PISTOL CREEK RESTORATION

CALIFORNIA LAND STEWARDSHIP PRGRAM
FISH FRIENDLY FARMING ENVIRONMENTAL CERTIFICATION
PROJECT REPORT

INTRODUCTION

The Fish Friendly Farming (FFF) Farm Conservation Plan completed and certified the Hop Kiln Winery recommended a revegetation project on the main creek, now termed Pistol Creek. A site visit with the site manager and representatives from Circuit Rider Productions identified the need for a geomorphic review of the creek channel.

BACKGROUND

One of the greatest challenges for creek and riparian restoration in the Russian River watershed is the large number of creeks with significant incision of the stream channel. Restoration on these sites must address returning the relationship of the stream channel to its floodplain for any revegetation or habitat re-creation to be successful. This evaluation discusses a site with significamt channel incision and the issues surrounding restoration activities. It should be noted that any restoration project of this type needs to be closely coordinated with the landowner and all attempts should be made to limit the impacts on agricultural lands.

The Middle Reach of the Russian River and lower Pistol Creek flow through a broad floodplain valley made up of deep deposits of sand and gravel. In alluvial creeks such as Pistol Creek, the channel is relatively small in comparison to its floodplain, or the flat valley lands next to the channel. Under unaltered natural conditions, flows from small floods frequently spill out of the channel and inundate the floodplain. As flows leave the channel, water slows down and spreads out over the floodplain. Typically this frequently flooded area is relatively small and adjacent to and slightly elevated above (+/- 5-10 ft.)the creek channel.

During flood events, meandering stream channels also erode, deposit sediment and change their location in their floodplain in a process of adjustment to conditions in the watershed as well as up and downstream channel conditions. The creek channel will vary in its width and depth as individual flood events provide various amounts of sediment or floodwater and the channel adjusts to these inputs.

In alluvial low slope creeks such as Pistol Creek, the stream channel typically has gravel bars, pools, and riffles formed through these flood and adjustment processes. These riffles, bars, and pools are spawning and rearing habitat for salmon and steelhead trout. Riparian vegetation grows on the floodplain adjacent to the scour channel and provides shade to keep pools cold.

Riparian trees require a floodplain that is slightly elevated above the channel and will be inundated frequently from small flood events. The relationship of the channel to its floodplain is a critical feature to consider when designing habitat restoration projects for riparian forest and fish habitat. The Russian River has been intensively mined for sand and gravel since the 1960's. As a result of these instream deep pit mines (>60 feet), the channel of the Russian River underwent significant changes. The pits remove deposits of sand and gravel in large amounts from the channel and floodplain. The natural replenishment of sediment from the watershed is much lower than the amounts of sand and gravel excavated. The result of this gravel mining was a large-scale deficit of sediment in the Middle Reach of the Russian River causing the river and creek channel to undergo enormous adjustments. The river channel downcut, or incised, over 20 feet into the floodplain. The Russian River both deepened and widened eroding several hundred acres of land. These dramatic changes in the Russian River Middle Reach are well documented in a number of studies (Collins and Dunne 1990, U.S. Army Corps of Engineers. 1985).

The incision of the Russian River affected its tributaries including Pistol Creek. As the elevation of the bottom of the Russian River channel downcut, or deepened, it altered the base elevation controlling Pistol Creek. The Pistol Creek channel adjusted by incising from its downstream confluence with the Russian River up the channel. Pistol Creek exhibits incision of 10-15 feet. Incision can also be observed in a number of tributary streams including Mill Creek and Story Creek.

There are several features of incised channels that directly affect a creek's ability to create and sustain riparian forest and fish habitats. Incised channels have downcut into their floodplain, forcing the majority of flood flows to be confined within the channel. Unlike a channel with an adjacent floodplain, the incised channel has no area for floodwater to spread out and slow down. Instead, the floodwater confined in the channel flows at high velocity and scours the channel bottom, eroding the channel deeper. Spawning gravel is scoured out, along with salmon redds, from the incised channel.

The former floodplain, now 10 or more feet above the channel, no longer functions to spread out and slow floodwater and is isolated from the channel except in very large, infrequent flood flows. The plants along the abandoned floodplain, or terrace, may be able to withstand the incision of the channel if their roots can continue to reach groundwater as the summer water level recedes to the level of the lower incised channel. However, the abandoned floodplain is no longer able to support new riparian seedlings due to the lack of flood flows and natural processes. The high velocity incised channel is also unable to support new seedlings due to these altered processes. (Class III in Figure 4).

Eventually, as the channel gets deeper and the alluvial banks get steeper, the banks are undercut and collapse. (Class IV in Figure 4). As the banks collapse, the channel widens out and the bank material creates a new floodplain adjacent to the lower channel. Flood flows are able to spread out and slow down over the new floodplain and scour is greatly reduced. The channel adjustment reestablishes the natural relationship of the floodplain to its channel. This process of adjustment from a period of incision to the deepening and eventual widening of the channel with the reforming of a new floodplain is well documented in numerous creeks in the Russian River system.

Restoration programs must recognize the functions in the incised channel of high velocity and scour, lack of a floodplain and steep, vertical banks, as well as the ongoing process of bank collapse and new floodplain development. By recognizing that natural processes have the greatest influence in determining the channel form and habitats, designing the restoration project to work with nature creates the most successful project and a more stable channel. Riparian plants require a floodplain adjacent to the channel to grow. Typically, re-creating a new floodplain from the abandoned floodplain is a first step in restoring habitat.

Planting willows using a “bioengineered” approach within the incised channel may create some growth. However without also changing the channel form to create an adequate floodplain the willows will not reduce velocities, nor will the willows reduce the natural process of channel adjustment through bank collapse and floodplain formation, which will occur anyway. If willows are installed at the base of the bank, but the banks remain steep and vertical, bank collapse will likely occur under flood conditions and the location and amount of collapse may be unpredictable and great, affecting important facilities near the channel. Designing the project to incorporate this eventual collapse by setting back banks will increase the stability of the creek and allow for a controlled alteration to achieve the adjustment in the channel form.

Another complicating factor at work on the downstream portion of the Middle Reach of the Russian River and on Pistol Creek is the backwater condition which is created by the 5-10 year frequency .

and larger flood events. The Wohler Narrows are large outcrops of hard rock which bind both sides of the Russian River channel restricting water flow into the lower Russian River canyon. During large flood events this backwater causes water in the Russian River channel and it tributaries to backup and pond, sometimes for days. Eventually at the end of the flood the reduction in flow downstream allows for the river and its tributaries to flow again and this release of the backwater condition results in a rapid movement of the flood water from Pistol Creek at a high enough velocity to scour the channel and erode the saturated banks.

SITE EVALUATION

On November 16, 2004 Fish Friendly Farming program staff in conjunction with staff from Enterra civil engineers walked the length of Pistol Creek from West Side Road to the reach downstream of the Service Road Bridge (see Figure 1). The results of this field evaluation are summarized in Table 1.

The 2004 field review found a 15-18 ft. nickpoint is located upstream of the Service Road bridge. On the right bank above Upstream of the nickpoint the creek channel had a meandering form with gravel bars and pools, a floodplain and moderate stream bank heights. Downstream of the nickpoint the creek has 15-18 ft. bank heights and is incised with no floodplain. The likely cause of the incision is the gravel extraction in the Russian River which has been occurring since the 1960's. The pattern of channel erosion is greatest at the downstream end of the creek where it meets the Russian River indicating the erosion is progressing from the river channel up the creek channel rather than being caused by a source in the creek's watershed which would tend to cause erosion from upstream to downstream. In addition the watershed of Pistol Creek is only 1.5 square miles and is in rural land uses.

In the January 1, 2006 flood the nickpoint migrated upstream and undercut and collapsed the Service Road bridge. Just upstream of the nickpoint is the base of the reservoir berm. Further progression of the incision and bank erosion could destabilize this berm and cause catastrophic failure. Such a failure would contribute significant fine sediment to the Russian River, a waterway listed as impaired by this pollutant.

As of July 2007 the owner has hired an engineering firm, Winzler and Kelly, to design a stabilization structure for the reservoir berm and the nickpoint. The project is undergoing permitting and will be constructed over the summer/fall 2007. The site owner is funding the project.

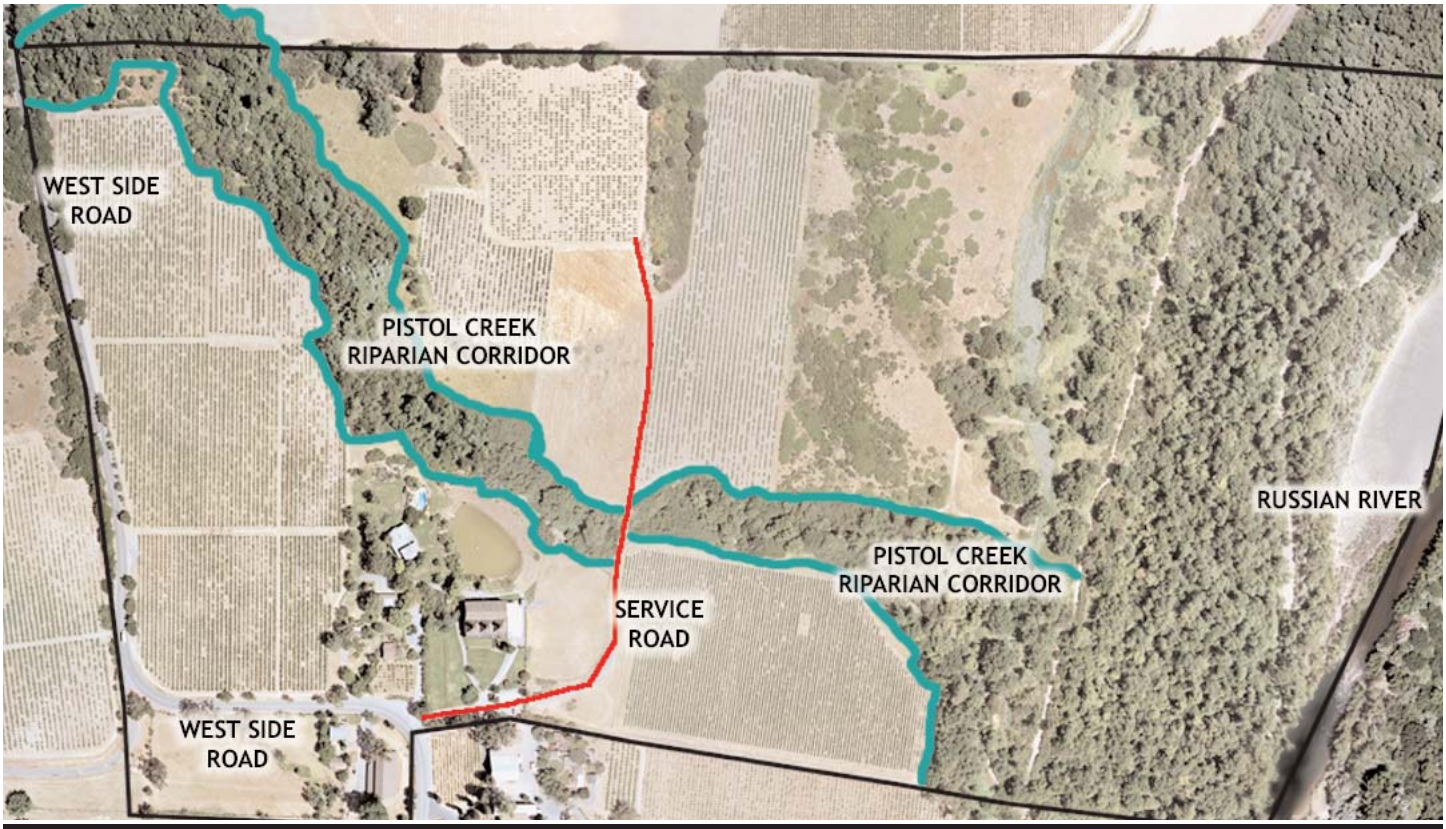


FIGURE 1 PISTOL CREEK RIPARIAN CORRIDOR ON HOP KILN WINERY SITE

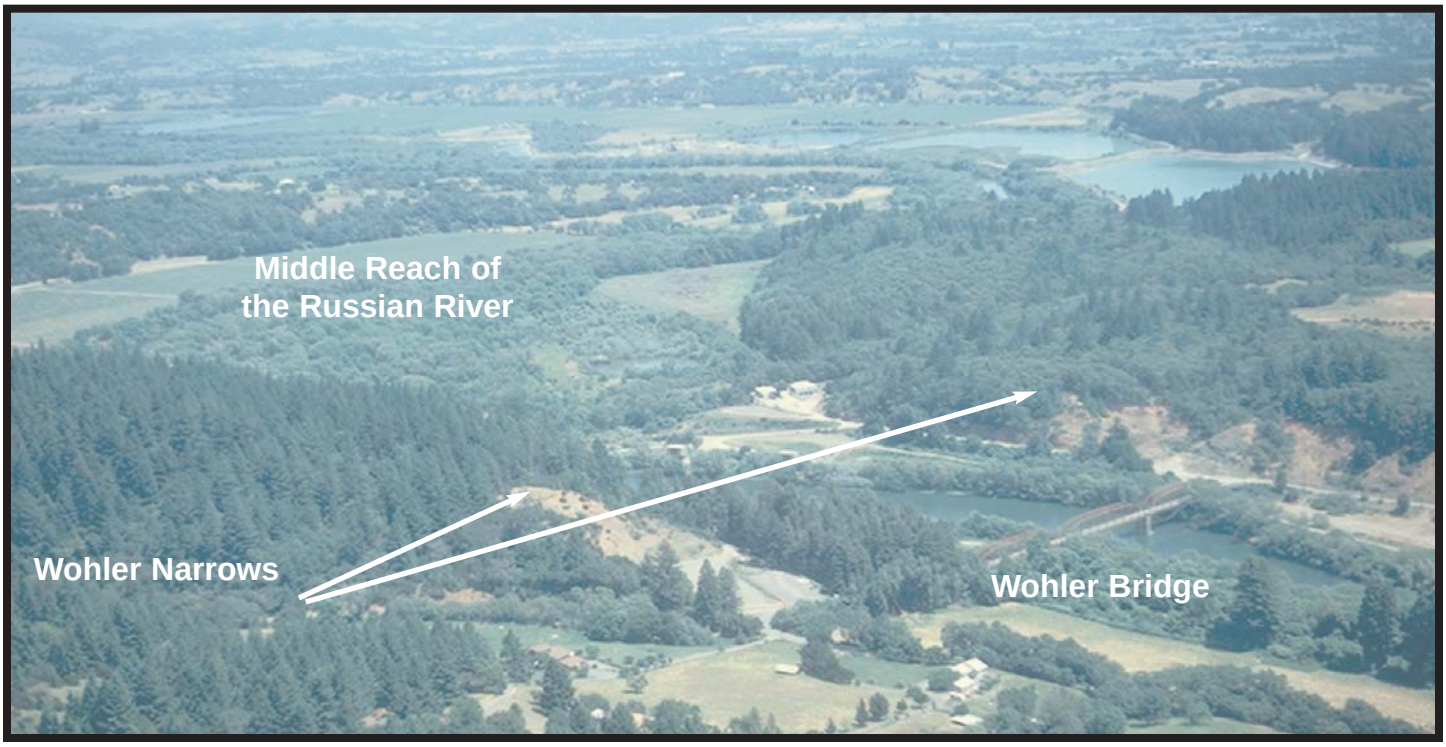
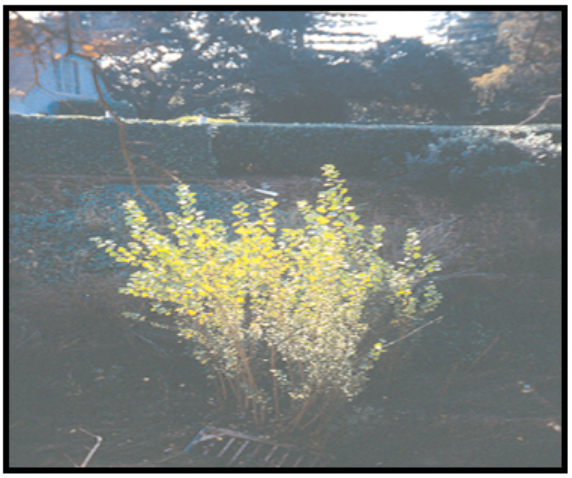


FIGURE 2 A VIEW LOOKING UPSTREAM AT THE RUSSIAN RIVER AND THE WOHLER NARROWS. THE HOP KILN PROPERTY IS JUST OFF OF THE PICTURE TO THE LEFT.



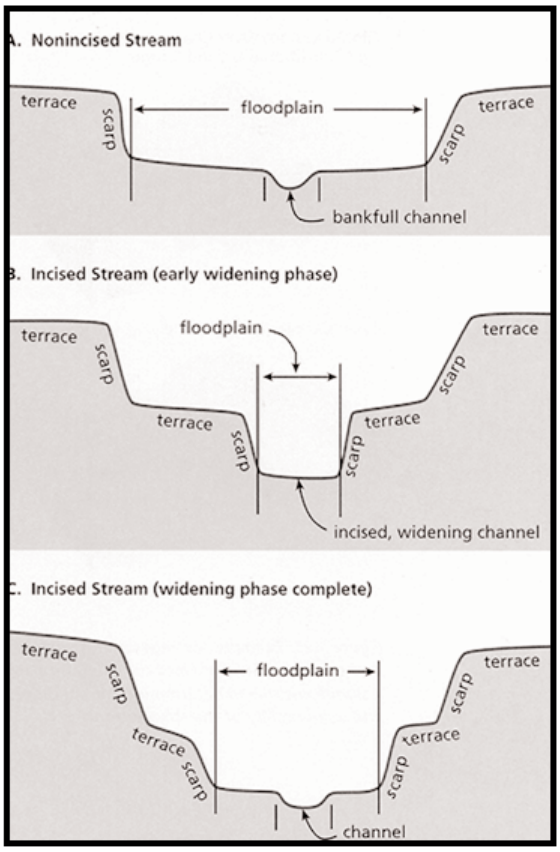


FIGURE 3 INCISION PROCESSES

For example if the channel incises due to changes in the base level of the main river, the velocity of the water increases and the flow deepens. The higher velocity water will erode the bed more causing the channel to deepen more changing the width to depth ratio. As the channel further deepens it becomes entrenched as there is no floodplain to widen out and slow down on. All the erosive force of the water is acting on the channel bed. Over time the channel will deepen to the point that the banks are unstable and they erode or fail. Through the process of bank failure the width of the channel is re-established and a new floodplain is formed. By readjusting over time to the original change, the channel reaches balance again.

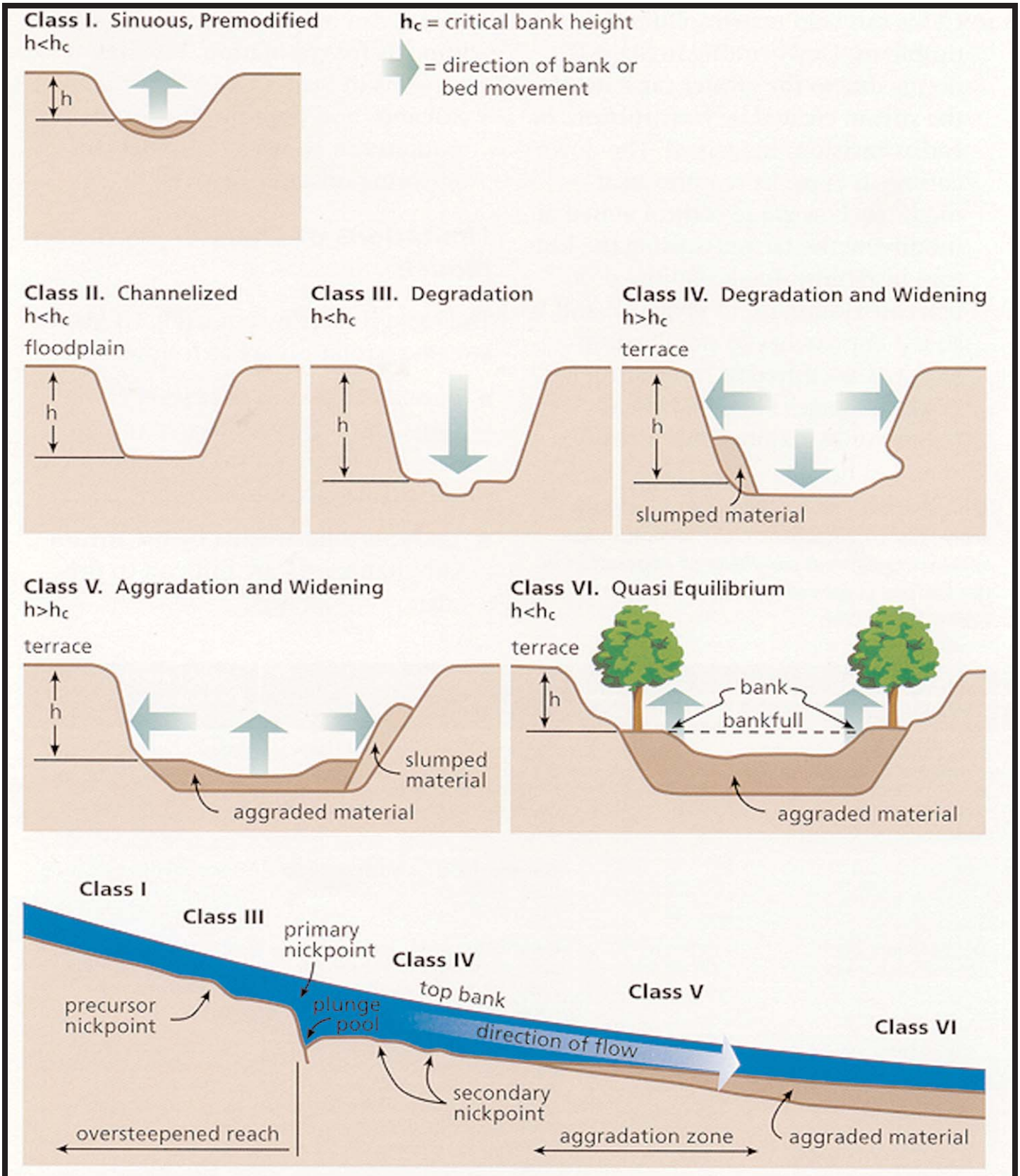


Figure 4 *Channel evolution model. A disturbed or unstable stream is in varying stages of disequilibrium along its length or profile. A channel evolution model theoretically may help predict future upstream or downstream changes in habitat and stream morphology.*

RESTORATION GOALS

The overall goals of the restoration project should be:

⌖ Stabilize the nickpoint to avoid further erosion of the channel upstream and possible destabilization of the reservoir berm as Phase 1 of the project. A grade stabilization structure of large rock designed by the site engineer is recommended. The structure will need to extend downward into the streambed and outward into the banks to protect the upstream area from further migration of the nickpoint and degradation. It is likely that a set of pool structures may be needed just downstream of the grade control structure to allow for salmonid passage. It is recommended that NOAA-Fisheries be consulted for the design of these pools. A number of permits will be required for the structure including Section 404 and 401 of the Clean Water act, 1600 Fish and Game Code and possibly local approvals.

⌖ Re-create a floodplain for the incised area of the channel downstream of the bridge and revegetate with a diversity of native riparian plants. Implement restoration in conjunction with vineyard redevelopment to allow for a widening of the creek corridor and integration with the vineyard drainage system as needed. The FFF program will coordinate with the project engineer on the design. There are a few locations in the Phase 2 area where clay hardpan is visible at the base of the bank and the extent of this layer will need to be taken into consideration as the hard clay can not be planted with native species unless it is thoroughly broken up.

⌖ Remove invasive non-native species including Himalayan Blackberry and Blue Periwinkle and Pierce's DIsease(PD) host species such as wild grape and revegetate with native riparian plants such as Oregon ash, red willow, valley oak, big leaf maple, Ca. buckeye, Ca bay laurel and non PD understory plants such as spicebush, snowberry, basket sedge and others. The FFF program will work with the project engineer and owner to produce a detailed revegetation plan.

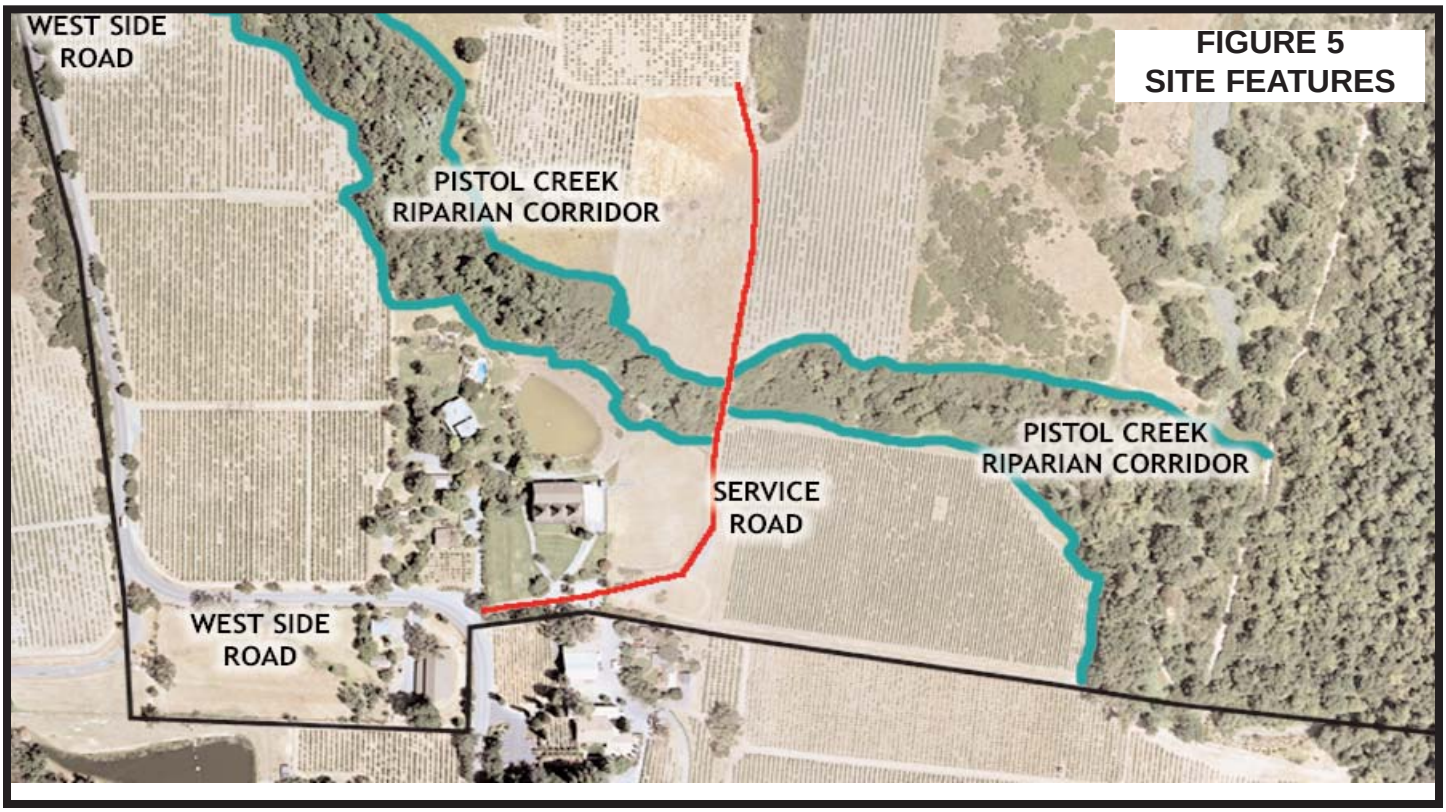


FIGURE 5
SITE FEATURES

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TABLE 1

Location	Notes*
West Side Rd. - Flag #1	No channel incision; trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: revegetate floodplain and banks. .
Flag #1 – Flag #2	Left bank is approximately 7 ft. tall and slightly undercut; floodplain on right and left banks; trees along creek: Ca. bay laurel, Oregon ash, valley oak. Recommendation: revegetate floodplain both sides; no stabilization or bank setback.
Flag #2 – Flag #3	Rock on right bank/hillslope; alluvium and floodplain on left bank; small section of undercut bank, but no major erosion; trees along creek: Ca. bay laurel, Oregon ash, Ca. buckeye. Recommendation: floodplain area on left bank needs revegetation. .
Flag #3 – Flag #4	Large rock/boulders in channel; rock on right bank/hillslope. Left bank of floodplain is stable; trees along creek: Oregon ash, Ca. bay laurel. Recommendation: floodplain on left bank needs revegetation.
Flag #4 – Flag #5	Rock on right bank/hillslope; large meander, trees along creek: Oregon ash, willow, Ca. bay laurel, oak, redwood stump in channel. Recommendation: setback 3:1 at point bar; revegetate with willow springs or mattresses on bank and plant area of floodplain to vineyard avenue (100-150 ft. at largest).
Flag #5 – Flag #6	Rocky hillslope on right bank; trees along creek: willow, oak, Ca. bay laurel. Recommendation: No setback needed; remove pipe in channel, revegetate floodplain
Flag #6 – Flag #7	Meandering channel, trees along creek: willows, oaks, Ca bay laurel Recommendation: Repair area of sheet flow into creek; review need for plastic pipe, revegetate floodplain
Flag #7	Willows make channel impassable.
Flag #7 – Flag #8	Rocky hillslope on right bank; gentle left bank, trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: revegetate floodplain
Flag #8 – Flag #9	Slightly steep left bank, trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: setback bank at 3:1; salvage sedges and replant on floodplain
Flag #9 – Flag #10	Meandering channel, right bank has large rock and 1 undercut bay tree; left bank has no scour, trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: revegetate floodplain.
Flag #10 – Flag #11	Right bank has rock and redwood stump; gentle left bank, trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: revegetate floodplain area, reservoir outlet- some erosion at pipe outlet; needs rock or plastic extension.
Flag #11 – Flag #12	Meandering channel, rocky right bank; floodplain on left, trees along creek: Ca. bay laurel, willow, CA. buckeye. Recommendation: revegetate floodplain.
Flag #12 – Flag #13 Service Road Bridge	Very active nickpoint; new 4 ft. erosion; bridge at Flag #13 has 18 ft. banks, trees along creek: Ca. bay laurel, willow, CA. buckeye, Oregon ash. Recommendation: setback banks 3:1 minimum or create floodplain on left bank (coordinated with vineyard redevelopment). A grade control structure is needed to reduce migration of nickpoint upstream and it will need to allow fish passage.
Flag #14 – Flag #15	Channel with 18 ft. banks at 1:1 or 0.5:1, eroding outer bank of meander, fence at top of bank along floodplain, trees along creek: willow, CA. buckeye. Recommendation: setback banks at 3:1 minimum or floodplain creation, revegetate floodplain.
Flag #15 – Flag #16	Right bank of meander, very unstable, but vineyard fence too close to setback, trees along creek: willow, Oregon ash, CA. buckeye. Recommendation: need to recreate floodplain or set banks back to reduce erosion and loss of fence, may require relocation of fence.
Flag #16 – Flag #17	Ended on right bank at old Fish and Game repair, trees along creek: Oregon ash, willow, CA. buckeye; fence at top of setback bank (currently 2:1 currently maybe 1.5:1). Recommendation: need to review area just downstream to determine if this prior repair will remain stable or likely to be eroded and needs to be set back to a more stable condition
Flag #17 – River Confluence	This reach is highly incised with 15-18 ft. banks with active bank failures Recommendation : setback banks at 3:1 minimum or floodplain creation and revegetation

Flags stretch from upstream to downstream

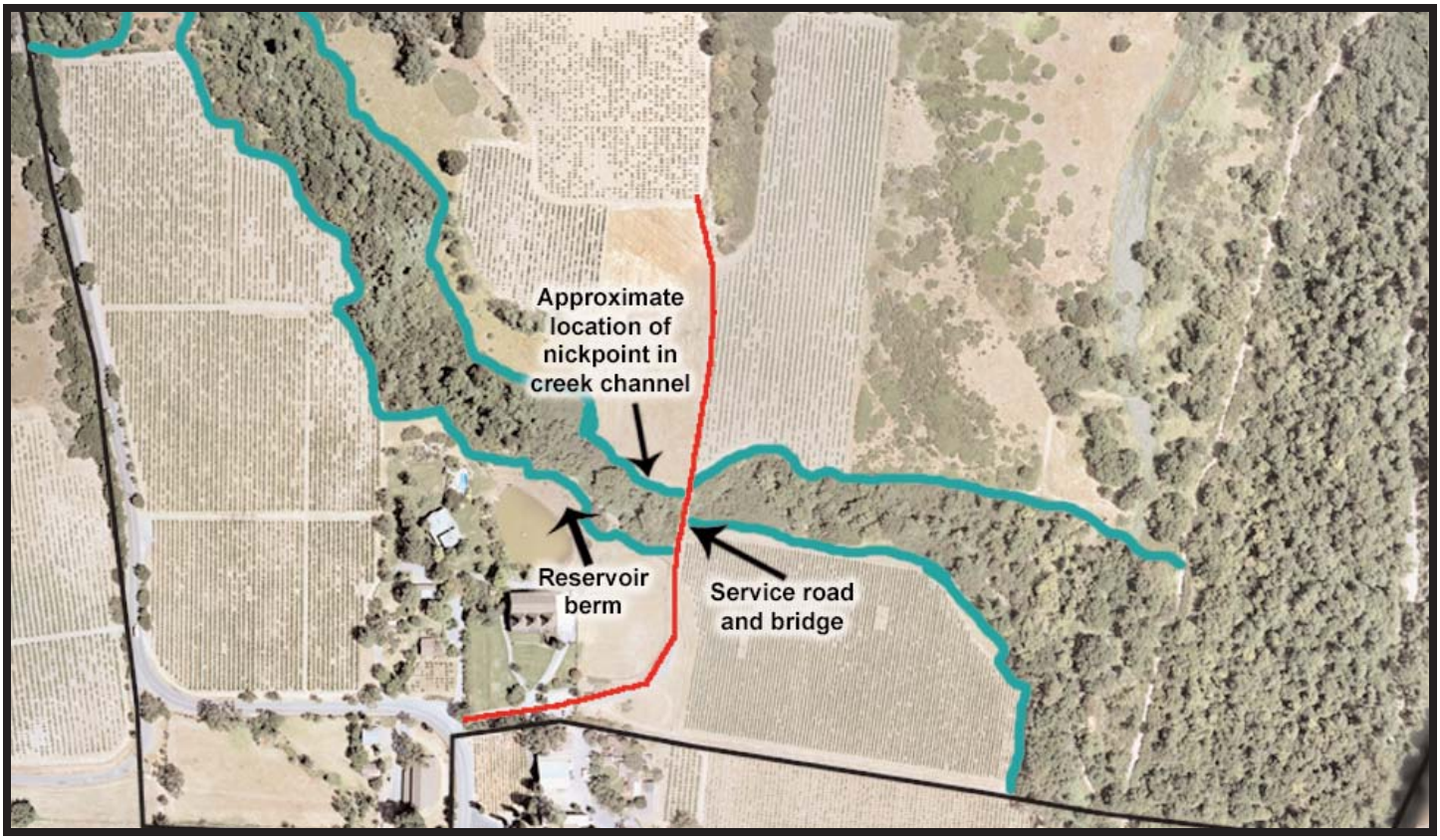

FIGURE 7 NICKPOINT LOCATION

FIGURE 8 LEFT BANK ADJACENT TO NICKPOINT SHOWING ACTIVE BANK FAILURE

FIGURE 9 ABOVE: CHANNEL OF PISTOL CREEK UPSTREAM OF NICKPOINT HAS LOW BANKS AND SHOWS LITTLE INCISION
FIGURE 10 BELOW: HARD ROCK OUTCROPS OCCUR ON RIGHT BANK IN UPSTREAM AREA

FIGURE 11: TOP OF STREAM BANK DOWNSTREAM OF NICKPOINT IN 2005 SHOWING IMMINENT BANK FAILURE AND LOSS OF RIPARIAN HABITAT

FIGURE 12 ABOVE: BANK FAILURE DOWNSTREAM OF NICKPOINT IN 2005
FIGURE 13 BELOW: DOWNSTREAM OF THE NICKPOINT WITH EROSION CAUSED BY OVERLAND FLOW RETURNING TO CHANNEL

FIGURES 14 AND 15: TWO VIEWS ON LOWER PISTOL CREEK NEXT TO CONFLUENCE WITH RUSSIAN RIVER MIDDLE REACH SHOWING EROSION FROM INCISION