State of California
California Natural Resources Agency
Department of Fish and Wildlife

Knoxville Wildlife Area
Final Draft Land Management Plan

April 2017

Approval

Knoxville Wildlife Area Final Draft Management Plan

Prepared by: H.T. Harvey & Associates, Ecological Consultants
983 University Avenue, Suite D.
Los Gatos, CA 95032

Approved by:

Scott Wilson, Regional Manager

Date

Table of Contents

Tables

Acknowledgements

This plan is an update of a plan approved in 2005 by the California Department of Fish and Game (now the Department of Fish and Wildlife) with the support of the Department of Environmental Science and Policy, University of California Natural Reserve System, and the Information Center for the Environment at the University of California, Davis. In addition, the University of California, Davis, has conducted rare plant surveys. In producing this update, the Department also has had the support of three consulting firms: H. T. Harvey & Associates, West Yost Associates, and GrassRoots Environmental. Lastly, to support this update, a grazing plan has been developed by retired University of California Cooperative Extension Specialist Dr. Mel George.

In addition to acknowledging the assistance of these groups, the Department acknowledges the contribution of individuals who provided oral or written input during development of the initial plan and this update.

Section 1. Introduction

1.1 Purpose of Acquisition and Acquisition History

The Knoxville Wildlife Area (KWA), located in the Northern Inner Coast Ranges of California at the northeast end of Napa County, comprises approximately 20,900 acres of woodland, grassland, riparian, and chaparral habitats on serpentine and nonserpentine substrates (Appendix A, Figure 1). The California Department of Fish and Wildlife (the Department) acquired these lands through transactions in 1989, 2000, 2005, and 2008. The primary purpose of these acquisitions was to protect, restore, and manage habitat. The history and purpose of these acquisitions is described further below.

The wildlife area was first designated by the California Fish and Game Commission in 1992, and at that time it consisted of three separate parcels, totaling 93 acres, that had been donated by the Que Pasa Corporation to the Department in 1989. The purpose of their acquisition was not specified. Because of the small size, isolation, and inaccessibility of these parcels, they have not been actively managed.

In 2000, the Department acquired the 8,087 acres of the South Knoxville Ranch. This has become the northern portion of the KWA. It was purchased from Homestake Mining Company of California using funds from a combination of sources: a grant by the David and Lucille Packard Foundation to the Land Trust of Napa County, donations by the Bechtel Family Foundation and the San Francisco Foundation (Evelyn Tilden Mohrhardt Fund), an allocation by the Wildlife Conservation Board from the Habitat Conservation Fund, and a donation in land value from Homestake Mining Company (i.e., the company agreed to sell the property for less than its appraised value). The acquisition of the property was largely coordinated within the Blue Ridge–Berryessa Natural Area (BRBNA) Conservation Partnership, and was facilitated by a number of partners, including the Land Trust of Napa County, Homestake Mining Company, and the University of California (UC).

The primary purpose of acquiring the South Knoxville Ranch, as outlined in the Department's Land Acquisition Evaluation, was to protect grasslands and oak woodlands and to restore the riparian habitat of Eticuera, Foley, Long Canyon, and Knoxville Creeks. In addition, the acquisition was viewed as advancing the goals of the BRBNA Conservation Partnership, a consortium of landowners, land managers, and other parties interested in protecting the natural resources of the Putah and Cache Creek watersheds.

In 2005, the Department acquired almost all of the 12,293-acre Todd/Lauf Ranch, which now constitutes most of the southern portion of the KWA. The main purpose of this acquisition was to protect, restore, and manage the landscape of grasslands, oak woodlands, serpentine chaparral, riparian, and cliff habitats. The purchase was funded by a Resource Legacy Fund Grant from The Nature Conservancy to the Napa Land Trust, by a Land and Water Conservation Fund grant and a grant from the State Coastal Conservancy to the Wildlife Conservation Board, and by the Wildlife Conservation Board from the Habitat Conservation Fund.

In 2008, the Department acquired the 738-acre Todd Property, which represented the remainder of the Todd/Lauf Ranch. The primary purpose of this acquisition was to protect grasslands, oak woodlands, and riparian habitats of the Eticuera and Toll Canyon Creek watersheds. The purchase was funded by the Wildlife Conservation Board from the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Fund (Proposition 84). The Napa County Land Trust and The Nature Conservancy facilitated the Department's acquisition of the property.

1.2 Purpose of This Land Management Plan

The Department develops management plans for all Department-administered lands. The Department's purpose in preparing these plans is multifold:

1. The plan guides the adaptive management of habitats, species, and programs described herein to achieve the Department's mission to protect and enhance wildlife values.

2. The plan serves as a guide for appropriate public uses of the property.

3. The plan serves as a descriptive inventory of fish, wildlife, and native and nonnative plant habitats which occur on this property.

4. The plan provides an overview of the property's operation and maintenance and personnel requirements to implement management goals. It serves as a budget planning aid for annual regional budget preparation.

5. The plan provides a description of potential and actual environmental impacts and subsequent mitigation which may occur during management, and contains environmental documentation to comply with state and federal statutes and regulations.

In addition, this land management plan (LMP) has the following purpose that is specific to the KWA:

- To apply an ecosystem approach to the management of the KWA, in a manner that promotes cooperative relationships with owners and managers of adjoining private and public lands.

1.3 The Planning Process

This LMP was first published in 2005 as the result of a joint effort among the Department, the UC Davis Natural Reserve System (NRS), and the UC Davis Information Center for the Environment (ICE). The LMP's content was developed using guidance from the following four information sources or processes:

- **Policy direction.** State and federal policies and laws, including Department regulations and goals, provided a framework for developing the plan, evaluating public input, and prioritizing resource surveys and management goals.
- **Public outreach.** Members of the public were given ample opportunity to express their desires regarding management and public use of the KWA, and to receive information about the plan.
- **Integrated planning.** Coordination with other agencies and landowners maximized plan benefits for the area's ecosystem functions and habitat values, recreational opportunities, private property, and cost-effective management practices. Other landowners with whom plan development was coordinated were the U.S. Bureau of Land Management (BLM), UC NRS, the Bureau of Reclamation (Reclamation), and Gamble Ranch.
- **Science and analysis.** This LMP's content reflects knowledge gleaned from current vegetation mapping; natural and cultural resource inventories; surveys for rare plants and animals, nonnative invasive plants, and historical sites; and a review of the scientific literature covering relevant management issues. Additional surveys were conducted as part of plan development, to fill key data gaps.

1.4 Contents of This Land Management Plan

This plan is organized as follows:

- Section 2, "Property Description," describes the physical and cultural characteristics and features of the KWA, including the history of its acquisition by the Department, current and past land uses, the geological and hydrological setting, and the area's prehistoric and historical context.
- Section 3, "Habitat and Species Description," presents an inventory of plant communities and species that are found on or that may use the KWA. These include sensitive species and communities, game animals, and invasive plants.
- Section 4, "Management Goals and Environmental Impacts," defines the elements, goals, and objectives of this LMP; outlines the tasks that will be undertaken to meets these goals and objectives; and summarizes the environmental impacts expected to result from land management tasks.
- Section 5, "Operations and Maintenance Summary," summarizes the operations and maintenance tasks, personnel, and funds needed to meet the goals of this plan.
- Section 6, "Climate Change Strategies," summarizes the Department strategies and actions related to climate change that have been incorporated into the goals and tasks of this plan's elements.
- Section 7, "Future Revisions to This Plan," outlines revision procedures that may be followed to incorporate new information and make other adjustments to keep this plan current.
- Section 8, "References," lists the literature cited in this plan.

- Section 9, "Abbreviations and Terms," lists and defines the acronyms, other abbreviations, and key terms used in this plan.
- Appendix A, "Map Book," contains all the maps and other graphics cited in this LMP and its appendices, including the regional map, property map, fire history map, geology and hydrology maps, vegetation community maps, native plant and weed distribution maps, and special-status species maps.
- Appendix B, "Public Outreach Summary," provides information on the public noticing and scoping meeting that helped to inform development of this plan and the related impact analysis performed for compliance with the California Environmental Quality Act (CEQA).
- Appendix C, "Initial Study/Negative Declaration," is the CEQA document that identifies the environmental impacts that would result from adoption and implementation of this LMP and describes how impacts would be maintained at or below a less-than-significant level.
- Appendix D, "Methods and Results of Biological Surveys," reports on the most recent biological surveys of the KWA, which were conducted to inform this plan.
- Appendix E, "Mapping Updates," describes the methods used by the Department's Vegetation Classification and Mapping Program (VegCAMP) and by H. T. Harvey & Associates to update the vegetation maps of the KWA for this LMP.
- Appendix F, "Rare Plant Survey Report," discusses the results of surveys conducted in 2015 and 2016 for special-status plants in the KWA, and lists plants observed in the wildlife area.
- Appendix G, "Fauna of the Knoxville Wildlife Area," comprises lists of the birds, mammals, fish, amphibians, and reptiles documented to occur in the KWA.
- Appendix H, "Pond Evaluation, Road Crossing Evaluation, and Zim Zim Creek Evaluation," contains three technical memoranda reviewing the hydrological features of the KWA.
- Appendix I, "Grazing Plan," describes grazing management techniques that will be used to meet goals and objectives.

Section 2. Property Description

2.1 Geographical Setting

The KWA is located mostly in northeast Napa County, 1.4 miles north of Lake Berryessa (Appendix A, Figure 2), and can be found on the U.S. Geological Survey's (USGS's) Brooks, Guinda, Knoxville, and Walter Springs 7.5-minute quadrangle maps. It is situated in hilly to mountainous terrain west of the Blue Ridge, which runs from north to south and reaches elevations of more than 3,000 feet. This ridge separates the KWA from the Sacramento and Capay Valleys to the east. Within the KWA, elevations range from a low of about 750 feet to a high of 2,600 feet near the Blue Ridge.

The KWA consists mostly of a rough oblong of approximately 20,800 acres, situated just west of the Yolo County border and the Blue Ridge. (A small portion of this area overlaps Yolo County in the northeast.) Another 93 acres, composed of three isolated parcels to the west, complete the KWA. The KWA is aligned along Berryessa–Knoxville Road, the only paved, public road in the area. Berryessa–Knoxville Road connects Highway 128 in the south to the intersection of Highways 29 and 53 in Lake County, to the northwest.

From the north, Knoxville Creek flows into the center of the KWA. A few miles farther south, Knoxville Creek is joined by Foley Creek from the northeast. It is then joined by, and takes the name of, Eticuera Creek, which originates in Long Canyon to the northeast. Farther south, Zim Zim Creek flows from the northwest to join Eticuera Creek. Ultimately, Eticuera Creek empties into Lake Berryessa, south of the KWA. Thus, the KWA encompasses much of the upper watershed of Eticuera Creek.

The three isolated parcels totaling approximately 93 acres are located about 1 mile west of the remainder of the KWA at its closest point. These parcels are located near reserve lands as well as public lands administered by BLM. They also are situated approximately a mile southeast of the Mysterious Valley Airport, a private airstrip in Pope Valley. The northernmost parcel lies along Adams Creek. The westernmost parcel lies just southeast of Turner Mountain. The southernmost parcel lies about a mile east of the historical Blue Monday Mine site.

The three parcels are not easily accessible by vehicle. The road nearest the parcels is an unnamed dirt road that branches off of Devilhead Road, north of the parcels, then follows Adams Ridge and crosses Adams Creek.

2.2 Property Boundaries and Adjacent Land Uses

2.2.1 Property Boundaries and Current Land Uses

The KWA is bordered by BLM's Cache Creek Management Unit to the north and east, by the UC Davis McLaughlin Reserve to the north and west, by BLM's Knoxville Recreation Area to the west, and by a single private ranch to the southwest. Current uses on adjacent properties are primarily low-to-moderate-intensity recreation (on BLM lands), research (at the McLaughlin Reserve), and cattle grazing (on private lands).

Berryessa–Knoxville Road provides public access to the KWA at its north and south ends. Other roads on neighboring lands are summarized as follows:

- A large portion of the Cache Creek Management Unit is a wilderness study area, with few roads and no development. An unnamed BLM road passes near the north boundary of the KWA. This road, which is open only during the dry season, branches off Rayhouse Road in Yolo County, runs past Fiske Lake along the ridge between Davis and Fiske Creeks, and dead-ends just below the Blue Ridge. This road provides access to the northern end of the KWA.
- BLM's Knoxville Recreation Area is managed for off-highway vehicle (OHV) use, but most OHV trails are concentrated away from the border with the KWA.
- The UC Davis McLaughlin Reserve, located on land that was formerly part of Homestake Mining Company's McLaughlin Mine operation, is closed to public access and is primarily used for academic teaching and research in the environmental, biological, and earth sciences.

2.2.2 Historical Land Uses

Ethnography

The KWA lies near the intersection of lands that were controlled by two separate ethnographic groups at the time of European contact, the Wappo and the Patwin. The Wappo language included five dialects (Sawyer 1978), distributed across two major territorial divisions. The smaller area included lands on the southern edge of Clear Lake; the larger ranged from just north of Napa and Sonoma up to Cloverdale and Middletown. The Wappo were known to readily adopt words from other languages spoken in their vicinity and, interestingly, gave at least one village a name which is still in use, cho*nóma, meaning "abandoned camp" (Sawyer 1978).

The Wappo were generally considered to be a relatively peaceful group, culturally influenced by the groups surrounding them. The notable exception was a conflict with the Alexander Valley Pomo, who had stolen stores of Wappo acorns. The Wappo attacked the group and killed several Pomo, who then sued for peace. The result was that the Alexander Valley Pomo abandoned several villages and the Wappo expanded into the newly acquired territory. The Wappo also struggled against the Spanish. Some were drafted for labor; others went to the Sonoma Mission between 1823 and 1834. By 1850, it was estimated that no more than 500 were

left in the Napa Valley (Yount 1966). In the 1910 census of the area, 73 individuals claimed Wappo membership (Kroeber 1925).

The Wappo lived in villages usually located on a creek or other water source. Villages included one or two sweathouses as well as houses of varying size. Village chiefs might be elected or appointed based on the organization of the individual village. Some villages even had multiple chiefs, each with different spheres of influence (Sawyer 1978). Seasonal travel to Clear Lake, the Russian River, the Pacific Coast, and Napa Glass Mountain was common.

The Patwin were a series of linguistically and culturally related groups who occupied a portion of the lower Sacramento Valley west of the Sacramento River and north of Suisun Bay, and westward into Napa County. Major sources of information on these groups include the works of Bennyhoff (1977), Johnson (1978), Kroeber (1925), McKern (1922, 1923), Powers (1877), and Work (1945). Although the Patwin groups had no common name, they spoke dialects of a single historically related language.

The term *Patwin* was used by several tribelets in reference to themselves and it does not denote a political unity. The Patwin tribelets of this region spoke dialects of Southern Wintuan, a language belonging to the Penutian language family that contains other groups such as the Miwok, Maidu, Costanoan, and Yokut.

Each tribelet typically consisted of one primary and several satellite villages, with a definite sense of territoriality and autonomy. Tribelets differed from one another in cultural details and dialect, and their territories were often bounded by the limits of a small drainage (Kroeber 1932). Each village had a chief, determined by inheritance from father to son if possible, who directed village activities and enjoyed almost unrestricted decision-making powers. His primary function was that of administrator in economic and ceremonial activities.

The Patwin had three social groupings based upon familial relationships: the paternal family, the family social group, and the household (McKern 1923). The paternal family was formed by a man, his children, brothers and sisters, brother's children, and so forth. The family social groups included the paternal family along with married sisters and other women whose husbands had not yet gained independent households. Households consisted of a husband and wife, unmarried sons and daughters, and married daughters and their husbands and children.

Historically, there was a friendly trade exchange between the Patwin and neighboring tribes such as the Nisenan and Konkow to the east, the Nomlaki to the north, the Costanoan and Plains Miwok to the south, and the Yuki, Wappo, Lake Miwok, and Pomos to the west. Important items of trade included bows, obsidian, finished shell beads, whole shells, flicker headbands, red woodpecker scalp belts, cordage for netting, magnesite beads, salmon, river otter pelts, game animals, and salt (Johnson 1978). Not all relationships between the Patwin tribelets and with other tribes were friendly, however. Disputes were acted

upon in the manner of feuds; provocations for battle included poaching, the most common offense, and death attributed to poisoning.

History

Napa County developed both in the valley near the Napa River and in the mountainous terrain rising from its banks. The area's topography, geology, soil, and weather conditions made it ideal for agricultural and ranching pursuits in particular, and these features prompted relatively early European settlement of the region.

The first nonnative people to venture to the Napa Valley were Spanish explorers in search of new mission sites. Padre Jose Altimira and Don Francisco Castro arrived in the valley in 1823. The first long-term Euro-American inhabitant, however, was George C. Yount, who arrived in 1831, not long after the Spanish explorers. Yount was granted the 11,000-acre Caymus Rancho from the Mexican Government, which was patented on April 3, 1863 (Perez 1996). The earliest viticultural effort in the Napa Valley is attributed to Yount, who also later built a gristmill and sawmill.

The availability of land and the natural abundance of resources soon attracted other settlers. By the 1840s, a small community had begun to develop. It was not until 1848 that the first public building was erected: a saloon. Around this time, early settler Nathan Coombs laid out the townsite of Napa. Over the next few years, various buildings and structures, including a crude bridge across the Napa River, were erected (Wallace and Kanaga 1901).

Throughout the valley, individual communities gave way to the development of formal towns. St. Helena was founded in 1853. In 1855, Yount founded Sebastopol, which was later renamed Yountville 2 years after his death. The population in the valley gradually expanded throughout the middle years of the 19th century, and received a further economic boost from the various mining interests that were discovered throughout the county beginning in the late 1840s.

One of the earliest mineral strikes in Napa County occurred in the winter of 1848–1849 with the discovery of silver deposits. Thousands of would-be miners flocked to the Napa Valley. Gold, copper, iron, and coal were also found in the county, but it was cinnabar (mercury ore) that proved most profitable. Cinnabar was discovered in 1861, during construction of Berryessa–Knoxville Road (the first road into Lake County), at what would become Knoxville, near the northwest boundary of the KWA. Mercury was a valuable commodity in the gold fields because it was used to process gold ore from hard-rock mines.

The X.L.C.R. mine began operation at the Knoxville deposit in 1861. As it changed ownership, the mine was variously named Redington, Boston, and finally Knoxville, in honor of Ranar B. Knox, coinventor of the Knox-Osbourne mercury furnace and one of the original lessees that operated the X.L.C.R. mine.

By 1877, the Napa County Assessor estimated the value of cinnabar mining claims throughout the county at $56,575. As news spread of the deposits, people flocked to the county, invigorating the local economy, and in

some cases, leading to dramatically inflated prices for the miner's basics, such as hammers, picks, blankets, and beans (Wallace and Kanaga 1901). The presence of the mine also provided a market for produce, meat, and oak firewood to fuel furnaces that were used to drive elemental mercury out of the ore. Ore processing required a substantial supply of firewood (more than a cord of wood to fuel a single furnace for 24 hours), and the area around Knoxville is noticeably devoid of woody vegetation. It is likely that substantial oak clearing occurred throughout the KWA to support the operations at Knoxville.

By 1880, the town of Knoxville had about 300 people and 50 buildings. Two other major mercury mines operated within a few miles of the KWA. The Manhattan mine (about 1 mile west of the KWA) opened in 1869, and at least four mines (later consolidated as the Reed Mine) operated above Davis Creek (about 2 miles northwest of the KWA) in the late 1800s.

Mining success in Napa and other parts of northern California (i.e., the Gold Rush) created a great demand, not only for the staples but for wine. By 1881, there were more than 1,000 acres of vines in the vicinity of St. Helena alone. From Yountville to St. Helena, vineyards covered an estimated 6,538 acres (Ketteringham 1961). As the mining boom eventually died down, agricultural pursuits, viticulture and ranching in particular, remained profitable and set the foundation for the region's economy.

Beginning around 1927, the Gamble family began buying up homesteads within the KWA, and eventually consolidated up to 18 homesteads into the Knoxville Ranch, which included the Knoxville mine and town site. The Gambles used the ranch to run their herd of 400 cattle, and also continued to work the mine on and off. To improve their rangeland, the Gambles removed oaks from 2,000 to 4,000 acres of the Knoxville Ranch, including from some areas that were completely cleared. In 1976, George Gamble closed the mine for the last time, and several years later razed what remained of the mine and the town because of looting and squatting. The old furnaces and piles of calcine (roasted ore) were buried.

In 1981, Homestake Mining Company bought the nearby Manhattan Mine after discovering an economic gold deposit in the same geologic formation that had produced mercury ore. Homestake dug an open pit mine at the site of the Manhattan Mine, and named the new operation the McLaughlin Mine. The McLaughlin pit was adjacent to the Knoxville Ranch, and in 1992 Homestake bought the Knoxville Ranch from the Gamble family in order to expand the pit. In 2000, Homestake sold the South Knoxville Ranch to the Department (but retained the mineral rights), and kept the North Knoxville Ranch, which included a portion of the McLaughlin pit, the Knoxville Mine, and most of the Knoxville town site. Excavation at the pit ceased in 1996, and in 2002 the McLaughlin Mine was decommissioned and torn down. Also in 2002, Homestake Mining Company (by then a subsidiary of Barrick Gold Corporation) signed an agreement with UC allowing the university to manage the property as a unit within its statewide NRS. The Homestake property is currently managed by UC Davis as the McLaughlin Reserve, which serves as an outdoor laboratory for academic teaching and research.

2.3 Geology, Soils, Climate, and Hydrology

2.3.1 Geology

Geology explains much of the diversity of soils, vegetation, hydrology, and wildlife habitat that occurs in the KWA. The geologic history of the KWA can be illuminated back to the late Jurassic and Cretaceous periods (140 to 100 million years ago) when the oceanic Farallon Plate was being subducted under the western margin of the North American continent. This event was responsible for forming much of California's Coast Ranges. The Farallon Plate consisted of oceanic crust extruded from midoceanic spreading centers. As molten rock crystallized from these spreading centers, it formed an ordered series of rocks that included peridotite at the base, gabbro, and basalt at the top. This series is collectively known as the Coast Range Ophiolite. Peridotite is rich in iron and magnesium (ultramafic), and under exposure to heat and seawater, much of the peridotite in the Coast Range Ophiolite was subsequently metamorphosed into serpentine rock. As the Farallon Plate descended beneath the North American Plate, it produced a series of volcanoes, similar to the present day Cascade Range. The magma that remained beneath these volcanoes cooled slowly at depth to produce the granitic Sierra Nevada batholith. As the ancient Sierra Nevada weathered, layers of sediment were deposited in an ocean basin at the continental margin, which occurred where the Great Central Valley meets the Sierra Nevada foothills in the present day. These layers are known as the Great Valley Sequence.

Subsequently, about 30 million years ago, a remnant of the Farallon Plate (the Juan de Fuca Plate), along with another oceanic plate, the Pacific Plate, came into contact with the continental North American Plate, forming the Mendocino Triple Junction off the coast of Northern California. North of the Triple Junction (i.e., into Oregon and Washington), the Juan de Fuca Plate subducts beneath the North American Plate. South of the junction, subduction was replaced with lateral movement between the North American Plate and Pacific Plate. As the jagged edges of these two plates slid laterally, localized centers of extension and compression became centers of volcanic activity and uplift (via thrust faults), respectively. This shift to lateral movement caused the formation of the San Andreas Fault system and the uplift of the Coast Ranges, which was comprised of the rocks from the Coast Range Ophiolite along with rocks from other terranes (e.g., the Franciscan Formation), near the KWA about 5 million years ago.

The Stony Creek Fault bisects the KWA, roughly along the path of Berryessa–Knoxville Road. Although now part of the San Andreas Fault system, the Stony Creek Fault may have originated in the Cretaceous as a north-trending fault in which Great Valley sediments were thrust over Coast Range Ophiolite. As a result of the Stony Creek Fault, rocks to the east of Berryessa–Knoxville Road in the KWA are mostly sedimentary rocks (sandstones and siltstones) derived from the Great Valley Sequence, whereas those to the west are largely serpentine and peridotite derived from the Coast Range Ophiolite. Beginning roughly 2 million years ago, volcanic activity occurred along the Stony Creek Fault near the KWA. This activity created hydrothermal systems, which brought mercury and gold-depositing waters to the surface. These hydrothermal systems are responsible for the gold and mercury deposits that were found at the Knoxville, Reed, and Manhattan Mines.

Compared to most other rocks, serpentine is rich in magnesium and iron, and sometimes in nickel, cobalt, and chromium. It is poor in calcium, silica, potassium, and sodium. As a consequence, many plants are unable to grow on serpentine. Those that do often have reduced stature, and serpentine plant communities typically are sparse. Serpentine substrates also support a large number of endemic species that have evolved mechanisms to tolerate the harsh growing conditions, but frequently are unable to compete with other species when growing off of serpentine. Within the KWA, plant communities growing on serpentine have compositions and structures that are distinctly different from those of communities growing on sedimentary substrates.

2.3.2 Soils

The following descriptions of the soil series or associations found in the KWA are based on official soil surveys published by the Natural Resources Conservation Service (NRCS 2013, 2014). The soil descriptions below occasionally group similar soil series into a single narrative where the series have generally similar characteristics; otherwise brief descriptions are provided for each soil series or association occurring in the KWA, and the distribution of these soil series or associations in the KWA, including those soils that formed from serpentine rocks, is shown in Appendix A, Figure 3.

Bressa and Dibble Complex

To the east of Berryessa–Knoxville Road, soils are mostly a complex of the Bressa and Dibble series. These soils are derived from the sandstone and shale of the Great Valley Sequence and occur on moderately level (15–30%) to steep (50–75%) slopes. In a representative profile of the Bressa series, the surface layer is pale brown, slightly acid silt loam, 10 inches thick. The subsoil is light yellowish brown and yellowish brown, slightly acid and medium acid silty clay loam, 23 inches thick. Weathered, soft sandstone is found at a depth of 33 inches. In a representative profile of the Dibble series, the surface layer is pale brown and brown, slightly acid silty clay loam, 9 inches thick. The subsoil is brown and yellowish brown, slightly acid silty clay and clay, 25 inches thick. Weathered sandstone is found at a depth of 34 inches. The plant cover on these soils is mostly scattered oaks and annual grasslands.

Maymen-Millsholm-Lodo Association

Scattered throughout the KWA, the Bressa-Dibble complex gives way to the Maymen-Millsholm-Lodo association. This association consists of steep and very steep soils on hills, mainly in the northern part of Napa County bordering Yolo County and extending southward to Lake Berryessa. The Maymen soils in this association are in convex areas on north-facing slopes of mainly 30–75%. The Millsholm soils are in convex areas on south-facing slopes of mainly 50–60%, near ridge peaks. The Lodo soils are in convex areas on south-facing slopes of mainly 30–75%.

The Maymen-Millsholm-Lodo association is about 50% Maymen soils, 20% Millsholm soils, 20% Lodo soils, and 10% rock outcrop. All these soils are considered well or excessively drained and are highly prone to

erosion. They are derived from sandstone and shale of the Great Valley Sequence and support vegetation that consists primarily of chamise, manzanita, scrub oak, and small trees in protected areas.

In a representative profile of a Maymen soil, the surface layer is pale brown, medium acid gravelly loam, 6 inches thick. The subsoil is light yellowish brown, strongly acid gravelly loam, 6 inches thick. Fractured sandstone is found at a depth of 12 inches. In a representative profile of a Millsholm soil, the surface layer is pale brown, medium acid loam, 4 inches thick. The subsoil is yellowish brown, medium acid clay loam. Sandstone is found at a depth of 12 inches. In a representative profile of a Lodo soil, the surface layer is brown, neutral loam, 4 inches thick. The subsoil is brown, neutral heavy loam, 3 inches thick. Fractured sandstone is found at a depth of 7 inches.

Rock Land and Outcrops

The eastern side of the KWA gives way to rock land and outcrops at the highest points of the Blue Ridge, a primarily sandstone deposit from the Great Valley Sequence that is relatively resistant to weathering. The rock land and outcrop areas are generally well drained. Steep slopes, 15–75%, result in high levels of runoff.

Contra Costa Series and Hambright-Rock Complex

The Contra Costa series and Hambright-Rock complex both occur only in the KWA in the northwestern corner, where Zim Zim Creek flows into the wildlife area. The Contra Costa series is loamy soil with slopes of 5–15%. The Hambright-Rock complex has slopes of 2–30% in the KWA. Both soil types are well drained with medium to high runoff levels. Whereas the Contra Costa series soil is ideal for grasslands, herbaceous plants, shrubs, rangeland, and wildlife habitat, the Hambright-Rock complex is poorly suited for all but herbaceous plants or shrubs.

Diablo Series

The Diablo series is found in the northwestern corner of the KWA. It is a clayey soil that, in the KWA, occurs only on the slopes immediately south and east of the Knoxville town site. The Diablo series consists of well-drained soils formed in material weathered from sandstone and shale. The plant cover is mostly annual grasses and scattered oaks. In a representative profile, the surface layer is dark gray and very dark gray acid clay, 25 inches thick. The underlying material is calcareous clay, 35 inches thick. It is light olive brown in the upper 12 inches and light yellowish brown in the lower 23 inches. Weathered sandstone and shale are found at a depth of 60 inches.

Henneke and Montara Series

On the west side of Berryessa–Knoxville Road, soils belong mostly to the serpentine-derived Henneke and Montara series. These are shallow soils with loamy to clayey textures, little horizon development, and high gravel and rock fragment content.

Henneke soils usually support chaparral, whereas Montara soils may support grassland. In a representative profile of a Henneke soil, the surface layer is reddish brown, neutral gravelly loam, 7 inches thick. The subsoil is reddish brown, mildly alkaline, very gravelly clay loam, 8 inches thick. Fractured, greenish blue serpentine is found at a depth of 15 inches. In a representative profile of a Montara soil, the surface layer is grayish brown and dark grayish brown, mildly alkaline clay loam, underlain at a depth of 12 inches by serpentine.

Los Gatos Series

The Los Gatos series can be found in the south-central region of the KWA. Los Gatos soil in the area is mostly loam, well drained, and with slopes of 30–50% toward the series' northern extents and 50–75% in the southern portion of the KWA. The high slopes result in high runoff levels. The soils are good for herbaceous plants and shrubs.

Tehama and Yolo Series

The Tehama series, as found in the KWA, consists of silty loam soils. The Yolo series is found in stream channels throughout the south-central region of the KWA, and consists of loamy soils. Soils of the series are well drained, with slopes of 0–5%. The Yolo series in the KWA predominately comprises loam soils with low runoff, whereas Tehama soils experience moderate runoff. The level ground, high permeability, and low to moderate runoff makes the Yolo stream channels and Tehama terraces ideal for grasslands, herbaceous plants, and shrubs.

2.3.3 Climate

The KWA has a typical Mediterranean climate, with hot, dry summers and precipitation occurring as rain in the winter. The weather station nearest the KWA is at the McLaughlin Reserve, along Hunting Creek, at an elevation of 2,200 feet (WRCC 2016). Measuring from the 1985–1986 water year (October 1–September 30) through the end of the 2014–2015 water year, the 29-year annual average for precipitation was 26 inches (WRCC 2016). Annual precipitation ranged from 11 inches (1995–1996) to 38 inches (2004–2005).

According to the PRISM Climate Group, 30-year normal maximum temperatures in July average 91.0°F and minimum temperatures in July average 58.6°F (PRISM Climate Group 2016). Conversely, average maximum temperatures in January are 54.5°F and average minimum temperatures in January are around 36.9°F.

The KWA falls within Zone 8 of the California Irrigation Management Information System (CIMIS) reference evapotranspiration map (CIMIS 1999). Evapotranspiration is the total loss of water from land to the atmosphere due to both evaporation and transpiration. Zone 8 is defined as having an average annual evapotranspiration of 49.4 inches.

Climate change is affecting fire regimes in northern California, including the Northern Inner Coast Ranges where the KWA is located (see Appendix A, Figure 4, for a depiction of the area's fire history). The warmer, drier, windier conditions associated with climate change cause more intense, faster-spreading fires, which are

more difficult to control and thus may reach larger sizes (Fried et al. 2004). These changes in fire behavior and control result in shorter intervals between fires and greater tree mortality from fire injuries, particularly when combined with drought stress (Van Mantgem et al. 2013). Thus, changes in fire regime can contribute to significant changes in vegetation structure, composition, and carbon storage (Enright et al. 2015).

Climate change also may be affecting the seasonal availability of soil water to plants, groundwater recharge, and the size and duration of spring–summer streamflows. From spring through fall, in the Northern Inner Coast Ranges where the KWA is located, there is a climatic water deficit. The potential for evapotranspiration exceeds precipitation enough for plants to deplete water stored in the soil, limiting plant growth and actual evapotranspiration. Climate change is increasing this water deficit in the Northern Inner Coast Ranges by increasing temperatures (and thus the potential for evapotranspiration) without a corresponding increase in precipitation, particularly in spring (Thorne et al. 2015, Micheli et al. 2012). Groundwater recharge also may diminish (Thorne et al. 2015), and a tendency for somewhat less, not more, spring precipitation has been predicted (Pierce et al. 2013). These changes could result in diminished spring–summer streamflows at the KWA. However, the ongoing changes to annual and seasonal precipitation are more uncertain than for temperature (Micheli et al. 2012, Thorne et al. 2015), in part because of the high variability in precipitation from year to year in northern California (Pierce et al. 2013).

2.3.4 Hydrology and Water Quality

Much of the KWA overlaps the watershed for Eticuera Creek and its tributaries, which in turn is within the greater Putah Creek watershed. Eticuera Creek originates in Long Canyon in the upper half of the wildlife area, and runs southward out to Berryessa–Knoxville Road. There, it is joined by Knoxville Creek and Foley Creek. Knoxville Creek is largely intermittent, with most stretches experiencing periods of zero flow in late summer. The stretch of Knoxville Creek in Township 11 North, Range 4 West, Section 16 may maintain a low level of flow year-round because of input from nearby springs in serpentine substrates. Outcrops of serpentine characteristically contain springs and seeps, many of which have year-round flow. Farther south, Eticuera Creek is joined by Zim Zim Creek from the west. The flows of Eticuera and Zim Zim Creeks are supplemented by runoff and spring flows via numerous tributaries that run through the KWA. The southwest area of the KWA is characterized by flows from Nevada Creek and its tributaries. The confluence of Nevada Creek and Eticuera Creek is south and west of the KWA.

Aside from these streams, more than 60 impoundments have been constructed by ranchers in the KWA for watering livestock. Most of the reservoirs produced by these impoundments are small and seasonally dry. When it owned the northern part of the KWA, Homestake Mining Company obtained the water rights for three of these reservoirs, with a total volume of 1.7 acre-feet. These rights were transferred to the Department along with ownership of the Homestake Mining property. Figure 5 in Appendix A shows the locations of streams and water impoundments in the KWA.

Water quality of the upper Knoxville Creek watershed was characterized by D'Appolonia Consulting Engineers in the early 1980s as part of the environmental review process for permitting the McLaughlin Mine. The hydrology of the Knoxville drainage is dominated by steep terrain and thin and poorly porous soils. The limited catchment area of the Knoxville drainage is reflected in the total suspended solids load of the stream; a heavy rainfall/runoff prompts an increase of total dissolved solids (more soil exposed to prolonged leaching). Low flow periods or stagnation reduce the total suspended solids load considerably.

The water quality of Knoxville Creek is affected by the complex geology of the drainage system as well as by the past operation of mercury mines (Manhattan and Knoxville) in the watershed. The chemistry of the surface water reflects the surrounding geology: high content of sodium and magnesium salts derives from serpentine in the watershed, and high concentrations of sodium, chloride, fluoride, arsenic, boron, manganese, and mercury arise from leaching of hydrothermal deposits. These natural inputs have undoubtedly been exacerbated by the operation of the Manhattan and Knoxville Mines, which exposed freshly extracted rock to accelerated leaching.

With the construction of the McLaughlin Mine in the early 1980s, any sediment or water input to Knoxville Creek from the Manhattan Mine ceased. Homestake Mining Company installed a pump-back system to contain any runoff from the McLaughlin Mine before it could enter Knoxville Creek. In 1999, Homestake built a similar system to contain any runoff from the historical Knoxville Mine.

Water quality in Knoxville Creek has been monitored at least annually since 1982 by Homestake Mining Company at a site (KC 3) on the McLaughlin Reserve, upstream of the KWA. This site is downstream of the McLaughlin Mine, but upstream of the Knoxville Mine site. Monitoring data show no obvious trends in any of the measured parameters (alkalinity/hardness, total dissolved solids/specific conductance, chloride, ammonia, sulfate, arsenic, boron, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, zinc, flow/total suspended solids).

2.4 Cultural Features

As described under Section 2.2.2, "Historical Land Uses," the KWA has been used for thousands of years, first by Native American antecedents to the Wappo and Patwin in the region today, then by settlers, miners, and ranchers. The following sections provide detail on the cultural artifacts associated with periods of prehistory and history in the KWA region, and summarize the cultural features known to be located in the KWA.

2.4.1 Prehistory

In the early 1970s, Fredrickson (1973, 1974) proposed a sequence of cultural patterns for the central districts of the Northern Coast Ranges. Below is a summary of these temporal periods, with descriptions of the associated cultural patterns that have been identified for the KWA region. The summaries incorporate recent taxonomic and interpretative revisions that are summarized from the work of White and Frederickson (1992).

Paleo-Indian Period (10,000 B.C. to 6,000 B.C.)

This period saw the first demonstrated entry and spread of humans into California, with most known sites situated along lakeshores. A developed milling tool technology may have been present, although evidence regarding this technology is scarce. The Post Pattern represents the earliest known occupation of the Northern Coast Ranges. This pattern is documented only at the Borax Lake site, and perhaps at the Mostin site (Moratto 1984). Characteristic artifacts noted in the lithic assemblages include fluted projectile points and flaked crescents.

Lower Archaic Period (6,000 B.C. to 3,000 B.C.)

The beginning of this period coincided with the middle Holocene climatic shift to more arid conditions, which dried up of pluvial lakes. Human subsistence appears to have been focused more on plant foods, although hunting provided important food and raw materials. Settlement appeared to be semisedentary. Most tools were manufactured of local materials, and exchange with other regions occurred on an ad hoc basis. Distinctive artifact types include large projectile points, milling slabs, and handstones. The Lower Archaic Borax Lake Pattern has been identified for this period in the Northern Coast Ranges. The Borax Lake Aspect, identified in the Clear Lake Basin, is the southernmost of three identified cultural divisions of this pattern. The most distinctive typological feature associated with the Borax Lake Aspect is wide-stemmed projectile points.

Middle Archaic Period (3,000 B.C. to 1,000 B.C.)

This period started at the end of mid-Holocene climatic conditions, when weather patterns became similar to present-day conditions. Discernable cultural changes likely reflect these changes in climate and accompanying variation in floral and faunal resources. Economic systems were more diverse and likely included acorn processing technology. Hunting remained an important source of food and raw materials, but reliance on plant foods appears to have dominated the subsistence system. There was an overall growth in population and expansion in land use. Artifacts characteristic of this period include the bowl mortar and pestle and large projectile points.

The earliest archaeological assemblages identified in the Napa Valley are distinguished by stylistically unique obsidian drills, keeled obsidian tools, concave-based projectile points, and thick lanceolate projectile points. The milling assemblage exclusively comprises milling slabs and handstones (White and Frederickson 1992, Bennyhoff 1994).

Upper Archaic Period (1,000 B.C. to A.D. 500)

A marked expansion of sociopolitical complexity marked this period, and there was a greater complexity of trade systems, with evidence for regular, sustained exchanges between groups. Shell beads gained in significance as possible indicators of personal status and as important trade items. This period retained large

projectile points in different forms, but the milling stone and handstone were replaced throughout most of California by the bowl mortar and pestle.

Emergent Period (A.D. 500 to 1,800)

This period is distinguished by the advent of several technological and social changes. The bow and arrow were introduced, ultimately replacing the atlatl. The exchange of goods between groups became more regular, with more raw materials and finished products entering the exchange networks. In the latter portion of this period (A.D. 1,500 to 1,800), exchange relations became highly regular and sophisticated. The clamshell disk bead became a monetary unit of exchange, and increasing quantities of goods were transported over greater distances.

During this period, the Augustine Pattern became the predominant economic/cultural manifestation in the Central Valley, Bay Area, and southern Northern Coast Ranges. Cultural traits that distinguish this pattern include preinterment grave-pit burning, tightly flexed burials, and cremation. Artifact assemblages include clam and *Olivella* shell disk beads, magnesite cylinders, and banjo-type *Haliotis* ornaments, as well as bird bone whistles and tubes and flanged steatite pipes. The mortar and pestle were the predominant milling implements, and small arrow points replaced the larger projectile point forms more commonly associated with atlatls. Also found in the tool assemblages are implements such as harpoons, bone fish hooks, and gorge hooks.

2.4.2 History

The historical period began around the mid-1800s, after Spanish missionaries first arrived in Napa Valley. As detailed under Section 2.2.2, "Historical Land Uses," the KWA region has supported farming, ranching, mining, and development of settlements and towns. Since early on, viticulture has been an important component of the local economy and land use. Artifacts of the historical period typically include the foundations and chimneys of homes and other buildings and the remains of bridges, roads, mining debris and equipment, and features such as fences, windmills, and ponds.

Known Cultural Resources in the KWA

Information on the cultural resources of the KWA was developed from a variety of sources, including the Northwest Information Center (NWIC) of the California Historical Resources Information System, the data collected by the Department, and interviews with former landowners.

There have been many cultural resource surveys of the KWA and surrounding regions. Formal archaeological surveys of the area have included Alan Bramlette's 1979 *An Archaeological Investigation of a Portion of Fryer Ranch along Eticuera Creek, Napa County, California*; Charles Whatford's October 2004 study, *Rumsey Incident, CA-LNU-007867, Cultural Resources Narrative*; and GrassRoots archaeologist Charlane Gross's (M.A., Registered Professional Archaeologist) June 2015 survey for the Department's Grassland Restoration Project. Generally, past archaeological surveys have focused on accessible locations, such as areas along KWA roads and on the

banks of Eticuera Creek. Since 1853, historical maps have depicted a road along what is now the alignment of the Berryessa–Knoxville Road. Unsurprisingly, the pattern that has emerged from surveys is that historical resources are found mostly near this and other roads. Prehistorical resources have been found mainly near Eticuera Creek.

Known cultural resource locations are limited to sites documented by the formal archaeological surveys, plus the sites identified by George Gamble and Wilton Fryer, representatives of the two ranching families that recently owned the bulk of the KWA. Interviews with these representatives produced information on multiple cultural resource locations that were discovered as the families ranched the land.

The known sites that have been identified in the KWA through surveys and interviews can be characterized as follows:

- a few dozen prehistoric lithic scatters, prehistoric sites with habitation debris, and isolated prehistoric artifacts, such as mortars;
- numerous sites containing ranching and farming infrastructure, such as fence posts, windmills, pump houses, wells, roads, barns, and ponds;
- the remains of several home sites, cabins, and other buildings;
- the remains of bridges and associated structures;
- a grave site and a cemetery;
- the Knoxville town site;
- two school sites;
- a few named roads, plus a stage stop and a toll house;
- mining features; and
- a fossil locale.

Much of the KWA has not been surveyed, and is highly likely to contain additional historical and prehistorical sites and resources. The locations of as-yet undiscovered resources throughout the area are likely to follow a pattern similar to that identified for the known resources, with historical sites located near transportation routes and prehistoric sites located near water. Historical resources are more readily discovered because they commonly have visible, aboveground components. Other resources typically are located below ground or are obscured by vegetation, so far more are likely to be present than have been located and documented. Additionally, more focused surveys or changing conditions in the KWA could reveal resources that were not detected during previous large-scale surveys.

Section 3. Habitat and Species Descriptions

This section describes in detail the biological resources present in the KWA. Section 3.1 discusses the vegetation communities in the wildlife area, with reference to the broad ecosystem types for which goals are set forth in Section 4. Also in Section 3.1 is a descriptive list of native, perennial grasses that occur in the KWA along with the invasive plant species that threaten ecosystem functions in the wildlife area. Section 3.2 briefly discusses the common wildlife species that use the KWA. Section 3.3 focuses on the special-status plant and animal species that are known to occur in the KWA.

3.1 Vegetation and Plants

3.1.1 Vegetation Communities

To support development of this LMP, vegetation community maps were updated by the Department's Vegetation Classification and Mapping Program (VegCAMP), then further revised to reflect current conditions in the KWA. A full description of the methods used in mapping the wildlife area's vegetation communities is provided in Appendix E. Note that, because of limitations associated with the mapping methods, the acreages of some plant communities that are difficult to identify on aerial photography (such as small, isolated wetlands or perennial grass–dominated stands) may be underestimated. The vegetation maps themselves are provided in Appendix A.

The vegetation communities of the KWA are described in the following sections using the nomenclature of the current Manual of California Vegetation (MCV) (Sawyer et al. 2009). The MCV defines a hierarchy of classes that capture distinctions among communities at different scales. The more broadly defined classes, *groups* and *macrogroups*, are regional categories—Californian chaparral is an example of a macrogroup. *Alliances* are more focused, and better distinguish among communities within a region in terms of species composition and diagnostic species. *Associations* are even more locally useful because they describe narrower categories, with multiple diagnostic species that help differentiate communities from one another on a local scale (Sawyer et al. 2009). In this section, associations and alliances are the most frequently used terms, and groups are used mainly to organize these classes.

Each of the KWA's many vegetation communities corresponds to one of the four ecosystem types used in this LMP to guide management of the KWA: riparian and aquatic, grassland and woodland, chaparral, and serpentine soil ecosystems. The characteristics of each of these four ecosystems, including those of the corresponding MCV groups, alliances, and associations found in the KWA, are described below.

Riparian and Aquatic Ecosystems (Nonserpentine)

Riparian and aquatic ecosystems in the KWA include seeps and springs, creeks with seasonal to limited year-round flow, ponds that were created throughout the wildlife area to be sources of water for livestock and

wildlife, and the wetlands, woodland, and scrub that borders these aquatic systems. Although this ecosystem occupies less than 1% of the KWA, it provides important wildlife habitat values and supports numerous species of migratory birds and special-status amphibians and reptiles, such as the foothill yellow-legged frog (*Rana boylii*) and western pond turtle (*Actinemys marmorata*). Riparian areas and ponds also provide important sources of water for wildlife. Additionally, because they are preferred areas for cattle to congregate (particularly from late spring into early fall), protection of these features is an important consideration in livestock management.

The dominant vegetation alliances and associations in riparian areas are a function of disturbance frequency and intensity (e.g., flooding, scour) and soil moisture. Areas with more frequent disturbance and soils that are at least periodically saturated support species like arroyo willow (*Salix lasiolepis*) and red willow (*S. laevigata*), whereas higher stream terraces, above the active stream channel, are dominated by valley oaks (*Quercus lobata*) occasionally intermixed with arroyo willow. Invasive species like tamarisk (*Tamarix* spp.) also may occur in riparian areas in the KWA. Although usually too small to be mapped as distinct vegetation stands, pond margins and limited areas of active stream channels also support emergent macrophytes, including creeping spikerush (*Eleocharis macrostachya*) and other marsh- or seep-associated plants like cattails (*Typha* spp.), tules (*Schenoplectus* spp.), various wetland grasses (including invasive species like dallisgrass [*Paspalum dilatatum*] and Harding grass [*Phalaris aquatica*]), and, on occasion, the invasive perennial pepperweed (*Lepidium latifolium*).

The acreages of the vegetation groups, alliances, and associations found in riparian and aquatic ecosystems (nonserpentine) in the KWA are shown in Table 3-1 (their distributions are mapped in Appendix A, Figure 7). More detailed descriptions of the species that occur in these vegetation alliances and associations can be found in the MCV (Sawyer et al. 2009).

Table 3-1. Communities of Riparian and Aquatic (Nonserpentine) Ecosystems in the Knoxville Wildlife Area

Vegetation Community Class		Acres
California broadleaf forest and woodland group		
Quercus lobata–Salix lasiolepis association		63
	Subtotal	63
Californian warm temperate marsh/seep group		
Californian warm temperate marsh/seep group		1
	Subtotal	1
Californian mixed annual/perennial freshwater vernal pool/swale/plain bottomland group		
Eleocharis macrostachya alliance		<1
	Subtotal	<1
Lacustrine and riverine (open water)		
Lacustrine and riverine		24
	Subtotal	24

Vegetation Community Class		Acres
Southwestern North American riparian evergreen and deciduous woodland group		
Salix laevigata alliance		7
	Subtotal	7
Southwestern North American riparian/wash scrub group		
Southwestern North American riparian/wash scrub group		9
Salix lasiolepis alliance		1
	Subtotal	10
Total nonserpentine aquatic and riparian ecosystems		**107**

Grassland and Woodland Ecosystems (Nonserpentine)

Grasslands and woodlands (on nonserpentine soils) are characterized by a variable overstory of trees, typically oaks or occasionally California buckeye (*Aesculus caifornica*) or California bay (*Umbellularia californica*), and an understory dominated by herbaceous species, many of which are nonnative, annual species.

These ecosystems dominate roughly 64% of the KWA. They occur as several distinct vegetation groups distinguished by the prevalence of native, perennial herbaceous species (versus nonnative, annual species) and by the cover and composition of tree species. Biotic and abiotic factors—including disturbance history and prior land use (e.g., livestock grazing frequency and intensity, agricultural use), fire history, soil characteristics, and slope aspect—determine the specific mix of native versus nonnative species, perennial versus annual species, and tree species composition in any given stand of vegetation. In herbaceous vegetation stands dominated by annual species, or in woodland understories where herbaceous annual species are common, the specific expression of dominant and codominant annual species in a given year primarily depends on the amount and timing of precipitation, and secondarily on the amount of residual biomass (or residual dry matter [RDM]) present before the start of the rainy season (Jackson and Bartolome 2002).

The two most common herbaceous vegetation groups mapped in the KWA are California annual forb/grass vegetation and Mediterranean California naturalized annual and perennial grassland (Table 3-2). Most stands of these groups are dominated by a variable mix of native and nonnative annual grasses, annual forbs, and perennial geophytes in genera such as *Bromus*, *Avena*, *Trifolium*, *Festuca*, *Plagiobothrys*, *Lasthenia*, *Lupinus*, *Eschscholzia*, *Clarkia*, *Brodiaea*, *Elymus*, *Erodium*, and numerous others. Native, perennial grasses in genera such as *Elymus*, *Stipa*, *Poa*, *Festuca*, and *Melica*, also may occur as scattered individual plants throughout these vegetation stands, and in some stands the invasive grasses Medusa head (*Elymus caput-medusae*) or barbed goatgrass (*Aegilops triuncialis*) may be community dominants. Delineation of specific alliances or associations from aerial photography often is not possible, and, in any event, distinct vegetation alliances and associations often do not reliably occur from year to year because California's highly variable weather patterns are the primary driver of plant community composition. In the KWA, only seminatural stands dominated by yellow star-thistle (*Centaurea solstitialis*) and alliances dominated by purple needlegrass (*Stipa pulchra*, the state grass of California) were delineated as more specific stands of herbaceous vegetation. Stands of yellow star-thistle, an

invasive species, are particularly noteworthy because active management (e.g., prescribed fire, targeted livestock grazing, or herbicides, coupled with seeding of native species) is required to convert these stands back to more typical California annual and perennial grassland.

Tree-dominated vegetation stands were mapped as the California broadleaf forest and woodland group, along with numerous affiliated vegetation alliances and associations. In the KWA, and in other foothill areas surrounding California's Central Valley, various species of oaks (*Quercus* spp.) are the dominant woodland tree—at the KWA, five of California's eight species of tree oaks were mapped as community dominants. Blue oak (*Q. douglasii*) and interior live oak (*Q. wislizeni*) are the most common species, with blue oaks commonly found in pure stands as open savanna or woodland with an herbaceous understory, and interior live oak occurring in mixed stands with various species of shrubs or foothill pine (*Pinus sabiniana*) occurring as codominant species. Soil depth and fertility typically determine whether stands are dominated by blue oak or interior live oak, with blue oak often more common in areas of shallow, rocky soils that are relatively less fertile compared to sites where alliances and associations of interior live oak are found. Along stream terraces with deeper, alluvial soils, valley oaks occur in savannas with an herbaceous understory. Coast live oaks (*Q. agrifolia*) grow in cooler areas, such as on northwest-facing slopes, in canyons, and in places with a relatively stronger marine air influence. Black oaks (*Q. kellogii*) grow in the coldest areas of the KWA, typically at higher elevations and on north-facing slopes, and on deeper, more fertile soils. California buckeye and California bay were the only non-oak tree alliances or associations mapped at the KWA. California buckeye often is found on hillslopes where it can intergrade with chaparral, and California bay generally occurs in mesic locations on north-facing slopes or in canyon bottoms.

The acreages of these vegetation groups, alliances, and associations are shown in Table 3-2, and their distributions are mapped in Appendix A, Figure 7. More detailed descriptions of the species in these vegetation alliances and associations can be found in the MCV (Sawyer et al. 2009).

Table 3-2. Communities of Grassland and Woodland (Nonserpentine) Ecosystems in the Knoxville Wildlife Area

Vegetation Community Class		Acres
California annual and perennial grassland macrogroup		
California annual and perennial grassland macrogroup		2
	Subtotal	2
California annual forb/grass vegetation group		
California annual forb/grass vegetation group		2,196
	Subtotal	2,196
Western dry upland perennial grassland group		
Western dry upland perennial grassland group		4
	Subtotal	4

Vegetation Community Class		Acres
Mediterranean California naturalized annual and perennial grassland group		
Mediterranean California naturalized annual and perennial grassland group		770
Stipa (Nassella) pulchra alliance		3
Centaurea (solstitialis, melitensis) seminatural stands		415
	Subtotal	1,187
Californian broadleaf forest and woodland group		
Californian broadleaf forest and woodland group		191
Aesculus californica alliance		143
Quercus agrifolia alliance		45
Quercus agrifolia/Frangula californica–Heteromeles arbutifolia association		4
Quercus douglasii alliance		1,234
Quercus douglasii/grass association		3,938
Quercus douglasii–Pinus sabiniana association		173
Quercus kelloggii alliance		49
Quercus lobata alliance		349
Quercus lobata–Quercus wislizeni association		9
Quercus wislizeni tree alliance		2,289
Quercus wislizeni/Ceanothus oliganthus provisional association		147
Quercus wislizeni–Pinus sabiniana/annual grass–herb association		40
Quercus wislizeni–Quercus douglasii–Aesculus californica association		15
Quercus wislizeni–Quercus douglasii–Pinus sabiniana/(grass) association		1,201
Umbellularia californica alliance		40
Umbellularia californica–Quercus wislizeni association		146
	Subtotal	10,012
Total grassland and woodland (nonserpentine) ecosystems		**13,401**

Chaparral Ecosystems (Nonserpentine)

Chaparral ecosystems are characterized by dense cover of drought-tolerant, evergreen shrubs, generally 3–9 feet tall and typically found on steeply to moderately sloping hillsides. Most chaparral shrubs are adapted to fire (their shoots regrow from the root crown following fire or their seeds require heat scarification for germination), and chaparral community dynamics (e.g., succession, species diversity, structural diversity) depend on periodic fires (Keeley and Davis 2007).

Nonserpentine chaparral dominates roughly 20% of the KWA and occurs as three main vegetation groups, generally determined by slope aspect. Hotter and drier west- or south-facing slopes are dominated by Californian xeric chaparral. Vegetation alliances and associations associated with this group are usually dominated by chamise (*Adenostoma fasciculatum*) and wedgeleaf ceanothus (*Ceanothus cuneatus*). Species such as

yerba santa (*Eriodictyon californicum*) and toyon (*Heteromeles arbutifolia*) also may be present, along with a sparse herbaceous layer (except in years immediately following a fire, when herbaceous plants flourish). On cooler or wetter north- and east-facing slopes, the Californian mesic chaparral group is more commonly encountered. Scrub oak (*Q. berberidifolia*) dominates these vegetation alliances and associations with species such as California buckeye, hairy-leaf ceanothus (*Ceanothus oliganthus*), birchleaf mountain mahogany (*Cercocarpusbetuloides*), and chamise. A third type of chaparral group, Californian premontane chaparral, is found in limited amounts on relatively cool, north-facing slopes. Hairy-leaf ceanothus is the dominant species in these vegetation alliances and associations. Finally, a fourth shrub-dominate group (although not strictly chaparral), central and south coastal California seral scrub, occurs in isolated parts of the KWA, primarily in open, disturbed areas dominated by the early-successional species silver bush lupine (*Lupinus albifrons*). The acreages of these vegetation groups, alliances, and associations are shown in Table 3-3, and their distributions are mapped in Appendix A, Figure 7. More detailed descriptions of the species that occur in these vegetation alliances and associations can be found in the MCV (Sawyer et al. 2009).

Table 3-3. Communities of Chaparral (Nonserpentine) Ecosystems in the Knoxville Wildlife Area

Vegetation Community Class	Acres
Californian premontane chaparral group	
Ceanothus oliganthus alliance	27
Ceanothus oliganthus–Adenostoma fasciculatum association	18
Subtotal	45
Californian mesic chaparral group	
Californian mesic chaparral group	605
Quercus berberidifolia alliance	165
Quercus berberidifolia/Aesculus californica provisional association	15
Quercus berberidifolia–Ceanothus oliganthus association	61
Quercus berberidifolia–Cercocarpus montanus association	14
Quercus berberidifolia–Adenostoma fasciculatum alliance	174
Subtotal	1,034
Californian xeric chaparral group	
Californian xeric chaparral group	8
Adenostoma fasciculatum alliance	2,791
Adenostoma fasciculatum association	641
Adenostoma fasciculatum–Heteromeles arbutifolia/Melica torreyana association	301
Ceanothus cuneatus alliance	439
Ceanothus cuneatus–Adenostoma fasciculatum association	63
Eriodictyon californicum alliance	10
Eriodictyon californicum/herbaceous association	2
Subtotal	4,254

Vegetation Community Class		Acres
Central and south coastal California seral scrub group		
Lupinus albifrons alliance		4
	Subtotal	4
Total chaparral (nonserpentine) ecosystems		**5,337**

Serpentine Soil Ecosystems

Serpentine soil ecosystems account for approximately 9% of the KWA. Serpentine rock underlies areas primarily located west of Berryessa–Knoxville Road. On this substrate, all of the above-described ecosystems differ in their species composition and vegetation structure from those on nonserpentine substrates. These differences have implications for management. For example, fewer invasive species are problematic on serpentine soils and there are several special-status plants that, in the KWA, occur only on serpentine soils. For this reason, serpentine ecosystems are treated as a separate Biological Element in this LMP.

Serpentinite is an ultramafic rock (i.e., a rock rich in magnesium and iron) containing large amounts of the mineral serpentine (California's state mineral), which is a hydrated form of magnesium silicate. Soils derived from serpentinite (serpentine soils) have relatively little available calcium, which is an essential nutrient for plants, low concentrations of other nutrients, and high concentrations of heavy metals (Kruckeberg 2002). These soils also tend to be shallow and rocky. The vegetation growing on these soils tends to be shorter and more open than similar vegetation on other soils, and is dominated by different species.

In the KWA, chaparral is much more extensive on serpentine substrates than on nonserpentine substrates, covering nearly 60% of serpentine areas as opposed to less than 30% of nonserpentine areas. As on nonserpentine substrates, however, slope aspect has a major influence on species composition, and mesic, xeric, and premontane chaparral (as described above) account for most chaparral on serpentine soils. Although many dominant or important alliances and associations are the same on serpentine and nonserpentine substrates, there are some major differences. In particular, leather oak (*Q. durata*), a species largely confined to serpentine substrates, dominates more than 40% of serpentine chaparral, and Sargent's cypress (*Hesperocyparis sargentii*), an endemic tree species occurring only on serpentine soils in California's Coast Ranges, is found in limited locations of the KWA (Table 3-4). Serpentine soils in the KWA also support open, sparse areas dominated by buckwheat (*Eriogonum* ssp.), silver bush lupine, and other smaller shrubs or subshrubs.

Grasslands cover a similar proportion, and woodlands a much smaller proportion, of serpentine soils in the KWA, relative to nonserpentine areas. The dominant and important species of grasslands and woodlands are similar to those described above. However, native perennial grasses (such as purple needlegrass) often are more important and dominate larger areas on serpentine soils. The vegetation maps (Appendix A) show that a greater area is dominated by perennial grasses in serpentine areas compared to nonserpentine areas (31 versus 7 acres), even though nonserpentine grasslands cover more than 10 times as much land (Table 3-4).

Serpentine aquatic and riparian areas consist of small waterways, seeps, and associated wetland and riparian vegetation. The lacustrine and riverine ecosystems found in nonserpentine areas are nearly absent on serpentine soils (and, where present, are not large enough to be delineated). Serpentine aquatic and riparian vegetation also differs from that in nonserpentine areas in their dominant species. In particular, Brewer's willow (*S. brewer*i), a species largely restricted to serpentine substrates, dominates more than half of the serpentine riparian vegetation in the KWA (Table 3-4).

The acreages of the vegetation groups, alliances, and associations that occur on serpentine at the KWA are shown in Table 3-4, and their distributions are mapped in Appendix A, Figure 7. More detailed descriptions of the species that occur in these vegetation alliances and associations can be found in the MCV (Sawyer et al. 2009).

Table 3-4. Communities of Serpentine[1] Soil Ecosystems in the Knoxville Wildlife Area

Vegetation Community Class		Acres
Serpentine chaparral ecosystems		
Californian evergreen coniferous forest and woodland group		
Callitropsis sargentii alliance		3
	Subtotal	3
Californian mesic chaparral group		
Californian mesic chaparral group		78
Quercus berberidifolia alliance		66
Quercus berberidifolia–Adenostoma fasciculatum alliance		13
Quercus berberidifolia/Aesculus californica provisional association		<1
Quercus berberidifolia–Ceanothus oliganthus association		8
	Subtotal	166
California premontane chaparral group		
Ceanothus oliganthus–Adenostoma fasciculatum association		27
Quercus durata alliance		132
Quercus durata–Adenostoma fasciculatum provisional association		357
	Subtotal	515
California xeric chaparral group		
Californian xeric chaparral group		145
Adenostoma fasciculatum alliance		126
Adenostoma fasciculatum association		39
Adenostoma fasciculatum–Heteromeles arbutifolia/Melica torreyana association		25
Ceanothus cuneatus–Adenostoma fasciculatum association		23
	Subtotal	358

Vegetation Community Class		Acres
Californian serpentine chaparral group		
Californian serpentine chaparral group		73
	Subtotal	73
Central California Coast Ranges cliff and canyon group		
Allium falcifolium–Eriogonum spp.*–Streptanthus* spp. provisional alliance		2
	Subtotal	2
Central and south coastal California seral scrub		
Eriogonum (*elongatum, nudum*) provisional alliance		1
Lupinus albifrons alliance		7
	Subtotal	9
Southern Vancouverian deciduous shrub		
Ceanothus integerrimus alliance		2
	Subtotal	2
Total serpentine chaparral ecosystems		**1,128**
Serpentine grassland and woodland ecosystems		
Californian broadleaf forest and woodland group		
Aesculus californica alliance		<1
Quercus douglasii alliance		23
Quercus douglasii/grass association		190
Quercus douglasii–Pinus sabiniana association		3
Quercus lobata alliance		24
Quercus wislizeni tree alliance		66
Quercus wislizeni–Pinus sabiniana/annual grass–herb association		2
Quercus wislizeni–Quercus douglasii–Pinus sabiniana/(grass) association		16
Umbellularia californica alliance		6
Umbellularia californica–Quercus wislizeni association		16
	Subtotal	347
California annual and perennial grassland macrogroup		
California annual and perennial grassland macrogroup		31
	Subtotal	31
California annual forb/grass vegetation group		
California annual forb/grass vegetation group		281
Lasthenia californica–Plantago erecta–Vulpia microstachys alliance		<1
	Subtotal	281
California perennial grassland group		
Melica (*californica, torreyana*) provisional alliance		6

Vegetation Community Class		Acres
Nassella pulchra alliance		15
	Subtotal	21
Mediterranean California naturalized annual and perennial grassland group		
Mediterranean California naturalized annual and perennial grassland group		63
	Subtotal	63
Western dry upland perennial grassland group		
Western dry upland perennial grassland group		10
	Subtotal	10
Total serpentine grassland and woodland ecosystems		**752**
Serpentine aquatic and riparian ecosystems		
California broadleaf forest and woodland group		
Quercus lobata–Salix lasiolepis association		<1
	Subtotal	<1
Californian mixed annual/perennial freshwater vernal pool / swale bottomland group		
Eryngium aristulatum alliance		1
	Subtotal	1
Californian warm temperate marsh/seep group		
Californian warm temperate marsh/seep group		2
Carex serratodens provisional alliance		5
Juncus (*oxymeris, xiphioides*) provisional alliance		1
	Subtotal	8
Southwestern North American riparian/wash scrub group		
Salix lasiolepis alliance		2
Salix breweri alliance		13
	Subtotal	15
Total serpentine aquatic and riparian ecosystems		**24**
Total serpentine ecosystems		**1,904**

[1] *Serpentine* indicates that plant community occurs on serpentine soil, as mapped in the Soil Survey of Napa County, or that the plant community is dominated by a species usually found on serpentine soil (ranking of SI, BE/SI, BE, or SE as described in Safford et al. 2005).

3.1.2 Native Grasses

As indicated above, much of the open grassland and oak woodland understory in the KWA is dominated by nonnative, annual grasses. However, native grasses, many of which are perennial, often occur as scattered individuals in these otherwise nonnative-dominated stands of vegetation. Occasionally they occur as discrete stands of vegetation, particularly on serpentine soils or in areas (e.g., hillslopes) that historically have been grazed by livestock less frequently and intensively.

Focused surveys for native grass species were completed as part of this LMP update (see Appendix D), and incidental observations of these and other species were recorded during additional rare plant surveys (see Appendix F). Scattered occurrences of the native beardless wild rye (*Elymus triticoides*), big squirreltail (*Elymus multisetus*), blue wild-rye (*E. glaucus*), California brome (*Bromus californica*), California fescue (*Festuca californica*), California melic (*Melica californica*), purple needlegrass, and foothill needlegrass (*Stipa lepida*) are found in various locations throughout the KWA (Appendix A, Figure 9). During the rare plant surveys, additional perennial native grasses were observed: California hairgrass (*Deschampsia cespitosa*), June grass (*Koeleria macrantha*), Geyer's onion grass (*Melica geyeri*), and common reed (*Phragmites australis*) (Appendix F). The annual native grass six-weeks fescue (*F. microstachys*) also grows in the KWA, particularly on serpentine soils and in areas of open, sparse grassland, often on shallow or rocky soils. Additionally, annual hairgrass (*D. danthonioides*) and Pacific foxtail (*Alopecurus saccatus*) were observed during the rare plant survey (Appendix F).

3.1.3 Invasive Plants

Most of the plant species in the KWA are native to California; the rest are nonnatives that have been imported, either intentionally or unintentionally, from elsewhere since European settlement. These nonnative species often outcompete natives to dominate natural plant communities in the KWA. Nonnative species that have the immediate potential to spread into and alter natural plant communities are considered *invasive*. The impacts of invasive species on native communities include species endangerment (Wilcove et al. 1998), reductions in biodiversity (Rosentreter 1994) and wildlife habitat (Bedunah 1992), alterations to ecosystem processes such as fire frequency (D'Antonio and Vitousek 1992) and nutrient cycling and hydrology (Vitousek 1990), increases in topsoil loss (Lacey et al. 1989), alterations to soil microclimate (Evans and Young 1984), and economic impacts, such as reductions in land value and livestock forage capacity (Sheley and Petroff 1999, Naylor 2000). The most severe impacts of invasive species often occur where they alter the disturbance regime, such as by increasing fire frequency (D'Antonio 2000, Levine et al. 2003).

Invasive plants are not distributed proportionally among vegetation types. Chaparral communities, both on and off serpentine soils, tend to have a low abundance of invasive species. Grasslands on serpentine substrates tend to have less cover of invasive species compared to nonserpentine grasslands. Annual grasslands and the herbaceous layers of riparian and woodland habitats may be dominated by invasive species.

Table 3-5 lists the invasive plants that are present in or have a high potential for spreading into the KWA (e.g., invasive plants present in similar habitats regionally). The identified species consist of:

- species listed in the 2005 LMP;
- species observed by H. T. Harvey & Associates during focused invasive plant surveys in selected portions of the KWA in 2015 (Appendix D);
- species observed by Dr. Daniel Potter during rare plant surveys in selected portions of the KWA in 2015 and 2016 (Appendix F);

- species observed incidentally by Department staff; and
- species identified using invasive plant distribution information in the CalWeedMapper (Cal-IPC 2015).

These plants also are described in the subsequent text. For the purpose of this LMP, invasive plants do not include widely naturalized, nonnative species that have been integrated into the flora of California for centuries (e.g., wild oats, soft chess, filaree), even though some sources consider these species to be invasive (e.g., Cal-IPC 2006).

Table 3-5. Invasive Species Potentially Threatening Knoxville Wildlife Area Ecosystems

Plant Species[1]			Ecosystems Threatened[3]				
Common Name	Scientific Name	Cal-IPC Rating[2]	Aquatic and Riparian	Grassland and Woodland	Chaparral	Serpentine	Present in KWA?
Arundo, giant reed	*Arundo donax*	H	X				No
Barbed goatgrass	*Aegilops triuncialis*	H		X	X	X	Yes
Black mustard	*Brassica nigra*	M	X	X			Yes
Brazilian waterweed	*Egeria densa*	H	X				No
Bull thistle	*Cirsium vulgare*	M	X	X			Yes
Cheatgrass	*Bromus tectorum*	H	X	X			No
Crimson fountaingrass	*Pennisetum setaceum*	M		X	X		No
Edible fig	*Ficus carica*	M	X				No
Eurasian watermilfoil	*Myriophyllum spicatum*	H	X				Yes
Fennel	*Foeniculum vulgare*	H	X	X			No
French broom	*Genista monspessulana*	H		X	X	X	No
Greater periwinkle	*Vinca major*	M	X	X	X		Yes
Harding grass	*Phalaris aquatica*	M	X	X			Yes
Himalayan blackberry	*Rubus armeniacus*	H	X				Yes
Italian thistle	*Carduus pycnocephalus*	M		X			Yes
Klamathweed	*Hypericum perforatum*	M		X			No
Medusa head	*Taeniatherum*	H		X		X	Yes

Plant Species[1]			Ecosystems Threatened[3]				
Common Name	Scientific Name	Cal-IPC Rating[2]	Aquatic and Riparian	Grassland and Woodland	Chaparral	Serpentine	Present in KWA?
	caput-medusae						
Pampas grass	*Cortaderia sellanoa*	H	X				No
Perennial pepperweed	*Lepidium latifolium*	H	X			X	Yes
Poison hemlock	*Conium maculatum*	M	X				No
Purple false brome	*Brachypodium distachyon*	M		X			Yes
Purple star-thistle	*Centaurea calcitrapa*	M		X			Yes
Ravennagrass	*Saccharum ravennae*	M	X				No
Scotch broom	*Cytisus scoparius*	H		X	X	X	No
Spanish broom	*Spartium junceum*	H			X	X	No
Stinkwort	*Dittrichia graveolens*	M	X	X			No
Tamarisk	*Tamarix ramosissima*	H	X				Yes
Teasel	*Dipsacus fullonum*	M	X	X			No
Tocalote	*Centaurea melitensis*	M		X		X	Yes
Tree of heaven	*Ailanthus altissima*	M	X	X	X		Yes
Yellow star-thistle	*Centaurea solstitialis*	H		X		X	Yes

Notes: Cal-IPC = California Invasive Plant Council. H = High, M = Moderate.

[1] Species that have invaded or have the immediate potential to invade the Knoxville Wildlife Area, and which may be a high priority for management owing to the potential severity of impacts and feasibility of control.

[2] High = species has severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Moderate = species has substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure.

[3] Ecosystems in which the species frequently becomes abundant are indicated based on Cal-IPC (2006) and the professional experience of H. T. Harvey & Associates biologists; many species can become locally abundant in highly disturbed areas.

Arundo, Giant Reed

Arundo, or giant reed (*Arundo donax*), is a tall, perennial, cane-like grass that is native to the Mediterranean region and tropical Asia. Arundo has seriously invaded waterways along coastal California regions and in the Central Valley, where it forms dense, monospecific stands. This species grows rapidly (up to 2 inches per day) and forms vast stands that reach heights of 7 to 26 feet. Arundo is adapted to dynamic riverine processes and reproduces vegetatively by rhizomes and fragmented stem nodes that are carried and established downstream (Bell 1997). Arundo typically grows in moist, well-drained sites but is capable of establishing on drier terraces and uplands adjacent to riparian zones. Dense monospecific stands of Arundo can outcompete native riparian vegetation and displace native wildlife. Arundo also is highly flammable and can quickly carry fire through riparian areas (DiTomaso and Healy 2007).

Arundo has not been detected in the KWA; however, it has been observed around Lake Berryessa, along Putah Creek, and in a drainage ditch that intersects Cache Creek near the unincorporated community of Capay (CalWeedMapper 2015). If this species spreads, it would threaten aquatic and riparian (nonserpentine) communities in the KWA.

Barbed Goatgrass

Barbed goatgrass is an annual grass native to Eurasia that was first recorded in California on the border of El Dorado and Sacramento Counties in 1914, after cattle from Mexico were imported and pastured (Kennedy 1928). It currently occupies a widespread and expanding area of grasslands and shrublands below roughly 3,600 feet in elevation in northern California (Peters et al. 1996). Barbed goatgrass favors rocky, gravelly, well-drained soils, including those derived from serpentine, and thrives in open grasslands and disturbed habitats such as roadsides and pastures (DiTomaso and Healy 2007). It first appears as scattered patches among native and naturalized species, but can quickly dominate localized areas (Peters et al. 1996). The barbed awns facilitate seed dispersal by livestock, wildlife, vehicles, water, and wind (DiTomaso and Healy 2007).

Barbed goatgrass flowers between May and July and matures from May to August, after most other common annual grasses, though this pattern may vary depending on the precipitation and temperature of a given season (Davy et al. 2008, Peters et al. 1996). The reddish-purplish heads can be easily distinguished in the field during late spring (Peters et al. 1996). Most seeds germinate in the first year after seedfall, but may remain dormant in the soil for up to 5 years (Peters et al. 1996). Barbed goatgrass generally is unpalatable to livestock (Peters et al. 1996) and can cause mechanical injury to livestock when the seeds embed in the skin and mucous membranes of animals. Heavy, prolonged grazing and flash grazing during the growing period are thought to increase the density of barbed goatgrass infestations (DiTomaso and Healy 2007).

The distribution of barbed goatgrass is expanding in northern California and in the central and southern coastal regions (Davy et al. 2008). As a result of its ability to thrive in undisturbed grasslands and serpentine habitats, barbed goatgrass poses a substantial threat to sensitive habitats in the KWA. In the KWA, barbed goatgrass occurs as small, scattered patches in grasslands and woodlands (nonserpentine) near the Wilson

Barn, in Toll Canyon, and in the Nevada Creek drainage (Appendix A, Figure 8a). The infestations in the Nevada Creek drainage were found in nonserpentine grasslands and woodlands along the ridge west of several livestock water ponds, in nonserpentine grasslands and woodlands in the upper Nevada Creek drainage, and in serpentine and chaparral ecosystems south of the creek.

Black Mustard

Black mustard (*Brassica nigra*) is an annual forb in the mustard family (Brassicaceae) that is native to Eurasia. It has a moderate impact on California ecosystems (Cal-IPC 2016). Black mustard matures quickly in the spring and produces a large amount of biomass in infested areas, potentially outcompeting native species through shading or an early reduction in soil moisture. Reproduction occurs by seeds, which are sticky when wet and are thus easily transferred by equipment, vehicles, or people working in or traveling through infested areas when moisture is present (Cal-IPC 2016). Like other invasive mustard species, black mustard can build up a large, long-lived seedbank at infestation sites. For example, deeply buried black mustard seeds may remain viable for as many as 50 years under field conditions (DiTomaso and Healy 2007).

This species often invades areas dominated by nonnative annual grasses and can contribute to type conversion of woodlands and scrublands into annual grasslands by adding to the early-season fuel load of an area, which can increase the amount of fuel available for fires. Although this species generally is considered an early successional plant, and thus might be expected to decrease in density or extent with increasing time since the last site disturbance, the typically large and long-lived seedbank, in combination with the repeated disturbance associated with heavy grazing, can favor the establishment of long-term infestations (Cal-IPC 2016).

Black mustard occurs in relatively low densities throughout the KWA, particularly in areas of prior disturbance in nonserpentine grasslands and woodlands and on serpentine soils along Berryessa–Knoxville Road and Zim Zim Creek (Appendix A, Figure 8b). When present, it typically composes less than 5% of plant cover on the landscape.

Brazilian Waterweed

Brazilian waterweed is an aquatic perennial herb in the waterweed family (Hydrocharitaceae) that is native to Argentina, Brazil, and Uruguay. It has a severe impact on California ecosystems (Cal-IPC 2016). Brazilian waterweed establishes by means of shoot and stem fragments in ponds, sloughs, shallow water developments, canals, lakes, reservoirs, and streams. It grows 15-foot-long stems and showy, white flowers that float on water. Brazilian waterweed forms dense stands that slow water movement, accumulate sediment, and reduce the abundance and diversity of native plants. It generally grows best in waters with high nutrient levels and where water movement is minimal. It tolerates a range of water qualities, temperatures, and depths but is most productive in shallow zones. Brazilian waterweed disperses when stem fragments break off and float away from the parent plant.

Brazilian waterweed has not been detected in the KWA.

Bull Thistle

Bull thistle (*Cirsium vulgare*) is a robust biennial thistle with dark green foliage and purple flower heads that are 1–2 inches wide. It is native to Europe, west Asia, and north Africa, and is now naturalized throughout the United States (Randall 2000). It probably was introduced as a seed contaminant in early colonial times and reached California by the late 1800s. It grows in coastal grasslands, near marshes, and in mountain meadows below 7,000 feet (Cal-IPC 2016). In California, bull thistle is a widespread agricultural pest with a moderate impact, particularly on hay crop values. It colonizes large and small disturbed locations, such as areas along roads and ditches, in burned or clear-cut forests, and in pastures and rangelands (Cal-IPC 2016). In typical wildland settings, bull thistle often occurs as scattered plants in disturbed areas (e.g., along roadsides), or occasionally as discrete infestations in areas of habitual disturbance (e.g., under oak trees, where cattle congregate); in these locations, bull thistle degrades wildlife habitat quality and forage values for livestock.

In the KWA, bull thistle is uncommon, patchy, and usually associated with wet or disturbed areas in nonserpentine grasslands and woodlands, and near seeps, particularly where livestock congregate. Bull thistle could outcompete native seep vegetation, but is unlikely to have widespread impacts in drier habitats of the KWA. Notable occurrences are located along Berryessa–Knoxville Road and near the Wilson Barn (Appendix A, Figure 8c).

Cheatgrass

Cheatgrass (*Bromus tectorum*), widely known for its rapid invasion and degradation of the intermountain West's semiarid grasslands, shrublands, and woodlands (Young et al. 1972, Mack 1981, Billings 1990), is a winter annual grass that continues to remain rare in the California floristic province, but has thoroughly invaded roadsides along Morgan Valley Road west of the KWA. It is native to Eurasia, was first introduced into multiple sites both intentionally and as a contaminant of wheat seed, and spread throughout the western United States along railroads and other rights-of-way, via livestock, agriculture, and other natural and human vectors (Mack 1981, Mosely et al. 1999). Cheatgrass can spread short distances via wind, whereas animals

(wild and domestic) carry cheatgrass in their feces, hooves, hair, feathers, and tails. Humans carry it in their shoes and socks. Although most cheatgrass seeds generally do not survive longer than 1 year in grasslands, they may remain viable for several years when stored dry in bales of hay or straw (Mosely et al. 1999). Cheatgrass has been shown to exhibit a tremendous range of environmental tolerance (Billings 1990, Young and Allen 1997), and therefore should be treated aggressively upon initial detection. Sites most susceptible to cheatgrass invasion are those with deep, loamy soils, and south-facing slopes. Cultivation and subsequent land abandonment, overgrazing, and repeated fire can all interact to proliferate cheatgrass, though it also can invade undisturbed wildlands (Mosely et al. 1999).

Cheatgrass has not been detected in the KWA; however, it is found nearby and could threaten the KWA's grasslands and oak woodlands with its potential to displace native and other invasive species (Mack 1981, Billings 1990, Knick and Rotenberry 1997).

Crimson Fountaingrass

Crimson fountaingrass (*Pennisetum setaceum*) is a perennial grass that grows to 5 feet tall and has white to purplish, spike-like panicles. This species is an escaped horticultural plant and an aggressive weed that invades disturbed sites, urban areas, and roadsides (Cal-IPC 2016). This plant also will invade coastal sage scrub, coastal dunes, and warm desert shrublands. In California, it is distributed throughout the central-western and southwestern regions, the San Francisco Bay Area, Sacramento–San Joaquin Delta, and the Sonoran Desert below 2,000 feet in elevation. Crimson fountaingrass blooms from July through August and reproduces by seed. Individual plants may be long-lived and have been known to survive for 20 years or more (DiTomaso and Healy 2007).

Crimson fountaingrass has not been detected in the KWA.

Edible Fig

Edible fig (*Ficus carica*) is a deciduous tree in the Moraceae family. This species, which grows up to 30 feet tall, is native to southern Arabia and was introduced to California by Spanish missionaries in the mid- to late 1700s. In California, it invades and dominates riparian forests, streamside habitats, levees, and canal banks in and around the Central Valley, surrounding foothills, the south coast, and the Channel Islands. Edible fig reproduces by seed and by vegetative growth (root and stem fragments). It prefers soils that stay moist throughout summer. This species can form dense thickets that outcompete native trees and understory vegetation. Such thickets are difficult to control because cutting or injuring the tree typically stimulates the development of numerous root sprouts.

Edible fig has not been detected in the KWA.

Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) is an aquatic perennial herb in the watermilfoil family (Haloragaceae) that is native to Greenland, North Africa, Europe, and Asia. It has a severe impact on California ecosystems (Cal-IPC 2016). Eurasian watermilfoil establishes by means of stem and root fragments, and rarely by seed germination, in ponds, shallow water developments, canals, lakes, and streams. It grows branching stems near the water surface, forming dense floating mats that outcompete native aquatic plants and create optimal habitat for mosquitos. It generally grows best in waters with high nutrient levels and where water movement is minimal. Eurasian watermilfoil tolerates a range of water qualities, temperatures, and depths. It can grow on sandy, silty, or rocky substrates but prefers fertile, fine-textured, inorganic sediments. This species disperses when stem and root fragments break off and float away from the parent plant.

Eurasian watermilfoil was observed in a single livestock pond in the KWA.

Fennel

Fennel (*Foeniculum vulgare*) is a perennial forb in the carrot family (Apiaceae) that is native to southern Europe and the Mediterranean region. It has a high impact on California ecosystems (Cal-IPC 2016). The plant grows 4–10 feet tall and has finely dissected leaves. Its small yellow flowers are clustered in large, rounded, umbrella-like groups that bloom from May through September. Fennel alters the composition and structure of many plant communities by forming dense, uniform stands that outcompete and exclude native plants.

Reproduction occurs from both root crowns and seeds. Seed production is prolific, peaking in August and September. Seeds are dispersed by water and animals, and by humans when seeds cling to clothing or mud on vehicles. Fennel invades open disturbed sites of various types, including roadsides, road cuts, fallow fields, grasslands, riparian areas, and wetland sites.

Fennel has not been detected in the KWA.

French Broom

French broom (*Genista monspessulana*) is a tall (up to 10-foot) evergreen shrub in the pea (Fabaceae) family. It is native to the Mediterranean region, and was introduced to California in the mid-1800s as a landscape ornamental. Its current distribution in California includes the Coast Ranges, Sierra Nevada foothills, Transverse Ranges, Channel Islands, and San Francisco Bay region. French broom frequently occurs in disturbed places such as riverbanks and road cuts, but it also can invade grasslands and open-canopy forests. It prefers siliceous soils, but can grow in various soil moisture conditions. This species is an aggressive invader that produces abundant seeds and will resprout from the root crown if it is cut, grazed, or burned. Seeds are dispersed by ants, birds, mammals, human activity, and water movement. French broom displaces native plant and forage species and can dominate plant communities by forming dense, monospecific stands.

French broom has not been detected in the KWA.

Greater Periwinkle

Greater periwinkle (*Vinca major*) is a rapidly spreading, herbaceous, perennial ground cover in the family Apocynaceae (Cal-IPC 2016). Native to central Europe, it was introduced as a showy ornamental plant, but has escaped cultivation. The species is spreading quickly through coastal counties, woodlands in foothill regions, and the Central Valley, and is rated as having a moderate impact on California ecosystems (DiTomaso and Healy 2007, Cal-IPC 2016). It is found even in deserts, but its preferred habitat consists of shady, moist locations. Periwinkle may bloom from early spring through summer, with showy, lavender-blue, funnel-shaped flowers (DiTomaso and Healy 2007, Cal-IPC 2016). Its dark green stems contain milky latex. In California, this plant is especially problematic in riparian areas, where it lowers species diversity by forming dense mats and outcompeting other vegetation (DiTomaso and Healy 2007, Cal-IPC 2016). The species typically reproduces vegetatively from trailing stems and stem fragments. Fragments of stems that wash downstream or that are left on the ground can start new invasions (DiTomaso and Healy 2007, Cal-IPC 2016).

Greater periwinkle was observed in the KWA during the rare plant surveys conducted in 2015 and 2016 (Appendix F).

Harding Grass

Harding grass (*Phalaris aquatica*) is a stout perennial grass with short rhizomes and grayish to bluish green leaves. The plant reaches 3 to 5 feet in height. This species prefers moist sites and can be found in riparian areas, fields, ditches, and depressions. Harding grass is concentrated along the California coast, in the Coast Ranges, the Bay Area, and the western slopes of the Sierra Nevada. Harding grass can outcompete and displace native plant species (Harrington and Lanini 2000), although it is generally more invasive in coastal regions (DiTomaso and Healy 2007). The bloom period is typically May through September, sometimes extending into December. Harding grass generally reproduces by seed and readily resprouts when disturbed by grazing, fire, and mowing (Cal-IPC 2016).

Harding grass occurs throughout the nonserpentine grassland and woodland ecosystems in the KWA (Appendix A, Figure 8d). During the area's historical ranching period, Harding grass probably was intentionally planted as forage for cattle. Its occurrence in the wildlife area is patchy, but the species can be locally abundant. It reaches its highest density in nonserpentine grasslands and woodlands between the mouths of Long Canyon and Foley Canyon. It also is sometimes concentrated in nonserpentine aquatic and riparian ecosystems (around ponds and streams) because it tolerates wet conditions, and several small infestations have been observed along Eticuera Creek.

Himalayan Blackberry

Himalayan blackberry (*Rubus armeniacus*) is a sprawling, robust shrub in the Rosaceae family, native to western Europe. In California, it occurs in riparian areas and, occasionally, in upland areas with persistent soil moisture, throughout the Coast Ranges, Central Valley, and Sierra Nevada. Flowers are characteristic of the rose family and are white to pinkish in color. This plant produces fruit from July to September and can produce 7,000 to 13,000 seeds per square yard. Mature fruits are edible and compose a small part of the diet of both native and nonnative wildlife. Himalayan blackberry can be distinguished from California blackberry by its taller, more robust stature and larger thorns and berries. The flower petals of California blackberry are narrower at the base and do not have the crinkled appearance of the Himalayan blackberry flower (DiTamaso and Healy 2007).

Himalayan blackberry is common in riparian areas and tolerates periods of inundation by fresh or brackish water. Such periodic flooding can produce long-lived, early seral plant communities that are conducive to the growth and spread of blackberries. This species is a strong competitor and rapidly displaces native plants by forming dense, impenetrable thickets that limit the growth of understory plants.

There is one documented occurrence of Himalayan blackberry in Eticuera Creek, near the mouth of Foley Canyon (Appendix A, Figure 8e), and the species may occur in other nonserpentine aquatic and riparian ecosystems of the KWA.

Italian Thistle

Italian thistle (*Carduus pycnocephalus*) is an annual plant native to the Mediterranean. It was accidentally introduced to California in the 1930s, and is now widespread below 3,000 feet in elevation, except in deserts (Goeden 1974, Bossard and Lichti 2000). Italian thistle grows in sandy to clay soils in disturbed open areas, road cuts, grasslands, pastures, and ruderal sites (DiTomaso and Healy 2007). The purple flower heads are smaller and fewer than those of bull thistle. Italian thistle reproduces by seed, and seeds can withstand a wide variety of temperature regimes. Italian thistle can reach high densities in local patches and can outcompete and displace native species. Because it frequently grows beneath oaks, it also has the potential to carry fire into the canopy.

Italian thistle is widespread in nonserpentine grasslands and woodlands in the KWA; however, it typically occurs in relatively low densities. It appears to thrive in the KWA's oak savannas, under the canopies of blue oaks, and in grasslands that have been disturbed (e.g., by past oak clearing) (Appendix A, Figure 8f). It is relatively dense in the nonserpentine grasslands and woodlands in Long Canyon, along Toll Canyon Creek, and in the vicinity of livestock ponds.

Klamathweed

Klamathweed (*Hypericum perforatum*) is a perennial plant that grows to 4 feet tall. It reproduces by seeds and vegetatively from rhizomes. The leaves of Klamathweed are dotted with oil glands that produce a chemical

compound toxic to livestock when ingested in sufficient quantities. This species flowers from June through September. Typical habitat includes pastures and rangeland, burned areas, and disturbed open areas in temperate climates. This species can tolerate slightly acidic to neutral soils but does not tolerate saturated soils. It is distributed throughout much of northern California below 4,900 feet (DiTomaso and Healy 2007) and it can occur at higher elevations in the Sierra Nevada.

Klamathweed has not been detected in the KWA.

Medusa Head

Medusa head is an annual grass that has spread rapidly throughout California. It is distinctive in grasslands because it reaches high densities and forms a uniform cover. Because of its high silica content, Medusa head is unpalatable to livestock and native herbivores, except in its earliest stages of growth. Unlike many other nonnative annual grasses that decompose after seed set, Medusa head persists through the winter and forms a dense thatch, which inhibits germination of native species and increases the likelihood and intensity of wildfire (Kan and Pollak 2000).

Medusa head is native to the Mediterranean region. It was introduced to the United States in the late 1800s, but has spread widely throughout California only in the last 50 years. Medusa head can negatively affect ecosystems by outcompeting and replacing native species, by tying up nutrients, and by increasing the intensity and frequency of fire. It also has a greater ability than many other nonnative annual grasses to invade some serpentine grasslands.

In the KWA, Medusa head is widespread throughout nonserpentine grasslands and woodlands, as well as serpentine ecosystems (Appendix A, Figure 8g), particularly on soils with a relative high clay content. Of all the invasive plant species discussed herein, it is probably the best established at the KWA.

Pampas Grass

Pampas grass (*Cortaderia sellanoa*) is a common ornamental perennial grass, native to Argentina, Brazil, and Uruguay. It escaped cultivation and now spreads along sandy, moist banks, and in northern California it is growing along the coast and at scattered locations from the Bay Area to the Central Valley (DiTomaso and Healy 2007). Pampas grass grows 7–20 feet tall, with long leaves rising from a tufted base. Stemmed plumes consist of hairy female flowers, deep violet when immature, turning pink to white when mature. Plants flower 2–3 years after germination, usually from late August through September, but sometimes in winter. Vegetative reproduction can occur when fragmented tillers receive adequate moisture and develop adventitious roots at the base of the shoot. Seedling establishment generally occurs in spring, requiring sandy soils, adequate moisture, and light; seedling survival is low in shaded areas or in competition with grasses or sedges. Pampas grass is drought- and heat-tolerant, and once established, its roots can spread up to 13 feet in diameter and 11.5 feet in depth. Plants survive roughly 15 years (DiTomaso 2000a). In riparian areas, this species competes

with seedling trees, shrubs, and herbaceous plants and slowing their establishment and growth (DiTomaso 2000a). It also creates a fire hazard and reduces the aesthetic and recreational value of riparian areas.

Pampas grass has not been detected in the KWA.

Perennial Pepperweed

Perennial pepperweed (*Lepidium latifolium*) is a member of the mustard family native to Eurasia. It threatens riparian areas by forming monospecific stands that exclude other plants (Corliss 1993, Trumbo 1994). It was first documented in California in 1936, and may have been introduced to California as a contaminant of sugar beet seed (Robbins et al. 1951). It also may have been introduced as a contaminant of straw bales used to stabilize soils in roadside construction areas (Howald 2000). This noxious weed is a multistemmed herb that grows 3.3–8.2 feet tall and contains a heavy, sometimes woody crown and spreading underground root system (Howald 2000). Stems and leaves are gray-green, and tiny white flowers, produced from May through July, occur in dense clusters at the tops of stems. Perennial pepperweed prefers brackish to saline or alkaline wetlands, in full sun, on heavy, moist soils, but is also found in native hay meadows and in agricultural fields where soil is slightly alkaline or saline, as well as on drier sites (Howald 2000).

Perennial pepperweed occupies an expanding area in grassland, riparian, and roadside ecosystems along Knoxville Creek. It is also common along Eticuera Creek and Zim Zim Creek (Appendix A, Figure 8h). Its distribution is concentrated near streams and in gullies, but has expanded across grasslands around Knoxville, as well as along roadsides.

Poison Hemlock

Poison hemlock (*Conium maculatum*) usually is a biennial plant that grows to 10 feet tall. It has dissected compound leaves and a purple-streaked stem. This species is highly toxic to humans and animals when ingested owing to the high concentration of alkaloids in the plant tissue. Poison hemlock invades disturbed, often moist sites, including pastures, fields, roadsides, riparian areas, and ditches. This species is distributed below 3,300 feet throughout California, except in the desert regions and the Modoc Plateau. Poison hemlock flowers from April through July, and seeds can survive up to 3 years in the seedbank (DiTomaso and Healy 2007).

Poison hemlock has not been detected in the KWA.

Purple False Brome

Purple false brome (*Brachypodium distachyon*) is an annual grass native to Eurasia. This species is locally abundant and predominantly occurs in the Sierra Nevada foothills, Central Valley, San Francisco Bay Area, central-western region of the state, and the south coast below 2,000 feet. It favors warm, south-facing slopes on poor, rocky soils, particularly in oak savannas and on the margins of oak woodlands (DiTomaso and Healy 2007). Purple false brome typically invades disturbed sites but can readily invade relatively undisturbed oak

woodlands and grasslands. It is considered unpalatable to livestock and wildlife because it lacks foliage and has firm spikelets with awned florets and fibrous stems. This species creates a dense layer of thatch and displaces native plant species (Cal-IPC 2016).

This species is common in the nonserpentine grasslands and woodlands of the KWA. It typically occurs as dense infestations among naturalized grasses (Appendix A, Figure 8i). Infestations are located in Toll Canyon, along Toll Canyon Creek, and in the naturalized grasslands in the Nevada Creek drainage.

Purple Star-Thistle

Purple star-thistle (*Centaurea calcitrapa*) is an annual, or sometimes a short-lived perennial, of the composite family that is native to the Mediterranean region of southern Europe and northern Africa. It has a moderate impact on California ecosystems (Cal-IPC 2016). This species can produce dense stands that exclude and replace desirable native and rangeland species. Purple star-thistle forms rosettes in its first growing season. Mature plants are 1–4 feet tall and produce numerous spiny purple flowers from July through October. Reproduction is by seed. Seeds remain in the flower heads until after the plants die, break off at the soil, and roll with the wind. Seeds also are transported in hay and by farm and ranch machinery. Purple star-thistle invades numerous disturbed sites, including active and fallow agricultural fields, pastures, roadsides, waste places, and disturbed or degraded grasslands and rangelands. It tolerates a range of soil textures and precipitation zones, but it prefers finer-textured soils and alluvium in areas that receive 9 or more inches of precipitation annually.

Purple star-thistle has been observed in one location in the KWA, along Zim Zim Creek (Appendix A, Figure 8j).

Ravennagrass

Ravennagrass (*Saccharum ravennae*) is a large perennial grass in the Poaceae family. It is an escaped horticultural plant from Eurasia that is spreading rapidly along Cache Creek in the Sacramento Valley. It establishes in disturbed areas and prefers moist places, such as marshes and riparian habitats. Because its growth habit is similar to that of giant reed and pampas grass, it has similar ecological impacts where it occurs. Little is known about its invasiveness and distribution, but it is considered to be an imminent problem. Its seeds are dispersed by wind and water. It alters fire dynamics, light availability, soil moisture, and the nutrient content of soils, as well as accumulating sediment. Ravennagrass can grow on more exposed soils than many other riparian species, so it also may alter streambank erosion patterns and encourage flooding. In some areas, it has formed monospecific stands that may outcompete native vegetation. Little is known about effective control mechanisms, but repeated mechanical and herbicide treatments may be necessary to prevent resprouting.

Ravennagrass has not been detected in the KWA, but it has been detected at the nearby McLaughlin Reserve.

Scotch Broom

Scotch broom (*Cytisus scoparius*) is a long-lived perennial shrub in the pea (Fabaceae) family. It is native to Europe and North Africa and was introduced to California in the 1850s as an ornamental shrub. Later, it was used to stabilize dunes to prevent erosion. It is found along the California coast from Monterey north to the Oregon border. It is also prevalent in El Dorado, Nevada, and Placer Counties in the Sierra Nevada foothills. This plant grows 6–10 feet tall, has sharply angled branches, and reproduces by seed when it reaches 2–3 feet in height (2–3 years old). Scotch broom grows in sunny sites with dry, sandy soil, spreading quickly through disturbed areas such as pastures, forest edges, riverbanks, and roadsides. It is a strong competitor and displaces native plant and forage species by forming dense, monospecific stands. Seedlings are also shade-tolerant and can therefore outcompete trees, making reforestation difficult. Established populations are difficult to eliminate because of the longevity of the species' seedbanks. Cutting plants to ground level and grazing (by goats) can help reduce resprouting. Prescribed burns do not prevent resprouting and may stimulate seed germination.

Scotch broom has not been detected in the KWA.

Spanish Broom

Spanish broom (*Spartium junceum*) is a Mediterranean shrub in the Fabaceae family. It grows to 10 feet tall and has yellow flowers that bloom from April through June. This species typically has leafless stems and lacks stipules, which differentiates it from French and Scotch brooms. Spanish broom supports deep, branching taproots that do not generate new shoots; however, plants cut above the crown can regenerate new shoots from the crown. This species is distributed below 2,000 feet in the San Francisco Bay Area, Sacramento Valley, western North Coast Ranges, western South Coast Ranges, western Transverse Range, and south coast.

Spanish broom has not been detected in the KWA.

Stinkwort

Stinkwort (*Dittrichia graveolens*) is an erect, fall-flowering, aromatic annual in the Asteraceae family that is native to the Mediterranean region. It was first reported in 1984 in Santa Clara County, and by 2012 had spread to 36 of the 58 counties in California. This weed is quickly spreading throughout California and the Central Valley (Brownsey et al. 2013). It grows in disturbed places, roadsides, pastures, fields, riparian woodlands, levees, washes, and the margins of wetlands and tidal marshes. It prefers well-drained, gravelly soils and thrives in arid conditions, but can also do well at the margins of wetlands. This plant grows to about 2.5 feet tall, with sticky, glandular-haired foliage and flower heads that consist of short, yellow, ray flowers and reddish disk flowers. Unlike most summer and late-season annuals, it flowers and produces seeds from September to December; one plant can produce up to 30,000 seeds, up to 90% of which may be viable (Brownsey et al. 2013). Stinkwort seeds may remain viable in the soil for 2–3 years, and they are capable of

germinating year-round, so the weed can quickly eliminate open spaces and pastureland. Seeds are likely spread by wind, mammals, birds, and human activity (Brownsey et al. 2013).

Although only limited information about stinkwort is available, this weed likely represents a habitat-transforming threat to native species diversity and abundance. Stinkwort has not been detected in the KWA, but it has been detected at the McLaughlin Reserve and is generally spreading rapidly throughout the northern Bay Area (CalWeedMapper 2015).

Tamarisk

Tamarisk (*Tamarix ramosissima*) is a many-branched shrub or tree less than 26 feet tall with small, scale-like leaves that contain salt glands, and small white to deep-pink flowers.

Tamarisk threatens riparian communities by causing dramatic changes in geomorphology, groundwater availability, soil chemistry, fire frequency, plant community composition, and native wildlife diversity (Lovich 2000). It traps and stabilizes alluvial sediments, resulting in narrowing of stream channels and more frequent flooding, and has been blamed for lowering water tables because of its high rates of evapotranspiration. Soil salinity is increased by inputs from salt glands on its leaves, which inhibits the growth of native riparian species (Anderson 1996), and leaf litter from this deciduous species increases fire frequency and alters soil chemistry to produce conditions that exclude competing riparian species (Busch 1995).

Tamarisk is native to Central Asia, from the Near East around the Caspian Sea through western China and North Korea (Baum 1978). It may have been introduced to California by the Spanish, but was not recognized until the 1800s (Robinson 1965). It was intentionally introduced throughout the West to provide windbreaks, erosion control, and shade, and as an ornamental. It has spread via seed and vegetative growth, with individual plants producing 500,000 tiny seeds per year (DiTomaso 1996), which are readily wind and water-dispersed. It also resprouts via roots (Lovich et al. 1994).

Tamarisk occupies habitats around streams and gullies in the KWA, mainly along Knoxville and Eticuera Creeks (Appendix A, Figure 8k). In 2001, the Department initiated a program to eradicate tamarisk from the KWA; although the program is ongoing, localized resprouting continues.

Teasel

Teasel (*Dipsacus fullonum*) is large biennial that flowers on 3.3-foot-high stalks that originate from basal rosettes. The rosettes and flowering stalks form dense stands, which include dried accumulated stalks from the past years' flowering. Teasel is a native of Europe, and is now a ubiquitous weed in the United States.

Teasel has not been detected in the KWA, but it occurs nearby in pastures, wet areas, and seeps (CalWeedMapper 2015). Teasel poses a particular threat to serpentine seeps because it appears capable of

invading despite harsh soil conditions. Once established, it forms large, monospecific stands that replace native seep vegetation.

Tocalote

Tocalote (*Centaurea melitensis*) threatens plant communities by displacing native plants and animals and reducing reproduction of some endangered plants. In general, little is known about the biology of tocalote (DiTomaso and Gerlach 2000). It is widely distributed in California, but is most widespread in the southern part of the state, with scattered small- to medium-sized populations occurring in and north of the Bay Area. It is generally believed to be spreading northward. In northern California, it appears to be most prevalent on warm, south-facing slopes, in rocky habitats, and even on serpentine substrates.

Tocalote is a winter annual with an early rosette growth form similar to that of yellow star-thistle. It was brought to California as a contaminant in wheat, barley, and oat seed during the Spanish mission period, with the earliest record of its appearance being seed in adobe bricks of a building constructed in 1797 in San Fernando. It appears to have been distributed in dry-farmed grain fields, and continues to be spread by humans, wild and domestic animals, and wind (DiTomaso and Gerlach 2000).

Tocalote produces several solitary or clustered, spiny, yellow flower heads during spring and early summer, with spines shorter and more lateral than those of yellow star-thistle and a brownish-purple tinge to the flower head. Tocalote germinates in the fall, bolts in early spring, and flowers from April through June (approximately 4–6 weeks before yellow star-thistle begins flowering). Flowering plants produce up to 100 heads with up to 60 seeds per head. Plants range in height from 2 to 35 inches (DiTomaso and Gerlach 2000).

In the KWA, tocalote remains uncommon and sparsely distributed in nonserpentine grasslands and woodlands in Toll Canyon, in the Nevada Creek drainage, and along Zim Zim Creek (Appendix A, Figure 8l).

Tree of Heaven

Tree of heaven (*Ailanthus altissima*) is a deciduous ornamental tree that is widely distributed in California with the exception of the eastern Sierra Nevada and desert regions. It is native to China and was introduced to the United States as a landscape ornamental, where it quickly spread to native plant communities. It is most abundant in disturbed sites, roadsides, landscaped sites, and riparian habitats. Tree of heaven tolerates acidic soils but does not tolerate persistent flooding. This species reproduces vegetatively by creeping roots, and by seed when its numerous samaras disperse by wind and water. Seed viability is less than 1 year, meaning that tree of heaven does not develop a persistent seedbank; however, the species grows quickly and can reach heights of up to 70 feet. Tree of heaven also is able to reproduce clonally, and a single individual can produce dense clonal stands as large as approximately 1 acre. These stands outcompete native vegetation, degrade wildlife habitat, and reduce and alter water conveyance in nearby aquatic habitat (DiTomaso and Healy 2007).

Tree of heaven occurs in several locations along Berryessa–Knoxville Road, along the reach of Eticuera Creek that parallels Berryessa–Knoxville Road, and along the reach of Eticuera Creek adjacent to the old landing strip (Appendix A, Figure 8m). Where it occurs, it generally is a sparse infestation in a nonserpentine aquatic or riparian community, but several larger infestations occur along the stretch of Eticuera Creek that parallels Berryessa–Knoxville Road.

Yellow Star-Thistle

An important candidate for weed management is yellow star-thistle. In areas that it has yet to invade, such as most serpentine and roadless grasslands, it is imperative to prevent its introduction or spread. In areas where it is already abundant, such as in sites near most roads (especially on nonserpentine substrates), control and management can be effective.

This species probably was first introduced to California in the mid-1800s, and has been spread along roads and other rights-of-way and throughout grasslands by vehicles, livestock, streams, wildlife, and wind (Roché and Roché 1988, Gerlach et al. 1998, Sheley and Petroff 1999). Yellow start-thistle germinates in the fall, grows a deep taproot while maintaining a small basal rosette, bolts in late May through the senescing canopy of annual grasses, and flowers during summer (Roché et al. 1994, Sheley and Petroff 1999). It is shade-intolerant and prefers deep, fertile soils (Roché et al. 1994).

Yellow star-thistle is abundant and widespread in nonserpentine grasslands and woodlands throughout the KWA; grasslands adjacent to Berryessa–Knoxville Road are dominated by this species (Appendix A, Figure 8n).

3.2 Animals

Appendix G lists all species of birds, mammals, fishes, reptiles, and amphibians that are known to occur in or near the KWA. The lists in Appendix G are based on the Department's 2005 KWA LMP, with additions made to reflect more recent observations.

The 2005 LMP fauna lists had been compiled by the Department using the results of wildlife monitoring at the McLaughlin Reserve, which is adjacent to the KWA and supports many of the same ecosystems. In addition, the 2005 lists draw on other surveys and data sources, as detailed below:

- Historical data on terrestrial vertebrates were collected by D'Appolonia Consulting Engineers in 1981 and 1982 and by the Homestake Mining Company from 1984 until 2002.
- Data on fish occurrence were collected during annual surveys conducted by Bodega Research Associates along Knoxville Creek between 1984 and 2002 (Enderlin 2002). The primary fish sampling station was upstream of the KWA, just upstream of the historical Knoxville town site. In 1994, two additional

sampling stations were established along Knoxville Creek, about 1.6 miles downstream of the primary station.

- Bird and mammal records for the KWA were documented by UC Davis scientist Dr. Darrell Slotten during his work on mercury at the Davis Creek Reservoir.
- Data on animals incidentally observed and reported by Department biologists and others were incorporated.
- The *Breeding Birds of Napa County, California* (Berner et al. 2003) was consulted.

To update the fauna lists for the current LMP, the following data were compiled and assessed to determine which animals should be added as occurring or likely to occur in the KWA:

- The results of focused surveys for certain special-status species, conducted in 2015 by H. T. Harvey & Associates, were incorporated as applicable. Studies included surveys and habitat assessments for prairie falcons (*Falco mexicanus*) and special-status reptiles and amphibians (Appendix D).
- Additional bird data were obtained from the *Breeding Birds of Napa County*, *California*; eBird database; and incidental observations made by H. T. Harvey & Associates biologists during biological surveys in 2015.
- Further data on animals incidentally observed by Department biologists were added to the fauna lists.
- Wildlife observations in the KWA that were reported to the Department's California Natural Diversity Database (CNDDB) were assessed to determine whether any additional species should be included in the fauna lists.

3.3 Endangered, Threatened, and Rare Species

3.3.1 Sensitive Plant Species

For the 2005 LMP, rare plant surveys were conducted by Jake Rugyt between 2002 and 2004; results of these surveys are detailed in the 2005 LMP (CDFW 2005). During these surveys, no state- or federally listed plant species were documented to occur in the KWA; however, three species identified by Rugyt (adobe lily [*Fritillaria pluriflora*]), green jewelflower [*Streptanthus hesperidis*], and Keck's checkerbloom [*Sidalcea keckii*][1]) were then categorized by the California Rare Plant Rank (CRPR)[2] system as rare, threatened, or endangered in

[1] See later discussions of taxonomic ambiguity regarding these species.
[2] California Rare Plant Ranks:
1A = plants presumed extirpated in California and either rare or extinct elsewhere.
1B = plants rare, threatened, or endangered in California and elsewhere.
2A = plants presumed extirpated in California, but common elsewhere.
2B = plants rare, threatened, or endangered in California, but more common elsewhere.
3 = plants about which more information is needed—a review list.
4 = plants of limited distribution—a watch list.
Threat code extensions:
.1 = seriously threatened in California.
.2 = fairly endangered in California.

California or elsewhere (CRPR 1B); one species (Heller's bush mallow [*Malacothamnus helleri*]) was on the review list (CRPR 3); and 14 species were classified as having limited distribution (CRPR 4). These 14 species were Purdy's onion (*Allium fimbriatum* var. *purdyi*), modest rockcress (*Arabis modesta*), Cleveland's milk vetch (*Astragalus clevelandii*), serpentine collomia (*Collomia diversifolia*), swamp larkspur (*Delphinium uliginosum*), Purdy's fritillary (*Fritillaria purdyi*), serpentine sunflower (*Helianthus exilis*), Hoover's lomatium (*Lomatium hooveri*), sylvan microseris (*Microseris sylvatica*), bare monkeyflower (*Mimulus nudatus*), green monardella (*Monardella viridis*), Jepson's navarretia (*Navarretia jepsonii*), Cleveland's ragwort (*Packera clevelandii*), and marsh zigadenus (*Toxicoscordion fontanum*). All of these species, except for two of the CRPR 4 plants, are endemic to, or most common on, serpentine substrates (CNPS 2016).

For the current update to the LMP, rare plant surveys were conducted in 2015 and 2016. These surveys, performed by Daniel Potter and Ninh Khuu of UC Davis, focused on the southern portion of the KWA, targeting land added to the area since 2008. Twelve field trips were made each year, primarily to areas west of the Knoxville-Berryessa Road, especially the western (upper) ends of the Zim Zim and Nevada Creek drainages, where serpentinite-derived soils are common.

A total of 19 rare plant taxa were encountered, one of which is rare, threatened, or endangered in California or elsewhere and is seriously threatened in California (CRPR 1B.1): northern California black walnut (*Juglans hindsii*). Seven are rare, threatened, or endangered in California or elsewhere and are considered fairly endangered in California (CRPR 1B.2): bent-neck fiddleneck (*Amsinckia lunaris*), pink creamsacs (*Castilleja rubicundula* ssp. *rubicundula*), adobe lily, Hall's harmonia (*Harmonia hallii*), Colusa layia (*Layia septentrionalis*), green jewelflower, and Kruckeberg's jewelflower (*Streptanthus morrisonii*).[1] Eleven species encountered are ranked CRPR 4 (having limited distribution): swamp larkspur, serpentine sunflower, marsh zigadenus, Cleveland's milk vetch, serpentine collomia, serpentine bird's-beak (*Cordylanthus tenuis* ssp. *brunneus*), Purdy's fritillary, Hoover's lomatium, bare monkeyflower, green monardella, and Jepson's navarretia.

Estimated population sizes, GPS points, habitat descriptions, photographs, and voucher specimens were taken to document rare plant occurrences. In addition, collections were made of non-rare plant taxa not previously recorded in the KWA, and an updated plant list was produced (Appendix F).

In addition to the species listed above, a *Sidalcea* species was encountered; whether it is the now-federally-listed endangered Keck's checkerbloom (*S. keckii)* or a more widely distributed species (*S. diploscypha*) was investigated. Analyses of molecular evidence were used to query the identity of individuals potentially assignable to the species *S. keckii*. Nucleotide sequence data from the nuclear ribosomal Internal Transcribed Spacer (ITS) region support the conclusion that plants found in the KWA that are morphologically similar to *S. keckii* are, in fact, more closely related to, and may be conspecific with, the more widely distributed species *S. diploscypha* (see Appendix F).

.3 = not very endangered in California.

The plant species that are CRPR 1B or CRPR 3 are eligible for state listing under the California Endangered Species Act (CESA). Impacts on these species or their habitats must be analyzed during CEQA review because they meet the definition of rare or endangered under the State CEQA Guidelines, Sections 15125 (c) and 15380 (CNPS 2016). CRPR 4 species are plants with limited distribution whose vulnerability to extinction appears low at this time. These species probably do not meet the eligibility requirements for state listing, but CNPS recommends that CRPR 4 plants be considered in the CEQA review process because many of them are of local significance. See Appendix C for the CEQA document that analyzes the potential impacts of LMP implementation on these plants and other biological resources.

The following paragraphs describe the sensitive plant species known to occur in the KWA.

Keck's Checkerbloom (Federally Listed as Endangered; CRPR 1B.1)

Keck's checkerbloom (*Sidalcea keckii*) was identified by Jake Rugyt in the surveys conducted for the 2005 LMP. For the LMP update, Daniel Potter and Ninh Khuu sampled five individuals apparently of this species from five separate populations in the KWA, as well as seven herbarium specimens from the herbarium of the UC Davis Center for Plant Diversity. The herbarium specimens originated from the inner North Coast Ranges, with three identified as *S. diploscypha* and four as *S. keckii.* After undertaking genetic testing using nuclear ribosomal ITS DNA sequences, which are widely used in molecular systematic studies of closely related plant species, Potter and Khuu concluded that the plants morphologically similar to *S. keckii* in the KWA and elsewhere in the Inner North Coast Ranges are not assignable to *S. keckii.* However, further work is needed to resolve their taxonomic status. They may represent an undescribed taxon (perhaps a subspecies of *S. diploscypha* or a separate species). Further study is clearly needed on the morphological and molecular variation in this group in order to resolve these taxonomic questions. (For full discussion, see Appendix F.)

Northern California Black Walnut (CRPR 1B.1)

Northern California black walnut is a tree that grows up to 75 feet tall along streams and disturbed slopes. This species is known from only three locations, because it has been widely cultivated as root stock for *Juglans regia* and hybrid plants have escaped cultivation. In the 2015–2016 survey effort, one population of northern California black walnut (*Juglans hindsii*) was encountered along Eticuera Creek and the Berryessa-Knoxville Road, consisting of about five individuals (Appendix F).

Adobe Lily (CRPR 1B.2)

Adobe lily (*Fritillaria pluriflora*) is a perennial geophyte that grows on serpentine mudflows (generally Maxwell Clay). This species is rare in Napa County, and occurs on few sites. In the surveys conducted for the 2005 LMP, this plant was observed about 1.25 miles southeast of Knoxville site near Knoxville Creek, at 1,150 feet in elevation. It is located both in KWA and on adjacent private property. Four-hundred ninety plants were counted in the KWA part of the population. More extensive surveys for this species did not disclose any additional populations.

In the 2015–2016 survey effort, two populations were encountered, north of Zim Zim trailhead, east and west of Berryessa-Knoxville Road. Both were in serpentine grassland outside the target area for this study, but were reported because they were both partly within the KWA boundary. The first, immediately adjacent to the road on both sides, consisted of about 500 individuals on the west side and about 10 individuals on the east side, whereas the second, west of the road on the way up to the ridge east of the Zim Zim Creek drainage, consisted of about 200 individuals (Appendix F).

Bent-Neck Fiddleneck (CRPR 1B.2)

Bent-neck fiddleneck (*Amsinckia lunaris*) is an annual herb that grows on gravelly slopes, often in serpentine soils, in grasslands, openings in woodlands, and coastal bluff scrub. This species is known from 64 occurrences in the Coast Ranges from Santa Cruz County to Colusa County. In the 2015–2016 survey effort, one population of bent-neck fiddleneck, with an estimated size of 500 individuals, was encountered in the upper Nevada Creek drainage in grassland just north of the creek (Appendix F).

Colusa Layia (CRPR 1B.2)

Colusa layia (*Layia septentrionalis*) is an annual herb that grows in serpentine or sandy soils in chaparral, cismontane woodland, and grasslands. There are dozens of occurrences in Lake and Napa Counties. In the 2015–2016 survey effort, one population of Colusa layia, of about 50 individuals, was encountered in oak woodland at the base of a rocky outcrop in the upper Nevada Creek drainage, just outside the KWA boundary; it was reported because its existence suggests that further exploration may reveal occurrences of this taxon in the KWA (Appendix F).

Green Jewelflower (CRPR 1B.2)

Green jewelflower (*Streptanthus hesperidis*) is an annual herb that grows on serpentine barrens and openings among serpentine chaparral. It is known from at least five sites in northern Napa County and from southern Lake County. In the surveys conducted for the 2005 LMP, this species was observed about 0.9 mile southeast of the Knoxville site at 1,350–1,450 feet in elevation. It occurred in a small serpentine barren in a population of 250–300 plants. No populations were found on other barrens within 0.25 mile of this population. In the 2015–2016 survey effort, one population of about 500 individuals was encountered on open rocky serpentine barrens along the road on top of the ridge southwest of Berryessa-Knoxville Road and east of the upper Zim Zim Creek drainage (Appendix F).

Hall's Harmonia (CRPR 1B.2)

Hall's harmonia (*Harmonia hallii*) is an annual herb that grows in serpentine soils in openings and disturbed areas in chaparral. This species is known from only 19 occurrences in Colusa, Lake, Napa, and Yolo counties. In the 2015–2016 survey effort, three populations of Hall's harmonia were encountered on open, rocky serpentine barrens on roadbeds north and east of Zim Zim Falls. The first and largest, consisting of about

1,050 individuals, was along the top of the ridge southwest of Berryessa-Knoxville Road, whereas the second and smallest (about 50 individuals) was to the northwest of the first, along the road descending into the Zim Zim Creek drainage. The third, with about 350 individuals, was somewhat farther west at the bottom of the descent, for a total of about 1,450 individuals (Appendix F).

Kruckeberg's Jewelflower (CRPR 1B.2)

Kruckeberg's jewelflower (*Streptanthus morrisonii* ssp. *kruckebergii*) is perennial herb that grows in serpentine soils in cismontane woodland. It has been recorded in just five locations in Lake, Napa, and Yolo Counties. The Jepson Manual (Baldwin et al. 2012) treats all variants of *Streptanthus morrisonii* as one species without recognizing infraspecific taxa, but this subspecies is listed in the CNPS Inventory of Rare, Threatened, and Endangered Plants of California (CNPS 2016) and tracked in the CNDDB (for full discussion, see Appendix F). In the 2015–2016 survey effort, one population of Kruckeberg's jewelflower, with an estimated size of 200 individuals, was observed in the upper Zim Zim Creek drainage (Appendix F). Thirty-five plants had been observed in this population in 2008.

Pink Creamsacs (CRPR 1B.2)

Pink creamsacs (*Castilleja rubicundula* ssp. *rubicundula*) is an annual herb that grows in serpentine soils in open grassland, openings in chaparral, cismontane woodland, and meadows and seeps. There are dozens of occurrences in Lake and Napa Counties. In the 2015–2016 survey effort, one population of pink creamsacs, with an estimated size of 10 individuals, was encountered in the upper Nevada Creek drainage, immediately adjacent to the creek (Appendix F).

Heller's Bush Mallow (CRPR 3.3)

Heller's bush mallow (*Malacothamnus helleri*) is a shrub found in postfire chaparral in sandstone soils and in gravel in riparian woodlands. In the surveys conducted for the 2005 LMP, one dense population surrounded by more sparsely scattered individuals, estimated at greater than 1,000 individuals, was observed west of Knoxville Creek near the confluence with Foley Creek, in chaparral. Another population of just five to 10 plants was observed in the isolated parcels of the western KWA, in riparian woodland. Other populations may occur in these vegetation types throughout the KWA, especially on the Blue Ridge. The Jepson Manual (Baldwin et al. 2012) treats Heller's bush mallow as a synonym of Fremont's bush mallow, but this species is listed in the CNPS inventory (2016) and tracked in the CNDDB. Location and rarity information for Heller's bush mallow is needed.

Marsh Zigadenus (CRPR 4.2)

Marsh zigadenus (*Toxicoscordion fontanum*) is a perennial geophyte that grows in serpentine streams and on alluvial fans in chaparral, cismontane woodland, lower montane coniferous forest, meadows and seeps, and marshes and swamps. Dozens of occurrences have been recorded in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, a population of 10–25 plants of this species was observed about 0.8 mile

southeast of Knoxville site in a stand of Brewer's willow. In the 2015–2016 survey effort, four populations were encountered in marshy areas along creeks on serpentine soils: three in the upper Zim Zim Creek drainage, with about 300, 500, and 100 individuals, respectively, and one in the upper Nevada Creek drainage, with about 100 individuals (Appendix F). This species may occur at other valley oak woodland sites along stream channels west of Knoxville Creek, where serpentine influence is evident along the channel.

Serpentine Sunflower (CRPR 4.2)

Serpentine sunflower (*Helianthus exilis*) is an annual herb that grows on serpentine seeps and along gravelly streamsides in chaparral and cismontane woodland. Location information for this species in Lake and Napa Counties is outdated. In the surveys conducted for the 2005 LMP, a population of 50–100 plants of this species was observed about 0.8 mile southeast of the Knoxville site, in a stand of Brewer's willow. In the 2015–2016 survey effort, three populations were encountered along creeks on serpentine soils: two in the upper Zim Zim Creek drainage, with about 500 and 200 individuals, respectively, and one in the upper Nevada Creek drainage, with about 50 individuals (Appendix F). This species also may occur in locations west of Knoxville Creek, north of the Foley Creek confluence.

Swamp Larkspur (CRPR 4.2)

Swamp larkspur (*Delphinium uliginosum*) is a perennial herb that grows on serpentine streambanks and in seasonal washes in chaparral and grassland. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, a population of 200–500 plants was observed about 0.8 mile southeast of the Knoxville site in a stand of Brewer's willow in serpentine grassland. At least three stream channels contained this species. In the 2015–2016 survey effort, the species was found diffusely distributed in wet areas of upper Zim Zim and Nevada Creek drainages, with a total of about 500 individuals (Appendix F). Additional plants are likely to occur west of Knoxville Creek where similar conditions occur.

Sylvan Microseris (CRPR 4.2)

Sylvan microseris (*Microseris sylvatica*) is a perennial herb that grows on grassy slopes and ridge tops in serpentine soils, as well as chaparral, cismontane woodland, Great Basin scrub, and pinyon and juniper woodland. In the surveys conducted for the 2005 LMP, 225–300 plants of this species (about half in a single patch) were observed in seven patches along the ridge between Foley Creek and Knoxville Creek in grassland. This ridge was extensively surveyed for additional patches without success. The presence of this species and Hoover's lomatium on this ridge suggest that some serpentine influence may be present. This species has not been located elsewhere in Napa County, but occurs in many other locations in California.

Bare Monkeyflower (CRPR 4.3)

Bare monkeyflower (*Mimulus nudatus*) is an annual herb that grows on barren or sparsely vegetated slopes or the flats of serpentine seeps in chaparral and cismontane woodland. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, an indeterminate number of

bare monkeyflowers was observed about 0.7 mile southeast of Knoxville town site, in a stand of Brewer's willow. In the 2015–2016 survey effort, three populations were encountered on open, rocky serpentine seeps in the upper Zim Zim Creek drainage: one on the western boundary of the KWA with about 500 individuals, the other two, with 500 and 100 individuals, respectively, to the east of the first (Appendix F). This species also may occur in locations west of Knoxville Creek and north of the Foley Creek confluence.

Cleveland's Milk Vetch (CRPR 4.3)

Cleveland's milk vetch (*Astragalus clevelandii*) is a perennial herb that grows on serpentine streams and seeps in chaparral, cismontane woodland, and riparian forest. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, 20–30 plants were observed about 0.8 mile southeast of the Knoxville site, in stands of Brewer's willow, at approximately 1,200 feet in elevation. At least two stream channels contained this species. This species also was observed in two of the isolated western parcels of the KWA, at 1,290 feet in elevation in serpentine grassland in one, and in a stand of Brewer's willow in the other. In the 2015–2016 survey effort, six populations were encountered in serpentine grassland adjacent to creeks: two in the upper Zim Zim Creek drainage, with one and 50 individuals, respectively; two in the upper Nevada Creek drainage, with five and 20 individuals, respectively; and two in the lower Nevada Creek drainage, with one (just outside the KWA boundary) and 50 individuals, respectively (Appendix F). This species also may occur west of Knoxville Creek and north of the Foley Creek confluence.

Cleveland's Ragwort (CRPR 4.3)

Cleveland's ragwort (*Packera clevelandii*) is a perennial herb that grows in serpentine streams and seeps in chaparral, woodlands, and grasslands. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, 10–25 plants were observed about 0.8 mile southeast of the Knoxville site, in a stand of Brewer's willow. It also was observed in serpentine grasslands in an isolated western parcel of the KWA, at 1,400 feet in elevation. This species may be found in other locations, west of Knoxville Creek and north of the Foley Creek confluence.

Green Monardella (CRPR 4.3)

Green monardella (*Monardella viridis*) is a perennial rhizomatous herb that grows on brushy and wooded slopes and in coniferous forests. It can occur in serpentine soils, but is also found on other substrates. This species is widespread in Napa County and occurs at numerous sites. In the surveys conducted for the 2005 LMP, it was observed only in two of the isolated western parcels, in chaparral. In the 2015–2016 survey effort, the species was found diffusely distributed in serpentine chaparral of the upper Zim Zim Creek drainage and slopes to the east, with a total of about 500 individuals (Appendix F).

Hoover's Lomatium (CRPR 4.3)

Hoover's lomatium (*Lomatium hooveri*) is a perennial herb that grows in serpentine and (rarely) volcanic soils in grasslands, chaparral, and cismontane woodland. There are dozens of occurrences of this species in Lake and

Napa Counties. In the surveys conducted for the 2005 LMP, 100–150 plants were observed in five locations at 1,000–1,500 feet in elevation. These sites were located in grasslands about 1.2 miles southeast of the Knoxville site. In the 2015–2016 survey effort, the species was found diffusely and widely distributed in serpentine grassland, woodland, barrens, and chaparral in the upper Zim Zim and Nevada Creek drainages, with a total of about 1,000 individuals (Appendix F). Surveys for this species have not discovered any occurrences east of Foley Creek.

Jepson's Navarretia (CRPR 4.3)

Jepson's navarretia (*Navarretia jepsonii*) is an annual herb that grows in openings in chaparral and cismontane woodland, and in grassy meadows, on serpentine substrates. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, this species was observed only in one of the isolated western parcels of the KWA, at 1,370 feet in elevation in serpentine grassland. In the 2015–2016 survey effort, the species was found diffusely distributed on rocky, open, serpentine barrens along roads in the upper Zim Zim Creek drainage and on the slope to the east, with a total of about 6,000 individuals (Appendix F).

Modest Rock Cress (CRPR 4.3)

Modest rock cress (*Arabis modesta*) is a perennial herb that grows in deep soil on steep slopes, cliffs, and shaded canyon ledges in chaparral and lower montane coniferous forest. This species is rare in Napa County, and is known from few sites along the Vaca Mountains and the Blue Ridge from Monticello Dam north. In the KWA, it grows among sandstone outcrops at the ridge top of the Blue Ridge, at 2,400 feet in elevation. In the surveys conducted for the 2005 LMP, five to 10 plants or more were observed in rough terrain.

Purdy's Fritillary (CRPR 4.3)

Purdy's fritillary (*Fritillaria purdyi*) is a perennial geophyte that grows on serpentine rock outcrops or barrens and dry ridges in chaparral, cismontane woodland, and lower montane coniferous forest. This species occurs in confined populations on serpentine and volcanic substrates in at least 20 locations in Napa County. In the surveys conducted for the 2005 LMP, 240 plants were observed about 0.8 mile southeast of the Knoxville site in a small serpentine barren. Extensive surveys did not disclose additional populations. However, 20 plants were observed in one of the isolated western parcels at 1,605 feet in elevation in chaparral. In the 2015–2016 survey effort, one population with about 1,000 individuals was encountered on open, rocky, serpentine barrens in the upper Zim Zim Creek drainage (Appendix F).

Purdy's Onion (CRPR 4.3)

Purdy's onion (*Allium fimbriatum* var. *purdyi*) is a perennial bulbiferous herb that grows on serpentine rock outcrops and in clay soils in chaparral and cismontane woodland. There is only one occurrence recorded near the KWA, but there are dozens more occurrences in Lake County to the north. In the surveys conducted for the 2005 LMP, 200–400 plants were observed at one site in a small serpentine barren in chaparral, between

1,350 and 1,450 feet in elevation. Surveys of other rock outcrops in the area did not discover additional populations.

Serpentine Bird's-Beak (CRPR 4.3)

Serpentine bird's-beak (*Cordylanthus tenuis* ssp. *brunneus*) is an annual herb that grows on (usually) serpentine soils in mixed-evergreen forest, closed-cone coniferous forest, cismontane woodland, and chaparral. There are dozens of occurrences of this species in Lake and Napa Counties. In the 2015–2016 survey effort, one population of serpentine bird's-beak, with about 1,000 individuals, was encountered in the very northwest corner of the target area for the study, in open, rocky serpentine chaparral north of upper Zim Zim Creek (Appendix F).

Serpentine Collomia (CRPR 4.3)

Serpentine collomia (*Collomia diversifolia*) is an annual herb that grows in rocky to gravelly soils on serpentine barrens and in openings in chaparral, grassland, and cismontane woodland. There are dozens of occurrences of this species in Lake and Napa Counties. In the surveys conducted for the 2005 LMP, 50–100 plants were observed in at least two locations, about 0.8 mile southeast of the Knoxville site in a small serpentine barren in chaparral. This species also was observed in two of the isolated western parcels, in chaparral and in serpentine grassland, respectively. In the 2015–2016 survey effort, this species was found diffusely distributed on rocky, open, serpentine barrens along roads in the upper Zim Zim Creek drainage and on the ridge to the east, with a total of about 1,000 individuals (Appendix F). This species is likely to occur in other serpentine-influenced communities in the KWA, especially west of Knoxville Creek and north of the Foley Creek confluence.

3.3.2 Special-Status Wildlife Species

In addition to the numerous common wildlife species that inhabit the KWA (see Appendix G), several special-status wildlife species occur or have the potential to occur in the KWA. *Special-status* species are those that are state or federally listed as endangered or threatened under the Endangered Species Act (ESA) or are candidates for listing as endangered or threatened. This designation also includes California species of special concern and California fully protected species.

Table 3-6 notes the potential for special-status wildlife species to occur in the KWA. Species listed in the table include both species that are known to occur in the KWA and those that could potentially occur in the KWA. Species known to occur are those that were observed and reported in one of the sources summarized in Section 3.2. Additional species that could occur in the KWA were identified based on a query of CNDDB records from within 5 miles of the KWA and a query of a database identifying federally listed species that could occur in Napa County (the U.S. Fish and Wildlife Service [USFWS] Information for Planning and Conservation [IPaC] database).

For the purposes of this LMP, Table 3-6 evaluates the likelihood that a special-status species could occur in the KWA. The following terms and criteria were used to assess each species' potential for occurrence:

- ***Known to occur*** means that one or more of the sources described in Section 3.2 verifies that the species has been observed in the KWA. This designation excludes observations of nonbreeding birds in the KWA.

- ***Likely to occur*** means that the species has not been observed in the KWA, but it has been observed locally (i.e., within 5 miles of the KWA) and suitable habitat exists in the KWA. For birds, this designation applies to species that have not been observed to breed in the KWA but that could be expected to breed there because suitable breeding habitat exists in the KWA.

- ***May occur*** means that the species has not been observed in the KWA (or for birds, has not been observed to breed in the KWA), but it has been observed regionally (i.e., more than 5 miles from the KWA) and suitable habitat exists in the KWA.

- ***Unlikely to occur*** means that, although the species has been observed regionally (i.e., more than 5 miles from the KWA), it has not been observed in the KWA (or for birds, has not been observed to breed in the KWA) and suitable habitat does not exist in the KWA.

- ***Does not occur*** means that the species could not possibly occur in the KWA, even though it is present regionally.

Four wildlife species designated by the Department as California species of special concern are known to occur in the KWA: the foothill yellow-legged frog, the western pond turtle, the long-eared owl (*Asio otus*), and the American badger (*Taxidea taxus*). Additionally, the prairie falcon (*Falco mexicanus*) is likely to occur and has been documented in the vicinity of KWA. Although this species was recently downlisted from a species of special concern to a watch-list species, the Department still considers the prairie falcon to be a species of management interest. Special-status species that are likely to occur and have been documented in the vicinity of the KWA are: the California red-legged frog (*Rana draytonii*) (federally listed as threatened and a California species of special concern), the golden eagle (*Aquila chrysaetos*) (fully protected), and the Townsend's big-eared bat (*Corynorhinus townsendii*) (candidate for state listing as threatened) (Table 3-6).

Reported occurrences of these species in and within a mile of the KWA are shown in Figure 6, and a short description of the life history and ecology of each special-status species that is either known to occur in the KWA or that is likely to occur in the KWA is provided below.

Table 3-6. Potential Occurrence of Special-Status Wildlife Species in the Knoxville Wildlife Area

Name	Status[1]	Habitat	Potential for Occurrence in KWA[2]
Invertebrates			
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT/–	Breeds in and forages exclusively on elderberry shrubs associated with riparian forest, elderberry savannas, and other Central Valley habitats. Occurs only in the Central Valley of California.	**Does not occur.** The KWA is outside the range of this species and does not provide suitable habitat for the species.
Vernal pool fairy shrimp *Branchinecta lynchi*	FT/–	Found in vernal pools and swales of many sizes and depths with cool water and moderate to sparse vegetation. Typically associated with shorter-ponding vernal pool habitats.	**Unlikely to occur.** Suitable habitat is not present in the KWA.
Vernal pool tadpole shrimp *Lepidurus packardi*	FE/–	Found in cool-water vernal pools, ditches, stock ponds, and similar seasonal wetland and vernal pool habitats. Although often associated with larger vernal pools, this species can occur in pools of many sizes and depths as long as the hydroperiod is appropriate. Typically associated with longer-ponding vernal pool habitats.	**Unlikely to occur.** Suitable habitat is not present in the KWA.
Amphibians			
California red-legged frog *Rana draytonii*	FT/SSC	Found in perennial or near-perennial lakes, ponds, reservoirs, slow-moving streams, marshes, bogs, and swamps in lowlands and foothills.	**Likely to occur.** Although uncommon throughout the northern Interior Coast Ranges, the KWA is within the range of this species. Three observations have been verified regionally (CNDDB 2016), south of Lake Berryessa and near Pope Valley, and observations have been reported at the McLaughlin Reserve (Enderlin 2002). The ponds throughout the KWA provide suitable breeding habitat for this species.
Foothill yellow-legged frog *Rana boylii*	–/SSC	Found in partly shaded, shallow streams, riffles, and pools with a rocky substrate and sunny banks, in a variety of habitats.	**Known to occur.** This species has been observed in Knoxville Creek, Eticuera Creek, and Zim Zim Creek. Suitable habitat is present in many stretches of these creeks.
Reptiles			
Giant garter snake *Thamnophis gigas*	FT/ST	Found in marshes, sloughs, drainage canals, irrigation ditches, rice fields, and slow-moving creeks.	**Does not occur.** The KWA is outside the range of this species and does not provide suitable habitat.

Name	Status[1]	Habitat	Potential for Occurrence in KWA[2]
Western pond turtle *Actinemys marmorata*	–/SSC	Found in slow-moving streams, rivers, lakes, ponds, wetlands, reservoirs, and brackish estuarine waters with deep pools and rocks, logs, and other exposed surfaces that are used for basking.	**Known to occur.** This species has been observed in Knoxville Creek, Eticuera Creek, and Zim Zim Creek. Suitable habitat is present in many stretches of these creeks.
Birds			
American peregrine falcon *Falco peregrinus anatum*	D/D, FP	Breeds on cliffs and human-made structures. Forages far afield to wetlands, lakes, rivers, or other water.	**May occur.** The sandstone bluffs along Blue Ridge, near the eastern boundary of the KWA, provide suitable breeding habitat for this species.
Bald eagle *Haliaeetus leucocephalus*	D/SE, FP	Nests in large trees with open branches along lake and river margins, usually within 1 mile of water.	**Unlikely to occur.** This species breeds on Davis Creek Reservoir adjacent to the KWA. The KWA does not provide suitable breeding habitat for bald eagle.
Bank swallow *Riparia riparia*	–/ST	Nests in colonies in vertical banks and cliffs with fine-textured and sandy soils near streams, rivers, lake, and ocean bluffs.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Burrowing owl *Athene cunicularia*	–/SSC	Found in grasslands, agricultural field margins, and ruderal habitat supporting short vegetation structure and abundant small mammal burrows.	**Unlikely to occur.** The KWA provides only marginally suitable breeding habitat for this species. Burrowing owls have been documented along roadsides near Lake Berryessa during winter; breeding in the vicinity of the KWA has not been confirmed.
Golden eagle *Aquila chrysaetos*	–/FP, WL	Nests in cliff-walled canyons in most parts of the species' range; also nests in large trees in open areas.	**Likely to occur.** The KWA provides suitable foraging habitat for this species. Incidental observations of golden eagles have been recorded in the KWA, and breeding has been documented along Blue Ridge. There are no confirmed breeding records for this species in the KWA.
Least bittern *Ixobrychus exilis*	–/SSC	Found in freshwater marshes with tall, dense emergent vegetation, woody vegetation, and grasses.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Loggerhead shrike *Lanius ludovicianus*	–/SSC	Found in shrubs and low, scattered trees amid grasslands and agricultural fields.	**Unlikely to occur.** The KWA provides only marginally suitable breeding habitat for this species.
Long-eared owl *Asio otus*	–/SSC	Found in oak, conifer, and riparian communities adjacent to open areas, such as grasslands and shrublands.	**Known to occur.** The species has been observed nesting in the KWA, and suitable breeding habitat for the species is present throughout the KWA.

Name	Status[1]	Habitat	Potential for Occurrence in KWA[2]
Mountain plover *Charadrius montanus*	–/SSC	Found in short, sparse grasslands and other sparsely vegetated open, dry areas in lowland habitats.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Northern spotted owl *Strix occidentalis caurina*	FT/SC, SSC	Found in dense, mature coniferous forests with standing snags, dense canopy closure, and a variety of species, age classes, and vegetation structure.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Olive-sided flycatcher *Contopus cooper*	–/SSC	Breeds in coniferous forests with open canopies, especially along the edges of clearings, open areas, and wooded streams.	**May occur.** Incidental observations of this species have been documented in the KWA during spring migration (April), and suitable breeding habitat for the species is present. There are no confirmed breeding records for this species in the KWA.
Prairie falcon *Falco mexicanus*	--/WL	Nests in rock outcroppings, cliffs, and canyons. Forages in grasslands, shrublands, pastures, and agricultural fields.	**Likely to occur.** This species nests in the sandstone bluffs along Blue Ridge, near the eastern boundary of the KWA. The species may forage in the KWA.
Short-eared owl *Asio flammeus*	–/SSC	Found in grasslands, both freshwater and saltmarsh, and irrigated alfalfa fields. Nests on bare ground in tall vegetation.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Swainson's hawk *Buteo swainsoni*	–/ST	Found in cottonwood riparian forests and in isolated trees in open grasslands adjacent to streams and agricultural crops, which are used for foraging.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
Tricolored blackbird *Agelaius tricolor*	–/SSC, SC	Nesting habitat includes emergent vegetation, such as cattail and tule, and nonnative vegetation, including blackberry, giant reed, mustards, thistles, tamarisk, and grain fields; also nests in agricultural fields.	**Unlikely to occur.** Suitable breeding habitat is not present in the KWA.
White-tailed kite *Elanus leucurus*	–/FP	Nesting habitat includes oak woodlands and isolated trees along marsh edges and field margins. Foraging habitat includes grasslands, meadows, and agricultural fields.	**May occur.** Incidental observations of this species have been reported in the KWA and suitable breeding habitat is present. There are no confirmed breeding records for this species in the KWA.

Name	Status[1]	Habitat	Potential for Occurrence in KWA[2]
Fishes			
Delta smelt *Hypomesus transpacificus*	FT/SE	Found in open surface waters in the Delta. Seasonally occupies Suisun Bay, Carquinez Strait, and San Pablo Bay. Found in Delta estuaries with dense aquatic vegetation and low occurrence of predators.	**Does not occur.** Physical barriers (i.e., Lake Solano and Lake Berryessa) preclude presence in the KWA and suitable habitat is not present.
Steelhead (Central Valley DPS) *Oncorhynchus mykiss*	FT/–	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and the Delta.	**Does not occur.** Physical barriers (i.e., Lake Solano and Lake Berryessa) preclude presence in the KWA.
Mammals			
American badger *Taxidea taxus*	–/SSC	Dry, open stages of most shrub, forest, and herbaceous communities, with friable soils.	**Known to occur.** Documented to occur in the KWA by Department staff, and suitable habitat is present.
Townsend's big-eared bat *Corynorhinus townsendii*	–/SC, SSC	Roosts in caves or cave-like features, including rock outcrops, mines, natural cavities, and hollow trees.	**Likely to occur.** Breeding colonies of this species have been documented in abandoned mine shafts at the McLaughlin Reserve adjacent to the KWA, and other suitable roosting habitat (tree hollows) is present in the KWA.
Pallid bat *Antrozous pallidus*	–/SSC	Roosts in crevices in rocky outcrops, caves, mines, trees (including bole cavities of oaks and exfoliating bark), and various human-made structures, such as bridges, barns, and vacant buildings.	**May occur.** Suitable habitat is present in the KWA.
Western mastiff bat *Eumops perotis californicus*	–/SSC	Occupies a wide variety of habitats from arid deserts and grasslands through mixed conifer forests. Roosts in crevices in cliff faces, high buildings, trees, and tunnels.	**May occur.** The cliffs and canyons throughout the KWA provide suitable habitat for this species.
Western red bat *Lasiurus blossevillii*	–/SSC	Roosts in the foliage of willow, cottonwood, and sycamore trees in riparian areas.	**May occur.** Suitable habitat is present in the KWA.

Name	Status[1]	Habitat	Potential for Occurrence in KWA[2]

Notes: DPS = distinct population segment; KWA = Knoxville Wildlife Area.

[1] Status definitions:

FE = federally listed as endangered.

FP = state fully protected species.

FP= federally proposed for listing.

FT = federally listed as threatened.

SC = state candidate for listing.

SE = state listed as endangered.

ST = state listed as threatened.

SSC = state species of special concern.

WL = on a watch list.

D = Downlisted.

[2] Potential for occurrence definitions:

Known to occur = one or more of the sources described in Section 3.2 verifies that the species has been observed in the KWA. This designation excludes observations of nonbreeding birds in the KWA.

Likely to occur = the species has not been observed in the KWA, but it has been observed locally (i.e., within 5 miles of the KWA) and suitable habitat exists in the KWA. For birds, this designation applies to species that have not been observed to breed in the KWA but that could be expected to breed there because suitable breeding habitat exists in the KWA.

May occur = the species has not been observed in the KWA (or for birds, has not been observed to breed in the KWA), but it has been observed regionally (i.e., more than 5 miles from the KWA) and suitable habitat exists in the KWA.

Unlikely to occur = although the species has been observed regionally (i.e., more than 5 miles from the KWA), it has not been observed in the KWA (or for birds, has not been observed to breed in the KWA) and suitable habitat does not exist in the KWA.

Does not occur = the species could not possibly occur in the KWA, even though it is present regionally.

Species Known to Occur in the KWA

Foothill Yellow-Legged Frog. The foothill yellow-legged frog, a stream-breeding frog, is a species of special concern in California. This species was historically found in most Pacific drainages from the Coast Ranges to the western Sierra Nevada and San Gabriel Mountain foothills (Jennings and Hayes 1994, Nafis 2016). Currently, the foothill yellow-legged frog may occupy only 55% of its historical range (Nafis 2016). Foothill yellow-legged frogs occur in streams in a variety of habitats, including valley-foothill woodlands, mixed conifer forests, chaparral, and wet meadows. This species prefers open, sunny stretches of low-velocity streams with cobble-sized rocks and shallow riffles (Jennings and Hayes 1994). In California, foothill yellow-legged frogs breed between mid-March and early June after the end of spring flooding. Larvae graze on algae and diatoms until metamorphosing, typically in low-flow backwaters, approximately 4–5 months after hatching (Hayes et al. 2005).

In the KWA, foothill yellow-legged frogs appear to be common in Knoxville Creek and Eticuera Creek (CDFG 2005, CNDDB 2016). In 2003, focused surveys for aquatic reptiles and amphibians were conducted for the northern portion of the KWA; these surveys included wet-season road surveys along Berryessa–Knoxville Road (which runs along Knoxville and Eticuera Creeks), nighttime spotlight surveys of ponds and creeks, and photodocumentation of all known stock ponds in the KWA. An evening spotlight survey for yellow-legged frogs along a segment of Knoxville Creek on March 14, 2004, yielded eight adults (all or mostly males) in a segment of creek approximately 0.17 mile long. This stretch of creek is immediately downstream of a private parcel and was treated for tamarisk removal prior to the survey. A second survey conducted along Eticuera Creek in 2004 yielded no foothill yellow-legged frogs, but other aquatic amphibians and reptiles, including Pacific treefrogs (*Pseudacris regilla*), western pond turtles, bullfrogs (*Lithobates catesbeianus*), and California newts (*Taricha torosa*), were abundant in sections of streams with relatively slow-moving or deep water. Additionally, Department biologists have incidentally observed probable foothill yellow-legged frog tadpoles in Eticuera Creek near the Wilson Barn, and recent habitat assessment surveys in 2015 documented the presence of suitable habitat for the species in many reaches of Eticuera and Zim Zim Creeks (Appendix D).

Documented occurrences of foothill yellow-legged frogs observed in the KWA are depicted in Appendix A, Figure 6.

Western Pond Turtle. Western pond turtles are a species of special concern in California. This species occurs in a wide range of both permanent and intermittent aquatic environments, including ponds, lakes, rivers, streams, vernal pools, marshes, and human-constructed water bodies, such as irrigation ditches and impoundments (Bury and Germano 2008). Aquatic habitat with suitable basking sites (such as logs, rocks, mats of floating vegetation, or open mud banks) and underwater refugia (such as rocks or submerged vegetation) is important for this species (Hays et al. 1999). These features are found in a variety of habitats, including oak woodlands, grasslands, open forests, and riparian communities. Western pond turtles breed

from March through August, and females excavate nests and lay eggs in uplands adjacent to aquatic features (Nafis 2016).

Western pond turtles are common in Knoxville and Eticuera Creeks. Surveys and incidental observations made in 2004 resulted in detections of western pond turtles in Eticuera Creek and in an oxbow of Knoxville Creek that is bisected by Berryessa–Knoxville Road; Department biologists also frequently observe western pond turtles in both creeks. Additional surveys were conducted in 2015 to assess the quality of habitat along Eticuera and Zim Zim Creeks. Five western pond turtles were observed along Eticuera Creek. The methods and results of these surveys are described in Appendix D, and occurrence records of western pond turtles observed in the KWA are depicted in Appendix A, Figure 6. No nonnative reptile species (such as red-eared sliders [*Trachemys scripta elegans*]), which could compete with western pond turtles, were observed in 2015.

Long-Eared Owl. The long-eared owl (*Asio otus*), a California species of special concern, is an uncommon year-long resident throughout much of the state, excluding the Central Valley. Long-eared owls typically occupy dense riparian habitats of willows and cottonwoods, but also belts of live oaks, particularly those paralleling stream courses or meadow edges. Long-eared owls also may be found in dense conifer stands at higher elevations. This species forages over open areas, including grasslands, meadows, and clearings. The long-eared owl breeds from early March to late July and typically nests in old corvid or hawk nests, clumps of mistletoe, tree cavities, and other locations that are relatively concealed from predators. The breeding season extends from approximately February through July (Marks et al. 1994, Haas 2004). Long-eared owls are known to occur in the KWA: nesting in Long Canyon was documented in 1990 (Berner et al. 2003).

American Badger. The American badger (*Taxidea taxus*), a California species of special concern, is a stocky, burrowing mammal that occurs in grassland habitats throughout the western United States. Badgers can have large territories, up to 21,000 acres in size, with territory size varying by sex and by season. They are strong diggers, and feed primarily on other burrowing mammals, such as California ground squirrels (*Otospermophilus beecheyi*). In the region of the KWA, American badgers may be found in annual grasslands, oak woodland savannas, semiarid shrub/scrublands, and any habitats with stable populations of ground squirrels or other fossorial rodents (i.e., gophers, kangaroo rats, or chipmunks [Zeiner et al. 1990]). Badgers are primarily nocturnal, although they often are active during the day. They breed during late summer, and females give birth to a litter of young the following spring. In the KWA, multiple American badgers have been observed on Department wildlife cameras, and a badger carcass was documented by Department staff.

Species Likely to Occur in the KWA

California Red-Legged Frog. The California red-legged frog is a federally listed threatened species and a California species of special concern. The species is found in perennial or near-perennial lakes, ponds, reservoirs, slow-moving streams, marshes, bogs, and swamps in lowlands and foothills. Breeding occurs from late November through early May after the onset of warm rains (Storer 1925, Jennings and Hays 1994). Preferred breeding habitat consists of deep perennial pools with emergent vegetation such as cattails, tules (*Schenoplectus* spp.), or sedges (*Carex* spp.) for attaching egg clusters (Hayes and Jennings 1988, Fellers 2005),

as well as shallow benches to act as nurseries for juveniles (Jennings and Hayes 1994). However, California red-legged frogs have also been observed to inhabit stock ponds, sewage treatment ponds, and artificial (i.e., concrete) pools completely devoid of vegetation (Storer 1925). Nonbreeding frogs may be found adjacent to streams and ponds in grasslands and woodlands. They use small mammal burrows in or under vegetation, willow root wads, the undersides of old boards and other debris in the riparian zone, and large cracks in the bottom of dried ponds as refugia (Jennings and Hayes 1994, USFWS 2002). The species has been documented at the McLaughlin Reserve (Enderlin 2002) and in three separate locations regionally (CNDDB 2016), but has not been documented in the KWA. The numerous ponds, especially those that lack predators (e.g., fish, bullfrogs), provide suitable breeding habitat for the species, and the adjacent grasslands provide suitable upland and overwintering habitat.

Golden Eagle. The golden eagle (*Aquila chrysaetos*), a California fully protected species, occupies a range of open habitats, including desert scrub, foothill cismontane woodlands, and annual or perennial grasslands. The species' breeding range in California excludes only the Central Valley, the immediate coast in the far north, and the southeastern corner of the state (Zeiner et al. 1990). Nesting habitat is characterized by large, remote patches of grassland or open woodland, a hilly topography that generates lift, an abundance of small mammal prey, and tall structures that serve as nest platforms and hunting perches. The nesting season begins in late January and continues through August. Following nesting, adult eagles usually remain in or near their breeding territory (Zeiner et al. 1990). Golden eagles are known to breed in the vicinity of the KWA (CNDDB 2016), they have been observed there incidentally, and the KWA provides suitable breeding and foraging habitat for the species.

Prairie Falcon. The prairie falcon was recently downgraded from a California species of special concern to a watch list species; however, the Department considers it to be a species of management interest in the KWA because it could be affected by resource management actions. Prairie falcons inhabit a variety of habitat types and elevation ranges up to approximately 11,000 feet. They nest on high rocky outcroppings, cliffs, and escarpments adjacent to arid grasslands and shrublands, where they hunt California ground squirrels, small birds, reptiles, and rodents (Steenhof 2013). Prairie falcons have nested in the sandstone bluffs on the west face of Blue Ridge, on BLM land adjacent to the central portion of the KWA, and on bluffs and escarpments in the surrounding area (CDFG 2005, CNDDB 2016). Prairie falcons have not been observed foraging within the KWA, although they have been observed flying along the face of the Blue Ridge in the south. The home ranges of these falcons probably extend beyond the boundaries of the KWA, but suitable foraging habitat is present in the area and the cliff faces and rock outcroppings of the Blue Ridge provide suitable habitat for the species. No prairie falcons were incidentally observed during the spring 2015 surveys.

Townsend's Big-Eared Bat. The Townsend's big-eared bat (*Corynorhinus townsendii*) is a California species of special concern and a candidate species for state listing as threatened. Townsend's big-eared bat is a colonial species that occurs in a wide variety of habitat types, including coniferous forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats (Sherwin and Piaggio 2005). Although the Townsend's big-eared bat is usually a cave-dwelling species, many colonies are found in human-made

structures, such as the attics of buildings or old abandoned mines. Known roost sites in California include limestone caves, lava tubes, mine tunnels, buildings, and other structures (Williams 1986). This species also roosts in deep crevices of redwood trees. The distribution of Townsend's big-eared bats is strongly correlated with the availability of roosting habitat and the absence of human disturbance at roost sites (Pierson and Rainey 1998, Sherwin and Piaggio 2005). Females aggregate in the spring at maternity colonies to begin their breeding season, which may extend through the end of August. Maternity colonies in California may be active from March through September (Pierson and Rainey 1998). This species has breeding colonies in abandoned mine shafts at the McLaughlin Reserve next to the KWA, and suitable habitat is present in the KWA.

Section 4. Management Goals and Environmental Impacts

4.1 Definition of Management Terms

The Department's land management program is organized into elements, goals, and tasks, which establish a hierarchy of management direction for the KWA. *Elements* define the broad categories of consideration, *goals* define objectives within the elements, and *tasks* establish specific actions to attain the goals. Elements themselves are somewhat hierarchical, with broader categories of consideration (e.g., ecosystems) listed before specific ones (e.g., facility maintenance needs). Together the elements, goals, and tasks express the policy direction that will guide the management of the KWA. To better acquaint the reader with this terminology, the following terms and meanings are established for use in this plan:

- **Element** refers to any biological, ecosystem, or cultural constituent; public use activity; or facility maintenance or management coordination program (as defined below) for which goals have been prepared and presented in this plan.
- **Biological Element** refers to any ecosystem, habitat, or species for which specific management goals have been developed in this plan.
- **Public Use Element** refers to any recreational use or other activity appropriate to and compatible with the purposes for which the KWA was acquired.
- **Facility Maintenance Element** refers to any maintenance or administrative program that helps provide for orderly and beneficial management of the Wildlife Area
- **Biological Monitoring Element** refers to the ongoing monitoring of ecosystem, habitat, and species characteristics that will inform adaptive management of the KWA.
- A **biological goal** is a statement of the intended long-range results of management to enhance, restore, or control any biological element.
- A **public use goal** is a statement of the desired type and level of public use compatible with the biological goals specified in this plan.
- A **facility maintenance goal** is a statement of the desired type and level of maintenance and management that are required to achieve the goals in this plan.
- A **biological monitoring goal** is a statement identifying the ecosystems and species that will be the focus of ongoing monitoring.
- **Tasks** are individual projects, actions, or measures necessary to achieve a goal and that are useful in planning operation and maintenance budgets.

4.2 Management Opportunities and Constraints

There are opportunities for managing the KWA's plants and animals and the habitats upon which they depend to benefit them and to enhance public use and enjoyment of the wildlife area. The primary source of management opportunities is the presence of large, contiguous areas of relatively intact, high-diversity ecosystems, including riparian areas and plant communities on serpentine soils. Legacy infrastructure from historical livestock grazing operations (roads, fences, stock ponds) also provides management opportunities.

However, resources and facilities also present several major constraints on management, including:

- limited access to large portions of the wildlife area that precludes some management tasks,
- county road crossings that impair the stream processes that sustain aquatic and riparian ecosystems,
- presence of invasive plant species that may be spread by public uses and management actions,
- sensitivity of some species and ecosystems to human activities,
- vegetation with a high potential for catastrophic wildfire,
- an unpaved road network that is largely a legacy of historical uses and in some cases is in disrepair and generating sediment inputs to streams and other water bodies,
- public safety needs, and
- limited and uncertain funding for many of the tasks involved in implementing this LMP.

4.3 Biological Elements

The purpose of the Biological Elements is to maintain and enhance aquatic, riparian, and upland ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired ecosystem functions.

This plan adopts an integrative ecosystem approach to resource management and thus defines the Biological Elements broadly. The approach is based on the principle that maintaining a healthy ecosystem is the most efficient way to ensure healthy populations of native wildlife, including rare and sensitive plants and animals and game species. The five Biological Elements addressed in this plan are as follows:

1. Aquatic and riparian ecosystems
2. Grassland and woodland ecosystems
3. Chaparral ecosystems
4. Serpentine soil ecosystems
5. Game species

The first four Biological Elements organize goals and tasks by ecosystem type, because maintaining the integrity of ecosystems is the most efficient way to ensure healthy populations of native species, including rare and sensitive plants and animals. These ecosystems are aquatic and riparian, grassland and woodland, chaparral, and serpentine soil ecosystems. Serpentine soil ecosystems primarily have chaparral and grassland vegetation, but are distinguished as a separate element because their atypical soil chemistry supports vegetation communities that differ in species composition and structure from those found on nonserpentine soils at the KWA, including a number of species that are restricted to serpentine soils. Game species (e.g., deer, turkey, and quail) are addressed by a separate, fifth Biological Element because their populations require specific management actions.

4.3.1 Aquatic and Riparian Ecosystems

Goal 1. Maintain Natural Sediment Movement through the Creek Ecosystem

Excessive erosion and sediment deposition degrades water quality and aquatic habitats, and by altering channel form can also degrade riparian ecosystems. Therefore, erosion and sediment control can be necessary for conservation of aquatic and riparian ecosystems.

Tasks:

1. Identify and prioritize (by severity) sources of erosion (e.g., dams, roads, trails, and firebreaks).

2. Abate high-priority erosion sources through revegetation with native species and biotechnical control measures that also sustain or enhance habitat for special-status wildlife (e.g., foothill yellow-legged frogs).

3. Develop maps identifying critical areas where emergency revegetation or biotechnical or structural measures may be needed to prevent erosion or flooding after a fire. Implement such measures as appropriate following fire or fire suppression.

In addition to performing the tasks listed above, the Department will implement the following measures in conjunction with any ground-disturbing management activities that occur in aquatic and riparian ecosystems.

4. If work will occur outside of the dry season, implement erosion and sediment control measures for significant ground-disturbing, operations. These measures may include revegetation with native plants, use of mulch, straw, or erosion control fabric to protect exposed soil, and the use of silt fencing, well-anchored sandbag cofferdams, coir logs, coir rolls, straw-bale dikes, or other barriers that prevent eroded soil from entering waterways by overland flow.

5. If work will occur outside of the dry season, implement stormwater pollution prevention measures for projects of more than 1 acre. Before beginning any construction project involving soil

disturbance greater than 1 acre, implement stormwater pollution prevention measures, including best management practices (BMPs) to eliminate or minimize the potential for construction-related pollution (e.g., sediment, fuels, pesticides, cement) to enter streamflows directly or through stormwater runoff.

Goal 2. Where Appropriate, Maintain Grazing Regime That Does Not Reduce Integrity of Riparian and Aquatic Ecosystems

Livestock use of creeks and riparian areas can destabilize channel banks, reduce woody vegetation, and degrade water quality. However, grazing is an important technique for managing the grasslands and woodlands surrounding riparian areas and streams. Thus, implementing a livestock grazing regime that does not reduce the integrity of riparian and aquatic ecosystems is necessary for attaining the goals of upland, riparian, and aquatic ecosystems.

Tasks:

1. Implement grazing plan measures that minimize livestock impacts on riparian areas and on existing ranch roads. Measures include limiting grazing by season, rotating livestock among four or more pastures to reduce residence time, providing water and nutritional attractants away from riparian areas (Appendix I).

2. Maintain or add fencing as needed to protect important riparian areas from inappropriate grazing, while ensuring that fenced areas remain available for deer fawning and other wildlife uses.

Goal 3. Control Nonnative Invasive Plant Species

The introduction and spread of nonnative invasive plants degrades riparian and aquatic ecosystems. Currently, nonnative invasive plants are present in riparian and aquatic ecosystems of the KWA, and additional species are present in other such ecosystems in the region, and may spread into the KWA (Table 3-5). Thus, attaining this goal would enhance these ecosystems and avoid the degradation that would result from further spread of these harmful species.

Tasks:

3. Identify nonnative invasive plant species that have invaded the KWA, and prioritize management of particular weed species. Base priorities on (1) the species' potential impacts on ecosystem function, and (2) the feasibility and impacts of controlling the species. Follow the priorities of existing state and federal programs where appropriate.

2. Implement the following weed management measures:

(a) Implement control plans for invasive plant species whose ecological impacts have been rated "high" by the California Invasive Plant Council (Cal-IPC) (e.g., perennial pepperweed, tamarisk) (see Table 3-5).
(b) Eradicate satellite infestations of invasive plant species whose ecological impacts have been rated "moderate" by Cal-IPC. Satellite infestations are discrete infestations of invasive plants, usually smaller than an acre, which are isolated from other infestations and thus present greater opportunities for eradication with focused treatment.
(c) Restore native plant communities when eradicating invasive plant infestations, focusing on expanding the cover of native grasses and woody riparian species, through planting, seeding, or facilitating natural recruitment.
(d) Plan travel routes and work areas to avoid invasive plant infestations, where feasible.
(e) Clean equipment, vehicles, and clothing after leaving infested areas and before entering uninfested areas.
(f) Use only certified weed-free fill and plant materials (e.g., seed mixtures, straw used for erosion control).
(g) Minimize soil and vegetation disturbance, and revegetate disturbed areas with native plant species.

3. Apply herbicides in conformance with the Department's Pesticide Use Program and product labels to ensure safe and effective use that avoids or minimizes adverse environmental effects.

4. Conduct a preactivity survey for special-status plant populations before applying herbicides to, or mechanically removing, invasive plant infestations. Avoid impacts if special-status plants are present. Preactivity surveys will be conducted focusing on suitable habitat for special-status plants.

5. Perform mechanical removal and herbicide treatment of invasive plant infestations outside the bird nesting season (January–August) when feasible to avoid impacts on nesting birds protected by the California Fish and Game Code, the ESA, CESA, and the federal Migratory Bird Treaty Act. If mechanical removal or herbicide treatment of vegetation is required during the bird nesting season, perform a preactivity survey to identify the locations of nesting birds and avoid affecting them.

6. Coordinate invasive plant management with neighboring property owners and land managers.

Goal 4. Protect and Enhance Habitat for Special-Status and Non-Listed Plants and Wildlife

The aquatic and riparian ecosystems of the KWA provide habitat for many plant and animal species, including species of special concern. Protecting and enhancing habitat is fundamental to the conservation of all these species, and is particularly important for species whose habitats have been degraded or which are vulnerable to impacts caused by human activities.

Tasks:

1. Protect and enhance stream habitat for foothill yellow-legged frogs.

2. Maintain and repair large stock ponds for use by western pond turtles. Enhance pond habitat for western pond turtles by planting emergent vegetation (e.g., tules or cattails) along shallow margins of ponds that are mostly more than 4 feet in depth, or installing basking logs, if such habitat is lacking.

3. Locate and protect upland nesting habitat for western pond turtles.

4. Continue planting native woody species (e.g., willows and cottonwoods) along creeks, where appropriate, and where planting such vegetation would not degrade existing, high-quality habitat for foothill yellow-legged frogs.

5. Conduct management activities and manage public uses to avoid or minimize effects on areas known to be occupied by special-status species, and to enhance habitat values.

6. Schedule ground-disturbing and vegetation-clearing activities to occur when effects on special-status species would be avoided, where practicable.

7. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species, plan these activities to avoid habitat occupied by special-status species and within an avoidance buffer around the habitat. Buffer widths will be determined using Department or USFWS guidance, as appropriate.

8. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species and activities must occur inside occupied habitat or an avoidance buffers, then conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species," as potentially present in the KWA and that occupy aquatic and riparian ecosystems).

9. Direct public activities away from areas known to be occupied by special-status plants. Control off-road vehicular trespass.

Impacts of the Aquatic and Riparian Ecosystems Element

The purpose of the Biological Elements is to maintain and enhance ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired ecosystem functions. Implementation of all the above-listed tasks will support this purpose by preserving and enhancing aquatic and riparian habitats. However, tasks that involve eradicating and controlling nonnative invasive plants, installing and maintaining fencing and signs, managing a grazing regime, repairing and maintaining water sources for animals, and planting native vegetation in restoration areas could result in minor and temporary environmental impacts. As discussed in the initial study/negative declaration (Appendix

C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use of construction equipment and vehicles; using herbicides; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some temporary habitat disturbance, this element's tasks ultimately will result in long-term benefits to habitats and native species, in support of the element's goals. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and coordination, impact avoidance, BMP implementation, regulatory compliance, restoration, and monitoring. For example, any negative effects of temporary soil disturbance will be minimized through the use of erosion and sedimentation control measures.

4.3.2 Grassland and Woodland Ecosystems

Goal 1. Maintain Fire Regime That Sustains Biodiversity of Grasslands and Woodlands

Oak woodland and grassland ecosystems are characterized by a surface fire regime. Periodic, low- to moderate-intensity fires decrease thatch and annual grass cover, top-kill shrubs and oak saplings, and increase herbaceous cover. Overall, they promote the biodiversity of woodlands and grasslands. Also, in the absence of fire, shrub and sapling cover increases, providing "ladder" fuels that increase the likelihood of fire entering the tree canopy and severely damaging and killing mature oak trees. Thus, fire management is important for sustaining the biodiversity of woodlands.

Tasks:

1. Develop a wildland fire response plan for the KWA. Develop this plan in coordination with the California Department of Forestry and Fire Prevention (CAL FIRE).

2. Provide CAL FIRE with maps of known sensitive biological and cultural resources.

3. Coordinate with CAL FIRE on prioritization and maintenance of ranch roads that are critical for fire protection.

4. Develop prescribed (controlled) burn plans for the wildlife area, tailored to the conditions of, and targeted outcomes for, specific habitat types and areas. Develop these plans in coordination with CAL FIRE.

5. Implement controlled burns to produce a patchwork of various successional stages without facilitating invasion by nonnative grasses.

Goal 2. Maintain Grazing Regime That Sustains Biodiversity of Grasslands and Woodlands

Grazing can have both beneficial and negative effects on the biodiversity of woodlands and grasslands. It reduces annual grass thatch, which serves as fine fuel and allows wildfires to start and spread; it reduces annual grass cover, potentially enhancing grassland species and structural diversity, which can improve habitat values for some wildlife species; and it reduces the cover of shrubs and saplings that can serve as ladder fuels allowing fire to enter the canopy and severely damage and kill mature oak trees. Grazing also is a potentially valuable tool for controlling invasive nonnative plants. However, inappropriate grazing also can reduce recruitment of trees from seedlings and saplings, and have other negative effects. Thus, implementing grazing practices designed to maximize beneficial effects and avoid negative effects will promote biodiversity.

Tasks:

1. Implement the KWA livestock grazing plan (Appendix I) to manage wildland fuels, to promote grassland structural and species diversity, and to control nonnative invasive species.

Goal 3. Control Invasive Species

The introduction and spread of nonnative invasive plants degrades grassland and woodland ecosystems. Currently, nonnative invasive plants are present in grassland and woodland ecosystems of the KWA, and additional species are present in other grassland and woodland ecosystems in the region, and may spread into the KWA (Table 3-5). Thus, attaining this goal would enhance these ecosystems and avoid the degradation that would result from further spread of these harmful species.

Tasks:

1. Identify nonnative invasive plant species that have invaded the KWA and prioritize management of particular weed species. Base grazing priorities on (1) the species' potential impacts on ecosystem function and (2) the feasibility and impacts of controlling the species. Priorities of existing state and federal programs will be followed where appropriate.

2. Implement the following weed management measures:

    (a) Implement control plans for invasive plant species whose ecological impacts have been rated "high" by Cal-IPC (e.g., yellow star-thistle, Medusa head, barbed goatgrass).
    (b) Eradicate satellite infestations of invasive plant species whose ecological impacts have been rated "moderate" by Cal-IPC (e.g., bull thistle, teasel).
    (c) Restore native plant communities when eradicating invasive plant infestations, focusing on expanding the cover of native bunch grasses, shrubs, and oaks.
    (d) Plan travel routes and work areas to avoid invasive plant infestations, where feasible.
    (e) Clean equipment, vehicles, and clothing after leaving infested areas and before entering uninfested areas.

(f) Use only certified weed-free fill and plant materials (e.g., seed mixtures, straw used for erosion control).
(g) Minimize soil and vegetation disturbance, and revegetate disturbed areas.

3. Apply herbicides in conformance with the Department's Pesticide Use Program and product labels to ensure safe and effective use that avoids or minimizes adverse environmental effects.

4. Conduct a preactivity survey for special-status plant populations before applying herbicides to, or mechanically removing, invasive plant infestations. Avoid impacts if special-status plants are present.

5. Perform mechanical removal and herbicide treatment of invasive plant infestations outside the bird nesting season (January–August) where feasible to avoid impacts on nesting birds protected by the California Fish and Game Code, the ESA, CESA, and the federal Migratory Bird Treaty Act. If mechanical removal and/or herbicide treatment of vegetation is required during the bird nesting season, perform a preactivity survey to identify the locations of nesting birds and avoid affecting them.

6. Coordinate invasive plant management with neighboring property owners and land managers.

Goal 4. Protect and Enhance Habitat for Special-Status and Nonlisted Plants and Wildlife

The grassland and woodland ecosystems of the KWA provide habitat for many plant and animal species, including species at risk of extinction. Protecting and enhancing habitat is fundamental to the conservation of all these species, and is particularly important for species whose habitats have been degraded or which are vulnerable to impacts caused by human activities.

Tasks:

1. Maintain or improve existing or create new water sources for wildlife populations as needed.

2. Facilitate oak recruitment (e.g., with plantings and/or protection from wildlife and cattle browsing), as needed to sustain woodlands.

3. Conduct management activities and manage public uses to avoid or minimize effects on areas known to be occupied by special-status species, and to enhance habitat values.

4. Schedule ground-disturbing and vegetation-clearing activities to occur when effects on special-status species would be avoided, where practicable.

5. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species, plan these activities to avoid habitat occupied by special-status species and

within an avoidance buffer around the habitat. Buffer widths will be determined using Department guidance, as appropriate.

6. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species and activities must occur inside occupied habitat or an avoidance buffers, then conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species," as potentially present in the KWA and that occupy grassland or woodland ecosystems).

7. Control off-road vehicular trespass.

8. Coordinate with CAL FIRE to develop a wildland fire response plan and prescribed burn plan for the KWA that would sustain the biodiversity of grassland and woodland ecosystems.

9. Plan and coordinate controlled burns with CAL FIRE to implement the prescribed burn plan.

Impacts of the Grassland and Woodland Ecosystems Element

The purpose of the Biological Elements is to maintain and enhance ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired ecosystem functions. Implementation of all the above-listed tasks will support this purpose by preserving and enhancing grassland and woodland habitats. However, the tasks that involve eradicating and controlling nonnative invasive plants, installing and maintaining fencing and signs, repairing and maintaining water sources for animals, and planting native vegetation in restoration areas could result in minor and temporary environmental impacts. As discussed in the initial study/negative declaration (Appendix C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; using herbicides; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some disturbance, this element's tasks ultimately will result in benefits to habitats and native species, in support of the element's goals. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and coordination, impact avoidance, BMP implementation, regulatory compliance, restoration, and monitoring. For example, BMPs will be used to minimize fire hazards during activities that require mechanical equipment.

Implementation of controlled burns, as described by Goal 1, Task 3, could result in environmental impacts beyond those described above. However, burns planned and coordinated with CAL FIRE to beneficially manage fuels and fire regimes are subject to the requirements and mitigation measures set forth under CAL

FIRE's statewide vegetation treatment program (CSBFFP 2016).[1] Throughout its consultation with CAL FIRE, the Department will ensure that any proposed prescribed burn meets all environmental and safety requirements set forth by the CAL FIRE program, including measures to minimize impacts on special-status species, cultural resources, air quality, and water quality.

4.3.3 Chaparral Ecosystems

Goal 1. Maintain Fire Regime That Sustains Biodiversity of Chaparral

Chaparral ecosystems are shrublands dominated by fire-adapted shrubs and characterized by periodic crown fires. Chaparral shrubs differ in their lifespans and in their rates of regeneration immediately following fires and during intervals between fires. Herbaceous chaparral species also differ in these attributes, and include several species for which germination is triggered by fire. However, controlled burns during cool, moist conditions (when soil has been wetted by rainfall) result in limited, less diverse regeneration from seed. Also, repeated burning at short intervals of one to several years not only reduces diversity, but can convert chaparral to other vegetation (e.g., grassland). Thus, the seasonal timing, frequency, and intensity of fire is a primary determinant of the biodiversity of chaparral ecosystems.

Tasks:

1. Coordinate with CAL FIRE to develop a wildland fire response plan and prescribed burn plan for the KWA that would sustain the biodiversity of chaparral ecosystems.

2. Implement strategically located controlled burns to facilitate the development of a patchwork of various successional stages without facilitating invasion by nonnative grasses.

Goal 2. Control Invasive Plant Species

The introduction and spread of nonnative invasive plants degrades chaparral ecosystems. Currently, nonnative invasive plants are present in chaparral ecosystems of the KWA and additional species are present in other chaparral ecosystems in the region, and may spread into the KWA (Table 3-5). Thus, attaining this goal would enhance these ecosystems and avoid the degradation that would result from further spread of these harmful species.

Tasks:

[1] As of the date of publication of this LMP, the program environmental impact report (PEIR) for CAL FIRE's statewide vegetation treatment program has been distributed for public comment, but has not yet been finalized. When a final PEIR and program are approved, the Department will review this LMP's assumptions regarding the requirements and mitigation measures prescribed by the CAL FIRE program, and will determine whether any additional CEQA review and documentation of Department burn plans are necessary.

1. Identify nonnative invasive plant species that have invaded the KWA, and prioritize management of particular invasive plants. Base priorities on (1) the species' potential impacts on ecosystem function and (2) the feasibility and impacts of controlling the species. Priorities of existing state and federal programs will be followed where appropriate.

2. Determine appropriate prevention, eradication, and control options for high-priority invasive plants.

3. Implement the following weed management measures:

   (a) Implement control plans for invasive plant species whose ecological impacts have been rated "high" by Cal-IPC (e.g., barbed goatgrass).
   (b) Eradicate satellite infestations of invasive plant species whose ecological impacts have been rated "moderate" by Cal-IPC (e.g., crimson fountaingrass).
   (c) Plan travel routes and work areas to avoid invasive plant infestations, where feasible.
   (d) Clean equipment, vehicles, and clothing after leaving infested areas and before entering uninfested areas.
   (e) Use only certified weed-free fill and plant materials (e.g., seed mixtures, straw used for erosion control).
   (f) Minimize soil and vegetation disturbance, and revegetate disturbed areas.

4. Apply herbicide in conformance with the Department's Pesticide Use Program and product labels to ensure safe and effective use that minimizes adverse environmental effects.

5. Conduct a preactivity survey for special-status plant populations before applying herbicides to, or mechanically removing, invasive plant infestations. Avoid impacts if special-status plants are present.

6. Perform mechanical removal and/or herbicide treatment of invasive plant infestations outside the bird nesting season (January–August) where feasible to avoid impacts on nesting birds protected by the California Fish and Game Code, the ESA, CESA, and the federal Migratory Bird Treaty Act. If mechanical removal and/or herbicide treatment of vegetation is required during the bird nesting season, perform a preactivity survey to identify the locations of nesting birds and avoid affecting them.

7. Coordinate invasive plant management with neighboring property owners and land managers.

Goal 3. Protect and Enhance Habitat for Special-Status and Nonlisted Plants and Wildlife

The chaparral ecosystems of the KWA provide habitat for a large number of plant and animal species, including species at risk of extinction. Protecting and enhancing habitat is fundamental to the conservation of all these species, and is particularly important for species whose habitats have been degraded or which are vulnerable to impacts caused by human activities.

Tasks:

1. Control off-road vehicular trespass.

2. Schedule ground-disturbing and vegetation-clearing activities to occur when effects on special-status species would be avoided, where practicable.

3. If ground-disturbing and vegetation-clearing activities cannot be schedule to avoid effects on special-status species, plan these activities to avoid habitat occupied by special-status species and within an avoidance buffer around the habitat. Buffer widths will be determined using Department or USFWS guidance, as appropriate.

4. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species and activities must occur inside occupied habitat or an avoidance buffers, then conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species," as potentially present in the KWA and that occupy chaparral ecosystems).

Impacts of the Chaparral Ecosystems Element

The purpose of the Biological Elements is to maintain and enhance ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired ecosystem functions. Implementation of all the above-listed tasks will support this purpose by preserving and enhancing chaparral habitats. However, during implementation of the tasks prescribed for controlling and eradicating nonnative invasive plants, minor and temporary environmental impacts could occur. As detailed in the initial study/negative declaration (Appendix C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; using herbicides; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some disturbance, this element's tasks ultimately will result in benefits to habitats and native species, in support of the element's goals. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and coordination, impact avoidance, BMP implementation, regulatory compliance, restoration, and monitoring.

Implementation of controlled burns, as described by Goal 1, Task 2, could result in environmental impacts beyond those described above. However, burns planned and coordinated with CAL FIRE to beneficially manage fuels and fire regimes are subject to the requirements and mitigation measures set forth under CAL FIRE's statewide vegetation treatment program (CSBFFP 2016). Throughout its consultation with CAL FIRE, the Department will ensure that any proposed prescribed burn meets all environmental and safety

requirements set forth by the CAL FIRE program, including measures to minimize impacts on special-status species, cultural resources, air quality, and water quality.

4.3.4 Serpentine Soil Ecosystems

Goal 1. Maintain Fire Regime That Sustains Biodiversity of Serpentine Ecosystems

Serpentine ecosystems at the KWA primarily have chaparral and grassland vegetation, which is dominated by species adapted to periodic wildfires. As described previously, chaparral shrubs differ in their lifespans and their rates of regeneration immediately following fires and during the intervals between fires. Herbaceous species found in chaparral and on serpentine soil also differ in these attributes, and include several species for which germination is triggered by fires. Thus, the frequency and intensity of fire is a primary determinant of the biodiversity of serpentine soil ecosystems.

Tasks:

1. Coordinate with CAL FIRE to develop a wildland fire response plan and prescribed burn plan for the KWA that sustains the biodiversity of serpentine ecosystems.

2. Implement controlled burns that produce a patchwork of various successional stages without facilitating invasion by nonnative grasses.

Goal 2. Control Invasive Plant Species

The introduction and spread of nonnative invasive plants degrades serpentine soil ecosystems. Because of the atypical chemistry and low fertility of serpentine soils, fewer nonnative plants invade these ecosystems compared to other ecosystems. Nonetheless, nonnative invasive plants are degrading the serpentine soil ecosystems of the KWA, and additional species are present in other serpentine ecosystems in the region, and may spread into the KWA (Table 3-5). Thus, attaining this goal would enhance these ecosystems and avoid the degradation that would result from further spread of these harmful species.

Tasks:

1. Identify nonnative invasive plant species that have invaded the KWA, and prioritize management of particular weed species. Base priorities on (1) the species' potential impacts on ecosystem function and (2) the feasibility and impacts of controlling the species. Follow existing federal and state priorities where appropriate.

2. Determine appropriate prevention, eradication, and control options for high-priority invasive plants.

3. Implement the following weed management measures:

(a) Implement control plans for invasive plant species whose ecological impacts have been rated "high" by Cal-IPC (e.g., barbed goatgrass).
(b) Eradicate satellite infestations of invasive plant species whose ecological impacts have been rated "moderate" by Cal-IPC (e.g., tocalote).
(c) Plan travel routes and work areas to avoid invasive plant infestations, where feasible.
(d) Clean equipment, vehicles, and clothing after leaving infested areas and before entering uninfested areas.
(e) Use only certified weed-free fill and plant materials (e.g., seed mixtures, straw used for erosion control).
(f) Minimize soil and vegetation disturbance, and revegetate disturbed areas.

4. Apply herbicide in conformance with the Department's Pesticide Use Program to ensure safe and effective herbicide use that minimizes adverse environmental effects.

5. Conduct a preactivity survey for special-status plant populations before applying herbicides to, or mechanically removing, invasive plant infestations. Avoid impacts if special-status plants are present.

6. Perform mechanical removal and/or herbicide treatment of invasive plant infestations outside the bird nesting season (January–August) to avoid impacts on nesting birds protected by the California Fish and Game Code, the ESA, CESA, and the federal Migratory Bird Treaty Act. If mechanical removal and/or herbicide treatment of vegetation is required during the bird nesting season, perform a preactivity survey to identify the locations of nesting birds and avoid affecting them.

7. Coordinate invasive plant management with neighboring property owners and land managers.

Goal 3. Protect and Enhance Habitat for Special-Status and Nonlisted Plants and Wildlife

The serpentine soil ecosystems of the KWA provide habitat for a large number of plant and animal species, including species at risk of extinction. Protecting and enhancing habitat is fundamental to the conservation of all these species, and is particularly important for species whose habitats have been degraded or which are vulnerable to impacts caused by human activities.

Tasks:

1. Direct public activities away from serpentine rock outcrops (barrens) and other areas known to be occupied by special-status plants. Control off-road vehicular trespass.

2. Schedule ground-disturbing and vegetation-clearing activities to occur when effects on special-status species would be avoided, where practicable.

3. If ground-disturbing and vegetation-clearing activities cannot be schedule to avoid effects on special-status species, plan these activities to avoid habitat occupied by special-status species and within an

avoidance buffer around the habitat. Buffer widths will be determined using Department or USFWS guidance, as appropriate.

4. If ground-disturbing and vegetation-clearing activities cannot be scheduled to avoid effects on special-status species and activities must occur inside occupied habitat or an avoidance buffers, then conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species," as potentially present in the KWA and that occupy serpentine ecosystems).

Impacts of the Serpentine Soil Ecosystems Element

The purpose of the Biological Elements is to maintain and enhance ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired ecosystem functions. Implementation of all the above-listed tasks will support this purpose by preserving and enhancing serpentine soil ecosystems. However, during implementation of the tasks prescribed for controlling and eradicating nonnative invasive plants, minor and temporary environmental impacts could occur. As detailed in the initial study/negative declaration (Appendix C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; using herbicides; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some disturbance, this element's tasks ultimately will result in benefits to habitats and native species, in support of the element's goals. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and coordination, impact avoidance, BMP implementation, regulatory compliance, restoration, and monitoring. For example, when appropriate funding and staffing resources are available, long-term monitoring of serpentine seep vegetation will be conducted to track trends in special-status plant populations.

Implementation of controlled burns, as described by Goal 1, Task 2, could result in environmental impacts beyond those described above. However, burns planned and coordinated with CAL FIRE to beneficially manage fuels and fire regimes are subject to the requirements and mitigation measures set forth under CAL FIRE's statewide vegetation treatment program (CSBFFP 2016). Throughout its consultation with CAL FIRE, the Department will ensure that any proposed prescribed burn meets all environmental and safety requirements set forth by the CAL FIRE program, including measures to minimize impacts on special-status species, cultural resources, air quality, and water quality.

4.3.5 Game Species

Goal 1. Maintain Healthy and Productive Game Populations

By pursuing this goal, the Department will continue to enact California Fish and Game Commission policies at the KWA. It is Fish and Game Commission policy to conserve, restore, and maintain big game and upland game bird habitat and to maintain big game and upland game bird populations at optimum levels on public and private lands within California.

Tasks:

1. Manage vegetation, including by retaining a certain amount and dispersion of dead and dying trees and shrubs, and manage available water to promote high-quality habitats for big game and upland game, with special emphasis on black-tailed deer, wild turkeys, mourning doves, and California quail.

2. Maintain or improve food sources for game species. This task may involve planting a diversity of native browse and grass species capitalizing on varying plants' seasonal phenologies to provide high-quality nutrition over the longest duration throughout the year. Mowing or burning may also be conducted to set back plant succession, providing more nutritious early successional–stage growth.

3. Implement, as appropriate, the recommendations prescribed in the *Habitat Guidelines for Mule Deer: California Woodland Chaparral Ecoregion* (Sommer et al. 2007), the *California Deer Conservation and Management Plan* (CDFW 2015a), and the respective plans for other game species occurring in the KWA.

4. Using prescribed fire or equipment, as appropriate, manage chaparral and other browse communities in a variety of seral stages to provide the broadest plant species diversity, age structure, and phenological state possible to encourage improved wildlife nutrition.

5. Encourage healthy oak regeneration through the use of livestock grazing (if appropriate) and by fencing and planting to support mast production (if needed).

6. If water availability is identified as limiting, construct and maintain wildlife water sources (guzzlers) suitably distributed across the KWA to provide water for game (and all wildlife) species during the hottest, driest portions of the year and during drought.

7. If warranted, reduce the disturbance, and potentially the harvest, of deer by implementing public access restrictions during all or part of the deer hunting season.

Impacts of the Game Species Element

The purpose of the Biological Elements is to maintain and enhance ecosystems of the KWA to support natural ecological processes, sustain healthy habitats for native plants and animals, and provide other desired

ecosystem functions. Implementation of all the above-listed tasks will support this purpose by enhancing habitat for native game species. However, tasks that require managing and planting vegetation, installing and maintaining fencing, and constructing, repairing, or otherwise maintaining water sources for animals could result in minor and temporary environmental impacts. As detailed in the initial study/negative declaration (Appendix C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use of construction equipment and vehicles; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some disturbance, this element's tasks ultimately will result in benefits to habitats and native species, in support of the element's goals. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and coordination, impact avoidance, BMP implementation, regulatory compliance, restoration, and monitoring. For example, BMPs will be used to prevent and contain accidental spills of hazardous materials during management activities.

Implementation of controlled burns, as described by Goal 1, Task 4, could result in environmental impacts beyond those described above. However, burns planned and coordinated with CAL FIRE to beneficially manage fuels and fire regimes are subject to the requirements and mitigation measures set forth under CAL FIRE's statewide vegetation treatment program (CSBFFP 2016). Throughout its consultation with CAL FIRE, the Department will ensure that any proposed prescribed burn meets all environmental and safety requirements set forth by the CAL FIRE program, including measures to minimize impacts on special-status species, cultural resources, air quality, and water quality.

4.4 Public Use Elements

The purpose of the Public Use Elements is to define, and provide support for, compatible public uses of the KWA.

As discussed previously, the mission of the Department is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. *Compatible public uses* refers to all uses that are consistent with the mission, the purpose of the KWA, and this LMP's Biological Elements. For the KWA, compatible public uses are low-impact recreational activities (e.g., hiking, wildlife observation, nature photography, horseback riding), hunting, and scientific research and environmental education activities.

Aside from compatible public uses, wildlife area land management plans are required to state whether any portion of the area is suitable for apiculture, and for suitable areas, whether apiculture is consistent with the plan's management goals (Section 1745.2 of the California Fish and Game Code). Department land managers must carefully consider the potential impacts of introducing managed bee colonies to a wildlife area where the Department mission is to uphold its trustee responsibility toward native habitats and wildlife resources.

There is evidence of competitive interactions between honeybees and native pollinators, particularly on native plants, where honeybees may reduce seed set by displacing other pollinators. A recent paper (Cane and Tepedino 2016) analyzed data from existing studies to quantify the extent to which honeybees compete with native bees. Because of the demonstrated potential for competition, there is reason for concern that apiculture is not compatible with goals for the KWA. In addition, apiculture is not suitable in the KWA because black bears are present throughout the wildlife area and likely would depredate beehives, and also because access limitations hinder the ability of Department staff and beekeepers to protect equipment from theft and vandalism. Thus, apiculture is not included as a public use element or discussed further in this LMP.

4.4.1 Public Access and Recreation

Goal 1. Identify Compatible Public Access and Recreation Opportunities

Because low-impact recreational activities (e.g., hiking, wildlife observation, nature photography, horseback riding) are compatible with management of ecological values, allowing public access to the wildlife area for these activities is an important means by which the Department carries out its mission. However, incompatible and inappropriate public access and use of the wildlife area can adversely affect the resources that the wildlife area was established to protect.

Tasks:

1. Install informational signs at key points of public access to the wildlife area. Signs will inform the public of the resource conservation and appropriate recreational use goals that the Department is implementing on the area. Information provided may include wildlife area maps and regulations; identification of areas closed to unauthorized vehicles and areas closed to all public access (as appropriate, including seasonal closures); interpretive materials; information on livestock grazing, prescribed burning, and other management activities occurring in the wildlife area; safety information; and contact information. Ensure that signs (or kiosks) avoid resources such as special-status plants, sensitive natural communities, wildlife habitat features, and cultural resources. If signs must be sited outside of developed and maintained areas (such as parking lots), the Department will conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species.")

Impacts of the Public Access and Recreation Element

The purpose of the Public Use Elements is to define, and provide support for, compatible public uses of the KWA. Implementation of the above task will support this purpose by informing and educating the public and enhancing their experience of the KWA in a manner compatible with the Biological Elements. However, installing and maintaining informational signs could result in minor and temporary environmental impacts. As detailed in the initial study/negative declaration (Appendix C), these impacts could be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment

and vehicles; using hazardous fluids (e.g., gasoline, oil) incidental to equipment use; and inadvertently directing public attention and pedestrian traffic toward sensitive resources.

Although the construction of informational signs may cause minor environmental impacts, greater awareness of the wildlife area, its regulations, and compatible public uses will discourage incompatible public uses that cause more serious harm, such as the creation and subsequent use of unauthorized hiking routes or vehicle trespass. Furthermore, to ensure that all management activities related to public access and recreation have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and design, impact avoidance, BMP implementation, regulatory compliance, and monitoring. For example, informational signs will be sited to avoid or minimize impacts on sensitive natural communities and native species of plants and wildlife.

4.4.2 Hunting

Goal 1. Provide Opportunities for Hunting

Revenue from hunting licenses and firearms is a significant funding source for habitat management in California. Hunting remains a priority recreational activity, where appropriate, for the Department, consistent with the Fish and Game Code and California Fish and Game Commission policies.

Tasks:

1. Manage hunt programs for game and non-game animals such as deer, dove, quail, turkeys and pigs.

2. Implement special hunts (e.g., for deer opener) as needed to avoid overcrowding issues and provide safe hunting conditions.

3. Establish hunter check stations where necessary and feasible in order to more effectively monitor harvest levels.

4. If funding allows, develop an informational kiosk to provide hunters with information at times when hunter check stations are not in operation but seasons are open.

Impacts of the Hunting Element

The purpose of the Public Use Elements is to define, and provide support for, compatible public uses of the KWA. Implementation of the above-listed tasks will support this purpose by informing and educating hunters and enhancing their experience of the KWA in a manner compatible with the Biological Elements. Further, the tasks will reduce the current level of environmental impact associated with this public use by better managing crowds and by monitoring activity and harvest levels. However, the task that requires developing an informational kiosk could result in minor and temporary environmental impacts by disturbing

soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use (see Appendix C).

Although it will involve some disturbance, installation of a kiosk ultimately will result in environmental benefits by supporting and informing appropriate and compatible hunting activities. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and design, impact avoidance, BMP implementation, and regulatory compliance. For example, the kiosk would depict the KWA's landmarks and boundaries, inform hunters of potential hazards, and remind them of applicable laws and restrictions. The kiosk also would be sited to avoid or minimize impacts on sensitive natural communities and species of native plants and wildlife.

4.4.3 Scientific Research

Goal 1. Support Appropriate Scientific Research

Scientific research can make substantial contributions to management of the KWA and broader contributions to the conservation of California's plants and wildlife and their habitats. Furthermore, it is the policy of the Fish and Game Commission that research be performed to provide scientific and management data to promote the protection, propagation, conservation, management, or administration of fish and wildlife resources of the state when such data are not available by other means.

Tasks:

1. Establish and/or maintain long-term working relationships with regional academic institutions.

2. Review and evaluate proposed research projects based on their compatibility with current uses, management, and purposes of the KWA. Conditions of approval for research projects may include:

    (a) proof of all necessary permits, such as permits for handling or collecting specimens;
    (b) submission of written progress reports to the Department;
    (c) a schedule of activities and deliverables;
    (d) provision of electronic copies of geospatial and all other field data and reports in a digital format specified by the Department;
    (e) submission of copies of CNDDB field data forms for species tracked by the Department;
    (f) agreement with temporal and spatial access requirements, prohibitions on work under some environmental (i.e., weather) conditions, and any appropriate avoidance or minimization measures;
    (g) submission of project proposals to the Department at least 2 months before approval is requested;

(h) acquisition of a Letter of Permission signed by the Bay/Delta Regional Manager, approving access for research.

3. Obtain data and published papers from KWA researchers.

4. Promote the wildlife area to regional academic institutions as a resource available for applied research into Department-specified topics.

5. Encourage long-term studies of water quality and quantity, special-status species populations, native plant and wildlife habitat quality, and other topics that could inform management of the wildlife area.

6. Support efforts to document the history of human activities in the KWA by encouraging academic research and cultural surveys where appropriate.

7. Require researchers to implement all applicable LMP tasks that would avoid and minimize potential impacts on the environment.

Impacts of the Scientific Research Element

The purpose of the Public Use Elements is to define, and provide support for, compatible public uses of the KWA. Scientific research is a compatible use because it can inform the management of biological (and cultural) resources and cause only minimal impacts.

As described, the Scientific Research Element requires no tasks that involve a physical change to the environment; however, if research proposed for the KWA involves environmental impacts, it will be subject to the requirements and measures listed in this LMP. Like other tasks, research activities must be compatible with enhancement and preservation of the KWA's resources, and must apply measures to avoid and minimize environmental impacts. Additionally, researchers proposing to handle or collect special-status species will be required to possess the appropriate permits.

4.4.4 Environmental Education

Goal 1. Promote Environmental Education

By pursuing this goal, the Department will continue to enact California Fish and Game Commission policies at the KWA. It is the policy of the Fish and Game Commission that the Department disseminate, to the maximum extent feasible, information to the public regarding all matters dealing with the conservation, protection, management, and administration of the state's fish and wildlife resources. It is also the Commission's policy that the Department encourage education programs that increase the public's respect and concern for wild animals and their knowledge of the interrelationships between wild animals, the environment, and society.

Tasks:

1. Install informational signs at key points of public access to the wildlife area. Signs will indicate that the wildlife area is managed for both resource conservation and compatible public access and recreation, and will provide interpretive materials describing the wildlife area and its resources. Ensure that signs (or kiosks) avoid resources such as special-status plants, sensitive natural communities, wildlife habitat features, and cultural resources. If signs must be sited outside of developed and maintained areas (such as parking lots), conduct preactivity surveys for potentially affected special-status species (i.e., species identified in Section 3.3, "Endangered, Threatened, and Rare Species."

2. Provide education and outreach on recognition, control, and prevention of the spread of invasive species, and make this information available on the Department website.

3. Provide staff assistance, materials, and Letters of Permission for educational activities at the KWA, if the activities are consistent with the goals of this plan.

4. Encourage all environmental education and natural resource interpretation (informal education) users to incorporate the Department's Natural Resource Education Messages guidelines in their field environmental education activities, curricula, and interpretive programs, both on and off site. These message guidelines address:

    - responsible recreation,
    - safe human-wildlife interactions,
    - conservation and protection of wildlife and habitats,
    - valuing our natural heritage, and
    - why biodiversity matters.

5. Partner with nonprofit groups and local schools to promote and support environmental education and volunteer opportunities.

6. Use local or Department volunteers to conduct interpretive events that increase the awareness and appreciation of the wildlife area.

7. Periodically conduct reviews of public uses of the wildlife area and evaluate rules, regulations, guidelines, and materials to ensure compatibility of public uses.

8. If public use reaches a significant level of demand, develop a more formal interpretive plan element in the management plan.

Impacts of the Environmental Education Element

The purpose of the Public Use Elements is to define, and provide support for, compatible public uses of the KWA. Implementation of all the above-listed tasks will support this purpose by increasing public awareness and appreciation of the KWA's resources, which also will help to reduce environmental impacts. However, the task that requires developing kiosks and signs could result in minor and temporary environmental impacts by disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use (see Appendix C).

Although it will involve some disturbance, installation of kiosks and signs ultimately will result in environmental benefits by supporting and informing compatible public activities. Furthermore, to ensure that all management activities have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning and design, impact avoidance, BMP implementation, regulatory compliance, and monitoring. For example, kiosks and signs will direct people toward locations without sensitive cultural or biological resources, and will be sited to avoid impacts.

4.5 Facility Maintenance Elements

The purpose of the Facility Maintenance Elements is to guide the Department's management of the KWA to support and allow achievement of this LMP's biological and public use goals. Supportive management practices consist of targeted application of funds and labor toward administration, maintenance, and enhancement projects; preservation of cultural resources; and collaboration with neighbors and partner agencies to better fulfill mutual objectives and optimize the use of staff, funds, and other resources.

4.5.1 Administration and Maintenance

Goal 1. Maintain Existing Data and Agreements Concerning Management and Resources

Maintaining current data on the management and resources of the wildlife area supports attainment of the goals for the Biological, Public Use, Facility Maintenance, and Biological Monitoring Elements.

Tasks:

1. Regularly update geographic information systems (GIS) data sources as information becomes available.

2. Administer renewal, modification, and termination of grazing allotments, as necessary.

3. Coordinate with local user groups to obtain volunteer labor when possible.

4. Investigate options that may be available to obtain consistent, dedicated funding sources for management of the wildlife area.

Goal 2. Comply with Applicable State and Federal Laws and Regulations

All Department actions must comply with all applicable state and federal laws and regulations.

Tasks:

1. Ensure that all actions undertaken in the wildlife area comply with applicable state and federal laws and regulations, including the ESA and CESA, Sections 401 and 404 of the Clean Water Act, Section 1602 of the California Fish and Game Code, and other applicable plans or regulations aimed at the protection of special-status species or their habitats.

Goal 3. Maintain Roads, Signs, Fencing, and Parking Areas

Maintenance of roads, signs, fencing, and parking areas contributes to resource protection, increases the safety of users, and discourages unauthorized use of the wildlife area.

Tasks:

1. Establish an annual monitoring and reporting program to document the condition of wildlife area facilities (roads, signs, fencing, parking areas, and other structures).

2. Fix or replace facilities as needed, according to the results of annual monitoring and as budgets allow.

3. Maintain the existing system of ranch roads where appropriate for administrative vehicle access and foot and equestrian access. Retire or restore those that are not needed, that are too costly to maintain, or that have negative downstream effects. This task involves annually mowing, removing downed trees, repairing washouts, replacing or installing watercourse crossings as necessary and appropriate, recontouring roadbeds, and developing a system of water bars and other erosion control measures.

4. As signs are replaced or installed, select sign locations and styles that are consistent with Department guidelines, the rural character of the area, and the aesthetics of the natural environment in the KWA.

5. Maintain existing fencing along Berryessa–Knoxville Road and install additional fencing as needed.

6. Keep parking areas graded and graveled.

7. Eradiate invasive species from parking areas as necessary.

8. Close parking areas as needed to prevent damage in the winter.

Goal 4. Maintain Ponds and Water Delivery System for Wildlife and Livestock

The KWA's ponds and water delivery system support the use of grazing as a management practice and provide resources for wildlife. Thus, their maintenance contributes to attainment of the Biological Element goals.

Tasks:

1. Review the stock pond inventory (Appendix H) and determine which ponds merit repair, ongoing maintenance, and weed management.

2. Review the existing water delivery system. If appropriate, repair and retain components of the system to provide water sources for wildlife (and livestock).

3. Repair or remove dams that are breached and causing erosion. Follow up on dam removal with weed control and revegetation using native species.

4. When feasible, remove or bury in place visible sections of the water delivery system that are not needed or are beyond repair.

5. Ensure that all actions undertaken in the wildlife area comply with the ESA and CESA, Sections 401 and 404 of the Clean Water Act, Section 1602 of the California Fish and Game Code, the State CEQA Guidelines, and other applicable plans and regulations that protect special-status species and aquatic ecosystems.

Impacts of the Administration and Maintenance Element

The purpose of the Facility Maintenance Elements is to guide the management of the KWA to support and allow achievement of this LMP's biological and public use goals. Implementation of all the above-listed tasks will support this purpose by prioritizing needs, ensuring regulatory compliance, and maintaining needed physical features and resources. However, the tasks that require repairing, replacing, cleaning, or otherwise maintaining roads, fences, signs, parking areas, and other structures; installing barriers; eradicating and controlling nonnative invasive plants; maintaining water sources for animals; and planting native vegetation in restoration areas could result in minor and temporary environmental impacts. As discussed in the initial study/negative declaration (Appendix C), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; using herbicides; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Although they involve some disturbance, this element's tasks ultimately will benefit the natural resources and compatible public uses of the KWA, because the normal degradation of access routes, barriers, water sources, natural habitats, and other managed features may expose sensitive resources to threats (e.g., weeds, unauthorized public access) and create hazards for visitors. Furthermore, to ensure that this element's tasks

have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning, coordination, and design; impact avoidance; BMP implementation; regulatory compliance; restoration; and monitoring.

4.5.2 Cultural Resources

Goal 1. Catalog and Preserve All Cultural Resources

It is the intent of the Department to provide long-term stewardship of cultural resources at the KWA.

Tasks:

1. Review and preserve known cultural resources.

   (a) Review cultural resources, including both prehistoric and historical materials that have been identified through previous surveys and interviews (inventoried by GrassRoots in 2015).
   (b) Identify and retain ranching improvements that may have management or historical value.
   (c) During the planning and design of new infrastructure and public access, or other ground-disturbing activities, avoid cultural resources to the extent feasible to protect them from degradation.

2. Survey the historical system of ranch roads for additional significant cultural resources, as budget allows.

3. Conduct cultural resource reviews and surveys before disturbance activities and after fires. Before conducting any activity that involves substantial vegetation clearing or ground disturbance, including the placement of new structures or travel routes, Department staff will consult available cultural resource survey maps and other maps of known resource locations to determine whether any cultural resources have been identified in the activity footprint. If a cultural resource survey has been performed in the area to be disturbed within the past 10 years, the survey results will be considered a sufficient basis for the Department to determine whether any cultural resources will be affected by the activity.

   Any resources identified during surveys will be documented on appropriate California Department of Parks and Recreation site record forms. The archaeologist will provide documentation of the survey and copies of new or updated site record forms to both the Department and the Northwest Information Center (NWIC).

   This task's measures do not apply to unanticipated ground disturbances that result from responses to emergencies, such as wildfires. However, if an emergency response is required (e.g., to a wildfire or other natural disaster), the Department will attempt to avoid damaging known cultural resources to

the extent feasible, using existing resource maps. Once emergency responses are complete, any damage to known cultural resources will be assessed, documented, and reported to the NWIC. If a fire clears an area that has not been archaeologically surveyed within the past 10 years, as budget allows, the Department will retain a qualified professional archaeologist to attempt a postfire survey before the vegetation has recovered—the typical level of vegetation in the KWA likely obscures many cultural resources that could be revealed in postfire conditions. New finds will be documented on appropriate California Department of Parks and Recreation site record forms, and copies of those forms will be added to the resource database for the KWA and forwarded to the NWIC.

4. Fully avoid impacts on cultural resources, or minimize impacts to the extent feasible. If the tasks above result in the finding that a cultural resource could be affected by a proposed activity, the Department will redesign or relocate the activity to avoid affecting the resource. If a Department activity cannot be redesigned or relocated sufficiently to avoid impacts on cultural resources, a qualified professional archaeologist will be retained to assess the resource's eligibility for listing on the California Register of Historical Resources (CRHR) and determine whether there would be a significant impact on an eligible resource. This assessment will occur before the activity is performed. Documentation of the assessment will be provided to the Department and NWIC. If a resource is found to be eligible or potentially eligible for the CRHR and cannot be avoided, appropriate treatment of the resource will be designed and implemented before the activity begins. Treatment design may require consultation with the Native American community, as appropriate. Treatment measures could include capping, documentation and research, preparation of a formal treatment plan, construction monitoring, subsurface testing, or data recovery. The qualified professional archaeologists performing the treatment will document all activities in the appropriate format, and provide copies to the Department and NWIC.

5. Stop work if cultural resources or human remains are discovered, and implement appropriate treatments to avoid or minimize impacts. If any buried archaeological materials are uncovered during management activities, such activities will cease within 50 feet of the find. If the activity is being conducted by a contractor, the contractor will notify the Department immediately of any discovery. A qualified professional archaeologist will be retained or supplied by the Department to evaluate the find and recommend appropriate treatment measures. Management activities will not resume within 50 feet of the find until it has been assessed and any appropriate treatment measures have been implemented.

   In accordance with the California Health and Safety Code, if human remains are uncovered during ground-disturbing activities, the Department (or its contractor) will immediately halt potentially damaging excavation within 50 feet of the burial and notify the county coroner, as well as a qualified professional archaeologist, if possible, to determine the nature of the remains. The coroner must examine all discoveries of human remains within 48 hours of receiving notice of a discovery on private or state lands (Health and Safety Code Section 7050.5[b]). If the coroner determines that the

remains are those of a Native American, he or she must contact the Native American Heritage Commission (NAHC) by phone within 24 hours of making that determination (Health and Safety Code Section 7050[c]). Following the coroner's findings, the Department, an archaeologist, and the NAHC-designated Most Likely Descendent will determine the ultimate treatment and disposition of the remains and take appropriate steps to ensure that additional human interments are not disturbed. The responsibilities for acting upon notification of a discovery of Native American human remains are identified in Public Resources Code Section 5097.9.

6. Remove improvements with no management or historical value, as needed. Some remnants of human activity may need to be removed or disturbed because of safety hazards, aesthetic impacts, or conflicts with other management goals.

Impacts of the Cultural Resources Element

The purpose of the Facility Maintenance Elements is to guide the management of the KWA to support and allow achievement of this LMP's biological and public use goals. Cultural resources are a physical feature of the KWA that must be protected and managed in order to enhance human understanding and appreciation of the KWA, augment future research and education opportunities, and sustain the aesthetic integrity and historical continuity that are valued by visitors to the wildlife area. Accordingly, all the above-listed cultural resource tasks will be incorporated into other management activities to fully avoid or minimize impacts on cultural resources and thereby facilitate achievement of the LMP's public use goals.

However, the task that directs the Department to remove improvements that have no management or cultural value could result in minor and temporary environmental impacts. Additionally, any preservation tasks that involve installation of fencing or other protective features could result in minor impacts. As discussed in the initial study/negative declaration (Appendix B), these impacts may be caused by temporarily disturbing soil or vegetation; generating dust, noise, and emissions through the use construction equipment and vehicles; and using hazardous fluids (e.g., gasoline, oil) incidental to equipment use.

Despite involving some disturbance, this task ultimately will benefit the natural and cultural resources and compatible public uses of the KWA by removing unsightly or hazardous features that degrade cultural, aesthetic, and ecological values. To ensure that this task has no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning, coordination, and design; impact avoidance; BMP implementation; regulatory compliance; and restoration. For example, bare areas exposed by the removal of structures will be covered or revegetated appropriately.

4.5.3 Management Coordination

Goal 1. Cooperate and Collaborate with Neighboring Landowners to Achieve Mutual Goals

By pursuing this goal, the Department will continue to enact the policies of the California Fish and Game Commission. It is Fish and Game Commission policy that the Department cooperate with local, state, and federal agencies and with all interested persons, groups, or organizations in every way to further the aims and purposes of fish and game conservation, preservation, propagation, protection, management, and administration. Such cooperation among neighboring landowners and land managers is essential for supporting achievement of this LMP's biological and public use goals, because both biological resources and compatible human uses benefit when larger regions, reflective of natural rather than artificial boundaries, are managed compatibly. Similarly, unintentional negative impacts of management decisions on neighboring lands can be forestalled through effective communication and partnership.

Furthermore, the Department recognizes that the 2015 establishment of the Berryessa Snow Mountain National Monument is evidence of considerable public and private support for collaborative regional management of natural resources.

Tasks:

1. Collaborate with regional conservation groups and partnerships, as appropriate:

   (a) Participate by attending meetings of regional conservation groups or partnerships when possible.
   (b) Work with groups or partnerships to identify regional conservation priorities.

2. Collaborate with BLM:

   (a) To install barriers to block illegal vehicular access at the northern boundary of the KWA.
   (b) On wildlife studies throughout the entire Knoxville–Lake Berryessa Region.

3. Collaborate with the Napa County Road Department to ensure that road maintenance activities are consistent with the goals of this LMP.

4. Collaborate with other neighbors:

   (a) Coordinate with BLM to enforce the vehicular prohibition in the KWA.
   (b) Maintain contact with managers of adjacent public lands and owners of adjacent private lands.
   (c) Coordinate weed management with neighboring landowners and land managers.
   (d) Discuss mutual signage needs and share labor and materials when possible.

Goal 2. Cooperate with Fire Responders

It is the policy of the Fish and Game Commission that the Department cooperate with CAL FIRE before, during, and after fires to reduce the effects of fires and fire suppression activities on sensitive habitats. This cooperation contributes to the attainment of this LMP's biological goals.

Tasks:

1. Coordinate with CAL FIRE to develop a wildland fire response plan (that includes an emergency-vehicle road maintenance plan) and a prescribed burn plan for the KWA.

2. Designate Department staff members responsible for coordinating with incident commanders and fire crews.

3. Provide maps to fire authorities showing sensitive resources.

4. Identify and implement BMPs to minimize construction-related fire hazards during activities that require mechanical equipment.

Goal 3. Coordinate with Department Law Enforcement and Napa County Sheriff's Department

Coordination between the Department's Wildlife Program Law Enforcement Division and the Napa County Sherriff's Department will lead to more effective law enforcement and support attainment of this LMP's public use goals.

Tasks:

1. Whenever feasible, coordinate law enforcement services.

2. Provide law enforcement with vehicular access to the KWA and provide current information regarding road conditions and closures.

3. Provide information to the Department's wardens and county deputies regarding resource laws and regulations specific to the KWA.

4. Coordinate with the CDFW wardens and the sheriff's department to enforce the vehicular prohibition in the KWA and to coordinate other law enforcement activities.

5. Pursue joint funding requests to address law enforcement concerns when such opportunities arise.

Goal 4. Collaborate with Other Entities to Achieve Mutual Goals

By pursuing this goal, the Department will continue to enact the policies of the California Fish and Game Commission. It is Fish and Game Commission policy that the Department cooperate with local, state, and federal agencies and with all interested persons, groups, or organizations in every way to further the aims and purposes of fish and game conservation, preservation, propagation, protection, management, and administration, and to enter into agreements for those purposes (California Fish and Game Commission 2016).

Tasks:

1. Collaborate with neighboring agencies or nonprofit organizations in restoration projects.

2. Partner with other public entities or nonprofit organizations to apply for grant funding for cooperative management activities.

Goal 5. Coordinate with Federal, State, and Local Organizations Regarding Plans That May Affect the KWA

Coordination of planning with other organizations will facilitate attainment of this LMP's goals by allowing groups to share information, avoid or resolve conflicts, and develop consistent and complementary activities and projects.

Tasks:

1. Review and provide recommendations on proposed plans and projects to achieve consistency with this LMP.

2. Participate in regional planning and resource management efforts.

3. Coordinate with regional agencies, stakeholders, and educational institutions to facilitate knowledge/data exchange and develop opportunities.

4. Coordinate with the following organizations regarding the topics described below:

    (a) Bay Area Air Quality Management District/Yolo-Solano Air Quality Management District—regulatory compliance
    (b) BLM—funding opportunities, public outreach, and resource management
    (c) CAL FIRE—fire management
    (d) Napa County Road Department—road maintenance
    (e) Napa County Sheriff's Department—law enforcement
    (f) Bureau of Reclamation—funding opportunities, public outreach, and resource management

(g) San Francisco Bay Regional Water Quality Control Board and State Water Resources Control Board—regulatory compliance
(h) U.S. Army Corps of Engineers—regulatory compliance
(i) USFWS—funding opportunities and special-status species issues
(j) UC NRS—funding opportunities, resource management, and scientific research

Goal 6. Avoid or Minimize Air and Water Quality, Noise, and Hazardous Materials Impacts

Air, water, noise, and hazardous materials impacts interfere with the attainment of this plan's biological and public use goals, as well as other goals. Thus, minimizing these impacts will eliminate or substantially reduce this interference.

Tasks:

1. Integrate applicable Bay Area Air Quality Management District and Yolo-Solano Air Quality Management District construction measures into activities to minimize air quality impacts. These measures include:

   (a) maintaining all equipment in accordance with manufacturer's specifications,
   (b) requiring that contractors use equipment that meets the California Air Resources Board's most recent certification standard for off-road heavy duty diesel engines,
   (c) limiting vehicle speeds on unpaved roads to 15 miles per hour,
   (d) limiting unnecessary vehicle idling to 5 minutes,
   (e) watering active construction sites at least twice daily,
   (f) covering inactive storage piles,
   (g) revegetating disturbed areas as soon as possible, and
   (h) complying with all permitting requirements when using controlled burning as a habitat management tool.

2. Before conducting activities greater than 1 acre in size or 7 work days in duration, assess air quality impacts and determine whether additional CEQA review and documentation are necessary.

3. When planning and conducting activities, integrate measures to avoid or minimize water quality impacts. These measures include:

   (a) minimizing vegetation and soil disturbance.
   (b) implementing erosion control BMPs as necessary (e.g., using silt fencing, well-anchored sandbag cofferdams, coir logs, coir rolls, straw-bale dikes, or other siltation barriers that prevent silt and other materials from eroding into streams),
   (c) performing instream work in dry conditions,
   (d) covering stockpiled soil, and

(e) revegetating disturbed areas.

4. Before conducting activities that involve the use of construction equipment within 500 feet of a private residence, prepare and implement a noise reduction plan to protect sensitive receptors. Noise reduction plans may include measures such as alternative construction techniques, modified operation of equipment, limited hours of operation, or noise barriers.

5. Before conducting projects involving the use of hazardous materials, establish and implement plans and BMPs to prevent and contain accidental spills.

Impacts of the Management Coordination Element

The purpose of the Facility Maintenance Elements is to guide the management of the KWA to support and allow achievement of this LMP's biological and public use goals. Implementation of all the above-listed tasks will support this purpose by creating opportunities to improve efficiency and achieve larger-scale, more robust conservation outcomes. For the most part, the tasks above do not involve changes in the physical environment; many simply describe the coordination and planning that is required to implement other tasks listed in this LMP, the impacts of which are discussed under other elements.

However, the task that recommends that the Department coordinate with BLM to block illegal vehicular access to the northern boundary of the KWA (Goal 1, Task 2[a]) is not discussed elsewhere, and could result in minor and temporary environmental impacts. Installing barriers or other facilities could disturb soil or vegetation; generate dust, noise, and emissions through the use construction equipment and vehicles; and use hazardous fluids (e.g., gasoline, oil) incidental to equipment use (see Appendix C).

Although it would involve some disturbance, this task ultimately would result in substantial environmental benefits by minimizing unauthorized vehicle access to the KWA, which damages sensitive habitats and other resources. Furthermore, to ensure that this task will have no impact or a less-than-significant impact, the Department will appropriately apply the tasks prescribed by this LMP that involve planning, coordination, and design; impact avoidance; BMP implementation; regulatory compliance; restoration; and monitoring.

4.6 Biological Monitoring Element

The purpose of the Biological Monitoring Element is to monitor the changing conditions of the KWA so that management actions may be adaptively tailored to better meet the goals of this LMP. Monitoring can inform the sound management of aquatic, riparian, and upland ecosystems both in and beyond the wildlife area.

Goal 1. Monitor Riparian and Aquatic Ecosystems

Monitoring will allow the Department to track and document resource conditions, allowing informed management of riparian and aquatic ecosystems.

Tasks:

1. Design and implement a program of long-term vegetation monitoring at the KWA that includes tracking the structure of riparian vegetation and characteristics of vegetative cover along channel banks.

2. Monitor the stability of channel banks, sediment deposition in channel beds, and erosion and sedimentation in creek ecosystems.

3. Monitor grazing effects in riparian areas.

4. Maintain mapped inventories of infestations of tamarisk and other invasive plant species whose ecological impacts have been rated "high" or "moderate" by Cal-IPC (see Table 3-5).

5. Establish bird census routes and monitor bird species of riparian ecosystems. When conducting bird surveys, follow Department or USFWS survey protocols, as appropriate.

6. Monitor the distribution and abundance of western pond turtles and yellow-legged frogs in riparian areas. When conducting wildlife surveys, follow Department or USFWS survey protocols, as appropriate.

Goal 2. Monitor Grassland and Woodland Ecosystems

Monitoring will allow the Department to track and document resource conditions, allowing informed management of grasslands and woodlands.

Tasks:

1. Design and implement a program of long-term vegetation monitoring at the KWA that includes tracking mature oak condition and mortality and the regeneration of oak saplings.

2. Monitor the effects of the grazing regime on the distribution and abundance of invasive plants, special-status plants, and native grasses, and on oak regeneration.

3. Monitor the effects of fire regimes on the suitability of grasslands and woodlands as habitat for wildlife.

4. Maintain mapped inventories of infestations of invasive plant species whose ecological impacts have been rated "high" or "moderate" by Cal-IPC (see Table 3-5).

5. Monitor frequently traveled routes for new infestations of invasive plants.

6. Monitor bird species of grasslands and woodlands.

7. Monitor identified populations of special-status plants.

Goal 3. Monitor Chaparral Ecosystems

Monitoring will allow the Department to track and document resource conditions, allowing informed management of chaparral.

Tasks:

1. Monitor the effects of the fire regime on the suitability of chaparral as habitat for wildlife.
2. Maintain mapped inventories of infestations of invasive plant species whose ecological impacts have been rated "high" or "moderate" by Cal-IPC (see Table 3-5).
3. Monitor frequently traveled routes for new infestations of invasive plants.
4. Monitor chaparral bird species.
5. Monitor identified populations of special-status plants.

Goal 4. Monitor Serpentine Soil Ecosystems

Monitoring will allow the Department to track and document resource conditions, allowing informed management of serpentine soil ecosystems.

Tasks:

1. Design and implement a program of long-term vegetation monitoring at the KWA that includes tracking characteristics of the vegetation of serpentine seeps.
2. Monitor the effects of the fire regime on the suitability of serpentine soil ecosystems as habitat for wildlife.
3. Maintain mapped inventories of infestations of invasive plant species whose ecological impacts have been rated "high" or "moderate" by Cal-IPC (see Table 3-5).
4. Monitor frequently traveled routes for new infestations of invasive plants.
5. Monitor bird species of serpentine soil ecosystems.
6. Monitor identified populations of special-status plants.

Goal 5. Monitor Game Populations

Monitoring will allow the Department to track and document the status of game populations, which will inform their management.

Tasks:

1. Design and implement a program of long-term monitoring to characterize the quantity and quality of black-tailed deer, California quail, mourning dove, and wild turkey habitats.

2. Assess black-tailed deer population characteristics. Collect data on abundance, habitat use, sex ratio, age structure, and harvest levels to inform deer herd management decisions.

3. Assess California quail, mourning dove, and wild turkey population characteristics. Collect data on habitat use and harvest levels if feasible.

Goal 6. Monitor Success of Management Activities

Monitoring that documents the outcomes of management activities will allow their effectiveness to be evaluated, and the effectiveness of subsequent management to be improved.

Tasks:

1. Monitor pre- and postrestoration ecological conditions to evaluate the success of restoration and associated actions (e.g., construction BMPs) and to refine restoration techniques in an adaptive management framework.

2. Evaluate the effectiveness of methods for controlling invasive plants and adjust methods as needed.

3. Evaluate the effectiveness of grazing treatments at achieving desired outcomes and adjust treatments as needed.

Impacts of the Biological Monitoring Element

The purpose of the Biological Monitoring Element is to monitor the changing conditions of the KWA so that management actions may be adaptively tailored to better meet the goals of this LMP. Implementation of the tasks under this element will not involve measurable physical changes to the environment—Department staff members conducting monitoring activities will not add to the environmental impacts already analyzed (elsewhere in this LMP and in Appendix C).

Section 5. Operations and Maintenance Summary

5.1 Operations and Maintenance Tasks to Implement Plan

Implementation of the tasks and achievement of the goals established in Section 4 of this LMP will require additional staffing and budgetary resources. This plan proposes proactive ecosystem management of watersheds at a level that is more intensive than was practiced in the past. However, the KWA is not currently assigned specific staff time or budget.

In addition, this plan will need to be kept current and revised as necessary to respond to changing situations. It is expected that ongoing adaptive management of the KWA, as well as advancement of scientific knowledge regarding invasive species control and restoration of native vegetation, will result in new techniques and opportunities for more effective management of the wildlife area. Procedures to help keep this plan current and relevant are described in Section 7.0, "Future Revisions to This Plan."

5.2 Existing Staff and Additional Personnel Needs Summary

Currently, no Department staff positions are specifically budgeted to the KWA. Existing staff positions do, however, provide services to the KWA, in the following proportions:

- Approximately 10% of an Senior Environmental Scientist's time (0.1 personnel year [PY])
- Approximately 25% of an Environmental Scientist's time (0.25 PY)
- Approximately 60% of a Wildlife Habitat Assistant's time (0.6 PY)
- Approximately 10% of a Scientific Aid's time (0.1 PY)
- Approximately 10% of a Wildlife Officer's time (0.1 PY)

To adequately support the KWA and to perform the tasks identified in this plan, a combination of program management, site monitoring and management, maintenance, and warden staffing is required. The staffing program proposed in the following bulleted list and subsections of this plan reflects the staffing needed to effectively manage the KWA, more accurately than does the existing condition shown above.

- Approximately 10% of an Senior Environmental Scientist's time (0.1 PY)
- Approximately 100% of an Environmental Scientist's time (1.0 PY)
- Approximately 100% of a Wildlife Habitat Assistant's time (1.0 PY)
- Approximately 100% of a Tractor Operator/Laborer's time (1.0 PY)
- Approximately 200% of a Scientific Aide's time (a Scientific Aide term is 9 months per year)

5.2.1 Program Management

Senior Environmental Scientist position (0.10 PY). The Senior Environmental Scientist will serve as the manager of the KWA, give direction to the Environmental Scientist and maintenance staff, and coordinate management with other private and public entities.

Environmental Scientist (1.0 PY). The Environmental Scientist will perform technical tasks, field coordination of joint-agency and nongovernmental organization projects, grant application tasks, public communication activities, on-site management of field operations, and coordination of research, monitoring, and data management.

5.2.2 Site Management

Wildlife Habitat Assistant position (1.0 PY). Day-to-day field operations will require a Wildlife Habitat Assistant. This individual will act as the on-site field person for the wildlife area, performing the basic maintenance and support functions. The individual will assist and lead regular Department staff, seasonal labor, and volunteers in performing maintenance tasks as directed by this plan.

5.2.3 Ongoing Maintenance

Tractor Operator/Laborer position (1.0 PY) Under the direction of the Senior Environmental Scientist supervisor, one skilled person will be required to operate machinery and perform maintenance tasks related to signing, access improvements, control of invasive species, infrastructure maintenance, development and repair, restoration, and other habitat improvement projects.

Scientific Aide (2.0 PY). Seasonal staff time will be required to assist with maintenance, monitoring, and restoration work throughout the year. Scientific Aides work the equivalent of 9 months per year. It is expected that two scientific aides over the period of 1 year will be adequate for assisting ongoing maintenance and site management.

5.2.4 Law Enforcement

Wildlife Officer (0.1 PY). The periodic presence of a Fish and Game Warden will be required to patrol the KWA to protect natural resources, especially during the high-use periods (turkey and deer hunting seasons). This individual will deal with fish and game violations and enforce other KWA regulations, including those related to vehicular access and vandalism. The individual also will assist neighboring landowners in addressing concerns regarding trespass and vandalism.

5.3 Operations and Maintenance Cost Summary

The proposed staffing and annual operations and maintenance budget has been summarized here in order to establish an annual estimated cost for the operation of the KWA.

5.3.1 Staffing

The annual cost of the proposed staffing program is itemized in Table 5-1.

Table 5-1. Annual Costs of Staffing Program

Position	PYs	Yearly Salary[1] ($)	Yearly Cost ($)
Senior Environmental Scientist	0.10	118,788	11,879
Environmental Scientist	1.0	72,696	72,696
Wildlife Habitat Assistant	1.0	49,200	49,200
Tractor Operator/Laborer, Range B	1.0	52,260	52,260
Scientific Aid	2.0	29,869	59,738
Wildlife Officer (Fish and Game Warden), Range B	0.1	71,136	7,114
Total Staffing	2.7		252,887

Notes: PY = personnel year.

[1] All salaries are shown at maximum rates, and state employee benefits are not included. Benefit costs primarily consist of pension and health benefit costs, which vary annually and among individuals much more than salary costs. Wardens also may receive additional compensation (longevity and education incentives) not shown in this chart.

5.3.2 Materials, Supplies, and Capital Equipment

A materials and supplies budget will be required to provide office supplies, materials, fuel, small tools, and other items to support management and maintenance activities. Cost considerations will include replacement signs, fences, and other barriers; herbicide; gravel; and other needed materials. The Department currently has, on site at the KWA, the tractor and road-grading equipment it needs to maintain dirt roads and continue a very limited amount of vegetation management. To undertake the tasks listed in this LMP, additional equipment such as mowers, vehicles, all-terrain vehicles, spray units, or tractors may be needed. Based on past expenditures and comparisons with other wildlife area operation costs, an annual budget of $100,000 is proposed.

The total annual cost (salaries, materials and supplies, and additional capital equipment) is estimated to be approximately $352,887 in 2016 dollars.

Section 6. Climate Change Strategies

Global climate change is a major challenge to the conservation of California's natural resources. To address this challenge, the Department has been developing policies and implementing actions to assess and minimize the exposure and vulnerability of California's plants, wildlife, and their habitats to the potential effects of climate change (https://www.wildlife.ca.gov/Explore/Organization/Climate-Energy). Climate change also is addressed as a targeted pressure, with accompanying strategies and objectives, in *California's State Wildlife Action Plan 2015—A Conservation Legacy for Californians* (CDFW 2015b). The KWA is located in the North Coast and Klamath Province identified in the action plan.

This section provides an overview of exposure and vulnerability to climate change effects. Actions to minimize climate change effects have been incorporated into the goals and tasks of this plan.

Global climate change is exposing plants and animals to physical changes to their environment that can affect the distribution and abundance of species. These changes include variations in temperature and precipitation and corresponding changes in watershed hydrology and wildfire risk. At the KWA, these changes are likely to result in shorter intervals between fires, greater tree mortality from fires, increased water deficits from spring through fall, and potentially diminished groundwater recharge and spring–summer streamflows, among other changes (see Section 2.3.3, "Climate"). These environmental changes alter habitats and their suitability for species. They also can cause physiological stress to organisms or amplify the impacts of other stressors, such as competition or predation by nonnative invasive species or habitat loss and fragmentation by conversion to agricultural or developed land uses.

Species differ in their sensitivity to stresses related to climate change and their ability to resist or adapt in response to them. This vulnerability is a product of many aspects of a species' ecology; however, a large portion of California's flora and fauna are moderately to highly vulnerable to climate change (CDFW 2015b).

The Department has developed the following key strategies and actions to adapt to climate change and reduce its impacts on the conservation of California's plants, animals, and habitats (California Department of Natural Resources 2014):

- Develop management practices to help safeguard species and ecosystems from climate risks.
- Enhance biodiversity monitoring in California to detect climate impacts and inform responses.
- Support environmental stewardship across sectors.
- Improve understanding of climate risks to biodiversity and habitats.
- Share and exchange information.

These strategies and actions have been incorporated into the goals and tasks of this LMP.

Section 7. Future Revisions to This Plan

All planning documents eventually become dated and require revision so that they can continue to provide practical direction for management activities. Although this LMP reflects the best information available during the planning process, inevitably new information will trigger the need to make adjustments. Such new information may include:

- feedback generated by the monitoring of management activities (adaptive management);
- other scientific research that informs improvements to management techniques;
- new documented threats to biotic communities, habitats, or wildlife species;
- new legislative or policy direction; or
- new land acquisitions.

A common and unfortunate situation is that the revision of planning documents is neglected because the process for revision is considered too involved and too cumbersome. To address this problem, this section incorporates a hierarchy of revision procedures in which the level of process and required involvement is proportionate to the level of change proposed. Public outreach will be conducted, and public input sought, in proportion to the proposed change to the LMP.

7.1 Minor Revisions

Minor revisions to this LMP are those that do not involve any change to the overall purposes of the plan. Minor revisions may include the addition of new property to the KWA or the adoption of limited changes to the goals and tasks as part of adaptive management or in response to other scientific information or legislative direction. Before approving such revisions, the Department will meet all of the following requirements:

- Prepare and approve CEQA documentation (if required).
- Consult appropriately within the region and with the Department's Lands and Facilities Branch.
- Consult appropriately with other agencies.
- Consult adjoining neighbors regarding the revision, if the revision is related to a specific location or the acquisition of additional land.
- Present information regarding the proposed revision to the BRBNA Conservation Partnership.

If all the above requirements are met, the minor revision may be prepared by the staff assigned to the wildlife area or by other Department resources, and will require approval by the Department's Regional Manager.

7.2 Major Revision or a New Comprehensive Management Plan

Major revisions to this LMP will constitute substantial revision to the plan in response to new policy direction, or development of a new comprehensive management plan. Such revisions will require a procedure comparable to the planning process, but also will be proportionate to the level of change that is proposed. Before approving major revisions, the Department will meet all of the following requirements:

- Prepare and approve appropriate CEQA documentation.
- Consult appropriately within the region and with the Department's Lands and Facilities Branch.
- Consult and coordinate appropriately with other agencies.
- Conduct a public outreach program proportionate to the level of the proposed revision.
- Present information regarding the proposed revision to the BRBNA Conservation Partnership.

If all the above requirements are met, the major revision may be prepared using available Department resources. The major revision will require recommendation by the Regional Manager and approval by the Director of the Department.

If the appropriate procedure for a particular revision is not apparent, the determination of which procedure to use will be made by the Regional Manager in consultation with the Lands and Facilities Branch.

7.3 Plan Status Reports

Periodic evaluation will be important to ensure that this LMP's goals and overall purpose are met. The Biological Monitoring Element (Section 4) lists multiple tasks that involve gathering data on overall management success and the effectiveness of specific management practices. To use these monitoring data effectively in its adaptive management of the KWA, the Department will periodically analyze the data and prepare plan status reports.

A plan status report will be prepared every 5 years after the LMP's adoption. Each plan status report will include:

- an evaluation of the status of attainment of the LMP's purpose and goals;
- an evaluation of the completion, as appropriate, of each task of the LMP;
- an evaluation of the effectiveness of the Department's efforts to coordinate with neighboring landowners, Napa County, CAL FIRE, and other land management and regulatory agencies;
- notation of important new scientific information that has bearing on the management of KWA; and

- recommended revisions to the LMP that would incorporate new information and improve its effectiveness.

The status reports will be prepared by the Area Manager. They will be submitted to the Department's Lands Program for review and comment, approved by the Regional Manager, and submitted to the Director of the Department. These reports will serve as a basis for revising this LMP and making appropriate adjustments to ongoing management practices.

Section 8. References

Anderson, B. W. 1996. Salt cedar, revegetation and riparian ecosystems in the Southwest. Pages 32–41 *in* J. E. Lovich, J. Randall, and M. Kelly, editors. Proceedings of the California Exotic Pest Plant Council Symposium 1995, Pacific Grove, California. California Exotic Pest Plant Council, Davis.

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2012. The Jepson Manual: Vascular Plants of California. Second edition. University of California Press, Berkeley.

Baum, B. R. 1978. The genus Tamarix. Israel Academy of Sciences and Humanities, Tel Aviv, Israel.

Bedunah, D. J. 1992. The complex ecology of weeds, grazing, and wildlife. Western Wildlands Summer:6–11.

Bell, G. P. 1997. Ecology and management of *Arundo donax*, and approaches to riparian habitat restoration in southern California. Pages 103–113 *in* J. H. Brock, M. Wade, P. Pyšek, and D. Green, editors, Plant Invasions: Studies from North America and Europe. Backhuys Publishers, The Netherlands.

Bennyhoff, James A. 1977. Linguistics in California Prehistory. Lecture delivered in the Department of Anthropology, San Francisco State University, San Francisco, California.

Berner, M., B. Grummer, R. Leong, and M. Rippey. 2003. Breeding Birds of Napa County, California. Ann Smith, editor. Napa-Solano Audubon Society, Vallejo, California.

Billings, W. D. 1990. *Bromus tectorum*, a biotic cause of ecosystem impoverishment in the Great Basin. in G. M. Woodwell, editor, The Earth in Transition: Patterns and Processes of Biotic Impoverishment. Cambridge University Press, New York, New York.

Bramlette, A. 1979. An Archaeological Investigation of a Portion of Fryer Ranch along Eticuera Creek, Napa County, California.

Brownsey R., G. B. Kyser, and J. M. DiTomaso. 2013. Stinkwort is rapidly expanding its range in California. California Agriculture 67(2):110–115.

Bury, R. B., and D. J. Germano. 2008. *Actinemys marmorata* (Baird and Girard 1852)—western pond turtle, Pacific pond turtle. In G. J. Rhodin, C. H. Pritchard, P. P. van Dijk, R. A. Saumure, K. A. Buhlmann, and J. B. Iverson, editors, Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs.

California Department of Natural Resources. 2014. Safeguarding California: Reducing Climate Risk—An Update to the 2009 California Climate Adaptation Strategy. Sacramento. <http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf>.

California Fish and Game Commission. 2016. Miscellaneous Policies of the Fish and Game Commission—Cooperation. <http://www.fgc.ca.gov/policy/p4misc.aspx>. Accessed July 20, 2016.

[Cal-IPC] California Invasive Plant Council. 2006. California Invasive Plant Inventory. Berkeley. <http://www.cal-ipc.org.>

[Cal-IPC] California Invasive Plant Council. 2015. California Invasive Plant Inventory Assessment Form. Berkeley, California. <http://www.cal-ipc.org/paf/>. Accessed 2015.

[Cal-IPC] California Invasive Plant Council. 2016. California Invasive Plant Inventory Assessment Form. Berkeley, California. <http://www.cal-ipc.org/paf/>. Accessed April 18, 2016.

Cane, H., and V. J. Tepedino. 2016. Gauging the Effect of Honey Bee Pollen Collection on Native Bee Communities. Conservation Letters 0(0). A Journal of the Society for Conservation Biology.

[CDFG] California Department of Fish and Game. 2005. Knoxville Wildlife Area Land Management Plan. California Department of Fish and Game, Central Coast Region.

[CDFW] California Department of Fish and Wildlife. 2015a. California Deer Conservation and Management Plan.

[CDFW] California Department of Fish and Wildlife. 2015b. California State Wildlife Action Plan 2015 Update: A Conservation Legacy for Californians. Sacramento. <https://www.wildlife.ca.gov/SWAP/Final>. Accessed March 3, 2016.

[CIMIS] California Irrigation Management Information System. 1999. Reference EvapoTranspiration. Prepared in conjunction with the California Department of Water Resources and the University of California, Davis, Land, Air, and Water Resources.

[CNDDB] California Natural Diversity Database. 2016. Rarefind 5. Results of electronic records search. California Department of Fish and Wildlife. Accessed April 8, 2016.

[CNPS] California Native Plant Society. 2016. Inventory of Rare, Threatened, and Endangered Plants of California. Version 8-02. <http://www.rareplants.cnps.org>.

Corliss, J. 1993. Tall whitetop's crowding out the natives. Agricultural Research May 1993:16.

[CSBFFP] California State Board of Forestry and Fire Protection. 2016. Program Environmental Impact Report for the Vegetation Treatment Program. March. Prepared by the California Department of Forestry and Fire Protection. <http://bofdata.fire.ca.gov/board_committees/resource_protection_committee/current_projects/vegetation_treatment_program_environmental_impact_report_(vtpeir)/preliminary_draft_vtp_eir_jan_2016/0._vegetation_treatment_program_draft_program_environmental_impact_report_march_2016_full.pdf>.

D'Antonio, C. M. 2000. Fire, plant invasions, and global changes. Pages 65–93 *in* H. A. Mooney and R. J. Hobbs, editors, Invasive Species in a Changing World. Island Press, Washington, D.C.

D'Antonio, C. M., and P. M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23.

Davy, J. S., J. M. DiTomaso, and E. A. Laca. 2008. Barb Goatgrass. University of California, Division of Agriculture and Natural Resources. <http://anrcatalog.ucdavis.edu>. Accessed April 8, 2016.

DiTomaso, J. 2000. *Cortaderia selloana* (Schultes) Asch. & Graebner. Pages 128–133 *in* C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

DiTomaso, J. M. 1996. Identification, biology and ecology of salt cedar. *In* Proceedings of the Saltcedar Management Workshop. Cooperative Extension, Imperial County, University of California, Davis, and the California Exotic Pest Plant Council, Davis.

DiTomaso, J. M., and J. D. J. Gerlach. 2000. *Centaurea melitensis* L. *In* C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

DiTomaso, J. M., and E. A. Healy. 2007. Weeds of California and Other Western States. Volumes 1 and 2. Publication 3488. University of California Division of Agriculture and Natural Resources, Davis.

eBird. 2015. eBird: An Online Database of Bird Distribution and Abundance [web application]. Ithaca, New York. <http://www.ebird.org>. Accessed May 15, 2015.

Enderlin, D., editor. 2002. McLaughlin Mine Annual Monitoring Report. July 1, 2001–June 30, 2002. Homestake Mining Company of California, Lower Lake, California.

Enright, N. J., J. B. Fontaine, D. Bowman, R. A. Bradstock, and R. J. Williams. 2015. Interval squeeze: altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes. Frontiers in Ecology and the Environment, 13(5):265–272

Evans, R. A., and J. A. Young. 1984. Microsite requirements for downy brome infestation and control on sagebrush rangelands. Weed Science 32, Supplement 1:13–17.

Fellers, G. M. 2005. *Rana draytonii* California red-legged frog. Pages 552–554 *in* M. Lannoo, editor, Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley.

Fredrickson, D. A. 1974. Cultural diversity in early central California: a view from the north Coast Ranges. Journal of California Anthropology 1(1):41–53.

Fredrickson, D. A. 1973. Early cultures of the north Coast Ranges, California. Dissertation. Department of Anthropology, University of California, Davis.

Fried, J. S., M. S. Torn, and E. Mills. 2004. The impact of climate change on wildfire severity: a regional forecast for northern California. Climate Change 64:169–191.

Fuhlendorf, S. D., and D. M. Engle. 2001. Restoring heterogeneity on rangelands: ecosystem management based on evolutionary grazing patterns. BioScience 51:625–632.

Gerlach, J., A. Deyer, and K. Rice. 1998. Grassland and foothill woodland ecosystems of the Central Valley. Fremontia 26:39–43.

[GrassRoots] GrassRoots Environmental. 2015. Cultural Resources Investigations, CDFW Airport Burn Project [memorandum]. Sacramento, California. Prepared for H. T. Harvey & Associates, Sacramento, California.

Haas, W. E. 2004. Long-eared Owl (*Asio otus*). Pages 291–293 *in* P. Unitt, editor, San Diego County Bird Atlas. Proceedings of the San Diego Society of Natural History 39.

Harrington, K. C., and W. T. Lanini. 2000. *Phalaris aquatica* L. Pages 262–266 *in* C. C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Hayes, M. P., and M. R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. In R. Sarzo, K. E. Severson, and D. R. Patton, technical coordinators, Proceedings of the Symposium on the Management of Amphibians, Reptiles, and Small Mammals in North America. General Technical Report (RM-166). U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station, Fort Collins, Colorado.

Hayes, M. P., S. J. Kupferberg, and A. J. Lind. 2005. Foothill yellow-legged frog (*Rana boylii*). *In* L. Jones, W. Leonard, and D. Olson, editors, Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington.

Hays, D. W., K. R. McAllister, S. A. Richardson, and D. W. Stinson. 1999. Washington State Recovery Plan for the Western Pond Turtle. Washington Department of Fish and Wildlife, Olympia.

Howald, A. 2000. *Lepidium latifolium* L. Pages 222–227 *in* C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Jackson, R., and J. Bartolome. 2002. A state-transition approach to understanding nonequilibrium plant community dynamics in Californian grasslands. Plant Ecology 162:49–65.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and Reptile Species of Special Concern in California. California Department of Fish and Game, Inland Fisheries Division.

Johnson, P. J. 1978. Patwin. *In* R. F. Heizer, editor, Handbook of North American Indians, Volume 8: California. Smithsonian Institution, Washington, D.C.

Kan, T., and O. Pollak. 2000. *Taeniatherum caput-medusae* (L.) Nevski. Pages 309–312 *in* C. C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Keeley, J. E., and F. W. Davis. 2007. Chaparral. Pages 339–366 *in* M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors, Terrestrial Vegetation of California. Third Edition. University of California Press, Berkeley.

Kennedy, P. B. 1928. Goatgrass or wild wheat (*Aegilops triuncialis*). Journal of the American Society of Agronomy 20:1292–1296.

Knick, S. T., and J. T. Rotenberry. 1997. Landscape characteristics of disturbed shrubsteppe habitats in southwestern Idaho (USA). Landscape Ecology 12:287–297.

Kroeber, A. L. 1925. Handbook of the Indians of California. Bureau of American Ethnology Bulletin 78. Washington, D.C.

Kroeber, A. L. 1932. The Patwin and their neighbors. University of California Publications in American Archaeology and Ethnology 29(4):253–423.

Kruckeberg, A. R. 2002. Geology and Plant Life: the Effects of Landforms and Rock Types on Plants. University of Washington Press, Seattle.

Levine, J. M., M. Vila, C. M. D'Antonio, J. S. Dukes, K. Grigulis, and S. Lavorel. 2003. Mechanisms underlying the impacts of exotic plant invasions. Proceedings of the Royal Society of London 270:775–781.

Lovich, J. 2000. *Tamarix ramosissima* Ledeb./*Tamarix chinensis*/*Tamarix gallica*/*Tamarix parviflora*. Pages 312–317 *in* C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Lovich, J. E., T. B. Egan, and R. C. de Gouvenain. 1994. Tamarisk control on public lands in the desert of southern California: two case studies. Pages 166–177 *in* California Weed Science Society, Proceedings of the Forty-Sixth Annual California Weed Conference.

Mack, R. N. 1981. Invasion of *Bromus tectorum* L. into western North America: an ecological chronicle. Agroecosystems 7:145–165.

Marks, J. S., D. L. Evans, and D. W. Holt. 1994. Long-eared owl (*Asio otus*). No. 211 *in* A. Poole and F. Gill, editors, The Birds of North America. Academy of Natural Sciences, Philadelphia, Pennsylvania.

McKern, W. C. 1922. Functional families of the Patwin. University of California Publications in American Archaeology and Ethnology 13(7):235–258.

McKern, W. C. 1923. Patwin houses. University of California Publications in American Archaeology and Ethnology 20(10):159–171.

Micheli, E., L. Flint, A. Flint, S. Weiss, and M. Kennedy. 2012. Downscaling future climate projections to the watershed scale: a north San Francisco Bay estuary case study. San Francisco Estuary and Watershed Science 10(4). <http://escholarship.org/uc/item/01n4z228>. Accessed March 21, 2016.

Mosely, J. C., S. C. Bunting, and M. E. Manoukian. 1999. Cheatgrass. Pages 175–188 *in* R. L. Sheley and J. K. Petroff, editors, Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis.

Nafis, G. 2016. A Guide to the Amphibians and Reptiles of California. <http://www.californiaherps.com>. Accessed April 11, 2016.

Naylor, R. L. 2000. The economics of alien species invasions. Pages 241–260 *in* H. A. Mooney and R. J. Hobbs, editors, Invasive Species in a Changing World. Island Press, Washington, D.C.

[NRCS] Natural Resources Conservation Service. 2013. Soil Survey Geographic Database (SSURGO) for Napa and Yolo Counties. <http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>.

[NRCS] Natural Resources Conservation Service. 2014. Soil Survey Geographic Database (SSURGO) for Napa and Yolo Counties. <http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>.

Peters, A., D. E. Johnson, and M. R. George. 1996. Barbed goatgrass: a threat to California rangelands. Rangelands 18:8–10.

Perez, C. N. 1996. Land Grants in Alta California. North Landmark Enterprises, Rancho Cordova, California.

Pierce, D. W., T. Das, D. R. Cayan, E. P. Maurer, N. L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M. A. Snyder, L. C. Sloan, G. Franco, and M. Tyree. 2013. Probabilistic estimates of future changes in California temperature and precipitation using statistical and dynamical downscaling. Climate Dynamics 40:839–856.

Pierson, E. D., and W. E. Rainey. 1998. Distribution, status, and management of Townsend's big-eared bat (*Corynorhinus townsendii*) in California. Technical Report Number 96-7. California Department of Fish and Game, Bird and Mammal Conservation Program, Sacramento.

Powers, S. 1877. Tribes of California. U.S. Department of the Interior, Geographical and Geological Survey of the Rocky Mountain Region, Contributions to North American Ethnology, III. Washington, D.C.

PRISM Climate Group. 2016. 30-Year Normals [web application]. Oregon State University, <http://prism.oregonstate.edu>.

Randall, J. M. 2000. *Cirsium vulgare* (Savi) Tenore. Pages 112–116 *in* C. C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors, Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Robinson, T. W. 1965. Introduction, Spread and Areal Extent of Saltcedar (Tamarix) in the Western States. Geological Survey Professional Paper No. 491-A. Washington, D.C.

Roché, B. F. J., C. T. Roché, and R. C. Chapman. 1994. Impacts of grassland habitat on yellow star thistle (*Centaurea solstitialis* L.) invasion. Northwest Science 68:86–96.

Roché, C. T., and B. F. J. Roché. 1988. Distribution and amount of four knapweed (*Centaurea* L.) species in eastern Washington. Northwest Science 62:242–253.

Rosentreter, R. 1994. Displacement of rare plants by exotic species. *In* S. B. Monsen and S. G. Kitchen, editors, Proceedings, Ecology and Management of Annual Rangelands. General Technical Report INT-GTR-313. U.S. Forest Service Intermountain Research Station.

Safford, H. D., J. H. Viers, and S. P. Harrison. 2005. Serpentine endemism in the California flora: a database of serpentine affinity. Madroño 52:222–257.

Sawyer, J. O. 1978. Wappo. Pages 256–263 *in* R. F. Heizer, editor, Handbook of North American Indians, Volume 8, California. Smithsonian Institution, Washington, D.C.

Sawyer et al. 2009. A Manual of California Vegetation. Second edition. California Native Plant Society, Sacramento.

Sheley, R. L., and J. K. Petroff, editors. 1999. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis.

Sherwin, R., and A. Piaggio. 2005. *Corynorhinus townsendii*. Western Bat Working Group. <http://wbwg.org/species_accounts/vespertilonidae/coto.pdf>.

Sommer, M. L., R. L. Barboza, R. A. Botta, E. B. Kleinfelter, M. E. Schauss, and J. R. Thompson. 2007. Habitat Guidelines for Mule Deer: California Woodland Chaparral Ecoregion. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies.

Steenhof, Karen. 2013. Prairie falcon (*Falco mexicanus*). No. 346 *in* A. Poole, editor, The Birds of North America Online. Cornell Lab of Ornithology Ithaca, New York. <http://bna.birds.cornell.edu/bna/species/346>. Accessed April 8, 2016.

Storer, T. I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27(1):1–342.

Thorne, J. H., R. M. Boynton, L. E. Flint, and A. L. Flint. 2015. The Magnitude and Spatial Patterns of Historical and Future Hydrologic Change in California's Watersheds. Ecosphere 6(2):24. <http://dx.doi.org/10.1890/ES14-00300.1>. Accessed March 21, 2016.

Trumbo, J. T. 1994. Perennial pepperweed: a threat to wildland areas. California Exotic Pest Plant Council News 2:4–5.

[USFWS] U.S. Fish and Wildlife Service. 2002. Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*). Region 1.

Van Mantegem, P. J., J. C. B. Nesmith, M. Keifer, E. E. Knapp, A. Flint, and L. Flint. 2013. Climate stress increases forest fire severity across the western United States. Ecology Letters. DOI: 10.1111/ele. 12151.

Vitousek, P. M. 1990. Biological invasions and ecosystem processes: towards an integration of population biology and ecosystem studies. Oikos 57.

Wallace, W. F., and T. Kanaga. 1901. Illustrated History of Napa County. Enquirer Print, Oakland, California.

Whatford, C. 2004. Rumsey Incident, CA-LNU-007867, Cultural Resources Narrative. October 18.

[WRCC] Western Regional Climate Center. 2016. Knoxville Creek California. <http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCKNO>. Accessed May 1, 2016.

Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48:607–615.

Williams, D. F. 1986. Mammalian Species of Special Concern in California. Prepared for the State of California, The Resources Agency, Department of Fish and Game.

Work, J. 1945. Fur Brigade to the Bonaventura: John Works California Expedition, 1832–1833, for the Hudson's Bay Company. A.B. Maloney, editor. California Historical Society, San Francisco.

Young, J. A., and F. L. Allen. 1997. Cheatgrass and range science: 1930–1950. Journal of Range Management 50:530–535.

Young, J. A., R. A. Evans, and J. Major. 1972. Alien plants in the Great Basin. Journal of Range Management 25:194–201.

Yount, G. C. 1966. Indians of the Napa Valley. Pages 153–164 *in* C. L. Camp, editor, George C. Yount and his Chronicles of the West, Comprising Extracts from his "Memoirs" and from the Orange Clark "Narrative." Old West Publishing Company, Denver, Colorado.

Zeiner, D. C., W. F. Laudenslayer Jr., K. E. Mayer, and M. White, editors. 1990. California's Wildlife. Volume II: Birds. California Department of Fish and Game, Sacramento.

Section 9. Abbreviations and Terms

The following abbreviations and defined terms are used in this plan with the meanings that are indicated below.

BLM	U.S. Bureau of Land Management
BMPs	best management practices
BRBNA	The Blue Ridge–Berryessa Natural Area—an area defined roughly by the Putah Creek watershed and the Cache Creek watershed below Clear Lake.
CAL FIRE	California Department of Forestry and Fire Prevention
Cal-IPC	California Invasive Plant Council
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CIMIS	California Irrigation Management Information System
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRHR	California Register of Historical Resources
CSBFFP	California State Board of Forestry and Fire Protection
Department	The California Department of Fish and Wildlife
DOQQ	digital orthophoto quarter quad
ESA	Endangered Species Act
ICE	Information Center for the Environment
IPaC	USFWS Information for Planning and Conservation
KWA	Knoxville Wildlife Area
LMP	land management plan
MCV	Manual of California Vegetation
NAHC	Native American Heritage Commission
NFD	not formally defined
NRCS	Natural Resources Conservation Service
NRS	Natural Reserve System
NWIC	Northwest Information Center
OHV	off-highway vehicle
PY	personnel year
RDM	residual dry matter
Reclamation	U.S. Bureau of Reclamation

Special-status species	Species that are state or federally listed as threatened, endangered; those considered as candidates or proposed for listing; state species of special concern; and plants ranked as rare, threatened, or endangered
UC	University of California
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator
VegCAMP	Vegetation Classification and Mapping Program
WRCC	Western Regional Climate Center