the same time and have caused serious flooding in the lower 5 miles of stream. The creek habitats of TWWA are greatly impacted by land use patterns, from expanding demographics to resource extraction.

Management Strategy
TCRCD will support implementation of projects, studies, and public education which have direct or indirect benefits to improve creek habitat that would reduce the rapid runoff and associated flooding. Priority projects, studies, and public education include:

- Promote watershed projects that augment stream flows in the foothills by storage and retain winter flood flows to moderate the hydrograph.
- Establish baseline information on geomorphology of the streams including slope, basic channel types, extent and type of riparian vegetation, and gravel counts. Future planning and assessment strategies could include:

2.1.7 Hardwood and Conifer Forests
Forests are vital to watershed health and wildlife needs. The vast majority of the nation’s threatened and endangered species have some or part of their habitat in forests. Freshwater supplies depend greatly on forested

Oak habitat after oak harvest in Tehama West Watershed
landscapes to continue delivering fresh, clean, and abundant water.

Existing Conditions and Assessment Conclusions
For conifer forests, wildfire suppression and commercial timber management have caused changes in the composition, density, and mean tree size in the Tehama West Watersheds as well as the entire American West. The extent or degree of change has not been well-quantified because there is little data on forest stands prior to the period when fire suppression was well established.

Hardwood forests have been harvested for firewood, range improvement, and subdivision development, which has affected large acreage within the watershed and resulted in reduced habitat area. This has caused a reduction in the number of acres covered by oak species and a reduction in the amount of canopy cover of associated woodlands. There has also been concern regarding whether blue oaks are adequately regenerating to replace dying trees. Failure to regenerate may also be influenced by changes in climate since 1850.

Tehama County has produced the Tehama County Oak Woodland Management Plan to help in management of its oak resources. Guidelines presented in the 2004 Draft pertain to fuel wood and range management projects. Some specific practices include:
- Retain at least 30 percent canopy cover in a variety of sizes and species originally present;
- Educate landowners regarding the economic benefits of maintaining oaks;
- Retain old trees with hollow limbs and boles for wildlife habitat;
- Seek management assistance from U.C. Extension and other local experts;
- Protect oaks during construction and avoid summertime watering; and
- Cluster housing to preserve wildlife corridors and habitats.

Management Strategy
The TCRCD will support implementation of projects, studies, and public education which have direct or indirect benefits to hardwood and conifer forests that would maintain the benefits that healthy forests provide. Priority projects, studies, and public education include:
- Encourage voluntary education and protection programs that assist private landowners in the management of their productive oak woodlands by promoting economic studies on the value of alternative and sustainable rangeland products, such as fee hunting, ecotourism, wild herb production, and firewood production;
- Use the resources and expertise of the Tehama County Economic Development Corporation in order to promote non-traditional, low intensity business ventures within the oak woodlands of Tehama County;
- Educate county landowners on the economic benefits of maintaining and restoring oak woodlands;
- When building within the oak woodland, encourage landowners to consider the impact of development practices on the longterm management of oaks found on their property;
- Inform private landowners regarding the value of well-managed oak woodlands;
- Educate landowners about potential threats to this resource and seek
funding that supports outreach to private landowners through the Tehama County RCD, NRCS, UC cooperative Extension, Wildlife Conservation Board, and others;
• Encourage landowners to protect oak woodlands for future generations by conserving large working landscapes with significant oak woodlands;
• Recognize sites according to landscape variables (size, shape, and connectivity to other habitats such as riparian) that support rich sustainable wildlife populations;
• Establish a monitoring program to evaluate conservation efforts;
• Encourage the Hardwood Advisory Committee to conduct biennial evaluations of the County’s oak woodlands, utilizing FRAP and other appropriate data sources;
• Increase communication between land managers, ranchers, and scientists regarding the protection and management of oak woodlands;
• Encourage research on oak woodland habitats;
• Encourage studies that evaluate oak regeneration in Tehama County;
• Encourage studies that evaluate the effects of changing land uses on oak woodland’s current values (wildlife, ranching, water, economics, etc.); and
• Encourage studies that provide Tehama County ranchers the ability to manage oak woodlands in a sustainable manner.

2.1.8 Fires and Fuels
Fire has long been a natural component of California ecosystems and is a critical component of a healthy and stable system. On the other hand, catastrophic wildfires can remove all vegetation, including organic materials and seeds from the soil and can create unhealthy conditions in the watershed, generating hazardous situations for those residing within the apportioned area. Fire suppression and timber/rangeland management has created changes in species composition and density. Projects designed to reduce the threat of catastrophic wildfires are a priority for watershed stability, with projects considered through fuel reduction or vegetation management.

Existing Conditions and Assessment Conclusions
Fire frequency, and its subsequent management, has had a significant effect on the landscape of ecosystems in the Tehama West Watershed. Throughout California, including the Tehama West Watershed, early Native Americans, shepherders, and cattlemen used fire as a tool to manage natural landscapes. Since fire suppression in the 1920s, much ground that was once open is now over-dense with brush or timber.

Forests today have undergone significant changes in species composition and structure. They now contain multi-level stands with a ladder fuel structure. Fires that occur are carried into the tree crowns by the ladder fuels. Once in the tree crowns, the fires move quickly with greater intensity. In general, the trend in fire size and severity within the watershed has increased. Recognizing fire’s natural role in and effects on different vegetation types is imperative to understanding not only the different fire management practices and policies that are implemented within the watershed, but also the potential effects to the ecosystem of total fire exclusion.

The Tehama West Watershed faces the growing problem of expansion of residential development into increasingly remote and historically fire prone areas. This area is known as the urban interface areas. These areas usually fall outside the boundaries of local fire districts and in State Responsibility Areas (SRA) that are handled by
CalFire. This adds a new complication to standard wildland firefighting tactics are shifted to include the need to protect human life and property. As such, CalFire has recognized the need to educate residents in the suburban interface areas on topics such as fuel management, proper clearance around structures, and responsible, fire safe behavior during fire seasons.

Management Strategy
The TCRCD will support implementation of projects, studies, and public education which have direct or indirect benefits to management of the landscape concerning fire and fuels. Priority projects, studies, and public education include:

- Implement Tehama West Fire and Fuels Management Plan by
  - Supporting fuel treatment and forest health,
  - Reducing hazardous fuel loads within the Wildland Urban Interface,
  - Reducing fuel loads and improving wildlife habitat, and
  - Encouraging and supporting inter-boundary projects between private and public entities;
- Identify projects that result in the protection of residents and firefighters, and public and private properties;
- Public outreach; and
- Tehama County and adjoining county fire plans.

2.1.9 Wetlands and Vernal Pools
Vernal pools are seasonal wetlands found on the West Coast of the United States. These shallow depressions, ranging in size from small puddles to several acres, are covered by water for short variable periods, usually from winter to spring, and usually become completely dry at some point during the year. Wetland and vernal pool habitats provide a variety of biologically diverse areas and are habitat for numerous rare and at-risk species. They provide forage for resident waterfowl and resting places for migratory waterfowl. Wetlands also are important refuges for native California plant and animal species. An inventory of wetlands and vernal pools, including the condition of these resources, would help produce a management plan encouraging the protection of these productive sites.
Existing Conditions and Assessment Conclusions

An example of sensitive wetlands in the TWW is the hardpan vernal pool complex found in a band from Red Bluff in the north to the Glenn County line in the south. Numerous studies have been conducted on vernal pool habitats in California by The Nature Conservancy (TNC), California Department of Fish and Game (CDFG), Natural Resources Conservation Service (NRCS) and others showing that grazing can help reduce the cover of invasive non-native species. Researchers concluded that grazing should be considered a potentially positive force for the maintenance of biodiversity in some situations. On the other hand, improperly managed grazing can negatively impact vernal pools. Disturbance can include the compaction of soils, particularly when they are wet, and excessive loss of native vegetation. In planning for grazing livestock, managers should consider the effects of grazing different livestock, season of grazing, and grazing intensity.

Vernal pools provide habitat for numerous plant and animal species. Of the 28 species of threatened and endangered plants known to occur in western Tehama County, 11 species (39 percent) are known to be strongly associated with serpentine soils, 6 species (21 percent) occur only in vernal pools, and two species (7 percent) are found in marshes and other wetlands. In other words, 19 of 28 rare plant species (68 percent) exist in habitats that are represented in only a very small percent of the watershed's lands, and, in the case of wetlands and marshes, in habitats that have been greatly reduced through historical development.

Development of commercial and residential properties, roads, utilities, and other infrastructure is likely to occur in or near existing communities and along the Interstate 5 corridor. In some cases, sensitive botanical resources lie in the path of this development. These resources include riparian plant communities, oak woodlands, vernal pool landscapes, and prime agricultural lands.

The nature and intensity of the grazing that occurred in vernal pool landscapes prior to the arrival of Europeans and domesticated livestock is unknown. The threat to vernal pool landscapes from development and other changes in land use is one of the largest threats to the Tehama West Watershed.

Management Strategy

The TCRCD will support implementation of projects, studies, and public education which have direct or indirect benefits to management of the landscape concerning wetlands and vernal pools. A discussion of priority projects, studies, and public education follows:

- Policies should be developed, and practices encouraged, that preserve and protect sufficient areas of these sensitive botanical resources so that they can continue to thrive and provide ecologic diversity in the landscape.
- Policies and practices should be developed that promote and encourage the continuation of livestock ranching in a sustainable manner. This may be achieved in part by research, education, and demonstrations that provide practical examples of livestock management that build soil fertility and diverse plant communities over time.
- Landscape management plans should be developed to meet these goals and to utilize the existing conditions of non-native vegetation and...
grazing intensity that may be afforded by domestic livestock.

- Monitoring of success in meeting the landscape management goals can be used to revise and fine tune management strategies, including the timing and intensity of grazing and fire.
- Additional research should be conducted on the benefits of balanced grazing on vernal pool landscapes. Additional information on vernal pools with soils and climatic conditions similar to those found in western Tehama County would be most useful.
- Ranchers and land managers should be encouraged to develop range management plans that protect and enhance vernal pool resources. This may include educational efforts by the Tehama County Resource Conservation District, cost sharing for fencing or watering troughs from the Natural Resources Conservation Service, and other programs.
- Projects which increase capacity for wet season storage and dry season release of stored water via the hydrologic system should be encouraged.

### 2.1.10 Water Quality Monitoring

The chemical, physical, and biological health of water is important enough to be covered by federal legislation and state legislation. Human interaction with their environment can have a direct effect on water quality. Introduction of contaminants such as human waste or increased sediment loading have the greatest impact upon the water within a watershed. In order to determine the level and the trend of water quality, continued and expanded monitoring is needed in the TWW.

**Existing Conditions and Assessment Conclusions**

Demographics and land use can have a pronounced effect on water quality, not only through the addition of contaminants to surface and ground water, but also through the use and management of soil and the potential increase in sediment and nutrient loading over background levels.

California Department of Water Resources Northern District monitored nine stations on four streams within the TWW: Elder, Red Bank, Reeds, and Thomes Creeks. USGS monitored seven additional stations on three streams including Red Bank, Elder, and Thomes Creeks at different periods from 1958 to 2000.

DWR and USGS monitoring have reported analytes that have exceeded their limits on Elder, Red Bank, Reeds, and Thomes Creeks for dissolved aluminum, dissolved iron, pH, total dissolved solids, water temperature, turbidity, specific conductance, and chloride. However, overall water quality in the watershed is good. It is recommended that further expanded studies be conducted to monitor surface and groundwater quality.

**Management Strategy**

The TCRCD will support implementation of projects, studies, and public education which have direct or indirect benefits to management of water quality within the watershed. Priority projects, studies, and public education include:

- Encouraging voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations, participation in citizen monitoring program activities, and distribution of water quality “fact sheets.”
- Expansion of the TCRCD monitoring program;
- Collaborate with and support other water quality monitoring programs.