Napa County Putah Creek Watershed
Watershed Assessment and Water Quality Monitoring Proposal
June 28, 2004

Lower Chiles Valley, Napa County Putah Creek Drainage

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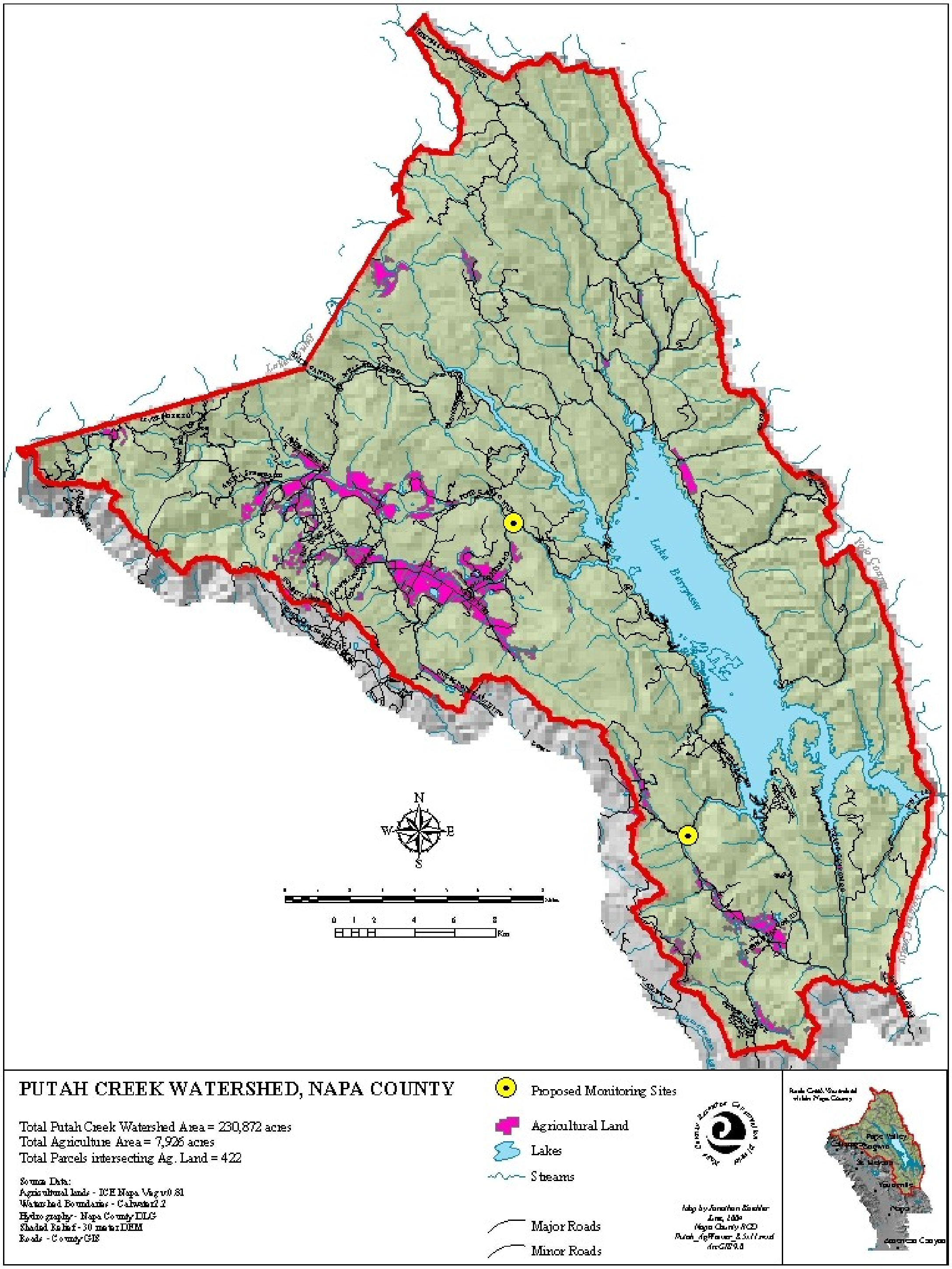
PUTAH CREEK WATERSHED, NAPA COUNTY
Total Putah Creek Watershed Area = 230,872 acres
Total Agriculture Area = 7,926 acres
Total Parcels intersecting Ag. Land = 422
Source Data:
Agricultural lands - ICE Napa Veg v0.81
Watershed Boundaries - Calwater2.2
Hydrography - Napa County DLG
Shaded Relief - 30 meter DEM
Roads - County GIS
Proposed Monitoring Sites
Agricultural Land
Lakes
Streams
Major Roads
Minor Roads
Lake Berryessa
N
S
E
W
Km

Introduction

In July, 2003, the Napa County Farm Bureau organized an informational meeting of landowners and farm agency representatives, to discuss local ramifications for the removal of agricultural waste discharge waivers in the Putah Creek watershed. Following this initial exploration of information known about Irrigated Lands Waivers, the NC Farm Bureau invited farmers in the Napa County Putah Creek area to join a coalition and apply for a group waiver. The group would organize to share best management practices and conduct water quality monitoring.

Since that initial meeting, representatives from Napa County Farm Bureau, USDA Natural Resouces Conservation Service, (NRCS) Napa County Resource Conservation District, (NCRCD), UC Cooperative Extension, and the Napa County Agricultural Commissioner have further studied the issue and determined that irrigated lands in the area are primarily drip-irrigated wine grape vineyards. These farm operations typically employ minimal use of chemical inputs and utilize farm cultural practices that present a very limited potential to impact downstream waters with pollutants of concern.

Water quality issues have been extensively discussed and addressed through various processes, including 2 different county watershed task forces and several technical advisory bodies, since 1989. This work has led to a series of local regulations to address soil erosion, water quality protection, and protection of riparian environmental resources. The resulting Napa County Conservation Regulations are widely regarded as some of the most comprehensive environmental protection statutes for agricultural land uses in the State of California. In addition, the trend toward utilizing more sustainable farming practices has had the effect of limiting farm chemical inputs.

On March 30, 2004, the Napa County Putah Creek Watershed Group, (NCPCWG) technical resource team, consisting of NCFB, NCRCD, NRCS, Dave Whitmer, Supervisor Diane Dillon, and Mike Napolitano, met with Region 5 RWQCB staff to present our initial findings and request a “low threat” finding for irrigated farmlands in Napa County. Region 5 staff, including Kelly Briggs and Bill Croyle found that the rationale for seeking a “low threat” finding was reasonable, but that staff were not in a position to make such a finding. Staff encouraged the NCPCWG to develop a basic water quality monitoring protocol proposal, which is incorporated into this report.

Watershed Setting:

The Putah Creek watershed encompasses lands in 3 counties. Headwaters in Lake County pass through Napa County and Lake Berryessa before entering Solano County, downstream of the Monticello dam. A total of 230,872 acres of land in Napa County drain into Lake Berryessa at the mid-point in the watershed. Most of the lands in the Napa County Putah Creek drainage are brushlands, rangelands, and include lands used in the past for quicksilver and gold mining.

Most of the Putah Creek watershed lands in Napa County currently have low-intensity uses. According to the Napa County Agricultural Commissioner's Office only 1.5% of these lands, or 3,461 acres, is devoted to more intensive agricultural production. Wine grape production encompasses 98.5% of that acreage, with olive production providing the balance. The vast majority of land in wine grape and olive production can be assumed to be irrigated. Drip irrigation is almost exclusively the mode of water delivery to these crops, although a small percentage of vineyards utilize overhead sprinklers for early spring frost protection of the vines. Dryland pastures and oat hay acreages in the 2002 County Agricultural Commissioner's report collectively added up to 5,760 acres, none of which are irrigated.

Over 80% of wine grape lands in the watershed drain to Lake Berryessa via Pope Creek from the northwest or Capell Creek from southwest portion of the drainage. Other lands noted in purple on the attached ICE map as "agricultural lands" are primarily non-irrigated, non-intensively farmed lands. These lands feed runoff to the lake from the north and east. A small area of irrigated lands north of the lake bordering the County line are part of wine grape farming operations in Lake County.

Climate:

In summer, Napa County is protected from the hot weather of the Central Valley of California by the coastal mountain ranges. The Pacific Ocean provides a source of cool, moist air in summer, and this steady flow of marine air holds temperatures at moderate levels.

Temperature patterns vary throughout the area because of the mountainous terrain. The range in temperature is greater in the higher mountainous valleys near Lake Berryessa.

The greatest variation in temperature occurs in summer. The average daily maximum temperature in July is in the 90's at Lake Berryessa. The highest temperature is more than 110° in the northeastern portion of the Putah Creek drainage. The average daily minimum temperatures are in the fifties throughout the County during the warm season.

Winters are generally mild, but there are occasional cold spells. In January, the average minimum temperature is in the thirties throughout the county, but a low of 15° has been recorded. Relatively warm temperatures are common in the afternoon. In January the average daily maximum temperature is in the middle fifties.

The last freezing temperature in spring generally occurs in March in most areas of the county, but it commonly occurs in February in the northeastern part. The first freezing temperature in fall generally occurs in November in most of the county and as late as December in the warmer northeastern part.

The growing season near Lake Berryessa is about 285 days. The vicinity of Lake Berryessa has greater climatic extremes than other parts of the county because of the mountainous terrain, which limits the effects of the Pacific Ocean.

Most of the annual precipitation falls during the period of November through April. The average annual precipitation ranges from 20 inches to 35 inches in the Putah drainage. The following precipitation map, taken from the NRCS Napa County Soil Survey provides a more detailed look at precipitation variation.

NAPA COUNTY, CALIFORNIA

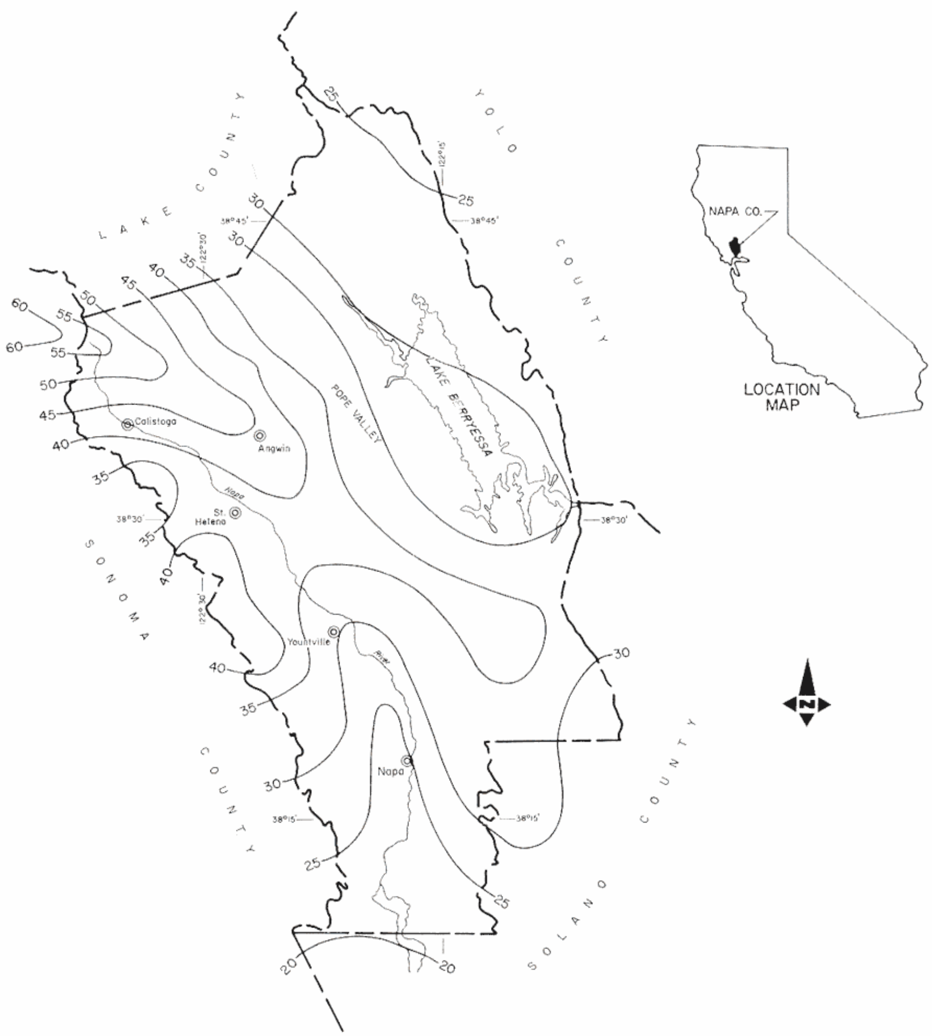

Figure 1.—Average annual precipitation in Napa County.

Land Use:

The great majority of land use in the Napa County Putah Creek drainage is recreation land, dryland rangeland, forestland, and mixed-shrub hardwood. These low-intensity uses account for over 98% of the acreage. In the close vicinity of Lake Berryessa, residences, vacation homes, and vacation mobile homes account for the most intensive land uses.

Soils:

The NRCS soil survey of Napa County lists 25 different soil mapping units on agricultural lands in the Putah Creek drainage. Most of these soils are upland soils and alluvial soils based in the Great Valley rock sequence of ancient marine sandstones and shales. A smaller portion of lands closer to ridgelines bordering the Napa River watershed are comprised of soils derived from igneous parent materials of the Sonoma Volcanics.

Erosion potential of these soils is variable. Depending on slope and soil "K" factor erodibility, most agriculture in the Putah Creek drainage is developed on lands with low to moderate erosion potential. Most hillside vineyards employ cover crops and various methods of storm runoff control practices to reduce soil erosion potential.

Attached to this report is a detailed soil map for agricultural lands in the Putah Creek drainage.

Drip systems supply the vast majority of irrigation water to vineyards, via low output emitters

Irrigated Lands:

Sources for irrigation water in the Putah Creek Drainage of Napa County are generally limited. No organized purveyors of water such as irrigation districts exist, leaving growers to develop their own sources. Typical sources of irrigation water are private wells and surface diversion impoundment reservoirs. Water rights are difficult to acquire from the State of California, and intensive County conservation regulations severely limit lands available for agricultural development.

Average annual application of irrigation waters varies from about 2 inches to 8 inches. Nearly all wine grape producers practice “deficit irrigation” following the recommendations of UC California researchers. This management scheme accounts for the relatively minimal irrigation applications, which are intended to boost wine grape quality.

Irrigation-induced soil erosion is not considered to be a concern in drip-irrigated wine grape vineyards. Application rates are well below minimum soil infiltration rates for all mapped soils in the Putah Creek drainage.

Runoff from farmlands is only a factor during the winter and spring rainy seasons. By the time initial runoff begins, usually in November or December, cover crops are providing ample control of runoff and erosion. Cover crops are also considered to be the most effective water quality protection measure. Cover crops provide very effective control of soil detachment and also enhance soil infiltration rates, which also reduce off-farm runoff.

Valuable Aquatic Resources:

The most notable aquatic resource in the Putah Creek drainage of Napa County is Lake Berryessa. Developed by the US Bureau of Reclamation in the early 1950’s, the lake provides recreation and is an important water supply source. Most waters are drawn by the Solano Irrigation District for use by Solano County farm and urban users. A small portion of waters, approximately 4,000 acre feet per year are allocated to Napa County, and are mainly used by urban lands around the western lake perimeter.

The dam at Lake Berryessa precludes the use of upstream waters by migratory fish species. Lake Berryessa is stocked for recreational fishing. Creeks feeding into the lake have some associated seasonal fish use, but most streams outside of the lake’s 440-foot elevation “take line” dry up in early to mid summer so do not provide perennial fish habitat.

Historic Water Quality Data:

Lake Berryessa is listed as an impaired water body by the Region V Water Quality Control Board. Mercury is the single pollutant or stressor noted in the 303D listing. The source of mercury is thought to be seepage and entrainment of materials from abandoned mines north of the lake. The Homestake Mine, a recently closed gold mine north of the lake operated a rigorous water quality monitoring program under state guidance to insure that runoff from mine tailings and mine reclamation areas met rigid water quality standards. The mine operated from 1983 to 2003.

The cities of Fairfield, Vacaville, and Benecia post annual water quality health-related standards for drinking water supplied from Lake Berryessa. A copy of the City of Benicia report is attached.

No known agricultural source or non-point source pollutants have been identified in the lake. In the early 1990’s, UC Davis undertook samples of cattle fecal matter to test for the presence of cryptosporidia. These samples were taken on dryland rangelands east of the lake, on ranches not mapped or classified as irrigated lands.

Pesticide Use in the Putah Creek Drainage

The vast majority of pesticides applied to lands in the Napa County Putah Creek drainage are applied to wine grapes. The following table summarizes pesticide use data compiled by the Napa County Agricultural Commissioner's office in the area. A total of 34 growers in the Putah Creek drainage (30 wine grape, 1 pasture, and 3 oat hay) reported pesticide use in calendar year 2003.

Winegrapes:

Pesticide/ Active Ingredient	Type of Pesticide	Amount of Pesticide Product *
Acetamiprid	Insecticide	11.9 lbs.
Avermectrin	Insecticide	0.8 gal.
Axoxystrobin	Fungicide	65.4 gal.
Bacillis subatilis	Insecticide	944.5 lbs.
Benomyl	Fungicide	5 lbs.
Bifenazate	Insecticide	21.1 lbs.
Capsaicin	Animal repellant	5.5 gal.
Carbaryl	Insecticide	5 lbs.
Copper hydroxide	Fungicide	291.4 gals.
Copper oxide	Fungicide	10 lbs.
Cyprodinil	Fungicide	29.4 lbs.
Dicloran	Fungicide	371.5 lbs.
Diquat dibromide	Herbicide	0.1 gal.
Fenarimol	Fungicide	7.8 gal.
Glyphosate	Transl. Herbicide	878.5 gal.
Hydrazine carboxyl acid	Acaracide	104.2 lbs.
Imidacloprid	Insecticide	27.8 lbs.
Kresoxim-methyl	Fungicide	52 lbs.
Mancozeb	Fungicide	30.3 gal.
Myclobutanil	Fungicide	431.1 lbs.
Napropamide	Herbicide	48 lbs.
Oryzalin	Herbicide	119.3 gal.
Oxyfluorfen	Herbicide	193.7 gal.
Paraquat	Contact Herbicide	0.7 gal.
Pendimethalin	Herbicide	22 gal.
Penetrants	Adjuvant	4.0 gal.
Petroleum distillate	Insecticide	3.4 gal.
Potassium bicarbonate	Fungicide	1818.4 lbs.
Pyridaben	Insecticide	30.8 lbs.
Simazine	Pre-Em. Herbicide	289.4 lbs.
Spreader binder adjuvant	Adjuvant	154.4 gal.
Sulphur	Fungicide/ Insecticide	75882.5 lbs.

Pesticide/ Active Ingredient	Type of Pesticide	Amount of Pesticide Product *
Tebuconazole	Fungicide	173.8 lbs.
Trifloxystrobin	Fungicide	98.5 lbs.
Trifumuzole	Fungicide	81.9 lbs.

Pasture and Hay, (Non-irrigated):

Pesticide/ Active Ingredient	Type of Pesticide	Amount of Pesticide Product*
2,4-D	Broadleaf herbicide	9.9 gal.
Bromoxynil	Herbicide	15.1 gal.

* Data reflects amount of manufactured product used, not active ingredient. Most manufactured products include inert ingredients, some at a very high percentage of the total product.

In pounds of active ingredient, elemental sulfur is by far the greatest pesticide usage in the Putah Creek watershed, distantly followed by glyphosate herbicide. Recent research results from evaluation of pesticide use data from Napa County by UC Davis (Napa County Agricultural Commissioner personal communication with Minghua Zhang [mhzhang@ucdavis.edu] and Jennifer Campos [jycampos@ucdavis.edu]; 530-754-9292) indicate a significant decline in FQPA I & II pesticide use in Napa County between 1993 and 2001 and substantiate that a high number of growers only use sulfur and glyphosate in their vineyards.

It should be noted that insecticide applications are not typically applied in the winter rainy season, when storm runoff from the land would be generated.

The January 2001 “Watershed Sanitary Survey Update” report, developed by Frank Morris, Solano County Water Agency, was consulted for further examination of historic and current water quality data. Mr. Morris was contacted by phone for further consultation, and was supportive of the NCPCWG concept for a “low threat” status finding. He referred us to Janice Oakley, CA Dept of Health Services, (DHS) for water quality sampling databases that the state maintains for Lake Berryesssa. Ms. Oakley found that 3 pesticides that are listed in the Napa County Agricultural Commissioner’s reporting in the Putah Creek area were tested for. Those materials included 2,4-D, Diquat, and Simazine. The DHS database indicated that in most years, there were no findings of the materials. It should be noted that the DHS monitoring locations would pick up runoff from Lake County, and runoff from non-agricultural lands around Lake Berryessa.

Existing Programs Addressing Water Quality Issues:

- ***Napa County Conservation Regulations***

In September, 1991, Napa County adopted some of the most stringent environmental standards in the State of California, enacting the Napa County Conservation Regulations Program. For the first time, this program addressed soil erosion, runoff, and riparian protection issues in developing and re-developing vineyard lands.

The ordinance requires that applicants planning to develop or re-plant vineyards on lands greater than 5% slope submit an erosion control plan. The plans undergo rigorous review by the Napa County RCD and County planning department. Additionally, all lands, regardless of slope, where vineyards are proposed for development must set back from seasonal and perennial creeks at least 35 feet, to allow for water quality protection, and riparian habitat protection.

The regulations require that growers propose and adopt best management practices, including cover crops, sediment control basins, storm runoff management, and riparian protection measures, before a permit is issued to allow for planting or replanting.

Pope Valley. No-till cover crop systems are commonly used to reduce runoff and erosion.

According to studies conducted by the NRCS, the potential for vineyard soil erosion in the County was reduced by more than 80%, following passage of the ordinance. Beginning in 1999, the County required growers to submit plans that fully addressed CEQA requirements, further restricting development of farmlands, under a rigorous set of new environmental standards.

A high percentage of the vineyards within the Putah Creek drainage have been developed or replanted since the passage of the County conservation regulations, so it can be assumed that the majority of these vineyards have instituted comprehensive best management practices to address water quality concerns.

- ***Green Certification:***

The **Napa Green Program** was officially launched in the spring of 2002. The purpose of the program is to develop a voluntary program where Napa Valley grape growers can participate in a farm planning process that will enhance the watershed, restore habitat, and use sustainable agriculture practices while addressing County, State and federal regulations such as the Clean Water Act, Endangered Species Act, California Department of Fish and Game Code, and County Conservation Regulations.

A Farm Plan addresses all aspects of the vineyard and property management. It outlines practices to achieve soil conservation, water conservation, stable drainage, riparian corridor enhancement, fisheries enhancement and long-term improvement and sustainability. An inventory and assessment of the natural resources, streams, soils, topography, and vegetation of the property as well as an analysis of current management practices must be performed as part of the plan.

The Napa Green Program recently received a grant in the amount of $292,000 from the Coastal Conservancy. This funding will allow for the development of the farm planning program, Beneficial Management Practices (BMP's), and initial farm planning workshops. These components will be custom for the conditions in the Napa River watershed, will be technically based, and will involve significant scientific analysis. The Napa Green Program creates a public/private partnership to help serve the needs of private landowners.

A Technical Advisory Group has formed which consists of local natural resource specialists such as USDA Natural Resource Conservation Service, Napa County Resource Conservation District, California Department of Fish and Game, Napa County Planning, Conservation and Development Department, Sierra Club, Friends of the Napa River, Napa County Farm Bureau, Napa Valley Vintners Association, Napa County Grapegrowers, individual growers and property owners and representatives from other interested stakeholder organizations.

The Program has support from a wide variety of groups including the Napa County Grapegrowers Association, Napa Valley Vintners Association, Napa County Farm Bureau, Sierra Club, the Audubon Society, the Napa County Agricultural Commissioner, UC Cooperative Extension, the Regional Water Quality Control Board, National Marine Fisheries Service and the Department of Fish and Game. The Napa County Resource Conservation District will be the lead agency in facilitating and administering the program.

Since its recent inception in 2002, the program has enrolled over 10,000 acres of land in the Napa River drainage. Some farmers from the Putah Creek drainage are expected to join the current version of the Napa Green Program, and the program itself is expected to expand into the Putah Creek drainage in the near future.

Proposed Water Quality Monitoring Program

The Napa County Putah Creek Watershed Group, (NCPCWG) is proposing to conduct its own water quality monitoring, in cooperation with the Sacramento Valley Water Quality Coalition, (SVWQC). Previously, the SVWQC had combined the Cache Creek and Putah Creek Watershed Group, (CCPCWG) and the the NCPCWG as a Lake/ Napa County unit. After the initial evaluation of the Napa County irrigated lands, the NCPCWG found that it would be most efficient and appropriate to conduct sampling under the Napa County RCD's water quality monitoring protocol. The rationale for selecting this approach can be best summarized by the following:

1) Irrigated agricultural lands in Napa County portions of the watershed represent a very small portion of the watershed, (3,400 acres within a 230,872 acre area).
2) Pesticide usage limited to a rather small palette of materials that have very low potential to become water quality contaminants. This is due to low usage, and application of material during periods of the year when runoff does not occur.
3) Virtually all farmlands are vineyards and olive orchards, which are drip irrigated, and most are farmed sustainably with practices such as cover crops. The cover crop programs and sediment management practices typically used or required for use by Napa County growers reduce soil erosion to very low levels.

4) Crops in the Lake County area include tree crops not grown in Napa County. These crops also typically involve a larger palette of pesticide materials not in use in Napa County.
5) The 2 proposed monitoring sites in Napa County will capture virtually all irrigated farmland runoff, with little or no background inputs of runoff from other land uses.

We therefore propose to extend the Napa County RCD's program of volunteer water quality monitoring to lands within the subject area. This program monitors regularly for temperature, dissolved oxygen, conductivity, and pH, and there is a further protocol for collecting samples for professional laboratory analysis. The RCD Water Quality Monitoring Protocol is included in the report appendix.

At least one monitoring site will be established in each of the 2 major Napa County Putah Creek drainages at Pope Creek and Capell Creek. The sites are located at a point downstream of major storm runoff, but above the high water level of receiving waters at Lake Berryessa. Specific monitoring sites will be selected based on a review of various criteria, including reported pesticide use, detections from previous monitoring, and the overall morphological, chemical, and physical characteristics of the hydrologic basin. Tentative locations of the 2 sites are shown on the attached map.

Temperature, dissolved oxygen, conductivity, and pH will be monitored at each site, and samples will be collected for chemical and physical analysis. A grab sample will be taken for chemical analysis, including an organophosphate/carbamate scan and specific tests for simazine and glyphosate. Another sample will be taken for analysis of suspended sediment concentration, (SSC), using ASTM Method D 3977-97, (Test Method B, Filtration).
Visits to the water quality monitoring sites will be carried out 4 times per year, approximately on the following dates: December 1, February 1, April 1, and June 1. If there is flow, all parameters will be measured, and sample collection and field measurements will be made by trained volunteers, or by RCD staff members. If there is no measurable flow, no water quality measurements will be made.

On each occasion when water quality monitoring is carried out, (a maximum of 4 times a year), a measurement of discharge will be made by RCD staff, with volunteer assistance. USGS-style velocity meters and wading or suspension equipment, and a depth-integrated composite sample, (equal transit rate method), will be taken for laboratory measurement of suspended sediment concentration, (SSC).

CA DHS has agreed to continue to supply the group with a database of Lake Berryessa test results for several pesticides known to be used in Napa County. We will compare these records with our own findings to supplement our knowledge of water quality in the general area. Additional interpretation may be required, as these sampled waters will include runoff from Lake County, and non-irrigated or non-agricultural lands in Napa County.

The Cache and Putah Creek Watershed Group has also developed a water quality monitoring program for lands upstream of Napa County. The Napa County Putah Creek Watershed Group will continue to coordinate and communicate with the Cache and Putah Lake County group, and explore ways the 2 groups might be able to complement each other's monitoring efforts.

Rationale for Low Threat

The NCPCWG continues to support the concept that irrigated agricultural lands in the Napa County Putah Creek watershed should be categorized as "low threat" lands, given the very low probability that agricultural operations pose water quality impairment potential.

Our findings and recommendations in summary are based on the following rationale:

- Irrigated agricultural lands are sparsely spread over a rather large area, comprising only 1.5% of watershed lands.
- Drip irrigated lands do not generate runoff during the growing season, when nearly all fertilizers, soil amendments, and pesticides are applied. On average, only 2 to 8 inches of supplemental irrigation water is applied to the land on an annual basis.
- As reported by the Napa County Agricultural Commissioner's Office, a very limited palette of pesticide materials are applied in very low quanitities on an annual basis in the watershed. Elemental sulphur is by far and away the most heavily applied material. Growers conduct intensive monitoring of pest and nutrient needs before applying materials to the land and crop. Recently reports indicate that application of pesticide materials on wine grapes in Napa County is on a downward trend.
- Regular studies conducted by the California Department of Health Service on waters of Lake Berryessa have not shown evidence of pesticide or nutrient materials of concern that would be generated from Napa County agricultural lands. All agricultural lands in the Napa County Putah Creek watershed drain to Lake Berryessa, and runoff to the lake is exclusively from winter/ early-spring season storm runoff.
- Napa County rigidly enforces one of the most intensive erosion control and water quality protection ordinances in the country. Enacted in 1991, the Napa County Conservation Regulations place strenuous requirements on all new vineyard lands and replanted lands on slopes 5% and steeper. These regulations require that growers provide scientifically defensible models and environmental studies to certify that runoff from the land does not carry significant amounts of sediment to streams and downstream lands. Commonly required erosion control practices include cover crops, buffer areas along streams, runoff management devices, and sediment control measures. Since enactment, the RCD and NRCS estimate that erosion rates have plummeted over 80%, as compared to pre-ordinance studies.
- Napa County grape growers regularly attend intensive training sessions on water quality protection requirements and technology transfer training on the latest Integrated Pest Management practices and environmental restoration technology. Groups such as the Napa Sustainable Winegrowing Group and the newly-enacted Green Certification Program draw large numbers of growers for seminars and training sessions that are held throughout the year.

APPENDIX:

NAPA COUNTY RESOURCE CONSERVATION DISTRICT
Napa River Watershed Monitoring

Water Quality Monitoring
PROTOCOLS

NAPA COUNTY RESOURCE CONSERVATION DISTRICT

Napa River Watershed Monitoring

Water Quality Monitoring Program
Site Selection

Site selection is coordinated between a member of the Napa County Resource Conservation District (RCD) staff and the volunteer monitor. The monitor may select a tributary or a reach of the Napa River in which he or she has interest, or may take on a site which is recommended by the RCD.

Once a general region for the monitoring site has been designated, the volunteer monitor and a RCD staff member go to the region and determine an appropriate location for the water quality monitoring. The preferred location for the testing is in a run habitat. A run is characterized by swiftly flowing reaches with little surface agitation and no major flow obstructions. If a run is not available, a site may be chosen in a glide habitat, or just upstream or downstream of a pool. However, during the dry season, as sites dry up, testing typically occurs in the nearest residual pool.

Water Quality Monitoring Program
Physical Site Assessment

A physical site assessment must be carried out at every site. The site assessment is done with the guidelines laid out in the RCD Site Survey Field Data Sheet. This survey can be conducted by the volunteer or an RCD staff member.

The vegetation portion of the survey is fairly detailed, and requires good riparian plant identification skills. It is important to ensure that the plant species have been correctly identified. The RCD has several volunteers who are trained in plant identification. Please contact the RCD at (707) 252-4188 if you are completing the site assessment survey yourself and are not confident with your plant identification skills.

Water Quality Monitoring
SAFETY SHEET

General:

1. Always let someone else know where you are, when you intend to return, and what to do if you don't come back at the appointed time.
2. Bring a field partner whenever possible.
3. Never cross private property without the permission of the landowner.
4. Watch for irate dogs, wildlife (snakes) and insects such as ticks, hornets, and wasps.
5. Carry a first aid kit and make sure someone knows how to use it.
6. Watch for poison oak, stinging nettle, and other types of vegetation that may cause rashes and irritation.
7. Never drink the water in the stream. Bring your own water from home.
8. Don't walk on unstable streambanks. Disturbing these banks can accelerate erosion and may prove dangerous if a bank collapses.
9. Be very careful not to disturb streamside vegetation.
10. Be very careful when monitoring if the stream is flowing swiftly, and do not attempt to wade into or across it under these conditions.
11. If at any time you feel uncomfortable about the condition of the stream or your surroundings, stop monitoring and leave the site.

When Using Chemicals:

1. Wear goggles (safety glasses) and gloves when handling chemicals.
2. Know your equipment, sampling instructions, and procedures before beginning.
3. Know the chemicals you are using and their hazards (see safety data sheets in kit).
4. Avoid contact between chemical reagents and skin, eye, nose, and mouth. Never use your fingers to stopper a sample bottle when shaking a solution.
5. Do not eat or drink while monitoring. Wash hands thoroughly before contact with eyes, food, or mouth.
6. Thoroughly rinse test tubes with de-ionized water after each test; dry hands and outside of tube.
7. Tightly close all reagent containers after use; check for correct cap.
8. Wipe up spills when they occur.
9. **Do not pour used chemicals or samples onto the ground or into the creek!** Place all solutions and used chemicals in a container and give to your field leader.

Water Quality Monitoring
Equipment List

All Parameters:
- ☐ Latex gloves
- ☐ Rubber boots
- ☐ Wide-mouth bottle for waste liquids
- ☐ Data sheet, pen, and clipboard

Conductivity
- ☐ Conductivity meter
- ☐ Eight batteries (#675, hearing aid): four in the meter and four extra
- ☐ Small screwdriver, attached to meter
- ☐ Conductivity standard solution: 447 uS
- ☐ Clear plastic cup

Dissolved Oxygen and Temperature
- ☐ LaMotte Dissolved Oxygen kit
- ☐ Sampling apparatus (where applicable)
- ☐ Bottle of Ivory Clear for cleaning
- ☐ Distilled water bottle and distilled water
- ☐ Towel to wipe spills
- ☐ Safety glasses and vinyl gloves
- ☐ Thermometer (LaMotte 1066)
- ☐ Bottle brush for cleaning

pH
- ☐ Litmus paper kit
- ☐ Clean cup to hold water during testing

Other
- ☐ Sample bottle with label for lab sample (when needed)

NAPA COUNTY RESOURCE CONSERVATION DISTRICT
Napa River Watershed Monitoring

Water Quality Monitoring Parameter
Temperature

Importance: Water temperature affects levels of dissolved oxygen, and is used to determine the percent saturation of dissolved oxygen. Many fish and aquatic organisms need a specific temperature range to survive. This protocol should be done in conjunction with the dissolved oxygen and conductivity tests.

Materials:

- ☐ Thermometer (Lamotte 1066)
- ☐ Data sheet, pen, and clipboard
- ☐ Dissolved Oxygen and Conductivity protocols and equipment

Procedure:

Air Temperature

1. Place the <u>dry</u> thermometer in the <u>shade</u> at the sampling site for three to five minutes. Read air temperature in degrees Celsius and record on Water Quality Monitoring Field Data Sheet.

Water Temperature

1. Place the thermometer in the stream at the same location that the sample was taken for dissolved oxygen. Keep submerged for at least three minutes.
2. Record the reading in Celsius under the “Water Testing” section of the Water Quality Monitoring Field Data Sheet.
3. Check your results against previous and historic results (if available) and acceptable ranges. Repeat the procedure if the reading is outside of the acceptable range or extremely different from typical results at that site.
4. If the procedure is repeated and the temperature reading is still outside the acceptable range, contact the RCD at (707) 252-4188.

The acceptable range for water temperature is approximately 2 – 23 C.

5. The thermometer should always be stored vertically. The RCD suggests storing it in the plastic graduated cylinder that is part of the dissolved oxygen test kit.

Water Quality Monitoring Parameter

Dissolved Oxygen

Importance: Dissolved oxygen is critical for fish and other aquatic species' survival in lakes, ponds and streams. Water with consistently high dissolved oxygen, 90% saturation or more, can support a greater diversity of aquatic organisms and a more stable ecosystem. Dissolved oxygen data, in conjunction with biological inventories and other water quality data, can be used to determine the capacity of the stream to support fish and other aquatic species. Low levels of dissolved oxygen may signal the presence of pollution in the water and indicate the need for further investigation.

Protocol Summary:

1. Take a sample of creek water using the bottle provided in the LaMotte test kit.
2. Using the titration method described below, and determine the amount of dissolved oxygen in milligrams per liter in the sample.
3. Determine the percent saturation of oxygen using the chart provided, correlating water temperature (*see Temperature protocol*) with the results for dissolved oxygen.

Materials

- ☐ LaMotte Dissolved Oxygen kit
- ☐ Sampling apparatus (where applicable)
- ☐ Wide-mouthed bottle for disposing of chemicals and dirty water
- ☐ Bottle of Ivory Clear for cleaning
- ☐ Rubber boots
- ☐ Distilled water bottle and distilled water
- ☐ Towel to wipe spills
- ☐ Safety glasses and vinyl gloves
- ☐ Thermometer (for Temperature protocol)

Important: ***Always wear gloves and safety glasses as you conduct this test. Wash hands afterwards.***

Dissolved Oxygen Protocol (continued)

Procedure:

<u>Collecting the Sample</u>

1. The sample should be taken from the reach of the creek determined during the site selection process, in the **main flow** of the stream. Avoid excessively turbulent or still water, and avoid areas near bridges or other

structures that impede water flow (unless you have specifically targeted these conditions for comparison sampling).

Note: Do not disturb the bottom of the stream upstream of the sampling site. Disturbances can affect the accuracy of results.

2. Rinse the sampling bottle at least once using the stream water.
3. Collect the sample at least 1” below the water surface and at least 1” above the stream bed. During low flow periods, sample from a pool and obtain the cleanest sample possible. Note the stream conditions on the data sheet in the comments section.
4. Hold the bottle upside down and immerse in the stream to collect the sample. Slowly invert the bottle underwater allowing air bubbles to escape.
5. Check the sample for air bubbles, gently tapping the side of the bottle to release any remaining bubbles.

Note: Air bubbles trapped in the bottle will artificially elevate the results.

6. Immediately cap the bottle. Hold the bottle by the capped end, so that your hand will not warm up the sample.

Note: Dissolved oxygen is extremely sensitive to temperature. If the sample warms up during processing, oxygen will be released from the sample affecting the results.

Important: The remainder of the dissolved oxygen procedure involves using the five chemical solutions in the kit. These solutions are called reagents, and should be handled with care.

- When adding reagents to the water sample, be sure to hold the reagent bottle vertically while squeezing the drops.
- The tip of the reagent bottle should be **½”** above the sample.
- **NEVER** allow the reagent bottle tip to touch the water sample because this will contaminate the reagent.
- A small amount of liquid from the sample bottle will be displaced and flow over the top as the reagents are added. The reagents will sink, so this will **not** affect results.

<u>Fixing (stabilizing) the Sample</u>

1. Remove cap from the sample bottle and **add 8 drops of *Manganous Sulfate*** (pinkish solution) holding the bottle of solution <u>vertically upside down</u> as you add the drops (see illustration).

2. **Add 8 drops of *Alkaline Potassium Iodide Azide***. Make sure to hold the reagent bottle vertically while adding drops.

3. Immediately **cap the sample** and invert the dissolved oxygen bottle gently to mix.

4. **Allow the precipitate (cloudy substance) to settle** below the shoulder of the bottle - 1-5 minutes.

5. **Add 8 drops of *Sulfuric Acid*** (be especially careful with this chemical). Cap bottle and shake vigorously until the dark brown crystals dissolve. A clear yellow color will appear. The sample is now "fixed" or stabilized and can be exposed to the atmosphere and temperature changes without changing the results.

Titrating the Sample

1. **Measure 20 ml** of the fixed sample (yellow liquid) into the graduated cylinder, being careful to check the measurement on a flat surface, with your eye at the level of the liquid. Transfer the liquid to the glass cylinder and cover the cylinder with the plastic cap.
2. Insert the titrator syringe into the hole at the mouth of the Sodium Thiosulfate bottle (with the plunger pressed down to the tip). Turn the bottle upside-down, and pull the plunger gently, **filling the titrator** syringe until the tip of the plunger lines up with the zero mark (see illustration). *Important: If there are any air bubbles in the titrator syringe as you begin to fill it, force them out by depressing the plunger back to the tip, then proceed to fill the titrator to the zero mark.*
3. **Add 8 drops *Starch Indicator*** to the solution and swirl the solution until it is a uniform blue/black color. Cap the glass cylinder.
4. **Insert the titrator into the hole in the cap** of the glass cylinder. By slowly pressing the plunger, add drops to the solution. Swirl solution after each addition.
5. **Continue adding drops** one at a time. As the color approaches pale blue, depress the plunger very slowly, allowing only 1/2 drop at a time. Continue until the liquid instantly turns colorless. Be sure to swirl thoroughly after each drop.

Note: Although color changes will occur where the drop first contacts the sample, the drop must be dispersed throughout the sample. The entire solution will turn clear and remain that way for 1-2 minutes when the process for the entire sample solution is at the end point.

NOTE: If the plunger tip reaches the bottom line of the titrator before endpoint color change, record the volume already used (probably 10 ppm or 10 drops). Then fill the titrator to the "7" line (adding 3 units of the sodium thiosulfate) using the small titrator tip attachment to extract the sodium thiosulfate (so that the titrator tip does not contaminate the reagant). Continue adding drops to the sample until the process is complete.

6. The correct result is the number at the point where the plunger tip meets the scale on the titrator (*if the titrator was refilled, add the first 10 ppm to the last reading to reflect the total amount of reagent dispensed*). Each minor division on the scale equals 0.2 milligrams per liter (mg/l). One mg/l = one ppm (part per million). **Record the test results in ppm on the data sheet.**
7. If your results are unusual or outside the acceptable ranges for dissolved oxygen, collect a new sample and repeat the above procedure. If the second set of results is still outside the acceptable ranges or normal range for the site, call the RCD at (707) 252-4188.

Acceptable ranges for dissolved oxygen are:
9 – 12 ppm in the summer and 6 – 11 in the winter.

Determining Percent Saturation

The percent saturation of oxygen in a sample of water depends on the water temperature. The colder the water, the more oxygen it can hold. *[For example, a sample with 10 Mg/L of dissolved oxygen at 10 C will have a lower saturation (87%) than a sample with 10 Mg/L dissolved oxygen at 15 C (97%).]*

1. To calculate percent saturation, you will need the results of the dissolved oxygen test, the temperature of the water, and the “Level of Dissolved Oxygen” chart (see next page).

2. Using a straight edge or a piece of paper, draw a straight line between the water temperature (at the top of the chart) and the dissolved oxygen value (at the bottom of the chart).

3. Note the value on the % Saturation line (sloping line in the middle) that your line crosses. **Record this value on your data sheet as the % saturation.**

Parameter: Water Quality Monitoring
Conductivity/Total Dissolved Solids

Description: Conductivity is the ability of water to conduct an electrical current. Dissolved ions (dissolved salts) in the water are conductors. By determining the flow of electricity through a water sample, we can detect the amount of dissolved ions in that sample. The conductivity sensor measures the electrical current (carried by the dissolved ions) flowing between two electrodes. A sample with a higher conductivity reading would have more dissolved ions, and vice versa.

Importance: The information gathered will create baseline data about the Napa River watershed and help to determine trends. If conductivity levels are high, it might signal the need for further investigation of additional water quality parameters.

Protocol Summary:

1. First **calibrate** the meter (before testing the water).

2. Immerse the meter's electrodes into the water sample. Only immerse to the brown line - **the meter is not waterproof**.

3. Record the number on the display.

Materials:

- ☐ Conductivity meter
- ☐ Eight batteries (#675, hearing aid): four in the meter and 4 extra
- ☐ Small screwdriver, attached to meter
- ☐ Conductivity standard solution
- ☐ Clear plastic cup
- ☐ Latex gloves
- ☐ Wide-mouth bottle for waste liquids
- ☐ Data sheet, pen, and clipboard

Procedure

Calibration of Instrument

Important: ***The conductivity meter MUST be calibrated before EACH use!***

1. Pour a small amount of conductivity standard (about 1/4 inch) into the clear plastic cup.
2. Remove the cap from the end of the meter, place the meter in the cup so that the electrodes are immersed in the liquid, and press the button on the face of the meter to turn it on.
3. Swirl liquid once gently and wait until the numbers on the display stabilize.
4. MAKE SURE you know the numerical value of your conductivity standard.
5. If the display does not read the correct number for the standard you are using, use the small screwdriver to turn the screw on the back of the meter. Adjust the meter, keeping the electrodes immersed in the standard solution and watching the display as it adjusts. It is correctly calibrated when it stabilizes at the same number as your conductivity standard.

Note: the meter only shows increments of 10 (for example: you will not see a # like 447)

Taking the Conductivity Reading

1. Dip meter into creek (if the creek is flowing swiftly see * below). Be sure not to immerse above the brown line. **THE METER IS NOT WATERPROOF.**
2. Swirl the sample once gently, then wait until the reading has stabilized. Record the number in the meter's display screen on the data sheet.
3. ***Switch off meter*** and replace cap. Batteries run down very quickly.
4. Check results against historical and recent results, and acceptable ranges. Repeat calibration and testing if the results are inconsistent or unusual. If results of the second testing are still unusual, call the RCD at (707) 252-4188

* When the stream is flowing swiftly, collect a sample from the main flow of the stream. The sample should be collected below the surface of the water, but above the stream bottom. Proceed to test the conductivity IMMEDIATELY from the gathered sample.

Note: Be sure to have extra batteries. You can not take a reading without them.

Acceptable ranges for Conductivity are 100 – 1000 uS/cm.

NAPA COUNTY RESOURCE CONSERVATION DISTRICT
Napa River Watershed Monitoring

Water Quality Monitoring Parameter
pH

Importance: pH is a measure of how acidic or basic (alkaline) the water is. as the pH decreases, water becomes more acidic, and as the pH increases, water becomes more basic. Fish and other aquatic life can tolerate only a limited pH range.

Materials

- ☐ Litmus paper kit
- ☐ Clean cup to hold water during testing

Procedure

1. Collect a sample of water in a clean cup from the main flow of the stream.
2. Tear off a small piece of the pH paper from the **lower range side** and dip it briefly into the water sample.
3. Match the color of the paper with the colors on the chart from the **SAME SIDE** (lower range side) of the pH kit.
4. If there is a close match in color, write the number under that color on your data sheet.
5. **If the match in color is a 6.0**, you <u>MUST</u> flip the kit over and tear a small piece of pH paper from **the higher range side** of the kit and repeat the above procedure using the color chart on the higher range side of the kit.

Acceptable ranges for pH are approximately from 6.0 – 9.0

Note: The pH kits we are using will only give you an approximate pH reading. They are not exact by any means. We are trying them out to determine if they are effective in noting significant alterations of pH.

Water Quality Monitoring
Lab Sample Collection

Importance: Taking actual samples from the creek and submitting them to the Department of Fish and Game laboratory provides additional water quality measurements across the entire watershed at one point in time. This will allow unusual occurrences to be noted. In addition, baseline information will be provided under different climatic conditions (winter spring, summer, and fall). DFG will test for hardness, alkalinity, turbidity, ammonia, and if warranted biological oxygen demand.

Materials
- Sample bottle with label for lab sample

Procedure

1. Samples will (most likely) be collected 4 times a year.
2. You will be notified by the RCD at least one week prior to the collection date.
3. The sample should be taken from the main flow of the stream. Submerge your sample bottle midway through the water column so that you are not collecting from the surface of the water or stream bottom, but midway in between.
4. Cap the sample bottle immediately and keep cool during transport.
5. The sample **MUST** be at the DFG lab within **12 hours** of the collection time.
6. **MAKE SURE** the label has the DATE, SITE NAME, SITE CODE, CREEK NAME, SAMPLER INITIALS, TIME of collection, and WATER TEMPERATURE of the creek at the time of collection.
7. Sample bottles can be dropped off either at the front desk of the DFG office on Silverado Trail in Yountville or at the RCD (if you give the RCD prior notice).

Note: If you suspect an unusual condition at your creek during when a lab sample collection is not scheduled, call the RCD at (707) 252-4188 to arrange a special lab testing of creek water from your site.

WHEN DATA SHEETS ARE COMPLETE

FAX completed data sheets to Napa RCD: **(707) 252-4219**

Or

Mail to: Napa County Resource Conservation District
Attn: Water Quality Program
1303 Jefferson St. Suite 500B
Napa, California 94559

If you have any questions or problems, call the office: (707) 252-4188