVELLY LOAMS, 30 TO 50 PERCENT SLOPES	very gravelly loam	2	Severe	Severe	1,168	629	1,608	Low	2,061	0.5%
177	TAMALPAIS-BARNABE VARIANT VERY GRAVELLY LOAMS, 50 TO 75 PERCENT SLOPES	very gravelly loam	2	Very severe	Severe	1,216			Low	1,783	0.5%
178	TOCALOMA-MCMULLIN COMPLEX, 15 TO 30 PERCENT SLOPES	gravelly loam	3	Moderate	Severe				Low	349	0.1%
179	TOCALOMA-MCMULLIN COMPLEX, 30 TO 50 PERCENT SLOPES	gravelly loam	3	Severe	Severe				Low	7,773	2.0%
180	TOCALOMA-MCMULLIN COMPLEX, 50 TO 75 SLOPES	gravelly loam	3	Very severe	Severe				Low	22,878	5.9%
181	TOCALOMA-MCMULLIN-URBAN LAND COMPLEX, 15 TO 30 PERCENT SLOPES	gravelly loam		Moderate	Severe				Low	1,184	0.3%
182	TOCALOMA-MCMULLIN-URBAN LAND COMPLEX, 30 TO 50 PERCENT SLOPES	gravelly loam	3	Severe	Severe		706	1,412	Low	5,095	1.3%
183	TOCALOMA-SAURIN ASSOCIATION, STEEP	clay loam	3	Moderate	Severe	1,059	625	1,250	Low	919	0.2%
184	TOCALOMA-SAURIN ASSOCIATION, VERY STEEP	clay loam	3	Severe	Severe	938	645	1,290	Low	17,623	4.5%
185	TOCALOMA-SAURIN ASSOCIATION, EXTREMELY STEEP	clay loam	3	Very severe	Severe	968	1,771	2,656	Low	23,496	6.0%
186	TOMALES FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES	fine sandy loam	4	Slight	Moderate	2,214	1,771	2,656	Low	1,499	0.4%
187	TOMALES FINE SANDY LOAM, 9 TO 15 PERCENT SLOPES	fine sandy loam	4	Slight	Severe	2,214	1,753	2,629	Low	2,531	0.6%
188	TOMALES FINE SANDY LOAM, 15 TO 30 PERCENT SLOPES	fine sandy loam	4	Moderate	Severe	2,191	1,735	2,602	Low	1,067	0.3%
189	TOMALES FINE SANDY LOAM, 30 TO 50 PERCENT SLOPES	fine sandy loam	4	Severe	Severe	2,168	1,717	2,576	Low	2,559	0.7%
190	TOMALES LOAM, 2 TO 9 PERCENT SLOPES	loam	4	Slight	Moderate	2,146	1,717	2,576	Low	591	0.2%
191	TOMALES LOAM, 9 TO 15 PERCENT SLOPES	loam	4	Slight	Severe	2,146	1,789	2,684	Low	4,967	1.3%
192	TOMALES LOAM, 15 TO 30 PERCENT SLOPES	loam	4	Moderate	Severe	2,237	1,717	2,576	Low	4,633	1.2%
193	TOMALES LOAM, 30 TO 50 PERCENT SLOPES	loam	4	Severe	Severe	2,146	1,711	2,667	Low	2,570	0.7%
194	TOMALES-SOBEGA LOAMS, 15 TO 30 PERCENT SLOPES	loam	4	Moderate	Severe	2,222	1,656	2,581	Low	39	0.0%
195	TOMALES-SOBEGA COMPLEX, 9 TO 15 PERCENT SLOPES	fine sandy loam	4	Slight	Severe	2,151	1,621	2,526	Low	840	0.2%
196	TOMALES-SOBEGA COMPLEX, 15 TO 30 PERCENT SLOPES	fine sandy loam	4	Moderate	Severe	2,105	1,692	2,637	Low	1,297	0.3%
197	TOMALES-STEINBECK FINE SANDY LOAMS, 30 TO 50 PERCENT SLOPES	fine sandy loam	4	Severe	Severe	2,198	1,750	2,727	Low	639	0.2%
198	TOMALES-STEINBECK LOAMS, 5 TO 15 PERCENT SLOPES	loam	4	Slight	Severe	2,273	1,674	2,609	Low	6,743	1.7%
199	TOMALES-STEINBECK LOAMS, 15 TO 30 PERCENT SLOPES	loam	4	Moderate	Severe	2,174	1,674	2,609	Low	1,957	0.5%
200	TOMALES-STEINBECK LOAMS, 30 TO 50 PERCENT SLOPES	loam	4	Severe	Severe	2,174			Not rated	320	0.1%
201	URBAN LAND-BALLARD COMPLEX, 0 TO 9 PERCENT SLOPES	gravelly loam		Not rated	Not rated				Not rated	1,023	0.3%
202	URBAN LAND-XERORTHENTS COMPLEX, 0 TO 9 PERCENT SLOPES			Not rated	Not rated				Not rated	2,816	0.7%
203	XERORTHENTS, FILL			Not rated	Not rated				Not rated	2,658	0.7%
204	XERORTHENTS-URBAN LAND COMPLEX, 0 TO 9 PERCENT SLOPES			Not rated	Not rated		1,052	2,892	Low	11,549	3.0%
205	YORKVILLE CLAY LOAM, 9 TO 15 PERCENT SLOPES	clay loam	4	Slight	Severe	2,454	1,052	2,892	Low	351	0.1%
206	YORKVILLE CLAY LOAM, 15 TO 30 PERCENT SLOPES	clay loam	4	Moderate	Severe	2,454	1,020	2,805	Low	1,083	0.3%
207	YORKVILLE CLAY LOAM, 30 TO 50 PERCENT SLOPES	clay loam	4	Severe	Severe	2,380	791	2,176	Low	5,442	1.4%
208	YORKVILLE-ROCK OUTCROP COMPLEX, 9 TO 15 PERCENT SLOPES	clay loam	4	Slight	Severe	1,846	774	2,129	Low	589	0.2%
209	YORKVILLE-ROCK OUTCROP COMPLEX, 15 TO 30 PERCENT SLOPES	clay loam	4	Moderate	Severe	1,806			Not rated	1,841	0.5%
210	WATER			Not rated	Not rated				Not rated	57,297	14.7%
211	DAMS			Not rated	Not rated					2	0.0%

Streambank Stability Line Intercept Transect (Gerstein and Harris 2005) Page ___ of ___

Contract #:______________ Contract Name:______________________________ Implementation Mo/Yr:_______
Site Name:____ Stream/Drainage:_____________________________
Evaluators:_____________ Date:_________Project Feature #/Name:_______________________ Transect #:_____
Transect Length:_______ Start Point:____

Streambank: (*Left* or *Right*) **Direction:** (*Upstream* or *Downstream*) **Project Phase:** (*Pre-treatment* or *Post-treatment*)

Bank Class			**0-3' Height Class**			**3-15' Height Class**			**>15' Height Class**			**Comments**
Start Distance	End Distance	Stability Class	Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(location, bearing, other plant species,)

Species Codes

				BRRS = Barren Soil
				ALLV = Gravel, sand, fines
				ROCK = Boulder, cobble, concrete
				LITT = Leaf litter
				HERB = Herbaceous
				ROOT = Woody roots
				LWD = Wood > 12"dia (SWD<12")
				REST = Restoration Structure
				OTST = Other Structure

Bank Stability Codes

STNT = stable bank, no treatment STPT = stable, treatment area UNPT = unstable, treatment area UNNT = Unstable bank, no treatment

LB = Left Bank, **RB** = Right Bank, **UPS** = Upstream, **DNS** = Downstream, ║ = Parallel, ┴ = Perpendicular
AF = annual forbs, **AG** = annual grass, **AFG** = annual forbs and grass, **PG** = perennial grass, **PF** = perennial forb

Additional Comments:

Riparian Line Intercept Transect (Harris et al. 2005)

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Contract #:_______________ Contract Name:______________________________ Implementation Mo/Yr:__________
Site Name:____ Stream/Drainage:_______________________________
Evaluators:___________________ Date:________ Project Feature #/Name:____________________ Method #:____
Transect #:_____ Length:_______ Start Point:____

Streambank: (*Left* or *Right*) **Direction:** (*Upstream* or *Downstream*) **Project Phase:** (*Pre-treatment* or *Post-treatment*)

0-3’ Height Class			**3-15’ Height Class**			**>15’ Height Class**			**Comments**
Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(location & bearing of transect, total # transects, other plant species observed)

Species Codes

			BRRS = Barren Soil
			ALLV = Gravel, sand, fines
			ROCK = Boulder, cobble, concrete
			LITT = Leaf litter
			HERB = Herbaceous
			ROOT = Woody roots
			LWD = Wood > 12”dia (SWD<12”)
			REST = Restoration Structure
			OTST = Other Structure

LB = Left Bank, **RB** = Right Bank, **UPS** = Upstream, **DNS** = Downstream, ‖ = Parallel, ⊥ = Perpendicular
AF = annual forbs, **AG** = annual grass, **AFG** = annual forbs and grass, **PG** = perennial grass, **PF** = perennial forb

Additional Comments:

Aquatic Habitat (adapted from Gerstein 2005)

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Site:________________________Contract Name/#:____________________________Crew:_________________
Stream:______________________Drainage:__________________________________Date:__________________

All Habitat Units	**Habitat Unit #**										
	Habitat Unit Type										
	Main or **S**ide channel										
	End Distance										
	Max Depth of Water										
	Width @ 1/3										
	Width @ 2/3										
	% Slackwater (winter only)										
Pool/ Flatwater	Shelter Value										
	% Unit Covered										
	1st element										
	% of total 1										
	2nd element										
	% of total 2										
Pools	Pool Former (element)										
	Origin of Former (natural or structure)										
	Depth of Tail Crest										
Restoration Structure Data	**Habitat Unit #**										
	Structure #										
	Structure Type										
	Structure Condition										
	Structure Problem										
	Upstream End Distance										
	Max Depth of Water										
	Shelter (% of unit covered by structure)										
	Slackwater (% created by structure in winter)										
Debris	**LWD #**										
	SWD #										
	Aggregate WD #										
Comments:											

Cover Elements	**Code**
Aquatic Veg	AV
Bedrock Ledge	BE
Boulder	BO
Bubble Curtain	BC
LWD (> 12”)	LW
Root Mass	RM
SWD (< 12”)	SW
Terrestrial Veg	TV
Undercut Bank	UB

Pool Former	**Code**
Bedrock	BE
Boulder	BO
Lateral Scour	LS
Live Tree	LT
LWD	LW
Multiple	MU
Rootwad	RW
Unknown	UN

Level III Habitat Types	**Code**
Main Channel Pool	MP
Scour Pool	SP
Backwater Pool	BP
Flatwater	FW
Riffle	RF
Cascade	CA
Dry	DR

Stream Shade (Harris et al. 2005)

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Contract #:_______________ Contract Name:_______________________________ Implementation Mo/Yr:_________
Site Name:____ Stream/Drainage:_______________________________
Evaluators:______________________________ Date:__________ Project Phase: (*Pre-treatment* or *Post-treatment*)
Project Feature #/Name:____ Start Point:____

Point #	Stream Distance	Canopy Density (17 total points)				Percent		Comments (Note tree composition, project feature, or planting zone)
		DNST	Right	UPST	Left	Deciduous	Evergreen	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

Water Temperature, Point: 1______________ 10 ______________ 20 ______________ 30 ______________
Air Temperature, Point: 1______________ 10 ______________ 20 ______________ 30 ______________

Additional Comments:

Channel Dimensions (Gerstein 2005, Gerstein and Harris 2005) Page _____ of _____

Contract #: **Contract Name:** **Implementation Mo/Yr:**

Site Name: **Stream/Drainage:**

Date: **Phase:** (*Pre-treatment* or *Post-treatment*) **Project Feature #/Name:** **XS #:**

Crew: **Level** **Stadia Rod** **Recorder**

Description of Survey (include BM & XP locations)**:**

Total Survey Length (ft & tenths)**:**

Station	**(+) BS**	**HI**	**(-) FS**	**Elevation**	**Comments** (record geomorphic features, substrate, veg. and other factors of interest at each station)

Codes: BM = Benchmark, **HI** = Height of Instrument, **FS** = Foresight, **BS** = Backsight, **XP** = Cross Section Endpoint, **LB** = Left Bank, **RB** = Right Bank, **UPS** = Upstream, **DNS** = Downstream, **FP** = Floodplain, **LT/MT/HT** = Low/Middle/High Terrace, **LEW/REW** = Left/Right Edge Water, **BKF** = Bankfull, **PB** = Point Bar, **TP** = Turning Point, ‖ = Parallel, ⊥ = Perpendicular

Additional Comments: