Coyote Valley Landscape Linkage

A Vision for a Resilient, Multi-benefit Landscape




December
2017

Prepared by the
SANTA CLARA VALLEY OPEN SPACE AUTHORITY

with the
CONSERVATION BIOLOGY INSTITUTE

The Santa Clara Valley Open Space Authority conserves the natural environment, supports agriculture, and connects people to nature, by protecting open spaces, natural areas, and working farms and ranches for future generations.
OpenSpaceAuthority.org

The Conservation Biology Institute provides scientific expertise to support conservation and recovery of biological diversity in its natural state through applied research, education, planning, and community service.
consbio.org

Open Space Authority Linkage Planning Team

Matt Freeman, M.C.R.P., Assistant General Manager
Galli Basson, M.S., Resource Management Specialist
Jake Smith, M.S., Conservation GIS Coordinator

Suggested Citation

Santa Clara Valley Open Space Authority and Conservation Biology Institute. 2017. *Coyote Valley Landscape Linkage: A Vision for a Resilient, Multi-benefit Landscape.* Santa Clara Valley Open Space Authority, San José, CA. 74p.

Photo credits: Patty Eaton, Janell Hillman, Cait Hutnik, Stephen Joseph, Tom Ingram, William K. Matthias, Deborah Mills, Derek Neumann, Pathways for Wildlife, Ryan Phillips, and Stuart Weiss.

Coyote Valley Landscape Linkage

A Vision for a Resilient, Multi-benefit Landscape

December 2017

OPEN SPACE AUTHORITY
SANTA CLARA VALLEY

CONSERVATION BIOLOGY INSTITUTE

Foreword

In 2014, the Santa Clara Valley Open Space Authority released the *Santa Clara Valley Greenprint*, its 30-year roadmap which identifies goals, priorities, and strategies for effective investments in nature that protect and restore the environment and maintain high quality of life in our urban communities. The Coyote Valley emerged as a top priority for focused conservation efforts, not only for its remarkable combination of biodiversity, farmland, and water resources in such close proximity to urban San José, but because protection of this landscape is the key to maintaining long-term ecological connectivity between one million acres of core habitat and natural areas in the Santa Cruz and Diablo Range Mountains that ring the Santa Clara Valley.

The *Coyote Valley Landscape Linkage* report articulates a vision to protect and restore essential areas within the valley that are vital to ensure ecological connectivity, health and resilience to a changing climate. Based on the latest science and field-based observations of how wildlife currently travel through the valley, the proposed linkage encompasses Fisher Creek and its floodplain, which is a critical pathway for wildlife movement between the surrounding mountains, as well as Laguna Seca, which provides an unparalleled opportunity for restoration of the largest freshwater wetland in the South Bay. Protection of these and other areas will benefit far-ranging wildlife species like badger and mountain lion, as well as many rare, threatened and endangered plants and animals that rely upon these habitats. These open spaces also serve as natural infrastructure for the City of San José and the larger region in that they provide essential urban services including protection of water quality, groundwater recharge and water supply, and downstream flood protection.

Many Californians' recent experience of four years of devastating drought followed by near-record flooding reminds us of the importance of planning our communities and landscapes to accommodate change. This mindset is more important now than ever as Santa Clara County is projected to add approximately 250,000 new residents over the next 15 years (ABAG 2017), while climate change threatens to induce more severe extremes in weather and rainfall patterns, putting a strain on the environment and provision of urban services.

The Coyote Valley presents a unique opportunity to design *with* nature in a way that benefits our natural and built environments through increased ecological resilience. Through a network of restored habitats and wildlife-friendly farms, we can protect those areas that are most essential to our well-being now and in a different climate future, while accommodating sustainable areas for appropriate growth and development. Indeed, California's innovative Climate Adaptation Strategy, *Safeguarding California Plan: 2017 Update*, calls for natural infrastructure solutions and multi-benefit projects that build climate preparedness in both the natural and built environments. Silicon Valley is a center of innovation: what better place to lead the way forward and demonstrate how strategic investments in nature combined with smart land use policies and urban design can support the health of the land and the natural infrastructure upon which our own well-being depends?

We at the Open Space Authority are pleased to share this vision with the community in the hope that it will inspire an appreciation about the importance of Coyote Valley to the ecological health of the City and the region. We aim to implement this vision in partnership with willing landowners, local and state agencies, public and private conservation partners, and with local residents who have such an important stake in this landscape. We hope you will join us in protecting this "last chance landscape" to ensure a resilient and climate-smart future for people and the environment.

Matt Freeman
Assistant General Manager
Santa Clara Valley Open Space Authority

A wildlife camera photo of a coyote on Tulare Hill.

Figures

Table of Contents

Acknowledgments

The Open Space Authority would like to thank all the individuals and agencies that provided valuable feedback on the draft Landscape Linkage Report, and Switky Communications Group for graphic design.

Process for Scientific Advisor Input and Review

The Scientific Advisory team was consulted between November 2016 and May 2017. Advisors were invited to participate in three different two-three hour online working sessions facilitated by Conservation Biology Institute using Databasin. Databasin allowed for data sharing, visualization, and participatory mapping. Advisors were also invited to a daylong field trip in the Coyote Valley to explore recommendations on the ground. In addition, some advisors provided additional time in the field exploring road crossings and other features of the landscape and those observations were used to inform the recommendations made in this report. Additional feedback was also solicited through targeted one-one conversations. A complete draft of the report was produced in April 2017, and then advisors were given through mid-May for review prior to the draft being released for public review in June 2017.

Coyote in Rancho Canada del Oro Open Space Preserve.

Team

The Coyote Valley landscape linkage vision and design was made possible by a dedicated team of scientific advisors who contributed their time and expertise in the creation of this product. The team was selected to: (1) assure the highest scientific quality from the perspective of various disciplines; (2) reflect detailed local knowledge; and (3) provide recommended actions that would be both effective and practical. The team is listed in alphabetical order.

Name	Affiliation	Expertise
Galli Basson, M.S.	Santa Clara Valley Open Space Authority	Ecology
Tanya Diamond, M.S.	Pathways for Wildlife	Wildlife Ecology
Matt Freeman, M.C.R.P.	Santa Clara Valley Open Space Authority	Regional Conservation Planning
Sasha Gennet, Ph.D.	The Nature Conservancy	Ecological Restoration
Morgan Gray, Ph.D.	UC Berkeley	Conservation Biology
Robin Grossinger, M.S.	San Francisco Estuary Institute	Ecology, Historical Reconstruction
Nicole Heller, Ph.D.	Peninsula Open Space Trust	Ecology, Climate Impacts, Resilience
Dave Johnston, B.S.	California Department of Fish and Wildlife	Wildlife Ecology
Jodi McGraw, Ph.D.	Jodi McGraw Consulting	Conservation Ecologist
Adina Merenlender, Ph.D.	UC Berkeley	Conservation Biology
Jim Robins, M.S.	Alnus Ecological	Ecological Restoration, Aquatic Ecology
S. Bry Sarté, PE, LEED AP	Sherwood Design Engineers	Engineering and Planning
Neal Sharma, MLA	Peninsula Open Space Trust	Landscape Ecology, Regional Planning
Jake Smith, M.S.	Santa Clara Valley Open Space Authority	Conservation GIS, Watershed Planning
Ahiga Snyder	Pathways for Wildlife	Wildlife Ecology
Jim Strittholt, Ph.D.	Conservation Biology Institute	Landscape Ecology, Conservation Biology
Lynne Trulio, Ph.D.	San José State University	Wildlife Ecology
Stuart Weiss, Ph.D.	Creekside Science for Earth Observations	Population Biology, Serpentine Ecology
Chris Wilmers, Ph.D.	UC Santa Cruz	Wildlife Ecology, Global Change

Highlights

- For many years, state and regional agencies, as well as independent scientists, have recognized the **importance of connecting California habitats via linkages** (or corridors) to ensure the conservation of regional biodiversity. Recent state and city policy decisions support corridor planning and protection of wildlife.
- At least four separate state and regional connectivity assessments have identified **Coyote Valley as the essential opportunity to link landscapes and connect habitats** for plants and wildlife, and to protect biodiversity in the Santa Cruz Mountains and Diablo Range now and in the face of climate change.
- **This report performs the next step identified in the 2013 *Bay Area Critical Linkages* report**, which recommended the formation of an implementation and stewardship committee to further refine regional linkage designs, including in Coyote Valley.
- **Protection of significant portions of the remaining Coyote Valley floor is required** to ensure the resilience and integrity of the 1.13+ million acres of core habitat in the surrounding Santa Cruz Mountains and Diablo Range. These lands include 457,000 acres of already-protected areas, representing an estimated $3.5 billion of conservation investment.
- **This report includes findings of a six-month planning process** to establish the vision of a landscape linkage in Coyote Valley connecting habitat in the Diablo Range and Santa Cruz Mountains for wildlife and enhanced water resources. A team of 18 local scientists and land managers integrated recommendations from previous connectivity analyses with new scientific findings and local expertise in order to develop recommendations for a specific design to achieve a functional landscape linkage in Coyote Valley.
- **Historically, Coyote Valley supported a rich mosaic of habitat types, many of which are now incredibly rare** in the San Francisco Bay Area. This mosaic – valley oak savanna, oak woodland, riparian forest, willow groves, wet meadows, valley freshwater marsh, and perennial freshwater ponds – supported a much greater diversity of animals and plants than exists today. In the northern portion of the Valley, the two mountain ranges come close together, and the valley elevation slopes down into a large natural wetland depression that forms the historic Laguna Seca and surrounding floodplain. **This topographically and ecologically rich landscape provides unparalleled opportunities for restoration** and enhancement to benefit these habitats and recover populations of the rare species that depend on them.
- **Coyote Valley provides important habitat for a number of rare and endangered species** and other native plants and animals of regional significance.
- **Coyote Valley offers a unique opportunity for restoration of Laguna Seca**, a rare and regionally significant freshwater wetland complex, as well as other rare communities such as valley oak savanna and riparian forests.
- In Northern Coyote Valley, the Fisher Creek corridor and Coyote Creek Parkway along Coyote Creek are **well-documented pathways for the movement of mammals** across the valley floor.

Coyote Valley Open Space Preserve, a linkage anchor and gateway to protected land in the Santa Cruz Mountains.

- **To improve connectivity and provide a landscape linkage, the Fisher Creek corridor needs to be enhanced and anchored** to intact, protected lands to the east, west, and north. In particular, to the east, the Coyote Creek Parkway and Coyote Ridge Open Space provide a core habitat anchor. To the west, protected Coyote Valley Open Space Preserve, Santa Teresa and Calero County Parks, and Rancho Cañada del Oro Open Space Preserve provide core habitat anchors. Tulare Hill provides a protected habitat anchor to the north. In addition, improved road crossings are needed at strategic locations for safe animal movement along corridors and among habitat anchors.
- **The linkage design follows ecological principles and best practices from ecological, hydrological, restoration, and sustainability science.** It centers on protection and enhancement of the Fisher Creek floodplain and the Laguna Seca wetland complex. The design represents a climate-smart 21st century urban-ecological infrastructure project, providing connectivity for plants and wildlife.
- **In addition to wildlife connectivity and habitat for rare and endangered species, Coyote Valley offers many additional community benefits**, including improved flood control, water quality and water supply, recreation, agriculture protection, and carbon sequestration. Preliminary ecological and hydrologic analysis highlights several areas in the Coyote Valley that should be prioritized for protection and restoration of natural habitats, and other areas where wildlife friendly agriculture can provide habitat or buffer natural areas, together resulting in significant water, carbon, and flood protection benefits, as well as new nature recreational opportunities for the City of San José.
- **Incompatible development in the North Coyote Valley will cause the immediate loss of habitat** for rare and endangered species, diminish water resources, and increase flood hazards, and will greatly diminish wildlife movement, including increases in wildlife-vehicle collision. These losses jeopardize numerous biological resources in and around the Valley, and further degrade the ecological integrity and resilience of the Santa Clara Valley region. **Collaboration between multiple private and public partners is needed to prevent these losses and to achieve the vision of a protected and functioning landscape linkage in Coyote Valley.**
- Because of its diverse terrain, soil types, and hydrologic features, **the North Coyote Valley offers an irreplaceable and unique opportunity** to functionally connect the biodiversity and wildlife populations of the Santa Cruz Mountains and the Diablo Range, while also providing a host of complementary benefits to the San José region. It is the only feasible location in Coyote Valley where all conservation best practices and ecological design principles can be applied to achieve the goal of a functional, resilient landscape linkage to protect biodiversity for the long-term.

Looking across Coyote Valley west towards the Santa Cruz Mountains.

Introduction

Coyote Valley is a last chance landscape. The Valley is situated in one of the world's top 25 most important biodiversity hotspots (the San Francisco Bay Region) and one of the six most important conservation areas in the US. (Stein *et al.* 2000). Coyote Valley is a conservation focal area of tremendous significance. It has been identified by the scientific community as an irreplaceable and unique opportunity to functionally connect the biodiversity (especially wildlife populations) of the Santa Cruz Mountains with the Diablo Range (Thorne *et al.* 2006; Spencer *et al.* 2010; Penrod *et al.* 2013). These two mountain ranges, which form part of the California Coastal Ranges, have been identified as one of the top nine conservation priority regions in the nation (Jenkins *et al.* 2015) and many of the remaining undeveloped lands have been identified as "essential" to protect by the Conservation Lands Network (Bay Area Open Space Council 2011). The *Santa Clara Valley Habitat Conservation Plan and Natural Community Conservation Plan* (HCP/NCCP), which was adopted in 2013, states that linking the Santa Cruz Mountains and Diablo Range via the Santa Clara Valley is one of its main landscape-level goals to ensure the long-term protection of wildlife and rare and endangered species. In the most recent *California State Wildlife Action Plan* (2015), establishing or maintaining connectivity among ecosystems is a "key ecological attribute" for all conservation targets within the Bay Delta and Central Coast Province.

The San Francisco Bay Area is also one of the most threatened regions in the country with over 135 imperiled species primarily caused from ongoing human development, alien species, and water diversions (Stein *et al.* 2000). If connectivity is not provided in natural landscapes, the risk of population extinction increases (Benson *et al.* 2016), especially as species require migration pathways in the face of ongoing climatic change (Noss *et al.* 1999; Heller and Zavaleta 2009). The combined effect of habitat loss and fragmentation has had a major negative impact on natural ecosystems and species all over the world, including this important region in California. Connecting species and processes between core natural habitats is a conservation imperative and important area of scientific development. See **Box 1** for definition of key terms and a summary of the importance of connectivity for wildlife.

Historically in the South San Francisco Bay, the Santa Cruz Mountains and the Diablo Range were intricately linked across the Santa Clara Valley through a mosaic of oak woodlands and oak savannas, grasslands, streams lined with riparian forest, and wetland complexes forming one intact ecosystem (San Francisco Estuary Institute 2006). Over time, the Valley became the primary focus for agricultural and urban development and the unique lowland natural habitats originally present experienced precipitous reductions ranging from 88-100% loss (Grossinger *et al.* 2007). Along with the widespread conversion of natural ecological communities, the Valley was further fragmented by numerous roads and railways.

The uplands of the Santa Cruz Mountains and Diablo Range avoided the mass conversion of habitat observed on the valley floor. An estimated 1.13 million acres of core habitat as defined in *Bay Area Critical Linkage* persists in the two mountain ranges (**Figure 1**). This mosaic of protected and working lands are functioning to sustain many endemic populations of rare animals and plants (Conservation Lands Network 2011), and also populations of numerous large wide-ranging mammals that regulate the health and diversity of terrestrial

Box 1: What Is Landscape Connectivity and Why Is It Important?

The combined effect of habitat loss and fragmentation has had a major negative impact on natural ecosystems and species all over the world. Due to this threat, connecting species and processes between core natural habitats has become a conservation imperative in many landscapes as expanding and intensification of human development and climate change exert tremendous pressures on natural communities, species, and ecological processes. An entire science has emerged from this need, including its own taxonomy and analytical tools.

Connectivity is defined as "the degree to which the landscape facilitates or impedes movement" (Taylor *et al.* 1993). Because of the widespread conversion and fragmentation of natural habitats by human activity, connectivity has become an essential component of many successful conservation plans.

Permeability, which is sometimes used interchangeably with the term connectivity, refers to the degree to which landscapes are conducive to wildlife movement and sustain ecological processes such as hydrologic and disturbance regimes, nutrient cycles, predator-prey interactions, and pollination. There are two ways to increase connectivity: (1) conserve more habitats in key areas that facilitate movement; and (2) mitigate landscape features that impede movement, such as roads, railroads, and urban development (Ament *et al.* 2014).

Corridors are distinct linear features whose primary function is to connect two or more significant (or core) habitat areas (Beier and Loe 1992). Corridors can be designed to facilitate the movement of selected wildlife species (wildlife corridors) or they can be designed more generally to accommodate diverse guilds of plants, animals and ecological processes.

Landscape linkages refer to broad areas that allow for the movement of wildlife and plant species from one area of suitable habitat to another and that support ecological processes (Ament *et al.* 2014).

Functional landscape linkages serve wildlife species in a number of important ways. They:

1. Allow for **daily travel** by animals throughout their home ranges (the area an animal travels to meet its daily needs);
2. Accommodate **migration** (or periodic, round-trip movements by wildlife) to support their life history needs (*i.e.* breeding, dispersal, capture of food);
3. Support **dispersal** movement by individuals that allows for the continued maintenance of demographic connections among populations and supports genetic diversity, which prevents the negative consequences associated with genetic bottlenecks and inbreeding. In some cases, it is important and necessary for individuals to use landscape linkages to recolonize areas where local extinctions have occurred (Beier and Noss 1998; Hilty *et al.* 2006; Groom *et al.* 2006); and
4. Provide the ability for species populations to **adapt to climate change** by providing routes (usually along various environmental gradients) that facilitate necessary range shifts. Without these landscape linkages, populations could easily become isolated and eventually extirpated from local environments.

ecosystems, such as mountain lions (*Puma concolor*), Tule elk (*Cervus canadensis nannodes*), black-tailed deer (*Odocoileus hemionus columbianus*), American badgers (*Taxidea taxus*), coyotes (*Canis latrans*), gray foxes (*Urocyon cinereoargenteus*), and bobcats (*Lynx rufus*). The continued health of these ecosystems is precarious as movement and dispersal of wildlife is constrained by many dangers and barriers. For large home range species such as mountain lion, the Santa Cruz Mountains are not extensive enough to support a population on its own based on guidelines by Beier (1993); this region is viable only if connected to the surrounding habitat. New genetic data bears out this theory, as research suggests some Santa Cruz Mountains puma have extremely low genetic diversity, indicating poor dispersal leading to genetic inbreeding depression (C. Wilmers, personal communication April 27, 2017). Large animal collisions with cars are a threat to wildlife and a major safety hazard. Between 2001

and 2011, large animal collisions resulted in over 2,080 fatalities nationwide (AAA 2017) and costs drivers around $4 billion dollars a year on repairs (Insurance Journal 2012). On Highway 17, nine mountain lions have been hit over the last nine years in Santa Clara County (Midpeninsula Regional Open Space District, 2016). The impact of roads on wildlife is greater as traffic volume increases, both in terms of number of animals hit by cars, and the size of the surrounding area in which wildlife are impacted (Bennett *et al.* 2011).

Looking across Coyote Valley from Coyote Ridge.

Coyote Valley, which is currently dominated by agricultural lands and contains some relatively intact riparian corridors, is one of a few areas within the Santa Clara Valley floor that still provides limited connectivity between the mountain ranges (Phillips *et al.* 2012; Diamond and Snyder 2016). The biological resources report prepared for the City of San José General Plan Update Envision San José 2040 reinforces this idea, stating that "stream and riparian corridors are rich habitats for wildlife and are also important corridors of movement, especially in areas such as Coyote Valley where these intact linear habitats can connect broader open space preserves" (H.T. Harvey & Associates 2009). However, based on existing and future development plans, this function is expected to degrade further, potentially to the point that Santa Cruz Mountains and Diablo Range become functionally isolated from an ecological perspective.

The imperative is to protect the few thousand acres within the valley floor in order to protect the resilience and integrity of the surrounding 1.13 million acres. The biological value of these protected lands is immense and represents a significant financial investment for the region. Of the 1.13 million acres of core habitat in the Santa Cruz Mountains and Diablo Range, 457,091 acres are protected (California Protected Areas Database 2016). Based on an estimated price of $7,700/acre, the protected lands alone represent approximately $3.5 billion dollars investment. This estimate does not include cost of stewardship and recreation enhancements.

Linkage and Conservation Planning

The importance of connecting natural habitat via corridors to ensure the conservation of biodiversity is not only important to conservation scientists and planners; it has also been widely recognized for years in California by multiple agencies as a priority and continues to be highlighted in new legislation and initiatives (see **Box 2**). In 2002, the California Department of Transportation commissioned wildland conservation planning in the Central Coast Region using mountain lion as the wildlife corridor focal species. Coyote Valley was identified as a vital linkage opportunity that is necessary to protect and restore in order to ensure sufficient migration between the ranges to promote healthy genetic diversity for mountain lions and other species with large home ranges (Thorne *et al.* 2006). In 2010, the Department of Transportation collaborated with the Department of Fish and Game to identify

key landscape linkages in the state (Spencer *et al.* 2010) resulting in the California Essential Connectivity map. This report mapped two viable linkage areas between the Santa Cruz and Diablo Ranges – a wide Coyote Valley linkage and a much narrower Pajaro River linkage.

Using a similar analytical approach to the statewide report, Penrod *et al.* (2013) focused more intently on the Bay Area. The results highlighted an important and relatively narrow Pajaro River linkage, and further refined the Coyote Valley linkage area into two narrower sections, one in the North Coyote Valley and one in the South. In 2013, a workshop was convened to gather national wildlife experts with local managers. This group further confirmed that active conservation is required in Coyote Valley to retain any remaining functions the valley is providing for animal movement (Rahmig 2013). Collectively, the reports show that at the scale of the entire South Bay Area, multiple linkage zones or corridors are essential to maintain and enhance wildlife movement and biodiversity range shifts, supporting the need for both the Coyote Valley and Pajaro corridors for connectivity. Efforts in Coyote Valley and the Pajaro should be viewed as complementary rather than either-or options. The principle of redundancy at multiple scales is required to assure success.

All regional and statewide planning reports show consensus that protecting and stewarding Coyote Valley as a landscape linkage for wildlife is essential for the long-term protection of biodiversity in the Santa Cruz Mountains and Diablo Range.

All regional and statewide planning reports show consensus that protecting and stewarding Coyote Valley as a landscape linkage for wildlife is essential for the long-term protection of biodiversity in the Santa Cruz Mountains and Diablo Range. Furthermore, a recent analysis showed that of all identified Bay Area Critical Linkages, the Coyote Valley linkage provides the best climate adaptation route for species, because of its large size and broad environmental gradient (Kreitler 2015), and thus greater resilience to the protected area network (Heller et al. 2015). The 2013 Bay Area Critical Linkages report not only identified Coyote Valley as a critical linkage, but also outlined key scientific principles and the recommended step of forming stewardship committees to collaborate on conservation and stewardship toward the implementation and long-term management of each critical linkage.

This report serves to further refine the regional need and develop a more comprehensive and multi-benefit vision for a protected critical linkage in Coyote Valley. It reports the findings of a six-month process conducted by a team of local and regional scientists to review the ecological setting of Coyote Valley; integrate new scientific findings with previous research; and develop a set of recommendations and a linkage design to achieve the vision of a functional, resilient landscape linkage in Coyote Valley that will serve to interconnect surrounding wildlands and protect against genetic isolation, extinction, and extensive biodiversity loss in the coming century. The design was developed from a multi-benefit perspective to identify complementary benefits of the linkage to surrounding communities, in particular the protection of water supply, water quality, flood control, and preservation of agriculture. The recommendations in this report are based in natural sciences and are intended to help guide current and future planning, restoration, and management, as well as stewardship of nearby private lands. While primarily intended to serve as a resource for conservation practitioners, public engagement with this document is welcome as it may also serve as a resource for the larger community to develop strategies to implement these recommendations. Many of these strategies will be based on a range of criteria and concerns that are beyond the scope of this document, including economic constraints and landowner desires. This document is intended to provide a scientific basis for a range of options that will inform broader planning processes.

Box 2: Public Policy on Wildlife Corridors

In recent years, the topic of wildlife corridors has taken a more prominent role in the California legislature. In 2015, AB 498 (Levine) took the first step by declaring it the policy of the state to encourage the protection of wildlife corridors through voluntary actions. In 2016, AB 2087 (Levine) took additional steps by creating Regional Conservation Investment Strategies (RCIS), which focus on mitigation and a more holistic approach to conservation, including landscape connectivity.

In the 2017 legislative session, two Park Bond proposals were merged through the Legislature process into a single $4 billion Park and Water Bond as SB 5 (de Leon) which was signed by the Governor. SB 5 will be on the June 2018 ballot and will include language to make the acquisition, rehabilitation, restoration, protection, and expansion of wildlife corridors and open space a priority. Over $400 million would be available for these types of projects and other natural resource projects, with a strong focus on climate preparedness, habitat resiliency, and resources enhancement. In April 2017, the Legislature passed and the Governor signed a Transportation Funding Package (SB 1), which includes $120 million over four years for advanced mitigation projects, including those pursued by the creation of mitigation credit agreements housed in RCIS pursuant to AB 2087 (Levine), which became law in 2016. RCIS will be a key tool in promoting better protection of wildlife corridors and other high priority conservation areas, and through mitigation credit agreements, would provide funding for these purposes.

Envision San José 2040: The City of San José General Plan recognizes that Coyote Valley serves as a landscape linkage between the Santa Cruz Mountains and the Diablo Range. Wildlife studies prepared to support the General Plan recommended, "On-going acquisition and preservation of strategic lands by either public or non-profit agencies can further promote beneficial connectivity between [these] wildlife habitat areas" (H.T. Harvey & Associates 2009). The General Plan includes a number of goals and policies related to natural communities and wildlife habitat protection that support the planning and implementation of a "multi-benefit" landscape linkage across Coyote Valley. These goals reflect the City's recognition of the need for, "… multiple jurisdictions to cooperate in the management of natural communities and wildlife habitat. Recognizing this interdependence, San José seeks to demonstrate environmental leadership through advocacy and cooperative efforts with other jurisdictions."

Examples of supportive policies include:

- **ER-2.1:** Ensure that new public and private development adjacent to riparian corridors in San José are consistent with the provisions of the City's Riparian Corridor Policy Study and any adopted Santa Clara Valley Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP).
- **ER-7.2:** In areas important to terrestrial wildlife movement, design new or improve existing roads so that they allow wildlife to continue to move across them (*e.g.*, either over the road surface or through under-crossings or over-crossings designed for the animals moving through the areas).
- **ER-7.5:** Support the ongoing identification and protection of critical linkages for wildlife movement in the Mid-Coyote Valley.

Santa Clara Valley Habitat Conservation Plan / Natural Communities Conservation Plan (HCP/NCCP): The Santa Clara Valley HCP/NCCP is designed to "protect, enhance, and restore ecosystem integrity and functionality for threatened and endangered species; enhance the diversity of plant and animal communities; and conserve habitat and contribute to the recovery of species listed or likely to be listed under the federal ESA or the California ESA" (ICF International 2012). The City of San José is a partner in the development and implementation of the HCP/NCCP. The HCP/NCCP identified the Coyote Valley linkage as a critical priority to meet its regional connectivity goals, and outlines several conservation actions to protect this linkage including targeted land acquisition west and east of Coyote Creek, habitat restoration of the valley floor, replacement or upgrade of key culverts and bridges, removal of median barriers, installation of directional fencing, and funding for ongoing research.

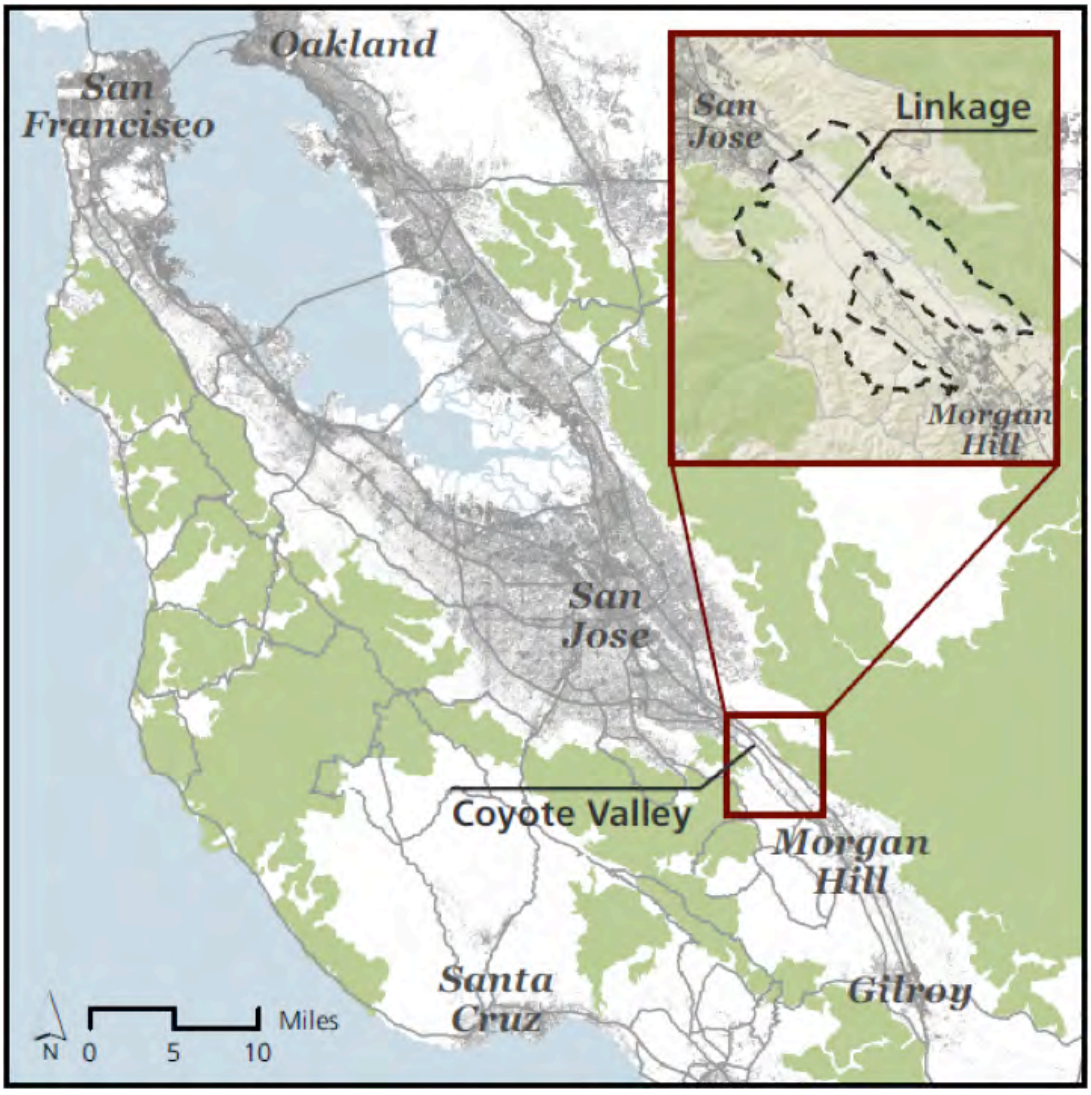


Figure 1. Regional map. This map shows the location of Coyote Valley in a regional context, with large landscape blocks of core habitat (green) that will be functionally connected by the protection of the Coyote Valley Linkage (see map inset).

Coyote Valley – Setting, History, and Current Conditions

Coyote Valley is a 7,400-acre area between San José and Morgan Hill (**Figure 1**). Largely undeveloped, it hosts a range of agricultural operations and some scattered commercial and residential development. Future urban development in Coyote Valley has been planned and debated for decades. Much of the area is subject to regulation by the city of San José, which has divided Coyote Valley into three areas.

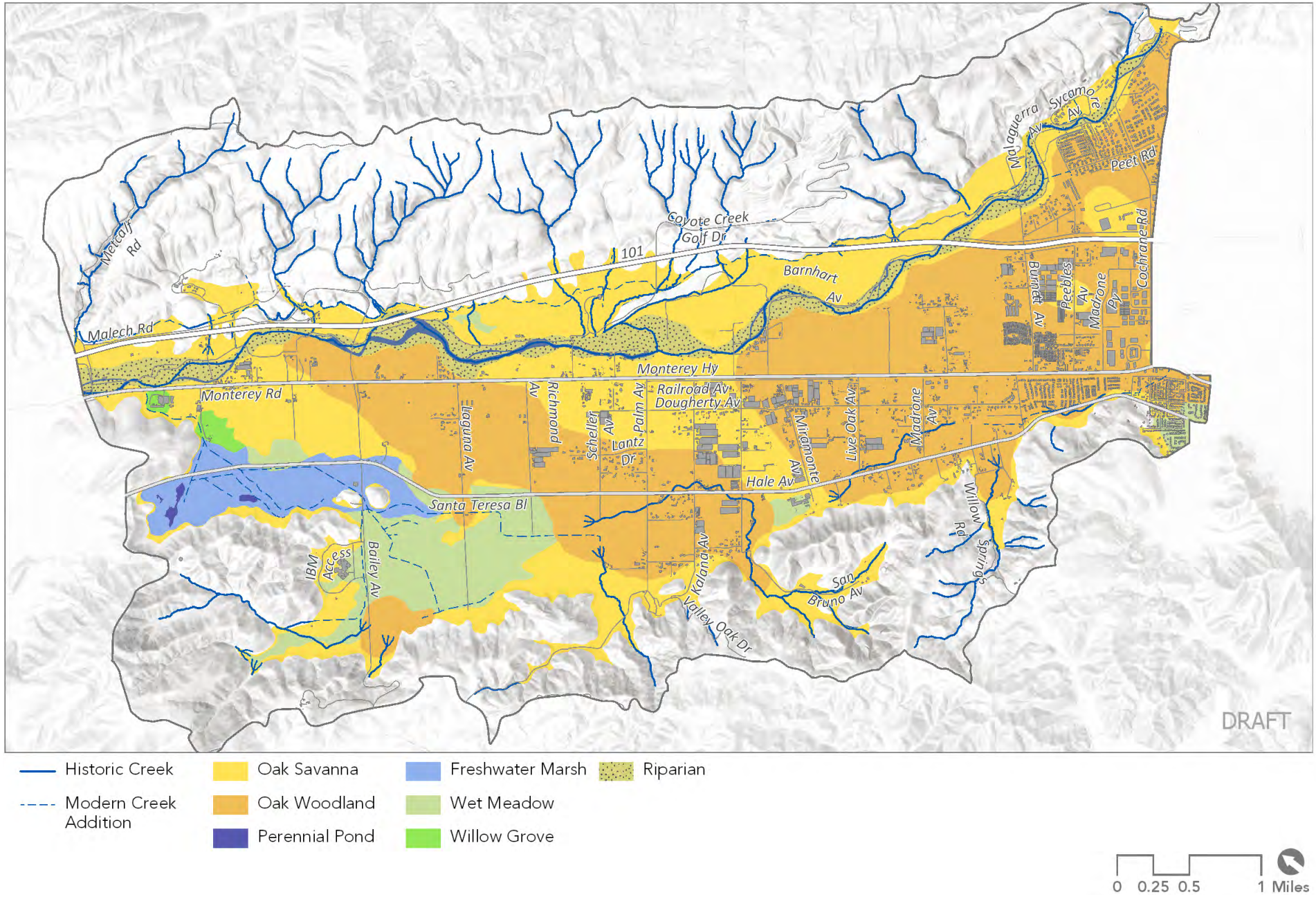
The North Coyote Valley consists of about 1,700 acres of land largely comprised of mixed agriculture with a few commercial operations, including an IBM research park and a satellite campus of Gavilan College. This northern area is within the city limits and has been earmarked for job creation in the future. The Mid Coyote Valley consists of approximately 2,000 acres similar in land use with the exception of three small residential subdivisions. This area is within the San José sphere of influence and land use is regulated by the Santa Clara County and the Local Agency Formation Commission of Santa Clara County (LAFCO). Until recently, it has been reserved for residential development. The 2040 General Plan no longer supports residential development in the mid-valley, stating that the city plans to "explore the use of agricultural easements, transfer/purchase of developments, or other options to keep Mid Coyote Valley as permanent agriculture." The South Coyote Valley consists of about 3,700 acres. It has the greatest concentration buildings and smaller parcels, which support smaller agricultural operations, commercial businesses and several scattered small residential subdivisions. This southern area is designated as a non-urban buffer based on an agreement between Santa Clara County and the cities of San José and Morgan Hill.

Historical and Current Conditions of Coyote Valley

Prior to 1900, when intense modification of the floodplain started to occur to make way for agriculture and homesteads, Coyote Valley hosted a rich mosaic of natural habitat types supporting greater diversity and abundance of plants and animals than observed today. The valley was dominated by five major habitat types – valley oak savanna, oak woodland, willow groves, wet meadows, valley freshwater marsh, and perennial freshwater ponds (Grossinger *et al.* 2007; **Figure 2**). Laguna Seca was one of the largest freshwater wetlands in the Bay Area and Coyote Creek was comprised of relatively open sycamore alluvial woodland, riparian scrub, and gravel bars. These habitat types that were once common in the low-lying areas between the San Francisco Bay and the forested uplands are now incredibly rare, ranked among the highest conservation priority in the nine Bay Area counties (Conservation Lands Network 2011).

The five historic major habitat types reconstructed and mapped by Grossinger *et al.* (2007) have experienced 85 to 100% declines due to the conversion to the various agricultural and urbanized land uses, which has increased surface water runoff and reduced natural groundwater recharge. Freshwater wetlands declined 85-91%; primarily Laguna Seca, which underwent significant hydrologic alteration as the region was developed (see photo). However, it remains an important feature on the landscape. Historically, Fisher Creek lacked a

Figure 2. Historical ecology. The historical ecology of the Coyote Valley region prior to 1900 as part of an expansive historic reconstruction of the Santa Clara Valley by Grossinger *et al.* (2007).



Looking south into Coyote Valley, a comparison of Laguna Seca from just prior to major draining of the wetland (December 1916) to 100 years later (December 2016). The January 2017 photo shows the same area after a recent flooding event, highlighting the potential for restoration. This photo series was compiled by the San Francisco Estuary Institute. From top to bottom, photographs courtesy of Santa Clara Valley Water District, Teddy Miller, and Robin Grossinger.

defined channel and outlet to Coyote Creek. Instead, rainwater draining from the Santa Cruz Mountains naturally fanned into floodwaters out over the western portion of the Valley allowing recharge of the groundwater basin, and providing surface water and groundwater that fed the Laguna Seca wetland complex. Today, Fisher Creek's drainage has been realigned, channelized, and connected to Coyote Creek, reducing supplies of surface water and groundwater that supported Laguna Seca. Grossinger *et al.* (2007) also identified an important temporal shift in land cover along Coyote Creek itself, from the relatively open alluvial woodland-sand bar system to more dense riparian forest vegetation dominated by cottonwood (*Populus fremontii*) due to the hydrologic manipulation of the system.

The most recent land cover data shows the amount of natural valley floor habitat in San José that has declined as a result of development (**Figure 3**). As shown in **Figure 3**, many of the habitat types in San José have significantly declined, and some have been eliminated completely. Development in this analysis includes both urbanization and agriculture. Agriculture is the dominant land use on the valley floor. Annual agriculture (especially hayfields) is the most common type of agriculture today, but some recent and notable transitions to perennial tree crops (*e.g.* orchards) have been observed.

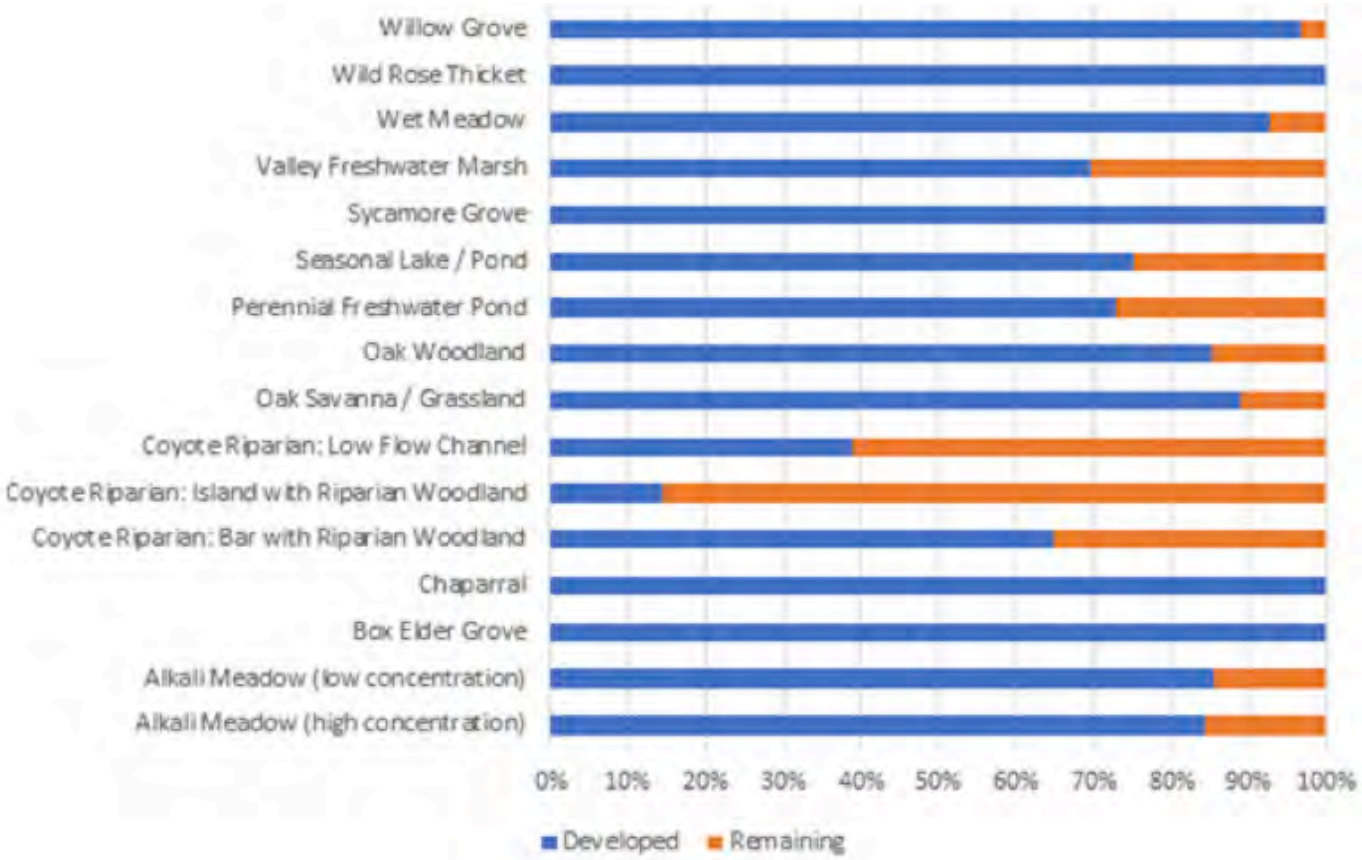
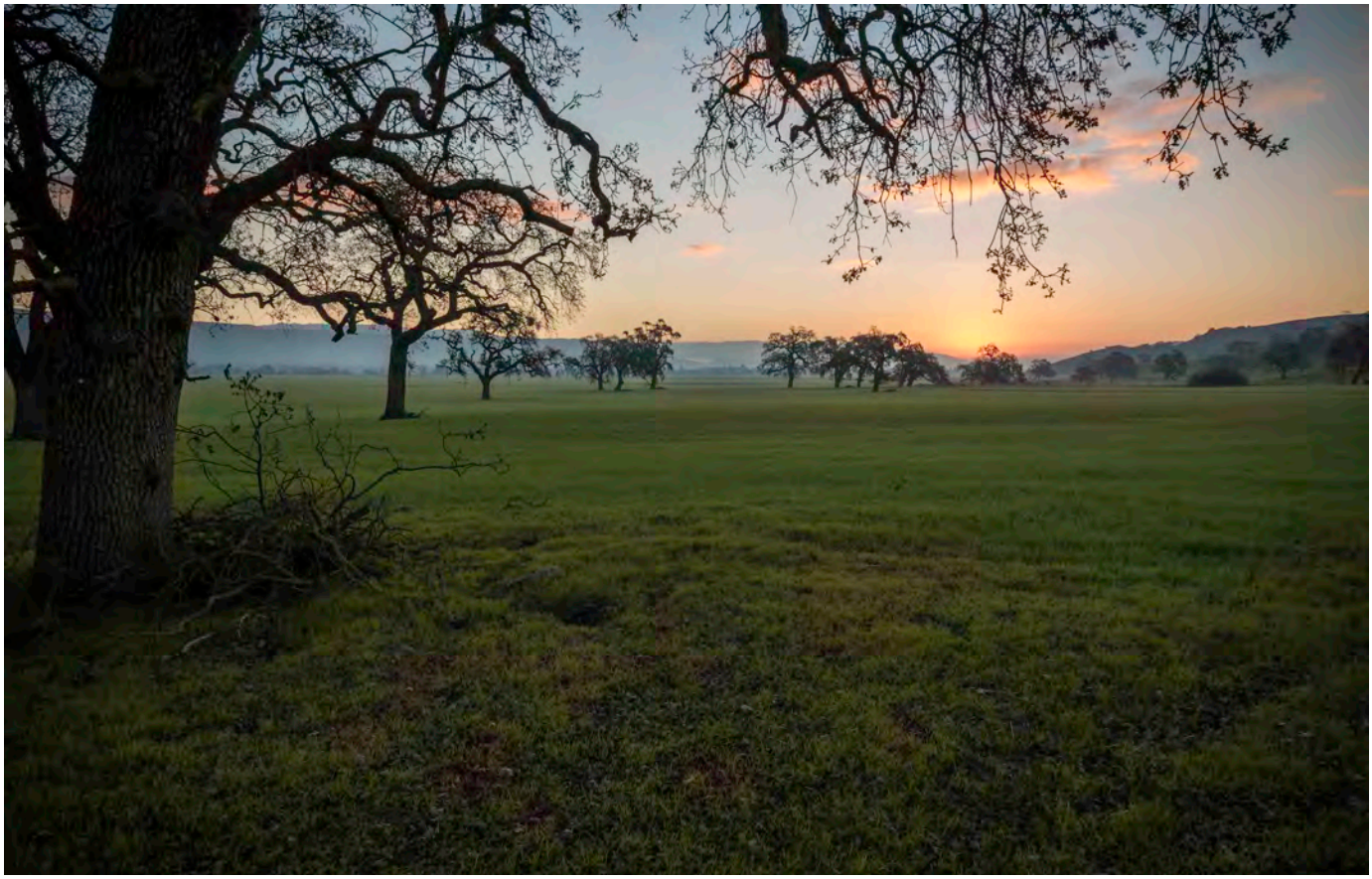


Figure 3. **Natural habitats converted to urban uses.**

A handful of significant developments occur in Coyote Valley linkage areas as well as in several main roadways (US 101, Monterey Highway, and Santa Teresa Boulevard) and current and proposed rail lines (*i.e.*, High Speed Rail), which collectively serve as significant barriers to wildlife movement in the landscape. Planned and proposed development along Monterey Highway would further compromise wildlife connectvitiy.

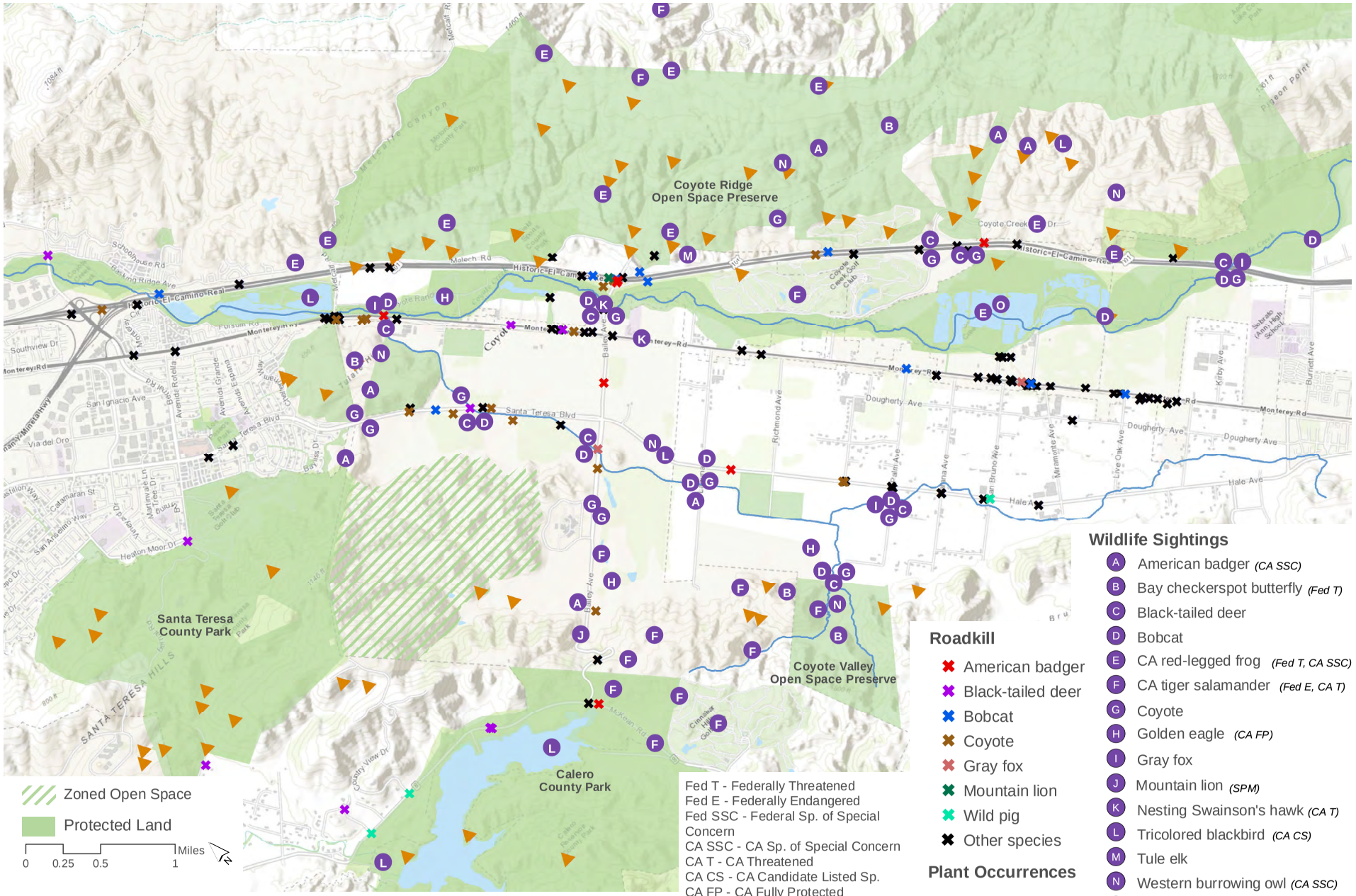
Biological Values of Coyote Valley

Coyote Valley is rich with biological diversity. While comprehensive biological surveys have not been conducted on many of the private lands in Coyote Valley, there has been considerable effort studying the biology in the area. Extensive research has confirmed the local and regional importance of this Valley from the standpoint of biological diversity, including its support for a number of rare and endangered species from a wide range of taxa, such as, most beautiful jewelflower (*Streptanthus albidus* ssp. *peramoenus*), Bay checkerspot butterfly (*Euphydryas editha bayensis*), western burrowing owl (*Athene cunicularia*), California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), tricolored blackbird (*Agelaius tricolor*), and Swainson's hawk (*Buteo swainsoni*) (**Figure 4**). Ongoing wildlife surveys in the region have established extensive use of the area as habitat for a variety of large mammals (*e.g.* coyote, bobcat, black-tailed deer, mountain lion, gray fox, North American badger) (Rahmig 2013), which is the taxonomic group of greatest focus when designing for landscape connectivity, because they are wide-ranging and often move long-distances for foraging and dispersal, and also because they are a public safety hazard in car collisions with significant economic cost.



Coyote Valley Open Space Preserve is an example of a remnant stand of oak savanna and is an example of how this landscape can be expanded.

Figure 4. Wildlife sightings and roadkill in Coyote Valley. Map highlighting locations of frequent wildlife roadkill where crossing improvements are needed, sites where wildlife (often multiple individuals) were observed, and CNDDB data.



Data sources: CNDDB, eBird, Pathways for Wildlife, Santa Clara Valley Open Space Authority, and F. Schilling, UC Davis.

Mammals

Numerous mammal species, including black-tailed deer, American badger, gray fox, California ground squirrel (*Otospermophilus beecheyi*), coyote, and bobcat, have been documented moving through the landscape using a network of creeks and major and minor culverts and underpasses designed for water conveyance (Diamond and Snyder 2016). A few pathways through the Valley have been identified as being routinely used by these and other species – not only for movement, but also for breeding and rearing of young (see photo). A comprehensive wildlife study examined the use of mammals on the eastern side of Coyote Valley, crossing from the Diablo Range under Highway 101 and into the Coyote Creek Parkway. This study found the highway to be permeable to allow passage of 26 different mammal species, including puma. Six culverts and two underpasses were particularly well used (Phillips *et al.* 2012; discussed further in Appendix 2).

Photo of adult bobcat with young taken by wildlife camera at the Fisher Creek –Monterey Road culvert on 10-30-2015 at 2:30am. Photo courtesy of Pathways for Wildlife.

On the western side of Coyote Valley, extensive wildlife use of the Fisher Creek corridor has been documented through roadkill analysis and camera trap surveys (Diamond and Snyder 2016). Fisher Creek has been confirmed as a significant mammal corridor, connecting the Santa Cruz Foothills across the valley floor, under Monterey Highway through the Monterey Road Fisher Creek culvert into Coyote Creek Parkway, along Coyote Creek, and then under Highway 101 to the Diablo Range. The Fisher Creek pathway is an essential corridor in the current landscape. Additional wildlife tracking studies are underway to identify other movement pathways and specific road crossings in Coyote Valley. In particular, a radio-collar study of two highly mobile mammals, bobcat and gray fox, commenced in May 2017. The study is led by University of California at Santa Cruz professor and wildlife ecologist Chris Wilmers and postdoctoral researcher and wildlife biologist Laurel Serieys, and is funded by the California Department of Fish and Wildlife through the Natural Community Conservation Planning Local Assistance Grant Program and the Gordon and Betty Moore Foundation (**Appendix 4**). A sizeable herd of Tule elk, which were reintroduced to the Mt. Hamilton foothills in 1978, lives next to Coyote Valley just east of Highway 101 (Phillips *et al.* 2012). Tule elk's historic range included the Santa Cruz Mountains. Reconnecting elk with its historic range is a complex issue, but warrants further planning.

This mountain lion was photographed by a Coyote Ridge wildlife cam.

Coyote Valley represents one of the last chances to protect and restore breeding habitat for the western burrowing owl.

Birds

Coyote Valley is a hotspot for bird diversity with 242 species documented in the area, including 17 species of raptors such as northern harrier (*Circus cyaneus*), ferruginous hawk (*Buteo regalis*), short-eared owl (*Asio flammeus*), and American kestrel (*Falco sparverius*). The only breeding occurrence of Swainson's hawk (state listed as a threatened species) in Santa Clara County is in Coyote Valley (Phillips et al. 2014). In addition to raptors, bird diversity includes 102 passerines, 27 shorebirds, 26 ducks and geese, and 13 pelicans and herons. Seventy-seven bird species are confirmed to breed in Coyote Valley (Vonshak *et al.* 2016). Many of the bird species are successfully using the habitat provided by the low-intensity agriculture in area (*e.g.*, hay fields) (Phillips *et al.* 2012).

Without habitat protection and active restoration it is likely that the western burrowing owl will disappear from Santa Clara County. Currently owls are found wintering in Coyote Valley, but are not returning or staying in the summer to breed (Lynne Trulio, personal communication, April 2017). The breeding pair population has declined steadily in Santa Clara County over the last 30 years, and has reached a critical point today (ICF International 2012). Owls breed exclusively in low elevation sites, and opportunities to create breeding owl habitat at low elevations in Santa Clara County are limited. Most valley floor habitat has been developed, thus severely limiting opportunities for burrowing owl reproduction. Coyote Valley represents a unique opportunity to enhance habitat for breeding owls and preserve overwintering habitat for northern migrants from Canada, Washington, and Oregon, where burrowing owls are endangered (Canada) or considered for listing (Washington) and a Federal Species of Special Concern (USFWS 2008). As Valley floor open space (including agricultural lands) is conserved, opportunities for wintering and breeding owl habitat should be evaluated, along with co-benefits to other species such as American badgers.

As Valley floor habitat is conserved (including agricultural lands), opportunities for wintering and breeding owl habitat should be evaluated, along with co-benefits to other species such as American badgers.

Small remnants of Laguna Seca, historically a 1,000+ acre freshwater wetland complex that contributed as an important Pacific Flyway stopover for migratory waterfowl, persist. Despite being dredged and partially drained in 1916 to clear the land for agriculture, the area still retains some wetland characteristics due to its low elevation position in the landscape and heavy clay soils, and waterbirds continue to use this habitat.

Aquatic Species

The Coyote watershed draining through Coyote Valley connects to Coyote Creek, an essential stream and a Priority 1 (highest conservation value) creek for steelhead and a number of other local fishes as designated by the Center for Ecosystem Management and Restoration (CEMAR). Coyote Creek is also designated as Critical Habitat for Steelhead by the USFWS (**Figure 5**). The creek also supports a number of other fish species that prefer warmer water temperatures, including California roach (*Lavinia symmetricus*) and Sacramento blackfish (*Orthodon microlepidotus*), adding to the local fish species diversity. Connectivity is important for aquatic species as well, but obviously different factors are involved in interrupting aquatic species movement (*e.g.*, dams and diversions, water temperature, water regulation, and water quality) compared to terrestrial species.

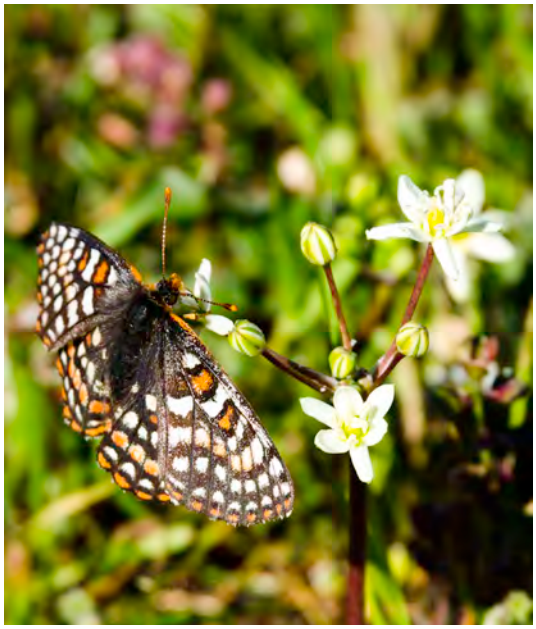
Amphibians and Reptiles

California red-legged frog.

The Coyote Valley Landscape Linkage area contains about 10% of the native reptile and amphibian species known to occur in California (California Department of Fish and Wildlife 2003). There are a number of reptile and amphibian species of special interest worth noting that have been documented on or around Coyote Valley (**Figure 4**). California tiger salamanders have been found throughout the linkage area and southern western pond turtles (*Actinemys pallida*) have been documented in Coyote Valley and neighboring Calero County Park. California red-legged frogs occupy the Diablo Range and Coyote Ridge Open Space Preserve just east of the linkage area. In fact, a portion of this range is designated as critical habitat (**Figure 5**) for this species.

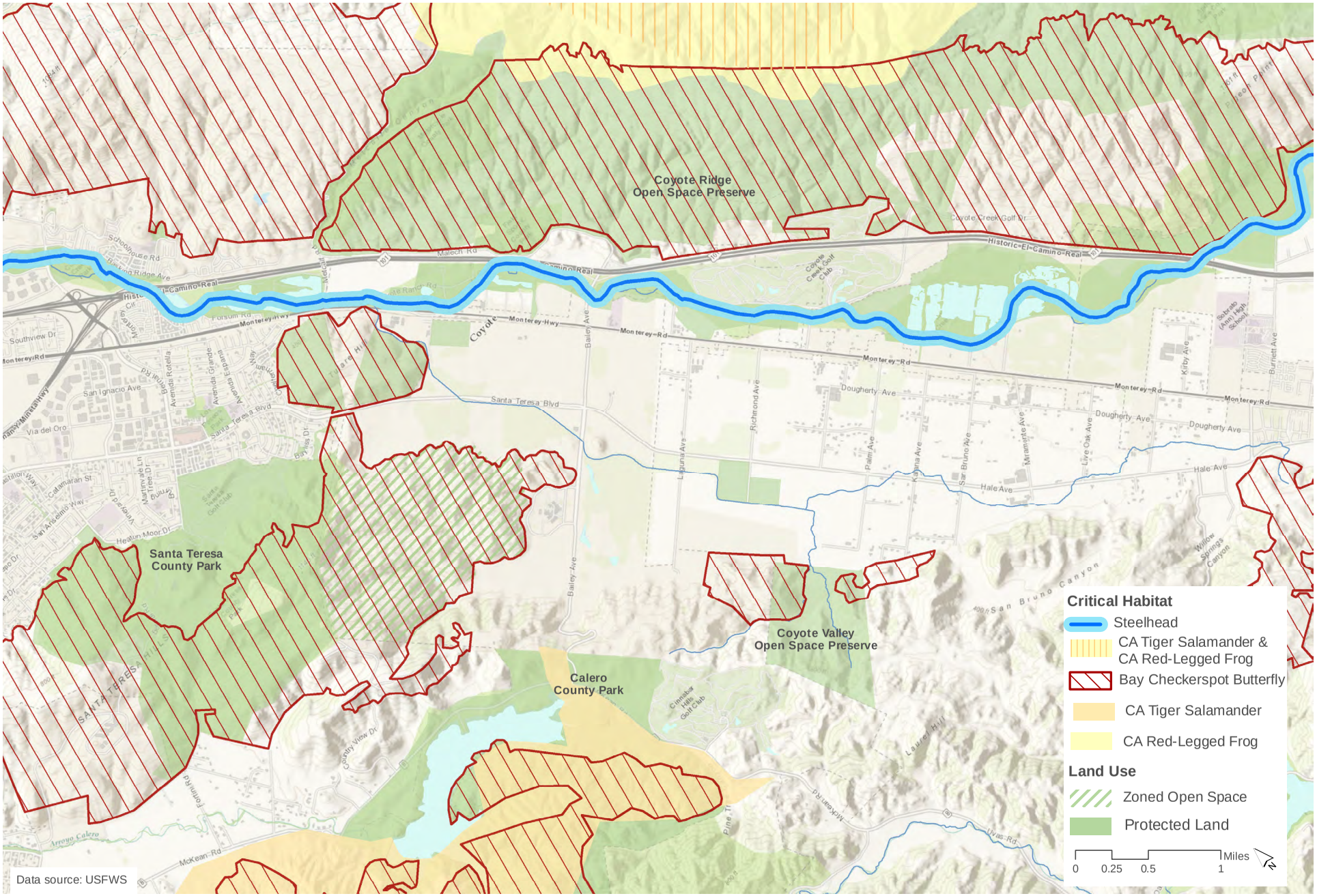
Invertebrates

There are many thousands of invertebrates in the region. The South San Francisco Bay region ranks as medium in invertebrate species rarity in the state, with many of these rare species occurring in unique grassland and scrub habitats (ICF International 2012). The rare plants are often intricately linked with the complex needs of various insects, especially moths and butterflies, such as the federally endangered Bay checkerspot butterfly. For this species, the primary larvae host plant is dwarf plantain (*Plantago erecta*). Under dry climate conditions, the larvae use purple owl's clover (*Castilleja densiflora* or *C. exserta*), which remains edible later in the season (US Fish and Wildlife Service 2017). As adults, the butterfly serves to pollinate a wide range of plant species. Critical habitat for the Bay checkerspot butterfly surrounds Coyote Valley and (**Figure 5**) Bay checkerspot butterflies are found in Coyote Valley at Tulare Hill and Coyote Valley Open Space Preserve, as well as adjacent to the linkage in the Coyote Ridge Open Space Preserve and Santa Teresa County Park.



Bay checkerspot butterfly.

Figure 5. Critical habitat in and around Coyote Valley.



Plants

Due to the diversity in terrain, microclimate, and soil characteristics, vascular plant species diversity is quite high within and around the linkage area. According to CalFlora, there are over 1,800 native vascular plant species in Santa Clara County, which represents approximately 27% of the flora known to occur in the state (Calflora 2017). Serpentine soils, which are common in the uplands in and around the linkage area, harbor populations of uniquely adapted plant species – some of which are federally endangered, such as the evergreen shrub coyote ceanothus (*Ceanothus ferrisiae*), Metcalf Canyon jewelflower (*Streptanthus glandulosus* ssp. *albidus*), and Santa Clara Valley dudleya (*Dudleya abramsii* ssp. *setchellii*), a small succulent that grows in rocky areas. Remnants of historic sycamore-alluvial woodlands, habitat that is rare in California, still exist along Coyote Creek Parkway.

Some rare plants found in the Coyote Valley Landscape Linkage area. From left to right, coyote ceanothus (*Ceanothus ferrisiae*), Metcalf Canyon jewelflower (*Streptanthus glandulosus* ssp. *albidus*), and Santa Clara Valley dudleya (*Dudleya abramsii* ssp. *setchellii*).

Sunset in Coyote Valley.

Coyote Valley Conservation Challenges and Opportunities

As the last remaining relatively undeveloped valley floor swath of land in the South San Francisco Bay Area, Coyote Valley represents the best opportunity to protect and enhance a critical wildlife corridor connecting the Santa Cruz and Diablo Mountain Ranges; however, this situation is tenuous. Imminent development threats and the proposed addition of a High Speed Rail alignment along Monterey Highway could significantly diminish the functionality and vitality of Coyote Valley for wildlife. These changes will further stress an already stressed system. Currently, Fisher Creek is the only clearly documented pathway for animals to move across the western side of the valley, and it has some serious challenges (Diamond and Snyder 2016). The Fisher Creek culvert under Monterey Highway functions as a movement pathway for terrestrial species only in the dry season and in drought years. The culvert has been inundated the entire 2016-2017 winter (see photo). With only this one culvert under Monterey Highway, and with intermittent functionality, animals try alternate routes to cross Monterey and other large roads. Roadkill data highlights a number of other locations (**Figure 4**) where animals are trying to move across Monterey, Santa Teresa, Highway 101, and Bailey Avenue, and existing barriers and traffic result in high rates of collision (Diamond and Snyder 2016; Shilling 2017).

Roads form effective barriers to many wildlife species – so much so that important gene flow is partially reduced or completely blocked resulting in genetic isolation. For example, Gray (2017) evaluated the genetic structure of 61 California ground squirrels separated by US Highway 101 within Coyote Valley linkage area and found greater genetic similarity among squirrels on the same side of the road than between squirrels from different sides of the road.

Tule elk require large areas of intact and connected habitat.

Images of the Fisher Creek culvert under Monterey Highway in December 2015 (left) and in January 2017 (right). Photos courtesy of Tanya Diamond.

These results indicate that the habitat fragmentation caused by the roads, especially the main highway, is acting as an effective barrier to gene flow within California ground squirrels in Coyote Valley. These findings suggest that roads are likely to be impacting the gene flow within other taxa as well.

Improving the permeability of Monterey Highway, the Union Pacific rail line, Santa Teresa Boulevard, Highway 101, Bailey Avenue, and other roads to reduce the high rates of roadkill, through relatively low-cost actions like adding wildlife directional fencing, removing debris, restoring vegetation, and creating gaps in the medians, is an issue of topical relevance among many local agencies. In addition, there is a need for major infrastructure additions and improvements to support safe wildlife movement, such as new and improved under-crossings and over-crossings, which are designed to meet the needs of specific wildlife species.
The conservation value of wildlife crossing structures is recognized as an effective applied measure both to help species persist in today's landscape, but also to adapt to climate change (Clevenger and Huijser 2011). In March 2017, the Valley Habitat Agency convened a Santa Clara County Wildlife Corridor Technical Working Group, which includes agency staff from the Santa Clara Valley Water District, Valley Transportation Authority, California Department of Fish and Wildlife, US Fish and Wildlife, Caltrans, Santa Clara County Parks, and the Santa Clara Valley Open Space Authority, among others, to meet and discuss opportunities and collaborations to improve wildlife permeability and habitat conditions in Coyote Valley. Staff from several of these agencies have also been working with the High Speed Rail Authority to integrate knowledge about wildlife into design criteria and ensure the lowest possible impacts to habitat connectivity, and explore possible mitigation projects that will enhance the existing road infrastructure to work better for wildlife.

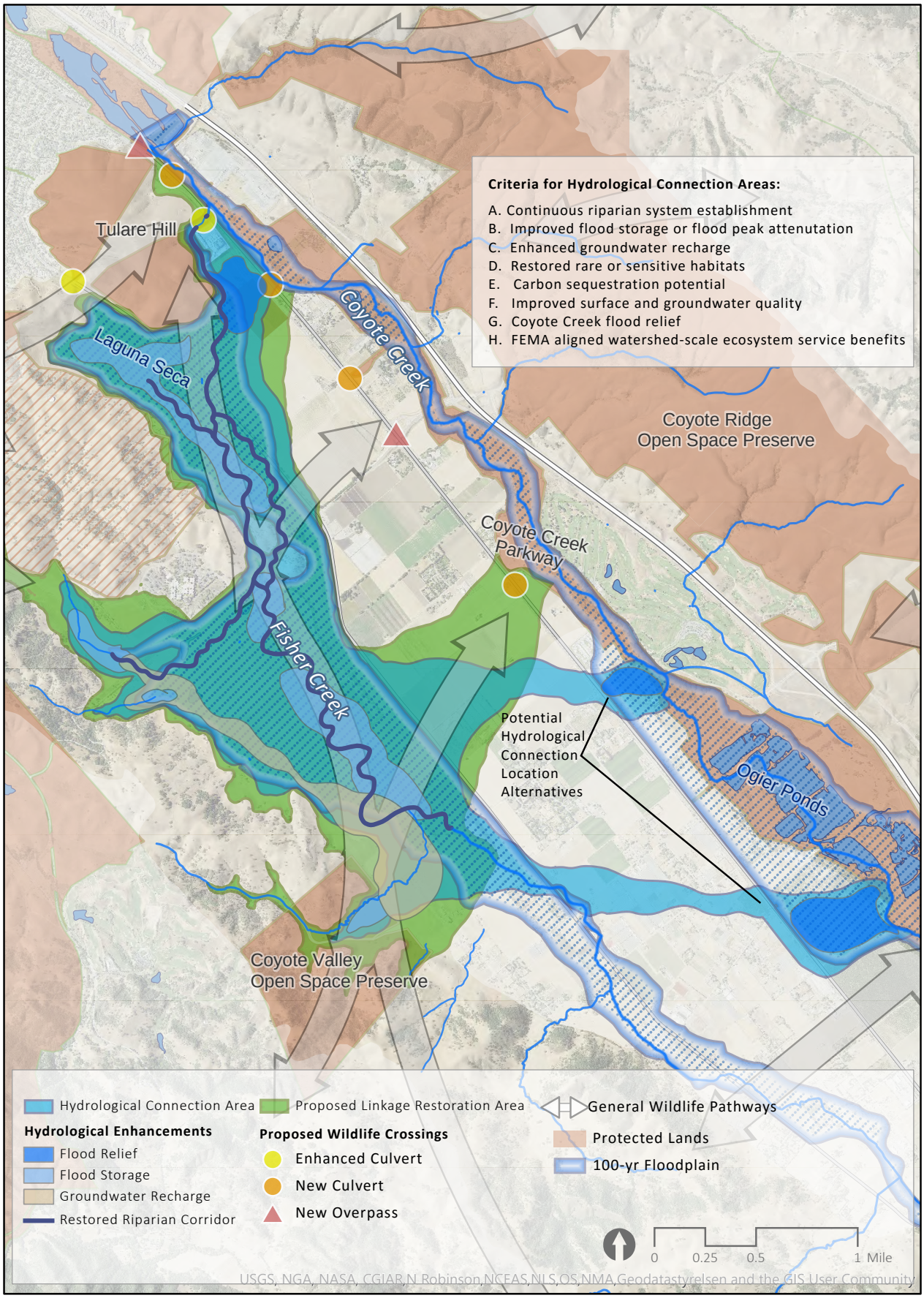
Integrating Water Resources and Habitat Connectivity for Ecological Resilience

In addition to its critical wildlife function, Coyote Valley also encompasses significant water resources within the Coyote Creek Watershed, affecting downstream areas like the City of San José. The Valley includes over 2,500 acres of open floodplains that slow and retain floodwater upstream of urban communities in the City of San José. It contains a significant groundwater recharge zone that is surrounded by open hillsides and drainages that naturally recharge Coyote Valley's groundwater sub-basin with rainfall and stream flows. The Coyote Valley groundwater sub-basin supplies groundwater to the Santa Clara Plain sub-basin, helping to protect Silicon Valley's groundwater supplies, especially during periods of drought (Robins 2016). This ability to capture and retain water could decline if the Valley is developed. Development in Coyote Valley could reduce groundwater recharge by an estimated 25% and require significant new stormwater infrastructure to avoid additional downstream impacts (City of San José 2007). Left unmitigated, stormwater impacts associated with development at the scale of the proposed Coyote Valley Specific Plan would nearly triple peak flows in Fisher Creek, from 1,530 cfs to 4,210 cfs (City of San José 2007).

A changing climate presents another set of challenges and opportunities for water resources in the Valley. Intense rainstorms in late 2016 and early 2017 caused extensive and repeated flooding throughout Coyote Valley and the City of San José. The future climate is projected to be more intense and variable than today's climate, with more extreme flood and drought events (Flint and Flint 2012; California Climate Console 2017). Conservation and restoration of upstream floodplains like those in Coyote Valley will become even more important for mitigating downstream flooding and drought as the climate continues to change. If the Coyote Valley landscape were managed and enhanced to keep more water in the Valley through land protection and restoration of the historic hydrology, it is estimated there would be a significant benefit to downstream communities and local ecology (**Figure 6**). For example, it was shown that Fisher Creek currently contributes approximately 57% of peak flows that exceed channel holding capacity during a 10-year flooding event at William Street, San José and that hydrologic restoration projects designed to spread, capture, and sink excess stormwater in the Coyote Valley could reduce the risk of flooding to downstream areas while also recharging Coyote Valley's groundwater sub-basin (Robins 2016). Implementation of this type of landscape-scale ecological infrastructure option would increase resilience within the landscape linkage, deliver other public benefits (Sarté and Stipisic 2016; Sarté 2017), and potentially save significant dollars in stormwater infrastructure and disaster cleanup (Robins 2016). Rather than the Coyote Valley being a source of more problems through increased development and more frequent and intense storm events, Coyote Valley could serve a critical natural infrastructure asset for the City of San José, helping to alleviate downstream flooding, increasing groundwater recharge, and improving water quality. (See **Box 3** for more information on protection and enhancement of the hydrological system in Coyote Valley).

Conservation and restoration of upstream floodplains like those in Coyote Valley will become even more important for mitigating downstream flooding and drought as the climate continues to change.

Figure 6. Conceptual opportunities for water resource enhancements in the linkage area. This figure depicts the conceptual relationship between the landscape linkage and provision of water services, where those areas proposed for habitat restoration can also potentially be managed to reduce flood impacts and increase recharge of groundwater supplies.



Box 3: An Ecological Infrastructure Solution for Water and Wildlife

A conceptual hydrological restoration vision for the Coyote Valley has been developed in parallel with the Wildlife Linkage. As these efforts have evolved, the synergies between restoration of Coyote Valley's hydrology and ecology have become more clear. This work has brought our team to conclude that a successful wildlife linkage in Coyote Valley will likely result in hydrologic connections that maintain and enhance the resilience of the linkage's ecological systems. The accompanying conceptual diagram (**Figure 6**) illustrates the relationship between the restoration of Coyote Valley's hydrology and how this work could result in sustainable gains in habitat quality and other ecosystem services. This approach is based in the concept that natural areas can serve as natural infrastructure that can be managed or enhanced to provide multiple benefits for humans and wildlife including essential urban services such as protection of water quality, groundwater recharge and water supply, and downstream flood protection.

Eight inter-related criteria were developed to identify potential hydrologic connection areas that would enhance habitats within Coyote Valley's wildlife linkages and provide additional ecosystem services to benefit the City of San José and the larger region. These eight criteria include:

A. Opportunities to establish a **contiguous riparian and floodplain system** along Fisher Creek with adequate width to optimize stream sinuosity, provide for safe wildlife utilization and movement, and to maximize ecological health.
B. Recognition of the existing **flood storage capacity** of land in Coyote Valley and the increased value it could provide through strategic conservation and restoration that increases or improves flood storage and flood peak attenuation.
C. Opportunities to enhance **local groundwater recharge** on lands under consideration for conservation. Groundwater management and recharge are important components of ensuring sustainable aquifer management, providing a cost-effective and resilient local water storage option during times of drought, and supporting sensitive and rare habitats like Laguna Seca.
D. The potential for areas to be restored to **rare or sensitive habitats**. These range from perennial freshwater wetlands to oak savannah habitats, both of which were abundant historically in the Coyote Valley.
E. The land's current and future **carbon sequestration potential**. Protection and restoration of perennial wetlands and seasonal wetlands, provides high and long-term carbon sequestration potential, in particular through avoided emissions by keeping hydric soils intact and free from disturbance.
F. The ability of conservation lands to play a role in improving **surface and groundwater water quality** through use of green infrastructure. Water quality benefits should be measured both in terms of downstream surface water as well as groundwater health.
G. The potential to provide **Coyote Creek flood relief**. There may be opportunities during uncontrolled spills from Anderson Dam or during extreme storm events for lands in Coyote Valley to directly provide benefit to Coyote Creek not only in terms of attenuating peak flows from Fisher Creek, but also by enabling floodwater from Coyote Creek to overbank to the west and/or to flow across the valley following the natural west-to-east sloping topography.
H. Opportunities to provide **watershed-scale benefits** that align with FEMA's methodology for protection facilities defined though the Hazard Mitigation Grant Program and that are supported with maximum 'ecosystem services' potential available.

These criteria should be considered as a starting point for identifying land conservation, wildlife linkage development, and maximizing hydrological benefit and ecological health. These concepts should be carefully considered in the advance of any further floodplain manipulation, transportation improvements or urban expansion.

This approach to restoring the hydrological system in Coyote Valley further supports and enhances habitat for a wide range of valued species, including rare plants, amphibians such as the California red-legged frog and California tiger salamander, numerous water birds, and the tricolored blackbird, which is currently proposed as a listed species in California. This could result in thousands of linear feet of a restored Fisher Creek and riparian corridor and hundreds of acres of various types of wetlands and wet meadows (Robins 2016). Other rare and valuable habitat types could also be brought back through restoration and enhancement such as valley oak savannas, willow groves, and native grasslands. These actions would help the County meet habitat and wetland mitigation goals developed in the *Santa Clara Valley Habitat Plan* that will be difficult to meet elsewhere, and could provide an opportunity for restoring breeding habitat for burrowing owls whose numbers have declined precipitously in Santa Clara County. It would also help the City of San José reach local carbon sequestration goals through the retention of more carbon in the wetland soils (Mitch *et al.* 2012) and through restored natural communities, particularly those with trees, as a single tree absorbs carbon dioxide at a rate of approximately 48 pounds per year (American Forests 2017).

Looking east across the linkage area from Coyote Valley Open Space Preserve.

Landscape Linkage Goals and Principles

Coyote Valley has many values that are worth protecting. The goal for the Coyote Valley Landscape Linkage is to maintain and improve the overall permeability of the landscape to provide quality live-in habitat for multiple species and support the movement of the full suite of native species and ecological and evolutionary processes, and as much as feasible provide other co-benefits for the improved resilience of the Santa Clara Valley. As has been outlined in previous reports, specific corridors and mitigation features will be needed to assure a fully functional landscape linkage (see **Box 1** for definitions). In this report, recommendations are refined and expanded to provide a specific vision for success.

Establishing clear goals for a landscape linkage is extremely important, so the proper linkage strategies can be developed and effectiveness of implementation can be evaluated over time (Beazley *et al.* 2005; Beier *et al.* 2011). The focal species and ecological processes chosen are particularly important as they drive the specific requirements and designs needed for success (see **Figure A1** in **Appendix 1** for list of focal species considered).

This report integrates and refines the modeling results from previous connectivity planning analyses (Spencer *et al.* 2010; Penrod *et al.* 2013) with information about focal species needs and best practices for corridor design emergent from conservation science to develop specific goals and design principles for the landscape linkage in order to ensure long-term connectivity that promotes native biodiversity (Anderson and Ferree 2010; Ackerly *et al.* 2010; Penrod *et al.* 2013; Beller *et al.* 2015).

The specific goals are:

- Permanently protect habitat connectivity for terrestrial and aquatic species.
- Provide live-in and dispersal habitat for a full community of species, including special-status species, which can also facilitate daily and seasonal migrations, as well as long-term range shifts as species adapt to a changing climate.
- Accommodate the range of taxa and guilds between mountain ranges, even those that are not currently in the area but might be in the future as species shift distribution in response to climate change.
- Protect, expand, and connect habitat patches in a way that minimizes edge effects.
- Prevent linkage fragmentation from future incompatible land uses (*e.g.* urban development, transportation projects, *etc.*).
- Use landscape resilience planning principles for sustainability (Beller *et al.* 2015) in an urban ecosystem in the face of a changing and uncertain future:
    - Incorporate as much terrestrial and aquatic landform diversity, complexity, and connectivity as possible.
    - Provide redundancy of elements (both habitat types and safe crossings).
    - Consider historical ecology to understand the driving factors of setting.
    - Provide space for dynamic natural processes (*e.g.* flooding) to operate.
    - Develop the project at the scale at which landscape processes can operate meaningfully.
- Integrate wildland conservation with other land uses where possible to promote multiple social and community benefits (*e.g.* agriculture, recreation, stormwater management).

The design principles to accomplish these goals are:

Maintain a wide wildland area. Existing research supports the strategy of optimizing the width, number, and variety of corridors at multiple spatial scales in order to support the full spectrum of native species and ecological processes on the landscape (Noss and Harris 1986; Noss 1987). In general, wider linkages areas are more effective than narrower ones (Hilty *et al.* 2006; Merenlender and Crawford 1998). Studies show that to support the suite of species requiring connectivity through Coyote Valley, the landscape linkage area should be least 2 km (1.2 miles) wide (Penrod *et al.* 2006; Beier 1995). These areas do not have to be free of all obstructions, but they do need to be sufficiently permeable and relatively intact to successfully accommodate species movement for the target species, and provide live-in habitat for species of importance such as bobcats, badgers, and gray foxes, as well as those with small-home ranges and short-dispersal distances, like amphibians, insects, and plants. A wide area provides enough space to support multiple habitat types, a redundancy of crossing options at pinch points, and the minimization of negative edge effects from light, noise, pesticides, traffic, and non-native species associated with urbanization. Without sufficient width and buffering from development and associated traffic, corridors may act as ecological traps rather than safe habitat, due to competition with generalist and non-native species, high predation rates, collisions with cars, ingestion of pesticides, and other concerns (Simberloff and Cox 1987; Resasco *et al.* 2014).

Protect nature's stage – areas with the least fragmentation, existing protected lands, and the most landform diversity and topographic and hydrological complexity. Ecological and evolutionary processes play out over large areas and over long time scales; they are driven by both spatial and temporal diversity. Adding new protected areas adjacent to existing protected areas results in larger conservation areas, which are easier to maintain and are more efficient at protecting biodiversity (ICF International 2012). Landform diversity helps drive species diversity and endemism while providing some protection of ecological processes and evolutionary potential in a region over time (Anderson and Ferree 2010; Beier and Brost 2010, Lawler *et al.* 2015, Heller *et al.* 2015). Physical and climatic environmental gradients are particularly important to protect as they create a wide diversity of climate conditions across small spatial areas – also known as micro-climatic buffering (Ackerly *et al.* 2010). These environmental gradients function to slow down the velocity of climate change effects on species (Loarie *et al.* 2009) and they provide natural range shift migration routes (Breshears *et al.* 2008; Mackenzie *et al.* 2011).

Restore freshwater wetlands and a more natural hydrologic regime. The protection and enhancement of aquatic habitats and water features in Coyote Valley is an important component of promoting and maintaining a functional and resilient corridor, especially due to the impacts of climate change. Water features (streams, wetlands, ponds) are important climate change refugia for many species (Klausmeyer *et al.* 2011; Mackenzie *et al.* 2011) and are essential to protect and restore, as water availability is projected to be potentially more volatile and uncertain in the future based on climate models (California Climate Console 2017). Hydrological restoration in Coyote Valley focused on capturing, spreading, and sinking additional water in the Valley instead of having it flow downstream represents a unique opportunity to restore hundreds of acres of unique and rare habitats (wetlands, wet meadows, ponds) that have largely vanished from the landscape in the last two centuries due to drainage for agriculture and urban development, including the historic Laguna Seca wetland complex within Fisher Creek's floodplain. Rare species such as California tiger salamander, warmwater fishes, and wetland bird and mammal species will expand their habitat. Numerous other wildlife species will be attracted to the wetland complex throughout the year, but especially during times of severe drought, making it an important component of a regional climate change adaptation strategy.

Restore a mosaic of natural communities along the valley floor, especially rare habitat that complements wetlands, such as Valley oak woodlands and savanna. While Coyote Valley is functioning to sustain some biological communities in today's landscape, habitat value could be greatly improved through land protection, restoration, and stewardship. This will require careful planning and time to achieve the desired effect, generally guided by the historic

ecology, in combination with novel conditions and drivers on the current landscape, and focused on maximizing the utility of the land to provide both ecological health, sustainability, and other important social co-benefits, such as improved flood management, water supply capture, and carbon sequestration. Returning these varied habitats is critical to support the full suite of native wildlife in the region that will benefit from connectivity between the mountain ranges, and also north-south from the Bay inland.

Improve permeability throughout the linkage by maintaining as much open space as possible and constraining further urban development. Keeping as much of the linkage area free of further development is fundamentally important to the success of the Coyote Valley landscape linkage. Low-intensity land use using state of the art design techniques and careful planning will be necessary to assure landscape permeability for wildlife, and reduce the direct and indirect effects of development on wildlife. Development, including buildings, access roads, parking lots, and water management features, decreases habitat availability for plants and wildlife. Indirect negative impacts from development include increased road traffic, noise, non-native species, and artificial lighting. It will be essential to develop within and around the linkage area carefully. New development should be placed as strategically as possible to minimize fragmentation and should follow wildlife-friendly best practices such as avoidance of excessive outside lighting and pesticide use, clustered development, native landscaping, bird smart glass for windows, control of pets, and strategic fencing (Beier and Loe 1992; Theobald *et al.* 1997).

Use low-intensity agriculture to complement the linkage and provide additional habitat complexity and diversity. These same principles of careful stewardship and planning are required for managing agricultural operations in the vicinity of the landscape linkage. Agriculture can be supportive or hostile of wildlife depending on the operation and practices. A mosaic of annual (especially hay crops) and perennial (especially fruit and nut trees) agriculture, perhaps in combination with crop rotations, and restored riparian buffers and hedgerows, may be desirable, and can provide valuable wildlife habitat for a wide range of species, and are supportive of wildlife in the current landscape (Phillips et al. 2012). The recent introduction of walnut groves in portions of the area may provide some of the same benefits as native oak woodlands from the standpoint of providing cover for wildlife movement, but it will be important not to convert too much of the agricultural landscape to orchards, as the numerous hay fields provide habitat for many grassland wildlife obligates, especially birds. Caution should be exercised in promoting high-intensity, high-value row crops in the landscape linkage as these operations tend to install fencing and other wildlife-hostile measures in order to satisfy food safety guidelines and to protect the crops from herbivory.

The linkage design builds on existing open space and calls for a network of restored habitats and wildlife-friendly farms.

Increase the number of engineered strategic connections across the more significant barriers. Engineering safe and effective wildlife crossings is a discipline of global significance, and there are a wide variety of means that will help different species to safely cross roads (*i.e.*, underpasses, overpasses, and strategic fencing). Proper installation of wildlife directional fencing has been shown to dramatically reduce highway collisions with wildlife (Clevenger *et al.* 2001).

Bobcats are frequently found in Coyote Valley.

Redundancy and complementarity are fundamental requirements – the more crossings that can be provided, and with variety, the greater the permeability and success of the landscape linkage. Additionally, there are maximum spacing intervals (*i.e.* distance between structures) at which infrastructure should be located (*e.g.* every mile) in order to be functional in meeting species' needs (Clevenger *et al.* 2001; Ruediger 2001; Clevenger and Wierzchowski 2006). Many animals will continue to try to cross in unsafe places if structures are too far and few between. Ungulates and large carnivores such as mountain lions prefer overpasses or very large underpasses, while smaller mammals such as bobcats and coyotes can successfully utilize medium- to large-sized underpasses or culverts (Ruediger and DiGiorgio 2007). Only small-bodied species can utilize small culverts. Culverts should follow the natural terrain of the landscape and not be perched upslope, as animals will often follow the natural contours of the land; in addition, culvert bottoms should be covered with natural substrates (Bond, 2003). Culverts must have periods of limited water or be equipped with permanent benches to allow animals to move through the structure during times of normal stream flows. As species show affinities for particular habitat types (for example, some prefer open grasslands while others will only move through wooded patches or along vegetated river corridors), it is important to have crossings that link different types of habitat so that species will naturally find and move through the landscape. (Further details about crossing improvements and design specifications are provided in **Appendix 2**).

Use multi-benefit landscape planning to ensure actions maximize public benefits while protecting unique values. Conservation actions that improve habitat availability and connectivity for wildlife are often the same actions that improve other environmental challenges as well. For instance, wildlife often follow water pathways when traveling and depend on water for survival. Riparian vegetation is needed for safe cover along waterways. Waterways with ample riparian vegetation surrounded by open floodplains diminish flood damages in extreme events. Open space overlying permeable soils and groundwater basins allows for groundwater recharge and sustains water supplies for urban and agricultural communities. Open space also provides opportunities for outdoor recreation and nature experiences that provide extensive public health and economic benefits. For example, the City of San José's growing system of parks and trails annually provide to residents an estimated benefit of $51.2 million for the direct recreational use of these park facilities; San José parks raise the value of nearby residential properties by $1 billion and increase property tax revenues by $12.1 million a year, provide stormwater management services valued at $6.43 million annually, and attract visitors to the City who spend $120 million annually in the local economy and generate $4.93 million in local tax revenues (Trust for Public Land 2016). Protection of local agriculture provides other benefits. In addition to providing habitat for some wildlife species, the orchards, hay and alfalfa fields common throughout the Coyote Valley are a small but vital part of the County's $300 million agricultural economy. These are just a few examples of how conservation actions for wildlife are aligned with other public benefits. Multi-benefit planning attempts to balance as many public benefits as possible, while at the same time prioritizing the most critical and unique functions. In this case, the priority for conservation is wildlife and biodiversity given the unique location of Coyote Valley as a last chance landscape for ecological connectivity between the Diablo and Santa Cruz Mountains. Establishing a firm foundation for wildlife as is laid out in this report, and then layering on other benefits, will likely result in high ecosystem service delivery.

The North Coyote Valley

The North, Mid and South Coyote Valley have all been considered as potential corridors in previous linkage assessments. There has been debate about the relative merits and equivalency of different parts of the Coyote Valley landscape for conservation investment to sustain and enhance wildlife connectivity. While all parts of the Valley are important to improve permeability for wildlife, the North Coyote Valley is the most feasible and promising location to apply all the design principles and achieve the specific goals toward a functional, resilient landscape linkage.

First, the geographic position of the North Coyote Valley in relation to the rest of the Santa Clara Valley makes it an ideal location because the distance between protected uplands is the narrowest near Tulare Hill compared to other linkage opportunities. Also, the land use in the North is far more permeable today than in the Mid or South, because there is less fragmentation and larger, more intact parcels (Diamond and Snyder 2016). Unlike the other potential linkage locations in Coyote Valley, the number of parcels in the North is relatively low, making it feasible to secure only a handful of land agreements to protect existing ecological values and lay the foundation for enhancement and restoration of a broad area of high-quality land. In areas with high fragmentation and many small parcels, securing long-term protection of a contiguous broad linkage would be extremely difficult and may be impossible. Thus, there is an important leverage opportunity in the North where a relatively small number of contiguous undeveloped acres can be protected, which would then function to connect 1.13 million acres of open space core habitat on both sides of the Valley.

Second, the existing protected and unprotected open space lands network in the North provides a unique opportunity to expand the overall viability of these lands while successfully addressing the larger regional landscape linkage needs. The matrix of undeveloped hay fields, remnant oak savanna, serpentine grassland, wet meadow and the Laguna Seca in the Valley floor are adjacent to the protected Coyote Creek Parkway (1,304 acres), Tulare Hill (~258 acres), Santa Teresa County Park (1,676 acres), Calero County Park (3,489 acres), and IBM open space (~1,174 acres) (**Figure 4**). Fisher Creek runs through this mosaic of land.

Laguna Seca has the potential to be the largest natural freshwater wetland in the County and is a key element of the linkage.

Camera traps have documented wildlife using Fisher Creek to cross the Valley (Diamond and Snyder 2016). It is pragmatic to take advantage of this existing functional route and enhance it. The floodplain of Fisher Creek and the extremely low-lying topography and high water table provide a strong rationale for establishing wetland restoration, including an improved riparian buffer to protect water quality and allow for wildlife movement year-round, including when the creek channel is too inundated with water for wildlife to navigate. Riparian floodplain protection provides important co-benefits of helping provide space for water to flood and recharge in the Valley, and avoiding economic and social costs associated with flood damage to infrastructure.

Restoration of Laguna Seca could expand breeding habitat for tricolored blackbirds.

Third, Laguna Seca is in the north, and there are no similar features in the other parts of Coyote Valley. Laguna Seca was one of the largest freshwater wetlands in Santa Clara County, and of particular importance, especially if more of its historic extent and functionality could be restored. Doing so would undoubtedly make Laguna Seca a focal point of the North Coyote landscape linkage. It would not only enhance the value of the linkage considerably, but it would also contribute to conservation beyond this region by expanding support for migratory waterfowl as San Francisco Bay is a critical stop-over area for waterbirds along the Pacific Flyway. Laguna Seca is especially valuable because it represents a freshwater wetland, whereas the ponds in San Francisco Bay are saline. Waterbirds prefer freshwater ponds for breeding, so Laguna Seca provides an opportunity to create waterbird breeding habitat. A restored Laguna Seca could also provide breeding habitat for tricolored blackbirds, which currently nest in nearby Calero County Park. The expanded wetland complex would also provide valuable live-in habitat for some species such as California tiger salamander, southern western pond turtle, and California red-legged frog, and would serve as a resource attractant, especially in times of drought, for all wildlife on both sides of the linkage. It would also provide critical buffering capacity to climate change warming trends and the altered frequency and intensity of extreme events such as more persistent droughts and more frequent and severe flooding by restoring water storage capacity on-site.

Fourth, while the protection and restoration of Laguna Seca is extremely important, it is only one of several important conservation values in the North. The North Coyote Valley is unique within the larger Coyote Valley, because it is the part of the landscape where the largest physical and climatic gradients are found, thus providing the highest–quality environment for connectivity and habitat restoration. It is the only area in Coyote Valley with a confluence of diverse terrain, soil types, and hydrologic features resulting in multiple habitat types converging in a relatively small area (Grossinger *et al.* 2007). This mosaic of habitat types consequently supports a wider range of species (both live-in species and move-through species), including several threatened and endangered species – more than in other parts of the Valley (see **Figure A2** in **Appendix 1**), and supports movement and dispersal as individuals follow these gradients naturally. Ecologically, the North Coyote Valley is still rich in species diversity, and still supports important ecological processes, which are compromised to varying degrees and threatened, but nevertheless still functioning. Enhancing these features and restoring as much of the natural communities – valley floor oak woodlands and savannas, grasslands, and marshlands – would be an essential component of this linkage.

For these reasons, the North is the best and first option to protect and enhance connectivity to meet the specific goals of a resilient, functional landscape linkage in the Coyote Valley. The remainder of the report discusses the specific design and conservation actions recommended for implementation of a primary landscape linkage in north Coyote Valley with complementary, secondary corridors in the Mid and South. More research and planning is needed to better understand the best opportunities for establishing secondary corridors.

Coyote Valley Linkage Design

The linkage design described in this report is a result of a six-month process that convened local scientists to integrate local expertise and new scientific findings to build on the recommendations of previous state and regional connectivity plans for Coyote Valley. The linkage design vision incorporates goals, design principles, historical ecology, wildlife studies, roadkill data, and focal species requirements to develop a functional landscape linkage that provides live-in and move-through habitat for a wide range of species. The Bay Area Critical Linkages (BACL) focal species formed the base of the focal species examined for this linkage design, and further refinements were made based on local knowledge, policy changes, and data from new wildlife research and new species occurrences learned about since the BACL report (see **Appendix 1** for more information on focal species, their regulatory status, and consideration for including them as focal species in the linkage design).

The focal species chosen represent wildlife that move through and utilize habitat in different ways. The mountain lion is a large carnivore that needs large areas to support gene flow and serves as an umbrella species for other species with smaller home ranges (Thorne *et al.* 2006). Additional species were chosen to ensure the linkage is designed based on the habitat requirements and movement needs of a diverse suite of species, including various mammals, amphibians, reptiles, birds, and invertebrates. The associated habitat types for each focal species, including consideration of their live-in and move-through requirements, were compared with the habitat types that exist or are proposed for restoration in the linkage design in order to ensure that the full suite of focal species would be accommodated (see **Figure A2** in **Appendix 1**).

Consultations with a civil engineering hydrology firm, Sherwood Engineering, were also conducted to further evaluate the relationship between the linkage design and potential benefits related to downstream flood control, particularly by restoring and enhancing Laguna Seca and the Fisher Creek floodplain to encourage recharge and water storage upstream from the confluence between Fisher Creek and Coyote Creek. Consultations indicate there are strong positive synergies between the linkage design and the opportunities to improve flood management and water quality and quantity (See **Box 3**).

Vision of a Restored and Resilient Landscape Linkage

Figure 7 depicts a vision of the landscape linkage, including a wide region designated for protection and habitat restoration, which meets the design principles and specific goals outlined in this report. Its design focuses on connecting the protected area anchors from east, west and north, south through the part of the Coyote Valley landscape that provides unique topographic gradients and hydrological features important for supporting biodiversity and climate resilience. The vision defines several major restoration or land use zones (indicated by letters), major wildlife pathways (broad arrows), and barrier mitigation opportunities (numbered symbols).

A A restored Laguna Seca wetland is an important focal point of the linkage. Restoration of this wetland complex provides an important resource for aquatic and terrestrial species as live-in and move-through habitat in the Valley floor, supporting a variety of wildlife including California tiger salamanders, California red-legged frogs, southern western pond turtles, wetland and waterfowl bird species (including migratory birds on the Pacific flyway), nesting habitat for tricolored blackbirds, and an important water source for mammals. Laguna Seca also improves flood retention in the Valley. Furthermore, every acre of the floodplain that is protected from development and allowed to flood in Coyote Valley will help provide flood control downstream.

B The Fisher drainage near where Fisher Creek meets the Monterey Highway is highly constrained and historically would have spread into large patches of riparian forest of willows, which provide unique and valuable bird habitat and absorb floodwaters. Restoring the riparian willow forest and providing Fisher Creek space to backwater and flood onto the landscape will be an important component of habitat restoration and flood control in the coming century as extreme rainfall events become more frequent. A restored floodplain also provides numerous co-benefits such as groundwater recharge, flood protection, and water quality enhancement. The willow riparian area provides rare habitat for songbirds, cover for mammal species, and a transition zone from the wetlands of Laguna Seca to restored oak savanna habitat.

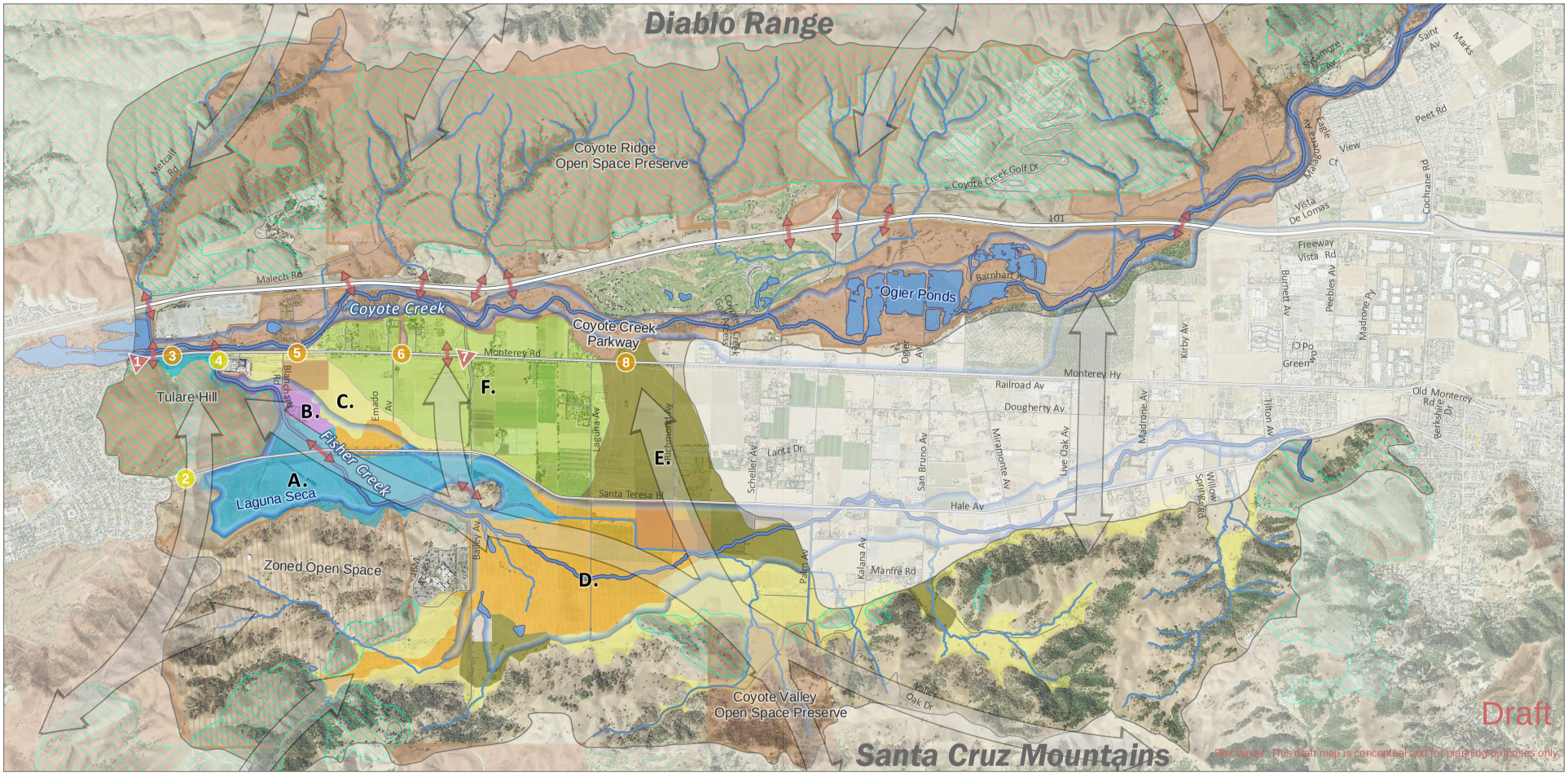
D The Fisher Creek floodplain forms the backbone of the linkage. As the only documented successful movement pathway for wildlife through the Valley floor and under the Monterey Highway, it is vital to protect and enhance this connection along Fisher Creek. If the Fisher Creek corridor were widened and more broadly restored with riparian vegetation and wet meadows, and the existing culvert under Monterey Highway were improved, it would be a more reliable corridor providing space for movement in all seasons, including when the water level in the channel is high. Restoring Fisher Creek includes potential re-alignment of the channel and restoration and revegetation of historic tributaries, as well as maintaining and revegetating the existing channel to provide improved cover and habitat for wildlife movement. These improvements would help the linkage to serve more species, including mountain lions, which have not been observed migrating east-west between the Santa Cruz and Diablo Ranges, presumably due to lack of adequate cover.

C and **E** Coyote Valley provides the rare opportunity to restore natural San Francisco Bay Area valley floor habitat, including valley oak woodland, oak savanna, and grasslands. These habitats provide cover for species to move between the Santa Cruz Mountains and into the Coyote Creek parkway, as well as important habitat for birds and mammals. Grassland and savanna in particular could serve as important stepping stone habitat patches for recovery of burrowing owls and badgers, both of which are found at Tulare Hill and Coyote Ridge Open Space Preserve.

Parts of the mid-valley are called out as the best opportunity to create a mosaic of orchards and oak woodlands to provide a secondary and complementary corridor for wildlife movement. Maintaining multiple cross-valley corridors is important to provide resiliency, and restoration of these communities is important to complement the wetland and riparian restoration and provide habitat diversity in the linkage to accommodate the full suite of focal species.

F A large zone generally dedicated to wildlife-friendly agriculture will provide complementary land use between urban development and core wildland habitat. Wildlife-friendly agriculture currently provides benefits such as foraging habitat for various small mammals and birds, such as a diverse and abundant raptor population and tricolored blackbirds. This area is also intended to provide move-through habitat for a range of less cover sensitive species and can be enhanced through hedgerows and other forms of cover to increase permeability for wildlife movement. In addition, agriculture brings many co-benefits

Figure 7. Coyote Valley Landscape Linkage vision. This map highlights main wildlife movement flows (white arrows), potential restoration zones, existing crossings (red arrows), and enhanced or potential new crossing sites (numbered symbols).



to the local community, economy, and preserves the area's rural character. In addition to the restored habitat types described, potentially high value groundwater recharge opportunities are located on the west side of the Valley, which is very important for retaining stormwater runoff and sustaining the natural hydrology of the watershed, particularly the Laguna Seca wetland complex. Fisher Creek could also provide additional space for Coyote Creek to backwater onto the landscape, which will be an important component of flood control in the coming century as extreme rainfall events become more frequent, resulting in increased flooding in downstream areas of San José.

Tulare Hill, which is mostly protected open space, is also a key existing feature in the design. Tulare Hill provides important and protected upland habitat, containing serpentine soils and associated obligate species such as Bay checkerspot butterfly. American badger and western burrowing owl have been documented there, both of which are focal species of the linkage design that also carry regulatory status. This landscape feature provides essential upland refuge habitat and functions as a stepping stone of habitat in the Valley floor. Tulare Hill has high conservation value, but at the same time it has steep, dry terrain, and lacks cover. By itself is not sufficient to accommodate the movement or habitat needs of many of the focal species (*e.g.* mammals) in Coyote Valley. The base of Tulare Hill was recently confirmed as a popular wildlife movement pathway, especially while the Fisher Creek was inundated during the 2016-2017 wet season (T. Diamond, personal communication, January 2017).

Numbered symbols: Implementation of the linkage as described above will also require reducing the isolating impacts from existing roads and other linear features that currently block wildlife movement and result in significant mortality of many of the focal species in the region. The biggest challenges from the standpoint of barriers in the North Coyote Valley linkage area are Highway 101, Monterey Highway, and the associated railroad line. Roadkill also routinely occurs along other secondary roads, including Santa Teresa Boulevard and Bailey Avenue (Diamond and Snyder 2016). These secondary roads will become increasingly problematic if development expands resulting in greater traffic volumes and increased potential for wildlife-vehicle collisions. Wildlife crossing infrastructure will be needed in strategic locations on these secondary roads as well.

Road Crossing Infrastructure

The vision and infrastructure maps (**Figure 7** and **Figure A3** in **Appendix 2**) show existing and proposed wildlife crossing infrastructure at roads and rail lines that would improve routine safe passage for a variety of taxa that have different habitat and corridor requirements and also facilitate movement in different seasons and under various disturbance conditions. The specific locations and design considerations for wildlife crossing infrastructure will require additional scientific evaluation and engineering consideration, to be conducted with key agency stakeholders.

Highway 101

Improving the overall permeability of Highway 101 is an important part of achieving the landscape linkage in Coyote Valley, and has been extensively explored by Phillips *et al.* (2012). Highway 101 is a 10-lane highway that has several locations where wildlife are successfully crossing under the roadway using existing culverts and underpasses. Despite the small size and form of the existing features, wildlife are sometimes successful. With some infrastructure upgrades and also improved maintenance and wildlife directional fencing, the use of these crossings by a wider range of animals could be improved (See **Appendix 2** for more details). For example, wildlife passage through several culverts under Highway 101 was documented in 2007-2008; however these culverts became blocked over time by sediment and debris (T. Diamond and A.R. Snyder, unpublished data). In 2016, Caltrans cleared the debris from two culverts and wildlife resumed the use of these features for passage under

the highway. A number of successful crossings have been documented with field cameras since maintenance occurred (T. Diamond and A.R. Snyder, unpublished data). This action provides a model for strategic coordinated documentation and maintenance that can be implemented at scale throughout the Valley by the newly formed Santa Clara County Wildlife Corridor Technical Working Group.

Monterey Highway

Monterey Highway is a four-lane road that poses an even more significant barrier to wildlife movement than Highway 101 in the current landscape, as evidenced by the lack of safe crossings options and the concentration of roadkill along this corridor (**Figure 4**). Much of the length of Monterey Highway features a four-foot tall concrete median with a two-foot fence on top of it, which provides an effective barrier to animals crossing at-grade. There is only one functional safe crossing, an underpass at the confluence of Fisher Creek and Coyote Creek (#4 in **Figure 7**, **Figure A3** in **Appendix 2**), and during high-water events it is inundated and not functional for terrestrial wildlife movement. For example, it was out of commission during most the 2016 -2017 winter. This culvert requires retrofitting or replacement to improve its functionality for wildlife, and retrofit may be required as part of any High Speed Rail alignment (S. Crossen, personal communication, January 2017) providing a good opportunity to leverage this investment and improve its utility for wildlife as well. Preliminary cost estimates of redoing the underpass culvert at the confluence of Fisher Creek and Coyote Creek would be between $1,700,000 and $2,100,000 (Sarté 2017).

Potential New Infrastructure

The need for wildlife passage infrastructure, or infrastructure designed for the needs of specific wildlife species, is an important conservation action in areas with habitat fragmentation (Clevenger and Huijser 2011). In a linkage area such as Coyote Valley, it is essential to construct infrastructure that has been located and designed to meet the needs for specific wildlife species, as well as to have the appropriate fencing and spacing that improves wildlife use (Clevenger and Huijser 2011). Considering these principles, which have been documented in numerous case studies of successful landscape linkages, it is necessary to provide multiple and complementary infrastructure solutions to improve the permeability of Coyote Valley for all wildlife. A suite of options for wildlife passage infrastructure is described below. Additional investigation and close partnership with resource and transportation agencies will be required to further develop the specifics of crossing locations and design throughout Coyote Valley.

Informed by camera traps and roadkill data (Diamond and Snyder 2016), local expert knowledge, and initial engineering analyses, a number of potential new overpass and underpass options aimed at primarily mitigating Monterey Highway, and secondarily mitigating Highway 101, Santa Teresa Boulevard, and the associated railroad line, have been identified in the North linkage area (**Figure 7**, **Figure A3** in **Appendix 2**). The width and length of the structure and complexity of the site will influence costs. Such factors would be identified during construction feasibility and design. The cost estimates included in this document are conceptual and will require additional planning, design, and engineering to determine the specific locations and type of infrastructure that is most cost-effective. High Speed Rail implementation will also impact plans for new infrastructure, especially near Monterey Highway. Land use on either side of the crossings is another consideration (ensuring that wildlife is able to move from one protected area to another in perpetuity). Based on precedent-setting costs of similar projects, overpasses are considerably more expensive than medium and large-scale underpasses (Sarté 2017); however, both are necessary to accommodate the full suite of wildlife in the region. Collaboration with transportation and wildlife agencies will be essential.

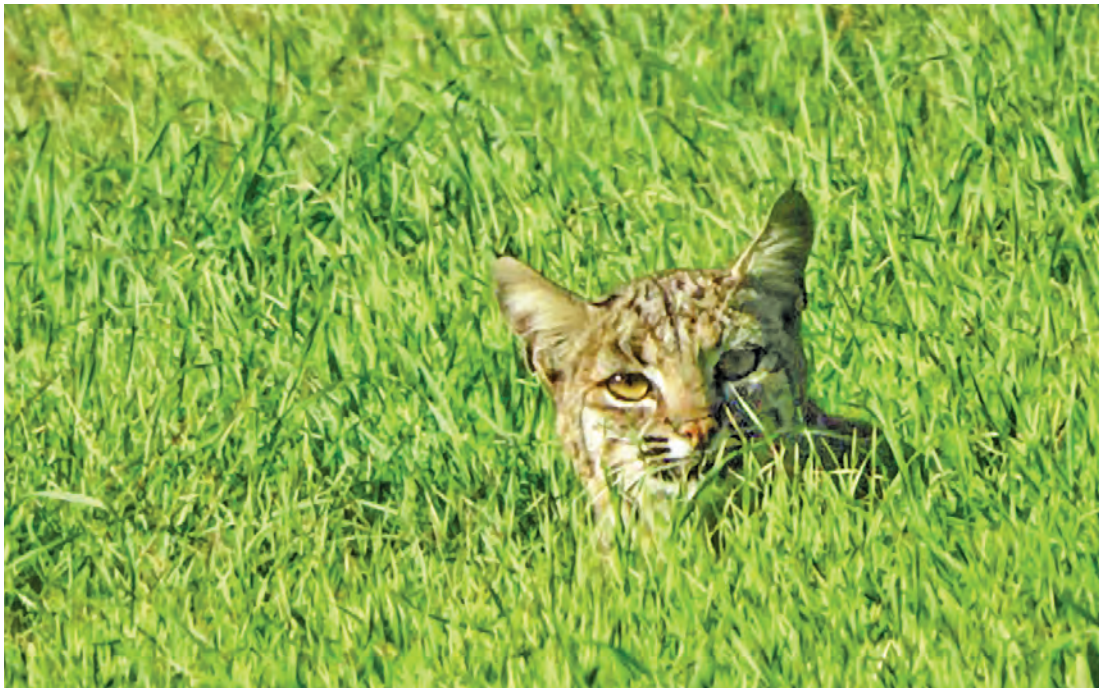
Wildlife Overpasses

In order to meet the needs of the identified focal species (**Appendix 1**) in relation to barriers presented by road and rail corridors, one or more overpasses designed for wildlife (see photos) are needed at Monterey Highway. Wildlife overpasses have been considered at two general locations in the study area – near Metcalf Road and Bailey Avenue.

The estimated total cost for overpass construction of an animal-only land bridge at the Metcalf Road site (#1 in **Figure 7**, **Figure A3** in **Appendix 2**), ranges from $10,300,000 to $21,400,000. However, the feasibility of over-crossing at Metcalf Road is extremely low given proposed alignments of High Speed Rail. The proposed alignment of High Speed Rail is unlikely to accommodate wildlife infrastructure at Metcalf because of the curve of the road and pinch between Coyote Creek Parkway and Tulare Hill, as well as a number of high voltage power lines (High Speed Rail Authority, personal communication, February 2017).

Another promising option for an overpass in the Coyote Valley is at the Bailey Road intersection with Monterey Highway (#7 in **Figure 7**, **Figure A3** in **Appendix 2**). This spot is more feasible than Metcalf in relation to current alignments planned by High Speed Rail. It would be possible in either proposed alignment, and could be accomplished through modifications to the existing bridge at Bailey Avenue. Cost estimates range from $10,500,000 to $25,750,000. The Bailey Exit at Highway 101 and the intersection of Bailey and Monterey are both road-kill hotspots with mountain lion, coyote, bobcat, raccoon, and badger killed at these locations (Diamond and Snyder 2016). In addition to Monterey, there is a need for improvements at 101. It may be preferable to develop a separate wildlife bridge or retrofit an existing culvert into an open span bridge at the drainage on the east side of Highway 101 just south of the Bailey interchange, as this provides a short and direct path into Coyote Creek Parkway (**Figure 7**, **Figure A3** in **Appendix 2**). The specific location and design of infrastructure would be subject to further evaluation and agency involvement. Some additional over-crossing infrastructure is highly recommended.

Examples of a wildlife overpass across Highway 191 in Wyoming (left) and a wildlife underpass under Highway 97 in Oregon (right).



Scientists are researching bobcat movements in Coyote Valley to inform design of wildlife crossings.

Wildlife Underpasses

Five new potential underpass opportunities have been identified, and if all or some combination were implemented they would assist wildlife movement and provide the requisite diversity and complementarity of infrastructure as needed to accommodate the life history needs of the focal species. The siting of these new underpasses, discussed below, is preliminary, and additional studies are needed to determine feasibility and design. Besides the underpasses themselves, it is essential to include features such as directional fencing to facilitate the movement of wildlife and reduce wildlife-vehicle collisions (Clevenger and Huijser 2011). The two less expensive underpasses would be at the Laguna-Santa Teresa Boulevard and Tulare Swale sites (#2 and #3 respectively in **Figure 7** and **Figure A3** in **Appendix 2**). Estimated costs for these two underpasses range from $1,300,000 to $1,500,000. The potential Monterey underpass at Blanchard Road (#5 in **Figure 7** and **Figure A3** in **Appendix 2**), Monterey near Emado Avenue (#6 in **Figure 7** and **Figure A3** in **Appendix 2**), and Monterey at mid-valley (#8 in **Figure 7**) would require a similar level of effort and are projected to cost approximately $1,500,000 to $1,800,000. Any of the potential sites for underpasses would require additional site planning and agency involvement, and their respective feasibility given High Speed Rail planning.

The median barrier presented by Monterey Highway is a priority for a fix toward increasing the permeability of Coyote Valley for wildlife. The City of San José has identified replacement of portions of the median with a barrier that is more permeable to wildlife (while still factoring in human safety) in the San José General Plan. There are other road barriers in the linkage area, such as the length of Santa Teresa Boulevard and Bailey Avenue. Solutions to these barriers may not require large engineered infrastructure. The magnitude of need will depend on how development proceeds in the Valley, and where corridors and crossing infrastructure are located. However, it will likely be worthwhile to invest in large engineered solutions in designated corridors that span the entire Valley, east to west. A recent meta-analysis of 50 scientific studies on the effectiveness of road mitigations (*i.e.* wildlife crossing infrastructure) in reducing roadkill, found that comparatively expensive mitigations (*e.g.* over-crossings, under-crossings, fencing) reduce large mammal roadkill much more than inexpensive measures (*e.g.* reflectors at-grade) (Rytwinski *et al.* 2016). Further investigation and monitoring is warranted to determine the location and design of mitigations to improve the permeability of these roadways.

Local and Statewide Precedents

There is a recent precedent for major wildlife crossing infrastructure investments in the region and state. There are two large projects in progress on Highway 17 in Santa Clara and Santa Cruz Counties: one near the Lexington Reservoir in Santa Clara County and the other at Laurel Curve in Santa Cruz County. The Lexington Reservoir project area ("Highway 17 Wildlife and Regional Trail Crossings") represents a multi-agency collaboration, including Midpeninsula Regional Open Space District, Caltrans, Santa Clara Valley Transportation Authority, Santa Clara County Parks, Santa Clara Valley Water District, Santa Clara County Roads and Airports Department, Bay Area Ridge Trail, Juan Batista de Anza Trail, Peninsula Open Space Trust, and Pathways for Wildlife. This project will connect protected lands and core habitat on either side of the highway through the development of specialized wildlife passage and regional trail infrastructure. The "Highway 17 Wildlife Passage Structures and Bay Area Ridge Trail Crossing Conceptual Design and Feasibility Study" provides a valuable case study for planning and implementation of wildlife passage infrastructure in Coyote Valley. The Laurel Curve project is also a multi-agency collaboration that includes Caltrans, Santa Cruz County Regional Transportation Commission, Land Trust of Santa Cruz County, and the California Department of Fish and Wildlife. The project has led to an advanced mitigation credit agreement between Caltrans and the California Department of Fish and Wildlife, establishing a framework for allowing transportation project credits to be applied to wildlife crossing infrastructure. At a regional scale, the long-term success of wildlife passage infrastructure investments within the Santa Cruz Mountains, at Highway 17, are directly tied to future conservation actions in Coyote Valley as ultimately species need to travel not only within the Santa Cruz Mountains but also to and from the Diablo and Gabilan ranges.

Animals such as mountain lions with large home ranges rely on linkages that connect habitat for dispersal.

In September 2017, Caltrans released the draft Environmental Documents for the Liberty Canyon Wildlife Crossing Project. This project proposes to build a wildlife crossing (overpass) across Highway 101 in Los Angeles County in order to help maintain wildlife populations that travel between the Santa Monica Mountains and Simi Hills, and ultimately to the Sierra Madre Mountain Range. The Liberty Canyon Wildlife Crossing would be the first of its kind in California.

Challenges of Implementation

While the northern part of the Coyote Valley is the highest quality site for a viable linkage, it is not without its challenges. A handful of significant development footprints occur in the North Coyote linkage area (namely PG&E Metcalf Transmission Substation, Calpine Corp Metcalf Energy Center, IBM campus, Gavilan Community College, and Coyote Storage), and serve as significant barriers to wildlife movement in this landscape. Despite these existing developments, abundant and diverse wildlife are still able to live in and move through the North Coyote Valley because the building footprints are relatively small (< 1% land cover) and traffic volumes are low (<10,000 cars/day Monterey at Bailey; data from City of San José). Facilities like MetCalf Energy have a low volume of associated human activity, and thus do not appear to be a significant barrier to wildlife movement. However, with the addition of a few new developments and associated subsequent increase in traffic and human activity, a

development threshold could be crossed and the vital wildlife function of Coyote Valley will be lost.

The City of San José zoned the North Coyote Valley as industrial development, and various projects are underway or are being proposed, including a number of large warehouse distribution centers or similar projects to support the growing e-commerce market, which would involve large building footprints and increased road traffic with the obvious negative impacts on the linkage. Poorly planned development of the North Coyote Valley will result in the loss of habitat for rare and endangered species, diminish wildlife movement, and increase roadkill, resulting in higher risk of biodiversity decline in the Santa Cruz and Diablo Mountains, especially in the face of climate change.

Looking west from Coyote Ridge Open Space Preserve across Coyote Valley and the Fisher Creek floodplain.

Next Steps and Recommendations

Achieving this landscape linkage vision will be challenging and will require significant investment of resources and long-term management, supported by an active collaboration among multiple public and private partners, including the Santa Clara Valley Open Space Authority, Santa Clara County Parks, Santa Clara Valley Water District, Valley Transportation Authority, Valley Habitat Agency, City of San José, Caltrans, High Speed Rail Authority, private landowners, farmers and ranchers, and the multitude of conservation non-profits focused in the area. High Speed Rail and the Regional Conservation Investment Strategy (RCIS) provide unique opportunities to help achieve the vision for the region.

Opportunities for partnerships include:

- **Conserve property**

  Work with willing sellers to conserve property needed to achieve linkage through fee or easement transactions. Given the extensive public benefits associated with endangered species habitat protection, flood control, agriculture, climate resilience, and other benefits associated with the landscape linkage, numerous state and federal grant funding sources can support land conservation efforts. The Sonoma Valley Wildlife Corridor, in Sonoma County, CA, provides a good model for land conservation in order to build a landscape linkage. In Coyote Valley, since the draft linkage report was released in June, POST secured two properties on the Valley floor totaling 90 acres.

- **Develop detailed restoration and management plans**

  Develop and implement a restoration and management plan for Laguna Seca, Fisher Creek, and other natural communities in Coyote Valley. A large-scale restoration and management plan would benefit from an interagency, multi-jurisdictional effort that complements existing plans or planning efforts such as the One Water Plan being developed by the Santa Clara Valley Water District. Other agencies involved in this effort should include the Valley Habitat Agency, the Santa Clara Valley Open Space Authority, Resource Conservation Districts, regulatory agencies, City of San José, and other stakeholders.

  Restoration planning should take advantage of the knowledge of historical ecology, as well as the experience gained from large-scale restoration plans in the region such as the South Bay Salt Pond Restoration Project (SBSPRP). As with the SBSPRP, restoration and management planning in Coyote Valley will need to balance a variety of species with different needs in a relatively small footprint that is under pressure from development on all sides. To be successful this will require a tremendous amount of planning and coordination with a variety of stakeholders, as well as adaptive management. Toward that end the effort will require guidance from the best available scientific knowledge to perform necessary research and help enable appropriate monitoring and evaluation for adaptive management.

- **Improve wildlife permeability of existing infrastructure**

  Improve permeability of existing infrastructure, such as cleaning of culverts, removing the Monterey Highway median barrier, and installing road crossing signs. The coordination of this work should be organized through the newly formed Santa Clara County Wildlife Corridor

Technical Working Group, which includes agency staff from the Santa Clara Valley Water District, Valley Transportation Authority, California Department of Fish and Wildlife, US Fish and Wildlife Service, Caltrans, the Santa Clara Valley Open Space Authority, Santa Clara County Parks, and the Valley Habitat Agency, and done in conjunction with High Speed Rail planning.

- **Plan, design, and implement additional wildlife crossings and make significant improvements to existing infrastructure**

  Install or redesign wildlife crossings in key locations as a component of landscape-scale restoration and management planning. Some existing infrastructure needs significant design and engineering (such as the Monterey Road culvert at Fisher and Coyote Creeks, or widening the Bailey overpass). New wildlife crossings will need to be designed and engineered to ensure multiple passage opportunities for all taxonomic guilds. Planning for new infrastructure for wildlife is a major undertaking and should follow the models of multiple agency partnerships, including the High Speed Rail Authority, Valley Transportation Authority, Santa Clara County Parks, Caltrans, and local conservation and open space agencies, as has been modeled at other successful wildlife crossing projects in the Bay Area and across the state.

- **Conduct hydrologic research to improve management of stormwater and flooding, and increase habitat**

  Conduct hydraulic and hydrological modeling to inform ecological restoration and wildlife crossing opportunities, including improvements to aquatic and riparian habitats, as well as how to improve other co-benefits such as downstream flood risk reduction and groundwater recharge. These efforts should complement other ongoing watershed planning efforts such as the City of San José stormwater plans and the Santa Clara Valley Water District One Water Plan and other water-related planning efforts, including green infrastructure planning. The Open Space Authority is already working in partnership with the Water District to implement a number of hydrological based analyses to specifically address the role of how open space in Coyote Valley could potentially support regional flood risk reduction efforts, long-term water supply reliability, and habitat impact mitigation. To this end, the Open Space Authority and the Water District are planning to incorporate findings from Coyote Valley analyses into their One Water Plan as a case study in integrated planning.

- **Continue studies that inform and document wildlife use**
  - Research how animals use the landscape to better inform the siting of wildlife crossings, the compatibility of different land use types (*e.g.* urban, agriculture) with wildlife movement, and planning and conservation efforts in the Mid and South Coyote Valley. Toward this end, a bobcat and gray fox study radio-collar study led by UC Santa Cruz, with assistance from Pathways for Wildlife, commenced in May 2017 (see **Appendix 4**).
  - Research movement pathways for smaller mammals in the Valley to ensure adequate habitat protection and safe crossings for species like amphibians and insects.
  - Research how seasonality and high flows in Coyote Creek and Fisher Creek affect wildlife movement.
  - As permeability improvements are implemented, it will be important to monitor the effects of before and after implementation to inform future enhancements.
  - Continue to document roadkill to inform wildlife crossings and permeability recommendations.

- **Explore corridor opportunities in the mid and southern portions of Coyote Valley and linkage opportunities that run north to south in Coyote Valley**

  The northern portion of Coyote Valley has been identified as a unique and irreplaceable opportunity to implement a primary landscape linkage because of its diverse terrain, soil types, and hydrologic features, proximity to protected lands, and current use by wildlife. The mid and southern portions of the Valley warrant additional planning and integration with the landscape linkage design. Opportunities to improve the north-south connection, including connectivity for wildlife traveling along Coyote Creek, should also be further explored.

- **Pursue outreach and education opportunities**

  Engage with local landowners, residents of the Cities of San José, Morgan Hill, and Gilroy, and City of San José staff, on the importance of wildlife linkages and the connection between the Santa Cruz Mountains and Diablo Range.

- **Plan and implement wildlife compatible recreational opportunities**

  Include partners such as Santa Clara County Parks, the City of San José, and Bay Area Ridge Trail Council to plan and implement recreational trail opportunities that are designed and located to be compatible with the linkage design. Several trails have been identified in The Santa Clara County Countywide Trails Master Plan Update (1995) in Coyote Valley, including the Bay Area Ridge Trail (El Sombroso/Penitencia segment), the Juan Bautista de Anza National Historic Trail, the Coyote Creek/Llagas Creek Sub-Regional Trail, and the Willow Springs Connector Trail.

- **Coordinate valley conservation efforts with regional open space and conservation efforts**

  Coordinate with neighboring open space agencies such as Santa Clara County Parks, Land Trust of Santa Clara Valley, and Midpeninsula Regional Open Space District on regional conservation efforts to ensure coordination of management practices, restoration, and wildlife permeability in the riparian corridors and surrounding hillsides.

- **Support wildlife-friendly agriculture**

  Work with the agricultural community in Coyote Valley, including the Farm Bureau, Cattlemen's Association, Natural Resources Conservation Service, Resource Conservation Districts, and resident farmers and ranchers to support local food production that is compatible with the linkage design and is wildlife-friendly. Stay apprised of best practices in coordination with regional partners such as Sonoma Land Trust and State Coastal Conservancy.

- **Support wildlife corridor policy**

  Engage with elected officials, regulatory agencies, and other stakeholders to integrate the landscape linkage, wildlife corridors, and wildlife crossings into state, regional, and local plans and policies, and into any future development plans in Coyote Valley. (See **Box 2**). Linkages are regional in nature and their implementation will benefit from plans and policies that support interagency and multi-jurisdictional approaches.

Looking east across the Coyote Valley toward the Diablo Range. Oaks, grasslands and ponds provide outstanding habitat.

Conclusion

Coyote Valley is at a crossroads. What happens over the next few years will not only determine the fate of the ecological values of this unique valley, but will also determine the fate of the millions of acres of surrounding natural lands and the numerous native species that depend upon the region. Applying proven scientific principles and best practices, the proposed landscape linkage design presented in this report is both expansive and visionary. Given the existing ecological values, current condition, and the high potential for development in the linkage area, the time for action is now.

The Coyote Valley Landscape Linkage represents an unparalleled opportunity to design with nature to ensure long-term ecological resilience for the natural and built environment. If the proposed linkage design is successfully implemented and the vision realized, the long-term ecological viability of one of the most biologically important areas in the country, and many regional conservation investments will be secured, as well as numerous co-benefits provided to the citizens of the City of San José, the region, and the state.

Coyote Ridge Open Space Preserve anchors the Linkage and serves as a gateway to protected open space in the Diablo Range.

Literature Cited

AAA (American Automobile Association). 2017. http://exchange.aaa.com/safety/roadway-safety/tips-to-avoid-vehicle-animal-collisions/#.WNU7OG_yt9M

Association of Bay Area Governments. 2017. https://www.sccgov.org/sites/dpd/AboutUs/CountyInfo/Pages/AboutCounty.aspx

Ackerly, D.D., S.R. Loarie, W.K. Cornwell, S.B. Weiss, H. Hamilton, R. Branciforte, and N.J.B. Kraft. 2010. The geography of climate change: implications for conservation biogeography. *Diversity and Distributions* 16: 476–487.

Ament R.A., P. McGowen, M.L. McClure, A. Rutherford, C. Ellis, and J. Grebenc. 2014. *Highway mitigation for wildlife in Northwest Montana*. Sonoran Institute, Bozeman. http://largelandscapes.org/media/publications/Highway-Mitigation-Wildlife-NW-Montana_1.pdf

American Forests. 2017. Forest Facts. http://www.americanforests.org/explore-forests/forest-facts/

Anderson, M.G. and C.E. Ferree. 2010. Conserving the stage: climate change and the geophysical underpinnings of species diversity. *PLoS One* 5(7): p.e11554.

Bay Area Open Space Council. 2011. *The Conservation Lands Network: San Francisco Bay Area Upland Habitat Goals Project Report*. Berkeley, California. 77p.

Beazley, K., L. Smandych, T. Snaith, F. MacKinnon, P. Austen-Smith Jr, and P. Duinker. 2005. Biodiversity considerations in conservation system planning: map-based approach for Nova Scotia, Canada. *Ecological Applications* 15: 2192–2208.

Beier, P. and S. Loe. 1992. A checklist for evaluating impacts to wildlife movement corridors. *Wildlife Society Bulletin* 20: 434-440.

Beier, P. 1993. Determining minimum habitat requirements and habitat corridors for cougars. *Conservation Biology* 7: 94-108.

Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. *Journal of Wildlife Management* 228-237.

Beier, P. and B. Brost. 2010. Use of land facets to plan for climate change: Conserving the arenas, not the actors. *Conservation Biology* 24(3): 701-710.

Beier, P. and R.F. Noss. 1998. Do habitat corridors provide connectivity? *Conservation Biology* 12(6): 1241-1252.

Beier, P., W. Spencer, R.F. Baldwin, and B.H. McRae. 2011. Toward best practices for developing regional connectivity maps. *Conservation Biology* 25(5): 879-892.

Beller, E., A. Robinson, R. Grossinger, and L. Grenier. 2015. *Landscape Resilience Framework: Operationalizing Ecological Resilience at the Landscape Scale.* San Francisco Estuary Institute - Aquatic Science Center. Richmond, California. 31p.

Bennett, V.J., W.P. Smith, and M.G. Betts. 2011. *Toward understanding the ecological impact of transportation corridors.* July 2011. PNW-GTR-846. USDA. U.S. Forest Service. Pacific Northwest Research Station.

Benson, J.F., P.J. Mahoney, J.A. Sikich, L.E. Serieys, J.P. Pollonger, H.B. Ernst, and S.P.D. Riley. 2016. Interactions between demography, genetics, and landscape connectivity increase extinction probability for a small population of large carnivores in a major metropolitan area. *Proceedings of the Royal Society* B 283(1837): 2016 Aug 31.

Breshears D.B., T.E. Huxman, H.D. Adams, C.B. Zou, and J.E. Davidson. 2008. Vegetation synchronously leans upslope as climate warms. *Proceedings of the National Academy of Sciences* 105, 11591-11592.

Bond, M. 2003. *Principles of Wildlife Corridor Design*. Center for Biological Diversity. http://www.biologicaldiversity.org/publications/papers/wild-corridors.pdf

California Department of Fish and Wildlife. 2003. Atlas of the Biodiversity of California. http://www.dfg.ca.gov/biogeodata/atlas

Calflora 2017. http://www.calflora.org

California Climate Console. 2017. Created by the Conservation Biology Institute for the California Energy Commission. http://climateconsole.org/ca

California Protected Areas Database. 2016. http://www.calands.org/data

California State Wildlife Action Plan. 2015. https://www.wildlife.ca.gov/SWAP/Final

City of San José. 2007. *Coyote Valley Specific Plan Environmental Impact Report.* http://coyotevalley.sanjoseca.gov/coyotevalley/publications_DEIR.htm

Clevenger, A.P., B. Chruzcz, and K.E. Gunson. 2001. Highway mitigation fencing reduces wildlife-vehicle collisions. *Wildlife Society Bulletin* 29(2): 646-653.

Clevenger, A.P. and M.P. Huijser. 2011. *Wildlife Crossing Structure Handbook: Design and Evaluation in North America.* https://roadecology.ucdavis.edu/files/content/projects/DOT-FHWA_Wildlife_Crossing_Structures_Handbook.pdf

Conservation Lands Network. 2011. *San Francisco Bay Area Upland Habitat Goals Project Report.* http://www.bayarealands.org/mapsdata.html

Diamond, T. and A. Snyder. 2016. *Coyote Valley Linkage Assessment Study Final Report.* Prepared for California Department of Fish and Wildlife, Santa Clara Valley Open Space Authority, and Guadalupe-Coyote Resource Conservation District. 79p.

Flint, L.E. and A.L. Flint. 2012. Downscaling future climate scenarios to fine scales for hydrologic and ecologic modeling and analysis. *Ecological Processes* 1, 2.

Gray, M. 2017. *The influence of land use and habitat fragmentation on landscape connectivity.* PhD dissertation, University of California at Berkeley.

Groom, M.J., G.K. Meffe, and C.R. Carroll. 2006. *Principles of Conservation Biology.* Sunderland: Sinauer Associates, pp. 174-251.

Grossinger, R. M., R.A. Askevold, C.J. Striplen, E. Brewster, S. Pearce, K.N. Larned, L.J. McKee, and J.N. Collins. 2007. *Coyote Creek watershed historical ecology study: historical condition, landscape change, and restoration potential in the eastern Santa Clara Valley, California.* SFEI Publication 426.

H.T. Harvey and Associates. 2009. *Envision San José 2040 General Plan Update Biological Resources Existing Conditions Report.*

Heller, N.E. and E.S. Zavaleta. 2009. Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation* 142(1): 14-32.

Heller, N.E., J. Kreitler, D.A. Ackerly, S.B. Weiss, A. Recinos, R. Branciforte, L.E. Flint, A.L. Flint and L.E. Micheli. 2015. Targeting climate diversity in conservation planning to build resilience to climate change. *Ecosphere* 64: 65.

Hilty, J.A., C. Brooks, E. Heaton, and A.M. Merenlender. 2006. Forecasting the effect of land-use change on native and non-native mammalian predator distributions. *Biodiversity and Conservation* 15(9): 2853-2871.

ICF International. 2012. *Santa Clara Valley Habitat Plan.* http://scv-habitatagency.org/178/Santa-Clara-Valley-Habitat-Plan

Insurance Journal. 2017. Car and deer collisions cause 200 deaths, cost $4 billion a year http://www.insurancejournal.com/news/national/2012/10/24/267786.htm

Jenkins, C. N., K.S. Van Houtan, S.L. Pimm, and J.O. Sexton. 2015. US protected lands mismatch biodiversity priorities. *Proceedings of the National Academy of Sciences* 112(16): 5081-5086.

Klausmeyer, K. R., M.R. Shaw, J.B. MacKenzie, and D.R. Cameron. 2011. Landscape-scale indicators of biodiversity's vulnerability to climate change. *Ecosphere* 2(8): 1-18.

Kreitler, J. 2015. *Climate Stability and Bay Area Critical Linkages.* United States Geological Survey. Unpublished manuscript.

Lambeck, R. J. 1997. Focal species: a multi-species umbrella for nature conservation. *Conservation Biology* 11(4): 849-856.

Lawler, J., D. Ackerly, C. Albano, M. Anderson, M. Cross, S. Dobrowski, J. Gill, N.E. Heller, R. Pressey, E. Sanderson, and S. Weiss. 2015. The theory behind, and challenges of, conserving nature's stage in a time of rapid change. *Conservation Biology* 29: 618-629.

Loarie, S. R., P.B. Duffy, H. Hamilton, G.P. Asner, C.B. Field, and D.D. Ackerly. 2009. The velocity of climate change. *Nature* 462(7276): 1052-1055.

Mackenzie, A., J. McGraw, and M. Freeman. 2011. *Conservation Blueprint for Santa Cruz County: An Assessment and Recommendations from the Land Trust of Santa Cruz County*. Land Trust of Santa Cruz County. Santa Cruz, California. 180 p.

Merenlender, A.M. and J. Crawford. 1998. *Vineyards in an oak landscape: Exploring the physical, biological, and social benefits of maintaining and restoring native vegetation in and around the vineyard.* University of California.

Midpeninsula Regional Open Space District. 2016. *Highway 17 Wildlife Passage Structures and Bay Area Ridge Trail Crossing Conceptual Design and Feasibility Study Preliminary Alternatives Report.* 161p. https://www.openspace.org/sites/default/files/Hwy17_PrelimAlternatives.pdf

Mitsch, W., B. Bernal, A. Nahlik, U. Mander, L. Zhang, C. Anderson, S. Jorgensen, and H. Brix. 2012. Wetlands, carbon, and climate change. *Landscape Ecology* 28(4): 583-597.

Noss, R.F. and L.D. Harris. 1986. Nodes, networks, and MUMs: Preserving diversity at all scales. *Environmental Management* 10(3): 299-309.

Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. *Natural Areas Journal* 7:2-13.

Noss, R.F., J.R. Strittholt, K. Vance-Borland, and P. Frost. 1999. A conservation plan for the Klamath-Siskiyou Ecoregion. *Natural Areas Journal* 19(4): 392-411.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W.D. Spencer, E. Rubin, R. Sauvajot, S. Riley, and D. Kamradt. 2006. *South Coast Missing Linkages Project: A Linkage Design for the Santa Monica-Sierra Madre Connection.* 213 p.

Penrod, K., P. E. Garding, C. Paulman, P. Beier, S. Weiss, N. Schaefer, R. Branciforte and K. Gaffney. 2013. *Critical Linkages: Bay Area & Beyond.* Produced by Science & Collaboration for Connected Wildlands, Fair Oaks, California in collaboration with the Bay Area Open Space Council's Conservation Lands Network.

Phillips, J., R. Phillips, N. Srinivacan, D. Sao, W. Laos, and P. Cornely. 2012. *Safe Passage for Coyote Valley: A Wildlife Linkage for the Highway 101 Corridor.* De Anza College, Environmental Studies Department, Cupertino, California. 35p.

Phillips, R., W. Bousman, M. Rogers, R. Bourbour, B. Martinico, and M. Mammoser. 2014. First successful nesting of Swainson's hawk in Santa Clara County, California since the 1800s. *Western Birds* 45:176-182.

Rahmig, T. 2013. ICF International Report entitled, *Coyote Valley Linkage Workshop-Summary and Recommendations*, submitted to the Gordon and Betty Moore Foundation September 24, 2013.

Resasco, J., N.M. Haddad, J.L. Orrock, D. Shoemaker, L.A. Brudvig, E.I. Damschen, J.J. Tewksbury, and D.J. Levey. 2014. Landscape corridors can increase invasion by an exotic species and reduce diversity of native species. *Ecology* 95: 2033-2039

Robins, J. 2016. *Summary of the Coyote Valley Water Resource Investment Strategy: Phase 1 Findings.* Report to Santa Clara Open Space Authority.

Ruediger, B. and M. DiGiorgio. 2007. *Safe Passage: A User's Guide to Developing Effective Highway Crossings for Carnivores and Other Wildlife.* Southern Rockies Ecosystem Project. 18p.

Rytwinski T., K. Soanes, J.A.G. Jaeger, L.Fahrig, C.S. Findlay, J. Houlahan, R. van der Rodeny, E.A. van der Grift. 2016. How Effective Is Road Mitigation at Reducing Road-Kill? A Meta-Analysis. *PLoS ONE* 11(11): e0166941. https://doi.org/10.1371/journal.pone.0166941

San Francisco Estuary Institute. 2006. *Coyote Creek Historical Ecology Study, January. Oakland, California.* Prepared for the Santa Clara Valley Water District. 230p.

Sarté, S.B. and M.M. Stipisic. 2016. *Water Infrastructure: Equitable Development of Resilient Systems.*

Sarté, S.B. 2017. *Ecological Opportunities Mapping through floodplain management.* Memorandum to Santa Clara Open Space Authority.

Shilling, F. 2017. California Roadkill Observation System http://www.wildlifecrossing.net/california/ February 13, 2017.

Simberloff, D., and J. Cox. 1987. Consequences and costs of conservation corridors. *Conservation Biology* 1: 63–71.

Spencer, W. D., P. Beier, K. Penrod, K. Winters, C. Paulman, H. Rustigian-Romsos, J. Strittholt, M. Parisi, and A. Pettler. 2010. *California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California.* Prepared for the California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration.

Stein, B.A., L.S. Kutner, and J.S. Adams. 2000. *Precious Heritage: The Status of Biodiversity in the United States.* Oxford University Press, New York, New York. 399p.

Taylor, P.D., L. Fahrig, K. Henein, and G. Merriam. 1993. Connectivity is a vital element of landscape structure. *Oikos* 68(3): 571-573.

TNC (The Nature Conservancy). 2006. California Central Coast Ecoregional Plan Update. Report and GIS Database.

Theobald, D.M., J.R. Miller, and N.T. Hobbs. 1997. Estimating the cumulative effects of development on wildlife habitat. *Landscape and Urban Planning* 39(1): 25-36.

Thorne, J., D. Cameron, and J.F. Quinn. 2006. A conservation design for the central coast of California and the evaluation of Mountain Lion as an umbrella species. *Natural Areas Journal* 26(2):137-148.

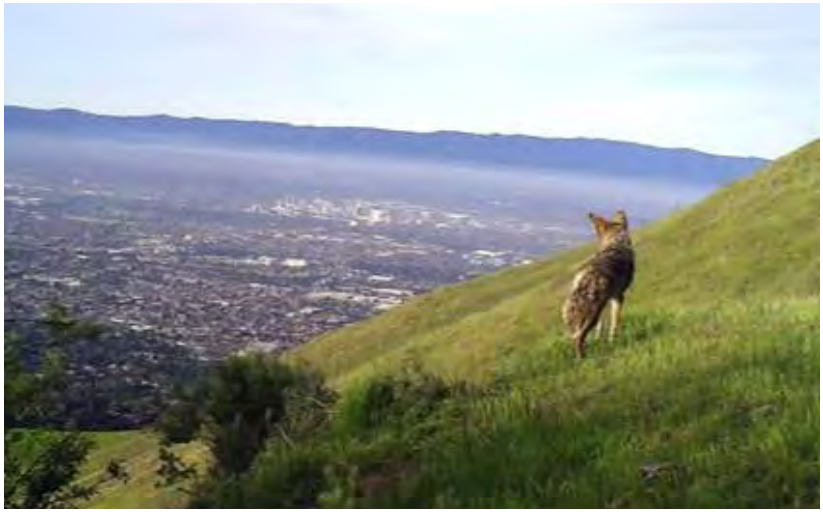
US Fish and Wildlife Service, Pacific Southwest Region. 2017. https://www.fws.gov/sacramento/es_species/Accounts/Invertebrates/es_bay-checkerspot-butterfly.htm

Vonshak, M., S. Kleinhaus, and R. Phillips. 2016. The Birds of Coyote Valley. Santa Clara Valley Audubon Society website. Accessed May 15, 2017.

Appendix 1: Focal Species and the North Coyote Valley

The Bay Area Critical Linkages (BACL) framework for ensuring functional connections for all species and ecological processes in the region utilized focal species from diverse taxonomic groups to represent a diversity of habitat requirements and movement needs (Penrod *et al.* 2013). Focal species move through and utilize habitat in a variety of ways (Beier and Loe 1992; Lambeck 1997) and biodiversity is best preserved in a linkage if the linkage is designed to support a broad array of native species. The BACL project included a diverse suite of focal species, including mammals, amphibians, reptiles, fish, birds, and invertebrates which were selected by a broad stakeholder process that included local scientists.

The BACL focal species list formed the basis for consideration in the North Coyote Valley linkage design (**Figure A1**); further refinements may be needed with additional input by ongoing research.



A coyote with a view of the City of San José in the background.

Figure A1. Focal species included in North Coyote Valley linkage design.

Species	Regulatory Status	Bay Area Critical Linkages Focal Species	Valley Habitat Plan/NCCP Covered Species	CA Wildlife Action Plan Focal Species and Species of Greatest Need (CDFW)	Other Considerations for Focal Species Selection
Mountain lion (*Puma concolor*)	SPM	X			
Coyote (*Canis latrans*)	none				Breeding populations documented in Coyote Valley (Diamond and Snyder 2016)
Bobcat (*Lynx rufus*)	none	X			High density detected in Coyote Valley, also breeding (Diamond and Snyder 2016)
Black-tailed deer (*Odocoileus hemionus*)	none	X			
American badger (*Taxidea taxus*)	CA SSC	X		X	
Gray fox (*Urocyon cinereoargenteus*)	none				Sensitive to humans, detected in study area, not detected in Pajaro linkage area (Diamond and Snyder 2016)
California ground squirrel (*Otospermophilus beecheyi*)	none				Creates habitat for other species on this list (*e.g.* CA tiger salamander and western burrowing owl). Genetic research shows fragmentation in Coyote Valley (Gray 2017)
Tricolored blackbird (*Agelaius tricolor*)	CA CS		X	X	Candidate species for listing; currently found in Coyote Valley
Loggerhead shrike (*Lanius ludovicianus*)	CA SSC, Fed SSC	X		X	
White-tailed kite (*Elanus leucurus*)	CA FP	X		X	
Swainson's hawk (*Buteo swainsoni*)	CA T			X	Only breeding population in Santa Clara County
Western burrowing owl (*Athene cunicularia*)	CA SSC	X	X	X	
Southern western pond turtle (*Actinemys pallida*)	CA SSC, Fed SSC	X	X	X	
California red-legged frog (*Rana draytonii*)	Fed T, CA SSC	X	X	X	
California tiger salamander (*Ambystoma californiense*)	Fed E, CA T	X	X	X	
Bay checkerspot butterfly (*Euphydryas editha bayensis*)	Fed T	X	X		

SPM: Specially protected mammal

CA SSC: California species of special concern

CA CS: California candidate listed species

Fed SSC: Federal species of special concern

CA FP: California fully protected

CA T: California threatened

Fed T: Federally threatened

Fed E: Federally endangered

The topographic complexity within the North Coyote Valley linkage area supports a variety of habitats or natural communities, which in turn support a diversity of individual species. The natural communities highlighted below are "special systems," because they are rare on the landscape and support high species diversity, such as serpentine grasslands, coast live oak and valley oak woodlands, riparian forests, and seasonal and permanent freshwater marshes (TNC 2006). By including these habitat types in the linkage design, a diverse suite of native plant and animal species will benefit.

Laguna Seca and wet meadow complexes are rare habitat and provide habitat for aquatic species, including breeding amphibians such as the California red-legged frog, California tiger salamander, and southern western pond turtle. They also provide habitat for birds, including migrants along the Pacific flyway and resident and breeding birds that nest in adjacent marshes and riparian areas. Twenty-six species of ducks and geese and 27 species of shorebirds have been documented in Coyote Valley. Restoration of Laguna Seca provides an opportunity to provide breeding habitat for tricolored blackbirds and other species that require freshwater wetlands for breeding. Waterbodies also provide water supply for terrestrial species, including black-tailed deer, and provide resiliency for a future climate that is likely to be drier and hotter.

Riparian Systems and Forests, which include native plant species such as cottonwoods, willows, boxelder, bay-laurel, buckeye, and sycamores, are also an important water source for terrestrial animals such as the gray fox, and are important movement corridors for both terrestrial and aquatic species. Many amphibians and reptiles use riparian systems for at least part of their lifecycle, including the California red-legged frog and southern western pond turtle. Riparian vegetation is important for a diversity of animals including nesting birds such as the yellow warbler and yellow-breasted chat.

Fisher Creek is a stream system with a silty stream bottom which historically may have supported Sacramento sucker (*Catostomus occidentalis*), Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Lavinia exilicauda*), and prickly sculpin (*Cottus asper*). Restoration of a riparian corridor would support some native fishes like Sacramento suckers or hitch, particularly if done in conjunction with removal of non-native fish. Coyote Creek provides spawning and rearing habitat for steelhead (*Oncorhynchus mykiss*), although it is limited in range based on water temperature, flow rates and non-native fish (Jerry Smith, personal communication, January 2017).

Grasslands/Rangelands support exceptional diversity, including many special status species such as Northern harrier, western burrowing owl, and American badger. Serpentine grasslands in particular support many rare, threatened, and endangered species including Bay checkerspot butterfly, most beautiful jewelflower, and Santa Clara Valley dudleya.

Oak Savanna and Oak Woodlands provide some of the most diverse and important habitats for birds and mammals, including the acorn woodpecker, California quail, and black-tailed deer. They also provide cover for species movement, including for mountain lions and bobcats. Increasing cover on the landscape is an essential component of the linkage design. The cavities and dense brush found in oak woodlands also provide den habitat for mammals, such as bobcats.

To ensure the linkage design meets the habitat needs of the focal species identified for both live-in and move-through habitat, the habitats requirements of each focal species were checked against the habitat types identified in the linkage design (**Figure A2**).

Figure A2. Focal species and associated habitats. This chart lists selected focal species and their associated habitats along with notes regarding live-in habitat and move-through habitat.

Species	Grasslands	Oak Savanna	Wet Meadow	Perennial Marsh (Laguna Seca)	Oak Woodland	Willow Forests	Riparian Forests	Agriculture compatibility	Live-in notes	Corridor use notes
Mountain lion (*Puma concolor*)		X			X	X	X	X if cover provided	Not expected in the Valley floor	Stream courses with gentle terrain preferred, but all habitats with cover. Open span bridges and overpasses preferred; med-large culvert adequate.
Coyote (*Canis latrans*)	X	X	X		X	X	X	X	Generalist	Prefer med-large culverts
Bobcat (*Lynx rufus*)	X	X	X		X	X	X	X if cover provided	Wide range of habitats, including coastal scrub, chaparral, sagebrush, oak woodlands, and forests. Make use of cavities and dense brush for cover and to site dens.	Areas with adequate plant cover. Prefer med-large culverts.
Black-tailed deer (*Odocoileus hemionus*)	X	X	X		X	X	X		Riparian forests, woodlands, conifer and riparian forests, access to perennial water source. Grasslands with cover.	Habitat with escape cover. (Sometimes avoids open, ag, and urban, especially if not habituated). Large open span bridges and overpasses preferred.
American badger (*Taxidea taxus*)	X	X			X	X	X	X	Open habitat such as grasslands. Prefer flatter, more gentle terrain.	Open grassland, scrub, riparian, fields, pastures. (Avoid urban and intense agriculture, although can use orchards and woodland habitats). Dry culverts preferred.
Gray fox (*Urocyon cinereoargenteus*)	X	X	X		X	X	X	X	Forest, brushy woodland, near farmlands and water.	Access to cover (for escape)
California ground squirrel (*Otospermophilus beecheyi*)	X	X	X		X	X	X	X	Fields, pastures, grasslands, open areas, oak woodlands. Require loose soil.	Access to cover. Med-Large culverts. Wet meadows can be habitat if higher ground such as mounds and hillocks exist
Tricolored blackbird (*Agelaius tricolor*)	X		X	X		X	X	X crops such as alfalfa and sunflower	Forages in agricultural fields (grains preferred), pastures, wetlands. Nests in freshwater marshes dominated by cattails, bulrushes, willows, nettles, mustards, thistles, and mallows.	
Loggerhead shrike (*Lanius ludovicianus*)	X	X	X	X		X	X	X	Open habitats with abundant prey. Use grasslands, pastures, savanna, riparian woodlands. Nests in dense shrubs and brush.	

Species	Grasslands	Oak Savanna	Wet Meadow	Perennial Marsh (Laguna Seca)	Oak Woodland	Willow Forests	Riparian Forests	Agriculture compatibility	Live-in notes	Corridor use notes
White-tailed kite (*Elanus leucurus*)	X	X			X		X	X	Forages in open grasslands, agriculture areas, wetlands, oak woodlands. Nests in riparian forests or areas with dense canopy and prey availability.	
Swainson's hawk (*Buteo swainsoni*)	X	X					X	X	Summer only. Open habitats for foraging (grassland and crop, grazing lands). Scattered stands of trees near ag fields and grasslands for nesting.	
Western burrowing owl (*Athene cunicularia*)	X	X	X					X	Open grassland, well drained and short vegetation. Open habitat for hunting. Need burrows.	Wet meadows can be habitat if higher ground such as mounds and hillocks exist.
Southern western pond turtle (*Actinemys pallida*)	X	X	X	X		X	X		Aquatic habitat and adjacent terrestrial areas. Generally perennial ponds, lakes, streams or pool, with slow moving water, basking sites. Upland sites tend to be grassland.	Travel through watercourses and riparian vegetation. Most nesting sites within 200m of aquatic habitat.
California red-legged frog (*Rana draytonii*)			X	X	X	X	X		Aquatic habitat with seasonal movements in terrestrial areas. Breeds in streams, creeks, ponds, and marshes.	Typically <0.5 km dispersal, but up to 3 km recorded.
California tiger salamander (*Ambystoma californiense*)	X	X	X	X			X		Temporary or permanent ponds or vernal pools with surrounding intact grasslands.	Riparian. Terrestrial habitat at least 600m from breeding ponds.
Bay checkerspot butterfly (*Euphydryas editha bayensis*)	X	X							Serpentine grasslands with a range of slopes and exposures.	Dispersal estimated at 9km, may move through coastal scrub and grazed annual grasslands and oak savanna. (Penrod *et al.* 2013)

Black-tailed deer, photographed with a wildlife cam at Coyote Valley Open Space Preserve, are frequently hit by vehicles on the roads in Coyote Valley. Improving wildlife crossings will increase safety for wildlife and people.

Appendix 2: Information on Existing Key Road Crossings and Suggested Modifications to Improve Their Function for Wildlife

This appendix presents a description of existing culverts and related infrastructure (which was not designed for the needs of wildlife) and recommendations for retrofit and/or improvements that would make these features more useful for wildlife passage. Many of these recommendations were gathered from previous reports. This list is not comprehensive. In order to prioritize and successfully design upgrades to existing infrastructure and to appropriately site and design new infrastructure that can most effectively mitigate impacts to wildlife movement, it is recommended that additional systematic and standardized wildlife monitoring be undertaken, involving key agencies and biological, ecological, and engineering experts. As described earlier in the report, it is critical to ensure that culverts, bridges, and other types of wildlife crossings are considered as a system north to south across the Coyote Valley Landscape Linkage area to ensure that the needs of all focal species can be accommodated year-round as they pass through the barriers that are presented by the area's roads, highways, and rail lines. One crossing location will not suffice; but a series of complimentary crossings may serve to improve the odds that connectivity can be effectively maintained. (See **Figure A3** for reference for all features identified).

Metcalf Bridge: Two-lane bridge spans Highway 101 between Tulare Hill Ecological Preserve and Metcalf Canyon. A restoration opportunity for this site is to convert the entire roadway as a wildlife crossing (and remove vehicles) by vegetating one or more lanes. This action does not address the way in which wildlife would need to cross the intersection of Monterey Highway and Metcalf. This intersection will be highly constrained with High Speed Rail with both an at-grade and viaduct alignment. Because dedicated wildlife bridges are considered to be the most effective crossing structures for the greatest variety of focal species, if this option proves infeasible then it will be very important to find an alternate location.

Monterey Highway: Four-lane road that has a four-foot tall concrete median with a two-foot fence on top of it, and has only one under-crossing along the road (at Fisher Creek). It is a significant barrier to wildlife movement in the current landscape, as evidenced by extensive roadkill. The City of San José has identified replacement of portions of the median with a barrier that is more permeable to wildlife (while still factoring in human safety) in the San José General Plan.

Fisher Creek and Monterey Highway Culvert (4, Figure A3): This dual box culvert is the only under-crossing for wildlife on Monterey Highway and is located at the confluence of Fisher Creek and Coyote Creek. There is rip-rap on the east side which makes it more difficult for animals such as deer to use. Restoration opportunity for this site is to modify the rip-rap and re-engineer to make it more permeable. Culvert can only be used by terrestrial wildlife in some seasons based on water flows. Opportunity exists to partner with High Speed Rail, City of San José, Valley Transportation Authority, and the Santa Clara Valley Water District, to enhance this crossing since alignment will require changes to Monterey Highway. Wildlife that have been documented using this site include bobcat (including kittens), deer, gray fox, opossum, ground squirrel, raccoon, and skunk.

Caltrans postmile 24.27, Figure A3: This culvert, which flows into Coyote Creek County Park, is fenced from Highway 101 on the west side and is open to the hills to the east. Directional fencing could promote the use of this culvert. The fencing here is in need of replacement due to age and wear. This area is a road-kill hotspot.

Caltrans postmile 24.0, Figure A3: Located east of Tulare Hill, this culvert leads to Coyote Creek County Park on the west side and to Coyote Ridge on the east side under Highway 101. The eastern entrance is blocked by a fence installed to prevent cattle from entering the culvert. Movement can be facilitated by relocating the fence back from entrance to allow access by animals and removing debris behind livestock fence.

Caltrans postmile 23.7, Figure A3: Pedestrian culvert between McCoullan Ranch on the east and the town of Coyote on the west of Highway 101, this tall culvert is regularly used by people and animals, and a mountain lion track was once found just outside the culvert (Diamond, unpublished data). It connects private, intact habitat in the east with habitat in Coyote Creek County Park.

Bailey Overpass: The Bailey overpass connects Coyote Ridge to Coyote Creek County Park. The Bailey exit from Highway 101 is a roadkill hotspot. Many animals are also hit on Monterey Highway near Bailey Road. Opportunity exists to add a vegetated lane to create a land bridge for wildlife. This is the only feasible location for an overpass currently identified. If the High Speed Rail embankment option is chosen, this overpass will need to be retrofitted to accommodate the new rail line (but "viaduct" would go over it).

Caltrans postmile 23.2, Figure A3: This culvert is located on Highway 101, just south of the Bailey exit. It flows into Coyote Creek County Park on the west side and is open to the hills and Coyote Ridge on the east side. This culvert was identified as the highest priority for maintenance by the Public Works Subcommittee of the Santa Clara County Wildlife Corridor Technical Working Group because it is full of debris. There is also a hole in the fence next to the culvert where bobcats were documented moving through (and eventually hit on Highway 101) suggesting the importance of repair (Diamond and Snyder, unpublished data).

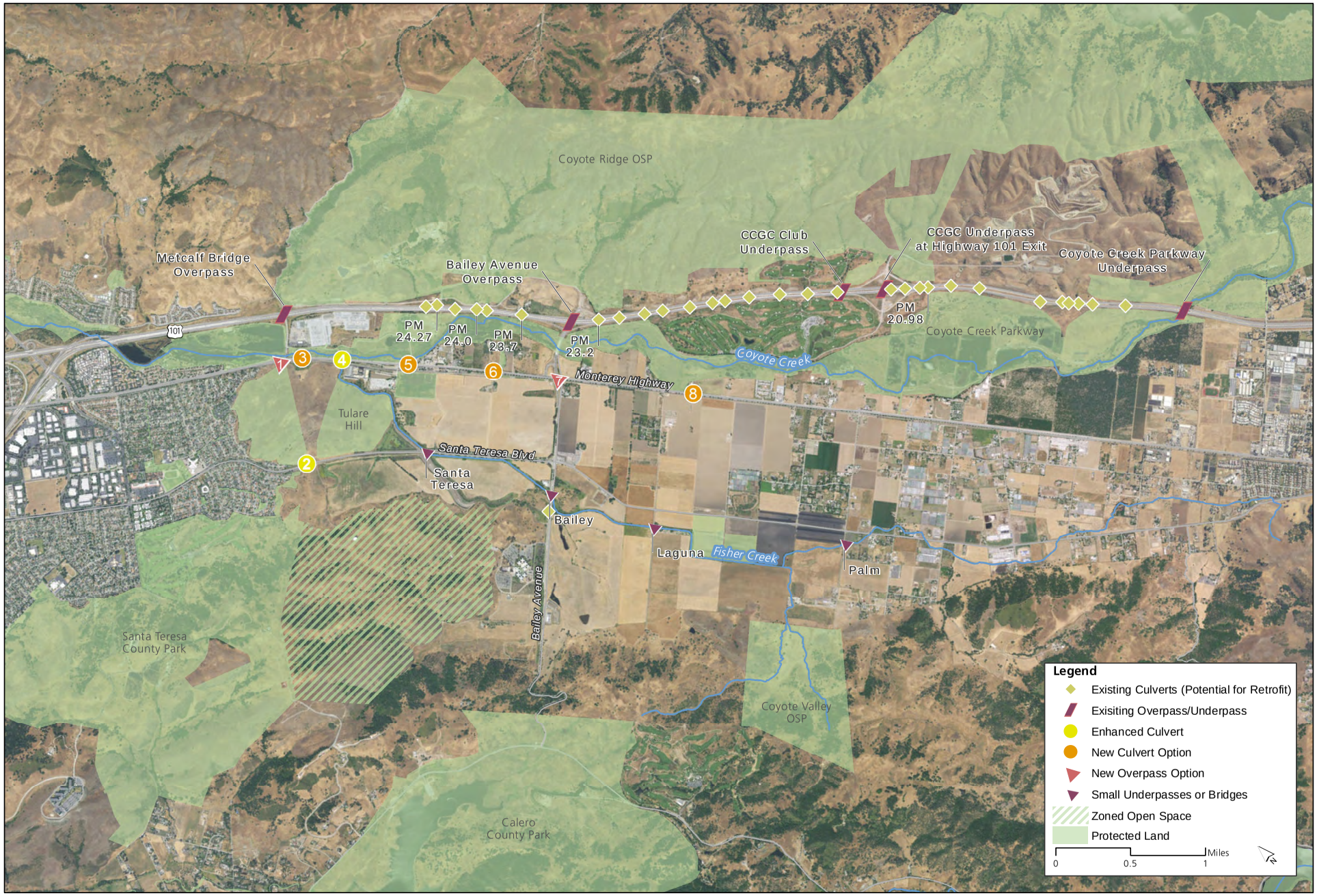
Caltrans postmile 20.98, Figure A3: This culvert connects Coyote Ridge on the east with Coyote Creek County Park on the west under Highway 101. This culvert was documented for use by wildlife until 2008 when it was blocked by debris. Per the request from the Valley Transportation Authority, Caltrans recently cleared the culvert to improve wildlife use (September 2016) and a coyote has since been documented traveling through (January 2017) (Diamond and Snyder, unpublished data). The Santa Clara Valley Water District, which facilitated monitoring access, is also planning restoration work on an adjacent parcel to improve wildlife corridor under the Safe, Clean Water Program's Priority D2. Data is being collected at this site which will be shared with Caltrans.

Coyote Creek Golf Club Underpass: The underpass for golf carts terminates at Coyote Ridge on the east side and into Coyote Creek County Park on the west side. There is fencing on the west side, although openings in the fence may permit wildlife movement onto the roadway.

Coyote Creek Golf Club Highway 101 Exit Underpass: This highway exit connects Coyote Ridge to the east and Coyote Creek Golf course and Coyote Creek County Park to the west. Deer (including juveniles), coyote, ground squirrel, opossum, raccoon, and skunk were detected traveling through here (Diamond and Snyder 2016), and it was suspected that Tule elk crossed here when they were documented west of Highway 101 (Dave Johnston, personal communication).

Coyote Creek Park Highway 101 Underpass: Located in the Southern end of Coyote Valley, this underpass features a paved bike trail on the north end and a dirt trail on the south end. On the west side, animals can travel along Coyote Creek into Coyote Valley or continue north up to Tulare Hill. On the east side it is contiguous with the eastern hills. This is a well-

Figure A3. Existing and proposed infrastructure. This map details infrastructure to improve wildlife permeability in Coyote Valley.



documented crossing location for wildlife, including mountain lion, coyote, deer, bobcat, and badger (De Anza College, unpublished data; Diamond and Snyder 2016).

Fisher Creek Bridge and Santa Teresa Road: Wildlife are able to move under this bridge when the water level is low. Wildlife detected includes bobcat, coyote (including juveniles), deer, ground squirrel, opossum, and raccoon.

Fisher Creek Bridge and Bailey Road: Wildlife are able to move under this bridge when the water level is low. Removal of exclusionary fences and replacing them with wildlife-friendly fencing and fish passage designs would improve permeability. Need buffer around creek with cover to provide passage when creek is too deep. Wildlife detected include bobcat, deer, raccoon, and skunk.

Fisher Creek Bridge and Laguna Drive: Installing directional fencing along the bridge to keep wildlife species within the creek bed and domestic animals out would increase permeability and reduce human-wildlife conflicts. Wildlife detected here are bobcat, coyote, ground squirrel, opossum, and raccoon (as well domestic dogs and cattle).

Fisher Creek Bridge and Palm Avenue: Wildlife are able to move under this bridge when the water level is low. Removal of exclusionary fences and replacing them with wildlife-friendly fencing would improve permeability. Need buffer around creek with cover to provide passage when creek is too deep. Wildlife detected includes bobcat, coyote, gray fox, ground squirrel, opossum, raccoon, and skunk.

Santa Teresa Blvd.: There is an existing box culvert that runs underneath Santa Teresa Road at the north end of Coyote Valley, between Tulare Hill and habitats on the west side of the road. Wildlife detected using this culvert include bobcat and potentially deer. This feature, or at least location, is a good candidate for upgraded infrastructure in order to accommodate safe passage by more species between protected upland habitat, particularly if development occurs in the valley and there is an increase in vehicular traffic on Santa Teresa Blvd. The location of this infrastructure should be suitable for year-round passage, when other pathways may be inundated.

Appendix 3: Preliminary Analysis of Proposed New Infrastructure Alternatives

Figure A4 presents general recommendations for the types and combinations of infrastructure that are recommended to improve the permeability of Coyote Valley for wildlife movement. The design of new infrastructure should be evaluated in the context of a comprehensive, landscape-scale planning process conducted by key agencies, stakeholders, and experts. Retrofit of existing and/or development of new infrastructure to improve the permeability of the Highway 101 corridor is not described in this report, but is essential to the long-term establishment and maintenance of the Coyote Valley landscape linkage (see **Appendix 2**).

Figure A4. Key crossing opportunities in the Coyote Valley near Monterey Highway.

Crossing	Type	Length (feet)	Sensitive species *	Habitat Connection (current or future)	Benefit	Challenges	Estimated costs (millions)**	Complementarity with other crossings
#1 Metcalf	Over	175 + 150	Elk, Badger, plants and invertebrates	Grassland	Proximity natural habitat and protected land	Lack of cover; HSR may constrain	$10 - 21	Fisher, ST, Laguna + [Blanchard or Emado]
#2 Santa Teresa	Under	~100	Badger	Wetland and Grassland	Unique location	--	$1 - 1.5	With all
#3 Tulare Swale	Under	175 - 200	Badger	Grassland	Proximity natural habitat and protected land; shorter length	Lack of cover; HSR constraint	$1.3 - 2.5	Fisher, ST, Laguna [Blanchard or Emado], and Bailey.
#4 Fisher	Under	--	Puma, Aquatic species, Pond Turtle, CRLF, CTS	Riparian	Only stream option; has existing functionality	Seasonal flooding; Requires upgrade	$1.3 - 1.5	ST, Laguna [Metcalf or Bailey] and [Blanchard or Emado]
#5 Blanchard	Under	125 + 125	Pond Turtle, CRLF, CTS	Grassland/ Riparian	Connectivity to Fisher Creek and protected land on both sides	Requires day lighting	$1.7 - 2.1	Fisher, ST, Laguna, [Metcalf or Bailey]
#6 Emado	Under	175	Badger	Grassland/ Woodland	Good distance from Fisher; Roadkill hotspot; vegetation corridor	--	$1.3 - 2	Fisher, ST, Laguna, [Metcalf or Bailey]
#7 Bailey	Over or Under	variable	Elk, Puma, Badger; plants and invertebrates	Grassland/ Woodland	High roadkill spot; existing structure; Compatible HSR	Traffic; Development	$10 - 25	Fisher, ST, Laguna, [Tulare Swale or Emado or Blanchard]
#8 Laguna	Under	<200	Badger	Agriculture/ Woodland	Unique location	Lack of cover; Far from Fisher	$1.3 - 1.5	With all

* Crossings should be designed to serve all focal species, including bobcat, gray fox, deer, coyote. To serve all species they need to be designed at sufficient width, height, and not too long (<200 feet). For under-crossings to serve large mammals, the preferred width is 20+ feet and height of 10-13 feet. A general rule is the longer the crossing, the larger it needs to be to provide sufficient 'openness.' For over-crossings, which are preferred for ungulates and large mammals, the width should be 75-230 feet (Ruediger and DiGeorgio 2007; Clevenger and Huijser 2011).

** Preliminary costs estimated by Sherwood Engineering.

A gray fox, one of the regionally rare species found in Coyote Valley.

Appendix 4: Coyote Valley Bobcat and Gray Fox Connectivity Study

Project Description

This study, led by the Wilmers Lab at UC Santa Cruz, will assess the effects of habitat fragmentation in Coyote Valley, by tracking bobcat (*Lynx rufus*) use of intact and modified habitats via advanced GPS-enabled collars fitted with accelerometers. The study is generating fine-scale movement data which will help us identify both location and frequency of road-crossings, movement corridors across the landscape, and preferred habitat. This project is an example of science-based conservation, where real-time data will be used to inform conservation and management actions, including prioritization of land protection in order to maintain functional habitat connectivity.

The project was initially planned to include bobcats and gray fox (*Urocyon cineroargenteus*), as both species are highly-mobile carnivores but may have different habitat preferences/requirements and exhibit differences in their sensitivities to urbanization. After the first field season was conducted, no gray foxes were successfully trapped and collared. Gray foxes were detected on wildlife cameras circa 2015. However, extensive camera monitoring in 2017 around the study area yielded only one confirmed gray fox detection, indicating a possible decline in the fox population. Additional investigation would be needed in order to determine the cause of the low detections during the term of this study. The project was initiated in spring 2017 and includes dry season and wet season field work and data collection. Field work is anticipated to be completed in spring 2018, with data analysis to follow.

Partners

- Wilmers Lab at the University of California, Santa Cruz (Dr. Wilmers, Principal Investigator)
- Pathways for Wildlife
- Peninsula Open Space Trust (POST)
- Santa Clara Valley Open Space Authority (SCVOSA)

Funders

- Gordon & Betty Moore Foundation
- California Department of Fish & Wildlife
- POST
- SCVOSA
- Santa Clara Valley Habitat Agency

Preliminary Observations to Date

Lots of bobcat activity was documented in the north valley, including uplands and valley floor (**Figures A5 and A6**). Note: The ability to capture individuals is limited to lands where the team has permissions from landowners, with the north valley featuring the highest number of trap locations.

Early data suggest that bobcats rely on vegetative cover for them to move safely unseen. Coyote Creek Parkway and Fisher Creek are important movement pathways, with the latter presenting important opportunities for restoration and enhancement. Around agricultural fields, including the mid-valley, they typically rely on narrow remaining stands of riparian vegetation along Fisher Creek.

Around golf courses and across open serpentine grassland habitat, bobcats spend a lot of time moving between stands of oaks.

Bobcats are crossing roads, both at-grade and below (where existing infrastructure permits), including frequent crossings along Bailey Avenue, Santa Teresa Boulevard, and Old Monterey Road (where one collared bobcat was struck and killed by a vehicle). The project team is looking to identify particular road-crossing hotspots with these data so that safe passage infrastructure projects can be identified and implemented. Because bobcats cross roads in a variety of areas, it is unlikely that even the best mitigations will prevent all wildlife-vehicle conflicts. However, by focusing infrastructure projects in areas where there is frequent roadkill of many species, along with hotspots based on bobcat data, it may be possible to significantly reduce or mitigate wildlife-vehicle conflict and mortality.

Next Steps

- Wet season field work to be conducted in late 2017 - early 2018.
- In parallel, samples from the study are being included in a larger genetic study on bobcats, the results of which will provide a preliminary genetic assessment of the Coyote Valley bobcats with special interest in evidence of population isolation by Highway 101 and Old Monterey Road, as well as general “genetic health” of the population.
- Final report complete summer 2019.

Maps

Circles are exact GPS points; lines are potential movement paths.

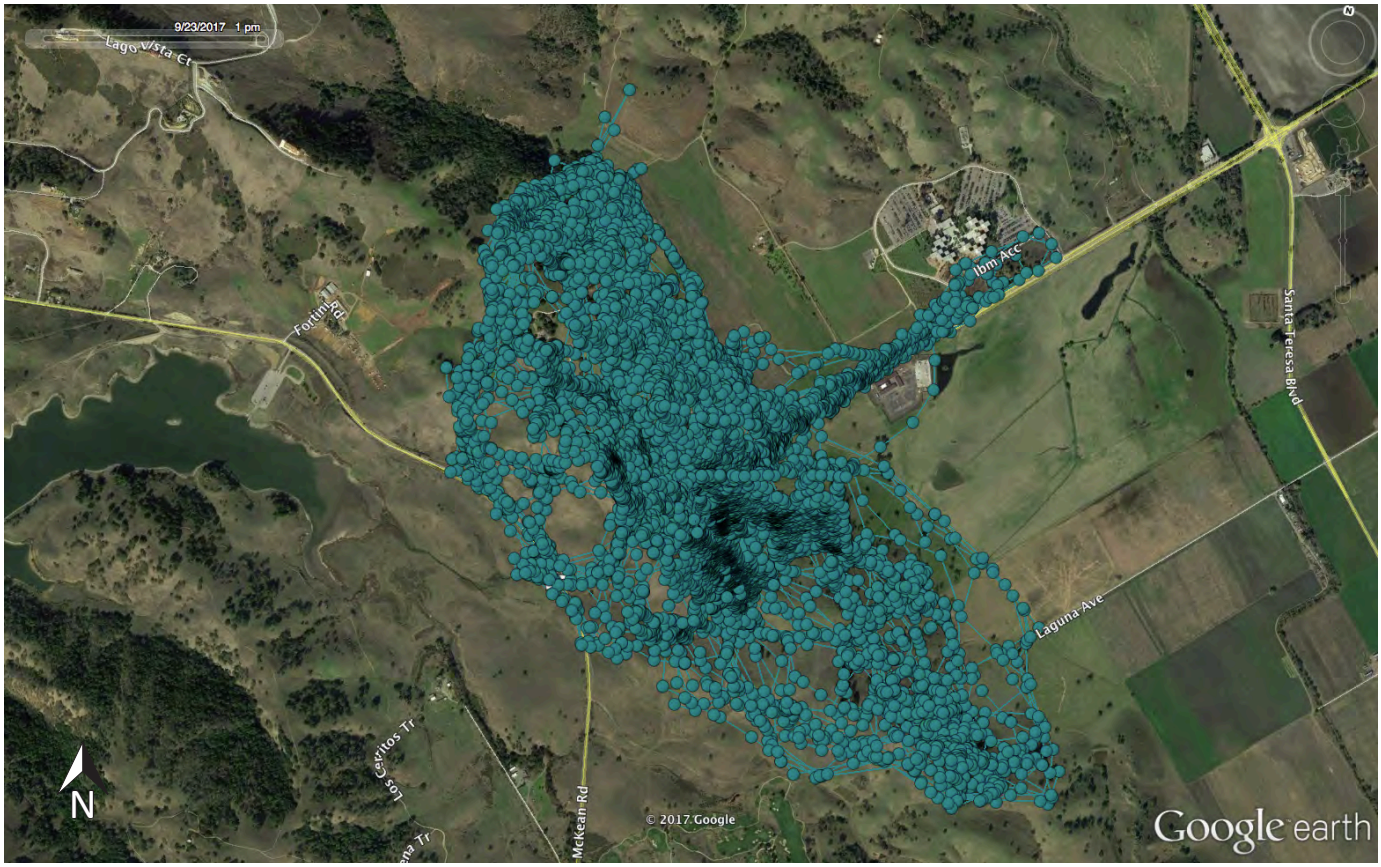


Figure A5. B03, a female who crosses Bailey Road at a high frequency.

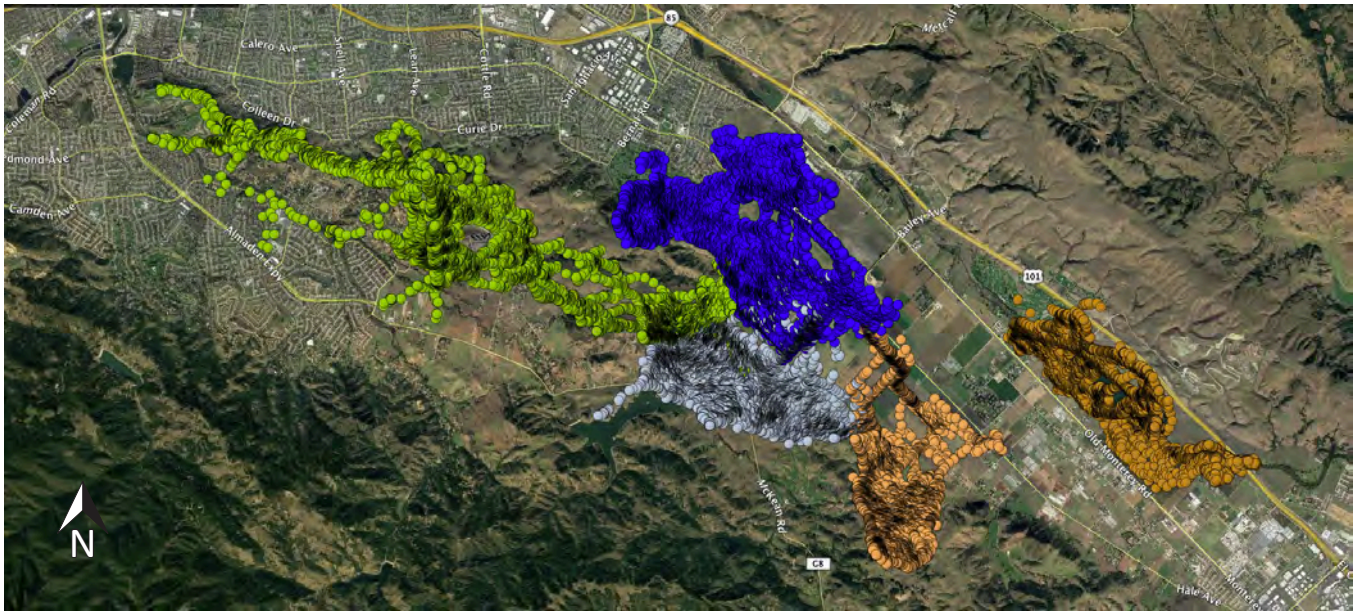


Figure A6. The territories of five males, showing how the landscape is partitioned.

Figure A7. B05, a female, showing movement from tree to tree as well as road crossings along Bailey Road.

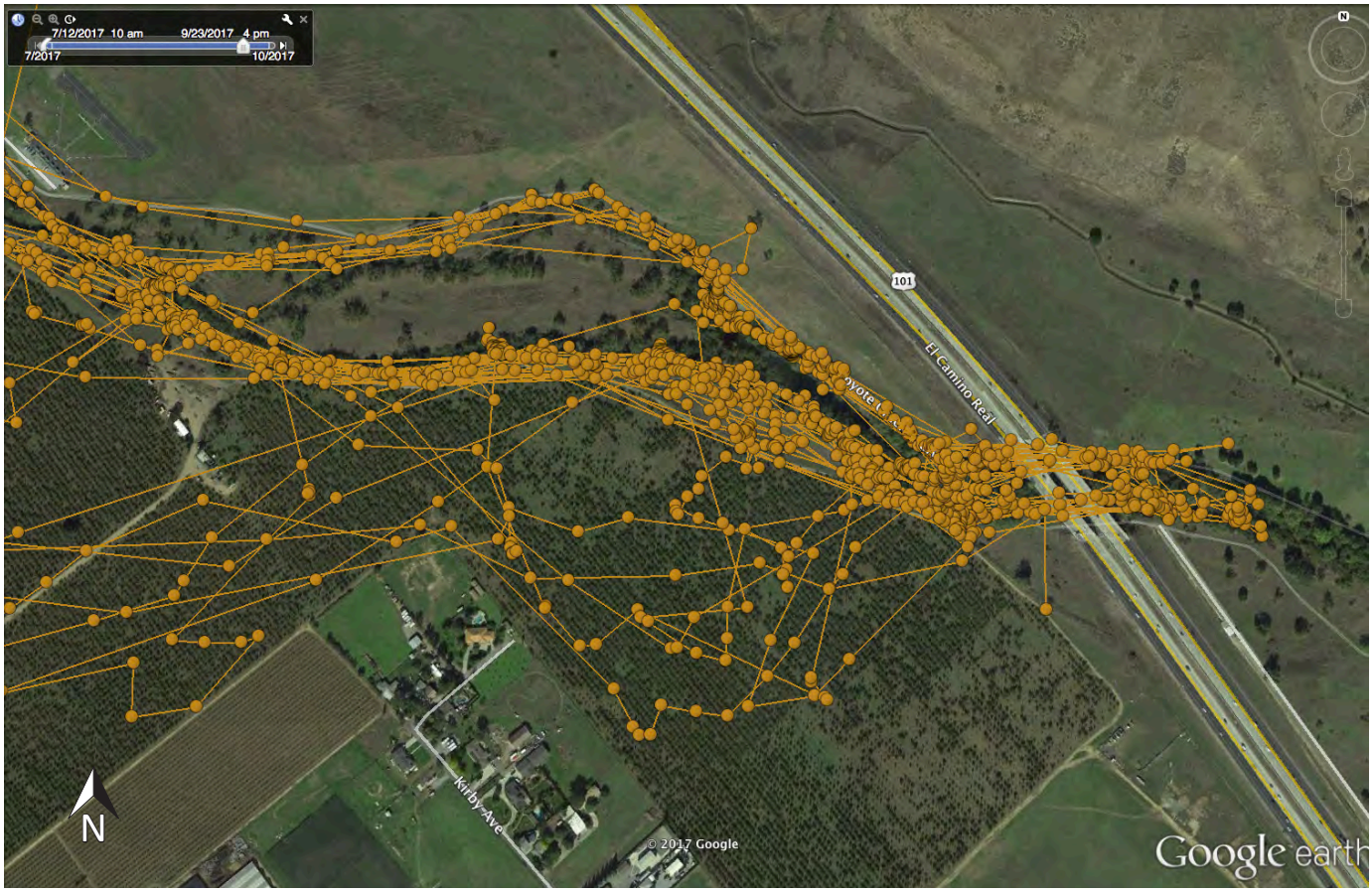


Figure A8. The path of B07, a male, showing the importance of tree cover (even orchards) and a successful crossing under Highway 101.

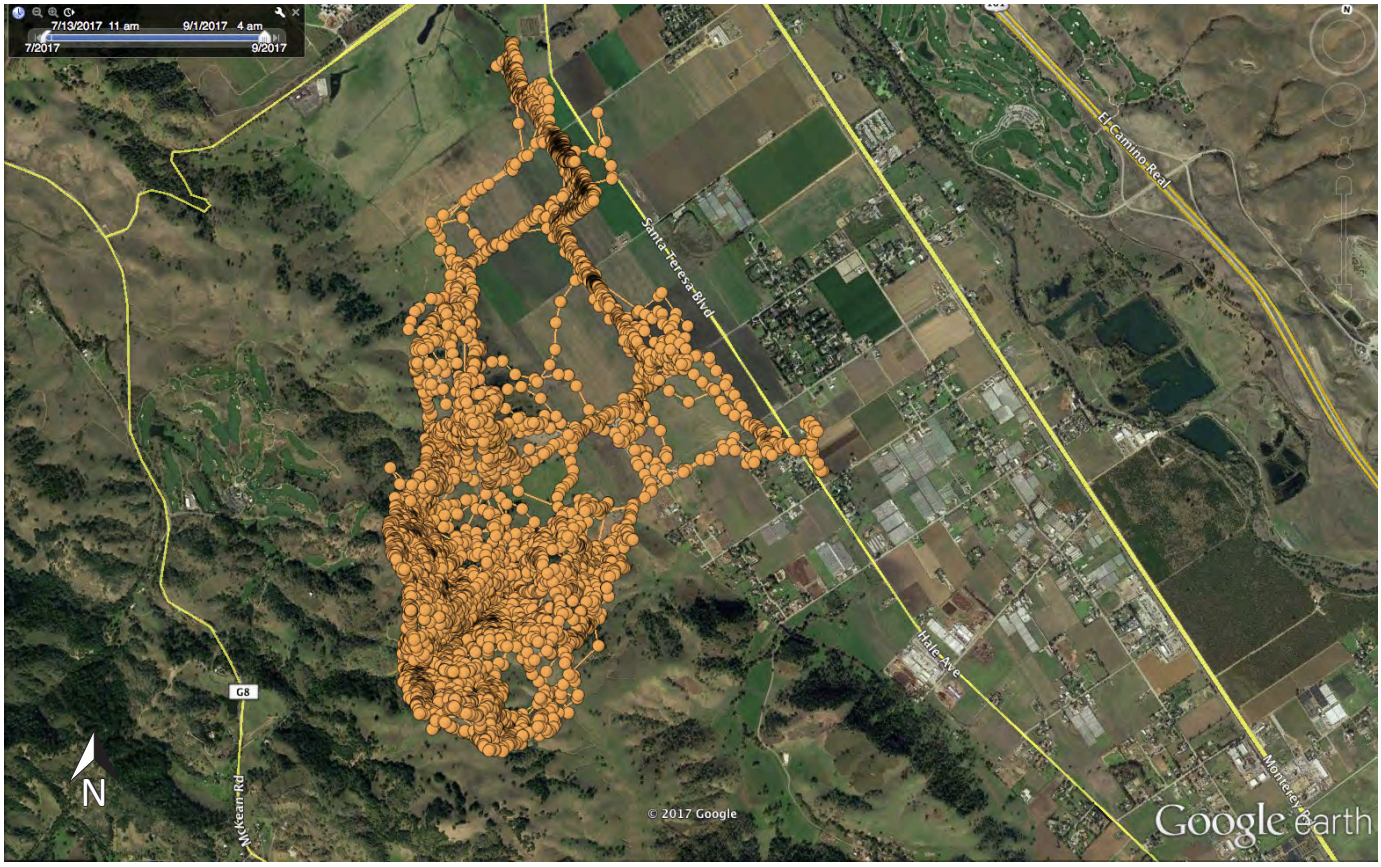


Figure A9. B08, a male, showing activity in the Coyote Valley Open Space Preserve, as well as travel along Fisher Creek in the mid-valley.

B02, an adult female also known as Elderberry, was radio-collared on June 19, 2017. In late July, Elderberry was killed by a vehicle on Monterey Highway in north Coyote Valley. Photo by Laurel Serieys.

Figure A10. B02, a female, showing (a) a successful crossing under Highway 101, and (b) two crossing locations over Monterey Highway, one where she crossed successfully and one where she was hit and killed.

Laguna Seca, Santa Clara County's largest freshwater wetland

Bringing the Landscape Linkage to Life

Coyote Valley is the best opportunity we have to preserve a lifeline between the Diablo Range and Santa Cruz Mountains. The Open Space Authority is leading a collaborative conservation effort that will benefit plants, wildlife, and the resilience of our entire region. These efforts include working with willing landowners to help protect Coyote Valley's natural and agricultural landscape and designing with transportation and wildlife agencies to implement safe wildlife crossings across roads, such as culverts and bridges. Our partners, including those listed below, are vital to this landscape linkage design:

- California Department of Fish and Wildlife
- CalTrans
- City of San José
- High Speed Rail Authority
- Pathways for Wildlife
- Peninsula Open Space Trust
- Santa Clara County Parks and Recreation Department
- Santa Clara Valley Audubon Society
- Santa Clara Valley Water District
- Valley Habitat Agency
- Valley Transportation Authority

For more information or to download the full report, go to **openspaceauthority.org/landscapelinkage**

This project was funded in part by Peninsula Open Space Trust (POST)

Santa Clara Valley Open Space Authority
408-224-7476
openspaceauthority.org