EFFECTS OF COUNTY LAND USE POLICIES AND MANAGEMENT PRACTICES ON ANADROMOUS SALMONIDS AND THEIR HABITATS

SONOMA, MARIN, SAN MATEO, SANTA CRUZ AND MONTEREY COUNTIES, CALIFORNIA

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The findings and conclusions presented in this report are the responsibility of the authors. Any errors, omissions or misinterpretations solely rest with them.

EXECUTIVE SUMMARY

The FishNet 4C program is a county-based, regional salmonid protection and restoration program, created under a Memorandum of Agreement between the six Central California Coastal Counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey. A prime objective of the FishNet 4C program has been to evaluate county land management practices and written policies relative to protecting salmonid populations, and to make recommendations for improving those practices and policies. This study accomplishes that objective. It was jointly conducted by the University of California and FishNet 4C program staff.

This study applies to the five counties of Sonoma, Marin, San Mateo, Santa Cruz and Monterey, except for areas upstream of dams that prevent fish migration. Mendocino County was covered in a prior assessment. The goal of this study was to determine the effectiveness of existing policies, regulations, environmental review procedures, and land management practices in minimizing effects of county-regulated or funded activities on anadromous salmonids and their habitats. Analysis of all pertinent county policies and procedures was performed by content analysis of documents to determine whether or not they address anadromous fish and their habitats. Field assessment of management practices and typical project activities was performed using a team environmental audit approach. The products of this study include: 1) list of county activities potentially affecting anadromous fish and their habitats; 2) inventory of existing policy and management tools; 3) summary assessment of land management practices as evaluated in the field; 4) evaluation of the existing tools used for protecting anadromous fish and their habitats 5) recommendations for modifications of existing policies and procedures, or additional procedures to bolster existing tools.

POLICY ANALYSIS CONCLUSIONS

All the counties' general plans articulate fish conservation goals to some degree, but counties vary in their adoption of specific ordinances to implement these goals. The most protective policies are found in the Coastal Zone. These include fairly extensive provisions for riparian buffers, maintenance of streamflow for anadromous fish, management of storm water, prohibitions on development on steep and unstable slopes, and construction mitigation.

Outside the coastal zone, protective policies are in place in parts of some counties but not others. Policies to protect riparian corridors can be considered a first line of defense for fish habitat. Specific riparian buffers are established in Marin, Santa Cruz, and portions of Sonoma County. Buffers in Marin and Sonoma vary from 50 to 100 feet depending on zone and topography, to a high of 200 feet for the Russian River. Santa Cruz's riparian buffers are smaller, measuring from 30 to 50 feet depending on

type of stream. Santa Cruz is the only county to have a specific ordinance implementing these provisions. However, all counties allow these buffers to be waived if they make a legal parcel unbuildable.

Sensitive habitat regulations that provide general protection are a second line of defense for fish habitat. Santa Cruz, Monterey, and San Mateo establish sensitive habitats countywide, while Sonoma designates these areas in only portions of the county. Only Santa Cruz, Sonoma, and San Mateo consult databases with current fish habitat information for project review. And only Santa Cruz has an implementation ordinance that leads county staff to review all discretionary and ministerial projects for proximity to sensitive habitat and requires buffers to protect habitat.

As a third resort, floodplain setback requirements may be used to keep development out of riparian areas. However, only Monterey County's floodplain policies establish mandatory setbacks for development, except agriculture, of 200 feet from riverbanks and 50 feet from watercourses.

Other protective policies attempt to avoid impacts to habitat by controlling water quantity modification, sedimentation, channel modification, and water quality in the five counties. Four of the five counties have language within their general plans requiring runoff rates not be changed from pre-development levels and protecting instream flows. Santa Cruz establishes minimum instream flow targets while San Mateo establishes supplementary review criteria for projects in primary fish habitat areas.

Grading controls are fairly extensive throughout the region. All counties require erosion control plans to accompany grading projects over a certain threshold in size. Winter grading is strongly discouraged and requires a winterization plan and measures to control erosion and runoff. Monterey and Santa Cruz have specific erosion control ordinances, which require control of all sources of human caused erosion. In addition, Monterey, Santa Cruz and Sonoma restrict development on slopes over 30 percent. Monterey and Sonoma prohibit conversions of steep slopes to agriculture, while Santa Cruz requires an erosion control plan and measures for all agricultural grading.

Avoidance of water quality impacts by non-point source pollution (NPS) is a more recent state and federal mandate. Marin, San Mateo, and portions of Sonoma County are covered by NPS pollution prevention ordinances that prohibit runoff of non-storm waters to county drains and impose requirements of dischargers. All counties prohibit installation of stream bank stability structures by landowners without a valid permit, although environmental review for issuance of such a permit is not always required.

One primary area of county responsibility is road and culvert maintenance for paved and unpaved county roads. Although many beneficial practices were viewed during the field assessment, there are very few written policies codifying how road and culvert maintenance and replacements are done in order to minimize water quality and sedimentation impacts. Regional efforts to develop and implement road maintenance BMPs are on-going and NMFS is in the process of completing a set of restrictive guidelines for low water crossing for anadromous fish bearing streams in this region. The counties have not yet adopted written policies governing these practices.

Lagoon breaching is another issue on which county policies are not fully developed. Santa Cruz prohibits lagoon sandbar breaching unless consistent with an approved management plan for the stream system, while other counties do not have formal written policies on this practice.

Another gap is in policy aimed at correcting and avoiding fish migration barriers. Counties, through the development review process and through direct installation and replacement of culverts, roads and bridges, are in a critical position to address migration barriers. Although field review showed that many innovative projects are being undertaken in the counties to improve fish migration, with the cooperation of the Department of Fish and Game, little written policy focuses on this issue.

MANAGEMENT PRACTICES ASSESSMENT CONCLUSIONS

Our review of county activities indicated several practices and/or problems that pose risk to anadromous fish and their habitats. Stream crossings are sometimes improperly designed, poorly constructed or inappropriately located. Because of the sheer number of crossings, this is a significant concern. In some areas where counties were responsible for numerous culvert repairs and replacements, it was unknown whether the affected stream supported anadromous fish. Even when crossings are designed for fish passage, there may be design or functional problems. No major new floodplain or riparian developments were observed, but when existing developments are modified, or existing lots are built on, there is often a waiver from required protections. The legacy of existing development in critical habitat areas is a concern in all the counties. This pertains to infrastructure and roads as well as private development.

Stream restoration projects appear uncoordinated and their effects at the watershed scale are uncertain. Bank stabilization, to prevent erosion on public and private properties, is the activity most directly affecting fish habitat. It is ubiquitous in the region and there are no effective controls in place to prevent local and cumulative impacts.

Observations at major new developments indicate that substantive controls are placed on storm water management. However, site clearing and construction activities commonly cause erosion and sedimentation if allowed to occur during the rainy season, which we observed in the field on more than one occasion. Although a broad array of erosion controls is used in the region, their implementation and effectiveness are uneven. Site inspections and erosion control monitoring of private developments by county staff were sporadic in many instances. Often county inspectors came from building or planning departments and were not well trained to evaluate erosion control techniques. Highly visible, large developments tend to have the best controls in place. In addition to unprotected soils, unprotected building materials and petroleum products were observed in the field.

Related to the issue of development location, is the problem of disaster-related road failures and landslides. These generally occur in predictable locations and will often reoccur in the same place. The problem is not completely solvable without relocation of the most unfavorably positioned facilities.

Storage of road maintenance spoils, landslide debris and other materials is not effectively controlled to prevent erosion, sedimentation and non-point source pollution. Lack of appropriate, affordable spoils storage sites is a problem in many of the counties.

Since many of the county-maintained roads are paved, the principal concern with road maintenance is disposal of ditch clearance materials and general drainage impacts. Three counties do have significant miles of unpaved roads that generate sediment both during and after maintenance. Unused but unrestored roads pose a hazard because they may fail in the future.

Channel and levee maintenance practices, including woody debris clearing from streams, are driven by the risk that flooding or infrastructure failure poses to public and private property. Again, the issue is location of development, but there is the added dimension of the original design that may have been inadequate to accommodate both flood control and fish.

Our review of wastewater treatment was not complete enough to provide a basis for conclusions. It appears that major facilities such as stables and wineries are adequately regulated.

Finally, lagoon breaching may be a regional issue worthy of further study.

RECOMMENDATIONS

Generally, the findings of the policy analysis were corroborated by the field assessment. Fish habitat protection policies and procedures that are applied in counties' coastal zones create a foundation for conservation of anadromous fish species. However, anadromous fish do not restrict themselves to these locations. Extension of coastal zone protective policies to non-coastal areas of the counties, as has been accomplished for the most part by Santa Cruz County, would greatly improve protection of fish habitat in the region.

Specific recommendations for improving fish habitat conservation are listed below.

1. Consider extending coastal zone protective policies to non-coastal areas of the counties where applicable and feasible.

2. Identify anadromous fish streams and tributaries in all the counties. Counties should participate in an overall program of habitat protection and prioritization for restoration at an individual watershed level.

3. Develop and adopt written standards for management practices and prioritization for action, including road reconstruction, decommissioning and maintenance that minimize sedimentation and runoff impacts. These should address disposal of spoils, stream crossings, culvert diversion potential, fish passage, and slope repair. Train staff in implementation of these standards.

4. Establish adequate spoils storage sites throughout the counties so that spoils from landslides and road maintenance can be stored safely away from anadromous streams.

5. Improve enforcement to eliminate impacts of wintertime grading. Train county inspectors in erosion control technology.

6. Develop an interdisciplinary review procedure for routine and emergency road and culvert placements which assesses and mitigates potential barriers to fish migration. The review procedure could take the form of a yearly post-implementation audit to see how things were done, especially for emergency projects. Develop a systematic program for replacement of barriers to upstream migration of salmonids.

7. Establish generous riparian buffer strips on anadromous streams, wherein development is prohibited. Define riparian protection areas on the basis of stream geomorphology rather than vegetation, flooding or arbitrary distances from streams. Enforce protection provisions with implementation ordinances. Tighten enforcement of existing riparian protection policies to make variances more difficult to obtain. Establish a fund for purchase of property or easements for cases in which implementing riparian buffers makes parcels unbuildable.

8. Consider developing a program for identifying especially unsuitable existing development, infrastructure and roads affecting anadromous fish streams. Consider options and opportunities for gradually eliminating them.

9. Work with the State Water Resources Control Board and other agencies to establish target levels of instream flow to maintain populations of anadromous fish. Incorporate these target levels into the County development review process and prohibit projects that jeopardize instream flows.

10. Develop alternatives to conventional bank stabilization for public and private projects and require evaluation of alternatives through the permit process. Treat all proposals to install bank stabilization on anadromous fish streams as discretionary and require CEQA review. This will normally be required for projects subject to DFG 1600 Stream Alteration Agreements but should be extended to emergency projects. Address cumulative effects of channel hardening in this review. Consider a review procedure in the form of a yearly post-implementation audit to see how things were done, especially for emergency projects.

11. To the degree possible, given design constraints, reduce the extent of riparian vegetation and sediment clearing done on anadromous fish streams that pose flooding hazards. Retain large woody debris within streams to the extent possible.

12. Conduct a regional study of lagoon breaching to determine cumulative effects of the practice. If warranted by study findings, adopt policies and implementation procedures that mitigate impacts.

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INTRODUCTION

The FishNet 4C program is a county-based, regional salmonid protection and restoration program, created under a Memorandum of Agreement between the six Central California Coastal Counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey. These counties, with the exception of Monterey, lie geographically within the Central California Coast Evolutionarily Significant Unit (CCCESU) as delineated by the National Marine Fisheries Service for coho salmon populations. Coho salmon was listed in this region in 1996 as *threatened* under the Federal Endangered Species Act (ESA), and *endangered* in San Mateo and Santa Cruz Counties under the California State ESA. Southern Mendocino, Sonoma, Marin, San Mateo and Santa Cruz Counties also fall within the CCCESU for steelhead trout, which was listed as *threatened* in 1997, and Monterey County falls within the South Central Coast ESU (SCCESU), also listed as *threatened* in 1997 for steelhead trout.

In light of the listings, Supervisors from the six counties decided to take a proactive stand for fisheries protection throughout the region, and formed FishNet 4C- the Fishery Network of the Central California Coastal Counties. FishNet 4C recognizes the need for the counties to meet the requirements of the Endangered Species Act to protect anadromous salmonids and their habitats, and the Clean Water Act to protect cold water fisheries. Given these requirements, a prime objective of the FishNet 4C program has been to evaluate county land management practices and written policies relative to protecting salmonid populations, and to make recommendations for improving those practices and policies. The results of that assessment and evaluation are presented in this report.

The FishNet 4C program was patterned after the Northern Five Counties Trans-boundary ESU Salmon Conservation Planning Project, which includes the counties of Mendocino, Humboldt, Siskiyou, Trinity, and Del Norte. The County of Mendocino is split, with the Russian River watershed falling into the FishNet 4C group, and the Northern Five Counties group representing the remaining watersheds in Mendocino. An evaluation of management practices in Mendocino County was not included in this study because it had already been completed in a similar assessment conducted for the northern counties in 1998.

METHODS

STUDY AREA

This study applies to the five counties of Sonoma, Marin, San Mateo, Santa Cruz and Monterey except for areas upstream of dams that prevent fish migration. This study did not include lands within the counties under federal or state jurisdiction or activities primarily regulated by state or federal agencies. The study area is further defined as private lands within county regulatory jurisdiction exclusive of lands where the primary uses are timber production or agriculture. County policies that regulate mining, timber and energy development were not reviewed.

The five counties are a mixture of urban, rural and wild lands. Much of the urban development has occurred and will continue to occur within cities. Population growth within unincorporated lands has varied from county to county over the past decade and is projected to vary in the future (See Table 1).

Table 1: Current Population and Population Growth in Unincorporated Areas

County	Current Population (2000)	Population Growth (last decade)	Projected Population Growth (2010)
Sonoma	153,000	-7,000	-15,000
Marin	69,800	6,100	
San Mateo	68,000	10,500	4,000
Santa Cruz	137,000	6,000	5,000
Monterey	106,000	12,000	8,000

Negative population growth has occurred and is projected for unincorporated Sonoma County due to annexations by cities.

Even today, large proportions of each county remain in rural agricultural uses or timberland. Sonoma County, for example, has 700,000 acres of land in timber and agricultural zoning classes. San Mateo has 160,000 and Santa Cruz 105,000 acres of land in these zoning classes. The counties utilize a variety of tools to maintain rural land uses including agricultural and timber production zoning, resource management and watershed protection zoning and open space acquisition.

The counties measure their potential future development in various ways as residential units, acres of uses, or population and employment growth. Data on build-out potential are incomplete for the counties Santa Cruz County, for example, estimates that over 12,000 new residential units are possible in unincorporated areas, and 13,000 second units. San Mateo's unincorporated areas may accommodate over 7000 new dwelling units under current zoning. The matter of future growth is complicated by the likelihood that when developed, at least some of the land will be annexed to cities.

The rates and types of developments occurring in the counties vary. Data on development processing, environmental review procedures (pursuant to the California Environmental Quality Act; CEQA) and construction are incomplete. The most complete information is available for San Mateo County. There, from 1991-1999 two to 17 subdivisions were processed and housing starts averaged 137 per year. Between 23-51 environmental reviews were conducted on development projects. In Santa Cruz County, data on fees for environmental review indicate that between 60-102 discretionary projects were processed during the same period. Marin County reports an average of about 5-15 environmental impact reports, 10-50 Negative Declarations and 200-400 categorical exemptions (e.g., building permits) per year. Monterey County estimates that at least 50 development projects have occurred in floodplains over the past decade. Subdivision processing in Monterey County has ranged from 15-32 over the past five years. Housing starts have averaged about 300 per year over the past three years. Sonoma County reports that about 325 net housing units per year have been built over the past five years. New subdivisions have created about 170 lots per year. These fragmentary data indicate that growth pressures are high throughout the region but that the nature of growth varies. For example, in Marin County, growth appears to be mainly infill on existing lots or redevelopment while in Monterey (and probably Sonoma) there are pressures on currently undeveloped land.

STUDY GOALS

The goal of this study was to determine the effectiveness of existing policies, regulations, environmental review procedures, and land use management practices in minimizing effects of county-regulated or funded activities on anadromous salmonids and their habitats. These activities include the range of discretionary development approvals as well as routine county activities such as road maintenance and flood control. The scope of review spanned planning and approval processes through implementation.

The study team's goal was to review projects and practices that were permitted and carried forth under current regulatory, policy and management regime. The authors recognize that County regulations and practices have evolved over time, and that specific problems and issues related to a given project reviewed as part of this study, were not in all instances reflective of that County's current regulations and practices.

The assessment included evaluation of the effectiveness of practices and policies in six categories of potential impacts:

?? Streamflow quantity modifications
?? Riparian clearing
?? Sedimentation
?? Instream habitat modification (physical)
?? Water quality impairment (thermal, biological or chemical)
?? Migration barriers

2. Based on study findings additional policies or procedures necessary to protect fish and habitats were proposed.

Task 1: Identify Activities with Potential Impacts

This study addresses the theory that some county activities affect anadromous salmonids and their habitats. The first step in this study was to identify the range of activities and specify their potential impacts. We excluded activities regulated by state or federal agencies: e.g., municipal water development, major flood control projects, forest practices, point source industries, state highways. We also excluded activities that are either federally funded or for which a federal permit would be necessary: e.g., instream mining, public utilities' use permits. These projects normally require a formal consultation with National Marine Fisheries Service under Section 7 of the Endangered Species Act. Finally, we did not consider activities within city limits or urban spheres of influence because the city in question would be the lead agency.

We focused on land use activities regulated by counties and possibly subject to state permits: residential, commercial, industrial uses, county and other local agency public works and recreation projects; and recurring maintenance and operations or emergency response in which the county is the primary decision maker: 1) county transportation system maintenance; 2) drainage and flood control system maintenance; 3) disaster preparedness and emergency response to natural or human-caused disasters. For purposes of analysis, activities occurring near streams supporting or potentially supporting anadromous fishes received the greatest attention.

During the initial phase of the study, the FishNet 4C steering committee realized that it wanted the assessment to include a high level of participation from county agency representatives. Planning teams were formed in each county and team members convened to help identify issues relevant to their individual counties. The FishNet 4C Program Director worked with the planning teams to determine which management practices and on-going maintenance activities were most important to evaluate in each county. The meetings served as an ongoing educational forum and helped to bring an awareness to county staff of the types of policies and management practices conducted by each county, which have the potential to impact fish habitat. The information gathered in this planning phase also helped in the selection of field review sites.

Task 2: Inventory Policies and Management Procedures

This task entailed identification of the formal and informal ways in which each county attempts to prevent or reduce potential effects on anadromous salmonids. We considered policy (e.g., general plans, subdivision, zoning and other ordinances, etc.) and environmental review procedures and associated mitigation measures (e.g., CEQA documents, permit conditions). We also reviewed practices, such as erosion control methods used at construction sites, in the field. This study did not attempt to reach specific conclusions on specific projects, but rather looked at the practices in the field as reflections of current policy and management decisions.

Task 3: Assessment of Policies and Management Practices

Analysis of county policies and procedures was performed by content analysis of documents to determine whether or not they address anadromous fish and their habitats. This was done systematically according to categories of impacts. All pertinent policies and regulations for all counties were reviewed.

Field assessment of management practices and typical project activities was accomplished using a team environmental audit approach. Field data collection procedures and forms were developed for this purpose. The goal of field assessment was to determine the effectiveness of county mitigation procedures in protecting anadromous fish and their habitats. Prior to conducting field site reviews, each county convened a FishNet Field Team. These teams differed in some cases from the Planning Teams by including staff more familiar with operations in the field. The Field Team leaders, in most cases a county planner or public works person, worked with the FishNet 4C Director, to select field sites based on recommendations from both the Planning and Field Team staff in each county. These recommendations were based on the previous exercise of determining which activities were most important to evaluate in each county. We then spent two full days in each county with the Field Teams, evaluating selected sites.

Task 4: Recommend Additional Protective Tools

The products of the first three tasks are: 1) list of county activities potentially affecting anadromous fish and their habitats; 2) inventory of existing policy and management tools; and 3) evaluation of the tools used for protecting anadromous fish and their habitats. These products are the basis for proposing modifications of existing policies and procedures, or prescribing additional procedures to bolster existing tools.

RESULTS

TASK 1. ACTIVITIES WITH POTENTIAL IMPACTS IN EACH COUNTY

A list of the activities considered important in the five counties was developed through the work of the County Planning Teams and the FishNet 4C Program Director. These activities are either conducted by county departments directly, or are regulated by the county with a county agency serving as the Lead Agency under the California Environmental Quality Act (CEQA). These activities have been categorized as I) short-term, related to construction, II) recurring, relating to maintenance or emergency response, or III) long-term, related to land use.

I. Short-term Construction

1. Site clearing
2. Grading/excavation/filling/aggregate extraction (instream mining not included)
3. Construction of permitted structures
4. Road construction
5. Culvert installation
6. Bridge construction
7. Low water crossing construction
8. Road surfacing
9. Levee construction
10. Channel construction and modification
11. Channel structure installation
12. Retention basins/overflow channels
13. Revegetation

II. Recurring Maintenance/Emergency Response

14. Emergency grading
15. Street sweeping
16. Road watering or other activities requiring water withdrawals from stream
17. Culvert clearance/repair
18. Bridge repair
19. Road regrading/resurfacing/maintenance
20. Channel clearing/maintenance
21. Levee repair
22. Floodplain clearing
23. Bank erosion control, stabilization and channel armoring (e.g., rip-rap)
24. Landslide removal/stabilization
25. Herbicide spraying
26. Roadside brushing
27. Roadside ditch clearing
28. Spoils management
29. Lagoon breaching
30. Low water crossing maintenance

III. Long Term Use-Related

31. Habitat loss/reduction
32. Domestic water use/stream drawdown
33. Storm drainage
34. Waste water discharge
35. Direct taking
36. Domestic animals (e.g., horses)

The identified activities were also categorized by the impacts they may cause to anadromous salmonids. This categorization is based upon Spence et. al. (1996).

IMPACT CATEGORIES FOR IDENTIFIED ACTIVITIES

Impact	Identified Activity
A. Streamflow Quantity Modifications	Habitat loss/reduction
	Road watering
	Road surfacing (impervious surfaces)
	Retention basins/overflow channels
	Domestic water use
	Storm drainage
B. Riparian Clearing	Roadside brushing
	Floodplain clearing
	Channel clearing
	Levee construction
	Channel construction
	Site clearing
C. Sedimentation	Grading/excavation/filling/aggregate extraction
	Culvert installation
	Bridge construction
	Emergency grading
	Street sweeping
	Culvert clearance/repair
	Bridge repair
	Road regrading/resurfacing
	Channel clearing
	Levee repair
	Landslide removal
D. Instream Habitat Modification (physical)	Habitat loss/reduction
	Erosion control and channel armoring
	Channel clearing
	Retention basins/overflow channels
	Channel structure installation
	Direct taking
E. Water Quality Impairment (thermal, biological or chemical)	Site clearing
	Channel structure installation
	Road watering

Street sweeping
Channel clearing
Floodplain clearing
Herbicide spraying
Storm drainage
Waste water discharge
Domestic animals

F. Migration Barriers

Channel structure installation
Retention basins/overflow channels
Channel construction
Culvert installation

G. Long-term Effects of Increased Urbanization

Loss of wildlife habitat, habitat corridor connectivity and biodiversity
Change in hydrograph due to increased impervious surfaces
Non point source runoff from roads, driveways, parking areas

The list of activities and impacts was the basis for the policy analysis and selection of sites for field assessment.

TASK 2/3: INVENTORY AND ASSESSMENT OF POLICIES

PLANNING REVIEW

Introduction

In California, land use planning authority is delegated to local governments, including 58 counties and 456 incorporated cities. State law requires that local governments adopt general plans for their physical development. These long-term plans comprise official county policy regarding the location of housing, business, industry, roads, parks and other land uses; protection of the public from environmental hazards; and the conservation of natural resources, including fisheries. State law requires that general plans contain seven components or "elements": land use, circulation, housing, conservation, open-space, noise, and safety.

Most of the land use and conservation policies developed by local governments are responses to state mandates. Good examples of this response are the “Local Coastal Plans” mandated by the California Coastal Act for all cities and counties that lie within the designated “Coastal Zone”. The goal of these plans is to maintain and enhance the quality and productivity of coastal waters and sensitive coastal habitats (including estuaries, wetlands, and riparian vegetation). Land use in and adjacent to biologically sensitive habitats may not alter or impact the biological productivity of these areas or the viability of species using these areas.

Habitat conservation planning is a broad responsibility of county government. Activities that may harm the habitat of an endangered species, in this case salmonids, must be reviewed by county staff to determine whether they may affect habitat. If so, then county staff must develop feasible measures to avoid these impacts through the environmental review process mandated by CEQA, and through implementation of county plans and ordinances.

General plan policies and ordinances are the beginning point for the development review process. Goals and policies in general plan elements may not be realized on the ground if there are no measures included in county ordinances to implement them. During development review, staff may add mitigations to projects through the CEQA process beyond those required by county elements or ordinances.

In this study, all general plan elements of the five counties were reviewed to identify policies for the protection of anadromous fish and their habitats. We conducted a review of most ordinances (e.g., zoning, subdivision) and implementation procedures for all five counties as well to determine if specific consideration is given to protection of anadromous salmonids.

Our policy review focused on activities for which the county is the lead agency under CEQA, primarily land development and construction. Other activities which we later reviewed in the field, such as maintenance of county roads, bridges, flood control structures, and emergency response to flooding and road closure often occur without written policies.

Table 2 lists the documents reviewed during this study. The results of the review are presented in a series of tables in Appendix A. These tables provide great detail on existing policies, internal planning consistency, and the relationships between policies and categories of impacts on anadromous salmonids. In the following sections, the highlights of our review are presented. It should be noted that the structure of general plans and their implementation ordinances varies considerably throughout the five county area. In Monterey County, all portions of the county are covered by area plans that implement policies specific to that area beyond those covered in the county general plan. Marin has a number of community plans with specific policies. Sonoma implements most of its general plan policies by means of its zoning ordinance and county codes. Santa Cruz integrates its coastal plan into its general plan and has many specific implementation ordinances for its general plan policies. All available documents were reviewed to identify the location of protective policies and their relative strengths.

Table 2: General Plan Elements and Ordinances Reviewed

County	General Plan Elements	Ordinances
Marin	Environmental quality element	Dam permit (amendment), Chapter 11.04
	Community development element	Watercourse diversion & obstruction, Chapter 11.08
	Transportation element	Grading, Chapter 19.08
	Housing element	Native tree preservation, Chapter 22.xx
	Noise element	Mining and quarrying, 23.06 (amendment)
	Environmental hazards element	Excavating, grading & filling, Chapter 23.08
	Agricultural element	Urban runoff, Chapter 23.18
	Community facilities element	Integrated pest management, Chapter 23.19
	Parks and recreation element	Improvements, Chapter 24.04
	Trails element	Drainage, Chapter 24.04.520
	Economic element	Grading, Chapter 24.04.620
	Local coastal plan unit I	Miscellaneous (bridges), Chapter 24.02.875
	Local coastal plan unit II	Local Coastal Plan code Chapter 22.56
	Tamalpais Area Community Plan	
	San Geronimo Valley Community Plan	
	Point Reyes Station Community Plan	
Monterey	Natural resources, Chapter I	Grading, Chapter 16.08
	Environmental constraints, Chapter II	Erosion control ordinance, Chapter 16.12
	Human resources, Chapter III	Floodplain regulations, Chapter 16.16
	Area development, Chapter IV	Preservation of Oak and Protected Trees, Chapter 16.60
	Countywide land use, Chapter V	Pajaro River banks & levees, Chapter 16.65
	Carmel Area Plan	Subdivision Ordinance, Title 19
	Carmel Valley Master Plan	Zoning ordinance, Title 21
	South County Area Plan	
	Greater Monterey Peninsula Area Plan	
	Toro Area Plan	
	Chachagua Area Plan	
	Central Salinas Valley Area Plan	
	North County Area Plan	
San Mateo	Vegetation, water, fish and wildlife, Chapter 1	Growth management
	Soil resources, Chapter 2	Floriculture
	Mineral resources, Chapter 3	Sensitive habitats

County	General Plan Elements	Ordinances
	Visual quality, Chapter 4	Riparian corridors
	Historical and resources, Chapter 5	Rare and endangered species
	Park and recreation resources, Chapter 6	Visual resources
	General land use, Chapter 7	Natural hazards
	Urban land use, Chapter 8	Recreation and visitor serving facilities
	Rural land use, Chapter 9	Zoning ordinance
	Water supply, Chapter 10	Excavation, grading, filling, clearing, Section 8600
	Waste water, Chapter 11	Grading permit standards handbook
	Transportation, Chapter 12	Significant tree ordinance 11,000 - 12,000
	Solid waste, Chapter 13	Riparian corridor/ zoning ordinance update
	Housing, Chapter 14	Storm Water Management Ordinance, Section 5000
	Natural hazards, Chapter 15	
	Local Coastal Plan	
	Man-made hazards, Chapter 16	
Santa Cruz	Land use element	Zoning ordinance, Chapter 13.10
	Circulation element	Site and landscape design review, Chapter 13.11
	Housing element	Coastal zone regulations, Chapter 13.20
	Conservation and open space element	Subdivision ordinance, Chapter 14.01
	Public safety and noise element	Geologic hazards, Chapter 16.10
	Parks, recreation and public facilities	Grading regulations, Chapter 16.20
	Community design	Erosion control, Chapter 16.22
		Riparian corridor protection, Chapter 16.30
		Sensitive habitat protection, Chapter 16.32
		Significant Tree Ordinance- Chapter 16.34
		Mining regulations, Chapter 16.54
Sonoma	Land use element	Erosion control plans required, Chapter 7
	Housing element	Flood damage prevention, Chapter 7
	Open space element	Storm water quality, Chapter 11
	Agricultural resources element	Watercourse protection ordinance 1108
	Resources conservation element	Anti roiling ordinance, Chapter 23, 3836R
	Public safety element	Zoning ordinance, Chapter 26
	Circulation and transit element	Vineyard erosion and sediment control ordinance , Chapter 30
	Air transportation element	
	Public facilities and services element	
	Noise element	

Since salmonid habitat conservation has not been a particular focus of state mandates, few policies directly protecting salmonid habitats were found in county level policies outside of the Coastal Zone. There are however, quite a few policies in place in the counties that serve to protect fish habitat. These policies protect wildlife habitat in general, reserve riparian corridors from development, prevent erosion and sedimentation, and regulate stream channel modification. They were reviewed for content and consistency and results are discussed by the following categories of impacts: wildlife habitat preservation in general, riparian clearing and floodplain management, streamflow quantity modification, sedimentation, instream habitat modification, water quality, and migration barriers.

Wildlife Habitat

All of the counties' general plans contain goals for maintaining wildlife and fish species within their jurisdictions. Fish habitat is protected by the same means as other sensitive wildlife habitat, through analysis during the CEQA environmental review process. Habitat protection goals and methods are generally articulated in the counties' open space and conservation elements (or their equivalents) and may be implemented in specific ordinances, including sensitive habitat protection ordinances and zoning ordinances (Table 3).

Table 3: Sensitive Habitat Protection Process

County	General Plan establishes sensitive habitat?	Projects checked for proximity to habitat?	Database shows current fish habitat?	County staff field checks mapped data?	Sensitive habitat requires buffers?	Sensitive habitat protection ordinance?
Marin	No	Yes, discretionary & some ministerial depending on zone	No	Yes, for some projects	No, although riparian areas have buffers	No
Monterey	Yes, countywide	Yes, both discretionary & ministerial	No	Yes	No	No
San Mateo	Yes, countywide	Yes, discretionary only	Yes	No	Yes, in the coastal zone	No
Santa Cruz	Yes, countywide	Yes, both discretionary & ministerial	Yes	Yes	Yes	Yes
Sonoma	Yes, Biotic Resource (BR) Districts only	Yes, discretionary plus projects in BR zone	Yes	Yes, publicly sponsored projects only	Yes, from designated wetlands & riparian corridors	No

The degree to which these sensitive habitat measures work to protect fish habitat varies between the counties, with the most strict and consistently applied policies in the Coastal Zone. All the counties require developments within or adjacent to special habitat areas to include appropriate mitigation measures. Applications for development permits are checked against locally developed maps and the California Department of Fish and Game (DFG) Natural Diversity Database to identify whether actions are proposed in or near a sensitive habitat. If so, then the applicants must provide an environmental assessment of the habitat prepared by a qualified biologist. Assessments must identify species and measures for protecting them and their habitat. All counties require buffer zones around habitats. However, every county allows buffer zone requirements to be modified if no feasible development alternative exists on the parcel.

Non-Coastal Areas: Sensitive habitat is designated in all the non-coastal areas in Santa Cruz, Monterey and San Mateo counties. Sonoma County establishes sensitive habitats in its Biotic Resources District only. Although the general plan directs the county to rezone all Critical Habitats to the Biotic

Resources Zone, some streams with anadromous habitat are excluded from this designation. However, all discretionary projects are reviewed for potential effects due to proximity to sensitive habitat.

Marin County's policies do not establish sensitive habitat areas in general, although the general plan does establish setbacks for riparian areas that constitute much of the county's sensitive habitat.

Santa Cruz County is unique among the counties because it implements sensitive habitat policies in non-coastal zone areas through a specific Sensitive Habitat Protection Ordinance. All riparian corridors in the county are considered to be sensitive habitat. Applications for both discretionary and ministerial building permits are checked for proximity to sensitive habitat on the county's Geographic Information Systems (GIS) database that incorporates up to date information on salmonid fish habitat. Gross scale mapping is then field checked by trained county staff. The ordinance establishes buffer zones within which land uses are restricted to be compatible with habitat needs. The ordinance also requires sensitive habitat areas to be put in easements, deed restrictions or protected by equivalent measures, degraded habitat to be restored as a condition of permit approval, and prohibits nearby domestic animals and exotic vegetation. However, these last measures are not normally applied to riparian corridors.

Lacking a specific habitat protection ordinance, other counties implement habitat protection measures in ways that may not be as effective, primarily through their zoning ordinances. In Monterey County, Areas of Special Biological Importance are checked mostly for discretionary projects, not ministerial projects (an example of a ministerial project is a single family house building permit on an approved lot). Habitat information does not include data on fish habitat and is not available on a GIS. Monterey County's Zoning Ordinance establishes buffers on these habitat areas, allowing development on parcels within 100 feet of habitats only where no significant impacts to long term maintenance of habitat occurs, even on a cumulative basis.

San Mateo County's General Plan directs the county to establish buffer zones adjacent to sensitive habitats with restricted uses, however, buffer zones are currently applied on a case by case basis. The Zoning Ordinance establishes performance criteria and development standards for permitted development within sensitive habitats and buffers. These involve excluding spawning and nesting areas from development, including intensive public recreational use. Watersheds whose streams are used for fish spawning grounds and nurseries must be managed to maintain the flow of fresh water.

Riparian Vegetation

Riparian vegetation is a critical component of high quality fish habitat. It provides channel bank stability and buffers the stream from inputs of heat, sediment, and water from adjacent lands. Disturbances that remove riparian vegetation can leave the stream channel vulnerable to erosion, and allow unacceptable levels of inputs to reach the stream. The status of riparian vegetation is largely determined by how streamside areas are managed. A primary way to protect riparian vegetation is to identify streamside management areas, give the areas special status and then restrict activities that may take place there.

Streamside management areas are designated in every county, although the amount of county area benefiting from these protections varies dramatically. Every county has riparian buffers established within its Coastal Zone. In non-coastal areas, riparian buffers are established throughout all parts of Santa Cruz and Marin Counties only. However, only Santa Cruz has a specific riparian corridor ordinance to implement riparian buffer provisions. Sonoma establishes riparian buffers in its Biotic Resources Districts only and San Mateo and Monterey have no non-coastal riparian buffers established.

Coastal Zone Riparian Buffers: All coastal counties are required by the State Coastal Zone Protection Act to have special protections for streamside management areas. There is no similar state directive for inland areas. Provisions for designating and protecting streamside areas are outlined in the counties' coastal elements and coastal zoning ordinances. Counties restrict most new development within a defined riparian corridor. Exceptions are provided for road maintenance and repair, placement of wells and utilities, and maintenance of existing flood control structures.

New development, including single family dwellings on existing lots, may occur within coastal streamside management areas with a discretionary permit when there is no feasible alternative site within the parcel. Applicants are required to provide a biological assessment of the project by a qualified biologist. New development must maintain the functional capacity of the habitat and developers may be required to replant riparian vegetation. Any development requires a Coastal Development Permit from the Coastal Commission.

Non-Coastal Riparian Buffers: Riparian buffers in non-coastal areas of the counties differ in size although the activities allowed within them are fairly uniform (Table 4). Uses allowed in the defined buffer strip include reconstruction and repair of existing structures, water supply projects, flood control projects, restoration projects, research and education, grazing and agriculture, channel maintenance, road and utility line crossings, and trails. In addition, emergency streambank protection and vegetation clearing for flood conveyance by county agencies are allowed. New roads and structures are not allowed.

Exceptions to these rules are possible, and new homes are permitted on existing lots when a parcel falls within the riparian buffer and denial would prohibit economic use of the property. In these cases, applicants are required to provide a biological assessment by a qualified biologist and to meet certain performance standards including minimizing disturbance of riparian vegetation and soil. Other mitigations such as on-site sediment retention and revegetation may be required through the review process.

Table 4: Riparian Buffers on Different Stream Types for Each County (Non-Coastal Zone)

County	Perennial Stream	Intermittent Stream	Ephemeral Stream
Marin (Streamside Conservation Areas) Marin (Streamside	?? 100' from stream center in Coastal Recreation Zone ?? 100' from stream center in Inland Rural	?? 100' from stream center in Coastal Recreation Zone ?? 100' from stream center in Inland Rural	For channels with riparian vegetation for 100' feet or important habitat: same as perennial and intermittent

County	Perennial Stream	Intermittent Stream	Ephemeral Stream
Conservation Areas)	Corridors ?? 50' from stream center in City Centered Corridor	Corridors ?? 50' from stream center in City Centered Corridor	
Santa Cruz (Riparian Corridors)	50' from top of channel or high water mark	30' from top of channel or high water mark	The landward limit of riparian vegetation
Sonoma (Streamside Conservation Areas)	From the top of higher bank: ?? 200' for the Russian River ?? 100' for flat land ?? 50' for upland areas ?? 50' for urban areas	From the top of the higher bank: ?? 100' for flat land ?? 50' for upland areas ?? 50' for urban areas	No specific designation
San Mateo	None	None	None
Monterey	None	None	None

Santa Cruz designates Riparian Corridors throughout the county and implements these policies through a Riparian Corridor Protection Ordinance. Riparian buffers measuring 50 feet from perennial and 30 feet from intermittent streams are established in which no development may take place. Exemptions include continuance of pre-existing non-agricultural uses not lapsed for more than a year, and pre-existing agricultural uses not lapsed within the last five years. Exceptions to these prohibitions may occur if there are special circumstances, or as a necessary part of a permitted activity. When exceptions are allowed, mitigations may include vegetated buffer strips, water breaks, surface treatments, and sediment catch basins.

Marin County's General Plan defines Streamside Conservation Areas (SCAs) for 100 feet on each side of streams within the Coastal Recreation Zone and Inland Rural Corridor, and 50 feet in the City Centered Corridor. Policies for these areas include prohibiting new development, restricting construction to the dry season only, protecting vegetation and discouraging any alteration of bed or banks, and encouraging restoration of the area. The county does not have a specific ordinance implementing these provisions.

Sonoma's Streamside Conservation Areas are 200 feet from the banks of the Russian River, 100 feet from streams in flat land, and 50 feet from streams in upland and urban areas in Biotic Resources Districts only. The Biotic Resources District covers most blue line streams in the county; however, some streams considered important habitat by DFG are excluded from this zone.

Monterey does not designate Riparian Corridors outside the Coastal Zone. The North and South County Area plans do require that new development not be allowed within any perennial or intermittent streams or be allowed to disturb natural banks and vegetation. No new developments are allowed within the riparian corridor. Several area plans specify that development may not encroach on the Arroyo Seco, Salinas, Naciemiento, and San Antonio Rivers.

San Mateo provides no special designations for streamside management areas outside the Coastal Zone. The general plan directs the County to develop guidelines for vegetation and debris control in riparian corridors. The county is currently developing a revision of its Zoning Ordinance to establish riparian corridors in one watershed, the San Francisquito. The Zoning amendment is due to be considered by the Board of Supervisors by December 2000. No timetable has been established for designation of riparian corridors throughout the rest of the county.

In addition to specific riparian corridor protections, other ordinances may function to protect riparian vegetation in some cases. These include tree preservation ordinances, runoff control ordinances, vineyard development ordinances, and flood control ordinances (Table 5).

Table 5: Riparian Vegetation Protection Policies

County	Streamside Management Areas	Tree Protection Ordinances	Other Tools
Marin	Coastal and inland	**Native Tree Preservation and Protection Ordinance** prohibits removal of trees > 6 – 10" DBH depending on species without a permit.	**Urban Runoff and Pollution Prevention Ordinance** prohibits removal of healthy streambank vegetation.
Monterey	Coastal only, not inland	**Preservation of Protected Trees Ordinance** prohibits removing native trees (including cottonwood and willow) >6" at 2' above the ground without a permit, not more than 3/lot/year (Chachagua Area plan only)	**Natural Resources Chapter** requires all modifications of riparian vegetation for flood control purposes to conform with an approved river management plan
San Mateo	Coastal only, not inland	**Heritage Tree and Significant Tree Ordinance** prohibits removal of trees with DBH> 38" (28" for some species) without a permit	**Storm Water Management Ordinance** prohibits removal of healthy streambank vegetation **Rural Road Maintenance Performance Standards** prohibits removal of live vegetation from channels except for exotics and plants causing instability
Santa Cruz	Coastal and inland	**Significant Tree Protection Ordinance** prohibits removal of trees >20" dbh or groups of 5 trees >12" dbh on a parcel without a permit in the Coastal Zone only	**Riparian Corridor and Wetlands Protection Ordinance** prohibits development within designated riparian corridors (discussed above)
Sonoma	Coastal and inland (in Biotic Resources Districts only)	**Tree Protection Ordinance** requires that "protected" trees > 9" in diameter, especially Valley Oak, damaged during construction be replaced or a fee paid	**Storm Water Quality Ordinance** prohibits removal of healthy streambank vegetation **Vineyard Erosion and Sediment Control Ordinance** requires agricultural setbacks of 25-50' from streams with no clearing of native vegetation

Tree Protection Ordinances: Ordinances protecting native vegetation and requiring permits for removal of trees may in some cases apply to riparian vegetation. These ordinances generally prohibit removal of native trees over a specified size without a tree removal permit, unless the tree is a nuisance or hazard. Tree removal must be mitigated by erosion control and replanting.

Runoff Control Ordinances: Marin, Sonoma, and San Mateo have urban runoff control ordinances implemented as part of their National Pollutant Discharge Elimination System permits. A provision of these ordinances prohibits removal of healthy streambank vegetation.

Other Ordinances: Sonoma County's Vineyard Erosion and Sediment Control Ordinance requires riparian setbacks of 25 to 50 feet from streams where removal of non-native vegetation is limited.

Monterey's Natural Resources Chapter requires the county to condition all modifications of riparian vegetation for flood control purposes to conform with an approved river management plan or with an approved landscape plan prepared by a landscape architect.

San Mateo County's Performance Standards for Rural Road Maintenance prohibit removal of live vegetation from stream channels except for vegetation which contributes to streambank instability or is exotic.

Floodplain Management

The riparian area is by definition, a portion of the stream's floodplain. Management of the floodplain to preserve riparian and stream functioning is critical to fish habitat quality. Keeping structures out of the floodplain reduces the chances of subsequent stream alteration. Experience has shown that once homes and businesses are constructed on the floodplain, there is increasing pressure to manage the stream channel to reduce flood and erosion risks. Often this will involve installation of levees, clearing of riparian vegetation, or hardening of channel banks, all with negative consequences for fish habitat. In addition, reduction of the stream's floodplain capacity increases the velocity of flood flows, allowing increased erosion to occur.

Floodplain management is treated similarly throughout the five county region, largely due to overriding federal policy on flood hazards (Table 6). The floodplain area is divided into two major sections, the floodway or primary floodplain and the flood zone, or secondary floodplain. The floodway is defined as the stream channel and immediately adjacent lands (i.e., bankfull). The floodzone is the area prone to flooding during the 100-year flood as defined by the Flood Insurance Rate Map (FIRM) delineated by the Federal Emergency Management Agency (FEMA). Floodways are considered the most hazardous portion of the floodplain and counties uniformly prohibit new development, structural improvements, and new parcels in floodways.

Table 6: Floodplain Protection Policies

County	Set back from banks required?	Restriction on fill in floodplain?
Marin	None beyond floodway	Yes, minimum necessary
Monterey	200' from Salinas, Pajaro, & Carmel Rivers, 50' from other watercourses	Yes, must not affect flood carrying capacity
San Mateo	None beyond floodway	Yes, must not affect flood carrying capacity
Santa Cruz	20' if no floodway is defined	Yes, 50 yards^3 maximum if no cumulative impact
Sonoma	100' except structures on lots in subdivisions where flood hazard is remote according to the Sonoma County water agency	Yes, zero net fill on lands in floodways and floodplains in the Laguna de Santa Rosa and tributaries only.

Monterey County's floodplain policies establish mandatory set backs of 200 feet from riverbanks and 50 feet from watercourses, except for agriculture, unless development will not reduce the capacity of existing rivers, affect other properties, or cause erosion hazards. The Environmental Constraints chapter of the General Plan prohibits all new development for which a discretionary permit is required, including filling, grading, and construction within 200 feet of Salinas, Pajaro, and Carmel riverbanks except as permitted by ordinance. Several area plans specify that development may not encroach on the Arroyo Seco, Salinas, Naciemiento, and San Antonio Rivers. The Chachagua Area Plan requires a setback of at least 20 feet from the top of bank of any tributary to the Carmel River.

Sonoma County's watercourse protection ordinance (#1108) prohibits construction of any structures within 100 feet of any embankment except on lots in subdivisions where flood hazard has been found to be remote by the Sonoma County Water Agency.

Apart from established setbacks, other counties' policies stress that creation of new parcels in floodplains and construction of flood control structures is undesirable, but these activities are still allowed if no alternative sites are available and mitigation measures are implemented. Variances are also allowed on existing lots of record surrounded by lots with existing structures below the base flood level. (However, granting of variances is rare. Marin County for example, has granted only one variance in 28 years.)

A development permit must be obtained before construction or development begins. The applicant must include a description of the extent to which any watercourse will be altered or relocated as a result of development. All counties require flood proofing of water and sewer facilities and restrict storage of hazardous wastes in floodplains to prevent contamination during floods. Developers must also demonstrate that their structures will not hamper floodflow and that the ability of water to flow through the area is not restricted.

Marin's Environmental Quality Element directs the county to promote compatible uses of the floodplain such as agriculture, wildlife habitat, and recreation and to retain natural features and conditions within flood control projects as much as possible. Easements held by the Flood Control District may not be transferred to allow development within floodways. The county strives to limit filling or other physical

alteration in floodways, floodplains, or ponding areas to the minimum necessary as determined in development permits.

Santa Cruz's Public Safety Element allows creation of new parcels in 100-year floodplains only if each proposed parcel contains at least one development site not subject to flood hazard. A restriction indicating the 100-year floodplain is recorded on the deed. A maximum of 50 cubic yards of fill may be placed within the 100-year floodplain for construction. The county requires a minimum setback of 20 feet from the banks of a watercourse where all development activities are prohibited if no specific floodway is designated on flood maps. New flood control structures are allowed only to protect existing development where no other alternative is feasible and where necessary for public safety. Structures must not adversely affect sand supply, increase erosion or flooding on adjacent properties, or restrict stream flows below minimum levels necessary for maintenance of fish and wildlife habitat.

San Mateo's Natural Hazards General Plan Policies require the county to determine appropriate densities and development standards for new developments proposed in flood hazard areas and to require detailed analysis of hazard risk and design of mitigation when development is proposed in these areas. The county is directed to retain natural floodplains and to guide development away from flood-prone areas. Flood hazard areas must be identified on any approved subdivision map. Floodplain regulations allow development in these areas as long as the proposed development does not adversely affect the flood carrying capacity of the area.

Sonoma County's Public Safety Element regulates developments including water diversion, vegetation removal, and grading and fills which may increase flooding. Priority is given to floodplain management over flood control structures. Flood damage prevention regulations prohibit construction in a floodplain without a permit. Variances may be issued if projects do not alter the existing flood capacity however, the county is directed to avoid giving variances without review. Filling in floodplains should be limited. County codes prohibit construction in a flood plain without a permit which may be granted if projects do not alter the existing flood capacity. Zero net fill of floodways and floodplains is allowed in the watershed of the Laguna de Santa Rosa.

Channel Modification and Maintenance

Modification of stream channels causes changes in habitat that can have negative impacts on fish. The primary agencies regulating activities in stream channels are the California Department of Fish and Game through the requirement for Streambed Alteration Agreements, and the federal government through the US Army Corps of Engineer's Section 404 permitting process.

The counties regulate modification of channels primarily through their land use designations which specify the types of activities which may occur in the channel (see also streamside management areas and floodplain management). Subdivision and flood management ordinances also describe the process necessary for permitting alteration of natural channels. In general, development within stream channels is restricted to fishery enhancement projects, road crossings, flood control and drainage channels, mineral

extraction, hydroelectric power facilities, fencing, agricultural diversions, wells, bank protection, and necessary utilities.

Coastal plan elements and zoning ordinances require that channelization, dams and other substantial alterations of rivers and streams be limited to water supply and flood control where no other method is feasible. All permit applications for these uses must demonstrate that sensitive habitat areas are protected against disruption and incorporate the best mitigation possible.

Bank Stability Structures: An activity of primary concern to the counties is the modification of stream channels by private landowners attempting to reduce bank erosion or flooding on their property. Each county imposes requirements on private landowners to obtain permits for channel modification. Permit requirements commonly include hydrologic analysis to demonstrate no negative impacts on downstream flooding or erosion. As a rule, these permits do not require applicants to evaluate the cumulative effects of their projects on fish habitat. Only San Mateo County has established performance standards for county sponsored bank stability projects in their rural areas.

Santa Cruz County's Riparian Corridor and Wetland Protection Ordinance requires landowners wishing to install bank stability structures to obtain permission to work within the riparian corridor in the form of a Riparian Exception. This permit may require environmental review through the CEQA process.

Marin County's Watercourse Diversion or Obstruction Ordinance regulates the obstruction of natural creeks or channels including depositing material and building retaining walls. The ordinance requires applicants wishing to install structures such as riprap within a stream channel to obtain a county creek permit. The permit may require an assessment by a civil engineer that construction will not impede the passage of water in the creek. Channel modifications made without a county creek permit are considered a public nuisance and may be abated. In addition, Marin's Urban Runoff and Pollution Prevention Ordinance prohibits depositing loose material in or near a watercourse.

Monterey County's floodplain regulations require that any riverbank protection, riparian vegetation trimming or removal, or channel modification activities be undertaken with a river work permit. A maintenance plan for all flood protection measures, such as levees, dikes, dams or reservoirs is required.

Bank stability review procedures in Sonoma County are not enacted as county ordinance. However, procedure currently followed by county staff requires applicants seeking to install bank stabilization structures to complete a zoning permit application with appropriate technical assessments, permits from appropriate agencies, and temporary and permanent erosion control measures. Site review is conducted by county staff.

The anti-roiling ordinance also requires that those seeking to perform any work to protect riparian property which has the potential of impairing water clarity must first obtain a permit from the Board of Supervisors. The BOS must find that the work will not unreasonably decrease the clarity of rivers and

stream in the county. The permit is then good for 30 days. This permit procedure also covers gravel mining and processing.

San Mateo requires that private applicants seeking to install bank stabilization structures obtain either a Grading Permit or a Building Permit. These permits may require environmental review through the CEQA process. Performance standards for maintenance of county roads in rural areas require use of rock riprap to be minimized, incorporation of biotechnical means when practical, removal of exotic vegetation, and reestablishment of native vegetation and canopy on fish bearing streams. Use of gabion baskets is prohibited below the ordinary high water line on fish bearing streams in order to prevent fish gilling.

Lagoon Breaching: Lagoons at the mouths of coastal streams are sometimes breached by county agencies to avoid flooding of adjacent properties. Santa Cruz's Conservation and Open Space Element prohibits lagoon sandbar breaching unless consistent with an approved management plan for the stream system. Sonoma County breaches the sand bar at the mouth of the Russian River in accordance with recommendations made by fish biologists in the 1994 Russian River Estuary Study. Monterey County continues to breach the Carmel River sandbars under conditions specified in its 1992 "Interim Plan and Criteria for Emergency Breaching of the Carmel River Mouth". The US Army Corps and Coastal Development permits for this activity have expired and the county is operating under emergency status.

Channel Maintenance: There are very few formal policies on channel maintenance in the five county area's general plans and ordinances. Generally, mitigations are established through Memorandums of Understanding or blanket Streambed Alteration Agreements with DFG. Conditions imposed include timing of clearing and restrictions on equipment in the stream bottom.

Monterey County's Natural Resources Chapter requires all modifications of riparian vegetation for flood control purposes to conform to an approved river management plan. San Mateo County is developing performance standards for management and removal of large woody debris and live vegetation from channels as part of its Stormwater Pollution Prevention Program (STOPP). These standards are due in June 2000.

Streamflow Quantity Modification

Streamflow quantity can be affected through withdrawals of water for domestic use and through increases in accumulated run off from surfaces hardened by development. Counties do not directly regulate water withdrawals, but they are responsible for regulation of drainage from developments (Table 7).

Table 7: Stream Flow Quantity Modification Avoidance Policies

County	Maintain Instream Flows (non-coastal)?	Can Runoff Rates be Changed by Development?
Marin	Requires determination of instream flow needs	No, countywide

County	Maintain Instream Flows (non-coastal)?	Can Runoff Rates be Changed by Development?
Monterey	Calls for groundwater management plan (North County only)	No, not in North County areas
San Mateo	Directs county to maintain stream flow and establishes supplementary review criteria in Primary Fish and Wildlife Habitat and Water Resource Areas	No, not in the Resource Management Zone, Primary Fish and Wildlife Habitat and Water Resource Areas
Santa Cruz	Requires determination of instream flow needs Establishes 95% of summer flow and 70% of winter flow targets	No, countywide
Sonoma	Directs county to maintain stream flow	No specific mention

Instream Flow Withdrawals: All of the counties acknowledge water supply as an issue in development and mandate water conservation and planning for the long term water needs of county residents. They also impose requirements on developers to prove the availability of water before subdivision and construction is allowed. However, only coastal zone policies require counties to determine and plan for instream flows adequate to protect fish habitat.

Local coastal plans direct counties, working with the state agencies, to establish and reserve instream flows sufficient to protect and maintain fishery resources and riparian vegetation. All new development proposals must be evaluated to determine that the new water use will not adversely affect the natural supply to the environment including fish habitat. Impoundments and diversion are limited to necessary water supply projects, and flood control projects where no other method of protecting existing structures in the floodplain is feasible.

Outside the Coastal Zone, four of the five counties have goals in their general plans to maintain adequate streamflow for fish habitat, but only Santa Cruz establishes minimum instream flow targets. San Mateo establishes supplementary review criteria for projects in primary fish habitat areas. Marin and Sonoma plans express the goal of ensuring that development maintains adequate stream flows, while Monterey's policies make no mention of instream flow but emphasize groundwater management instead.

Santa Cruz's Conservation and Open Space Element directs the county to make a determination, with the aid of appropriate agencies, of the minimum stream flow requirements to be used for the permitting and environmental review process. It then establishes a target for minimum stream flows for anadromous fish runs and requires this determination be made based on a biologic assessment. Perennial stream flow should be kept at 95 percent of normal during summer and 70 percent during winter baseflow levels. The county is directed to oppose new water rights applications or transfers that would individually or cumulatively diminish instream flows below this 95/70 standard. It also directs the county to require that new diversions, dams, and reservoirs constructed on anadromous fish streams provide adequate flow levels for fish production. Critical Water Supply Streams are designated where new or expanded water diversions should be prohibited or opposed by the county. New water supply projects

elsewhere should be conditioned to protect instream uses. The Public Safety Element requires that flood control structures built to protect existing development not restrict stream flows below minimums necessary for fish production.

San Mateo's General Plan directs the county to ensure that development maintains adequate stream flows and avoids depletion of groundwater. Supplementary review criteria for projects in areas of primary fish and wildlife habitat and water resource areas include ensuring that watersheds whose streams are used for fish spawning grounds and nurseries are managed to maintain the flow of fresh water needed.

Sonoma's Resource Conservation Element directs the county to design public and private projects to maintain instream flows. It also encourages construction of wastewater disposal systems designed to reclaim and reuse treated wastewater on agricultural crops. Marin's Environmental Quality Element requires that minimum flows necessary to protect fish habitat, riparian vegetation, and groundwater recharge is determined with state agencies.

Monterey's Natural Resources Chapter focuses its concerns on groundwater management. It requires land users to maintain groundwater recharge in vital water resource areas and directs the county to manage increased uses of groundwater carefully, especially in areas known to be overdrafted. The North County plan calls for development and implementation of a groundwater management plan to promote recharge. The Chachagua Area Plan also directs the county to work with appropriate agencies to develop a water supply system sufficient to allow fish migration to all portions of the Carmel and Arroyo Seco Rivers throughout the year.

Stormwater Retention: Another impact on streamflow and fish habitat arises from changes in the hydrologic properties of developed land. Development projects typically involve creation of hardened surfaces, impervious to precipitation. During storms, rain that flows from parking lots or roofs will enter streams more quickly than it would under natural conditions. In highly developed urban areas with mostly impervious surfaces, the change in the magnitude and timing of flow can have a significant effect on fish habitat.

To minimize these development related impacts, county zoning ordinances limit the amount of impervious surface allowed on any particular parcel within a land use zone. Other county policies prohibit changes in pre-development runoff rates. Four of the five counties have language within their general plans requiring runoff rates not be changed from pre-development levels, although not for all of the county areas. Also the degree to which counties specify how these rates should be maintained differs.

Santa Cruz's Public Safety Element requires onsite retention or detention of storm water to prevent any significant increase over pre-existing volumes and the Public Facilities Element requires that new discretionary development projects maintain runoff at pre-development rates. On-site retention and percolation of runoff is required for new development in Water Supply Watersheds (WSWs) in groundwater recharge areas and for all projects over an acre in size for which on and off site

improvements cannot be made. The Erosion Control Ordinance specifies the "design storm" for which runoff must be controlled which varies by soil type.

Monterey's North County Area Plan directs that runoff rates be maintained at pre-development levels. The Carmel Valley Master Plan encourages development of on-site storm water retention and infiltration basins in groundwater recharge areas. The Erosion Control Ordinance specifies measures of controlling runoff from a 10-year storm depending on the permeability of the site's soil. The Subdivision Ordinance also sets standards for drainage improvements including detention ponds, drainage swales, and check dams.

San Mateo's Zoning Ordinance requires that development projects maintain surface water runoff at or near existing levels within the designated Resource Management Zone. For areas of primary fish and wildlife habitat and water resource areas, the county must ensure that construction, including impermeable surfacing or compaction, does not disrupt natural patterns of groundwater recharge.

Marin's Environmental Quality Element prohibits runoff rates in excess of pre-development levels to prevent sedimentation problems. However, the general plan and ordinances do not mention specific measures to control runoff.

Sonoma County requires design and construction of drainage facilities in unincorporated areas to be reviewed by the Sonoma County Permit and Resource Management Department.

Sedimentation

Land development and construction activities may release sediment into anadromous fish streams unless adequately controlled. All of the counties' general plans and ordinances contain measures to control erosion and sedimentation. These include policies that address grading, winter grading, development on steep slopes, agricultural grading, and road maintenance (Table 8).

Table 8: Sedimentation Control Policies

County	Grading Ordinance Thresholds for Erosion Control Plans	Winter Grading Prohibitions	New Development Prohibited on Slopes > 30%?	Regulations on Agricultural Grading?
Marin	>10,000 feet^2 on a slope of >15% In an SCA	>150 yards^3 in Coastal Zone	Yes, Coastal Zone only	No
Monterey	>100 yards^3 >2 acres cleared >1 acre cleared in WSW or high erosion areas	>100 yards^3 in WSW or high erosion areas >1 acre cleared	Yes, county wide including new roads Any development requires a use permit	No, but three area plans and zoning prohibit conversion of uncultivated land > 25% slope Require a Use Permit for new or expanded operations on slopes of 15-25%.

County	Grading Ordinance Thresholds for Erosion Control Plans	Winter Grading Prohibitions	New Development Prohibited on Slopes > 30%?	Regulations on Agricultural Grading?
San Mateo	>150 yds^3 moved >1000 ft^2 in Scenic Corridor or sensitive habitat .>5000 ft^2 vegetation removed	Same as year round prohibitions	Yes, in Coastal Zone only	No
Santa Cruz	>100 yds^3 moved >1 acre vegetation cleared >1 acre in LDW or WSW Any clearing in sensitive habitat	> 100 $yards^3$ > 1 acre in size in areas of high erosion hazard in WSWs and LDWs	Yes, county wide including new roads Any development requires a geologic hazards assessment	Yes, grading ordinance requires a Grading Permit and Erosion Control Plan
Sonoma	UBC thresholds Grading near waterways Grading slopes > 10 % Permit required >50 $yds.^3$	Same as year round prohibitions	Yes, county wide including new roads	No, however vineyard plantings must be reviewed, and an erosion and sediment control plan followed on slopes likely to cause erosion for the type of soil present.

Coastal Zone Grading: County governments have the legal authority to control the size, timing, and location of grading and vegetation clearing done in conjunction with construction. The strength of these controls varies, and as usual, they are more restrictive and consistently applied in the Coastal Zone. Grading must be kept to a minimum, fit natural contours, not interrupt natural drainage patterns, and be limited in duration. Counties require a plan for installation of erosion control devices and a performance bond to assure installation and maintenance. Devices must include sediment basins and provisions to infiltrate or conduct surface runoff away from cut and fill slopes. Cut areas must be permanently stabilized and protected from erosion by vegetation or other means so that the erosion rate does not exceed that existing before development. Existing vegetation must be protected during construction and replanted as soon as possible, using native vegetation in SCAs.

Non-Coastal Zone Grading: In each of the counties, grading controls begin with the provisions of the Uniform Building Code (Appendix 33), that requires a grading plan for building permits. Work may be stopped if violations of the permit occur. Grading permits are typically not required for agriculture, emergency work, non-construction, or small projects that involve less than 500 cubic yards of material (or as little as 50 yards in Sonoma counties).

In addition to these basic conditions, all of the five counties have ordinances that require all sediment to remain on site. Project applications must be accompanied by erosion control plans specifying erosion and runoff control measures that will be put in place during the rainy season, from October 15th to April 15th of every year. Counties provide standards to developers in the form of recommended BMPs or standards handbooks. These standards generally specify that exposed areas are planted, seeded or bermed and storm water detention may be required. In addition to plans, a cash deposit may be required for use by the county to restore the site if the permit is not followed.

Marin's Excavating, Grading and Filling Ordinance requires erosion control and sedimentation plans whenever graded areas exceed 10,000 square feet on slopes over 15 percent, or within a Streamside Conservation Area (SCA). Permits are granted only if no siltation of watercourses will occur. Marin's Environmental Quality Element establishes policies for Stream Conservation Areas that include special erosion control measures. Provisions include discouraging soil disturbance, locating new roads and road fill slopes outside SCAs, and prohibitions on depositing spoils from road construction. On-site retention of sediment produced during and after construction may be required.

Monterey's Grading Ordinance prohibits grading liable to deposit debris in a drainage course, on slopes greater than 30 percent, or for levee construction (unless approved by the Flood Control District). The Erosion Control Ordinance requires control of all human induced erosion and sets forth required provisions for runoff control, land clearing, and winter operations. Runoff from a 10-year storm must be retained on site unless soil conditions make this infeasible, at which point runoff must be carried to the nearest drainage course using energy dissipaters. A land clearing permit is required for over two acres per year per site, or over one acre in water supply watersheds or high erosion hazard areas. The subdivision ordinance prohibits construction of private roads on slopes steeper than 15 percent.

San Mateo's Excavating, Grading, Filling, and Clearing Ordinance requires a grading permit when more than 150 cubic yards of soil is moved or if over 1000 square feet of grading occurs in a Scenic Corridor or within a sensitive habitat. A land clearing permit is required for removal of vegetation on an area over 5,000 square feet or on slopes greater than 20 percent.

Santa Cruz's Grading Ordinance requires a grading permit for excavation of over 100 cubic yards of material. Those projects under this threshold must conform to the county's Riparian Corridor, Sensitive Habitat, and Erosion Control Ordinances. The Erosion Control Ordinance requires an erosion control plan prior to issuance of a building, development or land division permit, and for clearing of one acre of vegetation throughout the county, or less than one acre in Water Supply Watersheds (WSWs) and Least Disturbed Watersheds (LDWs) or for any clearing in sensitive habitat. The Conservation and Open Space Element charges the county to require all new and existing development to install and maintain sediment basins or other strict erosion control measures to prevent siltation to streams.

Sonoma County's Resource Conservation Element requires erosion control measures for any discretionary project involving construction or grading near waterways or on lands over 10 percent slope. A grading permit is required for any project involving greater than 50 cubic yards of material. The county has adopted amendments to Chapter 33 of the Uniform Building Code that require construction and post construction erosion control measures to be identified on grading plans. Erosion control plans are required for winter grading. Any graded areas 10 percent or steeper for public or private road construction must have erosion control measures in accordance with Section 20 of CalTrans Standards.

Winter Grading: Counties regulate grading more strictly during the winter than at other times of the year because winter rains increase the potential for eroding soil to leave construction sites and cause sedimentation in streams. All counties have policies in place to require additional review and planning

for proposed winter grading and increased erosion control measures. All sites must have an erosion and sediment control plan with approved measures in place by October 15th or earlier if mandated. Required measures may include both erosion and runoff control measures such as basins, siltation fences, diversion dikes, infiltration trenches, filter buffer strips and creation of artificial wetlands and ponds.

Marin's Development Standards prohibit grading operations during the rainy season unless the county determines that there is no substantial risk of increased sediment discharge from the site. Winter grading must follow a phasing plan and may require a cash bond. Work done adjacent to Streamside Conservation Areas may be done in the dry season only, except for emergencies, and disturbed areas must be stabilized and replanted before the rainy season. On-site retention of sediment produced during and after construction may be required.

Santa Cruz's Erosion Control Ordinance prohibits land clearing over an acre in size or grading of over 100 cubic yards of material during the winter unless approved by the Planning Director. In these cases, specific measures including mulching, drainage, and runoff detention must be in place at the end of each day's work. Operations must cease during inclement weather. The Public Safety Element prohibits earth moving in areas of high erosion hazard in WSWs and LDWs during the winter unless work is pre-authorized and erosion control measures are put in place at the end of each workday.

Monterey County's Erosion Control Ordinance prohibits land clearing of over 1 acre per year per site or grading of over 100 cubic yards between October 15th to April 15th in water supply watersheds, and high erosion areas unless authorized by the Building Inspector. When operations do take place, disturbed surfaces must be protected, roads and driveways must have drainage facilities and erosion proof surfacing, and runoff must be detained or filtered by berms, vegetated filter strips and or catch basins. Controls must be maintained throughout the life of the project and in place at the end of each day's work.

Sonoma County code prohibits construction, grading, cutting, or filling between October 15th and April 15th except in accordance with an erosion control plan approved by the chief building official. Planting completed during the summer must be monitored and maintained until well established or until the rainy season, whichever comes first.

San Mateo County prohibits grading between October 15th and April 15th except in accordance with a Winterization Plan approved by county planning and public works. Staff distributes a set of construction site winterization guidelines to all contractors.

Development on Steep Slopes: Development on steep slopes carries increased potential for soil erosion and subsequent stream sedimentation. The degree to which development on steep slopes is restricted varies across and within the counties.

Monterey's Area Development policies prohibit development on slopes greater than 30 percent and require dedication of scenic easements for these areas. Where development does take place, special

erosion control and construction techniques are required. Monterey's Erosion Control Ordinance reiterates the prohibition on development on slopes over 30 percent while the Zoning Ordinance requires a Use Permit for development on slopes of 30 percent or more. Area plans set residential density at one site per acre for slopes below 20 percent and at one site per two acres between 20 and 30 percent.

Santa Cruz's Public Safety Element prohibits building structures on slopes greater than 30 percent except for single family homes on existing lots of record when no alternative is available. Site design should not allow access roads and driveways to cross slopes over 30 percent. The Geologic Hazards Ordinance implements these guidelines by requiring a geologic hazard assessment for development on slopes over 30 percent. New parcels may not be created if they lead to building and road sites on slopes more than 30 percent. The Grading Ordinance requires the maximum grade of a road to not exceed 15 percent, although it may be up to 20 percent for up to 200 feet. The Erosion Control Ordinance prohibits creation of new lots that require new access roads to cross slopes over 30 percent. Construction of new roads across slopes greater than 30 percent is prohibited on existing lots unless there is no other alternative.

Sonoma County's Resource Conservation Element requires design of discretionary projects so that structures and roads are not located on slopes of 30 percent or more. However this may be waived if it makes the parcel unbuildable. Erosion control measures must be included on discretionary projects involving construction or grading near waterways or on lands with slopes over 10 percent.

Marin prohibits development on slopes over 30 percent in the Coastal Zone only. San Mateo permits development in the rural areas of the Coastal Zone according to a Maximum Density Credit formula based on slope gradient and parcel size, which was developed within their Local Coastal Program.

Cultivation: Policies in Santa Cruz, Sonoma and portions of Monterey Counties regulate certain aspects of agricultural grading including conversion of uncultivated lands to cropland, and grading on steep slopes. Santa Cruz is unique in requiring a permit for agricultural grading. Plans must show erosion control measures to be taken on disturbed non-crop areas. The Planning Director may require review or design by an engineer for grading with erosion potential. Agricultural activities are exempt from the county's Erosion Control Ordinance.

Monterey's North County, Chachagua, and Central Salinas Valley area plans prohibit conversion of uncultivated land with slopes over 25 percent to cropland. They also require a Use Permit for development of new or expanded agricultural operations on uncultivated slopes of 15 to 25 percent. This is then implemented through the zoning ordinance.

Sonoma's Vineyard Erosion and Sediment Control Ordinance requires growers to get approval from the Agricultural Commissioner prior to planting or replanting vineyards. Planting is categorized according to slope and erodibility of soils. Those prone to erosion must have erosion and sediment control plans. All disturbed areas must be protected temporary and permanent measures. The ordinance prohibits most new vineyard plantings on slopes >50%.

Road Maintenance: There is very little written documentation of road maintenance procedures in the five county area. Monterey, Santa Cruz and San Mateo Counties are currently developing road maintenance BMPs as part of the Water Quality Protection Program for the Monterey Bay National Marine Sanctuary. The Sanctuary spans 400 miles California's Central Coast, including most of the shorelines of those three counties reviewed. The October 1999 "Action Plan IV: Agriculture and Rural Lands" calls for county public works and flood control agencies to develop maintenance practices that address sedimentation on public roads and waterways. Implementation steps call for training public works departments on erosion control, establishing BMPs for road maintenance, establishing spoils stockpile areas, and installing sediment retention basins to keep sediment from reaching waterways from roads.

San Mateo County has recently developed (June 2000) performance standards for road construction, maintenance, and repairs in rural areas to fulfill its NPDES permitting requirements. To prevent and control road related erosion these standards require culvert sizing to account for debris transport, installation of energy dissipaters on culverts, and use of rolling dips and water bars on unpaved roads. Side casting is prohibited. These standards require the county to conduct annual inspections, train personnel, and report results to the RWCQB.

Marin County's Municipal Water District is also in the process of developing a countywide, multi-agency MOU for rural road maintenance which will address sedimentation issues.

Water Quality

Water quality is an important component of fish habitat. Many of the regulations governing water quality are implemented through state and federal agencies. All of the counties' general plans identify the need to maintain high water quality standards for residents' drinking water and the environment, including wildlife and fish habitat. Several areas of county jurisdiction affect water quality including storm water pollution prevention, use of chemicals, zoning density and road maintenance.

Storm Water Pollution Prevention: Prevention of non-point source (NPS) pollution into streams is mandated by federal and state law. Current state law requires that projects over five acres in size file a Notice of Intent with the State Water Resources Control Board and develop an approved Storm Water Pollution Prevention Plan. The threshold for this requirement will soon decrease to one acre.

In addition, in order to comply with the federal Clean Water Act, San Mateo, Marin, and portions of Sonoma County have been mandated to apply for and maintain a permit from the National Pollutant Discharge Elimination System (NPDES) for their storm drain systems. These permits are issued to dischargers, including counties, and are administered by the State of California under the authority of the USEPA. (Individual businesses within the county must receive individual NPDES permits.) Counties must report annually to the Regional Water Quality Board describing the amount of pollution prevented by their actions which include planning review, inspections, enforcement, outreach and educational

activities. Counties report on the number of storm drains cleaned, miles of channels and creeks cleared, amount of material collected from street sweeping and chemical collection facilities.

To aid in implementation of NPDES requirements, these counties have enacted specific Storm Water Quality Protection Ordinances. The goal of these ordinances is to reduce pollutants in storm water discharges. Non-storm water discharges to a county storm drain are prohibited except when in compliance with an individual (NPDES) permit. Exempt discharges include water line flushing, landscape irrigation and lawn watering, irrigation water, diverted stream flows, rising groundwater, infiltration to separate storm drains, uncontaminated pumped groundwater, foundation and footing drains, water from crawl space pumps, air condition condensation, springs, residential car washing, flows from riparian habitats and wetlands, and flows from fire fighting and permitted use of reclaimed water.

Each discharger must comply with BMPs adopted by local agencies. Construction contractors must implement appropriate BMPs to prevent discharges of construction wastes or contaminants into county storm drains. Counties may require new developments to install permanent controls on volume and rate of storm water runoff.

Marin's Improvement Standards require additional measures, consisting of a county approved Surface Runoff Pollution Control Plan with construction and post construction BMPs in accordance with the current "Baseline Urban Runoff Control Plan for the Cities and County of Marin".

San Mateo's Zoning Ordinance implements development review criteria aimed at maintaining water quality. Solid and liquid waste discharge and disposal are not permitted to contaminate water resources, and discharge of water containing organic nutrients must be shifted from the aquatic environment to land whenever possible.

Monterey and Santa Cruz Counties, although they have no specific storm water pollution prevention ordinances, do require measures to reduce water quality degradation. Monterey's General Plan requires parking lots with greater than 20 spaces to include oil, grease, and silt traps to protect water quality. The Chachagua Area Plan requires the county health department to monitor riparian water in creeks and stream in areas of high development for septic system failure, and to impose remediation when problems are found.

Santa Cruz's Conservation and Open Space Element requires that new development minimize the discharge of pollutants by providing curbs and gutters on arterials, and oil, grease and silt traps for parking lots, land divisions and industrial uses.

Chemical Use: Santa Cruz's Conservation and Open Space Element prohibits the use of insecticides, herbicides or toxic chemicals within sensitive habitats except during an emergency, when habitat is threatened, or for flood control maintenance by Public Works. Other counties' general plans and policies make no mention of herbicide use. San Mateo's Zoning Ordinance requires that pesticide use not lead to significant or persistent adverse effects on the environment. Its Stormwater Pollution

Prevention Program (STOPP) includes BMPs for pesticide use by county and municipal agencies. Performance standards for county rural road maintenance require herbicide use to be done along county roads only in conjunction with an approved Vegetation Management Plan. The Agricultural Commissioner's Office, operating within each county and employing uniform statewide policies, is in the process of adopting a set of pesticide and herbicide standards that directly address the protection of Endangered Species including salmonids.

Density: Counties also address nonpoint source pollution (NPS) concerns by zoning certain areas as low density, minimizing the future sources of NPS from residential, commercial, and industrial development which will be allowed there. Santa Cruz designates Least Disturbed Watersheds (LDWs) and Water Supply Watersheds (WSWs) in which new parcels must be at least 10 acres (20 acres in the coastal zone). San Mateo's Resource Management District sets residential density at one parcel per 5 to 40 acres depending on slope and other criteria and requires that development proposals be reviewed to assure that no use will contribute to water quality deterioration.

Individual Watershed Management Plans: A number of water quality management plans have been developed for specific watersheds. These include the Pajaro Valley Basin Management Plan, Salinas Valley Water Project, Elkhorn Slough Wetland Management Plan, Pajaro River Water Quality Management Plan, Big Sur Protected Waterway Local Coastal Plan, San Lorenzo River and Watershed Management Plan, and Watsonville Sloughs Water Resources Management Plan in Santa Cruz and Monterey counties.

Migration Barriers

Culverts and bridges over anadromous fish streams may create a barrier to migration of fish when not properly sized or installed. Counties are responsible for direct installation of county culverts and bridges and review of privately constructed infrastructure as well. However, almost no mention of fish migration barriers is made in any of the county policies reviewed. One exception is Monterey's Chachagua Area Plan that directs the county to work with appropriate agencies to develop a water supply system sufficient to allow fish migration to all portions of the Carmel and Arroyo Seco Rivers throughout the year.

Summary of Policy Conclusions

All the counties' general plans articulate fish conservation goals to some degree, but counties vary in their adoption of specific ordinances to implement these goals. The most protective policies are found in the Coastal Zone which offers increased protection for important salmonid habitat throughout the Central California Coastal region. These include fairly extensive provisions for riparian buffers, maintenance of streamflow for anadromous fish, management of storm water, prohibitions on

development of steep and unstable slopes, and construction mitigations. However, the Coastal Zone is a small percentage of the overall geographical area in the five counties.

Outside the coastal zone, protective policies are in place in parts of some counties but not others. Policies to protect riparian corridors can be considered a first line of defense for fish habitat. Specific riparian buffers are established in Marin, Santa Cruz, and portions of Sonoma County. Buffers in Marin and Sonoma vary from 50 to 100 feet depending on zone and topography, to a high of 200 feet for the Russian River. Santa Cruz's riparian buffers are smaller, measuring from 30 to 50 feet depending on type of stream. Santa Cruz is the only county to have a specific ordinance implementing these provisions. However, all counties allow these buffers to be waived if they make a legal parcel unbuildable.

Sensitive habitat regulations that provide general protection are a second line of defense for fish habitat. Santa Cruz, Monterey, and San Mateo establish sensitive habitats countywide, while Sonoma designates these areas in only portions of the county. Only Santa Cruz, Sonoma, and San Mateo consult databases with current fish habitat information for project review. And only Santa Cruz has an implementation ordinance that leads county staff to review all discretionary and ministerial projects for proximity to sensitive habitat and requires buffers to protect habitat.

As a third resort, floodplain setback requirements may be used to keep development out of riparian areas. However, only Monterey County's floodplain policies establish mandatory set backs for development, except agriculture, of 200 feet from riverbanks and 50 feet from watercourses.

Other protective policies attempt to avoid impacts to habitat by controlling water quantity modification, sedimentation, channel modification, and water quality in the five counties. Four of the five counties have language within their general plans requiring runoff rates not be changed from pre-development levels and protecting instream flows. Santa Cruz establishes minimum instream flow targets while San Mateo establishes supplementary review criteria for projects in primary fish habitat areas.

Grading controls are fairly extensive throughout the region. All counties have mechanisms that require erosion control plans to accompany grading projects over a certain threshold in size. Winter grading is strongly discouraged and requires a winterization plan and measures to control erosion and runoff. Monterey and Santa Cruz have specific erosion control ordinances, which require control of all sources of human caused erosion. In addition, Monterey, Santa Cruz and Sonoma restrict development on slopes over 30 percent. Monterey and Sonoma prohibit conversions of steep slopes to agriculture while Santa Cruz requires an erosion control plan and measures for all agricultural grading.

Avoidance of water quality impacts by non-point source pollution is a more recent state and federal mandate. Marin, San Mateo, and portions of Sonoma County are covered by NPS pollution prevention ordinances that prohibit runoff of non-storm waters to county drains and impose requirements of dischargers. All counties prohibit installation of stream bank stability structures by landowners without a valid permit, although environmental review for issuance of such a permit is not always required.

One primary area of county responsibility is road maintenance for paved and unpaved county roads. Although many beneficial practices were viewed during the field assessment, there are very few written policies codifying how road maintenance is done in order to minimize water quality and sedimentation impacts. Regional efforts to develop and implement road maintenance BMPs are beginning to pay off. San Mateo County's new performance standards for rural road maintenance form a sound foundation for codifying road maintenance practices. However, performance standards for maintenance of urban roads have not yet been developed.

Lagoon breaching is another issue on which county policies are not fully developed. Santa Cruz prohibits lagoon sandbar breaching unless consistent with an approved management plan for the stream system and Sonoma has a developed biological assessment of their lagoon breaching efforts on the Russian River. Other counties do not have formal written policies on this practice.

Policies on channel maintenance and modification of large woody debris in streams are not fully developed. Much of this type of activity takes place without written county policies (but typically with input from the Department of Fish and Game. San Mateo County's new performance standards for rural roads do establish some guidelines in some areas.

Another gap is in policy aimed at correcting and avoiding fish migration barriers. Counties, through the development review process and through direct installation and replacement of culverts, roads and bridges are in a critical position to address migration barriers. Although field review showed that many innovative projects are being undertaken in the counties to improve fish migration with the cooperation of the DFG, little written policy focuses on this issue.

TASK 3: INVENTORY AND ASSESSMENT OF MANAGEMENT PRACTICES

MANAGEMENT PRACTICES ASSESSMENT RESULTS

Introduction

Over 60 sites were formally evaluated in the five county study area and many more were observed in passing. The activities observed and the mitigations applied appeared to be representative of the range of county regulated and sponsored projects in the region. Table 9 lists the projects visited by type of activity:

Table 9: Number and Type of Activities Assessed

Type of Activity	Number of Sites Visited
Stream Crossings	16
Floodplain and Riparian Development	6
Stream Restoration	4
Storm Water Management	2
Site Clearing and Grading	8
Spoils Storage and Disposal	2
Streambank Stabilization	6
Landslide Repair	4
Channel and Levee Maintenance	7
Road Maintenance	3
Subdivisions	5
Wastewater Treatment	2
Emergency Flood Control	1

Data forms for all of these activities are included in Appendix B. The following discussion presents the major findings of the field assessment.

Stream Crossings

The 16 stream crossings observed in the field included emergency and non-emergency culvert and bridge replacements, new bridge construction and maintenance of low water crossings (Table 10).

Table 10: Locations of Assessed Stream Crossings

Activity #	County	Location	Activity Type
1	Sonoma	Bohemian Highway	Culvert replacement
2	Sonoma	Graton Road	Culvert replacement
3	Santa Cruz	Tiehl Road	Bridge replacement
4	Santa Cruz	China Grade	Culvert replacement
5	Santa Cruz	Branciforte Road	Bridge construction

Activity #	County	Location	Activity Type
6	Santa Cruz	Crystal Creek	Culvert replacement
7	Santa Cruz	Logan Creek	Culvert replacement
8	San Mateo	Giovanni Road	Bridge construction
9	Monterey	Laureles Grade	Culvert replacement
10	Monterey	Esqualine Road	Bridge replacement
11	Monterey	Thorne Road	Low water crossing
12	Monterey	Salinas River	Low water crossing
13	Marin	Laverne Road	Culvert replacement
14	Sonoma	Bennett Valley Road	Bridge construction
15	Sonoma	Windsor	Low water crossing upgrade
16	Marin	Sir Francis Drake Blvd.	Culvert modification

Nearly all of the crossings evaluated had some problem. These included design flaws, unfavorable environmental locations or construction-related impacts. Formalized consistent crossing design criteria across the region could eliminate some but not all of these problems.

To put these evaluations in perspective it is helpful to review the extent of activity related to crossings. Unfortunately, data for the counties are incomplete (Table 11). (It should be noted that the wide variation in number of culverts is probably due to the manner in which the county defines culverts. For example, Sonoma County includes cross drains in its estimate of culverts. The actual number of culverts affecting fish-bearing streams in Sonoma County is about 4000.)

Table 11: County Maintained Stream Crossings

County	Culverts	Bridges	Low Water Crossings
Sonoma	10,000	350	4
Marin	>200	N/a	N/a
San Mateo	100	30	<10
Santa Cruz	3100	130	2
Monterey	N/a	173	N/a

The extent of maintenance and replacement of these facilities varies from county to county. Sonoma County estimates that 10 bridges and 1000 culverts require replacement. It replaces an average of one bridge and 50 culverts per year. Twelve bridges are scheduled for replacement in the next 5 years. Marin County has replaced or improved two bridges in the past decade. Thirty-two bridges are scheduled for repair or replacement in Santa Cruz, probably over the next twenty years. In Monterey, six bridges have been replaced in the last 10 years and 15 more will be replaced in the next decade. In San Mateo, four bridges have been replaced in the past 10 years and one more is scheduled. A few culverts are replaced there every year.

Emergency Culvert Replacements Five of the evaluated culvert and cross drain replacements were associated with storm damage. One was caused by fill bank failure. The culvert there was replaced

without a downspout and this may contribute to future erosion. Another culvert replacement under similar circumstances was better in two respects. The culvert was larger and it was equipped with a downspout and energy dissipater. Because of the inherently unstable terrain, however, it is likely that road and slope failures will recur at that site over time. On a third culvert replacement the original culvert was replaced with one twice its size. The culvert was incorrectly aligned however, and signs of erosion and slope failure were observed soon after installation. Without removing and repositioning the culvert, future road failure cannot be averted. The remaining two culvert replacements also involved upgrading to larger sized structures. Both of these had natural bottoms, facilitating fish passage. Both were located on tributaries to anadromous fish streams. On one site, headcutting was occurring due to the change in grade created by the new culvert. On the other, wintertime construction had generated some sediment. This second site had also been treated with stream channel grade controls to provide upstream grade control to prevent headcutting. It is uncertain if these structures will effectively control the grade in the affected stream reach. Grade control structures could also create new passage obstructions for fish.

Storm damaged culvert replacements are commonly funded through emergency relief provided by the Federal Highway Administration or Federal Emergency Management Agency. No formal design policy is used by the counties for culvert replacements. None of the culvert replacements described above appeared to provide a solution for the original cause of failure. Probability of future problems with all of them is high.

Routine Culvert Replacements We evaluated two routine culvert replacements. These differ from the five previously discussed because they were not associated with an emergency. Neither was on an anadromous fish stream. There are no permits required for routine work like this. Some construction-related erosion and sedimentation was observed, especially at one site where work had not been completed by late November.

At an existing box culvert we evaluated the retrofitting of fish passage facilities. These consisted of baffles in the culvert to slow velocities. Large blocks of concrete were also placed in the channel to produce a scour pool. The benefits of these efforts may not be long lasting, however because the creek is extremely unstable and is incising and headcutting leaving the culvert too high for fish passage.

Bridge Construction Of the five bridge construction projects, one could be considered a fisheries improvement project on an anadromous fish stream. It entailed the removal of a culvert and associated fill and replacement with a flat car bridge. The stream was rip rapped and revegetated with native riparian plants. Boulders were placed in the stream to control grade. During construction, the stream was diverted and hay bales were placed in the channel to control sediment. Slopes were treated with matting. Some erosion beneath the matting was observed. Potential long term impacts could be associated with the transfer of erosional energy downstream from the armored channel banks.

We evaluated two bridge replacements. These differed from each other primarily in design. One was designed to pass the 50–year flood. Its pilings were in the floodplain, however and could obstruct larger magnitude floods. The stream banks were stabilized and rip rapped, with potential erosional consequences downstream. Extensive revegetation with native plants was required in the construction

contract. The second bridge was constructed outside of the geomorphic floodplain and sized to pass larger magnitude floods. It was constructed over two summers to avoid impacts on the anadromous fish stream.

Two new bridges, one associated with a commercial use and one for a single-family residence, were evaluated. One was a modified flat car. It was installed above the 100-year flood level on an intermittent stream. Installation was by crane and no work was done within the channel. Abutment fills were rip rapped for erosion protection. The second installation was a more conventional bridge that was oversized to accommodate future development potential. The bridge was located above the floodplain of an anadromous fish stream. During installation in November, erosion from exposed soils was observed. The bridge construction also required some permanent clearing of riparian vegetation and removal of woody debris from the stream. Revegetation was required as mitigation at the site and temperature impacts due to riparian clearing will probably be mitigated by shade from the bridge itself.

Low Water Crossings Three low water crossings were evaluated. One that formerly had two small culverts had been upgraded to a larger culvert. This site and surrounding ranch roads had been improved with erosion and sedimentation control measures during the process of a residential-golf course development. The second was a major crossing on an anadromous fish stream. The crossing was a concrete slab with culverts and fish ladder (retrofit in 1984). The fish ladder appeared to create a velocity barrier. It also promotes poaching. Proposed upgrading of the crossing (replacement of roadbed and culverts) do not address the migration barrier or poaching problem. The third low water crossing was also on a major anadromous fish stream. In this case, the road surfacing is removed every year prior to floods and the road fill is allowed to wash downstream. The river carries substantial sediment and this is viewed as a relocation of stored sediment rather than a source of new sediment. When the crossing is reconstructed it is done at low water to reduce impacts on the stream.

Floodplain and Riparian Development

Six instances of floodplain and riparian development were observed in the field (Table 12). All but one of these involved either construction or modification of single residences or single commercial buildings. The other was a road construction project. No major developments such as new subdivisions were reviewed nor were we informed of any recent ones. The lack of major new floodplain developments in the region may reflect relatively strong policies against such development as well as the fact that many floodplains have already been developed. The legacy of existing uses and old approved subdivisions with sub-standard lots will continue to contribute to cumulative impacts on anadromous fish streams.

Table 12: Locations of Floodplain Development Assessed

Activity #	County	Location	Activity Type
1	Marin	Coyote Creek	Residential development in floodplain
2	Marin	San Geronimo	Residential development in floodplain
3	San Mateo	Half Moon Bay	Commercial development on bluff

Activity #	County	Location	Activity Type
4	San Mateo	Los Trancos	Commercial development in floodplain
4	San Mateo	Los Trancos	Commercial development in floodplain
5	Santa Cruz	Zayante Creek	Residential development in floodplain
6	San Mateo	San Francisquito	Road construction in floodplain

One project located adjacent to an anadromous fish stream was a subdivision dating back to the 1920's. At this site, we evaluated construction of a large home on a small lot with less than 20-foot setback from the stream. A waiver from the required 50-100 foot normal setback requirement had been granted because of the parcel size. Extensive clearing of riparian vegetation had been done and exotic landscaping introduced. Sediment from the construction site had accumulated in pools, even though erosion and sediment control measures had been applied. A portion of the creek had been channelized and rip rapped to provide stability.

The second project was comparable to the first with the exception that it involved an on-site septic sewage disposal system. A variance for a setback of the septic system from the stream had been granted due to lot size.

The third project was a development near the mouth of an anadromous fish stream on an adjacent terrace in the coastal zone. Again, a waiver from the normal 50-foot riparian setback was granted due to the lot size. The principal issue associated with this site was that bank erosion was occurring. The property owner had placed riprap to protect it and in the process had removed riparian vegetation and altered instream habitat. The riprap was illegal and was subsequently removed, but it's likely that future bank protection will be needed. The erosion had been accelerated by illegal placement of riprap by an upstream property owner that had shifted erosional energy downstream.

Two related projects were associated with expansion or reconstruction of commercial recreational facilities on an anadromous fish stream. Both involved removal or permanent replacement of riparian vegetation with structures. Extensive erosion control measures had been implemented but some sediment was observed in parking lot runoff. These projects were outside of the county Coastal Zone and no riparian setbacks were required. One project was located close to the stream but built on piers above the 100-year floodplain. There was a possibility that bank erosion would necessitate rip rapping or other treatment in the future to protect the structure.

One project was the raising of an existing home to a level above the 100-year floodplain on an anadromous fish stream. The existing septic system had to be converted to a pump-out system for "black water", with an additional system installed for gray water recycling. Riparian vegetation clearing had occurred but revegetation was planned. Because it was an existing use, an exception to the county riparian protection ordinance was granted. Erosion control measures were implemented but some sedimentation was observed. This situation occurs when a residence that is non-conforming to the county flood control ordinance is remodeled or otherwise required to obtain a building permit. County ordinances require bringing the structure into conformity insofar as possible.

The new road construction project we observed involved construction in the riparian zone of a tributary to an anadromous fish stream. A portion of the stream was also culverted. This had all occurred without county approval, which was granted after the fact. In addition to direct construction impacts, the project permanently removed riparian vegetation and instream habitat. Presence of the road introduced a potential source of sediment. Several remedial measures were required including removal of exotic landscaping and replacement with native riparian species, and monitoring of erosion control measures. An off-site creek ford was to be replaced with a bridge but the bridge did not eliminate cars using the ford.

Stream Restoration

These are projects specifically intended to benefit fish or their habitats. There have been a large number of fish habitat restoration projects undertaken in the study area by governmental and non-governmental agencies. The projects reviewed are a small but representative sample of these. All involved channel modification to improve habitat or remove migration barriers (Table 13). There does not appear to be much coordination between the counties or within any county on prioritizing restoration projects, although that is in the process of changing as a result of the FishNet 4C project. It is unknown if the effectiveness of any of these projects is being monitored.

Table 13: Locations of Restoration Activities Assessed

Activity #	County	Location	Activity Type
1	Marin	San Geronimo Creek	Migration barrier modification
2	Monterey	Carmel River	Channel modification, revegetation
3	San Mateo	Mills Creek	Channel modification, revegetation
4	San Mateo	Pescadero Creek	Channel modification

The first activity was modification of a dam that was deteriorated and presented a partial barrier to anadromous fish passage. The work included construction of step pools, lowering the dam, repairing an existing fish ladder, and upstream habitat restoration. Construction was done during the low flow period and streamflow was diverted around the construction site.

The second project involved stream channel modifications and revegetation to reduce existing erosion on adjacent private property. Some instream habitat restoration work was done as well, consisting of keying in large logs to create pools. This work was carried out under emergency conditions related to flooding in 1998. Channelization will help mobilize accumulated sediment, bank erosion should decrease, and riparian vegetation will reduce stream temperatures. During construction fish were relocated and screens were placed to protect fish and frogs. Streamflow was diverted around the construction site.

The third project, identified as a priority as part of a larger watershed enhancement plan, was an instream restoration in a state park. Installation of step pools and boulders and logs improved the

channel below a historic bridge structure. Non-native vegetation (eucalyptus) next to the stream was cleared. During construction, instream erosion control measures were installed and streamflow was diverted. When the erosion control measures were removed, sediment was released downstream. The project will benefit fish by enhancing habitat and migration. Difficulties with controlling regrowth of eucalyptus and establishing native riparian vegetation were noted.

The last project evaluated was the installation of instream structures to encourage channel scour and increase sediment transport. Root wads were also added to improve habitat. The first installation failed, apparently because the materials were not large enough to withstand peak flows. In the second installation, larger boulders were used. The project appeared to improve sediment transport and fish habitat but use of anchoring cables was viewed as a drawback. Also, there are no assurances that future floods will not wash out the structure.

Storm Water Management

All development projects (residential, commercial or industrial) generate increased runoff and nonpoint source pollution from impervious surfaces. They modify streamflow, possibly causing erosion or exacerbated flooding, and impair water quality. The counties have policies requiring that new developments not increase downstream runoff. Preventative measures such as retention basins have the effect of reducing nonpoint source pollution. Incidental observations of retention and sedimentation basins used in urban development were made throughout the study area and are discussed below, under Subdivisions. We evaluated one site in San Mateo County where a system of sediment and storm water retention basins had been integrated into an existing quarry operation. In this case, a creek that was tributary to an anadromous fish stream was placed underground to prevent it from suffering erosion and contributing to downstream sedimentation. This involved clearing of riparian vegetation but resulted in improved downstream water quality. The sediment basins are regularly maintained and additional sediment control measures are provided in active mining sites. A reclamation plan will be implemented as the mining phases out. This will include restoration of the creek.

At another site in Sonoma County, storm water runoff from a winery was diverted and treated before disposal on adjacent vineyard. Although this site was directly adjacent to an anadromous fish stream, no impacts on water quality or riparian vegetation were evident.

Site Clearing and Grading

We conducted field reviews at nine sites where clearing and grading were being conducted (Table 14). Six of these were development sites and three were road or utility construction sites. Site clearing and grading activities primarily have adverse effects when they extend into the rainy season. Although all of the counties nominally require construction shutdown or special conditions if construction is to extend past October 15th, these provisions are not consistently enforced. In some cases, extended construction

activities are allowed because projects are near completion. When erosion control devices are properly installed, the technology applied appears adequate for normal rainfall conditions.

Table 14: Locations of Grading Activities Assessed

Activity #	County	Location	Activity Type
1	Marin	Tennessee Valley	Site clearing and grading, subdivision
2	Marin	San Geronimo Valley	Site clearing and grading, subdivision
3	San Mateo	Skyline Drive	Site clearing and grading, single lot
4	Santa Cruz	Aptos	Site clearing and grading, single lot
5	Sonoma	Russian River	Grading, excavation for pipeline
6	Sonoma	Unincorporated Sonoma County	Grading for golf course
7	Sonoma	Bodega Hwy	Road widening
8	Sonoma	Lichau Creek	Site clearing and grading, subdivision
9	Sonoma	Graton	Road widening

On one subdivision, a sediment basin had failed because it was undersized. This resulted in a short-term release of fine sediment to an anadromous fish stream. Several investigating agencies (including DFG and NMFS) found no significant harm to fish. After this event, additional erosion control measures were implemented, including a constructed wetland. The use of sediment basins or their sizing appeared to have been inappropriate. The potential long-term consequences of development on this site include non-point source pollution and perhaps, increased runoff from impervious surfaces.

On a second subdivision we observed exposed soil with no effective erosion control measures implemented. The site was visited one day before county codes and the Regional Water Quality Control Board (RWQCB) requires winterization of construction sites to be in place. The site drained directly to an anadromous fish stream. A silt fence intended to intercept runoff was improperly installed.

Similar conditions were observed on a third small (seven lots) subdivision. Although this site did not drain directly to an anadromous fish stream, it was traversed by an ephemeral stream. Vegetation had been cleared from this stream and a large proportion of the site had exposed soil in December. Erosion control measures, including silt fences and straw mulch, were inadequate or improperly installed. As a consequence, sediment deposition was observed at the culvert inlet, downstream from the property.

The two single lot developments evaluated differed primarily in the extent of erosion control measures implemented. One was adjacent to an intermittent stream. The riparian vegetation had been partially cleared and no buffer was apparent. Most of the lot was graded and erosion control measures were limited to sediment controls at the base of the slope. These conditions were observed in December and winterization should have been in place. On the second lot, a larger area had been cleared and graded but extensive erosion control measures were in place. These included straw mulch on exposed soils, silt fences and energy dissipaters at drainage inlets. Stockpiled soils were well covered. Revegetation had not occurred but was planned.

At the site where we observed grading for a golf course, the developer was rehabilitating old roads and unstable slopes in conjunction with a new driving range. There had been a failure of erosion control measures after a storm that was detected through monitoring. Rehabilitation was intended to

permanently solve that problem. Extensive erosion control measures were observed at this site including use of silt fences, straw rolls on slopes, hay bales, etc. Areas of native grasses and wetlands were fenced for protection during construction. The site is located on a tributary to an anadromous fish stream. The review team raised potential long-term issues associated with use of fertilizers and pesticides.

The three public works projects (road widening and sewage line extension) were similar in that they were all occurring within existing road right-of-ways. One included lining roadside ditches with rock to prevent erosion, and revegetation of disturbed areas. No stockpiled soils were observed and construction was done during the dry season. Special care was required because the road was directly adjacent to a stream. The other road widening included creation of a new cut slope. During field inspections in December, erosion control measures (silt fences, wattles, hay bales, sediment basins at drainage inlets) were adequate. There had been some erosion initially but this had been mitigated by subsequent treatments. The sewage line extension was being done to replace residential septic systems notorious for failing. The area was directly adjacent to a major anadromous fish stream. Although the long-term effects of this project were considered exceptionally beneficial to water quality, short-term construction impacts were observed. The main problem was that the construction was behind schedule and had extended into the rainy season. No effective erosion control measures were in place. Soil was stockpiled with no covering, storm drains were not protected, and streets were tracked with mud. Rain was falling lightly during the evaluation and we were informed that under heavy rain conditions the project would be halted.

Spoils Storage and Disposal

Storage and disposal of road surfacing materials, soil and debris were formally evaluated at two locations but casually observed throughout the study area and in conjunction with other activities (Table 15). The recent severe rainy weather in the five county region has contributed to a large number of landslides and road failures. Consequently, there has been an increased demand for sites to store soil and debris. This is handled differently from county to county. Also, other agencies, such as CalTrans, have their own sites and procedures for disposal, some of which may conflict with local procedures.

The first activity evaluated was the storage of materials derived from cleaning inboard ditches or road maintenance. Materials were stored as berms along roads or in piles at locally wide spots along the road. No mitigation measures were evident and these materials could be eroded into watercourses. At a second site, we documented materials that had been illegally dumped along the roadside. While some counties have policies against roadside storage and dumping, the enforcement against these actions is not always possible adjacent to an anadromous fish stream.

Table 15: Locations of Spoils Storage and Disposal Assessed

Activity #	County	Location	Activity Type
1	San Mateo	Tunitas Creek	Ditch maintenance

2	Santa Cruz	China Grade	Roadside storage

Streambank Stabilization

We reviewed six projects involving streambank stabilization (Table 16). We observed many more examples of this practice throughout the five county area. Riprap is commonly used on the outside of meander bends, at culvert mouths, and at bridge abutments to prevent erosion. Less commonly, it is used as a protective measure on straight stream reaches where the road is very close to the stream. Generally, installation of riprap usually has minor sedimentation impacts. Unless an emergency situation, these impacts are subject to mitigation through the DFG Streambed Alteration Agreement process. Common mitigation measures applied include restriction of work to low flow periods and temporary diversion of streamflow away from the construction site.

Table 16: Locations of Streambank Stabilization Projects Assessed

Activity #	County	Location	Activity Type
1	Marin	San Geronimo V.	Road repair
2	San Mateo	La Honda Creek	Streambank stabilization
3	Santa Cruz	Soquel	Private land erosion control
4	Santa Cruz	King's Creek	Road repair
5	Sonoma	Colgan Creek	Private land erosion control
6	Santa Cruz	San Lorenzo R.	Streambank stabilization

The long-term impacts of riprapping stream sections can include transfer of erosional energy to other unprotected parts of the stream, with consequent impacts. This can cause changes in off-site instream habitat or cause downstream property damage (see discussion on Floodplain Development, above). Bank stabilization to prevent losses of property or infrastructure is probably the most common activity directly affecting fish habitat, especially since it is often associated with roads and crossings. Bank hardening typically prevents recovery of riparian vegetation, altering the temperature regime. Revegetation is rarely required on stabilization projects. Project-by-project incremental bank stabilization will often lead to cumulative impacts on erosion throughout a stream system. Eventually, the entire natural channel may disappear.

The first project evaluated was initiated due to slope erosion caused by road runoff. It was located on a road adjacent to an anadromous fish stream. Existing grouted riprap at the toe of the road slope was replaced and drainage was improved, resulting in reduced erosion. No revegetation was included in the project and potential impacts include elevated stream temperatures due to lack of canopy.

The second project was bank stabilization to reduce erosion on private land. It was done on an anadromous fish stream and underwent a full environmental review, including consultation with NMFS. Several mitigation measures were included such as stream diversion during construction, fish rescues, equipment exclusions and revegetation. Rock groins and rootwads were placed to improve instream habitat. Attempts at revegetating the armored banks failed but may be repeated in the future.

In two projects, gabion baskets and riprap were used to stabilize banks at a private residence and a bridge. The primary difference between these was that one had been revegetated with willows and the other had not been revegetated. The revegetated banks encouraged sediment deposition and reduced flood velocities, thereby reducing potential for off-site erosion. Both projects required hydrologic calculations to demonstrate no increase in downstream flood peaks or changes in velocity. However, these are done on a project-by-project basis and no cumulative assessment is done for entire stream systems. Since both projects are located on anadromous fish streams, this would appear to be a shortcoming. The private property project required a number of permits and mitigation measures. All work had to be done by hand and erosion control measures were required both during and after construction. With respect to the use of gabions versus biotechnical methods, gabions are believed to have adverse effects on fish (snaring) which makes them unpopular with NMFS and DFG.

On another project, a previously relocated channel (not an anadromous fish stream) was threatening existing development on a floodplain. Concrete slurry was placed over existing riprap to stabilize the banks for approximately two miles. Rock was placed in the channel to slow water velocities. Encroaching riparian vegetation was controlled with herbicides. This was essentially an emergency treatment for an existing problem. No mitigations for vegetation clearing, instream habitat modification or possible increases in downstream water temperatures were applied. The use of herbicides in urban flood control channels that lack significant or valuable habitat is typical.

In the last project, streambank stabilization was associated with a road reconstruction project. The road is located adjacent to an anadromous fish stream. Although erosion control measures were imposed as conditions in the DFG Streambed Alteration Agreement, several problems were observed. Stockpiled spoil materials were located on the shoulder and could be transported to the stream. The riprapped banks and road cut slope were not revegetated. The armored channel could transfer erosional energy downstream where there was a large streamside landslide.

Landslide Repair

Extreme storm events in the five county area trigger landslides along roads, especially if the roads are located in naturally unstable locations. Landslide repair is often conducted under emergency conditions and is often associated with road resurfacing and streambank stabilization. Data for the counties are incomplete but they indicate that in excess of 100 disaster-related landslides, road washouts and slope failures occur during a bad weather year in every county. Many of these are associated with roads in inner gorges or on otherwise naturally unstable terrain. All of the landslide repairs we evaluated had low likelihood of a permanent solution. The common element of all was a relatively low priority placed on revegetation. When adjacent to anadromous fish streams, revegetation is not just advisable for enhancing stability, but also for preventing surface erosion and providing shade canopy. Culvert failures and diversions are a significant cause of landslides. For example, in Santa Cruz, over ten percent of storm damage events over a three-year period (1996-8) were related to culverts. We evaluated four separate projects, one of which included two different treatments (Table 17).

Table 17: Locations of Landslide Repair Projects Assessed

Activity #	County	Location	Activity Type
1	Sonoma	Porter Creek	Emergency landslide stabilization
2	Santa Cruz	Trout Gulch Rd.	Two landslide repair treatments
3	San Mateo	Tunitas Creek	Road repair
4	San Mateo	Tunitas Creek	Road repair

The first project was a massive existing landslide that had actively moved for 10 days and resulted in months of road work. It was located immediately above an anadromous fish stream. Temporary drainage and erosion control measures had been implemented in anticipation of a major future repair project. Long term stabilization and repair will cost in excess of $1 million and will be funded from state emergency relief funds. We observed imminent failure on the slope above the creek. Landslide debris stockpiled behind concrete barriers to be used in the final repair was in danger of entering the stream. Scheduling for complete repair is awaiting completion of the project design.

The second project consisted of two repairs for road fill or road prism failures on an inner gorge road located above a tributary to an anadromous fish stream. The source of failure was diverted flow from plugged culverts. One treatment was reinforced earthen wall and the other was a concrete crib wall. Both treatments appeared partly effective in preventing further mass movement. During construction, there were temporary erosion and sedimentation effects. Many erosion control measures, including hay bales, mulch, rocked inboard ditches and jute netting were applied but were not completely effective. Slumping was observed at the interface between the concrete crib wall and natural soil surface. Revegetation of the concrete surface was not possible. According to county staff, revegetation is not normally required for landslide repair projects since natural revegetation occurs quickly. However, at this site, exotic rather than native plants were colonizing. It is unknown if the diversion potential at the culverts was corrected in order to prevent future problems.

The remaining two projects were closely related and on the same road adjacent to an anadromous fish stream. One involved a culvert failure that had caused a diversion and landslide. The culvert was replaced, the landslide was stabilized and the culvert mouth was armored. It is uncertain if the diversion potential at the culvert was eliminated. Erosion control measures did not appear to be effective and extensive revegetation had not been done. Long-term stability is questionable.

The other project was a road failure caused by a landslide above the road. When it failed, a large amount of sediment entered the creek. The reconstruction effort included armoring above and below the road. Landslide materials were sidecast over riprap, rather than disposed off-site. Jute netting and grass seed were then applied. Erosion beneath the netting was observed, creating a chronic source of sediment. Prospects for long-term stabilization seem low.

Channel and Levee Maintenance

Maintaining the capacity of channels to convey floodflows requires different levels of effort depending on the location of vulnerable structures or facilities relative to the channel and the design capacity of the flood control channel. In cases where development on floodplains has occurred, there may be compelling pressure to prevent flood damage. If the design capacity is limited (e.g., designed to convey relatively frequent floodflows but not low recurrence interval floods) then frequent maintenance may be needed. Maintaining channel capacity equates to clearing obstructions such as debris, sediment and vegetation. Since all of these are components of anadromous fish habitat, the impacts of channel maintenance can be significant. Short-term impacts of channel clearing on fish include loss of instream habitat, temperature increases and sedimentation.

Marin County maintains about 10 miles of flood control channel and eight miles of levees. Sonoma County has clearing easements on 150 miles of natural channel and also maintains 100 miles of constructed floodway. Monterey County maintains about 60 miles of channel and levee. San Mateo County maintains about nine miles of flood control channel. Data for Santa Cruz County is not available. Practices applied vary from county to county and even within each county from stream to stream.

We evaluated four channel clearing activities (Table 18). One involved an anadromous fish stream traversing an urban area susceptible to substantial flooding risk. At this site, clearance activities had historically been relatively aggressive, and included use of heavy equipment to completely remove colonizing riparian vegetation and sediment deposits. Follow-up treatments with herbicides were also done. Deferral of channel maintenance on that stream had contributed to flooding in 1998. Emergency clearing was done at that time but maintenance has since been suspended since due to fisheries concerns.

Table 18: Locations of Channel and Levee Maintenance Projects Assessed

Activity #	County	Location	Activity Type
1	Marin	Reed Creek	Channel clearing
2	Monterey	Pajaro River	Channel clearing
3	Monterey	Carmel River	Levee modification
4	Monterey	Torro Creek	Channel clearing
5	San Mateo	Alpine Creek.	Woody debris management
6	Sonoma	Santa Rosa Creek	Channel clearing
7	Santa Cruz	Zayante Creek	Woody debris management

At the second site, the stream is subject to aggradation due to upstream erosion. Willow recruitment occurs thereafter, impairing flood conveyance capacity. A neighborhood of 1500 homes is at risk. This is not an anadromous fish stream, but is tributary to one. Maintenance consists of hand removal of willow including roots during the dry season. The willow masses are placed on the banks where they may re-establish. Instream impacts are minimized by conducting the activities during the dry season.

At the two other sites, the channel clearing approach taken was less aggressive. Both of these streams support anadromous fish. On one stream, the channel capacity and flood hazard were such that vegetation encroachment in the channel was permissible. Former mechanical clearing and use of herbicides had been suspended for 10 years with no increase in flood hazard to neighboring properties. In the second case, vegetation is cleared from the channel and lower banks but retained on side slopes and levee top. Woody debris in the stream is retained, if pointed downstream.

At two sites we evaluated the treatment of woody debris within the stream channel. When large pieces of wood pose hazards to culverts and bridges they are systematically removed. At one site, wood was removed down to "knee level" but rootwads were left in place. The wood pieces removed were given to the local Resource Conservation District for placement in other streams. The county has policies on removal of woody debris that mandate protection of public infrastructure and private property.

At the second site, wood was left in the stream because the calendar deadline for removing it had passed. As a rule, rootwads are left in place. Depending on conditions, logs may be left or removed. In this instance, the log was relatively small and would probably be transported downstream at high flows.

The last channel and levee maintenance project reviewed was actually a modification of an existing levee to permit flooding onto adjacent property. The landowner was willing to flood his property and thereby prevent some downstream flooding. The levee was modified by installing riprapped notches in it. The notches must be periodically maintained by clearing vegetation. Although a positive non-structural solution to flooding, there is the possibility that juvenile steelhead can be transported through the notches at high flows and afterwards stranded in fields.

The activities reviewed reveal changed attitudes and practices towards channel and levee maintenance that are generally more benign towards fish and fish habitat. In cases where the flood hazard or capacity of a channel permits relaxed maintenance, there are distinct benefits. In cases where floodplain development has occurred, risks are high or infrastructure is threatened (e.g., from woody debris), counties may be limited in what they can do. They may be unable to do aggressive management due to environmental regulatory constraints. Quite often, it takes an emergency situation to reveal this dilemma.

Road Maintenance

Three road maintenance activities were evaluated (Table 19). Two involved periodic clearing of inboard ditches along paved roads. No specific best management practices were observed on these activities. While ditch clearing removes some accumulated sediment, it also removes vegetation and exposes soils to erosion. Disposal of ditch spoils was observed in roadside berms and at stream crossings, creating potential sediment sources. In one case, clearing was done infrequently to try to minimize chronic impacts.

Table 19: Locations of Road Maintenance Projects Assessed

Activity #	County	Location	Activity Type
1	Marin	Homestead V.	Ditch clearing
2	Santa Cruz	Branciforte Rd.	Brushing, ditch clearing
3	Marin	Woodacre	Fire road maintenance

The third activity evaluated was routine maintenance of unpaved fire roads. These roads are former logging and ranch roads that have been retained for access to open space lands. They are generally dirt and are mostly insloped with inboard ditches. Yearly maintenance consists of grading the road surface and ditch clearing. Some maintenance guidelines apply but erosion and sedimentation were observed at the activity site evaluated.

Road maintenance is a major potential source of sedimentation to streams. Deferring maintenance of inboard ditches can cause diversions and slope failures. All of the counties are responsible for maintaining many miles of roads (Table 20). With the exception of low standard, unpaved roads in parks and open space, most of these are surfaced and drained with inboard ditches. In some cases, existing roads in open space lands are neither maintained nor decommissioned. These represent a major potential hazard to water quality.

Table 20: Miles of County Maintained Roads

County	Total Miles of Road	Surfaced Road Miles	Unsurfaced Road Miles	New Road Miles Constructed/ Year
Sonoma	1400	1370	30	
Marin	870	420	450	<1
San Mateo	430	335	95	0
Santa Cruz	601	600	1	<1-2
Monterey	1153	1009	144	0

Subdivisions

We assessed four subdivisions where we primarily focused on grading, drainage and treatment of watercourses (Table 21). One of these was located near an anadromous fish stream. The master development plan included several mitigation measures aimed at protecting the stream. In addition to 100-foot setbacks from the riparian zone, active stream restoration was carried out. This included channel reconstruction and protection and eventually natural regeneration of riparian species. The storm drainage system was disconnected from the stream. Storm water was routed through rock-lined channels to detention ponds. Generally, the positive effects of development included revegetation of a degraded riparian corridor, elimination of erosion and sediment sources, reduced water temperature (due to increased canopy cover) and improved instream habitat. The likelihood of future channel clearing to prevent flooding was reduced by the setback and by the generally low flood hazard. However, as with any urbanization, this development has the potential to cause increased runoff and nonpoint source pollution.

Table 21: Locations of Subdivisions Assessed

Activity #	County	Location	Activity Type
1	Marin	Lucas Valley	Stream restoration in subdivision
2	Monterey	Salinas	Storm drainage in subdivision
3	Monterey	Hwy 68	Subdivision and golf course
4	Santa Cruz	Soquel	Storm drainage in subdivision

The remaining three subdivisions had several characteristics in common. All had implemented extensive erosion control measures. All had integrated sediment and stormwater retention basins into the drainage system. All were required to demonstrate no net change in downstream flooding. In one, wetland areas were designated and protected. However, in that same project natural channels (ephemeral) were used to convey stormwater and had been developed with retention basins. At all sites, some attempts were made to avoid natural channels or restore existing erosion problems. Generally, erosion control measures seemed adequate at these sites, even though there was exposed soil present on all sites after the beginning of the rainy season. The effectiveness of sediment and stormwater retention basins will depend on their long-term maintenance.

Controls over new subdivisions in these counties are relatively sophisticated, as indicated by the activities reviewed. Data on development potential of the five counties have not been completely analyzed but development pressures appear to be highest in Sonoma and Monterey Counties. Available data indicate that each county with the exception of Marin and Santa Cruz processes at least 10 subdivisions per year. During this assessment, we were not informed of any new subdivision proposed within the floodplain of anadromous fish streams.

The practice of disconnecting development drainage from natural streams either with retention basins or other means is a definite change from former practices. Many subdivision ordinances still require or allow disposal of storm drainage into a natural channel.

Wastewater Treatment

We evaluated two wastewater treatment projects, one for a horse stable in San Mateo County and another for a winery in Sonoma County. The stable operates under a use permit. It is located near an anadromous fish stream. Water quality impacts are controlled by directing runoff to a sediment basin, off hauling of manure and covering stockpiled manure during the rainy season. The manure management plan is subject to annual approval by the Regional Water Quality Control Board. The County Environmental Health Department also reviews commercial stables with more than 150 horses. No significant impacts to the stream were observed at this site.

At the winery site evaluated, groundwater from deep wells was used for processing grapes. The processing wastewater was drained to a pair of ponds where it was aerated, solids were settled and the remaining wastewater was then recycled for vineyard irrigation. Although adjacent to an anadromous

fish stream, no stream water was used for irrigation and no runoff from the developed area directly entered the stream. Mitigation measures appeared to prevent adverse water quality impacts as well as minimize possibilities of instream flow reductions.

Emergency Flood Control

We evaluated one emergency flood control project, sand bar breaching in Monterey County. The breaching is carried out annually by the County to prevent flooding to houses located at the shoreline of the Carmel River lagoon. Although there is a plan under which the breaching is performed, permits to conduct this activity have expired. When emergency conditions occur, there may be significant impacts to juvenile salmonids and other aquatic life in the lagoon. The extent of impact is presently unknown.

The mouths of at least four coastal rivers in the five county region (Russian, Carmel, Salinas and Pajaro) are subject to closure by sand bars. They eventually breach naturally but artificial breaching is commonly practiced. The total number of rivers, the frequency of the activity and the cumulative impacts on anadromous fish have not been determined.

Summary of Management Practices Conclusions

Our review of county activities indicated several practices and/or problems that pose risk to anadromous fish and their habitats. Stream crossings are sometimes improperly designed, poorly constructed or inappropriately located. Because of the sheer number of crossings, this is a significant concern. Even when crossings are designed for fish passage, there may be design or functional problems. No major new floodplain or riparian developments were observed, but when existing developments are modified, or existing lots are built on, there is often a waiver from required protections. The legacy of existing development in critical habitat areas is a concern in all the counties. This pertains to infrastructure and roads as well as private development.

Stream restoration projects appear uncoordinated and their effects at the watershed scale are uncertain. Observations at major new developments indicate that substantive controls are placed on stormwater management. However, site clearing and construction activities commonly cause erosion and sedimentation if allowed to occur during the rainy season. Although a broad array of erosion controls is used in the region, their implementation and effectiveness are uneven. Highly visible, large developments tend to have the best controls in place. Storage of road maintenance spoils, landslide debris and other materials is not effectively controlled to prevent erosion, sedimentation and nonpoint source pollution. In addition to unprotected soils, unprotected building materials and petroleum products were observed in the field.

Bank stabilization to prevent erosion on public and private properties is the activity most directly affecting fish habitat. It is ubiquitous in the region and there are no effective controls in place to prevent local and cumulative impacts. Related to the issue of development location is the problem of disaster-related road failures and landslides. These generally occur in predictable locations and will often reoccur

in the same place. The problem is not completely solvable without relocation of the most unfavorably positioned facilities.

Channel and levee maintenance practices, including woody debris clearing from streams, are highly dependent on the risk that flooding or infrastructure failure poses to public and private property. Again, the issue is location of development but there is the added dimension of the original design that may have been inadequate to accommodate both flood control and fish.

Since many of the county-maintained roads are paved, the principal concern with road maintenance is disposal of ditch clearance materials and general drainage impacts. Three counties do have significant miles of unpaved roads that generate sediment both during and after maintenance. Unused, but unrestored roads pose a hazard because they may fail in the future.

Our review of wastewater treatment was not complete enough to provide a basis for conclusions. It appears that major facilities are adequately regulated.

Finally, lagoon breaching may be a regional issue worthy of further study.

TASK 4: RECOMMENDED ADDITIONAL PROTECTIVE TOOLS

RECOMMENDATIONS

Generally, the findings of the policy analysis were corroborated by the field assessment. Fish habitat protection policies and procedures that are applied in counties' coastal zones create a foundation for conservation of anadromous fish species. However, anadromous fish do not restrict themselves to these locations. Extension of coastal zone protective policies to non-coastal areas of the counties, as has been accomplished for the most part by Santa Cruz County, would greatly improve protection of fish habitat in the region.

Specific recommendations for improving fish habitat conservation are listed below.

1). Consider extending coastal zone protective policies to non-coastal areas of the counties where applicable and feasible.

2). Identify anadromous fish streams and tributaries in all the counties. Counties should participate in an overall program of habitat protection and prioritization for restoration at an individual watershed level.

3). Develop and adopt written standards for management practices and prioritization for action, including road reconstruction, decommissioning and maintenance that minimize sedimentation and runoff impacts. These should address disposal of spoils, stream crossings, culvert diversion potential, fish passage, and slope repair. Train staff in implementation of these standards.

4). Establish adequate spoils storage sites throughout the counties so that spoils from landslides and road maintenance can be stored safely away from anadromous streams.

5). Improve enforcement to eliminate impacts of wintertime grading. Train county inspectors in erosion control technology.

6). Develop an interdisciplinary review procedure for routine and emergency road and culvert placements which assesses and mitigates potential barriers to fish migration. The review procedure could take the form of a yearly post-implementation audit to see how things were done, especially for emergency projects. Develop a systematic program for replacement of barriers to upstream migration of salmonids

7). Establish generous riparian buffer strips on anadromous streams, wherein development is prohibited. Define riparian protection areas on the basis of stream geomorphology rather than vegetation, flooding or arbitrary distances from streams. Enforce protection provisions with implementation ordinances. Tighten enforcement of existing riparian protection policies to make variances more difficult to obtain. Establish a fund for purchase of property or easements for cases in which implementing riparian buffers makes parcels unbuildable.

8). Consider developing a program for identifying especially unsuitable existing development, infrastructure and roads affecting anadromous fish streams. Consider options and opportunities for gradually eliminating them.

9). Work with the State Water Resources Control Board and other agencies to establish target levels of instream flow to maintain populations of anadromous fish. Incorporate these target levels into the County development review process and prohibit projects that jeopardize instream flows.

10). Develop alternatives to conventional bank stabilization for public and private projects and require evaluation of alternatives through the permit process. Treat all proposals to install bank stabilization on anadromous fish streams as discretionary and require CEQA review. This will normally be required for projects subject to DFG 1600 Stream Alteration Agreements but should be extended to emergency projects. Address cumulative effects of channel hardening in this review. Consider a review procedure in the form of a yearly post-implementation audit to see how things were done, especially for emergency projects.

11). To the degree possible, given design constraints, reduce the extent of riparian vegetation and sediment clearing done on anadromous fish streams that pose flooding hazards. Retain large woody debris within streams to the extent possible.

12.) Conduct a regional study of lagoon breaching to determine cumulative effects of the practice. If warranted by study findings, adopt policies and implementation procedures that mitigate impacts.