6. PROJECT ALTERNATIVES

This section provides a more detailed explanation of the different bank stabilization and restoration strategies recommended in Section 5.

6.1 RATIONALE FOR THE PROJECT ALTERNATIVES

Section 4 of this report explains how we have broken the RDRT reach of the Napa River into several stages, based on the modified Schumm stream classification scheme. Section 5 of the report synthesizes the opportunities and constraints. We need to be aware that some opportunities and constraints are partially contradictory. For example, in narrow channel reaches there is a contradiction between designing a channel that is in long-term equilibrium with its surroundings, and one that minimizes loss of surrounding land and mature bank top vegetation. In this section of the report we have developed a series of alternative conceptual plans that place different degrees of emphasis on the opportunities and constraints, to enable landowners to select the conceptual approaches that best meet their requirements.

We have used the channel stages as a foundation for conceptual plans, by developing several alternative plans for each type of channel. Each alternative will achieve some or all of the desired goals, within the stated constraints. We have produced five alternative conceptual approaches for each of Stages 3-5 and three alternatives for Stage 6 channel reaches that meet these goals. For each plan there is an inside and outside bend option.

Goals:

- Minimize the need for ongoing channel stabilization and maintenance.
- Recreate a landscape and processes that sustain a continuous, native riparian cover in the river corridor.
- Restore natural river/floodplain interactions where possible within the new channel corridor. Increase and enhance riverine habitat value and complexity.

For each stage we have developed the following approaches (the affected channel widths are shown in Figure 6):

a) **Current management alternative** – what would probably happen over the next 50 years at this site if we continue to manage it as at present? This is assumed to be local repair work after big events that cause bank erosion, but no systematic channel modification.

b) **In bankfull channel alternative** – the minimum solution that would fulfill some of the project goals, and generally would involve only work within the existing bankfull channel footprint. This alternative involves holding the toe on the outside bend to reduce further bank erosion, and requires as little earth moving as possible. Depending on stage and conditions the toe protection would probably be rock or large woody debris structures (the lower the stage number, the harder the protection). The toe protection would be backed up by planting to increase habitat value, bank protection and to improve the appearance of the toe protection. If there is evidence that the channel is incising the toe will be protected from undercutting using rock in the channel bed.

This solution would be the least expensive in the short term, and would provide bank protection by reducing toe undercutting. It is compatible with the constraints on loss of land and removal of mature trees. However, toe protection alone may be insufficient to provide long-term stabilization of critical outside bends in some reaches, so this may be a shorter-term solution, requiring more maintenance or repair. In some confined reaches the erosive forces may be so high that without bank regrading medium to long-term stabilization is not possible using toe protection alone. In addition, this type of option is less likely to receive permitting and external funding, and has the least habitat benefit (may even be detrimental).

c) **In bank-top alternative** – an intermediate solution that would achieve more goals but which would still stay within the existing bank top footprint. It would generally include the bank toe measures from option b) plus bank stabilization using vegetative approaches. This might involve sculpting small terraces between bankfull and bank top, or using vegetative soil lifts, where the gradient permitted. If there is space between the levee or cultivated area and bank top this solution might also involve limited slope regrading to encroach as close as possible to this point. Note that in some steeply incised channel reaches (Stages 3-4) it may not be possible to develop this option because the bank angle is currently unstable.

This option would provide greater long-term bank stability and habitat enhancement than b). It would potentially reduce the river's erosive power by providing more space for energy dissipation during large flows. It would be more expensive in the short term, while staying within the bank top constraints. It would be more likely to receive permitting and external funding than option b), and is likely to have a longer design life and lower recurrent maintenance and repairs costs.

d) **Managed river corridor alternative** – a solution that involves regrading the banks where necessary to create a stage 6 channel and corridor. In reaches where constraints exist and the full-scale managed corridor cannot be carried out, some outside bends might still need toe (and bank) protection in places, with inside bends terraced. All unstable banks would be regraded to a stable angle, and appropriate vegetation plantings used.

This solution is the conceptual approach with the greatest chance of receiving permitting and external funding. In the long term it is the most sustainable approach, has the lowest recurrent costs (maintenance and repair) and has the highest environmental benefits. However, this solution is the most expensive in terms of short-term costs, and may involve loss of adjacent land or modification to farming activities (e.g. rolling levees), especially in channel reaches that are currently narrow (e.g. Stage 3/4 reaches). It has the greatest potential conflicts with constraints over landuse and presence of mature trees on the bank top, and the greatest short-term disruption to the channel corridor.

e) **Natural river corridor recovery alternative** – This plan assumes that given time the Napa River will recover to a stable form, equivalent of a stage 6 channel. Rather than intervening in the channel this option is to calculate how much width the stable corridor will require and over what time scale, and plan accordingly. The plan would involve calculating set-back distances in different locations, if needed, and identifying the timing and position of relocated features such as flood protection levees. The advantages of this option are that it results in a stable river corridor with no intervention and limited or no permitting issues. The cost occurs in two time scales; the phased relocation of flood defenses and access roads and disruption to adjacent farmland in the short to medium term, and the gradual loss of land over the next 50-100 years as erosion widens the river corridor. The principal disadvantage of this option in addition to the eventual loss of land is the long recovery time for the geomorphic and habitat processes.

6.2 DIFFERENCES IN CONCEPTUAL APPROACH FOR DIFFERENT STAGES

As the width of the channel corridor increases from stage 3 to 6, the restoration options become more flexible. We can achieve more in a stage 5 reach with a 'within bankfull channel' option than we can in a stage 3 reach. In a specific stage 3 reach there may not be a viable 'within channel' or 'within bank top' solution, because the banks are currently too steep, and stabilizing them will inevitably require grading the bank top backwards to a stable angle. In a stage 4 reach the 'within channel' option might be confined to rock armor the toe and plant vegetation above, while in a stage 5 the same option may be to introduce root wads, create riffles and other habitat structures etc. Depending on stage, and local conditions, greater or lesser degrees of 'hard engineering' would be appropriate. For example, a Stage 3 outside bend b) solution might involve installing rock vanes (deflectors) to keep the deepest part of the channel away from the outside bank. In a stage 6 outside bend option b) might be to install root wads, which would act as both habitat and strengthening measures. Because the stage 6 channel is closer to equilibrium and has more width to dissipate erosive energy it needs less hard engineering.

Not every solution is likely to be viable for every type of reach. The table below shows an assessment of the sustainability of different conceptual solutions in different stages.

Table 1. Sustainability Assessment

	Option a Current action	**Option b Within bankfull**	**Option c Within banktop**	**Option d Managed river corridor**	**Option e Natural river corridor**
Stage 3	Low	Low	Medium	High	High
Stage 4	Low	Low	Medium	High	High
Stage 5	Medium	Medium	High	High	High
Stage 6	High	High	High	High	High

Sustainability – the likelihood of a solution persisting longer than 10 years without repair and extensive maintenance.

6.3 STAGE 3 INCISED AND INCISING CHANNELS

In Stage 3 channels a key issue is to ensure that bed lowering does not undermine bank protection.

6.3.1 Alternative 3A - No Action Alternative

If no action is taken in stage 3 reaches the channel will continue to incise until bank height becomes critical, at which point bank slumping will occur. As the channel becomes more incised floods of increasing size will be confined within the channel, increasing erosion. The combination of unstable banks and confined flow will lead to channel widening and bank erosion. Deep continuous pools will dominate the channel and bank erosion will remove from the bank and bank top, lowering habitat value. These sections will require frequent maintenance if the adjacent land is to be protected.

6.3.2 Alternative 3B – Within Bankfull Channel Alternative - Toe and Bank Rock Armoring with Grade Control Structures and Live Planting

Stabilizing a stage 3 reach within the confines of the bankfull channel is inherently difficult and may be unsustainable over a long timescale, as this approach does not address the fundamental problem of confined, erosive flow conditions. Hydraulic analysis suggests that without channel widening stage 3 reaches will still contain flows up to and possibly including the 100-year flood. As a result this alternative will be subjected to great erosive forces and would require heavy engineering, with a potentially limited life span. This approach would require grade control structures (heavy rock sills buried in trenches flush with the stream bed) to prevent flows from eroding underneath toe protection, and these structures would have to be keyed into the banks to avoid outflanking by bank erosion. Rock sizing would require more detailed hydraulic analysis. Above the bankfull channel live planting would be carried out for habitat enhancement. This approach would be a site specific remedy, and would not contribute to increased river system stability except by preventing the migration of knickpoints upstream.

6.3.3 Alternative 3C – Within Banktop Alternative - Toe Rock Armoring with Grade Control Structures and Vanes, Limited Grading and Biotechnical Bank Stabilization

Stabilizing a stage 3 reach within the confines of the banktop channel is also inherently difficult as the bank angle is generally at or close to the critical angle (angle at which collapsing will occur) and so there is limited or no scope for bank regrading. Where there is scope for limited regrading this will be used to increase the banktop channel width, slightly reducing flood elevation during larger events and so reducing erosion potential. This approach would also require grade control structures to prevent flows from eroding underneath toe protection, and these structures would have to be keyed into the banks to avoid outflanking by bank erosion. Rock sizing would require more detailed hydraulic analysis. Above the bankfull channel live planting would be carried out for habitat enhancement. This approach would make a small contribution to system stability by slightly reducing the erosivity of flows.

6.3.4 Alternative 3D – Managed River Corridor Approach - Bank Top Set-Back to Create Terraces with Toe Rock Armoring if needed

Setting back the banktop margin and regrading the banks is the best long term solution to stabilizing a stage 3 reach, since this approach reduces confinement and lowers erosion potential during floods, tackling one of the main sources of the channel instability. The extra width would reduce the tendency for scour to occur, removing the need for expensive grade control structures. Created terraces along the bankfull channel margins would increase habitat value, provide some flood storage capacity and reduce erosion potential on the banks and downstream. If required toe protection could be used on outside bends where the river threatened banktop property or infrastructure. This approach would increase the overall stability of the river system. Based on comparison of recovered (stage 6) reaches, a typical setback would need to be approximately 65 feet.

6.3.5 Alternative 3E – Natural Recovery

As for 3D, except that the channel would be allowed to recover naturally rather than by engineered terracing. The setback distance needed would be calculated based on reference reaches. This approach would increase the overall stability of the river system.

6.4 STAGE 4 INCISED, WIDENING CHANNEL

In Stage 4 channels the key issue is to ensure that protection maintains sufficient toe protection so that the bank is not undermined from below. Stage 4 channels are still very confined, so that larger flood events such as the 10 and 25-year event remain confined within the banktop area, especially in sections with levees.

6.4.1 Alternative 4A - No Action Alternative

If no action is taken stage 4 channels will become wider due to a combination of bank erosion and bank collapse. The inner bank will tend to widen at the top, eroding adjacent land, while forming a vegetated point bar or terrace at the base. The outside bend will tend to erode by slumping, and remain very steep and unvegetated. Stage 4 channels may also undergo some bed erosion.

6.4.2 Alternative 4B – Bankfull Channel Approach - Toe Rock Armoring and Biotechnical Bank Stabilization

Stabilizing a stage 4 reach within the confines of the bankfull area is difficult as flows will continue to be highly erosive during flood conditions, and the B solution tackles the symptom rather than the problem. As with a stage 3 channel there is a risk of toe protection being undermined by scour, so toe armor must be keyed into the channel bed a sufficient depth to avoid this (based on scour calculations for each site). However, full grade control is unlikely to be needed unless the presence of knickpoints downstream suggests potential problems may migrate up channel. Due to the confined nature of stage 4 channels this alternative would require heavy rock (size to be calculated by hydraulic calculations) and may have a more limited design life than other solutions. It would not contribute to overall system stability.

6.4.3 Alternative 4C – Banktop Alternative - Toe Rock Armoring and Benching within Existing Bank Top Margins

Alternative 4C accelerates the natural tendency of stage 4 channels to develop terraces on the inside bend, creating overflow areas that reduce flood levels during peak flows, thereby reducing erosive forces on the outside of the bend. This alternative goes some way towards solving the underlying problem of confined flows, and is a more sustainable solution than Alternative 4B. However, in some cases there will not be sufficient space within the banktop footprint to regrade the banks without oversteepening them. Widening the channel will allow a less heavily engineered approach to toe protection, with smaller rock and potential for more bioengineering (design to be confirmed after hydraulic calculations). This design will create greater habitat value than 4B, have longer lifespan and will make some contribution to system stability by lowering flood levels at higher flows.

6.4.4 Alternative 4D – Managed River Corridor Alternative - Bank Top Set-back to Create Terraces and Toe Rock Armoring if needed

Setting back the banktop margin and regrading the banks is the best long term solution to stabilizing a stage 4 reach, since this approach reduces confinement and lowers erosion potential during floods, tackling one of the main sources of the channel instability. Created terraces along the bankfull channel margins would increase habitat value, provide some flood storage capacity and reduce erosion potential on the banks and downstream. If required toe protection could be used on outside bends where the river threatened banktop property or infrastructure. This approach would increase the overall stability of the river system.

6.4.5 Alternative 4E – Natural River Corridor Alternative

As for 4D but with natural erosion processes taking the place of engineered regrading.

6.5 STAGE 5 WIDENED, AGGRADING CHANNELS

In stage 5 reaches the channel is close to stability and biotechnical solutions may be used to ‘help it along the way’. However, outside bends may still experience local erosion, especially on impinging bends, and this may require stabilization. Stage 5 reaches are also sites where potentially large improvements in habitat could be made using revegetation and by creating habitat structures.

6.5.1 Alternative 5A - No Action Alternative

Stage 5 reaches will gradually evolve into stable channels, as excess material eroded from the banks is redistributed in the channel to form terraces and point bars, increasing channel complexity. In bend areas the channel will tend to migrate outwards on the outside bend through erosion and bank collapse processes, as vegetated point bars develop on the inside bend.

6.5.2 Alternative 5B – Within Bankfull Alternative - Toe protection on Outside Bends

Where bank protection is required (for example where flow impinges on the bank) toe protection can be achieved using a combination of rock and biotechnical solutions such as root wads, increasing habitat value as well as reducing bank erosion. These techniques are more sustainable in stage 5 reaches as the wider channel results in lower flow elevations and erosion potential during floods. This approach will not increase the stability of the river as a whole, but will contribute to greater habitat value.

6.5.3 Alternative 5C - Within Banktop Alternative - Toe Protection with Limited Regrading

Stage 5 reaches often have valuable tree habitat, and this should be preserved where possible. However, there may be scope for limited bank regrading on narrow 'early' stage 5 reaches (e.g. in the upper portions of the project reach) where full terrace development has not yet taken place. Regrading will reduce flood elevations and erosion potential, and will contribute to overall system stability.

6.5.4 Alternative 5D – Managed River Corridor Alternative - Bank Top Set-back to Create Terraces and High Flow Channels

Bearing the constraints from Alternative 5C in mind, there is scope for setting back the tops of stage 5 reaches to allow full terrace development, especially in narrow 'early' stage 5 reaches. In addition, these reaches can be used to add value to the overall river system by reconstructing high flow bypass channels.

6.5.5 Alternative 5E – Natural River Corridor Alternative

As for 5D but with natural erosion processes taking the place of engineered regrading.

6.6 STAGE 6 NEWLY EQUILIBRATED CHANNELS

Stage 6 reaches are sections of channel that have regained equilibrium with the watershed and surrounding channel areas. As such they pose few problems except where bank erosion has reached the limit of the riparian corridor, threatening adjacent land. In these areas local bank toe protection may be required. Stage 6 reaches also represent areas where overall value can be added to the project by enhancing environmental habitat.

6.6.1 Alternative 6A - No-action Alternative

Under a no-action scenario stage 6 reaches will migrate within the riparian corridor, and may periodically reach its limits and erode outwards at relatively slow rates. Migration will create local areas of bank erosion and point bar deposition, increasing habitat complexity and creating diverse aquatic habitat such as riffle and poll sequences.

6.6.2 Alternative 6B – Within Bankfull Channel Alternative – Large Woody Debris Bank Toe Protection

Where local bank erosion problems are found the bank may be stabilized using large woody debris or other biotechnical approaches. The greater width of stage 6 reaches permits less heavily engineered approaches as flow depths and erosive forces are lower during floods. Individual large woody debris structures will require hydraulic calculation for final design.

6.6.3 Alternative 6C – Within Banktop Alternative – Large Woody Debris Toe Protection and Limited Bank Regrading

Subject to the constraints of existing vegetation, there may be scope to regrade banks within the banktop limit to increase bank stability on outside bends, or improve terraces (for example to create high flow secondary channels).

6.6.4 Alternative 6D – Managed River Corridor Alternative – Habitat enhancement

Subject to the constraints of existing vegetation, there may be scope to regrade banks beyond the banktop limit to increase bank stability on outside bends, or improve terraces (for example to create high flow secondary channels). Habitat structures may also be developed to improve aquatic quality.

6.6.5 Alternative 6E – Natural River Corridor Alternative

Although lateral migration of a stage 6 reach is unlikely to be extensive or rapid, it will occur over time and could be planned for by assessing migration rates and likely set-back distances.

6.7 INTEGRATING THE HABITAT ASSESSMENT WITH THE GEOMORPHIC ASSESSMENT

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November 4, 2003

6.7.1 Introduction

A habitat survey was conducted during the week of November 18 – 22, 2002 along the Rutherford reach of the main-stem Napa River to document the amount and condition of available habitat to for fish and other aquatic organisms. Observations of fish and other pertinent flora and fauna were documented. Recommendations for habitat improvement activities are based upon target habitat conditions suitable for native fish species of the Napa River. This survey focused primarily on the life history requirements of salmonids within the Napa River basin. Chinook salmon and steelhead serve as indicators of general habitat needs of native cold-water fish species and other aquatic organisms in the main-stem Napa River and lower-gradient reaches of some tributaries.

A snorkel survey along approximately four miles of the Napa River was conducted on August 15, 2003 by Jonathan Koehler and Todd Adams. The purpose of the survey was to document fish species present in this reach, and to determine whether salmonids (juvenile steelhead or Chinook salmon) were utilizing this section of the river for summer rearing. Size ranges were visually estimated and recorded for target species. At a minimum, every tenth pool was snorkeled, but additional pools with high potential for salmonids were also snorkeled to increase our chances of detecting rare or sparsely distributed fish. This survey followed general snorkel fish count methodologies, which yield rough estimates of relative abundance within the sampling reach.

6.7.2 Habitat Survey Results

Pools comprised 47% of the total length of this survey with 44% of these pools having a maximum depth of three feet or more (Table 1). This high number of deep pools is generally favorable for fish habitat, specifically salmonids. However, throughout much of the survey very long pools with little complexity were observed. Although, pools comprised a large percentage of the total surveyed length, these marginal pools do not represent favorable fish habitat. In general the marginal pools were more like deep glides with relatively even bottoms, little scour, and had primarily fine substrate (sand and silt). Several suitable pool habitats were observed and noted throughout the survey.

The best pool habitat was generally in areas where the river was not immediately confined by steep banks and levees. In sections of the survey reach where a floodplain or flood-terrace is present, the river has higher pool-riffle frequency which tends to improve habitat complexity and in turn create a broader range of aquatic habitats. In sections of the survey with highly confined banks the overall habitat tended to be more homogenous with less separation between riffles and pools. This is supported by the relatively high percentage of flatwater habitat (33%) in the survey reach. Flatwater represents a marginal habitat for salmonids and tends to favor warmer water predatory fish species such as smallmouth bass and Sacramento pikeminnow. In general, most flatwater habitats had very little cover and were dominated by fine substrate. Large schools (50+) of Sacramento pikeminnow and Sacramento sucker were observed most commonly in flatwater habitats.

Table 2. Summary of fish habitat elements for survey reach

Canopy Density:	53%
Channel Length:	21,773 ft.
Riffle/flatwater Mean Width:	15.6 ft.
Total Pool Mean Depth:	1.9 ft.
Base Flow:	Low
Temperature:	Water: 10 - 15 °C Air: 11 - 21 °C
Dominant Bank Vegetation:	Deciduous Trees
Vegetative Cover:	77%
Dominant Bank Substrate:	Silt/Clay/Sand
Evergreen Component:	1%
Deciduous Component:	92%
Dry Channel:	48 ft.
Pools >= 3 ft. deep:	44%
Mean Pool Shelter Rating:	70
Dominant Shelter:	Large Woody Debris
Occurrence of LWD:	20%
Pools by Stream Length:	47%

Canopy throughout much of the survey was low or marginal. The mean canopy density for the entire survey was 53% comprised mostly of deciduous trees. Target canopy densities for salmonid streams are approximately 75% and above. The lack of stream canopy in many areas appears to be exacerbated by heavy bank erosion and bank failure. Disturbed areas were common throughout the survey, and they were typically either open or colonized by young willow and alder. Some areas of the survey, primarily those with flood terraces, were well covered and shaded with a mix of young and mature riparian trees.

The surveyed reach of the Napa River does not provide much suitable summer-rearing habitat for steelhead due to elevated summer temperatures, presence of native and introduced predatory fish species, and hydrologic conditions during summer and winter. In most large river systems, steelhead typically spawn in smaller tributary streams with suitable gravel size and cool water. A small population of fall-run Chinook is currently present in the Napa River and strays from CDFG releases in the bay are also migrating up the Napa River to spawn (J. Emig, CDFG, pers. comm.). Chinook salmon would likely use the Napa River in the Rutherford region to spawn and rear if conditions were more suitable. Given the current habitat conditions in the mainstem it is doubtful that a large self-sustaining population of Chinook salmon could subsist in the basin. Efforts to improve habitat quality and quantity in the mainstem have the potential to improve the long-term prospect of a population increase, but this will likely take several years or decades.

No physical barriers to fish migration were observed during this survey. A potential obstacle exists at the Zinfandel Lane crossing where concrete and boulders have been placed in the channel. This collection of large boulders combined with the concrete bridge abutments form a steep series of cascades that may limit fish passage during moderate to low flows. Although not a complete barrier, this obstacle may limit the success of downstream migration during late spring and possibly adults moving upstream during fall and winter.

6.7.3 Habitat Summary

Pool habitat was abundant throughout the survey reach; although it was lacking depth and complexity in many areas. Many pools were very long and wide with little shelter or complexity. These marginal pools commonly had fine substrate, which does not provide favorable habitat for most fish or aquatic macroinvertebrates. Marginal pool habitats and extensive flatwater habitats were typically associated with channel confinement and bank erosion. Areas of the river that had a more defined floodplain or flood terrace had tighter pool/riffle spacing and more favorable habitat complexity.

Riparian canopy was generally low in the survey reach. In general canopy was deficient in areas with heavy bank erosion and where the channel was highly confined. Areas with a defined flood terrace had a good mix of young and mature riparian trees as well as a generally wider riparian zone. Efforts to increase the number of riparian trees through planting would improve bank stability, increase riparian habitat, and provide a long term source of LWD for in-stream shelter and invertebrate forage.

Introduced and native warmer-water predatory fish species were common throughout much of the survey reach. Most of these fish were associated with marginal pools and flatwater habitats. These habitats favor warmer-water predatory fish due to elevated summer temperatures and a lack of hiding cover for prey. Efforts to decrease the number of long homogenous pool and flatwater habitats may give native cold-water fish the advantage.

6.7.4 Snorkel Survey Results

A total of eleven fish species were documented in the ~ four mile survey reach (Table 2). This total was comprised of seven native species and four introduced species (primarily from the eastern U.S.). Throughout the reach, twelve pools were fully snorkeled, and several other habitat units were partially surveyed.

Juvenile steelhead in the young-of-year size class (< 3 inches) were observed in one pool. Larger steelhead / resident rainbow trout were found in several locations, but appeared more frequently in the lower half of the survey reach. A total of 22 steelhead/rainbow trout were observed. No juvenile

Chinook salmon were seen. Water clarity became worse as we moved upstream, and towards the end of the survey limited our visibility to ~ 2 feet. Water temperatures were not measured; however variations in temperature (~ 5° - 10°F) could be felt as we moved into deeper shaded areas with good canopy cover. In general, we found trout in these colder, well-shaded parts of pools.

The most abundant fish species were minnows (*Cyprinidae*), and suckers (*Catastomidae*) with large mixed schools in most pools. Trout were found in pools with deep scour, heavy shade, good cover, and cooler temperatures. It was somewhat unexpected to find any salmonids in this reach, since none were observed during the habitat survey in November, 2002. The size classes seen were primarily smolt size (6-8 inches) or resident fish size, but we can't determine the life history of these fish just by looking at them. The young-of-year were seen in one pool and nowhere else suggesting that successful spawning in this reach is not common. Typically, one would expect to find mostly young-of-year, fewer 1+ fish, and far fewer 2+ fish in a good spawning and rearing stream. The size ranges in the survey reach suggest these are either resident trout or stranded steelhead smolts from upstream tributaries that are waiting out the summer in holding pools on their way to the ocean this winter.

Table 3. Summary of fish species observed during snorkel survey (8/15/03)
(along ~ 4 miles of the Napa River in the Rutherford Dust Restoration reach)

Common Name	Scientific Name	Origin	Abundance (estimate)	Size Range (estimate)
California Roach	*Lavinia symmetricus*	Native	High	~1 – 4 inches
Hardhead	*Mylopharodon conocephalus*	Native	High	~ 2 – 7 inches
Sacramento Pikeminnow	*Ptychocheilus grandis*	Native	High	~ 2 – 18 inches
Sacramento Sucker	*Catostomus occidentalis*	Native	Moderate	~ 2 – 12 inches
Threespine Stickleback	*Gasterosteus aculeatus*	Native	Moderate	~1 – 2 inches
Steelhead / Rainbow Trout	*Oncorhynchus mykiss*	Native	Low	~3 – 13 inches
Tule Perch	*Hysterocarpus traski*	Native	Low	~ 3 – 5 inches
Bluegill	*Lepomis macrochirus*	Introduced	Moderate	~ 3 – 6 inches
Green Sunfish	*Lepomis cyanellus*	Introduced	Low	~ 4 – 6 inches
Smallmouth Bass	*Micropterus dolomieu*	Introduced	Low	~ 2 – 10 inches
Largemouth Bass	*Micropterus salmoides*	Introduced	Low	~ 6 inches

A total of 11 species were documented including seven native and four introduced species.

6.7.5 Fisheries Restoration Priorities

The Rutherford reach currently offers limited habitat for native salmonids (Chinook salmon, and steelhead trout), and efforts to improve the surrounding riparian zone and reduce the impacts from habitat encroachment and channel modification are likely the only long-term solution to reverse this condition. Restoration projects that target hot spots while addressing the broader issues that have ultimately caused these problems are vital for success. Focusing on localized (sub-reach) restoration sites which improve habitat quality and quantity may temporarily improve the situation but will not create a sustainable aquatic ecosystem that is healthy and diverse. Several small-scale improvements (pool forming weirs, rootwad placement, LWD placement) can be made as the large-scale reach level projects are undertaken. It is logical that areas with severe confinement and the associated problems need to be restored first.

The Napa River, if allowed to function more naturally over time, will return to a state of quasi-equilibrium, which will benefit the aquatic and riparian ecosystems. In terms of time needed to achieve these goals, it is realistic to assume that several years and perhaps decades will be required to see the return of spawning salmonids to this reach. However, this is an important migration corridor that could immediately benefit anadromous fish and resident native species. Although salmonids are the focus, restoration projects will benefit other native fish species as well as California freshwater shrimp, which would be helped by more habitat in the form of well covered pools.

Following is a prioritized list of fisheries requirements as they relate to current geomorphic conditions within the Rutherford reach of the Napa River. Reach specific benefits are discussed in the final section and are based on the preferred alternatives outlined in the conceptual plan.

1. *Habitat complexity, lack of LWD or cover* – Reaches 1, 2, 4, and 8 are relatively homogenous and dominated by long shallow pools with very little cover. Installing logs, rootwads, and carefully placed boulders wherever feasible would create more complexity for the short term. These would provide a temporary (~5 year) improvement as the riparian plantings mature and begin to function as sources of woody debris and cover. Invariably, these “structures” fail and are washed away, but they would be a good transitional start to recovering some native fish habitat.
2. *Spawning gravel, and excessive fine sediment* – Fine sediment has filled in many pools and covered otherwise suitable salmonid spawning gravels. Additional rough features such as logs, rock weirs, or rootwads placed in the channel would help sort spawning gravels as well.
3. *Floodplain, energy dissipation* – Mobile gravel beds scour spawning redds and create difficult conditions for much of the benthic invertebrate community. A lack of high water flood refugia for young fish can make it impossible for young fish to survive winter storms. It would be very beneficial, for Chinook especially, to create flood terraces with side channels that retain water into late spring. Young Chinook, and to a lesser extent steelhead, use such side channels and back waters as rearing habitat and as refuge from high winter flows. These must be well shaded to prevent stressful temperatures, and it is preferable to have good connectivity with the main channel to allow exchange of fresh water.

4. *Shade from riparian canopy* – Riparian trees and woody vegetation provide a source of organic forage for aquatic invertebrates, large woody debris recruitment, cooling effects from shade, and create a wind barrier. From a fisheries standpoint, riparian canopy densities should be between 75 - 90%.
5. *Riffle/pool morphology* – The Rutherford Reach had very few riffles, especially in reaches 1, 2, and 6. The lack of riffles greatly limits benthic invertebrate production, which is the main source of food for juvenile salmonids and many other native fish. Riffles also act to aerate the water and create a more distinct separation of niches for aquatic organisms.
6. *Migration corridor* – No physical obstructions were found during the surveys. The whole reach would greatly benefit from an increase in holding/resting areas for adults and smolts (typically 5-7" steelhead and ~3" Chinook outmigrants). Steelhead and Chinook salmon smolts are most vulnerable to elevated temperature and predation as they move downstream, so cover and deep pools are vital to a successful journey.

Reach 1 - The preferred alternative of increasing meander in this reach would benefit salmonids by increasing the amount of fast water habitat (riffles, runs). The formation of backwaters from old channels would also provide rearing and overwintering habitat. Meander would also improve the riffle/pool spacing and create corner scour pools, which are excellent habitat for juvenile steelhead.

Reach 2 - This reach is dominated by long pool-glides with little complexity or cover. The preferred alternative would provide instream shelter from biotechnical structures including weirs and logs that are designed to increase pool frequency and complexity for spawning and summer rearing. This would also increase the separation of riffles and pools into more distinct units giving young salmonids protection from predation and high flows.

Reach 3 - Natural recovery of this reach will allow the stream habitat to improve over a longer period (25-50 years). Woody debris recruitment into the river will help shape this process.

Reach 4 - Fish habitat is homogenous and lacks complexity throughout this section of the river. The preferred alternative for this reach would greatly improve the quantity and quality of salmonid habitat by setting back the channel and relieving bank confinement in this reach. The creation of a wider floodplain (potentially with side channels) would provide overwintering and rearing habitat while dissipating much of the energy from high winter storm flows. Once colonized by riparian vegetation, this setback would be a long term source of woody debris for pool formation, invertebrate forage, instream shelter, and shade.

Reach 5 - Revegetation will further stabilize the banks reducing sediment delivery, improving water quality, and providing a long-term source of woody debris.

Reach 6 - Same as Reach 3.

Reach 7 - Same as Reach 5.

Reach 8 - As described above for reach 4, the preferred alternative for this reach would benefit salmonids during several lifestages. It would also create holding/resting habitat for adult fish migrating through this area during high flow periods.

6.8 RIPARIAN VEGETATION AND HABITAT RESTORATION

Ellie Insley, Ellie Insley and Associates
with
Todd Adams, Napa County Flood Control and Water Conservation District

6.8.1 Introduction

A riparian vegetation study was conducted in April 2003 as part of the preparation of the conceptual plan. The protocol used was a modified version of the California Native Plant Society Rapid Assessment Protocol.

The main purpose of the study was to identify significant stands of riparian vegetation, to be used to guide the recommendations for channel modification and minimize potential damage to riparian habitat. An additional purpose of the study was to identify stands of native and non-native plants, particularly Pierce's disease host plants, and develop a conceptual plan for removing non-natives and restoring riparian habitat. This section summarizes the data collected, provides recommendations for riparian habitat restoration, and explains how the data were used in developing the conceptual plan for geomorphic channel modification.

For the purposes of this conceptual plan, "significant stands" were defined as large, mature trees with a diameter of 12 inches or greater, primarily valley oak, coast live oak and walnut (see Figure 20). These slower growing trees were considered significant because of the great amount of time it takes them to mature, while pioneer species such as willow, alder, and cottonwood mature much faster. Habitat benefits of mature trees include greater production of shelter and food resources for wildlife, and greater shade and resulting lower stream temperature to benefit fish. While the definition of significant stands was useful for the conceptual plan, more detailed analysis and identification of significant riparian habitat will be done when developing the detailed designs for channel modification of each reach.

The significant stands tend to be found at banktop, since oaks and walnuts are not tolerant of the scouring flows that occur along the stream banks. As a result, implementation of Alternatives A through C would have little to no impact on significant stands, because those alternatives are confined to the streambank and channel and do not affect the banktop. Implementation of Alternative D could potentially have an impact on significant stands, because it involves modifications to the banktop. Alternative E could also have an impact as "natural" widening of the channel may cause significant trees to be undermined and fall into the river.

6.8.2 Existing Conditions of Riparian Vegetation

The riparian vegetation varies greatly throughout the study area, and includes extensive stands of native trees, found in reaches 1, 2, 3, 5, 6 and 7, as well as narrow bands of weedy vegetation with little to no overstory, as in parts of reach 4. The understory varies from non-native annuals and perennials to remnant patches of native species.

Reach 1 has by far the greatest number and extent of significant stands of mature native trees, primarily valley oak, with some coast live oak and walnut. Reach 2 has the next greatest number of significant stands of mature trees, with valley oak, coast live oak and walnut, followed by reach 3 and 5, with valley oaks.

Extensive stands of cottonwood, alder and willow grow, primarily in reaches 3, 5, 6, and 7. While these trees are not included in the recording of significant stands because of their fast growth rate, they provide excellent wildlife habitat and other habitat values for aquatic species. It is notable that these species tend to dominate in the reaches that have a wide, low floodplain. These reaches are close to or have achieved a new dynamic equilibrium (Schumm's stages 5 and 6).

In most areas the understory consists primarily of non-native species, such as Himalayan blackberry, periwinkle and other annual and perennial weeds. There are remnant patches of native understory species, occasionally in large concentrations, including snowberry, Santa Barbara sedge, and creeping wild rye, particularly in Reaches 2, 5, 6 and 7. In these reaches it is not unusual to find areas where both the understory and overstory are comprised of native plant species, and plant diversity is the highest. The existence of a healthy native understory occurs in these reaches primarily because the landowners have undertaken revegetation projects to remove Himalayan blackberry and periwinkle and replant with natives shrubs, to reduce Pierce's disease in adjacent vineyards.

The width of the riparian corridor, which includes the vegetated area on both sides of the river and the channel, varies throughout the study area. In reach 1 the riparian corridor is the widest, in places over 600 feet wide. Reaches 3, 5, 6 and 7 also have a relatively wide riparian corridor, ranging from 250 to 400 feet. Most of the other reaches have narrow bands of riparian vegetation, often only one tree wide on either side of the river, providing a 150 foot wide riparian corridor. Those reaches with narrow riparian corridors (parts of reaches 2, 4 and 8) tend to occur along the confined, eroding sections of the river, and are very vulnerable to loss of the remaining trees, as the erosion undermines the trees' root systems. In general, the areas with a wide (over 250 foot wide) riparian corridor make up about 50% of the Rutherford project area.

6.8.3 General Recommendations for Riparian Restoration/Revegetation

While it is impossible to fully restore the riparian habitat in the Rutherford reach due to changes caused by human settlement, there are measures that can be taken to enhance and rehabilitate the remaining habitat, particularly if the recommended changes in channel geomorphology are implemented.

Below are broad recommendations for riparian habitat restoration. These recommendations will be further developed, with input from the landowners, as the Conceptual Plan evolves into a detailed restoration plan for the Rutherford Reach.

6.8.3.1 Remove Non-Native Invasive Species and Replant with Native Species

There are several invasive plant species that cause significant harm to riparian habitat, and in some cases to vineyards as well. These species include non-native trees such as tree of heaven, black locust and eucalyptus. Tree of heaven poses a particular danger, since it is extremely fast growing and produces a multitude of seeds. Invasive shrubs and grasses include giant reed (*Arundo donax*), and the Pierce's disease host plants Himalayan blackberry, periwinkle and wild grape. Many of these species suppress the growth of native plants, on which native wildlife depends. Some plants, such as giant reed, can in time totally destroy the riparian habitat, and reduce its wildlife value almost to zero. Replanting with native species will restore the natural diversity of the habitat.

For a more detailed discussion about removing Pierce's disease host plants and other invasive species, please see the specific sections on those topics.

6.8.3.2 Establish a Buffer Zone along the Riparian Corridor

A riparian buffer is a zone of vegetated land between a stream and an adjacent land use, planted with permanent vegetation (grass, shrubs and trees), which can filter runoff and maintain the water quality and biologic functions of the stream. A healthy riparian buffer zone filters sediment, nutrients, and pathogens from stormwater runoff, moderates water temperatures, stabilizes banks, and provides food and shelter for invertebrates, fish, amphibians, reptiles, birds, and mammals.

There are many parts of the Rutherford reach where an extensive buffer zone already exists, and other areas were the riparian zone is only one-tree wide, or has no permanent vegetation at all. In the latter two cases, bank erosion is more likely to occur and claim valuable land. In these areas it is wise to plan ahead and begin riparian reforestation by planting trees and understory plants. This buffer will help slow future erosion of the streambank by establishing a new root system that can hold the soil, in addition to providing wildlife habitat and filtering run-off. The width of the buffer zone depends on the availability of land, the landowner's goals, and their interest in improving habitat, water quality and bank stability.

A buffer that includes a layering of native vegetation, with a mix of overstory trees and understory shrubs, sedges, grasses, and vines, provides the greatest combination of benefits. Below is a short list of native plants that would be appropriate in the buffer zone along the Napa River in Rutherford. For more on native plants, see the Pierce's disease section on page 53.

Table 4. Short List of Native Plants for Rutherford Reach Buffers

Trees	**Shrubs**	**Grasses & Sedges**	**Vines**
valley oak (*Quercus lobata*)	coyote brush (*Baccharis pilularis*)	blue wild rye (*Elymus glaucus*)	Pipevine *(Aristolochia californica)*
coast live oak (*Quercus agrifolia*)	brown dogwood (*Cornus glabrata)*	creeping wild rye (*Leymus triticoides*)	Honeysuckle (*Lonicera hispidula*)
big leaf maple (*Acer macrophyllum*)	American dogwood (*Cornus sericea*)	California brome (*Bromus carinatus*)	Manroot (*Marah fabaceus*)
Buckeye (*Aesculus californica*)	Snowberry (*Symphoricarpos albus*)	meadow barley (*Hordeum brachyantherum*)	
California bay laurel (*Umbellularia californica*)	Spicebush (*Calycanthus occidentalis*)	Santa Barbara sedge (*Carex barbarae)*	
Oregon ash (*Fraxinus latifolia*)	wild rose (*Rosa californica*)		

6.8.4 General Recommendations by Reach for Riparian Restoration

Following are recommendations for treatment of the riparian zone in specific reaches, according to the type, location and condition of riparian habitat along the stream channel.

A. ***Wide** **banktop and streambank stands of riparian trees with primarily non-native understory:*** This condition is found in Reach 1, Schumm Stages 3 and 4. The conceptual plan calls for installing in-channel structures to induce gradual, focused erosion and widening, creating a new floodplain.

   Recommendation: Preserve existing vegetation and, where feasible, remove the non-native understory species and replant with native shrubs and grasses.

B. ***Narrow banktop and streambank stands of riparian trees with native understory:*** This condition is found on the west bank of Reach 2 and parts of 8, Schumm Stages 4 and early 5. In these reaches the conceptual plan calls for Alternative C and D, local biotechnical bank stabilization and limited bank regrading/floodplain formation, while preserving banktop significant trees.

   Recommendation: Preserve existing vegetation and, where feasible, widen the banktop riparian forest, by planting native trees and understory species, coordinating with design of the recommended channel modifications.

C. ***Narrow** banktop and streambank stands of **riparian trees** with **non-native** **understory**:* This condition is found in parts of Reach 2, 4 and 8, Schumm Stages 4 and early 5. In these reaches the conceptual plan calls for Alternative C and/or D, local biotechnical bank stabilization and bank regrading/floodplain formation, while preserving banktop significant trees.

   Recommendation: As in condition b. above, preserve existing vegetation while widening the banktop forest where feasible, coordinating with design of the recommended channel modifications. Remove non-native species and replant with natives.

D. ***Narrow** banktop and streambank areas with **little to no overstory** and **non-native** **understory**:* This condition is found on the west side of Reach 4, Schumm Stages 4 and early 5. The conceptual plan calls for alternative D, creating of a new floodplain within a 65-foot wide swath along most of the reach and planting native species accordingly.

   Although some parts of Reach 4 are described in condition c. (above), much of this reach has little to no overstory, particularly on the west side. However there are some significant, mature trees on the east side and the southern part of the west side, which should be preserved where possible. This reach would benefit greatly from widening the riparian corridor and planting native overstory and understory species.

E. ***Wide active channel and floodplain and gravel bar areas with extensive riparian habitat** with cottonwood, willow and alder, and **native and non-native understory**:* This condition is found in Reaches 5, 6, 7, and parts of 3 and 8, Schumm Stages late 5 and 6. The conceptual plan for these reaches call for local biotechnical bank stabilization where necessary.

   Recommendations: These reaches should be managed to remove non-native species where possible, while suppressing their regrowth. It is very difficult and usually unnecessary to install new native plants in active channel areas, because the active channel is constantly scoured by floods. On the floodplain areas (above the bankfull scour zone), seeding with appropriate native grasses and planting willow cuttings and some sedge species is possible.

6.8.5 Vegetation Management for Pierce's Disease

Damage to vineyards from Pierce's disease (PD) is an important issue in the Rutherford reach of the Napa River. PD can be lethal to grapevines, and has caused significant damage in streamside vineyards. One approach to reducing PD in vineyards is through managing riparian plants that host the bacterium and insect vector that transmit it.

The following is a brief overview of the topic, with specific information for the Rutherford reach. Further information on Pierce's disease is available through the Napa County RCD 707-252-4188, the Department of Fish and Game 707-944-5500, and the UC Cooperative Extension 707-253-4221. Also visit the website: http://www.cnr.berkeley.edu/xylella/north/info.htm to find the "Information Manual:

Riparian Vegetation Management for Pierce's Disease in North Coast California Vineyards. September 2000." (available in hard copy through the Napa County RCD).

6.8.5.1 Background – Causes of Pierce's Disease

Pierce's disease is caused by the *Xylella fastidiosa* bacterium, which multiplies in the water conducting tissue of infected grapevines, causing water stress and often death of the vine. PD infections are transmitted by insects that feed on the tissue of an infected plant, pick up the bacteria and insert it into the tissue of another plant while continuing to feed. In North Coast counties the blue-green sharpshooter is the most important vector for the bacteria.

To pose a PD threat to grapevines, plants must carry the bacteria systemically (throughout the water conducting tissue) and they must be breeding hosts for the blue-green sharpshooter. There are several plants that fit the description, both native and non-native:

Table 5. Plants capable of harboring Pierce's Disease

Native Plants	Non-Native Plants
California blackberry	periwinkle
mugwort	Himalayan blackberry
California grape	wild grape (hybrid)
stinging nettle	
blue elderberry	
mulefat	

6.8.5.2 Vegetation Management for Pierce's Disease

Vegetation management for PD involves the removal or suppression of host species, and replanting with native plants that do not host PD. It is important to carefully plan, design and implement a PD vegetation management project, in order to protect wildlife habitat and prevent erosion that can result from vegetation removal. Also, the riparian zone is within the jurisdiction of the Department of Fish and Game and other regulatory agencies, and it is important to obtain appropriate permits before undertaking vegetation management.

As mentioned above, both native and non-native plants can be PD hosts. The non-native Himalayan blackberry, wild grape and periwinkle make up the greatest proportion in biomass of PD host species. In comparison, California blackberry, mugwort and the other native host species contribute a much smaller fraction to the PD problem. Therefore, in most cases it is possible to undertake an effective PD vegetation management project by removing Himalayan blackberry, periwinkle and wild grape, and selectively removing, but not fully eliminating, the native species. Blue elderberry is a special case, since it is the host plant for the federally listed (threatened) valley elderberry longhorn beetle, and the Department of Fish and Game prohibits its removal in Napa County, in addition to Central Valley counties.

6.8.5.3 Revegetating with Native Plants

It is interesting to note that PD host plants are primarily shrubs and groundcovers that grow in the understory of the riparian zone. Understory plants provide important food and shelter for wildlife, including ground nesting birds such as quail. When the understory is removed in a PD revegetation project, it is very important to replace it with native shrubs and vines that will not cause PD, therefore ensuring that the wildlife habitat is maintained.

There are a variety of native plants that can replace PD host species. A short list of recommended shrubs includes snowberry, spicebush, wild rose, dogwood, and coyote brush. Native grasses and sedges include Santa Barbara sedge, creeping wild rye, blue wild rye, meadow barley, and California brome. Vines include two native honeysuckle and a wild cucumber. Choosing the appropriate native plants can be complicated, since each plant has a preferred location on the streambank, a preferred amount of sun or shade, and a preferred soil type. The Information Manual: Riparian Vegetation Management for PD, provides a more complete listing of plants and their preferences. Consult with the Napa County RCD or other native plant specialists, for the correct plant selection.

PD revegetation projects require follow-up maintenance for at least 3 years, to ensure that weeds are suppressed and the native plants successfully reestablish. In addition, there is no time limit on monitoring for regrowth of PD host species, as unwanted seeds will wash down in winter from upstream infestations or be deposited by birds and mammals.

6.8.5.4 Pierce's Disease Revegetation in the Rutherford Reach

The vegetation mapping completed in April 2003 provides useful information about PD host plants. The data identify the approximate location of all plants in the riparian zone to the level of genus and often species. Using these data, maps were created that locate Himalayan blackberry and periwinkle in the riparian zone, and also indicate their density. Please see Figure 21 and Figure 22.

Many landowners in the Rutherford area have undertaken PD vegetation management projects, particularly in Reaches 2, 4, 5, 6, 7 and 8. As is evident on the maps of periwinkle and Himalayan blackberry, there remain extensive areas to be treated.

In some reaches, PD vegetation management projects can be undertaken immediately, while in others it may be wise to delay or undertake more limited vegetation management. In the reaches where major channel modifications are recommended (such as parts of Reach 2, 4, and 8), money spent on a complete vegetation management project could be wasted, since the areas replanted may be modified again in the near future. Therefore, "limited" vegetation management in such reaches may be more appropriate. This approach could involve removing host plants and installing native grass seed and willow as a temporary revegetation measure. Once the channel modifications are completed, a full revegetation would be done. Such a modified revegetation approach must be approved by the Department of Fish and Game during the permit process. Meanwhile, in areas where minor channel modifications or none at all are needed, PD revegetation need not be delayed.

6.8.6 Managing Invasive Plants

Nonnative invasive plants are widely recognized as a threat to the environment and commerce throughout the world. These plants often take over and replace native flora and fauna because they were introduced without their native predators, herbivores, and pathogens to control their populations. The following is a summary of a few common non-native invasive plants in the Rutherford reach that are threatening the health and integrity of the Napa River and its riparian habitat.

6.8.6.1 Arundo donax – *Giant Reed*

Arundo donax is an extremely fast-growing plant resembling bamboo. It can grow four inches per day, and up to 30 feet tall. This aggressive plant easily out-competes native understory vegetation and can potentially cause catastrophic wildfires that destroy the forests as well. A shallow root system and large above-ground biomass makes Arundo a poor stabilizer of stream banks and a potential source of debris that can exacerbate bank erosion and cause flooding.

A survey conducted in the winter of 2002 identified a total of 119 patches of Arundo in the Rutherford reach covering a total area of 22,865 square yards, or 4.8 acres. The locations and sizes of the Arundo patches are shown in Figure 23. A large portion of the Arundo is located downstream of Rutherford Cross Road where there is a much wider floodplain. Some of the property owners have initiated eradication projects in this area and their work has significantly reduced the amount of Arundo growing in the floodplain.

The Department of Fish and Game (DFG) is currently reviewing a grant proposal submitted by the Napa County Flood Control and Water Conservation District (NCFCWCD) to eradicate Arundo from the Rutherford reach. If the grant is approved, the DFG will provide funds to hire crews to cut and remove the Arundo biomass, the NCFCWCD will obtain the proper permits, prepare revegetation plans, provide herbicides, native plants, and technical support, and the landowner will conduct follow up treatments (e.g. herbicide application, tarping, etc.) and plant native vegetation.

6.8.6.2 Non-native Invasive Plants that Host Pierce's Disease

As mentioned in the section on vegetation management for Pierce's disease, there are several non-native plants that host the bacterium that causes PD, and the insect vector that transmits it. The most important of these non-native species, Himalayan blackberry (*Rubus discolor*), periwinkle (*Vinca major*), and wild grape (*Vitis sp.*), are also very invasive plants that take over large portions of the riparian zone, overwhelming native species and eliminating habitat for native wildlife. Removing them (and replacing them with native plants) will enhance the riparian habitat while improving the economic viability of vineyards.

6.8.6.3 Other Non-native Invasive Plants

Survey work conducted in 2003 also documented the presence of tree of heaven, black locust, and scarlet wisteria in the Rutherford reach. These non-native species degrade the health and integrity of the riparian zone by displacing native plants. Further survey work to identify and map these species in the Rutherford reach is highly recommended, as is the preparation and implementation of eradication plans.

Tree of heaven (*Ailanthus altissima*) and black locust (*Robinia pseudoacacia*) are trees that grow predominantly on the mid to top-of -bank. Fortunately, these weedy trees are still relatively uncommon in the Rutherford reach and easy to cut down and treat with herbicides. On the other hand, these trees are prolific seed producers and long-term monitoring will be required to remove young saplings until the seed bank is exhausted.

Scarlet wisteria (*Sesbania punicea*) is a recent invader of California streams, and was not known to occur in the Napa River watershed until it was spotted in the Rutherford reach in the summer of 2003. This plant is a high priority for eradication because it is on the California Exotic Pest Council's list of species that have the potential to spread explosively. Scarlet Wisteria is a deciduous shrub or small tree with lovely red flowers, and is quite attractive in people's yards. Plants that escape into the wild prefer to grow in the active channel bottom and aggressively invade gravel bars. The establishment of this plant on gravel bars can exacerbate bank erosion on outside bends.

6.8.7 Guidelines for In Channel Vegetation Management

Vegetation that grows in the channel, such as willow, tends to slow stream flows and trap sediment, forming point bars and in-channel islands. This process of vegetation growth and sediment deposition is natural, and often occurs in Stage 5 channels, as the river establishes a new equilibrium. It also occurs in Stage 6 channels once the new equilibrium has evolved, and the river adjusts within its banks. From the standpoint of river ecology these changes are desirable, because the point bars, back channels, and in-channel vegetation create ideal fish and wildlife habitat. Also, the new features help decrease flow velocities, and the overall erosive force of the river, because the length and roughness of the channel has increased.

Quite often in places where these features evolve, the opposite stream bank becomes vulnerable to erosion. As vegetation grows and point bars form on one side, the stream flow is focused on the toe and slopes of the opposite bank. The damage can vary from minor bank scour to full scale bank collapse and loss of property. If the opposite bank is well vegetated, the damage is often minimized as the foliage slows the flow on the soil surface and the roots hold the bank in place.

The landowner of the eroding bank has a variety of options. One is to allow the river to adjust by eroding the bank. Often this option is not feasible for economic reasons or because of desirable banktop structures. A second option is to "manage" the vegetation in the channel where the point bar is forming, thinning it and allowing the water to flow more easily and directly downstream, taking pressure off of the eroding bank. A third option is to install flow deflectors such as "barbs" or "veins" at the toe of the eroding bank to fold the flows away from the vulnerable bank. Yet another option is to strengthen the slope using biotechnical bank stabilization techniques, such as a willow mattress. Depending on the severity of the problem, one technique or a combination of techniques may be used.

Vegetation management may seem like the ideal route to take, since it is simpler and less expensive than installing flow deflectors and biotechnical slope protection. On the other hand, removal of in-channel vegetation can negatively impact the aquatic and riparian habitat, and can speed stream flows, possibly causing incision of the channel bed and bank instability downstream and upstream. In addition, vegetation management must be ongoing and can be labor intensive, since the willows will regrow and the point bars reform every year.

In certain circumstances, in-channel vegetation management can be an appropriate response if done carefully. The vegetation trimming should be done only in small, isolated and focused areas to minimize damage to habitat and adjacent property.

6.8.8 The Guidelines

In-channel vegetation management guidelines have been developed for the Rutherford Reach, in cooperation with the Napa County Flood Control and Water Conservation District (NCFCWCD). These guidelines assume that vegetation management will be done under the existing 1601 Routine Maintenance Agreement between the NCFCWCD and the Department of Fish and Game (DFG) (Notification Number: R3-2001-0610). Many of these guidelines were taken directly from the Agreement.

These guidelines will periodically be reviewed, modified as necessary, and approved by a standing technical team that is committed to stewardship of the river and that includes the landowners, land managers and agencies that make regulatory decisions.

Todd Adams or Mike Forte of the NCFCWCD will provide training and limited supervision for the crews (supplied by landowners) and conduct an inspection after the work is completed to ensure that the work was performed as approved.

- All vegetation to be removed shall first be flagged by landowner crews, and reviewed and approved by Todd Adams or Mike Forte of the NCFCWCD .
- Vegetation removal shall be performed only between August 1st and October 31st to minimize adverse impacts to fish and wildlife resources and their habitats, including nesting birds.
- Live vegetation removal shall be limited to plants that cause stream flows to directly impact adjacent or opposite stream banks or that cause debris jams that may result in excessive bank erosion or flood damage to property.
- No trees over 4 inches diameter at breast height (dbh) may be removed. Exceptions require the prior approval of a Department of Fish and Game representative.

- Trees larger than 4 inches dbh can be limbed up to a maximum 8 feet above the stream bed provided that vegetation with a high shelter or shade value for fish and other aquatic animals is preserved.
- Live willows which are cut and relatively straight can be stockpiled for use in local biotechnical bank stabilization projects. Willows to be used in biotechnical projects should be cut cleanly with no damage to the bark and placed in water in the shade to remain live and fresh.
- All debris generated from vegetation management work, including material stored for future biotechnical projects, shall be removed from the stream channel before October 31st.
- Cut plants flush with the ground surface or above, so as not to disturb roots.
- Use hand tools such as hand pruners, loppers or pruning saws. Avoid use of chain saws where possible, because of likely deposits of oil into the stream area. If chain saws must be used, use vegetable-based oils as a lubricant.
- For nonnative invasive species (NIS) removal only, Aquamaster (Rodeo®) may be used according to manufacturers directions. Methods of removal/control include cut-stump or cut, resprout, and spray regrowth. The cut-stump method is preferred within 6 feet of water to minimize herbicide drift into the water. During NIS removal, no alteration of the physical topography shall occur. Depending on the extent/scope of NIS eradication, a separate DFG/RWQCB permit may be required.
- No equipment shall be operated in a live stream channel.

Rutherford Dust Society
Napa River

Fish Habitat Assessment

Habitat-Type Map: All habitat units are grouped by function and physical characteristics according to Level II habitat typing methodologies, which summarize stream features based on fish habitat requirements. Pool types are combined, Flatwater includes glides, runs, and pocket water, and Riffles include both high and low gradient riffles in addition to cascades.

Legend

Tributaries

Napa River

Functional Habitat Type

Pool

Flatwater

Riffle

Dry

Survey Reach Summary:

Length: 4.14 miles (2.57 km)
Total Number of Units: 259
Total Pools: 105
Total Flatwater: 81
Total Riffles: 72

Percent Total Length:

Pools: 48%
Flatwater: 33%
Riffle: 19%

0 0.5 Miles

0 0.5 Kilometers

Map Scale = **1:15,843**

1 inch equals 0.25 miles

Source Data:
1:100,000 Routed Hydrography (CDFG)
7.5' USGS Topo Quad (Rutherford)
Napa RCD Habitat Survey data (2002)
Napa County Roads (Napa County)
Napa County Parcels (Napa County)

Napa County Resource Conservation District

Map by Jonathan Koehler
Napa County RCD
March, 2003
ArcGIS 8.2
G:\GIS\Projects\RDRT_Napa_Riv.mxd

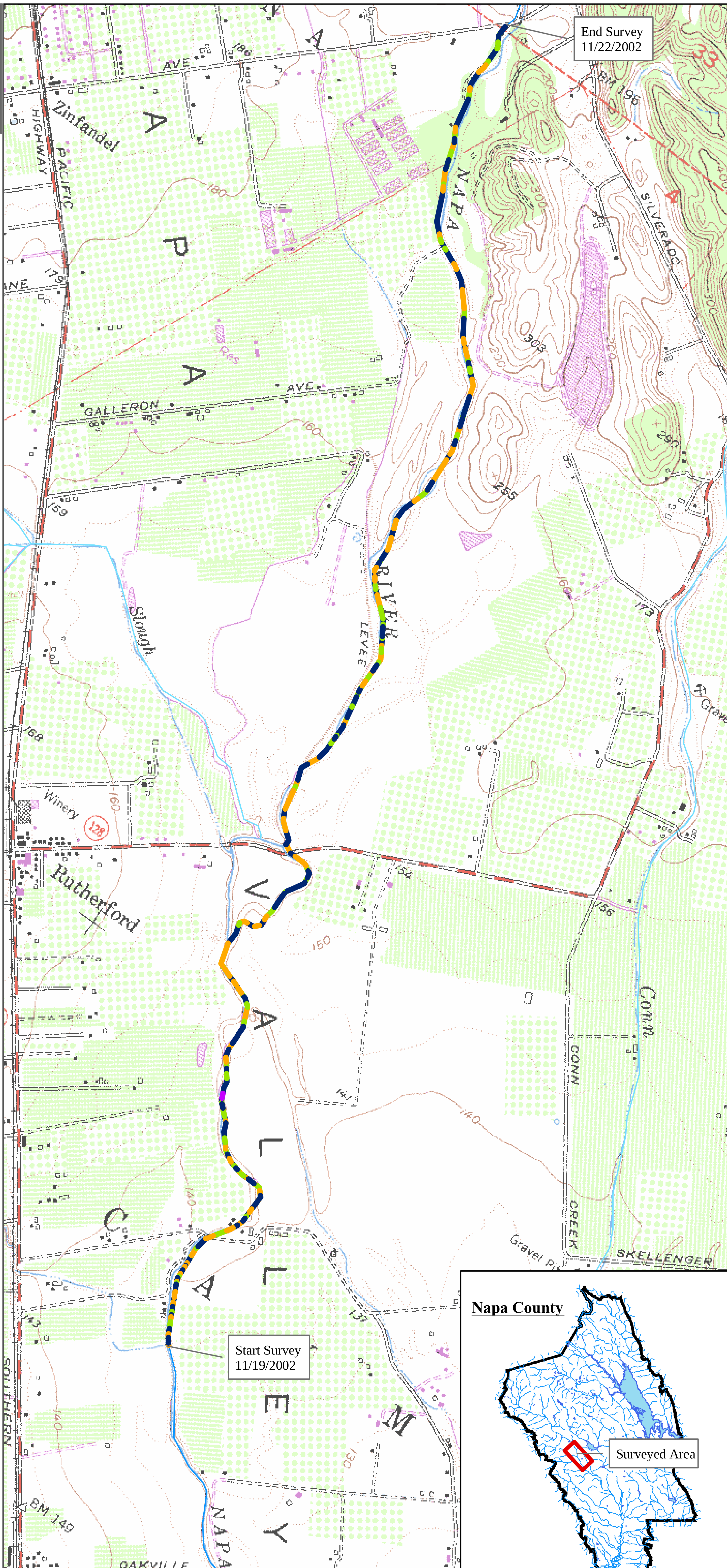

Figure 17. Habitat Type Map of the Rutherford Reach

Rutherford Dust Society
Napa River

Fish Habitat Assessment

Riparian Canopy Map:
Canopy densities were measured in approximately 30% of surveyed units using a spherical densiometer.

Legend

- Tributaries
- Napa River
- Roads

Percent Canopy

- < 25 %
- 25 - 50 %
- 50 - 75 %
- 75 - 100 %

0 — 0.5 Miles

0 — 0.5 Kilometers

Map Scale = 1:15,843
1 inch equals 0.25 miles

Source Data:
1:100,000 Routed Hydrography (CDFG)
Napa RCD Habitat Survey data (2002)
Napa County Roads (Napa County)
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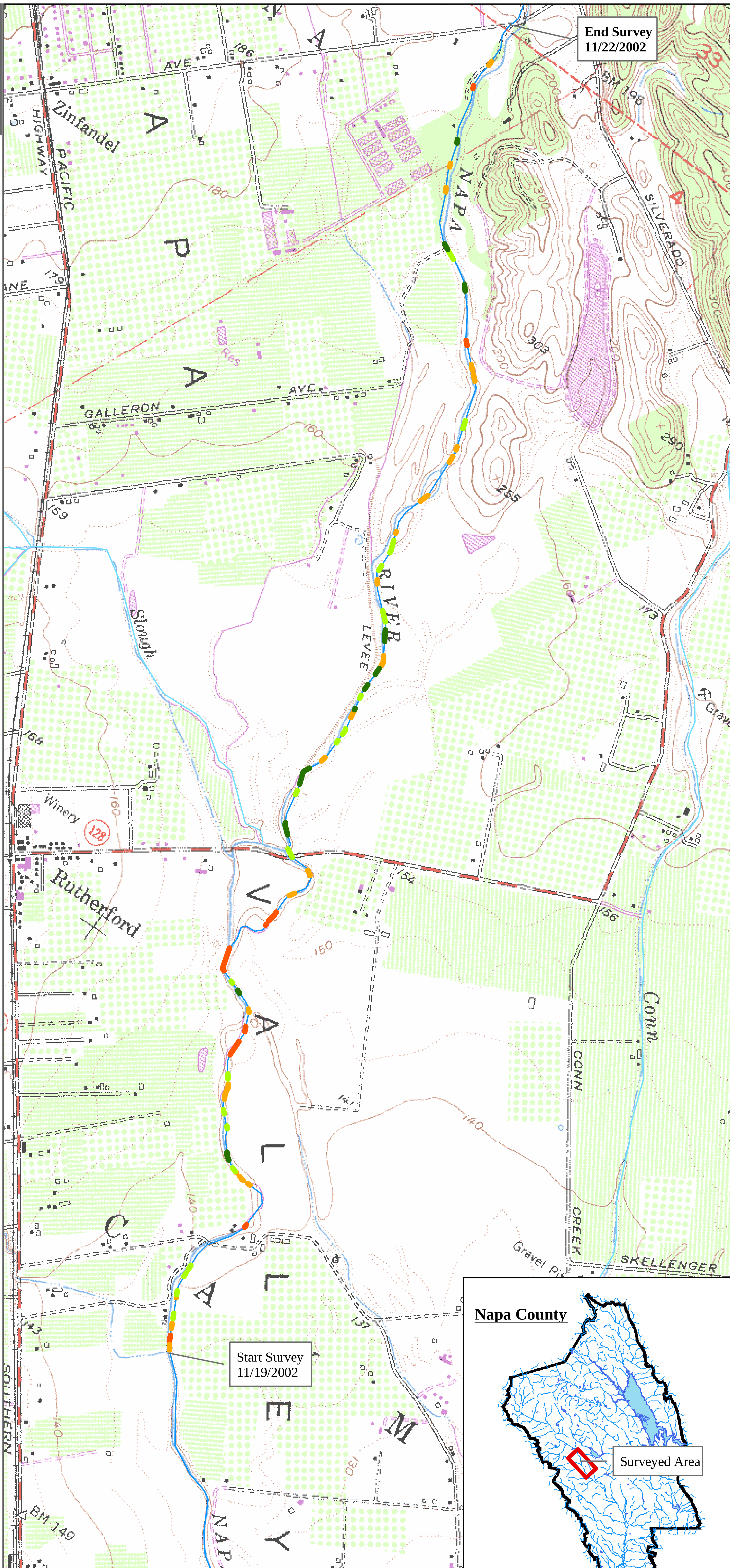
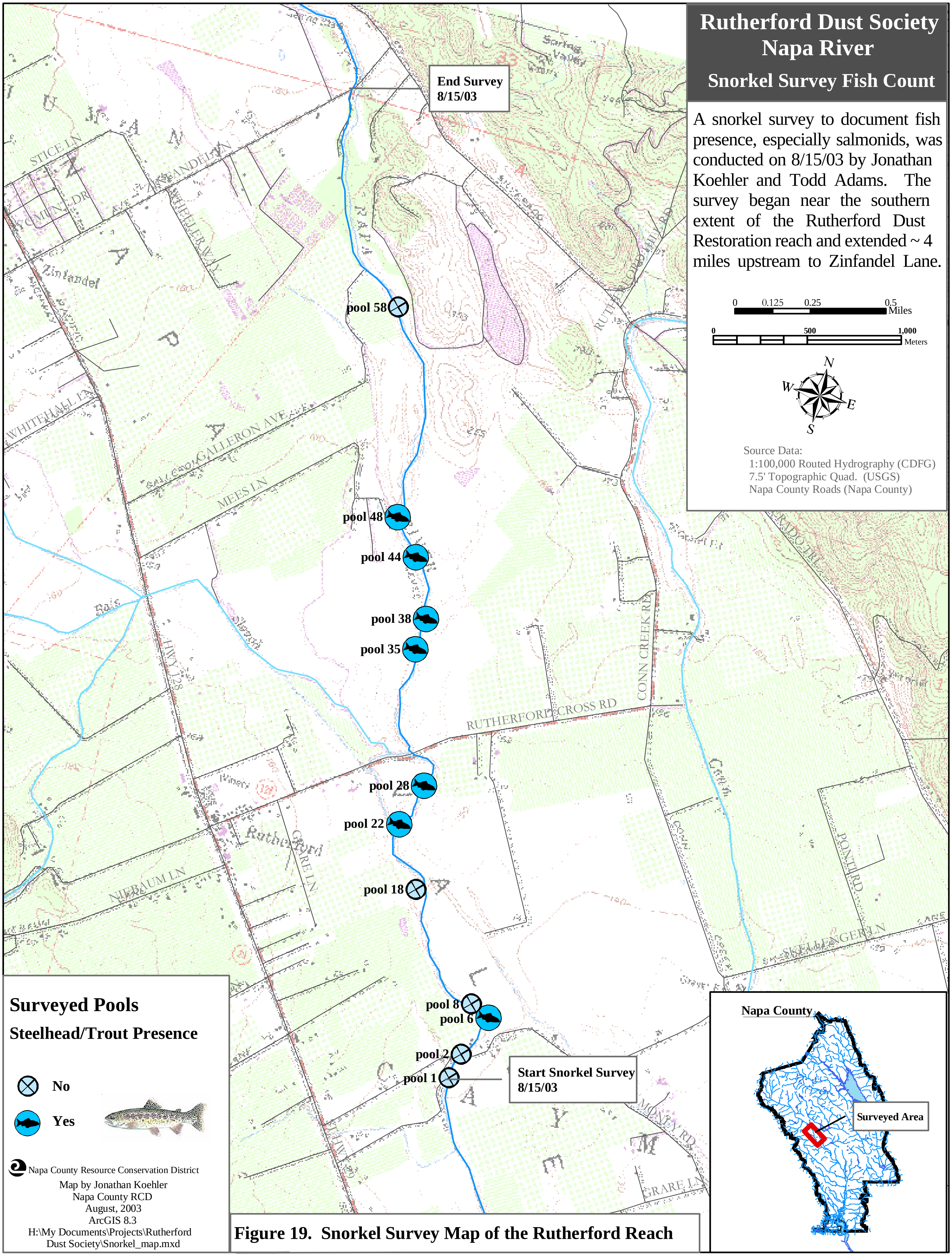


Figure 18. Riparian Canopy map of the Rutherford reach

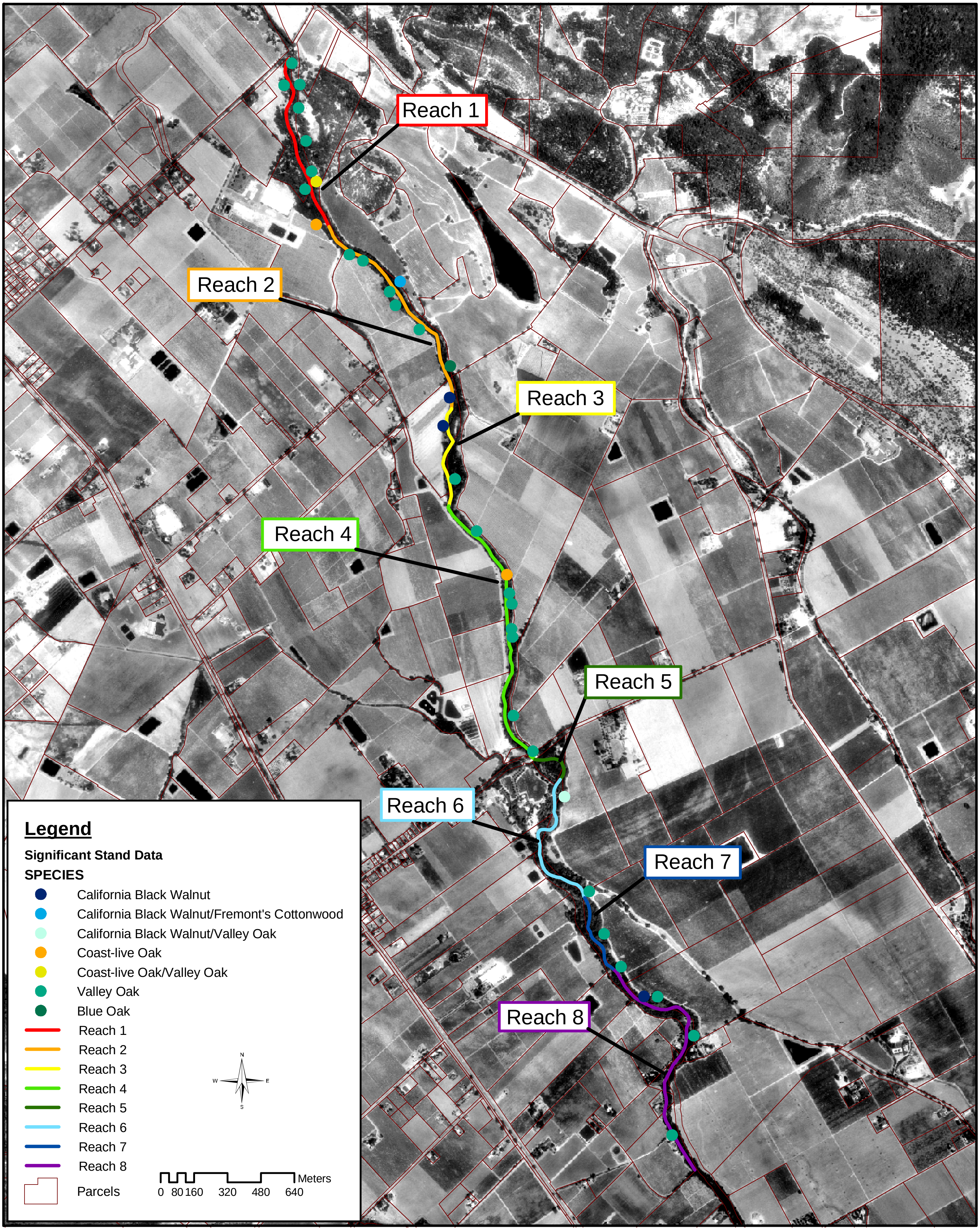
Rutherford Dust Society
Napa River
Snorkel Survey Fish Count

A snorkel survey to document fish presence, especially salmonids, was conducted on 8/15/03 by Jonathan Koehler and Todd Adams. The survey began near the southern extent of the Rutherford Dust Restoration reach and extended ~ 4 miles upstream to Zinfandel Lane.



Napa County Resource Conservation District
Map by Jonathan Koehler
Napa County RCD
August, 2003
ArcGIS 8.3
H:\My Documents\Projects\Rutherford Dust Society\Snorkel_map.mxd

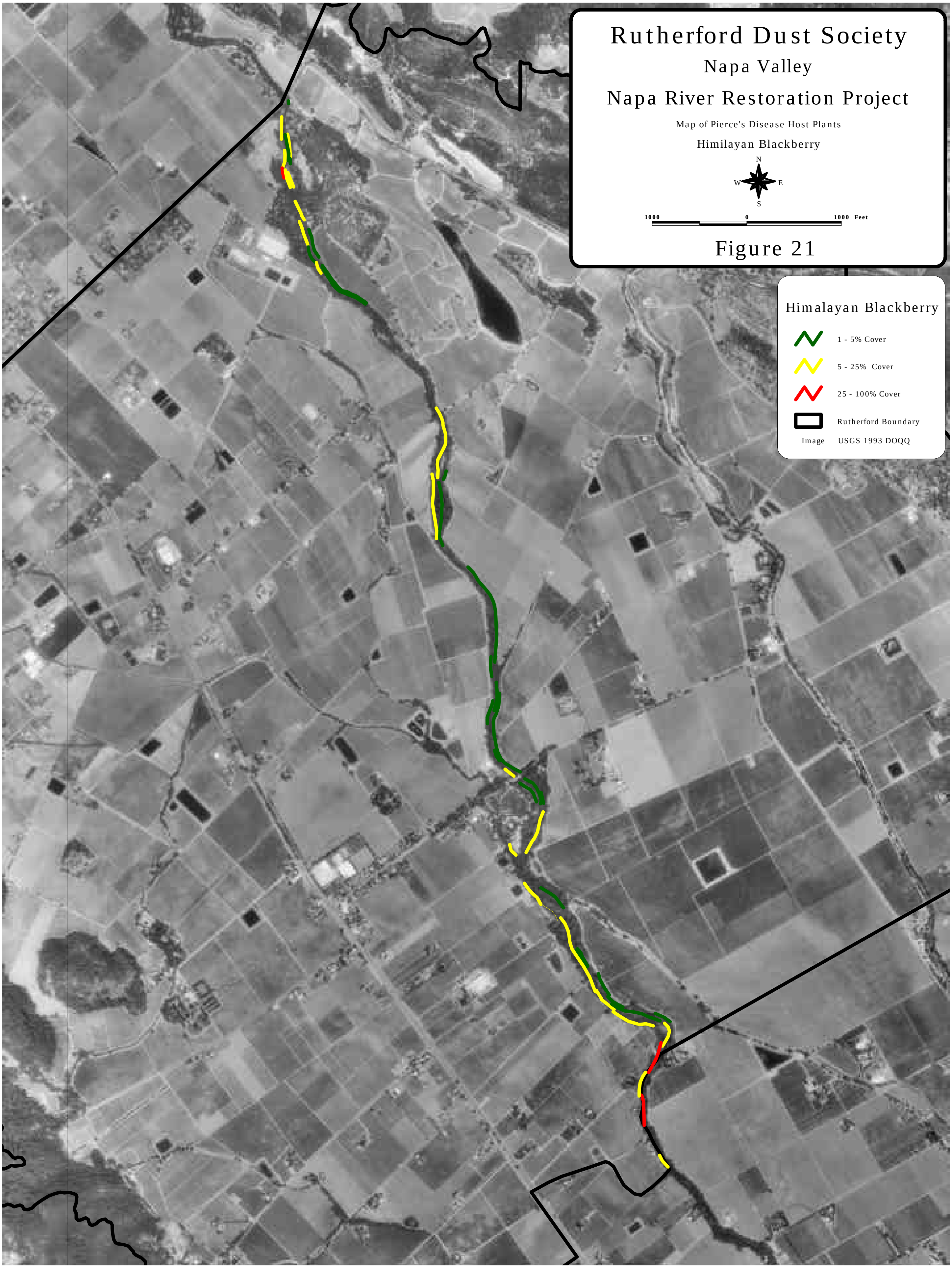
Figure 19. Snorkel Survey Map of the Rutherford Reach

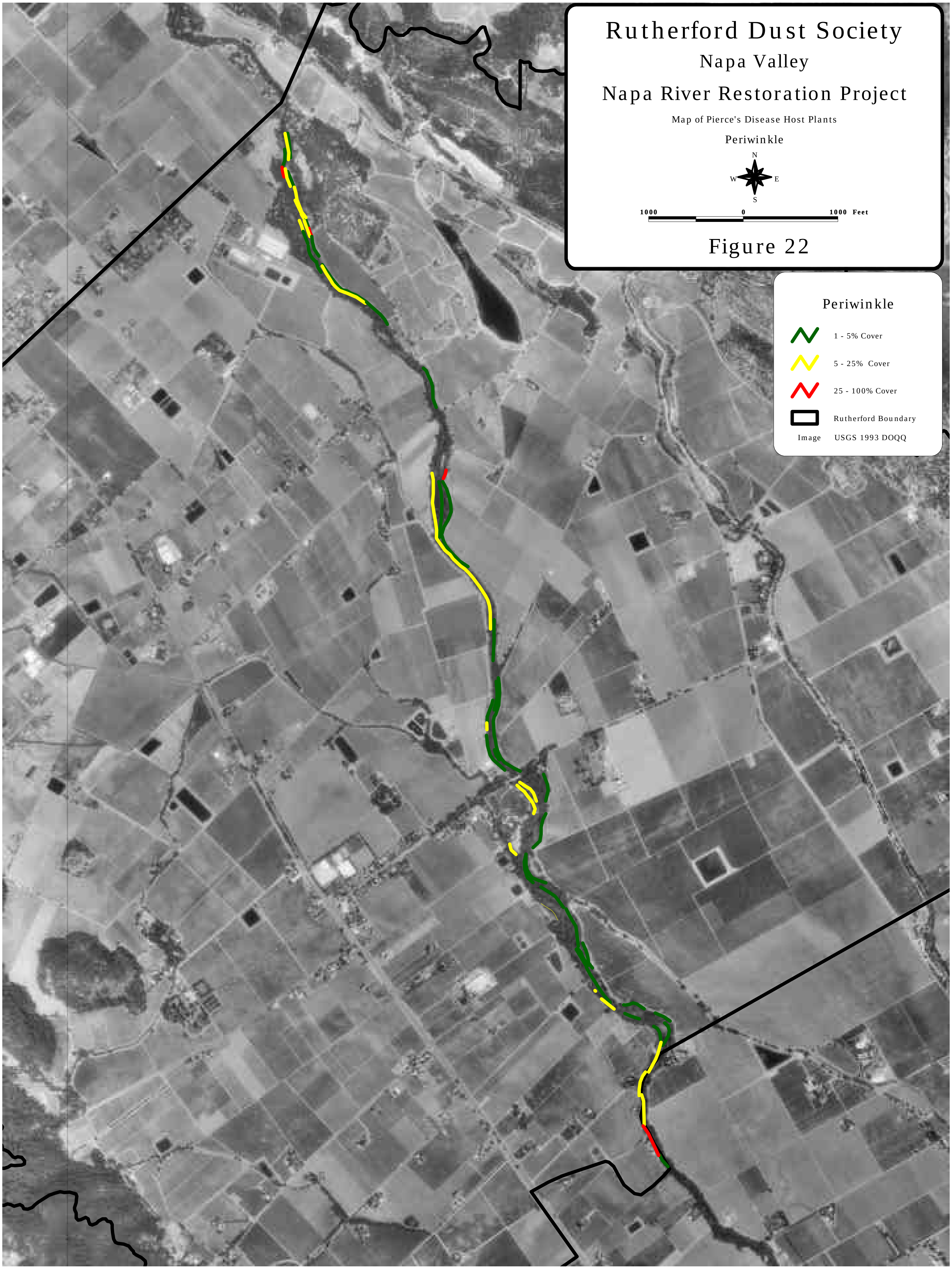


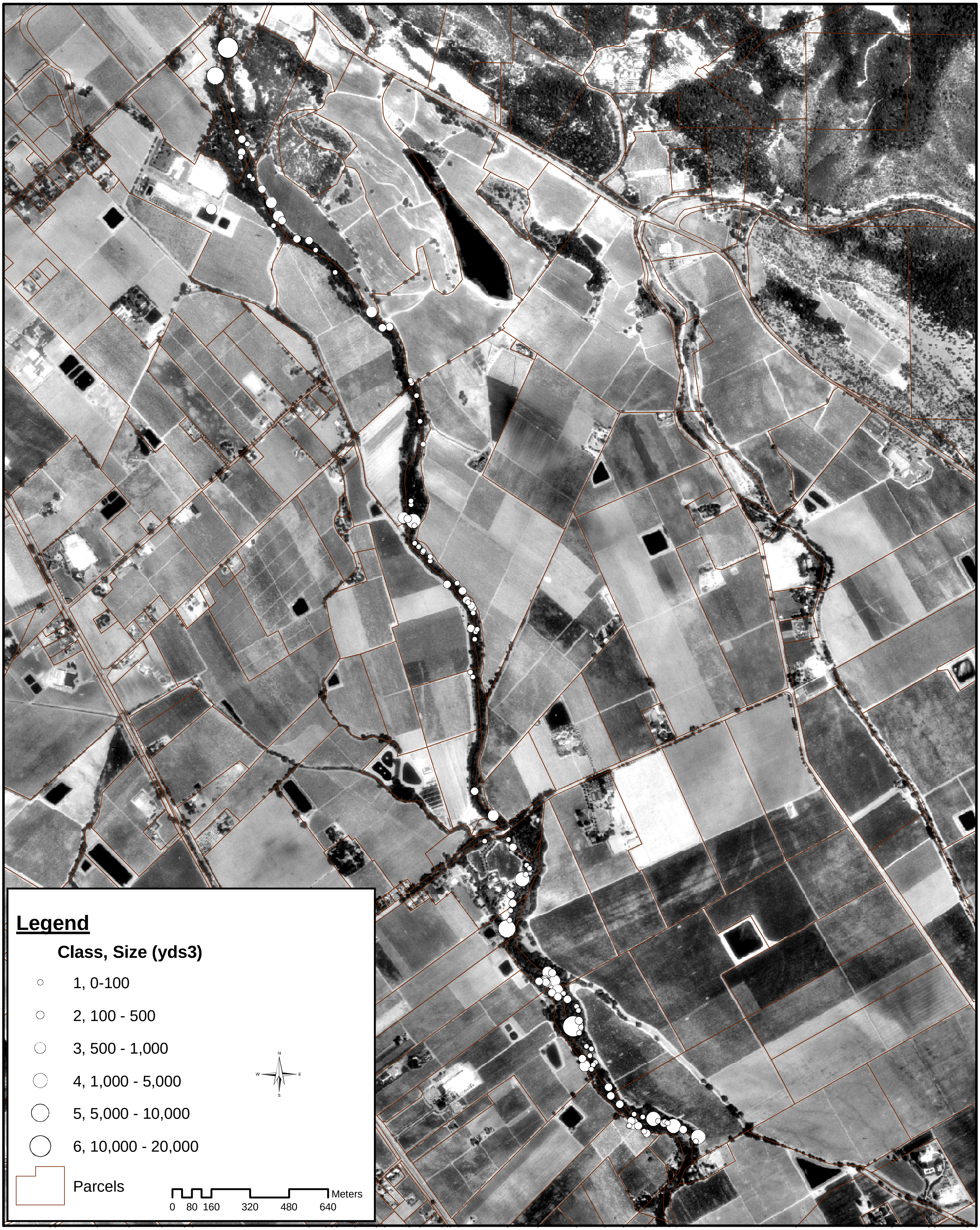
Napa River Rutherford Reach Restoration Conceptual Design
Significant Stand Vegetation

Figure 20

Napa County Conservation Division
Creation Date: 4/2003
Revision Date: 11/18/2003


Rutherford Dust Society
Napa Valley
Napa River Restoration Project
Map of Pierce's Disease Host Plants
Himilayan Blackberry
N
W
E
S
1000
0
1000 Feet
Figure 21
Himalayan Blackberry
1 - 5% Cover
5 - 25% Cover
25 - 100% Cover
Rutherford Boundary
Image USGS 1993 DOQQ


Rutherford Dust Society
Napa Valley
Napa River Restoration Project
Map of Pierce's Disease Host Plants
Periwinkle
N
W
E
S
1000
0
1000 Feet
Figure 22
Periwinkle
1 - 5% Cover
5 - 25% Cover
25 - 100% Cover
Rutherford Boundary
Image USGS 1993 DOQQ



Napa River Rutherford Reach Conceptual Design
Arundo Survey - October 2002

Figure 23

Napa County Conservation Division
Creation Date: 5/03
Revision Date: 11/18/03