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Coyote Valley Reptile and Amphibian Linkage Study
Findings and Recommendations

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Table of Contents

Section 1. Introduction 1
Section 2. Assessment of Baseline Conditions of Species Occurrences and Habitat 4
2.1 Methods 4
2.2 Findings on Occurrences and Potential Occurrences 5
2.2.1 California Tiger Salamander 5
2.2.2 California Red-legged Frog 13
2.2.3 Upland/Dispersal Habitat Conditions 18
2.2.4 Western Pond Turtle 19
Section 3. Assessment of Baseline Conditions of Landscape Linkages Across Coyote Valley 23
3.1 Methods 23
3.2 Findings 28
3.2.1 Discussion of Habitat Conditions/Land Use Types and Potential Dispersal Impediments 28
3.2.2 Habitat Connectivity for California Tiger Salamanders 31
3.2.3 Least Cost Path Analyses for California Tiger Salamanders 34
3.2.4 Habitat Connectivity for California Red-legged Frogs 42
3.2.5 Least Cost Path Analyses for California Red-legged Frogs 44
3.2.6 Habitat Connectivity for Western Pond Turtles 51
3.2.7 Least Cost Path Analyses for Western Pond Turtles 52
Section 4. Data Gaps, and Recommendations to Increase Populations and Improve Connectivity 59
4.1 Data Gaps 59
4.1.1 California Tiger Salamander 59
4.1.2 California Red-legged Frog 59
4.1.3 Western Pond Turtle 60
4.2 Findings—Enhancement Recommendations 60
4.2.1 California Tiger Salamander 61
4.2.2 California Red-legged Frog 63
4.2.3 Western Pond Turtle 64
Section 5. Literature Cited 66

Figures

Figure 1. Vicinity Map 2
Figure 2. Coyote Valley Study Area 3
Figure 3. California Tiger Salamander Occurrences in and around Study Area 6
Figure 4. California Red-legged Frog Occurrences in and around Study Area 7
Figure 5. Western Pond Turtle Occurrences in and around Study Area 8
Figure 6. Roads, Creeks, Ponds, Linkages, and other Features within Study Area 15
Figure 7. California Tiger Salamander Origin and Destination Points in Relation to Occurrences 25
Figure 8. California Red-legged Frog Origin and Destination Points in Relation to Occurrences 26
Figure 9. Western Pond Turtle Origin and Destination Points in Relation to Occurrences 27
Figure 10. California Tiger Salamander Occurrences with Least Cost Pathways 35
Figure 11. California Tiger Salamander Cost Surface with Least Cost Pathways 36

Figure 12. California Red-legged Frog Occurrences with Least Cost Pathways 45
Figure 13. California Red-legged Frog Cost Surface with Least Cost Pathways 46
Figure 14. Western Pond Turtle Occurrences with Least Cost Pathways 53
Figure 15. Western Pond Turtle Cost Surface with Least Cost Pathways 54

Appendices

Appendix A. Tables 1-6. .... A-1
Appendix B. Least Cost Pathways Discussed in Report B-1

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Section 1. Introduction

This document describes the findings of the Coyote Valley Reptile and Amphibian Linkage Study, which assessed the ability of the California red-legged frog (*Rana draytonii;* CRLF), California tiger salamander (*Ambystoma californiense*; CTS), and western pond turtle (*Emys marmorata*; WPT) to move within and across Coyote Valley in south-central Santa Clara County. Coyote Valley is an 11.6 mi^2 area containing mixed land uses, including open space, agricultural fields, and residential areas (Figures 1 and 2). Coyote Valley is identified as a significant wildlife linkage between the Santa Cruz Mountains and the Diablo Ranges in the California Essential Habitat Connectivity Project (Spencer et al. 2010), the Bay Area Critical Linkages Project (Penrod et al. 2013), the Santa Cruz Mountains Linkages Conceptual Area Protection Plan (McGraw 2012), and the Santa Clara Valley Habitat Plan (Habitat Plan; ICF International 2012) because of the low density of development in the valley and close proximity of the foothills of the two mountain ranges on each side of the valley (Figure 1). The eastern foothills of the Santa Cruz Mountains, on the west side of the valley, are dominated by grassland, oak woodland, and oak savanna, while the western foothills of the Diablo Range, east of the valley, are dominated by grassland. Approximately 70% of the valley floor is occupied by agricultural fields. Despite its small size, the extent of agricultural activity and development, and fragmentation of sensitive habitats, the Coyote Valley area still supports the CRLF, CTS, and WPT, though the first two species occur predominantly in the foothills at the edges of the valley. The study area is bisected by a major freeway (US-101), a major secondary road (Monterey Road), numerous smaller roads (such as Santa Teresa Boulevard), and an existing rail line, all of which impede wildlife movement, and the High-Speed Rail Authority is proposing a rail alignment that could further divide the valley floor (Figure 2).

The three focal species for the assessment are reptile and amphibian species covered by the Habitat Plan. This study (1) evaluated the existing and potential distribution of the focal species and habitats that support them in and around Coyote Valley, (2) assessed the current potential for these species to move within and across the valley, and (3) identified potential measures to benefit these species' populations and connectivity within and across the valley.

This report describes our methods and findings related to the identification of the baseline conditions of each species' occurrences and habitat in the study, as well as the baseline condition of landscape linkages across the valley for each species. It then summarizes our recommendations for addressing data gaps, and for increasing populations and improving connectivity for each species. The purpose of this report is to inform future decisions about the feasibility of cross-valley connectivity for these species and to guide future conservation efforts for these species in Coyote valley.

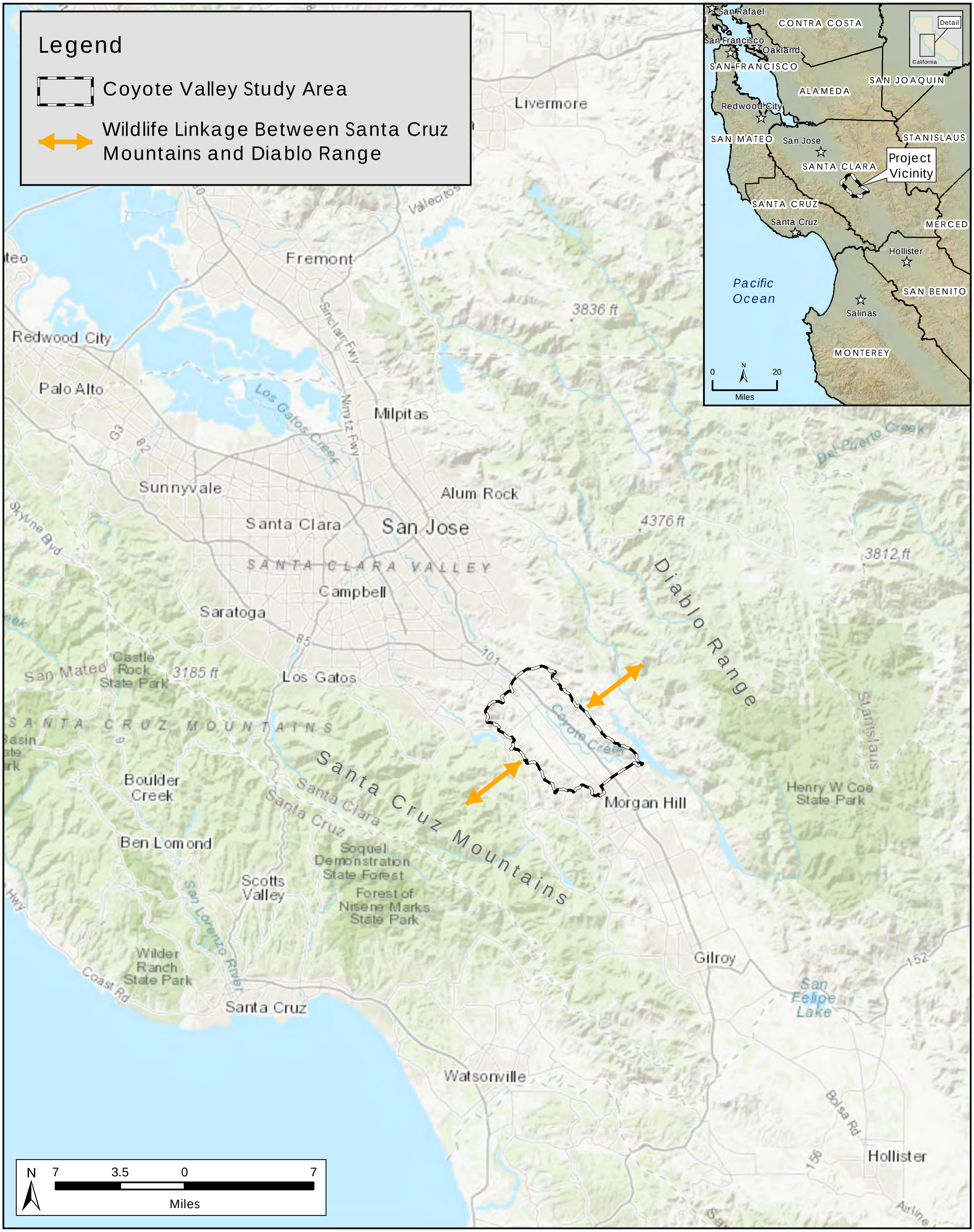

Figure 1. Vicinity Map

Coyote Valley Reptile and Amphibian Linkage Study

January 2020

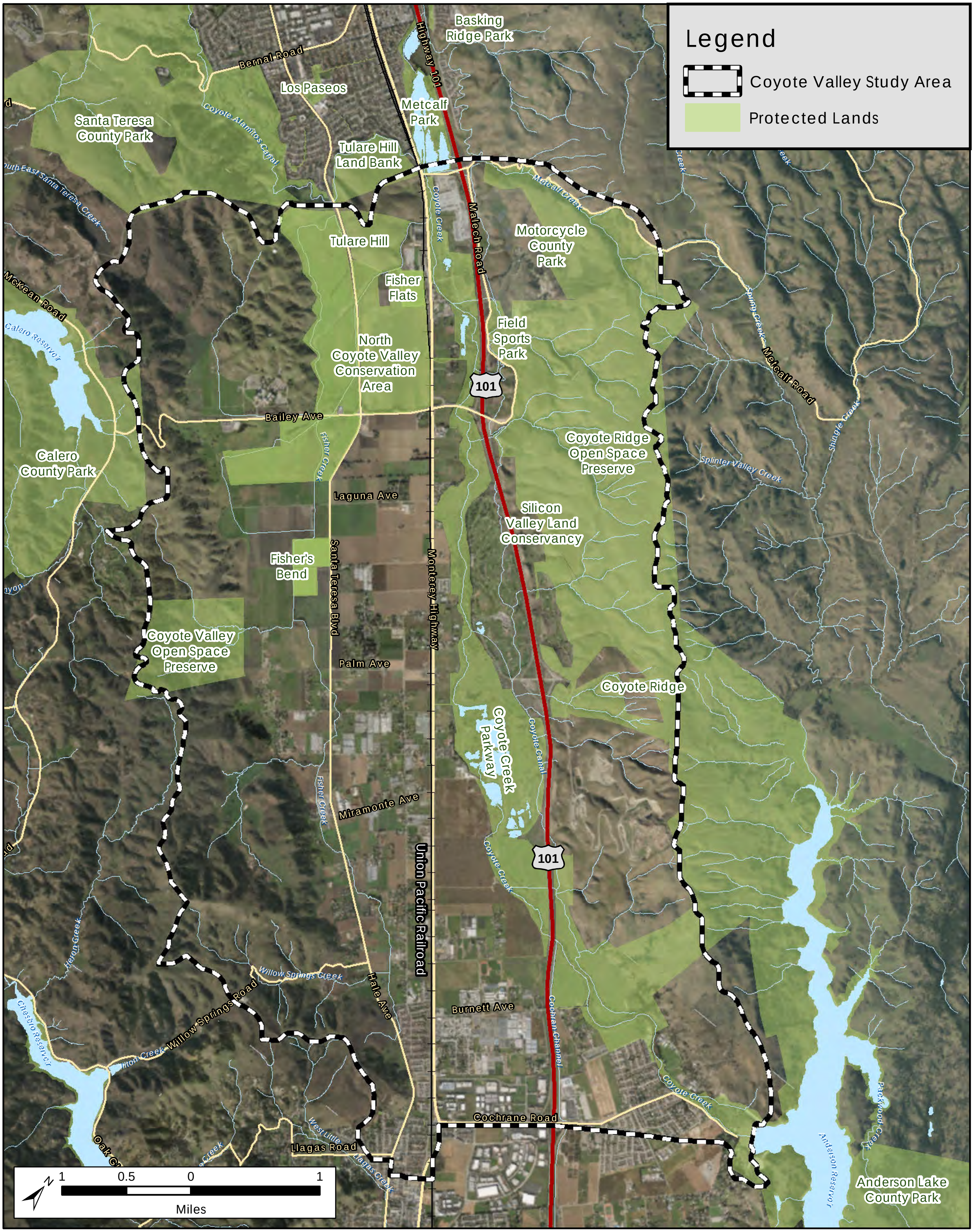

Figure 2. Coyote Valley Study Area

Coyote Valley Reptile and Amphibian Linkage Study

January 2020

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Section 2. Assessment of Baseline Conditions of Species Occurrences and Habitat

2.1 Methods

H. T. Harvey & Associates senior herpetologist Jeff Wilkinson, Ph.D., compiled information on the baseline condition for each of the focal species (CTS, CRLF, and WPT) within Coyote Valley and the surrounding foothills, using previously reported occurrences to identify known locations and a review of aerial photos, coupled with field surveys, to assess habitat conditions.

To identify locations of previously reported occurrences of the focal species, Jeff reviewed the following sources: the California Natural Diversity Database (CNDDB 2019), the Habitat Plan (ICF International 2012), *Santa Clara Valley Water District CRLF distribution and status – 1997* (H. T. Harvey & Associates 1997), *Santa Clara Valley Water District California tiger salamander distribution and status – 1999* (H. T. Harvey & Associates 1999a), *Santa Clara Valley Water District western pond turtle distribution and status – 1999* (H. T. Harvey & Associates 1999b), *Santa Clara Valley Water District California tiger salamander surveys and site assessments at selected Santa Clara County locations* (H. T. Harvey & Associates 2012a), *Santa Clara Valley Water District western pond turtle site assessments and surveys at selected Santa Clara County locations* (H. T. Harvey & Associates 2012b), and other reports of H. T. Harvey & Associates observations of the focal species during surveys of lands in and around Coyote Valley. He also reviewed specimen records from the California Academy of Sciences (CAS) and Museum of Vertebrate Zoology (MVZ). He reviewed, but did not include locality data from, iNaturalist[1] because in many cases the locality data are intentionally obscured for special-status species.

Locations of potential breeding sites (such as ponds) and important nonbreeding aquatic and upland habitat in the study area were compiled using habitat mapping by the Habitat Plan (e.g., GIS layers for ponds), aerial photos, topographic maps, and our field knowledge of Coyote Valley. Subsequently, Jeff assessed habitat suitability and quality in the field by driving and walking roads and trails, and viewing lands in and around Coyote Valley from accessible locations. The primary purpose of this field assessment (from the perspective of habitat quality) was to determine upland habitat conditions, which may be used by WPT for nesting and by CRLF and CTS for upland refugia and dispersal. Jeff also assessed whether and to what extent the essential habitat elements for each species occur on various lands (i.e., abundance and distribution of small mammal burrows which provide upland refugia for CTS, and to some extent, CRLF).

We then prepared maps showing areas of known occurrence of each of the focal species, as well as areas providing suitable habitat (taking into account all life history stages of each species) that could support each species.

[1] https://www.inaturalist.org

2.2 Findings on Occurrences and Potential Occurrences

Figures 3, 4, and 5 depict our findings for the CTS, CRLF, and WPT, respectively. For CTS and CRLF, these figures depict areas of known occurrence (including documented breeding), known or potential breeding locations, and areas surrounding known breeding locations where these species could potentially occur. For WPT, breeding locations (which are very rarely detected, and are not specifically reported as such in CNDDB) are not indicated; Figure 5 simply depicts areas of known WPT occurrence. Information on each species is provided below.

2.2.1 California Tiger Salamander

2.2.1.1 Areas of Known Occurrence

As shown in Figure 3, CTS have been recorded in several locations within and around the study area, primarily in the hills on either side of Coyote Valley but also in some locations within the margins of the northern valley floor. There are four general areas of known occurrences of CTS within the study area, and six additional areas of occurrence outside the study area. These nine occurrences are described below, and in greater detail in Table 1 of Appendix A.

CTS 1

This occurrence consists of three non-breeding observations in the study area around Anderson Dam, and two nearby CTS observations outside and southeast of the study area (H. T. Harvey & Associates 2012a). A pond is located in the southeast corner of the study area, just east of Cochrane Road (Grid E5 of Figure 3), that could be a potential breeding pond for the individuals observed in the study area. However, there is a known breeding pond (Rosendin Pond, in Anderson Lake County Park) approximately 0.3 mile east of the dam (0.1 east and outside of the study area) that could also be the source of all these observations. A seasonal pond west of Hendry Drive, approximately 1.1 mi southeast of the study area is assumed (but not documented), based on nearby observations of adults, to be another breeding site (Grid E5 of Figure 3; H. T. Harvey & Associates 2012a). An additional pond between the south curve of Liberata Drive and north end of McDonald Lane (Grid E5 of Figure 3) may also provide breeding habitat for this population, though CTS breeding has not been documented.

CTS 2

This occurrence is associated with an MVZ specimen (MVZ 31854) collected in 1931 at a locality simply stated as "Madrone" with geocoordinate of 37.150321° -121.667036°[2], placing it along Madrone Parkway at the south end of Taylor Avenue in what appears to be a ditch (Grid C4 of Figure 3). We assume that any population associated with this occurrence record is considered extirpated (CNDDB 2019).

[2] http://portal.vertnet.org/o/mvz/amphibian-and-reptile-specimens?id=http-arctos-database-museum-guid-mvz-herp-31854-seid-819637

CTS 3

This occurrence is an adult specimen (CAS 187394) collected from the vicinity of the Coyote Creek Golf Club in 1981 and a larval specimen (CAS 203271) collected from a fairway pond on Coyote Creek Golf Club in 1996[3] (Grid C3 of Figure 3). It is unclear if the population associated with these specimens is extant, but if so then this population would most likely be persisting between Highway 101 to the east and Coyote Creek or Monterey Road to the west, as these features provide likely dispersal barriers. There are up to six ponds in the Coyote Creek Golf Club that could potentially provide breeding habitat for this population, but the management of both the ponds and surrounding upland habitat for golf course use may not be conducive to population viability (see comments on golf courses and parks on page 29).

CTS 4

This occurrence consists of five known breeding ponds in the northwestern portion of the study area: 1) a stock pond 0.40 miles directly east of the junction of Bailey Avenue and McKean Road; 2) a stock pond 0.63 miles directly east of the junction of Bailey Avenue and McKean Road; 3) a stock pond at the base of a hill 0.2 mile southeast of the western end of Laguna Avenue; 4) a 6-acre pond at the bottom of a canyon 0.5 mile south of the western end of Laguna Avenue; and 5) an abandoned golf course pond on the south side of Bailey Avenue, 0.85 mile southwest of the intersection of Bailey Avenue and Santa Teresa Boulevard (Grids B2 and B3 of Figure 3; CNDDB 2019). This abandoned golf course pond is one of the three ponds also known as the Sobrato Ponds on the valley floor south of Bailey Avenue. There are two additional breeding ponds outside of the study area that help document the population in the vicinity of the northwest corner of the study area as follows: 6) a stock pond immediately north of the Cinnabar Hills Golf Course and 0.34 mile east of McKean Road; and 7) a stock pond 0.2 mile east of the intersection of Bailey Avenue and McKean Road (Grids B2 and B3 of Figure 3). In addition, an adult individual was observed on McKean Road, two adults were observed in the general location of Cinnabar Golf Course, and three adults were observed in grassland near the western end of the western most Sobrato Pond (Grids A2 and B2 of Figure 3; CNDDB 2019, H. T. Harvey & Associates 2000a).

Based on their close proximity to each other, it is apparent that these seven documented breeding ponds within CTS 4 represent a population that is using ponds at the base of, or in, the foothills between the valley floor and McKean Road. It is unknown whether or not the Sobrato Ponds are currently being used by this population or the current status of this population, because the observation of breeding in the middle pond was made over 20 years ago, no CTS larvae were observed in any of the Sobrato Ponds during CTS larval surveys in 2002 (H. T. Harvey & Associates 2002), and the CTS population using the middle pond has been considered extirpated in CNDDB (2019). However, all three Sobrato Ponds are currently present and may still function as breeding habitat. A larva observed in one of the ponds adjacent to the Cinnabar Golf Course in 2012 indicates that a breeding population in this area was present more recently.

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[3]http://researcharchive.calacademy.org/research/herpetology/catalog/index.asp?xAction=getrec&close=true&CatalogNo=CAS+203271

The following two occurrences are clusters of observations outside of and adjacent to the northern and northeastern portion of the study area that represent one or more populations.

CTS 5

This occurrence consists of a cluster of observations of larvae and adults from four ponds and one wetland east of Highway 101 and north of Metcalf Road just north of the study area (Grids C1 and D1 of Figure 3) from 1999 to 2017 and adults translocated from a housing development near these ponds in 2003 and 2004.

CTS 6

This occurrence consists of a cluster of observations of hundreds of larvae, juveniles, and adults in 14 ponds and intervening upland habitat from 2005 to 2017 during biological monitoring of activities to decommission the UTC facility (Grids D2, E2, and E3 of Figure 3).

There are four additional occurrences near, but outside of, the western and southern sides of the study area as follows.

CTS 7

This occurrence is documented breeding in a stock pond approximately 0.35 mi northwest of the northern boundary of the study area on its western side (Grid B1 of Figure 3).

CTS 8

This occurrence is a cluster of observations of breeding in three ponds, one of which was as recent as this year (H. T. Harvey & Associates 2019a), located approximately 1.6 mi west of, and on the opposite side of McKean Road from, the northwestern border of the study area (Grid A1 of Figure 3).

CTS 9

This occurrence is of an adult found dead on the road near Chesbro Reservoir, approximately 1 mi south of the southwestern portion of the study area (Grid A4 of Figure 3).

CTS 10

This occurrence consists of documented breeding in one or more stock ponds approximately 1.8 mi south of the southern portion of the study area (Grid B5 of Figure 3).

2.2.1.2 Other Potential Breeding Locations

A number of additional ponds, primarily stock ponds but also including some larger/deeper seasonal wetlands, provide potential breeding sites (PBS) for CTS in and around the study area (Figure 3). Those locations where CTS have been confirmed breeding, or have been observed nearby, are discussed in the previous section above. Following is a summary of additional features that provide potential for use by CTS as breeding habitat but no occurrences have been documented.

Three general areas in the study area provide some potential for use by CTS as breeding habitat, but breeding is unlikely due to amount of disturbance in the site and in surrounding uplands and/or due to high populations of predators, particularly bullfrogs (*Lithobates catesbeianus*) and fish:

- Potential breeding site 1 (indicated as "PBS 1" on Figure 3). Off-channel seasonal Ogier Ponds, along Coyote Creek (Grid D3 of Figure 3). These ponds are not within the channel of Coyote Creek so could be used by CTS to breed if fish are not present. However, fish from adjacent, perennial ponds are able to enter these seasonal ponds during high-water conditions, which occur when flows in Coyote Creek are high (due to groundwater connectivity with the creek). H. T. Harvey & Associates surveyed these ponds for CTS larvae in 2019, for the Santa Clara Valley Water District (Valley Water). No larvae were detected, but multiple fish species and bullfrog adults and tadpoles were observed (H. T. Harvey & Associates 2019b).
- Potential breeding site 2. Two artificial industrial ponds associated with an industrial facility at the intersection of Hale Avenue and Miramonte Avenue (Grid C3 of Figure 3). They were not accessible in the field, but due to being associated with the industrial facility and nearby uplands subject to intensive cultivation disturbance, we do not expect CTS to breed here.
- Potential breeding site 3. A pond just northeast of Hale Avenue (Grid C3 of Figure 3) associated with an agricultural complex at the intersection of Hale Avenue and San Bruno Avenue. This pond was on private property but was observed from Hale Avenue. As with the two ponds above, CTS may attempt to breed in this pond if they are in the nearby uplands, but success would depend on how much disturbance this pond receives (see comments on rural residential and agricultural developed land uses on page 29).

Several other features in the study area as described below have no known records of presence in the vicinity, but we determined them to be potentially high-quality breeding habitat surrounded by high-quality upland habitat:

- Potential breeding site 4. Two ponds or wetlands near the Kirby Canyon Landfill access road, northeast of Highway 101 (Grid D3 of Figure 3) that currently serve as mitigation for wetlands and CRLF. CRLF have been observed breeding in at least one of these ponds. The surrounding upland habitat is mostly undisturbed grassland, except for the disturbance associated with the Kirby Canyon Landfill. CTS, if residing in the nearby upland, may also attempt to breed in the adjacent sedimentation ponds but may not be successful due to the disturbed nature of these ponds.
- Potential breeding site 5. A pond in the extreme southeast corner of the Coyote Creek Golf Course, east of Highway 101 (Grid D3 of Figure 3). It is our understanding that this pond was created in 1997 as mitigation for impacts of the expansion of the Coyote Creek Golf Course on CTS. CTS found on the Golf Course in or near the existing breeding site at that time were to be relocated to this pond in 1998 and then the pond was to be monitored for breeding by CTS for 10 years to determine whether or not it is a successful breeding site for CTS. However, it is unclear to us whether or not this mitigation measure was implemented. Other than the golf course to the northwest, this pond is surrounded by upland consisting of annual grassland, and serpentine bunchgrass grassland, Highway 101 to the southwest poses a barrier to dispersal in that direction.

- Potential breeding site 6. Seven ponds and wetlands along the slopes of Coyote Ridge east of Highway 101 from Metcalf Road to south of Bailey Avenue (Grids D1 and D2 of Figure 3). One pond is located next to a house on private property, and there are also a series of pools that form within Coyote Canal. California red-legged frog adults have been observed in the pond, and California red-legged frog tadpoles have been observed in the pools in Coyote Canal. The other ponds are stock ponds on private property and were not accessible in the field but appear (based on review of aerial photos) to be able to hold water into the summer and are surrounded by upland annual grassland.
- Potential breeding site 7. Two ponds northwest of Bailey Avenue, west-northwest of the IBM campus (Grid B2 of Figure 3). The ponds were not accessible in the field but appear to be stock ponds surrounded by annual grassland and oak woodland/savanna.
- Potential breeding site 8. Two ponded areas on the North Coyote Valley Conservation Area, north of Bailey Avenue, east of the IBM campus (Grid C2). These ponded areas contain water through much of the summer and therefore could be used by CRLF for breeding. H. T. Harvey & Associates surveyed these ponded areas for CRLF in the past with negative results, though California newts (*Taricha torosa*), Pacific treefrogs (*Hyliola regilla*), and western toads (*Anaxyrus boreas*) were observed (H. T. Harvey & Associates 2000c).
- Potential breeding site 9. One pond southwest of the southwestern end of Palm Avenue (Grid B3 of Figure 3). This pond was recently constructed by the Santa Clara Valley Open Space Authority on the Coyote Valley Open Space Preserve and is adjacent to annual grassland and oak woodland/savanna.

2.2.1.3 Upland/Dispersal Habitat Conditions

According to the Final Rule for listing the central population of the California tiger salamander as threatened under FESA (USFWS 2004), adult California tiger salamander have been observed up to 1.3 miles from breeding ponds (S. Sweet, University of California, Santa Barbara, in litt. 1998). Austin and Shaffer (1992) reported dispersal distances of at least 1 mile. Trenham et al. (2001) observed a high probability of adult California tiger salamander dispersing between pools up to 2200 feet (0.42 mile) apart, but did not observe dispersal events longer than 2300 feet (0.44 mile). Trenham and Shaffer (2005) estimated 50, 90, and 95 percent of adult California tiger salamanders were within 492, 1608, and 2034 feet of their study pond, respectively, and that 95 percent of juvenile California tiger salamanders were within 2067 feet (0.39 mile) of the pond, with 85 percent concentrated between 656 and 1969 feet, but none were found at 2625 feet (0.50 mile). However, Orloff (2007) reported longer-distance dispersal by a few individuals in a population in Pittsburg, immediately east of the Action Area. Her results suggest that some individuals may have been traveling at least 1.3 miles from aquatic breeding habitat to upland aestivation habitat. Collectively, these studies suggest that dispersal distances may vary among populations and/or sites, that California tiger salamander abundance likely decreases with increasing distance from a breeding pond, and that a few individuals may disperse up to 1.3 miles from breeding areas. Suitability of various types of upland habitats and land uses for use by CTS, either as dry-season residency habitat or during dispersal, is discussed in detail in our assessment of existing habitat connectivity and linkage (Section 3.2) below.

2.2.2 California Red-legged Frog

2.2.2.1 Areas of Known Occurrence

As shown in Figure 4, CRLF have been recorded in a number of locations on the east side of the study area that we have grouped into two general occurrences (CRLF 1 and 2). We have also identified three general groupings of CRLF observations just outside of the east side of the study area (CRLF 3, 4, and 5). However, there are no known CRLF occurrences within, and few in the vicinity of, the west side of the study area. West of Coyote Valley, there are five occurrence records of CRLF outside of but within (or just over) 2.0 mi of the study area (CRLF 6-10). Some of these records are accompanied by imprecise location information and/or are not recent. All of these occurrences are discussed below and in greater detail in Table 2 of Appendix A.

There are several known occurrences of CRLF within and closely adjacent to the study area on the east side of Coyote Valley. These occurrences are grouped into three clusters from northwest to southeast along and at the base of the hills to the northeast of Highway 101, a fourth cluster adjacent to, but to the northeast of, Coyote Ridge, and a fifth occurrence at the southeast corner of the study area. These five occurrences (CRLF 1-5) are discussed below and in greater detail in Table 2 of Appendix A.

CRLF 1

This occurrence cluster includes observations of breeding as late as 2012 in two in-channel pools of the Coyote Canal and two stock ponds, and presence of adults and juveniles in nearby drainages and in-channel pools of Coyote Canal, on either side of Bailey Avenue on the northeast side of Highway 101 (Grids C2 and D2 of Figure 4; CNDDB 2019, H. T. Harvey & Associates 2012a).

CRLF 2

This occurrence cluster includes a number of observations of CRLF in the vicinity of the Kirby Canyon Landfill and, secondarily, the Ogier Ponds. CRLF adults, juveniles, tadpoles, and egg masses were reported in one of the large in-channel ponds of Coyote Creek on the southwest side of Highway 101 (a.k.a. the larger Ogier Ponds) in 2002 and 2003 (Grid C3 of Figure 4; CNDDB 2019). There is a series of observations from 1980 to 2017 of CRLF adults and tadpoles from and near a CRLF mitigation pond and a wetland on both sides of the Coyote Creek Golf Club Drive from its overcrossing of Highway 101 to the entrance to Kirby Canyon Landfill (Grid D3 of Figure 4). In addition, CRLF have been recorded in ditches and drainages within the Caltrans right-of-way along both the northeast and southwest side of Highway 101 (Grid C3 of Figure 4), and in Coyote Canal at a culvert under Highway 101 at the southwest edge of the landfill (Grids C3 and C4 of Figure 4; H. T. Harvey & Associates 2012a, CNDDB 2019). This occurrence cluster also includes adults and juveniles in small drainages north and northeast of the Kirby Canyon Landfill and Coyote Creek Golf Club Road at Highway 101 (Grid D3 of Figure 4; H. T. Harvey & Associates 2015, CNDDB 2019). Most likely, the mitigation pond and wetland for the Kirby Canyon Landfill are the sources for this population. Individuals from these breeding sites may disperse through uplands and along drainages, ditches, and the Coyote Canal, and disperse southwest of Highway 101 through culverts under the highway.

CRLF 3

This occurrence cluster includes observations of breeding in two ponds (including presence of juveniles and adults as late as 2017 in one of these ponds) and presence of multiple adults and juveniles in other nearby ponds northwest of Metcalf Road, and adults in Coyote Canal just southeast of Metcalf Road, all on the northeast side of Highway 101, and a detection of calling (presumably from one or more adult males) from within one of the Coyote Creek Parkway Lakes on the southwest side of Highway 101 (Grid C1 of Figure 4).

It is unclear whether this detection in the Coyote Creek Parkway Lakes is of multiple adults, which may indicate breeding potential or simply a detection of a single adult frog. Coyote Creek crosses under Highway 101 and Highway 85 at this spot, and a frog could potentially disperse to the Parkway Lakes from the aforementioned known breeding ponds east of Highway 101. We can therefore conclude that a population of CRLF are most likely currently breeding in one, possibly two, stock ponds in this cluster and using at least one other stock pond northwest of, and Coyote Creek Canal southeast of, Metcalf Road, east of Highway 101; the nature of the species' occurrence at the Parkway Lakes southwest of Highway 101 (i.e., whether or not the species breeds there) is unknown.

Occurrence clusters CRLF 1 – CRLF 3 are traversed by drainages flowing from east to west along the western-facing slope of Coyote Ridge (e.g., Metcalf Creek and Coyote Creek Branches C-E of Figure 6). Some of these drainages flow into the abandoned Coyote Canal, then exit the canal at culverts under Highway 101 and enter Coyote Creek. This canal begins at a diversion dam about 0.5 mi downstream of Anderson Dam and runs northwest along the northeast side of Coyote Creek and then along Highway 101, where it runs through a culvert under Highway 101 just southeast of the Ogier Ponds. It then runs along the southwest side of Highway 101 and through the Coyote Creek Golf Course northwestward before crossing through a culvert under Highway 101 and continuing along the northeast side of Highway 101 to just southeast of Metcalf Road (see Figure 6). It culverts under Highway 101 at linkage number 11 of Table 4 (approximately midway between Metcalf Road and Bailey Avenue, see below) to eventually join Coyote Creek just southeast of the Coyote Narrows (Grid C2 of Figure 6; Buchan and Randall 2003). Therefore, in addition to providing breeding habitat, Coyote Canal provides a dispersal corridor for CRLF between and perpendicular to these drainages east of Highway 101.

CRLF 4

This occurrence cluster includes 10 occurrence records that document breeding in ponds and pools of creeks, and two occurrence records of individual frogs, within and surrounding the UTC facility northeast of the study area from 1989 to 2017 (Grids D2, D3, E2, and E3 of Figure 4; CNDDB 2019). Of particular interest are observations of breeding in six ponds extending from the northwest to the southeast near and adjacent to the northeast border of the study area at the top of the ridge of the eastern slopes of Coyote Valley (Grids D2 and D3 of Figure 4). In our opinion, these breeding ponds allow for CRLF to disperse overland and through the drainages on both the western and eastern facing slopes to the breeding ponds in occurrence clusters CRLF 1–CRLF 3 at the base of the western slopes and breeding ponds and pools to the northeast of the study area in the UTC facility.

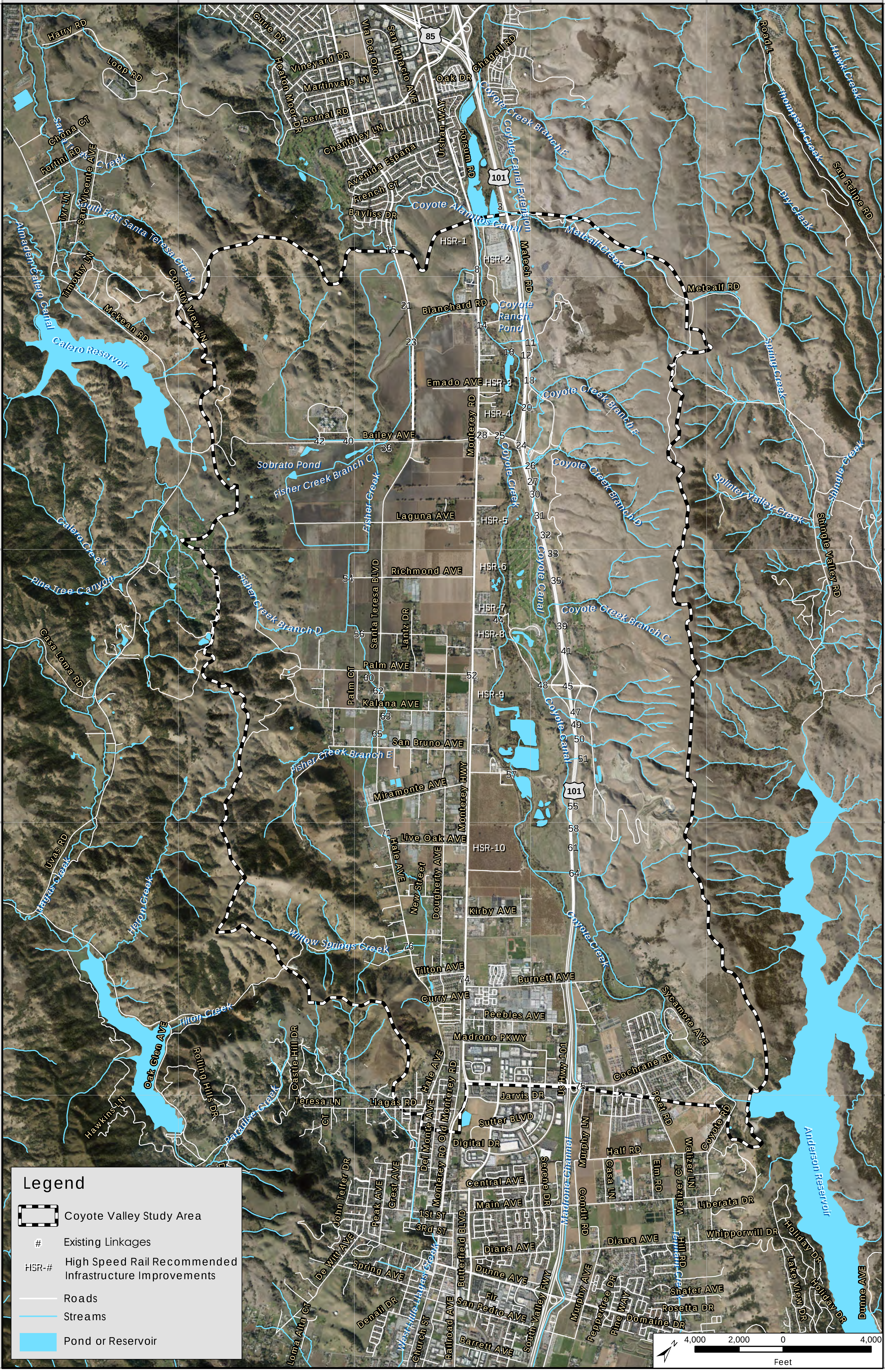

Figure 6. Roads, **Creeks, Ponds, Linkages**, and **Other Features within Study Area**

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

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CRLF 5

This occurrence is of multiple juveniles observed around Rosendin Pond in Anderson Lake County Park (Grid E5 of Figure 4). This is the same known breeding pond described for occurrence CTS 1 above. On August 15 and 21, 2010, five or more juveniles were observed in wetland vegetation around the edges of this pond (S. Rottenborn, pers. obs.). Myriad bullfrogs were also present here. Given the presence of juvenile CRLF and the absence of more suitable breeding habitat elsewhere in the vicinity, it is likely that CRLF bred here, and successfully, despite the abundance of bullfrogs. This pond is seasonal in most years.

In contrast to the five occurrences above, there are five known occurrences of CRLF within (or just over) 2.0 miles of the study area on the west side of Coyote Valley, as described below and in greater detail in Table 2 of Appendix A.

CRLF 6

This occurrence is associated with a pond in Santa Teresa County Park on the south side of the golf course within the park, approximately 0.5 mi northwest of the study area (Grid B1 of Figure 4). There is no mention as to whether this record is of adults or tadpoles. Therefore, it is difficult to determine whether or not this locality may be a breeding site for this species. Also, this record is from 1969, with no more recent occurrences recorded, indicating that surveys would be necessary to determine whether or not individuals are currently occupying this site.

CRLF 7

This occurrence is stated as "duck pond Vierra Ranch at the base of Calero Reservoir". The exact locality is unknown according to CNDDB (2019), and the geocoordinates place the locality among development northwest of, and adjacent to, McKean Road approximately 1.1 mi west of the study area (Grid A1 of Figure 4), prompting CNDDB to state that "the pond may no longer be extant". However, there is a small pond approximately 0.4 mi to the south of the geocoordinates for the record, on the same side of McKean Road, and there is a large ponded wetland at the base of the Calero Dam approximately 0.6 mi to the south of the geocoordinates for the record, on the opposite side of McKean Road. Many bullfrogs were observed in the large ponded wetland but an unidentified frog (possibly CRLF) was also observed during CTS surveys in 2012 (H. T. Harvey & Associates 2012a). Therefore, surveys for CRLF at the large ponded wetland at the base of the Calero Dam and the small pond mentioned above would be necessary to determine if CRLF are currently present in the vicinity of this record. Surveys for CRLF adults and tadpoles have been performed at a pond that was restored to provide breeding conditions for CRLF approximately 1.0 mi northwest of the large ponded wetland since 2017 without documenting presence, even though CTS larvae and bullfrog tadpoles have been documented from the pond (H. T. Harvey & Associates 2018).

CRLF 8

This occurrence is of an adult observed in a pool in Cherry Creek, approximately 0.6 mi upstream of Calero Reservoir adjacent to Cottle Trail in the Calero County Park. This occurrence is just over 2 mi west of the study area and is not shown on Figure 4.

CRLF 9

The exact locality of this occurrence is unknown but stated as a cattle tank near McKean Road, about 0.4 mi southeast of the Casa Loma Road intersection (Grid A3 of Figure 4). The observation for this record occurred in 1969 and there are no more recent observations recorded in the vicinity of this record. There are six ponds within 0.38 mi of the geocoordinates for the record, which may provide breeding and foraging habitat for this species. Therefore, surveys of these ponds would be necessary to determine if CRLF are currently present and possibly breeding in these ponds in the vicinity of this record.

CRLF 10

The locality for this occurrence is simply stated as "Chesbro Reservoir", which is approximately just over 1 mi south of the edge of the study area (Grid A4 of Figure 4). The record implies that multiple individuals were observed in 1991. No more recent observations have been documented within the vicinity of this record. There are at least four ponds between the reservoir and the study area (including the pond at the base of the dam) that should be surveyed to determine if CRLF are currently present and possibly breeding in these ponds in the vicinity of this record.

2.2.2.2 Other Potential Breeding Locations

A number of stock ponds provide potential breeding sites (PBS) for CRLF in and around the study area (Figure 4). Those locations where CRLF have been confirmed breeding are discussed in the previous section above. Following is a summary of additional features that provide potential for use by CRLF as breeding habitat.

- Potential breeding site 1. Off-channel seasonal Ogier Ponds, along Coyote Creek (Grid C4 of Figure 4) as mentioned previously for CTS – These ponds may provide breeding habitat for CRLF but were surveyed by H. T. Harvey & Associates for CRLF in 2019, for Valley Water, with negative results. Multiple fish species and bullfrog adults were observed (H. T. Harvey & Associates 2019b).
- Potential breeding site 7. The two ponds northwest of Bailey Avenue, west-northwest of the IBM campus previously mentioned for CTS (Grid B2 of Figure 4).
- Potential breeding site 8. The two ponded areas north of Bailey Avenue, east of the IBM campus previously mentioned for CTS (Grid B2 of Figure 4).
- Potential breeding site 10. The Sobrato Ponds (Grid B2 of Figure 4) – These ponds have been surveyed in the past with negative results (H. T. Harvey & Associates 2000b). However, all three ponds are considered perennial and the easternmost pond has developed into a pond that CRFL are typically attracted to, with extensive emergent vegetation and down woody debris (Photo 1).
- Potential breeding site 11. Three stock ponds from which occurrences of CTS 4 have been documented (Grids B2 and B3) – If these ponds hold water through much of the summer, they could attract CRLF from nearby offsite localities, and CRLF may ultimately attempt to breed.
- Fisher Creek from the confluence with Coyote Creek (Grid C2 of Figure 6) upstream to Laguna Avenue (Grid B2 of Figure 6) – This creek contains some pooling that may provide dispersal and foraging and

possibly breeding habitat for CRLF. H. T. Harvey & Associates surveyed sections of this creek north of Bailey Avenue in the past with negative results (H. T. Harvey & Associates 2000c).

- Coyote Creek – With the many off-channel ponds and deeper pools, Coyote Creek may be expected to provide dispersal and foraging habitat and possibly breeding habitat for CRLF. Breeding was observed in 2002 and 2003 in the large in-channel Ogier Ponds (see above) but H. T. Harvey & Associates surveyed Coyote Creek from Metcalf Road upstream to the base of Anderson Dam for CRLF in 2019, for Valley Water with negative results. Instead, multiple fish species and numerous bullfrog adults were observed (H. T. Harvey & Associates 2019b). The presence of fish and bullfrogs may negatively impact any potential breeding by CRLF.
- Potential breeding site 12. Coyote Ranch Pond (Grid C2 of Figure 4) – This pond typifies a CRLF breeding pond with extensive emergent vegetation along the edge of deep perennial water (Photo 2). H. T. Harvey & Associates surveyed this pond for CRLF in 2019, for Valley Water with negative results. Multiple bullfrog adults were observed (H. T. Harvey & Associates 2019b).
- Potential breeding sites 13. Approximately 20 ponds outside of and between the western border of the study area and McKean/Uvas Road (Grid A3 of Figure 4) – We have no information on the habitat suitability of these ponds for CRLF but consider that if CRLF are in the vicinity of the study area they would most likely be utilizing some of these ponds for foraging and possibly breeding.

Photo 1. Easternmost Sobrato Pond on the North Coyote Valley Conservation Area.

Photo 2. Coyote Ranch Pond.

2.2.3 Upland/Dispersal Habitat Conditions

CRLF have been reported dispersing distances of up to 2.0 miles from breeding locations (Bulger et al. 2003). In assessing upland habitat conditions, we focused on areas within 2.0 miles from known or potential breeding locations but also considered upland habitat conditions elsewhere in the study area. CRLF have been found to disperse longer distances than CTS, and they can disperse over upland habitats. However, dispersal over upland habitats likely occurs most frequently during the wet season, and they typically do not disperse long distances without crossing or utilizing nearby aquatic habitats such as creeks, ponds, or ditches during these dispersal events (Bulger et al. 2003, Tatarian 2008). Suitability of various types of upland habitats and land uses for use by CRLF is discussed in detail in our assessment of existing habitat connectivity and linkage (Section 3.2) below.

2.2.4 Western Pond Turtle

2.2.4.1 Areas of Known Occurrence

As shown in Figure 5, WPT have been recorded in a number of locations associated with Coyote Creek and adjacent waterbodies on the east side of Coyote Valley, and in fewer locations (associated with reservoirs and a few stock ponds) west of the valley. We have identified nine occurrences that we discuss below and in greater detail in Table 3 of Appendix A.

WPT 1

This occurrence is described as an observation of at least one WPT in a pond approximately 0.6 mi east of the intersection of Bailey Avenue and McKean Road in 1996 (Grid B2 of Figure 5; CNDDB 2019). CTS have also been observed in this pond (see above for CTS). This is the only known WPT occurrence within the study area west of Monterey Road. This pond is surrounded by annual grassland/oak woodland on the western slopes of the study area. At the base of the slopes to the west is agricultural fields, with the large abandoned golf course ponds (Sobrato Ponds) approximately 0.4 to 0.9 mi to the northwest.

There are four sets of occurrences outside of the study area to the west as follows.

WPT 2

An observation of one or more WPT in a pond on the Santa Teresa Golf Course in 1993 (CNDDB 2019). This is most likely the same pond where CRLF were observed in 1969 (CNDDB 2019). This pond is approximately 0.6 mi north-northwest of the northern border of the study area (Grid B1 of Figure 5). The intervening upland consists of annual grassland with oak woodland, and serpentine bunchgrass grassland into the study area. The nearest ponds within the study area to this pond are on the IBM property, approximately 1.5 mi to the south-southeast. There is also a pond approximately 0.4 mi to the southwest within Santa Teresa County Park.

WPT 3

These series of observations are from 1998, 2012, and 2016-2018 from Calero Reservoir, the wetland at the base of the Calero Dam, and at least one pond named "Calero Pond" approximately 1.0 northwest of the Calero Dam, and individuals relocated from that pond to the spillway pond at the base of Calero Dam in 2017 (CNDDB 2019, H. T. Harvey & Associates 2012b, 2017, 2018). These are relatively recent observations from approximately 0.6 to over 2 mi from, and on the opposite side of McKean Road of, the occurrence within the study area (Grids A1 and A2 of Figure 5).

WPT 4

An observation of one or more WPT in a pond approximately 0.85 mi southeast of the intersection of Bailey Avenue and McKean Road in 1996 (CNDDB 2019). This pond is within the Cinnabar Hills Golf Course, approximately 0.75 south-southwest from the observation within the study area on the same side of McKean

Road (Grid A3 of Figure 5). Other than the golf course, the upland between this pond and the one within the study area consists of annual grassland and oak woodland on the eastern slopes.

WPT 5

An observation of seven WPT from Chesbro Reservoir in 1998 and one WPT in the spillway pond at the base of Chesbro Reservoir in 2012 (CNDDB 2019, H. T. Harvey & Associates 2012b). Chesbro Reservoir is approximately 1.0 southwest of the southwest corner of the study area (Grids A4 and A5 of Figure 5).

On the east side of the study area, there are four general WPT occurrences east of Monterey Road as described below.

WPT 6

The length of the Coyote Canal from Bailey Avenue to Metcalf Road is considered occupied by WPT in CNDDB (2019). This consideration is based on two observations of WPT within the canal between Metcalf Road and Bailey Avenue in 1988 and 1989 (Grid C2 of Figure 5; H. T. Harvey & Associates 1999), and an observation of a WPT in a pond adjacent to the canal between these two observations in 2012 (Grid C2 of Figure 5; H. T. Harvey & Associates 2012b).

WPT 7

This occurrence is based on three observations of WPT in the large pools of Coyote Creek at the base of Anderson Dam in 2015, 2016, and 2019 (Grid D5 of Figure 5; CNDDB 2019, H. T. Harvey & Associates 2016, 2019). These observations document WPT presence within Coyote Creek on the northeast side of Highway 101.

WPT 8

This occurrence is a series of observations of WPT occurrences from 1988 to 2019 at eight localities within Coyote Creek and adjacent ponds from southeast of the Ogier Ponds (Grid C3 of Figure 5) downstream to the Metcalf Ponds, north of Metcalf Road (Grid C1 of Figure 5; CNDDB 2019, H. T. Harvey & Associates 1999, 2012b, 2019, Dan Stephens, pers. comm.). This occurrence also includes an observation of a deceased gravid female on the northbound (Coyote Creek) side of Monterey Road (Grid C2 of Figure 5) in 2015 (Santa Clara County Wildlife Corridor Technical Working Group, Coyote Valley Subcommittee 2019) that we believe exited Coyote Creek and tried to cross Monterey Road before being struck by a vehicle.

WPT 9

This occurrence is a number of observations in the 1970s of an unknown number of WPT in Coyote Creek east of Highway 101 at Tennant Road (CNDDB 2019, H. T. Harvey & Associates 1999). This location is approximately 1 mi northwest of and on the opposite side of Highway 101 from the observations in the Metcalf Ponds in WPT 8 (Grid C1 of Figure 5).

Collectively, WPT occurrences 6-9 indicate that WPT are present in Coyote Creek and the Coyote Canal at the base of the western slope of Coyote Ridge and utilize these corridors to disperse northwest to southeast, on both sides of Highway 101. They are most likely crossing under Highway 101 where Highway 101 passes over Coyote Creek north of the study area and within the southern part of the study area. WPT may also be crossing under Highway 101 where the Coyote Canal crosses under Highway 101 just northwest of the Coyote Creek Golf Club and between Metcalf Road and Bailey Avenue (where there are occurrence records on both the east and west of Highway 101), as the canal is likely a dispersal corridor for WPT. Overland crossings under Highway 101 might also occur at the undercrossings for Coyote Creek Golf Club Road and the golf course path (though there are no occurrence records both east and west of Highway 101 in the vicinity of these undercrossings).

As mentioned above, there is only one occurrence record (WPT 1) west of Monterey Road within the study area, indicating that WPT are restricted to the study area east of Monterey Road and scarce in portions of the study area west of Monterey Road. The scarcity (or absence) of WPT from most of the western side of the valley was recently supported by visual surveys conducted by H. T. Harvey & Associates in several ponds within the North Coyote Valley Conservation Area; no WPT were observed in those ponds, despite the presence of suitable habitat (Photo 1). However, occurrences outside of the study area in the vicinity of WPT 1 (i.e., WPT 2, 3, and 4) indicate that a WPT population is present within dispersal distance of the northwest corner of the study area.

2.2.4.2 Other Potential Aquatic Habitat Locations

In addition to the waterbodies indicated in the previous section as supporting WPT, a number of stock ponds and streams provide suitable aquatic habitat for WPT in and around the study area (Figure 5). Following is a summary of additional aquatic features that provide habitat for WPT.

- The Sobrato Ponds (Grid B2 of Figure 5) – As mentioned for CRLF, all three ponds are considered perennial and the easternmost pond contains extensive emergent vegetation that provides concealment, and down woody debris that provides basking sites (Photo 1).
- The two ponds northwest of Bailey Avenue, west-northwest of the IBM campus previously mentioned for CTS and CRLF (Grid B2 of Figure 5).
- Two stock ponds where CTS have been documented in CTS 4 (Grid A2 and B3 of Figure 5) – If these ponds hold water through much of the summer, they could attract WPT from nearby localities.
- Fisher Creek from the confluence with Coyote Creek (Grid C2 of Figure 6) upstream to Laguna Avenue (Grid B2 of Figure 6) – This creek contains some deeper pooling that may provide foraging habitat for WPT.
- Approximately 20 ponds outside of and between the western border of the study area and McKean/Uvas Road as mentioned for CRLF above (Grid A3 of Figure 5) – We have no information on the habitat suitability of the ponds for WPT but consider that if WPT are in the vicinity of the study area (i.e., WPT 4), they would most likely be utilizing some of these ponds as aquatic habitat.

2.2.4.3 Upland/Dispersal Habitat Conditions

Our review of upland habitat conditions in and adjacent to the study area result in similarities with CRLF above, as WPT preferably do not disperse overland except to leave unsuitable aquatic habitat (e.g., a drying pond), to overwinter, or when females travel onto land from aquatic habitat to dig a nest for egg laying (Reese and Welsh 1997, Rathbun et al. 2002). Suitability of various types of upland habitats and land uses for use by WPT is discussed in detail in our assessment of existing habitat connectivity and linkage (Section 3.2) below.

Section 3. Assessment of Baseline Conditions of Landscape Linkages Across Coyote Valley

3.1 Methods

H. T. Harvey & Associates reviewed existing information from OSA's Coyote Valley Landscape Linkage report (Santa Clara Valley Open Space Authority 2017); a report on reducing wildlife-vehicle collisions on Monterey Road (Santa Clara County Wildlife Corridor Technical Working Group Coyote Valley Subcommittee 2019); a database of culverts and crossings of major roadways and rail lines maintained by the SCVWD (on behalf of the Santa Clara County Wildlife Corridor Technical Working Group); and Habitat Plan land cover mapping. H. T. Harvey & Associates then compiled information on the baseline conditions of the study area, including habitat/land use conditions on the valley floor and particularly important landscape linkage elements (such as potential movement corridors that facilitate dispersal or features that impede movement) that influence the ability of the focal species to disperse within and across Coyote Valley (Table 4 of Appendix A). We refined the land cover mapping to create a detailed habitat map. We used data from previous H. T. Harvey reports in the study area, including wetland delineations and special-status species surveys, to add details such as wetland and marsh features. We also delineated certain agricultural practices separately from the Habitat Plan classifications to differentiate intensively cultivated fields that could pose a greater impediment/barrier to movement due to the lack of ground squirrel burrows and other refuges.

Information on habitat conditions that influence the ability of these species to move through the study area was then derived from the review of background information and field assessments described in the previous section on baseline habitat conditions. In addition, Jeff Wilkinson evaluated (in the field) the degree to which various features may impede movement by these species; such features included Coyote Creek (which may serve as an impediment to movement by CTS, especially during the wet season when flows are high and CTS are most mobile); artificial infrastructure such as Highway 101, Monterey Road, the Union Pacific rail line, Santa Teresa Boulevard, McKean Road, and Bailey Avenue; and various land uses and activities, such as developed land, agriculture, and water diversion and manipulation.

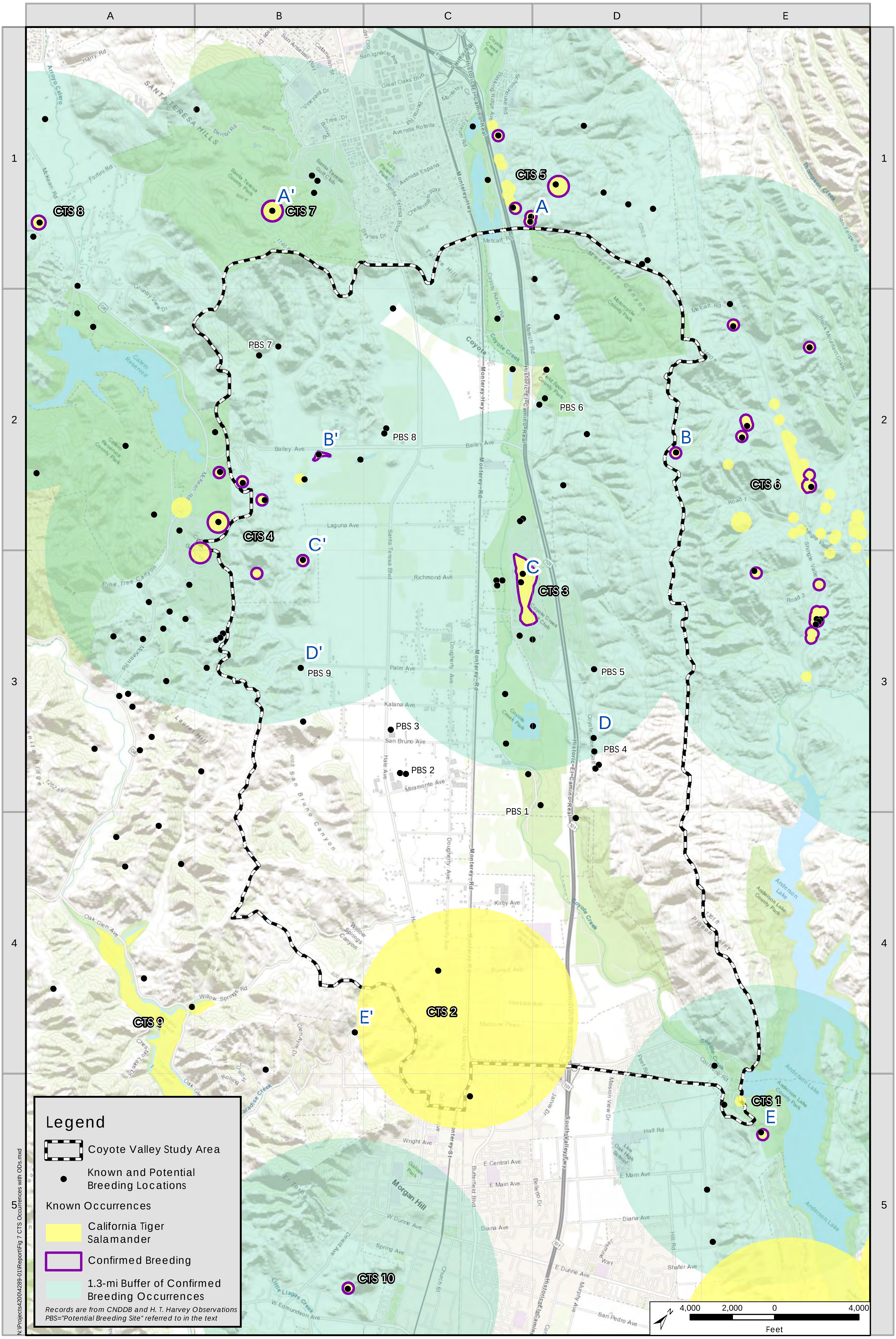
Using this information, H. T. Harvey & Associates ecologists and GIS staff created Least Cost Path Analysis (LCPA) models to provide a somewhat quantitative means of describing the routes that CTS, CRLF, and WPT might take in moving within and across Coyote Valley between certain ponds. Because these species differ with respect to dispersal abilities and characteristics, separate LCPA approaches were taken for each species. For example:

- CRLF and WPT use creeks and riparian habitat adjacent to creeks as dispersal habitat, whereas these habitat types are considered impediments to dispersal for CTS;
- WPT would likely use reservoirs to disperse and forage, whereas CRLF, and particularly CTS, would avoid these larger water bodies due to aquatic predators;

- CTS will disperse over drier habitat types, such as chaparral and scrub, grassland, and barren areas, more readily, whereas CRLF and WPT more likely use more mesic habitat types such as woodlands;
- Due to their smaller size and slower dispersal capabilities, CTS will most likely have more difficulty dispersing over moderate agriculture, golf courses, and rural-residential land cover types than either CRLF or WPT;
- Curbs provide dispersal impediments for CTS and small WPT, though CRLF could easily jump over them.

H. T. Harvey & Associates assigned scores to various habitat/land use types or discrete features (such as roads, the rail line, and Coyote Creek) to reflect the ease or difficulty that individuals of each species would have in crossing these habitat types and features (Table 5 of Appendix A). This was then converted to a raster containing square cells with 5-ft dimensions. We selected five (A–E) origin and five (A'–E') destination locations for CTS (Figure 7), five (A–E) origin and five (A'–E') destination locations for CRLF (Figure 8), and four origin (A–D) and five (A'–E') destination locations for WPT (Figure 9) on either side of the valley based on confirmed breeding or occupancy locations and the potential for occupancy based on the information in the previous sections. Optimal points were chosen in the northern, middle, and southern portions of the study area to distribute the potential paths through the study area so that we could assess whether feasible movement pathways were present in various parts of the study area (e.g., the more developed southern portion of the study area vs. the less developed northern portion of the study area).

Using the Spatial Analyst extension, "Distance" toolset, in ArcGIS version 10.7.1 (ESRI) we performed a LCPA between one origin and one destination location. For each path a 'cost surface raster' was created by assigning values representing the cost of movement to the landcover raster. Separate cost rasters were created for each of the species due to their different dispersal habitat preferences. For example, riparian woodland is more difficult for tiger salamanders to traverse compared to grassland (Wang et. al 2009), but frogs and turtles would prefer woodland over grassland. The habitat delineation and cost assignments took into account the various factors associated with movement such as elevation, dessication, use of harmful pesticides, etc. so a weighted-sum analysis was not necessary. A 'cost distance raster' and 'backlink' raster were intermediate outputs that assigned a value to each cell equal to the cumulative cost of reaching it from the origin location. A backlink raster assigned a directional decision to each cell based on the cost surface raster. These two intermediate outputs were then used to determine the best single line that a path should take to achieve the least accumulative cost to arrive at the destination location. These steps were repeated for each of the three species for multiple potential origin and destination locations distributed throughout the study area from north to south.



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Ecological Consultants

Figure 7. California Tiger Salamander Origin and Destination Points in Relation to Occurrences

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

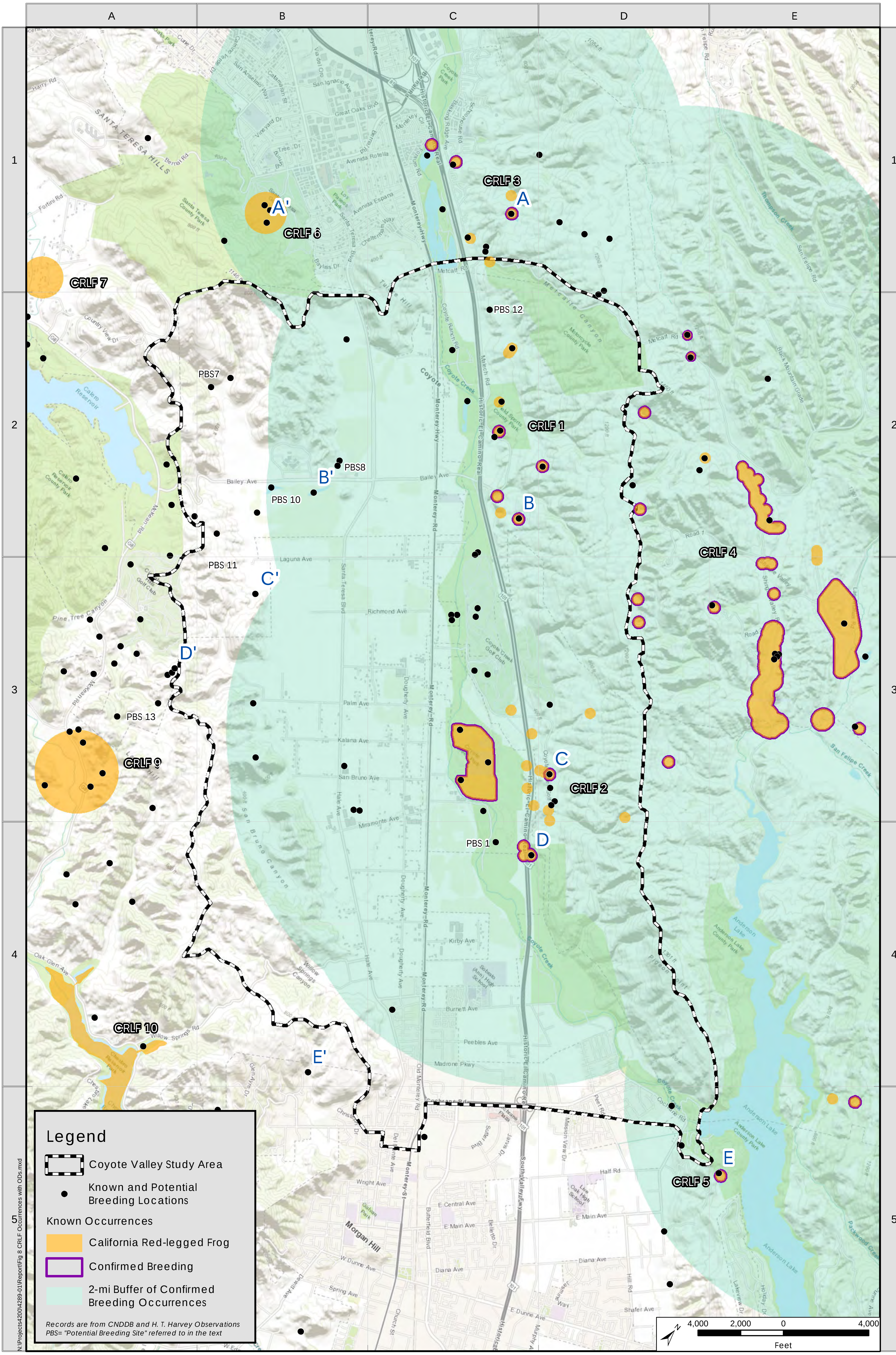

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Figure 8. California Red-legged Frog Origin and Destination Points in Relation to Occurrences

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

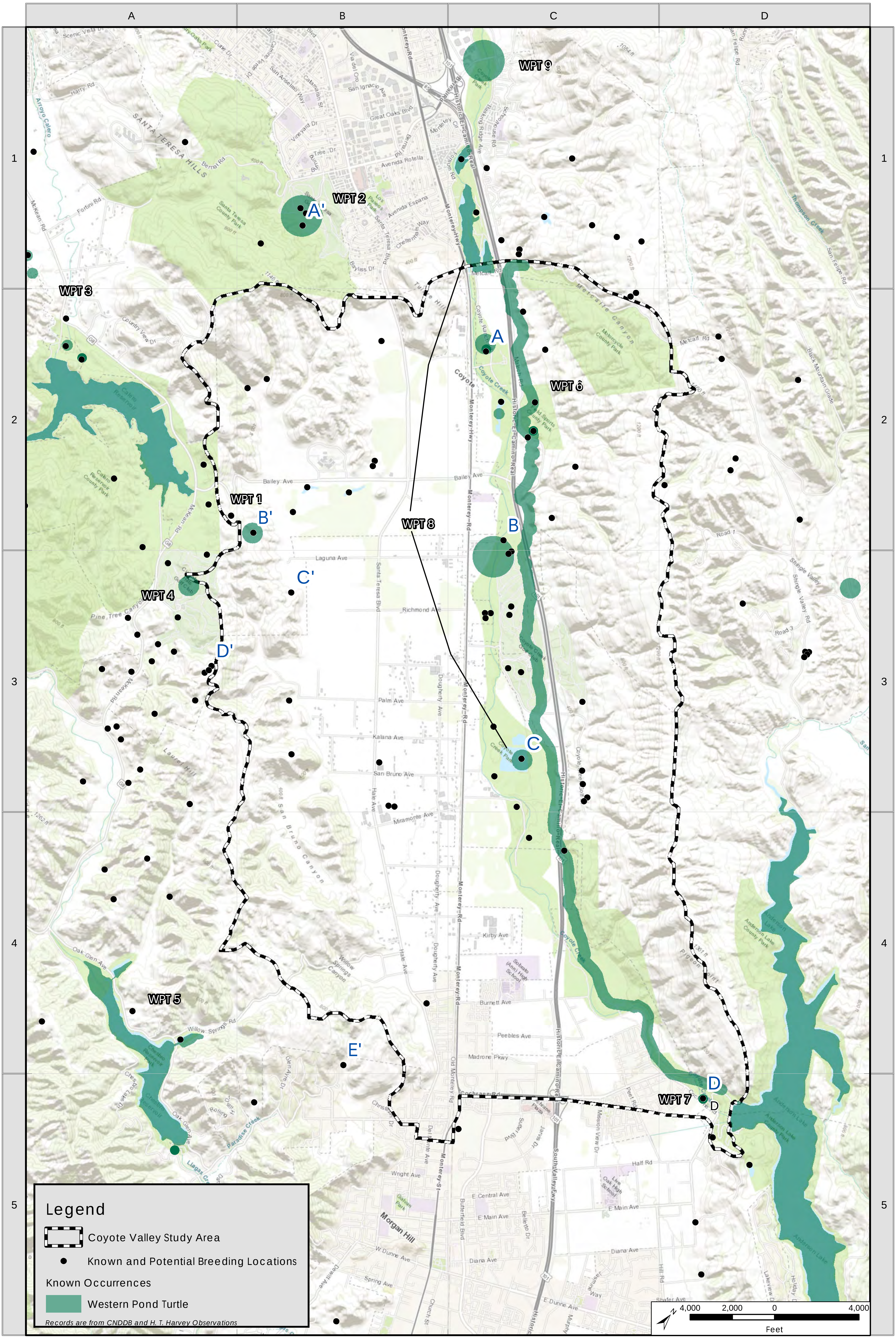

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Figure 9. Western Pond Turtle Origin and Destination Points in Relation to Occurrences

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

For each species, we prepared maps showing potential movement pathways (using examples from the LCPA) within and across Coyote Valley, including maps showing these potential movement pathways in the context of known occurrences, known and potential breeding/aquatic habitat areas, and areas of potential occurrence in uplands surrounding known breeding/aquatic habitats. In addition, maps showing potential movement pathways relative to the LCPA scoring (showing ease or difficulty of movement through various areas) were prepared.

3.2 Findings

3.2.1 Discussion of Habitat Conditions/Land Use Types and Potential Dispersal Impediments

The habitat/land use features within the study area were described previously. In this section, we describe these conditions in greater detail with respect to their suitability for use by CTS, CRLF, and WPT for movement within and across Coyote Valley. First, we provide a general overview of conditions related to movement. We then provide a more detailed, species-by-species discussion of these issues.

Of the various habitat and land cover types within the study area, those most conducive to movement by the focal species provide some combination of open ground for ease of movement with patches of vegetative cover (to conceal individuals from predators) and refugia from predators and desiccation, such as California ground squirrel burrows that may be used by CTS (and possibly CRLF) and debris that may be used by any of the three species. Following is a discussion of these habitat/land cover types, roughly ordered from most suitable to least suitable:

- Streams and canals, including Coyote Creek, the Coyote Canal, Fisher Creek and the Fisher Creek bypass, wet ditches on the northern valley floor, and smaller drainages in the hills on both the east and west sides of the valley, provide aquatic habitat that supports higher-quality movement habitat for the CRLF and WPT than surrounding upland habitats. Some of these features, such as portions of the Coyote Canal and the smaller hillside drainages, may provide only intermittently wet conditions (i.e., they may be dry during much of the dry season), but when they hold water, they would provide suitable aquatic foraging habitat and refugia for CRLF and WPT. Other features, such as Coyote Creek, Fisher Creek and the Fisher Creek bypass, and portions of other watercourses, are perennially wet and provide higher-quality year-round dispersal habitat and refugia. Riparian habitat associated with streams provides leaf litter and debris that can be used as refugia. CTS may disperse along these watercourses incidentally, but they are not thought to disperse preferentially along watercourses as CRLF and WPT do. Nevertheless, CTS could use debris along riparian habitats as refugia.
- Grassland or other modestly vegetated habitats with California ground squirrel burrows provide refugia for dispersing CTS. CRLF are not thought to be as dependent on burrows in upland habitats as are CTS, and WPT are not known to use small mammal burrows as refugia, but CTS can disperse well through modestly vegetated habitats with sufficient burrows. Areas that provide ground squirrel burrows but that are disced regularly do not typically provide high-quality dispersal habitat for CTS, as burrows may be buried by

discing, and moving through the coarse substrate of a disced field is likely difficult for CTS. Examples of where grassland providing ample ground squirrel burrows is present in the study area include the grassy hills surrounding the valley (including the hills west of the valley, the IBM Hills, Tulare Hill, and Coyote Ridge), as well as some grassy and ruderal areas, and infrequently cultivated lands, along the east side of Monterey Road.

- Lands under moderate agriculture that in some years or seasons have active row crop planting but in other years or seasons are left fallow allow rodent burrows and ruderal vegetation to occupy the land when left fallow, thus providing some refugia and cover for dispersing individuals of the focal species. However, the row crops and active agricultural activities are still considered impediments to dispersal. Lands under moderate agriculture make up approximately 18% of the land cover types on the valley floor and are mostly in the northern part of the valley, with parcels interspersed among the rural residential and agricultural developed land cover types in the central and southern parts of the study area.

- Golf courses and parks—even though golf courses and parks are mostly open, and thus pose no obvious barriers to dispersal, they are considered unsuitable upland habitat due to constant maintenance activities on the fairways and greens, such as mowing and vehicular activity (which kills the focal species above ground), applications of herbicides and pesticides (poisoning aquatic habitat during runoff), elimination of rodent burrows (which removes refugia), and installation of irrigation and other infrastructure (irrigation boxes are known amphibian traps). Also, in addition to herbicide and pesticide runoff, the potential presence of exotic aquatic predators, such as crayfish, carp, sunfish, and bullfrogs, typically render golf course ponds unconducive to breeding by CTS and CRLF. Golf courses and parks make up only 3.4% of the land cover types within the study area, mostly associated with the Coyote Creek Golf Club, but also including parks interspersed among the more heavily developed land use in the southeastern part of the study area.

- Rural residential and agricultural developed land uses consist of sparsely dispersed homes, barns, and other structures, and equipment on these lands, which would impede dispersal by the focal species when encountered. However, some portions of these lands contain ruderal ground and debris cover that may allow for rodent burrows that would provide some refugia, particularly for CTS and CRLF. Some of these properties also contain ponds. However, these ponds are typically used as water sources for agriculture (water is drawn from the pond), mechanically altered (excavated or filled), or used for dumping toxins or waste; these activities would make them unconducive to breeding by CTS and CRLF, as these activities would at best disturb breeding adults and at worst kill adults and/or larvae. Rural residential and agricultural developed land cover types make up approximately 6.3% of the land cover types, interspersed among the intensively cultivated agriculture and moderate agriculture through the center of the study area, north of the heavily developed areas.

- Lands that are intensively and regularly cultivated, especially for row crops, provide few or no small mammal burrows and are frequently disturbed. During portions of the year, no vegetative cover at all is present on these lands. Intensively cultivated lands make up approximately 6.2% of the land cover types, mostly concentrated in two areas – one through the center of the study area, south of Bailey Avenue, and another east of Monterey Road, south of Barhnart Avenue.

- Heavily developed (urban/suburban) areas consist of multiple relatively closely packed buildings and associates hardscape (roads, parking lots, etc.), fences, pools, and landscaping (devoid of rodent burrows). This land cover type makes up approximately 6.4% of the land cover types, mostly concentrated in the southeast end of the study area. Heavily developed areas provide no suitable habitat for movement by these species, and are thus considered a barrier to dispersal.

We identified a number of features within the study area that impede movement by the focal species. These features, including elements such as undercrossings and overcrossings that allow some potential for movement through these features, are as follows:

- Highway 101—Highway 101 is an eight lane highway with a solid, continuous concrete median. There are several potential linkage areas crossing the highway as follows: 26 culverts crossing under the highway, overcrossings at Metcalf Road and Bailey Avenue, a golf course cart undercrossing at the Coyote Creek Golf Club, the Coyote Creek Golf Club Drive undercrossing just south of Coyote Golf Course, and Coyote Creek itself in the sourthern part of the study area.
- Coyote Creek – Coyote Creek is considered an impediment for CTS only; it is considered a potential dispersal corridor for CRLF and a known dispersal corridor (and aquatic habitat) for WPT.
- Monterey Road—Monterey Road is a four lane, rather heavily used road with a concrete median. Breaks in the median occur at Metcalf Road, Blanchard Road, Bailey Avenue (Bailey Avenue crosses over Monterey Road but there are breaks north and south of the overcrossing), Palm Avenue, Live Oak Avenue, and Tilton Avenue. The median also contains small openings at the base approximately every 40-50 ft to allow water to flow under the median. There is also a culvert for Fisher Creek to flow under the road into Coyote Creek just south of Metcalf Road.
- Union Pacific Railroad Tracks—these railroad tracks parallel the west side of Monterey Road. The rails are slightly elevated above the ballast on the railway sleeper (tie) so that a small animal (i.e., CTS or small CRLF) would be able to crawl between the rails and ballast at multiple spots throughout the length of the track. CRLF could easily hop over the rails anywhere along these tracks. Also, at Blanchard Road, Emado Avenue (north of Bailey Avenue), Fox Lane, Palm Avenue, Live Oak Avenue, and Tilton Avenue, the rails are at the same level as the road, which would allow all three species to cross, and Bailey Avenue at the north end of the study area crosses over, and Monterey Road at the south end of the study area crosses under the tracks.
- Santa Teresa Boulevard—Santa Teresa Boulevard is a medium to heavily used, mostly two lane road that parallels Monterey Road along the west-central portion of Coyote Valley. Unlike Monterey Road, Santa Teresa Boulevard does not contain a median along most of the length of the road to divide traffic. However, curbs are present along the northern and southern sections of the road in the study area. For example, there is a curb on one or both sides of the road from the housing development north of the study area to Bailey Avenue, with periodic gaps in the curb for vehicles to enter or exit the road. The curbs provide dispersal impediments for CTS and small WPT, though CRLF could easily jump over them.

- Bailey Avenue – A curb is present along most of the north side of this two to four-lane road from Highway 101 to near the Fisher Creek undercrossing. West of Fisher Creek, no curb is present.

3.2.2 Habitat Connectivity for California Tiger Salamanders

Primary issues related to habitat connectivity for CTS are discussed below.

Highway 101—this highway is a significant impediment to dispersal. CTS that might attempt to cross Highway 101 during dispersal events from breeding ponds to the east would most likely die by vehicular strikes, if any successfully avoid vehicular strikes, they would encounter the concrete median and be trapped at the median, unable to disperse further. The closest undercrossings to currently known CTS breeding ponds are the culverts (Photos 1 and 2) midway between Metcalf Road and Bailey Avenue (linkage numbers 10 and 11 of Table 4 and Figure 6)[4], approximately 1.1 mi southeast of occurrence CTS 5 above (in grid C2 of Figure 6). For a CTS to use these culverts, though, would require the unlikely scenario of a CTS dispersing southeast from this pond for over 1 mi (which is near the maximum known dispersal distance for this species) before turning westward and crossing under Highway 101 through one of these culverts.

Photo 3. Culvert under Highway 101 at linkage number 10.

Photo 4. Culvert under Highway 101 at linkage number 11.

The other possible undercrossing linkages are further south at the Coyote Creek Golf Club. If CTS are present and actively breeding in the ponds of the Coyote Creek Golf Club or created CTS mitigation pond at the southeastern end of the eastern portion (east of Highway 101) of the Coyote Creek Golf Club, they would be able to use the four culverts adjacent to the southern half of the golf course (e.g., linkage numbers 35, 38, 39, and 41) and the golf course path that cross under Highway 101 (linkage number 43), which are well within dispersal distance from these potential breeding ponds.

[4] All linkage numbers are listed in Table 4 and appear in Figures 6 and 16–40 [Note: Figures 16-40, depicting specific LCPA results, are in Appendix B].

The overcrossings at Metcalf Road and Bailey Avenue (linkage numbers 4 and 24) also currently provide potential linkages between any current breeding site east of Highway 101 and upland west of Highway 101. For example, the overcrossing at Metcalf Road is only 0.2 mi southwest of the closest currently known breeding pond north of Metcalf Road. However, a CTS would be required to enter onto Metcalf Road before it becomes elevated, travel at least approximately 665 ft along Metcalf Road as it crosses over Highway 101 and leave Metcalf Road onto the upland adjacent to Metcalf Road between the Coyote Creek Percolation Ponds and the substation, if there is no curb. This would expose the CTS to potential vehicular strikes and desiccation while crossing over Highway 101.

Bailey Avenue is approximately 2.0 mi southeast of the same breeding pond north of Metcalf Road, so beyond the dispersal distance for CTS, and a little over 1.0 mi northwest of the prior known breeding pond on the Coyote Creek Golf Club, so within but at the limit of the dispersal distance for CTS. This overpass not only crosses Highway 101 but also Coyote Creek, Monterey Road, and the Union Pacific Railroad tracks. The advantage here is that a CTS using this overcrossing would be able to cross three potential barriers in one crossing. The disadvantage is that this crossing exposes the CTS to vehicular strikes and desiccation for over 2,700 ft (over 0.5 mi), particularly with the curbs along the road adjacent to upland, preventing CTS from being able to exit the road onto the upland.

Coyote Creek—CTS do not breed in Coyote Creek, nor would they use Coyote Creek as aquatic foraging or preferential dispersal habitat. Instead, Coyote Creek may be considered a substantial impediment to CTS movement because of higher winter flows when CTS are dispersing, which would wash individuals downstream; presence of dense riparian vegetation that might impede CTS movement; absence of typical rodent burrows for refugia; steep banks that are difficult to climb up or down; and a concentrated presence of both aquatic and terrestrial predators (i.e., fish, bullfrogs, raccoons, skunks, herons, etc.). Although it is possible that CTS might be able to cross Coyote Creek, so it is not an absolute barrier to dispersal, the likelihood of CTS successfully crossing the creek is low. Possible overcrossings of Coyote Creek from northwest to southeast are Metcalf Road, Coyote Ranch Road, and Coyote Creek Trail southeast of Coyote Ranch Road (linkage numbers 6, 14, and 16), Coyote Creek Trail north of Bailey Avenue and Bailey Avenue (linkage numbers 22 and 25), Coyote Creek Golf Drive, Coyote Creek Trail southeast of Palm Avenue, and Barnhart Avenue (linkage numbers 44, 53, and 57). Metcalf Road and Bailey Avenue are not considered good overcrossings as discussed above. Coyote Ranch Road, which is currently not being used by traffic, provides a better crossing. Several overcrossings for the Coyote Creek Trail may also be better crossings than roads currently used by vehicles because of the absence of traffic use during nocturnal dispersal events. However, a CTS would not be able to actively search for any of these overcrossings or would know where they are located; rather, they may use one only if it occurs along an individual's dispersal route to or from a breeding pond.

Monterey Road—due to the high amount of traffic and a concrete median, this road is considered a near barrier to dispersal, as a CTS crossing the road would most likely encounter vehicular strike and encounter the median at mid-crossing. However, the barrier is not considered complete, even with the existence of the median, because small openings at the base of the barrier, spaced approximately 40-50 ft apart, could allow a CTS to cross under the median. A CTS may also cross the road at the intersections with Metcalf Road, Blanchard Road, Bailey Avenue, Palm Avenue, Live Oak Avenue, and Tilton Avenue (linkage numbers 7, 13, 28, 52, 68, and 74). However, CTS attempting to cross Monterey Road at these intersections would be exposed to curbs (restricting movement onto and off of the roads), storm drains (which could trap and wash CTS into nearby drainages, i.e., Coyote Creek), and increased traffic traveling on these roads and turning from these road onto Monterey Road (increasing the potential for vehicular strikes), which would most likely negate the benefit of the breaks in the median for CTS crossing.

Union Pacific Railroad Tracks—the railroad tracks are considered an impediment but not a barrier to dispersal for CTS, because an individual CTS may be able to crawl between the rail and ballast at multiple spots throughout the length of the track. However, the rock of the ballast bed provides a poor movement substrate for CTS, potentially deterring a CTS from crossing the tracks.

Santa Teresa Boulevard—the curbs present along the northern (from the housing development north of the study area to Bailey Avenue) and southern sections of the road in the study area would pose an impediment to a dispersing CTS. For example, if a CTS were to disperse westward from Tulare Hill and try to cross this section of the road, it would most likely encounter the curb and be forced to stay on the road, alter its travel direction, and travel along the curb until it reached one of these gaps before continuing westward, exposing it to desiccation, vehicular strike, or loss into a storm drain. There are no curbs between Bailey Avenue and Tilton Avenue (except for limited curbs at intersections), thus allowing the CTS to cross the road mostly unimpeded. South of Tilton Avenue, to the southern boundary of the study area, there is a curb on at least the eastern side of the road.

Bailey Avenue—a CTS dispersing across Bailey Avenue east of the IBM campus would most likely encounter one or more curbs, storm drains, and increased traffic. West of the IBM campus, as the road narrows to only two lanes with no curb, a CTS would be mostly unimpeded to dispersal, but subject to vehicular strikes.

Heavily developed areas—we consider heavily developed areas to be barriers to dispersal because CTS attempting to disperse through this land cover type would most likely encounter the buildings, road, and other infrastructure and perish due to desiccation, entrapment, predation, and being injured or killed by human activities.

Rural residential and agricultural developed—we consider rural residential and agricultural developed land cover types as significant impediments to dispersal because CTS attempting to disperse through these land cover types might encounter the buildings, road, and other infrastructure and be blocked from further dispersal, and suffer the negative impacts of being blocked (e.g., a CTS might be able to move around the buildings and infrastructure but would be exposed to being crushed, entrapped, or desiccated). However, the ruderal ground cover between these structures may provide refugia in the form of rodent burrows, and debris may also provide temporary refugia. As a result, rural residential and developed agricultural lands do not pose as much of a barrier to dispersal as heavily developed areas.

Intensively cultivated agriculture—because lands under intensively cultivated agriculture are devoid of ruderal ground cover and rodent burrows due to intense discing and management, we consider this type of land cover a near barrier to dispersal due to the lack of refugia over a large distance, and a CTS dispersing through the center of this land cover type would most likely desiccate before reaching the opposite side. Although juvenile and adult CTS may not be palatable to some predators, predation attempts still occur. For example, H. T. Harvey & Associates biologists have observed multiple CTS that had been killed by avian predators even if they were not eaten. As a result, CTS that attempt to cross large open expanses, such as bare agricultural fields, are subject to injury or mortality from predation attempts.

Moderate agriculture—a CTS typically would not be able to disperse through this land cover type during active agriculture but may be able to disperse through it during the periods when left fallow, using the rodent burrows around the periphery (and possibly encroaching into the interior) as refugia. Therefore, we consider this land cover type to be an impediment to dispersal but not a complete barrier, depending on the condition when CTS are dispersing.

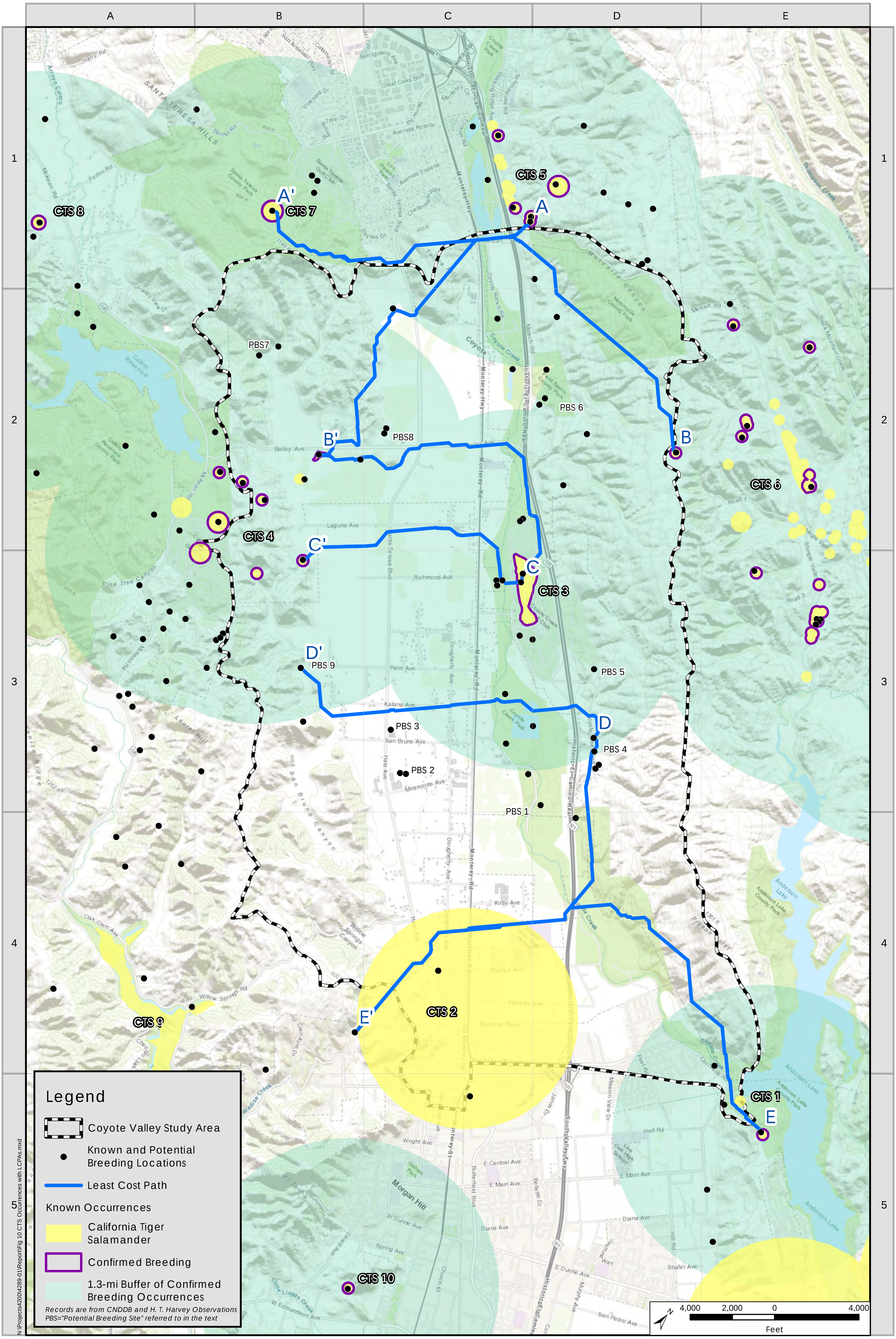
Golf courses and parks—we consider this land cover type an impediment to dispersal for CTS due to the active suppression of rodent burrows (which removes refugia), constant maintenance activities on the lawns, fairways, and greens, such as mowing and driving (which kills CTS above ground), applications of herbicides and pesticides (poisoning both adults and larvae during runoff), and installation of irrigation and other infrastructure (irrigation boxes are known amphibian traps).

3.2.3 Least Cost Path Analyses for California Tiger Salamanders

We conducted LCPA modeling for all potential pathways from each origin to each destination point in the northern, central, and southern portions of the study area to evaluate which pathways might be most efficient for movement of CTS between known or potential breeding ponds on the east and west sides of the study area and how different distances (across the valley) and intervening land use types might affect the pathways. The results of these analyses are provided in Table 6 of Appendix A with respect to the straight-line distance between origin and destination points; the least-cost pathway distance that a CTS would actually need to travel to get from an origin to a destination; and the pathway "cost", with higher numbers representing more costly pathways.

From these analyses for CTS, we provide eight LCPA pathways that represent the pathways with the least costs to CTS dispersing from selected origins on the east side to selected destinations on the west side of the study area, and conversely from selected origins on the west side to selected destinations on the east side of the study area. Figure 10 depicts these pathways in the context of known occurrences and known and potential breeding sites; Figure 11 depicts these pathways in the context of land uses and dispersal impediments, and depicts the relative ease or difficulty of CTS movement through various land uses and features in the study area; Figures 16–23 in Appendix B show each of the eight LCPA pathways relative to land uses and impediments at a closer scale. Each of these pathways is briefly discussed below.

It should be noted that these least cost pathways represent theoretically optimal pathways for individual CTS to traverse between the origin and destination rather than pathways that are likely to be taken by individuals. In reality, individuals do not have perfect information about their surroundings, such as what impediments may



H. T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 10. California Tiger Salamander Occurences with Least Cost Pathways
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
January 2020

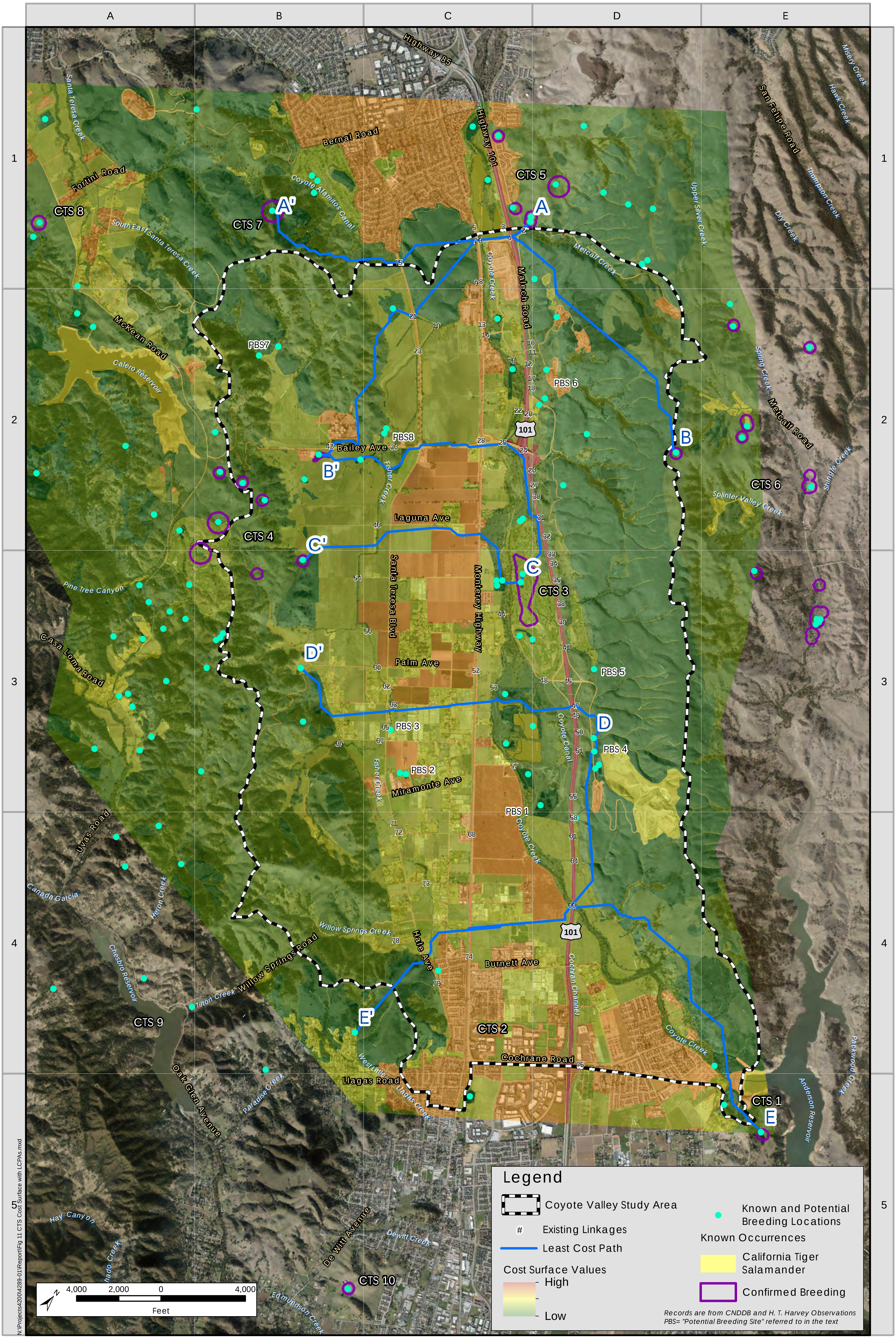


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Figure 11. California Tiger Salamander Cost Surface with Least Cost Pathways
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
January 2020

lie ahead of them and where they may or may not be able to feasibly navigate those impediments. As a result, this LCPA modeling has been performed to help us understand the difficulty these species may have in moving from one side of Coyote Valley to the other. For example, because the LCPA pathways represent optimal pathways, actual dispersal events would likely be more costly, and longer, than the LCPA pathways. Therefore, if the length of an LCPA pathway exceeds the known dispersal capabilities of individuals of a species, we know that under existing habitat and impediment conditions, cross-valley dispersal is infeasible except, perhaps, over multiple generations. However, this LCPA modeling will also inform conservation efforts by suggesting where crossings of impediments, enhancement of upland habitat, and new breeding ponds (to facilitate multi-generational dispersal of genes) may best promote cross-valley dispersal.

3.2.3.1 CTS LCPA Pathway 1

This LCPA pathway (Figure 16) is from Point A, the closest of the known breeding ponds northeast of Metcalf Road in occurrence cluster CTS 5, to Point A', a known breeding pond in the Santa Teresa County Park depicted as CTS 7 (Point A to Point A' of Figure 10). The pathway crosses over Highway 101 and Coyote Creek along Metcalf Road (linkage numbers 4 and 6), crosses Monterey Road at the intersection of Metcalf Road and Monterey Road (linkage number 7), then the Union Pacific Railroad tracks; heads southwest across grassland habitat of Tulare Hill to Santa Teresa Boulevard; crosses under Santa Teresa Boulevard via a culvert for the Coyote Alamitos Canal (linkage number 15); then travels along the open space north of the study area for approximately 1.5 mi to the pond at point A'. This pathway crosses the study area only along the northern border at Metcalf Road before exiting the study area to traverse the open space northwest of the study area.

At approximately 2.7 mi long and a cost of 26519, this pathway has the lowest cost for a CTS to travel from point A, on the east side of the study area, to any point on the western side of the study area. However, this pathway is longer than two other pathways for this species in the analysis (CTS LCPA pathway 5 from point C to point C' and a CTS LCPA pathway from point C to point D' in Table 6). This is also the pathway that the analysis determined to have the lowest cost for a CTS to travel from point A' to any point on the eastern side of the study area (Table 6). This low cost is most likely due to being able to traverse mostly over undisturbed land cover types after crossing Monterey Road. However, traveling on Metcalf Road to cross over Highway 101 and Coyote Creek, then crossing Monterey Road, and being able to locate the culvert under Santa Teresa Boulevard, are considered major impediments and barriers to dispersal.

In summary, the LCPA selected this pathway as the most efficient means of CTS movement between the westernmost known breeding pond northeast of Metcalf Road and any known or potential breeding site on the western side of the study area by maximizing movement through grassland with ground squirrel burrows and using the only (or best) potential crossing locations of Highway 101, Coyote Creek, Monterey Road, and Santa Teresa Boulevard. Even though the two endpoints for this pathway represent the third closest ponds to each other on the east and west sides of the northern portion of the valley, the intervening distance between these ponds, along this pathway, is almost twice the known dispersal capabilities of any individual CTS. As a result, this pathway is not a feasible movement pathway for an individual. For example, it would take a juvenile (the most likely dispersal life stage) a minimum of 74 nights to travel this distance, based on a juvenile above ground average travel duration of less than an hour (0.85 hour) per night and an average travel distance of 69-187 ft

(Loredo et al. 1996, Shaffer et al. 1991). In fact, Metcalf Road over Highway 101, at 665 ft, would take a juvenile a minimum of 3 h (fast) or average of 6 h to cross – much longer than the typical 0.85 h that a juvenile travels from a pond before entering a refuge (Loredo et al. 1996) and exposing the CTS to potential vehicular strikes and desiccation.

In addition, CTS movement along this pathway would necessitate having individuals successfully traverse major impediments to dispersal, using tenuous connections such as using Metcalf Road to cross over both Highway 101 and Coyote Creek, and being able to successfully cross over Monterey Road at Metcalf Road. Although it is possible that individuals could do this, the likelihood of an individual dispersing through this narrow "bottleneck" between Monterey Road and the east side of Highway 101 from a breeding location, walking along the appropriate pathway (without knowing where it is heading), and then being able to successfully navigate traffic along these roads is extremely low.

3.2.3.2 CTS LCPA Pathway 2

This LCPA pathway (Figure 17) is from Point B', the middle golf course pond south of Bailey Avenue in occurrence cluster CTS 4, to point A, the same breeding ponds for occurrence cluster CTS 5 as in CTS LCPA pathway 1 (point B' to point A of Figure 10). The pathway travels from the pond at point B' through moderate agriculture southeast of Bailey Avenue, then crosses Bailey Avenue and enters the marsh and riparian habitat between the campus and Bailey Avenue; travels through this habitat to the southeast corner of the IBM campus, turns northwest along the edge of the campus before crossing northward through the annual grassland and oak woodlands of the hills west of Laguna Seca; traverses moderate agriculture to, and then crosses, the seasonal wetland habitat of Laguna Seca; it then follows the drainage from Laguna Seca to Santa Teresa Boulevard, crosses under Santa Teresa Boulevard through a culvert for this drainage (linkage number 21), then heads north through the grassland habitat of Tulare Hill to Monterey Road; then the pathway is the same as CTS LCPA pathway 1 over Monterey Road, Coyote Creek, and Highway 101 to the known breeding ponds at point A.

At approximately 3.4 mi long, this pathway has the lowest cost of 37389 for a CTS to travel from point B' to any point on the east side of the study area. The pathway traverses approximately 0.55 mi of disturbed land cover types and 2.57 mi of natural land cover types. The major impediments and barriers to dispersal are traveling on Metcalf Road to cross over Highway 101 and Coyote Creek, crossing Monterey Road, being able to locate the culvert under Santa Teresa Boulevard, and finally crossing Bailey Avenue. Crossing moderate agriculture may be an impediment to a barrier depending on the state of agriculture during dispersal events.

As with CTS LCPA pathway 1, the intervening distance between these two points, along this pathway, is much greater than the dispersal capabilities of any individual CTS. For this general pathway to be feasible, CTS would need to be breeding in Laguna Seca, so that Laguna Seca provided a "stepping stone" for movement of individuals or genes between ponds on the east and west sides of the valley, or new breeding ponds that could act as stepping stones would need to be constructed so that, over multiple generations, genes could be shared between populations on either side of the valley as individuals disperse among the intervening stepping-stone ponds.

3.2.3.3 CTS LCPA Pathway 3

This LCPA pathway (Figure 18) is from point B, a known breeding pond associated with CTS 6, just east of the eastern border of the study area, to point A', the known breeding pond in the Santa Teresa County Park depicted as CTS 7 (point B to point A' in Figure 10). This pathway travels northwestward over serpentine bunchgrass grassland and chaparral on the western facing slopes to Metcalf Road; then it follows the same pathway as for CTS LCPA pathway 1 to the pond at point A'.

At approximately 5.1 mi long, this pathway is approximately 1.4 times longer than two other pathways from point B (point B to point B' and point B to point C' of Table 6), but provides the lowest cost of 39346 for a CTS to travel from point B to any point on the west side of the study area. This is mostly due to the majority of the upland traversed by CTS being undisturbed grassland and chaparral habitat.

3.2.3.4 CTS LCPA Pathway 4

This LCPA pathway (Figure 19) is from point C, one of the Coyote Creek Golf Club ponds presumed to have been a breeding pond for CTS, at least in the past in occurrence CTS 3, to point B', the middle golf course pond south of Bailey Avenue in occurrence cluster CTS 4 (point C to point B' of Figure 10). This pathway travels north through Coyote Creek Golf Course to near Highway 101; follows northward through grassland along Highway 101 to Bailey Avenue; the pathway turns southwestward through grassland along the southern side of Bailey Avenue; then enters riparian habitat to cross Coyote Creek, exits Coyote Creek and travels through moderate agriculture to Monterey Road; the pathway crosses Monterey Road at the intersection with Bailey Avenue (linkage number 28); travels along the south side of Bailey Avenue through rural residential land use type; crosses Bailey Avenue to the north side (crossing four lanes and possibly encountering a curb); travels through moderate agriculture along the north side of Bailey Avenue; crosses Bailey Avenue at the Santa Teresa Boulevard intersection; travels along the south side of Bailey Avenue through moderate agriculture to seasonal wetland on the east side of Spreckels Hill, travels through this seasonal wetland around the south side of Spreckels Hill, then through the eastern most golf course pond south of Bailey Avenue; finally the pathway travels through moderate agriculture to point B' at the middle golf course pond.

This pathway, at approximately 3.34 mi, provides the least cost at 49065 for a CTS to travel from point C to any other point on the west side of the study area. However, this cost is relatively high due to the need for a CTS to cross Monterey Road, and then Bailey Avenue multiple times to avoid less conducive land use cover types to dispersal for this species (i.e., intensively cultivated agriculture).

3.2.3.5 CTS LCPA Pathway 5

This LCPA pathway (Figure 20) is from point C', a known breeding pond southwest of the western end of Laguna Avenue, to point C at occurrence CTS 3 (point C' to point C of Figure 10). The pathway exits the pond at point C', traverses northeastward through serpentine bunchgrass grassland, then moderate agriculture, channelized Fisher Creek, more moderate agriculture before reaching Santa Teresa Boulevard; the pathway crosses Santa Teresa Boulevard (here a two lane road with no median or curb), then agricultural developed and moderate agriculture land use types; the pathway then travels the shortest distance (approximately 630 ft) through intensively cultivated agriculture before crossing the Union Pacific Railroad tracks; then the pathway crosses Monterey Road (requiring a CTS to cross 4 lanes of road and under the median through one of the aforementioned openings); the pathway turns eastward through grassland to Coyote Creek, crosses the creek onto the Coyote Creek Golf Course, crossing the golf course to point C in one of the golf course ponds.

This pathway, at a length of 2.41 mi, is shorter than any of the other previous pathways presented. However, the relative cost of 49484, which is the lowest cost for a CTS to travel from point C' to any point on the east side of the study area, is higher than any of the other previous pathways presented. Based on this analysis, it is our opinion that dispersal across middle Coyote Valley is infeasible for CTS under existing conditions due to the length of the movement pathway (nearly 2.4 mi), but more importantly the difficulty CTS would have navigating Coyote Creek, Monterey Road, Santa Teresa Boulevard, and intervening land uses. Because the 2.4-mi pathway is longer than individual CTS are known to disperse, and no suitable aquatic breeding habitat is present in the central part of middle Coyote Valley to provide a "stepping stone" breeding population, it is our conclusion that CTS dispersal (either by individuals, or via genetic exchange over multiple generations) across middle Coyote Valley is not feasible under existing conditions.

3.2.3.6 CTS LCPA Pathway 6

This LCPA pathway (Figure 21) is from point D, a potential breeding pond east of Highway 101, northwest of Kirby Canyon Landfill, to point D', a potential breeding pond constructed by the Santa Clara Valley Open Space Authority on the Coyote Valley Open Space Preserve (point D to point D' of Figure 10). The pathway travels northwest through grassland before turning southwest, crossing Coyote Creek Golf Drive, then travels west through annual grassland to Highway 101; the pathway crosses under Highway 101 through a culvert (linkage number 47); then crosses through more annual grassland and mixed oak woodland to the northern edge of the large in-stream Ogier Ponds of Coyote Creek; the pathway crosses through riparian habitat adjacent to Coyote Creek and aquatic habitat of Coyote Creek, and annual grassland; the pathway then crosses moderate agriculture (however, appears more disturbed) to Monterey Road; crosses Monterey Road similar to CTS LCPA pathway 5, and Union Pacific Railroad tracks, then crosses an agricultural road, more moderate agriculture, and rural residential land use types, Kalana Avenue (a two-lane road), then a patchwork of rural residential, moderate agriculture, and agricultural developed land use types to a northern flowing Fisher Creek, more rural residential land use type to Hale Avenue (southern extension of Santa Teresa Boulevard); the pathway crosses over Hale Avenue to moderate agriculture to Manfre Road, crosses the road and rural residential land use type before entering serpentine bunchgrass grassland of the western hills, turns northwestward traveling through this and annual grassland land cover types before crossing moderate agriculture to reach the pond at D'. The pathway goes through approximately 1.4 mi of disturbed land cover types and 1.5 mi of natural land cover types. The major impediments or barriers to dispersal are Highway 101 and Monterey Road, then other roads, rural residential, and agricultural developed land use types. Less intensive impediments to dispersal would be moderate agriculture and Coyote Creek.

The two endpoints for this pathway represents potential CTS breeding ponds on either side of middle Coyote Valley, in different locations from those discussed in CTS LCPA pathway 5 above. As in the previous example, this pathway illustrates the most efficient pathway for a CTS to attempt crossing this part of the valley. This pathway, at a length of 3.25 mi, is the pathway with the lowest cost of 49697 for a CTS to travel from point D to any point on the west side of the study area, and from point D' to any point on the eastern side of the study area. However, this cost is higher than any of the previously presented pathways. Based on this analysis, it is our opinion that dispersal across middle Coyote Valley is infeasible for CTS under existing conditions due to the length of the movement pathway (3.25 mi) and, more importantly, the difficulty CTS would have navigating Coyote Creek, Monterey Road, Santa Teresa Boulevard, and intervening land uses. There is no suitable aquatic breeding habitat present in the central part of middle Coyote Valley, near or along this pathway, to provide a "stepping stone" breeding population, and therefore it is our conclusion that CTS dispersal (either by individuals, or via genetic exchange over multiple generations) across this portion of middle Coyote Valley is not feasible under existing conditions.

3.2.3.7 CTS LCPA Pathway 7

This LCPA pathway (Figure 22) is from point E', a potential breeding site outside and south of the southwest edge of the study area, to point D, the same potential breeding pond east of Highway 101, northwest of Kirby Canyon Landfill assessed in CTS LCPA 3 (point E' to point D of Figure 10). The pathway exits the pond at point E' and travels north through valley oak woodland and serpentine bunchgrass grassland of the hills along the southwest edge of the study area; crosses over Hale Avenue (southern extension of Santa Teresa Boulevard); travels through rural residential and moderate agriculture before turning northeast along the northern edge of suburban development; the pathway continues to travel through agricultural developed; crosses the Union Pacific Railroad tracks, then the four lane Monterey Road and under the center median; the pathway crosses through an urban park and moderate agriculture and around the southern edge of intensively cultivated agriculture to Coyote Creek; it then turns north and crosses Coyote Creek and under Highway 101 at the Highway 101 Coyote Creek overcrossing (linkage number 66); it finally travels through moderate agriculture before turning northwest to travel through annual grassland and serpentine bunchgrass grassland to the potential breeding pond at point D.

At approximately 4.1 mi long and a cost of 54300, this pathway provides the lowest cost for a CTS to travel from point E' to any point on the eastern side of the study area. The pathway goes through approximately 1.8 mi of disturbed land cover types and 2.3 mi of natural land cover types. The major impediments or barriers to dispersal are Highway 101, Monterey Road, and Hale Avenue, then an urban park and agricultural developed. Less intensive impediments to dispersal would be moderate agriculture and Coyote Creek. The LCPA output utilized the Coyote Creek undercrossing of Highway 101 and skirted around and between intensive agricultural lands and heavily developed lands. However, at a length of 4.1 mi and at the highest relative cost of 54300 presented so far, this pathway is much too long through less conducive land cover types, without any aquatic habitat "stepping stones", for CTS dispersal, either by individuals or via genetic exchange over multiple generations. Therefore, CTS dispersal across the southern portion of Coyote Valley is not feasible under existing conditions.

3.2.3.8 CTS LCPA Pathway 8

This LCPA pathway (Figure 23) is from point E, a known breeding pond just outside of the southeast corner of the study area associated with occurrence CTS 1, to point E', the potential breeding site outside and south of the southwest edge of the study area (point E to point E' of Figure 10). This pathway travels northwest through oak woodland and coastal scrub land cover types to rural residential land use type before crossing Coyote Creek at the base of the Anderson Dam; the pathway continues northwestward through coastal scrub, serpentine chaparral, serpentine bunchgrass grassland, annual grassland, and oak woodland then turns southwest to travel through moderate agriculture to the Highway 101 Coyote Creek overcrossing (linkage number 66); from here the pathway is the same as for CTS LCPA pathway 7 above to the potential breeding pond at point E'. At approximately 5.6 mi long, and a cost of 66883, this pathway provides the lowest cost for a CTS to travel from point E to any point on the west side of the study area. However this cost is higher than any previous pathway presented, with the same issues as with CTS LCPA pathway 7, providing evidence that CTS dispersal across the southern portion of Coyote Valley is not feasible under existing conditions.

In summary, the LCPA analyses for CTS dispersal across Coyote Valley suggest that CTS dispersal across the valley is highly unlikely to be occurring under existing conditions. Due to distances between ponds on either side of the valley, the lack of intervening ponds that may serve as "stepping stone" populations, and low habitat quality in intervening land uses, CTS dispersal across the valley is completely infeasible under existing conditions except, possibly, at the northern end of the valley. There, the distance between known breeding ponds is less, and intervening land uses are more favorable for CTS dispersal (with more natural grassland and less intensive agriculture and developed land) than in middle and southern Coyote Valley. Nevertheless, distances between known breeding ponds on either side of northern Coyote Valley is still too great for dispersal by individual CTS across the valley.

If CTS can breed in ponds on the northern valley floor, particularly at Laguna Seca, then genetic exchange may be feasible over multiple generations, as individuals disperse between ponds south of the IBM campus and Laguna Seca, and between Laguna Seca and ponds east of Highway 101 and north of Metcalf Road. However, the intervening distances between Laguna Seca and those ponds to the southwest and east, coupled with dispersal impediments (particularly near Highway 101 and Metcalf Road), make it highly unlikely that any dispersal of individuals or genes is occurring under existing conditions. In particular, dispersal between ponds east of Highway 101 and any areas west of Monterey Road is highly impeded.

3.2.4 Habitat Connectivity for California Red-legged Frogs

Primary issues related to habitat connectivity for CRLF are discussed below. Compared to CTS, CRLF spend more time (year round) in and near waterbodies. As a result, they are often found in culverts that provide moisture and cover from predators. This attraction toward culverts means that CRLF naturally gravitate toward features that allow them to cross under roads or other impediments, thus facilitating dispersal across these impediments.

Highway 101—this highway is a significant impediment to CRLF dispersal, as discussed for CTS above. However, CRLF can cross under Highway 101 using culverts, and because CRLF are closely associated with waterbodies year-round, they are more likely than CTS to be dispersing along creeks, and along Coyote Canal, in locations that would allow them to cross under Highway 101. For example, CRLF are known to occur in Coyote Canal where it crosses under Highway 101 southwest of the Kirby Canyon Landfill (linkage number 58), and a natural creek flowing under the highway between the canal undercrossing and Coyote Creek Golf Drive (linkage number 50) also provides a pathway by which CRLF likely cross under the highway on occasion. CRLF are not thought to be breeding along Coyote Creek in the study area, but any CRLF dispersing along the creek could cross under Highway 101 either north of Cochrane Road (linkage number 66) or near the Highway 101/Highway 85 interchange (linkage number 1).

Monterey Road—due to the high amount of traffic and a concrete median, this road is considered a near barrier to dispersal, as discussed for CTS above. Because of the narrow nature of the slits under the concrete barrier, CRLF likely cannot cross under the median barrier as CTS might be able to do, relegating CRLF to crossing Monterey Road at intersections or using the Bailey Avenue overpass if they are able to cross overland at all. Vehicular traffic would hinder such crossing attempts substantially. The most appropriate means of crossing Monterey Road is the Fisher Creek culvert (linkage number 8).

Union Pacific Railroad Tracks—because adult frogs can jump over the rails, and juvenile frogs can either jump over or crawl under the rails, these tracks do not represent a substantial impediment to CRLF dispersal. Nevertheless, because CRLF are likely to occur primarily close to water, the Fisher Creek culvert under the rail line (linkage number 9) represents the highest-quality, and most likely means, of crossing the tracks.

Santa Teresa Boulevard—CRLF would be able to cross over the road even in areas where curbs are present. Because this species is likely to occur primarily close to water, creek undercrossings and culverts provide the most suitable locations for crossing, however. North of Bailey Avenue, the best crossings are the culverts for the Laguna Seca drainage channel and Fisher Creek (linkage numbers 21 and 23, respectively). South of Bailey Avenue, the best undercrossings are culverts for Fisher Creek between Palm Avenue and Kalana Avenue (linkage number 62), between Kalana Avenue and San Bruno Avenue (linkage number 65), and just north of Live Oak Avenue (linkage number 71).

Bailey Avenue—CRLF would be able to cross over the road even in areas where curbs are present. Because this species is likely to occur primarily close to water, creek undercrossings, such as the Fisher Creek culvert (linkage number 36), provide the most suitable crossing locations.

Heavily developed areas—we consider heavily developed areas to be barriers to dispersal because CRLF attempting to disperse through this land cover type would most likely encounter the buildings, road, and other infrastructure and perish due to desiccation, entrapment, predation, and being injured or killed by human activities.

Rural residential and agricultural developed—as discussed above for CTS, rural residential and agricultural developed land cover types are significant impediments to dispersal by CRLF. However, debris within these areas provides some refugia for dispersing CRLF, and due to the greater dispersal capabilities of CRLF (i.e., being able to move more quickly and over longer distances than CTS), CRLF could disperse some distance into or through these land use types. As a result, rural residential and developed agricultural lands do not pose as much of a barrier to dispersal as heavily developed areas.

Intensively cultivated agriculture—because lands under intensively cultivated agriculture are devoid of ruderal ground cover and rodent burrows due to intense discing and management, we consider this type of land cover a substantial impediment to CRLF dispersal due to the lack of refugia over a large distance. Having greater mobility than CTS, CRLF might be better able to navigate larger expanses of cultivated fields, though there is still some risk of desiccation if no refugia are available. In addition, CRLF crossing open areas are subject to predation.

Moderate agriculture—these lands provide poor dispersal habitat when they are bare or are under active cultivation, but as discussed for CTS above, they provide at least moderate-quality dispersal habitat when they are fallow.

Golf courses and parks—we consider this land cover type an impediment to dispersal for CRLF for the reasons discussed for CTS above. However, golf course ponds may provide foraging habitat for post-metamorphic CRLF and thus be an attraction for CRLF.

3.2.5 Least Cost Path Analyses for California Red-legged Frogs

As with CTS above, we conducted LCPA modeling for potential pathways between selected origins and destinations in the northern, central, and southern portions of the study area to evaluate which pathways might be most efficient for movement of CRLF between known or potential breeding sites on the east and west sides of the study area and how different distances (across the valley) and intervening land use types might affect the pathways. The results of these analyses are provided in Table 6 of Appendix A. The LCPAs for CRLF differed slightly from those for CTS in that Coyote Creek and Fisher Creek were considered movement corridors and received lower resistance scores instead of being dispersal impediments with higher resistance scores for CTS. Also, the median barrier on Monterey Road is considered a barrier to dispersal instead of a potentially passable impediment because adult CRLF would not be able to cross under the median through the small openings (as CTS might); therefore, Monterey Road received a relatively high score except where there were breaks in the median (Table 5 of Appendix A).

From these analyses for CRLF, we provide nine LCPA pathways that represent the pathways with the least costs to CRLF dispersing from each point on the east side to a point on the west side of the study area, and conversely from each point on the west side to a point on the east side of the study area. Figure 12 depicts these pathways in the context of known occurrences and known and potential breeding sites; Figure 13 depicts these pathways in the context of land uses and dispersal impediments, and depicts the relative ease or difficulty of CRLF movement through various land uses and features in the study area; and Figures 24–32 in Appendix B show each of the nine LCPA pathways relative to land uses and impediments at a closer scale. These LCPA pathways are described below.

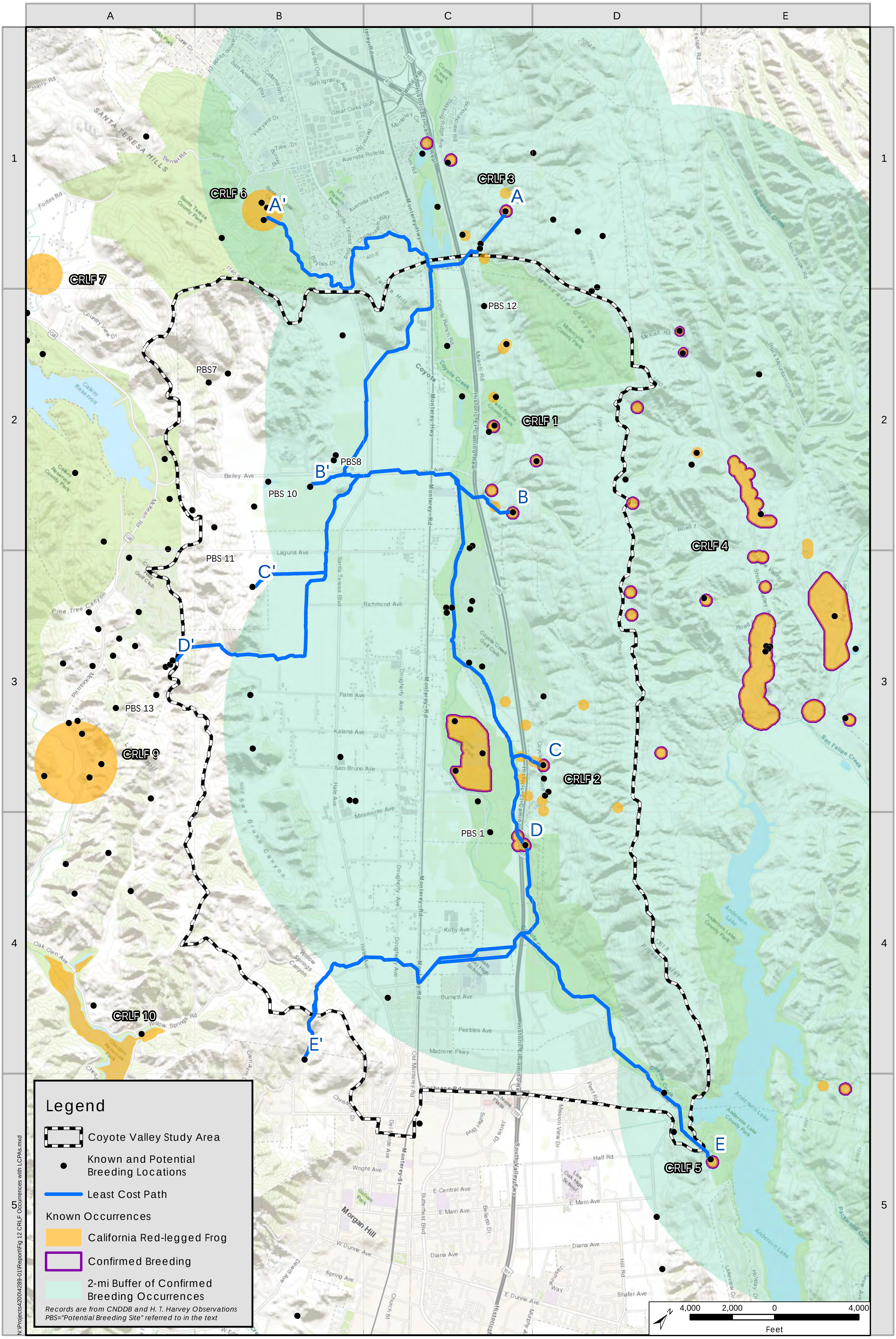

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Figure 12. California Red-legged Frog Occurrences with Least Cost Pathways
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
January 2020

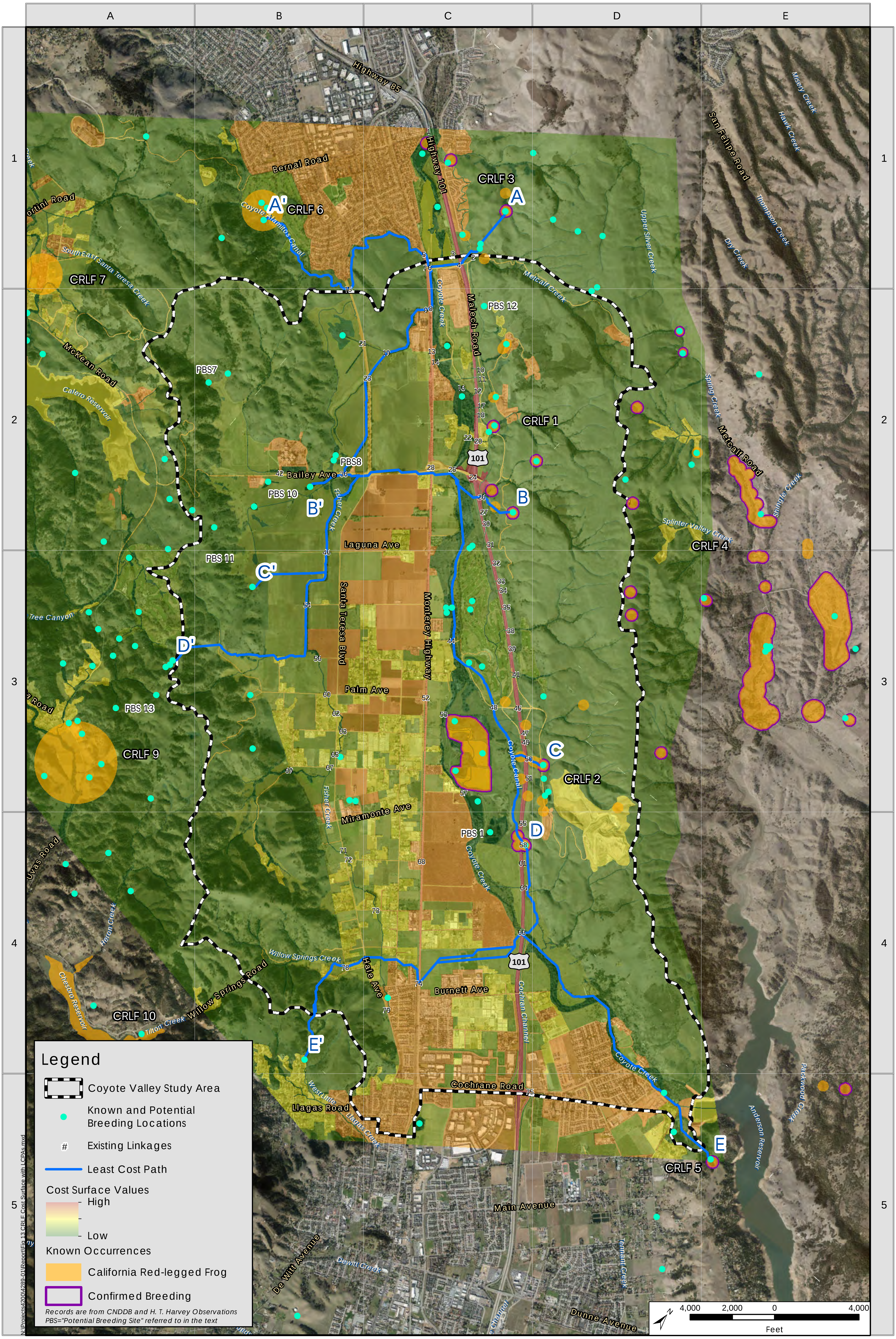

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Figure 13. California Red-legged Frog Cost Surface with Least Cost Pathways

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

3.2.5.1 CRLF LCPA Pathway 1

This LCPA pathway (Figure 24) is from point A', a pond on the Santa Teresa Golf Course northwest of the study area where CRLF have been recorded in occurrence CRLF 6, to point A, a known CRLF breeding pond north of Metcalf Road and east of Highway 101 in occurrence cluster CRLF 3 (point A' to point A of Figure 12). This pathway travels southeastward through the Coyote Alamitos Canal, and through grassland and oak woodland, around the southern edge of suburban development to Santa Teresa Boulevard; crosses under Santa Teresa Boulevard via a culvert for the canal (linkage number 15); travels through the canal along the southern edge of the suburban development to Monterey Road; crosses under the Union Pacific Railroad tracks and Monterey Road via a culvert for the canal (linkage number 6) then travels southeast through Coyote Creek to the northern edge of Metcalf Road; travels through disturbed grassland of Metcalf Park along the northern side of Metcalf Road; then the pathway crosses over Highway 101 on Metcalf Road (linkage number 4) before turning north and traveling through grassland, under a road through a culvert, through more grassland and two ponds (known breeding ponds for CTS) before reaching the pond at point A.

At approximately 3.6 mi long, this pathway has the lowest cost of 27454 for a CRLF to travel from point A' to any point on the east side of the study area. However, as with CTS in CTS LCPA pathways 1–3, this pathway requires the CRLF to cross Highway 101 on the Metcalf road, exposing it to potential vehicular strikes. In addition, this pathway is well beyond the known dispersal capabilities of any single individual CRLF.

3.2.5.2 CRLF LCPA Pathway 2

This LCPA pathway (Figure 25) is from point A, a known CRLF breeding pond north of Metcalf Road and east of Highway 101 in CRLF occurrence cluster 3, to point B', the eastern most former golf course pond (Sobrato Pond) south of Bailey Avenue where CRLF have not been recorded, but which provides potential breeding habitat (point A to point B' of Figure 12). This pathway is the same as CRLF LCPA pathway 1 from point A to Coyote Creek where it enters the creek; the pathway travels through the creek under the bridge for Metcalf Road, then continues upstream through Coyote Creek to Fisher Creek; uses the Fisher Creek culvert to cross under Monterey Road (linkage number 8) and the Union Pacific Railroad tracks (linkage number 9); then travels southwest, following Fisher Creek upstream, crossing under Santa Teresa Boulevard (linkage number 23) and Bailey Avenue (linkage number 36); the pathway exits the creek to travel across a short distance of moderate agriculture to point B' at the former golf course pond.

At a cost of 26249, this pathway has the lowest cost for this species to travel from point A to any point on the west side of the study area. At a distance of approximately 3.6 mi, this pathway is beyond the maximum dispersal distance known for any individual CRLF. However, because this pathway follows aquatic habitats throughout most of its length, crossing overland only through upland grassland that is suitable for CRLF movement, it is possible that an individual CRLF could make such a trip. If not, however, it is unlikely that CRLF movements along this pathway would occur over multiple generations, as Coyote Creek and Fisher Creek are unlikely to provide suitable CRLF breeding habitat due to the abundance of bullfrogs and fish. Laguna Seca provides a possible "stepping stone" breeding site, but due to its shallow conditions in most years, and the presence of fish and bullfrogs in its drainage channel, it may not be suitable for use by breeding CRLF. Therefore, under existing conditions, there is a low probability of CRLF dispersal across the northern part of the valley. It is interesting to note that this pathway has a relatively lower cost than CRLF LCPA pathway 1 above even though the distance is the same.

3.2.5.3 CRLF LCPA Pathway 3

This LCPA pathway (Figure 26) is from point B, a known CRLF breeding pond associated with occurrence cluster CRLF 1, to point B', the eastern most former golf course pond (Sobrato Pond) south of Bailey Avenue (point B to B' of Figure 12). The pathway travels southwest from the pond at point B through serpentine bunchgrass and grassland to Coyote Canal, travels a short distance along the canal before crossing under Highway 101 at a nearby culvert (linkage number 26); the pathway travels west through grassland then riparian habitat to Coyote Creek, after crossing Coyote Creek, it traverses moderate agriculture along the south side of Bailey Avenue to Monterey Road; from here to Spreckels Hill, the pathway is the same CTS LCPA pathway 4 (see Figure 19); the pathway then travels through seasonal wetland and Fisher Creek along the north side of Spreckels Hill, then a short distance across moderate agriculture to the pond at point B'.

At a distance of 2.08 mi, this pathway is shorter and, at a cost of 26117, has a lower cost than the previous two pathways, and any other pathway in the analysis. This is also the lowest cost pathway from point B' to any point on the east side of the study area. However, this pathway has the same issues as with CTS LCPA pathway 4 above of exposing a frog to potential vehicular strikes when required to cross Monterey Road and Bailey Avenue.

3.2.5.4 CRLF LCPA Pathway 4

This LCPA pathway (Figure 27) is from point C', a pond associated with occurrence cluster CTS 4 from which CTS are known to have bred, to point B, a known CRLF breeding pond associated with occurrence cluster CRLF 1 (point C' to point B of Figure 12). Based on a review of aerial photos, the pond at pond C' appears potentially suitable for use by CRLF. This pathway travels northeast along serpentine rock outcrop, then through a short distance of moderate agriculture to a channelize branch of Fisher Creek; it travels northwest through this channel then northeast through Fisher Creek to the south side of Spreckels Hill, where it travels through seasonal wetland along the south side of Spreckels Hill northward to the south side of Bailey Avenue; from here the pathway is the same as CRLF LCPA pathway 3 above to the pond at point B.

This pathway provides the lowest cost from point C' to any point on the east side of the study area (Table 6). At a distance of 3.34 mi, this pathway is shorter but has a higher cost, at 33663, than CRLF LCPA pathways 1 and 2 above (Table 6).

3.2.5.5 CRLF LCPA Pathway 5

This LCPA pathway (Figure 28) is from point D', the closest of three ponds to the mid-western border of the study area, to point B, a known CRLF breeding pond associated with occurrence cluster CRLF 1 (point D' to point B of Figure 12). The pathway travels northeast through grassland and oak woodland on the eastern facing slopes, west of the study area before entering a branch of Fisher Creek, it then travels through this branch to

Fisher Creek where it turns northeastward traveling through the creek, under Richmond Avenue and Laguna Avenue through culverts (linkage numbers 54 and 46, respectively) to the southern side of Spreckels Hill; from here the pathway is the same as CRLF LCPA pathway 4 above.

This pathway, at a distance of 4.87 mi and a cost of 42995, provides the lowest cost for this species to travel from point D' to any point on the east side of the study area (Table 6).

3.2.5.6 CRLF LCPA Pathway 6

This LCPA pathway (Figure 29) is from point C, a known breeding pond within the Kirby Canyon Landfill associated with occurrence cluster CRLF 2, to point B', the eastern most former golf course pond (Sobrato Pond) south of Bailey Avenue (point C to point B' of Figure 12). This pathway enters a drainage adjacent to the pond at point C, then travels through this drainage under Coyote Creek Golf Drive, then through a culvert under Highway 101 (linkage number 50) to Coyote Canal, it travels northwest through a branch of the canal to Coyote Creek, it travels northwestward through Coyote Creek to the south side of Bailey Avenue; from here the pathway is the same as CRLF LCPA pathway 3 above. This pathway, at a distance of 4.57 mi and a cost of 37870, provides the lowest cost for a CRLF to travel from point C to any point on the west side of the study area (Table 6).

3.2.5.7 CRLF LCPA Pathway 7

This LCPA pathway (Figure 30) is from point D, a known breeding pool in a culvert under Highway 101 (linkage number 58) associated with occurrence cluster CRLF 2, to point B', the eastern most former golf course pond (Sobrato Pond) south of Bailey Avenue (point D to point B' of Figure 12). This pathway travels northwest through the Coyote Canal, then through a branch of the canal to Coyote Creek; from here the pathway is the same as pathway CRLF LCPA pathway 4 above.

This pathway, at a distance of 5.12 mi and a cost of 40754, provides the lowest cost for a CRLF to travel from point D to any point on the west side of the study area (Table 6). However, this distance is well beyond the maximum dispersal distance known for any individual CRLF, and the cost is relatively high. There are three important takeaways from this and the previous three pathways. The first takeaway is that Monterey Road, with the median, becomes a near barrier to dispersal for CRLF because adult CRLF cannot pass under the small openings at the base of the median. Therefore, a CRLF must locate a gap in the barrier (or undercrossing to Monterey Road). The second takeaway is that land with intensively cultivated agriculture on the west side of Monterey Road is rather large and somewhat continuous between these endpoint ponds in the mid part of the study area so that the nearest break in the median without intensively cultivated agriculture to cross is at Bailey Avenue. Finally, a CRLF would prefer to travel through aquatic habitat such as Coyote Creek, Coyote Canal, and Fisher Creek before traversing overland. These preferences and obstacles tend to push the pathways northward where conditions are better suited for CRLF to travel through the land cover types as illustrated in Figure 13.

3.2.5.8 CRLF LCPA Pathway 8

This LCPA pathway (Figure 31) is from point E', a potential breeding site outside and south of the southwest edge of the study area, to Point D, the same breeding pool in a culvert under Highway 101 in CRLF LCPA pathway 7 above (point E' to point D of Figure 12). This pathway travels north-northwestward from the pond through oak woodland and grassland, then downstream through a drainage to Willow Springs Creek; the pathway turns northeastward traveling through Willow Springs Creek under an unnamed road through a culvert (linkage number 78) and Hale Avenue through a second culvert (linkage number 76) before reaching a channelized tributary to Fisher Creek; the pathway exits Fisher Creek and travels northeastward crossing Dougherty Avenue to the northern edge of residential land use; the pathway travels west through moderate agriculture, then south along Monterey road to the intersection with Tilton Avenue; the pathway crosses Monterey Road at Tilton Avenue (linkage number 74), then travels northwestward through moderate agriculture and park land use types before turning north through moderate agriculture (skirting around intensively cultivated agriculture and developed areas); from here the pathway crosses Coyote Creek and under Highway 101 at the Highway 101 Coyote Creek overcrossing (linkage number 66); the pathway turns northwest through moderate agriculture and then grassland along the east side of Highway 101 to point D.

At a cost of 43820, this pathway provides the lowest cost for a CRLF to travel from point E' to any point on the east side of the study area, but at a distance of approximately 4.0 mi this pathway is beyond the maximum dispersal distance known for any individual CRLF. In addition, this relatively high cost is a result of this pathway traversing upland areas, rather than watercourses, and therefore it is highly unlikely that this pathway would ever be "discovered" by a CRLF, as no CRLF would know that this is the lowest cost pathway between potential breeding sites on either side of the valley. Rather, this pathway is depicted for the purpose of demonstrating that cross-valley dispersal by CRLF in the southern Coyote Valley is likely infeasible.

3.2.5.9 CRLF LCPA Pathway 9

This LCPA pathway (Figure 32) is from point E, a known breeding pond just southeast of the study area associated with CRLF 5, to point E', the same pond just outside and south of the southwest edge of the study area in CRLF LCPA pathway 8 above (point E to point E' of Figure 12). The pathway travels northwest through oak woodland and grassland to Coyote Creek at the base of Anderson Dam, it travels through riparian habitat of Coyote Creek and adjacent moderate agriculture to the Highway 101 Coyote Creek overcrossing (linkage number 66), where it crosses under Highway 101; from here the pathway is the same as CRLF LCPA pathway 8 above.

This pathway has the lowest cost from point E to any point on the west side of the study area, but at a distance of approximately 6.0 mi and a relatively high cost of 46836, this pathway is beyond the maximum dispersal distance known for any individual CRLF, and as in CRLF LCPA pathway 8, dispersal by CRLF in the southern Coyote Valley across extensive disturbed upland land use types is likely infeasible.

In summary, the LCPA analyses for CRLF dispersal across Coyote Valley suggest that dispersal across the valley is highly unlikely to be occurring under existing conditions. Due to distances between ponds on either side of the valley, the lack of intervening high-quality breeding habitat that may serve as "stepping stone" populations, and low habitat quality in intervening land uses in middle and southern Coyote Valley, CRLF dispersal across the valley is completely infeasible under existing conditions except, possibly, at the northern end of the valley. There, the distance between known and potential breeding areas is less, and the presence of aquatic habitat (along Fisher Creek in particular) allows for a higher probability of successful dispersal across the valley, given that dispersing CRLF are most likely to remain close to aquatic habitat. Nevertheless, because CRLF are unlikely to be able to breed successfully in Coyote Creek or Fisher Creek, dispersal across the valley would rely on very long dispersal events by individuals (exceeding known dispersal capabilities of the species) or the ability of CRLF to occasionally breed successfully in Laguna Seca or somewhere along Fisher Creek, thus allowing genetic exchange over multiple generations.

3.2.6 Habitat Connectivity for Western Pond Turtles

Primary issues related to habitat connectivity for WPT are discussed below. Like CRLF, WPT are expected to occur primarily in and near waterbodies. Although females may disperse into uplands to nest, overland dispersal is unlikely to occur, or at least unlikely to be successful over long distances (Rathbun et al. 2002).

Highway 101—this highway is a significant impediment to WPT dispersal. However, WPT are present on both sides of the highway because they reside in Coyote Creek. Therefore, although the locations where they may cross Highway 101 are limited, they are expected to easily cross the highway via the Coyote Creek undercrossings at the Highway 101/Highway 85 interchange and north of Cochrane Road (linkage numbers 1 and 66, respectively).

Monterey Road—as discussed for CRLF above, WPT can only cross Monterey Road overland at intersections where there is no median barrier. The best crossing is the culvert for Fisher Creek (linkage number 8). Although the drop structure and riprap at the lower end of this culvert represent an impediment to WPT dispersal, particularly dispersal in an upstream direction, WPT can likely navigate this structure.

Union Pacific Railroad Tracks—adult WPT may be able to climb over the rails. However, small WPT cannot climb over or crawl under the rails, and therefore they could make overland crossings of the rail line only at road crossings. As a result, the best crossing is the culvert for Fisher Creek (linkage number 8).

Santa Teresa Boulevard—north of Bailey Avenue, the best crossings are the culverts for the Laguna Seca drainage channel or Fisher Creek (linkage numbers 21 and 23, respectively). South of Bailey Avenue, the best crossings are culverts for Fisher Creek (linkage numbers 62, 65, 71, and 79). Where curbs are present, small WPT probably cannot cross over the road's surface. Where curbs are absent, WPT could cross over the road, though vehicular traffic would reduce the likelihood of successful overland dispersal.

Bailey Avenue—small WPT are likely unable to cross over the road where curbs are present. Where curbs are absent, WPT could cross over the road, though vehicular traffic would reduce the likelihood of successful overland dispersal. Because this species is likely to occur primarily close to water, creek undercrossings such as the Fisher Creek culvert (linkage number 36) provide the most suitable crossing locations.

Heavily developed areas—we consider heavily developed areas to be barriers to dispersal because WPT attempting to disperse through this land cover type would most likely encounter the buildings, road, and other infrastructure and perish due to entrapment, predation, and being injured or killed by human activities.

Rural residential and agricultural developed—as discussed above for CTS and CRLF, rural residential and agricultural developed land cover types are significant impediments to dispersal by WPT. Debris within these areas provides some refugia for dispersing WPT, and therefore rural residential and developed agricultural lands do not pose as much of a barrier to dispersal as heavily developed areas.

Intensively cultivated agriculture—because lands under intensively cultivated agriculture are devoid of ruderal ground cover, we consider this type of land cover a substantial impediment to WPT dispersal due to the lack of refugia over a large distance. In addition, WPT crossing open areas are subject to predation.

Moderate agriculture—these lands provide poor dispersal habitat when they are bare or are under active cultivation, but as discussed for CTS and CRLF above, they provide at least moderate-quality dispersal habitat when they are fallow.

Golf courses and parks—we consider this land cover type an impediment to dispersal for WPT for the reasons discussed for CTS above. However, we would expect WPT to be attracted to golf course ponds, and utilize the ponds as aquatic foraging habitat.

3.2.7 Least Cost Path Analyses for Western Pond Turtles

As with CTS and CRLF above, we conducted LCPA modeling for potential pathways between selected origins and destinations in the northern, central, and southern portions of the study area to evaluate which pathways might be most efficient for movement of WPT between known or potential breeding sites on the east and west sides of the study area and how different distances (across the valley) and intervening land use types might affect the pathways (Table 6). As discussed previously, except for reservoirs, the LCPA scores for WPT are the same as for CRLF (Table 5).

From these analyses for WPT, we provide eight LCPA pathways that represent the pathways with the least costs to WPT dispersing from each point on the east side to a point on the west side of the study area, and conversely from each point on the west side to a point on the east side of the study area. Figure 14 depicts these pathways in the context of known occurrences and known and potential breeding sites; Figure 15 depicts these pathways in the context of land uses and dispersal impediments, and depicts the relative ease or difficulty of WPT movement through various land uses and features in the study area; and Figures 33-40 in Appendix B show each of the eight LCPA pathways relative to land uses and impediments at a closer scale. These LCPA pathways are described below.

3.2.7.1 WPT LCPA Pathway 1

This LCPA pathway (Figure 33) is from point A, a known WPT occurrence at the Coyote Ranch Pond in occurrence cluster WPT 8, to point A', a pond on the Santa Teresa Golf Course northwest of the study area

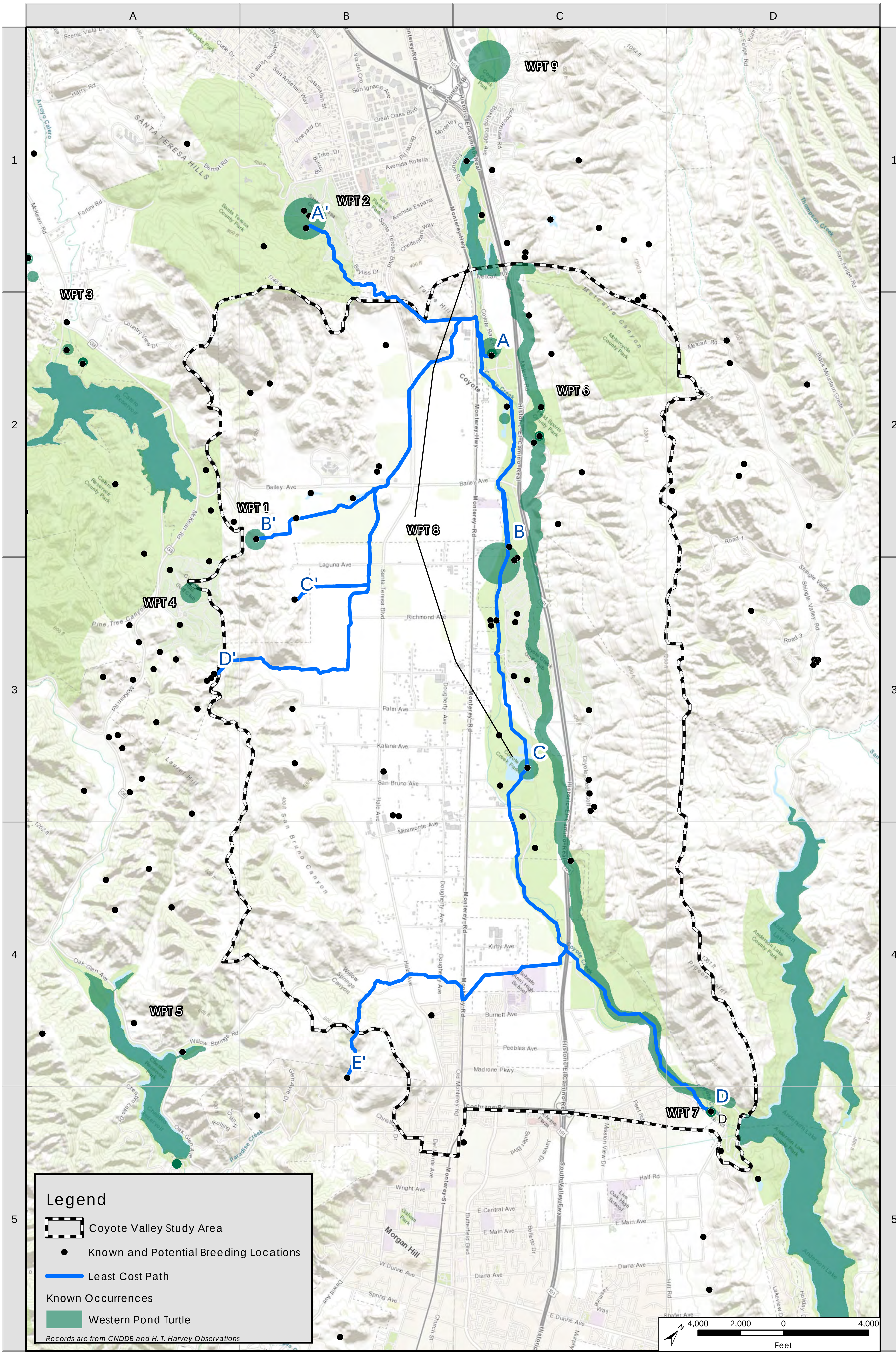

Figure 14. Western Pond Turtle Occurrences with Least Cost Pathways

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

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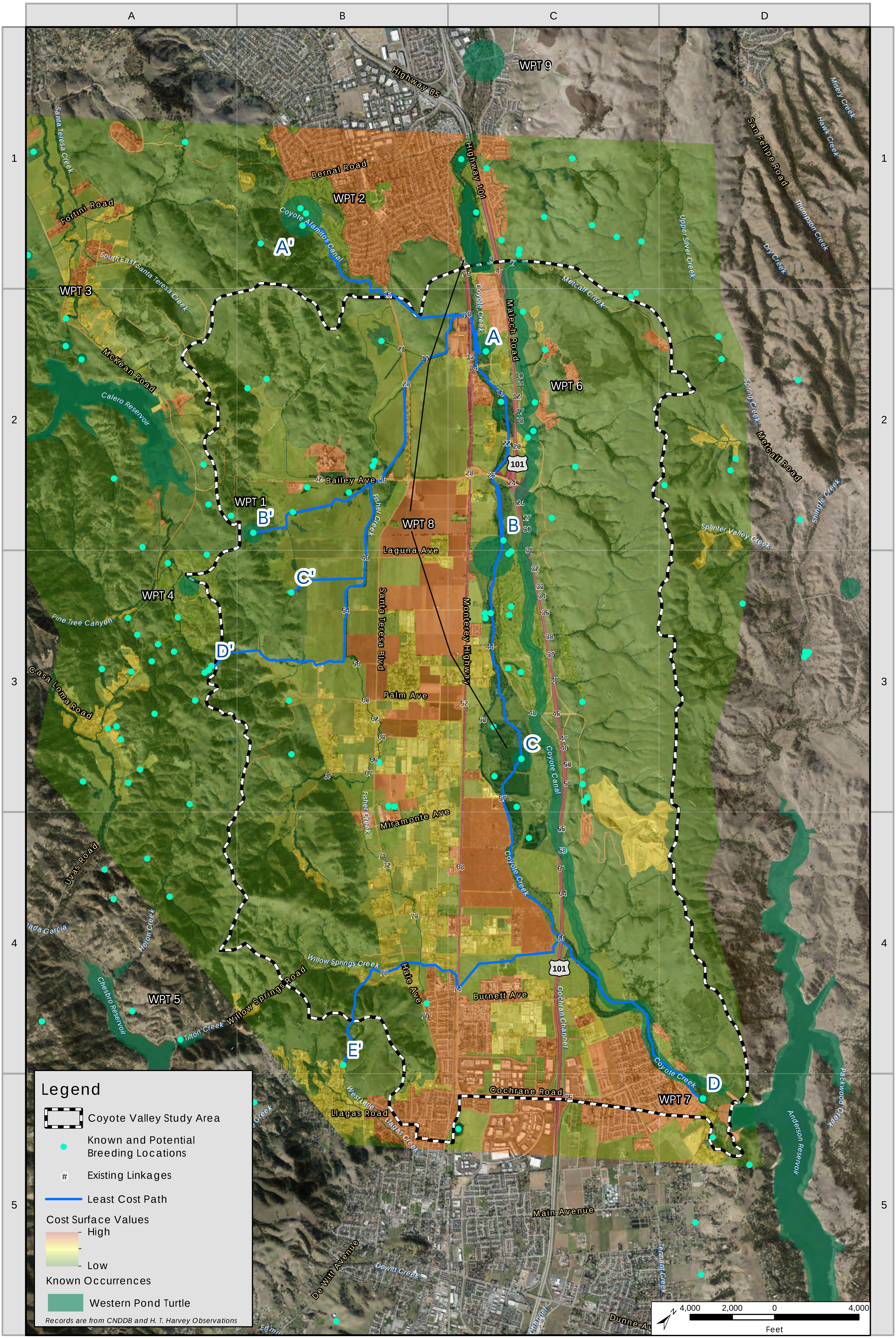

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Figure 5c. Western Pond Turtle Cost Surface with Least Cost Pathways

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

January 2020

where WPT have been recorded in occurrence WPT 2 (point A to point A' of Figure 14). The pathway follows Coyote Creek downstream to Fisher Creek; uses the Fisher Creek culvert to cross under Monterey Road (linkage number 8) and the Union Pacific Railroad tracks (linkage number 9); then soon exits Fisher Creek to traverse upland grassland to the typically dry Coyote-Alamitos Canal, crossing under Santa Teresa Boulevard through a culvert for this canal (linkage number 15), then traveling mostly in the canal to the golf course, where it exits the canal and travels overland to the pond at point A'.

This pathway is approximately 2.5 mi long at a relative cost of 17891, and is the least cost pathway from point A to any point on the west side of the study area and from point A' to any point on the east side of the study area. The two endpoint ponds represent the closest ponds on the east side of the valley (albeit, still on the west side of Highway 101) and the west side of the valley that are known to support WPT. At a distance of 2.5 mi, this northern pathway may be beyond the dispersal capabilities of WPT. In addition, even though the cost is relatively low, because much of this pathway relies on long-distance WPT movement over upland grassland, dry canal, and golf course habitats, it is unlikely that any WPT would actually select this pathway due to the propensity of this species to remain close to water. Therefore, it is unlikely that dispersal between the Santa Teresa Golf Course pond and the Coyote Ranch pond is currently feasible for WPT.

3.2.7.2 WPT LCPA Pathway 2

This LCPA pathway (Figure 34) is from point B', the closest pond in the study area west of the valley where WPT have been recorded in occurrence WPT 1, to point A, the Coyote Ranch Pond, which is the same starting point as in WPT LCPA 1 (point B' to point A of Figure 14). The pathway travels northeast across oak savanna and upland grassland, then a short distance across moderate agriculture to the western most Sobrato Pond; it leaves the pond through a ditch traveling northeastward to Fisher Creek at the northwest side of Spreckels Hill; the pathway travels through Fisher Creek, first under Bailey Avenue via a culvert (linkage number 36) then under Santa Teresa Boulevard via a second culvert (linkage number 23); the pathway continues downstream to a culvert under the Union Pacific Railroad tracks and Monterey Road (linkage number 9 and 8, respectively), then to the confluence with Coyote Creek, where it turns southeastward and upstream to Coyote Ranch Pond.

At a cost of 21922, this pathway has the lowest cost for a WPT to travel from point B' to any point on the eastern side of the study area. At a distance of 3.8 mi, this pathway may be beyond the dispersal capabilities of WPT, and the relative cost is higher than for WPT LCPA pathway 1. However, the majority of the pathway follows aquatic habitat (along Coyote Creek, Fisher Creek, wet ditches, and a pond west of Fisher Creek), and the traverse of upland habitat at the west end of this pathway is relatively short. As a result, it is possible for a WPT to follow this pathway. However, due to the distance between known occupied ponds on the east and west sides of the valley, it is more likely that any cross-valley dispersal would occur over generations. Such dispersal of genetic information is feasible, as WPT could use Fisher Creek or multiple ponds on the valley floor as aquatic habitat, potentially nesting in adjacent uplands (if not disturbed by agricultural activities), so that over time, genetic information could be shared across the valley as individuals move along Fisher Creek. However, because WPT have not been observed in Fisher Creek or in any of the ponds in the vicinity of former golf course (a.k.a. Sobrato Ponds), it is unknown whether enough WPT are present within the northern valley floor that individuals do disperse through this part of the valley.

3.2.7.3 WPT LCPA Pathway 3

This LCPA pathway (Figure 35) is from point C', a pond in the study area just south of the western end of Laguna Avenue, to point A, the Coyote Ranch Pond (point C' to point A of Figure 14). This pathway begins the same as CRLF LCPA pathway 4 (in section 3.2.5.4) to Spreckels Hill; from here the pathway is the same as WPT LCPA pathway 2 above to Coyote Ranch Pond. This pathway is approximately 4.1 mi long and, at a cost of 22912, has the lowest cost for a WPT to travel from point C' to any point on the east side of the study area (Table 6).

3.2.7.4 WPT LCPA Pathway 4

This LCPA pathway (Figure 36) is from point D', the closest of three ponds to the mid-western border of the study area, to point A, the Coyote Ranch Pond (point D' to point A of Figure 14). The pathway begins the same as CRLF LCPA pathway 5 (in section 3.2.5.5) to Spreckels Hill; from here the pathway is the same as WPT LCPA pathways 2 above to Coyote Ranch Pond. This pathway is approximately 5.7 mi long and, and at a cost of 32244, has the lowest cost for a WPT to travel from point D' to any point on the east side of the study area (Table 6).

3.2.7.5 WPT LCPA Pathway 5

This LCPA pathway (Figure 37) is from point B, an area of known occurrence in Coyote Creek just northwest of the Coyote Creek Golf Course in the occurrence cluster WPT 8, to point A', a pond on the Santa Teresa Golf Course (point B to point A' of Figure 14). The pathway follows Coyote Creek downstream to the confluence with Fisher Creek; from here the pathway is the same as WPT LCPA pathway 1 above to the pond on the Santa Teresa Golf Course. At a cost of 27582 and a distance of approximately 4.4 mi, this pathway has the lowest cost from point B to any point on the west side of the study area.

3.2.7.6 WPT LCPA Pathway 6

This LCPA pathway (Figure 38) is from point C, an area of known occurrence at the Ogier Ponds in the occurrence cluster WPT 8, to point A', a pond on the Santa Teresa Golf Course (point C to point A' of Figure 14). The pathway follows Coyote Creek downstream to the confluence with Fisher Creek; from here the pathway is the same as WPT LCPA pathway 1 above to the pond on the Santa Teresa Golf Course.

At a cost of 38972 and a distance of approximately 6.5 mi, this pathway has the lowest cost from point C to any point on the west side of the study area (Table 6). It is important to note that this pathway and all the previously discussed pathways utilize Fisher Creek where it crosses under Monterey Road and the Union Pacific Railroad tracks in the north of the study area (linkage numbers 8 and 9, respectively). We suggest that this is because the median along Monterey Road and the extensive amount of intensively cultivated agriculture force the pathways northward where costs to dispersal are lower for WPT as illustrated in Figure 15.

3.2.7.7 WPT LCPA Pathway 7

This LCPA pathway (Figure 39) is from point E', a pond outside and south of the southwest edge of the study area, to Point C, an area of known occurrence at the Ogier Ponds (point E' to point C of Figure 14). From point E' to Coyote Creek, this pathway is the same as CRLF LCPA pathway 8 (in section 3.2.5.8); from here the pathway travels through Coyote Creek northwestward to point C at the Ogier Ponds.

With a distance of approximately 3.8 mi and a cost of 46772, this pathway has the lowest cost for a WPT to disperse from point E' to any point on the east side of the study area (Table 6). However, even though the distance is comparable with WPT LCPA pathway 2, the cost is much higher because most of this pathway traverses upland areas, rather than watercourses. It is therefore highly unlikely that this pathway would ever be "discovered" by a WPT, as no WPT would know that this is the least cost pathway between potential breeding sites on either side of the valley. Monterey Road in particular would represent a nearly impassable barrier for WPT dispersal along this pathway. Rather, this pathway is depicted for the purpose of demonstrating that cross-valley dispersal by WPT in the southern Coyote Valley is likely infeasible.

3.2.7.8 WPT LCPA Pathway 8

This LCPA pathway (Figure 40) is from D, an area of known occurrence along Coyote Creek below Anderson Dam in occurrence WPT 7, to point E', the same pond outside and south of the southwest edge of the study area as in WPT LCPA pathway 7 above (point D to point E' of Figure 14). The pathway follows Coyote Creek downstream to the Highway 101 Coyote Creek overcrossing (linkage number 66); from here the pathway is the same as WPT LCPA pathway 7 above.

At a cost of 48904, this pathway provides the lowest cost for a WPT to travel from point D to any point on the west side of the study area (Table 6). However, at a distance of approximately 5.2 mi, this pathway is beyond the maximum dispersal distance known for any individual WPT. In addition, as with WPT LCPA pathway 7 above, this pathway would most likely not be used by WPT due to the unconducive land cover types that WPT must traverse.

In summary, the LCPA analyses for WPT dispersal across Coyote Valley suggest that dispersal across the valley is highly unlikely to be occurring under existing conditions, at least by single individuals. Due to distances between ponds on either side of the valley, the lack of intervening high-quality breeding habitat that may serve as "stepping stone" populations, low habitat quality in intervening land uses, and the lack of any suitable crossings of Monterey Road, WPT dispersal across the valley is completely infeasible under existing conditions in middle and southern Coyote Valley. At the northern end of the valley, the distance between known and suitable aquatic habitat areas is less, and the presence of aquatic habitat (along Fisher Creek in particular) allows for a higher probability of successful dispersal across the valley, given that dispersing WPT are most likely to remain close to aquatic habitat. Due to the distances between suitable habitat on either side of the valley, individual WPT likely cannot disperse across the valley. However, cross-valley exchange of genetic information could occur over generations, as WPT could use Fisher Creek or multiple ponds on the valley floor as aquatic habitat, potentially nesting in adjacent uplands, so that over time, genetic information could be shared across the valley as individuals move along Fisher Creek.

Section 4. Data Gaps, and Recommendations to Increase Populations and Improve Connectivity

4.1 Data Gaps

In the process of performing our analysis, we identified several data gaps that, if filled, would inform the assessment of potential movements by the focal species within and across Coyote Valley. The data gaps that would be most important to fill, and that could be feasibly filled with further surveys, involve determining whether these species occur in (and in the case of CTS and CRLF, breed in) certain waterbodies. The locations where further surveys would be most important in informing this evaluation are as follows.

4.1.1 California Tiger Salamander

Larval CTS surveys to determine current population and breeding status would be worthwhile at several ponds that have not been previously surveyed or where there are previous, but older, occurrences and where an update on occupancy and breeding status would be useful. These ponds are listed below:

- Ponds associated with CTS 3, particularly PBS 5 (as it was created as a potential breeding pond for CTS), and the nearby PBS 4
- Ponds associated with CTS 4, including the Sobrato Ponds south of Bailey Avenue
- The pond associated with CTS 7
- Potential breeding sites 6, 7, and 9
- Laguna Seca

4.1.2 California Red-legged Frog

Surveys of adults, larvae, and/or metamorphs to determine current population and breeding status would be worthwhile at several ponds that have not been previously surveyed or where there are previous, but older, occurrences and where an update on occupancy and breeding status would be useful. These ponds are listed below:

- Sobrato Ponds (PBS 10), particularly the most eastern one
- Two ponds northwest of Bailey Avenue, west-northwest of the IBM campus (PBS 7)
- The pond in Santa Teresa County Park northwest of study area (pond associated with CRLF 6 of Figure 4 and Table 1 in Appendix A)
- Three stock ponds of PBS 11 where CTS have been documented

- Any of the approximately 20 ponds of PBS 13 outside of and between the western border of the study area and McKean/Uvas Road

4.1.3 Western Pond Turtle

Surveys for WPT in the same ponds listed above for CRLF would improve information on the occurrence of WPT. In addition, surveys of Fisher Creek and the Laguna Seca drainage channel would provide information on the degree to which this species occurs in those areas.

What would be even more valuable, in terms of information on movement by these species, would be observations of dispersing individuals.

4.2 Findings—Enhancement Recommendations

We have identified recommendations for habitat enhancement that would have two objectives:

(1) to make existing least cost pathways (i.e., those pathways that were addressed by our analysis) more feasible by improving habitat conditions, improving connectivity across impediments, and introducing breeding locations/aquatic habitats in more areas between the east and west sides of the valley to increase the potential for dispersants to actually find areas of connectivity.

(2) to enhance habitat and connectivity in strategic locations to provide new, shorter, feasible pathways through the valley.

For all three species, it would be extremely difficult to achieve dispersal across the middle and southern portions of Coyote Valley, even with new land acquisitions and installation of new crossings to allow individuals to traverse Monterey Road. South of the Palm Avenue/Kalana Avenue area, where there is extensive agricultural-industrial land use, it is unlikely that land uses could be changed in sufficient locations on both sides of Monterey Road and across the valley to provide room for the suitable aquatic "stepping stones" necessary for cross-valley dispersal (either by individuals or over multiple generations) to be feasible. Hydrology to allow for construction of new ponds may also not be available in these areas in sufficient quantity for stepping stones to be constructed.

In the areas from the Palm Avenue/Kalana Avenue area north to the Richmond Avenue/Laguna Avenue area, there is less development, and land acquisition could potentially be more feasible. In these areas, dispersal by the focal species could be enhanced if:

- new ponds could be constructed across the valley, providing stepping stones for movement of individuals and genetic exchange;
- breeding habitat (especially for CTS and CRLF, which may not currently breed or regularly occur on the east side of the middle valley in the vicinity of the Coyote Creek Golf Club) could be provided or enhanced on the east side of the valley; and
- suitable under- or over-crossings of Monterey Road were provided.

However, all of those enhancements would be necessary for the focal species to be able to cross middle Coyote Valley between the Palm Avenue/Kalana Avenue area and the Richmond Avenue/Laguna Avenue area, necessitating considerable land acquisition and cost.

The most feasible means of improving the potential for movement of individuals of the focal species would be located in the northern part of the valley, north of Laguna Avenue, because less infrastructure would be required for navigating dispersal impediments. Therefore, our primary recommendations focus on that area.

4.2.1 California Tiger Salamander

Following are recommendations for enhancements that can be made to facilitate movement of CTS (individuals and/or genetic exchange) in northern Coyote Valley:

- Pond enhancement and creation—if conditions along this path can be made more conducive for CTS occupation and breeding, then CTS are more likely to disperse through this pathway, even if only over generations. One way to enhance conditions is to provide breeding habitat (ponds) spaced at distances that CTS are more likely to disperse (within 1.3 mi, and preferably much closer) so that each of these ponds become sources of dispersal. Enhancing existing habitat and/or creating new habitat for breeding could occur near or at the following locations:
    - If it is determined that CTS are not breeding in the Sobrato Ponds, then the possible reason why they are not breeding should be investigated and mitigated (e.g., removal of predatory fish and bullfrogs).
    - Similarly, if CTS are not breeding in Laguna Seca, measures could be taken to improve habitat suitability for breeding (e.g., by removing predators and/or creating deeper pools within the broader Laguna Seca area that would pond longer, if hydroperiod in the larger lake is unsuitable for successful breeding.
    - Multiple ponds could be created at the bases of draws from the foothills west of Laguna Seca.
    - There is an existing seep, which may be an old stock pond, on the northeast side of Tulare Hill just south of the west end of Metcalf Road. Adequate hydrology is likely present to allow for construction of a pond at this location.
    - If hydrology is suitable for CTS pond creation at the lower ends of any other draws on the northeast and east side of Tulare Hill (e.g., two drainages across Fisher Creek from the Metcalf Energy Center), ponds created in those areas could provide stepping stones east of Laguna Seca.
    - The triangular area bounded by Santa Teresa Boulevard, Fisher Creek, and the Laguna Seca drainage channel would likely support a pond if excavated down to groundwater, and would be a potential location for a new pond.
- Conversion of agricultural fields to CTS upland habitat—upland habitats that are currently occupied by agricultural activities could be converted to annual grassland (grazing land) so that they are repopulated by burrowing rodents (particularly ground squirrels) to provide refugia for dispersing CTS. Improving upland habitat around and between existing and new/enhanced breeding ponds would allow CTS populations to increase and expand in, and would improve movement within, the northern part of the study area.

- Existing linkage enhancement and new linkage construction—even with the creation of breeding ponds to create a stepping stone of breeding sources through the study area, and converting upland around these ponds to be more conducive to dispersal and occupation, CTS may still not be able to disperse through the study area because of the five major impediments to dispersal. In particular, the "bottleneck" formed by Highway 101, Coyote Creek, Monterey Road, and the railroad tracks would be very difficult to improve to allow CTS to cross through this area. The only effective means of encouraging CTS dispersal through that area is to have ponds supporting CTS breeding populations as close as possible on the west side of the railroad tracks and east side of Highway 101 and enhance infrastructure between those ponds to allow some CTS to be able to successfully move between the ponds. Following are our recommendations for enhancement of linkages across the five major impediments to dispersal of CTS.
    - Highway 101—CTS need to be able to reach and move along Metcalf Road for them to be able to effectively cross Highway 101 (and Coyote Creek, discussed below). Mechanisms for improving dispersal, such as widening Metcalf Road to provide a wildlife-friendly dispersal area (e.g., a "sidewalk" on the overcrossing, with refugia for small animals such as CTS) should be explored. It may also be necessary to create a stepping stone pond closer to Metcalf Road on the east side of Highway 101, and an exclusion barrier to keep CTS off Metcalf Road and Highway 101 and guide them from that pond to the wildlife-friendly overcrossing.
    - Coyote Creek—the wildlife-friendly overcrossing along Metcalf Road described in the previous bullet could be extended over Coyote Creek, with a low exclusion barrier to funnel animals along Metcalf Road and prevent them from wandering into Coyote Creek or the Metcalf Ponds/Parkway Lakes.
    - Monterey Road—if CTS are to cross Highway 101 and Coyote Creek along Metcalf Road, some means of funneling them (e.g., through undercrossings) across Monterey Road and the railroad tracks would be necessary. Opportunities for creating undercrossings should be explored; exclusion barriers to funnel CTS to this undercrossing may be needed. To improve the potential for CTS to use such an undercrossing, a stepping stone pond could be constructed in the swale on the northeast side of Tulare Hill (described above) to establish a breeding population in that area, and upland habitat could be enhanced as needed. Wildlife under or overcrossings of Monterey Road have been proposed for the High Speed Rail project (see Figure 6). Least cost path analyses that included these proposed crossings slightly changed some of the pathways for this species (e.g., CTS LCPA pathway 4, which utilized HSR-4 to avoid crossing Monterey Road at the Bailey Avenue intersection and then crossing Bailey Avenue north to land cover type with less cost; see Figure 41 in Appendix B).
    - Santa Teresa Boulevard—exclusion barriers on both sides of the road could be constructed to guide CTS (and CRLF and WPT) to suitable crossings. These may be new undercrossings or the existing undercrossing that receives water from Laguna Seca. However, whether to install exclusion barriers must be weighed carefully against the benefits of potential overland dispersal of other species, however.
    - Bailey Avenue—exclusion barriers on both sides of the road could be constructed to guide CTS to proper crossings, at least where curbs are present. These may be new undercrossings or the existing undercrossing east of the IBM campus.

Although the most feasible means of encouraging cross-valley gene flow for CTS involve enhancements in the northern part of the valley, it is important that subpopulations in the foothills of the middle and southern Coyote Valley be connected to subpopulations in the northern valley so that, over generations, genes can flow among all these subpopulations. To accomplish that, additional ponds could be constructed in suitable locations along the base of the west slope of Coyote Ridge to link CTS breeding near Anderson Dam with those near Metcalf Road, and new ponds could be constructed along the western side of the valley to provide similar stepping stones that allow north-south dispersal. These ponds should consist of a mix of seasonal ponds that support hydrology suitable for breeding by CTS and ponds with longer ponding duration (including perennial ponds) to support breeding and nonbreeding aquatic habitat for CRLF, as well as aquatic habitat for WPT.

4.2.2 California Red-legged Frog

Following are recommendations for enhancements that can be made to facilitate movement of CRLF (individuals and/or genetic exchange) in northern Coyote Valley:

- In addition to the recommendations for CTS above, we recommend that Fisher Creek be improved for occupation by CRLF. Fisher Creek is the only water course that traverses through the study area to connect the drainages on the western side of the study area to Coyote Creek and ultimately the drainages on the eastern side. However, at present much of Fisher Creek is channelized through moderate agricultural land use reducing its value as a movement corridor for CRLF. Improvements to Fisher Creek could include:
    - Recontouring the creek to allow it to become a more natural meandering creek, also include side pools and deeper in-stream pools.
    - Acquisition of land adjacent to the creek and changing this land cover into more natural undisturbed upland habitat. Typically 300 ft buffers are preferred on each side of a creek corridor to allow for upland use by CRLF.
- New linkage construction across Monterey Road—in examining wildlife under or overcrossings of Monterey Road that have been proposed for the High Speed Rail project, we have identified a few crossings that slightly changed some of the pathways for this species (e.g., CRLF LCPA pathway 3, which utilized HSR-4 to avoid crossing Monterey Road at the Bailey Avenue intersection and then crossing Bailey Avenue north to land cover type with less cost; see Figure 42 in Appendix B).
- It is our opinion that Coyote Creek is an important dispersal corridor for CRLF but is being diminished in its capacity to facilitate dispersal by the presence of nonnative aquatic predators.
    - We recommend that a bullfrog eradication or reduction program be considered for Coyote Creek and other hydrologically connected and nearby aquatic habitats. During surveys since 2012 of Coyote Creek, Coyote Canal, and Sobrato Ponds, H. T. Harvey & Associates has reported observations of large healthy populations of bullfrogs in these aquatic systems. Bullfrogs are known predators of, and competitors with, CRLF. It is our assumption that the lack of CRLF observations in Coyote Creek through the study area in 2019 (H. T. Harvey & Associates 2019b) is due to this abundance of bullfrogs.

- o We also recommend that Coyote Creek be surveyed for the presence of nonnative predatory fish. During surveys in 2019, several observations of carp were reported in the creek (H. T. Harvey & Associates 2019b). If it is determined that large populations of nonnative predatory fish are present, then an eradication program may need to be considered.

4.2.3 Western Pond Turtle

In addition to the recommendations above for CTS and CRLF, we include additional recommendations for enhancements that can be made to facilitate movement of WPT (individuals and/or genetic exchange) in northern Coyote Valley:

- As for CRLF, we believe that Fisher Creek can be an important dispersal corridor for WPT to disperse across the study area but currently is not due to a drop structure at the eastern end of the culvert for Fisher Creek under Monterey Road that possibly prevents WPT from being able to enter Fisher Creek from Coyote Creek. We recommend that the drop structure be removed or reconfigured in a way to allow WPT to more easily access Fisher Creek from Coyote Creek.
- New linkage construction across Monterey Road—in examining wildlife under or overcrossings of Monterey Road that have been proposed for the High Speed Rail project, we have identified a few crossings that, at lower costs, dramatically changed some of the pathways for this species. For example, WPT LCPA pathway 6 utilized HSR-9 to cross Monterey Road further south in the study area instead of traveling to the northern part of the valley before crossing to the west side (compare Figure 38 with Figure 43 in Appendix B). The distance of approximately 2.9 mi from point C to C' in this new LCPA pathway is 45% shorter than the approximately 6.5 mi from point C to A' in the original LCPA pathway. However, the new cost of 35267 is only 9.5% lower than the original cost of 38972, indicating that, even with newly constructed crossings further south in the study area provided by the High Speed Rail project, the improvement for WPT dispersal across the valley may be only marginal.
- We recommend that when considering constructing any exclusion barrier at culverts for Fisher Creek to cross under roads or at other undercrossing under roads, such as Monterey Road, Santa Teresa Boulevard, and Bailey Avenue for the purpose of funneling CTS or CRLF into these undercrossings, that these exclusion barriers are also constructed to funnel WPT away from the roads and into these undercrossings. A deceased WPT was recently observed on Monterey Road near the Fisher Creek culvert (Santa Clara County Wildlife Corridor Technical Working Group, Coyote Valley Subcommittee 2019), indicating that the WPT attempted to cross the road possibly because it was unable to enter the culvert due to the drop structure.

For all three species, we recommend that a monitoring program be established to determine the effectiveness of any measures implemented to enhance habitat and/or connectivity. For example, if breeding and/or aquatic foraging habitat is enhanced or new breeding/aquatic foraging habitat is created, this habitat should be periodically surveyed to determine if it being used, and to what degree it is being used, by these species and if not, to investigate the possible causes for nonuse. Including in this monitoring program could be the use of camera traps designed for detecting small ectotherm vertebrates, such as CRLS, CTS, and WPT (Hobbs and

Brehme 2017), which could be strategically placed along exclusion barriers and at entrances to linkages to determine whether or not these exclusion barriers and linkages are functioning properly to facilitate individuals of these species crossing barriers and impediments.

We understand that several of these recommendations may be challenging to achieve, and would require additional coordination among several public and private entities, including federal and state agencies to determine which recommendations may be achievable and which recommendations may provide the greatest effect in helping the species cross the valley.

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Appendix A. Tables 1-6.

Table 1. CTS Occurrences in and around Study Area

Occurrence	Details	Source
CTS 1	Adult on road at top of dam in winter of 2001 (CNDDB Occ. #651); CTS in weep hole in floor of dam spillway in 2011 (SCVWD 2012); CTS in drain near top of boat ramp on March 4, 2016 (SR); deceased juvenile in Main Avenue Percolation Ponds and two adults in upland east of Hendry Drive in 2010 (H. T. Harvey & Associates 2012a); CTS breeding in pond approximately 0.3 mi east of dam (0.1 mi east and outside of study area) in April of 2002 (CNDDB Occ. #718).	CNDDB 2019; SCVWD 2012; H. T. Harvey & Associates 2012a; S. Rottenborn (pers. obs.)
CTS 2	MVZ specimen (MVZ 31854) collected from "Madrone" with associated geocoordinates 37.150321° -121.667036°[5], placing it along Madrone Parkway at south end of Taylor Avenue in 1931 (CNDDB Occ. #42). Locality for CAS specimen (CAS 187394) collected in 1981 also associated with CNDDB Occ. #42 was misidentified in CNDDB thus moved to CTS 3.	CNDDB 2019; MVZ database
CTS 3	CAS specimen (CAS 187394) collected from "Coyote Creek at Madrone, above Riverside Golf Course" with geocoordinates of 37.198192° -121.706800°[6] in 1981 (CNDDB Occ. #42), placing it within Coyote Creek Golf Course; larval specimen (CAS 203271) collected in 1996 from fairway pond on Coyote Creek Golf Club[7] (CNDDB Occ. 559).	CNDDB 2019; CAS database
CTS 4	Series of three larvae and one egg (CAS 207140) collected from stock pond 0.40 mi directly east of junction of Bailey Avenue and McKean Road in 1997 (CNDDB Occ. #429); series of five larvae and 12 eggs (CAS 207141) collected from stock pond 0.63 mi directly east of junction of Bailey Avenue and McKean Road in 1998 (CNDDB Occ. #425); several eggs in stock pond at base of hill 0.2 mi southeast of western end of Laguna Avenue in 1998 (CNDDB Occ. #428); several eggs in six-acre pond at bottom of canyon 0.5 mi south of western end of Laguna Avenue (CNDDB Occ. #426); adult female (CAS 207109) collected along edge of abandoned golf course pond (a.k.a. middle Sobrato Pond) on south side of Bailey Avenue 0.85 mi southwest of intersection of Bailey Avenue and Santa Teresa Boulevard in 1998 and observation of one larva in same pond in spring of same year (CNDDB Occurrence #427); adult male (CAS 203229) collected in 1996 and larva observed in 2012 from stock pond immediately north of Cinnabar Hills Golf Course and 0.34 mi east of McKean Road (CNDDB Occ. #558); adult female (CAS 203219) collected from McKean Road in 1997 (CNDDB Occ. #557); adult male and adult female in general location of Cinnabar Golf Course in 1996 (CNDDB Occ. #556); two larvae in stock pond 0.2 mi east of intersection of Bailey Avenue and McKean Road in 1998 (CNDDB	CNDDB 2019; CAS database; H. T. Harvey & Associates 2000a

[5] http://portal.vertnet.org/o/mvz/amphibian-and-reptile-specimens?id=http-arctos-database-museum-guid-mvz-herp-31854-seid-819637
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[7] http://researcharchive.calacademy.org/research/herpetology/catalog/index.asp?xAction=getrec&close=true&CatalogNo=CAS+203271

Occurrence	Details	Source
	Occ. #430); three adults observed in grassland near western end of western most Sobrato Pond on February 13, 2000 by H. T. Harvey & Associates (H. T. Harvey & Associates 2000a).	
CTS 5	Larvae and adults from four ponds and one wetland east of Highway 101 and north of Metcalf Road just north of study area in 1999, 2000, 2011, and 2017 (CNDDB Occ. #563, 1273; LSA 2014; Jennings 2017) and adults translocated from housing development near these ponds in 2003 and 2004.	CNDDB 2019; LSA 2014; Jennings 2017
CTS 6	Hundreds of larvae, juveniles, and adults in 14 ponds and intervening upland habitat on decommissioned UTC facility from 2005 to 2017 (CNDDB Occ. #111, 1056, 1057, 1058, 1059, 1060, 1072, 1075, 1076, 1108, 1274, H. T. Harvey & Associates 2005, BBL 2006).	CNDDB 2019; H. T. Harvey & Associates 2005; BBL 2006
CTS 7	Larvae in stock pond approximately 0.35 mi northwest of northern boundary of study area on western side in 1992 (CNDDB Occ. #1272).	CNDDB 2019
CTS 8	Larvae in three ponds approximately 1.6 mi west of, and on opposite side of McKean Road from, northwestern border of study area in 1998 (CNDDB Occ. #450) and in 2016-2018 (H. T. Harvey & Associates 2018).	CNDDB 2019; H. T. Harvey & Associates 2018
CTS 9	Adult (CAS 187404) found dead on road near Chesbro Reservoir, approximately 1 mi south of southwestern portion of study area (CNDDB Occ. #540).	CNDDB 2019; CAS database
CTS 10	CTS larvae observed in one or more stock ponds approximately 1.8 mi south of southern portion of study area (CNDDB Occ. #1234).	CNDDB 2019

Table 2. CRLF Occurrences in and around Study Area

Occurrence	Details	Source
CRLF 1	At least two observations of CRLF within pool of incised creek and nearby created pond within creek (CNDDB Occ. #620); observations of one adult in northern in-channel pool and tadpoles in southern in-channel pool of Coyote Canal in 2012 (H. T. Harvey & Associates 2012, CNDDB Occ. #1525); observations of tadpoles in stock pond (UTC-9) in 2005, two adults and one juvenile in seasonal drainage near Coyote Canal in 2011, and one adult and 20 tadpoles in in-channel pool of Coyote Canal in 2012 (H. T. Harvey & Associates 2012, CNDDB Occ. #1117); observation of more than 10 tadpoles in stock pond (UTC-10) in 2005 and 2006 (CNDDB Occ. #1118).	CNDDB 2019; H. T. Harvey & Associates 2012
CRLF 2	Observations of CRLF adults, juveniles, tadpoles, and egg masses in one of multiple large in-channel ponds of Coyote Creek in 2002 and 2003 (CNDDB Occ. #620); series of observations of CRLF adults and tadpoles from and near mitigation ponds and wetland on both sides of Coyote Creek Golf Club Drive from its overcrossing of Highway 101 to entrance to Kirby Canyon Landfill (ponds were established as breeding ponds for CRLF), and in ditches and drainages within Caltrans right-of-way along both northeast and southwest side of Highway 101, and in Coyote Canal at culvert under Highway 101 at southwest edge of landfill from 1980 to 2017 (H. T. Harvey & Associates 2012, CNDDB Occ. #538); observation of adult within drainage on slopes just north of Kirby Canyon Landfill in 2000 (CNDDB Occ. #537); observation of juvenile within small drainage at top of slopes, approximately 1.4 mi northeast of overcrossing of Coyote Creek Golf Club Road at Highway 101 in 2015 and 2016 (H. T. Harvey & Associates 2015, CNDDB Occ. #1462); observation of adult within drainage on slopes, approximately 0.6 mi northeast of overcrossing of Coyote Creek Golf Club Road at Highway 101 in 2015 (H. T. Harvey & Associates 2015, CNDDB Occ. #1526).	CNDDB 2019; H. T. Harvey & Associates 2012; H. T. Harvey & Associates 2015
CRLF 3	Voucher specimen (CAS 238596) collected from "stock pond in tributary to Coyote Creek, about 0.80 miles northwest of Metcalf Road between the abandoned Evergreen Canal and Hwy 101" in 1999, and adult detected calling in "small lake within Coyote Creek drainage…adjacent to Hwy 101" in 2011 (CNDDB Occ. #553; this is one of the Parkway Lakes); tadpoles observed in pond at this approximate locality in 2011 (LSA 2014); eight juveniles and four adults observed in same pond in 2017 (Jennings 2017); voucher specimen (CAS 211720) collected from "stock pond, 0.6 miles northwest of Metcalf Road and the abandoned Evergreen Canal crossing" in 2000 (CNDDB Occ. #564); CRLF tadpoles observed in stock pond approximately 0.07 mi southeast of geocoordinates for CNDDB Occ. #564 in 2011 (LSA 2014); multiple CRLF observed in stock pond at southeast end of housing development, approximately 0.05 mi northeast of Highway 101 in 1999 (CNDDB Occ. #556); multiple observations of at least 5 adults (in one observation in 2000) in Coyote Creek Canal on southeast side of Metcalf Road in Metcalf Canyon in 1980, 1984, 1989, and 2000 (CNDDB Occ. #419).	CNDDB 2019; CAS database; LSA 2014; Jennings 2017
CRLF 4	Observations of over 41 adults, 20 juveniles, 327 tadpoles, and several egg masses within Las Animas Creek and Shingle Valley Creek, about six mi north of Morgan Hill in 1989, 2005, 2006, 2007, 2009, 2010, 2011, and 2016 (CNDDB Occ. #21); observations of one larva and several egg masses in artificial pond (UTC-6), 0.25 mi east of Las Animas Creek and San Felipe road, 1.1 mi north of Anderson Lake in 2005 and 2006 (CNDDB Occ. #972); observations of 20 adults, 26 juveniles, and eight tadpoles in vicinity of Las Animas Creek, from about 1.4 to 2.1 mi north northwest of Anderson Lake in 2005, 2006, 2010, 2011,	CNDDB 2019

Occurrence	Details	Source
	2016, and 2017 (CNDDB Occ. #973); observations of approximately 36 adults, 30 juveniles, over 300 tadpoles, and five egg masses in vicinity of Shingle Creek and Shingle Valley Road from about 0.1 to 0.7 mi southeast of Metcalf Road junction, southeast of San Jose, including pond UTC-PWR-4, in 2005, 2006, 2007, 2009, 2010, 2011, 2016, and 2017 (CNDDB Occ. #975); observations of one adult and one juvenile in wetland #207, 1.1 air mi east southeast of intersection of Metcalf Road and Shingle Valley Road, east of Shingle Valley in 2007 and 2011, respectively (CNDDB Occ. #1094); observations of over 33 adults, 34 juveniles, 16 tadpoles, and three egg masses in stock pond on hillside and Pond UTC-8, 1 mi west northwest of intersection of Metcalf Road and Shingle Valley Road, east of San Jose in 2005, 2006, 2011, 2016, and 2017 (CNDDB Occ. #1116); observation of three tadpoles in Pond UTC-14, 1.4 mi southeast of intersection of Metcalf Road and Shingle Valley Road, east of San Jose in 2006 (CNDDB Occ. #1119); observations of over 100 tadpoles from each of two stock ponds (UTC-16, 17), 1.65 mi south southeast of intersection of Metcalf Road and Shingle Valley Road, east of San Jose in 2006 (CNDDB Occ. #1120); observation of one larva in Pond UTC-15, 1.0 mi south southwest of intersection of Metcalf Road and Shingle Valley Road, east of San Jose in 2007 (CNDDB Occ. #1121); observation of 10 tadpoles stock pond (UTC-20), 0.9 mi east southeast of intersection of Metcalf Road and Shingle Valley road, east of San Jose in 2007 (CNDDB Occ. #1122); observations of one juvenile and one adult in seasonal pond, approximately 0.3 mi southwest of Metcalf Road at Shingle Valley Road and 2.0 mi northeast of Highway 101 at Baily Avenue, east of Motorcycle County Park in 2009 and 2011, respectively (CNDDB Occ. #1527); observations of four adults and 40 tadpoles in pools with creek in vicinity of Shingle Valley road, from about 1.0-1.25 mi southeast of Metcalf Road junction, east of Coyote Ridge Preserve in 2011 (CNDDB Occ. #1528).	
CRLF 5	Observation of juveniles around Rosendin Pond in Anderson Lake County Park. On August 15 and 21, 2010, five or more juveniles were observed in wetland vegetation around the edges of this pond (S. Rottenborn, pers. obs.). Myriad bullfrogs were also present here. Given the presence of juvenile CRLF and the absence of more suitable breeding habitat elsewhere in the vicinity, it is likely that CRLF bred here, and successfully, despite the abundance of bullfrogs. This pond is seasonal in most years.	
CRLF 6	Unknown number and age class of CRLF observed from pond in Santa Teresa County Park on south side of golf course within park in 1969 (CNDDB Occ. #1524), approximately 0.5 mi northwest of study area.	CNDDB 2019
CRLF 7	Unknown number and age class of CRLF observed from pond stated as "duck pond Vierra Ranch at the base of Calero Reservoir … pond may no longer be extant" (CNDDB Occ. #1523). Exact locality unknown and geocoordinates place locality among development northwest of, and adjacent to, McKean Road approximately 1.1 mi west of northwestern part of study area.	CNDDB 2019
CRLF 8	Adult observed within pool in Cherry Creek, approximately 0.6 mi upstream of Calero Reservoir, adjacent to Cottle Trail in Calero County Park in 1998 (CNDDB Occ. #254). Record just over 2 mi west of northwestern part of study area.	CNDDB 2019
CRLF 9	Unknown number and age class of CRLF observed from cattle tank near McKean Road, about 0.4 mi southeast of the Casa Loma Road intersection in 1969 (CNDDB Occ. #1529). Six ponds within 0.38 mi of geocoordinates for record, which may provide breeding and foraging habitat for CRLF.	CNDDB 2019

Occurrence	Details	Source
CRLF 10	Multiple individuals observed in vicinity of "Chesbro Reservoir" in 1991 (CNDDB Occ. #548), approximately just over 1 mi south of western edge of study area. At least four ponds between reservoir and study area (including pond at base of dam) may provide aquatic and possibly breeding habitat for CRLF in vicinity of record.	CNDDB 2019

Table 3. WPT Occurrences in and around Study Area

Occurrence	Details	Source
WPT 1	Observation of at least one WPT in pond approximately 0.6 mi east of intersection of Bailey Avenue and McKean Road in 1996 (CNDDB Occ. #1449).	CNDDB 2019
WPT 2	Observation of one or more WPT in pond on Santa Teresa Golf Course in 1993 (CNDDB Occ. #1452), approximately 0.6 mi north-northwest of northern border of study area.	CNDDB 2019
WPT 3	Observations of seven adults in stock pond ("Calero Pond") and wetland near Old Almaden-Calero Canal, about 0.5 to 0.8 mi northwest of McKean Road at Cherry Canyon road, northwest of Calero Reservoir in 1998, 2012, 2016, 2018 (H. T. Harvey & Associates 2012b, 2018, CNDDB Occ. #303); observations of at least nine adults and one juvenile in pond in Calero Creek, about 0.1 mi north of Calero Reservoir Dam, 0.2 mi southeast of McKean Road, at Cherry Canyon Road in 2012 (H. T. Harvey & Associates 2012b, CNDDB Occ. #1453); observation of unknown number of WPT in Calero Reservoir in 1987 (CNDDB Occ. #1454); relocation of two WPT from "Calero Pond" to spillway pond at base of Calero Dam in 2017 (H. T. Harvey & Associates 2017).	CNDDB 2019; H. T. Harvey & Associates 2012b, 2017, 2018
WPT 4	Observation of one or more WPT in pond approximately 0.85 mi southeast of intersection of Bailey Avenue and McKean Road in 1996 (CNDDB Occ. #1450), location currently in Cinnabar Hills Golf Course.	CNDDB 2019
WPT 5	Observation of seven WPT from Chesbro Reservoir in 1998 (CNDDB Occ. #177); observation of one WPT in spillway pond at base of Chesbro Reservoir in 2012 (H. T. Harvey & Associates 2012b). Chesbro Reservoir is approximately 1.0 southwest of southwest corner of study area.	CNDDB 2019; H. T. Harvey & Associates 2012b
WPT 6	Two observations of WPT within Coyote Canal between Metcalf Road and Bailey Avenue in 1988 and 1989, and observation of one WPT in pond adjacent to canal between these two observations in 2012 (H. T. Harvey & Associates 1999, H. T. Harvey & Associates 2012b, CNDDB Occ. #1445).	CNDDB 2019; H. T. Harvey & Associates 1999, 2012b
WPT 7	Three observations of adult WPT in large pools of Coyote Creek at base of Anderson Dam in 2015 (CNDDB #1445), and in 2016 and 2019 (H. T. Harvey & Associates 2016, 2019).	CNDDB 2019; H. T. Harvey & Associates 2016, 2019
WPT 8	Observation of two WPT in one of multiple large in-stream Ogier Ponds at approximately 37.18316° -121.69265° in Coyote Creek in 2003 (CNDDB Occ. #1445), H. T. Harvey & Associates staff also observed WPT in several Ogier Ponds on multiple occasions over past 20 years; observations of unknown number of WPT in Coyote Creek north of Coyote Creek Golf Club at approximately 37.20198° -121.71780° in 1988 and 1989 (CNDDB Occ. #1446), as reported in H. T. Harvey & Associates (1999); observation of adult WPT in pool of Coyote Creek approximately 0.5 mi northwest of Highway 101 overpass of Coyote Creek at 37.17141° -121.67770° in 2019 (Dan Stephens, pers. comm.); observation of one WPT in off-channel pond along Coyote Creek adjacent to Coyote Creek Golf Club (north of western golf course entrance road) at approximately 37.19406° -121.71190° in 2019 (H. T. Harvey & Associates 2019); observation of one WPT in off-channel pond along Coyote Creek, just south of Coyote Ranch, at approximately 37.21535° -121.73225° in 2012 (H. T. Harvey & Associates 2012b, CNDDB Occ. #1446); observations of unknown number of WPT in Coyote Ranch Pond adjacent to Coyote Creek at approximately 37.22060° -121.74063° in 1989 and 2012 (H. T. Harvey & Associates 1999, 2012b, CNDDB Occ. #1447); observations of at least three adult WPT in in-channel pool just south of Metcalf Road at	CNDDB 2019; H. T. Harvey & Associates 1999, 2012b, 2019

Occurrence	Details	Source
	approximately 37.22586° -121.74961° in 2019 (H. T. Harvey & Associates 2019); observations of multiple WPT in Coyote Creek and Metcalf Ponds, from Metcalf Road downstream to Highway 101 in 1989, 1998, 2008, and 2011 (CNDDB Occ. #178).	
WPT 9	Observations of unknown number of WPT in Coyote Creek east of Highway 101 at Tennant Road in 1970s (CNDDB Occ. #1451) as reported by H. T. Harvey & Associates (1999).	CNDDB 2019; H. T. Harvey & Associates 1999

Table 4. Potential linkages across barriers and impediments within the Study Area

Linkage Number	Geocoordinates		Description of Linkage
1	-121.7651745	37.23971074	Highway 101 crossing over Coyote Creek
2	-121.7466425	37.23140508	Wildlife crossing under Metcalf Road
3	-121.7495497	37.23005408	Coyote Alamitos Canal crossing under Highway 101
4	-121.7475649	37.22943753	Metcalf Road crossing over Highway 101
5	-121.7530285	37.22750263	Coyote Alamitos Canal crossing under Monterey Road
6	-121.7508614	37.22668853	Metcalf Road crossing over Coyote Creek
7	-121.7512036	37.22648165	Opening in Median along Monterey Road at Metcalf Road
8	-121.7464445	37.22275249	Fisher Creek crossing under Monterey Road through dual box culvert
9	-121.7466064	37.22241454	Fisher Creek crossing under UPRR
10	-121.7337768	37.2209497	Culvert under Highway 101 at PM 24.35 E
11	-121.7328748	37.22042436	Coyote Alamitos Canal crossing under Highway 101 through box culvert at PM 24.27 E
12	-121.7318947	37.21864977	Culvert under Highway 101 at PM 24.1 E
13	-121.7417838	37.21860735	Opening in Median along Monterey Road at Blanchard Road
14	-121.7401872	37.21786841	Coyote Ranch Road crossing over Coyote Creek
15	-121.7586472	37.21764281	Coyote Alamitos Canal crossing under Santa Teresa Boulevard
16	-121.734242	37.21753461	Coyote Creek Trail crossing over Coyote Creek
17	-121.729769	37.21740183	Culvert under Highway 101 at PM 24.0 E
18	-121.7289445	37.21653251	Culvert under Highway 101 at PM 23.97 E
19	-121.7472112	37.21462394	Ditch from Laguna Seca crossing under road prior to confluence with Fisher Creek
20	-121.7264922	37.21374491	Culvert under Highway 101 at PM 23.7 E
21	-121.7511019	37.21356668	Canal from Laguna Seca crossing through culvert under Santa Teresa Boulevard
22	-121.7281499	37.21319694	Coyote Creek Trail crossing over Coyote Creek
23	-121.7468204	37.21052711	Fisher Creek crossing under Santa Teresa Boulevard
24	-121.7232817	37.20972841	Bailey Avenue crossing over Highway 101
25	-121.7266585	37.20872824	Bailey Avenue crossing over Coyote Creek
26	-121.7201047	37.20851318	Culvert under Highway 101 at PM 23.2 E
27	-121.7182245	37.20721651	Culvert under Highway 101 at PM 23.06 E
28	-121.729526	37.20710138	Opening in Median along Monterey Road at Bailey Avenue

Linkage Number	Geocoordinates		Description of Linkage
29	-121.7292231	37.2067559	Bailey Avenue crossing over Monterey Road
30	-121.7167591	37.20626342	Culvert under Highway 101 at PM 22.9 E
31	-121.7139737	37.20458423	Culvert/drain under Highway 101 at PM 22.77 E
32	-121.7112898	37.2032226	Culvert under Highway 101 at PM 22.59 E
33	-121.7087867	37.20186309	Culvert under Highway 101 at PM 22.42 E
34	-121.7076248	37.20118765	Culvert under Highway 101 at PM 22.34 E
35	-121.7053562	37.19975943	Culvert under Highway 101 at PM 22.17 E
36	-121.739553	37.19903914	Fisher Creek crossing under Bailey Avenue through box culvert
37	-121.7410543	37.19800021	Branch of Fisher Creek crossing under Bailey Avenue through culvert
38	-121.7023239	37.19777844	Culvert under Highway 101 at PM 21.98 E
39	-121.7002336	37.19612587	Culvert under Highway 101 at PM 21.8 E
40	-121.7441745	37.19603959	Branch of Fisher Creek crossing under under IBM driveway through culvert
41	-121.6970157	37.19394245	Culvert under Highway 101 at PM 21.6 E
42	-121.7475625	37.19366688	Branch of Fisher Creek crossing under under IBM driveway through culvert
43	-121.6970945	37.19344937	Golf Cart Path of Coyote Creek Golf Course crossing under Highway 101
44	-121.7086023	37.19171355	Coyote Creek Golf Drive crossing over Coyote Creek
45	-121.6932736	37.19074175	Coyote Creek Golf Course Drive crossing over Highway 101
46	-121.7333801	37.18989317	Fisher Creek crossing under Laguna Avenue through culvert
47	-121.6897258	37.18892201	Culvert under Highway 101 at PM 21.04 E
48	-121.6963354	37.18878132	Coyote Alamitos Canal crossing under Coyote Creek Golf Course Drive
49	-121.6888252	37.18820055	Culvert under Highway 101 at PM 20.98 E
50	-121.6864984	37.18667511	Culvert under Highway 101 at PM 20.82 E
51	-121.6844593	37.18482736	Culvert under Highway 101 at PM 20.63 E
52	-121.7057156	37.18395214	Opening in Median along Monterey Road at Palm Avenue
53	-121.7017406	37.18384185	Coyote Creek Trail crossing over Coyote Creek
54	-121.7301844	37.18301922	Fisher Creek crossing under Richmond Avenue through culvert
55	-121.680421	37.17980985	Culvert under Highway 101 at PM 20.22 E
56	-121.7232062	37.17866679	Fisher Creek crossing under foot bridge at Scheller Avenue
57	-121.6909062	37.17780074	Barnhart Avenue crossing over Coyote Creek
58	-121.6780721	37.17774895	Coyote Alamitos Canal crossing under Highway 101 at PM 20.1 E

Linkage Number	Geocoordinates		Description of Linkage
59	-121.6773535	37.17689019	Culvert under Highway 101 at PM 19.97 E
60	-121.7182536	37.17587818	Fisher Creek crossing under Palm Avenue through culvert
61	-121.6762013	37.17587533	Culvert under Highway 101 at PM 19.8 E
62	-121.7151097	37.17479042	Fisher Creek crossing under Hale Avenue (N) through culvert
63	-121.7123282	37.17360582	Fisher Creek crossing under Kalana Avenue through culvert
64	-121.6734313	37.17354387	Culvert under Highway 101 at PM 19.66 E
65	-121.7108711	37.17065734	Fisher Creek crossing under Hale Avenue through culvert
66	-121.6689542	37.16895905	Highway 101 crossing over Coyote Creek
67	-121.7101147	37.16891661	Fisher Creek crossing under San Bruno Avenue through culvert
68	-121.6888567	37.16744323	Opening in Median along Monterey Road at Live Oak Avenue
69	-121.7148208	37.16517291	Fisher Creek crossing under San Bruno Avenue through culvert
70	-121.6627223	37.16284823	Cochrane Channel under Burnett Ave
71	-121.6993239	37.16162446	Fisher Creek crossing under Hale Avenue through culvert
72	-121.6980699	37.16140646	Fisher Creek crossing under Live Oak Avenue through culvert
73	-121.6893005	37.15873443	Fisher Creek crossing under Madrone Avenue through culvert
74	-121.6762489	37.15516646	Opening in Median along Monterey Road at Tilton Avenue
75	-121.6510621	37.15393195	Cochrane Channel under Cochrane Rd
76	-121.685605	37.15315061	Fisher Creek crossing under Hale Avenue (S) through culvert
77	-121.6802724	37.15183629	Fisher Creek crossing under Tilton Ave
78	-121.6869771	37.15052173	Fisher Creek crossing under road through culvert
79	-121.6773848	37.14981802	Fisher Creek crossing under Hale Avenue (S2) through culvert

Table 5. Land cover types within and around Study Area, with relative costs to each species as designated by H. T. Harvey & Associates

Land Cover Type	Cost CTS	Cost CRLF	Cost WPT	Acreage
Agricultural Road	10	10	10	120.8
Agriculture Developed	5	5	5	503.2
Bailey Road	10	10	10	12.2
Bike Path	10	10	10	4.7
Blue Oak Woodland	2	2	2	691.4
California Annual Grassland	2	2	2	5952.6
Central California Sycamore Alluvial Woodland	3	2	2	51.2
Coast Live Oak Forest and Woodland	3	2	2	1581.7
Coastal and Valley Freshwater Marsh	1	1	1	105.7
Coyote Brush Scrub	1	2	2	15.7
Creek	3	1	1	743.2
Culvert (40ft)	1	1	1	6.3
Foothill Pine - Oak Woodland	3	2	2	105.2
Freeway	1000	1000	1000	219.0
Golf Course Road	10	10	10	0.8
Golf Courses / Urban Parks	4	3	3	1081.5
Grain, Row-crop, Hay and Pasture, Disced / Short-term Fallowed	4	3	3	4169.7
Intensively Cultivated Agriculture	15	15	15	1161.5
Landfill	5	5	5	206.8
Landfill Road	10	10	10	3.5
Mixed Evergreen Forest	3	3	3	25.8
Mixed Oak Woodland and Forest	3	2	2	4004.2
Mixed Riparian Forest and Woodland	3	1	1	375.3
Mixed Serpentine Chaparral	1	2	2	950.1
Median Section of Monterey Road	15	100	1000	97.6
No Median Section of Monterey Road	10	10	10	0.3
No Median Road	10	10	10	75.0
Northern Coastal Scrub / Diablan Sage Scrub	1	2	2	389.4
Northern Mixed Chaparral / Chamise Chaparral	1	2	2	102.5
Orchard	4	3	3	320.5
Ornamental Woodland	4	4	4	1.9
Overcrossing	10	10	10	3.3
Pond	1	1	1	117.4
Reservoir	6	5	1	431.1
Road	10	10	10	152.3
Rock Outcrop	4	3	3	3.9
Rural-residential	5	5	5	1430.5
Seasonal Wetland	1	1	1	78.4
Serpentine Bunchgrass Grassland	1	2	2	6145.4
Serpentine Rock Outcrop / Barrens	1	2	2	136.9
Serpentine Seep	1	1	1	10.1
Undercrossing	1	1	1	5.3

Land Cover Type	Cost CTS	Cost CRLF	Cost WPT	Acreage
Urban - Suburban	15	15	15	2984.3
Urban Road	10	10	10	180.4
Valley Oak Woodland	2	2	2	392.9
Willow Riparian Forest and Scrub	3	1	1	214.2

Table 6. All least cost paths analysed for each species. Paths in last column match those in text and figures.

Species	Origin	Destination	Straight-line Distance	Pathway Distance	Difference	Pathway Cost	Pathway
CTS	A	A'	2.32	2.74	0.42	26519	CTS 1
CTS	A	B'	2.83	3.43	0.60	37389	CTS 2
CTS	A	C'	3.66	4.54	0.88	51715	
CTS	A	D'	4.50	5.52	1.02	61774	
CTS	A	E'	7.45	9.00	1.55	81819	
CTS	B	A'	4.22	5.12	0.90	39346	CTS 3
CTS	B	B'	3.21	3.62	0.41	45420	
CTS	B	C'	3.49	3.79	0.30	56767	
CTS	B	D'	3.88	5.31	1.43	61643	
CTS	B	E'	5.95	7.07	1.12	69950	
CTS	C	A'	4.01	5.61	1.60	49538	
CTS	C	B'	2.15	3.34	1.19	49065	CTS 4
CTS	C	C'	1.97	2.41	0.44	49484	CTS 5
CTS	C	D'	2.12	2.39	0.27	54423	
CTS	C	E'	4.31	6.13	1.82	69728	
CTS	D	A'	5.54	6.85	1.31	51677	
CTS	D	B'	3.55	4.95	1.40	52578	
CTS	D	C'	3.06	3.92	0.86	56036	
CTS	D	D'	2.70	3.25	0.55	49697	CTS 6
CTS	D	E'	3.40	4.16	0.76	54300	CTS 7
CTS	E	A'	9.36	11.40	2.04	76775	
CTS	E	B'	7.26	9.03	1.77	78030	
CTS	E	C'	6.58	7.89	1.31	81599	
CTS	E	D'	5.87	6.82	0.95	74276	
CTS	E	E'	3.75	5.60	1.85	66883	CTS 8
CRLF	A	A'	2.18	3.63	1.45	27454	CRLF 1
CRLF	A	B'	3.04	3.63	0.59	26249	CRLF 2
CRLF	A	C'	4.07	5.01	0.94	34711	
CRLF	A	D'	5.02	6.54	1.52	44043	
CRLF	A	E'	7.82	9.94	2.12	60152	
CRLF	B	A'	3.45	4.50	1.05	29736	
CRLF	B	B'	1.83	2.08	0.25	26117	CRLF 3
CRLF	B	C'	2.43	3.34	0.91	33663	CRLF 4
CRLF	B	D'	3.33	4.87	1.54	42995	CRLF 5
CRLF	B	E'	5.26	8.27	3.01	59103	
CRLF	C	A'	5.50	6.98	1.48	41490	
CRLF	C	B'	3.26	4.57	1.31	37870	CRLF 6
CRLF	C	C'	3.06	5.82	2.76	45416	
CRLF	C	D'	3.46	4.69	1.23	48904	
CRLF	C	E'	3.40	4.98	1.58	49529	
CRLF	D	A'	6.08	7.53	1.45	44374	
CRLF	D	B'	3.75	5.12	1.37	40754	CRLF 7

Species	Origin	Destination	Straight-line Distance	Pathway Distance	Difference	Pathway Cost	Pathway
CRLF	D	C'	3.37	4.37	1.00	47942	
CRLF	D	D'	3.57	4.47	0.90	49140	
CRLF	D	E'	2.76	4.04	1.28	43820	CRLF 8
CRLF	E	A'	9.34	11.26	1.92	67878	
CRLF	E	B'	7.03	8.85	1.82	64258	
CRLF	E	C'	6.58	8.05	1.47	70253	
CRLF	E	D'	6.58	8.15	1.57	71451	
CRLF	E	E'	3.75	6.02	2.27	56836	CRLF 9
WPT	A	A'	2.00	2.52	0.52	17891	WPT 1
WPT	A	B'	2.65	3.82	1.20	21922	WPT 2
WPT	A	C'	2.78	4.12	1.34	22912	WPT 3
WPT	A	D'	3.75	5.65	1.90	32244	WPT 4
WPT	A	E'	6.53	9.04	2.51	48352	
WPT	B	A'	3.35	4.35	1.00	27582	WPT 5
WPT	B	B'	2.25	3.03	0.78	31430	
WPT	B	C'	1.96	3.20	1.24	31503	
WPT	B	D'	2.85	4.72	1.87	40835	
WPT	B	E'	4.92	8.12	3.20	56943	
WPT	C	A'	5.17	6.47	1.30	38972	WPT 6
WPT	C	B'	3.15	5.14	1.99	42820	
WPT	C	C'	2.55	5.31	2.76	42894	
WPT	C	D'	2.90	3.99	1.09	44806	
WPT	C	E'	3.18	5.03	1.85	47830	WPT 7
WPT	D	A'	8.62	10.48	1.86	59950	
WPT	D	B'	6.49	9.16	2.67	63798	
WPT	D	C'	5.85	9.33	3.48	63872	
WPT	D	D'	5.88	7.92	2.04	65528	
WPT	D	E'	3.24	5.24	2.00	48904	WPT 8

Appendix B. Least Cost Pathways Discussed in Report

Each pathway is from a specific point on one side of the study area to the point on the other side of the study that generates the "least cost" for an individual of the species (i.e., the theoretically optimal pathway).

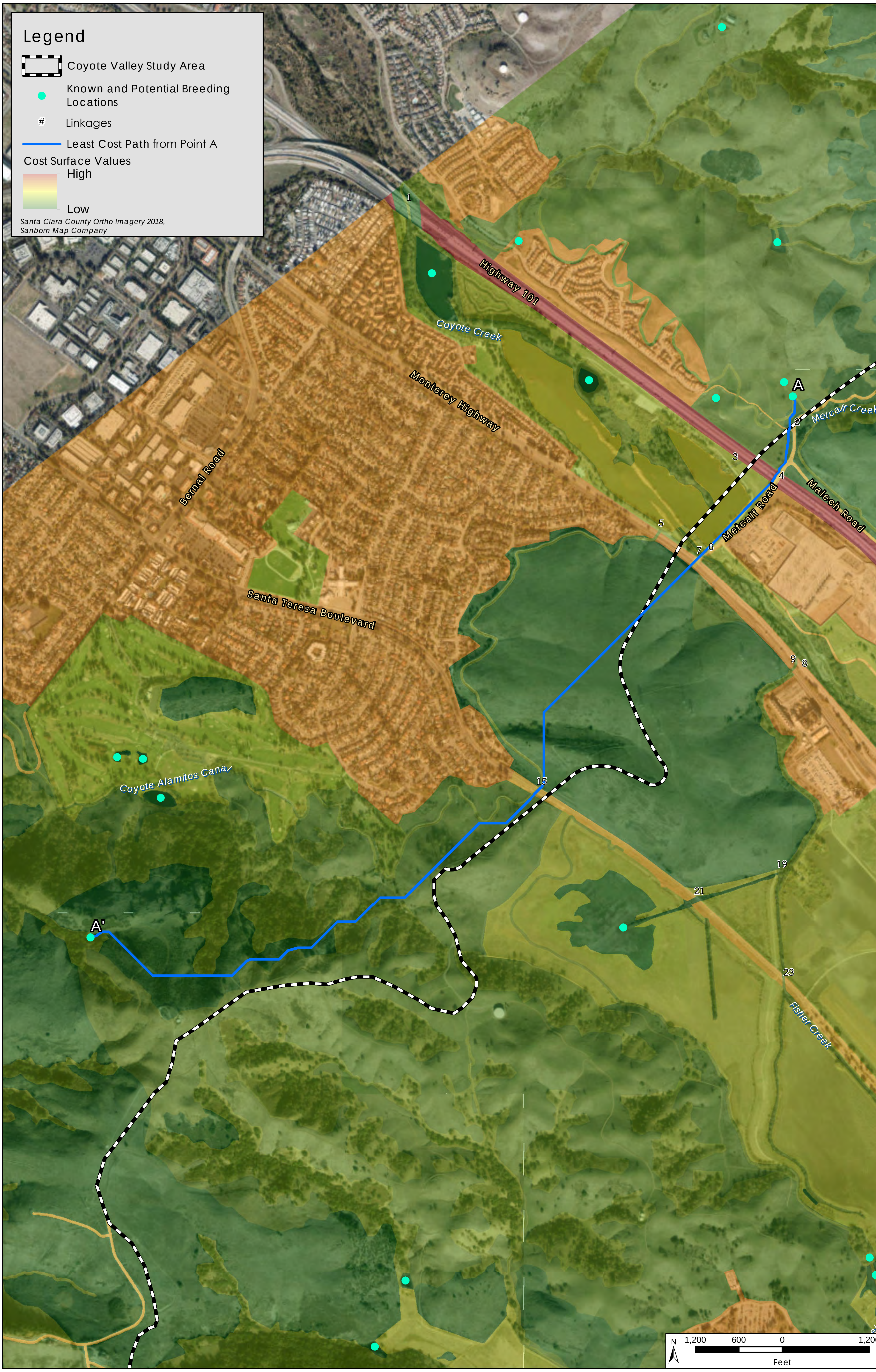

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Figure 16. California Tiger Salamander Least Cost Pathway 1

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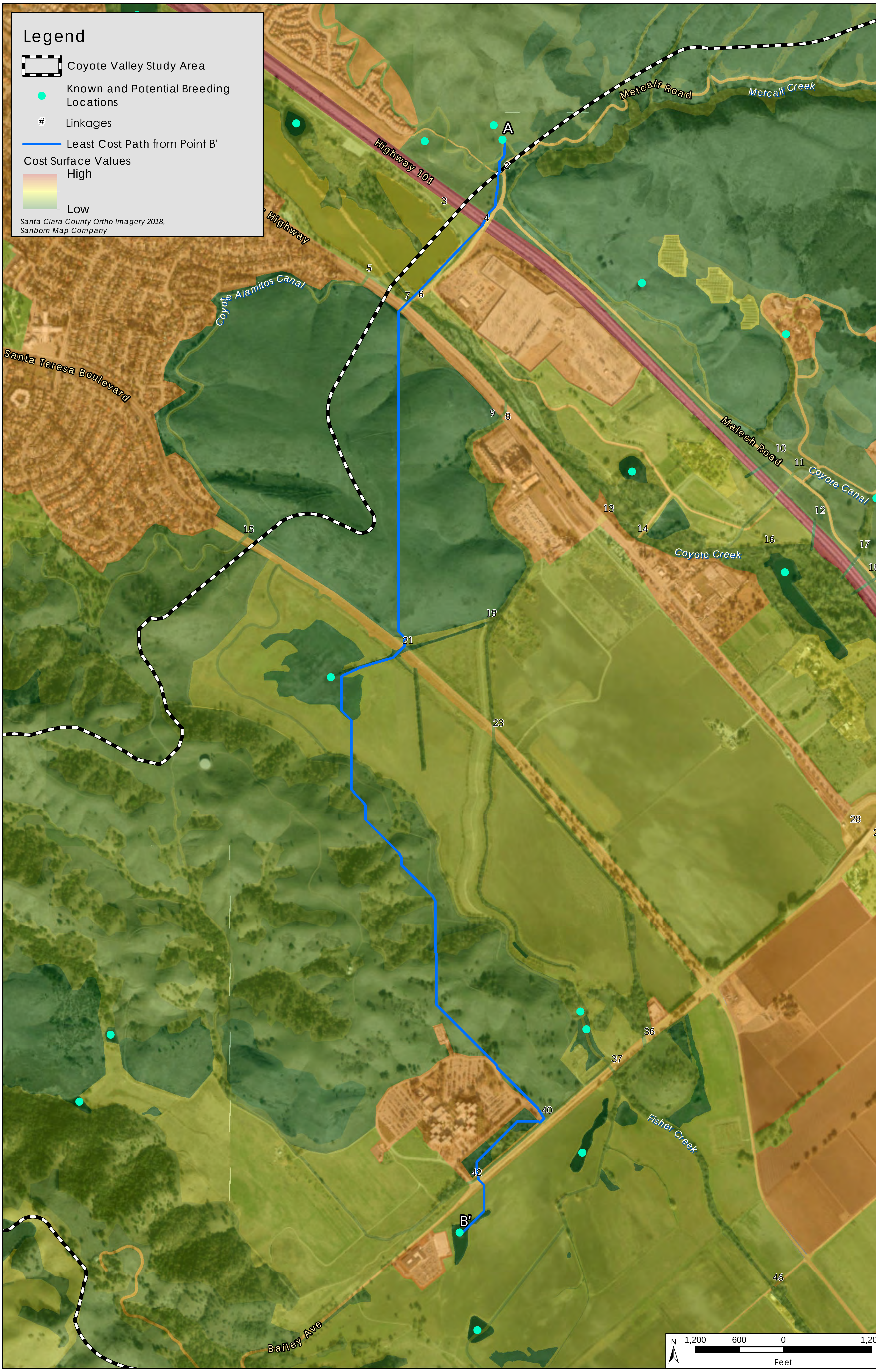

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Figure 17. California Tiger Salamander Least Cost Pathway 2

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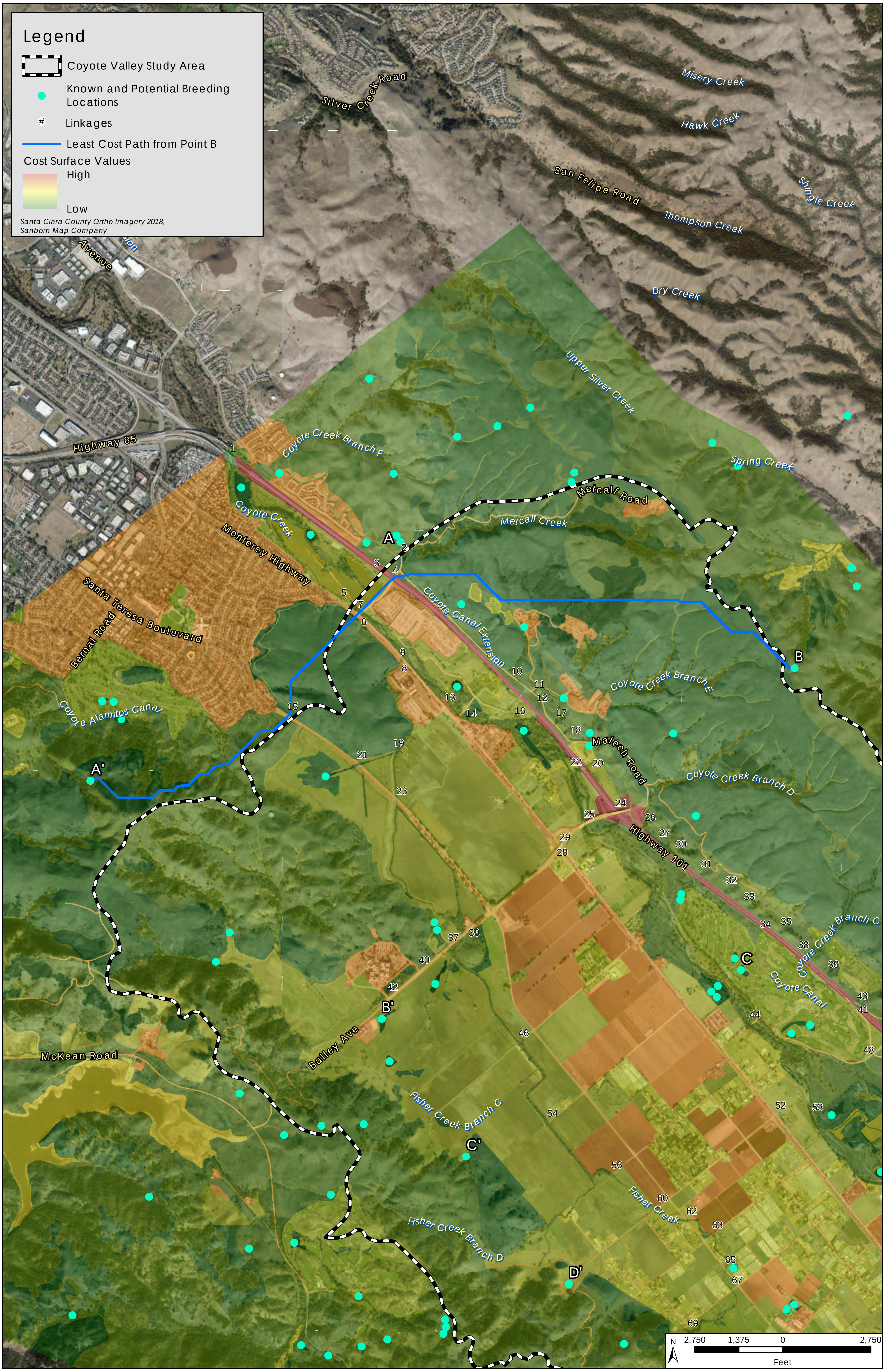

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Figure 18. California Tiger Salamander Least Cost Pathway 3

Coyote Valley Reptile and Amphibian Linkage Study (4289-01)

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Figure 19. California Tiger Salamander Least Cost Pathway 4
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Figure 20. California Tiger Salamander Least Cost Pathway 5
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Figure 21. California Tiger Salamander Least Cost Pathway 6
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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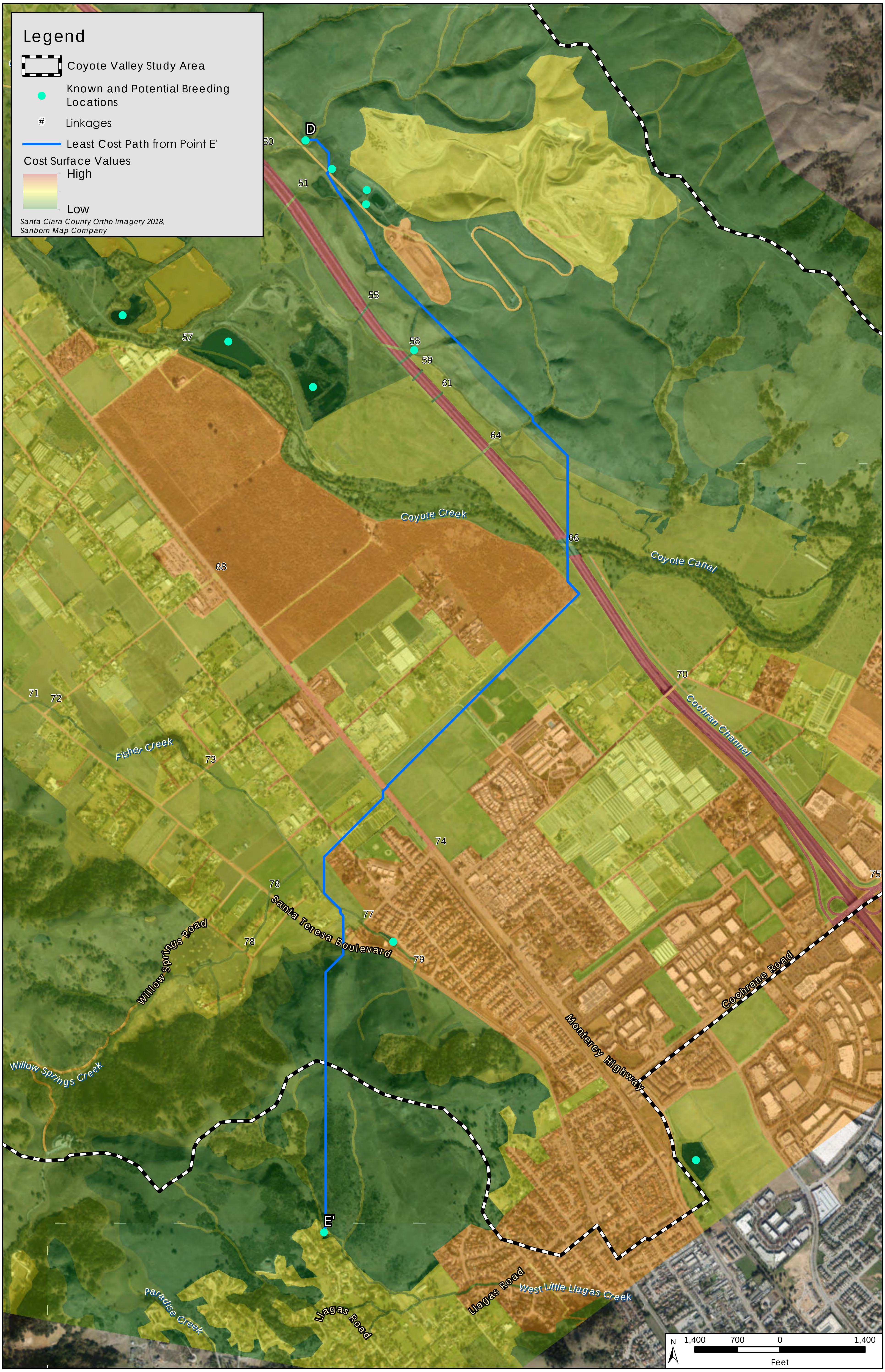

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Figure 22. California Tiger Salamander Least Cost Pathway 7

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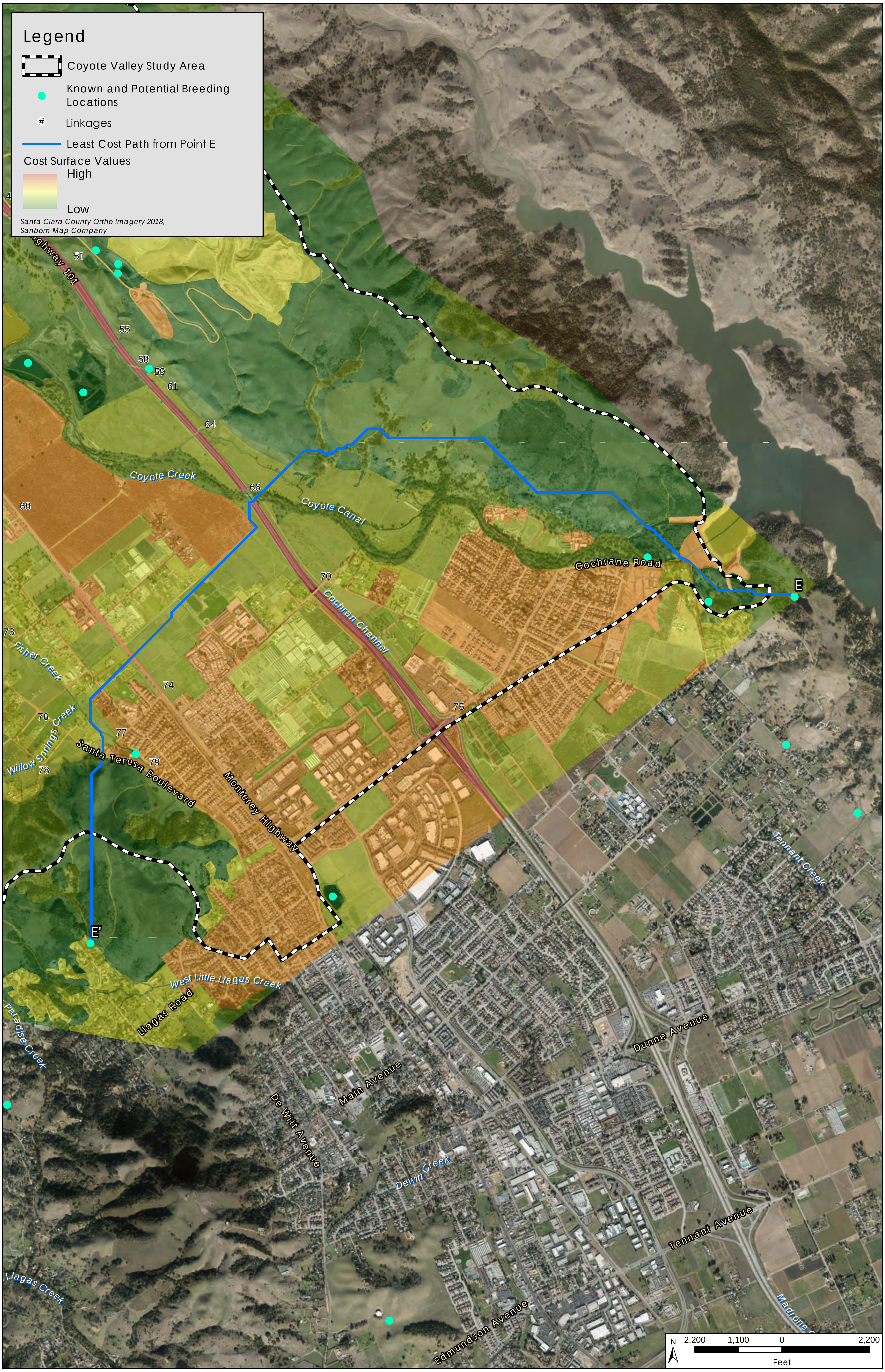

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Figure **23**. California Tiger Salamander Least Cost Path**way 8**
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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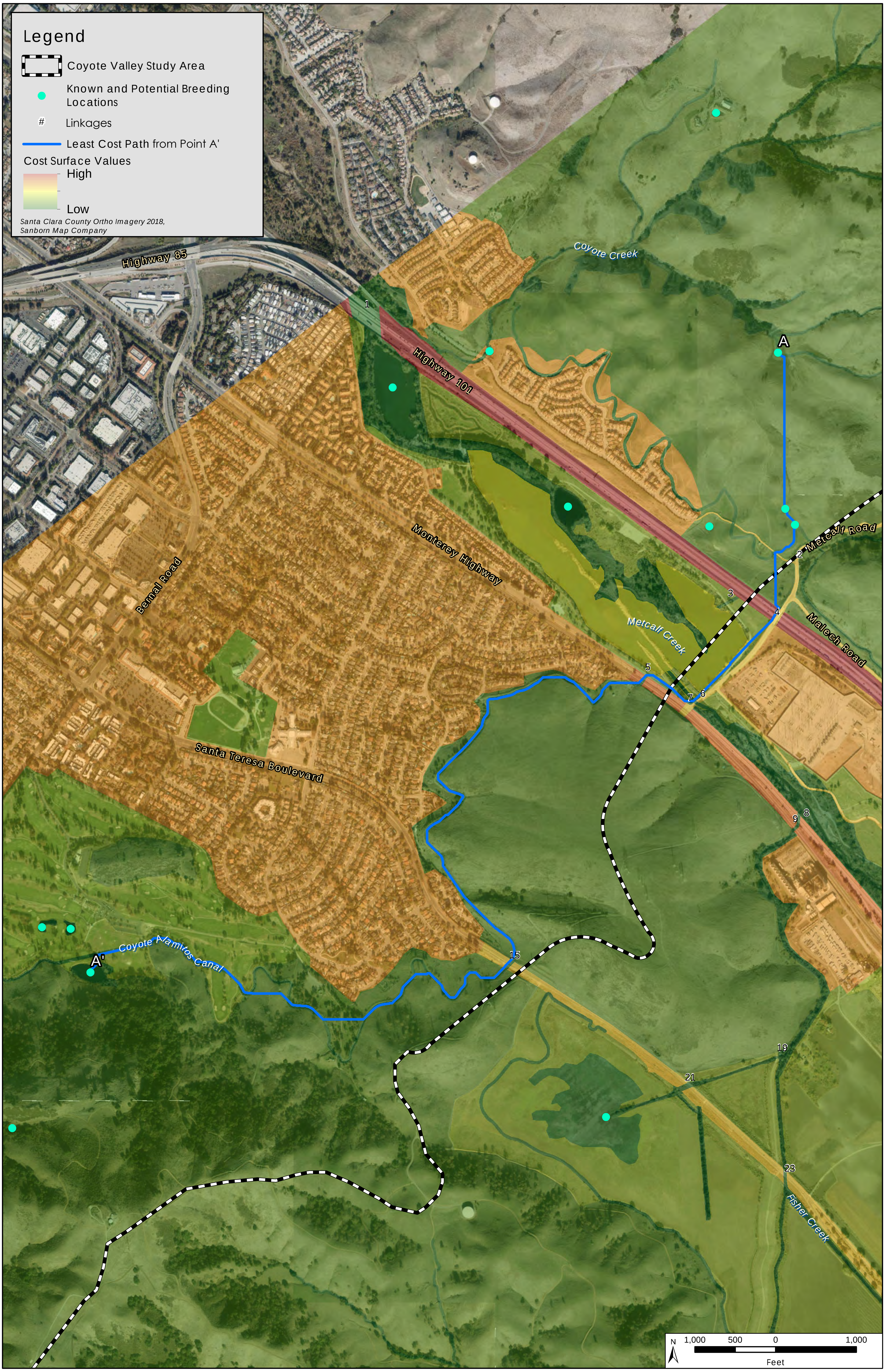

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Figure **24**. California red-legged frog Least Cost Path**way 1**
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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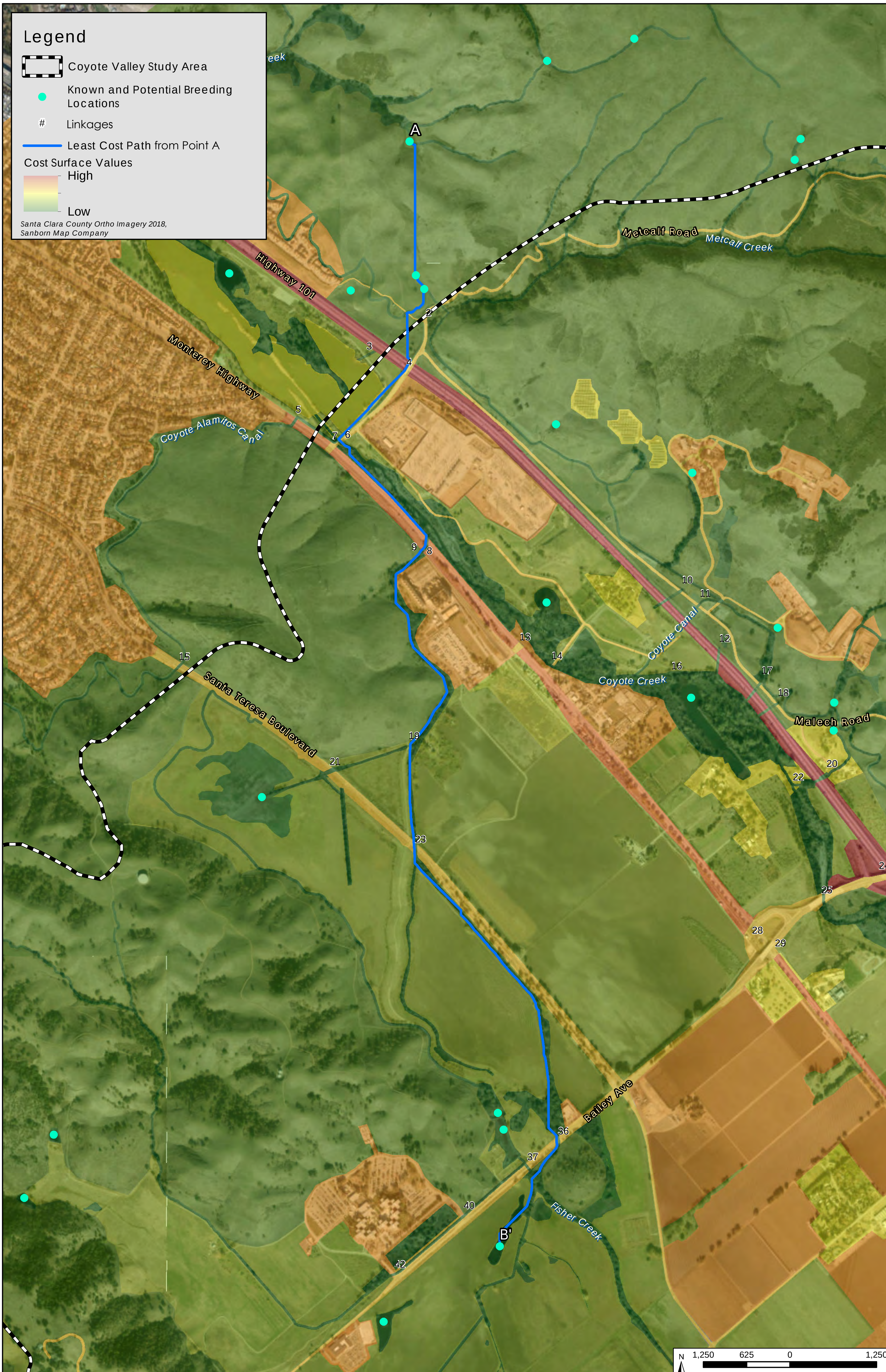

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Figure **25**. California red-legged frog Least Cost Path**way 2**
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Figure 26. California red-legged frog Least Cost Pathway 3

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Figure 27. California red-legged frog Least Cost Pathway 4
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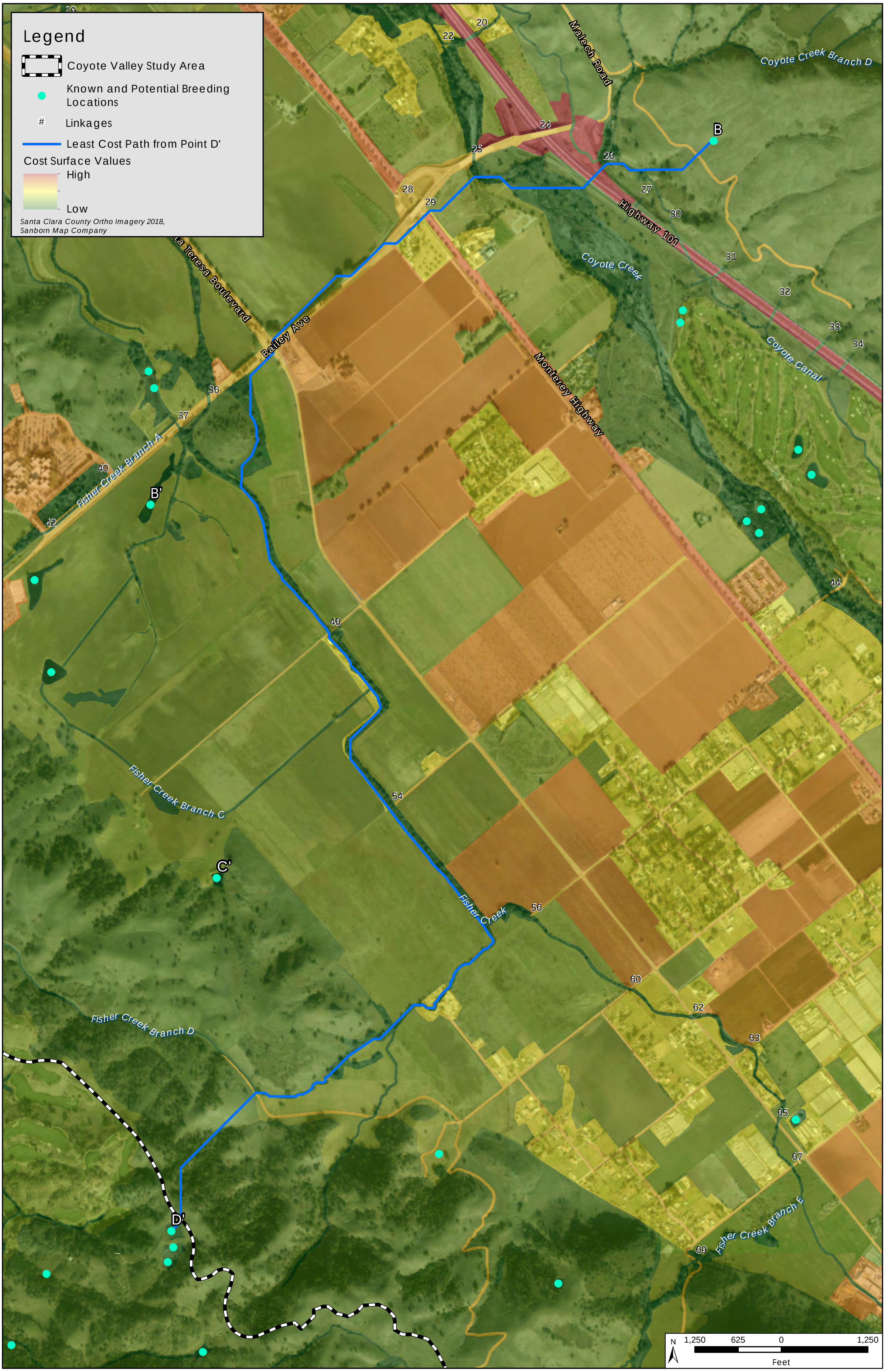

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Figure 28. California red-legged frog Least Cost Pathway 5

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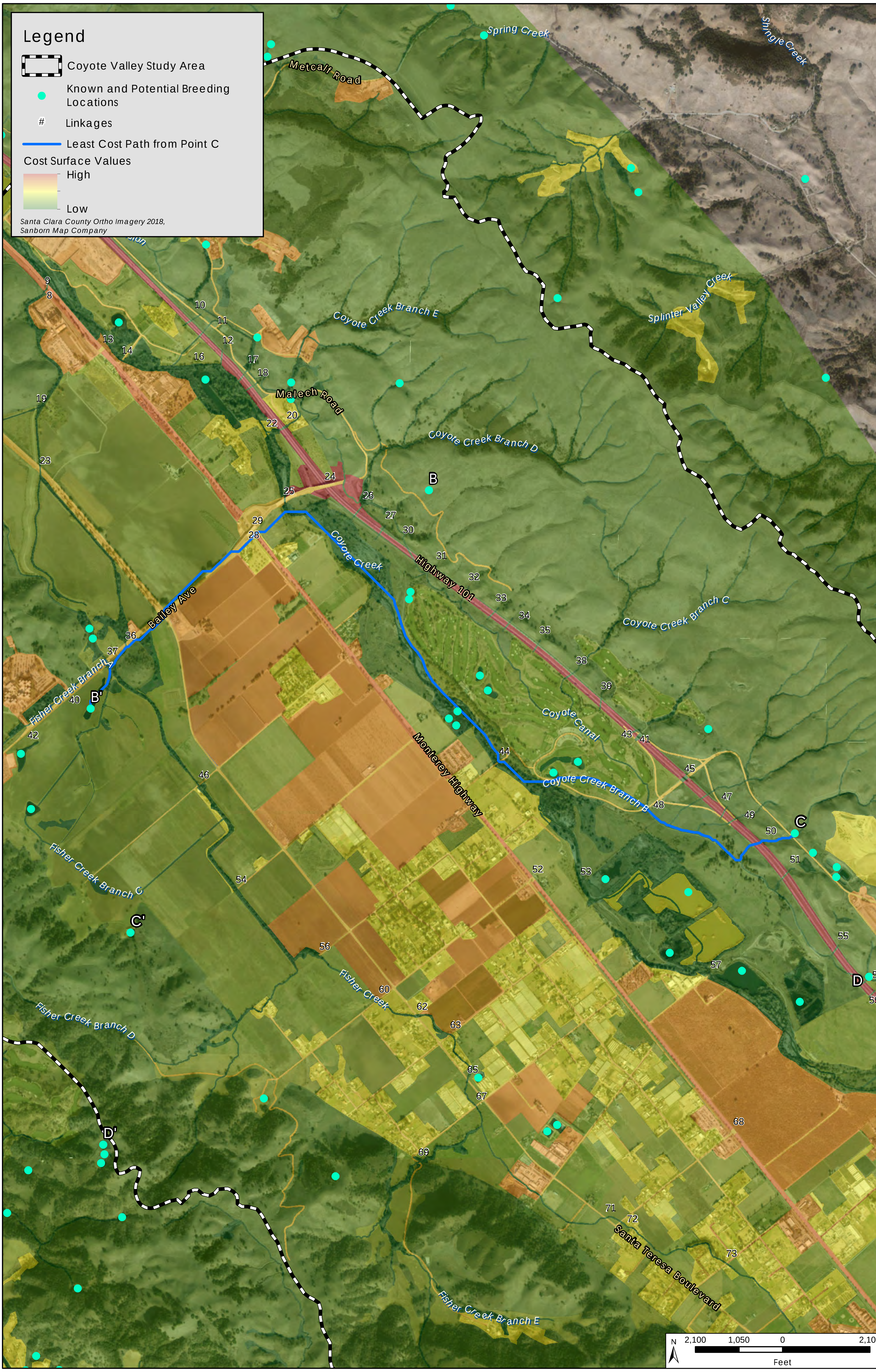

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Figure 29. California red-legged frog Least Cost Pathway 6
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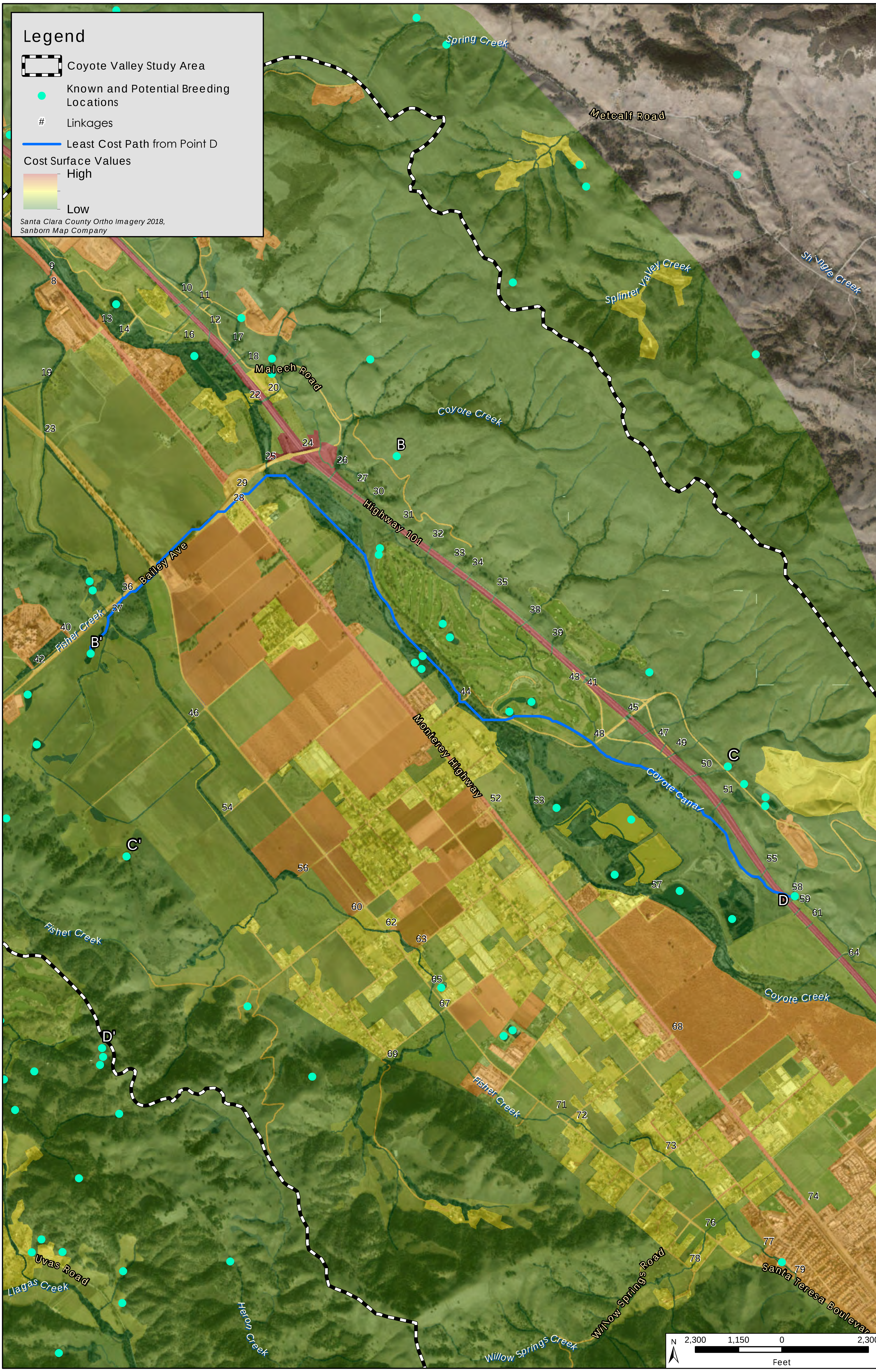

Figure **30**. California red-legged frog Least Cost Path**way 7**

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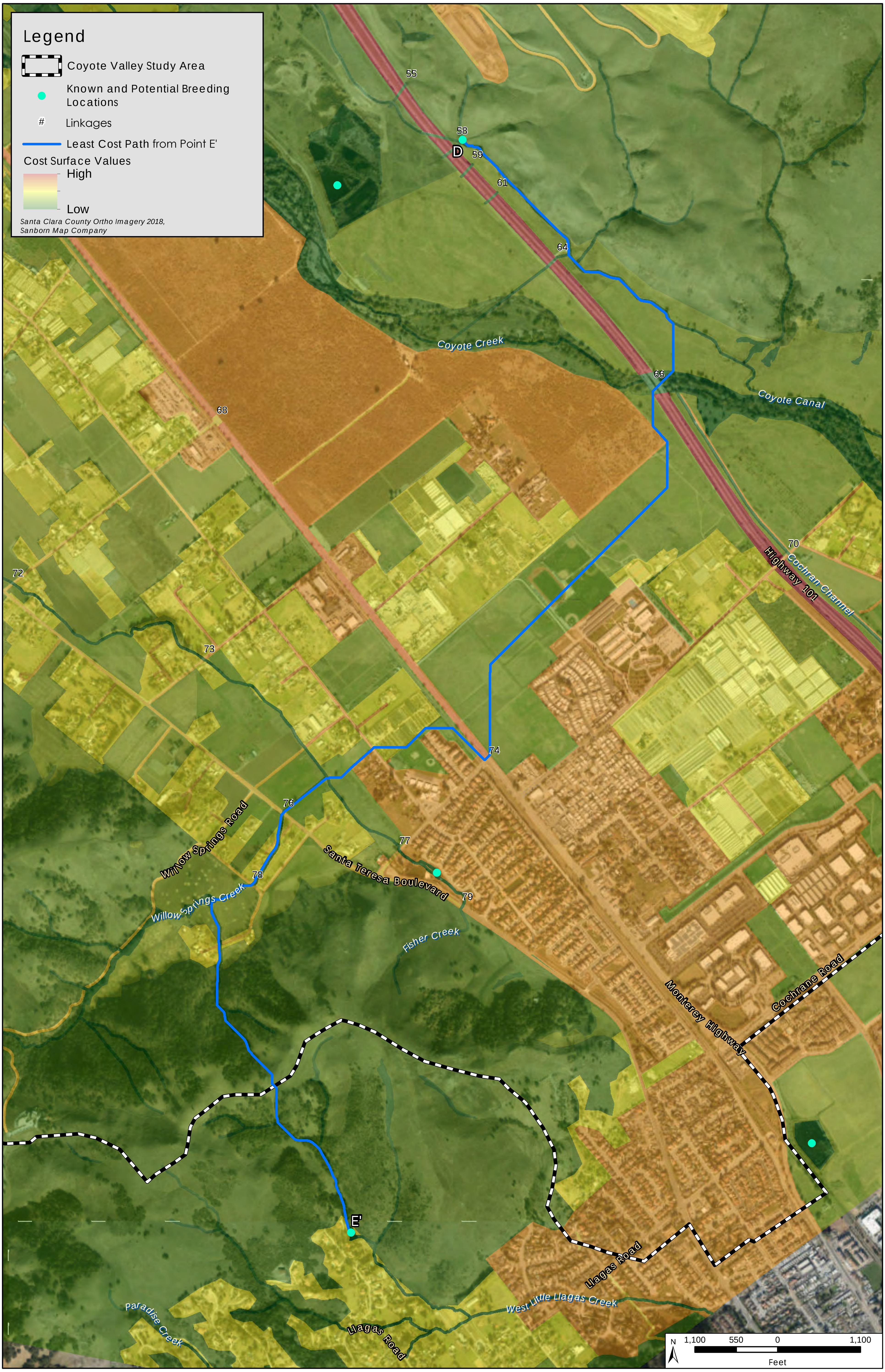

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Figure **31**. California red-legged frog Least Cost Path**way 8**
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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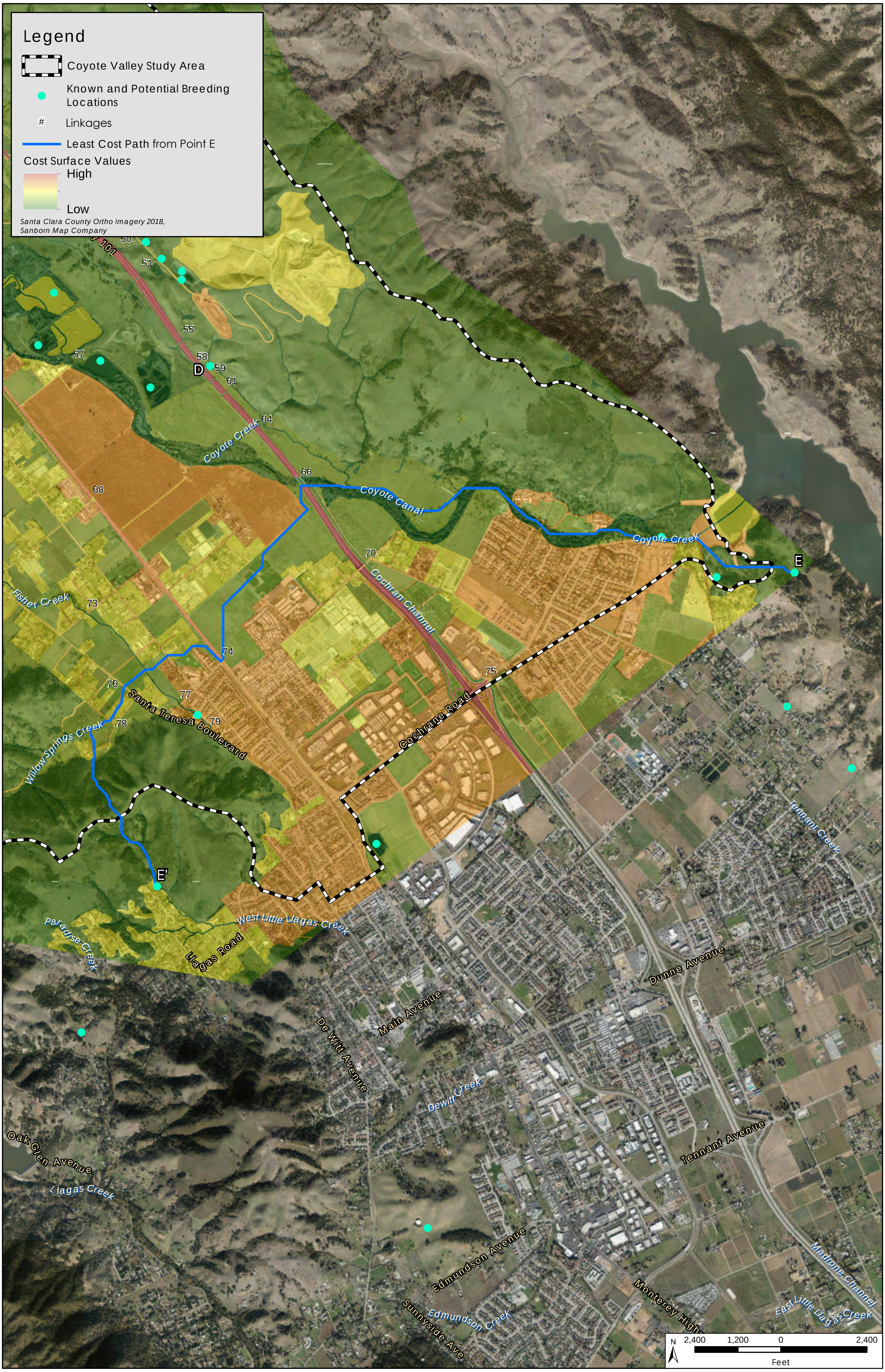

Figure **32**. California red-legged frog Least Cost Path**way 9**

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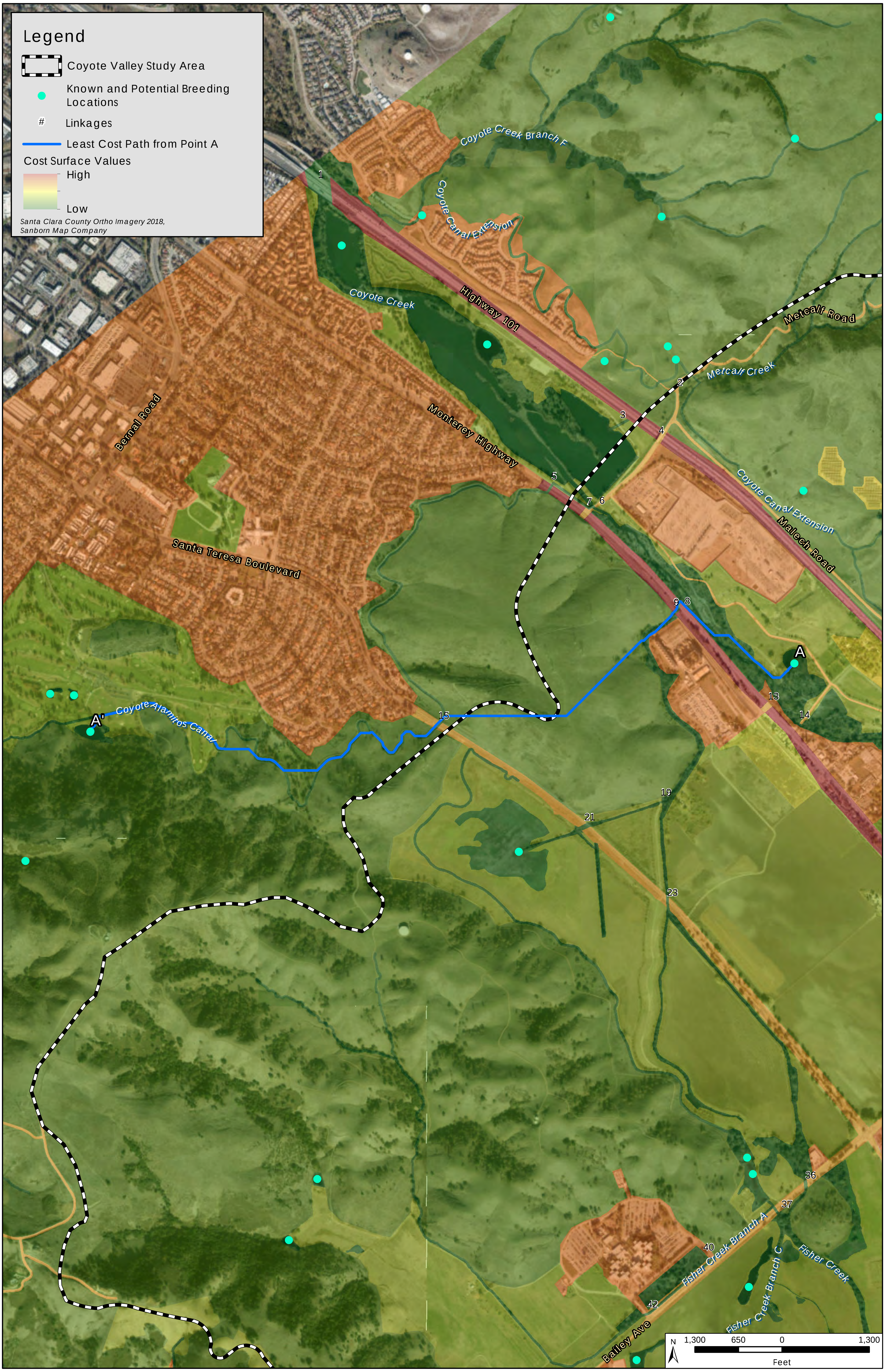

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Figure 33. Western Pond Turtle Least Cost Pathway 1

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Figure 34. Western Pond Turtle Least Cost Pathway 2

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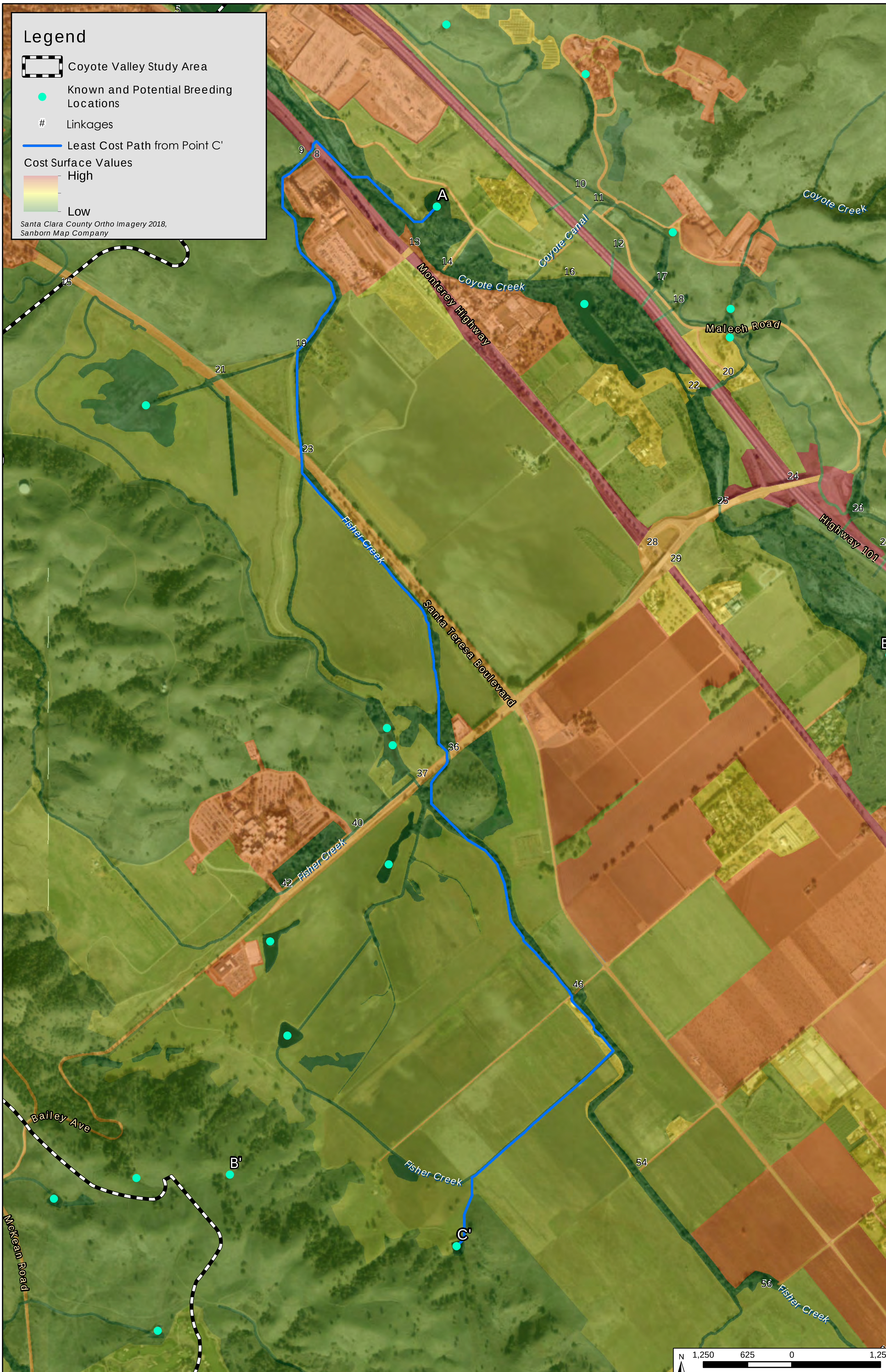

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Figure 35. Western Pond Turtle Least Cost Pathway 3
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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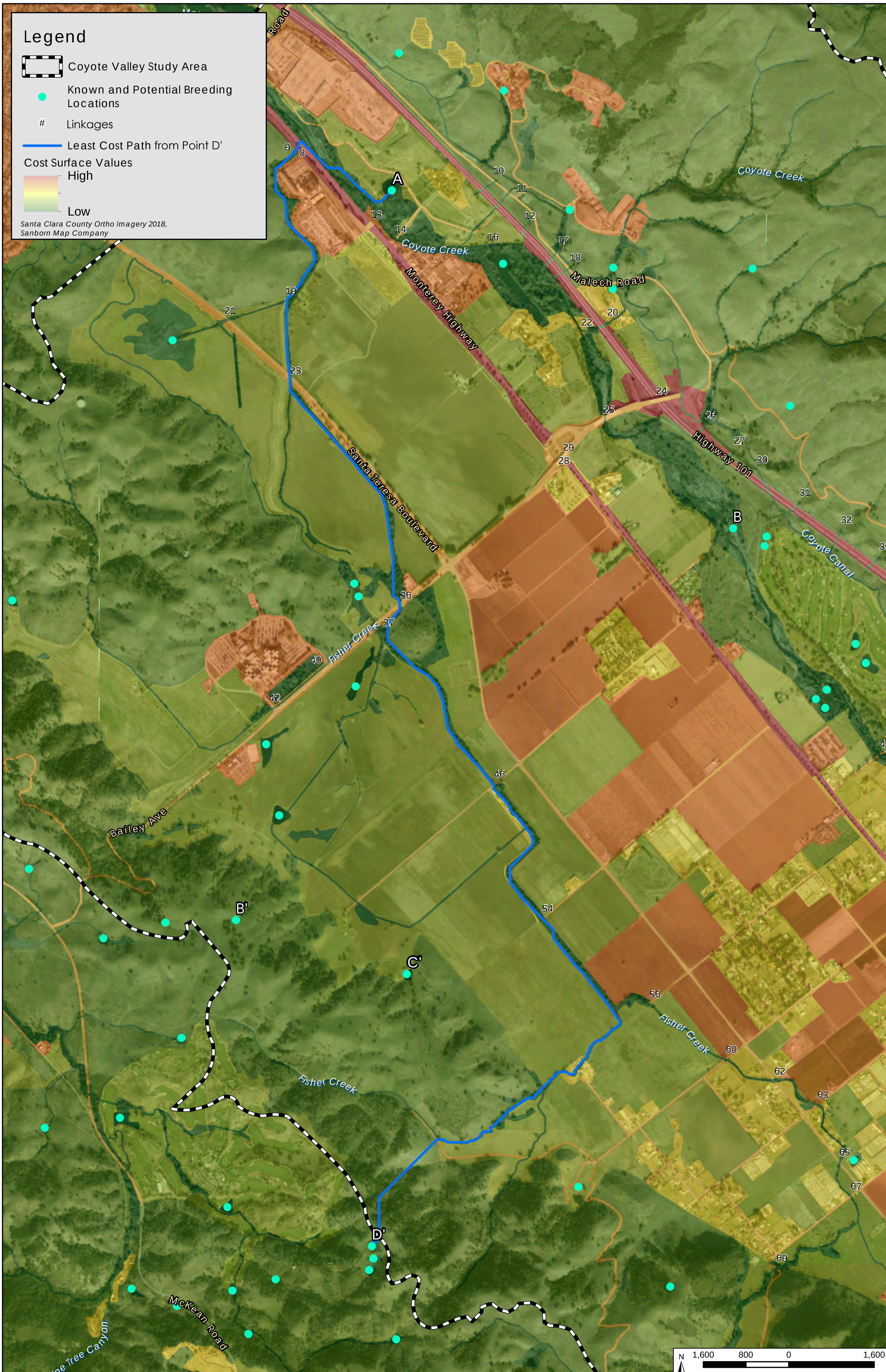

Figure **36**. Western Pond Turtle Least Cost Path**way 4**

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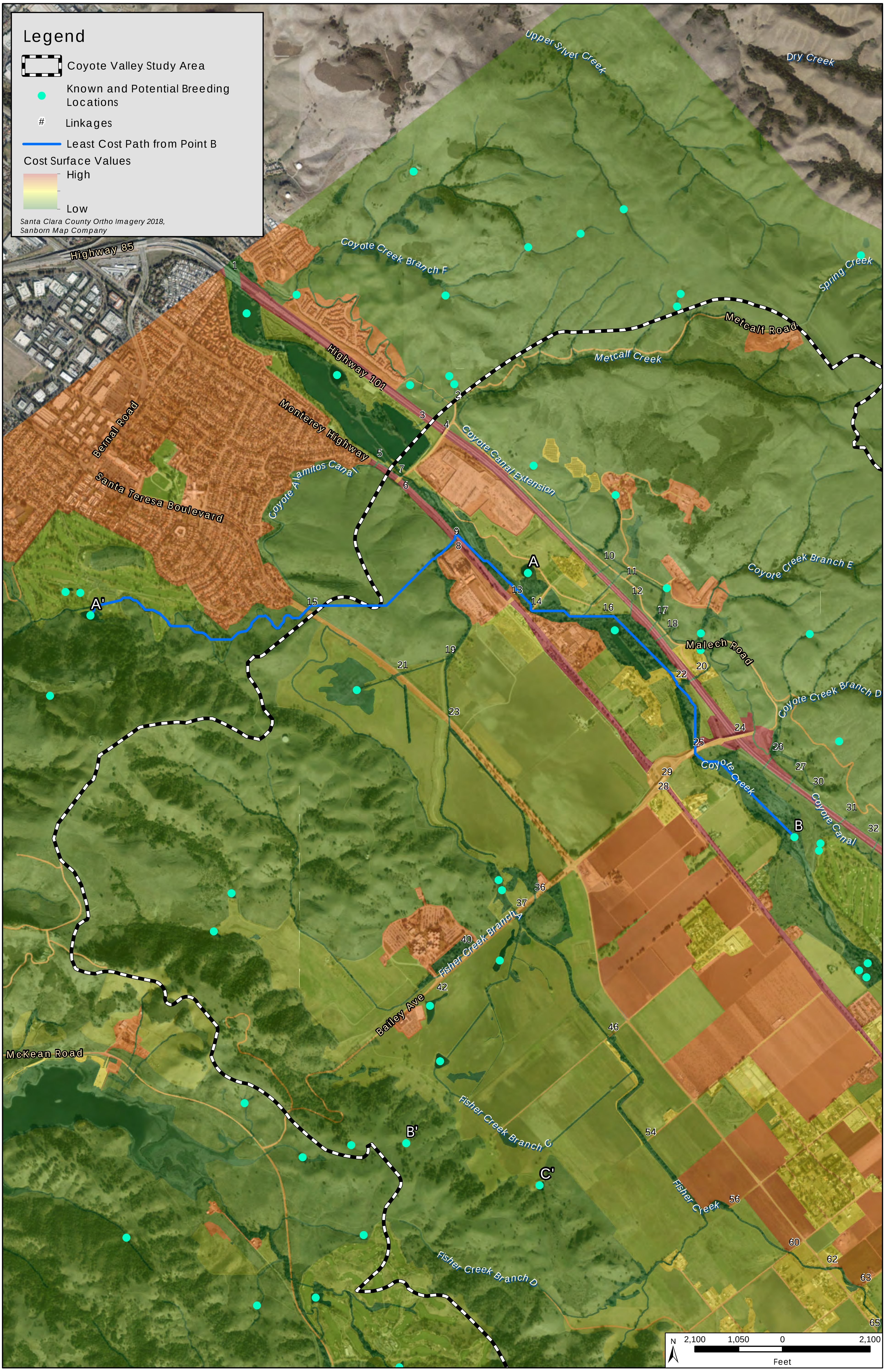

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Figure 37. Western Pond Turtle Least Cost Pathway 5
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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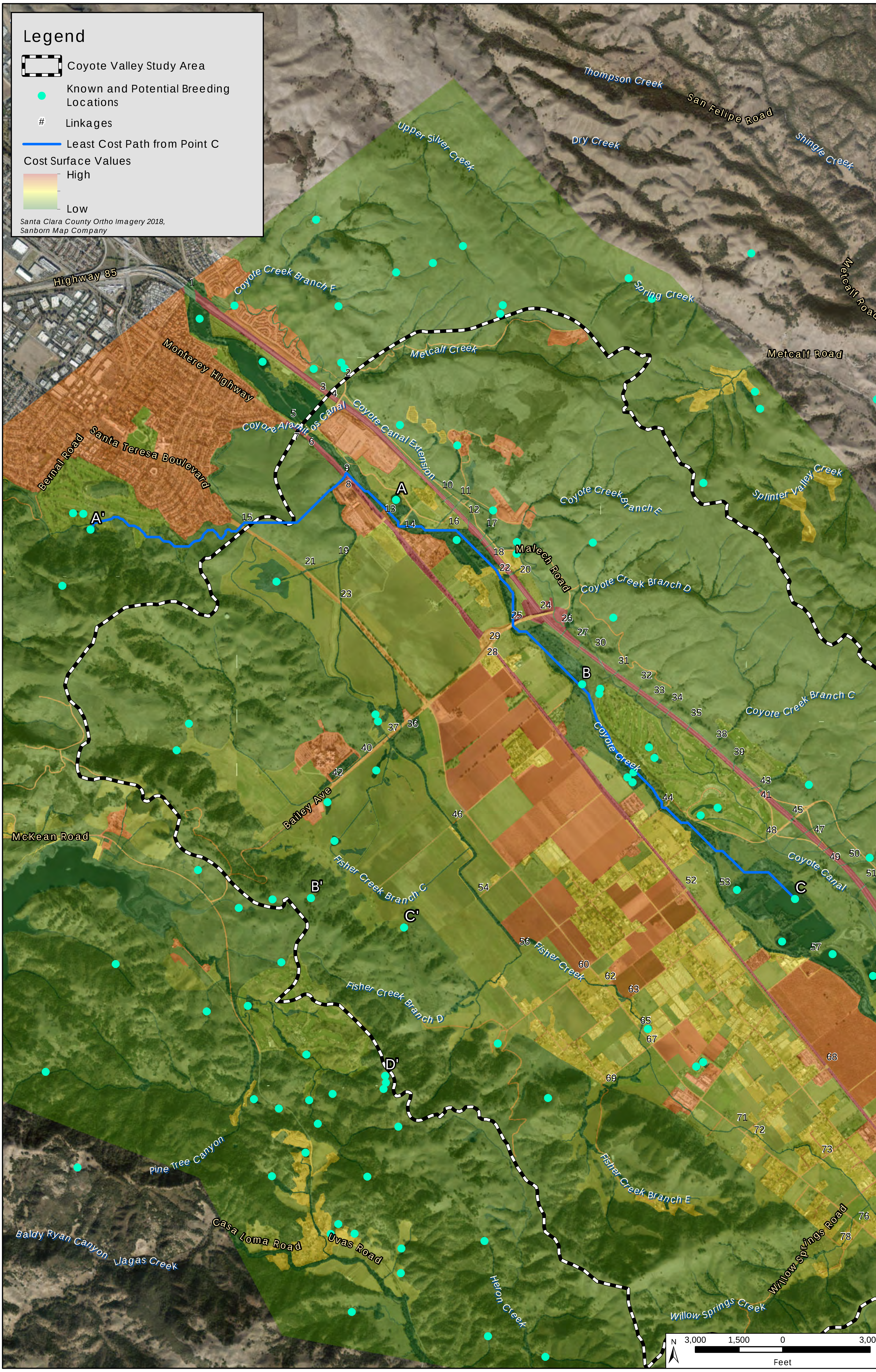

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Figure 38. Western Pond Turtle Least Cost Pathway 6
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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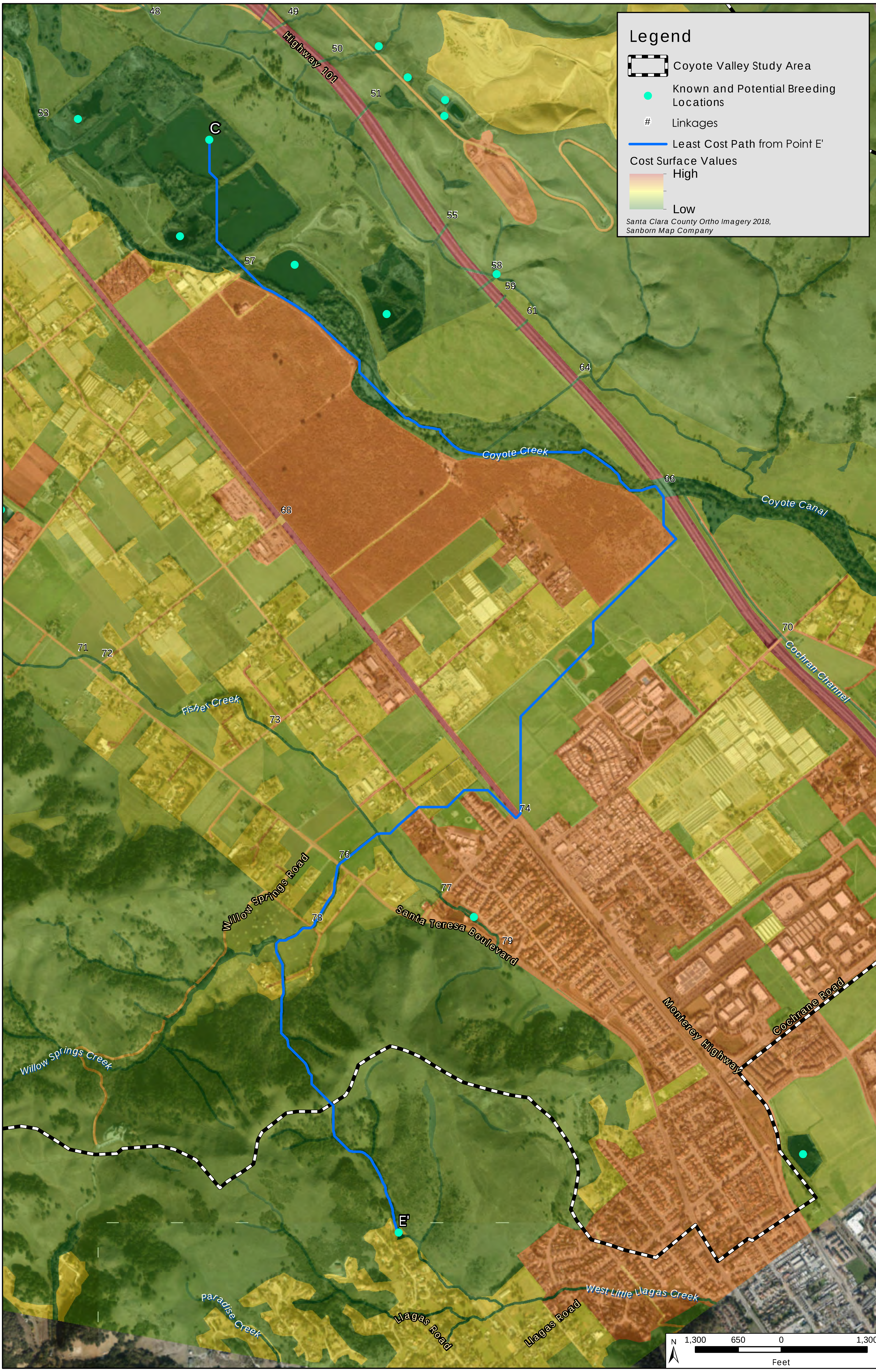

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Figure **39**. Western Pond Turtle Least Cost Path**way 7**
Coyote Valley Reptile and Amphibian Linkage Study (4289-01)
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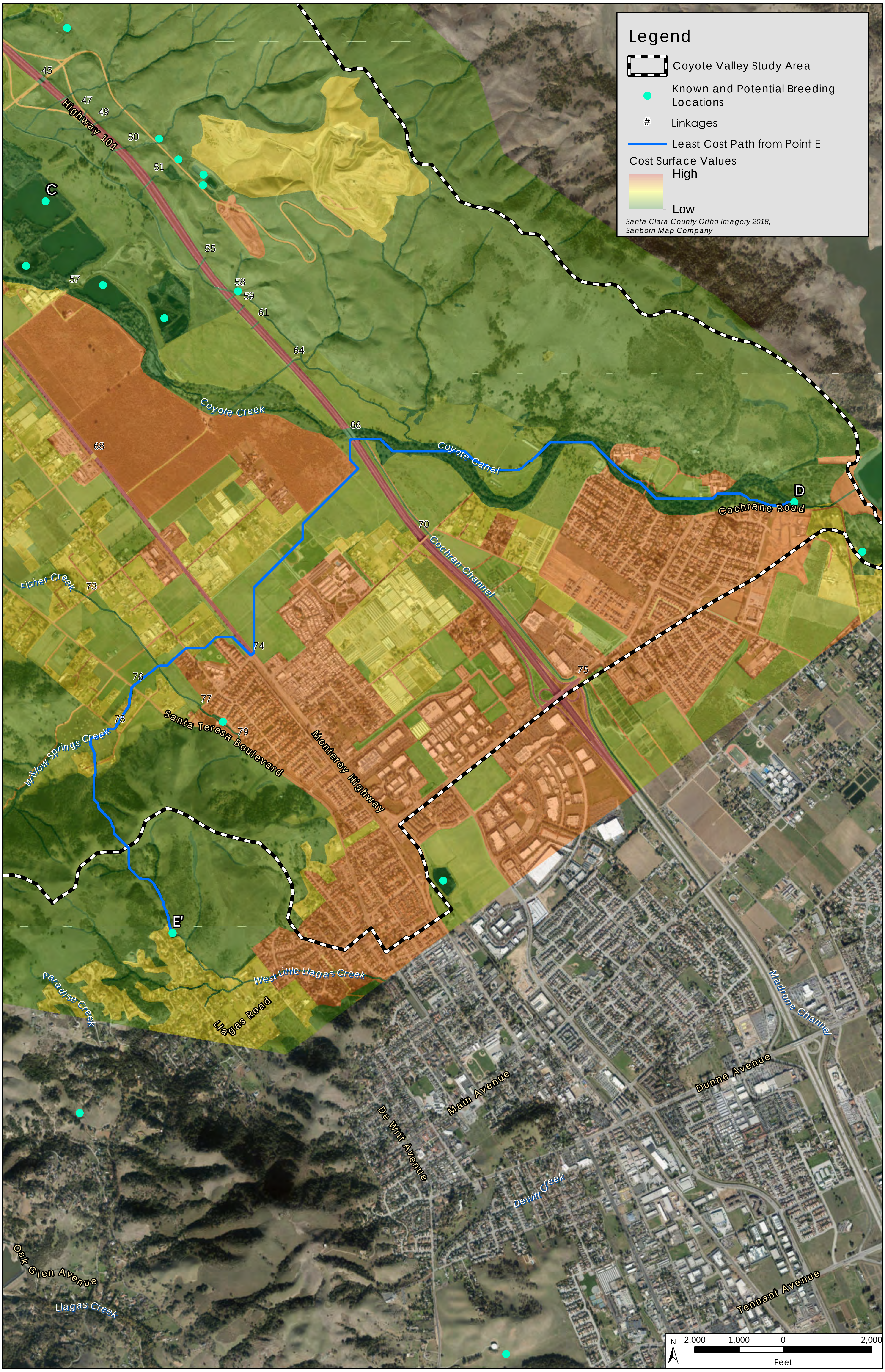

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Figure 40. Western Pond Turtle Least Cost Pathway 8
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Figure **41**. California Tiger Salamander Least Cost Path**way 4** with High Speed Rail Recommended Infrastructure

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Figure 42. California Red-legged Frog Least Cost **Pathway 3** with High Speed Rail Recommended Infrastructure

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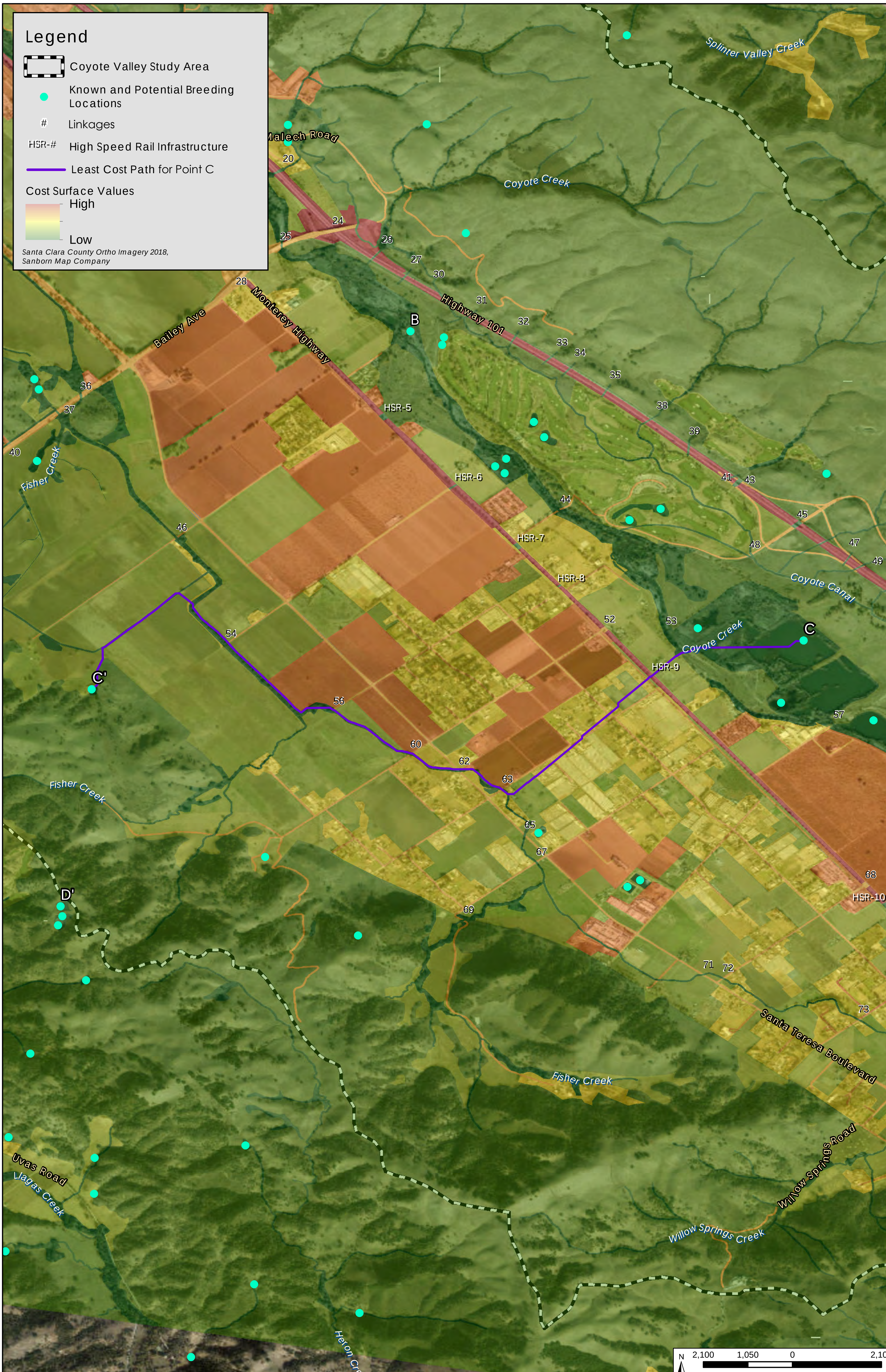

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Figure **43**. Western Pond Turtle Least Cost Path**way 6** with High Speed Rail Recommended Infrastructure
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