Appendix D-2

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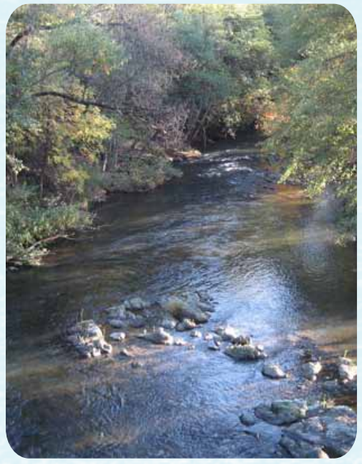


Dry Creek

Habitat Enhancement Demonstration Projects

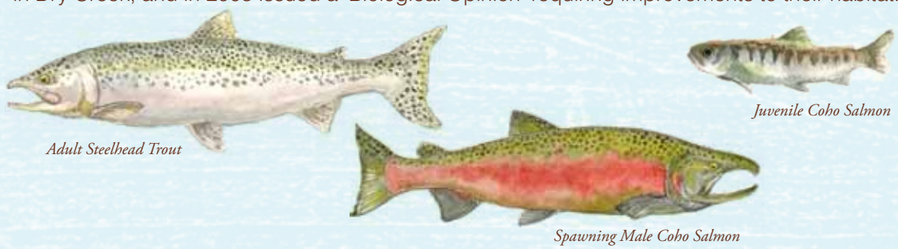
Concept Designs

Introduction

Dry Creek meanders through a pastoral landscape to where it meets the Russian River near the town of Healdsburg in Sonoma County, California. The fertile land along its banks has long been used for agriculture, and that tradition continues today. The Dry Creek Valley is renowned for producing some of the world's finest wines.

The waters of Dry Creek flow 14 miles from the Warm Springs Dam to the mouth of the Russian River. The dam is operated by the Army Corps of Engineers to control floods and for recreation, and by the Sonoma County Water Agency to supply potable water to 600,000 consumers in Sonoma and northern Marin Counties.

Dry Creek is home to native threatened and endangered fish, including coho salmon, Chinook salmon, and steelhead trout. The National Marine Fisheries Service has determined that the operation of Warm Springs Dam could threaten the survival of coho salmon and steelhead trout in Dry Creek, and in 2008 issued a 'Biological Opinion' requiring improvements to their habitat.



Adult Steelhead Trout

Juvenile Coho Salmon

Spawning Male Coho Salmon

These fish are most vulnerable in their juvenile phase as they prepare to swim out to the ocean as small, young fish called 'smolts.' In order to thrive, they need slow water and diverse habitat in summer, and places to rest and take refuge during the high flow dam releases that occur in winter. All of these crucial habitat elements are in short supply in the Dry Creek of current times. This booklet discusses a conceptual plan to re-create these rare habitats.

The Biological Opinion lays out a timeline for the habitat work, which will ultimately result in over six miles of habitat enhancement in Dry Creek by 2020. A group of cooperating landowners in the Dry Creek Valley has come together with the Sonoma County Water Agency to begin planning the implementation of the first phase of these enhancements. This will be accomplished through a series of 'demonstration' projects within a 1.1 mile length of Dry Creek in the middle of the valley, extending from the mouth of Grape Creek downstream to the mouth of Crane Creek. Construction of the demonstration projects is scheduled to begin in 2011.

Implementation of the demonstration projects is an important first step in the longer-term process of improving habitat conditions in Dry Creek. This series of projects provides an opportunity to showcase fish habitat enhancement approaches that may be used elsewhere in Dry Creek over the next decade.

The following pages summarize the enhancement approaches that will be implemented along the 1.1 mile "Demonstration Reach" of Dry Creek. To start, we'll describe the current conditions in Dry Creek and why suitable habitat for juvenile coho and steelhead is lacking. In subsequent pages, we'll describe the proposed enhancements – first in general, and then in site-specific detail.

Table of Contents

Dry Creek Today

Conditions that exist in Dry Creek today have resulted from 150 years of settlement, land use and stream management in the area. Historically, Dry Creek was nearly dry or had very low streamflow in the summer, and in the winter, would flood dramatically, though infrequently. The name 'Dry Creek' comes from those times.

Beginning in the 1850s, many of the forested areas of the upper valley were cut, which increased the rate at which water, soil and gravel were delivered to the valley. This caused the creek bed to cut down into the valley bottom through a stream process called 'incision.' During the 1900s, construction of dams and gravel mining on the Russian River indirectly accelerated the incision of Dry Creek's stream bed, which in turn caused many streambanks to erode. The creek bed between the two streambanks was generally bare gravel and sand, as the creek continued to nearly dry out each year.

Pre-dam image of Dry Creek.

In the 1970s and 1980s, Warm Springs Dam was constructed at the junction of Dry Creek and Warm Springs Creek. Its operation began in 1984 to provide flood control in the winter, and to store water year-round for municipal, domestic and industrial uses.

Warm Springs Dam.

The dam has affected Dry Creek in many ways. First, it has reduced the severity of floods. However, high flow periods now typically last longer than before the dam was constructed, and the stream flows at a much higher level through the summer. The dam also blocks gravel and cobbles from flowing to the lower valley. With smaller floods and higher summer flows, many areas of the streambed that had been bare now support dense vegetation.

Stream conditions in Dry Creek today are similar to what can be seen in many other streams that have been incised or confined between levees and streambank revetments. This confinement impairs the natural formation of essential fish habitat. The result in Dry Creek is that pools, runs and glides are quite long for a stream its size. These areas also have swifter velocities and poor habitat quality, resulting in a stressful environment for young coho salmon and steelhead when they are at their most vulnerable.

Deep, swift, long pool with dense vegetation.

Riffle habitats, which are important fish food production areas of the stream, are only present in a proportionally small area. The dense vegetative growth, which often provides many benefits to a stream, is no longer pruned by annual flood events. This lack of pruning further confines streamflow and contributes to reduced quality of fish habitat. Though many areas that had been subject to erosion have stabilized, other areas are still vulnerable to streambank erosion. This includes places where the stream flows up against tall streambanks, or breaks through the vegetative growth into bare areas.

Bank erosion on Dry Creek.

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Improving Dry Creek: The Enhancement Toolbox

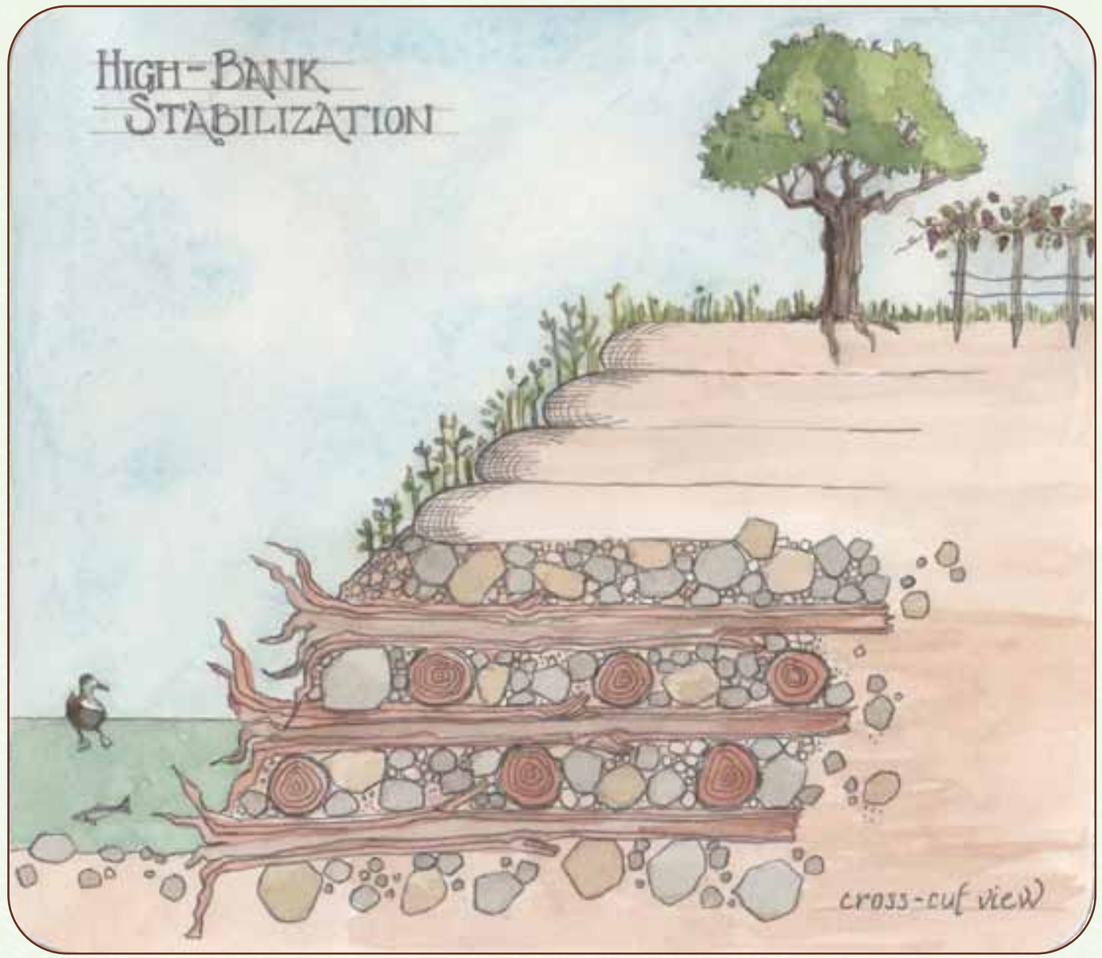
Enhancements in the Demonstration Reach will emphasize natural stream characteristics, or geomorphology, which refers to the manner in which water and sediment combine to create habitat features friendly to fish. By using enhancement practices that emulate natural geomorphic conditions, the benefits provided to young coho and steelhead and their longevity are optimized.

The following illustrations describe typical enhancement practices – the 'tools' in the enhancement 'toolbox.' These may be repeated in isolation at several locations, or in varying combinations, depending on the geomorphic conditions specific to of each site. In subsequent pages, we'll show how these 'tools' would be applied to the demonstration reach.

Streambank Stabilization

This solution is applied in areas of bank erosion to retain valuable property and to enhance the habitat characteristics along the edge of the stream. Two similar, yet slightly different approaches will be used on Dry Creek:

1. For low streambanks (less than six to seven feet tall), eroding materials will be excavated and the streambank rebuilt with a combination of logs, boulders, cobbles and soil. The area is then planted with native riparian vegetation. This forms a very durable, habitat-friendly streambank.



2. For high streambanks (greater than seven feet tall), the base of the streambank will be rebuilt in a manner similar to what was described for low streambanks. The upper part of the streambank will also be rebuilt with a technique that encapsulates soil in strong fabric blankets made from coconut fiber. Native plants are planted right through the fabric. After three to five years, the blankets decompose and the native vegetation takes over the role of stabilizing the upper part of the streambank. This approach also forms a very durable, habitat-friendly streambank that serves to protect valuable property.

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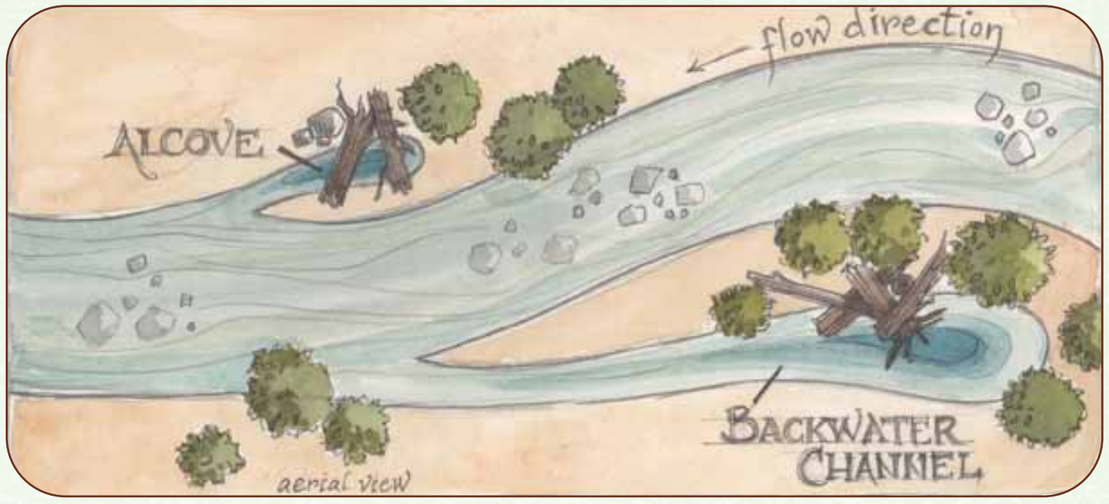
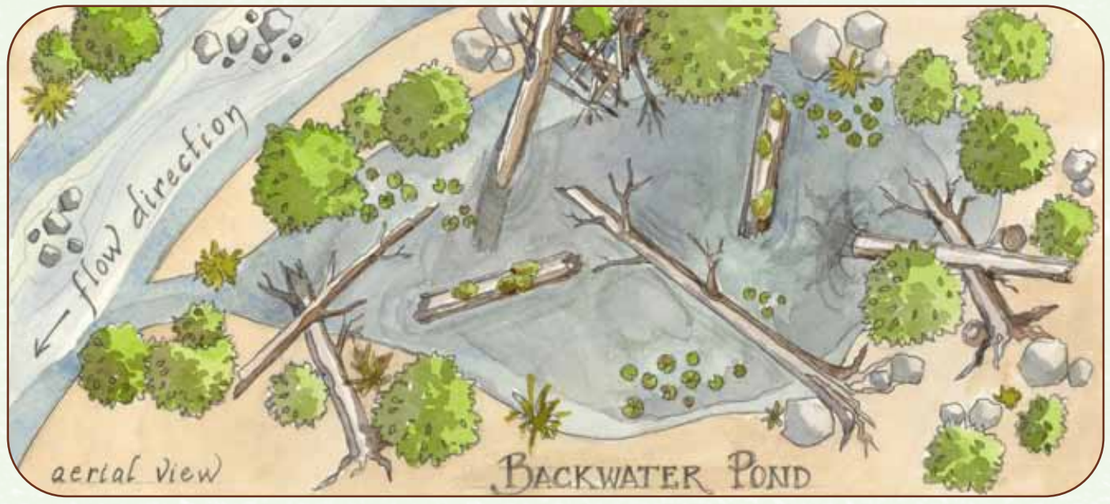
Backwater Channels, Alcoves, & Ponds

Backwater channels, alcoves and ponds are areas off to the side of the stream that in summer connect to the main stream only at their downstream end. During this time, water backs into these areas, and has very low or no current. In addition to still waters, logs that protrude into or float on the water, in combination with floating and submerged vegetation, and surrounding tall vegetation make these areas very attractive to young fish, particularly coho salmon. They use these areas to search for food, to rest and to avoid predators. During winter periods, these backwater areas will continue to have quiet water despite occasional flows moving through them. In Dry Creek, this type of habitat will be primarily constructed in wider areas of the creek. Construction of these areas will include excavation to form the channel, pool or ponds, and include placement of logs at appropriate locations, planting of aquatic vegetation and management of surrounding vegetation.





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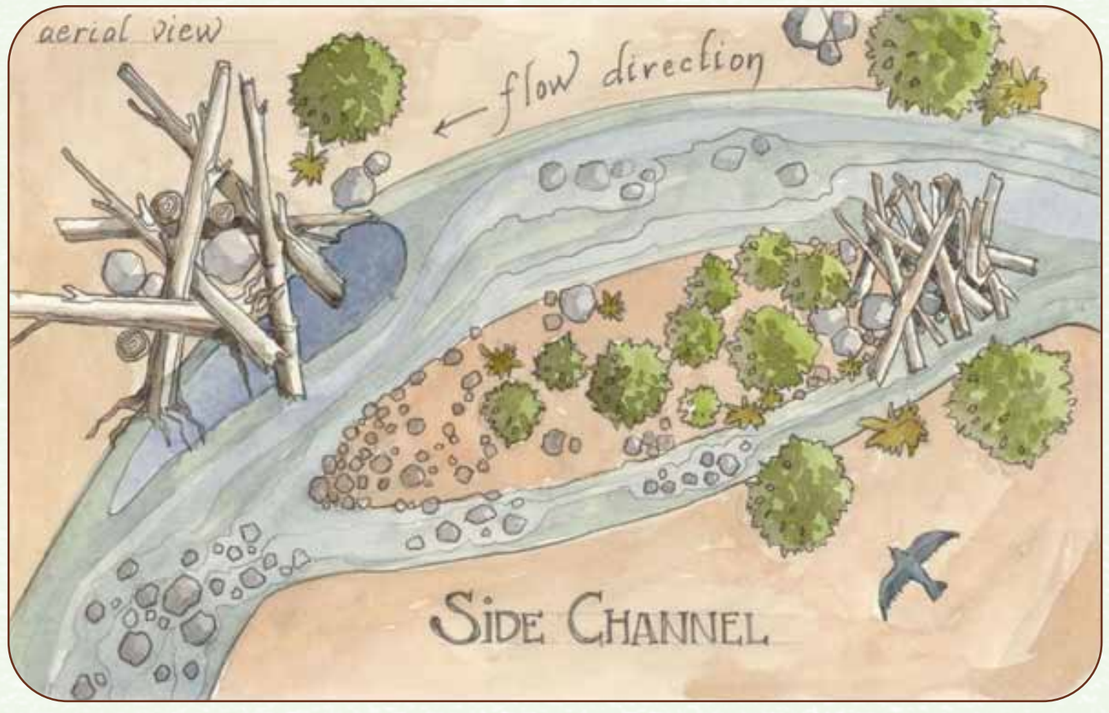
Side Channels

Side channels run parallel to the main stream and connect to the main stream at both ends, even during the summer. The flow of the stream is split between the two channels. This serves to reduce the stream current, which in combination with pools and logs in the water, make these areas attractive to coho salmon and steelhead trout. The fish use these areas to search for food, to rest and to avoid predators. In Dry Creek, this type of habitat will also be primarily constructed in wider areas of the creek. In some of these areas, old abandoned channels may be excavated to provide enhanced side channels. Construction of these areas will entail excavation to form the channel and pools, placement of logs at appropriate locations, and management of the surrounding vegetation.



Log Jams

A log jam is an accumulation of logs that may be constructed in an area where it would be beneficial to initiate or stabilize a turn or fork in the channel. The log jam serves to anchor the stream's location by being an immobile object along one or both banks, acting similar to a bridge abutment or a natural bedrock outcrop. Deep pools may form next to log jams through the interaction of the logs and flowing water, creating excellent fish habitat. To create a log jam, an area is excavated and then logs are stacked and knit together with boulders and "snags" (trunks of dead trees that remain standing vertical to the horizon). This combination stabilizes the log jam during floods.

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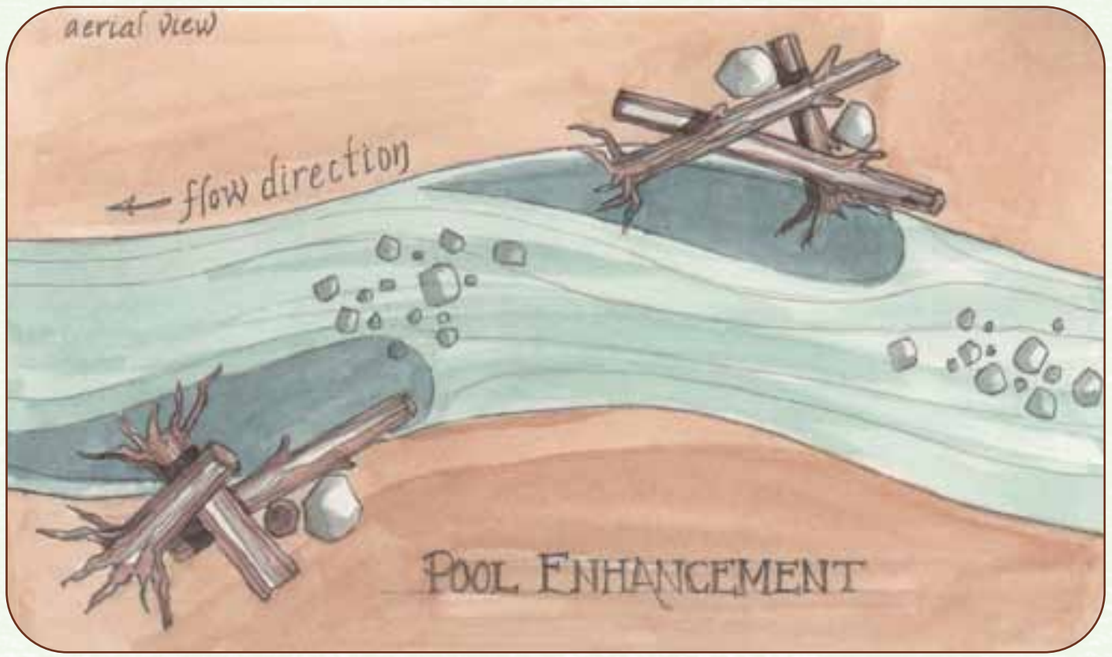
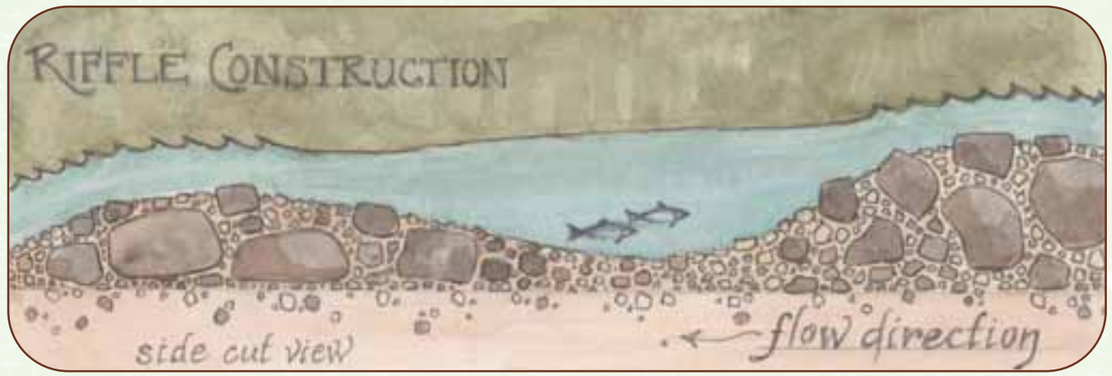
Pool Enhancement

Pools are deeper areas of the stream. In a healthy stream, pools provide key habitat for young fish because currents are slow, the flow patterns are diverse, and fish can hide beneath logs that project into the water. Pool enhancement in Dry Creek will act to increase the variety of habitat for young fish, and create areas that have sheltered currents that young fish prefer. This will be accomplished through selective grading of existing pool features and the installation of logs in the water.



Riffle Construction

Riffles are areas where the streambed is steeper and the current is swift. Riffles play a key role in controlling the elevation of the streambed and releasing the stream's energy to slow the current flowing through adjoining pools. They also serve as the stream's grocery store, as much of the food produced in a stream comes from these places. Construction of riffles in Dry Creek will improve the quality of the adjoining pools for fish and stabilize the stream bed while providing the fish with a wider variety of things to eat. Riffles are constructed by building mounds of small boulders, cobbles, gravel and sand across the stream.



Riparian Vegetation Management

Dry Creek has extensive vegetative growth along the channel, which includes many non-native or invasive weed species. In some areas, overly dense stands of vegetation impair stream function by channelizing the flow of the creek and acting like a levee, which forces energy into the creek bed, and results in pools that are too long, with water that moves too swiftly. Riparian vegetation management will include selective thinning of existing vegetation, removal of invasive weeds, and in some cases, replanting of native vegetation.

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The Demonstration Reach

The 1.1 mile Demonstration Reach is located in the middle of the Dry Creek Valley, extending from the mouth of Grape Creek downstream to the mouth of Crane Creek (see photo 1, below). The landowners along this stretch of the creek have joined forces to begin planning the first phase of habitat enhancement on Dry Creek.

Implementation of habitat enhancement in this reach is an important first step in the longer-term process of improving habitat conditions in Dry Creek. This series of projects provides an opportunity to improve habitat while also showcasing a range of fish habitat enhancement approaches that may be used elsewhere in Dry Creek over the next decade. Construction of the demonstration projects is scheduled to begin in 2011.

In this document, the Demonstration Reach has been divided into 5 'sub-reaches' according to common characteristics (see photo 2, next page). The reaches are labeled according to their distance, in miles, above the mouth of Dry Creek. This distance is commonly referred to as 'river miles.' In the following pages, we'll show the proposed enhancements for each reach in site-specific detail.

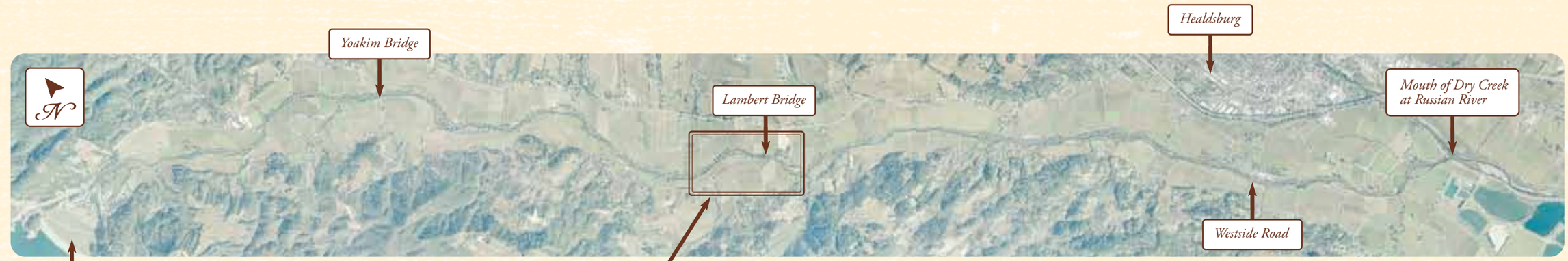

Photo 1: Today, Dry Creek runs 14 miles from Warm Springs Dam to the Russian River. The box in the map above indicates the location of the 1.1 mile demonstration reach.

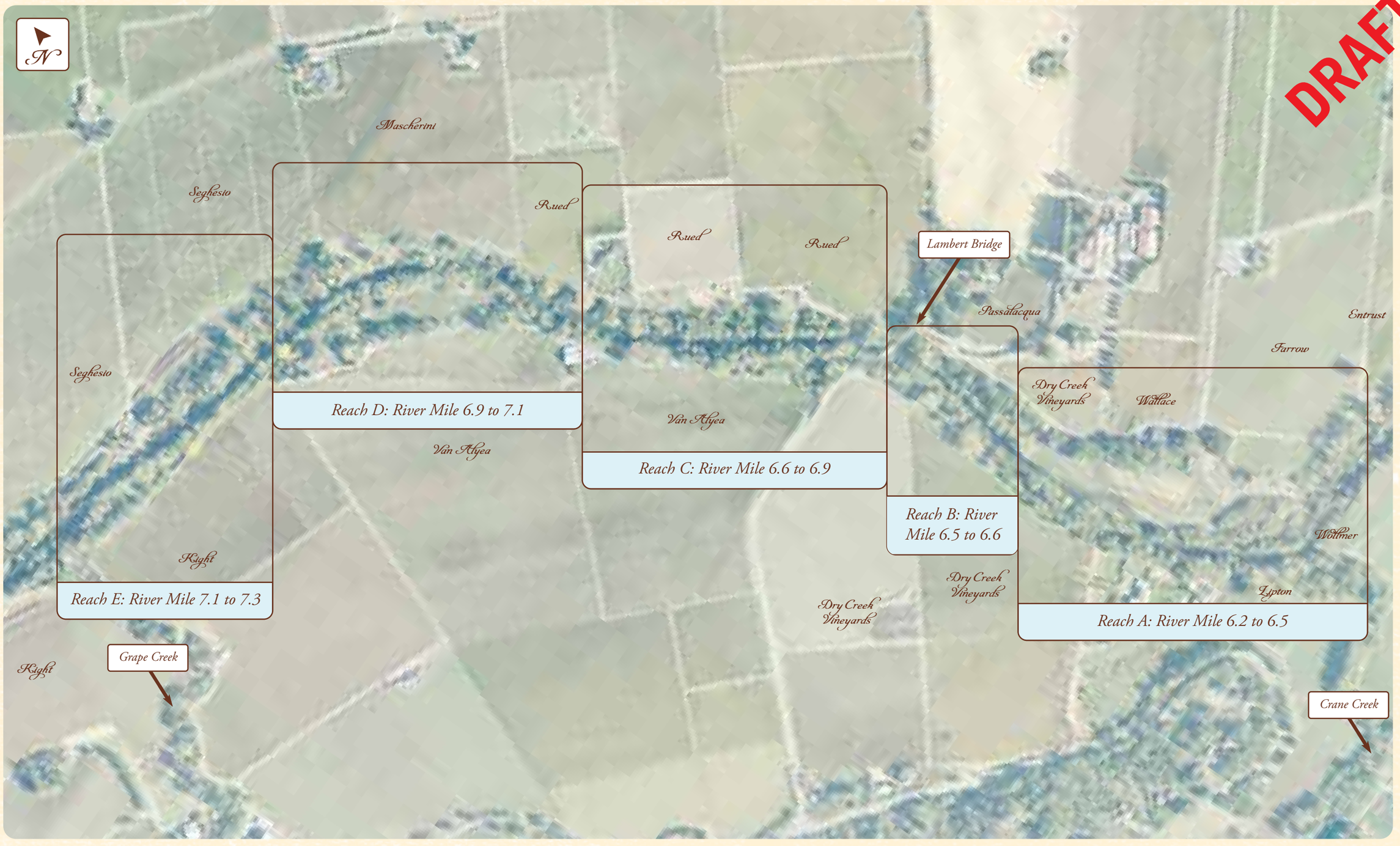

Photo #2: The 5 demonstration project sub-reaches.

Reach A

River Mile 6.2 to 6.5

This is one of the more complex and dynamic sub-reaches in the Demonstration Reach. It includes a series of riffles, glides and pools, one side channel that flows in the winter, and a large area where the creek used to flow and now only flows during very high winter floods. Crane Creek flows into a deep pool near the downstream end of the reach, and there is one area that is actively eroding. This sub-reach has a number of significant enhancement opportunities, including backwater and side channels, log jams, riffle construction, streambank stabilization and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Streambank Stabilization

Riffle Construction

Backwater Channels

Log Jams

Riparian Vegetation Management

Location of Reach A on Dry Creek

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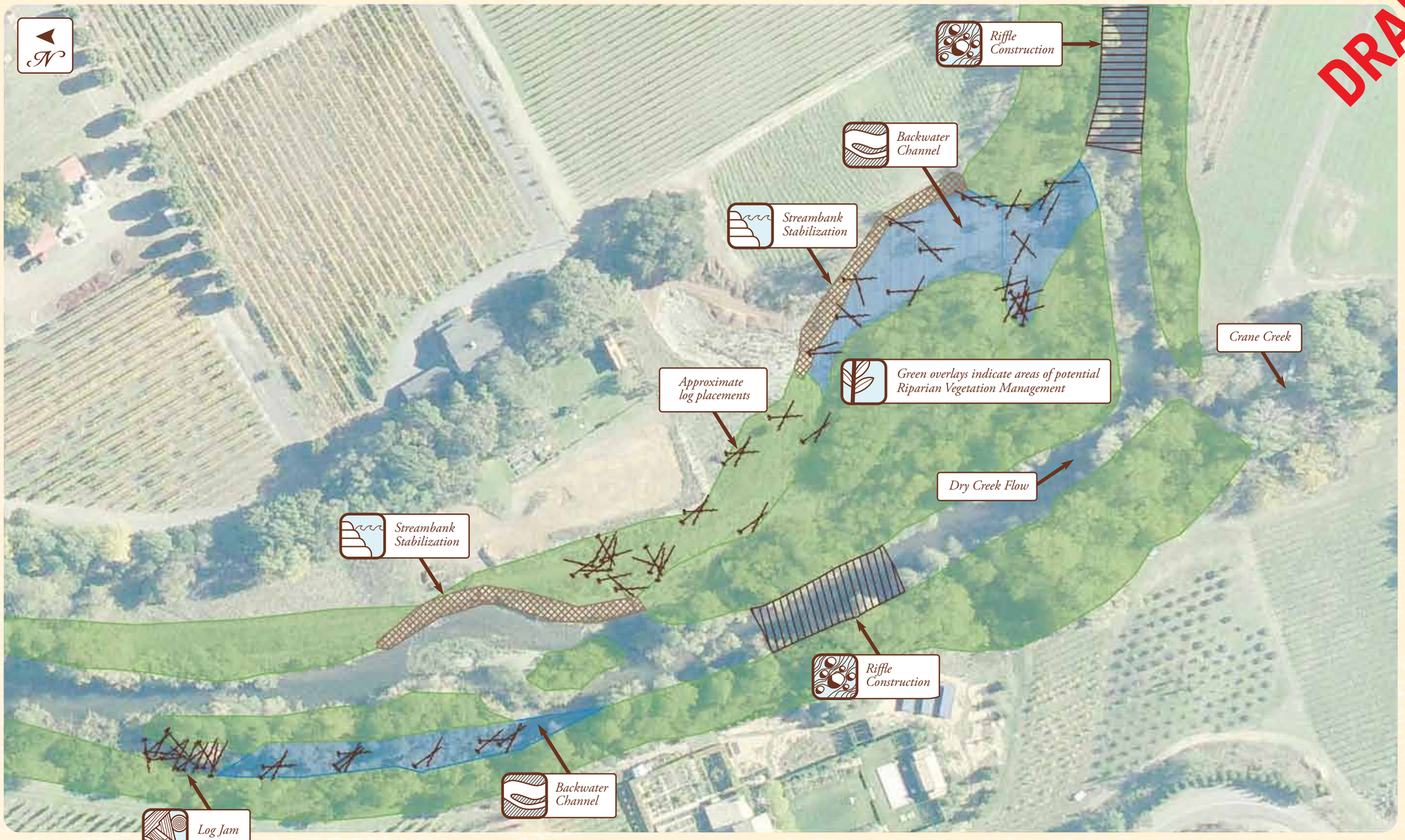
Reach A: Existing Condition

Scale: 1 inch equals 150 feet



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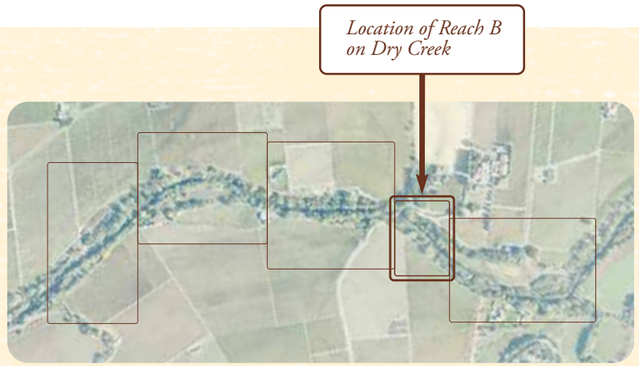
Reach A: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach B



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River Mile 6.5 to 6.6

This short sub-reach is immediately downstream of Lambert Bridge. In this area, the stream is confined and includes a small bedrock cascade and other bedrock outcrops, a short riffle, two glides and two pools. Enhancement opportunities in this subreach are limited to riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show where the enhancement might be utilized. Enhancement solutions are described in detail on pages 3 through 6.

Riparian Vegetation Management

Reach B: Existing Condition
Scale: 1 inch equals 150 feet

Reach B: Proposed Enhancement

Scale: 1 inch equals 100 feet

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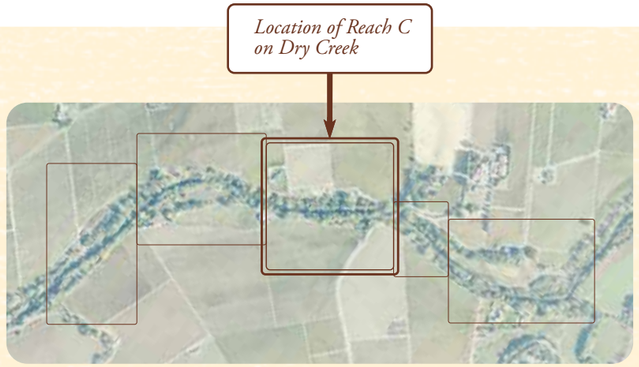
Reach C



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River Mile 6.6 to 6.9

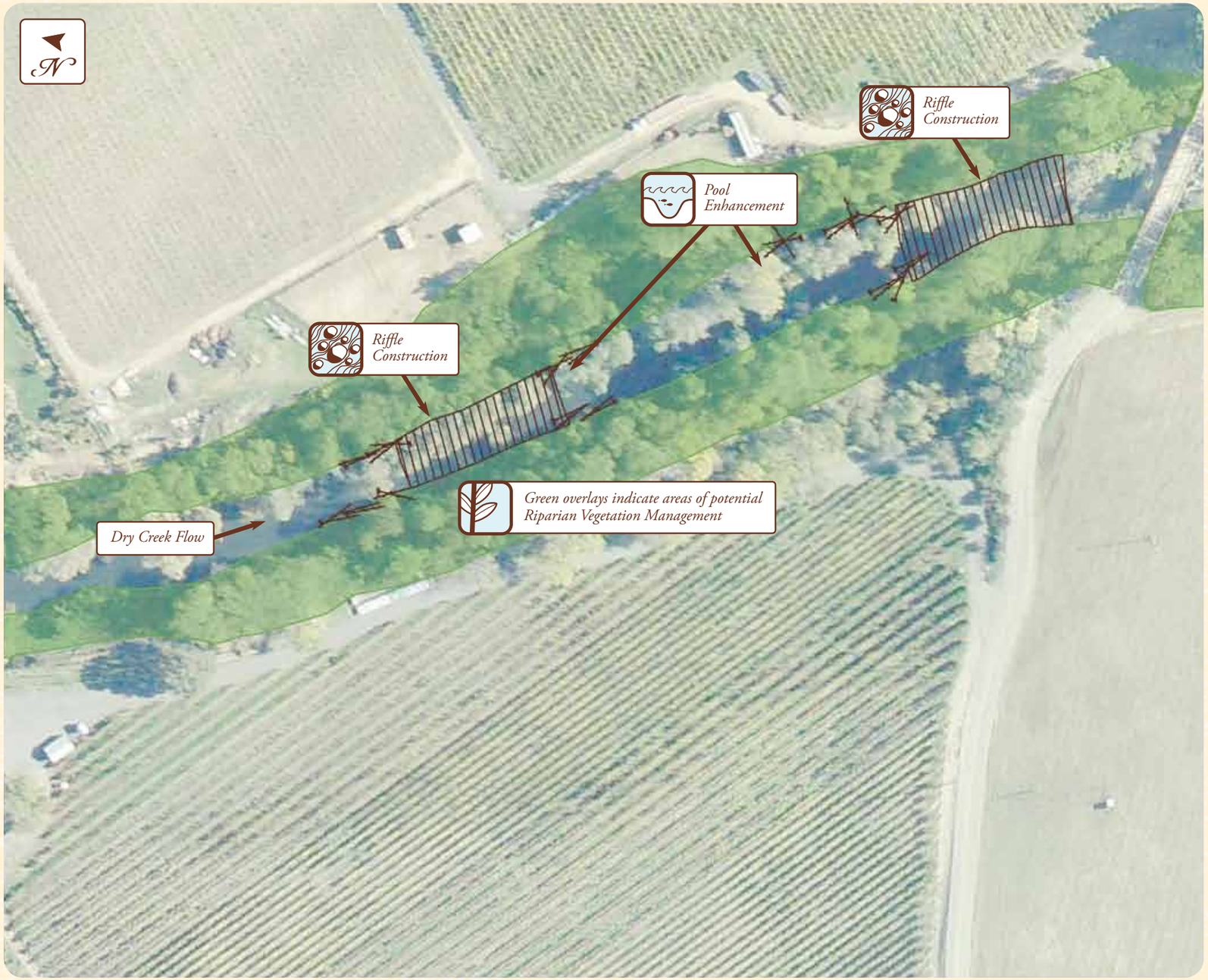
This sub-reach is immediately upstream of Lambert Bridge. In this area, the stream is confined and includes a bedrock outcrop and one long pool. Enhancement opportunities in this subreach include riffle construction, pool enhancement, and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Reach C: Existing Condition
Scale: 1 inch equals 150 feet

Riffle Construction

Pool Enhancement

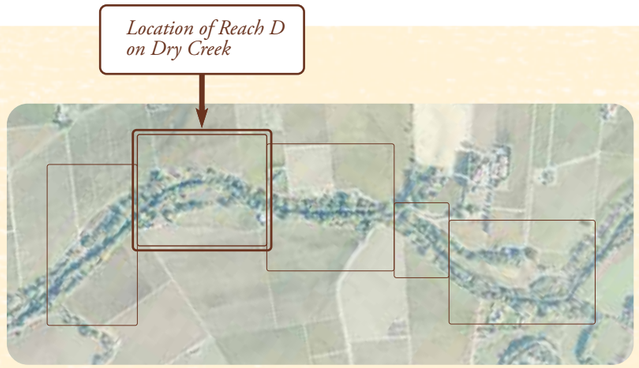
Riparian Vegetation Management



Reach C: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach D



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River Mile 6.9 to 7.1

This is one of the wider sub-reaches in the Demonstration Reach. It includes a series of short riffles, glides and pools, the beginning of a long pool that connects to Reach C, and a large area where the creek used to flow and now only flows during very high winter floods. The northeast bank has eroded and one area along that bank is actively eroding. This sub-reach has a number of significant enhancement opportunities, including a backwater channel or pond, pool enhancement, riffle construction, high streambank enhancement and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Streambank Stabilization

Riffle Construction

Backwater Channels

Pool Enhancement

Riparian Vegetation Management

Reach D: Existing Condition

Scale: 1 inch equals 150 feet

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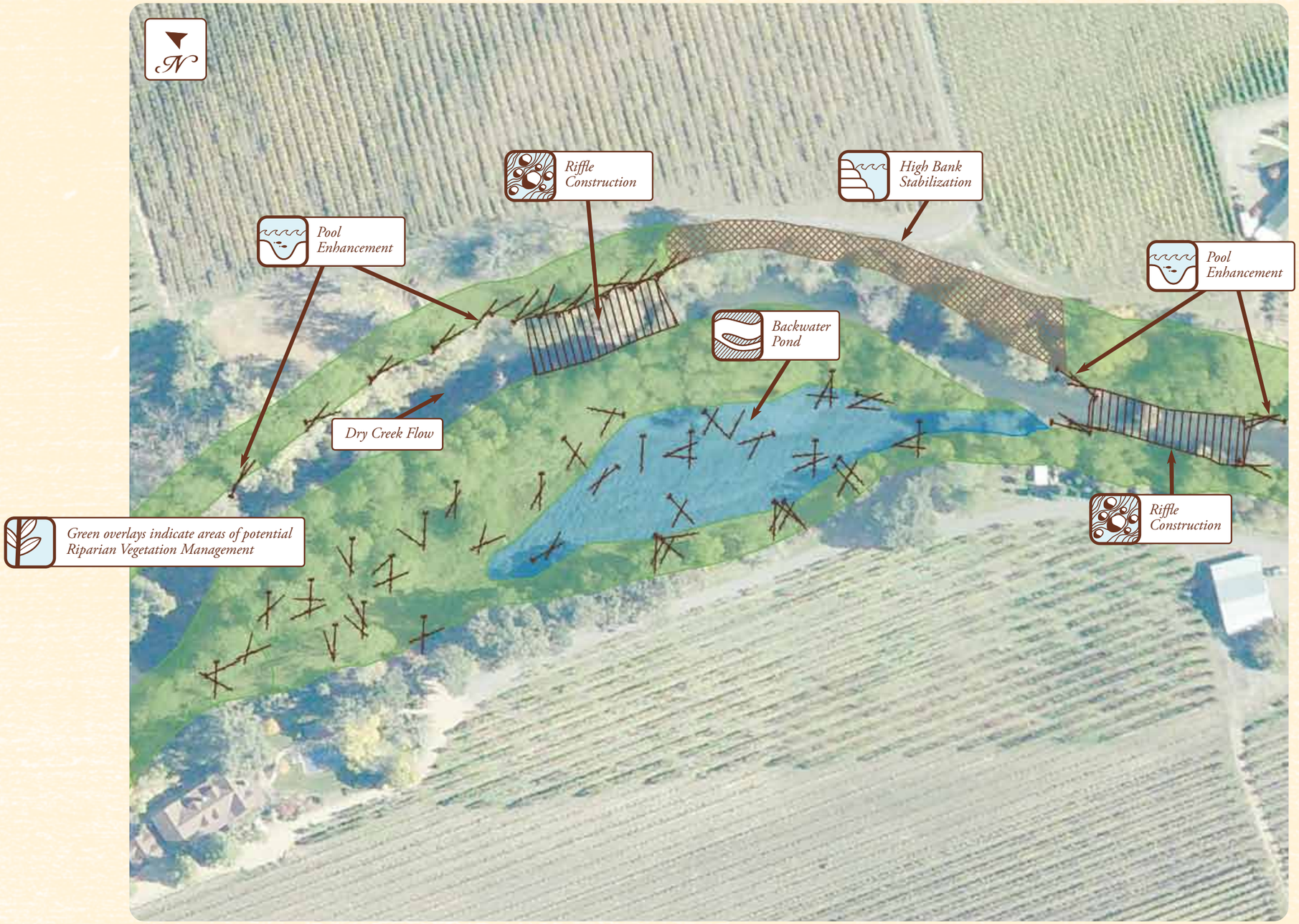
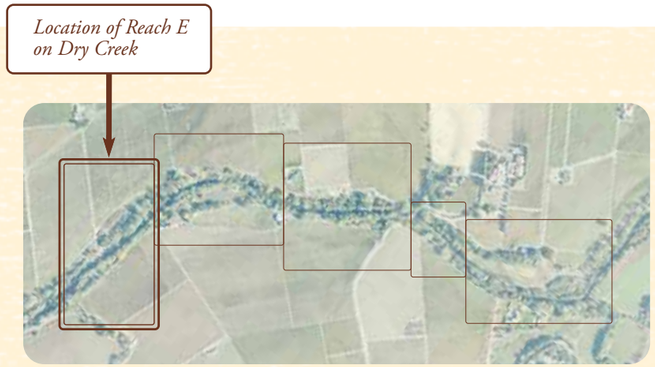


Reach D: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach E



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River Mile 7.1 to 7.3

Grape Creek enters this moderately confined sub-reach into a pool at the upstream end. It includes a series of short riffles, glides and long pools, and three side channels that flow during the winter. The area near the mouth of Grape Creek shifted during the winter of 2009-2010, with one side channel filling with gravel, and another side channel being created. This sub-reach has enhancement opportunities that include a backwater channel, log jams, riffle construction, pool enhancement, and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Backwater Channels

Riffle Construction

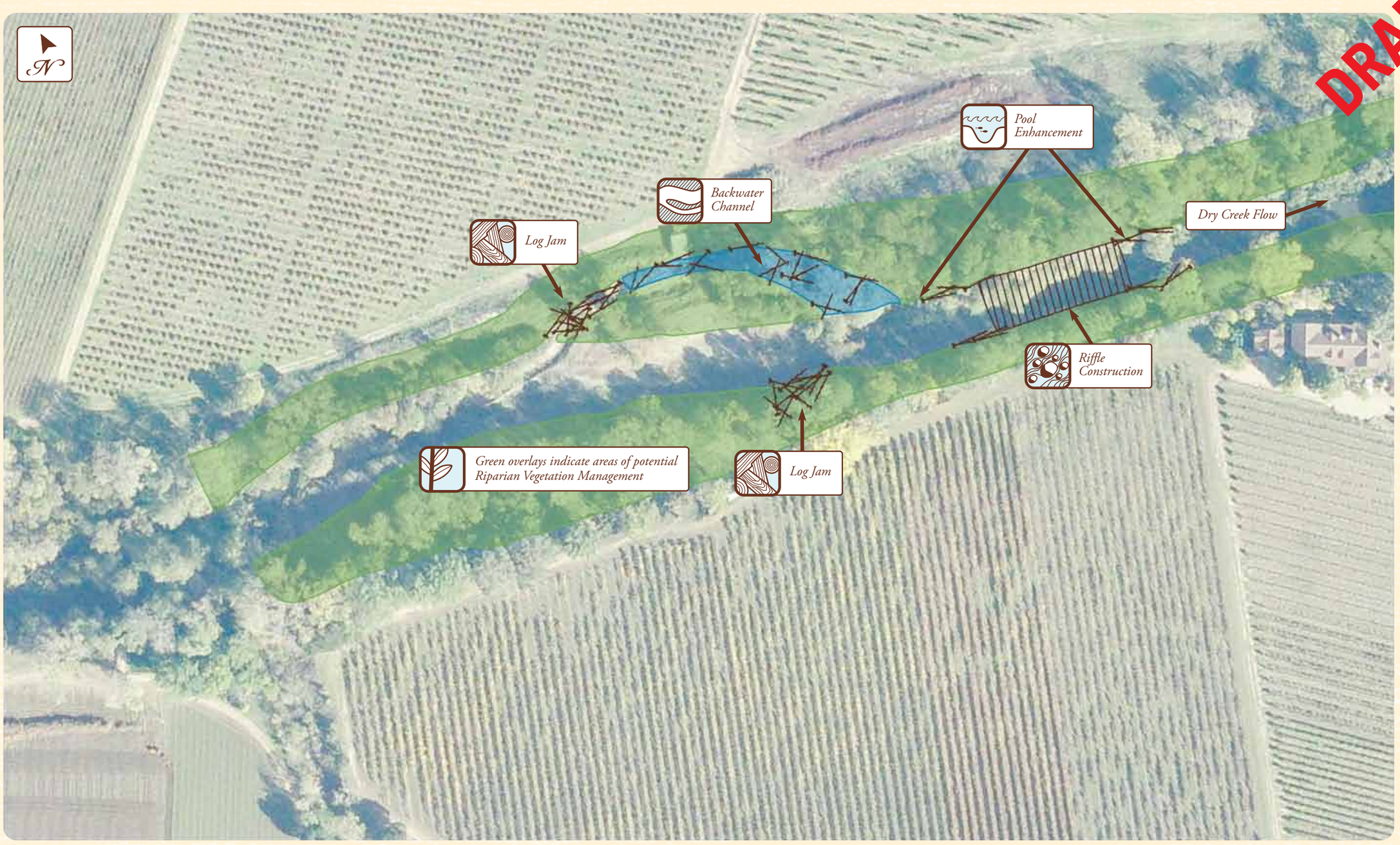
Log Jams

Pool Enhancement

Riparian Vegetation Management

Reach E: Existing Condition

Scale: 1 inch equals 150 feet



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Reach E: Proposed Enhancement

Scale: 1 inch equals 100 feet

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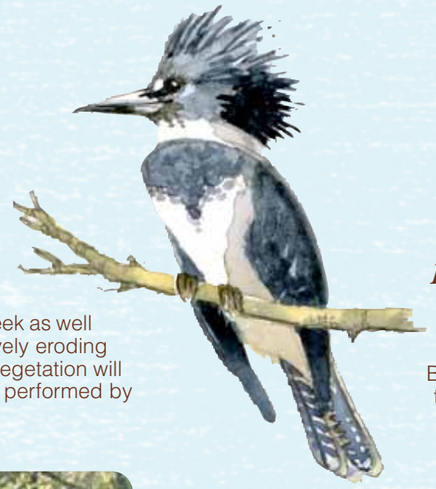
Questions & Answers



How will the enhancement work benefit the property holders along Dry Creek?

Enhancement work completed in the demonstration reach will benefit landowners who live along Dry Creek as well as fish and other wildlife that share the habitat. It will also benefit the function of the stream itself. Actively eroding stream banks and stream beds will be stabilized where they threaten valuable property; overly-dense vegetation will be thinned – thereby reducing noxious weed species; and routine inspection and maintenance will be performed by the agency as needed or requested.

How will the enhancement work benefit the greater Dry Creek community and the extended communities of Sonoma and Marin counties?

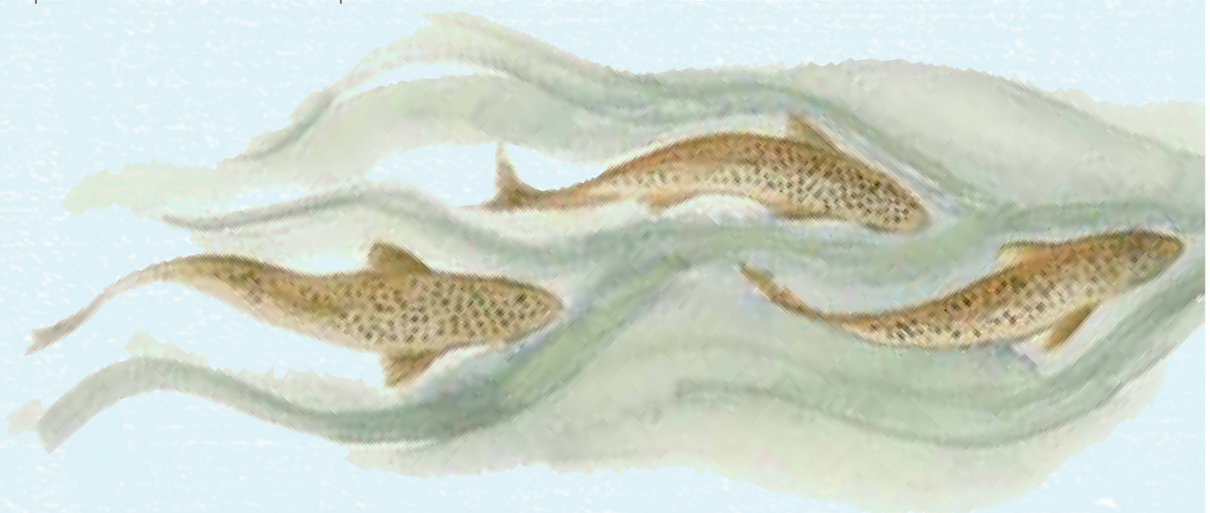
The enhancement work in the creek provides the means to implement the terms of the Biological Opinion, and is less intrusive to the lives and livelihoods of the Dry Creek Community than other alternatives. It also ensures Sonoma County Water Agency's ability to convey water down Dry Creek to the 600,000 customers who depend on its delivery.

The demonstration projects only cover a mile of Dry Creek. Is there a plan to restore the entire Dry Creek? And if so, when is that slated to happen? And how long will it take?

The Biological Opinion requires that 6 miles of Dry Creek be enhanced to provide an overall balance of suitable habitat within the 14 mile length below the dam. The work will occur in phases, with one mile of enhancement to be completed by 2014, and two additional miles of enhancement done by 2017. If the first three miles of enhancement have been successful, the final three miles of enhancement will be completed by 2020.

What will it be like while enhancement work is going on?

The intensity of the work will vary with each site. In some areas, the work will be completed with a combination of heavy construction equipment – such as bulldozers, backhoes and dump trucks – and a team of individuals experienced in enhancement construction. In these areas, the stream will be temporarily diverted around active construction zones. In other areas, where work consists solely of vegetation management, the task will be primarily accomplished by skilled labor. *In every case*, crews will be conscientious about keeping impacts to a minimum, and measures will be in place to control dust and to complete the work in a manner that minimizes inconveniences to land owners.



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During the restoration effort, what precautionary measures will be taken to ensure fish, other wildlife, and native plants in the area aren't harmed?

During periods when work is being done, the stream will be diverted around the work zone and aquatic life within the construction zone will be relocated to safe areas. Stringent control measures will be employed to prevent degradation of sensitive areas. Terrestrial wildlife and birds naturally tend to migrate away from a work zone, but they readily return to occupy enhanced areas once the work is complete. Work in the stream is done only during certain time periods to keep impacts on fish and other aquatic wildlife to a minimum.

How long will it take before the restoration activity is complete?

Construction on the demonstration projects will start in the summer of 2011. Depending on the final designs for the work, remaining items may be completed by the summer of 2012.

How long will it take before the creek looks "recovered" and evidence of the enhancement work is no longer visible?

The enhancement work will provide renewed habitat for fish and wildlife immediately following construction. As stream-side zones re-vegetate, signs of the work will begin to fade – usually within the first few years after project completion. In three to five years, evidence of the work will be very hard to see.

How much will it cost and who is paying for it?

The final composition of the demonstration projects has not been determined, so a detailed cost estimate is not currently available. The preliminary planning budget for the work is $7.25 million. Once a project plan has been selected and finalized, a detailed cost estimate will be prepared. Funding for the work will come from a variety of sources, and will include ratepayers, state and federal grants, and existing tax revenues that can be designated for this purpose.

Who will make sure it's implemented?

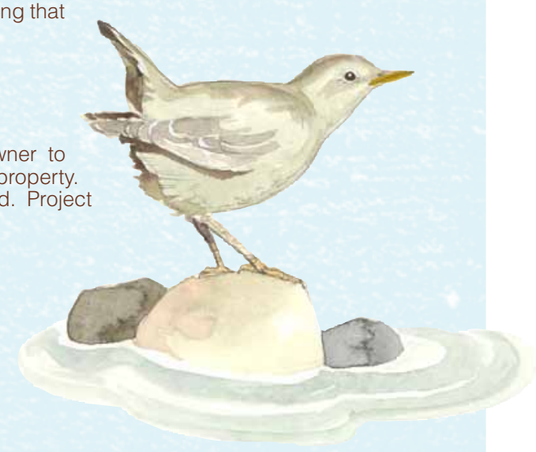
The Sonoma County Water Agency and the Army Corps of Engineers are leading the effort to implement the enhancement work. The National Marine Fisheries Service and the California Department of Fish and Game are responsible for verifying that the work completed meets the expectations of the Biological Opinion.

Who will make sure the projects are maintained?

The Sonoma County Water Agency will be working with each landowner to develop long-term agreements specifically tailored to the details of each property. These agreements will specify how maintenance will be accomplished. Project maintenance will ultimately be the responsibility of the Water Agency.

How can the public get involved?

Please visit http://www.scwa.ca.gov/rrifr/ to learn more about the Biological Opinion, the enhancement work, and how to get involved.



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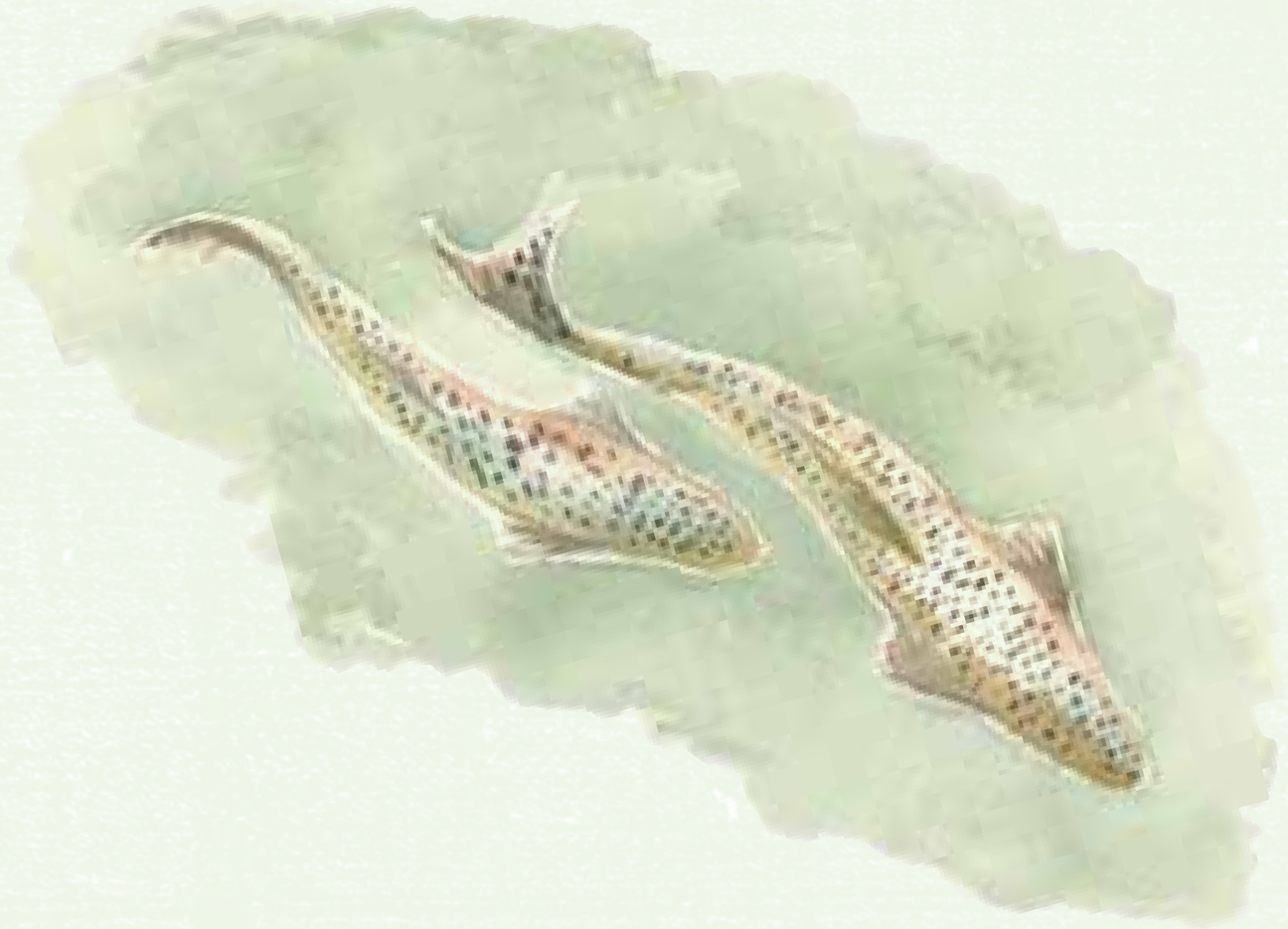

SONOMA COUNTY WATER AGENCY

RRIFR
Russian River Instream Flow and Restoration

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