MARIN COUNTYWIDE PLAN

Hydrology and Water Quality Technical Background Report

Alex Hinds, Community Development Director
Michele Rodriguez, Principal Planner, AICP
Frederick Vogler, GIS Manager
Dan Dawson, Senior Planner
Kristin Drumm, Planner
Don Allee, Clerical Support

Special Consultants:

Clearwater Hydrology
2974 Adeline St.
Berkeley, CA 94703

Nichols • Berman
110 East D Street, Suite E
Benicia, CA 94510

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The Marin County Community Development Agency, Planning Division
3501 Civic Center Drive, San Rafael, CA 94903

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1. HYDROLOGY AND WATER QUALITY

A. PURPOSE AND BACKGROUND

This Environmental Quality Technical Report on Hydrology and Water Quality in the Marin Countywide Planning Area (CWPA) updates the previous edition which was prepared in 1991. That report described the existing hydrologic environment, the regulatory framework affecting surface and ground waters, including stream conservation areas (SCAs) and other resource conservation zones, the composition and responsibilities of the Marin County Flood Control and Water Conservation District (MCFCWCD), and the status of water quality in the region's streams and bays. It also incorporated an assessment of the policies and programs adopted in the 1977 Environmental Quality Element. The current report has four primary objectives:

1. Update the discussion of the regulatory environment, particularly as it pertains to surface and groundwater quality, water supply, and habitat preservation;
2. Assess the current hydrologic conditions and water quality in the waters of the CWPA, as well as the status of the region's drinking water supplies;
3. Evaluate the performance of the policies and programs pertinent to water resources in the Environmental Quality Element of the 1991 Countywide Plan.
4. Recommend revisions or refinements to the 1991 CWP policies and programs which would enhance water quality and aquatic habitat, improve channel stability, and maximize the County's ability to mitigate the effects of future development on water resources.

B. REGULATORY FRAMEWORK

1. Water Supply

The Marin Municipal Water District (MMWD) was formed under the provisions of the Municipal Water District Act of 1911. At the state level, water districts are under the authority of numerous sections of the California Water Code, related to potable water. Code regulations regarding the use of reclaimed water also apply to MMWD and NMWD (North Marin Water District). The State Department of Health Services has the primary responsibility for overseeing water district compliance with potable and reclaimed water standards. The California Department of Water Resources (DWR) regulates the construction and operation of the larger water supply dams in the MMWD and NMWD systems through the auspices of its Division of Safety of Dams. DWR's Division of Water Rights sets requirements for the purchase and maintenance of water rights. Both the State Water Resources Control Board (SWRCB) and its local Regional Water Quality Control Boards (RWQCB) have regulatory authority over the districts in matters related to instream flow requirements and reservoir releases, as well as enforcement authority in the event of chemical spills, and general water quality abatement. Finally, the California Department of Fish and Game (CDFG) has advisory and permitting authority regarding stream stabilization, restoration, and general construction activities that are conducted within a defined stream channel.

MMWD and NMWD staff must keep abreast of current revisions to the CA. Water Code, which undergoes continual amendment, and other regulatory requirements. For example, MMWD's water quality department follows developments in water quality regulations issued by the U.S. Environmental Protection Agency (EPA), SWRCB and RWQCB. Similarly, MMWD's Watershed Department follows endangered species regulations that affect water district operations and watershed management functions. The California Association of Water Agencies acts as an information clearinghouse for local water districts and water agencies.

Several bills pertaining to natural and municipal water systems and municipal water agencies have been enacted during 2004 and 2005 by the State legislature. Below is a list of bills, along with brief descriptions of the bills, obtained from the Association of California Water Agencies.

2004

Assembly Bill No. 2470 (Kehoe) "Authorizes a local agency to educate the public about water conservation by distributing an informational booklet or materials to buyers of real estate containing up to four residential units. Provides that if an informational booklet or materials are delivered to a buyer, that information shall be deemed adequate and the seller or broker is not required to provide additional information concerning water conservation and conservation programs."

Assembly Bill No. 2717 (Laird) "California Urban Water Conservation Council: stakeholders. Declares the Legislature's intent that the California Urban Water Conservation Council convene a stakeholder workgroup composed of public and private agencies, and associations to evaluate and recommend proposals for improving the efficiency of water use in new and existing urban irrigated landscapes in the state. Contains other related provisions."

Assembly Bill No. 2918 (Laird) "Requires the Public Utilities Commission to evaluate the interrelationship between the commission's electricity policies and water policies as they relate to saline water conversion through ocean desalination, and to report to the Governor and the Legislature, on or before January 1, 2006, on the balance between electricity ratepayers and water ratepayers. The commission is required to invite the Department of Water Resources, the State Water Resources Control Board, the Department of Fish and Game, the State Energy Resources Conservation and Development Commission, and the California Coastal Commission, to participate in the evaluation."

Assembly Bill No. 318 (Alpert) "Requires that urban water management plans developed by urban water suppliers pursuant to the Urban Water Management Planning Act describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply."

Assembly Bill No. 2528 (Lowenthal) "Deletes the requirement in the California Safe Drinking Water Act that every public water system serving more than 10,000 service connections and detecting one or more contaminants in drinking water exceeding the public health goal must prepare a brief written report. Requires instead that the operator of wholesale or retail public water systems, as defined, must provide notice relating to contamination of any drinking water that exceeds the maximum containment level, a response level, or a notification level, as defined, including, but not limited to, notification to the

Public Utilities Commission if the public water system is a regulated public utility. Contains other related provisions and other existing laws."

Assembly Bill No. 2121 (Committee on Budget) "Requires the State Water Resources Control Board to prepare an annual written summary, in chart form, of pending applications to appropriate water in the Counties of Marin, Napa, Sonoma, Mendocino, and Humboldt, and would require certain information to be included in that summary. Authorizes the board to post that information on its Web site. Requires the board, on or before January 1, 2007, to adopt principles and guidelines for maintaining instream flows in certain streams in accordance with state policy for water quality control, for the purposes of water right administration, and authorizes the board to adopt principles and guidelines for maintaining instream flows in other streams for those purposes."

Assembly Bill No. 107 (Steinberg) "Authorizes flood control districts that are authorized to construct, manage, maintain, or repair levees and other flood control works under the jurisdiction of the Reclamation Board to adopt more stringent standards, for prospective application, for the operation and maintenance of those flood control works. The standards adopted by the governing body of the public entity will become effective upon approval by the Reclamation Board. Authorizes the Reclamation Board to unilaterally revise these standards upon 90 days' written notice to the public entity."

Assembly Bill No. 2733 (Strickland) "On and after January 1, 2005, requires persons extracting groundwater in a board-designated local area to file the required notice with a board-designated local public agency or court-appointed watermaster instead of the State Water Resources Control Board. Designated local agencies can impose a fee to pay for related administrative expenses."

Senate Bill No. 1514 (Poochigian) "Requires that a water district or any other local agency make a reasonable effort to obtain names and addresses of holders of interest in delinquent property that the district or agency takes title of and terminates the party's interest in the delinquent real property. Reasonable effort is defined as obtaining a preliminary title report, litigation guarantee, lot book guarantee or similar report from a title company, or county record searches. Related costs will be added to the amount of the delinquency that will be paid in order to clear the delinquency and/or redeem the delinquent property."

Senate Bill No. 1107 (Committee on Budget and Fiscal Review) "Resources budget trailer bill. Increases the share of costs, from 50% to 100%, that water right holders are required to pay for the administration and distribution of water in watermaster service areas and establishes new grant programs for public agencies and nonprofit organizations that implement specified projects. Includes other provisions related to resources." (Urgency statute effective August 16, 2004.)

Assembly Bill No. 2572 (Kehoe) "Requires an urban water supplier, as defined, on or before January 1, 2025, to install water meters on all municipal and industrial water service connections that are located in its service area. Contains certain exemptions and other related provisions."

Assembly Bill No. 2529 (Kehoe) "Establishes a program for marine managed areas pursuant to which the State Water Resources Control Board would award grants, upon the appropriation of funds for that purpose, to local public agencies and nonprofit organizations to restore and protect the water quality

and environment of marine managed areas. Requires the State Water Resources Control Board to appoint a marine managed areas water quality task force for the purpose of recommending projects to fund in connection with that program."

2005

Senate Bill No. 1110 (Committee on Natural Resources and Water) "Deletes several obsolete provisions and makes non-controversial changes in state law relating to public resources, including provisions regarding the Department of Fish and Game and public works projects."

Senate Bill No. 796 (Figueroa) "Establishes the Government Modernization, Efficiency, Accountability, and Transparency Act of 2005, and requires state agencies to provide specified information on their web sites to assist consumers in obtaining government services and participating in the regulatory process."

2. Water Quality

a. Surface water quality

1. Federal and Regional Water Quality Regulations

Addressing its legal mandates from the U.S Environmental Protection Agency (EPA) and the state's Porter-Cologne Act, the San Francisco Bay Regional Water Quality Control Board (RWQCB, or "Regional Board") developed and adopted the first *Water Quality Control Plan for the San Francisco Bay Basin* ("Basin Plan") in 1968. [1] After several revisions and an extensive public hearing process, the current Basin Plan was adopted in 1995 (1995 Basin Plan). The 1995 Basin Plan describes beneficial uses that the RWQCB will protect and water quality objectives required to achieve these beneficial uses. Beneficial uses are categorized for the principal streams, lakes/reservoirs and embayments within the CWPA, including those identified in the Central, San Pablo and Marin Coastal Basins (Tables 2-3, 2-5 and 2-6). Table 1 lists the existing ("E") beneficial uses for these waterways. Regional Board staff indicated that potential ("P") and limited ("L") beneficial uses were not investigated fully in the Basin Plan due to inadequate resources and funding priorities. Thus, the absence of the "P" designation in Table 1 does not necessarily mean that there is no potential for enhancing or restoring a particular beneficial use.

The Federal Water Pollution Control Act (commonly referred to as the Clean Water Act [CWA]) of 1972, as amended in 1987, prohibits the discharge of pollutants into waters of the United States unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Section 402(p) of the 1987 amendments established a framework for regulating municipal, industrial and construction stormwater discharges under the NPDES program. In California, NPDES permits are issued through the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs). To date, communities with populations over 100,000, high-risk industries identified by the US Environmental Protection Agency (EPA), and construction projects of five acres or more must obtain an NPDES permit. [2]

Table 1 – Beneficial Uses for Principal Streams, Lakes and Embayments

Basin	Waterbody	REC-1	REC-2	SHELL	SPWN	WARM	WILD
San Pablo Bay Basin							
	San Pablo Bay	E	E	E	E		E
	Miller Creek	E	E		E	E	E
	Gallinas Creek		E			E	E
	Novato Creek	P	P		P	P	E
	Stafford Lake	E	E		E	E	E
Central Basin – S.F. Bay							
	S.F. Bay – Central	E	E	E	E		E
	San Rafael Creek		E			E	E
	Corte Madera Creek	P	E		P	E	E
	Phoenix Lake	E	E		E	E	E
Richardson Bay		E	E	E	E		E
	Arroyo Corte Madera	P	E	E	E		E
	Del Presidio						
Pacific Ocean (Marin)							
Drakes Estero		E	E				E
	First Valley Creek	P	E				E
Limantour Estero		E	E	E	E		E
Bolinas Bay							
	Bolinas Lagoon	E	E	E	E		E
	Easkot Creek						
Redwood Creek		E	E	E	E	E	E

Source: 1985 Basin Plan (RWQCB)

E -- existing beneficial use

P – potential beneficial use

AGR = Agricultural Supply

COLD = Cold Freshwater Habitat

COMM = Ocean, Commercial & Sport Fishing

EST = Estuarine Habitat

FRSH = Freshwater Replenishment

IND = Industrial Service Supply

MAR = Marine Habitat

MIGR = Fish Migration

MUN = Municipal and Domestic Supply

NAV = Navigation

PROC = Industrial Process Supply

Table 1 (Continued)– Beneficial Uses for Principal Streams, Lakes and Embayments

Basin	Waterbody	REC-1	REC-2	SHELL	SPWN	WARM	WILD
Tomales Bay							
	Tomales Bay Estuary		E	E		E	
	Milarton Gulch						
	Lagunitas Creek	E	E		E	E	E
Walker Creek							
	Walker Creek	P	P		E	E	E
	Salmon Creek						
	Soulajoule Reservoir	E	E			E	E
Lagunitas Creek		E	E		E	E	E
	Kent Lake	E	E		E	E	E
	Nicasio Reservoir	E	E		E	E	E
	Nicasio Creek	E	E		E		E
	Alpine Lake	E	E		E	E	E
	Bon Tempe Lake	E	E		E	E	E
	Lake Lagunitas	E	E		E	E	E
	Olema Creek	E			E	E	E
	Pine Gulch Creek		E		E	E	E

RARE = Preservation of Rare and Endang. Species
REC 1 = Water Contact Recreation
REC 2 = Noncontact Water Recreation
SHELL = Shellfish Harvesting
SPWN = Fish Spawning
WARM = Warm Freshwater Habitat
WILD = Wildlife Habitat

Table 1 (Continued)– Beneficial Uses for Principal Streams, Lakes and Embayments

Basin	Waterbody	ARG	COLD	COMM	EST	FRSH	IND	MAR	MIGR	MUN	NAV	PROC	RARE
San Pablo Bay Basin													
	San Pablo Bay			E	E		E		E		E		E
	Miller Creek		E						E				E
	Gallinas Creek		E										E
	Novato Creek		P						P	E			E
	Stafford Lake		E							E			
Central Basin – S.F. Bay													
	S.F. Bay – Central			E	E		E		E		E	E	E
	San Rafael Creek		E								E		
	Corte Madera Creek		E						P				E
	Phoenix Lake		E							E			
Richardson Bay				E	E		E		E		E		E
	Arroyo Corte Madera		E										
	Del Pesidio												
Pacific Ocean (Marin)													
Drakes Estero				E				E		E			E
	First Valley Creek		E										
Limantour Estero				E				E					E
Bolinas Bay													
	Bolinas Lagoon			E				E	E				E
	Easkot Creek												
Redwood Creek		E	E			E				E			

Table 1 (Continued)– Beneficial Uses for Principal Streams, Lakes and Embayments

Basin	Waterbody	ARG	COLD	COMM	EST	FRSH	IND	MAR	MIGR	MUN	NAV	PROC	RARE
Tomales Bay													
	Tomales Bay Estuary												
	Milarton Gulch												
	Lagunitas Creek	E	E						E	E			E
Walker Creek													
	Walker Creek		E						E				E
	Salmon Creek												
	Soulajoule Reservoir					E				E			
Lagunitas Creek		E	E						E	E			E
	Kent Lake		E							E			
	Nicasio Reservoir		P			E				E			
	Nicasio Creek		E			E			E	E			
	Alpine Lake		E							E			
	Bon Tempe Lake		E							E			
	Lake Lagunitas		E							E			
	Olema Creek		E						E		E		
	Pine Gulch Creek		E						E	E			

In August 1999, the SWRCB reissued the General Construction Activity Storm Water Permit (Water Quality Order 99-08-DWQ referred to as "General Permit"). As the result of subsequent litigation (*San Francisco Bay Keeper et al. vs. State Water Resources Control Board*), the Monitoring Program and Reporting Requirements section of the current General Permit was modified in April 2001 (SWRCB Resolution 2001-46). For all construction projects conducted after this date, project applicants (i.e. dischargers) are instructed to design and implement a Stormwater Pollution Prevention Plan (SWPPP) that includes sampling and analysis (i.e. monitoring) of stormwater in two instances:

- Where site stormwater discharges directly to a water body that is designated as impaired for sedimentation/siltation or turbidity by the SWRCB on its Section 303(d) List.
- Where other pollutants that are known or should be known by permittees to occur on construction sites and that can not be visually observed or detected in storm water discharges could result in or contribute to exceedance of water quality objectives in receiving waters.

The modified provisions documented in Resolution 2001-46 cover the implementation schedule for the new regulations, identification of pollutant sources and Best Management Practices (BMPs), as well as monitoring program and reporting requirements. (SWRCB web site, Sept. 2001)

b. Section 303(d) impaired waterbodies and total maximum daily loads (TMDLs)

In addition to the Phase II stormwater regulations, Marin County and its member municipalities will be required to comply with new federal water quality criteria for total maximum daily loads (TMDLs) designated for several high priority stormwater contaminants, including mercury and PCBs, and the pesticide diazinon. The TMDL regulations are designed to limit contaminant loading of stormwater influent to the San Francisco Bay Estuary, which can assimilate only certain quantities of contaminants before its beneficial uses become significantly impaired.

Relevant sections of the Marin County Code that address general hydrologic and water quality issues and related development standards include:

- Title 11: Harbors and Waterways- regulates both the construction and repair of dams not regulated by the State and the diversion or obstruction of watercourses. Of particular interest regarding hydrology and water quality are Section 11.08-010 Interfering with water flow; and 11.08.050-060 Permit required for construction/Application-Fees. Section 11.08-010 prohibits the discharge of fill, debris, waste, bank stabilization materials into creeks if the discharge obstructs or impedes flow in the channel. However, it also exempts channel or bank modifications that improve or realign the channel, as long as natural flows are not diverted, obstructed or prevented. Sections 11.08.050-060 require that any property owner contemplating instream improvements such as channel realignment and bank protection measures secure a creek permit from the County DPW prior to construction.

- Title 22: Development Code- encompasses both Zoning and Subdivision Ordinances. Section 22.94 Primary Floodway District and Section 22.95 Secondary Floodway District - establish Primary (F-1) and Secondary (F-2) Floodway Districts and regulates floodway encroachment (see Environmental Hazards Element Technical Report- Flooding for further discussion). It also establishes requirements for site preparation, design and use of projects to satisfy the goals and

objectives of the Countywide Plan, both within the City-Centered Corridor and the Coastal Recreational Corridor, which is subject to the permitting authority of the California Coastal Commission.

Sections 22.10.040 and 22.16.030 identify design requirements for projects zoned as Residential, Multiple Planned District (RMP), including those applied to site preparation, grading, roadway design, erosion control measures and site drainage. While the sub-section on Drainage discusses design measures to reduce the risk of erosion to adjacent properties, it does not mention the conversion of natural channels to storm drain systems.

Section 22.14.060, Bayfront Conservation (-BFC) Combining District, identifies the boundaries of environmentally sensitive areas along the shoreline of San Francisco Bay and restricts development therein. The -BFC enhances the County's policy of encouraging regulatory flood control by discouraging development in sensitive baylands. It also requires the mitigation of environmental impacts due to development, and prohibits diking or filling of wetland areas within the tidal zone.

Article V, Coastal Zones was approved by the Marin County Board of Supervisors on June 24, 2003, however, this recent County Code update has not yet been approved by the California Coastal Commission (CCC). Pending approval by the CCC, land located within the coastal zone will continue to be regulated by relevant provisions of Title 22 of the Marin County Code that were in effect prior to the current Code. The Coastal Development Code describes development requirements, standards and conditions for developments in the Coastal Recreational Corridor. Many of these projects are subject to conditions of the Local Coastal Program (LCP) and must secure coastal development permits from the CCC. In nearly every case, the standards described in this section are much stricter than those governing development elsewhere in the County, i.e. outside the Coastal Recreation Corridor. Water supply, septic system design, sediment and erosion control, and stream and wetland resource protection are discussed in detail in this section. Two specific provisions relate to developments within or adjacent to blue line streams as identified on USGS 7.5-minute quadrangle sheets: 1) post-project peak flow rates shall not exceed those of the pre-project condition, and 2) development setbacks from stream channels shall be 100 feet from the nearest top of bank, or 50 feet beyond the edge of established riparian vegetation, whichever is greater.

Chapter 22.52, Tidelands Permits, pertains to land and water areas with elevations the mean high tide (MHT). Construction, dumping, filling, excavating dredging and the placement of piers or other structures is prohibited in the defined tidelands. Applications for the installation of structures may be conditionally approved as long as they meet certain conditions, including not causing an increase in the likelihood of flooding on adjoining lands.

- Title 23 Natural Resources: Chapter 23.08 sets standards for earth grading operations. Chapter 23.09 Floodplain Management- establishes the Special Flood Hazard Areas (SFHAs) as defined by FEMA for the base 100-year flood event as the standard definition of the channel floodplain covered by the section. It also establishes permit requirements for proposed floodplain construction projects, prohibits floodway encroachments and sets standards for construction, utilities and subdivisions. Special provisions for coastal high hazard areas are defined in Section 23.09.039.

Chapter 23.18, Article 2, Discharge Regulations and Requirements, Sections 23.18.0060- 23.18.094 – prohibit the discharge of non-storm water discharges to a County storm drain and requires that all other discharges (with specified exemptions) be in compliance with a NPDES permit for the discharge. They grant the Director of Public Works the authority to establish temporary and/or permanent controls on the volume and rate of stormwater runoff from new developments and redevelopments; establish creek maintenance responsibilities and guidelines for creekside property owners; control unpermitted discharges, channel excavation and fill; set standards for parking lots and similar structures; and regulate unpermitted construction, modification or removal of existing structures within a watercourse.

- Title 24: Development Standards, Chapter 24.04 Improvements, VI. Drainage Facilities, VII. Subsidence, and VIII. Grading- set standards for the design and construction of channels, catch basins and conduits, and drainage setbacks; cites minimum elevations for garage floors and finished floors of structures for flood protection; and regulates the conduct of grading with no distinction between instream and off-stream environs.

  The Title 24, Chapter 24.04 Improvements, VIII Grading, Sections 24.04.620 – 24.04.740 sets standards for grading operations, including the protection of disturbed areas using erosion control measures, restrictions on the timing of grading operations, permit and bonding requirements for development projects, and the application of Best Management Practices (BMPs) for erosion control and water quality management.

2. Groundwater Quality

The principal set of water quality regulations associated with groundwater development in California is the federal Safe Drinking Water Act of 1974, amended in 1986 and 1996. This Act gave EPA the authority to delegate the primary responsibility for enforcement of drinking water regulations to the states. The states adopt, implement and enforce the standards established by the federal drinking water program. In conjunction with the federal legislation, California has promulgated Chapter 4 of the California Health and Safety Code, the California Safe Drinking Water Act. Actual standards for drinking water are cited in Title III of the federal Clean Water Act. (CWA) and are monitored by the State Department of Health Services (DHS). (USEPA web site: www.epa.gov)

Developers of individual and community groundwater wells must test and analyze well water samples for Title III constituents and submit the results to the State Department of Health Services (DHS), prior to bringing a well into service. Chemical, physical, bacteriological and radiological tests are required which measure the levels of color, odor, turbidity, metals, nutrients, coliform bacteria, and many organic and inorganic chemical constituents. The frequency of sampling and testing for this extensive list of elements ranges from weekly (coliform bacteria) to every four years for radiological parameters. (DHS web site: www.dhs.ca.gov.)

Other legislation that affects groundwater quality in the CWPA includes the federal Resource Conservation and Recovery Act of 1976, the Comprehensive Environmental Response and the Compensation and Liability Act of 1986 (formerly the Superfund Amendments and Reauthorization

Act). Both of these acts address the monitoring and enforcement authority of the federal government to mandate technical studies, field experiments, legal actions and other remedies to remediate hazardous waste and groundwater contamination.

The California legislature in its *Supplemental Report of the 1999 Budget Act* required the State Water Resources Control Board (SWRCB) to develop a comprehensive ambient groundwater monitoring plan. In response to this mandate, the SWRCB has instituted the Groundwater Ambient Monitoring and Assessment Program (GAMA). The purpose of the program is to assess the water quality and relative susceptibility of groundwater resources in the State. Its two components include the California Aquifer Susceptibility Assessment and the Voluntary Domestic Well Assessment. The program is affiliated with the SWRCB Division of Clean Water Programs, Land Disposal Section, Groundwater Special Studies Unit. (SWRCB web site: www.swrcb.ca.gov)

C. MAPPING SUMMARY

This technical report on Hydrology and Water Quality in the CWPA refers to maps and tables, each of which is given an exhibit or table number, as appropriate. Table 1 lists the beneficial uses of water bodies in the CWPA as established in the 1995 Basin Plan (RWQCB 1995), while Tables H-2 and H-3 refer to Marin Municipal Water District supply vs. demand projections for the Year 2025 and County Groundwater Basin Characteristics, respectively. Exhibit 1 is the map of CWPA watersheds and principal hydrologic features. It includes watershed boundaries, blue line streams, lakes, reservoirs and embayments, as well as the locations of rain gauging and stream gauging stations. Exhibit 2 is a map that depicts the geographical areas in the CWPA that are not served by any of the established community water districts. Residences and farmsteads in these areas must rely on spring systems or individual wells for a potable water supply. Exhibit 3 is a map of probable maximum well yields in Marin County. Exhibit 4 is a rainfall "isohyetal" map of the CWPA area, which depicts mean annual precipitation totals in the form of isohyetes, i.e. contours of equal rainfall amounts. Exhibit 5 is a map of the significant groundwater basins in the CWPA. Finally, Exhibit 6 maps the open space areas within the CWPA and delineates County streams that support sensitive aquatic habitats for the federally-listed steelhead and Coho salmon. Exhibits are inserted immediately following the page on which they are first mentioned.

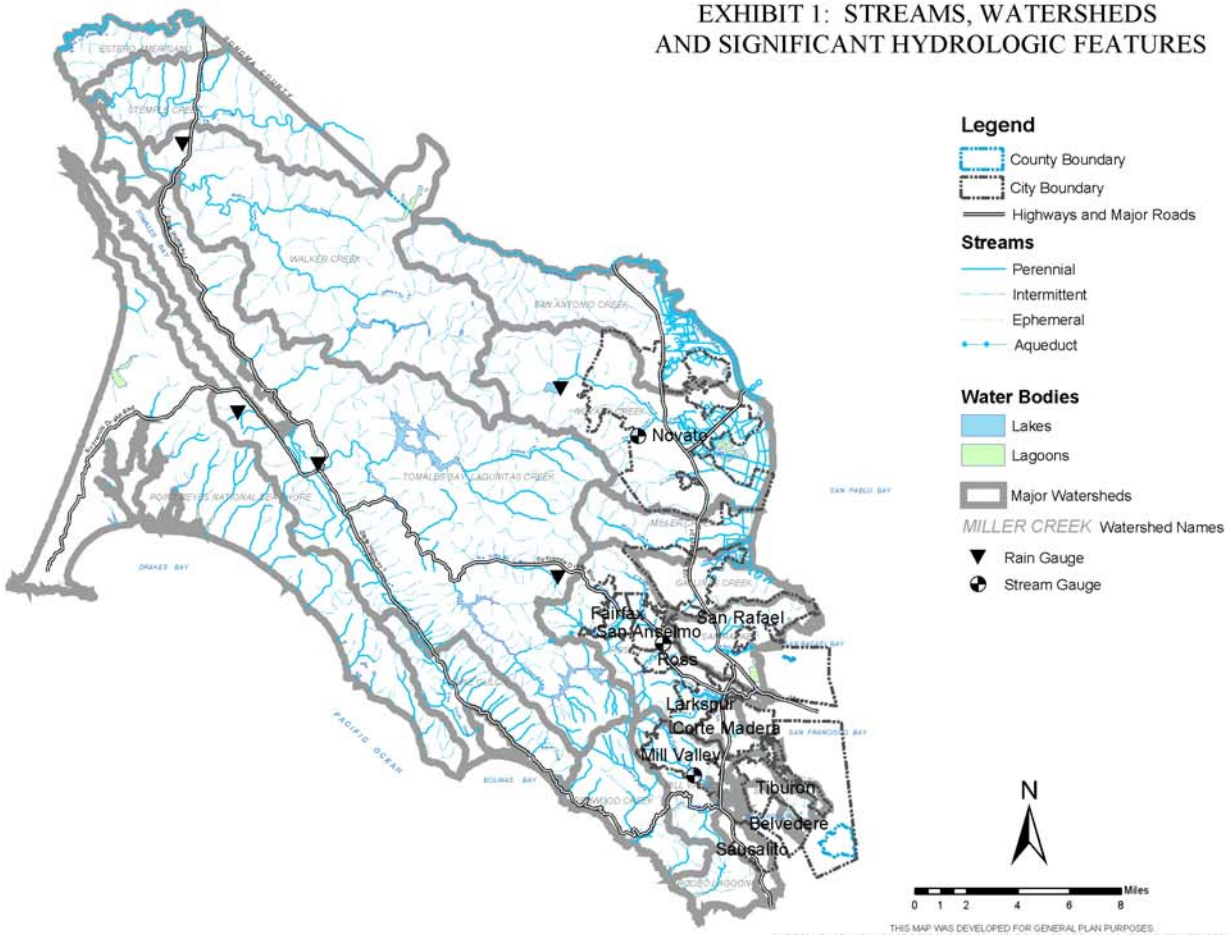
D. SETTING

1. Water Supply

Marin County's drinking water supplies are derived primarily from surface water sources, including reservoirs and piped diversions from the Russian River Basin in Sonoma County. The Marin Municipal Water District (MMWD) and the North Marin Water District (NMWD) are the principal entities managing and delivering these supplies to residential and commercial consumers in the CWP area. MMWD serves southern and central Marin County, while NMWD serves the City of Novato and portions of the Inland Rural and Coastal Recreational corridors. Exhibit 1 depicts County streams and other

SOURCE: COUNTY OF MARIN

EXHIBIT 1: STREAMS, WATERSHEDS
AND SIGNIFICANT HYDROLOGIC FEATURES



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hydrologic features, including major water supply reservoirs operated by MMWD and NMWD for their Marin County service areas.

Small community water districts along the Coastal Recreational corridor serve the rest of the remaining user base. These water districts include the Stinson Beach County Water District (SBCWD), the Bolinas Community Public Utility District (BCPUD), the Inverness Public Utility District (IPUD), and the Muir Beach Community Services District (MBCSD). The community of Dillon Beach is served by two small independent water companies, the California Water Service Company (formerly Coast Springs Water Company) and the Estero Mutual Water Company. Both the Muir Beach and Dillon Beach systems rely on groundwater pumping for their water supplies. (Written communication from Drew McIntyre, NMWD, August 2001.)

a. MMWD

The MMWD manages seven water supply reservoirs, five of which impound runoff from the Lagunitas Creek Watershed. Lake Lagunitas, Bon Tempe Reservoir, Alpine Lake, Kent Lake and Nicasio Reservoir combine to provide a maximum storage capacity of 68,560 acre-feet. Two additional reservoirs, Phoenix Lake and Soulajule Reservoir bring the system-wide capacity to 79,561 acre-feet. Phoenix Lake is located on a tributary to Corte Madera Creek, while Soulajule Reservoir is located on Arroyo Sausal, a tributary to Walker Creek, which itself is confluent with Tomales Bay. (Systems Operations Report: Lagunitas Creek, Marin County; D. Roxon MMWD, Feb. 1992)

In 1982, the District raised Peters Dam which increased the storage capacity of Kent Lake. As mitigation for this project, the State Water Resources Control Board (SWRCB) ordered the District to study the instream flow requirements for fish in lower Lagunitas Creek, below the dam. The results of the study were released in 1995. The SWRCB then issued Order WR95-17, which mandated the implementation of an instream flow augmentation program for Lagunitas Creek, as well as implementation of a sediment and riparian management plan and a streambed and habitat monitoring program. Instream flows are subject to augmentation via reservoir releases depending on gauged discharges in the lower reach of the Creek. In defined low water years, these releases must be increased to meet minimum instream flows downstream.

The sediment and riparian management plan was completed in 1997 (Prunuske Chatham 1997). It included recommendations for the construction of instream structures for habitat enhancement, stream and watershed erosion control projects, and riparian revegetation. The monitoring component of the Board Order included requirements for streambed monitoring (e.g. condition of spawning gravel beds, pool development, large woody debris concentration and fish and shrimp surveys), riparian habitat attributes and monitoring of sediment input and source areas. (Clearwater Hydrology conversation with Greg Andrew, fisheries biologist, MMWD, Sept. 2001)

The safe yield of the MMWD water system is roughly 30,000 acre-feet. This safe yield accounts for maintenance of a minimum continuous reservoir storage of 10,000 acre-feet, which serves to ensure normal pumped distribution of District supplies during severe droughts. Prior to the issuance of SWRCB Order 95-17, the safe yield included 25,700 acre-feet of reservoir storage and 4,300 acre-feet of diverted Russian River flows. Under a 1993 agreement negotiated between MMWD and the Sonoma County Water Agency (SCWA), which manages the Russian River water storage and distribution

system, MMWD could receive up to 14,300 acre-feet of Russian River Basin water annually. However, since the MMWD and NMWD share the same delivery pipeline and NMWD has a contractual priority, MMWD has yet to receive more than 8,000 acre-feet/year.

A capital improvement program intended for construction of a separate cross-basin diversion for the MMWD was approved by County voters in 1994. However, to date political considerations have stalled the initiation of the facilities expansion. While the current water diversion agreement with SCWA has offset the storage losses associated with instream flow releases to Lagunitas Creek, the MMWD supply will require implementation of the cross-basin diversion to meet projected growth demand in the CWP area. (D.Roxon, ibid; D. McIntyre, ibid, Clearwater Hydrology conversation with Dana Roxon, MMWD, Oct. 2001)

Assuming there are maximum (w/separate pipeline) and minimum (w/o pipeline) water supply scenarios for MMWD in the next two decades, the current projections for water supply vs. demand for Year 2025 are listed in Table 2: Water Demand (Year 2025)

Table 2
Marin Municipal Water District: Water Supply and Demand Projections for Year 2025

	Acre-Feet/Year
Water Demand Reduction due to expanded water reclamation	40,100 2,000
Water Supply: Marin Co. Reservoirs Sonoma Co. Aqueduct	 27,500 14,300 (w/sep. intertie) 8,000 (w/o sep. intertie)
Potential Deficit/Surplus	-2,600 (deficit w/o intertie) +3,700 (surplus w/intertie)

As the figures in the exhibit indicate, the construction of a separate pipeline intertie to the SCWA's Russian River distribution system will be required to meet MMWD's projected customer demand at Year 2025.

b. NMWD

NMWD maintains two independent water storage and distribution systems within its jurisdiction. The principal system serves the Novato area and derives its water supplies from two sources: Stafford Lake and cross-basin diversions from the Russian River Basin. The second, smaller system serves portions of West Marin, including the communities of Point Reyes Station, Olema, Inverness Park and Paradise Ranch Estates. This West Marin system utilizes groundwater that is pumped from two wells adjacent to Lagunitas Creek in Paradise Ranch Estates and a backup well at Gallagher Ranch. The backup well is brought on-line when low streamflow on Lagunitas Creek induces increased salt water intrusion into the principal pumping area. This backup well serves only a portion of the service area and is inadequate to

meet the total system water demand. Moreover, it is not yet connected to the rest of the West Marin distribution system.

Unlike the MMWD supply, the NMWD receives the bulk of its Novato area supply (80 percent) from Sonoma County. The safe annual yield for Stafford Lake supplies is 1,750 acre-feet. To meet the system demand, the NMWD has negotiated a Master Water Supply Agreement with the SCWA. Under the most recent (11th) amendment to the Master Agreement, the District is entitled to receive up to 19.9 million gallons per day (mgd) for the average peak month and 14,100 acre-feet annually from the Russian River Aqueduct. Temporary impairment of the SCWA system facilities has reduced the current peak-month take to 18.1 mgd. However, the full entitlement is expected by summer 2006. At the maximum entitlement, NMWD expects to be able to meet its system demands through the year 2025.

The wells serving the West Marin distribution system are founded in the alluvial aquifer that underlies the Lagunitas Valley. Significant aquifer recharge occurs through streambed infiltration along Lagunitas Creek. In average or wet years, the local watershed runoff and upstream reservoir releases provide more than sufficient recharge to meet the water use demands of the West Marin service area and to maintain instream flows for fish. NMWD estimates the extent of the annual groundwater withdrawals at less than one percent of the average annual streamflow. During droughts, however, NMWD is prohibited by SWRCB Order WR 95-17 from extracting groundwater from these wells during the low flow season which extends from July through October. NMWD has an "intertie" agreement with MMWD that allows it to request an exchange of system supplies. Under this 1993 agreement, MMWD releases stored water into Lagunitas Creek from Kent Lake in order to maintain acceptable streamflow in the pumped reach of the Creek. NMWD in turn conveys an equivalent volume of water to the MMWD system via the Russian River Aqueduct. Since the SWRCB Order mandates that MMWD increase its releases to Lagunitas Creek in dry years in order to provide sufficient water for fish, these flows are augmented to accommodate the downstream groundwater withdrawals. The difference is accounted for and traded via the Russian River intertie.

The existing Intertie Agreement between MMWD and NMWD runs through 2014 and provides for an annual exchange of 250 acre-feet. NMWD also has an agreement with Giacomini Ranch wherein the District can utilize a portion of the Ranch's appropriated water right to satisfy Lagunitas Creek instream flow requirements. (McIntyre, op cit.)

The NMWD has prepared the Long Range Plan For West Marin (NMWD 2001) which details the demand and supply projections for its two service areas over the short to long-term planning horizon. The Plan includes recommendations for replacement of aging, damaged or inadequate storage, pumping and distribution facilities in the West Marin system. Two development alternatives were presented for consideration by the District. Implementation of either of the Plan alternatives would achieve four design objectives:

5. In addition to supplying sufficient operational storage (25 percent of the maximum day demand for each service area), provide sufficient storage capacity (i.e. storage tanks) to accommodate the higher of: a) required emergency storage volume or b) fire flow storage. Supplying the total emergency storage and fire flow storage volumes would be financially infeasible for this small water system.

6. Provide two water storage tanks in each pressure zone that cannot obtain water from storage in a higher pressure zone. The second tank would supply some redundancy in the storage system, which would allow for tank maintenance without an interruption in supply.

7. Replace or upgrade existing storage tanks and pumping capacities to meet demands at ultimate buildout under current zoning, and to satisfy seismic safety requirements.

8. Provide a supply back-up to the existing well field at Paradise Ranch Estates (Lagunitas Valley) in case salt water intrusion contaminates that portion of the aquifer.

Most of the piping in the West Marin distribution system was replaced in the 1970s and 1980s. Thus, with one exception, replacement of distribution system piping was not part of the proposed alternatives presented in the Plan. For the recommended Plan alternative, Alternative 2, short-term improvements would include the following:

- Upgrading the Bear Valley pump station
- Replacing and/or upgrading Paradise Ranch Estates storage tanks
- Installing a new storage tank at Olema
- Selective tank seismic upgrades
- Replacing and upgrading two Inverness Park pumps and installing a pressure reducing valve
- Installing booster pumps at three PRE pump stations
- Installing a parallel 8-inch water main in Highway 1

Future, long-term improvements include continuing seismic upgrades, additional replacements and/or upgrades of existing storage tanks, installation of a connecting pipeline from the Gallagher well to the rest of the West Marin distribution system and development of a second Gallagher well. (Brelje & Race 2001)

As noted above, completion of the facilities improvements and expansions recommended in the Plan would provide NMWD with supplies sufficient to meet area demand at ultimate buildout under existing General Plan zoning. Furthermore, NMWD already owns adequate water right entitlements to develop the required supply. (Drew McIntyre, op cit., Dec. 2001)

c. Community Water Districts

The community water districts in Bolinas and Inverness derive their water supplies from surface streams, via direct diversion to storage, treatment and distribution facilities. The BCPUD diverts water from Arroyo Hondo for a safe yield of 40 acre-feet. The aging distribution system is estimated to lose between 15 and 20 percent of the system capacity to leakage. Capital improvements to correct system

deficiencies are still outstanding and new water hookups have been prohibited to protect existing supplies.

The IPUD diverts and stores streamflow during the wet winter season and maintains a storage and distribution capacity of roughly 95 acre-feet per year. Three filtration plants, one each in First, Second and Third Valleys, treat the water prior to distribution to local customers. The District expects to meet future water demands with its current facilities, except for eventual replacement of storage tanks, as required. The community of Inverness is nearly built-out, as only a few potentially developable lots remain. (Clearwater Hydrology conversation with Carin Gann, general manager, Inverness PUD, Dec. 2001)

The communities of Muir Beach and Dillon Beach rely on groundwater for their drinking water supplies. Limited populations in these communities are supplied by modest well production. The Muir Beach Community Services District (MBCSD) operates two groundwater wells, a newly installed (2005) well yields 60 gallons per minute (gpm), and the older well, now the back-up well, yields around 40 (gpm). (Clearwater Hydrology conversation with Harvey Pearlman, water manager, MBCSD, Oct. 2005) In addition, the MBCSD maintains storage tanks with a combined capacity of 250,000 gallons. Another storage tank is planned to be installed, bringing the total capacity to 300,000 gallons. Since perhaps only 10-15 buildable lots remain in its service area, these planned MBCSD facilities expansions are expected to meet the ultimate water demand for the community. (Clearwater Hydrology conversation with Donovan MacFarlane, operations manager, MBCSD, Dec. 2001)

Dillon Beach is served by two private water companies, the California Water Service Company (CWSC) and the Estero Mutual Water Company. The combined capacity of these two providers totals approximately 10,000 gallons per day. Estero Mutual also maintains a permitted stream diversion on a tributary to Estero de San Antonio. Diverted flows are stored in a small reservoir with a capacity of 49 acre-feet. (D. McIntyre, op cit.)

The CWSC operates seven groundwater wells in Dillon Beach with a maximum combined yield of roughly 35 gpm. During the drier summer months, the yield drops to 16-17 gpm. Two of the wells, referred to locally as tunnel well and side hill well, are not currently used as potable water sources. This is due to poorer quality water associated with the shallow and downgradient exposure of these horizontal wells, whose flows are conveyed in surface channels once they exit the bedrock. The CWSC currently has a moratorium on new service hookups and is in the process of assessing the feasibility of further developing one of its existing wells. The Company is seeking a more reliable single well supply (e.g. 60+ gpm) that will enable it to suspend the moratorium and pump water more economically. The CWSC also maintains two storage tanks with a combined capacity of 335,000 gallons. (Clearwater Hydrology conversation with Tom Fitzgerald, area manager, California Water Service Company, Dec. 2001)

d. Areas Outside of Current Municipal and Community Water District Service Areas

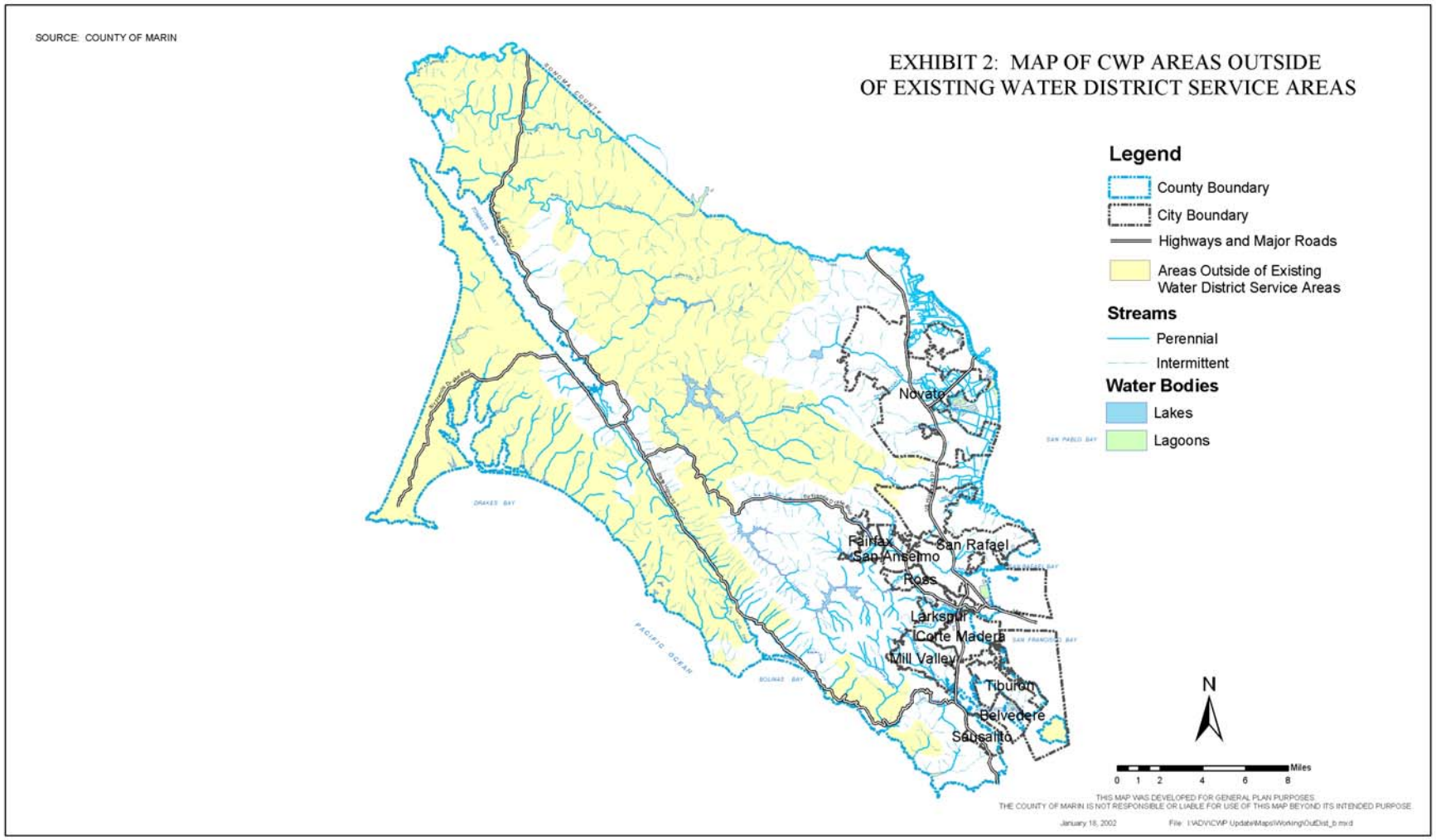
Exhibit 2 (CWP Areas Not Served by Existing Water Districts) outlines the geographic region within the CWP area that falls outside of any of the current municipal and community water service areas. Since no water company or service district distribution systems serve this region, current and future

residents must rely on either individual groundwater wells or small spring-based storage systems. Spring-based systems are often susceptible to severe capacity drops during extended periods of drought, but proven perennial springs can supply enough water for single residences.

0The bulk of the unserved areas are underlain by poorly permeable rock with limited storage capacity or thin deposits of alluvium or colluvium, which have insufficient saturated thickness to yield substantial quantities of water to wells. According to a macro-scale geologic interpretation of potential well yields in the San Francisco Bay Region (Webster (USGS) 1972), well yields in these areas range from 0.1 to 10 gallons per minute (gpm), with the majority of wells yielding less than 5 gpm. **Exhibit 3** is a partial reproduction of this mapping for the lands of the CWPA. With the exception of the Pt. Reyes peninsula, which is permanently dedicated to parkland and public open space, Bolinas Point, and Novato Valley, only small pockets of alluvial valleys are projected to yield in excess of 10 gpm (typically, 10-100 gpm). A few of these small areas of greater yield are located in the Lagunitas Valley, where NMWD maintains and operates its small well field for the West Marin service area. Here, the District pumps at rates of 250-300 gpm, well above the general projections of the USGS mapping. This indicates that individual wells can successfully be developed with significantly higher yields than the predicted range. In most cases, such high yielding wells tap deeper aquifers, at correspondingly higher costs. In fractured or sheared rock, which is fairly common in the Franciscan complex that underlies much of upland Marin County, both the spring-based and individual well water systems are subject to contamination from degrading or malfunctioning septic systems.

2. Regional Surface Water Hydrology

The Marin Countywide Plan Area (CWPA) encompasses roughly 480 square miles of baylands, alluvial valleys, and uplands which drain to the western margins of Central San Francisco Bay and San Pablo Bay, as well as the Pacific Ocean. The spine of the Coastal


SOURCE: COUNTY OF MARIN
EXHIBIT 2: MAP OF CWP AREAS OUTSIDE
OF EXISTING WATER DISTRICT SERVICE AREAS
Legend
County Boundary
City Boundary
Highways and Major Roads
Areas Outside of Existing
Water District Service Areas
Streams
Perennial
Intermittent
Water Bodies
Lakes
Lagoons
Novato
Fairfax
San Anselmo
San Rafael
Ross
Larkspur
Corte Madera
Mill Valley
Tiburon
Belvedere
Sausalito
N
Miles
0 1 2 4 6 8
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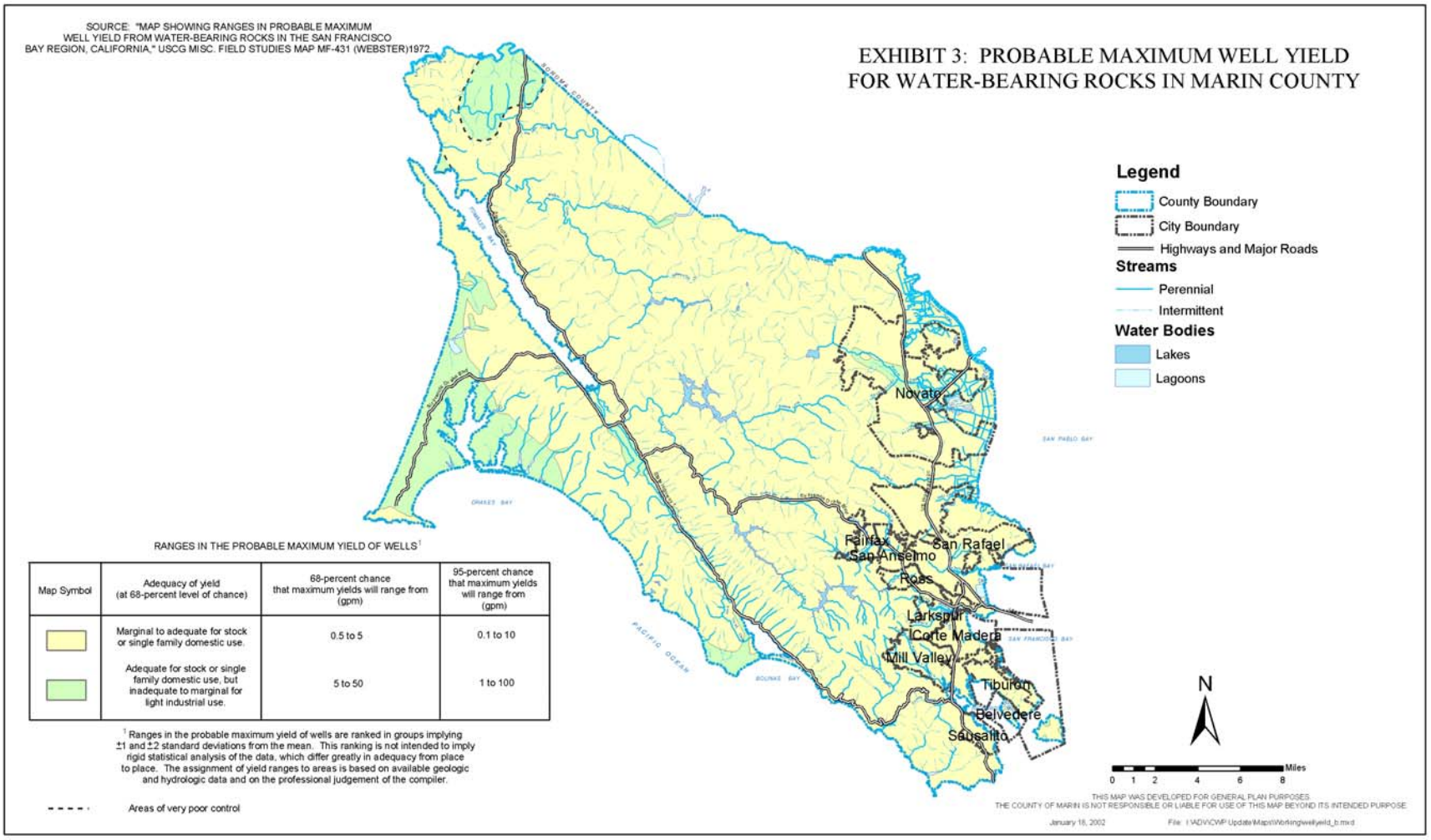
SOURCE: "MAP SHOWING RANGES IN PROBABLE MAXIMUM WELL YIELD FROM WATER-BEARING ROCKS IN THE SAN FRANCISCO BAY REGION, CALIFORNIA," USCG MISC. FIELD STUDIES MAP MF-431 (WEBSTER)1972
EXHIBIT 3: PROBABLE MAXIMUM WELL YIELD FOR WATER-BEARING ROCKS IN MARIN COUNTY
Legend
County Boundary
City Boundary
Highways and Major Roads
Streams
Perennial
Intermittent
Water Bodies
Lakes
Lagoons
Novato
Fairfax
San Anselmo
San Rafael
Ross
Larkspur
Corte Madera
Mill Valley
Tiburon
Belvedere
Sausalito
N
0 1 2 4 6 8 Miles
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RANGES IN THE PROBABLE MAXIMUM YIELD OF WELLS†
Map Symbol
Adequacy of yield (at 68-percent level of chance)
68-percent chance that maximum yields will range from (gpm)
95-percent chance that maximum yields will range from (gpm)
Marginal to adequate for stock or single family domestic use.
0.5 to 5
0.1 to 10
Adequate for stock or single family domestic use, but inadequate to marginal for light industrial use.
5 to 50
1 to 100
† Ranges in the probable maximum yield of wells are ranked in groups implying ±1 and ±2 standard deviations from the mean. This ranking is not intended to imply rigid statistical analysis of the data, which differ greatly in adequacy from place to place. The assignment of yield ranges to areas is based on available geologic and hydrologic data and on the professional judgement of the compiler.
Areas of very poor control

Range geographically separates the watershed lands tributary to the Bays from lands on the west-facing slopes that drain to the Pacific Ocean. Elevations in these diverse landforms range from sea level at the Bay and Ocean margins to more than 2,500 feet along Mt. Tamalpais. Geologically, the low-lying lands in the CWPA belong to the bay plain and alluvial valley depositional provinces, while the higher elevation lands occupy the foothills and Marin uplands erosional provinces (Brown and Jackson, USGS, 1974).

The lowest elevation zones of the bay and alluvial valley depositional province are characterized by tidal marshes, diked and filled baylands, and broad areas of alluvial fan, floodplain and deltaic deposits. The bulk of these areas are underlain at varying depths by bay mud and tidal siltation rates can be high, particularly where subsided diked lands are opened to tidal action. Common land uses comprise salt marsh and grassland biotic communities, subdivisions founded on imported fill, and subsiding farmland surrounded by tidal levees or dikes. The communities of Kay Park and Santa Venetia are examples of settlements established in these bay plains.

At slightly higher elevations, the valley slopes increase and the thickness of the underlying alluvium increases. Watershed sediments are conveyed through streams in this zone to depositional zones in local floodplains and bay outlets. Urban development encroaches on much of this zone. Other land uses include grassland and riparian biotic communities, and pasture. Pasture lands along the inland corridor include the St. Vincent's/Silveira Ranch property and other unurbanized lands situated primarily to the east of Highway 101 and north of the City of San Rafael. Large tracts of pasture and agricultural lands, primarily dairy operations, are maintained through zoning mandates along the coastal recreational corridor. Major urban populations occupy the region's alluvial valleys along the City-Centered Corridor.

The foothills erosional province contacts the bay plain and alluvial valley depositional province and transitions to the Marin uplands erosional province, which encompasses the highest elevation zone in the CWPA. This province comprises portions of the Inland Rural Corridor that is described in the Countywide Plan. It is characterized by rolling hills extending to elevations of roughly 1,000 feet. Slope steepness typically reaches 20 percent, but slope lengths are significantly shorter than those associated with the uplands erosional province.

Dominant erosional processes in the foothills erosional province include gullying, streambank failure, and slump earthflows. Hillslope and streambank instability can be triggered by intensive grazing which compacts underlying soils and denudes stabilizing riparian vegetation. Such grazing is limited along the inland corridor lands, but is widespread among the coastal lands that are largely in agricultural and grazed open space uses. The foothills terrain is characterized by coastal scrub and riparian woodland, and is also utilized for low density suburban and rural development. Much of the mid-elevation lands occupied by the cities and towns of the region are part of this erosional province, as are the extensive open space and watershed lands extending southwest from Tomales Bay to Drakes Bay and Limantour Estero.

The Marin uplands erosional province comprises the mountainous regions of the County, including the slopes of Mt. Tamalpais and the highlands of Bolinas Ridge, the Marin Headlands, Pt. San Pedro Ridge and Big Rock Ridge. Bedrock outcrops are common on these lands, which are otherwise dominated by relatively thin soils. Runoff from these uplands provides the water supply for the bulk of the urban

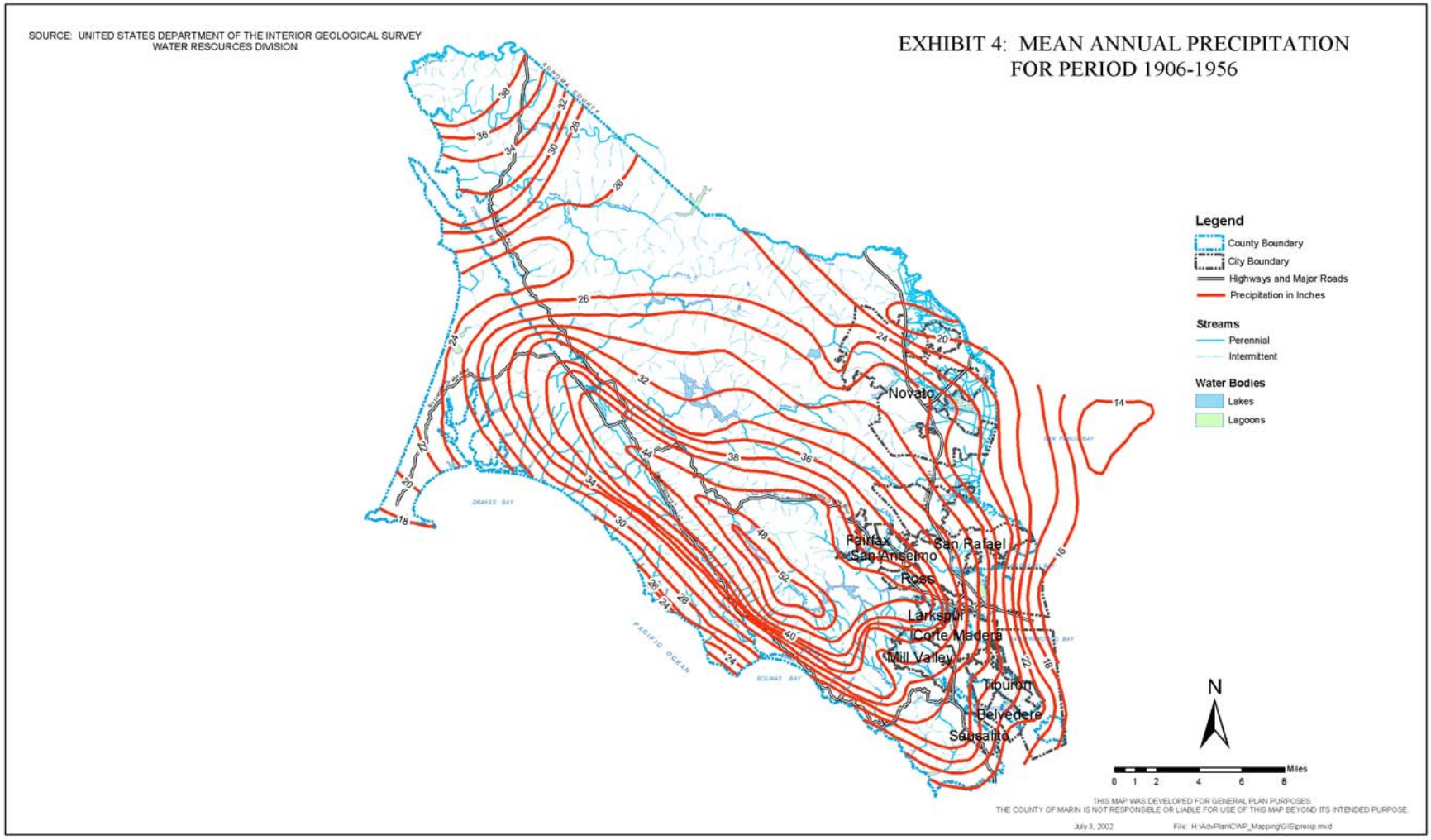
population. Accordingly, the principal uses of these high elevation lands within the CWPA are watershed lands and public and private open space.

Exhibit 1 depicts the streams, watersheds and significant hydrologic features within the GPA. The principal eastern watersheds draining to San Francisco Bay/San Pablo/Richardson Bay include: Arroyo Corte Madera del Presidio, Coyote Creek, Corte Madera Creek, San Rafael Creek, Las Gallinas Creek, Miller Creek, Novato Creek and San Antonio Creek. Principal Pacific Ocean Watersheds include Estero Americano, Stemple Creek, Walker Creek, Laguintas Creek, Olema Creek, Pine Gulch Creek and Redwood Creek. Tomales Bay, Bolinas Bay, Drakes Estero and Limantour Estero represent significant ecological habitats, as does the extensive tidal wetlands that form the Novato Creek Marsh. Several of the principal streams in the CWPA have been designated as critical habitat for anadramous fish, although the most important of these from a species survival perspective occur in the Pacific Ocean tributaries (Clearwater Hydrology conversation with Bill Cox, CDFG, Sept. 2001). The sections on "Surface Water Quality" and "Stream Restoration" discuss the ecological attributes of CWPA streams in more detail.

With the exception of the upper reach of Miller Creek, which is affected by livestock grazing yet otherwise remains undisturbed, streams in the City Centered Corridor have been significantly modified by dams (Novato Creek- Stafford Dam), flood control projects, storm drain installations and other urban encroachments. In the few relatively unmodified stream reaches and in the bulk of the streams in the Inland Rural and Coastal Recreational Corridors, otherwise natural channels have typically been detrimentally affected by historical logging and livestock grazing. Significant opportunities exist for restoring the geomorphic stability and hydrologic functions of these historically degraded channels. These opportunities and guidance regarding the hydrologic design for stream restoration are discussed further in the section on Stream and Wetland Restoration Opportunities.

Mean annual rainfall in the CWPA ranges from 18 inches at Pt. San Pedro to 50 inches or more along the ridgeline of Mt Tamalpais. **Exhibit 4** is a mean annual rainfall map of the CWPA, based on USGS rainfall data for the period 1906-1956 (Rantz 1971). This is the best available long-term compilation of regional rainfall data for the CWPA. Orographic influences associated with Mt. Tamalpais are responsible for the elevated rainfall totals in this central southern portion of the CWPA. Most of the area rainfall occurs during the wet winter season which typically extends from November through March. Significant runoff events occur in response to prolonged rainfall of two to three days' duration, punctuated by short periods of intense nested rainfall.

Damage-inducing flooding has occurred infrequently in the Countywide Plan area, primarily in the lower lying alluvial valleys and Bay plains of the City-Centered Corridor.


SOURCE: UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
EXHIBIT 4: MEAN ANNUAL PRECIPITATION
FOR PERIOD 1906-1956
Legend
County Boundary
City Boundary
Highways and Major Roads
Precipitation in Inches
Streams
Perennial
Intermittent
Water Bodies
Lakes
Lagoons
Novato
Fairfax
San Rafael
San Anselmo
Ross
Larkspur
Corte Madera
Mill Valley
Tiburon
Belvedere
Sausalito
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From 1950 to 1970, major floods occurred in 1952, 1955, 1958, 1967 and 1970. Over the past 30 years, significant flooding has occurred in portions of Corte Madera, Larkspur, Greenbrae, Ross, San Anselmo, San Rafael and Novato in January 1982, January and December 1983, February 1986, January 1997 and February 1998. Severe floods in the CWPA can also occasionally cause channel instability in area streams.

Two forms of flooding occur in the Countywide Plan area: 1) tidal flooding and 2) watershed flooding. Coincident tidal and watershed flooding can also occur. Tidal flooding develops when high tides exceed either the top of bank elevation of tidal sloughs and channels, or the crest of bay levees. Watershed flooding occurs in response to severe runoff-inducing rainfall over the tributary watershed of one of the region's stream channels. Major watershed floods are typically generated by rainstorms of 3-4 days duration that include nested periods of high intensity rainfall. Such rainstorms occur primarily during the wet winter season which normally extends from November through March. When watershed flooding occurs in conjunction with high bay tides, the extent and/or depth of overbank flooding or levee overtopping can increase due to an upward adjustment in the flood water surface profile. For an expanded discussion of historical flooding events in the County, see Section D1 of the Technical Background Report on Flooding.

3. Regional Groundwater Hydrology

In general, regional groundwater conditions in the CWPA have not been well documented. According to the U.S. Geological Survey (USGS) and the California Department of Water Resources (DWR), no regional studies of groundwater availability or quality have been conducted in Marin County. The *1995 Basin Plan* cites four significant groundwater basins: Ross Valley, Novato Valley, Petaluma Valley and the Sebastapol-Merced Formation, which includes the town of Dillon Beach, at the northern edge of Tomales Bay. The Petaluma Valley Basin includes a small portion of northern Marin County, but is primarily situated in Sonoma County. Lagunitas Valley is not listed in the Basin Plan discussion. However, based on yield data from the North Marin Water District (NMWD) wells in Lagunitas Valley, the safe yield is likely in excess of the quantity cited for the Ross Valley Basin. **Exhibit 5** shows the location and extent of the principal groundwater basins in the CWPA, including Lagunitas Valley. Table 3 lists some defining characteristics of the principal groundwater basins in Marin County, including areal extent, average aquifer depths, total basin storage capacity and perennial safe yield. This information was gathered by preparers of the *Basin Plan* from local water agencies and specific studies/reports for specific geographical areas in the County. Tabulated information for Lagunitas Valley was added, yet it represents at best a lower bound to the potential range of safe yield for the valley aquifers. Note that in some drought years the West Marin system wells cannot be pumped at normal rates due to salt water intrusion. This contingency affects the safe yield considered for groundwater withdrawal.

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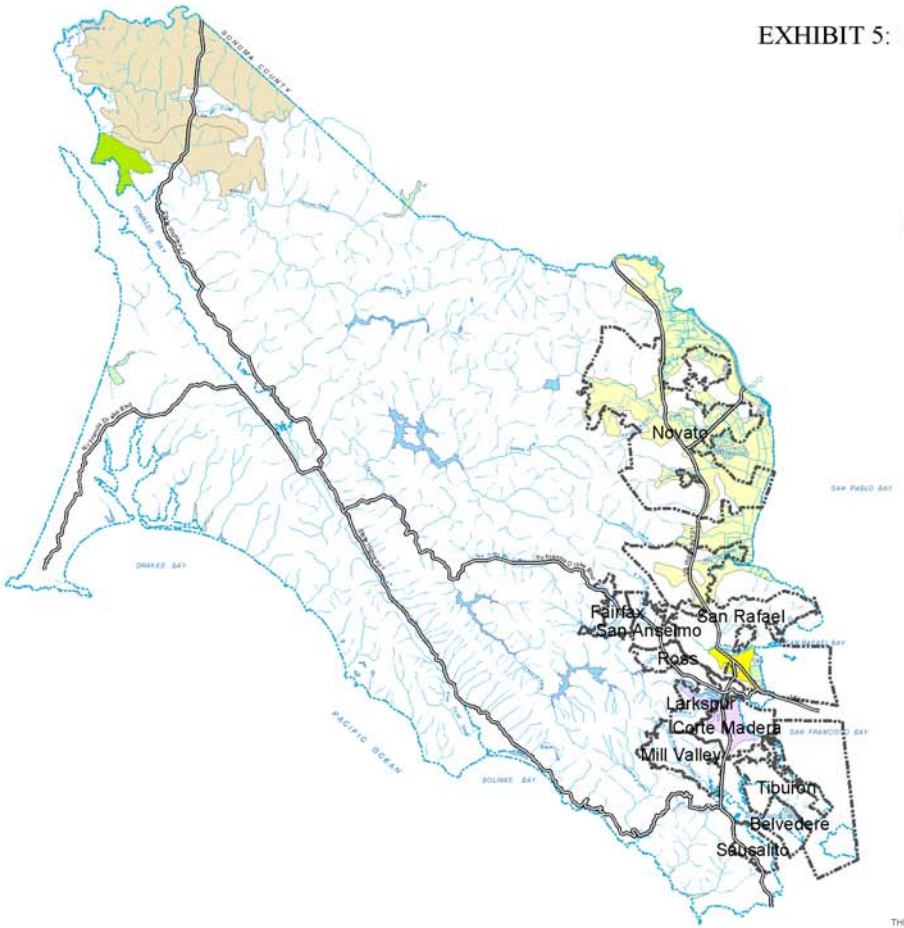
SOURCE: TEALE GIS SOLUTIONS GROUP AS DEFINED BY THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

EXHIBIT 5: GROUNDWATER BASINS



Legend

- County Boundary
- City Boundary
- Highways and Major Roads

Streams

- Perennial
- Intermittent

Water Bodies

- Lakes
- Lagoons

Groundwater Basins

- NOVATO VALLEY
- PETALUMA VALLEY
- ROSS VALLEY
- SAN RAFAEL VALLEY
- SAND POINT AREA
- WILSON GROVE FORMATION HIGHLANDS

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Table 3
Groundwater Basin Characteristics for Marin County

Groundwater Basin	Areal extent (sq. mi.)	Depth Zone (ft.)	Storage Capacity (ac. – ft.)	Perennial Safe Yield (ac. ft.)
Novato Valley	17.5	55-90	NA	NA
Sand Point Area	2.0	20-300	NA	NA
San Rafael	NA	NA	NA	NA
Ross Valley	18	10-60	1380	350
Petaluma Valley	41	0-900	21. mil	NA
Laguintas Valley	NA	NA	NA	300 +/-

According to the Director of the Department of Public Works for the Town of Ross, groundwater is utilized only for landscape irrigation, both public and private. (Clearwater Hydrology conversation with Robert Elias, Director of Public Works, Town of San Anselmo and former Director of Public Works, Town of Ross, Sept. 2001)
The City of Novato does not depend on well water for its public water supply, as it is adequately served by stored water at Stafford Lake and its piped allocation from the Sonoma County Water Agency (SCWA). Thus, well water is used by a few private landowners and no current information on groundwater quality is available. In fact, the City has had a policy of capping private wells, wherever possible to avoid aquifer contamination. (Clearwater Hydrology conversation with Robert Weil, P.E., City of Novato/Coastland Civil Engineering, Sept. 2001)
Potable water wells are maintained and operated by the NMWD as part of its West Marin supply system, which serves the Pt. Reyes Station and Inverness Park communities. As indicated above in the section on Water Supply, during average and wet years, these wells are adequate to serve the needs of the West Marin service area. However, during droughts the reduction in groundwater recharge can result in sea water intrusion into the zone of groundwater pumping. The lack of recharge can also reduce instream flows for fish, which are protected under State Water Resources Control Board Order WR95-17. Under these conditions, the NMWD secures additional releases from Kent Lake under its intertie agreement with MMWD. These releases produce enough instream flow for both fish and the NMWD's groundwater pumping requirements.
The communities of Dillon Beach, Stinson Beach and Muir Beach each depend either wholly or partly on groundwater for their community water supplies. The current Dillon Beach wells have limited yields under 30 gallons per minute and a total well field capacity of only 35 gpm. (Clearwater Hydrology conversation with Tom Fitzgerald, Area Manager, California Water Service Company, Guerneville, CA., Sept. /Dec. 2001) The Muir Beach Community Services District (MBCSD) operates a single 40 gpm well in the alluvial valley adjacent to Redwood Creek (Donovan MacFarlane, Muir Beach Community Services District, Sept. 2001). For more information on the other water supply facilities maintained by these communities, see the section on Water Supply.

a. Groundwater Recharge

Groundwater recharge to the CWPA's principal aquifers occurs when infiltrated rainfall ultimately reaches the water table within the alluvium that comprises the aquifers. In these recharge areas, there is a downward component to the groundwater flow and the water table usually lies at greater depth. In discharge areas, the groundwater flow has a significant upward flow component and the water table is shallow (e.g. spring outlets and stream channels. Typically, areas of significant groundwater recharge include the portions of alluvial valleys that have not been subject to intensive urban or suburban

development, and the fractured bedrock that accepts infiltrated rainfall on the surrounding hillslopes. Within the alluvial materials in these stream valleys, the hydraulic conductivity of sediments may vary by orders of magnitude, due to the spatial and temporal variations in the nature of the deposited sediments. For example, coarse sediments (e.g. sands and gravels) laid down by fluvial processes can be interspersed with finer sediments (e.g. silts and clays) that are deposited over adjoining floodplains. Since the alignment and profile of natural channels change over time, alternating lenses of these riverine and floodplain deposits can occur along portions of the valley floor that are no longer occupied by streams or their current floodplains. In general, significant zones of groundwater recharge within the CWPA are coincident with the areas delineated as significant groundwater basins, i.e. the alluvial valleys of Ross, Novato and Lagunitas.

Critical groundwater recharge areas exist wherever small communities in the Coastal Recreational Corridor rely on groundwater for their potable water supply (e.g. Inverness, Point Reyes, Dillon Beach, Muir Beach, and Stinson Beach). As noted above under Section 3. Regional Groundwater Hydrology, the NMWD relies on groundwater for its West Marin distribution system. In addition, coastal and inland streams that support critical species such as steelhead and Coho salmon are fed by shallow groundwater aquifers. Thus, the valley alluvium that occupies the largely undeveloped floodplains of Olema Creek, Laguintas Creek, and other small streams identified as critical streams for these listed species represents an important source of groundwater recharge in the CWPA.

4. Surface Water Quality

The quality of stormwater runoff in the CWPA affects the biotic health of both inland waterways and the downstream receiving waters of San Rafael and San Pablo Bays. It also influences the extent and quality of water-oriented recreational uses. While the chemical characteristics of natural waters vary with local geology and climatic influences (e.g. rainfall and temperature), the impact of human activities typically occurs more dramatically over a shorter time period. Residential and commercial development, the most common urban land uses in the CWPA, result in increased pollutant loading of stormwater discharged to local waterways. Contaminated runoff is generated and concentrated over impervious surfaces in these urbanizing portions of the watersheds and enters storm drains, eventually reaching creeks and/or San Rafael and San Pablo Bays. This type of dispersed contaminant loading is referred to as non-point source pollution. Constituents in urban stormwater in the Bay Area include fine sediments, heavy metals, trace organics (e.g. pesticides, PCBs), nutrients, and oil and grease.

Rural land uses, in particular cattle grazing and feedlots and horse stables, can also introduce significant contaminants to surface runoff which eventually discharges to streams. In the Inland Rural and City Centered Corridors, these areas are limited within the CWPA to the undeveloped portions of the Miller Creek Watershed, i.e. the Wetzel and former Grady Ranches and St. Vincent's/Silveira Ranch, and portions of other watersheds to the north, through the City of Novato. Lands in the Coastal Recreational Corridor which drain to the Pacific Ocean, by contrast, are largely zoned for agricultural, ranchstead and open space uses. Significant portions of non-forested land in these areas have been grazed since European colonization. Even some of the newer developments in the western portions of the Inland Rural Corridor (e.g. French Ranch) incorporate some horse stabling and riding facilities.

The 2003 California 303(d) List and TMDL Project Schedule (RWQCB, USEPA 2005) contains descriptions of each regulated pollutant, sources, priorities and the expected date of TMDL

implementation for significant streams and water bodies in the San Francisco Bay Region. The San Francisco Bay mercury TMDL was adopted in 2004. Other TMDL projects are scheduled for completion by 2008. All urban streams in the urban City-Centered Corridor of the CWPA, including Arroyo Corte Madera del Presidio Creek, Corte Madera Creek, Miller Creek, and Novato Creek are listed as impaired for the pesticide Diazinon. This appears to be based on the ubiquitous nature of the chemical in urban environs, rather than specific water quality sampling. TMDLs for Diazinon are expected toward the end of 2005.

For the Central San Francisco Bay and San Pablo Bay, commonly listed pollutants include the pesticides Chlordane, DDT, Diazinon and Dieldrin; dioxin compounds; exotic species; furan compounds; mercury and; PCBs (dioxin-like and non-dioxin like) and selenium. In addition, San Pablo Bay is listed as impaired for the metal nickel. San Pablo Bay circulation and water quality are influenced strongly by the volume of freshwater runoff exiting the Delta and the tributary channels that discharge watershed runoff from the City-Centered Corridor of Marin County and the southern regions of Sonoma and Napa Counties. Wet season runoff is typically accompanied by higher sediment loads, particularly fine-grained particles that act as an adsorpting surface for contaminants. The highest levels of arsenic, mercury and nickel were documented in the San Pablo Bay as noted in the most recent monitoring data (2003) on the San Francisco Bay published by the Regional Monitoring Program (RMP) of the San Francisco Bay Estuary Institute (SFEI 2005). In fact, the DOC concentration measured at the Petaluma River sampling station in February 2001 was the 2nd highest DOC concentration measured in the history of the RMP, which originated in 1993. Related sediment sampling and testing undertaken in an earlier RMP study (SFEI 1997) noted that sediment samples from wetland channels in China Camp Marsh and Petaluma Marsh were generally more contaminated than samples from the adjacent San Pablo Bay station. This is an indication of the sediment trapping efficiency of marshes, and the lack of efficient circulation in many wetland areas.

Richardson Bay is impaired similarly to San Pablo Bay, except that its list of impairing pollutants excludes Diazinon,, nickel and selenium, and includes high coliform counts. Until 1983, a number of municipal sewerage agencies discharged treated wastewater to some of the shallower portions of Richardson Bay. In addition, houseboats and live-aboard boats, primarily in the Sausalito harbor area, were responsible for illegal wastewater discharges in and around the harbors. Both the shallow portions of the Bay and the harbor/marina areas are subject to seasonally poor hydraulic circulation. This produced coliform counts that were higher than acceptable for both water-contact recreation and shellfish harvesting (Bay Conservation and Development Commission 1983).

In response to regulatory agency mandates, the Sewerage Agency of Southern Marin constructed a combined sewer outfall that conveyed wastewater from treatment plants operated by the City of Mill Valley and the Richardson Bay Sanitary District to a discharge point in Raccoon Strait. Due to its position adjacent to the Tiburon Peninsula and the efficient scouring of tidal currents, Raccoon Strait maintains a depth of 90 feet and a dilution rate of 1,400:1. (Clearwater Hydrology conversation with David Coe, General Manager, Sewerage Agency of Southern Marin, Dec. 2001) Thus, the wastewater treatment plant discharges no longer contribute to the elevated coliform counts registered in the Bay. Likewise, the City of Sausalito has enacted a stringent zoning ordinance regarding houseboats and live-aboards. Article 5, Section 10.505 and 10.506 regulate houseboats and single-family "ark" dwellings. The regulations mandate that all houseboats be provided with a City-approved sewer connection. Still, data compiled by the Regional Water Quality Control Board (RWQCB) through 2003 indicates that

some sampling stations continue to show elevated levels of coliform (RWQCB, raw data email from Farhad Ghodrati 2005).

Of the listed TMDL pollutants, highest priorities have been assigned to mercury (Adopted 2004), dioxin-like PCBs, dioxin and furan compounds, and exotic species.

Impairing pollutants in the listed unurbanized streams and bays of the western Coastal Recreational Corridor include:

- Tomales Bay: Mercury (due to mining in the watershed), nutrients, pathogens, and sedimentation/siltation
- Lagunitas Creek: Nutrients, pathogens, and sedimentation/siltation
- Walker Creek: Mercury, nutrients, sedimentation/siltation

To gage the performance of the TMDL criteria, it is likely that the Countywide Program and its sister City programs will be required to implement a more extensive schedule of stormwater sampling, testing and reporting. To date, the MCFCWCD, in association with BASMAA and the RWQCB, has participated in sampling programs for PCBs, mercury and organochlorine pesticides. In addition, the County is currently working on a mercury identification and source reduction study plan with the North Bay Watershed Association (NBWA). In its role as the local permitting authority for development projects within the CWPA, the County DPW also has responsibility for review and approval of SWPPPs which are prepared by developers and other project proponents in association with NPDES General Permit provisions for stormwater. (Clearwater Hydrology conversation with Elizabeth Lewis, MCFCWCD Creek Naturalist and MCSTOPPP Coordinator, Sept.- Dec. 2001)

a. Standardized urban stormwater mitigation plans (SUSMPs)

The SUSMP defines new requirements for the integration of the "start at the source" approach to stormwater control and treatment in development and redevelopment projects. Front-end site design for the minimization of stormwater runoff and contaminant migration are the foundation of the "start at the source" approach. SUSMPs have recently been adopted in the Los Angeles and San Diego areas of Southern California, and similar standards (whether or not they are referred to as SUSMPs) are currently being incorporated into the upcoming reissue of the NPDES stormwater permit for Santa Clara County. While the public comment on proposed requirements for Bay Area SUSPs is underway, the deliberations will likely result in higher standards of performance for municipal stormwater pollution prevention programs

b. County Water Quality Programs

1. Marin County Stormwater Pollution Prevention Program (MCSTOPPP)

While most of the communities in Marin County currently have populations of less than the NPDES threshold, Marin County is still required by the 1995 Basin Plan to develop and implement a baseline

control program to prevent the increase of pollutants in stormwater discharges. To comply with these requirements, Marin County municipalities joined together in the early 1990s to develop a countywide program. The Marin County Stormwater Pollution Prevention Program, referred to as MCSTOPPP, encompasses both the Countywide Program and Local Programs. It provides regional oversight and support for the Local Programs that are now in-force in all municipalities in Marin County. Staff with the Countywide Program meet with Regional Board staff annually to discuss program performance and goals, as well as evolving stormwater regulations. Countywide Program staff also coordinate with other Countywide Programs in the Bay Area, as well as other regional and state agencies, to keep current with new developments in stormwater treatment technologies. MCSTOPPP's current program plan and implementation schedule are detailed in *Action Plan 2005: Protecting and Enhancing Marin County's Watersheds*.[3] The Draft *Action Plan 2010* is currently in the review phase.

MCSTOPPP has developed and implements the Aquatic Macroinvertebrate Sampling Program, primarily in streams along the City-Centered Corridor. The purpose of the program is to assess both the habitat and water quality of urban streams. Information gathered by the program monitoring supplements monitoring of chemical constituents in stream waters, which is more costly. Beginning in the fall of 1999, MCSTOPPP coordinators and community volunteers applied the California Stream Bioassessment Procedure which was developed by the US Environmental Protection Agency (EPA) and the California Department of Fish and Game (CDFG), and conducted habitat surveys on Arroyo Corte Madera del Presidio, Corte Madera Creek, Miller Creek and Novato Creek since 1999. The program is ongoing. (MCSTOPPP web site: www.mcstoppp.org)

Phase II NPDES stormwater permitting regulations were implemented in 2003. Under this phase of the regulations, all Marin municipalities were required to obtain NPDES permit coverage. According to *Action Plan 2005*, the Regional Board intends to adopt a NPDES general permit for the Countywide Program and specific instructions on how the Local Programs can obtain coverage under the general permit. The Phase II regulations mandated that MCSTOPPP implement a minimum of six pollution control measures in order to meet program objectives. These control measures are:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site storm runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

In conjunction with each of the above control measures, MCSTOPPP was required to submit a list of Best Management Practices (BMPs) and measurable goals for the implementation of each BMP. BMPs are erosion and pollutant control measures that minimize the discharge of contaminated stormwater from non-point source areas. Draft *Action Plan 2010* describes activities throughout the document

which represent MCSTOPPP's BMPs. Appendix A, Performance Standards, details measurable goals. (Page 28 of PDF)

2. County of Marin urban runoff pollution prevention ordinance

Chapter 23.18 of the Marin County Code specifies guidelines for minimizing and controlling illicit discharges (non-stormwater) to area storm drains or watercourses, and for reducing pollutants in storm water discharges to the maximum extent practicable. Its intent is to protect and enhance water quality in area water bodies and wetlands in a manner pursuant to and consistent with the federal Clean Water Act. The Ordinance describes exempted activities (e.g. agricultural operations, NPDES permitted discharges), watercourse protections and BMPs for new developments and redevelopments.

Section 23.18.093 of the Ordinance outlines provisions related to site erosion and sedimentation controls, establishes the authority of the Director of Public Works to mandate controls on the rate and volume of runoff produced from a development or redevelopment site, and further establishes the authority of the Director of Public Works to mandate permanent controls designed for the removal of sediment and other pollutants. Such runoff controls could potentially be applied to enact prohibitions on the common "undergrounding" of surface drainageways, as storm drain systems are one of the principal factors in increasing peak flow rates. Taken cumulatively, increased peak flows in even minor (i.e. non-blue line) channels or swales can result in flashier runoff response in blue-line streams during the more frequent (e.g. <2-year recurrence interval) rainstorms normally not considered in flood risk calculations. In addition, properly maintained surface water drainageways act as biofilters for heavy metals and other contaminants, particularly those adsorbed onto fine sediments.

The current language of Section 23.18.093 does not specify under what conditions the development-related construction of storm drain systems should be allowed. With the imminent implementation of TMDLs for County streams, bays, and wetland receiving waters, ecologically sensitive BMPs will increasingly be required at the site design level of a development project. These site design BMPs to minimize surface runoff and off-site contaminant migration are described in the *Start At the Source Manual* (BASMAA 1999) and its companion guidebook, *Start at the Source Tools Handbook* (BASMAA 2000).

c. Water Quality Data for the CWPA

Actual water quality data collection for CWPA streams and its Pacific Ocean embayments has historically been limited to project-specific purposes, typically in conjunction with regulatory activities by federal and state agencies (e.g. RWQCB, USGS, Corps of Engineers, US Fish and Wildlife Service (USFWS) or California Dept. of Fish and Game (CDFG)). Water quality in the water supply reservoirs of the MMWD and NMMWD are regularly sampled and tested for dissolved oxygen (DO), temperature and turbidity. In addition, the RWQCB, USGS, California Dept. of Water Resources (CDWR) and the non-profit San Francisco Estuary Institute (SFEI) maintain water quality monitoring programs for Central San Francisco Bay, San Pablo Bay, and Richardson and San Rafael Bays.

The most recent CWPA surface water quality monitoring for which published results are available was undertaken on behalf of the Joint Stormwater Agency in October and November 2000 (Kinnetic Laboratories Inc. 2001). The sponsoring agency includes MCSTOPPP, as well as other municipal clean

water or pollution prevention programs from Santa Clara, Contra Costa and San Mateo counties and the cities of Vallejo and Fairfield-Suisun. Four stormwater monitoring stations were sampled within the lands of the CWPA, one each in the urban areas of Mill Valley (Arroyo Corte Madera del Presidio Creek), San Rafael (San Rafael Creek), Novato (Novato Creek), and one on Miller Creek, just west of Highway 101. In each case, the sampling sites were in open channels at the outlets to storm drains. Sampled sediments were analyzed for PCBs, Total and Methyl Mercury (Hg), Total Organic Carbon and percent silt/clay. No clear statistical relationship could be determined for different urban land uses and levels of contaminants. However, sampled open space areas (unurbanized) exhibited contaminant concentrations ranging from one (total mercury and methyl mercury) to two (PCBs) orders of magnitude lower than urban sites. The sampling site on Arroyo Corte Madera del Presidio exhibited the highest contaminant concentrations of any of the four Marin County sites. It should be noted, however, that measured background levels of methyl mercury are typically one-half of the level of the those measured in mixed urban environs. Moreover, the methylation process is considered more effective where fine sediments (e.g. clays and silts) are combined with elevated levels of organic matter, conditions which were present in the wetland environment of the Arroyo Corte Madera del Presidio sampling station.

Additional stormwater quality data (Hg and PCBs) were collected during a year-long effort by the staff of MCSTOPPP and the San Francisco Estuary Institute (SFEI) in 1999. While this local data has contributed to the regional assessment of contaminant loading, no conclusions regarding water quality trends are possible with such a small sample size.

In the late summer of 2001, the San Francisco Chronicle reported that RWQCB and MCFCWCD staff had sampled sediment in storm drains conveying stormwater to the Pacheco Pond Wildlife Area in Novato. The sediment was found to contain high concentrations of the pesticides DDT and Chlordane.

In addition to the County-specific efforts described above, municipalities conduct periodic monitoring of stormwater within their jurisdictions. Water quality data obtained from this monitoring is shared with MCSTOPPP coordinators on a regular basis. Similarly, accumulated data from the municipalities and those generated from MCSTOPPP's own efforts are shared with the RWQCB under the requirements of the County's NPDES permit.

1. Tomales Bay water quality

As noted above, the RWQCB has listed Tomales Bay as an impaired Section 303(d) water body for mercury, nutrients, pathogens and sedimentation/siltation. Two of its principal tributaries, Walker and Lagunitas Creeks, are also listed for nutrients and sedimentation/siltation. Walker Creek is impaired for mercury, the result of surface mining activities in its watershed. Lagunitas Creek, while not impaired for mercury, is also impaired for pathogens due most likely to aging, malfunctioning septic systems in its watershed.

Numerous federal and state agencies, water and utility districts, watershed groups, aquaculture operators and university researchers are currently involved in water quality monitoring in Tomales Bay and its principal tributaries, Lagunitas, Walker and Olema Creeks. Two watershed groups, the Tomales Bay Watershed Council (TBWC) and the Tomales Bay Septic Task Force Advisory Committee (SEPTAC), are taking lead roles in compiling existing data from these disparate sources. TBWC has

retained a water quality consultant to prepare a watershed management plan for Tomales Bay. The plan will summarize all existing water quality data for the bay and its tributaries, assess requirements for future data collection and analysis, and outline an action plan for realization of identified water quality objectives. (Tomales Bay Watershed Management Plan- Draft Outline, supplied by Neysa King, TBWC, August 2001).

2. Regional Board Watershed Management Initiative and the North Bay Watershed Association

The regulatory activities of the SWQCB and the RWQCBs are guided by a five-year *Strategic Plan* which was updated in 2001. The 1995 *Strategic Plan* marked the beginning of the Watershed Management Initiative (WMI) which was developed by the State and Regional Boards to promote a better understanding of watershed-scale influences on regional water quality. [4] The Regional Board identified critical watersheds and water quality issues for each of the Bay Area counties under its jurisdiction. For the City Centered Corridor in Eastern Marin County, *Action Plan 2005* indicates several significant Regional Board concerns regarding water quality issues, including three proposed development projects in diked wetlands (the Bahia development has since been defeated in a local initiative), the proposed upstream expansion of the Corps of Engineers project on Corte Madera Creek, and the erosion control project underway on Novato Creek. One of the wetland development projects, Bahia, was recently defeated in a local initiative.

Also in the City Centered Corridor and extending to the Inland Rural Corridor, but excluded from the *Action Plan 2005* list of concerns, is Miller Creek. Recent unpublished results from a field investigation of the watershed hydrology and fluvial geomorphology of Miller Creek sponsored by the RWQCB and SFEI have identified an intact native trout population in the creek. The watershed inventory included field identification and mapping of geomorphic and hydraulic channel conditions along the entire main stem creek. The documented channel conditions included bank and bed stability, sediment sources and estimated sediment yield, habitat attributes (e.g. pool frequency and depth, riparian canopy and channel shading), and biotic health. The researchers also identified potential channel stabilization and restoration opportunities.

In the Coastal Recreational Corridor, the RWQCB cites hill and gully erosion and impacts to stream corridors, runoff from confined animal (dairy) waste, and coliform contamination of shellfish growing areas of Tomales Bay (*Action Plan 2005*).

Another emerging regional entity involved in water quality and water resource issues is the North Bay Watershed Association (NBWA). Founded in 2000, the NBWA is composed of regulated local and regional public agencies that manage and implement projects affecting water resources in Marin and Sonoma Counties. The group includes sanitation agencies, the Counties of Marin and Sonoma, the Cities of San Rafael and Petaluma, MCSTOPPP, and area water districts. Its stated purpose is:

"to help regulated local and regional public agencies work cooperatively on water resources issues that impact areas beyond traditional boundaries in order to promote stewardship of the North Bay Watershed." [5]

The NBWA plans to form a watershed council that would include representatives from the NBWA, state and federal regulatory agencies, agriculture and landowners, business and environmental leaders, as well as at-large representatives from the communities and local watershed groups. It would work in an advisory role to include all facets of the community with interests in water resources in the development and implementation of NBWA projects and activities related to grant funding. The NBWA has developed technical committees in the areas of water quality, habitat and flood protection and integrated water resources. The committees will serve to inform the development of future NBWA projects and initiatives.

5. Groundwater Quality

Regional groundwater quality data for the lands of the CWPA is non-existent. According to the USGS and the CDWR, no regional studies of groundwater availability or quality have been conducted in Marin County. The *1995 Basin Plan* cites three significant groundwater basins: Ross Valley, Novato Valley and the Sebastapol-Merced Formation, which includes the town of Dillon Beach, at the northern edge of Tomales Bay. According to the Director of the Department of Public Works for the Town of Ross, groundwater is utilized only for landscape irrigation, both public and private. Thus, there is no water quality monitoring of the Town's well water. Aside from the County Department of Environmental Health Services' (DEHS) initial sampling of well water for new well installations, no water quality information is available for wells in the Ross Valley. (Clearwater Hydrology conversation with Robert Elias, Director of Public Works, Town of San Anselmo and former Director of Public Works, Town of Ross, Sept. 2001)

The City of Novato does not depend on well water for its public water supply, as it is adequately served by stored water at Stafford Lake and its piped allocation from the Sonoma County Water Agency (SCWA). Thus, well water is used by a few private landowners and no current information on groundwater quality is available. In fact, the City has had a policy of capping private wells, wherever possible to avoid aquifer contamination. (Clearwater Hydrology conversation with Robert Weil, P.E., City of Novato/Coastland Civil Engineering, Sept. 2001)

Potable water wells are maintained and operated by the NMWD as part of its West Marin supply system, which serves the Pt. Reyes Station and Inverness Park communities. NMWD maintains an ongoing groundwater monitoring program at well sites along this reach of Lagunitas Valley. Constituents are monitored on a quarterly basis and include among others: specific conductivity, TDS, hardness, alkalinity, metals, salts, nitrates and nitrites, pH, turbidity and temperature. Given the length of the monitoring and its consistency, these data represent one reliable source of groundwater quality information in the Tomales Bay Watershed.

The Towns of Dillon Beach, Stinson Beach and Muir Beach each depend either wholly or partly on groundwater for their community water supplies. However, apart from Title III water testing conducted for municipal supplies under permit agreements with the State Division of Environmental Health Services, no supplemental groundwater quality monitoring is conducted by these water districts. (Clearwater Hydrology conversation with Tom Fitzgerald, Area Manager, Coast Water Service, Guernville, CA., Sept. 2001; Donovan Mac Farlane, Muir Beach Community Services District, Sept. 2001)

Groundwater monitoring is also conducted in association with the performance of septic systems on larger commercial properties in the Inland Rural and Coastal Recreational Corridors (e.g. Olema Ranch Campground). Water quality data for these locations are available in the form of Self-Monitoring Reports that are required by the RWQCB for projects with permitted Waste Discharge Requirements. Self-Monitoring reports are available for inspection at the offices of the RWQCB in Oakland.

E. STREAM AND WETLAND RESTORATION OPPORTUNITIES

1. Overview

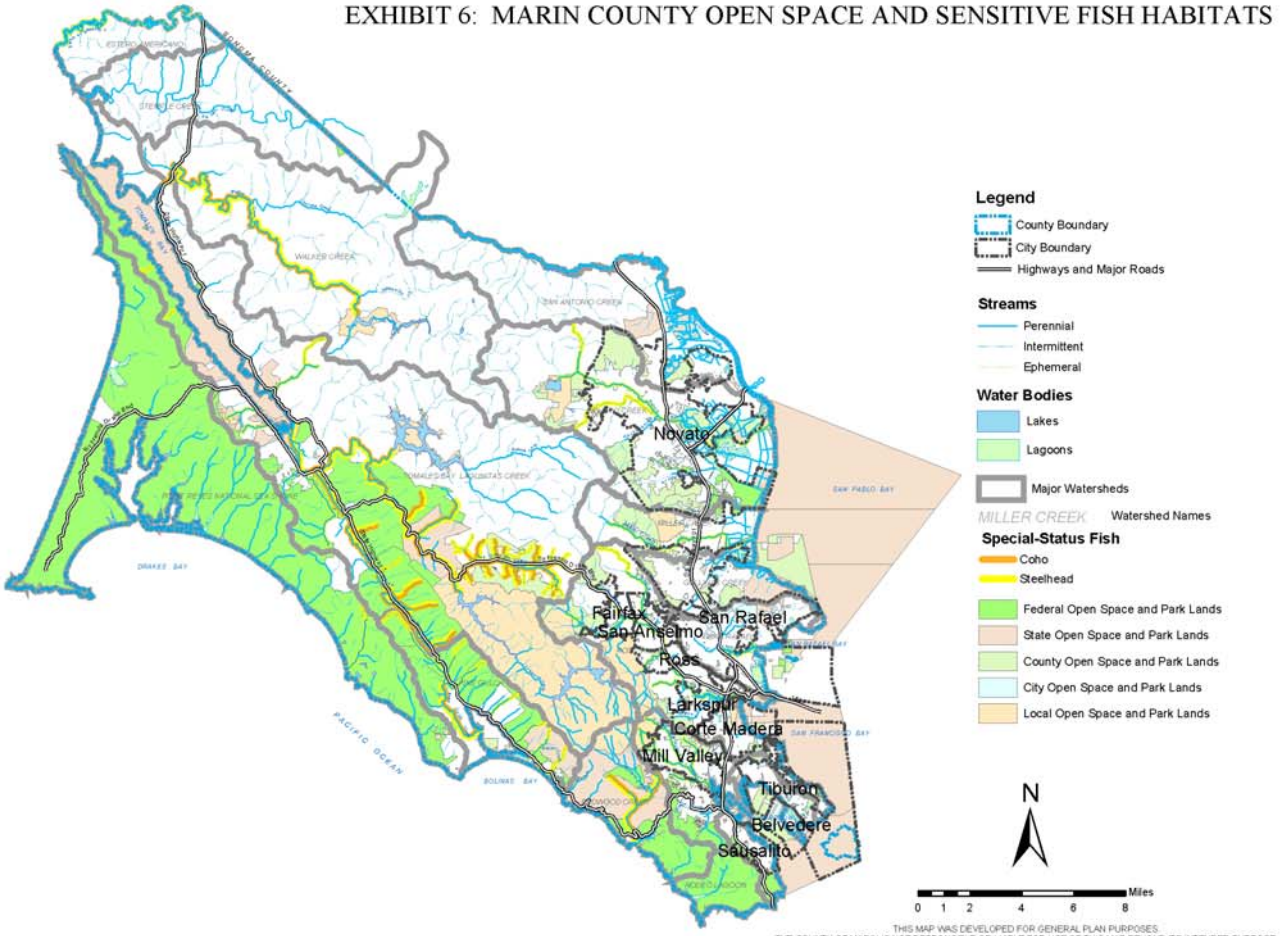
Marin County contains large tracts of public/private open space, protected park and watershed lands and agricultural lands that have experienced ecological stress due to poorly managed land uses such as livestock grazing, timber harvesting, road construction, and urbanization. The affected lands offer substantial opportunities for a more enlightened application of watershed management, including changes in land use practices and intensities, erosion control, and stream and wetland restoration. Limited opportunities for stream and wetland restoration also exist in some of the County's urban and suburban areas. The recent federal listing of coho salmon and steelhead as threatened species has increased regulatory protections for identified critical spawning streams. Also, increasingly stringent stream management objectives for Marin County set forth in its 401 Water Quality Certification (SFRWQCB 1996- locate exact reference, indirect ref. in Collins 1998) mandate the development and implementation of alternatives to traditional engineering design and maintenance of streams for flood control. In the City Centered Corridor, the designated critical streams for salmonids include Miller Creek, Corte Madera Creek, Arroyo Corte Madera del Presidio, and Novato Creek. In the Coastal Recreational Corridor, most of the significant streams carry the designation as critical habitat: Lagunitas Creek, San Geronimo Creek, Walker Creek, Olema Creek and Redwood Creek.

Exhibit 6 depicts the significant perennial and intermittent streams in Marin County. The figure also highlights those streams that have been designated as critical habitat for anadramous fish, as well as the County and federal entities responsible for stewardship of the bulk of these watershed lands. Besides private farmsteads, large tracts of open space lands are administered by the Golden Gate National Recreation Area (GGNRA), the Marin Municipal Water District (MMWD), the Marin County Open Space District (MCOSD), Pt. Reyes National Seashore, Audubon Canyon Ranch and various private water districts. The Marin County Resource Conservation District (MCRCD) assists in stewardship of local agricultural lands, primarily in the Inland Rural and Coastal Recreational Corridors. Its mission is primarily educational, as an agricultural extension service of the U.S. Department of Agriculture. However, the MCRCD also receives grant funding for planning and implementation of watershed erosion control projects, and assists local farmers and ranchers with their own erosion control efforts.

The County DPW has permit authority over residential, commercial and industrial development in its jurisdiction. In addition, the Environmental Quality Element of the 1994 Marin Countywide Plan, Policy EQ 2.2 and 2.3 mandates minimum 50 feet to 100-feet development setbacks from the top of bank for all the County's perennial and intermittent streams. Plan policies also define accepted land uses within these delineated Stream Conservation Areas (SCAs), as well as conditions regarding stream and vegetation management. Still, the County Development Code allows developers and their civil engineers to implement significant modifications to smaller creek channels, including their wholesale replacement by storm drain systems.

SOURCE: COUNTY OF MARIN

EXHIBIT 6: MARIN COUNTY OPEN SPACE AND SENSITIVE FISH HABITATS



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Typically, the smaller channels that fall outside of the SCA regulations are undefined swales or unstable gullies with minimal tributary watersheds that convey only ephemeral flow (i.e. during and immediately following a rainstorm). These ephemeral channels are the headwater tributaries of intermittent streams, and modification of their hydrologic function can affect the sediment and water discharges that influence the hydraulic and geomorphic stability of the more significant downstream channels. Moreover, the Marin County Development Code has no requirements for on-site mitigation of development-induced peak flow rates. Thus, this latitude granted the development community has subtle repercussions on the stability of downstream receiving streams.

Storm drain systems intensify the flashiness of stormwater runoff by accelerating its delivery to downstream channels. Combined with the replacement of permeable floodplain areas by impervious surfaces, storm drain system installation increases peak flow rates. This is particularly true for the more frequent flows. While such increases may not affect downstream flooding during severe, infrequent storm events (e.g. 100-year flood), they can alter the portion of the flow regime that influences channel formation.

Once flows up to the bankfull discharge, equal to roughly the 1.5-2-year discharge, are altered significantly, channel stability can decline if the sediment supply remains relatively constant. Increased peak flows are reflected in the channel's increased capacity to transport sediment. If the incoming sediment supply is not increased, the channel will begin to erode its bed and/or banks to satisfy the capacity for transport. Initially, this diminution of stability may manifest as small scale instabilities (e.g. bank slumping, excessive undercutting of the toe of bank). However, when severe winter flow seasons do occur, the already compromised banks can fail as major slumps trigger like failures downstream due to flow diversions, tree collapse and debris dam blowouts. Often the severe channel instability that develops during and after major floods is wholly attributed to those floods, rather than the progressive instability that preceded them.

2. Countywide Stream Restoration Opportunities

Up until the mid-1990's, watershed erosion control efforts constituted the primary impetus for stream restoration in Marin County. However, in 1997, the Central California Coast steelhead ESU (Evolutionarily Significant Unit) was listed as a threatened species under the federal Endangered Species Act (ESA). Later coho salmon were also given this designation. To guide public and private efforts at minimizing illegal "take" of these listed species, the National Marine Fisheries Service published the Section 4(d) Rule in June 2000. The 4(d) Rule went into effect in September 2000. It identifies both activities that are likely to harm listed salmon and steelhead and thirteen specific "limits" that describe exempted activities, i.e. activities that are already permitted under other sections of the ESA. Specifically, "Limit 8- Habitat Restoration Limits on the Take Prohibitions" exempts activities that are undertaken as "part of a watershed conservation plan", or "whose primary purpose is to restore natural aquatic or riparian habitat processes or conditions; it is an activity that would not be undertaken but for its restoration purpose". Therefore, stream restoration or bank stabilization projects that are designed and constructed in accordance with the principles of fluvial geomorphology and which incorporate features that truly enhance aquatic habitat should meet the criteria specified in Limit 8.

Among County departments, the MCFCWCD and MCOSD have assumed major roles in promoting a more ecologically sensitive approach to watershed and stream management and in assisting landowners

and stream restoration. The MCFCWCD oversees the County's implementation of the SFRWQCB's Water Quality Control Plan for the San Francisco Bay Region (i.e. 1995 Basin Plan), which requires the County and its member municipalities to enact programs that control the discharge of stormwater and other contaminants to the Bay and other receiving waters. This occurs through the aegis of the Marin County Stormwater Pollution Prevention Program (MCSTOPPP), which is a sub-section in MCFCWCD. It also is responsible for conducting watershed/stream assessments and implementing new stream management policies. MCFCWCD staff who are directly involved in these initiatives have received exceptionally high marks from interested state and federal resource and regulatory agencies (e.g. CH pers. communication with Bill Cox, CDFG, Sept. 2001).

MCOSD has been instrumental in preparing and enacting watershed management plans for the Cascade Canyon and White Hill Open Space Preserves, as well as other lands within its jurisdiction. Concern over the potential for catastrophic fires, as well as the impacts of trail and watershed erosion on critical salmonid stream habitat have led the District to implement more ecologically sensitive road and trail maintenance procedures These efforts have yielded significant improvements in roadway drainage which have likely reduced sediment yields to streamcourses (B. Cox, ibid).

Several other federal and regional agencies are actively involved in watershed studies and stream restoration projects within their jurisdictions. As outlined above, these include the GGNRA, Pt. Reyes National Seashore, MCRCD and MMWD. Also, local watershed councils and associations have formed around specific water bodies. These include the Tomales Bay Watershed Council, FishNet 4C, Friends of Corte Madera Creek, and the Septic Task Force Advisory Committee (SEPTAC), which consists of citizen representatives and County staff concerned about water quality impairment in the streams and bays in the Inland Rural and Coastal Recreational Corridors of Western Marin. Most recently (summer 2001), this list has expanded to include Blue Circle, a master coordinating group consisting of representatives of different citizen watershed organizations. Its intent is to facilitate communication and to provide a regional forum for sharing strategies and technologies for watershed management and habitat enhancement.

a. Golden Gate National Recreation Area (GGNRA)

The GGNRA administers watershed and habitat restoration projects on federal coastal lands extending south from Bolinas Lagoon to the Golden Gate. North of Bolinas Lagoon, GGNRA lands are administered by the Pt. Reyes National Seashore. Both GGNRA and PRNS are part of the National Park Service (NPS), regionally headquartered in the Presidio in San Francisco. Current GGNRA projects related to stream and watershed restoration include Redwood Creek and Eskoot Creek. The lower reaches of both of these creeks have historically been subject to floodplain modifications for agriculture and flood control purposes. In addition, logging and skid road construction have resulted in unstable watershed terrain, including landslide activity. GGNRA obtained SB271 grant funds to conduct a field investigation of sediment source areas in the Redwood Creek Watershed. NPS recently acquired funding to purchase the 35-acre Banducci Property on Redwood Creek between Muir Woods and Muir Beach. A restoration project was constructed in 2003 on the property to limit bank erosion and provide habitat for listed steelhead and coho salmon. Future restoration is planned at the site along with restoration projects of the aggraded channel and lost wetland area at Big Lagoon. Some funding has been secured and other sources of funding are being sought for project implementation. GGNRA has also been involved with the Corps of Engineers' Bolinas Lagoon Project. Historical logging, road

construction and livestock grazing in the Lagoon Watershed have produced excessive rates of sedimentation in the Lagoon. The declining tidal prism could eventually close the Lagoon's tidal inlet absent efforts to control watershed erosion. GGNRA and its consultants have proposed Lagoon dredging to increase the tidal prism and improve water quality conditions. (Clearwater Hydrology conversation with Darren Fong, GGNRA, Sept. 2001)

b. Pt. Reyes National Seashore (PRNS)

The National Park Service administers Pt. Reyes National Seashore (PRNS) which encompasses 75,000 acres of rolling hills, coastal bluffs and shoreline environs extending south from Tomales Bay, as well as nearly 25,000 acres of adjoining GGNRA lands. Streams within its boundaries include Olema Creek, Pine Gulch Creek and Redwood Creek. Both the Olema Creek and Pine Gulch Creek Watersheds have been degraded by cattle grazing, particularly unregulated access to riparian corridors. This has resulted in widespread gully development, downstream sedimentation and direct and indirect loss of riparian vegetation through trampling of banks and lateral channel migration, respectively. A Limiting Factors Analysis, funded by Prop 13 is currently being completed for both Lagunitas and Olema Creeks. A coastal watershed assessment report is due out in June 2006, and a General Management Plan and Water Resources Stewardship Plan for PRNS are also to be finalized sometime in 2006 (Clearwater Hydrology correspondence with Brandon Ketchum, September 2005)

c. Marin Municipal Water District (MMWD)

As described in the water supply portion of this report, MMWD operates an extensive network of dams and reservoirs which supply water to most of the inland corridor of Main County. By virtue of these activities, MMWD has significantly affected the flow regimes on many of the major streams draining the Coast Range and has diverted the water to the population centers along the City Centered Corridor. The principal streams affected by reservoir construction are Lagunitas Creek (downstream of Kent Lake) and Walker Creek (downstream of Soulajule Reservoir).

In the wake of the prolonged drought in the late 1970s, MMWD petitioned the State Water Resources Control Board (SWRCB) for permission to raise Peters Dam and increase the impoundment on Kent Lake. The SWRCB issued Order WR 95-17 which allowed the District to raise the dam and mandated mitigation for impacts to downstream aquatic resources. Baseline streamflow and sediment data was collected on Lagunitas Creek from 1983-95. This data was used to determine the impact of flow regulation on the flushing of watershed sediments and instream habitat degradation. It was also applied to a determination of normal vs. low water years, a distinction used to evaluate the need for augmentation of reservoir releases. In addition, instream and riparian habitat characteristics were assessed and some local erosion projects were undertaken, including gully and bank stabilization projects.

A comprehensive sediment and riparian management plan for Lagunitas Creek was completed in 1997. The plan includes recommendations for watershed erosion control (e.g. gully stabilization, fire/dirt road removal and maintenance procedures and landslide remediation), instream structures for habitat enhancement, spawning gravel importation, and riparian revegetation. Also, in accordance with the SWRCB Order, the management plan outlined monitoring requirements for streambed morphology and texture, fish and freshwater shrimp species and riparian vegetation, as well as completed bank

stabilization and erosion control projects. Specific projects are currently underway in conformance with the management plan recommendations. Marin County representatives, including Supervisor Kinsey, participate on the Lagunitas Creek Technical Advisory Committee, which oversees the implementation of the management plan. (Clearwater Hydrology conversation with Greg Andrew, Fisheries Biologist, MMWD, Sept. 2001)

In addition to the stream gauging and habitat monitoring on Lagunitas Creek, MMWD maintains stream gages on San Geronimo Creek, one of the Lagunitas Creek tributaries, and Walker Creek. A sediment study, which assessed suspended sediment concentrations and bedload, was completed for San Geronimo Creek in 2000. Extensive gully stabilization and stream restoration efforts have been implemented on Walker Creek, primarily under the auspices of the MCRCD.

d. Marin County Resource Conservation District (MCRCD)

The MCRCD is an independent resource management agency that maintains loose historical links to the Natural Resource Conservation Service (NRCS) of the U.S. Department of Agriculture. It collaborates with landowners in the planning and implementation of soil conservation, erosion control and stream and riparian restoration projects in the Tomales Bay, Drakes Bay, Stemple Creek, Stafford Lake and San Antonio Creek Watersheds. Supervised by a volunteer Board of Supervisors, the District is self-funding and its small staff obtains grant funding for its projects, which have included significant gully stabilization and stream and riparian restoration efforts on Stemple Creek and Walker Creek. The District commissioned the Stemple Creek Watershed Plan in 1994 and has implemented restoration projects recommended in that plan over the past six years. Additional projects in this watershed are continuing under the auspices of the Sonoma County Resource Conservation District, which shares jurisdiction of watershed lands with MCRCD.

Recently, the County has allocated grant monies to the MCRCD to enable it to retain two full-time staff. This has greatly improved the District's own grant acquisition process, which funds its erosion control and stream restoration efforts. Most grant funding obtained by the District requires some form of in-kind matching funds or landowner participation. In addition, some grant funding includes a retention provision, which has created significant problems for the District in its efforts at reimbursing retained contractors and landowners for erosion control and restoration services. (Clearwater Hydrology conversation with Nancy Scolari, MCRCD staff and Salley Gale, Vice President MCRCD Board of Supervisors)

e. Friends of Corte Madera Creek (FCMC)

FCMC is a watershed stakeholder group concerned with flood control and stream habitat along Corte Madera Creek and its upstream tributaries. FCMC has been an active participant in the ongoing discussions regarding the upstream completion of the Corps of Engineers Corte Madera Creek Flood Control Project. It has also be involved in the assessment of watershed erosion, sedimentation and fish habitat in the Cascade Canyon and White Hill Management Areas, which is currently being conducted by the MCOSD. In partnership with the MCFCWCD the group commissioned a geomorphic assessment of the Corte Madera Creek Watershed (Stetson Engineers 2000), as well as a study of fishery resources in the Watershed (AA Rich & Associates 2000), both of which are available to the public. The MCFCWCD sponsored the grant which funded the geomorphic assessment.

f. Tomales Bay Watershed Council (TBWC)

The TBWC was created in January 2000 with the initial goal of improving and protecting water quality in Tomales Bay. Tomales Bay supports the local economy through recreational tourism and aquaculture, primarily shellfish harvesting operations. It is also the receiving water for significant West Marin streams, including Laguintas Creek, San Geronimo Creek, Olema Creek, Chileno Creek and Walker Creek. Aside from the southern watersheds which encompass much of the Pt. Reyes National Seashore lands, the principal land use in the Tomales Bay Watershed is dairy farming. With the recent listing of Central Coast salmon and steelhead as threatened and the associated publication of Rule 4(d), the original goal was expanded to include the enhancement and protection of stream and riparian habitat in the Bay's tributary watersheds.

The Council consists of roughly 25 stakeholders, with regulatory and resource agency representatives (e.g. Pt. Reyes/National Park Service, RWQCB, CDFG) accounting for one-quarter to one-third of the total. The Tomales Bay Agricultural Group and the MCRCD are represented, as are staff of the County Department of Environmental Health Services (DEHS), the Director of the County Community Development Agency, and County Supervisor Steve Kinsey. Aquaculture operators are also represented. Among the environmental groups involved are the Tomales Bay Association, the Tomales Bay Advisory Committee, the Septic Task Force Advisory Committee (SEPTAC) and the Salmon Protection and Watershed Network (SPAWN).

Contaminated runoff from dairy farms and aging residential septic systems have degraded Tomales Bay water quality. This has resulted in its listing as an impaired water body for heavy mercury, nutrients, pathogens and sedimentation/siltation by the RWQCB. For further discussion of this link to the Council's work, see the section on Water Quality. Historical logging and continuing cattle grazing in the surrounding watershed lands have spawned significant gully development and/or channel instabilities. This has increased the delivery of sediment to the Bay's tributaries, degrading instream habitat for fish. For this reason, Laguintas and Walker Creeks have been designated by the RWQCB as impaired for sedimentation/siltation. As noted above, MMWD has been actively monitoring sediment loading and instream habitat characteristics in Lagunitas and San Geronimo Creeks since the 1980s.

TBWC has retained a water quality consultant to prepare a Watershed Stewardship Plan for the Tomales Bay Watershed. A Draft Plan was completed in March 2003. The Plan describes four actions to achieve its outlined goals. These actions include water quality monitoring in the Bay and surrounding watershed, reducing nonpoint source pollution, protecting and restoring habitat and public outreach and education about Tomales Bay and its watershed. g. North Bay Watershed Association (NBWA)

The member agencies that constitute the NBWA are described in the prior section on Water Quality. In addition to its coordinating role in bi-County water resource planning, the NBWA promotes and assists in obtaining grant funding for stream and wetland restoration projects in the Main-Sonoma area. At this stage in the organizations young history, actual restoration projects are under consideration, but none have been implemented.

3. Specific Stream Restoration Opportunities on County Jurisdictional Lands

Within its immediate jurisdiction, the MCFCWCD plans to facilitate stream restoration efforts on both Miller Creek and a small perennial creek located in the San Rafael Meadows neighborhood. A recent unpublished investigation of the fluvial geomorphology and biotic condition of Miller Creek was undertaken by the MCFCWCD, in association with the San Francisco Bay Estuary Institute's Watershed Inventory Project. The investigation concluded that Miller Creek maintains a native trout population and provides some of the best habitat for anadramous fish in the County. Sampling of channel bed sediments also indicated that the fine sediment loading was greater than expected for a watershed in this geologic terrain. Thus, upstream bank and channel erosion along Miller Creek is likely an inhibiting factor in the maintenance and enhancement of salmonid habitat in the watershed. (Unpublished data from L. Collins investigation, furnished by Liz Lewis, MCFCWCD, Feb. 2001).

County staff are currently advising small landowners in the application of biotechnical bank stabilization methods. MCFCWCD is also taking a lead role in the preparation of grant proposals for ecologically sensitive stabilization/restoration projects on Miller Creek under the Department of Water Resources' Urban Creeks Restoration Program. (Liz Lewis, pers. comm., Feb. 2001). Initial steps have been taken to facilitate and locate funding for one such project on the Wetzel Ranch property. While the right-of-way constraints on the Wetzel Ranch property are significant, ecologically sensitive bank stabilization could be implemented through that reach.

Immediately upstream of the Wetzel Ranch boundary, the bed of Miller Creek rises abruptly at the system's most severe barrier to fish passage. The channel headcut, which reaches a height of roughly 15 feet, has been haphazardly stabilized by former landowners using riprap and concrete debris. Upstream of the headcut on the property now owned by Lucasfilm Ltd. (formerly the Grady Ranch), the meandering channel is severely degraded, and is characterized by an excessive width-depth ratio, vertical to near vertical banks and a high degree of entrenchment. A preliminary restoration plan for this upper reach of Miller Creek was prepared in association with the Lucasfilm Ltd. Master Plan (Nichols Berman 1996). The restoration plan includes the conversion of the fish barrier to a passable step-pool cascade. If these contiguous restoration projects were implemented, the length of the Miller Creek channel open to migratory fish would dramatically increase and downstream loading of fine sediments would decrease.

Both the City of San Rafael and the County of Marin participated in the preparation of a study of land use and environmental enhancement opportunities on the St. Vincent's/Silveira Ranch property east of Highway 101. Study recommendations regarding flood control and stream and riparian corridor enhancement included: 1) re-alignment of Miller Creek east of the NWPRR tracks to approximate its historic alignment to San Pablo Bay; and 2) restoration of Miller Creek, particularly in the reach immediately west of the NWPRR tracks where the banks are unstable and habitat degraded.

a. Stream Restoration- Design and Implementation

Over the past 15 years, the design and construction practices associated with the hydrologic restoration of streams and their associated biotic habitats have steadily evolved and are now recognized as credible alternatives to standard engineering channel design and stabilization measures (e.g. concrete lining, concrete retaining walls, rock riprap and gabion revetments). Prior to this period, the accepted channel

design criteria applied by flood control engineers focused on efficient conveyance of the stormwater runoff generated by the maximum design storm (e.g. 100-year flood) for the contributing watershed. Typically, this entailed a structurally reinforced, regular trapezoidal channel cross-section which was not very effective at transporting the channel sediment load at low to moderate discharges. While this design configuration allowed for development in previously functional floodplains, it also resulted in significant maintenance costs and the destruction of significant riparian habitat. Accumulated sediment and vegetation in these flood control channels had to be removed periodically to maintain the lower hydraulic roughness values associated with the design flood protection levels. This maintenance precluded the establishment of natural biotic and aquatic habitats either in or alongside the channels.

As noted above, federal and state resource and environmental agencies have begun to apply stricter environmental constraints on flood control and stabilization projects, including their requirements for in-channel maintenance of vegetation. Regulatory requirements have, in turn, precipitated more proposals and projects incorporating some form of stream or riparian habitat restoration. Unfortunately, much of what passes for stream restoration does not integrate basic principles of fluvial geomorphology with commonly understood hydraulic engineering design. In the urban and suburban attempts at restoration, project site constraints such as limited right-of-way, multiple parcel ownership and geomorphically entrenched (i.e. incised) channel conditions make real stream restoration more difficult, if not infeasible. However, in such settings biotechnical bank stabilization techniques (also referred to as "soil bioengineering") can provide some enhancement of riparian habitat, even if more structural stabilization elements (e.g. rock or gabion revetments) dominate the design.

To the extent possible, the primary goal of a stream restoration project, be it a natural channel restoration utilizing geomorphic design principles or a more limited bank stabilization project, should be to create a stable channel. A stable channel is defined as a channel that is in a state of quasi-equilibrium with the prevailing water and sediment regime. In extreme cases of undersupply or oversupply of incoming watershed sediment, (e.g. upstream reservoir- undersupply; or massively unstable hillslopes or higher terraces- oversupply), the water and sediment regime are in such flux that the stable channel is a continuously morphing target. However, for relatively stable watershed conditions, a stable channel form is a practical and attainable goal. If stable conditions exist in a particular restoration/stabilization reach, it is unlikely that project construction (with appropriate professional supervision) will have a detrimental effect on adjacent channel reaches.

Where sufficient right-of-way is available to accommodate a natural stream restoration, design elements should include the following:

- A hydraulic design that considers both the water and sediment discharge characteristics of the stream, as well as its morphological character. For example, the form and cross-section of a low-gradient, meandering channel would differ from that of a higher gradient (>2 percent) channel with little or no sinuosity.

- A channel plan form (e.g. alignment, sinuosity) that matches that which is characteristic of natural streams with similar slopes, channel and bank sediments, and flow regime in the region.

- A composite channel cross-section that incorporates low flow and bankfull channels. The low flow channel conveys flow for longer periods into the dry season, while the bankfull channel conveys

flows at the 1.5- to 2- year recurrence interval without excessive scour or deposition. The exception to this design format would be in a gully repair with a minor winter base flow.

- Biotechnical bank stabilization methods to promote the quick establishment of riparian trees and other native vegetation. Certain types of biotechnical measures (e.g. native material revetments) can also provide a really limited and beneficial scouring of the channel bed. The establishment of riparian trees increases stream shading (especially south and west facing bank planting), lowers water temperatures and improves aquatic habitat. Targeted structural measures can be instituted where erosive pressures are high and right-of-way restrictions limit the extent of flood terrace or floodplain construction. Care should be taken, however, to match the extent of such stabilization with the local hydraulic conditions. Excessive stabilization can reduce the potential for habitat restoration, while inadequate stabilization can result in severe erosion where the structural protection transitions to the native bank.

- Channel bed stabilization and/or habitat enhancement features which stabilize the bed and adjacent banks (particularly in higher gradient streams), dissipate excessive erosive energies in floodflows, and promote local variations in the streambed topography (e.g. scour pools).

- Where channel re-alignment is required due to right-of-way or other constraints, the sediments that comprise the channel bed and low terraces (if included) should be of similar size and gradation as nearby channels with similar geology and slopes. Some natural sorting of bed material will occur during the first flow season following construction. However, in most high gradient streams, natural bed armoring typically forms over time in response to the locally higher bed shear stresses that accompany these channels. Thus, failure to install natural armoring material with appropriate levels of embeddedness can result in early channel incision and undesirable channel adjustments.

F. MARIN COUNTYWIDE PLAN REVIEW

Countywide Plan policies and programs which directly or indirectly address hydrology and water quality issues fall into three categories:

- Flood control and flood hazard protection

- Impacts of construction on hydrologic and biological processes

- Stream and Creekside Conservation Areas (SCAs)

Table 4 outlines each of the pertinent policies and programs cited in the 1994 CWP that pertain directly to watershed runoff and peak flow generation, stream stability, stream habitat quality, hydrologic attributes of stream conservation areas (SCAs), stormwater runoff quality and development effects on erosion, sedimentation and instream habitat and water quality. It identifies whether the policies and programs are sufficient in their present form, should be eliminated due to redundancy or lack of relevance, or require some refinement. Policies and programs related to flood control and flood hazard protection are evaluated in a similar manner in the companion Environmental Hazards Element Technical Report on Flooding. Due to its importance in promoting ecologically-sensitive management

along CWPA stream corridors and enhancing water quality, a general discussion of SCAs and their significance in flooding and flood control efforts is included below.

Stream Conservation Areas (SCAs) are defined under CWP Policy EQ-2.3 as follows:

Policy EQ-2.3 Definition of Stream Conservation Areas. A Stream Conservation Area (SCA) should be designated along all natural watercourses shown as a solid or dashed blue line on the most recent appropriate USGS quad sheet, or along all watercourses supporting riparian vegetation for a length of 100 feet or more. The zones consist of the watercourse itself between the tops of the banks and a strip of land extending laterally outward from the top of both banks, to a width of 100 feet on each side in the Coastal Recreation and Inland Rural Corridors and to a width of 50 feet on each side in the City-Centered Corridor on smaller infill lots. Where large tracts of land in the City-Centered Corridor are proposed for development, the 100-foot buffer should be applied, where consistent with legal requirements, and other planning and environmental goals. In the Coastal Recreation and Inland Rural Corridors, the zone should be extended if necessary to include an area 50 feet landward from the edge of riparian vegetation.

Stream Conservation Areas (SCAs) protect the following valuable hydrologic functions pertinent to groundwater recharge, stream stability, erosion control and water quality, and instream and riparian habitat:

> Infiltration and groundwater recharge- In many valley environs in the CWP, the principal zone of rainfall infiltration and groundwater recharge is the alluvium (e.g. sands and gravels) that occupy the valley floor. The restrictions on development within the SCAs, in particular the introduction of new impervious surfaces, maximize the extent of rainfall infiltration and groundwater recharge on the valley floor. This infiltrated and recharge process extends the time over which the rainfall discharges to local stream channels as seepage and groundwater discharge. The natural diversion of this water from the process of storm runoff generation reduces the peak flow rates associated with channel discharges for a given storm event. Maintenance of natural rates of runoff over portions of the watershed eases flooding pressures on hydraulic structures and natural channel reaches located further downstream. CWP Policies EQ-2.15: Stream Alterations and EQ-2.28: Protection of Watersheds, Aquifer Recharge Areas and Natural Drainage Systems directly address the maintenance of infiltration and groundwater recharge attributes in SCAs. Policies EQ-2.9: Minimal Disturbance of Vegetation and EQ-2.11: Modification of Natural Channels indirectly pertain to these attributes via the protection of riparian vegetation and the minimization of impervious surfaces.
>
> Stream channel stability—SCAs provide protection of riparian vegetation along stream corridors. Riparian vegetation, particularly riparian trees, has a direct impact on the stability of streambanks. When riparian vegetation is removed, the shear and tensile strength provided to streambank soils by the root masses of trees and other riparian plants is lost. The streambanks then become more vulnerable to various forms of erosion and failure, e.g. slumping following high flow events, trampling by cattle access. This is not to infer that all corridors with riparian vegetation are stable. If upstream compaction of soils and gully formation occur due to livestock grazing, urbanization, or other detrimental watershed practices, the balance between stream

discharge and sediment load can be lost and instabilities can ensue. However, even in such cases, the impact of bank erosion and stream instability is minimized by the aforementioned effects of riparian vegetation along the stream corridor. When streambanks become unstable, entire reaches of a stream channel, at and downstream of the initial instability, can undergo a process of progressive destabilization due to debris obstructions, heightened sediment deposition (e.g. in bar deposits and debris jams) and instream flow deflections. This can reduce the effective flood conveyance in a stream and increase local flood elevations.

One current CWP policy directly addresses channel stability concerns: Policy EQ-2.9: Minimal Disturbance of Vegetation. Several other policies indirectly infer some link to this SCA attribute, including Policies EQ- 2.4: Land Uses in Stream Conservation Areas, EQ-2.5: Prohibited Land Uses in Stream Conservation Areas, EQ-2.8: Retention of Riparian Vegetation, EQ-2.10: Tree and Shrub Plantings and EQ 2.22 Altering Stream Flow, Bed and Banks.

Erosion, sedimentation and water quality- In addition to the erosion of streambanks associated with loss of riparian vegetation along stream corridors, the vegetated corridor acts as a filter for sediments moving in overland flow (either in broad swales, small channels or overland) toward the principal stream channels. Water pollutants such as heavy metals can adsorb onto sediment particles, which are transported in runoff to streams. However, when sufficient vegetated buffers and vegetated swales (i.e. bioswales) are provided to convey runoff toward streams, the vegetation filters the contaminated sediments from the runoff. Concentrations of herbicide and pesticide residues, as well as oil and grease residues, can also be reduced to some extent by vegetated buffers. Since turf and other native grasses often are more efficient filter mediums than relatively sparsely vegetated areas underneath riparian tree canopies, the 50-feet buffer landward of the actual riparian boundary which is cited in the existing SCA ordinance is crucial to the performance of the SCA in its water quality protection function.

Existing CWP policies that directly refer to erosion, sedimentation and water quality in SCAs include Policies EQ-2.8: Retention of Riparian Vegetation, EQ-2.14: Monitoring Stream Conservation Areas, EQ-2.15: Stream Alterations, EQ-2.23 Seasonal Development Factors, EQ-2.29: Upstream Development Impacts, and EQ-2.31: Water Quality. Policies that only indirectly pertain to erosion, sedimentation and water quality in SCAs include Policies EQ- 2.4: Land Uses in Stream Conservation Areas, EQ-2.5: Prohibited Land Uses in Stream Conservation Areas, , EQ-2.9: Minimal Disturbance of Vegetation, EQ-2.11: Modification of Natural Channels, EQ-2.17: Stream Management Plans, EQ-2.18: Soil Disturbance, EQ-2.20: Retention of Sediment, and EQ-2.21: Roads, Road Spills and Roadfill Slopes.

Instream and riparian habitat- As noted in the above discussion on the erosion, sedimentation and water quality effects of SCAs, the combined riparian plus landward vegetative buffer specified in the SCA ordinance is crucial in maintaining the SCA's water quality function. This water quality maintenance function as it relates to stormwater runoff has an important influence on the quality of instream waters and the health of the aquatic habitat. Improved stormwater quality, particularly in combination with a reduced dependency on storm drain installations to convey developed area runoff, has a direct impact on the viability of receiving waters to support fish and the invertebrates they feed on.

Existing CWP policies that directly address instream and riparian habitat include Policies EQ-2.4: Land Uses in Stream Conservation Areas, EQ-2.8: Retention of Riparian Vegetation, EQ-2.9: Minimal Disturbance of Vegetation, EQ-2.11: Modification of Natural Channels, EQ-2.14: Monitoring Stream Conservation Areas, EQ-2.15: Stream Alterations, EQ 2.22 Altering Stream Flow, Bed and Banks, EQ-2.24: Enhancement of Stream Conservation Areas, and EQ-2.31: Water Quality. Policies EQ-2.5: Prohibited Uses in Stream Conservation Areas, EQ-2.10: Tree and Shrub Plantings, EQ-2.17: Stream Management Plans, EQ-2.23 Seasonal Development Factors, EQ-2.26: Restoration of Damaged Portions of Stream Conservation Areas, EQ-2.28: Protection of Watersheds, Aquifer Recharge Areas and Natural Drainage Systems, and EQ-2.29: Upstream Development Impacts relate indirectly to instream and riparian habitat.

As MCSTOPPP's Aquatic Macroinvertebrate Sampling Program has discovered in its initial sampling and surveying efforts, invertebrate species diversity and sensitive species populations increase with increasing distance upstream into the watershed. (Clearwater Hydrology conversation with Elizabeth Lewis, op cit.) Given the settlement patterns in the County, this strongly suggests a link between degraded stormwater quality and a reduction in instream habitat quality.

G. KEY ISSUES, TRENDS AND OPPORTUNITIES

The NPDES permit program implemented Phase II stormwater regulations in 2003. TMDL criteria for selected stormwater contaminants, including mercury (2004), PCBs, diazinon, and other pollutants will be implemented during 2005–2008. A more substantial stormwater monitoring program would include sampling and laboratory testing for TMDL constituents and perhaps a wider array of regulated contaminants.

For new development and redevelopment along the urbanized eastern corridor, particularly in areas still drained by quasi-natural streams, the issue of peak flow and water quality mitigation needs to be addressed in a more comprehensive manner by the Department of Public Works, including the MCFCWCD, and the Community Development Agency. At present, the Development Standards outlined in Title 24 of the County Code are administered by the Department of Public Works. These standards consist of specific design specifications and directives that are evaluated at the Precise Plan level of a development project.

The Development Code (Title 22), which comprises both the County Zoning and Subdivision ordinances, guides the initial layout and design approach taken by developers at the Master Plan and Tentative Map stages of a project. The current County Development Code does not include strong enough guidance to the development community to influence a move toward integration of start-at-the-source design features. In combination with similarly strengthened specifications for new construction in the Title 24 Development Standards, the County would be able to influence development projects toward a more ecologically sensitive approach. Such changes could reduce the time and expense of environmental review, as many of the protests of the interested communities and regulatory agencies are associated with undergrounding of drainageways (i.e. replacement with storm drain systems), peak flow increases and water quality and sensitive habitat impacts- all of which could be minimized if the

development community utilized more ecologically-sensitive design features at the earliest stages of the planning and environmental review process.

In August 2001, staff with both the Land Use and Water Resources Division of the County DPW and the MCFCWCD prepared a memorandum that identified several sections of Title 22 which could be modified to conform more closely with project design guidelines outlined in *Start at the Source: Design Guidance Manual for Stormwater Quality Protection* (Bay Area Stormwater Managers Agencies Association (BASMAA) 1999) and *Start at the Source Tools Handbook* (BASMAA/EOA, Inc. 2000). Only one of the recommended sections pertained directly to flooding: Section 22.080 Parking Requirements. For this section, the recommended language comprised two bullet items:

- Reduce impervious area through shared parking
- Encourage the use of pervious surfaces (i.e. Turfblock, porous asphalt, gravel) wherever feasible, especially for overflow parking.

The County has three strong regulatory pillars to utilize in promoting modifications to the Development Code: Phase II NPDES stormwater permit requirements (2003); TMDLs for high priority contaminants, including mercury (2004), PCBs and Diazinon (due in 2005-2008); and Rule 4(d) for steelhead (2000). On-site stormwater design is a significant link in the chain of hydrologic influences on water quality and aquatic habitat.

Finally, the County will have the opportunity to support stream and wetland restoration projects within the CWPA, both on lands under its active jurisdiction and on County lands administered by the federal government and by NMWD and MMWD. Stream restoration opportunities exist on the small perennial drainage in the San Rafael Meadows subdivision and on Miller Creek, both upstream and downstream of Highway 101. Some wetland restoration potential also exists in association with the St. Vincent's/Silveira Park lands east of Highway 101. In addition, significant opportunities exist for the County to continue in its already strong cooperative efforts to facilitate watershed management activities by local watershed groups, coalitions and resource organizations. These include the MCRCD, FishNet 4C, the Tomales Bay Watershed Council (TBWC), SEPTAC and the Friends of Corte Madera Creek. If properly implemented, watershed management plans can enhance water quality and aquatic habitat in both streams and the downstream receiving waters of Marin's plentiful bays and lagoons.

Specific recommendations for water quality and restoration projects and activities within the CWPA include:

- Promote MCSTOPPP's development of BMP lists and stormwater sampling, testing and reporting obligations required to meet the Phase II NPDES stormwater protection goals and TMDL water quality criteria.
- Support the incorporation of Standardized Urban Stormwater Mitigation Plans (SUSMPs) or their equivalent into the County's soon-to-be issued NPDES stormwater permit.

- Modify Title 23: Natural Resources and Title 24: Development Standards of the County Code in the following areas:

- Strengthen code language in Section 23.18.093 items (b) and (c) regarding BMPs for new developments and redevelopments. Enforce the implementation of site design measures that minimize increases in runoff volume and peak flows. Refer project applicants to the BASMAA publications: *Start at the Source: Design Guidance Manual for Stormwater Quality Protection* (BASMAA 1999) and *Start at the Source Tools Handbook* (BASMAA/EOA, Inc. 2000); and strictly enforce the implementation of this approach via DPW's review and permitting authority. Prohibit the elimination of surface drainageways and their substitution by storm drain systems, wherever surface drainageways can be retained without exacerbating local flooding conditions. For headwaters swales or gullies that drain small watershed areas, minor drainageway re-alignment and/or restoration should be preferred over storm drain installations.

- Consolidate and clarify all SCA-related policies and programs which are at present overlap and lack specificity. Add protections for all channels delineated on the Marin County Soil Survey. The Soil Survey includes well-defined channels that do not show up as blue line streams on the USGS quadrangle sheets. Channel setbacks should be modified to provide setbacks from the top of bank as determined by a 2:1 extrapolation from the toe of bank, rather than from the top of bank per se. In degraded reaches of creeks, future bank retreat will be accommodated by this adjustment in the SCA provisions. Minimum buffers landward of areas of significant riparian vegetation, currently specified at 50 feet in width, should be retained.

- Continue the County's strong representation in the watershed management and planning activities of the Tomales Bay Watershed Council (TBWC), the Septic Task Force Advisory Committee (SEPTAC), and the North Bay Watershed Association.

- Explore the possibility of obtaining the services of the USGS to conduct a regional groundwater study of the Tomales Bay Watershed, including the Walker, Lagunitas, Stemple and Olema Creek Watersheds. The State Water Resources Control Board (SWRCB) has recently passed Resolution No. 2001-026 authorizing the Executive Director to enter into an agreement with the USGS or Lawrence Livermore National Laboratories, or other public agency to conduct ambient groundwater monitoring. The total allocation is not to exceed $2,245,000. (SWRCB web site, Sept. 2001)

- Continue to assist the MCRCD with grant assistance in order to facilitate their collaborative erosion control and stream restoration activities with local North Marin landowners and farm/ranch operators. Grant assistance has allowed the District to maintain two full-time staff, which is critical for its pursuit of additional project funding and landowner cooperation.

- Upgrade the County's trail and rural road maintenance practices to reduce local erosion, water quality and habitat impacts. Implement proper trail and roadway drainage practices; retrofit old culvert outlets with ecologically appropriate energy dissipation measures; and stabilize and revegetate gullies that have formed in response to culvert installation. Where fish passage has been eliminated due to culvert-induced scour, rebuild transition structures appropriate for fish passage.

(Trail improvements and erosion reduction activities of this sort are currently being implemented by the MCOSD as part of the Cascade Canyon and White Hill Management Plan.) The MCRCD Board Vice-President has cited culvert-induced gully erosion as a critical factor in continuing watershed erosion and downstream sedimentation in Western Marin (Clearwater Hydrology conversation with Salley Gale, MCRCD Board V.P., Sept. 2001).

- In association with the MCFCWCD's ongoing channel maintenance and stormwater quality initiatives, promote the implementation of the above-mentioned trail and road maintenance practices among municipalities in the CWPA. While the County's recent efforts at amending road and trail practices have produced some encouraging results thus far, the same effort has been largely absent at the city level. (Clearwater Hydrology conversation with Bill Cox, biologist, CDFG, Sept. 2001)

- Some potential may exist for tidal wetland or seasonal wetland restoration at the lower end of Miller Creek, in conjunction with the ultimate development of the St. Vincent's/Silveira Ranch property. The County should advocate for a strong wetland restoration component along the tidal reach of Miller Creek.

- Continue with MCFCWCD staff efforts toward obtaining grant funding for restoration of portions of Miller Creek through the Marinwood residential subdivision and potentially on the Wetzel Ranch property.

- Lucasfilm Ltd. has proposed to restore the upper reaches of Miller Creek on the former Grady Ranch. This reach of the creek is critical to expanding anadramous fish habitat, as it would include the removal of an in-stream barrier to migration. The County should promote implementation of this restoration program, if and when it is proposed.

- Investigate assisting the Marinwood Community Services District in obtaining grant funding for modifications to the original Miller Creek restoration along the Lucas Valley Estates Subdivision reach. Specifically, the modifications would be to retrofit and/or amend the existing channel stabilization measures to improve channel geomorphological function and instream habitat for fish (e.g. add pool habitat through the reach). Initially, the targeted sub-reach would extend from 250 ft. below the lower subdivision bridge crossing to 250 ft. above the crossing. Other sub-reaches could also be modified based on an available funding and an evaluation of fish habitat objectives and the recent geomorphic survey of Miller Creek by Laurel Collins (unpublished).

Table 4
EVALUATION OF EXISTING COUNTYWIDE PLAN
HYDROLOGY POLICIES AND PROGRAMS

Environmental Quality Element

RESOURCE CONSERVATION AREAS

1. Stream and Creekside Conservation Areas	
Policy EQ-2.1 Value of Riparian Systems. Riparian systems, streams and their riparian and woodland habitat are irreplaceable and should be officially recognized and protected as essential environmental resources, because of their values for erosion control, water quality, fish and wildlife, aesthetics, recreation, and the health of human communities.	Needs Refinement. Add mention of groundwater recharge and channel stability to values list.
Policy EQ-2.2 Streams Defined as Blue Lines on USGS Quad Maps. All perennial and intermittent streams, which are defined as natural watercourses shown as solid or dashed blue lines on the most recent appropriate USGS quad sheet, should be subject to these stream and creekside protection policies. A perennial stream is further defined as: a watercourse that flows throughout the year (except for infrequent or extended periods of drought), although surface water flow may be temporarily discontinuous in some reaches of the channel such as between pools. An intermittent stream is further defined as: *a watercourse that flows during the wet season, continues to flow after the period of precipitation, and ceases surface flow during at least part of the dry season.* An ephemeral stream should be subject to these policies if it supports riparian vegetation for a length of 100 feet or more. An ephemeral stream which does not support vegetation for 100 feet or more may also be subject to the SCA policies if it is demonstrated that the stream has value for flood control, water quality, or habitat which supports rare, endangered, or migratory species. An ephemeral stream is defined as: *a watercourse which carries only surface runoff and flows during and immediately after periods of precipitation.*	Needs Refinement (Potentially). Consult with Bill Cox of CDFG and others involved with sensitive species habitat preservation- ephemeral streams w/o 100 ft. long riparian corridor which has a defined channel (incised) may warrant SCA status.

Policy EQ-2.3 Definition of Stream Conservation Areas. A Stream Conservation Area (SCA) should be designated along all natural watercourses shown as a solid or dashed blue line on the most recent appropriate USGS quad sheet, or along all watercourses supporting riparian vegetation for a length of 100 feet or more. The zones consist of the watercourse itself between the tops of the banks and a strip of land extending laterally outward from the top of both banks, to a width of 100 feet on each side in the Coastal Recreation and Inland Rural Corridors and to a width of 50 feet on each side in the City-Centered Corridor on smaller infill lots. Where large tracts of land in the City-Centered Corridor are proposed for development, the 100-foot buffer should be applied, where consistent with legal requirements, and other planning and environmental goals. In the Coastal Recreation and Inland Rural Corridors, the zone should be extended if necessary to include an area 50 feet landward from the edge of riparian vegetation.	Needs Refinement
Program EQ-2.3a Protection of Stream Conservation Area. The County shall implement the policies for Stream Conservation Areas through its established permit review processes and/or through adoption of specific new ordinances. When a development permit is applied for, staff will determine whether the proposed development falls within the zone, generally 100 feet from the banks of streams (50 feet from the banks of streams in the City-Centered Corridor). If the project is in this zone, staff will determine whether the proposed use is permitted by right under the Stream Conservation policies, as well as by the underlying zoning. If the proposed use is not a permitted use in Policy EQ-2.4 and it is not a prohibited use in Policy EQ-2.5 of Stream Conservation policies, but it is allowed under the zoning, the applicant may apply for a development permit. In order for such a permit to be issued for an existing parcel, it should be determined that the parcel either: Falls entirely within the Stream Conservation Area; or Development on any other portion of the parcel (outside the SCZ) would have greater impacts on water quality. If the proposal involves the creation of a new parcel, any needed modifications should be made to assure that no development occurs within the Conservation Area to the extent possible. Applicants shall be required to submit adequate information to determine whether the Stream Conservation Area policies are being met. All development permit applications shall be reviewed for conformity with these policies, and in accordance with the California Environmental Quality Act. Proposals which do not conform to Stream Conservation policies, and which cannot be modified or mitigated so that they do conform, shall be denied. Information on 100-year floodplains should be made available for public and staff reference and shall be incorporated into all planning reviews	Needs Refinement. Specifically define the physical dimensions of the zone (e.g. refer to existing CWP figure EQ-3) and adjust the streamward edge of the SCA to show 50 or 100 ft. landward of the 2:1 projection of the nearest toe of bank. This is more conservative than taking it from the existing top of bank, if the bank happens to be nearly vertical. Also, include a landward buffer of grassland or other undevelopable land of 50 ft. outside of the landward edge of riparian vegetation.

Program EQ-2.3bEstablish a Fund to Fence Sensitive Stream Areas. The County should explore the feasibility of creating a fund, established in conjunction with the Resource Conservation District and the Soil Conservation Service, and other relevant agencies, to pay the cost of fencing sensitive streamside areas (on private property) which could be impacted by cattle grazing.	Needs Refinement. Appears to be in conflict with Policy EQ-2.4 which allows grazing in SCAs. Expand the discussion to clarify under what circumstances fencing should be sought. Otherwise insert a statement of preference for ungrazed SCAs or partial livestock access at stabilized stream access points (i.e. planned gaps in exclosure fencing).
Policy EQ-2.4 Land uses in Stream Conservation Areas (SCAs). The following uses are permitted in the SCA by development permits, provided these uses are allowed by the underlying zoning: • all currently existing structures and uses including reconstruction and repairs • necessary water supply projects • flood control projects • projects to improve fish and wildlife habitat • grazing of livestock and other agricultural uses • maintenance of water channels for erosion control and other purposes • road and utility line crossings • water monitoring installations • trails	Needs Refinement. Requires better defined exemptions, circumstances under which grazing and flood control projects are allowed; specify types of erosion control that are preferred (consult with MCFCWCD). Also, blanket permission for grazing of livestock and other agricultural uses can lead to severe channel destabilization and impairment of instream water quality. Thus, there should be mention of appropriate grazing which would be managed according to the health of the riparian corridor and/or the stream channel itself. Grazing densities and scheduling should be approved only where it is part of a riparian/range management program approved by the County. Otherwise, some stream systems that are currently unstable and largely devoid of a healthy riparian corridor could continue to act as sediment sources that are detrimental to aquatic habitat, including fish and shellfish (e.g. Tomales Bay).
Policy EQ-2.5 Prohibited Land Uses in Stream Conservation Areas. The following new uses are prohibited in the SCA: • roads and utility lines, except at crossings • confinement of livestock • dumping or disposal of refuse • use of motorized recreational vehicles • any structural improvement (excluding repairs) other than those identified in Policy EQ-2.4, including residences, barns, and storage buildings, unless allowed by a development permit in Policy EQ-2.6.	Needs Refinement. Add horse stables and riding rings which could compromise stream quality in the event of overbank flooding and normally due to entrained sediment in overland runoff.

Policy EQ-2.6 Other Allowable Land Uses in the Stream Conservation Areas. Other uses may be allowed in the SCA by development permit, provided these uses conform to all other policies for SCAs and are: • allowed by the underlying zoning • on existing parcels that fall entirely within the zone • on existing parcels where it can be conclusively demonstrated that development on any other part of the parcel would have a more adverse effect on water quality or other environmental impacts.	Still Applicable.
Policy EQ-2.7 Consideration of Costs. All concerned agencies should take aesthetic, scenic, environmental, and recreational benefits into full consideration when computing costs of alternatives for modifications of streams (applicants will be required to obtain a Streambed Alteration Agreement from the State Department of Fish and Game).	Still Applicable.
Policy EQ-2.8 Retention of the Natural Vegetation. The retention of the natural vegetation in an SCA should be encouraged in order to realize benefits such as soil erosion prevention, stream, shade, etc. When vegetation must be removed and soil disturbed within the SCA, or when vegetation has been destroyed or eliminated, the area should be re-seeded or replanted with native plants of the habitat as soon as possible. Broom and other aggressive exotic plants should be removed and replaced with native plants.	Needs Refinement. Benefits: erosion control and reductions in downstream sedimentation, enhances channel stability, preserves water quality and aquatic and wildlife habitat (e.g. stream shading and invertebrate populations) for fish and other species.
Policy EQ-2.9 Minimal Disturbance of Vegetation. Disturbance of vegetation within the SCA should be minimized or avoided whenever possible. Minimizing or avoiding disturbance of streamside vegetation is particularly important for trees and shrubs which provide shade, stability for the streambank, and wildlife habitat. Vegetation may partially block streams creating a ponding effect which may be beneficial fish habitat. Tree growth may be cleared from the stream channel when it unduly restricts flood flows, to protect health, safety, and welfare.	Needs Refinement. Tree growth or debris should be cleared from the channel if it unduly restricts floodflows or jeopardizes streambank stability due to the deflection of currents at high flows, to protect
Policy EQ-2.10 Tree and Shrub Plantings. Trees and shrubs to be planted along watercourses should include a variety of species that would naturally grow in or near the creek. In general, the planting of exotic trees should be avoided. When removal of riparian vegetation is unavoidable, and mitigation is required, replacement should be at a 2:1 ratio, whenever feasible. Enhancement and restoration of culverted streams is encouraged, whenever feasible.	Needs Refinement. Last sentence seems to belong elsewhere, perhaps EQ-2.11
Policy EQ-2.11 Modification of Natural Channels. Modification of natural channels within SCAs for flood control, etc., should be done in a manner that retains and protects the vegetation forming ground cover and shade. Special attention should be given to the protection of riparian vegetation.	Needs Refinement. Add strong preference for exclusion of storm drains and culverts within SCAs.

Policy EQ-2.14 Monitoring Stream Conservation Areas. A system of monitoring SCAs should be established to assure the protection of vegetation, soils, water quality, and wildlife habitat along streams.	Needs Refinement. Clarify how this is being accomplished. To date, no formal monitoring of SCAs is conducted by MCFCWCD. Consult with MCFCWCD to determine whether such a system is feasible given the number of streams involved and County resources. Mention could be made of the Aquatic Macroinvertebrate Sampling Program and goals or objectives of same (this program uses volunteer labor under supervision/coordination of County staff.
Policy EQ-2.15 Stream Alterations. Before any stream alterations are permitted, the minimum water flows necessary to protect fish habitats, water quality, riparian vegetation, groundwater recharge areas, and downstream users should be determined in conjunction with the State Department of Fish and Game and the Division of Water Rights of the State Water Resources Control Board.	Needs Refinement. The language of this policy seems to fit diversions rather than alterations. The text would be fine if the subject was Stream Diversions. A separate policy could be crafted to deal with Stream Alteration, including CDFG, RWQCB, US ACOE consultation.
Policy EQ-2.17 Stream Management Programs. Projects and stream management programs which improve the opportunity for fishing and enhance the abundance of sport fish should be encouraged and supported.	Still Applicable.
Policy EQ-2.18 Soil Disturbance. Soil disturbance should be discouraged within the SCA. Where absolutely necessary it should be limited to the smallest surface area and volume of soil possible and for the shortest practical length of time.	Needs Refinement. Add mention of requirement for revegetation following disturbance, with use of native plant species. Also refer to Policy EQ-2.10 for mitigation ratios. Alternatively, combine EQ-2.10 and EQ-2.18.
Policy EQ-2.19 Surface Runoff. Surface runoff rates in excess of pre-development levels should not be allowed where a new problem will be created or where the runoff will exacerbate an existing problem.	Needs Refinement. (Expand and combine with BMP policy)

Policy EQ-2.20 Retention of Sediment. On-site facilities for the retention of sediments or contribution toward regional sediment control measures produced by development should be provided during construction and, if necessary, upon project completion. Continued maintenance of these facilities should be required.	Needs Refinement. Too vague. Update wording to stress installation and monitoring/maintenance of BMPs for contractor activities, for erosion and sediment control and for post-construction conditions, including monitoring and maintenance of these measures. Clarify under what circumstances actual sediment retention basins or contributions to regional sediment retention facilities would be applicable.
Policy EQ-2.21 Roads, Road Spoils, and Roadfill Slopes. New roads and roadfill slopes should be located outside the SCA, except at stream crossings. No spoil from road construction should be deposited within the SCA. At road crossings in the SCAs, special effort should be taken to stabilize soil surfaces.	Needs Refinement. Add strong preference for clear span bridge crossings that preserve the hydraulic geometry of the channel at low to moderate flows. Also add mention of culvert designs that allow for maintenance of fish passage and preservation of the existing streambed gradient.
Policy EQ-2.22 Altering Stream Flow, Bed, or Banks. Filling, grading excavating, obstructing flow, or altering the bed or banks of the stream channel and riparian system shall be discouraged. Such activity will only be allowed after completion of environmental review, identification of appropriate mitigation measures, and issuance of a permit by the Department of Public Works.	Needs Refinement. Add mention requirement to obtain a Stream Alteration Agreement from CDFG, a Waiver of Water Quality Certification from the RWQCB and potentially, a Nationwide Permit from the US ACOE.
Policy EQ-2.23 Seasonal Development Factors. Development work adjacent to and affecting SCAs should be done during the dry season only, except for emergency repairs. Disturbed surfaces should be stabilized and replanted, and areas where woody vegetation has been removed should be replanted with suitable species before the beginning of the rainy season.	Needs Refinement. Planting for revegetation and erosion control is normally conducted at the onset of the winter rainy season (mid-late October) in the case of seeding and in mid-winter (dormant season) in the case of instream willow plantings. Summer or early fall plantings of woody species should account for moisture availability and temporary or permanent irrigation, or hand watering should be conducted if necessary.

Policy EQ-2.24 Enhancement of Stream Conservation Areas. Uses and development within SCAs should enhance the appearance of the streamside environment and protect native vegetation. Through careful site analysis and development, views should be preserved and the integrity of the streamside environment should be protected. The County should work in close cooperation with the flood control districts, water districts, and wildlife agencies in the design and choice of materials for construction and alterations within the SCAs.	Still Applicable. (Combine w/ EQ 2.4)
Policy EQ-2.26 Restoration of Damaged Portions of Stream Conservation Areas. Damaged portions of SCAs should, wherever possible, be restored to their natural state. When it is not possible to return the SCA to a natural state, the portions of the channels that have been significantly altered for flood control should be improved for urban open space uses such as landscaped areas and paths. These improvements should enhance habitat values.	Needs Refinement. Clarify that even where flood control channel improvements are conducted, channel design should be accomplished using integrated principles of hydraulic engineering and fluvial geomorphology.
Policy EQ-2.27 Water Resource Management. Water resources should be managed in a systematic manner that is sensitive to natural capacities, ecological impacts, and equitable consideration of the many water-related needs of the County.	Eliminate. This policy seems to vague and unfocused to be of any import.
Policy EQ-2.28 Protection of Watersheds, Aquifer Recharge areas, and Natural Drainage Systems. High priority should be given to the protection of watersheds, aquifer-recharge areas, and natural drainage systems in any consideration of land use.	Needs Refinement. Add mention of preference for maintenance of existing natural drainageways over storm drain installations and culverts.
Policy EQ-2.29 Upstream Development Impacts. The effect of upstream development on downstream land uses should be examined during project review. The following issues should be considered: • Increase in surface runoff • potential for erosion • corresponding increase in downstream sedimentation • decrease in water quality	Needs Refinement. Add mention of stream channel stability.
Policy EQ-2.30 Water Impoundment Areas. Water impoundment areas should have marginal protection areas and should be protected and maintained for their water supply, as well as environmental and recreational values.	Needs Refinement. Adjust language "marginal" as it's used here could be taken to mean scant, rather than its intended meaning- as a conservation buffer.
Policy EQ-2.31 Water Quality. Water quality should be maintained or enhanced in order to promote the continued environmental health of natural waterway habitats. A Surface Runoff Pollution Control Program should be developed for the County.	Needs Refinement. Update this to reflect the current status of MCFCWCD/MCSTOPP programs and directives.
Policy EQ-2.32 Educational Uses. The use of streams and surrounding lands for education purposes should be encouraged.	Still Applicable.

Policy EQ-2.33 Streams in Development Plans. Streams which are part of lands to be developed are a resource for their aesthetic and wildlife values. Vegetated buffer areas of native plants should be included in plans in order to protect the habitat for wildlife, to preserve and focus views, and to assure public safety. Vegetated buffer areas, rather than fencing, should be utilized except where safety issues or specific environmental concerns need to be addressed.	Needs Refinement. Clarify whether this discussion pertains to just SCA blue-line streams or all streams w/ defined channels. Substitute SCA language for general "buffer" references. Also, this policy may just be redundant.
Policy EQ-2.34 Land Divisions in Stream Conservation Areas. Land divisions should be reviewed for size of parcels and property line locations relative to creeks to allow management of the creek by one property owner, to the greatest extent possible.	
Policy EQ-2.36 Floodplain Management Ordinance. The ordinance for floodplain management in compliance with regulations for the Federal Flood Control Insurance Program should continue to be implemented.	Transfer to Env. Hazards section or combine with other policies cited therein. Also, change wording of existing sentence under this heading to "The ordinance for floodplain management in compliance with regulations for the National Flood Insurance Program should continue to be implemented."
Policy EQ-2.38 Flood Control Measures. Flood control measures should retain natural features and conditions as much as possible. Compatible uses (agriculture, wildlife habitat, recreation, etc.) of flood ponding areas and seasonal floodways should be promoted.	Still Applicable.
Policy EQ-2.39 Flood Ponding Areas. Publicly controlled flood ponding areas should be retained. Ponding covenants or easements held by the Flood Control District on property should not be transferred to other properties to allow development within floodways.	Transfer to Env. Hazards section or combine with other policies therein.
Policy EQ-2.40 Alteration to Floodways, Floodplains and Ponding Areas. Filling or other physical alteration in floodways, floodplains, or ponding areas should be limited to the minimum necessary as determined in development permits issued by the County.	Transfer to Env. Hazards section or combine with other policies therein.

3. Bayfront Conservation Areas

Policy EQ-2.46 Freshwater Habitats. Freshwater habitats in the bayfront areas associated with freshwater streams and small former marshes should be preserved and/or expanded so that the circulation, distribution, and flow of the fresh water supply is facilitated.	Still Applicable.
Policy EQ-2.47 Use of Flood Barriers for Seasonal Habitat. Natural or managed flood basins should be utilized to provide seasonal habitat for waterfowl and shorebirds.	Still Applicable

Policy EQ-2.48 Transfer of Development Rights. The County shall allow the transfer of the development potential of diked historic marshlands which are restored to tidal status or enhanced as wetlands habitat to upland sites, provided that development on the upland site complies with development standards for the protection of adjacent habitat areas.	Still Applicable.
Policy EQ-2.49 Planned District Development Review with Environmental Assessment. The County shall review all proposed development within the Bayfront Conservation Zone in accordance with the planned district review procedure in order to ensure maximum possible habitat restoration and protection. An Environmental Assessment of existing environmental conditions (biologic, geologic, hazard, and aesthetic) shall be required prior to submittal of development plans.	Still applicable.
Program EQ-2.49a Environmental Assessment of Bayfront Lands. Environmental assessment (biologic, geologic, hazard, and aesthetic) of existing conditions on proposed development sites will be completed prior to preparation of master plans and development plans. These assessments will include recommendations for siting and design that will avoid adverse environmental impacts. When it is not possible to avoid impact, recommendations shall include provisions for minimizing environmental impact. The assessment should serve as a portion of the Environmental Impact Report on the project and recommendations should be incorporated into the project itself. Refer to Program 2.43a for detailed criteria to be used in formulating recommendations for siting and design.	Still Applicable.
Policy EQ-2.50 Coordination with Trustee Agencies within Bayfront Conservation Areas. The County shall facilitate consultation and coordination with the trustee agencies (Department of Fish and Game, U.S. Fish and Wildlife Service, the Corps of Engineers, EPA, Regional Water Quality Control Board, and BCDC) during environmental review and during review of other proposals for lands within the Bayfront Conservation Zone.	Still Applicable.
Program EQ-2.50a Early Consultation with Other Agencies. Any development project within the Bayfront Conservation Zone is subject to the review, and possibly the permit process, of federal and state agencies with jurisdiction over wetlands. It is critical that the applicant consult with these agencies at the very outset of a development project. The County will make every effort to coordinate its review process with the review process of other agencies, consulting with them on the environmental assessment and the master plan. The applicant will be informed at the first contact with the Community Development Agency which other agencies are likely to claim jurisdiction and what the policies and standards of those agencies are regarding development activities in the Bayfront Conservation Zone. The National Wetland Inventory Maps (NWI) will aid County staff in providing this information to applicants.	Still Applicable.

Policy EQ-2.51 Minimal Impacts Within Bayfront Conservation Zone. The County shall ensure that development in the County occurs in a manner which minimizes the impact of earth disturbance, erosion, and water pollution within the Bayfront Conservation Zone.	Needs Refinement. Add mention of impacts to freshwater and tidal wetlands.
Policy EQ-2.52 Disruption to Runoff and Stream Flow. Disruption or impediment to runoff and stream flow in the watersheds of Marin County marshes should not be permitted if an environmental assessment indicates that the quality of the water entering the marshes and bay would be diminished.	Still Applicable.
Policy EQ-2.53 Siting of Industrial Facilities. The development and siting of industrial (and any other) facilities adjacent to bayfront areas should be planned to eliminate significant adverse environmental impacts on the water quality of the bay and marshes.	Needs Refinement. Seems redundant (e.g. see Program EQ-2.49a)
Policy EQ-2.54 Tides and Currents. The development of jetties, piers, outfalls, etc., should not be allowed to alter the movement patterns of the bay's tides and currents, such that significant adverse impacts would result.	Needs Refinement. Clarify the nature of the potentially adverse impacts: e.g. increased sedimentation rates, shoreline or beach erosion.
Policy EQ-2.55 Bay Fill. The County shall discourage any bay fill that diverts and retards currents, increases the deposition of sediments, or causes erosion and pollution.	Needs Refinement. Add regulatory considerations for any bay fill, i.e. BCDC, Dept. of Army, and RWQCB permits.
Policy EQ-2.56 Waste Discharge. The County shall not permit waste discharge which would contaminate water resources or adversely affect any inter-tidal environment. Municipal discharges should move toward partial consolidation and relocation of discharge points.	Still Applicable.
Policy EQ-2.57 Basin Plan. The County Department of Public Works shall continue to cooperate with the EPA and the Regional Water Quality Control Board in implementation of the San Francisco Bay Basin Plan. This includes the preparation of a Baseline Control Program. This program will help to prevent future water quality problems and limit increases in pollutant discharge.	Needs Refinement. Update citing current water quality programs such as NPDES stormwater permitting, SWPPP review, monitoring of TMDLs et al.
Policy EQ-2.64 Land Uses in Floodplains. Areas defined as floodplain should serve the dual purpose of habitat and flood protection. Areas should be evaluated periodically to determine whether increases in the volume and rate of runoff from urbanization or natural forces warrant further flood mitigation measures.	Needs Refinement. Refer to flood policies in Hazards section and/or clarify difference between uses allowed in floodway (F-1) or floodway fringe (F-2). Also, change first sentence to read: "Areas defined as floodplain should serve the three-fold purpose of habitat, groundwater recharge and flood protection. Maximizing the extent of groundwater recharge, where applicable, increases stream base flow and improves instream habitat and water quality."

Policy EQ-2.65 100-year Floodplain. The County's regulatory procedures should reflect 100-year floodplain areas as determined by the Federal Emergency Management Agency (FEMA).	Still Applicable.
Policy EQ-2.66 Use of Shoreline Areas. Public use of the shoreline areas is desirable and should be encouraged consistent with ecological and safety considerations.	Still Applicable.

THE BUILT ENVIRONMENT

1. General Policies	
Policy EQ-3.1 Project Review Procedures. The County shall continue to implement and review specific procedures for reviewing public and private actions that significantly affect the quality of the environment throughout the county, in accordance with the characteristics of each proposed action and each potential location (see Table EQ-7).	Eliminate. (What is this policy saying?)
Policy EQ-3.2 Air, Water, and Noise Pollution. Air, water, and noise pollution shall be prevented or minimized.	Eliminate. Too general, replace with more substantive policy or eliminate.
Policy EQ-3.4 Changes to Hydrological and Biological Processes. No operation shall cause irreversible damage or more than minimum reversible change to natural hydrological and biological processes. .	Still Applicable. OK, although the language is very broad and unfocused
Policy EQ-3.7 Avoidance of Hazards from Earthquake, Erosion, Landslide, Floods, and Fires. Construction and operations shall be located and designed to avoid or minimize the hazards from earthquake, erosion, landslides, floods, fire, and accidents consistent with policies and programs in the Environmental Hazards Element.	Still Applicable.
<u>Land Uses</u>	
Policy EQ-3.21 Creekside Development. Along creeks, development must retain the natural vegetation, prevent water pollution, and minimize flood hazards from runoff (see Figure EQ-13).	Eliminate. Redundant after SCA policies above.

[1] *Water Quality Control Plan- San Francisco Bay Basin (Region 2).* California Regional Water Quality Control Board, San Francisco Bay Region. June 1995.

[2] *California Storm Water Best Management Practice Handbooks.* Stormwater Quality Task Force. March 1993.

[3] *Stormwater Management FY 2000/01- 2004/05 Action Plan: Protecting and Enhancing Marin County's Watersheds.* Marin County Stormwater Pollution Prevention Program. Prepared by EOA, Inc.,January 2001.

[4] Marin County Stormwater Pollution Prevention Program. Ibid.

[5] *The North Bay Watershed Association (NBWA).* Pamphlet prepared by the NBWA. February 2001.