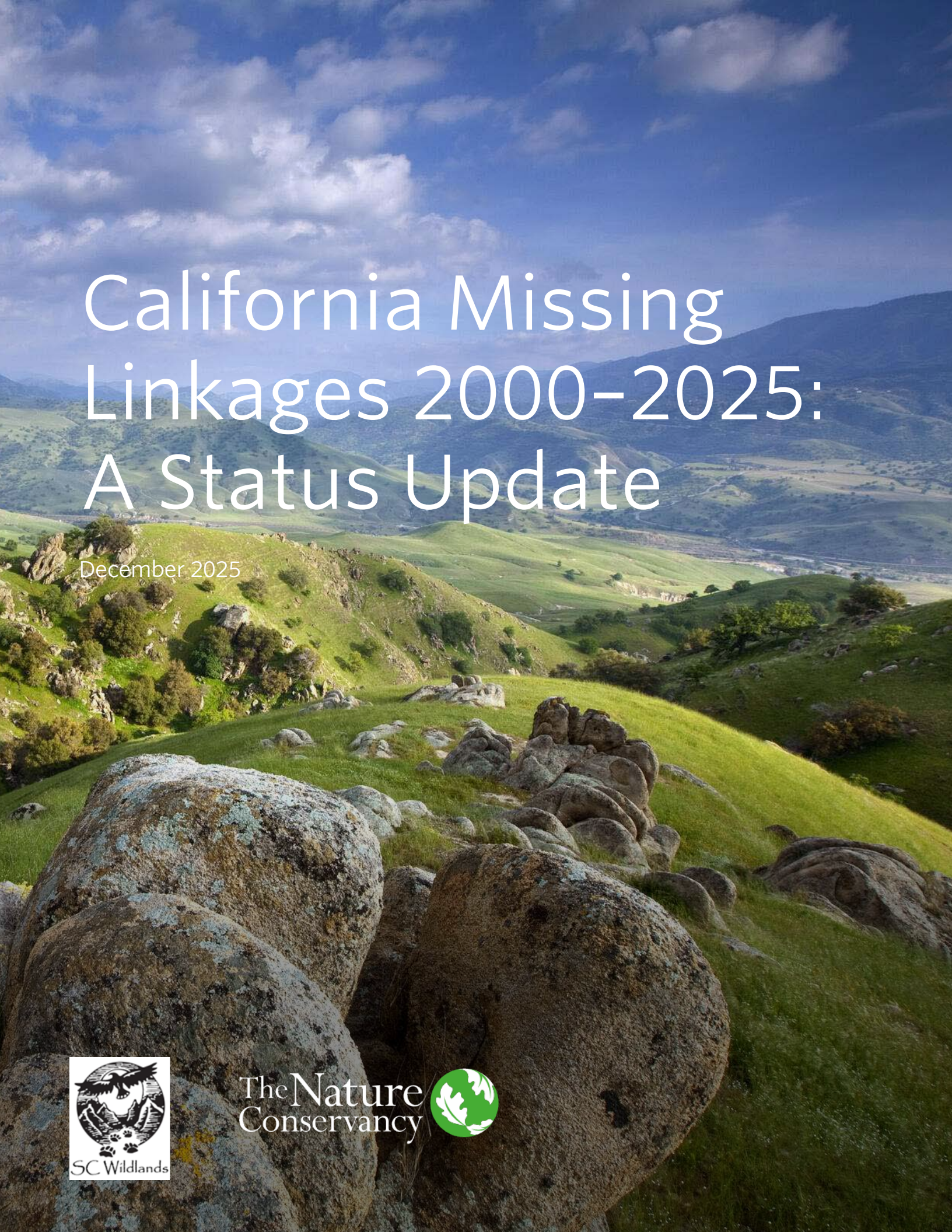

California Missing Linkages 2000–2025: A Status Update

December 2025

SC Wildlands

The Nature Conservancy

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Recommended Citation: The Nature Conservancy and SC Wildlands. 2025. California Missing Linkages 2000-2025: A Status Update.

Acknowledgements: This report benefited from contributions, review, and comments from the following individuals: from the California Department of Fish and Wildlife: Evan Greenspan, Michael Hardy, Melanie Gogol-Prokurat, and Juan Torres; from San Diego Zoo Wildlife Alliance: Charlie de la Rosa; from the U.S. Geological Survey: Emily Perkins; from the U.S. Fish and Wildlife Service: Kevin Hauser.

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Cover photo: © Ian Shive | The rolling hills and oak trees of the Frank and Joan Randall Preserve in the Tehachapi Mountains.

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Executive Summary

The 2000 California Missing Linkages Conference was a landmark event that brought ecological connectivity to the forefront of conservation planning in the state. It led to the identification of 232-plus ecological linkages and catalyzed a wave of connectivity assessments and implementation efforts across California. Now, 25 years later, conservation practitioners are reconvening to evaluate the status of these original linkages—assessing conservation gains and losses, identifying emerging threats and opportunities, as well as the science, partnerships, policy, and funding needed to guide the next generation of action. The California Missing Linkages 25th Anniversary Symposium will be held on January 8-9th, 2026 in Sacramento. The symposium reflects the efforts of an interagency Steering Committee and planning team, including organizations such as The Nature Conservancy and SC Wildlands (co-chairs), along with state and federal agencies, conservation NGOs, and research institutions.

This report, entitled *California Missing Linkages 2000–2025: A Status Update*, was prepared by The Nature Conservancy and SC Wildlands. It provides an overview of progress in ecological connectivity over the past 25 years, with a focus on the 232 linkages identified in the original statewide initiative in 2000, the first effort to map and prioritize corridors essential for sustaining California's biodiversity. Since then, connectivity has become a central conservation strategy, especially in the context of climate change, supporting species migration, genetic diversity, and ecosystem services that benefit both wildlife and people. This status update also aims to inform the identification of additional connectivity landscapes beyond those that were originally mapped in 2000, helping to expand and refine a future statewide vision for ecological connectivity.

While this analysis does not represent a comprehensive statewide connectivity assessment—since the original 2000 effort did not identify all ecological linkages—it provides updated data and insights that participants at the California Missing Linkages 25th Anniversary Symposium can use to refine linkage configurations, add linkages or key connectivity areas that were missed, and identify areas for conservation action. The status update can also be used to identify overlapping priorities, fill data gaps on science, partnerships, stewardship, and barriers for remediation, and align conservation actions with broader landscape-scale goals. This collaborative approach of bringing people together to review connectivity efforts across the state, enhances strategic planning, supports multi-agency coordination, and ensures that connectivity efforts are resilient to future land use and climate changes.

The network of linkage buffers spans over 14.2 million acres, many serving as critical corridors across diverse ecoregions. As of 2025, 61% of the linkage buffers are protected or conserved, and most linkages retain high levels of natural landcover despite modest losses and increasing development pressure. Notably, large landscape linkages (≥10 km wide) remain the most intact, with 100% meeting natural landcover thresholds. Between 2000 and 2025, over 993,000 acres were added to conservation within the linkage buffers, with the North Coast and Central Coast-Bay Area Ecoregions accounting for more than half of this gain. Impervious surface cover remains relatively low, averaging just 9%, with 87% of linkages under 20% impervious surface—indicating limited fragmentation to date. However, 55% of constrained linkages have been severed such that they would now be considered "missing links", and development projections suggest that additional constrained linkages may face significant urbanization by 2050.

Scientific innovations such as advanced GIS modeling, integration of genetic and movement data, and climate-informed analyses have transformed connectivity planning. Regional and statewide assessments, including the South Coast Missing Linkages, the California Essential Habitat Connectivity Project, and TNC's

Resilient Connected Network, have provided critical data and guidance. Tool advancements, such as wildlife tracking and monitoring technologies have improved data collection and corridor validation.

Policy and funding mechanisms have also evolved. Programs like the Forest Legacy and Williamson Acts help preserve working lands that intersect with key linkages. Conservation planning has also expanded, with Natural Community Conservation Plans now covering 39% of linkage buffers and Resource Conservation Investment Strategies guiding land use in over 100 linkage buffers. Barriers to wildlife movement have been identified for remediation across the state with linkage buffers intersecting 656 miles (31%) of identified California Department of Fish and Wildlife barriers and 88 (34%) of Caltrans Active, Planned or Unfunded Barrier Remediation Projects.

While considerable progress has been made, continued investment in land protection and barrier remediation, as well as policy innovation and cross-sector collaboration, are essential to secure California's ecological connectivity and resilience for future generations.

Introduction

Missing Linkages: Restoring Connectivity to the California Landscape (Penrod et al. 2001) emerged from a landmark event in 2000 that brought together over 150 land managers, planners, and scientists to identify and characterize ecological linkages considered critical to sustaining California's biodiversity. The goal of this first-of-its-kind effort was to raise awareness regarding the need to protect and restore ecological connectivity in California and to inspire the partnerships, science, planning and policies needed for implementation. Led by a coalition of organizations including CalWild, California State Parks, The Nature Conservancy, San Diego Zoo, and the U.S. Geological Survey, the effort resulted in the identification and characterization of 232-plus linkages across the state and brought habitat connectivity to the forefront of conservation thinking. The resultant *Missing Linkages* report (2001) catalyzed many connectivity planning initiatives across California and beyond, including the *South Coast Missing Linkages* (Beier et al. 2006), California Essential Habitat Connectivity (Spencer et al. 2010), and TNC's Resilient Connected Network (Anderson et al. 2025) among others.

Over the past 25 years, ecological connectivity has evolved from an abstract concept in landscape ecology to a central pillar of biodiversity conservation, leading to advancements in scientific research, supportive policy and funding, and collaborative action. Connectivity is essential to safeguard and sustain habitats, biodiversity, and ecosystem functions such as migration, hydrology, nutrient cycling, pollination, seed dispersal, food security, climate resilience and disease resistance (Hilty et al., 2020). Protecting and restoring ecological connectivity via habitat linkages or "corridors" has been identified as the most frequently recommended approach to maintain ecosystem resilience in the face of climate change (Heller and Zavaleta 2009).This review assesses the scientific advancements in connectivity planning and evaluates conservation gains, habitat losses, opportunities and threats across the original California Missing Linkages. As we look toward 2050, it is important to reflect on the progress we have made and where gaps remain to sharpen our focus on the actions and landscapes that are vital to securing a connected California and beyond for future generations.

The Importance of a Connected California

California is the third largest and the most biologically diverse state in the United States. It is also one of the world's biodiversity hotspots, home to more than 6,500 plant species and over 1,000 vertebrate species, many of which are endemic and found nowhere else (Mittermeier et al. 1999, Stein et al. 2000).

California is the most populous state in the nation, with over 39 million residents as of 2024 and projections suggest the state could reach nearly 50 million by 2050 (Public Policy Institute of California, 2025). Growth over the past 25 years has resulted in the loss of over one million acres of natural habitat (California Governor's Office, 2024, Lee-Ashley et al. 2019). Habitat loss and linear infrastructure barriers fragment natural landscapes, isolating wildlife populations and disrupting ecological processes, making it harder for species to migrate, find mates, and adapt to environmental changes.

Pressures on ecological connectivity are further compounded by climate-related stressors including more frequent and severe droughts, altered fire regimes, floods, and heatwaves, which are further degrading natural habitats. These changes threaten ecosystems and species across the state, particularly those already stressed by habitat fragmentation (California Climate Adaptation Strategy, n.d.).

Although climate change was acknowledged as a driver of ecological change in the early 2000s, the role of ecological connectivity in addressing climate-related stressors was not widely recognized or integrated into conservation planning at the time. Today, connectivity is understood as a critical climate adaptation strategy, enabling species to shift ranges, maintain genetic diversity, and survive in dynamic environments.

Connectivity also benefits people. Intact, connected ecosystems provide critical services such as clean water, pollination, carbon storage, food security, and natural pest control, as well as support mental and physical well-being through access to nature (Conservation International, 2021). For Indigenous communities, intact landscapes hold deep cultural, spiritual, and subsistence significance (Grim n.d.).

As California plans for future growth, balancing development with conservation will be critical. Poorly planned infrastructure, housing, and energy projects could sever key wildlife corridors and undermine regional conservation strategies. Conversely, protecting and restoring connectivity can enhance climate resilience, support sustainable land stewardship and provide opportunities for working lands. In short, ecological connectivity is not just a conservation priority, it is a foundation for a livable, climate-resilient California that supports both people and nature.

Advancements in Connectivity Planning, Policy and Funding

Over the past 25 years, connectivity conservation in California has been significantly advanced by a convergence of technological innovation, supportive policy and funding initiatives, and collective action. Breakthroughs in computing power, data collection and analytics have revolutionized our ability to model and monitor wildlife movement patterns in real time, providing critical insights into habitat use and migration corridors. At the same time, landscape-scale conservation efforts—often driven by dynamic public-private partnerships—have mobilized interested parties around shared goals for ecological connectivity. These collaborative efforts have led to progressive state, regional, and local policies, along with dedicated funding streams, which have translated scientific understanding into tangible, on-the-ground conservation outcomes. Together, these developments have laid a strong foundation for more connected and resilient natural landscapes across California. Advancements in connectivity policy and funding between 2000 and 2025 are detailed in a separate draft report prepared by Wildlands Network.

Advancements in Connectivity Planning

Since 2000, scientists have been mapping ecological connectivity at multiple scales using a variety of methods. At the time of the 2000 conference, the use of geographic information systems (GIS) to model movement pathways was just beginning to gain traction and has evolved considerably over the last 25 years. Connectivity modeling has progressed from identifying optimal linear pathways, to mapping broad multi-

strand linkages, and more recently, to complex connectivity analyses that model all possible pathways across a landscape simultaneously.

A major advancement has been the integration of empirical data—such as species occurrence, movement, and genetic data--into connectivity analyses. These data have been used to validate models, inform resistance surfaces (a key input to both early and contemporary analyses), delineate ungulate migration corridors, and measure gene flow between populations by correlating genetic relatedness with landscape features. Additionally, climate change considerations have increasingly been incorporated into connectivity analyses to predict how shifting habitats may alter movement patterns over time.

Over the last 25 years, four statewide connectivity assessments, and numerous regional assessments, either focused on multi-species or single-species—have been conducted through collaborations with wildlife experts, government agencies, and NGOs, with more expected in the future. The most recent State Wildlife Action Plan released by the California Department of Fish and Wildlife (CDFW 2025) estimates that 60% of the state has been covered by fine-scale species-specific modeling and addressing the remaining gaps is identified as a priority. These connectivity assessments have been widely utilized and informed numerous conservation planning efforts across the state. Below, we provide an overview of the progression of statewide and regional connectivity assessments over time.

Statewide Connectivity Assessments

The *California Essential Habitat Connectivity Project* (Spencer et al. 2010), commissioned by Caltrans and CDFW, was the first statewide connectivity assessment. It modeled least cost corridors based on landscape naturalness to identify Essential Connectivity Areas between Large Natural Landscape Blocks, offering a vision for a connected California to sustain native species, natural communities and ecological processes. It produced three key outputs: 1) A statewide Essential Habitat Connectivity Map; 2) A database characterizing the mapped areas; and 3) Guidance for mitigating the fragmenting effects of roads and for developing species-specific connectivity plans at local and regional levels to refine Essential Connectivity Areas and Natural Landscape Blocks.

Omniscape Present-Day Connectivity (TNC and Conservation Science Partners 2017) was the first to apply more advanced techniques to generate the second statewide connectivity analysis for California. This assessment used a modified version of Circuitscape (Shah and McRae 2008) with a moving-window algorithm to quantify ecological flow (potential connectivity) among all pixels within a 50km radius across the state. A human modification layer was used as the resistance surface, where high-quality habitat had low resistance and barriers had high resistance. All possible pathways between movement sources and destinations were identified and classified into categories: Diffuse (many movement options), Intensified (limited pathways), Channelized (critical remaining corridors through heavily modified landscapes), Impeded, and Land Use May Restrict Movement (primarily agriculture). These classifications help pinpoint regions where connectivity is most threatened and where conservation efforts could be most impactful to maintain biodiversity and reduce wildlife mortality risks.

Terrestrial Connectivity Dataset (CDFW 2017) synthesized the best available spatial data on wildlife movement and habitat connectivity in California. Designed to support the integration of biodiversity conservation with transportation and infrastructure planning, this dataset is regularly updated as new information becomes available (2019, 2025). As one of four core components of the *Areas of Conservation Emphasis (ACE)* data—alongside Terrestrial Biodiversity, Significant Habitats, and Climate Resilience—the Terrestrial Connectivity dataset provides detailed summaries within 2.5-mi^2 ACE hexagons. These summaries include the presence of mapped corridors or linkages with information on the source and links to

the data on BIOS, and their proximity to large, contiguous natural areas. With the 2025 update, each hexagon is now flagged with the focal species associated with modeled linkages that intersect it, broken down by taxonomic groups. Connectivity ranks, listed in order of importance are: (1) Irreplaceable and Essential Corridors (Rank 5), (2) Conservation Planning Linkages (Rank 4), (3) Connections with Implementation Flexibility (Rank 3), (4) Large Natural Habitat Areas (Rank 2), and (5) Limited Connectivity Opportunity Areas (Rank 1).

TNC's *Resilient and Connected Network* integrates present-day land use, topographic diversity, and future climate projections to identify wildlife movement pathways and areas where California's most biodiverse landscapes are also likely to be resilient to climate change. It incorporates cutting-edge connectivity models (Cameron et al., 2022; Schloss et al., 2022) to highlights areas—called *climate linkages*—where ecological flow exceeds expectations due to climate-driven movement potential. It accounts for human modification as a barrier and emphasizes the importance of landscape features that contribute to resilience, such as refugia—areas where habitats are more likely to remain stable—and a diversity of microclimates that offer species adaptive options under changing conditions.

Regional Connectivity Assessments

The South Coast Missing Linkages (SCML) initiative was the first effort to model connectivity in California (Penrod et al., 2003**,** Luke et al., 2004, Penrod et al., 2004ab, Penrod et al., 2005abcd, Penrod et al., 2006abc, Beier et al., 2006, SC Wildlands 2008). The network was designed based on the needs of a taxonomically diverse set of 109 focal species. Least-cost corridors were modeled for a subset of species between species-specific core areas within protected areas; joined into a preliminary linkage network; then modified using patch size and patch configuration analyses to add habitat when needed, including riparian corridors, to ensure final linkages provided live-in and move-through habitat for all focal species.

The *Las Californias Binational Conservation Initiative* (CBI et al., 2004) proposed a binational conservation network to maintain ecological connectivity, protect sensitive species, and address land use differences between the United States and Mexico. While not using a connectivity analysis per se, it laid out a framework for habitat conservation across the California–Baja California border region, emphasizing the shared ecological richness and threats facing this globally significant biodiversity hotspot. The 2015 Las Californias Binational Conservation Initiative Decadal Review (Stallcup et al., 2015) assessed progress and setbacks over the previous decade, noting that while some conservation gains were made—particularly in San Diego County—over 120,000 acres of habitat were lost to development, with disproportionately fewer protections on the Baja California, Mexico side.

Conservation Design for the Central Coast of California and the Evaluation of Mountain Lion as an Umbrella Species (Thorne et al., 2006) used a least-cost corridor analysis that identified a network of core areas and linkages covering 49% of the region and assessed the network's ability to represent a range of biodiversity elements. The results showed that the mountain lion network captured a high proportion of many biodiversity features—such as 88% of old-growth redwood and 79% of steelhead watersheds—but underrepresented some endemic amphibians, reptiles, and mammals.

Spatial scale effects on conservation network design: tradeoffs and omissions in regional versus local scale planning (Huber et al., 2010) used the MARXAN reserve selection algorithm and least cost corridor analysis at the ecoregional scale and for five counties to identify a potential regional conservation network for the Central Valley Ecoregion. The results suggested planning efforts limited to one scale may neglect biodiversity patterns and ecological processes that are important at other scales. An intersection of results was used to prioritize cores and corridors important at both scales.

Habitat Connectivity Planning for Selected Focal Species in the Carrizo Plain (Penrod et al., 2010) was undertaken to assist California Energy Commission, County of San Luis Obispo, CDFW and U.S. Fish and Wildlife Service in assessing connectivity baseline conditions for three species of management concern tule elk, pronghorn antelope, and San Joaquin kit fox) in the Carrizo Plain, where large-scale solar projects were proposed, using methods similar to those developed for the SCML project described above.

A Linkage Network for the California Deserts (Penrod et al., 2012) was the first connectivity assessment in California to integrate climate considerations. The linkage network was based, in part, on the needs of a taxonomically diverse set of 44 focal species selected to capture a variety of movement needs and ecological requirements. The assessment largely used the SCML approach but was supplemented with the land facet approach (Brost and Beier 2010) to design climate-robust linkages. The focal species linkages and land facet linkages were combined and then refined to delineate the final Desert Linkage Network.

Conserving population linkages for the Mojave Desert Tortoise (Gopherus agassizii) (Averill-Murray et al., 2013) modeled least-cost corridors between delineated Tortoise Conservation Areas to develop a conservation network for the species. The authors cautioned other models that assumed more permeable tortoise habitat revealed much broader linkages but noted approximately 700 km^2 of habitat within the minimum linkages were already at risk through solar energy development. The authors acknowledged the network may or may not be able to support viable tortoise populations and accommodate climate change but argued conservation decisions could not be delayed as linkages may be severed before they are protected.

Critical Linkages: Bay Area & Beyond (Penrod et al., 2013) used a collaborative process to design 14 landscape-scale linkages for a taxonomically diverse group of 66 focal species to crucial to maintaining connected wildlife populations from Mendocino National Forest in the north to the beaches of the Santa Lucia Range on Los Padres National Forest and Hearst Ranch in the south, and eastward to the southern end of the Inner Coast Range. The approach used was similar to the SCML initiative described above, but instead of using large, protected areas as targeted endpoints, it delineated Large Landscape Blocks that built upon existing protected areas/easements and roadless areas.

Wildlife Connectivity across the Northern Sierra Nevada Foothills (Krause et al., 2015) identified potential corridors within the region and between the foothills and adjacent ecoregions such as the Central Valley and Sierra Nevada. The study was led by the California Department of Fish and Wildlife and involved contributions from multiple partners and experts. Species-specific data were used to model 246 least cost corridors connecting 198 landscape blocks, identifying core habitats and least cost corridors for 30 focal species, including nine passage species (species that move through the corridor) and 21 corridor dwellers (species that may require more than one generation to move through the corridor). The study also identified 280 riparian corridors and 169 land facet corridors connecting 94 landscape blocks to support species and their movements under future climate conditions.

The Mayacamas to Berryessa Connectivity Network (M2B) (Gray et al., 2018) is a collaborative landscape-scale conservation initiative aimed at enhancing ecological connectivity and climate resilience across Northern California's inner Coast Ranges, spanning Sonoma, Napa, and Lake counties. Using advanced habitat mapping, linkage analyses, and climate threat assessments, the M2B team produced site-specific corridor action roadmap to protect biodiversity, watershed health, and forest ecosystems.

A range-wide model of contemporary, omnidirectional connectivity for the threatened Mojave desert tortoise (Gray et al., 2019) was developed based on empirical movement data and a circuit-theoretic approach. They first estimated habitat potential (i.e., quality) for tortoise movement across its range using the published literature, linear mixed models, multiple environmental factors derived from remotely sensed data, and

recent solar and wind development footprints. The resultant raster was used to represent landscape conductance and model multidirectional connectivity for tortoises in Circuitscape.

Habitat Connectivity for Fishers and Martens in the Klamath Basin Region of California and Oregon (Spencer et al., 2019) developed species distribution models with habitat values calculated and mapped using MaxEnt, relevant environmental values and recorded occurrences for each species. The suitability results for each species were used to generate core areas and to create the resistance surface for modeling least-cost corridors using Linkage Mapper.

Mapping Habitat Connectivity Priority Areas that are Climate-wise and Multi-scale, for Three Regions of California (Gallo et al., 2019) identifies and prioritizes habitat connectivity areas across three ecologically significant regions in California—the Modoc Plateau, Sacramento Valley, and West Mojave Desert. The effort integrated structural and species-specific connectivity analyses to map corridors that support wildlife movement and two climate focused approaches. Higher values were given to pathways that facilitate climate-induced range shifts and prioritized core areas and linkages that include climate refugia and microrefugia.

Climate Resilient Connectivity for the South Coast Ecoregion of California (Jennings et al., 2019) applied a scenario-based approach using ensemble species distribution models and connectivity models linked with dynamic metapopulation models for five focal species. The study assessed how climate change, land use shifts, and ecological uncertainty affect wildlife movement. Three linkage modeling approaches were used: least cost corridor analysis, Circuitscape and land facet analysis. Least cost corridor analyses were run for each species under historic conditions (2000) and at ten decadal intervals (2010-2100) under four future climate scenarios.

CDFW has been mapping *Ungulate Migration Corridors, Stopovers and Winter Ranges* of elk, mule deer, and pronghorn herds around the state using the Migration Mapper tool to analyze datasets from GPS collars to identify conservation opportunities and barriers to migration. The Migration Mapper application developed by researchers at the Wyoming Migration Initiative uses a Brownian bridge movement analysis of GPS collar data to identify and map migration corridors and prioritizes corridors based on the number of animals migrating through specific areas. Initiated in 2018 as part of a broad collaboration across the west in support of Secretarial Order 3362, the Department continues to map migration corridors for additional herds around the state.

There are also single species connectivity assessments (e.g., Zeller et al., 2017, Dutcher et al., 2020, Hromada et al., 2020) in California not captured in this summary.

Many of the connectivity analyses described can be viewed on the CDFW BIOS website.

Statewide and Ecoregional Missing Linkages Status Update Summaries

The goal of this analysis is to assess connectivity gains and losses over the past 25 years for each of the 232 Missing Linkages identified across California in 2000, and to evaluate the challenges, threats, and opportunities facing each linkage moving forward. While this analysis does not represent a comprehensive statewide connectivity assessment—since the original 2000 effort did not identify all ecological linkages—it provides updated data and insights that Missing Linkages 25th Anniversary symposium participants can use to refine linkage configurations, add linkages or key connectivity areas that were missed, and identify areas for conservation action. Participants can use the status update to identify overlapping priorities, fill data gaps on science, partnerships, stewardship, and barriers for remediation, and align conservation actions with broader landscape-scale goals. This collaborative approach—bringing people together to review connectivity efforts across the state—enhances strategic planning, supports multi-agency coordination, and ensures that connectivity efforts are resilient to future land use and climate changes.

It is important to underscore that the linkage boundaries used in this update are not meant to encompass the full extent of each linkage but instead reflect a consistent unit of analysis that enables comparison over time using a standardized minimum mapping framework. The results of this update, after incorporating symposium participants input, can be used with other new or existing assessments—such as regional connectivity models, climate resilience mapping, and wildlife movement studies—to create a more comprehensive and layered understanding of ecological networks across the state and within each ecoregion.

Approach

The assessment began with refinement of each of the linkages identified at the 2000 Missing Linkages conference. The delineation of the original linkages relied on expert opinion and were largely conceptual, representing linear connections between habitat patches based on general landscape features. While the conference was entitled "Missing Linkages," only a subset of the original linkages lacked continuous natural habitat and were truly missing in 2000. Some were choke points at risk of being severed, while others were relatively intact linkages that lacked protections or wildlife crossing infrastructure. Refinement was required to 1) align the linkages with natural landcover as of 2000 and to correspond with specific details (e.g., geographic features, protected lands) from the original datasheets and, 2) develop a consistent classification system of linkage types. Next, a linkage buffer (i.e., 500 m, 1 km, 2 km, 5 km, or 10 km) was selected that best captured natural landcover in 2000 and met other criteria, to establish a baseline for comparisons and to serve as the primary unit for the analysis. In addition,10 km buffers were established for all linkages to provide landscape context. The linkage buffer selection process (e.g., percent intact and width of impervious surface as of 2000) was also used to consistently characterize the type of linkage: Large Landscape Linkage (10 km wide), Landscape Linkage (5 km wide), Linkage (2 km wide), Constrained Linkage (1 km wide), and Riparian Corridor or Missing Link (500 m wide). These classifications differ from the original 2000 linkage types (i.e., Landscape Linkage, Choke-point, Missing Link), which lacked specific criteria.

Several metrics were calculated for each linkage buffer and landscape context buffer to assess conservation gains and losses between 2000 and 2025, such as increase in protection status, increase in regional conservation plans, reduction in natural landcover, and increase in impervious surface. Threats were assessed using projected development, timber harvest plans, and Williamson Act non-renewals, while challenges in terms of infrastructure, zoning for development, and feasibility (e.g., average cost per acre)

were also evaluated. Several opportunity metrics were also calculated, such as zoning for open space, priority barriers for remediation, and critical habitat. We also assessed the overlap with several subsequent connectivity analyses conducted since 2000.

Refinement of Original Missing Linkages Arrows

During the 2000 California Missing Linkages Conference, participants in ecoregional breakout sessions drew arrows to represent individual wildlife movement corridors directly onto 1:250,000 scale basemaps. This resulted in the identification of 232 Missing Linkages represented by 319 Missing Linkages arrows (MLAs) with each represented by a unique spatial feature in GIS. For linkages with multiple arrows, sub-IDs were created (e.g., Linkage ID SC55 had three arrows with sub-IDs SC55a, SC55b, SC55c). We also refined the ecoregions to which some MLAs were allocated (e.g., Bay Area), though we retained the Linkage ID. Our first step in completing the status update entailed refining the alignment of the 319 MLAs based on 2000 conditions. The original spatial features of each MLA were adjusted to address the scale at which the arrows were drawn using details from the associated datasheets (e.g., targeted protected areas, geographic features, focal species, barriers) and relevant data, such as 2000 natural landcover (USGS 2024), hydrology, and topographic features as follows:

- MLAs were refined to roughly follow the centerline of natural landcover in 2000 (USGS 2024) to the greatest extent possible.
- MLAs identified as riparian connections (e.g., Santa Clara River) were refined to follow river or stream features using California Streams hydrology layer, with extent modified if needed, to follow intent on datasheet (e.g., between protected areas, below dam).
- MLAs were refined to connect protected areas specified in the associated datasheet using California Protected Areas Database and Easement Database (CPAD/CCED 2024b).
- MLAs were refined to follow geographic features specified in the associated datasheet (e.g., shift San Jacinto-Badlands to topographic feature), using topographic basemaps in ArcGIS Pro.

In addition, 14 riparian connections were split into segments to reflect differences in landcover context as of 2000, which resulted in an increase from 319 to 333 MLAs. For example, after replacing the original geometry of the Coyote Creek MLA with the stream feature, the MLA was split at the edge of the City of San Jose to distinguish between the heavily urban and channelized portion of lower Coyote Creek (20a) and the more natural portion of upper Coyote Creek (20b). This allowed for varying linkage buffers widths, as described below.

Delineating and Defining Linkage Buffers for Assessment

In order to complete spatial analyses for this status update, we first attributed each MLA to one of five linkage buffer widths and types (see Table 1) based on Bentrup (2008) and Beier (2018). This "linkage buffer" served as the primary unit of analysis, with the intent to select the widest linkage buffer that best captured natural landcover in 2000 (USGS) to establish a baseline for comparison in 2025. In addition to the linkage buffer, we also applied a 10 km buffer to each MLA to provide landscape context and a standardized unit of measure that could be used for statewide comparisons.

To determine the linkage buffer width and type for each MLA, two primary layers were developed based on conditions in 2000: simplified natural landcover and impervious surface. The National Land Cover Database (NLCD) for 2000 (USGS) was used to generate a simplified natural landcover layer by removing all categories associated with development and agriculture (e.g., Developed High Intensity, Cultivated Crops) and combining all remaining natural landcover categories. For each MLA, percent natural landcover was calculated for all five potential linkage buffer widths. The Annual NLCD Impervious Surface Descriptor 2000 was used in relation to natural landcover to discern between truly developed lands and agricultural lands that

may be restorable, based on the presence of linear infrastructure and developed categories. A series of spatial queries were performed on the simplified 2000 natural landcover layer (e.g., ≥ 98% natural landcover within 10km buffer) in order to systematically assess which MLAs met various criteria for each linkage buffer width and type (see Table 1). Each MLA was then assessed individually against these criteria to select the appropriate linkage buffer width/type.

Table 1. Linkage Types Widths and Criteria for Inclusion

LINKAGE TYPE & BUFFER WIDTH	CRITERIA FOR INCLUSION IN LINKAGE BUFFER WIDTH CLASS
Large Landscape Linkage (10km)	≥ 98% Natural Landcover (NLCD 2000). No highly constricted impervious surface areas > 2km wide, leaving at least 8km swaths of fairly permeable habitat. Road barriers, which can be remediated, as well as scattered rural residential development did not preclude designation.
Landscape Linkage (5km)	≥ 95% Natural Landcover (NLCD 2000). No highly constricted impervious surface areas > 2 km wide, leaving at least 3 km wide swaths of fairly permeable habitat. Road barriers and scattered rural residential development did not preclude designation.
Linkage (2km)	≥ 85% Natural Landcover (NLCD 2000). May be constrained by highly impervious surface areas or pockets of rural development but no area is constrained to < 1km at any point along the linkage. Road barriers or scattered rural development did not preclude designation.
Constrained Linkage (1km)	≥ 70% Natural Landcover (NLCD 2000). Fairly continuous habitat but may be constrained by impervious surface in some areas. Road barriers or scattered rural development did not preclude designation as a Constrained Linkage.
Missing Link or Riparian Corridor (500m)	< 70% Natural Landcover (NLCD 2000). Riparian corridors may include restorable agricultural landcover. For terrestrial linkages, if length includes > 2km gap of impervious surface area considered Missing Link or Steppingstone.

Metrics for Assessment

Several metrics were calculated for each linkage buffer and surrounding landscape context buffer to assess conservation gains, losses, threats, opportunities and challenges (see Table 2). For the great majority of datasets, area in acres was calculated and summarized within the buffers associated with each MLA. The percentage of each buffer was also calculated for each dataset. When metrics included both 2000 and 2024/2025 comparisons, percent change was calculated. for example, percent natural landcover change was calculated as: ((NLCD2024 – NLCD2000) / NLCD2000) * 100.

For datasets based on linear features (e.g., Linear Infrastructure, Wildlife Movement Barriers, Wild & Scenic Rivers), length in miles was calculated and summarized within each MLA buffer. For point-based datasets (i.e., Caltrans Fish and Wildlife Barrier Remediation Projects, Fish Passage Priorities), the number of features per buffer were summed and the Project ID or Fish Passage Assessment ID was recorded. From the Landscape Intactness (CBI 2025) dataset, including average, standard deviation and number of observations were calculated for Landscape Intactness, Weighted Road Density, and Network Metrics for Patch Neighborhood and Core Neighborhood within each MLA buffer. Additionally, one dataset was assessed using a binary (yes/no) indicator to denote presence or absence within each buffer.

We also calculated the area and percentage overlap with several statewide and regional connectivity assessments conducted since 2000 for each MLA buffer.

The following statewide and ecoregional summaries provide an overview of the results of the analyses based on the linkage buffers. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Table 2. Metrics to Assess Connectivity Gains, Losses, Threats, Challenges and Opportunities

DATA	METRIC	SOURCE AND YEAR
METRICS FOR CONNECTIVITY GAINS		
Protected Areas & Conservation Easements	Acres, % cover	CPAD/CCED 2025a; CDFW 2025a
Natural Community Conservation Plans/Multiple Species Conservation Plans	Acres, % cover, and % change	San Diego Gas and Electric 1995; County of Orange Central/Coastal 1996; City of Poway 1996; City of San Diego 1997; Kern Water Bank 1997; South San Diego County 1998; City of La Mesa 1999; City of Carlsbad 2004; Western Riverside County 2004; City of Chula Vista 2005; Coachella Valley 2008; East Contra Costa County 2007; San Diego County Water Authority 2011; Santa Clara Valley Habitat Plan 2013; Desert Renewable Conservation Plan 2016; Orange County Transportation Authority 2017; Yolo County 2019; Placer County Conservation Plan 2021
Resource Conservation Investment Strategy	Binary: yes/no in boundary	BIOS layer ds3011
Designated critical habitat for ESA-listed species	Acres, % cover, and % change, Miles	USFWS 2025; NMFS 2023
Active & Planned Terrestrial Wildlife Barrier Remediation Projects	Number/Count	Caltrans 2024a
Active, Planned & Remediated Fish Passage Remediation Projects	Number/Count	Caltrans 2024b
Wilderness Areas and Wild and Scenic Rivers	Acres, % cover, and % change, Miles	National Wilderness Areas 2025; USA Wild and Scenic Rivers 2025; California Department of Water Resources 2022; CalWild 2019
METRICS FOR CONNECTIVITY LOSSES		
Natural Landcover	Acres, % cover, and % change	USGS NLCD 2024
Impervious Surfaces	Acres, % cover, and % change	USGS NLCD 2024
Tree Cover and Shrub Cover	Acres, % cover, and % change	Allred et al. 2021
METRICS FOR THREATS TO CONNECTIVITY		
Projected Land Use Patterns Business As Usual Projections	Acres, % cover	Sleeter et al. 2017

Renewable energy projects (solar and wind)	Acres, % cover, Number/Count	BLM 2016; Fujita et al. 2023; CEC 2025; Hoen et al. 2025
Williamson Act - Nonrenewal	Acres, % cover	California Department of Conservation 2024
Timber Harvest Areas Private and Industrial Timberlands	Acres, % cover	CALFIRE 2025
METRICS FOR EVALUATING CHALLENGES TO PROTECTING AND RESTORING CONNECTIVITY		
Linear infrastructure	Type/Length Miles	TIGER 2024; Caltrans 2024cd
Average Weighted Road Density	Index/per km^2	Conservation Biology Institute (CBI) 2025
Ownerships per linkage > 10 acres	Number, Avg Size, Max Size	TNC unpublished
Land Values for Parcels > 10 acres	Avg Cost/Acre	TNC unpublished
Land Use Zoning for Development	Acres, % cover	California Office of Land Use and Climate Innovation 2024ab
METRICS TO EVALUATE CONNECTIVITY OPPORTUNITIES		
Caltrans Priority Unfunded Terrestrial Wildlife Barriers	Number/Count	Caltrans 2024a
Caltrans Priority Unfunded Fish Passage Barriers	Number/Count	Caltrans 2024b
Fish Passage Priorities	Number/Count	CDFW 2023
Wildlife Movement Barriers	Miles	CDFW 2025b
Designated critical habitat for ESA-listed species	Acres, % cover, and % change, Miles	USFWS 2025; NMFS 2023
Terrestrial Irreplaceability Areas of Conservation Emphasis Ranks 4 & 5	Acres, % cover	CDFW 2024
Terrestrial Connectivity Areas of Conservation Emphasis Ranks 4 & 5	Acres, % cover	CDFW 2025c
Land Use Zoning Open Space	Acres, % cover	California Office of Land Use and Climate Innovation 2024ab
Landscape Intactness	Index, Average	CBI 2025
Network Metrics: Patch Neighborhood 1-km circular radius, Core Neighborhood 1-km radius	Index	CBI 2025
Working Lands Williamson Act 2023	Acres, % cover	California Department of Conservation 2024
Inventoried Roadless Areas - Roadless Area Conservation Rule	Acres, % cover	USDA Forest Service 2001

Statewide Missing Linkages Summary

The 333 linkage buffers across the state of California range in size from 1,089 to 503,272 acres (average 45,271 acres; SD 55,327 acres) with a net area of 14,189,970 acres. In 2000, 71% (235/333) of linkage buffers met or exceeded the recommended 2km (1.2 mi) minimum linkage width (Beier 2018) and met the requirements of either >85% natural landcover for Linkages (2km wide); >95% natural landcover for Landscape Linkages (5km wide), or >98% natural landcover for Large Landscape Linkages (10km wide). By 2025, 65% (219 of 333) of linkage buffers met or exceeded these same standards. Additionally, by 2025, 55% of constrained linkage buffers would now be considered "missing links" due to loss of natural landcover, such that they no longer meet the >85% natural landcover requirement.

Linkage type statistics and breakdown by ecoregion:

- 90 Large Landscape Linkages (10km wide), average 85,844 acres (range 34,958-503,272 acres)
- 87 Landscape Linkages (5km wide), average 70,898 acres (range 13,955-395,180 acres)
- 58 Linkages (2km wide), average 16,033 acres (range 2,414-89,258 acres)
- 31 Constrained Linkages (1km wide), average 6,845 acres (range 1,251-29,902 acres)
- 67 Riparian Corridors or Missing Links (500m wide), average 6,426 acres (range 1,089-21,421 acres)

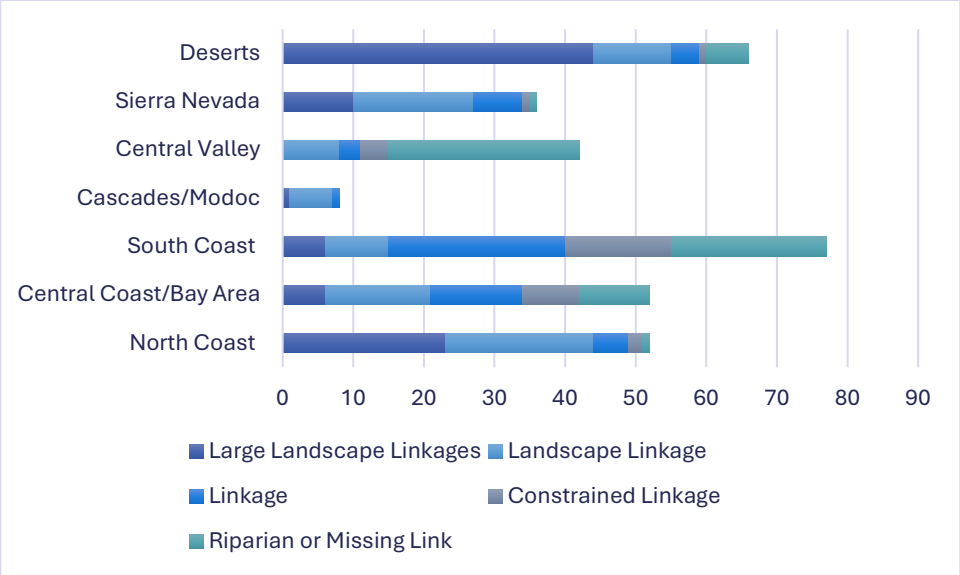


FIGURE 1. LINKAGE TYPE BY ECOREGION.

Impervious Surface Change, 2000-2024

- Increase of approximately 62,835 acres of impervious surface (USGS 2024) across the net area of the linkage buffers 2000-2024
- In 2024, impervious surface cover across all linkage buffers averages 9%
- 87% (290) of linkage buffers have < 20% impervious surface in 2024
- 6% (21) of linkage buffers have 20-40% impervious surface in 2024
- 4% (14) of linkage buffers have 40-60% impervious surface
- 6 linkage buffers have 60-80% impervious surface
- Less than 1% (2) of linkage buffers have >80% impervious surface in 2024:
    - Griffith Park-Verdugo (89% impervious surface in 2024; 90% impervious surface in 2000)

    - Puente-San Jose-San Gabriel (88% impervious surface in 2024; 77% impervious surface in 2000))

Natural Landcover Change, 2000-2024

- Loss of 82,429 acres of natural landcover 2000-2024 (USGS 2024) across all linkage buffers
- 74% (247) of linkage buffers retain >80% natural landcover as of 2024
    - 100% (90/90) of Large Landscape Linkages still meet >98% natural landcover threshold
    - 91% (79/87) of Landscape Linkages still meet >95% natural landcover threshold
    - 86% (50/58) of Linkages still meet >85% natural landcover threshold
    - 45% (14/31) Constrained Linkages retain > 85% natural landcover
- 8% (28) of linkage buffers retained 60–80% natural landcover
- 7% (24) of linkage buffers retained 40-60% natural landcover
- 10% (34) of linkage buffers have <40% natural landcover in 2025
- 82% (272) of linkage buffers saw at least some reduction in natural landcover, averaging roughly 350 acres per linkage (range 2.40 to 21,376 acres).
    - 13 linkage buffers lost > 1,000 acres of natural landcover
    - Fresno-Sacramento Landscape Linkage in Central Valley had the greatest loss in natural landcover at 21,376 acres but still retains 87% natural landcover
- 17% (57) of linkage buffers saw an increase in natural landcover, ranging from 1.34 to 1,244 acres with an average increase of 172 acres
- Tule River Riparian Corridor in the Central Valley had the largest increase in natural landcover, at 1,244 –acres, suggesting restoration

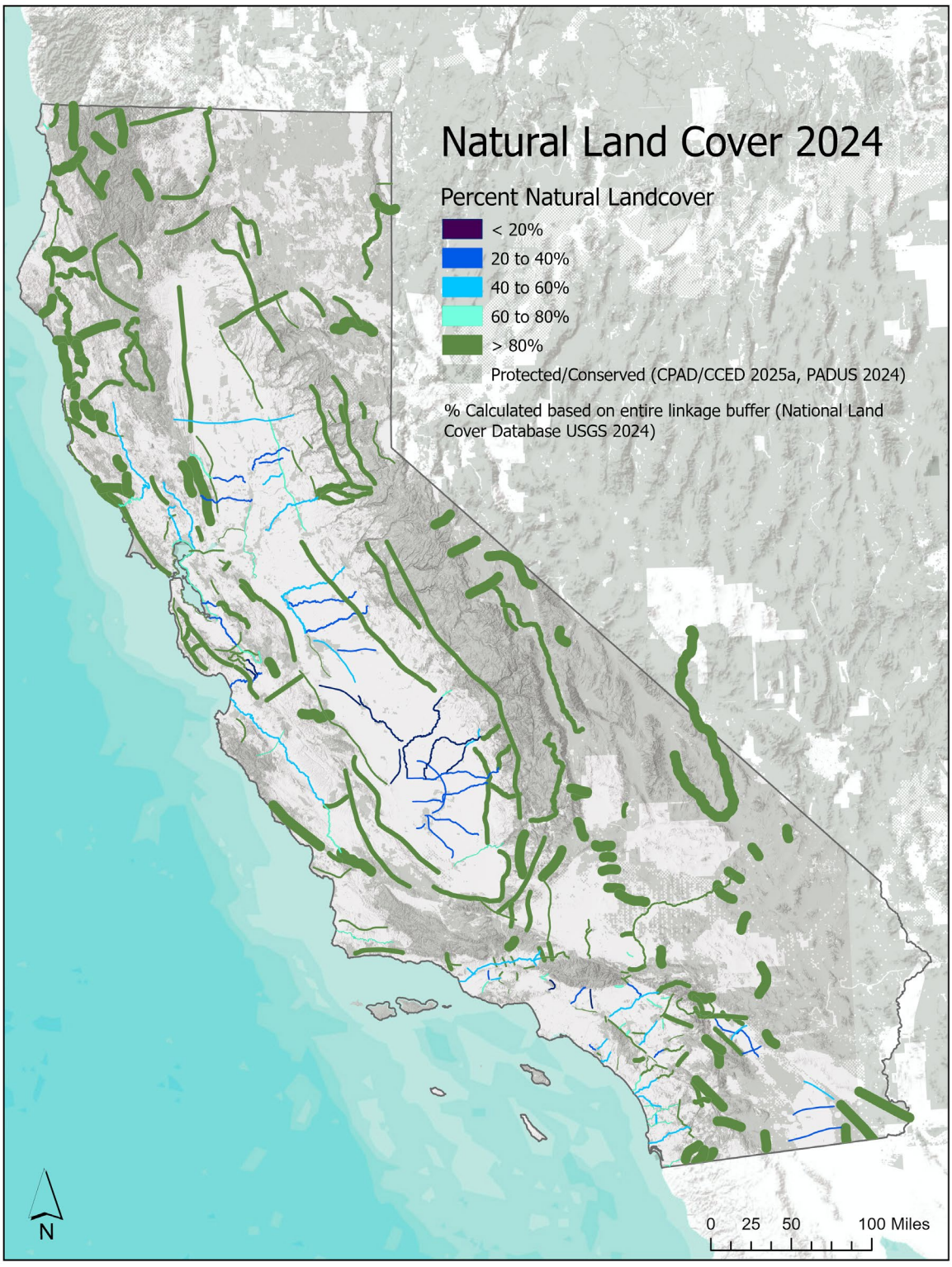


FIGURE 2. NATURAL LAND COVER ACROSS LINKAGE BUFFERS.

Protection Status 2000-2025

An estimated 993,089 net acres have been added to conservation across linkage buffers since 2000. As of 2025, 61% (8,642,776/14,189,970 acres) of the net linkage area across the state is protected in fee or conservation easement (CPAD/CCED 2025a, CDFW 2025a).

- 20% (68) linkage buffers are > 80% protected/conserved
- 12% (40) of linkage buffers are 60-80% protected/conserved, 35 still >80% natural landcover
- 24% (81) of linkage buffers are 40-60%, protected/conserved, 68 still >80% natural landcover
- 20% (67) of linkage buffers are 20-40% protected/conserved, 41 still >80% natural landcover
- 23% (77) of linkage buffers are < 20% protected/conserved, 35 still >80% natural landcover
- 46% (152) of linkage buffers saw >1,000-acre increase in protection since 2000, while 26 saw >10,000-acre increase in protection during this time frame
- The Top 10 linkage buffers with the greatest increase in protection were all Large Landscape Linkages (10km wide) or Landscape Linkages (5km wide):
    - Southern Diablo-Carrizo (+71,9996 acres) in Central Coast Ecoregion
    - Los Padres-Hearst Castle (+63,015 acres) in Central Coast Ecoregion
    - Owens Lake (+43,903 acres) in Sierra Nevada Ecoregion
    - Blue Ridge-Berryessa (+40,786 acres) in North Coast Ecoregion
    - Southern Sierra Checkerboard west (+36,922 acres) in Sierra Nevada Ecoregion
    - Southern San Joaquin Valley (+36,121 acres) in Central Valley Ecoregion
    - Red Mountain-Sinkyone (+28,185 acres) in North Coast Ecoregion
    - Southern Sierra Checkerboard central (+27,239 acres) in Sierra Nevada Ecoregion
    - Peninsular-Borrego (+22,908 acres) in Desert Ecoregion
    - Pinoche Valley-Highway 25 (+20,800 acres) in Central Coast Ecoregion
- Roughly 53% of the increase in protected and conserved acres in the linkage buffers between 2000-2025 was in the North Coast and Central Coast Ecoregions (see Figure 2).

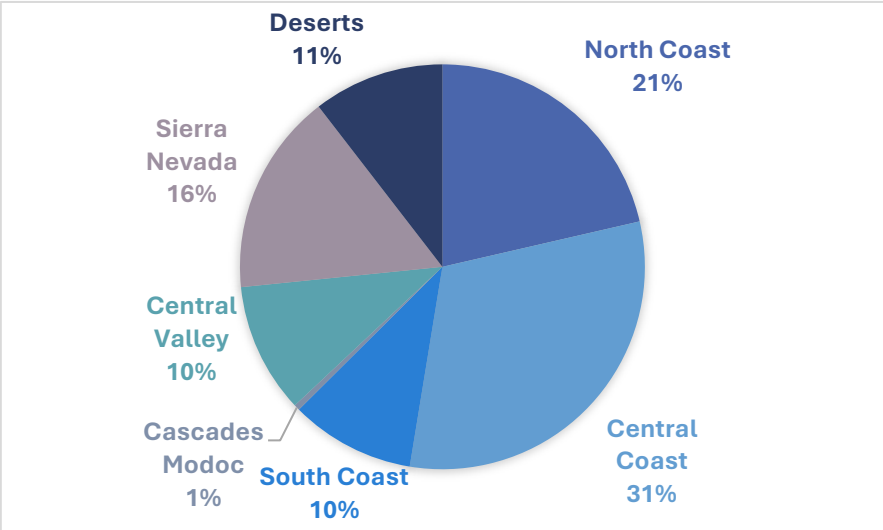


FIGURE 3. PERCENT OF ACRES PROTECTED/CONSERVED BETWEEN 2000-2025

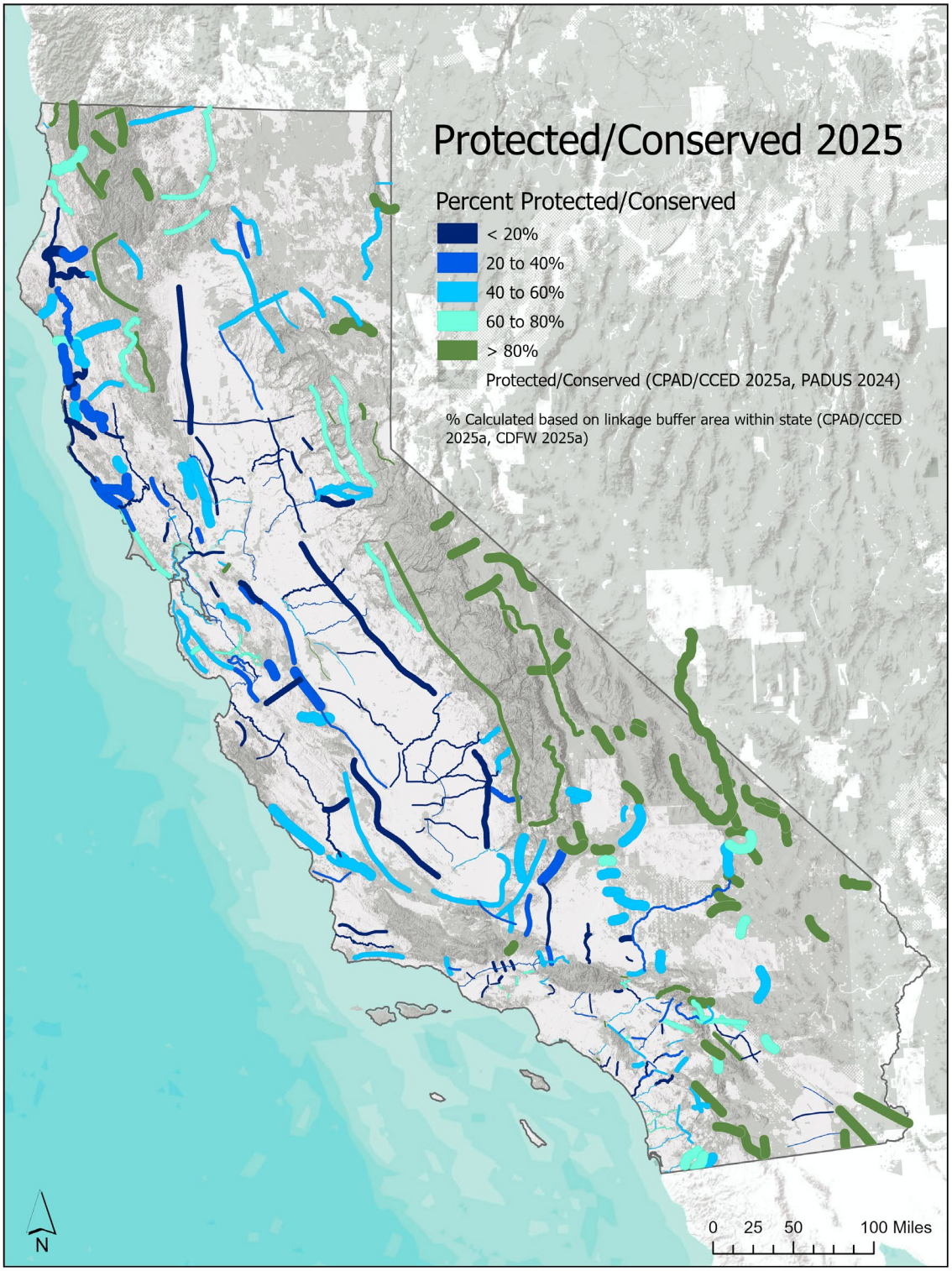


FIGURE 4. PERCENT OF ACRES PROTECTED/CONSERVED BETWEEN 2000-2025

Federal and State Designations for Conservation Lands in California 2000-2025

- Federal Wilderness Area Designations (USDA Forest Service 2025)
  - Net increase of 217,522 acres (2000–2025) across all linkage buffers in state
  - 2000: 28% (92) of linkage buffers include Wilderness; total 1,826,657 acres; average 5,904 acres per linkage
    - 83 linkage buffers include >1,000 acres of designated Wilderness
    - 55 linkage buffers include >10,000 acres of designated Wilderness
  - 2025: 32% (107) of linkage buffers include Wilderness; total 2,044,179 acres; average 6,665 acres per linkage
    - 95 linkage buffers include >1,000 acres of Wilderness
    - 60 linkage buffers include >10,000 acres of Wilderness
  - 2025: 16% (53) of linkage buffers have >20% Wilderness
    - Linkage buffers with >80% of their area designated as Wilderness are all Large Landscape Linkages (10km wide) associated with the California Deserts:
      - Panamint Dunes
      - Emigrant Pass (2 linkages)
      - Kingston-Mesquite
      - Silurian-Avawatz Mountains, increased from 41 to 81% Wilderness
- Federal and State Wild and Scenic Rivers Designations (Inter-agency Wild and Scenic River Council 2025, California Department of Water Resources 2022, CalWild 2019)
  - Increase of 91 miles in linkage buffers (2000–2025)
  - 2000: 11% (35) of linkage buffers contain Wild and Scenic Rivers; total 669 miles
  - 2025: 15% (50) of linkage buffers contain Wild and Scenic Rivers; total 760 miles
  - The linkage buffers with the largest gains in Wild and Scenic Rivers:
    - Amargosa River 0-26.72 miles
    - Morongo Valley 0-19.26 miles
    - E. Sierra-White Mountains 0-17.40 miles
    - Whitewater River 0-14.29 miles
    - Resting Springs 0-7.46 miles
    - San Jacinto-Santa Rosa 0-6.21 miles
    - Cache Creek-Bear Valley 0-5.59 miles
- Inventoried Roadless Areas (Roadless Area Conservation Rule; USDA Forest Service 2001)
  - Present in 22% (73) of linkage buffers; total 744,625 acres
  - 7% (24) of linkage buffers overlap >20% Inventoried Roadless Area
  - 25 linkage buffers have Inventoried Roadless Areas >10,000 acres
  - White Mountains-Benton Range/Mono Lake has greatest area 57,788 acres

Critical Habitat 2000-2025

Across linkage buffers in California:

- Terrestrial Critical Habitat (USFWS 2025) increased from 654,525 acres in 2000 to 3,026,141 acres in 2025 across linkage buffers in the state
- Aquatic Critical Habitat (USFWS 2025, NMFS 2023) increased from 1,034 miles in 2000 to 3,889 miles in 2025
- As of 2025, 79% (264) of linkage buffers include Terrestrial Critical Habitat, with 55% (184) including over 1,000 acres and 21% (70) having > 40% of their area designated
- 12 linkage buffers increased from < 1% Terrestrial Critical Habitat in 2000 to > 80% in 2025

- As of 2025, 28% (94) of linkage buffers have > 1 mile of designated Aquatic Critical Habitat, with 23% (77) including more than 6 miles and 8% (25) including more than 62 miles.

Conservation Plans 2000-2025

- In 2000, seven Natural Community Conservation Plans (NCCP) were in the implementation phase (San Diego Gas and Electric 1995, County of Orange Central/Coastal 1996, City of Poway 1996, City of San Diego 1997, Kern Water Bank 1997, South San Diego County 1998, City of La Mesa 1999) covering a net area of 68,770 acres across 5% (16) of linkage buffers.
- In 2025, 18 NCCPs were in the implementation phase , covering a net area of 2,057,982 acres across 39% (130) of linkage buffers, with 11 additional plans completed since 2000 (City of Carlsbad 2004, Western Riverside County 2004, City of Chula Vista 2005, Coachella Valley 2008, East Contra Costa County 2007, San Diego County Water Authority 2011, Santa Clara Valley Habitat Plan 2013, Desert Renewable Conservation Plan 2016, Orange County Transportation Authority 2017, Yolo County 2019, Placer County Conservation Plan 2021).
- The 130 linkage buffers that overlap with an NCCP have an average of 17,299 acres described for conservation, with individual buffers ranging from 29 to 162,663 acres. Of these 130 linkage buffers:
    - 18 have > 80% of the linkage buffer area described for conservation
    - 22 have 60 to 80% of the linkage buffer area described for conservation
    - 32 have 40 to 60% of the linkage buffer area described for conservation
    - 23 have 20 to 40% of the linkage buffer area described for conservation
    - 35 have < 20% of the linkage buffer area described for conservation
- Resource Conservation Investment Strategies:
    - Eleven plans completed between 2019-2024
    - 31% (104) of linkage buffers overlap at least one of the following RCIS planning areas:
        - North Bay Baylands RCIS (2024): Overlap with % (6 linkage buffers)
        - East Bay RCIS (2021): Overlap with % (15 linkage buffers)
        - Santa Clara RCIS (2019): Overlap with % (17 linkage buffers)
        - Santa Cruz RCIS (2023): Overlap with % (6 linkage buffers)
        - Monterey County RCIS (2021): Overlap with % (11 linkage buffers)
        - Yolo County RCIS (2020): Overlap with 8 linkage buffers
        - Mid-Sacramento Valley (2021): Overlap with 2 linkage buffers
        - Antelope Valley RCIS (2022): Overlap with 8 linkage buffers
        - San Bernardino County RCIS (2024): Overlap with 32 linkage buffers
        - Kaweah Groundwater Subbasin RCIS (2022): Overlap with 6 linkage buffers
        - San Joaquin Valley RCIS (2025): Overlap with 16 linkage buffers

Land Use and Zoning

65% (9,541,165 acres) of the total linkage buffer area across the state is zoned as open space (California Office of Land Use and Climate Innovation [COLUCI] 2024ab), including existing protected lands.

- 30% (99) of linkage buffers are zoned > 80% open space
- 13% (43) of linkage buffers are zoned 60–80% open space
- 24% (80) of linkage buffers are zoned 40-60% open space
- 17% (57) of linkage buffers are zoned 20-40% open space
- 16% (54) of linkage buffers are zoned <20% open space

6% (901,518 acres) of the total linkage buffer area across the state is zoned for development [COLUCI 2024ab).

- 74% (248) of linkage buffers are zoned <20% development, 208 remain 80-100% natural
- 15% (50) of linkage buffers are zoned 20-40% development, 30 remain 72-99% natural
- 8% (25) of linkage buffers are zoned 40-60% development; 15 remain 71-97% natural
- < 1% (5) of linkage buffers are zoned 60-80% development; 4 remain 74-97% natural
- < 1% (5) of linkage buffers are zoned for 60-80% development; 3 remain 76-86% natural

Business As Usual Development Projections for 2050

Development Projections for 2050 under "Business as Usual" patterns (Sleeter et al. 2017) suggest:

- 76% (252) of linkage buffers projected to be < 20% developed by 2050
- 10% (33) of linkage buffers projected to be 20-40% developed by 2050
- 6% (20) of linkage buffers projected to be 40-60% developed by 2050
- 5% (18) of linkage buffers projected to be 60-80% developed by 2050
- 3% (10) of linkage buffers projected to be > 80% developed by 2050
    - Southern Corona-Temecula Foothills Constrained Linkage projected to be 86% developed by 2050, is currently 66% zoned for development yet retains 86% natural landcover

Working Lands

- 55% (183) of linkage buffers include Williamson Act enrolled lands (Department of Conservation 2024), with an average of 11,119 acres per linkage, ranging from 1.91 to 195,779 acres, and covering a net total of 1,965,238 acres across linkage buffers.
- Of the 183 linkage buffers that include Williamson Act enrolled lands:
    - 1 has > 80% of the linkage buffer area enrolled
    - 11 have 60 to 80% of the linkage buffer area enrolled
    - 38 have 40 to 60% of the linkage buffer area enrolled
    - 38 have 20 to 40% of the linkage buffer area enrolled
    - 83 have < 20% of the linkage buffer area enrolled
- 22% (40) of the linkage buffers with Williamson Act enrolled lands have > 10,000 acres enrolled, all of which retain 87-100% natural landcover, including 10 Large Landscape Linkages (10km wide), 26 Landscape Linkages (5km wide), and 4 Linkages (2km wide)
- 3 linkage buffers with the most enrolled acreage lie within the Central Valley:
    - Fresno-Sacramento supports the most acreage (195,779 acres, 77% of linkage), which retains 87% natural landcover
    - Sacramento Valley Grasslands (146,446 acres, 81% of linkage), which retains 98% natural landcover
    - Carrizo Plain-W. San Joaquin Valley (103,750 acres, 54% of linkage), which retains 95% natural landcover
- 10% (33) of linkage buffers include non-renewal lands totaling 21,641 acres, 6 of which include > 1000 acres of non-renewal acreage
- 19% (63) of linkage buffers had completed/approved timber harvest plans on private timberlands between 2010-2025 (CalFire 2025), ranging from 2.81 to 22,204 acres per linkage and covering a net area of 296,024 acres across linkage buffers
- Mendocino Redwoods Circle (6e) has the largest area of completed/approved timber harvest plans (22,204 acres covering 25% of its area)
- Of the 63 linkage buffers that include timber harvest plans:
    - Only 1 linkage buffer, Mendocino Redwoods Circle (6b), has > 40% of its area (16,805 acres) covered by timber harvest plans
    - 21% (13/63) have between 20 to 40% of the linkage buffer covered by timber harvest plans

- 78% (49/63) have < 20% of the linkage buffer covered by timber harvest plans

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers across the state (CBI 2025):

- 6% (19) of linkage buffers ranked as Very High Landscape Intactness (.75 to 1.00), all of which are associated with the Desert Ecoregion
- 18% (60) of linkage buffers ranked as High Landscape Intactness (.75 to .50)
- 41% (138) of linkage buffers ranked as Moderately High Landscape Intactness (.50 to 0)
- 35% (115) of linkage buffers ranked as Moderately Low Landscape Intactness (0 to -.50)
- 1 linkage buffer ranked as Low Landscape Intactness (-.50 to -.75)

Overlap with Statewide Connectivity Analyses

A total of 67% (222) of linkage buffers had >80% overlap with at least one statewide connectivity analysis and less than 25% of area identified as impeded (TNC 2017).

- Statewide Connectivity Studies Overlap Statistics:
  - California Essential Habitat Connectivity Network (Spencer et al. 2010):
    - 63% overlap across all linkage buffers (9,258,149 acres)
    - 33% (110) of linkages have > 80% overlap
  - Present-Day Connectivity Omniscape (TNC 2017):
    - 84% overlap across all linkage buffers for combined Diffuse, Intensified, Channelized categories (12,277,830 acres)
    - 56% (186) of linkage buffers have > 80% overlap
  - Resilient and Connected Network (TNC 2020):
    - 68% overlap across all linkage buffers (9,903,750 acres)
    - 32% (108) of linkage buffers have >80% overlap
  - Climate-specific linkages (Schloss et al. 2021):
    - 18% overlap across all linkage buffers (2,589,590 acres)
    - Average overlap of 8,389 acres per linkage buffer
    - 3 linkage buffers are > 60% climate-specific linkages (Morongo Valley, Cajon Pass, Klamath-Siskiyou-Cascades)
    - 4% (13) of linkage buffers are 40-60% climate-specific linkages
    - 31% (102) of linkage buffers are 20-40% climate-specific linkages
    - 65% (215) of linkage buffers are < 20% climate-specific linkages

Infrastructure

- Roads and Rail
  - Primary roads (TIGER 2024) overlap 41% (136) of linkage buffers, totaling ~681 miles (range: 0.03–63.29 miles)
  - Secondary roads (TIGER 2024) overlap 74% (246) of linkage buffers, totaling 2,208 miles (range: 0.09–99.62 miles)
  - Total road length (Caltrans 2024a) across all linkages: 29,623 miles, average: 98.6 miles per linkage (range: 2.95 for Surprise Valley Bighorn Sheep to 960.41 miles at Owens Lake)
  - Average weighted road density across linkage buffers: 1.32 miles^2 (range: 0.03 miles^2 for Panamint Dunes to 6.97 miles^2 at Griffith Park-Verdugo Hills)
  - Railroads (Caltrans 2024b) cross 42% (140) linkages, totaling ~555 miles (range: .31–52.15 miles)
- Renewable Energy

- Solar installations (Hoen et al. 2025, CEC 2025) overlap 17% (57) of linkage buffers, totaling 10,189 acres across linkage buffers
- The two largest solar installation acreage overlaps two of the San Gabriel-Tehachapi Linkages, together totaling 3,330 acres
- Wind energy (Fujita et al. 2023) development overlaps 15 linkages, with 2,416 turbines, ranging from two to 684 turbines per linkage, with a San Gabriel-Tehachapi linkage having the greatest number.

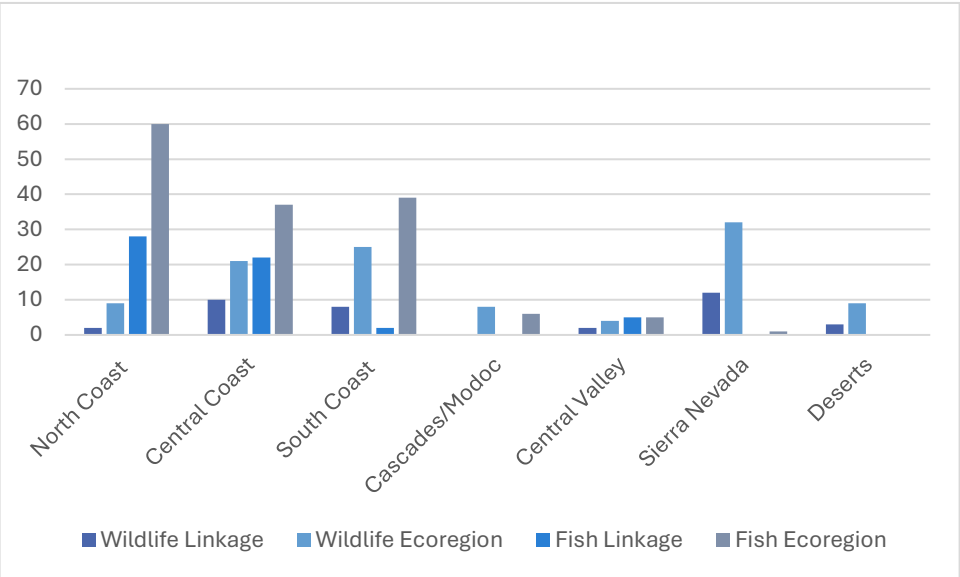
- Wildlife Barriers and Remediation
  - California Department of Fish and Wildlife (CDFW 2025b) has identified 656 miles of wildlife barriers that intersect linkage buffers. This represents 22% of total net miles (3,005 miles) of wildlife barriers identified by CDFW throughout the state.
  - 39% (130) of linkage buffers intersect CDFW barriers, ranging from 0.15 to 54.40 miles.
  - CDFW has identified 204 linear barrier segments across the state, and linkage buffers intersect 126 (61%) of CDFW barrier segments.
  - Caltrans has 88 Active, Planned or Unfunded Barrier Remediation Projects that intersect linkage buffers. This includes 34 Terrestrial Wildlife Barriers, representing 31% of total wildlife barrier locations (108) identified by Caltrans (2024c). This also includes 54 Fish Passage Barriers, representing 36% of total fish and wildlife barrier locations (148) identified by Caltrans (2024d).
  - 15% (50) of linkage buffers have at least one Caltrans Active, Planned or Unfunded Fish or Wildlife Barrier Remediation Project, with 19 linkage buffers have > 2 projects
  - Southern Sierra Checkboard westernmost linkage buffer has the greatest number of Terrestrial Wildlife Barrier Remediation Projects, with 7 projects identified along State Route 58 between the Tehachapi Mountains and southern Sierra Nevada Mountains.
  - 

FIGURE 5. CALTRANS FISH AND WILDLIFE BARRIER REMEDIATION PROJECTS (ACTIVE, PLANNED, AND UNFUNDED PRIORITIES) WITHIN LINKAGE BUFFERS.

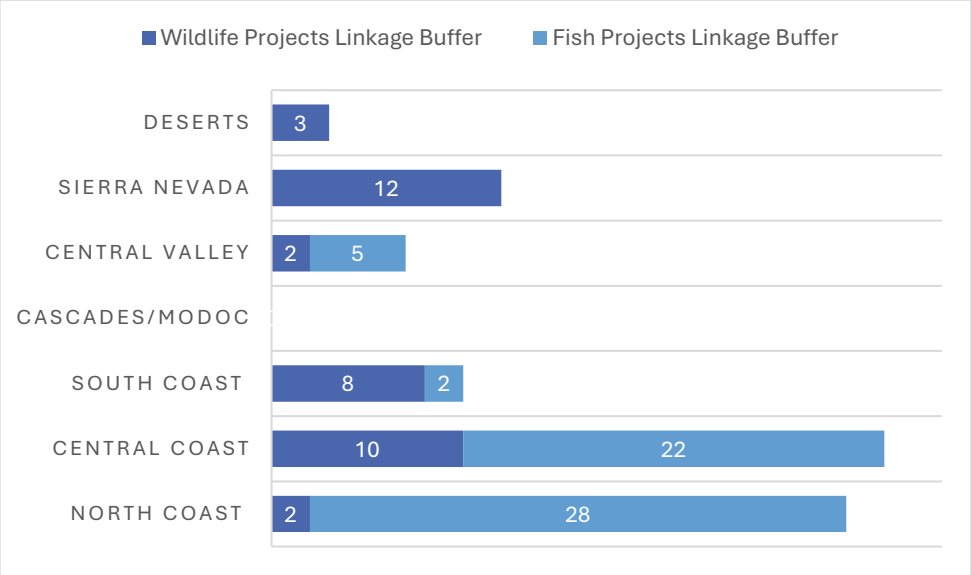


FIGURE 6. FISH AND WILDLIFE BARRIER REMEDIATION PROJECTS (ACTIVE, PLANNED, AND UNFUNDED PRIORITIES) WITHIN LINKAGE BUFFERS AND TOTALS BY ECOREGION.

Ecoregional Linkages Summaries

Below we present a summary of the results of the assessments for each of the seven ecoregions (Figure 8): North Coast, Central Coast/Bay Area, South Coast, Great Central Valley, Cascades/Modoc Plateau, Sierra Nevada, and Mojave and Sonoran Deserts.

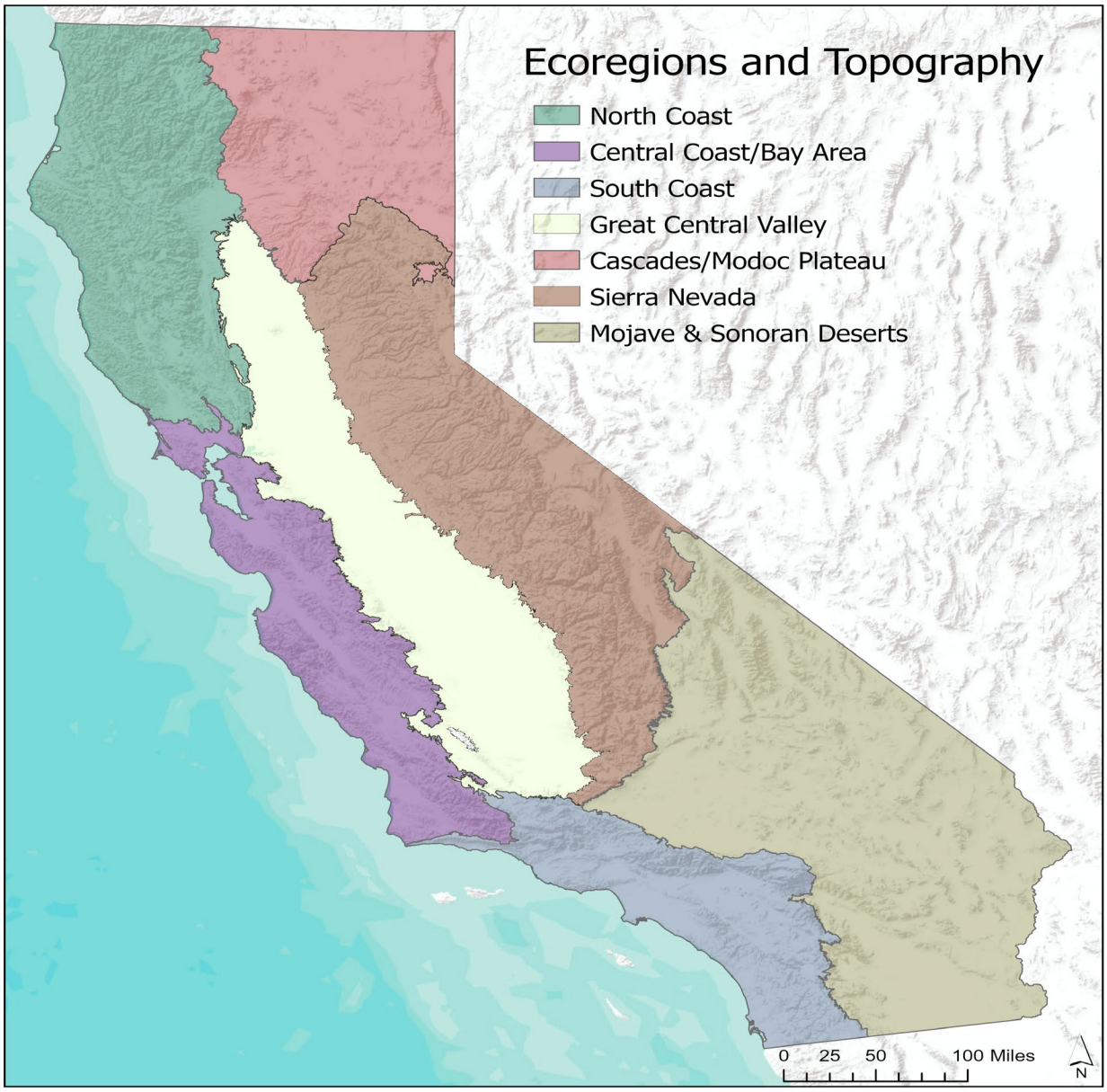


FIGURE 7. CALIFORNIA ECOREGIONS AND TOPOGRAPHY.

North Coast Ecoregion Summary

The North Coast Ecoregion extends from northern Sonoma County to Del Norte County, encompassing rugged coastlines, forested mountains, and river valleys shaped by the Pacific Ocean. Major rivers—including the Klamath, Eel, Navarro, and Ten Mile—flow westward into estuaries that support rich biodiversity. The region's habitats include mixed coniferous and evergreen forests, coastal prairies, riparian woodlands, freshwater wetlands, and estuaries, all influenced by a temperate, fog-rich climate. These ecosystems provide critical spawning grounds for coho and Chinook salmon, and upland forests support species like the northern spotted owl and Pacific fisher. The region is home to numerous tribes, such as the Yurok, Hoopa Valley, Karuk, Bear River Band of Rohnerville Rancheria, Round Valley, and Manchester Band of Pomo, whose land stewardship and cultural heritages are integral to the landscape. Land ownership is a mix of public lands—including national forests (Six Rivers, Klamath, Mendocino, and Shasta-Trinity), state parks, and Bureau of Land Management lands—and private holdings, notably by industrial timber companies.

Despite retaining high levels of natural landcover and ecological integrity over the last 25 years, the region continues to face localized threats from logging, road construction, water diversion, and development zoning, which fragment habitats and impact wildlife movement and stream health.

There are 52 linkages buffers associated with the North Coast Ecoregion, ranging in size from 2,249 to 176,198 acres with a net area of ~3 million acres, of which 2.9 million acres are in California. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

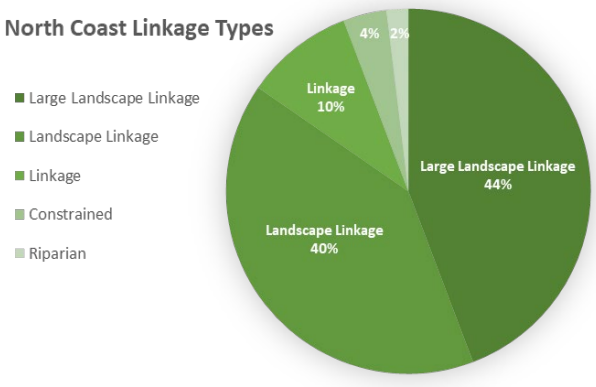


FIGURE 8. THE DIFFERENT TYPES OF LINKAGES IN THE NORTH COAST

Breakdown by linkage type is detailed below and in Figure 9.

- 23 Large Landscape Linkages (10km wide)
- 21 Landscape Linkages (5km wide)
- 5 Linkages (2km wide)
- 2 Constrained Linkages (1km wide)
- 1 Riparian Corridor (500m wide)

Natural Landcover Change, 2000-2025

- Loss of 1,252 acres of natural landcover across all linkage buffers since 2000
- 94% (49) of linkage buffers retain >90% natural landcover
- 89% (45) of linkage buffers retain >95% natural landcover
- 67% (35) of linkage buffers saw a reduction in natural landcover ranging from 16 to 557 acres
- Klamath Siskiyou-Cascades Linkage saw a 700-acre increase in natural landcover, suggesting restoration.

Impervious Surface Change, 2000-2025

- Increase of 1,747 acres in impervious surfaces across all linkage buffers since 2000
- 67% (35) of linkage buffers have >1,000 acres of impervious surface
- South Fork Eel linkage buffer has the greatest amount of impervious surface (4,450 acres).

Protection Status 2000-2025

A total of 217,266 acres has been added to conservation across linkage buffers since 2000. As of 2025, 57% of the net linkage area is protected in fee or conservation easement.

- Average percentage protected per linkage: 49%
- 21% (11) of linkage buffers are >80% protected/conserved
- 12% (6) of linkage buffers are 60–80% protected/conserved; all remain > 95% natural landcover
- 25% (13) of linkage buffers are 40–60% protected/conserved; 12 remain > 90% natural landcover
- 19% (10) of linkage buffers are 20–40% protected/conserved; all remain > 95% natural landcover
- 23% (12) of linkage buffers are <20% protected/conserved; 9 remain > 85% natural landcover
- 10 linkages had >10,000 acres protected/conserved between 2000–2025
- Largest gains:
    - Blue Ridge–Berryessa: +40,786 acres
    - Red Mountain–Sinkyone: +28,185 acres

Federal and State Conservation Land Designations in California

- Wilderness Area Designations
    - Increase of 69,011 acres (2000–2025)
    - 2000: 27% (14) of linkage buffers included Wilderness; total 281,157 acres; average 20,0823 acres per linkage
    - 2025: 42% (22) of linkage buffers in Wilderness; total 350,168 acres; average 15,917 acres
    - 2025: 19% (10) of linkage buffers have >20% Wilderness; highest: 55% (Yolla Bolly–Snow Mountain)
- Federal and State Wild and Scenic Rivers Designations
    - Increase of 6.46 miles (2000–2025)
    - 2000: 44% (23) of linkage buffers contain Wild and Scenic Rivers; total 485 miles
    - 2025: 50% (26) of linkage buffers contain Wild and Scenic Rivers; total 492 miles; average 18.92 miles (range .26 to 123.03 miles)
- Inventoried Roadless Areas
    - Present in 35% (18) linkage buffers; total 258,868 acres; average 14,382 acres
    - 39% (7) of linkage buffers have >20% overlap with Inventoried Roadless Area

Critical Habitat 2000-2025

There was an overall increase of 777,544 acres and 1,436 miles of designated critical habitat in the linkage buffers.

- Terrestrial Critical Habitat increased from 0 acres in 2000 to 777,544 acres in 2025
    - 2025: 92% (48) of linkage buffers include Terrestrial Critical Habitat; average ~16,199 acres (range: 46-111,142 acres)
        - 58% (28) of linkage buffers include over 10,000 acres
        - 25% (12) of linkage buffers have > 40% of their area designated
    - Aquatic Critical Habitat increased from 893 miles in 2000 to 2,329 miles in 2025
        - 2000: 37% (19) of linkage buffers had aquatic critical habitat; net length of 893 miles
        - 2025: 67% (35) of linkage buffers have aquatic critical habitat; net length of 2,329 miles
        - 58% (30) of linkage buffers have > 16 miles of designated aquatic critical habitat

Conservation Plans

- Major industrial timber companies (e.g., Green Diamond Resource Company [USFWS 2019], Sierra Pacific Industries [2016, 2020ab], Humboldt Mendocino Redwoods Company [2019]) have Habitat Conservation Plans (HCP) for multiple species in the region (spatial data not available)
- Yolo RCIS and Land Conservation Plan (2020) overlaps two Blue Ridge-Berryessa linkages; sets framework for voluntary conservation/stewardship

Land Use and Zoning

- 63% of total linkage buffer area (1,853,857 acres) is zoned as open space (including existing protected lands).
    - 27% (14) of linkage buffers are zoned > 80% open space
    - 17% (9) of linkage buffers are zoned 60-80% open space
    - 19% (10) of linkage buffers are zoned 40-60% open space
    - 17% (9) of linkage buffers are zoned 20-40% open space
    - 19% (10) of linkage buffers are zoned <20% open space
- 6.7% of the total linkage buffer area (199,464 acres) is zoned for development.
    - 78% (41) of linkage buffers are zoned < 20% development
    - 17% (9) of linkage buffers are zoned 20-40% development
    - 2.5% (2) of linkage buffers are zoned 40-60% development (Russian River and Coastal Prairie and Wetlands 9c)

Business As Usual Development Projections for 2050

"Business As Usual" projections for 2050 suggest that the North Coast Ecoregion is not expected to experience significant growth.

Working Lands

- 71% (37) of linkage buffers had completed/approved timber harvest plans on private timberlands between 2010-2025, ranging from 29 to 22,204 acres per linkage and covering a net area of 170,500 acres across linkage buffers
    - Mendocino Redwoods Circle (6e) has the largest area of completed/approved timber harvest plans (22,204 acres covering 25% of its area)
    - Mendocino Redwoods Circle (6b), has > 40% of its area (16,805 acres) covered by timber harvest plans
- 56% (29) of linkage buffers currently enrolled in Williamson Act, ranging from 30 to 60,179 acres per linkage and covering a net total of 211,940 acres across linkage buffers
    - Eastern Blue Ridge-Berryessa Large Landscape Linkage supports the most enrolled acreage (60,179 acres) covering 34% of its area
- A total of 1,386 acres in Williams Act contracts were not renewed across four linkage buffers
    - South Fork Eel Landscape Linkage had the most acres not renewed (1,221 acres)

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers:

- 27% (14) of linkage buffers ranked High Landscape Intactness
- 54% (28) of linkage buffers ranked Moderately High Landscape Intactness
- 19% (10) of linkage buffers ranked Moderately Low Landscape Intactness
- Linkage buffers with Highest Average Landscape Intactness in the region
    - Two Blue Ridge-Berryessa Large Landscape Linkages
    - Klamath-Siskiyou North-South (19g) Large Landscape Linkage

Overlap with Statewide/Regional Connectivity Analyses

A total of 47 of 52 linkage buffers (>90%) had >80% overlap with at least one statewide or regional connectivity analysis.

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 60% overlap across all linkage buffers (1.78 million acres)
        - 27% (14) of linkage buffers had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017):
        - 91% overlap with the combined Diffuse, Intensified and Channelized categories across all linkage buffers (2.7 million acres)
        - 85% (44) of linkage buffers have >80% overlap

    - Resilient and Connected Network (TNC 2020):
        - 77% overlap across all linkage buffers (2.28 million acres)
        - 48% (25) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 24% overlap across all linkage buffers (716,000 acres)
        - Average of 14,851 acres of overlap per linkage
- Regional Connectivity Studies Overlap Statistics:
    - Critical Linkages Bay Area & Beyond (Penrod et al. 2013):
        - 17% (9) of linkage buffers have >80% overlap
    - Pacific fisher model (Spencer 2019):
        - 12% (6) of linkage buffers have >80% overlap
    - Pacific marten model (Spencer et al. 2019):
        - One linkage buffer has >80% overlap
    - Humboldt marten assessment (Slauson et al. 2019):
        - One linkage buffer has >80% overlap
    - Mayacamas to Berryessa Network (Gray et al. 2018):
        - 8% (4) of linkage buffers have >80% overlap
    - Sacramento Valley Assessment (Gallo et al. 2019):
        - One linkage buffer (Blue Ridge–Berryessa) has >80% overlap
    - Klamath-Siskiyou Conservation Assessment: (Strittholt et al. 1999):
        - 15% (8) of linkage buffers have >80% overlap

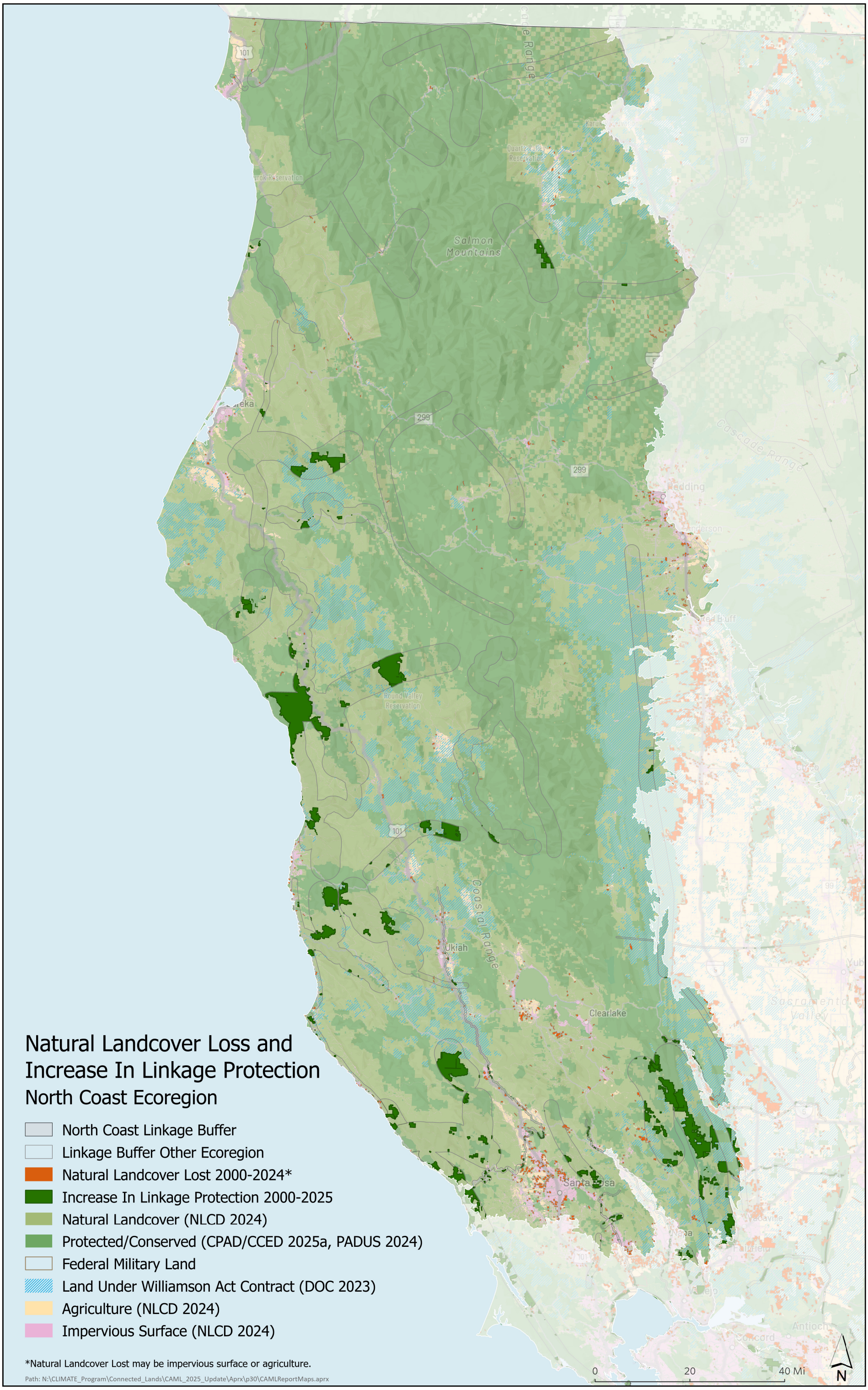
Infrastructure

- Roads and Rail
    - All 52 linkage buffers contain some form of rail or roadway infrastructure
    - Primary roads overlap 19% (10 linkage buffers), totaling ~105 miles (range: 0.03–63.29 miles)
    - Secondary roads overlap 77% (40 linkage buffers), totaling ~420 miles (range: 0.20–56.84 miles)
    - Total road length across all linkage buffers: ~6,772 miles (average: 147.74 miles per linkage)
    - South Fork Eel River linkage buffer has the highest road density and total road length
    - Average weighted road density per linkage buffer: 1.21 mi^2 (range: 0.30–3.83 mi^2)
    - Railroads cross 21% (11 linkage buffers), totaling ~84 miles (range: 1.14–22.18 miles)
- Wildlife Barriers and Remediation
    - CDFW identified 50.7 miles (81.55 km) of wildlife barriers that intersect with linkage buffers
    - 17% (9) of linkage buffers intersect CDFW barriers, ranging from 1.26 to 10.37 miles; average: ~ 5.63 miles
    - There are 30 Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity Projects or Caltrans Active and Priority Planned Funding Fish Remediation Projects within 15 linkage buffers (29%); 7 of those 15 linkage buffers (47%) have more than one Caltrans project
    - Overlap with CDFW and Caltrans Barriers is detailed in Table 3

Table 3. Overlap of Linkages with CDFW and Caltrans Barriers in the North Coast Ecoregion

LINKAGE NAME	CALTRANS CONNECTIVITY PROJECT ID	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
Blue Creek-Redwood-Hoopa-Six Rivers		8.22	Berry Glen to Klamath River	W173
Coastal Prairie and Wetlands (9a)	706958, 713078			
Coastal Prairie and Wetlands (9b)	706971, 706956			

Coastal Prairie and Wetlands (9c)	20240103, 20220103, 713068			
Coastal Prairie and Wetlands (9d)	723192			
Humboldt to Headwaters	707129, 712977			
Jackson State - Sanhedrin (MNF)	713110			
Jedidiah Smith Redwoods-Rogue River NF	720982	8.87	Crescent City to Oregon Border	W172
Klamath-Siskiyou - Cascades (20a)		3.16	I-5 Yreka to Oregon Border	W005
Klamath-Siskiyou - Cascades (20b)		3.21	I-5/SR299 Intersection to I-5/SR89 Intersection	W010
Klamath-Siskiyou - Cascades (20c)		3.68	I-5/SR299 Intersection to I-5/SR89 Intersection	W010
Klamath-Siskiyou/North-South (19b)		10.37	Crescent City to Oregon Border	W172
Klamath-Siskiyou/North-South (19d)	707168, 707169			
Klamath-Siskiyou/North-South (19i)	720509			
Mendocino Redwood Circle	707187, 707185, 706968			
N. Sonoma Coast - Lake Sonoma (17a)	723190			
Red Mountain -Sinkyone	707115			
Redwood N.P. - Lacks Creek ACEC	715562	5.33	US101 Red School House, Big Lagoon, Orick (3.02 miles); Berry Glen to Klamath River (2.31 miles)	W007, W173
Sonoma Mtn.- Mayacumas Mtn		1.26	SR12 near Glen Ellen	W026
South Fork Eel	713042, 713040, 713038, 707157, 707159, 707160, 707115, 712991	6.58	South Fork Eel River by Benbow (1.09 miles); Garberville to Redway (5.47 miles)	W077, W081
South Fork Eel Riversource (5b)	706987			
Total Projects /Miles/Segments	30	50.7		10



Map A. North Coast Ecoregion

Central Coast-Bay Area Ecoregion Summary

The Central Coast-Bay Area Ecoregion (Central Coast) extends from Marin County to Santa Barbara County, spanning all or portions of 15 counties. The Central Coast encompasses a rich mosaic of habitats, including coastal sage scrub, chaparral, oak woodlands, coniferous forest, riparian corridors, grasslands, and wetlands. These ecosystems support diverse wildlife and are critical for maintaining regional ecological connectivity. Major rivers such as the Salinas and Santa Ynez, and Alameda and Coyote creeks provide essential riparian corridors for species movement. The region is also home to numerous tribes, such as the Miwok, Yokut, Ohlone, Esselen, Salinan, and Chumash, whose land stewardship and cultural heritages are integral to the landscape. Public conservation lands include Los Padres National Forest, Ventana Wilderness, state parks, and land managed by local land trusts. Conservation planning efforts have expanded significantly since 2000, with multiple NCCPs and RCISs now guiding regional conservation strategies.

The Central Coast is the second most populous ecoregion, with an estimated 2025 population of nearly 7.6 million (California Department of Finance, 2025). Over the past 25 years the population has grown by almost 900,000 or 12 %, with the most significant increases taking place in Santa Clara, Contra Costa and San Benito counties (California Department of Finance 2000, 2025). Although the Central Coast ecoregion remains a vital landscape for ecological connectivity, ongoing urban development, linear infrastructure expansion, invasive species and climate change, pose challenges to its long-term resilience (SWAP 2015). While many linkages still support healthy natural habitats, future pressures—especially near sensitive areas like stream corridors—could fragment ecosystems and reduce their functionality. Conservation and barrier remediation efforts have made meaningful progress, yet uneven protection levels and emerging threats remain.

There are 52 linkage buffers associated with the Central Coast Ecoregion, ranging in size from 1,252 to 173,468 acres with a net area of ~1.7 million acres. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and shown in Figure 11.

- 6 Large Landscape Linkages (10km wide)
- 15 Landscape Linkages (5km wide)
- 13 Linkages (2km wide)
- 8 Constrained Linkages (1km wide)
- 10 Riparian Corridors (500m wide)

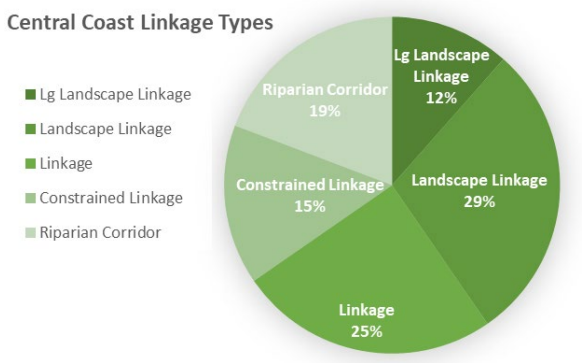


FIGURE 9. THE DIFFERENT TYPES OF LINKAGES IN THE CENTRAL COAST

Natural Landcover Change, 2000-2025

- Loss of 5,607 acres of natural landcover 2000-2025 across all linkage buffers
- 58% (30) of linkage buffers retained >90% natural landcover
- 75% (39) of linkage buffers retained >80% natural landcover
- 10% (5) of linkage buffers retained 60–80% natural landcover
- 6% (3) of linkage buffers retained 40-60% natural landcover
- 10% (5) of linkage buffers retained <40% natural landcover
- 85% (44) of linkage buffers saw a reduction in natural landcover, ranging from a loss of 6 acres to 839 acres (Salinas River Riparian Corridor)

- Camp Roberts Landscape Linkage had a 308-acre increase in natural landcover over this time frame, suggesting restoration

Impervious Surface Change, 2000-2025

- Increase of approximately 8,163 acres of impervious surface across the overall net area of the linkage buffers 2000-2025
- In 2024, impervious surface cover across all linkage buffers averages 11% (range: .004 - .66)
- Only 8% (4) of linkage buffers have >40% impervious surface in 2024:
    - Coyote Creek (66%)
    - Alameda Creek (66%)
    - Llagas Creek (40%)
    - Uvas Creek (40%)
- Lower N. Salinas River (20a) largest increase +1157.60 acres, from 20% to 27% of its area

Protection Status 2000-2025

A total of 316,666 acres has been added to conservation across linkage buffers since 2000. As of 2025, 43% of the net linkage area (741,688 acres) is protected in fee or conservation easement.

- Average percent protected per linkage: 38% (range 0.04 to .84)
- Only one linkage is > 80% protected/conserved
- 15% (8) of linkage buffers are 60-80% protected/conserved; 7 remain > 80% natural landcover
- 27% (14) of linkage buffers are 40-60%, protected/conserved; all remain > 80% natural landcover
- 31% (16) of linkage buffers are 20-40% protected/conserved; 9 remain > 80% natural landcover
- 25% (13) of linkage buffers are < 20% protected/conserved; 7 remain > 80% natural landcover
- Seven linkages saw a 10,000-acre increase in protection since 2000
- Linkages with the largest increase in protection:
    - Southern Diablo-Carrizo Linkage (+71,9996 acres)
    - Los Padres-Hearst Linkage (+63,015 acres).

Federal and State Designations for Conservation Lands in California

- Wilderness Area Designations
    - No increase in Wilderness Area designations (2000–2025)
    - 2025: 15% (8) of linkage buffers include Wilderness Areas
        - Total: 46,194 acres
        - Range: 21–24,687 acres per buffer
- Highest overlap: 21% (North Salinas River)
- Federal and State Wild and Scenic Rivers Designations
    - No linkage buffers include Wild and Scenic Rivers as of 2025
- Inventoried Roadless Areas
    - 2025: 6% (3) of linkage buffers within Inventoried Roadless Areas
        - Total: 30,021 acres
        - Range: 53–16,532 acres per buffer

Critical Habitat 2000-2025

There was an overall increase of 546,545 acres and 961 miles of designated critical habitat in the linkage buffers.

- Terrestrial Critical Habitat increased from 14,890 acres in 2000 to 561,435 acres in 2025
    - 2000: 10% (5) of linkage buffers had designated critical habitat, net area 14,890 acres
    - 2025: 94% (49) of linkage buffers have designated critical habitat for terrestrial or near shore species, net area of 561,435 acres (range 31 – 101,237 acres)
- Aquatic Critical Habitat increased from 198 miles in 2000 to 1,159 miles in 2025
    - 2000: 14% (7) of linkage buffers had designated aquatic critical habitat, net length of 198 miles, ranging from 3 to 78 miles
    - 2025: 73% (38) of linkage buffers have aquatic critical habitat, net length 1,159 miles (range 0.8 to 171 miles)

- 2025, 42% (22) of linkage buffers have > 40% of their area designated as Critical Habitat and 35% (18) have > 15.5 miles of designated Aquatic Critical Habitat.

Conservation Plans 2000-2025

- No conservation plans existed in 2000; multiple NCCPs are in implementation phase and RCISs have been completed.
- 2025 NCCPs: 138,544 acres described for conservation in an NCCP/HCP
  - 27% (14) of linkage buffers overlap NCCP areas
  - An average of 9,896 acres described for conservation in an NCCP per linkage; range: 29–47,277 acres
  - 71% (10) of linkage buffers have >40% of area describes for conservation in an NCCP
  - 2 Clayton Ridge–Mt. Diablo–Concord linkage buffers have 51–92% overlap with the East Contra Costa Plan area (2007)
  - 12 linkage buffers have .003-95% overlap with the Santa Clara Valley Habitat Plan area (2013), 8 with > 40% of area described for conservation
- RCIS: 5 plans completed between 2019-2024
  - 75% (39) of linkage buffers overlap at least one RCIS planning boundary
    - North Bay Baylands RCIS (2024): Overlap with 10% (5 linkage buffers)
    - East Bay RCIS (2021): Overlap with 29% (15 linkage buffers)
    - Santa Clara RCIS (2019): Overlap with 29% (15 linkage buffers)
    - Santa Cruz RCIS (2023): Overlap with10% (5 linkage buffers)
    - Monterey County RCIS (2021): Overlap with16% (8 linkage buffers)

Land Use and Zoning

- 49% of total linkage buffer area (858,814 acres) is zoned as open space (including existing protected lands).
  - 12% (6) of linkage buffers are zoned > 80% open space
  - 15% (8) of linkage buffers are zoned 60–80% open space
  - 33% (17) of linkage buffers are zoned 40-60% open space
  - 23% (12) of linkage buffers are zoned 20-40% open space
  - 17% (9) of linkage buffers are zoned <20% open space
- 8% of total linkage buffer area (131,163 acres) is zoned for development
  - 77% (40) of linkage buffers are zoned <20% development
  - 17% (9) linkage buffers are zoned 20-40% development
  - 6% (3) of linkage buffers are zoned 40-60% development
  - The Llagas Creek and Uvas Creek linkages have the greatest area zoned for development (55%)

Business As Usual Development Projections for 2050

- 35% (18) of linkage buffers projected to be >20% developed by 2050.
- 13% (7) of linkage buffers are projected to be >40% developed by 2050
- Highest projected growth in Riparian Corridor linkage buffers 500 meters wide (1,640 feet) :
  - Coyote Creek: 76% of linkage buffer projected for development by 2050
  - Llagas Creek: 72% of linkage buffer projected for development by 2050
  - Alameda Creek: 66% of linkage buffer projected for development by 2050
  - Uvas Creek: 63% of linkage buffer projected for development by 2050.

Working Lands

- 88% (46) of linkage buffers include Williamson Act enrolled lands, average 12,537 acres enrolled per linkage (range 1.91 to 99,866 acres), net total of 576,690 acres across linkage buffers.
- Southern Diablo-Carrizo supports the most enrolled acreage (99,866 acres, 57% of linkage buffer)
- Linkages with the highest percentage enrollment in Williamson Act include the Hollister–San Luis-Pinoche Hills linkage (74% of linkage area enrolled) and Highway 52–Pacheco Pass Linkage (66% of linkage area enrolled).

- 27% (14) of linkage buffers include non-renewal lands totaling 12,789 acres. Linkages with the largest non-renewal acreage: Santa Cruz Mountain Linkages 8b (5549 acres) and 8d (3,737 acres)
- 13% (7) of linkage buffers had completed/approved timber harvest plans on private timberlands between 2010-2025, ranging from 2.81 to 4,334 acres per linkage and covering a net area of 15,320 acres across linkage buffers
- 5 of the linkage buffers with timber harvest plans are associated with the Santa Cruz Mountains, 4 of which were > 2,900 acres

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers:

- 8% (4) of linkage buffers ranked High Landscape Intactness
- 58% (30) of linkage buffers ranked Moderately High Landscape Intactness
- 35% (18) of linkage buffers ranked Moderately Low Landscape Intactness
- High Intactness-ranked linkages:
    - Highway 152–Pacheco Pass
    - Los Padres–Hearst Castle
    - Lower N. Salinas River (20b)
    - Pinoche Valley–Highway 25

Overlap with Statewide/Regional Connectivity Analyses

A total of 39 of 52 linkages (75%) had >80% overlap with at least one statewide or regional connectivity analysis and less than 25% of area identified as impeded (TNC 2017).

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 73% overlap across all linkage buffers (1,265,175 acres)
        - 42% (22) of linkages have >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017):
        - 80% overlap across all linkage buffers for combined Diffuse, Intensified, Channelized categories (1,394,316 acres)
        - 46% (24) of linkage buffers have >80% overlap
    - Resilient and Connected Network (TNC 2020):
        - 82% overlap across all linkage buffers (1,417,948 acres)
        - 50% (26) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 22% overlap across all linkage buffers (388,341 acres)
        - Average overlap of 7,763 acres per linkage buffer
- Regional Connectivity Studies Overlap Statistics:
    - Critical Linkages Bay Area & Beyond (Penrod et al. 2013):
        - 44% (23) of linkage buffers have >80% overlap
    - Central Coast Mountain Lion Assessment (Thorne et al 2006):
        - 25% (13) of linkage buffers have >80% overlap
    - Climate Resilient Connectivity for South Coast (Jennings 2019):
        - 8% (4) of linkage buffers have > 80% overlap
    - Sacramento Valley Assessment (Gallo et al. 2019):
        - 4% (2) of linkage buffers have > 80% overlap
    - Central Valley Assessment (Huber et al. 2010):
        - One linkage buffer has >80% overlap.

Infrastructure

- Roads and Rail
    - Primary roads overlap 54% (28) of linkage buffers, totaling ~115 miles (range: 0.17–13.39 miles)

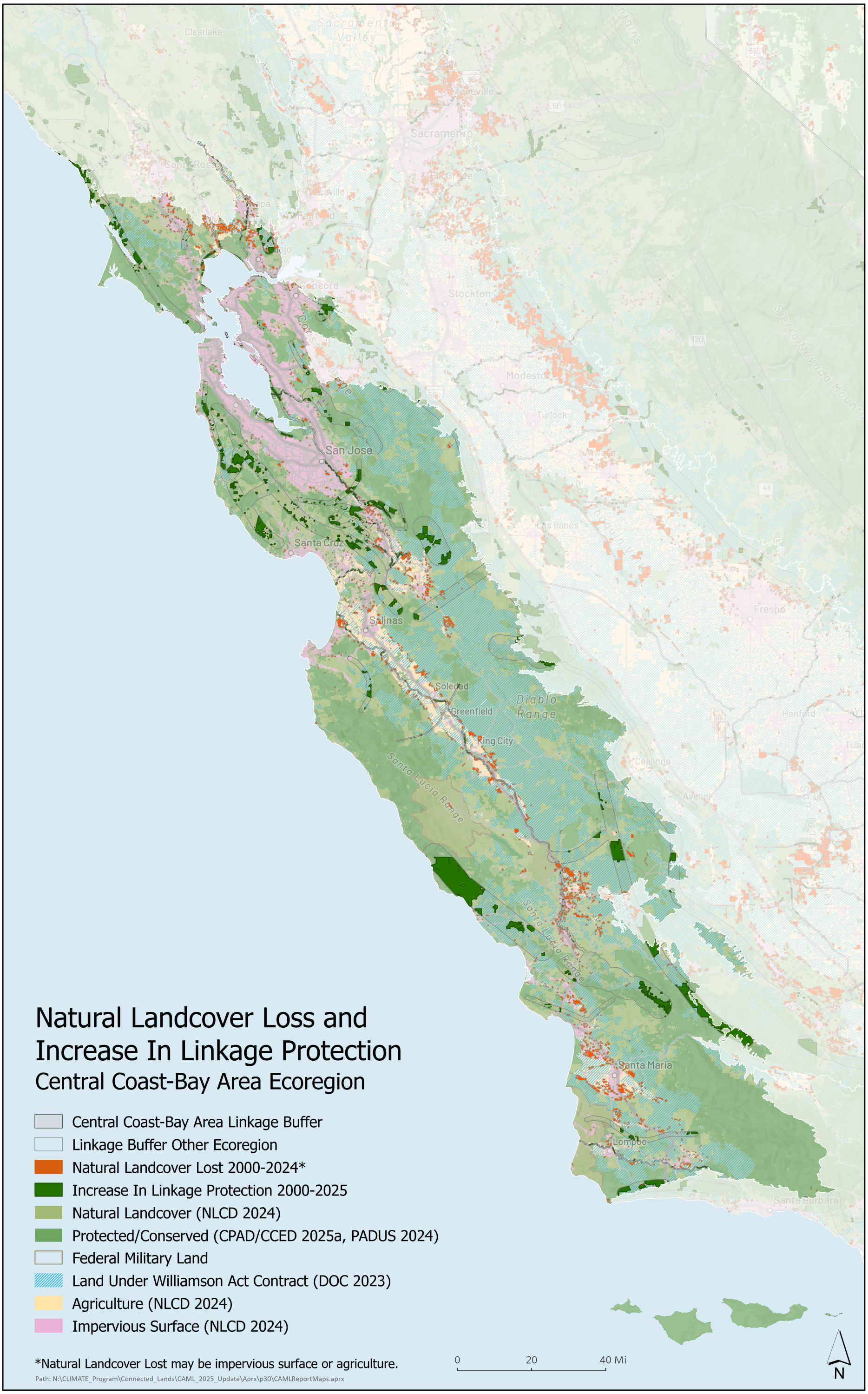
    - Secondary roads overlap 69% (36) of linkage buffers, totaling 385 miles (range: 0.34–66.16 miles)
    - Total road length across all linkage buffers: 4,863 miles (average: 101.1 miles per linkage)
    - Santa Cruz Mountains Linkage 8b has the most roads of all linkages in region
    - Average weighted road density: 1.57 miles^2 (range: 0.64 miles^2 (Highway 52 Pacheco Pass) to 4.7 miles^2 (Coyote Creek)
    - Railroads cross 56% (29) linkages, totaling ~109 miles (range: 0.35–25.99 miles).
- Renewable Energy
    - Solar installations overlap 13% (7) of linkage buffers, totaling 1,235 acres across linkage buffers
    - The largest solar installation acreage overlaps the Pinoche Valley-Highway 52 Linkage (1,155 acres)
    - Wind energy development overlaps one linkage (Altamont Hills Linkage). In 2000 there were 173 turbines; in 2025 there are 211
- Wildlife Barriers and Remediation
    - CDFW identified 106.8 miles (172 km) of wildlife barriers that intersect with the linkage buffers
    - 50% (27) of linkage buffers intersect CDFW barriers, ranging from 0.1 to 7.46 miles
    - A total of 5 CDFW Fish Passage Priority locations identified across 9 linkage buffers
    - There are 31 Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity Projects within 22% (12) of linkage buffers
    - Seven of the linkage buffers have more than one Caltrans project
    - Overlap with CDFW and Caltrans Barriers is detailed in Table 4

Table 4. Overlap of Linkages with CDFW and Caltrans Barriers in the Central Coast Ecoregion

LINKAGE NAME	CALTRANS CONNECTIVITY PROJECT ID	CDFW FISH PASSAGE PRIORITY ID	TOTAL CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
Vargas Plateau - Nile Canyon (4b)			1.5	I-680 Sunol Ridge to Niles Canyon (1.01 miles); SR-84 & Calveras Rd, Sunol Ridge to Niles Canyon (0.50 miles)	W029, W028
Coyote Creek (20b)	20240414		9.39	US-101 Metcalf/Burnett (4.33 miles); Bailey Ave (0.54 miles); Monterey Road (4.52 miles)	W022, W160, W195
Bay Wetlands (16a)		704129	3.38	SR-37	W202
Santa Cruz - Mt. Hamilton	20220412		7.76	SR-17 Los Gatos-Scotts Valley (1.11 miles); 17947-17787 Alma Bridge Rd (2.21 miles); Santa Teresa Rd (0.89 miles); McKean Rd (1.16 miles); US-101 Metcalf/Burnett (1.27 miles); Monterey Rd (1.09 miles)	W023, W154, W159, W161, W022, W195
Santa Cruz Mountains (8c)	713774				

Coastal Wetlands for Pacific Flyway (14b)	706059, 732665, 706079, 706078, 759028, 706054, 761088, 765071, 732659	706059			
Santa Cruz Mtn.- Hamilton Mtn.			5.01	Santa Teresa Blvd (1.24 miles); McKean Rd (2.06 miles); Monterey Rd (0.89 miles); US-101 Metcalf/Burnett (0.83 miles)	W159, W161, W195, W022
Gaviota Coast	20220521, 20220520, 706388, 706669, 707414		3.24	Gaviota Pass	W163
Cuesta Grade	707246, 700061	700061	4.54	US-101 Cuesta Grade	W034
S. Diablo – Carizzo			1.39	SR-46 Cholame Valley	W203
Santa Cruz Mountains (8b)	20240412, 20240413, 758036		6	SR-17 Los Gatos-Scotts Valley (5.3 miles); I-280 at Edgewood Rd (0.7 miles)	W023, W157
Santa Cruz Mountains (8d)	20240412, 706675				
Los Padres - Hearst Castle			11.05	SR-46 Green Valley	W208
Alameda Creek Watershed (19a)	20220410		15.73	SR-84 & Calaveras Rd, Sunol Ridge to Niles Canyon (11.83 miles); I-680 Sunol Ridge to Niles Canyon (3.8 miles)	W029, W028
Highway 152 - Pacheco Pass	20220415, 20220416		6.7	SR-152 Pacheco Pass/San Luis Reservoir	W030
Llagas Creek (19a)			2.56	McKean Rd	W161
Altamont Hills			6.36	I-580 Livermore to Tracy (3.75 miles); Vasco Road (2.61 miles)	W158, W200
Coastal Wetlands for Pacific Flyway (14a)	723190, 723192, 733266, 723191				
S Luis Reservoir - Pinoche Hills			0.38	SR-152 Pacheco Pass/San Luis Reservoir	W030
Coyote Creek (20a)	713518		0.37	US-101 Metcalf/Burnett (0.14 miles); Monterey Road (0.24 miles)	W022, W195
Vargas Plateau - Nile Canyon (4a)			1.56	I-680 Sunol Ridge to Niles Canyon (1.34 miles); SR-84 & Calveras Rd, Sunol Ridge to Niles Canyon (0.22 miles)	W029, W028
Sonoma Creek			0.76	SR-12 near Glen Ellen (0.43 miles); SR-37 (0.33 miles)	W026, W202

Santa Cruz Mtns – Gabilan			9.92	US-101 Bottleneck Prunedale split off (1.38 miles); US-101 Prunedale (4.52 miles); SR-129 Chittenden (4.01 miles)	W162, W041, W024
Pajaro River			4.87	US-101 Prunedale (1.28 miles); SR-129 Chittenden (3.59 miles)	W041, W024
Fort Ord – Ventana		718842			
Pleasanton Ridge - Las Trampas			1.88	I-580 Castro Valley to Dublin	W027
Santa Lucia - Gabilan, Ventana Wilderness		707025			
Napa River			1.12	SR-29	W201
Santa Ynez River			0.62	SR-154	W165
Via San Antonio - Vandenberg/Sedgwick			2.77	SR-1 Vandenberg Rd	W049
Salinas River Riparian Corridor			2.89	US-101 Camp Roberts	W211
Camp Roberts			3.62	US-101 Camp Roberts	W211
Lower N. Salinas River (20a)			3.67	US-101 Camp Roberts	W211
Total projects/miles/segments	31	5	106.8		27



Map B. Central Coast Ecoregion

South Coast Ecoregion Summary

California's South Coast Ecoregion is a biologically rich and geographically diverse area encompassing coastal plains, foothills, mountain ranges, and offshore islands across parts of six counties, including Los Angeles, Ventura, Orange, Riverside, San Bernardino, and San Diego counties. Its ecosystems range from coastal sage scrub and chaparral to oak woodlands, montane conifer forests, riparian corridors, and estuaries, supporting a high number of endemic and threatened species. The region is home to numerous tribes, such as the Chumash, Pechanga, Morongo, Pala, and Los Coyotes, and whose land stewardship and cultural heritages are integral to the region. Major public landowners include federal agencies like the U.S. Forest Service (managing Angeles, Cleveland, and Los Padres national forests), the National Park Service (e.g., Santa Monica Mountains National Recreation Area), and the Department of Defense (e.g., Camp Pendleton). State agencies such as California State Parks and CDFW oversee numerous parks and ecological reserves, while regional entities like the Mountains Recreation and Conservation Authority manage several open space lands.

With a dense and growing human population exceeding 20 million (2025 Census Bureau), urbanization has led to widespread habitat loss, fragmentation, and increased demand for water and infrastructure. Riverside County is the fastest growing county in the state, with an increase of over one million residents between 2000 and 2025. Major threats to the region that further exacerbate fragmentation include land-use change, linear infrastructure (e.g., high speed rail, border wall), climate impacts, invasive species, and altered fire regimes—all of which pose serious challenges to the ecological connectivity and resilience of this ecoregion.

There are 77 linkages buffers associated with the South Coast Ecoregion, ranging in size from 1,809 to 69,969 acres with a net area of ~880,406 acres. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and in Figure 13.

- 6 Large Landscape Linkages (10km wide)
- 9 Landscape Linkages (5km wide)
- 25 Linkages (2km wide)
- 15 Constrained Linkages (1km wide)
- 22 Missing Links or Riparian Corridors (500m wide)

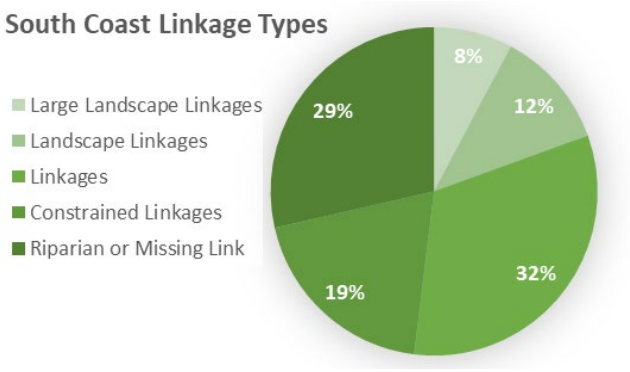


FIGURE 10. THE DIFFERENT TYPES OF LINKAGES IN THE SOUTH COAST

Natural Landcover Change, 2000-2025

- Loss of 13,788 acres of natural landcover across all linkage buffers since 2000
- Average natural landcover in 2025: 76%
- 84% (65) of linkage buffers saw a reduction in natural landcover since 2000
- In 2000, 62% (48) of linkage buffers supported >80% natural landcover
- In 2025:

- 58% (45) of linkage buffers retained >80% natural landcover
- 18% (14) of linkage buffers have 60-80% natural landcover
- 14% (11) of linkage buffers have 40-60% natural landcover
- Remaining seven linkage buffers have <40% natural landcover

Impervious Surface Change, 2000-2025

- Increase of 16,372 acres in impervious surfaces across all linkage buffers since 2000
- In 2000, 25% (19) of linkage buffers had >25% impervious surface with an average of 15% impervious surface per linkage
- In 2025, ~34% (26) of linkage buffers have 25% impervious surface, with an average of 21% impervious surface per linkage

Protection Status 2000-2025

A total of 101,088 acres has been added to conservation across linkage buffers since 2000. As of 2025, 56% (493,773 acres) of the net linkage area is protected in fee or conservation easement.

- Average percent protected per linkage: 42%
- 10% (8) of linkage buffers are >80% protected/conserved
- 16% (12) of linkage buffers are 60-80% protected/conserved; 8 remain > 80% natural landcover
- 26% (20) of linkage buffers are 40-60%, protected/conserved; 12 remain >80% natural landcover
- 23% (18) of linkage buffers are 20-40% protected/conserved; 10 remain >80% natural landcover
- 25% (19) of linkage buffers are < 20% protected/conserved; 7 remain >80% natural landcover
- Largest conservation gains:
  - Otay-Cleveland National Forest Linkage 8a (+15,434 acres)
  - San Jacinto-Badlands Linkage (+8,758 acres)

Federal and State Designations for Conservation Lands in California

- Wilderness Area Designations
  - Increase of 5,673 acres in Wilderness Area (2000–2025)
  - 2000: 17% (13) of linkage buffers within Wilderness Areas, totaling 48,047 acres
  - 2025: 21% (16) of linkage buffers within Wilderness Areas, totaling 53,720 acres
- Federal and State Wild and Scenic Rivers Designations
  - No Wild and Scenic Rivers in 2000
  - 2025: Three linkage buffers overlap Wild and Scenic Rivers; ranging between 2.8 to 6.4 miles and totaling 13.97 miles
  - The three Wild and Scenic Rivers overlap the San Jacinto-Santa Rosa and the San Jacinto-Badlands Linkages
- Inventoried Roadless Areas
  - 23% (18) of linkage buffers include Inventoried Roadless Areas, covering a net area of 66,344 acres
  - 3,686 acres average size of Inventoried Roadless Area (range 27.58 to 22,890 acres)
  - Eight linkage buffers include >20% cover by Inventoried Roadless Area

Critical Habitat 2000-2025

There was an overall increase of 127,450 acres and 41 miles of designated critical habitat across the linkage buffers.

- Terrestrial Critical Habitat increased from 16,212 acres in 2000 to 143,662 acres in 2025
- 2000: 16% (12) of linkage buffers had terrestrial critical habitat (range 85 to 3,096 acres)
- 2025: 87% (67) of linkage buffers have terrestrial critical habitat (range 14 to 29,422 acres)
  - 34% (26) of linkage buffers have >20% of area designated as Critical Habitat
- Aquatic Critical Habitat increased from 0 miles in 2000 to 41 miles in 2025

- 2025: 9% (7) of linkage buffers include Aquatic Critical Habitat (range 0.35 to 33.55 miles)

Conservation Plans 2000-2025

- NCCPs: 13 plans in the South Coast Ecoregion:
  - Seven NCCPs existed in 2000; Six additional NCCPs have entered implementation phase since 2000
  - In 2000, there were 68,425 acres described for conservation across 19% (15) linkage buffers associated with 6 NCCPs
  - In 2025, there are 187,679 acres described for conservation across 53% (41) linkage buffers associated with 13 NCCPs, reflecting an increase of 119,254 acres described for conservation since 2000
  - 29% (22) of linkage buffers have >40% area included in an NCCP
  - Additional NCCPs are planned for northern and eastern San Diego County
- RCIS: 2 plans completed between 2000-2024:
  - 19% (15) of linkage buffers overlap at least one RCIS
  - Antelope Valley RCIS (2022) : Overlaps 3 linkage buffers
  - San Bernardino County RCIS (2024) : Overlaps 12 linkage buffers

Land Use and Zoning

- 63% of total linkage buffer area (553,695 acres) is zoned as open space (including existing protected lands):
  - 18% (14) of linkage buffers are zoned > 80% open space
  - 16% (12) of linkage buffers are zoned 60-80% open space
  - 35% (27) of linkage buffers are zoned 40-60% open space
  - 19% (15) of linkage buffers are zoned 20-40% open space
  - 12% (9) of linkage buffers are zoned <20% open space
- 15% of the total linkage buffer area (132,643 acres) is zoned for development:
  - 49% (39) of linkage buffers are zoned < 20% development
  - 22% (17) of linkage buffers are zoned 20-40% development
  - 29% (22) of linkage buffers are zoned >40% development
  - Lower Santa Margarita-Pechanga Linkage, within Camp Pendleton, has the greatest area (98%) zoned for development, followed by Christianitos Linkage (83% zoned for development) and Puente-San Jose-San Gabriel Linkage (81% zoned for development).

Business As Usual Development Projections for 2050

- 149,751 acres across all linkage buffers may be threatened by development by 2050
- 45% (35) of linkage buffers predicted to be >40% developed by 2050
- 13% (10) of linkage buffers expected to be >80% developed by 2050

Working Lands

- 43% (33) of linkage buffers are currently enrolled in Williamson Act, ranging from 26 to 13,601 acres per linkage and covering a net total of 39,134 acres across linkage buffers
- The Cuyamaca-Palomar linkage has the most enrolled acreage (13,601 acres), covering 39% of the linkage buffer area

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers: 5% (4) of the linkage buffers ranked High Landscape Intactness

- 38% (29) ranked Moderately High Landscape Intactness

- 55% (42) ranked Moderately Low Landscape Intactness
- Four highest ranked Landscape Intactness
    - San Jacinto-Badlands Landscape Linkage
    - Sierra Madre-Castaic Large Landscape Linkage
    - Two San Jacinto-Santa Rosa Large Landscape Linkages

Overlap with Statewide/Regional Connectivity Analyses

A total of 42 linkage buffers (55%) overlap >80% with at least one statewide or regional connectivity analysis and have < 25% of their area identified as impeded (TNC 2017):

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010)
        - 67% overlap across all linkage buffers (587,185 acres)
        - 32% (25) of linkage buffers had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017):
        - 75% overlap with combined Diffuse, Intensified, and Channelized categories across all linkage buffers (657,742 acres)
        - 29% (23) of linkage buffers have >80% overlap
    - Resilient and Connected Network (TNC 2020):
        - 72% overlap across all linkage buffers (630,110 acres)
        - 26% (20) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 26% overlap across all linkage buffers (233,199 acres)
- Regional Connectivity Studies Overlap Statistics:
    - South Coast Missing Linkages (Beier et al. 2006, SC Wildlands 2008):
        - 51% overlap across all linkage buffers (448,453 acres)
        - 22% (17) of linkage buffers have > 80% overlap
    - Climate Resilient Connectivity for the South Coast (Jennings et al. 2019):
        - 71% overlap across all linkage buffers (624,012 acres)
        - 36% (28) of linkages buffers have > 80% overlap
    - Linkage Network for the California Desert (Penrod et al. 2012):
        - 2 linkage buffers have >80% overlap
    - South Coast Vision Map (Hunter 1999, Hunter et al. 2003):
        - Network of 77 linkage buffers captures 95% of identified connectivity zones and 79 of identified stewardship zones

Infrastructure

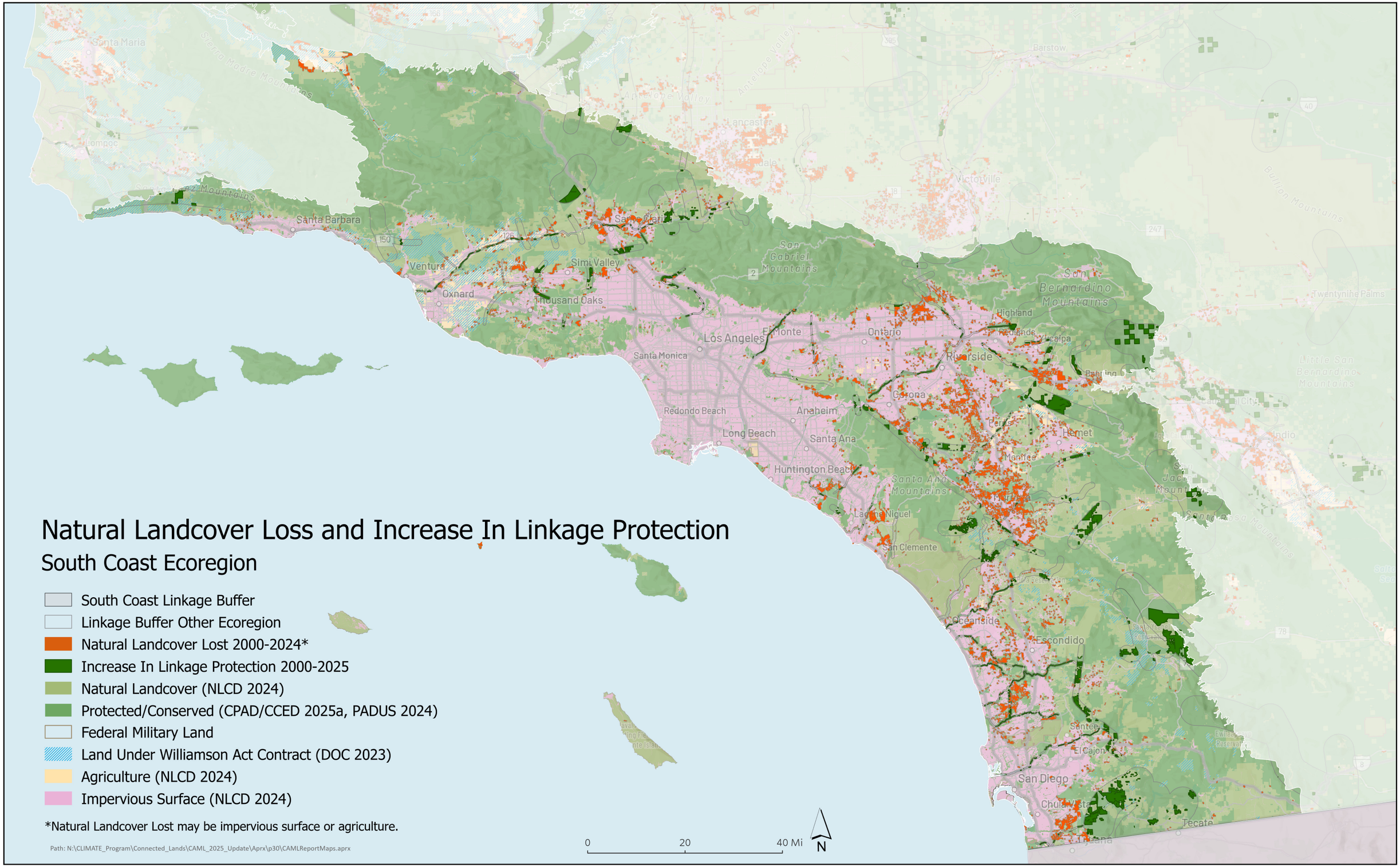
- Roads and Rail
    - All 77 linkage buffers contain some form of rail or roadway infrastructure
    - Primary roads overlap 57% (44) of linkage buffers, totaling ~167 miles
    - Secondary roads overlap 61% (47) of linkage buffers, totaling ~241 miles (range: 0.09–24.33 miles)
    - Total road length across all linkages: ~3,308 miles (average: 47.11 miles per linkage)
    - Average weighted road density: 1.91 miles^2 (range: 0.5– 6.97 miles^2)
    - Railroads cross 42% (32 linkage buffers), totaling ~69 miles (range: 0.31–17.93 miles)
- Renewable Energy
    - Solar energy development occurs in 14% (11 linkage buffers), ranging from 0.59-33.66 acres for a total net area of 78 acres
    - Wind development occurs in one linkage (San Gorgonio Pass). In 2000 there were 50 wind turbines; in 2025 there are 116.
- Wildlife Barriers and Remediation
    - CDFW identified 69.2 miles (111.37 km) of wildlife barriers that intersect with linkage buffers

- 50% (27 linkage buffers) are intersected by CDFW barriers, ranging from one to 15.7 miles; average: ~ 2.2 miles
- There are 9 Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity Projects and 2 Caltrans Active and Priority Planned Funding Fish Remediation Projects within 14% (11) of linkage buffers)
- All Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity barriers overlap with CDFW Barriers
- Six of the linkage buffers have 2 or more separate identified wildlife barriers
- Overlap with CDFW and Caltrans Barriers is detailed in Table 5

Table 5. Overlap of Linkages with CDFW and Caltrans Barriers in the South Coast Ecoregion

LINKAGE NAME	CALTRANS PROJECT ID	CDFW FISH FPAD	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
Otay Mountain-Cleveland NF west	20241143		7.16	Multiple Species Conservation Program wildlife infrastructure plan for SR94	W045
Castaic Hwy 5 Undercrossing			7.05	I-5 Sierra Madre-Castaic Ranges	W231
San Gorgonio Pass	20240823		5.82	I-10 Banning Pass	W058
Lower Santa Clara River		758971	5.05	SR126 Santa Susana Mountains to Los Padres (1.4 miles); Antelope Valley Freeway (3.32 miles); US101 Santa Clara River Conejo Grade (0.33 miles)	W104; W164; W214
Corona-Temecula Foothills north			4.94	Ortega Highway SR74 entire length (4.47 miles); SR91 N-S Mountain lion movement barrier "B Canyon" (0.47 miles)	W137; W052
Soledad Canyon-Mint Canyon east			3.67	Antelope Valley Freeway	W164
San Jacinto-Badlands			3.64	Gilman Springs Road	W131
Upper Santa Clara River			3.57	Antelope Valley Freeway	W164
Soledad Canyon-Mint Canyon central	20240722		3.5	Antelope Valley Freeway	W164
Palomar-San Jacinto			3.47	SR79 from Temecula to Aguanga	W226
Hwy 5 Newhall Pass	80000005		3.44	I-5 North of Sylmar (2.14 miles); Antelope Valley Freeway (1.3 miles)	W047; W164
San Diego Foothill Corridor			2.57	SR67 Mapleview St to Etcheverry St (1.27 miles); I-8 East of San Diego/El Cajon (1.29 miles)	W044; W107
Oak Valley			2.3	Gilman Springs Road (1.41 miles); SR60	W131; W135

				Badlands REMEDIATED (0.88 miles)	
Cristianitos	20221242		1.9	Ortega Highway (SR74 entire length)	W137
Upper Lytle Creek			1.83	Cajon Pass, I-15 and I-215 (1.15 miles); Glen Helen at Lytle Creek (0.55 miles); Fontana Union Water Co Operational Berm (0.12 miles)	W060; W138; W144
Santa Susana Pass	20220725		1.54	Simi Hills to Santa Susana Mountains	W103
Laguna Canyon Wilderness -Aliso Canyon			1.52	SR133 Coastal Newport Beach	W113
Cajon Pass north	20220831		1.39	Cajon Pass, I-15 and I-215	W060
Cajon Pass south			1.38	Cajon Pass, I-15 and I-215	W060
Coal Canyon			1.35	SR91 N-S Mountain lion movement barrier "B Canyon"	W052
Pechanga Corridor	80000014		1.28	I-15 Temecula to E Mission Rd, mountain lion E-W movement barrier	W046
Lower Lytle Creek			0.73	Railroad Drop Structure in Cajon Creek below I-210 (0.14 miles); Cajon Pass I-15 and I-215 (0.32 miles); Glen Helen at Lytle Creek (0.27 miles)	W145; W060; W138
Conejo Grade			0.68	US101 Santa Clara River Conejo Grade	W214
Ventura-Ojai	713867		0.57	SR33 Red Mountain to Sulphur Mountain	W051
San Diego River			0.47	SR67 Mapleview St to Etcheverry St	W044
Liberty Canyon Hwy 101	80000009		0.45	US101 Liberty Canyon	W042
Upper Santa Ana River			0.42	Seven Oaks Dam (NE of San Bernardino)	W142
Soledad Canyon-Mint Canyon west			0.32	Antelope Valley Freeway	W164
El Toro Linkage			0.32	SR133 Coastal Newport Beach	W113
Lower Santa Ana River			0.17	LaCadena Dr South drop structure (SW of I-10 and I-215	W143
Casitas			0.09	SR150 Santa Ana Valley to Lake Casitas	W105
Oso Creek	706807	766667, 706810			
Santa Clara River-Hwy 126 N-S Central					
Total projects/miles/segments	11	3	69.2		26



Map C. South Coast Ecoregion

Great Central Valley Ecoregion Summary

The Great Central Valley (Central Valley) Ecoregion is bound by the North Coast, Cascades, Sierra Nevada, Tehachapi and Coast ranges. Major rivers that flow through and across the valley include the Sacramento, Feather, Stanislaus, Tuolumne, Merced, San Joaquin, Kings, Tule, and Kern rivers. The primary natural communities of the Central Valley are oak woodland, oak savanna, grasslands, riparian woodland and scrub, alkali and saltbush scrub, vernal pool, dunes, and freshwater marsh. Some key species of the valley include San Joaquin kit fox, brush rabbit, blunt-nosed leopard lizard, Buena Vista Lake shrew, Fresno kangaroo rat, San Joaquin pocket mouse, Chinook salmon and steelhead trout. The region is home to numerous tribes, including the Miwok, Yokuts, Mono and Paiute tribes, and whose land stewardship and cultural heritages are integral to the landscape. There are several National Wildlife Refuges in the Central Valley, including Sacramento, Delevan, Colusa, Sutter, Kesterson, San Luis, Merced, Pixley, Gray Lodge and Kern, as well as land administered by Bureau of Land Management, California State Parks, and the Army Corps of Engineers. There are also several large military installations.

The Great Central Valley Ecoregion has the least amount of publicly owned land, with the great majority of the region made up of working lands. A variety of agricultural crops cover much of the valley floor, while much of the remaining natural habitats of the region are working rangelands in the surrounding foothills. Major rivers and streams provide potential movement pathways between remnant habitats on the valley floor and surrounding rangelands. As agricultural lands in Central Valley are retired—primarily due to water scarcity and groundwater regulations—many are being repurposed for habitat restoration, groundwater recharge, solar energy development, and dryland grazing, offering potential opportunities to restore connectivity both within and across the valley floor.

Between 2000 and 2025, the Central Valley experienced a population increase of over 1.6 million people, growing by approximately 31.5%, with counties like San Joaquin, Kern, and Merced seeing the highest growth rates. This growth was driven by factors such as affordable housing, migration from coastal urban centers, and expanding agricultural and logistics economies.

There are 42 linkages buffers associated with the Great Central Valley Ecoregion, ranging in size from 1,231 to 252,758 acres with a net area of 1,533,162 acres. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and in Figure 15.

- 8 Landscape Linkages (5km wide)
- 3 Linkages (2km wide)
- 4 Constrained Linkages (1km wide)
- 27 Riparian Corridors or Missing links (500m wide)

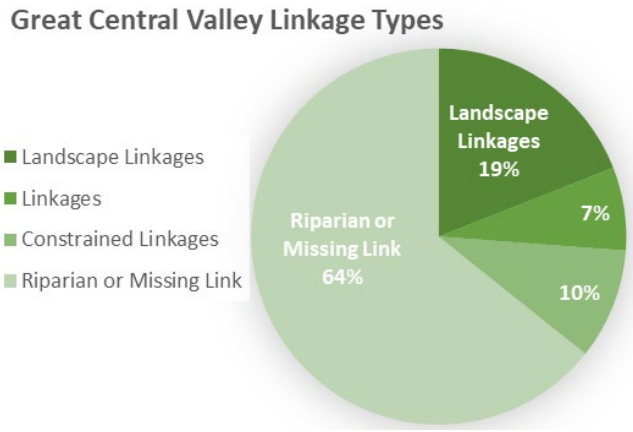


FIGURE 11. THE DIFFERENT TYPES OF LINKAGES IN THE GREAT CENTRAL VALLEY

Natural Landcover Change, 2000-2025

- In 2000, 31% (13) of linkage buffers supported > 80% natural landcover (average 95% natural landcover per

linkage); 12% (5) had 60-80% natural landcover; 24% (10) had 40-60% natural landcover; 33% (14) had < 40% natural landcover

- Net loss of 41,262 acres of natural landcover across all linkage buffers since 2000
- In 2025, the same 13 linkage buffers retained > 80% natural landcover; down to 93% average natural landcover per linkage
- 81% (34) of linkage buffers saw a reduction in natural landcover since 2000, ranging from 6 to 21,376 acres
  - Fresno-Sacramento saw the greatest change from 95% to 87% natural landcover19% (8) of linkage buffers saw an increase in natural landcover, suggesting restoration
    - Tule River had the greatest increase in natural landcover (1,244 acres), from 24 to 33% natural landcover, suggesting restoration.

Impervious Surface Change, 2000-2025

- Increase of 17,894 acres in impervious surfaces across all linkage buffers since 2000
- 36% (15) of linkage buffers have >1,000 acres of impervious surface
- 4 linkage buffers are greater than 25% impervious surface; 2 remain >60% natural landcover:
  - Kern River 29% impervious (2,458 acres) retains 65% natural landcover
  - Sacramento Valley Grasslands 28% impervious (8,288 acres) retains 69% natural landcover
- Carrizo Plain-W. San Joaquin Valley has the greatest amount of impervious surface (9,986 acres) yet retains 95% natural landcover

Protection Status 2000-2025

A total of 105,537 acres has been added to conservation across linkage buffers since 2000. As of 2025, 19% of the net linkage area (285,107 acres) is protected in fee or conservation easement.

- Average percent protected per linkage: 22% (range 0 to 87%)
- 1 linkage buffer is > 80% protected/conserved, the Madera-Merced (18a) Constrained Linkage
- 14% (6) of linkage buffers are 40-60%, protected/conserved, 3 maintain >60% natural landcover
  - Kern River Riparian Corridor retains 65% natural landcover
  - South End San Joaquin Valley Landscape Linkage retains 96% natural landcover
  - Grizzly-Cache Slough Constrained Linkage retains 82% natural landcover
- 31% (13) of linkage buffers are 20-40% protected/conserved; 5 remain >80% natural landcover
  - Carrizo Plain-W. San Joaquin Valley (8b) Landscape Linkage retains 99% natural landcover
  - Deer Creek-Sand Ridge Landscape Linkage retains 99% natural landcover
  - Carrizo Plain-W. San Joaquin Valley (8a) Landscape Linkage retains 98% natural landcover
  - Carrizo Plain-W. San Joaquin Valley (8c) Linkage retains 95% natural landcover
  - Sacramento Valley Grasslands (20d) Linkage retains 89% natural landcover
- 52% (22) linkages are < 20% protected/conserved; 6 remain >60% natural landcover
  - Sacramento Valley Grasslands (20c) Landscape Linkage retains 98% natural landcover
  - Southeastern Foothills Landscape Linkage retains 96% natural landcover
  - Carrizo-W. San Joaquin Valley (8d) Landscape Linkage retains 94% natural landcover
  - Fresno-Sacramento Landscape Linkage retains 87% natural landcover
  - Sacramento Valley Grasslands (20a) Linkage retains 88% natural landcover
  - Sacramento Valley Grasslands (20b) Constrained Linkage retains 69% natural landcover

Federal and State Designations for Conservation Lands in California

- No Wilderness Area Designations in Great Central Valley
- Federal and State Wild and Scenic Rivers Designations
  - Increase of 5.68 miles (2000–2025)

    - 2000: 1 linkage, Sacramento Valley Grasslands included 0.4 miles of Wild and Scenic Rivers
    - 2025: 5% of linkages (2) total 6.8 miles of Wild and Scenic Rivers:
        - Cache Creek-Bear Valley (27a) 5.68 miles added as Wild and Scenic River
- Inventoried Roadless Areas
    - Present in 5% (2) of linkages; total: 5,269 acres
        - Deer Creek-Sand Ridge (6b) Landscape Linkage includes 5,136 acres of an IRA
        - Kern River Riparian Corridor includes 133 acres of an IRA

Critical Habitat 2000-2025

Across linkage buffers, Terrestrial Critical Habitat increased from 62,114 acres in 2000 to 214,504 acres in 2025, while Aquatic Critical Habitat increased from 2 miles to 423 miles during this time frame.

- As of 2025, 64% (27) of linkage buffers include Terrestrial Critical Habitat, with 56% (15) including over 1,000 acres and 15% (4) having > 40% of their area designated
- 2 linkage buffers increased from < 1% Terrestrial Critical Habitat in 2000 to > 40% in 2025
    - Carrizo Plain-W. San Joaquin Valley (8a) Landscape Linkage 80% Critical Habitat
    - Fresno-Sacramento Landscape Linkage 38% Critical Habitat
- As of 2025, 38% (16) of linkage buffers include Aquatic Critical Habitat
- 29% (12) of linkage buffers have > 10 miles of Aquatic Critical Habitat, while 5 have >40 miles
    - North South Cross Delta
    - All 4 Lower San Joaquin River Riparian Corridors

Conservation Plans 2000-2025

In 2000, the Kern Water Bank NCCP/HCP was the only conservation plan encompassing roughly 324 acres of the Kern River Riparian Corridor.

- In 2025, 4 overlapping NCCPs are in the implementation phase and multiple RCIS are underway.
- NCCPs: 26,165 acres described for conservation across linkage buffers
    - 26% (11) of linkage buffers overlap NCCP areas
    - Average: 2,430 acres described for conservation per linkage; range: 145–6,429 acres
    - 27% (3) of linkage buffers have >40% of area in an NCCP
    - East Contra Costa NCCP (2007) overlaps 2 linkage buffers
    - Yolo County NCCP (2019) overlaps 4 linkage buffers
    - Placer County MSCP (2021) overlaps 4 linkage buffers
    - Kern Water Bank NCCP/HCP overlaps 1 linkage buffer
- RCIS: 5 plans completed between 2020-2024
    - 57% (24) of linkage buffers overlap at least one RCIS
        - East Bay RCIS (2021): Overlaps 2 linkage buffers
        - Yolo County RCIS (2020): Overlaps 4 linkage buffers
        - Mid-Sacramento Valley (2021): Overlaps 1 linkage buffer
        - Kaweah Groundwater Subbasin RCIS (2022): Overlaps 5 linkage buffers
        - San Joaquin Valley RCIS (2025): Overlaps 12 linkage buffers

Land Use and Zoning

- 21% of total linkage buffer area (322,998 acres) is zoned as open space (including existing protected lands)
    - 1 linkage buffer is zoned > 80% open space (Madera-Merced Linkage 18a)
    - 5% (2) linkage buffers are zoned 60-80% open space
    - 12% (5) linkage buffers are zoned 40-60% open space

    - 38% (16) linkage buffers are zoned 20-40% open space
    - 43% (18) linkage buffers are zoned <20% open space
- 3% of the total linkage buffer area (48,016 acres) is zoned for development
    - 95% (40) of linkage buffers are zoned < 20% development
    - 1 linkage buffer is zoned 20-40% development
    - 1 linkage buffer is zoned 40% development (Sacramento Valley Grasslands 20b)

Business As Usual Development Projections for 2050

The Central Valley linkage buffers are not expected to experience much growth, with roughly 5% of the total area projected to be developed.

- 83% (35) of linkage buffers are projected to be < 20% developed in 2050, with 76% (32) projected to be < 10% developed.
- Dry Creek-Natomas E Main Drain-American River is projected to be the most developed by 2050 (72%); it currently supports 45% natural landcover

Working Lands

- 98% (41) of linkages buffers have land currently enrolled in the Williamson Act, cover 61% (936,656 acres) of the net area across the linkage buffers
- Average of 22,520 acres currently enrolled per linkage buffer, ranging from 0 to 195,779 acres
- 26% (11) of linkage buffers have >20,000 acres enrolled; all retain >87% natural landcover
- Three Landscape Linkage buffers have >100,000 acres enrolled
    - Fresno-Sacramento has the most enrolled acreage, covering 77% of its area and remains 87% natural landcover
    - Sacramento Valley Grasslands (20c) has 146,446 acres enrolled, covering 81% of its area and remains 98% natural landcover
    - Carrizo Plain-W San Joaquin Valley (8d) has 103,749 acres enrolled, covering 54% of its area and remains 95% natural landcover

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers

- 5% (2) of linkage buffers ranked High Landscape Intactness
- 24% (10) of linkage buffers ranked Moderately High Landscape Intactness
- 71% (30) of linkage buffers ranked Moderately Low Landscape Intactness
- Top two Landscape Intactness-ranked linkages:
    - Carrizo Plain-W. San Joaquin Valley (8b) scored 0.61
    - Deer Creek-Sand Ridge (6b) scored 0.61

Overlap with Statewide/Regional Connectivity Analyses

A total of 19 of 42 linkages (45%) had >80% overlap with at least one statewide or regional connectivity analysis and had < 25% of area identified as impeded by Present-Day Connectivity Omniscape (TNC 2017).

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 72% overlap across all linkage buffers (1,102,404 acres)
        - 26% (11) of linkage buffers had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017)
        - 64% overlap across all linkage buffers (982,155 acres)
        - 10% (4) of linkage buffers have >80% overlap

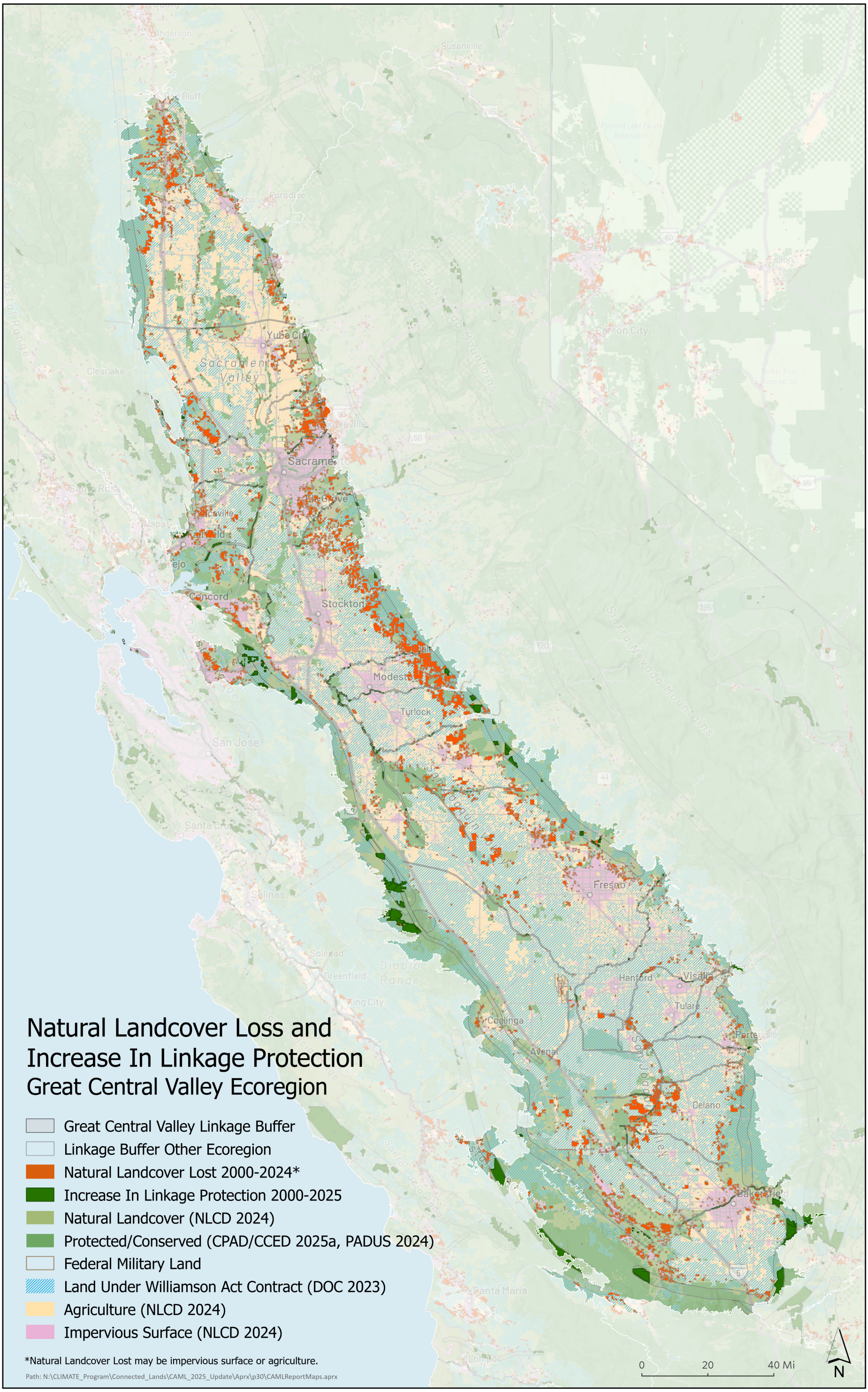
    - Resilient and Connected Network (TNC 2020)
        - 76% overlap across all linkage buffers (1,164,634 acres)
        - 19% (8) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 7% overlap across all linkage buffers (112,496 acres)
        - Average of 2,682 acres per linkage
        - Madera-Merced Linkage (18a) has >25% identified as climate specific linkages
- Regional Connectivity Studies Overlap Statistics:
    - Central Valley Cores and Corridors (Huber et al. 2010)
        - 14% (6) of linkage buffers have >80% overlap
    - Climate-Wise Sacramento Valley (Gallo et al. 2019)
        - 14% (6) linkage buffers have >80% overlap
    - South Coast Missing Linkages (Beier et al. 2006, SC Wildlands 2008)
        - One linkage buffer has >80% overlap
    - Critical Linkages: Bay Area & Beyond (Penrod et al. 2013)
        - One linkage buffer has >80% overlap

Infrastructure

- Roads and Rail
    - All linkage buffers contain some form of rail or roadway infrastructure
    - Primary roads overlap 55% (23) of linkage buffers, totaling ~46 (range: 0.62–7.3 miles)
    - Secondary roads overlap 95% (40) of linkage buffers, totaling ~213 miles (range: 0.34–35.02 miles)
    - Total road length across all linkages: ~2,668 miles (average: 67.61 miles per linkage)
    - Lost Hills-Semitropic Ridge has the least length of all roads at 6 miles
    - Lower San Joaquin River (19d) has the lowest average road density
    - Average weighted road density is .84 mi^2 (range: .20 mi^2–2.14 mi^2)
    - Railroads cross 69% (29) of linkage buffers, totaling ~46 miles (range: .32–6.93 miles).
- Wildlife Barriers and Remediation
    - CDFW identified 31.35 miles (50.46 km) of wildlife barriers that intersect linkage buffers
    - 26% (11) of linkage buffers are intersected by CDFW barriers, ranging from .11 to 7.25 miles; average: ~ 2.85 miles
    - CDFW has identified 10 Fish Passage Priorities across 6 linkage buffers
    - There are 6 Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity Projects in 4 linkage buffers, 3 of which have more than one Caltrans project.
    - Overlap with CDFW and Caltrans Barriers is detailed in Table 6

Table 6. Linkages that Overlap with CDFW and Caltrans Barriers in the Great Central Valley Ecoregion

LINKAGE NAME	CALTRANS CONNECTIVITY PROJECT ID	CDFW FISH FPAD	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
Bear River-Coon Creek-Auburn Ravine (24b)		737315			
Carrizo Plain - W. San Joaquin Valley (8a)			7.25	I-580 Livermore to Tracy (3.27 miles); Vasco Rd (3.98 miles)	W158; W200
Carrizo Plain - W. San Joaquin Valley (8b)			1.57	SR152 Pacheco Pass/San Luis Reservoir	W030
Carrizo Plain - W. San Joaquin Valley (8d)			7.04	SR46 Cholame Valley (3.62 miles); Cholame Valley (3.42 miles)	W203; W102
Cosumnes River -Mather			0.44	SR49 Nashville to El Dorado	W181
Fresno - Sacramento	201760; 761519	737065			
Grizzly - Cache Slough			0.67	SR12 (Walters Rd to SR113)	W155
Hwy 43 - Garces Highway			1.01	High Speed Rail Alpaugh	W035
Kern River			3.23	SR178 Canebrake	W037
Lower San Joaquin River (19a)	201760; 761519	70296, 76666, 737156			
Lower San Joaquin River (19c)		73707, 73706, 737065			
Madera - Merced linkage (18a)			2.81	Concrete Canal Los Banos	W040
Putah Creek		704779			
Sacramento Valley Grasslands (20b)			0.11	US50 Aerojet	W094
Sacramento Valley Grasslands (20c)			1.18	SR20 Salt Creek, West of Williams	W013
Sacramento Valley Grasslands (20d)		704281			
South End San Joaquin Valley			6.05	I-5 Grapevine (2.7 miles); SR33 Grocer Grade (3.35 miles)	W036; W210
Total projects/miles/segments	6	11	31.35		14



Map D. Great Central Valley Ecoregion

Cascades-Modoc Plateau Ecoregion Summary

The Cascades-Modoc Plateau Ecoregion is bound by the North Coast ranges to the west, the Harney Basin and Great Basin to the north and east, and the Sierra Nevada Range to the south. The primary natural communities mixed coniferous forests, juniper woodlands, sagebrush and shrub steppe, oak woodlands, grasslands, riparian forests and woodlands, and vernal pools, supporting pronghorn antelope and mule deer herds, sage grouse, and Pacific marten and fisher. The region is home to several tribes, such as the Modoc, Achumawi, Paiute, and Atsugewi, whose land stewardship and cultural heritages are integral to the landscape.

Much of the public lands in the region is federally held, such as Modoc, Lassen, and Shasta National Forests, Lassen-Volcanic National Park, Whiskeytown-Shasta Trinity National Recreation Area, Lava Beds National Monument, and several National Wildlife Refuges. The region presents strong opportunities for maintaining ecological connectivity due to its high levels of natural landcover, open space zoning, and alignment with regional conservation planning efforts and connectivity models. These conditions support habitat resilience and species movement across diverse landscapes. However, threats persist from logging, road infrastructure expansion, and uneven protection across linkage buffers. Some areas face development pressure and habitat fragmentation, particularly near transportation corridors and stream zones.

There are eight linkage buffers associated with the Cascades-Modoc Plateau Ecoregion, ranging in size from 7,476 to 172,856 acres with a net area of 666,071 acres, with 642,929 acres in California. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and in Figure 17.

- 1 Large Landscape Linkage (10km wide)
- 1 Large Landscape Linkage (10 km wide)
- 6 Landscape Linkages (5km wide)
- 1 Linkage (2km wide)

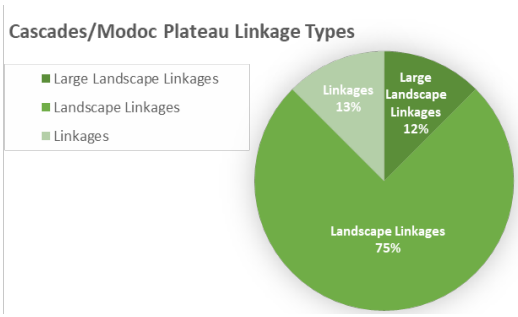


FIGURE 12. THE TYPES OF LINKAGES IN THE CASCADES-MODOC PLATEAU

Natural Landcover Change, 2000-2025

- Loss of ~2,500 acres of natural landcover across all linkage buffers since 2000
- All 8 linkage buffers retained >90% natural landcover
- Great Basin Riparian Linkage experienced a loss of 1,661 acres of natural landcover
- Lassen-Shasta Old Forest Linkage had ~ 300-acre increase in natural landcover, and a decrease in impervious surface (-8.89%), suggesting restoration

Impervious Surface Change, 2000-2025

- Increase of ~800 acres in impervious surfaces across all linkage buffers since 2000
- Impervious surfaces cover 4-6% of five linkage buffers, each with greater than 2,000 acres of impervious surface, with the West Lassen-Fisher Linkage having the greatest amount (8,562 acres)
- Most impervious surface related to extensive road network, mostly logging roads

Protection Status 2000-2025

A total of 4,688 acres has been added to conservation across linkage buffers since 2000. As of 2025, 53% (340,895 acres) of the net linkage area is protected in fee or conservation easement.

- Average percent protected per linkage: 53%
- Surprise Valley Bighorn Sheep Linkage (4b) is > 80% protected/conserved
- California-Oregon Cascades Linkage is 60-80% protected/conserved; remains 96% natural landcover
- 64% (5) linkage buffers are 40-60%, protected/conserved; all remain > 95% natural landcover
- Fountain Fire linkage buffer is 25% protected/conserved; remains > 94% natural landcover

Federal and State Designations for Conservation Lands in California

- Wilderness Area Designations
  - No increase 2000-2025
  - 63% (5) of linkage buffers include Wilderness, totaling 32,621 acres; averaging 6,524 acres
- Wild and Scenic River Federal and State Designations
  - No increase 2000-2025
  - 25% (2 linkage buffers) support Wild and Scenic Rivers
  - Total length Wild and Scenic Rivers: 10.56 miles in West Lassen-Fisher Linkage and 31.07 miles in Lassen Foothills Linkage, with about 4.35 miles of overlap
- Inventoried Roadless Areas
  - Present in 63% (5) of linkage buffers, net area 38,891 acres
  - West Lassen-Fisher linkage largest overlap with Inventoried Roadless Area (20,357 acres)

Critical Habitat 2000-2025

- There was no designated critical habitat across linkage buffers in 2000
- In 2025, there is 32,572 acres of Terrestrial Critical Habitat that overlaps 50% (4) of linkage buffers (range: 1,299 to 15,099 acres)
- Aquatic Critical Habitat overlaps 25% (2) linkage buffers, with 14.2 miles in the Western Lassen-Fisher Linkage and 30.1 miles in Lassen Foothills linkage, with 4.1 miles overlap

Conservation Plans 2000-2025

- Ecoregion includes priority area targeted by Secretarial Order 3362 (Improving Habitat Quality in Western Big Game Winter Range and Migration Corridors), signed in 2018; area supports all species targeted by the Order (elk, mule deer and pronghorn antelope)
- Area includes Natural Resources Conservation Service Critical Conservation Area

Land Use and Zoning

- 77% of total linkage buffer area (492,612 acres) is zoned as open space (including existing protected lands)
  - 63% (5) linkage buffers are zoned > 80% open space
  - 38% (3) linkage buffers are zoned 40-60% open space

    - Fountain Fire Linkage is zoned 94% open space but currently only supports 25% conserved/protected land
- 69% of the total area across linkage buffers zoned for development (14,510 acres) lies within the Wester Lassen-Fisher Linkage, near Highway 299, which has been identified by CDFW as a barrier to wildlife movement (W065)

Business As Usual Development Projections for 2050

"Business as Usual" projections for 2050 suggest that the Cascades-Modoc Plateau Ecoregion is not expected to experience significant growth.

Working Lands

- 50% (4) of linkage buffers are currently enrolled in Williamson Act, ranging from 258 to 24,663 acres per linkage and covering a net total of 30,370 acres across linkage buffers
- Approximately 80% of the land enrolled in the Williamson Act is within the western portion of the Lassen Foothills Landscape Linkage
- 63% (5) of linkage buffers had completed/approved timber harvest plans on private timberlands between 2010-2025, averaging 11,511 acres per linkage, with a range from 3,509 to 18,086 acres per linkage and covering a net area of 57,352 acres across linkage buffers

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers

- 2 linkages, Surprise Valley (4b) and Great Basin Riparian ranked High Landscape Intactness
- 75% (6) of linkage buffers ranked Moderately High Landscape Intactness

Overlap with Statewide/Regional Connectivity Analyses

All eight linkage buffers have >90% overlap with at least one statewide or regional connectivity analysis.

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 66% overlap across all linkage buffers (422,858 acres)
        - 38% (3) of linkage buffers had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017):
        - 94% overlap with combined Diffuse, Intensified, and Channelized categories (601,729 acres)
        - 88% (7) of linkage buffers have >90% overlap
        - One linkage has >25% of its area identified as impeded (Surprise Valley 4a)
    - Resilient and Connected Network (TNC 2020):
        - 59% overlap across all linkage buffers (378,931)
        - 38% (3) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 19% overlap across all linkage buffers (123,639 acres)
        - Average 16,020 acres of climate-specific linkages
- Regional Connectivity Studies Overlap Statistics:
    - Pacific Fisher Model (Spencer et al. 2019)
        - West Lassen Fisher linkage buffer has > 80% overlap
    - Pacific Marten Model (Spencer et al. 2019):
        - California-Oregon Cascades linkage buffer has > 80% overlap
    - Climate-wise and Multiscale Connectivity Priority Areas for the Modoc (Gallo 2019):

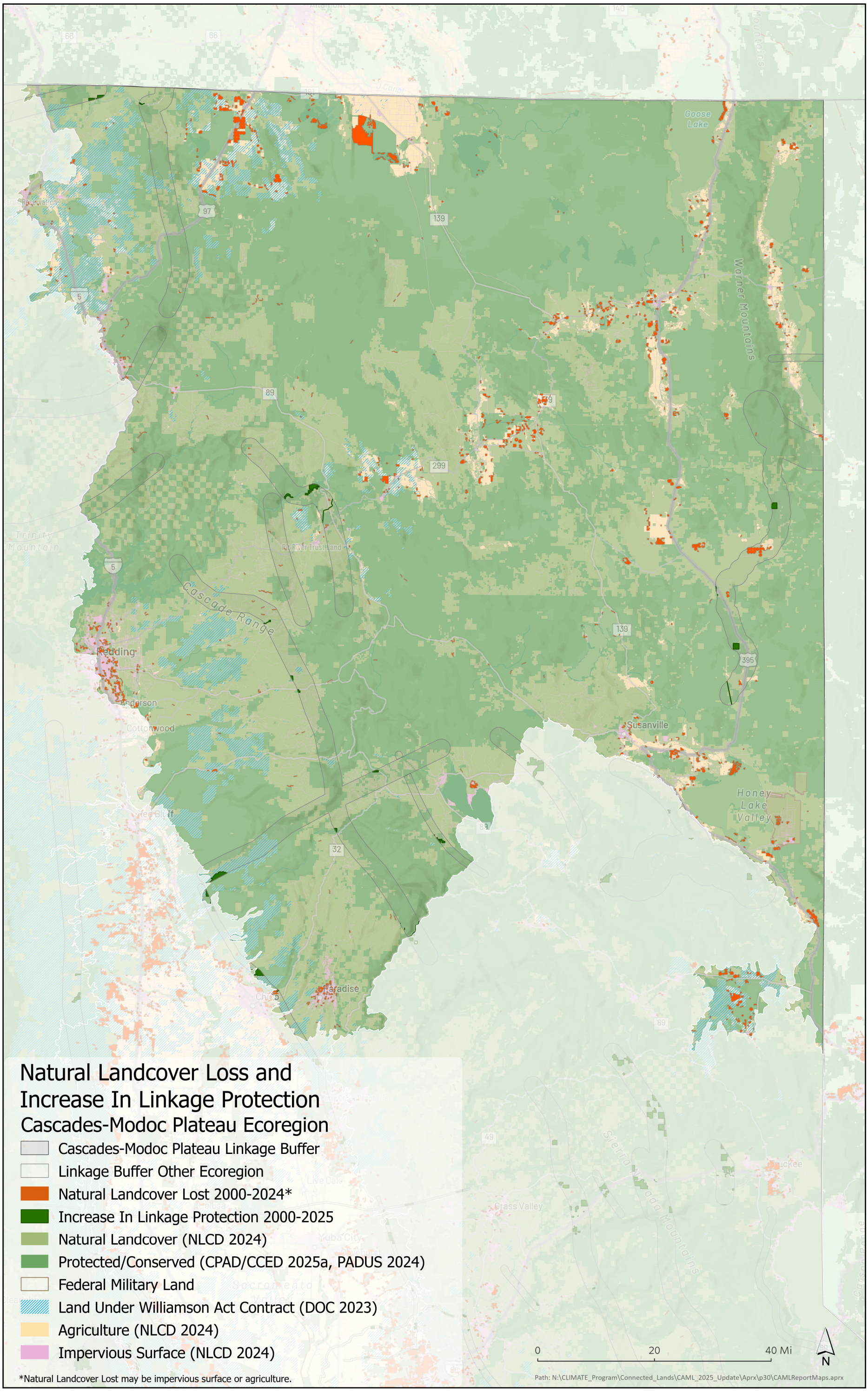
        - 25% (2) of linkage buffers have >80% overlap
- CDFW has also delineated Ungulate Migration Corridors, Migration Stopovers, and Winter Ranges based on GPS-collar data for deer, elk, and pronghorn in this region

Infrastructure

- Roads and Rail
    - All 8 linkage buffers contain some form of rail or roadway infrastructure
    - No primary roads overlap any of the linkage buffers
    - Secondary roads overlap 75% (6 linkage buffers), total ~68 miles (range: 3.32-21.54 miles)
    - Total road length across all linkage buffers: 1,508 miles (average: 188.46 miles per linkage)
    - Average weighted road density: 0.73 miles^2 (range: 0.11 miles^2–1.06 miles^2)
    - Railroads cross 25% (2) of linkage buffers; total 7.43 miles (range: 3.57–3,86 miles)
- Wildlife Barriers and Remediation
    - CDFW identified 18.64 miles (30 km) of wildlife barriers across linkage buffers
    - 50% (4) linkages are bisected by CDFW barriers, ranging from 2.69 miles to 8.9 miles; average: 4.67 miles
    - CDFW has identified 7 fish passage priorities within the Klamath River Watershed that overlap with the California-Oregon Cascades Linkage buffer
    - There are no Caltrans Active, Planned, or Priority Unfunded Fish and Wildlife Connectivity Projects within any of the linkage buffers
    - The U.S. Route 97 Elk Overcrossing, currently under construction by Caltrans District 2, is just west of the California-Oregon Cascades Linkage, and is expected to benefit elk, deer and mountain lion
    - Overlap with CDFW Barriers and Priorities is detailed in Table 7

Table 7. Linkages that Overlap with CDFW Barriers and Priorities in the Cascades-Modoc Plateau Ecoregion

LINKAGE NAME		CDFW FISH PASSAGE PRIORITY ID	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
West Lassen – Fisher		765702, 766654 through 766661	8.9	I-5/SR-299 intersection East to SR-299/Hatchet Pass (3.98 miles); SR-32E Transfer/Deer Creek (3.98 miles); and SR-36E Mineral to Paynes Creek (0.93 miles)	W065; W072; W073
Fountain Fire			2.69	I-5/SR-299 intersection East to SR-299/Hatchet Pass	W065
California-Oregon Cascades Link			3.32	US-97 Grass Lake	W008
Lassen Foothills			3.76	SR-36E Mill Creek to Chester	W003
Total projects/miles/segments		7	18.64		6



Map E. Cascades-Modoc Plateau Ecoregion

Sierra Nevada Ecoregion Summary

The Sierra Nevada Ecoregion extends from the southern Cascade Mountains in the north to the Tehachapi Mountains in the south, with the Central Valley forming the western boundary and the Great Basin its eastern edge. The rugged mountains and steep elevational gradients create a variety of vegetation zones. From oak woodlands, grassland, and chaparral interspersed with riparian forests in the foothills, to mixed montane and coniferous forest further upslope, to subalpine and alpine forests and wet meadows at higher elevations, with the eastern slopes dominated by more xeric forests, sagebrush and desert scrubs. Major rivers—including the American, Feather, Tuolumne, Cosumnes, Merced, Kings rivers—flow westward into the Central Valley. The rich diversity of habitats supports an array of species, such as the Pacific fisher, bighorn sheep, northern and California spotted owls, Sierra Nevada yellow-legged frog, Yosemite toad, steelhead, Chinook salmon, and Lahontan cutthroat trout. The region is also home to numerous tribes, such as the Tule River, Shingle Springs, Washoe, Paiute, Shoshone, Miwok, Mono, and Yokuts, whose stewardship and cultural heritages are integral to the landscape.

Most of the ecoregion is in public ownership—including Yosemite, Sequoia, and Kings Canyon national parks, several national forests (e.g., Plumas, Tahoe, Eldorado, Stanislaus, Sierra, Inyo, Lake Tahoe, Sequoia), state parks, and Bureau of Land Management lands—and private holdings, notably by industrial timber companies. Despite retaining high levels of natural landcover over the last 25 years, the ecoregion continues to face threats from logging and its associated road construction that fragments forested habitats and water diversions, which impact stream health. Rural development, particularly in the foothills, is also a threat.

There are 36 linkage buffers associated with the Sierra Nevada Ecoregion, ranging in size from 3,252 to 395,180 acres with a net area of 2,878,385 acres. Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and in Figure 19.

- 10 Large Landscape Linkages (10km wide)
- 17 Landscape Linkages (5 km wide)
- 7 Linkages (2km wide)
- 1 Constrained Linkage (1km wide)
- 1 Riparian Corridor (< 500m wide)

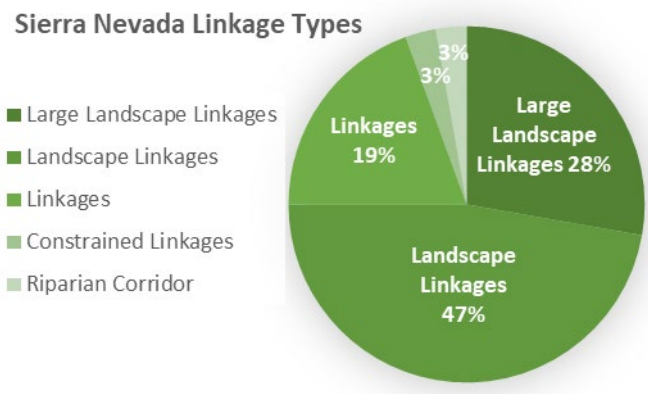


FIGURE 13. TYPES OF LINKAGES IN THE SIERRA NEVADA

Natural Landcover Change, 2000-2025

- In 2000, 97% (35) of linkage buffers supported > 80% natural landcover; average 94% natural landcover per linkage
- Loss of 7,730 acres of natural landcover across all linkage buffers since 2000
- 86% (31) of linkage buffers saw a reduction in natural landcover since 2000, ranging from 3 to 2,623 acres; Owens Lake saw the greatest loss yet still retains 94% natural landcover
- In 2025, 94% (34) of linkage buffers retained > 80% natural landcover; average 94% natural landcover per linkage
- Only two linkages have < 80% natural landcover in 2025

    - Kings River Constrained Linkage buffer retains 77% natural landcover, down from 81% in 2000, with a loss of 146 acres of natural landcover during this time frame.
    - Outside Creek-Elk Bayou Riparian Corridor retains 50% natural landcover, down from 62% in 2000, with a loss of 402 acres of natural landcover during this time frame.

Impervious Surface Change, 2000-2025

- Increase of 4,653 acres in impervious surfaces across all linkage buffers since 2000
- 58% (21) of linkage buffers have > 1,000 acres of impervious surface, mostly roadways
- Yosemite-Kings Canyon Landscape Linkage (5km wide) has the greatest amount of impervious surface (7,303 acres) yet retains 98% natural landcover

Protection Status 2000-2025

A total of 163,834 acres has been added to conservation across linkage buffers since 2000. As of 2025, 77% of the net linkage area is protected in fee or conservation easement.

- Average percentage protected per linkage: 63%
- 39% (14) of linkage buffers are >80% protected/conserved; all remain > 94% natural landcover
- 11% (4) of linkage buffers are 60–80% protected/conserved; all remain > 95% natural landcover
- 28% (10) of linkage buffers are 40–60% protected/conserved; all remain > 94% natural landcover
- 11% (4) of linkage buffers are 20–40% protected/conserved; 3 remain > 80% natural landcover
- 11% (4) of linkage buffers are <20% protected/conserved; 3 remain > 80% natural landcover
- 23 linkages had >1,000 acres protected/conserved between 2000–2025
- Largest gains:
    - Owens Lake: +43,903 acres
    - 3 Southern Sierra Checkerboard linkages combined: +71,007 acres
        - Southern Sierra Checkerboard (west) +36,922 acres
        - Southern Sierra Checkerboard (central) +27,239 acres
        - Southern Sierra Checkerboard (east) +6,846 acres

Federal and State Designations for Conservation Lands in California

- Wilderness Area Designations
    - Increase of 49,848 acres (2000–2025) across three linkage buffers; largest increase White Mountains-Benton Range +28,775 acres
    - 2000: 33% (12) of linkage buffers include Wilderness; total 327,457 acres; average 27,288 acres per linkage
    - 2025: 36% (13) of linkage buffers in Wilderness; total 377,305 acres; average 29,024 acres per linkage
    - 2025: 25% (9) of linkage buffers have >20% Wilderness; highest: 69% (South Fork Kern River)
- Federal and State Wild and Scenic River Designations
    - Increase of 17.38 miles (2000–2025)
    - 2000: 25% (9) of linkage buffers contain Wild and Scenic Rivers; total 145.09 miles
    - 2025: 31% (11) of linkage buffers contain Wild and Scenic Rivers; total 162.47 miles
- Inventoried Roadless Areas
    - Present in 56% (20) linkage buffers; total 340,568 acres, average 17,276 acres
    - 22% (8) of linkage buffers overlap >28% Inventoried Roadless Area

- Greatest percent of area in Inventoried Roadless Area: 42% of E. Sierra-White Mountains (27,335 acres)
- Seven linkage buffers have > 20,000 acres of Inventoried Roadless Areas:
  - White Mountains-Benton Range/Mono Lake 57,788 acres
  - Owens Valley: 41,872 acres
  - Yosemite-Kings Canyon: 39,142 acres
  - E. Sierra White Mountains (south): 37,418 acres
  - E. Sierra-White Mountains (north): 27,335 acres
  - El Dorado-Tahoe National Forest: 25,227 acres
  - White Mountains-Inyo Mountains: 20,893 acres

Critical Habitat 2000-2025

- Terrestrial Critical Habitat increased from 65,590 acres in 2000 to 701,089 acres in 2025
  - As of 2025, 69% (25) of linkage buffers include Terrestrial Critical Habitat, with 88% (22) including over 2,000 acres and 32% (8) having > 40% of their area designated
  - 2 linkage buffers increased from < 1% Terrestrial Critical Habitat in 2000 to > 80% in 2025, both associated with the E. Sierra-White Mountains linkage buffers
  - Aquatic Critical Habitat increased from 0 miles in 2000 to 2.32 miles in 2025; associated with the Placer County Oak Woodlands linkage buffer

Conservation Plans

No conservation plans existed in 2000; in 2025 there are a few NCCPs and RCISs that have been completed

- NCCPs: 115,086 acres described for conservation across 7 linkage buffers
- 19% (7) of linkage buffers overlap NCCP/MSCP areas
- An average of 16,441 acres described for conservation across 7 linkages; range: 404–57,734 acres
  - 6 linkage buffers overlap Desert Renewable Energy Conservation Plan (BLM 2016) National Conservation Lands, Areas of Environmental Concern or Wildlife Allocation designations.
  - Southern Sierra Checkerboard eastern linkage has the greatest acreage and is 57% described for conservation
  - Southern Sierra Checkerboard central linkage is 33% described for conservation, covering 37,682 acres
  - Placer County Oak Woodlands linkage overlaps 404 acres of the Placer County NCCP (2021)
- Two linkage buffers overlap the planning boundaries for Resource Conservation Investment Strategies
  - Outside Creek-Elk Bayou linkage buffer overlaps Kaweah Groundwater Subbasin RCIS (2022)
  - Southern Sierra linkage buffer has slight overlap with the Antelope Valley RCIS (2021)
- Habitat Conservation Plans (HCP) identified, though no spatial data was available.
  - Sierra Pacific Industries has an HCP for Northern and California Spotted Owl (2020a), a Candidate Conservation Agreement with Assurances for Fishers (2016), and an HCP and Safe Harbor Agreement for Seven Anadromous Fish Populations (2020b).
  - Tehachapi Uplands Multiple Species Habitat Conservation Plan (2013) encompasses portions of the Tejon Ranch.

Land Use and Zoning

- 83% of total linkage buffer area (2,386,193 acres) is zoned as open space (including existing protected lands).
  - 53% (19) of linkage buffers are zoned > 80% open space

    - 8% (3) of linkage buffers are zoned 60-80% open space
    - 25% (9) of linkage buffers are zoned 40-60% open space
    - 6% (2) of linkage buffers are zoned 20-40% open space
    - 8% (3) of linkage buffers are zoned <20% open space

- 6% of the total linkage buffer area (182,360 acres) is zoned for development.
    - 75% (27) of linkage buffers are zoned < 20% development
    - 17% (6) of linkage buffers are zoned 20-40% development
    - 6% (2) of linkage buffers are zoned 40-60% development
    - 1 linkage buffer is > 80% zoned for development (N-S Oak woodland Linkage in El Dorado County)

Business As Usual Development Projections for 2050

"Business as Usual" projections suggest that the Sierra Nevada Ecoregion is not expected to experience much growth.

Working Lands

- 56% (20) of linkage buffers currently enrolled in the Williamson Act, ranging from 47 to 58,182 acres per linkage and covering a net total of 155,626 acres across linkage buffers
- Southern Sierra Checkerboard western linkage buffer supports the most enrolled Williamson Act acreage, covering 48% of its area
- A total of 59 acres in Williamson Act contracts were not renewed in one linkage buffer
- 39% (14) of linkage buffers had completed/approved timber harvest plans on private timberlands between 2010-2025, ranging from 14 to 12,617 acres per linkage and covering a net area of 55,573 acres across these linkage buffers

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers:

- 36% (13) of linkage buffers ranked High Landscape Intactness
- 44% (16) of linkage buffers ranked Moderately High Landscape Intactness
- 19% (7) of linkage buffers ranked Moderately Low Landscape Intactness
- Top 5 Landscape Intactness-ranked linkages:
    - Sierra Nevada-Coso Hills (.73)
    - E. Sierra-White Mountains (.73)
    - South Fork Kern River (.71)
    - Owens Valley (.71)
    - White Mountains-Inyo Mountains (.71)

Overlap with Statewide/Regional Connectivity Analyses

A total of 89% (32) of linkage buffers had >80% overlap with at least one statewide or regional connectivity analysis.

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 59% overlap across all linkage buffers (1,712,580 acres)

        - 77% (6) of linkage buffers had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017):
        - 89% overlap with the combined Diffuse, Intensified and Channelized categories across all linkage buffers (2,572,888 acres)
        - 78% (28) of linkage buffers have >80% overlap
    - Resilient and Connected Network (TNC 2020):
        - 75% overlap across all linkage buffers (2,166,031 acres)
        - 44% (16) of linkage buffers have >80% overlap
    - Climate-specific linkages (Schloss et al. 2021):
        - 18% overlap across all linkage buffers (504,463 acres)
        - 7 linkage buffers have >25% of their area identified as climate linkages
        - Average of 14,276 acres per linkage
- Regional Connectivity Studies Overlap Statistics:
    - Sierra Nevada Foothills Assessment (Krause et al. 2015)
        - 1 linkage buffer has >80% overlap
    - Climate-Wise Modoc Assessment (Gallo et al. 2019)
        - 1 linkage buffer has >80% overlap
    - Climate-Wise Sacramento Valley Assessment (Gallo et al. 2019)
        - 2 linkage buffers have >80% overlap
    - A Linkage Network for the California Deserts (Penrod et al. 2012)
        - 2 linkage buffers have >80% overlap
    - Central Valley Cores and Corridors (Huber et al. 2010
        - 1 linkage buffer has >80% overlap
    - Climate Resilient Connectivity for South Coast (Jennings et al. 2019)
        - 1 linkage buffer has >80% overlap

Infrastructure

- Roads and Rail
    - All 36 linkage buffers contain some form of linear infrastructure
    - Primary roads overlap 25% (9 linkage buffers), totaling ~46 miles (range: 2.49–8 miles)
    - Secondary roads overlap 83% (30 linkage buffers), totaling ~420 miles (range: 0.27–99.62 miles)
    - Total road length across all linkage buffers: ~6,119 miles (average: 183.71 miles per linkage); Owens Lakes has the highest total road length
    - Average weighted road density per linkage buffer: 1.08 mi^2 (range: 0.30–3.08 mi^2); westernmost Interstate 80 Corridor has the highest average weighted road density
    - Railroads cross 33% (12 linkage buffers), totaling ~64 miles (range: .32–17.35 miles)
- Wildlife Barriers and Remediation
    - CDFW identified 155.69 miles (250.56 km) of wildlife barriers that intersect linkage buffers
    - 58% (21) of linkage buffers are bisected by CDFW barriers (see Table 8), ranging from 1.12 to 33.8 miles; average ~ 7.88 miles
    - There are 12 Caltrans Active, Planned, or Priority Unfunded Wildlife Connectivity Projects within 17% (6 linkage buffers); 7 of those projects are in the westernmost Southern Sierra Checkerboard (see Table 8)
    - Barrier I-80 Donner Summit Bisects Sierra Nevada (W011) in the Interstate 80 Corridor (12a) has been remediated

- Overlap with CDFW and Caltrans Barriers detailed in Table 8

Table 8. Linkages that Overlap with CDFW and Caltrans Barriers in the Sierra Nevada Ecoregion

LINKAGE NAME	CALTRANS CONNECTIVITY PROJECT ID	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
Owens Lake	20240928	33.80	US395 near Independence, elk roadkill site (10.9 miles); SR-190/SR-136 loop from Lone Pine to Olancha (9.7 miles; Los Angeles Aqueduct (13.22 miles)	W228; W229; W134
South Fork Kern River		20.81	SR-178 Canebrake	W037
E. Sierra - White Mountains (8c)		13.77	SR-108 Strawberry to US39 (53.53 miles); US395 Mono County Bridgeport to Sonora Junction (10.23 miles)	W038; W055
Yosemite - Kings Canyon	20240620	12.89	Oakhurst-Wawona (7.16 miles); Prather-Huntington Lake (5.73 miles)	W099; W101
Southern Sierra Checkerboard (10c)	20240924, 20220937, 20220938, 20240925, 20240926, 20220939, 20240927	12.70	SR-58 Tehachapi Grade (9.89 miles); SR-178 Canebrake (2.81 miles)	W033; W037
E. Sierra - White Mountains (8a)		8.94	US395 from Mammoth to Bridgeport	W141
Sierra Nevada - Coso Hills		7.71	US395 Lone Pine to Kramer Junction	W133
Upper Cosumnes River (7a)		7.33	SR-58 Lower Bear Reservoir to Kirkwood (5.31 miles); SR-49 Nashville to El Dorado (2.02 miles)	W092; W181
E. Sierra - White Mountains (8b)		6.52	US395 from Mammoth to Bridgeport	W141
Upper Cosumnes River (7c)		6.01	SR-49 Nashville to El Dorado	W181
Interstate 80 Corridor (12a)		5.34	I-80 Donner Summit Bisects Sierra Nevada (REMEDIATED; 1.94 miles); I-80 Crest of the Sierra (3.41 miles)	W011; W183
Owens Valley		4.82	US395 near Independence, elk roadkill site	W228
Tahoe - Shoreline		4.07	Pioneer Trail (1.29 miles); US50 Tahoe Basin (1.39 miles); SR-89 Tahoe Basin (1.39 miles)	W179; W177; W178
Interstate 80 Corridor (12b)		3.91	I-80, Yuba Gap, bisects Sierra Nevada	W088
Southern Sierra Checkerboard (10a)	20240927	3.86	SR-58 Tehachapi Grade	W033
Stanislaus National Forest Recovery		3.39	Groveland-Yosemite	W100
Interstate 80 Corridor (12c)		2.86	SR-20, Intersection I-80, Canals	W090
Southern Sierra		2.78	I-5 Grapevine	W036
Interstate 80 Corridor (12d)		1.58	I-80, Foothills	W089
Lake Almanor (14b)		1.34	SR-36E Mill Creek to Chester	W003
Upper Cosumnes River (7b)		1.12	SR-49, Nashville to El Dorado	W181
St. Johns - Cottonwood - Cross Creek				
White Mountains - Benton Range/Mono Lake				
El Dorado - Tahoe N.F. Checkerboard (11a)	80000002			

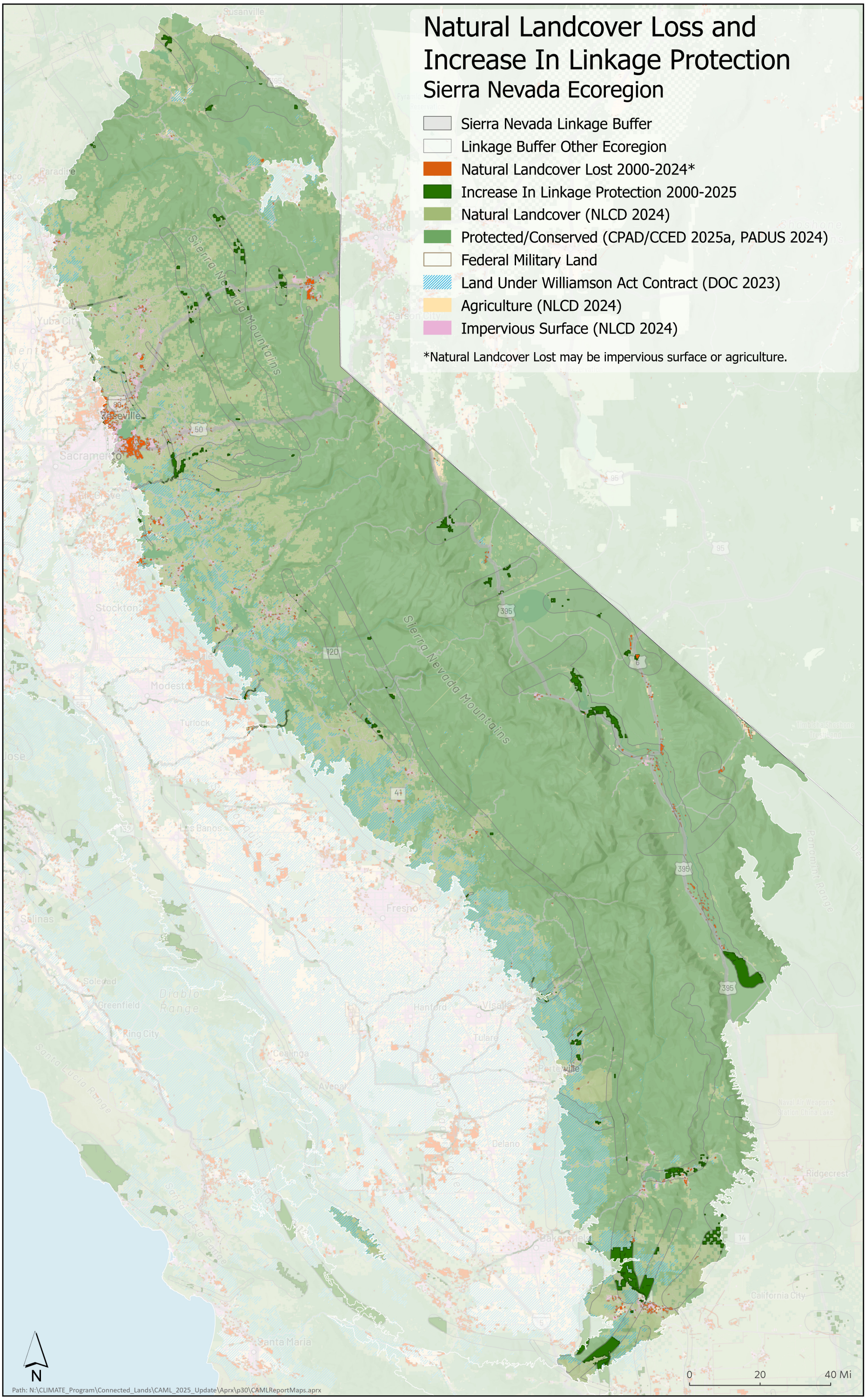
North Fork Tule				
White Mountains - Inyo Mountains				
El Dorado - Tahoe N.F. Checkerboard (11b)				
E. Sierra - Owen's Gorge	20240928			
projects/miles/segments	12	155.69		24

Natural Landcover Loss and Increase In Linkage Protection

Sierra Nevada Ecoregion

- Sierra Nevada Linkage Buffer
- Linkage Buffer Other Ecoregion
- Natural Landcover Lost 2000-2024*
- Increase In Linkage Protection 2000-2025
- Natural Landcover (NLCD 2024)
- Protected/Conserved (CPAD/CCED 2025a, PADUS 2024)
- Federal Military Land
- Land Under Williamson Act Contract (DOC 2023)
- Agriculture (NLCD 2024)
- Impervious Surface (NLCD 2024)

*Natural Landcover Lost may be impervious surface or agriculture.



Map F. Sierra Nevada Ecoregion

Mojave and Sonoran Deserts Ecoregion Summary

The Mojave and Sonoran Deserts Ecoregion is roughly bound by the San Gabriel, San Bernardino, and Peninsular ranges to the west, the Tehachapi and Sierra Nevada ranges to the north, and the Nevada and Arizona deserts to the east. The primary natural communities of the region include Joshua tree woodlands, creosote bush scrub, pinyon-pine juniper woodland, desert riparian, washes and bajadas, and an occasional palm oasis. The Mojave Desert is higher in elevation, supporting evergreen trees such as Joshua tree, juniper and pinyon pine, while the Sonoran Desert is dominated by creosote bush scrub and saltbush scrub. Characteristic species include bighorn sheep, desert tortoise, Mojave ground squirrel, and chuckwalla. The region is home to numerous tribes, such as Paiute, Yokut, Panamint Shoshone, Serrano, Cahuilla, Mohave, Yuma, and Chemchuevi, whose land stewardship and cultural heritages are integral to the landscape.

Most of the region is publicly held, with the Bureau of Land Management administering the great majority of land in the region, including several National Monuments including Mojave Trails, Sand to Snow, Castle Mountains, and the recently designated Chuckwalla National Monument that is co-managed with the Torres Martinez Desert Cahuilla Indians, the Fort Yuma Quechan Indian Tribe, the Cahuilla Band of Indians, the Chemehuevi Indian Tribe, and the Colorado River Indian Tribes. Other significant public lands include Joshua Tree National Park, Death Valley National Park, Mojave National Preserve, Anza Borrego and Cuyamaca-Rancho state parks, and the Salton Sea National Wildlife Refuge. There are also several large military installations in the region, including China Lake, Twentynine Palms, Chocolate Mountains, and Edwards Air Force Base. The region is home to about one million people, concentrated in urban centers like Victorville, Palm Springs, and El Centro.

There are 66 linkages buffers associated with the Mojave and Sonoran Deserts Ecoregion, ranging in size from 1,989 to 503,272 acres with a net area of 3,738,234 acres in California (4,022,428 acres including transboundary linkage buffers). Please visit the California Missing Linkages 2000–2025: A Status Update interactive map for detailed results of the analyses for each linkage, for both the linkage buffer and landscape context buffer.

Breakdown by linkage type is detailed below and in Figure 21.

- 44 Large Landscape Linkages (10km wide)
- 11 Landscape Linkages (5km wide)
- 4 Linkages (2km wide)
- 1 Constrained Linkage (1km wide)
- 6 Riparian Corridors or Missing Links (500m wide)

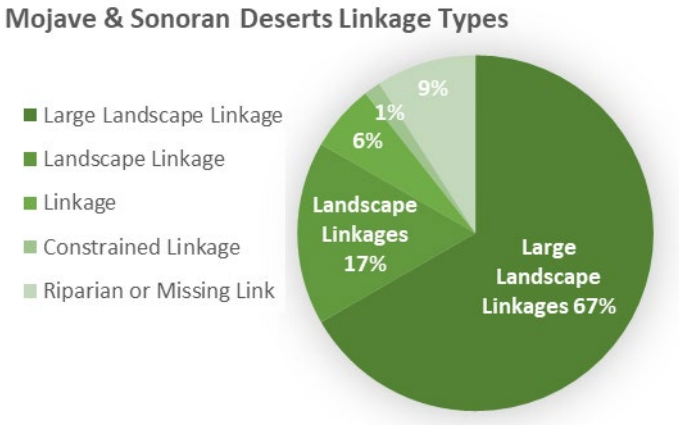


FIGURE 14. TYPES OF LINKAGES IN THE MOJAVE AND SONORAN DESERTS

Natural Landcover Change, 2000-2025

- In 2000, average 93% natural landcover across the 66 linkage buffers
    - 89% (59) of linkage buffers supported > 80% natural landcover, with 93% having >95% natural landcover
    - One linkage buffer had 60-80% natural landcover

    - 5% (3) of linkage buffers had 40-60% natural landcover
    - 5% (3) of linkage buffers had 20-40% natural landcover
- Net loss of 11,264 acres of natural landcover across all linkage buffers since 2000
- 92% (61) of linkage buffers saw a reduction in natural landcover since 2000, ranging from 2 to 1,577 acres
- Greatest losses associated with three Landscape Linkage buffers in close proximity to one another:
    - Two related to the San Bernardino-San Jacinto Linkage (Penrod et al. 2005):
        - Whitewater River loss of 1,577 acres, from 97% to 92% natural landcover
        - San Gorgonio River/Whitewater River loss of 811 acres, from 95% to 90% natural
    - East West-Imperial-Coachella Valley (9e) loss of 1174 acres, from 96% to 94% natural
- In 2025, the same 59 linkage buffers (89%) remain > 80% natural landcover; down to 92% average natural landcover per linkage
- 395 South of Ridgecrest (14f) Constrained Linkage saw the greatest percent change, from 78% to 64% natural landcover between this time frame

Impervious Surface Change, 2000-2025

- Increase of 14,173 acres in impervious surfaces across all linkage buffers since 2000
- 23% (15) of linkage buffers have >1,000 acres of impervious surface, only 3 < 86% natural
- Three linkage buffers are greater than 25% impervious surface
    - Lower Whitewater River 58% impervious surface
    - East West-Imperial-Coachella Valley 49% impervious surface
    - 395 South of Ridgecrest 36% impervious surface
- Mojave River Linkage, a critical east-west movement corridor through the ecoregion, has the greatest amount of impervious surface (10,932 acres) yet remains 86% natural landcover.

Protection Status 2000-2025

A total of 106,292 acres has been added to conservation across linkage buffers since 2000. As of 2025, 80% of the net linkage area is protected in fee or conservation easement.

- Average percent protected per linkage: 69% (range 0 to 100%)
- 48% (32) of linkage buffers are > 80% protected/conserved, 69% (22) > 95% protected/conserved
- 14% (9) of linkage buffers are 60-80% protected/conserved, all remain > 90% natural landcover
- 20% (13) of linkage buffers are 40-60%, protected/conserved, all Large Landscape Linkages or Landscape Linkages >95% natural landcover, except East West-Imperial-Coachella Valley Linkage (9f) that remains 86% natural landcover
- 8% (5) of linkage buffers are 20-40% protected/conserved, two remain > 80% natural landcover
    - Mojave River Linkage retains 86% natural landcover is 31% protected/conserved
    - San Gabriel-Tehachapi Landscape Linkage (12b) retains 97% natural landcover is 20% protected/conserved
- 11% (7) linkages are < 20% protected/conserved, 4 with > 60% natural landcover
    - San Gabriel-Tehachapi Linkage (12a) remains 88% natural is 4% protected
    - Big Rock Creek Linkage remains 93% natural is 2% protected
    - 395 South Ridgecrest Landscape Linkage (14e) remains 97% natural is 2% protected/conserved
    - 395 South Ridgecrest Constrained Linkage (14f) remains 64% natural, 0% in conservation

Federal Designations for Conservation Lands in California

- Wilderness Area Designations
- Increase of 91,924 acres (2000–2025) across 7 linkage buffers
    - Five Large Landscape Linkages had the greatest increases:
        - Soda-Avawatz Mountains, from 0 to 40% of its area +34,370 acres
        - I-15 Soda Mountains, from 5 to 41% of its area +19,567 acres, total 22,443 acres

        - Avawatz Mountains-Silurian Hills, from 20 to 38% of its area +18,519 acres, total 39,522 acres
        - Silurian Hills-Avawatz Mountains, from 41 to 81% of its area +22,600 acres, total 45,389 acres (only slight overlap of Wilderness in 2000 with Avawatz-Silurian)
        - Amargosa River, from 66 to 69% of its area in California (43-45% full buffer into Nevada), all Wilderness in California +14,828 acres, total 348,483 acres
    - 2000: 61% (40) of linkage buffers include Wilderness; total 1,097,787 acres; average 27,445 acres per linkage
    - 2025: 64% (42) of linkage buffers include Wilderness; total 1,189,711 acres; average 28,326 acres per linkage
    - 2025: 29% (19) of linkage buffers are > 20% Wilderness, while 8% (5) of linkage buffers are > 80% designated Wilderness; highest: 99.8% (Panamint Dunes)
- Wild and Scenic Rivers Designations
    - Increase from 0 in 2000 to 50.44 miles in 2025
    - 2025: 9% (6) of linkage buffers contain Wild and Scenic Rivers, with 5 linkages > 5 miles and some overlap between them
        - Amargosa River 26.55 miles, with 7.18 miles in Resting Springs and 5.33 miles in Dumont Dunes overlapping the Amargosa Wild and Scenic River
        - Whitewater River Landscape Linkage (46b) includes 14.32 miles of the Whitewater Wild and Scenic River, while Morongo Valley Large Landscape Linkage includes 19.36 miles of Whitewater Wild and Scenic River, with some overlap between them.
- Inventoried Roadless Areas
    - Present in 9% (6) linkage buffers; total 9,546 acres, average 1,591 acres (range 67 to 4,180 acres)
    - Five linkage buffers with no designated Wilderness include Inventoried Roadless Areas
        - Peninsular-Borrego Large Landscape Linkage 4,180-acre Inventoried Roadless Area
        - San Gabriel-Tehachapi Landscape Linkage (12b) 1,899-acre Inventoried Roadless Area
        - San Gabriel-Tehachapi Landscape Linkage (12c) 1,870-acre Inventoried Roadless Area
        - Granite-San Bernardino Mountains Large Landscape Linkage 1,360-acre Inventoried Roadless Area
        - Mojave River Linkage 67-acre Inventoried Roadless Area

Critical Habitat 2000-2025

- Terrestrial Critical Habitat increased 128,829 acres between 2000-2025
- In 2000, 41% (27) of linkage buffers included Critical Habitat with a net area of 497,667 acres
- As of 2025, 67% (44) of linkage buffers include Critical Habitat with a net area of 626,496 acres
- 73% (32 of 44) of linkage buffers include over 1,000 acres of Critical Habitat, with 12 linkages having > 40% of their area designated
- 8 linkage buffers increased from 0 acres in 2000 to > 2,500 acres of Critical Habitat in 2025
    - Border-Interstate 8 (7a) +55,505 acres (52% of area)
    - San Jacinto-Santa Rosa +21,793 acres (44% of area)
    - Border-Interstate 8 (7b) +17,285 acres (32% of area)
    - East West-Imperial-Coachella Valley (9f) +2,545 acres (21% of area)
    - Summit Valley +4,720 acres (20% of area)
    - Peninsular-Borrego (6a) +10,979 acres (13% of area)
    - Algodones Dunes (4a) +9,750 acres (8% of area)
    - Whitewater River (46b) +2,866 acres (8% of area)

Conservation Plans 2000-2025

- No non-federal conservation plans existed in 2000; 2 MSCP/NCCPs in implementation phase and 2 RCIS are completed and approved as of 2025
- 2025 MSCP/NCCPs: 1,602,069 acres or 43% of net area in linkages described for conservation:
    - Coachella Valley Multiple Species Conservation Plan (2008) +213,312 acres
    - Desert Renewable Energy Conservation Plan (2016) National Conservation Lands, Areas of Environmental Concern and Wildlife Allocation designations +1,388,757 acres

- 86% (57) of linkage buffers overlap an MCSP/NCCP
- Average: 26,643 acres described for conservation per linkage; range: 0–162,663 acres
    - 17% (11) of linkage buffers > 80% described for conservation
    - 18% (12) of linkage buffers 60-80% described for conservation
    - 20% (13) of linkage buffers 40-60% described for conservation
    - 9% (6) of linkage buffers 20-40% described for conservation
    - 23% (15) of linkage buffers > 0 but < 20% described for conservation
- RCIS: Two plans completed between 2021-2024.
    - 33% (22) of linkage buffers overlap an RCIS
        - San Bernardino County RCIS (2024): 27% (18) of linkage buffers
        - Antelope Valley RCIS (2021): 6% (4) of linkage buffers

Land Use and Zoning

- 84% of total linkage buffer area (3,158,329 acres) is zoned as open space (including existing protected lands).
    - 61% (40) of linkage buffers are zoned > 80% open space
    - 14% (9) linkage buffers are zoned 60-80% open space
    - 14% (9) linkage buffers are zoned 40-60% open space
    - 5% (3) linkage buffers are zoned 20-40% open space
    - 8% (5) linkage buffers are zoned <20% open space
- 5% of the total linkage buffer area (204,115 acres) is zoned for development.
    - 82% (54) of linkage buffers are zoned < 20% development
    - 12% (8) linkages are zoned 20-40% development
    - 6% (4) linkages are zoned > 40% development
    - 8 Linkages that retain > 80% natural landcover that are particularly at-risk of being severed:
        - 395 South of Ridgecrest (14e): 97% natural, 77% zoned for development
        - Joshua Tree: 99% natural, 21% zoned for development
        - Summit Valley: 96% natural, 46% zoned for development
        - Mojave River: 86% natural, 36% zoned for development
        - Granite-San Bernardino Mountains: 98% natural, 32% zoned for development
        - San Gorgonio River/Whitewater River: 90% natural, 26% zoned for development
        - Whitewater River (46b) 92% natural, 16% zoned for development
        - Border-Interstate 8 (7b) 99% natural, 12% zoned for development

Business As Usual Development Projections for 2050

"Business as Usual" projections suggest that the Mojave and Sonoran deserts are not expected to experience significant growth.

Working Lands

- 15% (10) of linkage buffers include land currently enrolled in Williamson Act, ranging from 29 to 12,771 acres, covering a net area of 38,008 acres
- 5 linkage buffers have > 900 acres enrolled
    - San Gabriel-Tehachapi Mountains (12c) 12,771 acres (39% of area)
    - San Gabriel-Tehachapi Mountains (12b) 11,458 acres (22% of area)
    - Peninsular-Borrego (6b) 7,761 acres (7% of area)
    - Peninsular-Borrego (6a) 4,061 acres (5% of area)
    - Mojave River 973 acres (1% of area)

Landscape Intactness 2025

Average landscape intactness scores for linkage buffers:29% (19) of linkage buffers ranked Very High Landscape Intactness

- 32% (21) of linkage buffers ranked High Landscape Intactness

- 26% (17) of linkage buffers ranked Moderately High Landscape Intactness
- 12% (8) of linkage buffers ranked Moderately Low Landscape Intactness
- One linkage buffer ranked Low Landscape Intactness

Overlap with Statewide/Regional Connectivity Analyses

A total of 58 of 66 linkages (88%) had >80% overlap with at least one statewide or regional connectivity analysis.

- Statewide Connectivity Studies Overlap Statistics:
    - California Essential Habitat Connectivity Network (Spencer et al. 2010):
        - 66% overlap across all linkage buffers (2,478,230 acres)
        - 41% (27) of linkages had >80% overlap
    - Present-Day Connectivity Omniscape (TNC 2017)
        - 94% overlap across all linkage buffers (3,519,798 acres)
        - 85% (56) of linkages have >80% overlap
    - Resilient and Connected Network (TNC 2020)
        - 53% overlap across all linkage buffers (1,989,525 acres)
        - 14% (9) of linkages have >80% overlap;
    - Climate-specific linkages (Schloss et al. 2021):
        - 15% overlap across all linkage buffers (550,388 acres)
        - 23% (15) of linkage buffers have > 25% of area identified as climate-specific linkages
        - Average of 9,287 acres per linkage
- Regional Connectivity Studies Overlap Statistics:
    - Omnidirectional Connectivity Mojave Desert tortoise (Gray et al. 2019)
        - 20% (13) of linkages have >80% overlap
    - Tortoise Conservation Areas Assessment (Averill-Murray et al. 2013)
        - 15% (10) of linkages have >80% overlap
    - Climate-Wise Connectivity West Mojave (Gallo et al. 2019)
        - 9% (6) of linkages have >80% overlap
    - Desert Linkage Network (Penrod et al. 2012)
        - 11% (7) of linkages have >80% overlap
    - Climate Resilient Connectivity South Coast (Jennings et al. 2019):
        - 1 linkage buffer has >80% overlap

Infrastructure

- Renewable Energy
    - 20% (13) of linkage buffers overlap solar ground installations, net area ~6,365 acres (range 1 acre to 1,776 acres)
    - Three linkage buffers include > 1,000 acres of solar
        - San Gabriel-Tehachapi Mountains (12a) 1,776 acres
        - San Gabriel-Tehachapi Mountains (12b) 1,554 acres
        - 395 South of Ridgecrest (14e) 1,275 acres
    - 24% (16) of linkage buffers include Development Focus Areas (DFA) for renewable energy under the DRECP (BLM 2016), net area 37,498 acres (range 38.6 acres to 11,207 acres)
    - 6 Development Focus Areas > 1,000 acres
        - Algodones Dunes (4b) 11,207 acres
        - East Searles Valley 10,349 acres
        - 395 South of Ridgecrest (14c) 5,574 acres
        - 395 South of Ridgecrest (14b) 5,092 acres
        - Highway 58 from 395 through WMP Desert Wildlife Management Area 1,296 acres
    - 2000: Wind Turbines in 6 linkage buffers; total 782 turbines (range 7–533 turbines)
    - 2025: Wind Turbines in 10 linkage buffers; total 1,316 turbines (range 2–684 turbines)

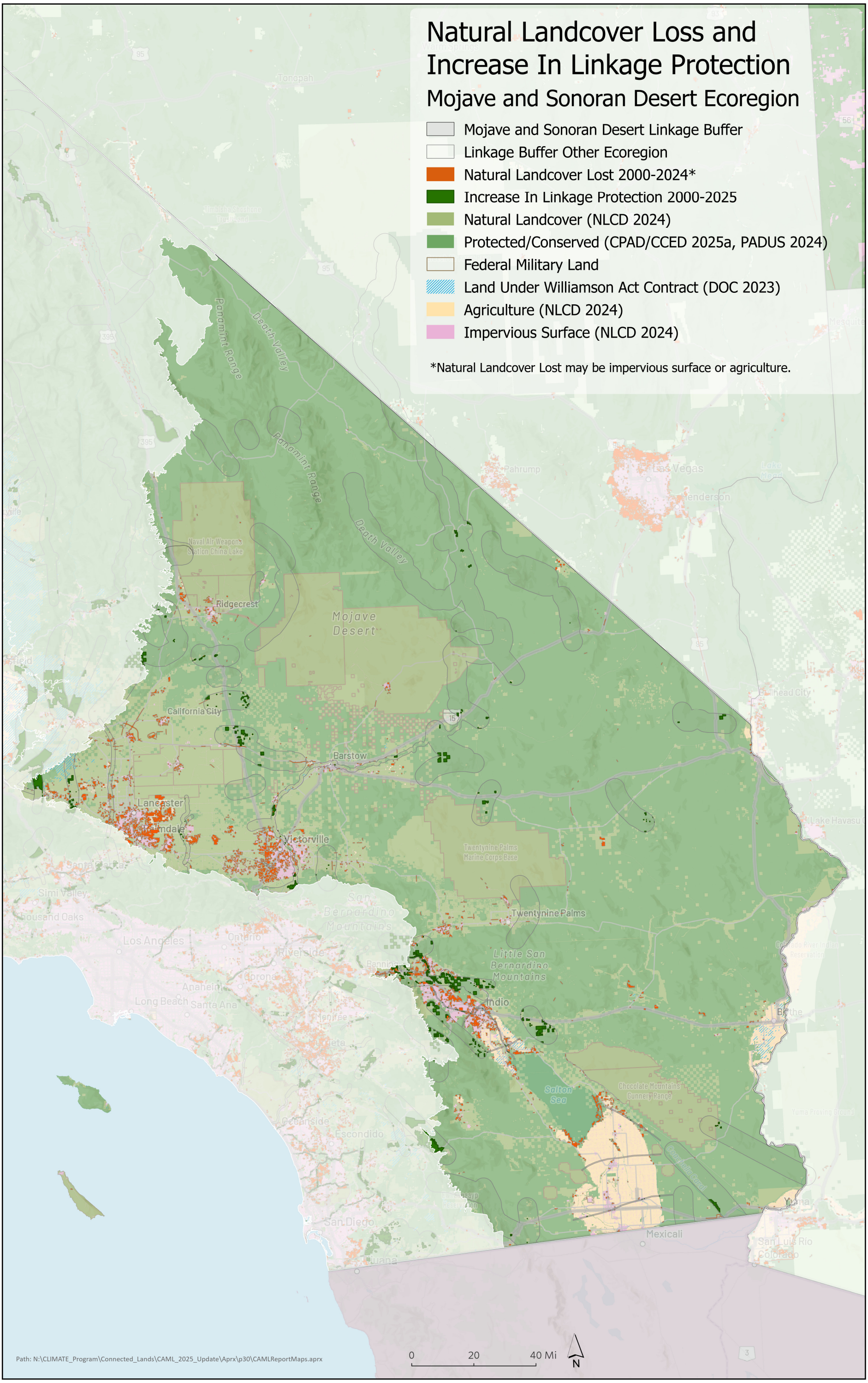
- Roads and Rail
    - All 66 linkage buffers contain some form of rail or roadway infrastructure.
    - Primary roads overlap 33% (22) of linkages; total ~205 miles (range: 0.33–16.59 miles)
    - Secondary roads overlap 71% (47) of linkages; total ~464 miles (range: 0.35–65.56 miles)
    - Total road length across all linkages: ~4,845 miles (average: 80.32 miles per linkage)
    - Mojave River has the highest total road length: ~382 miles
    - Average weighted road density: .93 mi^2 (range: 0.03–5.29 mi^2)
    - 395 South of Ridgecrest (14f) has highest average weighted road density
    - Railroads cross 38% (25) linkages, totaling ~183 miles (range: 0.31–52.15 miles)

- Wildlife Barriers and Remediation
    - CDFW identified 230 miles (370.15 km) of wildlife barriers that intersect linkage buffers
    - 41% (27) linkages are intersected by CDFW barriers, ranging from 1.51 to 45.26 miles; average: ~ 8.52 miles
    - There are three Caltrans Active, Planned, or Priority Unfunded Wildlife Connectivity Projects within two linkage buffers
    - CDFW and Caltrans Barriers overlap with linkage buffers detailed in Table 9

Table 9. Linkages that Overlap CDFW and Caltrans Barriers in the Mojave and Sonoran Deserts Ecoregion

LINKAGE NAME	CALTRANS CONNECTIVITY PROJECT ID	CDFW BARRIER MILES	CDFW BARRIER SEGMENT NAME	CDFW BARRIER ID
395 South of Ridgecrest (14a)		7.06	US395 Lone Pine to Kramer Junction	W133
395 South of Ridgecrest (14b)		6.33	US395 Lone Pine to Kramer Junction	W133
395 South of Ridgecrest (14c)		9.91	SR58 West Mojave (2.63 miles); US395 Lone Pine to Kramer Junction (7.28 miles)	W205; W133
395 South of Ridgecrest (14d)		6.21	US395 Kramer Junction to Victorville	W132
395 South of Ridgecrest (14e)		3.17	US395 Kramer Junction to Victorville	W132
Algodones Dune System (4a)		27.99	Coachella Canal (19.71 miles); All American Canal (8.28 miles)	W148; W149
Algodones Dune System (4b)		6.31	All American Canal	W149
Algodones Sand Source		1.04	Coachella Canal	W148
Border - Interstate 8 (7a)		20.42	I-8 Imperial County (13.84 miles); US/Mexico Boundary Fence (6.57 miles)	W061; W146
Border - Interstate 8 (7b)		4.32	I-8 Imperial County	W061
Cady Mountain Potential Core Area (23a)		0.94	1-40 Pisgah Desert Tortoise priority area	W221
Cady Mountain Potential Core Area (23b)		6.19	Brightline/Cave Mtn/Soda Mtn/Clark Mtn	W166
Clark Mountains (17a)	20230804	11.58	Kellbaker Rd. Cima Rd MNP (5.24 miles); Brightline /Cave Mtn/Soda Mtn/Clark/Mtn (6.33 miles)	W219; W166
Freeman Junction		17.34	SR178 Canebrake (6.11 miles); SR14 West Mojave (10.34 miles); SR178 West Mojave (0.89 miles)	W037; W204; W206
Hwy 58 from 395 through WMP DWMA (17b)		28.12	SR58 West Mojave (23.69 miles); US395 Kramer Junction to Victorville (2.96 miles); US395 Lone Pine to Kramer Junction (1.45 miles)	W205; W132; W133
Interstate 15 - Soda Mountains		6.93	Brightline/Cave Mtn/Soda Mtn/Clark Mtn	W166
Joshua Tree		4.17	SR62 through Twentynine Palms	W140

Mojave Preserve Unit		10.85	Kellbaker Rd. Cima Rd MNP (4.63 miles); Brightline /Cave Mtn/Soda Mtn/Clark/Mtn (6.21 miles)	W219; W166
Mojave River - Barstow/Camp Cady		5.32	SR58 West Mojave (1.3 miles); Brightline/ Cave Mtn/Soda Mtn/Clark Mtn (4.02 miles)	W205; W166
Morongo Valley	20220828, 20220834	9.15	SR62 through Twentynine Palms	W227
North Santa Rosa - San Jacinto		5.56	SR74 Palms to Pines Scenic Byway	W059
Poison Canyon		7.33	US395 Lone Pine to Kramer Junction	W133
San Gorgonio /Whitewater River		3.83	I-10 Banning Pass	W058
Shavers Valley		15.30	I-10 Coachella Canal to Blythe (7.65 miles); I-10 Chuckwalla & Shavers Valley (7.65 miles)	W230; W130
Sierra - Coso		6.47	US395 Lone Pine to Kramer Junction	W133
Whitewater River (46b)		3.64	I-10 Banning Pass (3.35 miles); SR62 through Morongo Valley (0.29 miles)	W058; W227
Total projects/miles/segments	3	230		19



Map G. Mojave and Sonoran Deserts Ecoregion

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