



EXECUTIVE SUMMARY

CHAPTER 1: INTRODUCTION

The purpose of the Clear Lake Integrated Watershed Management Plan (CLIWMP) is to describe past and current conditions of the watershed and watershed management. This information is then used to identify opportunities to improve and/or protect the health and quality of conditions in the watershed. The goal of the CLIWMP is to plan and work toward an environmentally and economically healthy watershed that benefits the community and is sustainable for future generations. The CLIWMP provides an overall program for watershed management and identifies specific implementation actions.

The Clear Lake Watershed, with an area of about 520 square miles, is located in the California Coast Ranges, 80 miles north of San Francisco. The topography of the watershed is generally steep and rugged with elevations ranging from 1,318 - 4,840 feet above sea level. At its center lies Clear Lake, the largest, natural freshwater lake located entirely in California, with 68 square miles of surface area and an average depth of 26 feet. Clear Lake drains to the east via Cache Creek to the Sacramento River.

CHAPTER 2: WATER RESOURCES

Surface Water Quality

With a vast watershed, relatively shallow depth, and Mediterranean climate, Clear Lake's water is warm and very productive, or eutrophic, creating a paradise for fish and wildlife. Even though it is a shallow lake, Clear Lake is ancient. Lake sediment cores show that a lake has existed continually in this area for at least 450,000 years and possibly as long as 2.5 million years.

Clear Lake has been subject to nuisance algal blooms for much of the past century. It was added to the federal Clean Water Act Section 303(d) list of impaired water bodies for nutrients in 1986. Although Clear Lake water clarity improved significantly beginning in 1992, a widespread, noxious, and persistent algal bloom occurred during the summer of 2009.

Extensive research has been conducted on the factors controlling algal blooms. Researchers concluded that the source of excess nutrients comes from sediments entering the lake. Increased erosion caused by development around the lake led to significantly higher sedimentation rates in the lake beginning in about 1930. Researchers determined that the most effective method of reducing the blooms would be to reduce phosphorus inputs, which enter the lake primarily as

sediments. Iron and sulphate may also influence blue-green algal growth, and their roles need to be better understood.

Many actions have been taken to reduce sediment and nutrient inputs to Clear Lake, and others are proposed in this plan. These past and proposed management activities are discussed in the Land Use Chapter.

The Central Valley Regional Water Quality Control Board (CVRWQCB) adopted a Total Maximum Daily Load (TMDL) for nutrients in Clear Lake in 2006. The TMDL sets a chlorophyll limit, or target level¹, for Clear Lake water, and recommends a 40% reduction in phosphorus to Clear Lake in order to achieve this goal. The county contested the findings of the TMDL because there was very little chlorophyll data and the assumptions used to develop the 40% phosphorus reduction target were flawed. In addition the county finds that recent data indicate improved clarity without a corresponding decrease in phosphorus.

The Clear Lake TMDL Stakeholders Committee (CLTSC) developed a monitoring and implementation plan for the Clear Lake TMDL that was approved by the CVRWQCB in 2008. The CLTSC recommends additional limnological studies to determine what factors are controlling the lake's condition, what were lake conditions prior to European influence, and what management is needed to restore these conditions. These would be followed by a public process to evaluate the studies and establish criteria for determining when Clear Lake is no longer impaired for nutrients.

Clear Lake contains elevated levels of mercury. A 1987 health advisory by the California Department of Health Services recommends limited consumption of fish from Clear Lake. Clear Lake was placed on the Clean Water Act Section 303(d) list of impaired water bodies for mercury in 1988.

The major source of mercury to Clear Lake is the Sulphur Bank Mercury Mine (SBMM), an open pit mercury mine located on the east end of the Oaks Arm of Clear Lake. The mine opened in 1865, converted to an open pit mine in 1927, and ceased operations in 1957. It is now a United States Environmental Protection Agency (USEPA) Superfund site. Thus far clean up efforts have included a 1992 project to control direct erosion of mine tailings into the lake and a 2007-2008 project to remove contaminated mine wastes from the adjacent Elem Indian Colony.

The pit where mercury mining occurred at the SBMM is filled with acidic water that leaches through the waste rock pile and into Clear Lake. This leachate is a significant source of mercury to Clear Lake. Additional remediation of the Super Fund site will require maintaining the water level in the pit low enough to minimize groundwater flow from the impoundment to the lake, and containment of the solid mine waste.

¹ The target level is 73 µg/L of chlorophyll a, a pigment found in plants and the algae in Clear Lake.

The TMDL for Mercury in Clear Lake was approved in 2002. It sets a numeric target for fish tissue mercury levels², and specifies load allocations and required reductions. It specifies that mercury loads from the SBMM are to be reduced 95%, and those from the remainder of the watershed by 20%.

As required by the mercury TMDL, the Lake County Watershed Protection District (LCWPD) conducted studies from 2006-2008 to locate mercury hotspots in the Clear Lake Watershed and improve estimates of mercury loads from tributaries to Clear Lake. It also investigated the location of abandoned mercury mines and prospects recorded by the United States Geological Survey (USGS) in the Clear Lake Watershed. Of nine mine sites, five could not be accurately located, and two of the sites were possibly located outside of the Clear Lake Watershed. Additional investigations were not made on the SBMM and only the Utopia Mine, located on Highway 20 north of Lucerne, was monitored. Limited areas of significantly elevated mercury levels were found in Clear Lake adjacent to this mine.

Monitoring of mercury concentrations in sediments throughout the watershed found that the background mercury concentration for the Clear Lake Watershed was less than 0.1 µg/g, approximately one half of the background concentration for the Coast Ranges. Water sampling at the three gaged stream locations in the Clear Lake Watershed found somewhat lower estimates of watershed mercury loading than in previous studies.

Pesticides applied directly to Clear Lake and aquatic systems include herbicides for aquatic plant control, and insecticides to control disease vectors such as mosquitoes. Past use (1940s-1950s) of DDD to control the Clear Lake gnat led to the near collapse of the grebe population.

Numerous agencies and organizations monitor a wide range of water quality parameters both in Clear Lake and its tributaries. These agencies include the California Department of Food and Agriculture (CDFA), the California Department of Water Resources (DWR), the Lake County Farm Bureau Education Corporation, the LCWPD, the Lake County Vector Control District (LCVCD), and Big Valley Rancheria.

Surface Water Supply

Essentially all consumptive use of surface water in the Clear Lake Watershed is from Clear Lake. This use has been estimated at approximately 14,000 acre feet in 2000. Currently 19 utilities around Clear Lake serve 27,000 Lake County residents with Clear Lake water, and 17 of these purveyors purchase the water from the Yolo County Flood Control and Water Conservation District (YCFCWCD), which manages stored water in the lake.

² The target level is 0.09 and 0.19 mg methyl mercury/kg dry weight of tissue in trophic level 3 and 4 fish, respectively.

Water stored in Clear Lake is managed by YCFCWCD. At its maximum this storage can be significantly higher than total water use in the basin (41,000 acre feet). If the lake is below 3.22 feet Rumsey on May 1, Yolo County receives no water, and it receives increasing amounts up to 150,000 acre-feet when the lake is full.

The largest tributaries to Clear Lake are Scotts and Middle Creeks, entering the lake at Rodman Slough, and Kelsey Creek, entering the lake from Big Valley. The combined area of these three sub-watersheds constitutes 50% of the Clear Lake Watershed. The combined stream flow from these tributaries is estimated to be 73% of total stream flow entering the lake. In the Clear Lake Watershed, only these three creeks have permanent stream flow gages.

Lake County, in collaboration with Napa, Yolo, and Colusa Counties and the Solano Water Agency, is currently developing an Integrated Regional Water Management Plan (IRWMP) for the Cache and Putah Creek watersheds and most of the remaining area of Yolo County. The Clear Lake Watershed is at the head of the Cache Creek watershed. The IRWMP will promote a regional and integrated approach to water management.

Groundwater Quality

Most information on groundwater quality in the Clear Lake Watershed has been collected in Big Valley. In general, groundwater quality is adequate for agricultural and residential purposes. Big Valley also has localized problems with hydrothermal features that contribute high levels of iron and boron and elevated ratios of magnesium to calcium. High levels of boron are injurious to many crops. High levels of iron or hardness impart nuisance properties to drinking water such as taste, odor, staining of clothing or scale formation in plumbing fixtures. These minerals also cause clogging of irrigation systems, especially micro-irrigation systems.

DWR periodically monitors well water physical and chemical water quality parameters. Small drinking water system purveyors are regulated by the Lake County Environmental Health Division (LCEHD), and large drinking water system purveyors are regulated by the California Department of Public Health.

Groundwater Supply

The major groundwater basins in the Clear Lake Watershed are Big Valley, Scotts Valley, and Upper Lake Valley. The estimated safe yield of aquifers in Big Valley is 60,000 acre-feet, in Scotts Valley is 4,500 acre-feet, and in Upper Lake Valley is 5,000 acre-feet. Groundwater use in these three valleys was estimated to be 22-67% of the safe yield, and therefore groundwater overdraft is not currently considered to be a problem. However, groundwater shortages can occur in very dry years.

Although groundwater use may not exceed safe yield, it can lead to earlier drying of streams, thereby impacting water quality and aquatic life. In addition, groundwater storage declined as a result of stream channelization and gravel mining in the early and mid 20th Century.

Groundwater use, estimated in 2000, was 28,000 acre-feet for the Clear Lake Watershed. This is likely to have been less than historic use, when the acreage of pears was greater. It may also have declined since the time of the inventory as pear acreage has continued to decline.

Groundwater management is covered by the Big Valley and Lake County Groundwater Management Plans and by County policies and ordinances.

Watershed Education and Outreach

Water resource and watershed education and outreach programs are offered by schools, county departments, local Tribes, state and federal agencies, and local environmental groups.

Recommended Actions

Recommended water resources actions will protect ground and surface water quality, ensure a sustainable and affordable long-term water supply, develop new surface water supplies, increase groundwater recharge, and encourage water conservation. In addition, research and monitoring, interagency communication, and education programs will be continued and improved.

Recommended actions of this Clear Lake Integrated Watershed Management Plan (CLIWMP) frequently impact more than one area of resources and/or resource management and therefore apply to more than one chapter. A detailed description of each action is given in only one chapter. Table ES-1 indicates the chapter where each action is presented, and it indicates the other chapters where the action applies. Table ES-2 shows the timeframe and priorities for implementation of each action. Actions in this table were given a high or medium priority from the perspective of water resource management. Figure ES-1 summarizes many of the changes in the Clear Lake Watershed beginning in the 1870s.

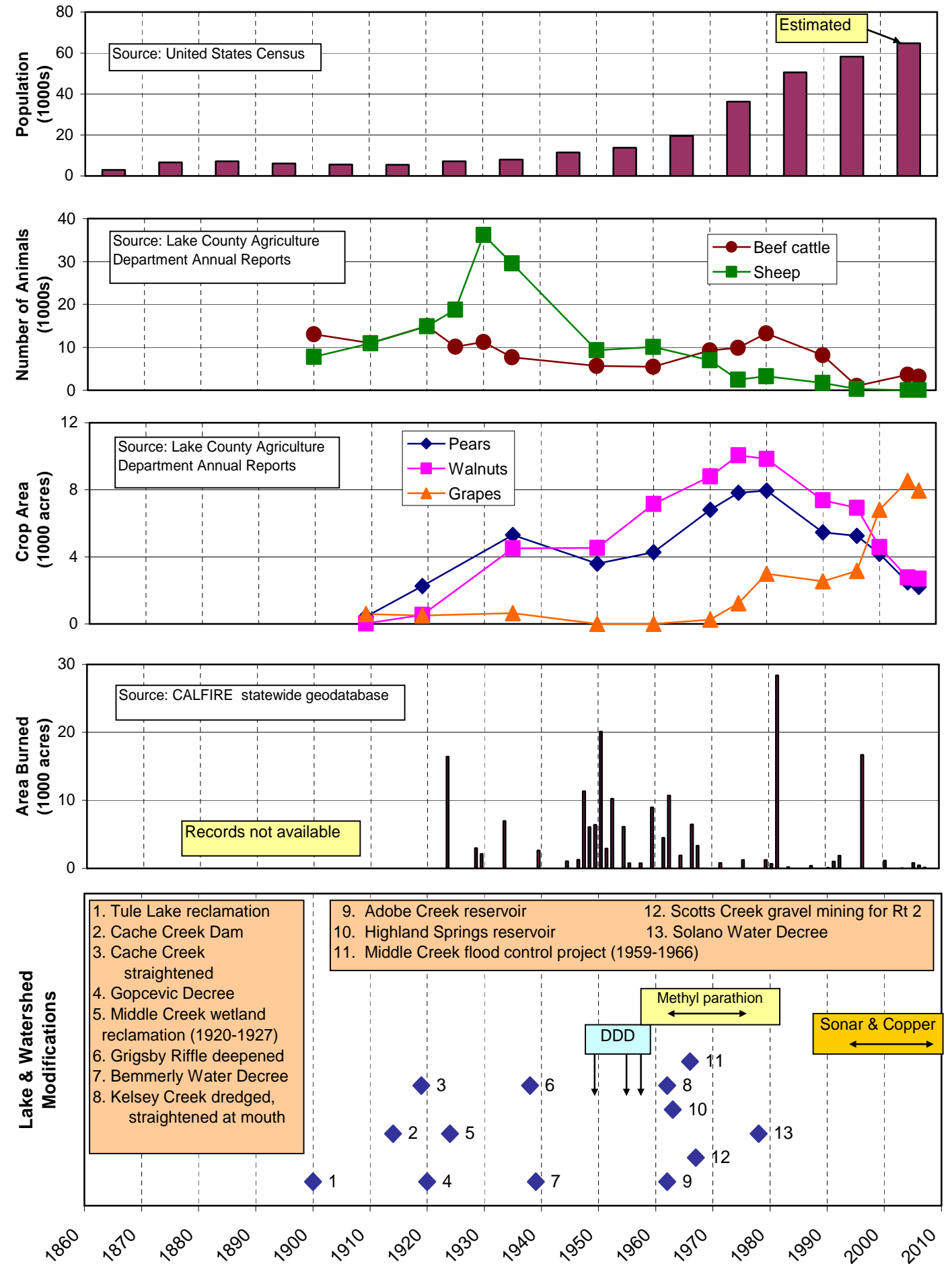
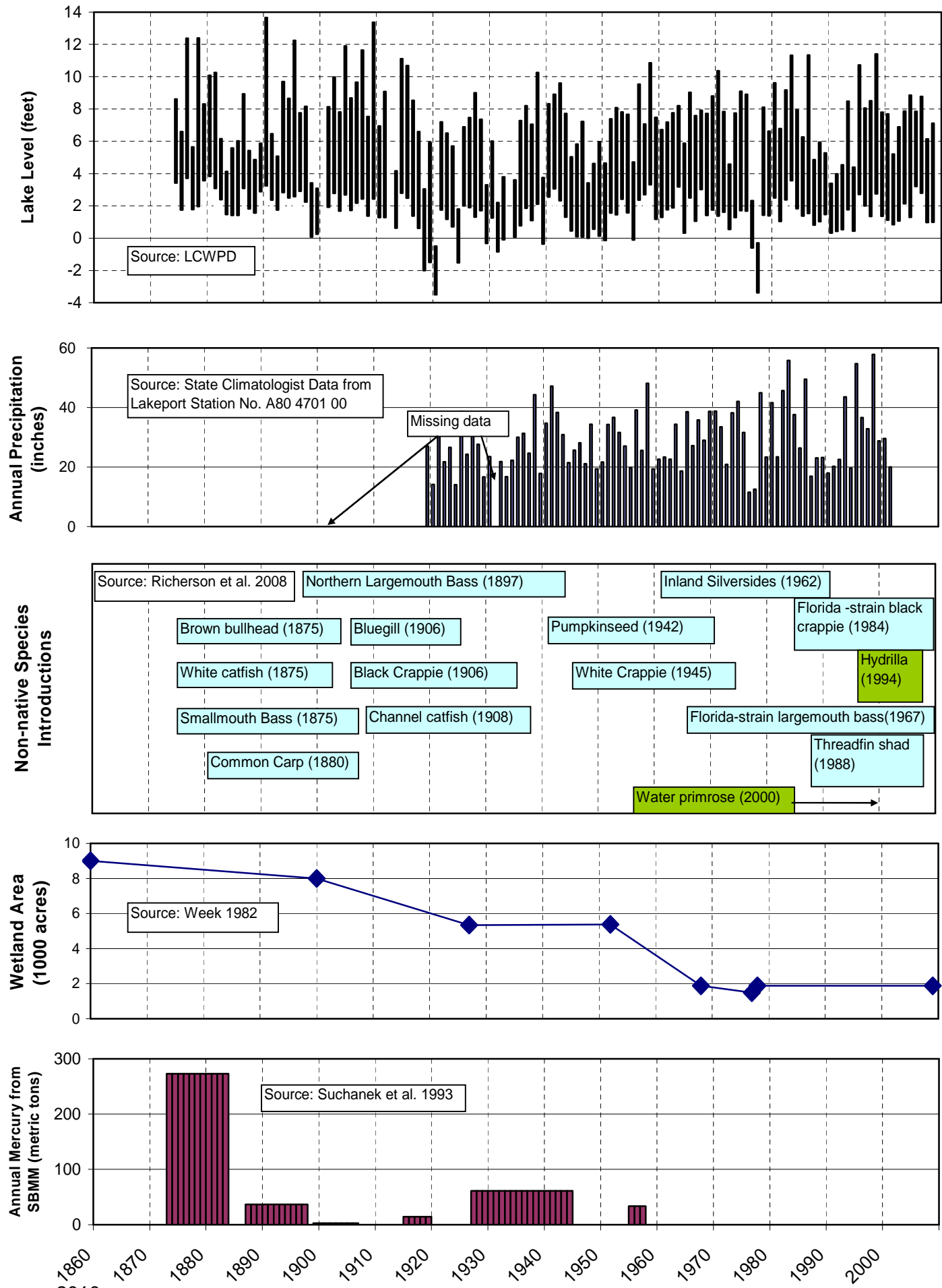


Table ES-1 Chapters where actions are described and where they are applicable.

Chapter where action is described	Chapter(s) where action is applicable							
	2. Water Resources	3. Land Use	4. Wildlife and Habitat Resources	5. Recreation and Aesthetics	6. Invasive Species	7. Floodplain Management	8. Lake Management	9. Climate Change
Chapter 2. Water Resources								
2.8.2 Complete the Middle Creek Flood Damage Reduction & Ecosystem Restoration Project	X	X	X	X		X	X	X
2.8.3 Implement Site Remediation at Sulphur Bank Mercury Mine	X		X				X	
2.8.4 Improve Understanding of Clear Lake Limnology	X						X	
2.8.5 Create a Water Resources Metadata Library	X	X				X	X	
2.8.6 Coordinate a Comprehensive Clear Lake Watershed Monitoring Program	X	X				X	X	X
2.8.7 Support and Increase Watershed Education & Outreach	X	X	X	X	X	X	X	X
2.8.8 Develop and Implement an Interagency Coordination Strategy	X	X	X	X	X	X	X	X
2.8.9 Complete the Integrated Regional Water Management Plan	X	X	X	X	X	X	X	X
2.8.10 Increase Reuse of Treated Wastewater	X	X						X
2.8.11 Increase Water Conservation	X	X						X
2.8.12 Complete the Adobe Creek Conjunctive Use Project	X	X	X					X
2.8.13 Update the Cost Benefit Analysis of the Lakeport Dam	X					X		
Chapter 3. Land Use Impacts								
3.10.2 Review and Revise County Wetland Policies and Ordinances	X	X	X			X	X	
3.10.3 Encourage Wetland Mitigation Bank Development	X	X	X					
3.10.4 Restore Stream Channel Hydrology and Associated Habitats	X	X	X			X		X
3.10.5 Fully Implement the Lake County Clean Water Program	X	X						
3.10.6 Complete the Full Circle Wastewater Reuse System	X	X						
3.10.7 Expand Wastewater Capital Improvement Programs	X	X						
3.10.8 Improve Wastewater Treatment Options for Un-Sewered Areas	X	X						
3.10.9 Expand Programs to Prevent Illegal Waste Disposal	X	X						
3.10.10 Prevent and Clean Up After Illegal Marijuana Growing	X	X	X	X				
3.10.11 Survey and Improve Road and Trail Conditions	X	X						
3.10.12 Implement the Lake County Community Wildfire Protection Plan	X	X	X					X
Chapter 4. Wildlife and Habitat Resources								
4.6.2 Research & Develop a Management Plan for Native Clear Lake Fish			X	X			X	
4.6.3 Protect and Restore Lake and Shoreline Wildlife Habitat	X		X	X			X	X
4.6.4 Improve Fish Passage in Clear Lake Tributaries			X					
4.6.5 Develop a Tree Management Plan		X	X	X				X
Chapter 5. Recreation and Aesthetics								
5.4.2 Improve Clear Lake Access and Public Amenities	X			X			X	
5.4.3 Promote a Private Boat Tow Service for Clear Lake				X			X	
5.4.4 Develop Boat Pump-out Stations Around Clear Lake	X			X			X	
5.4.5 Improve Public Access at Blue Lakes	X			X				
5.4.6 Create and Implement a Countywide Integrated Multiple Use Trails Plan				X				
5.4.7 Protect Open Space	X	X	X	X		X		X
5.4.8 Support and Expand Ecotourism Opportunities				X				
Chapter 6. Invasive Species								
6.5.2 Develop Boat Cleaning Stations around Clear Lake			X	X	X			
6.5.3 Adaptively Manage Invasive Mussel Prevention			X	X	X		X	X
6.5.4 Eradicate Hydrilla from Clear Lake			X	X	X		X	X
6.5.5 Develop an Aquatic Invasive Species Management Plan	X		X	X	X		X	X
6.5.6 Complete, Adopt & Implement a Countywide Weed Management Plan			X		X			X
Chapter 7. Lake Floodplain Management								
7.5.2 Pursue the Cache Creek Flow Enhancement Project	X					X	X	X
7.5.3 Promote Compatible Uses of the Floodplains	X	X	X	X		X	X	
7.5.4 Reduce Flood Damage in Developed Areas		X				X	X	
Chapter 8. Lake Management								
8.12.2 Update the Shoreline Ordinance (Chapter 23 Lake County Code)	X	X	X	X			X	
8.12.3 Fully Implement the Integrated Aquatic Plant Management Plan			X	X	X		X	
Chapter 9. Climate Change								
9.3.2 Minimize Greenhouse Gas Emissions	X	X	X	X	X	X	X	X

Table ES-2 Timeline and priorities for recommended actions.

Chapter where action is described	Implementation Schedule- Years																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Limited Duration Projects										Continuing Programs and Projects									
Chapter 2. Water Resources																				
2.8.2 Complete the Middle Creek Flood Damage Reduction & Ecosystem Restoration Project	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority										
2.8.3 Implement Site Remediation at Sulphur Bank Mercury Mine	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority										
2.8.4 Improve Understanding of Clear Lake Limnology	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority										
2.8.5 Create a Water Resources Metadata Library	Medium Priority	Medium Priority	Medium Priority																	
2.8.6 Develop and Coordinate a Comprehensive Clear Lake Watershed Monitoring Program	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
2.8.7 Support and Increase Watershed Education & Outreach	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
2.8.8 Develop and Implement an Interagency Coordination Strategy	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
2.8.9 Complete the Integrated Regional Water Management Plan	High Priority	High Priority																		
2.8.10 Increase Reuse of Treated Wastewater	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
2.8.11 Increase Water Conservation	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
2.8.13 Complete the Adobe Creek Conjunctive Use Project	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority										
2.8.14 Update the Cost Benefit Analysis of the Lakeport Dam										Medium Priority	Medium Priority									
Chapter 3. Land Use Impacts																				
3.10.2 Review and Revise County Wetland Policies and Ordinances	High Priority	High Priority	High Priority																	
3.10.3 Encourage Wetland Mitigation Bank Development	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority															
3.10.4 Restore Stream Channel Hydrology and Associated Habitats	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
3.10.5 Fully Implement the Lake County Clean Water Program	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
3.10.6 Complete the Full Circle Wastewater Reuse System	High Priority	High Priority	High Priority	High Priority	High Priority															
3.10.7 Expand Wastewater Capital Improvement Programs	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
3.10.8 Improve Wastewater Treatment Options for Un-Sewered Areas	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
3.10.9 Expand Programs to Prevent Illegal Waste Disposal	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
3.10.10 Prevent and Clean Up after Illegal Marijuana Growing	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
3.10.11 Survey and Improve Road and Trail Conditions	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
3.10.12 Implement the Lake County Community Wildfire Protection Plan	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
Chapter 4. Wildlife and Habitat Resources																				
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4.6.4 Improve Fish Passage in Clear Lake Tributaries	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
4.6.5 Develop a Tree Management Plan	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority										
Chapter 5. Recreation and Aesthetics																				
5.5.2 Improve Clear Lake Access and Public Amenities	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
5.5.3 Promote a Private Boat Tow Service for Clear Lake	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority															
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5.5.5 Improve Public Access at Blue Lakes						Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
5.5.6 Create and Implement a Countywide Integrated Multiple Use Trails Plan	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
5.5.7 Create a Lake County Recreation Program						Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
5.5.8 Protect Open Space	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority	High Priority
5.5.9 Support and Expand Ecotourism Opportunities	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
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	Chapter 7. Lake Floodplain Management																			
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7.5.3 Promote Compatible Uses of the Floodplains	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
7.5.4 Reduce Flood Damage in Developed Areas	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority
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Chapter 9. Climate Change																				
9.3.2 Minimize Greenhouse Gas Emissions	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority	Medium Priority

CHAPTER 3: LAND USE IMPACTS

Native American Land Use Prior to European Settlement

Native American people have lived in the Clear Lake Watershed for at least 10,000 years. They lived in balance with the ecosystem, which supported abundant fish and wildlife, and clean air and water. Fishing and hunting, and a reliance on natural materials, such as tules for boats and houses, obsidian for tools, and acorns and other plants for food, formed the basis of their economy.

Agriculture

Agriculture has been one of the major land use and economic activities in the Clear Lake Watershed since the arrival of American and European settlers in the mid 1800s. Studies of lake sediment cores have shown, however, that a significant increase in sedimentation rates began in approximately 1930 with the advent of heavy earth-moving equipment. Agricultural land use activities with potential impacts on water resources include wetland loss, floodplain encroachment and stream channelization, pesticide and fertilizer use, and groundwater use.

Wetlands have a considerable capacity to filter sediment and nutrients from influent streams, and they also provide valuable habitat for wildlife and fish. About 79% of the wetlands around Clear Lake have been lost due to reclamation for agriculture and other development.

Lake County has been pursuing the Middle Creek Flood Damage Reduction and Ecosystem Restoration Project (Middle Creek Project) since 1995. This project is located at the outlet of the two largest tributaries to Clear Lake, Scotts and Middle Creeks. The project would restore approximately 1,650 acres of land by breaching levees and allowing the land to flood. About 1,400 acres of this land would become wetlands and open water, which would double the current area of wetlands around Clear Lake.

Broad, floodplain valleys are the most suitable areas for agriculture with level land, deep soils, and readily available water. To improve agricultural efficiency and reduce flooding, streams in these valleys have been significantly modified by straightening, deepening, and levee-building. In-stream gravel mining has also contributed significantly to stream channelization.

Channelized streams have higher stream velocities that lead to increased streambank erosion and further lowering of the streambed. Lower streambeds reduce groundwater recharge as the upper limit of the groundwater table drops to the new streambed level. Loss of natural stream meanders leads to degraded habitat with reduced diversity of riparian vegetation and the loss of pool and riffle sequences that create good aquatic habitat.

Adoptions of the Creek Management Plan in 1981, and the Aggregate Resources Management Plan in 1994, have eliminated most gravel mining in Lake County streams. The Kelsey Creek Detention Structure was built in 1987 to improve groundwater recharge in the creek from Kelseyville to the location of the structure, 1.5 miles downstream. Current county policies and regulations discourage additional, non-compatible development in floodplains.

Agriculture accounts for the majority of pesticide use in Lake County. This pesticide use is heavily regulated by the California Department of Pesticide Regulation (DPR) with enforcement done by the Lake County Agriculture Department (LCAD). CVRWQCB now requires monitoring of streams in agricultural areas. As part of the Sacramento Valley Water Quality Coalition, monitoring for pesticides in the Clear Lake Watershed has been done on McGaugh Slough in Big Valley and on Middle Creek. The only exceedance found so far was for *E. coli*, a bacteria found in the gut of most animals. The source of the *E. coli* has not been determined. DPR has collected all records of pesticide sampling in wells since 1983. No pesticide contamination of groundwater has been found in Lake County based on DPR records.

The primary potential fertilizer contaminant of groundwater is nitrate. Increasing nitrate levels have been found in some areas of Big Valley. The nitrate source, whether fertilizer, livestock, or human waste, is unknown. Phosphorus fertilizer is utilized in agriculture; however, it is applied at such low rates that it is unlikely to be a significant phosphorus source to Clear Lake.

Agriculture accounts for 82% of water use in the Clear Lake Watershed and most of this comes from groundwater. Groundwater pumping for agriculture may impact fish, wildlife, and riparian vegetation due to earlier drying of streams in most years. Potential negative impacts of agricultural water use during drought years include water shortages, increased energy to pump water from deeper levels, deterioration of groundwater due to intrusion of hydrothermal waters, and ground subsidence leading to reduced groundwater storage. These drought-related impacts may be more severe in localized areas.

The Big Valley Groundwater Management Plan (1999) and the Lake County Groundwater Management Plan (2006) provide guidance on managing groundwater resources. Plan objectives include maintenance of a sustainable, high quality water supply for agricultural, environmental, and urban uses, facilitation of projects to replenish groundwater, and improved understanding of groundwater resources.

Rural Lands

Lands classified as rural lands in the Lake County General plan are generally private lands that are remote or have steep topography. Rural lands provide important watershed functions such as groundwater recharge, precipitation

collection, and filtering. Many uses of rural lands, such as residential, agricultural, wildlife habitat, and recreational uses, are covered in other sections.

Geothermal energy production occurs primarily in rural lands in an area called the Geysers in the southern portion of the Clear Lake Watershed. Over-use of the steam fields has led to declines in energy production, and Lake County and the City of Santa Rosa are now sending treated wastewater to the Geysers to maintain current levels of geothermal production. Potential water quality and watershed impacts of geothermal energy production are regulated by Lake County.

Residential and Commercial Land Use

In the past, in areas of commercial and residential development, stream channelization and levee building for flood control were common practices. This channelization along with the increase in impermeable surfaces due to building and paving, increases stormwater run-off, which leads to high stream flows during storms and reduced groundwater re-charge.

Stormwater runoff from commercial and residential areas has the potential to contribute a variety of pollutants to surface waters, including heavy metals, pesticides, and other synthetic organic compounds, oil and grease from vehicles and roads, fertilizers, sediment, and pathogens.

USEPA regulations require small Municipal Separate Storm Sewer Systems (MS4s) to acquire National Pollution Discharge Elimination System (NPDES) permits that stipulate conditions for stormwater discharges. The County of Lake, City of Clear Lake, and Lakeport fell under this requirement and have joined together as co-permittees. They developed a Storm Water Management Program (SWMP) named the Lake County Clean Water Program (LCCWP) in 2003. Due to lack of funding and high staff work loads, progress toward implementing this program has been incomplete.

Illegal waste disposal causes potential ground and surface water contamination, health hazards, unsightly conditions, and significant costs associated with prevention and clean-up. Prevention of illegal dumping relies on low-cost curbside trash pick up, free or low cost collection for other types of waste, and public education and outreach. The Lake County Community Development Department maintains an abatement process for clean-up of illegal dumpsites, and CRMP groups clean-up many local creeks. Enforcement of laws prohibiting illegal waste disposal is carried out by the Lake County Sheriff's Department. The California Department of Fish and Game (DFG) is involved in enforcement when illegal dumping occurs within 150 feet of a water body.

There are seven wastewater treatment plants that service all major and some smaller communities around Clear Lake. Wastewater collection and treatment system operators must have permits, called Waste Discharge Requirements, which specify the conditions under which they operate and prohibit discharges to

surface waters. Due to aging and inadequate infrastructure, spills sometimes occur, especially during the rainy season.

The Lake County Sanitation District (LACOSAN) has completed two phases of a project to collect treated wastewater from around the lake and inject it into the Geysers geothermal steam fields in order to reduce wastewater storage capacity issues. The system now serves the north and eastern sides of the lake from North Lakeport to Clearlake. The final phase of the pipeline, when completed, will completely encircle the lake with connections to the City of Lakeport and Kelseyville.

Many residences in the Clear Lake Watershed are served by on-site wastewater treatment systems (septic systems). As of 2006, there were approximately 12,300 of these systems in the Clear Lake Watershed. The systems are concentrated in communities surrounding the Lower and Oaks arms of Clear Lake. Septic system contamination of Clear Lake and its tributaries is possible through overflow, or through percolation into groundwater that is in connection with these surface water bodies.

LCEHD enforces an ordinance that sets design criteria for new septic systems and repairs of existing systems. LCEHD is in the process of developing an operating permit for advanced treatment systems, which require periodic maintenance to operate properly.

Public Lands

Public lands make up 24% of the Clear Lake Watershed. Major land use issues include erosion and sedimentation from roads, trails, and off-highway vehicle (OHV) use, wildfire hazard management, and illegal marijuana growing. Large, illegal marijuana growing operations occur most frequently in remote areas on public lands. They not only de-water small, headwaters streams, and therefore reduce streamflows lower in the watershed; they pollute water with contaminants such as fertilizer, pesticides, and diesel.

Erosion and Sedimentation

Erosion and sedimentation contribute excess nutrients that cause algal blooms in Clear Lake and damage aquatic habitat. While a certain level of erosion occurs naturally, land surface erosion is accelerated when vegetative cover is removed and/or soil is disturbed. Streambank erosion is increased above natural levels when stream flows are concentrated due to development and road building, or when streams are channelized, all of which lead to higher flow velocities.

Land surface erosion may occur due to agricultural tillage and livestock grazing. Walnut orchards and vineyards are the two major agricultural crops found on hillsides in the Clear Lake Watershed. Tillage in vineyards is reduced compared to walnut orchards. Therefore, the replacement of walnut orchards with vineyards in recent years has probably reduced erosion from agricultural lands. The Lake

County Grading Ordinance, updated in 2007, increases oversight of agricultural development on sloping land.

In the past, agricultural development resulted in stream channelization, which contributes to streambank erosion. Livestock also damage riparian vegetation and increase streambank erosion by heavy use of riparian areas.

Road construction and operation can be significant sources of erosion. Lake County has mapped a total of 1,500 miles of unpaved roads, trails, and firebreaks in the Clear Lake Watershed. Road and trail systems have chronic, and systemic impacts, such as concentrating water flows and transporting sediment directly from the road surface to adjacent water courses. They also have localized impacts, causing landslides or blow-outs from plugged culverts.

Modifications to roads, such as out-sloping and constructing rolling dips, disperse water flows and reduce potential sedimentation and maintenance costs. Regular maintenance also prevents potential blow-outs. Public agencies, such as the Bureau of Land Management (BLM), United States Forest Service (USFS) and Lake County, report insufficient funding to adequately maintain and improve unpaved roads. The status of roads on private lands has not been documented.

Grading during construction contributes a small (estimated 4%) proportion of sediment loads in Clear Lake, but this erosion is readily prevented by implementation of best management practices (BMPs). The updated Lake County Grading Ordinance regulates construction grading based on the size of the project, and factors such as soil type, steepness, and proximity to a watercourse. The LCCWP also contains provisions to ensure that construction and post-construction BMPs are followed. Post-construction BMPs include site and landscape design to reduce and properly channel runoff.

Fire Hazard and Management

With California's dry summers, wildfire is a natural occurrence. Wildfire affects water quality by increasing erosion and sedimentation. Fuel loading is high in much of the Clear Lake Watershed, in part due to national and state policies of fire suppression that have been in place for most of the past century.

Wildfire control in the Clear Lake Watershed is managed under cooperative agreements among the California Department of Forestry and Fire Protection (CALFIRE), resource management agencies such as BLM and USFS, and local fire districts. The recently adopted Lake County Community Wildfire Protection Program (CWPP) sets priorities for fire control projects throughout the county. Projects to establish fuel breaks along high-travel roadways and to reduce fuel loading help to prevent wildfires and subsequent damage to water quality. Prescribed fire to reduce fuel loads is carried out under cool, damp conditions, and is confined to specified areas. It therefore contributes much less to erosion and sedimentation and is a positive alternative to large-scale wildfire. Other methods for fuel load reduction include brush mowing and intensive livestock grazing.

Recommended Actions

Land use actions will protect the county's natural resources while supporting the overall economic and social growth of the county. This will be done by differentiating between urban and rural or resource areas such as floodplains, wetlands, and wildlife habitat areas. Public facilities will provide an affordable and safe water supply and adequate wastewater collection and treatment. Stormwater pollution prevention will continue to be implemented to protect ground and surface water from construction activities and urban runoff. Fuel modification and reduction programs will be implemented to reduce fire hazard conditions. Table ES-1 lists land use actions proposed in this plan, and Table ES-2 shows the timeframe for implementation of the actions.

CHAPTER 4: WILDLIFE AND WILDLIFE HABITAT RESOURCES

Clear Lake Lacustrine Habitat

Clear Lake is naturally eutrophic, or nutrient rich, and it therefore supports large algae, plant, invertebrate, and fish populations.

Currently, there are 11 native and 19 introduced fish species in Clear Lake. Populations of most of the native fish in Clear Lake are reduced compared to pre-European levels, and three native fish species once found in the lake are now presumed extinct. The introduction of sport fish, such as catfish and bass, has led to greatly improved angling opportunities that are important to the local tourist economy.

The loss of approximately 79% of the wetlands surrounding Clear Lake represents a significant habitat loss for juvenile fish and many water fowl.

Aquatic herbicide use has increased to control hydrilla and other aquatic plants. DFG studied the effects of these herbicides on aquatic organisms and determined that the potential harm to Clear Lake and the Sacramento-San Joaquin Delta from

uncontrolled hydrilla growth, far outweighed short-term damage to aquatic invertebrates.

Mercury in Clear Lake biomagnifies in the aquatic food chain, meaning that its concentration increases with each step in the food chain. Therefore, fish at higher levels in the food chain contain levels of methyl-mercury potentially dangerous to humans and birds, such as osprey and grebes, that consume the fish. Despite high mercury levels in osprey and grebes at Clear Lake, other factors limit the success of these birds. Osprey require adequate, stable nest sites and abundant food, and grebes require protection from disturbance and stable water levels during nesting.

Periodic die-offs due to disease have been observed for both birds and fish at Clear Lake. The most serious threat for birds is avian cholera. Outbreaks of this disease occur under cold winter conditions for bird species that are in close contact. Recently (2008) “koi herpes virus” led to a fish die-off that affected only carp in Clear Lake.

Activities, such as dredging and filling, that impact lakes, wetlands, and streams are regulated by the United States Army Corps of Engineers (USACE) and DFG. The United States Fish and Wildlife Service (USFWS) administers the Endangered Species Act, and DFG is the lead agency for fisheries and wildlife management in the state. The most recent DFG Fisheries Management Plan for Clear Lake dates to 2000.

Wetlands

The two major types of wetlands in the Clear Lake Basin are freshwater marshes with emergent wetland vegetation such as sedges, rushes, cattails and tules, and vernal pools, seasonally flooded depressions that occur above a hard-pan. Vernal pools alternate between flooded and very dry conditions, and therefore have an unusual plant community, adapted to these conditions.

Approximately 21% (1,920 acres) of Clear Lake’s original wetland area remains. The majority of these wetlands occur at Anderson Marsh State Park, the Rodman Slough area, the Big Valley shoreline, and the area between Clearlake Oaks and the SBMM. Only 6% of remaining wetlands exist outside these areas; however, even small and scattered wetlands provide important fish and wildlife habitat.

Vernal pools are usually located within surrounding grasslands. A total of 1,640 acres of vernal pools have been mapped in the Clear Lake Watershed, mostly on private lands.

Since 1995, Lake County has been pursuing the Middle Creek Project, which would nearly double the current area of wetlands around Clear Lake. In addition, the County Shoreline Ordinance prohibits removal of wetland vegetation on residential properties and has a lakewide, no-net-loss program of wetland vegetation for commercial, resort, or public properties.

Riparian and Riverine Habitats

Riparian habitats are found along streams and rivers and are characterized by vegetation that requires or tolerates wet conditions. Riverine habitats are the aquatic (underwater) habitats characterized by intermittent or continually running water in streams and rivers. These two habitats are discussed together in this section.

In the headwaters, or highest portions of the watershed, streams are typically smaller, with steeper gradients, and riparian vegetation may be simply an extension of the surrounding forest. Larger streams with year round flow are often excellent trout habitat, with cold water maintained from groundwater recharge. Downstream, the transitional zone is characterized by reduced stream gradients, a limited floodplain, and riparian tree species such as willow, ash, alder, and maple. Conditions in perennial streams are often suitable for trout and some warm water species. Finally, in lower portions of the watershed, broad level valleys are created by stream deposition of sediments (alluvial material). In their natural condition, stream channels meander, creating a mosaic of riparian vegetation stages. The deep alluvial soils support complex, multi-layered tree and shrub canopies that are important to a wide array of wildlife. Dominant tree species include cottonwood and valley oak. Water conditions are generally suitable for warm water fish species, and the lowest reaches of most streams dry up during the summer months.

Livestock grazing, timber harvesting, road building and operation, and OHV travel in stream channels and on stream banks damage riparian vegetation and increase erosion. Erosion and sedimentation contribute nutrients to streams that lead to excessive algal growth and biological oxygen demand. Sediment also fills in gravels that are important habitat for invertebrates at the base of the food chain, and for eggs and fry of many fish species. Stream channelization eliminates the habitat variations caused by natural stream meanders, and potentially affects the area of riparian habitat due to lowering the groundwater table.

Several native fish species spawn in the lower reaches of Clear Lake tributaries during the spring. Earlier drying of streams and barriers to fish migration have led to the apparent extinction of the Clear Lake splittail and near elimination of the pikeminnow from Clear Lake. Clear Lake hitch numbers are also much reduced compared to historic levels, and a local Coordinated Resource Management and Planning (CRMP) group, the Chi Council, is dedicated to restoring hitch populations.

Federal and state agencies, USFS, BLM and CALFIRE, managing large areas of land in the Clear Lake Watershed, have programs and policies to protect riparian areas. The Lake County Zoning Ordinance protects riparian corridors through the waterways (WW) combining district, and the Lake County Grading Ordinance

defines watercourse corridor setbacks based on the stream classification and erosion hazard rating.

Upland Habitats

In the wide, lower elevation valleys of the watershed, areas once dominated by valley oak woodlands have been largely converted to agricultural, residential, and commercial uses. Habitats on hillsides in the watershed consist primarily of blue oak and interior live oak woodlands and grasslands at lower elevations, chaparral and oak-foothill pine woodlands on slopes at middle elevations, and mixed conifer and conifer-hardwood forests at higher elevations in the watershed.

The state and federal policy of fire suppression that has been followed for most of the past century has led to an accumulation of fuels in many upland plant communities. The fuel accumulation puts vegetation, and consequently wildlife habitat, at a greater risk of catastrophic losses from wildfires. Not only are forested areas at risk, chaparral areas that have not burned for many decades lack diverse growth stages that comprise diverse wildlife habitats. These chaparral stands become too tall and tough to provide deer browse. In areas that have recently burned, stream and spring flows increase for several years, and these increased flows are important for fish and wildlife.

Wildlife habitat in forest areas has been affected by extensive logging that occurred from the late 1850s to the early 1930s in both the Kelsey and Middle Creek watersheds. In Boggs Mountain Demonstration State Forest (BMDSF) near Kelsey Creek, the forest is now a young, even-aged forest, and management objectives are to create an all-aged forest structure with more biologically diverse habitat. In Mendocino National Forest (MNF) in the Middle Creek watershed, selective removal of conifers has converted many conifer plant communities to conifer-hardwood communities.

Recommended Actions

Recommended wildlife and habitat actions will promote healthy ecosystems throughout the Clear Lake Watershed. Important fish and wildlife habitats in/around Clear Lake and in its watershed will be preserved by a combination of clustering development, limiting development in sensitive areas, and public acquisition of environmentally significant lands. Wildlife habitats identified as requiring preservation and/or restoration include wetlands, riparian areas, oak woodlands, and forests. Recommended Wildlife and Wildlife Habitat actions are listed in Table ES-1. Table ES-2 shows the timeframe for implementation of the actions.

CHAPTER 5: RECREATION AND AESTHETICS

Lake Recreation

As the largest lake in Northern California, Clear Lake is a major recreational resource for swimmers, boaters, anglers, and bird watchers, and Blue Lakes and Highland Springs Reservoir also offer lake-based recreation in the watershed.

Periodic algal blooms render swimming and other contact water sports unattractive in Clear Lake. These blooms have declined substantially since 1991, with the exception of 2009 when algae was a problem for much of the summer. Upper Blue Lake and Highland Springs Reservoir generally remain clear without significant algal blooms. Increased aquatic plant growth in Clear Lake since 1992 interferes with swimming, both as a nuisance and a potential hazard. Use of aquatic herbicides is needed to keep some public swimming areas clear for swimming.

Fishing for bass, catfish, and other fish is very popular on Clear Lake. The lake is considered the best bass fishing lake in the Western United States and hosts numerous bass fishing tournaments. The state Office of Environmental Health Hazard Assessment (OEHHA) has issued a health advisory recommending limited consumption of Clear Lake fish due to mercury contamination. Nine designated fish areas along the shores of Clear Lake limit boat speed, reduce the conflicts between speed boats and anglers, and protect fish and wildlife.

Public parks, beaches and boat ramps offer recreational opportunities around the lake. Nineteen public access points have amenities such as parking lots, boat launches, restrooms, and picnic areas. The remaining 44 public access points are unimproved parcels or streets adjacent to the lake.

Excellent wildlife viewing is found at the County Rodman Slough Park, Clear Lake State Park near Kelseyville, and Anderson Marsh State Historical Park near Lower Lake. Non-motorized boating in vessels such as canoes and kayaks is an excellent way to view the lake and wildlife, and a series of brochures for seven water trails has recently been completed for non-motorized vessels.

Motorized boating is very popular on Clear Lake. Motorized water vessels include pleasure boats, ski boats, fishing boats, pontoon or “patio” boats, and personal watercraft. Control of aquatic plant growth is necessary in many areas to allow boat passage without engine clogging and damage. Public facilities need to be upgraded to insure adequate, enjoyable, and environmentally-friendly boating opportunities.

Boating-related environmental issues include pollution due to lack of trash or sanitary waste disposal facilities and the spread of invasive species. Noise from motorized water craft can disturb residents around the lake, and noise and boat wakes have been shown to disturb grebes.

Watershed Recreation

Although most of the land in the Clear Lake Watershed remains as open space in a natural condition, much of it is privately owned. Opportunities for non-motorized trail based activities such as hiking, mountain biking, and horseback riding are found at Clear Lake State Park, Anderson Marsh State Historic Park, Highland Springs Recreation Area, BMDSF, and Cow Mountain Recreation Area. MNF also has a trail system, but all of the MNF trails in the Clear Lake Watershed are for OHV use. The Lake County Public Services Department (LCPSD) is designing a non-motorized, ridgeline trail along the North Shore of Clear Lake. The recent acquisition by Lake County of large land holdings on the top of Mt. Konocti will also provide opportunities for non-motorized trail development. LCPSD has hired a consultant to develop an integrated countywide multiple use trails plan that will catalogue currently available trails, recommend linkages between recreation areas and communities, and recommend a short term implementation strategy.

Hunting and fishing are popular activities in the Clear Lake Watershed. Deer populations are down significantly from highs in the 1940s and 1950s. This may be due to changes in land use, such as winter grazing of cattle on upland habitats, increased road kills, and a reduction in browse due to fire suppression.

The two main areas for OHV recreation in the Clear Lake Watershed are the southern portion of the BLM Cow Mountain Recreation Area, and MNF in the Middle Creek watershed. Both of these areas attract significant numbers of visitors from outside the county. OHV use on private land is also popular; however, it can be problematic due to the irritation of noise and dust to neighbors. Unauthorized OHV use on private land is a significant problem in some areas. OHV use is a potential contributor to erosion and sedimentation when trail maintenance is insufficient, when vehicles travel in stream beds and on stream banks, and when they travel off of designated trails. Both MNF and BLM discourage off-trail riding and schedule regular trail maintenance; however, funding for road and trail monitoring and maintenance has declined in recent years.

Agritourism is now attracting visitors to Lake County for farm stays, local festivals, and wine tasting. It has the potential to benefit the local economy while preserving agriculture and the open space benefits that agriculture provides.

Ecotourism is nature based tourism that has a low impact on the environment. It includes activities such as visiting parks, wildlife viewing, hiking, bicycling, horseback riding, and non-motorized boating. It usually requires little infrastructure, has less impact on the environment, and is more compatible with preserving natural ecosystems than other forms of tourism. With Clear Lake's spectacular scenery and abundant wildlife, ecotourism has the potential to be a significant attraction for out-of-county visitors.

Recommended Actions

Recommended recreation actions will ensure easy public access to Clear Lake while enhancing the recreation-based economy of Lake County. They will provide a parks, recreation, and open space system to serve Lake County residents and visitors. The integrated multiple use trails system will provide access to recreational facilities, parks, and public trail systems. Recreation actions recommended in this plan are listed in Table ES-1. Table ES-2 shows the timeframe for implementation of the actions.

CHAPTER 6: INVASIVE SPECIES

Invasive species are non-native species whose introduction could cause economic or environmental harm or pose a health hazard to humans or animals. When it comes to control or eradication, the most harmful species and those with the greatest potential to be effectively controlled are often the ones that are targeted.

Invasive aquatic plants in Clear Lake include hydrilla, water primrose and Eurasian watermilfoil. Hydrilla is an A-rated aquatic weed which fills the entire water column if allowed to grow. It was discovered in Clear Lake in 1994 and has been subject to a CDFA eradication program since then. Water primrose is damaging to the Clear Lake ecosystem because it climbs on, and out-competes, emergent vegetation such as tules. It has been subject to limited control efforts as funding has become available. Eurasian watermilfoil has not yet reached damaging populations in Clear Lake.

Invasive Quagga and Zebra Mussels could severely disrupt Clear Lake's aquatic food web and require costly maintenance to lake water intake systems and boats. To prevent introduction of these pests, the Lake County Board of Supervisors passed urgency and permanent ordinances in 2008 requiring inspection of all vessels launched in Lake County waters.

Some of the most serious terrestrial invasive species in Lake County are plants. These include riparian plants such as arundo and tamarisk. Both of these plants out-compete native riparian vegetation, and tamarisk leads to salt that excludes other non-salt tolerant plants. Since 2001, there has been a program to inventory and eradicate arundo and inventory tamarisk in Lake County. Current funding for this program is limited, although the need is still great.

West Nile virus is considered an invasive species. It is vectored by mosquitoes and presents a serious health threat to horses, humans, and many bird species. LCVCD controls mosquito populations and monitors for West Nile virus in the county.

USFWS regulates importation and transport of invasive species. In California DFG focuses on aquatic invasive species management, and CDFA is charged with preventing importation of pests and diseases and control of pests (including weeds) in the state. In Clear Lake, aquatic plants are managed under the Clear Lake Integrated Aquatic Plant Management Plan (IAPMP) adopted in 2005. A Lake County Non-native Invasive Aquatic Plant ordinance was passed in 2006 to make the possession, sale, release, gifting, or planting of nine specific non-native, invasive aquatic plants unlawful in Lake County. The recently formed Lake County Invasive Species Council is focusing on excluding Eurasian mussels from Clear Lake.

Recommended Actions

Recommended actions will strive to protect natural resources from invasive species and encourage coordination among public agencies with management responsibilities for natural areas and invasive species prevention. Specific actions are listed in Table ES-1, and their implementation timeframe is shown in Table ES-2.

CHAPTER 7: FLOODPLAIN MANAGEMENT

Clear Lake Flooding

Due to its size, Clear Lake responds slowly to storm events and rises to flood stage only after prolonged, high intensity storms. When this happens, Clear Lake's natural outlet, Cache Creek, is too small to allow floodwater to leave the lake as fast as it enters. This causes Clear Lake to rise rapidly during heavy, prolonged rainstorms, and prolongs flood levels after the rains have stopped. Cache Creek Dam is not the source of Clear Lake flooding because it releases water much faster than does the Cache Creek Channel above the dam.

Operation of Cache Creek Dam and the Cache Creek Outlet are regulated by two court decrees. The Gopcevic Decree prohibits raising the lake level above 7.56 feet on the Rumsey Gage, except during storms and floods; however, the constricted conditions on Cache Creek make it impossible to follow this decree during some flood conditions. The Gopcevic Decree also defines how the Cache Creek Dam is to be operated to achieve specified lake levels on specific dates. The Bemmerly Decree prevents widening, deepening, or enlarging the Cache Creek Outlet Channel so as to increase the flow of waters from Clear Lake into Cache Creek.

Clear Lake flooding affects over 2,500 structures around the entire perimeter of Clear Lake and can last for as long as 90 days. In addition to flooding of homes, flooding of access roads makes properties unsafe to live in and inaccessible to emergency services. Flood waters also flow into the sanitary sewer systems that serve most of the lake front areas, potentially resulting in overflows of raw and

treated wastewater into developed areas and Clear Lake. In the sewerless areas, similar contamination from septic systems occurs.

Agricultural lands, primarily at the north end of Big Valley are subject to flooding for weeks. This flooding can harm perennial crops such as wine grapes and pears if it continues into the growing season.

Levees in the Upper Lake Reclamation Area provide less than a 4-year level of protection. Most of the lands in this area are agricultural; however, 18 flood prone homes are located in this area. Also at risk of flooding are State Highway 20, the Nice-Lucerne Cutoff, and the PG&E transmission lines as they cross through the reclaimed lands.

Watershed Flooding

Channelization of tributaries and construction of levees has increased the rate of delivery of flood waters and reduced the amount of storage of floodwaters within the watershed, as described in Chapter 3. However, due to Clear Lake's large surface area, the limited outlet channel capacity, and long duration of flooding, these activities probably have negligible impact on the magnitude of Clear Lake flood events.

Management

Lake County and the Cities of Lakeport and Clearlake participate in the National Flood Insurance Program. In participating communities, property owners are eligible to purchase flood insurance for their properties. In addition, the communities must adopt and enforce building regulations that require new development and redevelopment to comply with minimum standards designed to minimize flood damage.

Lake County has actively pursued resolution to Clear Lake flooding for over 100 years. Pursuit of options to increase Cache Creek flow remains a priority. Implementation of the options will require modification of the Bemmerly and possibly the Gopcevic Decrees.

Recommended Actions

Recommended floodplain management actions will minimize impacts to the watershed, quality of life, and health and safety of the community. Floodplain development will be restricted to compatible uses. Table ES-1 lists the lake floodplain management actions recommended by this plan, and Table ES-2 shows the implementation timeframe.

CHAPTER 8: LAKE MANAGEMENT

Lake management activities related to water quality and supply, fisheries, wildlife habitat, recreation and aesthetics, invasive species, and floodplain management have been covered in previous chapters.

Lakebed Management

The Lakebed Management function of the Public Works Water Resources Division (LCLM) is responsible for managing the public trust in Clear Lake below the high water mark for the State of California. The trust is to insure that the lands will be used for general statewide interests in furtherance of commerce, navigation, fishing, recreation, and preservation of the land and waters in their natural state. Landowners have title to lands between the high and low water marks, However, this title is impressed with the public trust, and must be used in a way compatible with the public interest. The State of California owns the land below the low water mark.

As part of managing the public trust in Clear Lake, the Lake County Shoreline Ordinance defines standards for the design, location, and number of any structures to be built below the lake's high water mark, and it describes a permit process for structures, activities, and uses of the lake. Structures regulated by the ordinance include piers, docks, floats, boat ramps and launching facilities, buoys, jetties, breakwaters, marinas, harbors, and shore zone protective structures. Activities regulated by the ordinance include filling, dredging, and beach clearing. In practice, filling is no longer permitted by the USACE, and beach clearing is not permitted on residential properties. Lake uses such as jet ski races or water ski competitions also require permits.

LCLM maintains the 11 county-owned navigation lights and maintains swim buoys and swim areas at public parks. LCLM operates boats to break up and sink algal mats when necessary, supports DFG and DWR with boats when needed, and reports wildlife related incidents to DFG. The IAPMP, described in the following section is managed by LCLM.

Aquatic Plants

Aquatic plant growth increased following the increase in Clear Lake water clarity that began in the 1990s. This has created congested conditions along the shoreline that restrict swimming, boating, and other recreational activities, and LCLM activities have shifted to aquatic plant management.

The California Environmental Quality Act (CEQA) approved IAPMP was adopted in 2005 to support the continued multiple uses of Clear Lake, insure reasonable and easy lake access, and identify environmentally sound and cost effective aquatic plant management techniques for lakefront property owners. The plan also calls for avoiding adverse impacts on human health, non-target

plants and animals, and property; minimizing the potential for introduction of nonnative plant and animal species; and ensuring compliance with the CVRWQCB NPDES permit and TMDL requirements.

As part of the IAPMP, LCLM provides a single-point permitting process for aquatic weed control. Landowners must pay for a permit and hire only licensed and registered qualified applicators who apply herbicides according to government regulations. As part of the monitoring plan under the NPDES permit, LCLM monitors aquatic herbicide levels at approximately 10% of the herbicide application sites.

Vector Control

LCVCD was organized in 1948 to control both mosquitoes and the Clear Lake gnat. It also monitors numerous species of midges, which can be nuisances due to allergic reactions following exposure to the midges and due to egg masses deposited on buildings, boats, and vehicles.

In order to better understand the biology and control of the pest insects, LCVCD carries out a sampling program for a variety of organisms including planktonic algae, zooplankton, benthic organisms, and fish caught by beach seines and surface trawls. It also conducts gut content analysis of some insects and fish. LCVCD personnel monitor for mosquito larvae in water sources, including Clear Lake and adjacent wetlands, from spring through fall, and they monitor for West Nile virus which is vectored by mosquitoes.

Recommended Actions

The Lake County General Plan recognizes that “Clear Lake is the County’s single most valuable natural resource, important for its habitat, aesthetic and economic values” (LCCDD 2008). The CLIWMP is intended as a comprehensive lake management plan for Clear Lake. Recommended actions directly related to Clear Lake management are those listed in, or applicable to the Lake Management Chapter (Table ES-1). The timeframe for implementation of the actions is shown in Table ES-2.

CHAPTER 9: CLIMATE CHANGE

Trends over the past century, during which greenhouse gas emissions have risen and global temperatures have increased, may be an indication of continuing changes. Analysis of precipitation since 1920 in the Clear Lake Watershed shows a slight increase in total annual precipitation. There is also a trend for increasing variability in total annual precipitation, which indicates that drought and/or flood conditions may be increasingly common.

As part of California's efforts to predict climate change, scientists used six global climate models with two emissions scenarios to predict climate change until 2100. In general, the results predict a decrease in total rainfall and an increase in intense rainfall events. Rising temperatures are likely to increase water demand for agriculture, urban, and natural ecosystem uses.

Effects of climate change on natural ecosystems have already been observed. The range of some animal and plant species has shifted up in elevation and/or northward. Other predicted changes are increased frequency and severity of wildfires, more frequent blooms of harmful algae, and declining water quality due to warmer conditions. Vernal pool and freshwater lake species may be more susceptible to extirpation than other species because they are unable to emigrate if water quality or temperature changes affect them.

Recommended Actions

Climate change is a potential threat to Clear Lake and its watershed. Actions in this plan will assist in adapting to climate change through regional planning, increasing water conservation, improving floodplain management, and protecting habitat continuity. Projects and regulations proposed in the plan will be analyzed in order to decrease greenhouse gas emissions. Recommended actions related to climate change are listed in Table ES-1.

Reader's Guide for the CLIWMP

The list of acronyms and abbreviations used in this document is available as an 11 ½ X 17 inch fold out at the end of the document. This enables the reader to view the list while reading the rest of the document.

A glossary of technical terms is available at the end of the document.

Plates are found as 11 ½ X 17 inch fold outs following the main document.

References are indicated in the text as (Last Name of Author, Year of publication). They can then be looked up in the list of references in Appendix A. At times the author was an organization. Organizations with long names are abbreviated using the first initial of each word in the organization's name. Again they can be found alphabetically in the list of references in Appendix A.