Appendix D

Flood Control Impacts in the Petaluma River Watershed

Flood Control Impacts in the Petaluma River Watershed

Prepared for

Southern Sonoma County Resource Conservation District
Petaluma River Watershed Enhancement Plan

Prepared by
Prunuske Chatham, Inc.
P.O. Box 828
Occidental, CA 95465
(707) 874-0100

July 1998

This project has been funded wholly or in part by the United States Environmental Protection Agency Agreement No. C6999482-97-0 to the State Water Resources Control Board and by Contract No. 6-048-250-0 in the amount of $144,115.00. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the State Water Resources Control Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Southern Sonoma County Resource Conservation District has contracted with Prunuske Chatham, Inc., an environmental consulting firm located in Occidental, to produce this document entitled *Summary of Flood Control Impacts in the Petaluma River Watershed.*

TABLE OF CONTENTS

SUMMARY OF
FLOOD CONTROL IMPACTS
IN THE PETALUMA RIVER WATERSHED

1.0 Introduction

Like most California rivers, the Petaluma River leaves its banks and spreads out into its floodplain on a regular basis. When the local human population was sparse, flooding was not considered a serious problem. Now, with lives and developed property at stake, it has become an urgent issue. Dramatic population growth, increases in paved and surfaced areas within the watershed, and ongoing erosion in tributary channels, combined with a recent spate of heavy storms, has galvanized the community and public agencies into action. The U.S. Army Corps of Engineers (ACOE) and the City of Petaluma (City) are beginning a channel widening project in the troubled Payran reach of the Petaluma River that will accommodate a 40-year flood event. The City and Sonoma County have also been considering flood control measures in the Denman Flats and Willow Brook Creek reaches.

Downstream of the City, large areas of agricultural land are dependent on a system of levees. Most were constructed by farmers and ranchers in the late 1800s when public policy championed the reclamation of salt marsh "wasteland" into productive use. The levee system is generally in good repair, but breaks do occur. Burrowing muskrats and wave action from boats and wind threaten levee integrity.

In the winter of 1997-98, levees in the Lakeville area were overtopped by the high flows in the river. Although flooding in this area does not have the impact on homes and other structures that flooding in the city has, it can have a profound effect on agricultural lands. The salt intrusion alone can seriously alter soil productivity. The Southern Sonoma County Resource Conservation District (SSCRCD) works with local landowners and the ACOE to secure blanket permits that allow ongoing levee maintenance.

As part of the *Petaluma River Watershed Enhancement Plan,* the SSCRCD has retained Prunuske Chatham, Inc. (PCI) to compile existing information on flood control, to prepare a brief summary of potential habitat impacts from proposed flood control projects, and to create a map of flood areas within the watershed. The map that delineates the 100-year flood zone as defined by the Federal Emergency Management Agency (FEMA) is attached.

2. 0 Summary of Existing Information

Given the long interest in navigation and flood control on the Petaluma River, many studies, reports, and histories of the river exist. The chief players

in flood control in the Petaluma River are the ACOE, the City, and the Sonoma County Water Agency (SCWA). The ACOE has maintained a channel for navigation from the mouth of the river to the Washington Street Bridge since the 1930s. SCWA is responsible for flood control throughout Sonoma County. The City, of course, maintains a vital interest in the safety and economic well-being of its citizens. The State Coastal Conservancy (SCC) and the City have also recently prepared an access and enhancement plan for a portion of the river corridor that addresses flood control as part of overall river management.

Below are brief summaries of several recent documents that address current flood issues. Each of these, in turn, contain extensive reference lists of additional information sources.

2.1 Sonoma County Water Agency. 1986. *Petaluma River Watershed Master Drainage Plan.* Prepared for the City of Petaluma.

The SCWA prepared the *Petaluma River Watershed Master Drainage Plan* at the request of the City and on the recommendation of the Zone 2A Flood Control Advisory Committee. Petaluma Basin Zone 2A encompasses 87 square miles and includes the Petaluma River watershed north of San Antonio Creek. A seven-member advisory committee meets at least once a year to recommend budget priorities to the SCWA Board of Directors (i.e., the Sonoma County Board of Supervisors). All of the members are residents of the District; six are appointed by the SCWA Board of Directors and one by the City. The *Petaluma River Watershed Master Drainage Plan* continues to guide the recommendations of the Zone 2A Flood Control Advisory Committee.

The master plan describes the hydrology of the watershed and identifies possible solutions to flooding problems. It includes brief sections on geology, climate, water quality, land use, and biotic and cultural resources. It also delineates areas of flooding for a 100-year frequency storm event.

The plan has a concise and interesting summary of previous studies of the Petaluma River going back to an ACOE report dated December, 1879, that recommends creating a 50-foot wide by 3-foot deep channel with three "cutoffs." The first flood control report in the list is dated 1896. It was prepared by the California Department of Public Works and recommended creation of a canal for navigation and the diversion of Lynch and Washington Creeks onto the salt marsh east of the town of Petaluma to reduce sedimentation in the main channel. The first ACOE report on flooding, dated August, 1942, concluded that "a plan could be developed to alleviate flooding and channel erosion on Petaluma River and its tributaries by construction of levees, channels, interceptor ditches and drop structures, along with implementation of proper grazing and land use practices."

The *Petaluma River Watershed Master Drainage Plan* identifies three areas that experience flooding that causes "serious damage to improved properties and structures." These are the Payran reach from the turning basin to the confluence with Lynch Creek, the Denman reach from Corona Road to the confluence of Liberty Creek and Willow Brook Creek, and the Willow Brook Creek reach, which begins just west of Stony Point Road and extends to Ely Road (see attached Map of Petaluma River Master Drainage Plan—Petaluma River Flood Mitigation Alternatives). After a brief discussion of non-structural flood control methods, such as public purchase of flood-prone property, the master plan describes three sets of structural flood control measures: 1) diversion and storage to slow and manage storm flows; 2) channel enlargement to allow storm flows to move faster through flood-prone areas; and 3) combinations of diversion and storage with channel modification. Hydrographs, which show the discharge over time, are provided for each alternative.

Diversion and storage alternatives include three elements: 1) the Petaluma bypass, which would collect water from Capri, Lynch, Washington, East Washington, and Adobe Creeks and divert it into Ellis Creek; 2) construction of a 12 to 15-foot high dam at Denman Flats, which would flood about 240 acres in a 100-year storm event; and 3) the Willow Brook Creek diversion, which would capture flow from Willow Brook Creek at Ely Road and divert it through an open channel to the reservoir created by the Denman dam. Hydrographs are also provided for the combination of the Petaluma bypass and the Denman reservoir and the combination of the bypass, the reservoir, and the Willow Brook Creek diversion.

Channel enlargement and modification alternatives are presented for three areas: 1) the Payran reach from just upstream of Lynch Creek to D Street; 2) the Denman reach from Willow Brook Creek to just downstream of Corona Road; and 3) the Willow Brook Creek reach from Ely Road to the Petaluma River. The channels proposed would be earthen with unspecified bank protection at "transitions, stress areas and bridges." Combinations of channel modification in two and in all three of the reaches are also presented, as is the combination of channel enlargement with diversion and storage elements. Table 3.2 on page 3-25 of the master drainage plan summarizes the costs, peak flows, and water surface elevations of all alternatives.

The plan also includes "34 Project Needs Reports" that summarize additional potential improvements to address street and property flooding throughout the watershed. Most involve construction of open channels or installation of concrete storm drains to move water out of flooded areas. Many follow natural waterways and could have a profound impact on riparian habitat.

The plan also includes a section on flood control financing and a very general Environmental Checklist, which concludes that environmental analysis

would have to be conducted on a project-by-project basis to determine if the projects would have a significant impact on biotic or historic resources. The discussion on cumulative impact is amazingly given current environmental standards, and it is limited to the impacts of construction of the smaller projects on the hydrology of the Petaluma River.

2.2 WESCO (Western Ecological Services Company, Inc.). 1988. *Summary of interim reports and advisory statements on the proposed Petaluma River Watershed Master Drainage Plan.* Prepared for the City of Petaluma.

WESCO was retained by the City to provide an independent review of the SCWA's *Petaluma River Watershed Master Drainage Plan*. The interim reports include a hydrologic and hydraulic analysis by Philip Williams & Associates (PWA) and a fairly in-depth report on biological resources prepared by WESCO. PWA concluded that the Denman dam by itself would result in only a 4% decrease in peak flows at the Payran reach. The bypass channel as proposed by SCWA would reduce the peak discharge at the Payran reach by 24%, and extension of the bypass to include Willow Brook Creek would decrease the Payran discharge by 40%.

The biological resources report identified potential impacts of the proposed flood control measures. Construction of the Denman dam would impact three acres of vernal pools and two species of concern, the Petaluma popcorn flower and north coast semaphore grass. The combination of the dam with the Willow Brook Creek diversion would also affect passage of steelhead trout to and from Willow Brook Creek.

The report indicates that the bypass could have far reaching biological impacts. The bypass could substantially reduce in size 14 acres of coastal salt marsh at the mouth of Ellis Creek. This area is the uppermost extent of the Petaluma Marsh and provides suitable habitat for California clapper rail, California black rail, salt marsh yellowthroat, and other species of concern. Pool habitat in the reaches of the creeks cut off by the bypass would be reduced or eliminated. Salmonid passage would be profoundly affected as would instream habitat for rearing salmonids and resident fish. Changes in the volume and timing of stream flow would also impact the health and species composition of riparian plants. The channel modification alternatives proposed by SCWA would impact riparian habitat and fish passage, particularly during construction.

The report briefly identifies possible mitigation measures, including the re-establishment of riparian vegetation and avoidance of salt marsh and other critical habitats where possible. Where avoidance is not possible, the report suggests construction of additional wetlands. As for fish mitigation, the report suggests self-cleaning fish screens and maintenance of flows that meet the

U.S. Fish and Wildlife Service (USFWS) passage criteria for chinook salmon and steelhead trout.

2.3 JNRA (John Northmore Roberts and Associates, Berkeley, CA). 1992. *Alternatives Report, Petaluma River Access and Enhancement Plan.* Prepared for City of Petaluma and State Coastal Conservancy.

This is the second report from a team of consultants retained by the City with funding from the SCC to develop an access and enhancement plan for a 7.8 mile reach of the Petaluma River from Willow Brook Creek to the Highway 101 bridge. The consultants worked with a citizen River Advisory Committee and a Technical Advisory Committee to create goals and select alternatives. At this time (July, 1998), the City is still engaged in the design process for this reach; no projects are currently scheduled.

The report considers many aspects of river corridor use, including recreation, natural habitats, economic development, and flood control. Two of the River Advisory Committee's nine primary goals are to maintain navigability of the river and to improve flood control. All of the alternatives call for a greenway with varying lengths of trails and for preservation and enhancement of riparian and adjoining habitats. The importance of linking habitat areas and using biotechnical bank stabilization to maximize even marginal habitat is emphasized throughout the report.

The report divides the study reach into six areas. The authors make recommendations for flood control and bank protection for each. The section on the Upstream Area (Willow Brook Creek to Lynch Creek) contains a discussion of the SCWA's proposal of a grassed trapezoidal channel versus the flood terrace configuration proposed by WESCO and PWA. Both channels are designed to carry a 100-year storm flow as recommended in the report, but the flood terrace configuration would incorporate a low flow channel and a bench that could be restored to wet meadow and riparian forest. An interesting series of cross-sections illustrating how each alternative would look at various locations is included in the report.

Recommendations for the Payran reach include widening the channel to accommodate the 100-year flood and establishing a continuous native vegetation zone along the river. The report encourages the community to work with the ACOE to develop a plan that provides both flood control and habitat restoration. Channel widening to handle a 100-year flood is also recommended for the Lakeville Agri-Industrial Area (Edith Street to, and including, Dairyman's Feed).

Appendix A to the report includes a summary of public input from many sources, including neighborhood meetings, the two advisory committees, and a workshop.

2.4 U.S. Army Corps of Engineers and City of Petaluma. March, 1995. Petaluma River, California, detailed project report for flood control. *Final Environmental Impact Statement/Environmental Impact Report.*

The City and ACOE investigated alternatives for reducing flood damage in the City from the Petaluma River. The specific study area extends from Lynch Creek to below Lakeville Street.

The Final Environmental Impact Statement (FEIS) addressed three alternatives: 1) no project; 2) channel improvements that would result in a 10-year level of flood protection, which is named the NED (National Economic Development) Plan because it was given the highest benefit-to-cost ratio of the plans considered; and 3) the Recommended Plan, which would result in a 40-year level of flood protection given the City's existing 2005 General Plan build-out scenario. The project designers assumed that full watershed development would occur by the year 2040 and that the natural upstream storage area of Denman Flat would remain in its present condition. Other alternatives, such as 100-year flood protection, flood-proofing, and flood control dams, were eliminated from in-depth analysis during the reconnaissance phase due largely to high costs and severe environmental impacts. Construction of the Recommended Plan is scheduled to begin in May of 1999, although at the time of the writing of this summary the ACOE has announced that they may be delayed by five months.

The Recommended Plan (see attached Map of Detailed Project Report—Petaluma River General Plan 40-Year Protection) includes approximately 3,700 feet of U-shaped and trapezoidal channel, replacement of two railroad bridges and two street bridges, 4,600 feet of concrete floodwalls, a weir at the upstream end of the project, and removal of two houses and one business. Unavoidable significant impacts identified are loss of 1.42 acres of riparian scrub-shrub, 0.17 acres of shaded aquatic habitat, 0.18 acres of emergent marsh, 2.13 acres of intertidal mud flats, 6.8 acres of grassland/ruderal habitat, 1.47 acres of exotic vegetation, and a gain of 4.04 acres of open water habitat. Mitigation measures for these impacts include revegetation of in-channel benches and the upper channel banks of the trapezoidal channel and revegetation of several areas totaling 9.28 acres with riparian scrub-shrub and grassland habitat. Proposed mitigation measures for the Sacramento splittail focus on planting riverside benches with emergent vegetation and riparian trees and piping freshwater flows around the construction zone to insure that downstream habitat would remain available.

The FEIS appendices contain the USFWS coordination report, which prescribes mitigation measures and advises the ACOE on the least environmentally damaging alternative. The recommendations include the statement that USFWS "maintain(s) that the Corps should adequately

evaluate the cumulative effects to fish and wildlife . . . in combination with other proposed development projects along the Petaluma River." The appendices also contain agency and public comments to the FEIS, along with the ACOE's responses. The transcript of the NEPA/CEQA hearing before the Petaluma City Council on August 15, 1994, is of particular interest in that residents bring up many concerns, especially in the arena of cumulative impacts, that would apply to future flood control projects, as well as to the ACOE project.

3.0 Summary of Potential Habitat Impacts from Proposed Systems

Environmental impacts rarely exist as discrete elements. Each is tied to many others with the resulting web of impacts often greater than the predicted sum of the parts. The appendices to the ACOE's FEIS, particularly the input of the USFWS and concerned citizens, raise many pithy questions about the effects of that project. The fisheries and riparian sections of the WESCO review of SCWA's *Petaluma River Watershed Master Drainage Plan* also presents some thoughtful information on immediate and long-term impacts.

Without the funding to finance independent studies, the role of concerned citizens and small public agencies such as Resource Conservation Districts is often to ask questions during the environmental review process and to make sure that everything that could possibly be impacted is put on the table for discussion. Well documented citizen monitoring can also be a powerful information tool. Photographs of flooding or erosion, observations of fish and other wildlife, and cost estimates of damages incurred to agricultural products are all examples of important information contained within the local community that is often missing from the official environmental review process.

The following list sums up the major areas of impact to habitat that are associated with flood control projects. These are discussed in greater detail in the reports listed in Section 2 above and in other sources referenced within these reports.

3.1 Riparian habitat.

Riparian habitat is in the direct line of fire in many flood control projects. In order to access the channel and alter it, trees and shrubs have to be removed. Trapezoidal channels break the connection between established riparian habitat and open water, one of the most productive habitat zones. Even most modified channel designs, such as the current ACOE project, that incorporate low flow channels and benches rarely allow that direct interface, although they do bring the riparian habitat closer to the water surface. On the positive side, riparian habitat restoration has proven successful throughout the state. The technology is well developed and effective. In areas where non-native

plants dominate the riparian zone, flood control projects can present an opportunity to restore a native plant community.

Projects that alter the flow regime, such as the bypass, can indirectly affect riparian vegetation by changing the water table and/or the length of time that creekside plants receive water. Year-round flows in Walker Creek in neighboring Marin County, which began in the 1980s, appear to have encouraged willow and alder growth on the lower banks. Reduction or removal of these flows, such as is proposed for the bypass, would favor the return of grasses and woody plants that flourish in drier conditions. Aquatic life that takes shelter in willow roots growing into the water could be profoundly impacted over time by changes in species composition.

3.2 Other wetlands.
In addition to riparian areas, other wetlands may potentially be impacted by proposed projects. Some impacts are direct, such as the loss or significant alteration of the upper end of the Petaluma Marsh at Ellis Creek if the bypass is constructed. The Denman dam and reservoir would drown several acres of vernal pool habitat. Other effects are less readily visible. Subtle changes in upstream hydrology can alter the quantity and quality of water entering wetlands and can change the amount of sediment flowing into them.

Wetland reconstruction and management is far from a precise science at this time. The relationship between water, topography, soils, tidal influence, and the biotic community is immensely complex. Artificial wetlands created for mitigation frequently do not function as predicted, and rarely fully replace the lost natural habitat. Rigorous monitoring of impacted wetlands for long periods of time following project construction—at least ten years—is essential to adjust management strategies to achieve mitigation goals.

3.3 Instream habitat and fishery resources.
Flood control projects that modify the channel invariably disturb instream habitat. In some examples, such as the current ACOE project in Petaluma, project designers claim they can restore most of the habitat to its previous condition. In more complex reaches such as in the upper tributaries, restoring pools, riffles, overhanging logs, undercut banks, emergent wetlands, and other elements of vigorous instream habitat to previous conditions would be a challenging, if not impossible, task. The channel maintenance required for the continued functioning of most flood control projects also returns the channel bottom back to its disturbed condition on a regular basis.

Upstream or downstream projects that change the hydraulics of the channel also change the shape and function of the instream habitat. Slower water, for example, provides more suitable habitat for different insects and plants than the faster moving streams.

Resident fish are impacted by many changes to their homes. Warmer water can breed disease or attract fish predators. Loss of cover leaves them vulnerable. Channel maintenance can disrupt their reproductive cycles. Salmonids are impacted not only by these immediate effects, but also by diversions or changes in flow regimes. The bypass proposals could result in insufficient flows to attract fish upstream to spawn in Willow Brook and Lichau Creeks. Returning fish could be stranded in the bypass or in Denman reservoir if it were constructed as part of the flood control system.

The WESCO report discussed in Section 2.2 above also states that migrating salmonids could be impacted by channel modifications in the main stem of the Petaluma River. Although they don't spawn or rear there, they need adequate flows and resting habitat to pass through it.

3.4 Agricultural resources.

The ability of a landscape to support its population is a basic component of environmental health. Conserving the productivity of agricultural lands is a vital responsibility, particularly in Sonoma County with its rapidly growing population. Flood control projects affect agricultural lands in many ways. The proposed Denman reservoir, for example, would seasonally flood over 400 acres of land, thereby limiting its use to crops or grazing practices compatible with seasonal inundation. Projects that change the rate of water and sediment flowing through the system, such as the proposed bypass and channel modification, could affect groundwater recharge, downstream flooding, and/or erosion.

On the other hand, flood control projects can protect agricultural lands from the harmful impacts of floods. Reservoirs can provide water for irrigation and fire control.

Agriculture can also impact flooding. Concerted erosion control efforts can reduce downstream sedimentation and ultimately increase channel capacity over time. In the Petaluma River watershed, the impact of upstream erosion on City flooding is far outweighed by the impact of development in the floodplain and the covering of permeable surfaces with pavement and structures.

3.5 Stream function.

Many channel modifications profoundly affect the flow of sediment through a system. Although they may solve one problem, they can also create or exacerbate others that will require ongoing mitigation work. Channel straightening, for example, can increase flow velocities and lead to increased bank erosion downstream. Projects that decrease a stream's gradient can cause sediment deposition and require regular cleaning, which can be a profound disturbance to any habitat that does become established in the new channel.

Flood control projects can also change the quantity and timing of water flowing through the channel. The Denman dam, for example, would hold flows and release them slowly. The bypass proposals would reduce the volume of water flowing through each of the affected creeks downstream of the bypass. As was discussed above, these changes in water availability affect both the biotic habitat and agricultural production.

3.6 Economics.

Although not a direct habitat impact, economics are the engine driving many flood control projects. Since projects that take better care of the environment often cost more initially, cost is often used as the reason to choose other alternatives. Some questions that can help to clearly define the actual bottom line include:

- Are permit acquisition and public review costs realistically built into the budget? What, for example, does a three-year fight with the USFWS actually cost taxpayers?

- Is maintenance realistically included in the budget, including acquiring appropriate environmental permits?

- What is the long-term cost-to-benefit ratio for agricultural operations and small businesses impacted by the proposed project?

- Could there be long-term cost savings by incorporating community enhancement goals into flood control projects in one fell swoop, rather than constructing multiple projects? Would other funding sources become available if this were done?

3.7 Cumulative impact.

Cumulative impact is the orphan of many environmental reviews. Even with a rigorous scoping process, the decisions regarding what will be included in the cumulative impact analysis and to what extent is highly subjective. Limited budgets and official mandates further constrain the breadth of inquiry. Frequently, the local community needs to serve as the memory and voice of all the different projects and plans occurring within a watershed. Again, it is not always necessary or even possible to know the answers, just to articulate the community's questions and concerns.

4.0 References

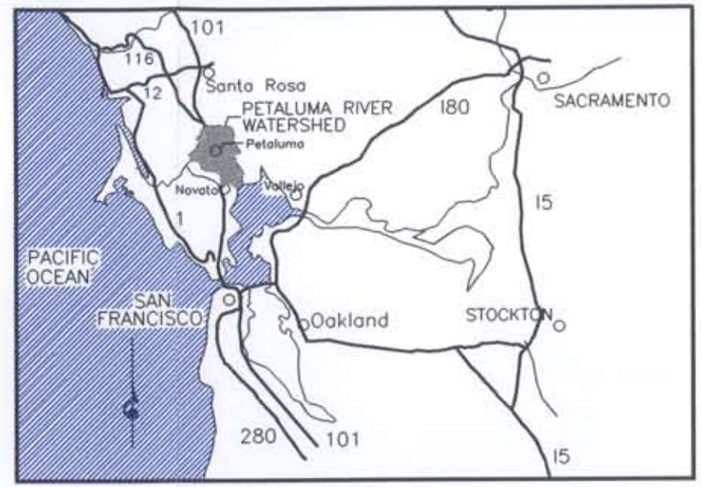
Hargis, Tom. City of Petaluma. June, 1998. Personal communication with Martha Neuman and Liza Prunuske, PCI.

JNRA (John Northmore Roberts and Associates, Berkeley, CA). 1992. *Alternatives Report, Petaluma River Access and Enhancement Plan.* Prepared for City of Petaluma and State Coastal Conservancy.

Sonoma County Water Agency. 1986. *Petaluma River Watershed Master Drainage Plan.* Prepared for the City of Petaluma.

U.S. Army Corps of Engineers and City of Petaluma. March, 1995. Petaluma River, California, detailed project report for flood control. *Final Environmental Impact Statement/Environmental Impact Report.*

WESCO (Western Ecological Services Company, Inc.). 1988. *Summary of interim reports and advisory statements on the proposed Petaluma River Watershed Master Drainage Plan.* Prepared for the City of Petaluma.



VICINITY MAP

LEGEND

- PETALUMA CITY BOUNDARY
- CONTOUR LINE @ 100' INTERVALS
- HYDROGRAPHIC FEATURE
- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- 100 YEAR FLOOD PLAIN

PRUNUSKE CHATHAM, INC.
P.O. BOX 828
OCCIDENTAL, CA 95465
(707) 874-0100

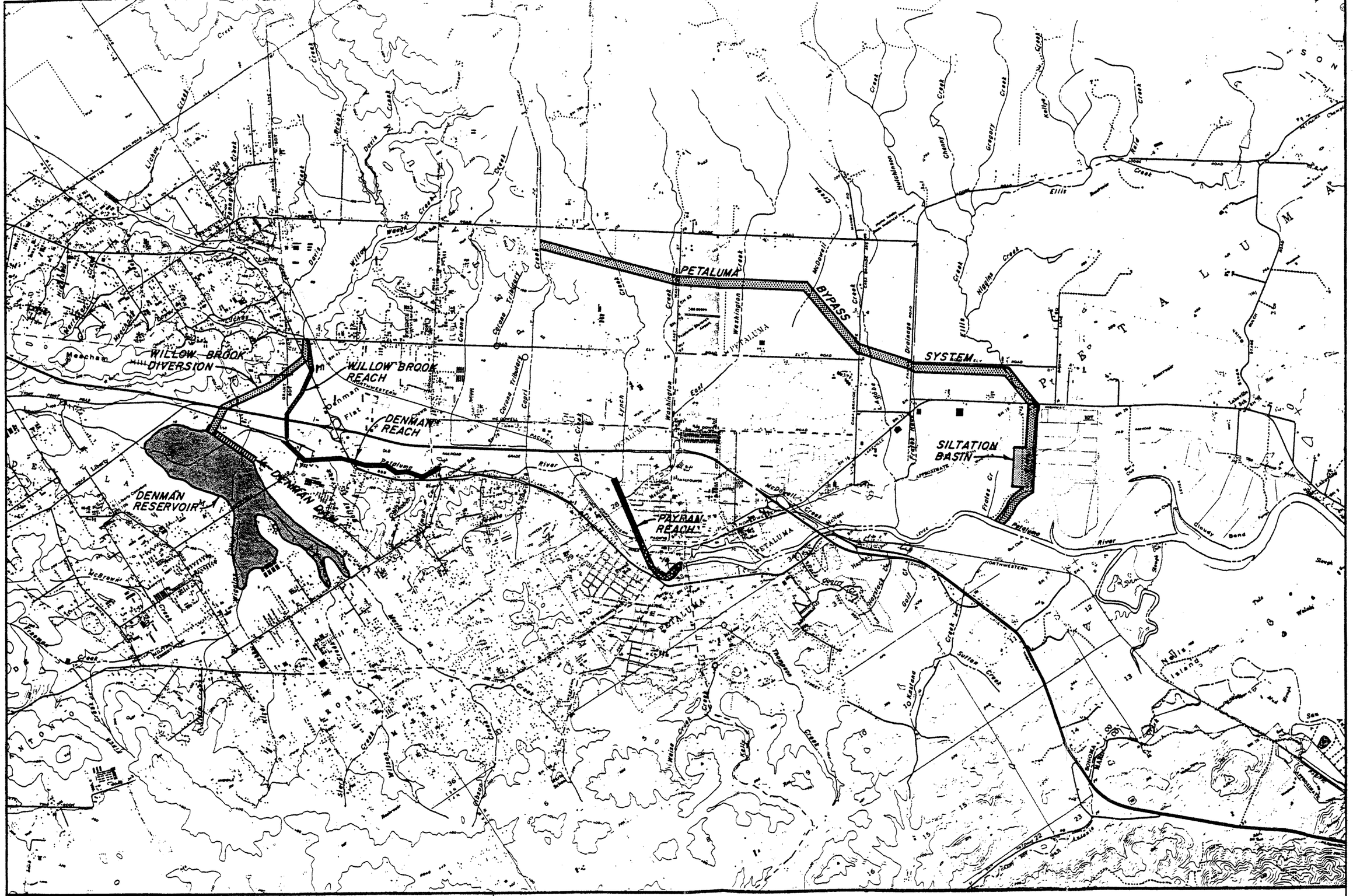
DATE: May, 1998
SCALE: 1" = 5,000'
CHECKED BY: MN
DRAFTED BY: EA

REVISIONS	BY	

PREPARED FOR:
SOUTHERN SONOMA COUNTY
RESOURCE CONSERVATION DISTRICT

100 YEAR FLOOD PLAIN IN THE PETALUMA RIVER WATERSHED

SHEET 1 OF 1



MAP NO.	PETALUMA RIVER WATERSHED MASTER DRAINAGE PLAN
3M	PETALUMA RIVER FLOOD MITIGATION ALTERNATES
	PREPARED BY: SONOMA COUNTY WATER AGENCY

Figure 1.

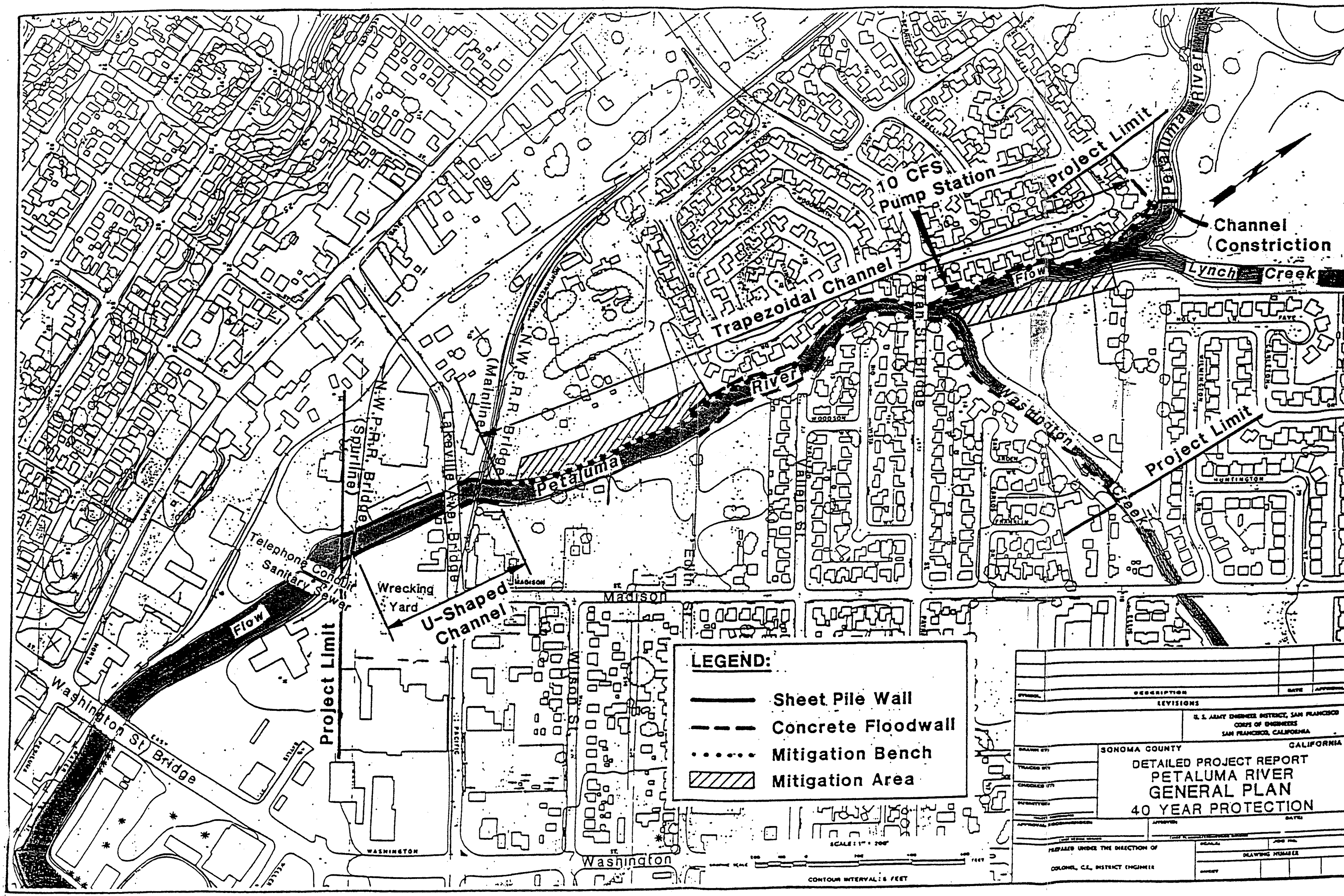

10 CFS
Pump Station
Project Limit
Channel
Constriction
Lynch Creek
Flow
Trapezoidal Channel
River
Petaluma River
Washington Creek
Project Limit
N.W.P.R.R. Bridge
(Mainline)
N.W.P.R.R. Bridge
(Spurline)
Lakeville Ave. Bridge
Telephone Conduit
Sanitary Sewer
Wrecking
Yard
U-Shaped
Channel
Project Limit
Flow
Washington St Bridge
Madison
Wilson St
Vallejo St
Edith
Payran St Bridge
Washington
LEGEND:
Sheet Pile Wall
Concrete Floodwall
Mitigation Bench
Mitigation Area
DESCRIPTION
DATE
APPROVAL
REVISIONS
U. S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA
SONOMA COUNTY
CALIFORNIA
DETAILED PROJECT REPORT
PETALUMA RIVER
GENERAL PLAN
40 YEAR PROTECTION
PREPARED UNDER THE DIRECTION OF
COLONEL, C.E., DISTRICT ENGINEER
DRAWING NUMBER
CONTOUR INTERVAL: 5 FEET

Figure 2.