An update on the latest findings from mountain lion research in San Diego County, the region, and the state

Winston Vickers and Walter Boyce, UC Davis Wildlife Health Center

Photo courtesy Irvine Ranch Conservancy

Support

- Calif. State Parks
- Calif. Dept. of Fish and Wildlife
- The Nature Conservancy
- San Diego County Association of Governments
- NCCP-Local Assistance Grant Program
- Orange County Natural Communities Coalition
- Foothill East Transportation Corridor Agency
- National Science Foundation
- The McBeth Foundation
- The Anza Borrego Foundation
- The Felidae Fund
- The San Diego Foundation
- Institute for Wildlife Studies
- Private Donors

Cooperation

- Cal Poly Pomona Civil Engineering
- USFS, USGS, BLM, USFWS, National Park Service, US Navy and Marine Corp.
- Orange, Riverside, and San Diego County Parks
- Audubon Starr Ranch Reserve
- Irvine Ranch Conservancy
- Pala and Pauma Tribes
- Western Riverside County Regional Conservation Authority
- Various regional water agencies
- Cal Trans and Orange County Transportation Agency
- Rancho Mission Viejo

Stories told by genetics

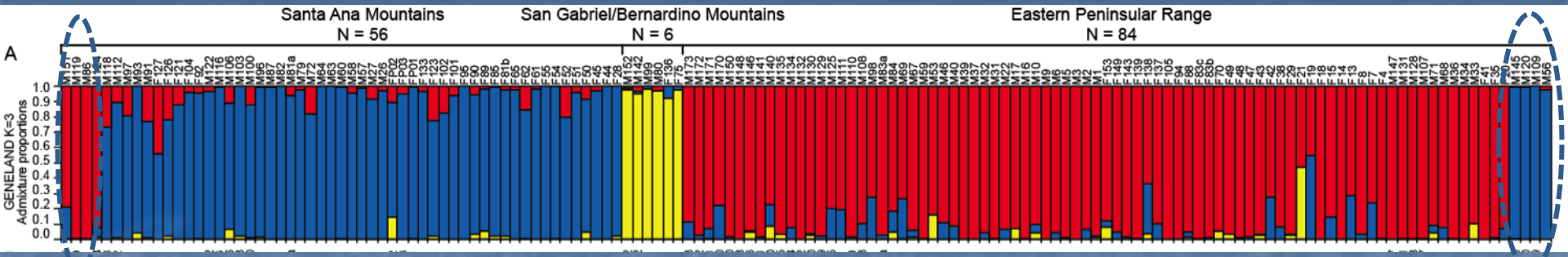
OPEN ACCESS Freely available online

PLOS ONE

Fractured Genetic Connectivity Threatens a Southern California Puma (*Puma concolor*) Population

Holly B. Ernest[1,2*¤], T. Winston Vickers[1], Scott A. Morrison[3], Michael R. Buchalski[1,2], Walter M. Boyce[1]

1 Wildlife Health Center, School of Veterinary Medicine, University of California Davis, Davis, California, United States of America, 2 Wildlife and Ecology Unit, Veterinary Genetics Laboratory, School of Veterinary Medicine, University of California Davis, Davis, California, United States of America, 3 The Nature Conservancy, San Francisco, California, United States of America



M86

Santa Ana Mountains

Eastern Peninsular Range

ROYAL SOCIETY OPEN SCIENCE

rsos.royalsocietypublishing.org

Research

Check for updates

Cite this article: Gustafson KD, Vickers TW, Boyce WM, Ernest HB. 2017 A single migrant enhances the genetic diversity of an inbred puma population. *R. Soc. open sci.* **4**: 170115. http://dx.doi.org/10.1098/rsos.170115

A single migrant enhances the genetic diversity of an inbred puma population

Kyle D. Gustafson[1], T. Winston Vickers[2], Walter M. Boyce[2] and Holly B. Ernest[1]

[1]Wildlife Genomics and Disease Ecology Laboratory, Department of Veterinary Sciences, University of Wyoming, Laramie, WY 82070, USA

[2]Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California, Davis, CA 95616, USA

Gustafson et al. 2017

M86 - 11 offspring – enhanced diversity
M86 and over half of offspring known deceased

Photo Credit: Irvine Ranch Conservancy

Conservation Genetics
https://doi.org/10.1007/s10592-018-1125-0

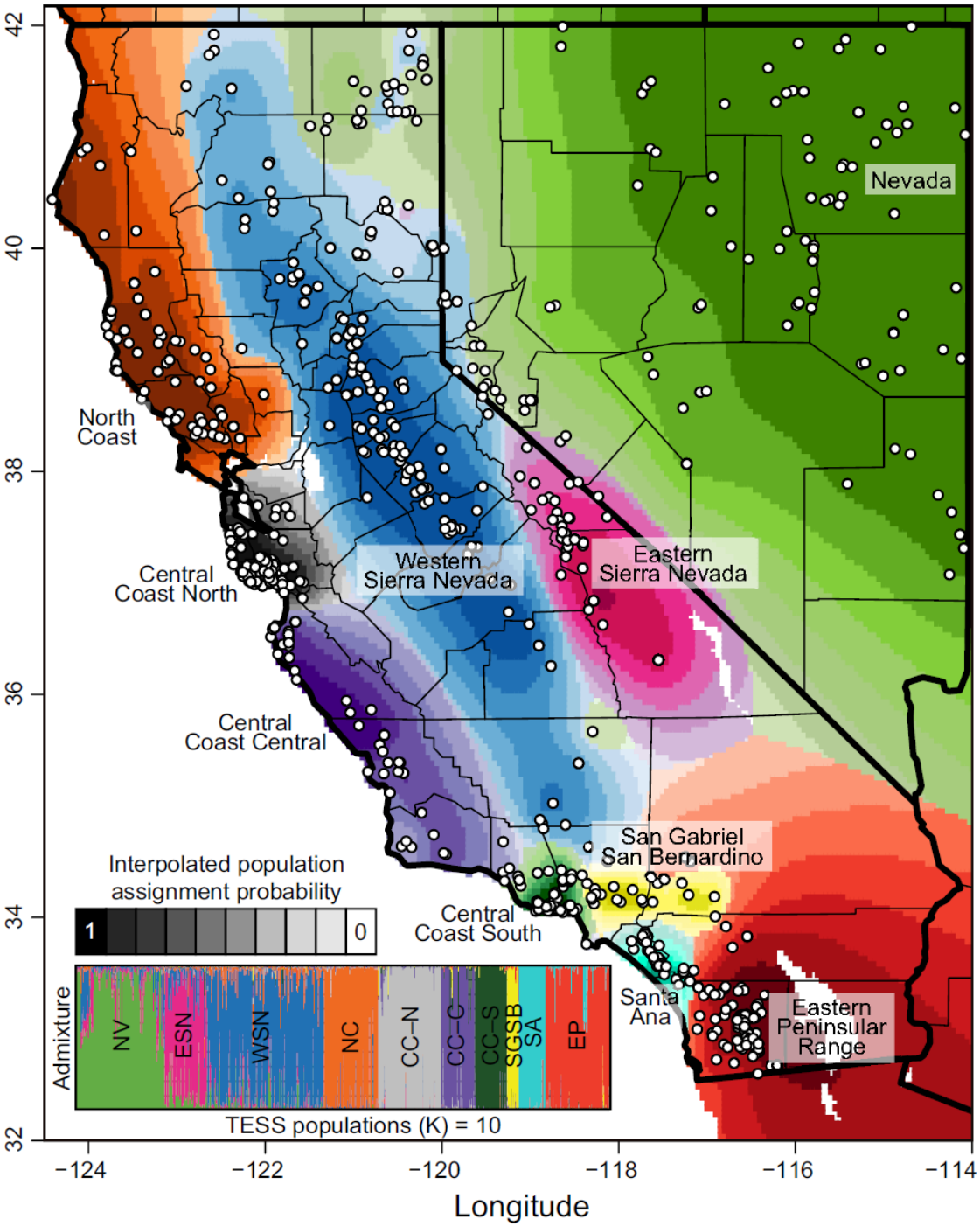
RESEARCH ARTICLE

Genetic source–sink dynamics among naturally structured and anthropogenically fragmented puma populations

Kyle D. Gustafson[1,2] · Roderick B. Gagne[1] · T. Winston Vickers[3] · Seth P. D. Riley[4] · Christopher C. Wilmers[5] · Vernon C. Bleich[6] · Becky M. Pierce[7] · Marc Kenyon[8] · Tracy L. Drazenovich[9] · Jeff A. Sikich[4] · Walter M. Boyce[3] · Holly B. Ernest[1]

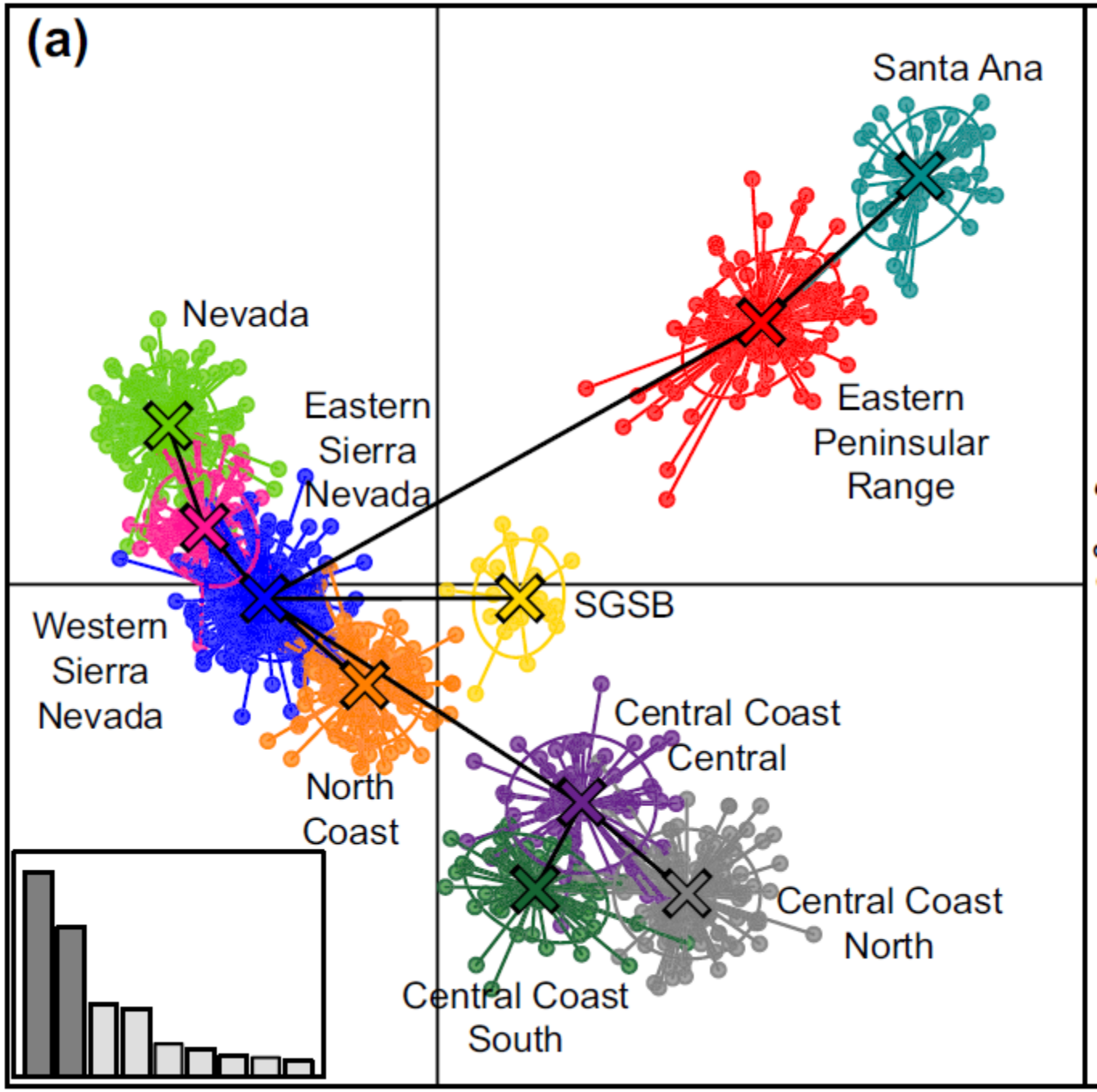
California mountain lions are divided into ten identifiable subpopulations (with one subpopulation consistent with Nevada mountain lions), with genetic restriction and isolation not just in the Santa Monicas and Santa Anas, but also the San Bernardinos/San Gabriels and others.

From Gustafson et al. 2018



Functional connectedness of puma populations, based on a discriminant analysis of principal components and bi-directional migration rate estimates (multiplied by 100 for visualization). Each dot represents an individual (a). Each color represents a population. Black lines indicate the most closely-related population based on genetic dissimilarities.

From Gustafson et al. 2018



Ecological Applications, 0(0), 2019, e01868

Extinction vortex dynamics of top predators isolated by urbanization

John F. Benson,[1,2,8] Peter J. Mahoney,[3] T. Winston Vickers,[4] Jeff A. Sikich,[5] Paul Beier,[6] Seth P. D. Riley,[2,5] Holly B. Ernest,[7] and Walter M. Boyce[4]

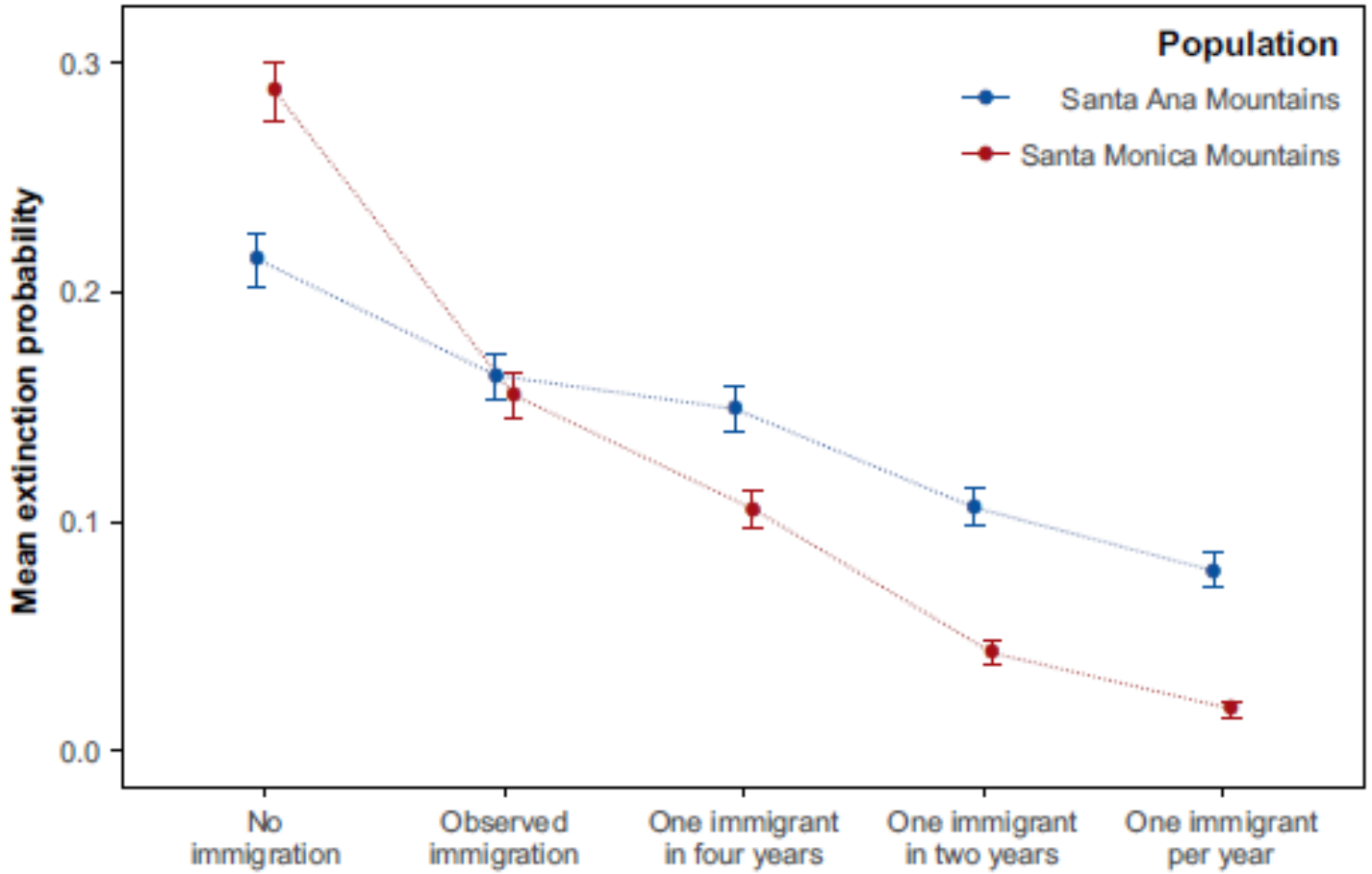


FIG. 2. Estimated extinction probability (without considering potential inbreeding effects) in 50 yr for mountain lion populations in the Santa Ana and Santa Monica Mountains from an individual-based population model based on 5,000 projections and varying levels of immigration.

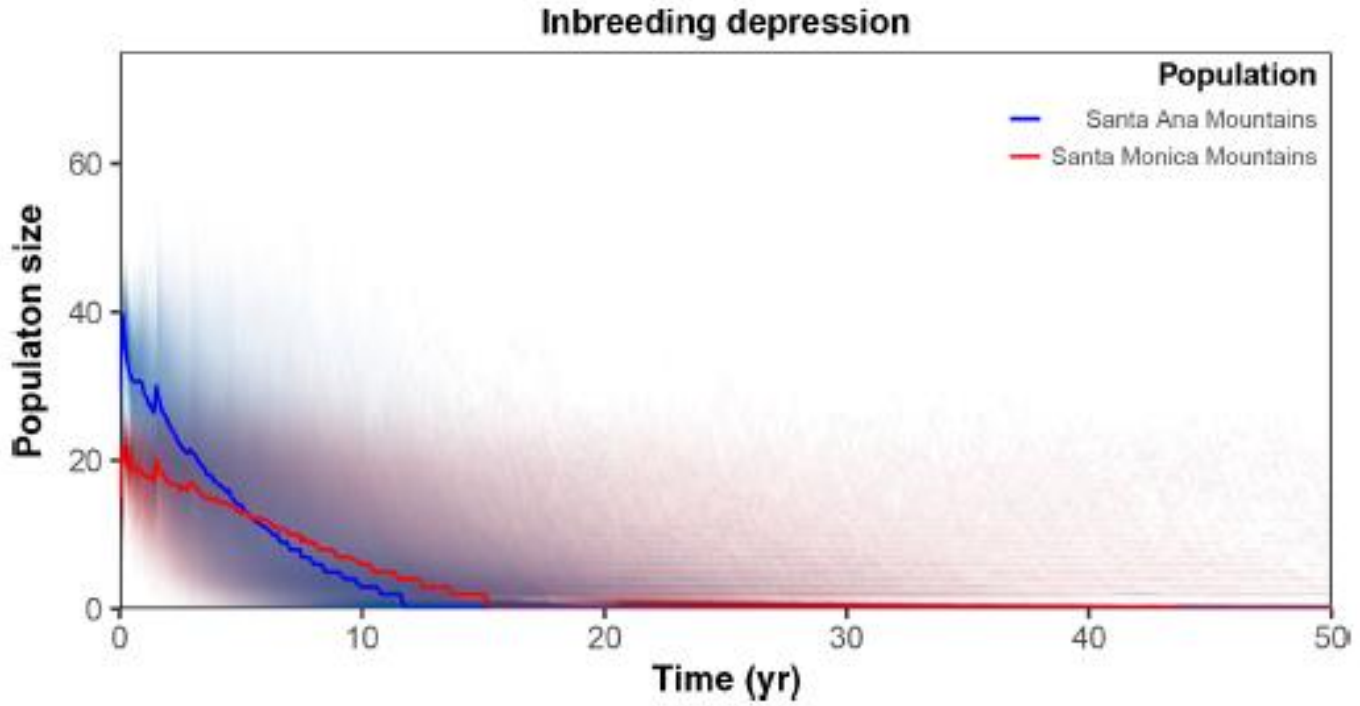
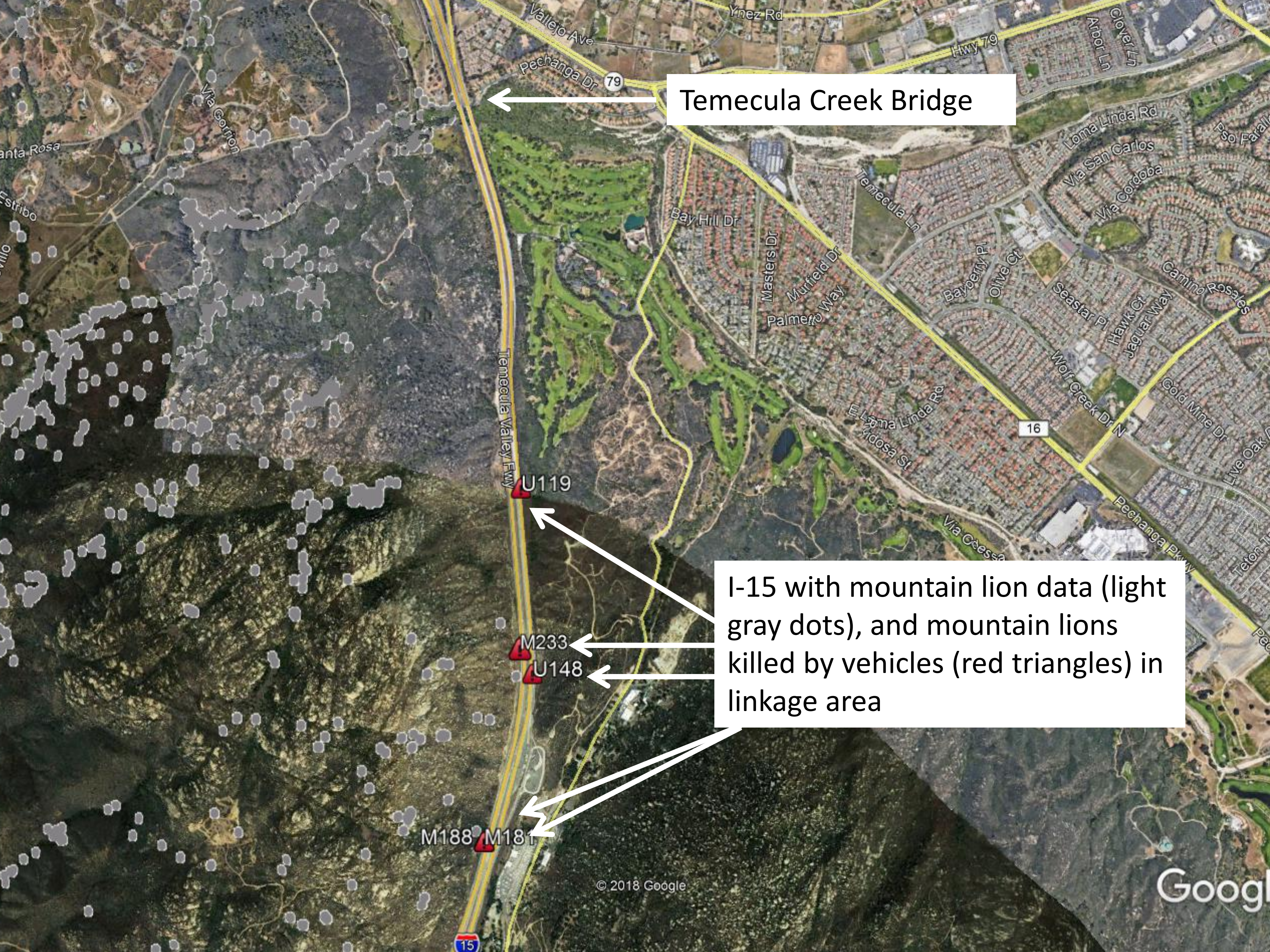


FIG. 4. Density-dependent demographic projections from individual-based population model showing predicted population sizes for mountain lions in the Santa Ana and Santa Monica Mountains over 50 yr based on 5,000 projections when we simulated inbreeding depression with the observed level of immigration.

- 15-20% likelihood of extirpation in 50 years due to stochastic/demographic factors with current level of immigration
- Median time to extirpation if inbreeding depression effects occur in Santa Ana's is 12 yrs
- Analysis data cutoff was 2016 – 3 yrs ago

- Maintaining genetic diversity in the population requires at least one migrant every 1-2 yrs

- Mitigation strategies should target two main threats – isolation and mortality


Temecula Creek Bridge
I-15 with mountain lion data (light gray dots), and mountain lions killed by vehicles (red triangles) in linkage area
U119
M233
U148
M188
M181
Temecula Valley Fwy
Pechanga Dr
Vallejo Ave
Ynez Rd
Hwy 79
79
Arbor Ln
Clover Ln
Loma Linda Rd
Via San Carlos
Via Cordoba
Pso Parallel
Via Gorrion
Santa Rosa
Estribo
Bay Hill Dr
Temecula Ln
Masters Dr
Muirfield Dr
Palmetto Way
Bayberry Pl
Olive Ct
Seastar Pl
Hawk Ct
Jaguar Way
Camino Rosales
Wolf Creek Dr N
Gold Mine Dr
Live Oak Dr
16
E Loma Linda Rd
Vidosa St
Via Cuesta
Pechanga Pkwy
15
© 2018 Google
Google

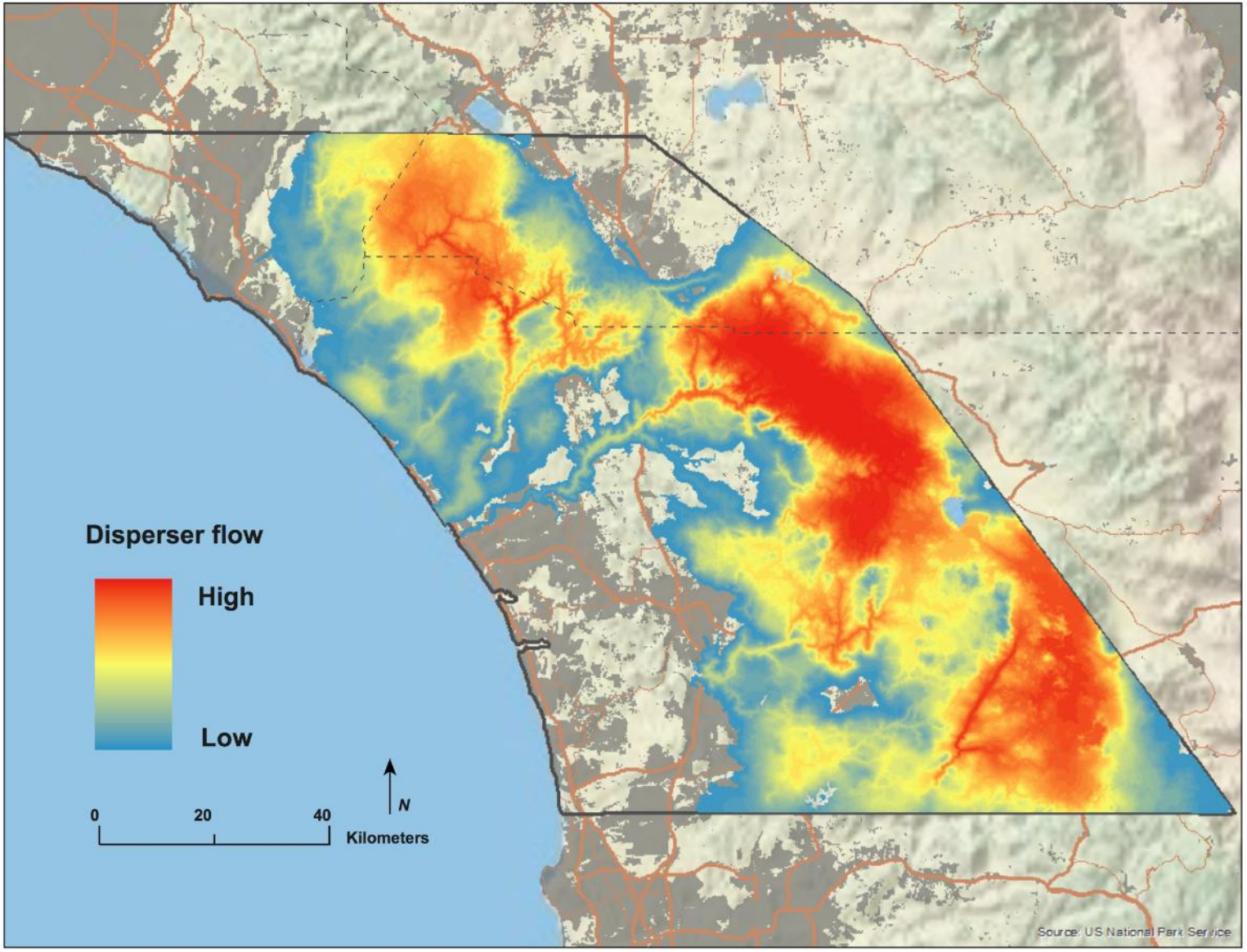
Landscape Ecol (2016) 31:1319–1335
DOI 10.1007/s10980-015-0301-6

RESEARCH ARTICLE

Using step and path selection functions for estimating resistance to movement: pumas as a case study

Katherine A. Zeller · Kevin McGarigal · Samuel A. Cushman · Paul Beier · T. Winston Vickers · Walter M. Boyce

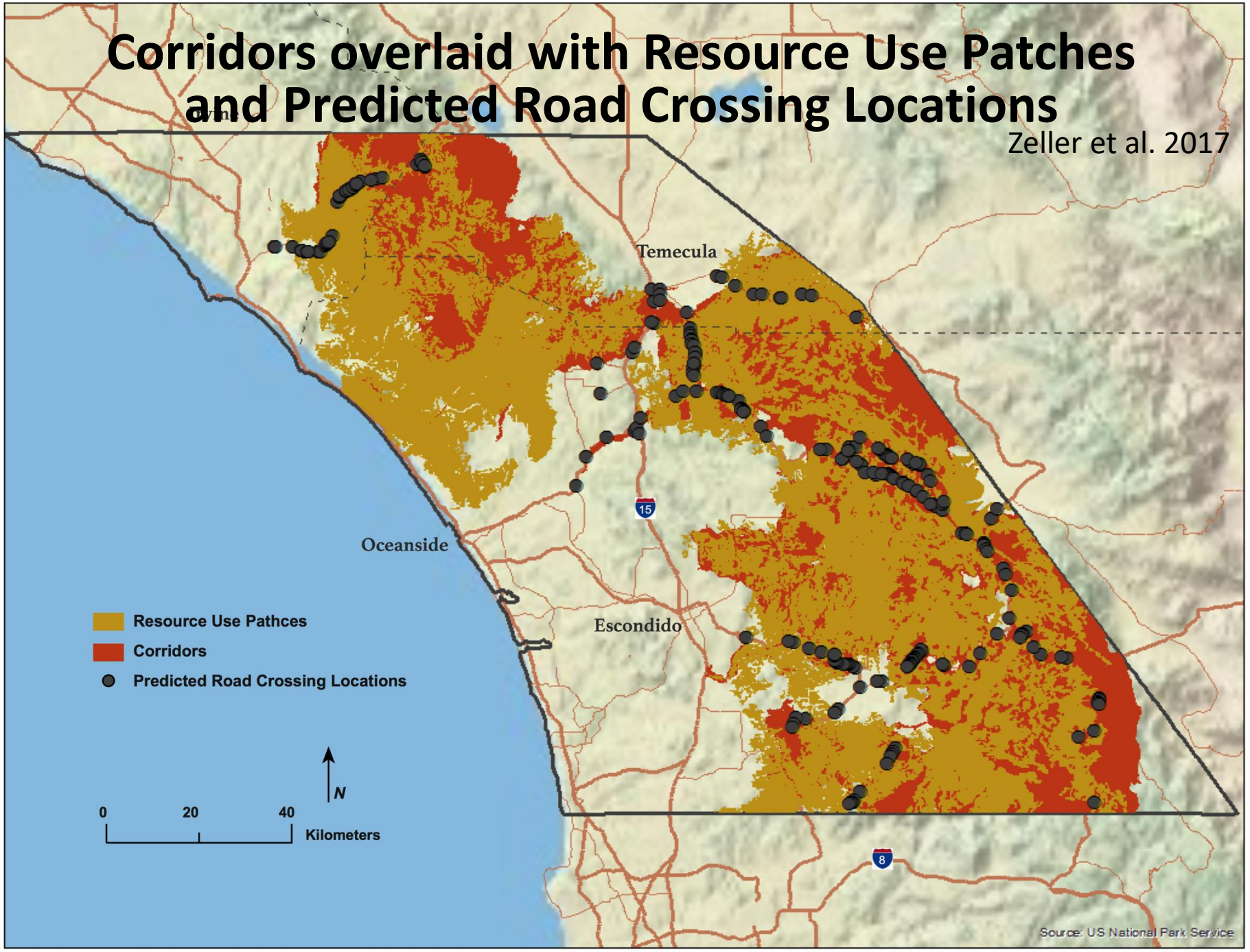
Landscape Corridor Definition Using Disperser Data



Zeller et al. 2017

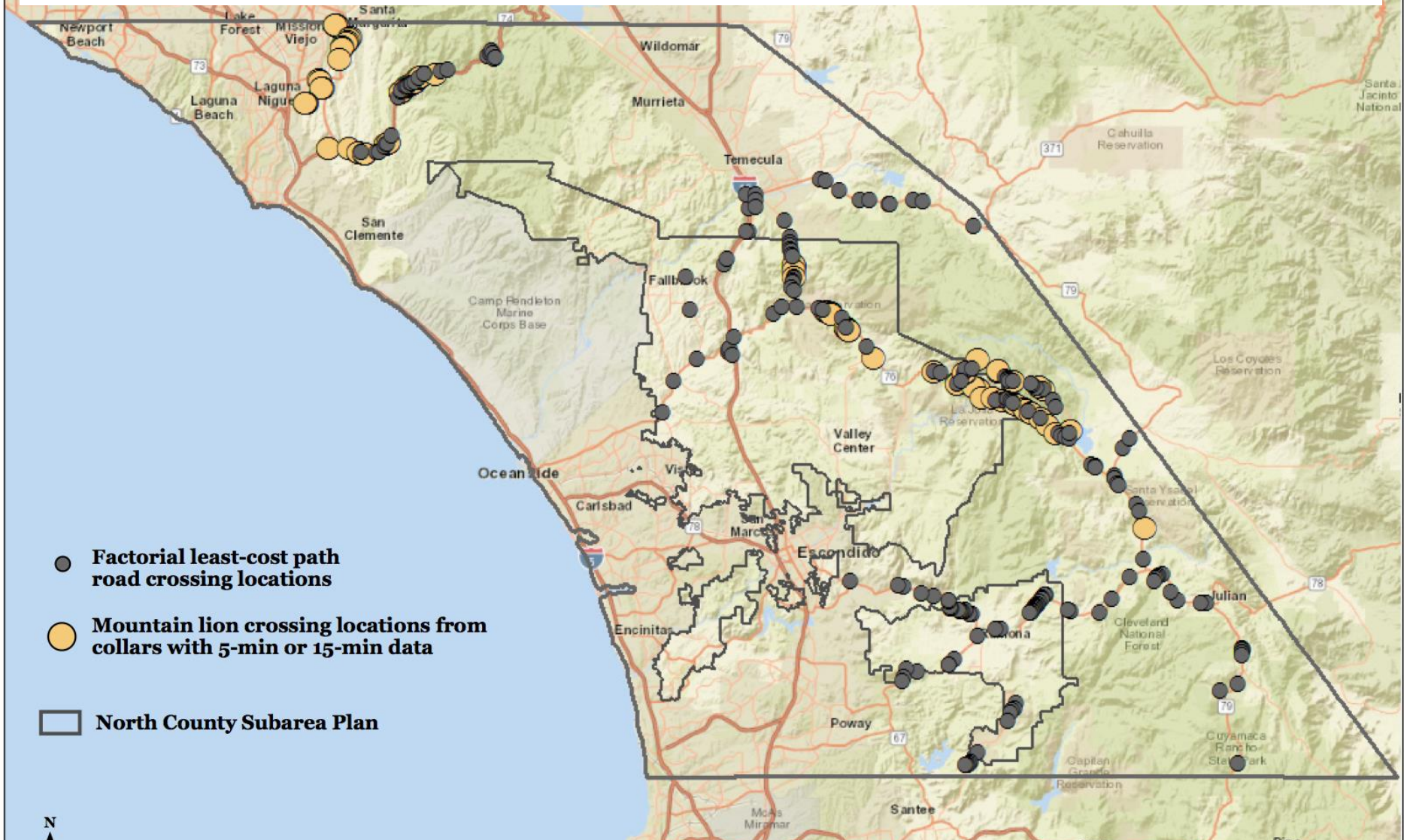
Corridors overlaid with Resource Use Patches and Predicted Road Crossing Locations

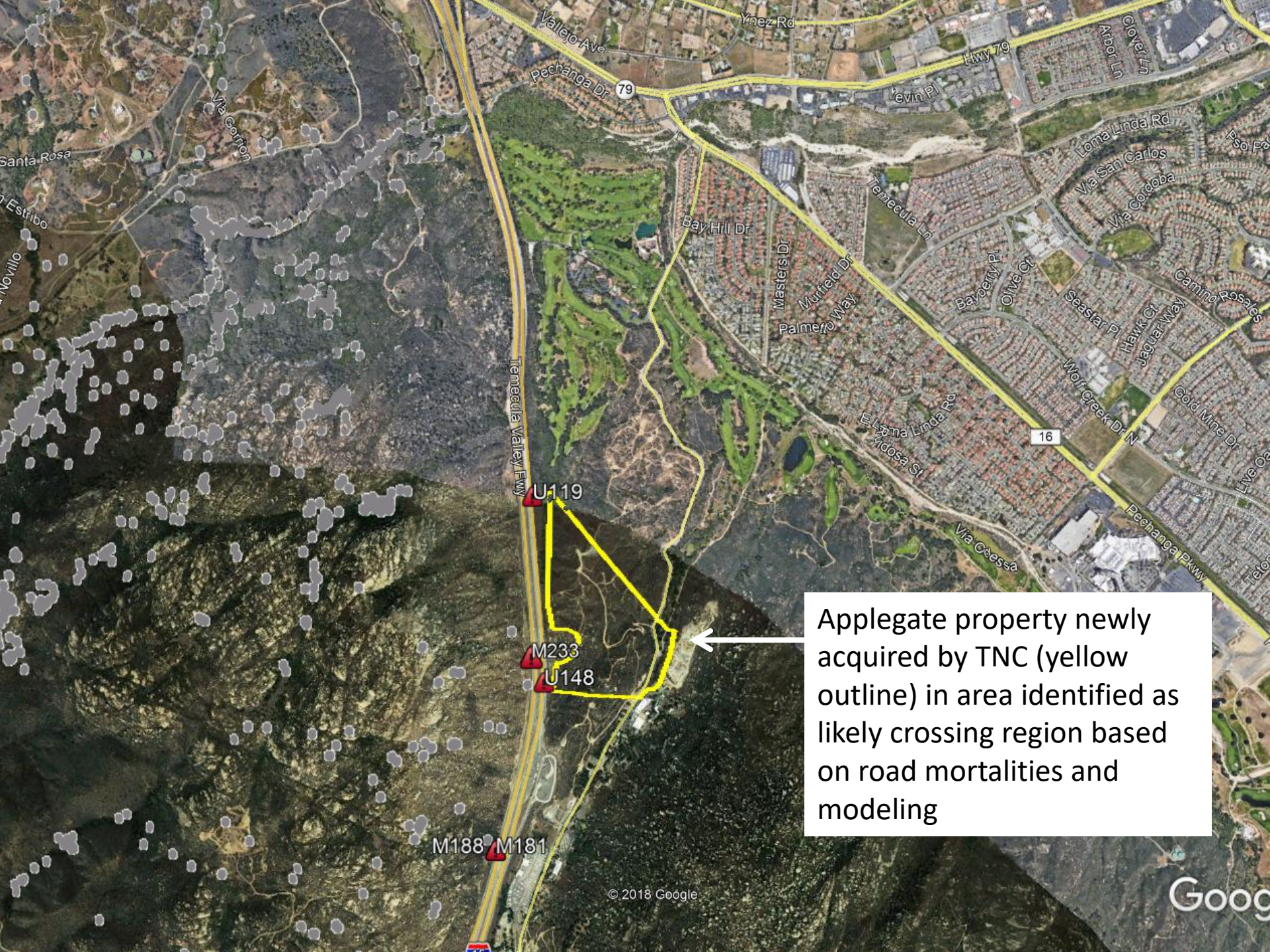
Zeller et al. 2017



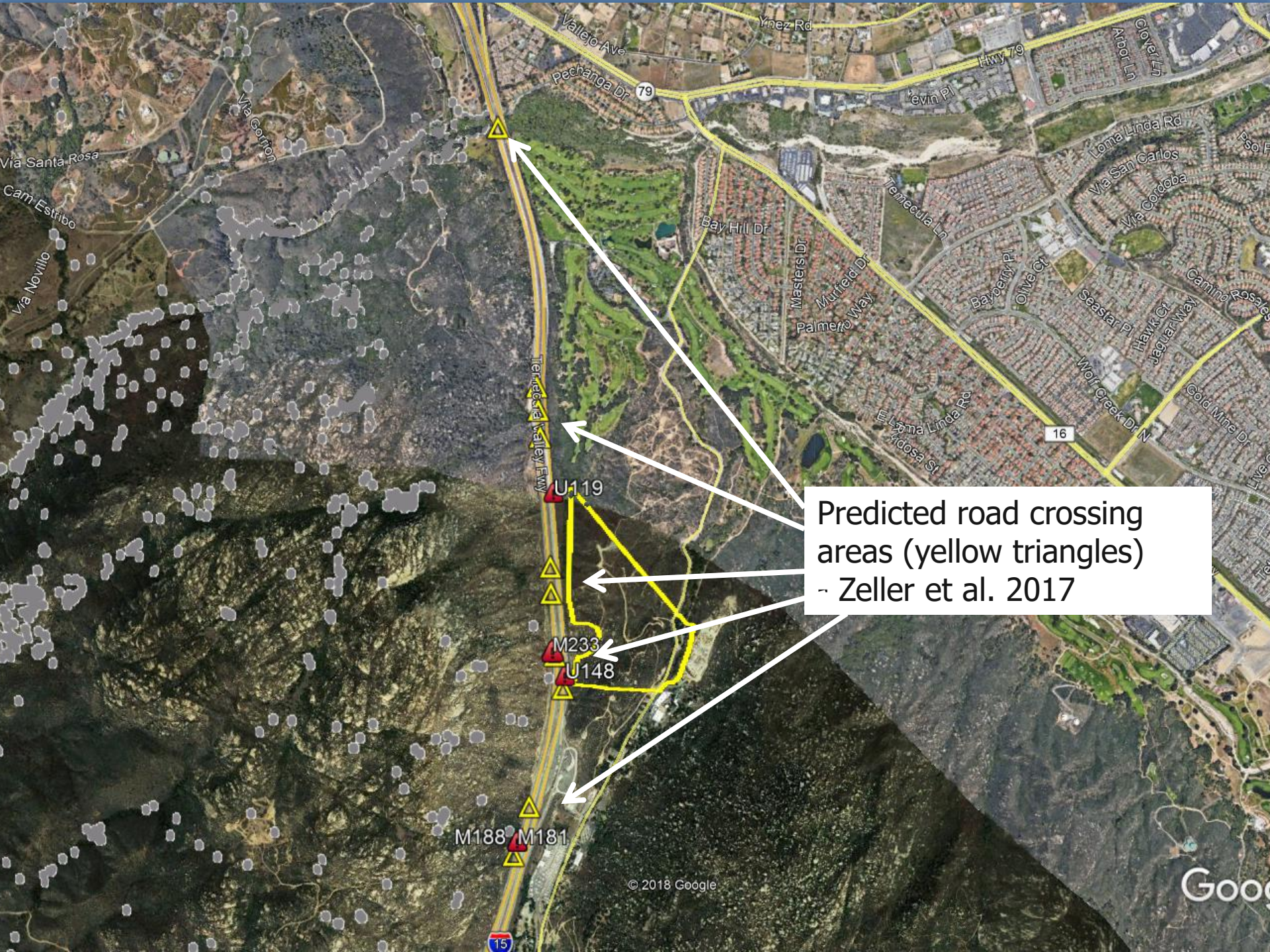
1,540 crossings of major roads east of I-15 by 51 collared pumas, at least 16% were struck (Vickers et al. 2015,2017)

Designing improvements for high risk sections





Applegate property newly acquired by TNC (yellow outline) in area identified as likely crossing region based on road mortalities and modeling


Predicted road crossing areas (yellow triangles) - Zeller et al. 2017
U119
M233
U148
M188
M181
Vallejo Ave
Ynez Rd
Pechanga Dr
Hwy 79
Clover Ln
Arbor Ln
Levin Pl
Loma Linda Rd
Via San Carlos
Via Cordoba
Paso R
Via Gorron
Via Santa Rosa
Cam Estribo
Via Novillo
Bay Hill Dr
Masters Dr
Murfield Dr
Temecula Ln
Bayberry Pl
Olive Ct
Palmetto Way
Seastar Pl
Hawk Ct
Jaguar Way
Camino Rosales
Wolf Creek Dr N
Cold Mine Dr
E Loma Linda Rd
Idosa St
Temecula Valley Fwy
16
15
© 2018 Google

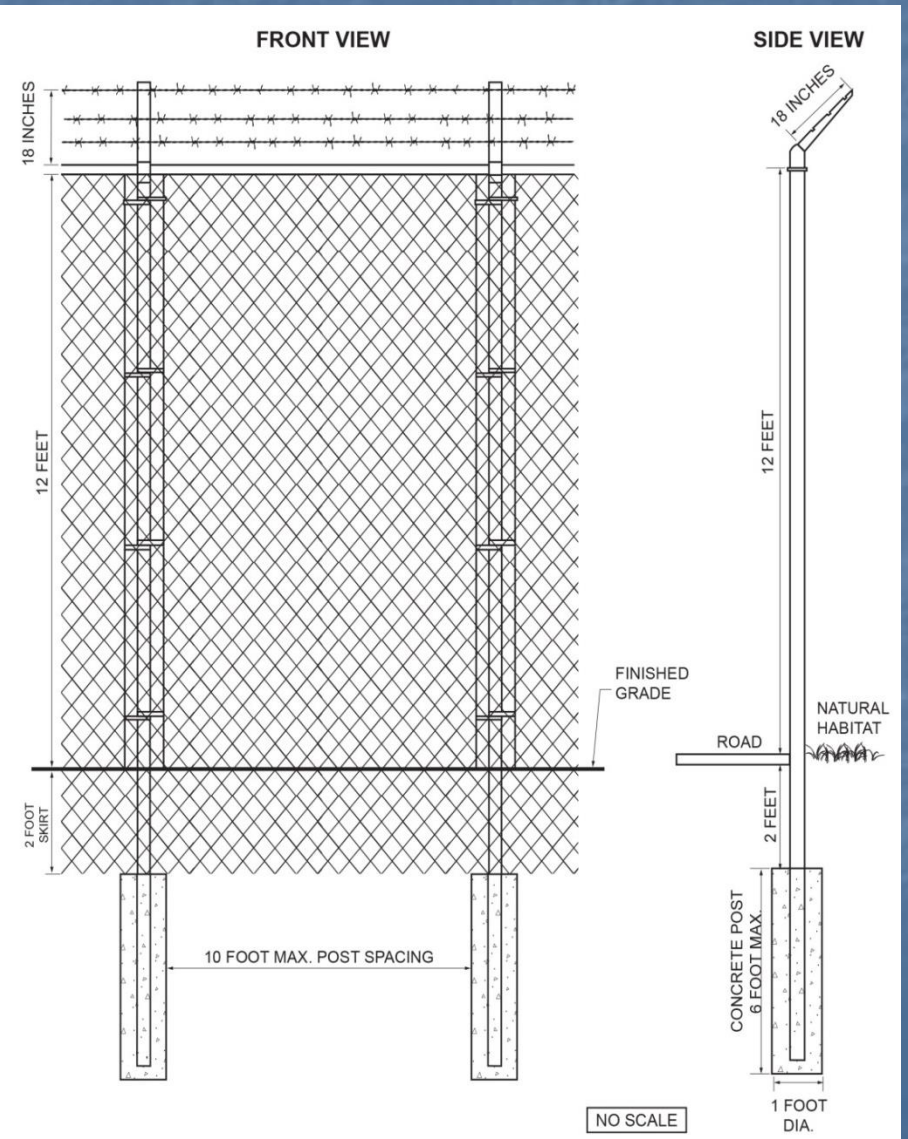
Potential Improvements for reducing mortality:

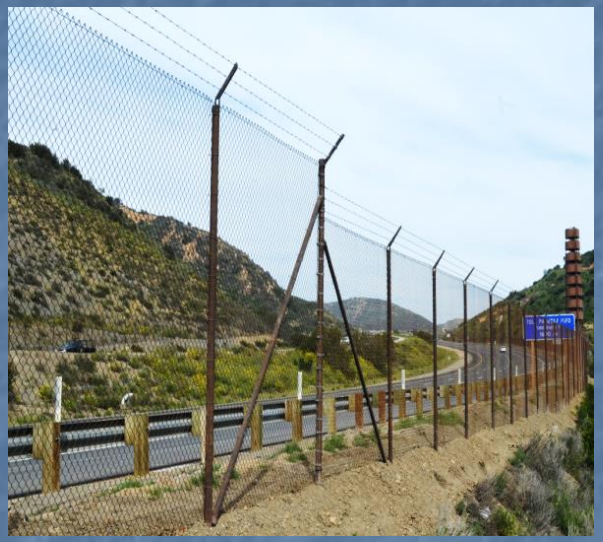
Fencing projects:

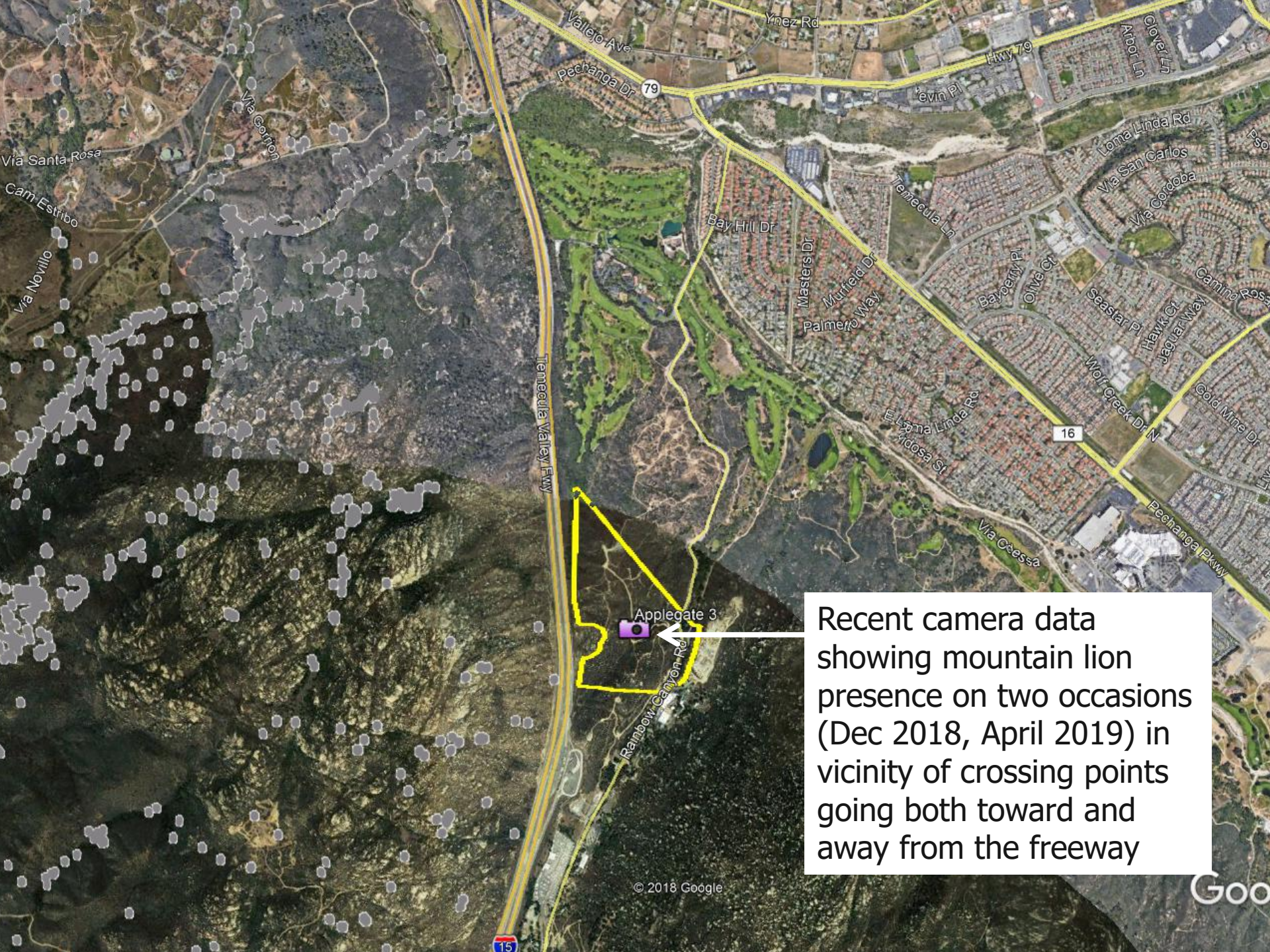
- Cal Trans current project in Riv Co section of 15
- Proposing planning for fencing from border to Mission Rd.

SR 241 FENCING PROJECT

(100% REDUCTION IN MORTALITY – DEER, BOBCAT, MT. LION, AND OVER 95% FOR COYOTES)



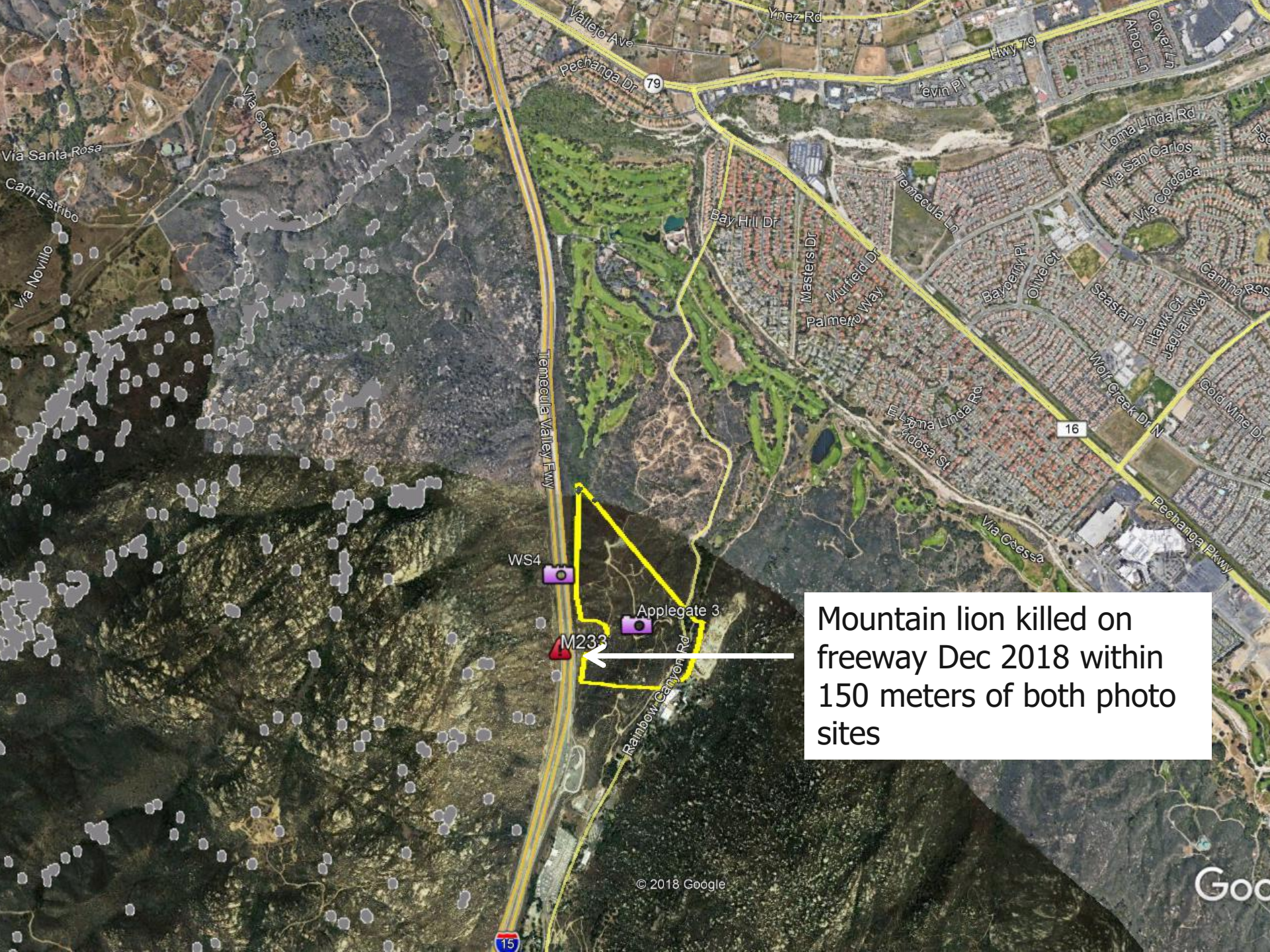




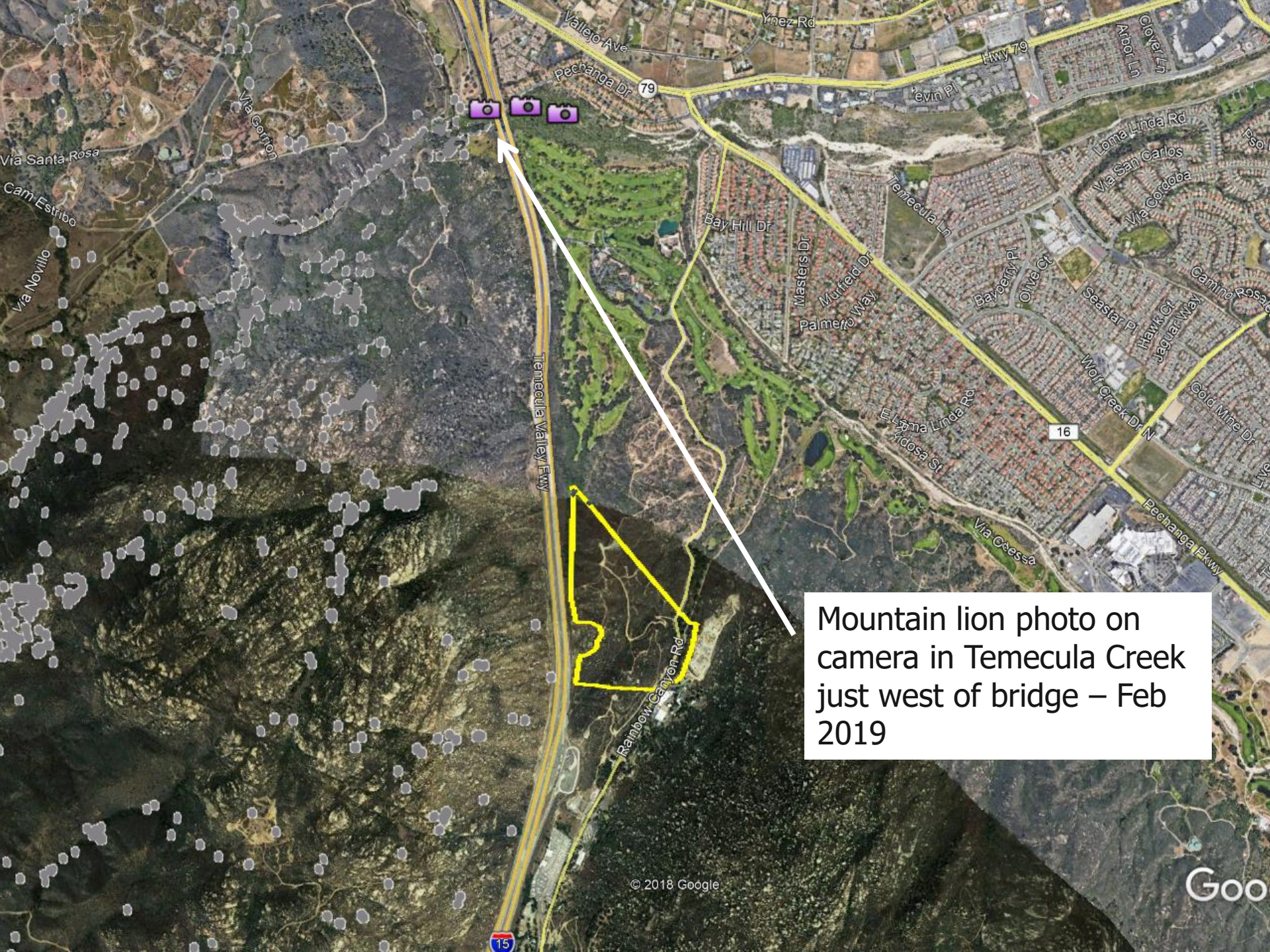
Recent camera data showing mountain lion presence on two occasions (Dec 2018, April 2019) in vicinity of crossing points going both toward and away from the freeway

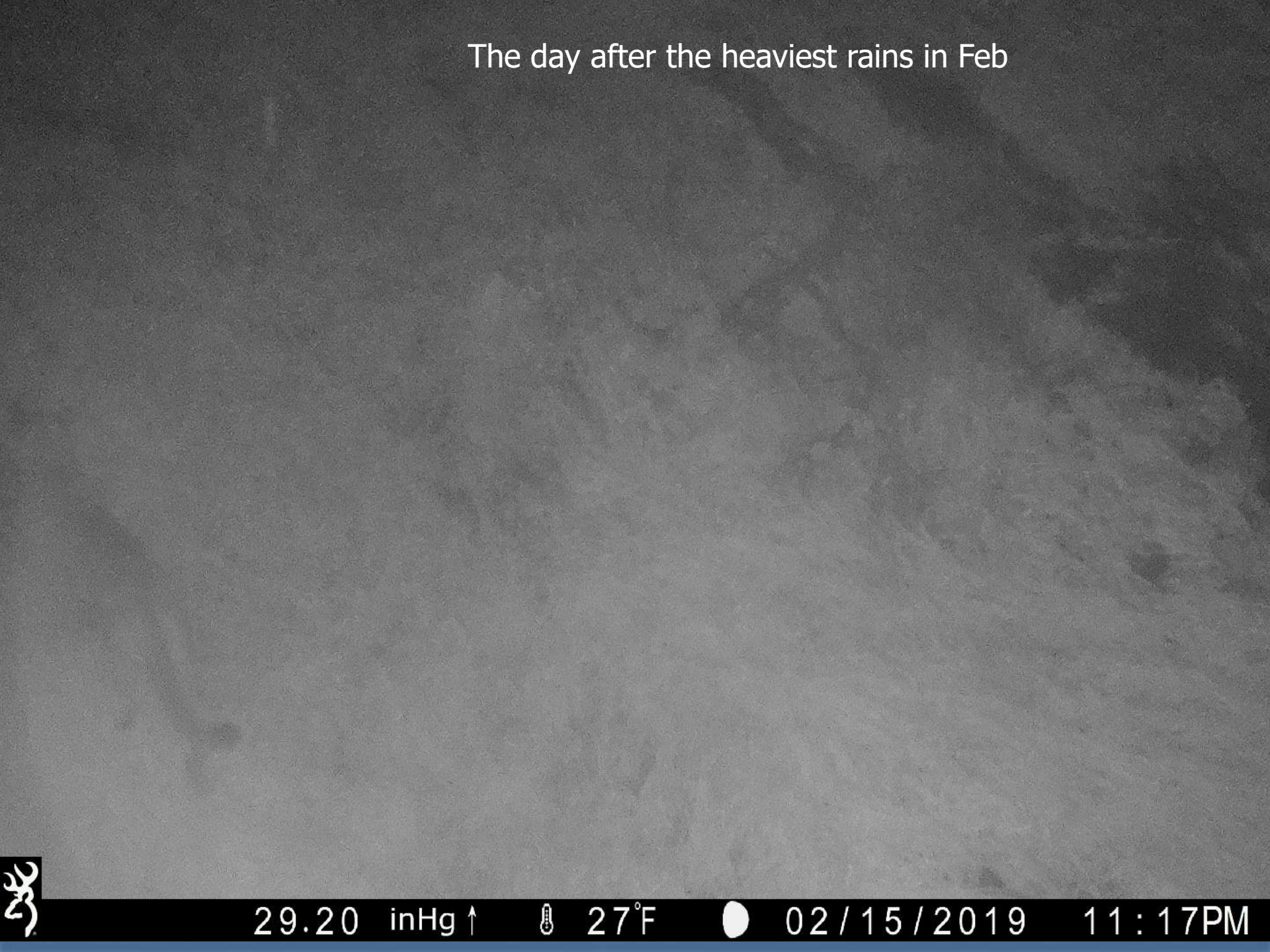

Vallejo Ave
Ynez Rd
Pechanga Dr
79
Hwy 79
Arbor Ln
Clover Ln
Levin Pl
Loma Linda Rd
Via San Carlos
Via Cordoba
Temecula Ln
Bay Hill Dr
Masters Dr
Murfield Dr
Palmero Way
Bayberry Pl
Olive Ct
Seastar Pl
Hawk Ct
Jaguar Way
Camino Rosales
Wolf Creek Dr N
Gold Mine Dr
E Loma Linda Rd
Vidosa St
16
Pechanga Pkwy
Via Caessa
Via Gorrion
Via Novillo
Temecula Valley Fwy
WS4
Applegate 3
Rainbow Canyon Rd
© 2018 Google
Camera data showing mountain lion presence in vicinity of crossing points on west side near culvert - Dec 2018

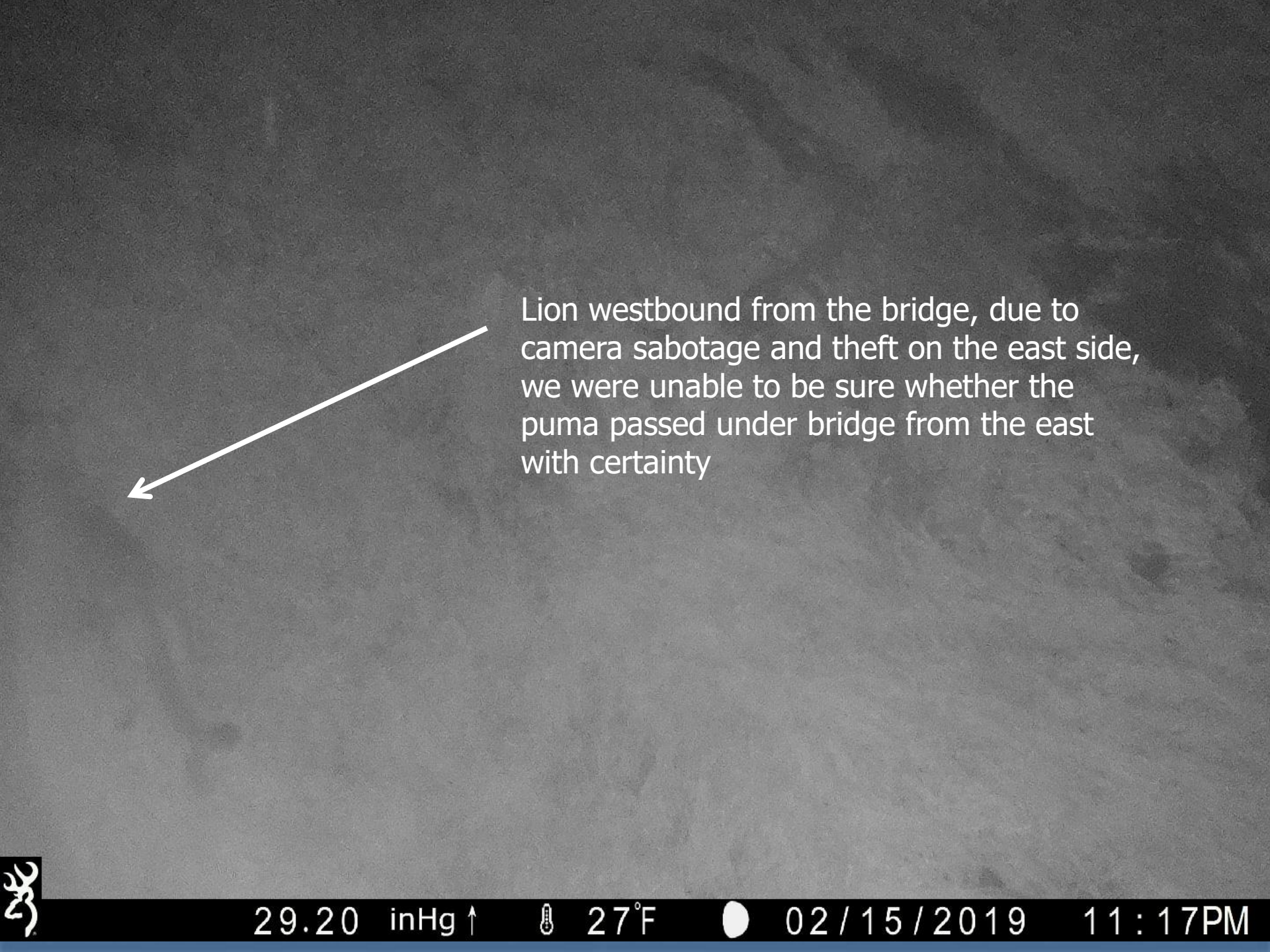

Bushnell
12–23–2018 18:48:34

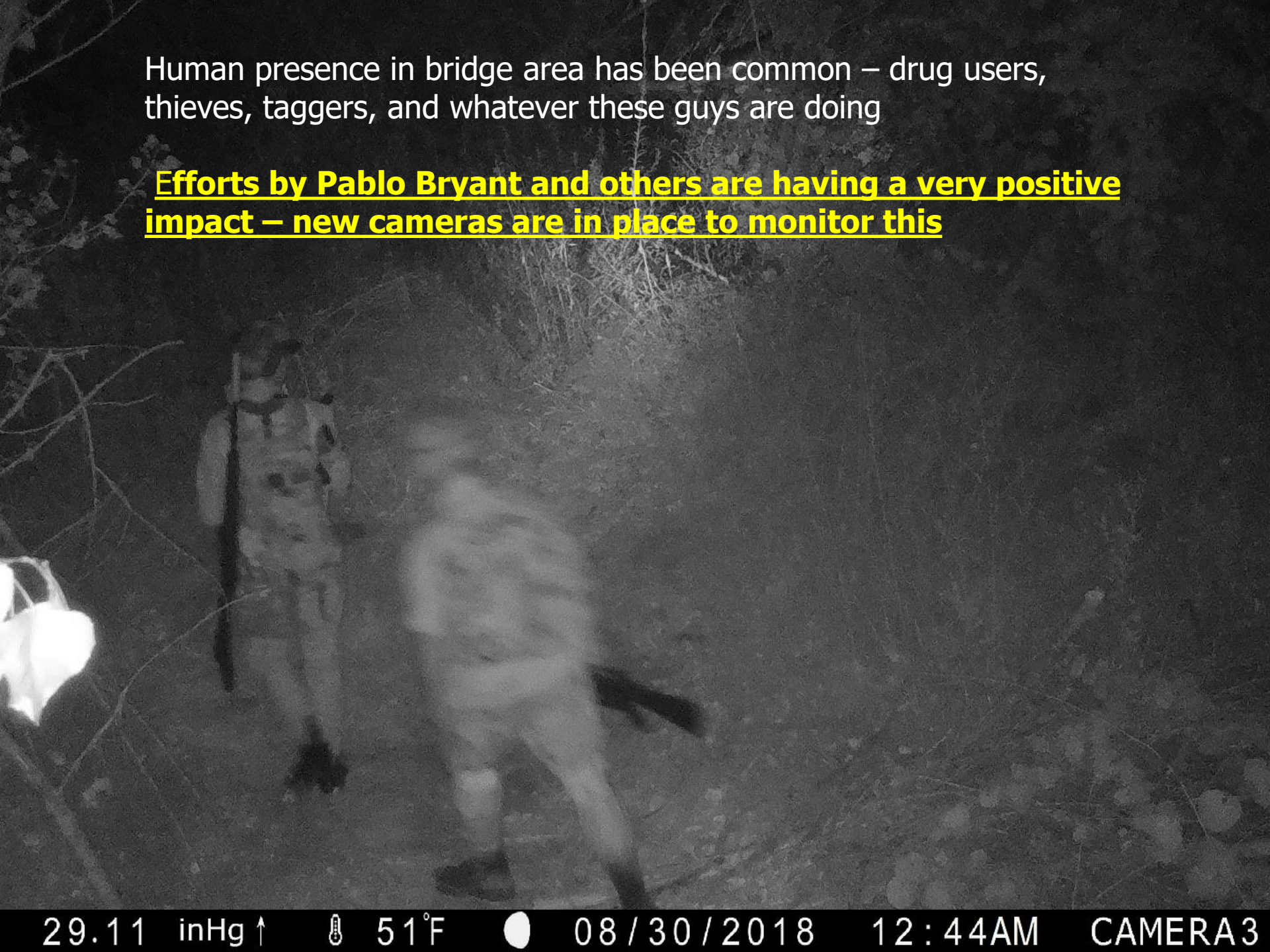


Mountain lion killed on freeway Dec 2018 within 150 meters of both photo sites

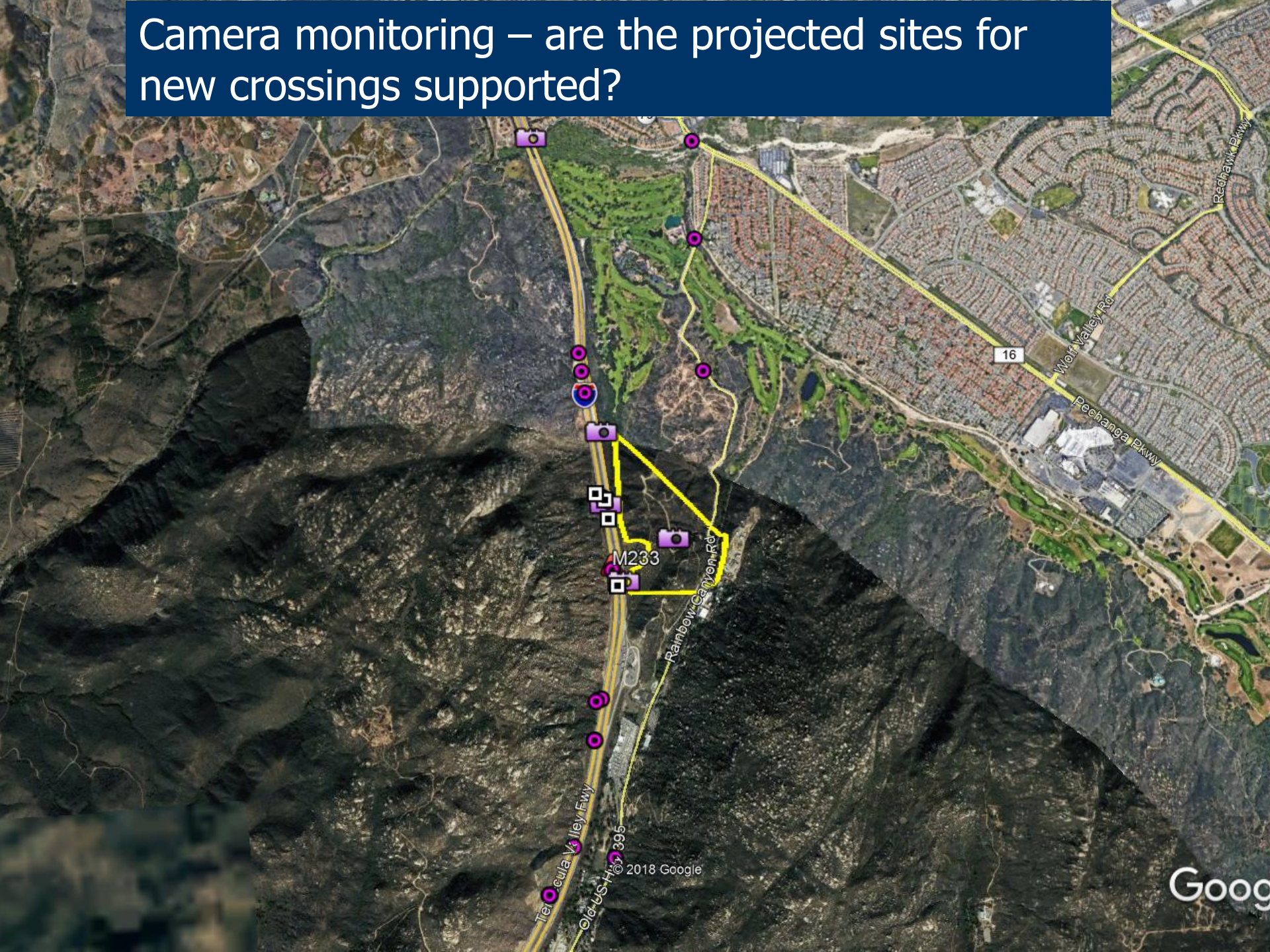

Mountain lion photo on camera in Temecula Creek just west of bridge – Feb 2019
Vallejo Ave
Ynez Rd
Pechanga Dr
79
Hwy 79
Arbor Ln
Clover Ln
Kevin Pl
Via Gorrion
Via Santa Rosa
Cam Estribo
Via Novillo
Loma Linda Rd
Via San Carlos
Via Cordoba
Temecula Ln
Bay Hill Dr
Masters Dr
Mufield Dr
Palmero Way
Bayberry Pl
Olivé Ct
Seastar Pl
Hawk Ct
Jaguar Way
Camino Rosa
Wolf Creek Dr N
Gold Mine Dr
E Loma Linda Rd
Adosa St
16
Via Caessa
Pechanga Pkwy
Temecula Valley Fwy
Rainbow Canyon Rd
© 2018 Google
15


The day after the heaviest rains in Feb
29.20 inHg
27°F
02/15/2019
11:17PM


Lion westbound from the bridge, due to camera sabotage and theft on the east side, we were unable to be sure whether the puma passed under bridge from the east with certainty
29.20 inHg
27°F
02/15/2019
11:17PM

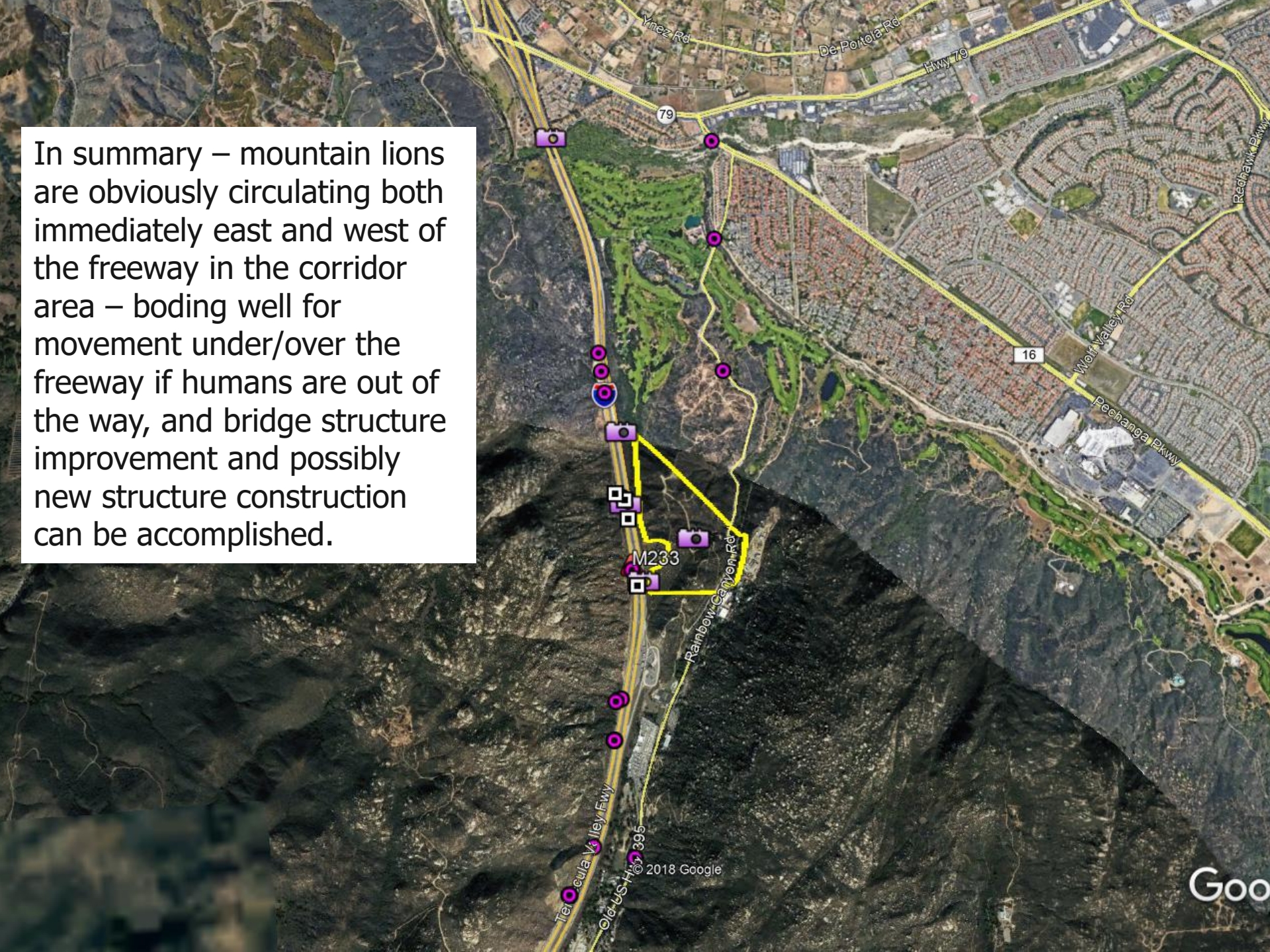

Human presence in bridge area has been common – drug users, thieves, taggers, and whatever these guys are doing
Efforts by Pablo Bryant and others are having a very positive impact – new cameras are in place to monitor this
29.11 inHg
51°F
08/30/2018
12:44AM
CAMERA3

Camera monitoring – are the projected sites for new crossings supported?




Bushnell
TROPHY CAM
53°F 11°C
07-16-2019 22:01:14


TROPHY CAM
53 °F 11 °C
07-16-2019 22:19


In summary – mountain lions are obviously circulating both immediately east and west of the freeway in the corridor area – boding well for movement under/over the freeway if humans are out of the way, and bridge structure improvement and possibly new structure construction can be accomplished.
Ynez Rd
De Portola Rd
Hwy 79
79
16
Wolf Valley Rd
Pechanga Pkwy
Redhawk Pkwy
M233
Rainbow Canyon Rd
Temecula Valley Fwy
Old US-Hwy 395
© 2018 Google

Potential Improvements for reducing mortality:

Fencing projects:

- Cal Trans current project in Riv Co section of 15
- Proposing planning for fencing from border to Mission Rd.

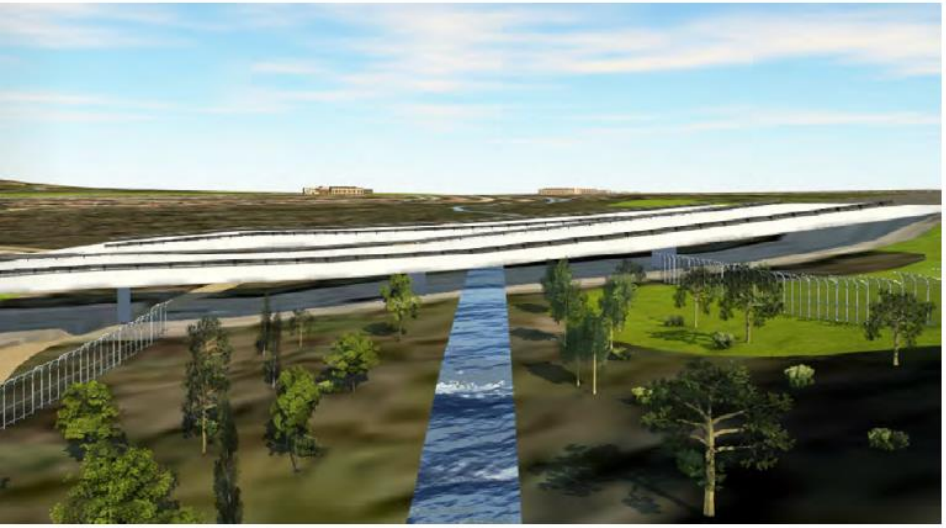
Improving Connectivity:

- UCD – CPP project
- Regional assessment and "Roadmap" for future connectivity

Cal Poly Pomona Civil Engineering Senior Projects

Design Alternatives

- Underpass
- Culvert
- Overpass



Passageway 1 Site Investigation

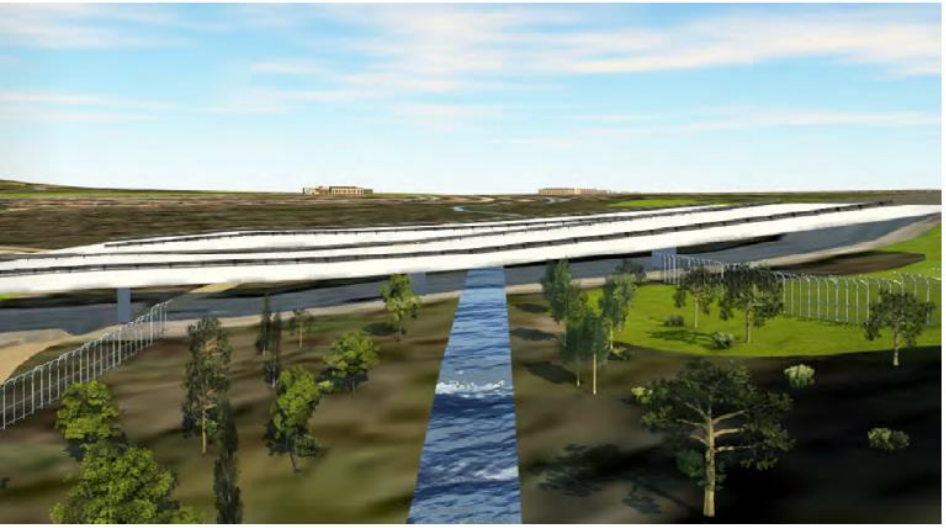
Temecula Creek Underpass

Passageway 1 Site Investigation

Cal Poly Pomona Civil Engineering Senior Projects

Design Alternatives

- Underpass
- Culvert
- Overpass



CPP proposal Temecula Creek Bridge

Phasing Description & Timeline

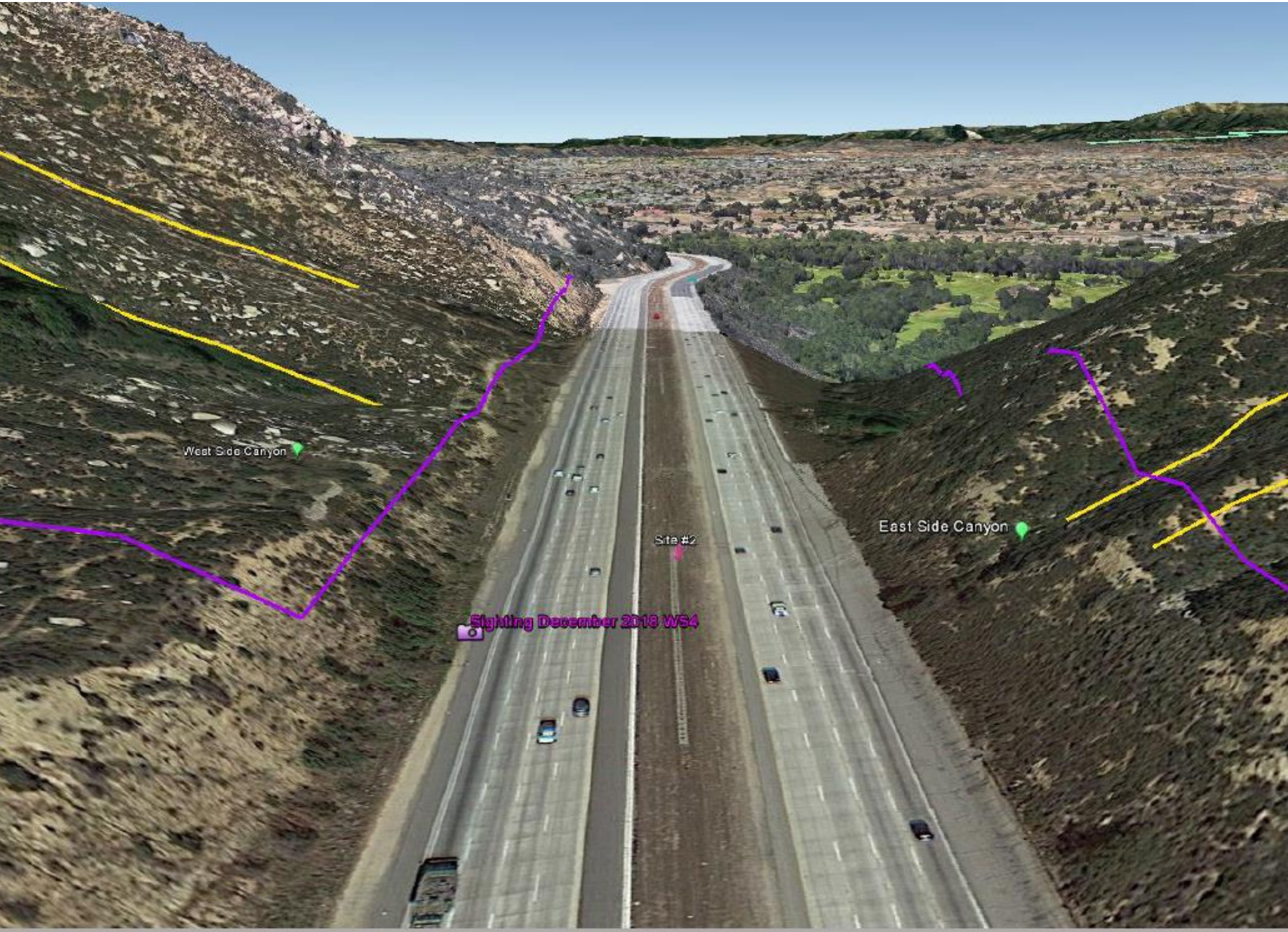
Phase I: Signs
- Warning signs
- 2 months

Phase II: Vegetation
- Native species planted
- 6 months - 1 year

Phase III: Fencing
- Chain link fencing (humans)
- Wildlife Fencing
- 2 alternative layouts
- 6 months-1 year

Phase IV: Sound Baffles
- Sound baffles installed

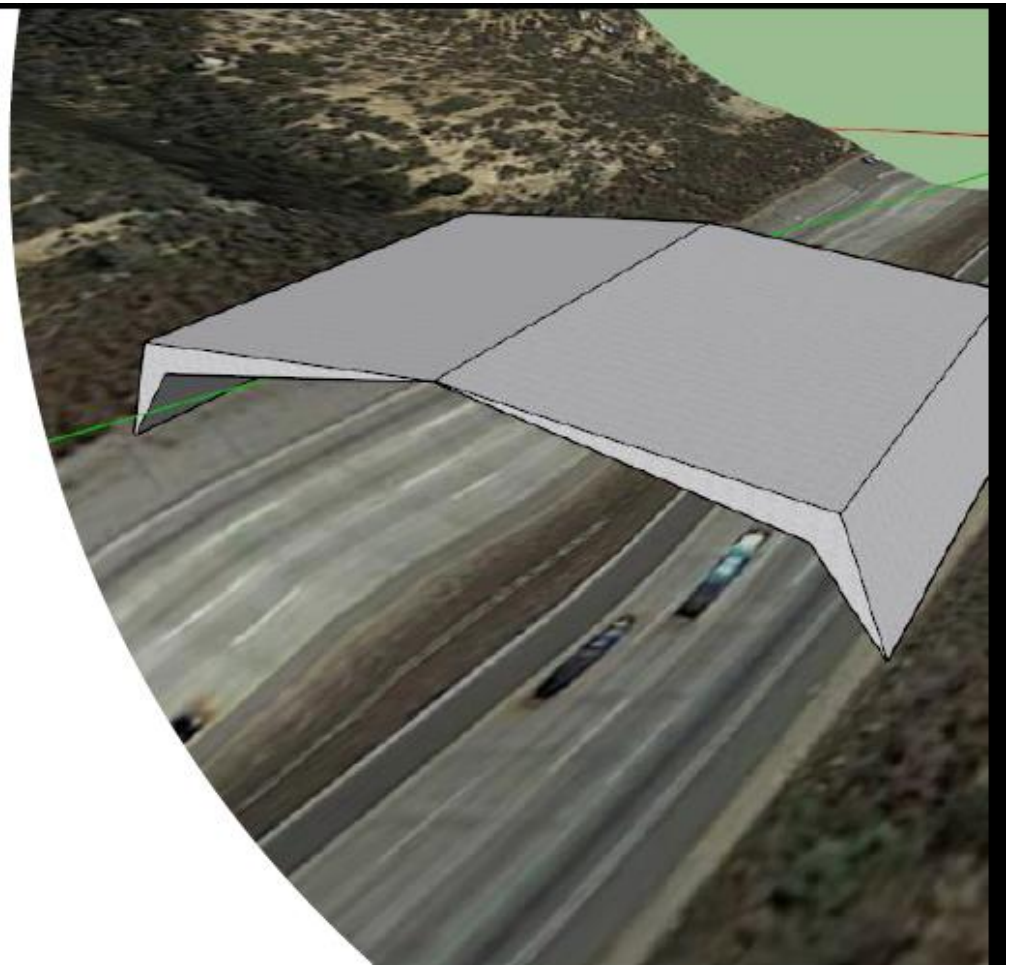

SITE 2
Chosen Location
Site 2 is selected based on the site selection criteria
15
Temecula Valley Fwy
Google Earth
100 ft


West Side Canyon
Site #2
East Side Canyon
Sighting December 2018 WS4

Design Alternative 1

Design Alternative 2

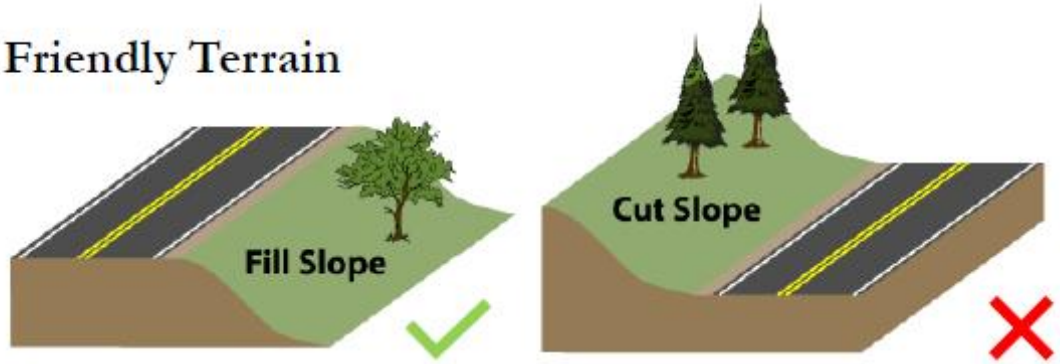
Hypar-Nature Design



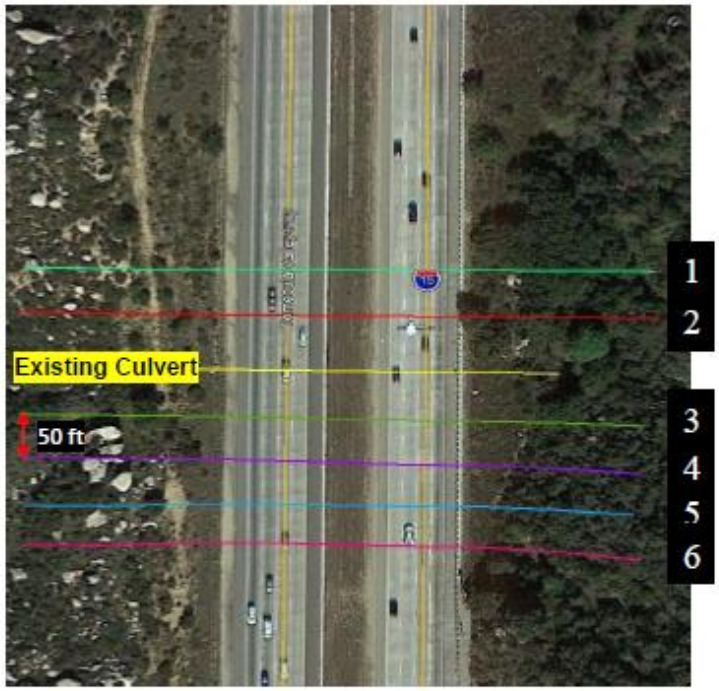
Proposed Culvert Location Criteria

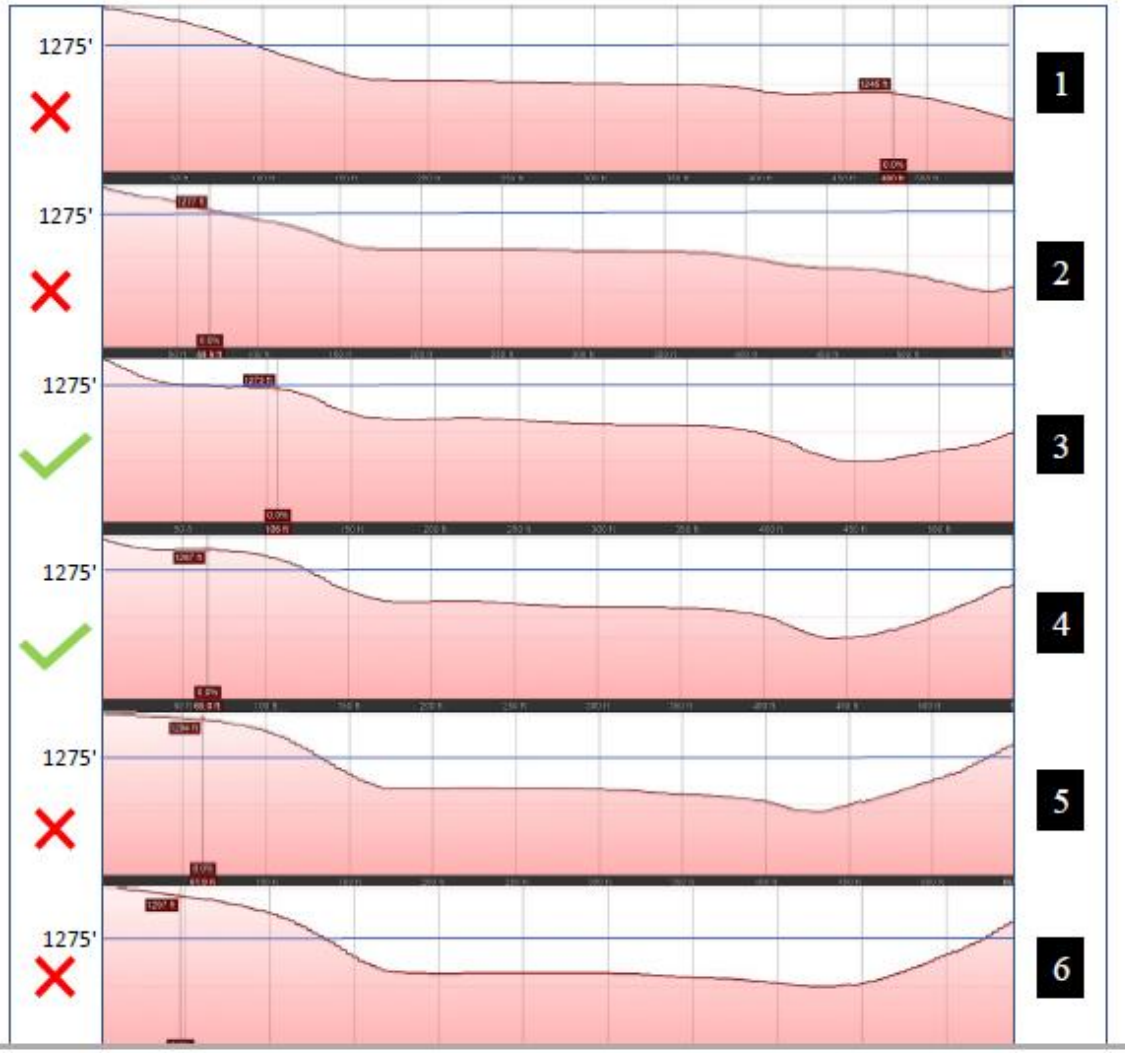
Location Criteria
Friendly Terrain
Canyon

- **Friendly Terrain**



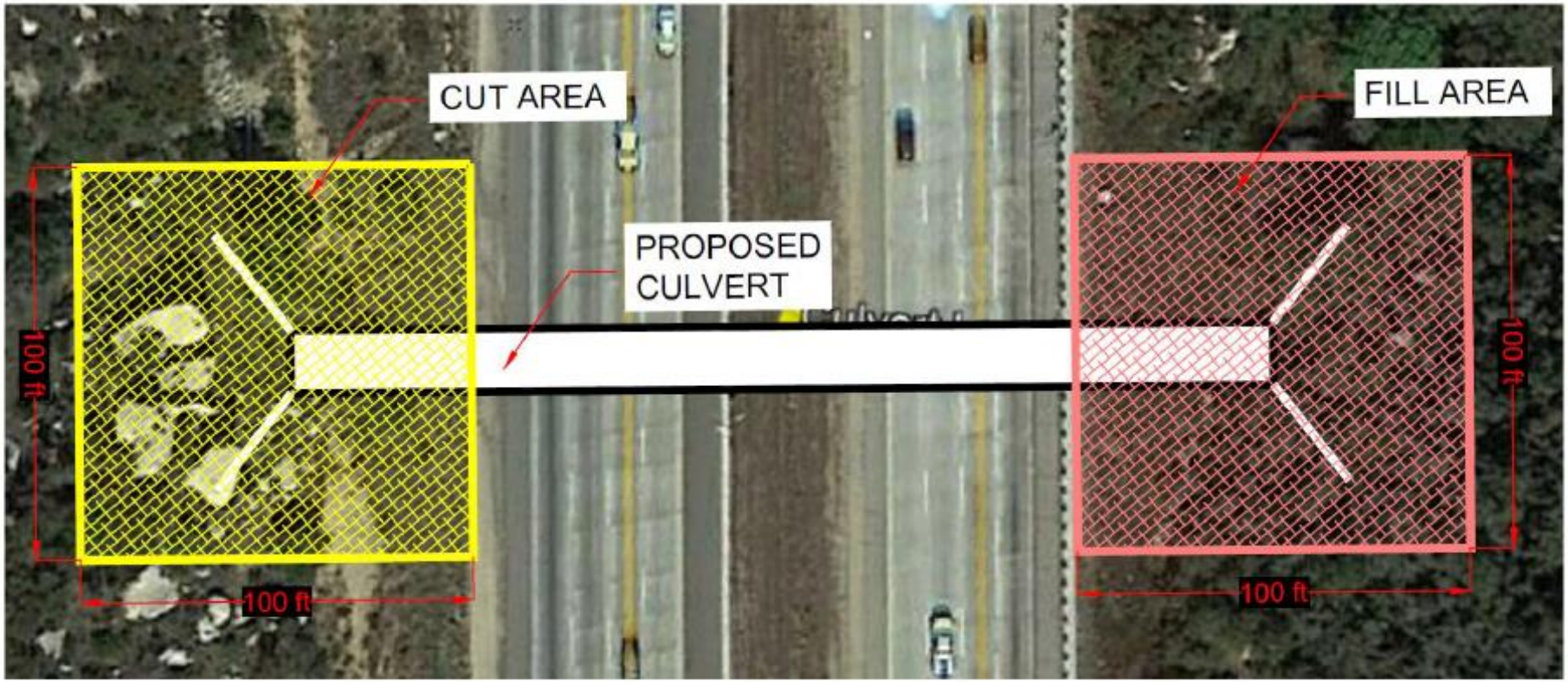
- **Canyon**



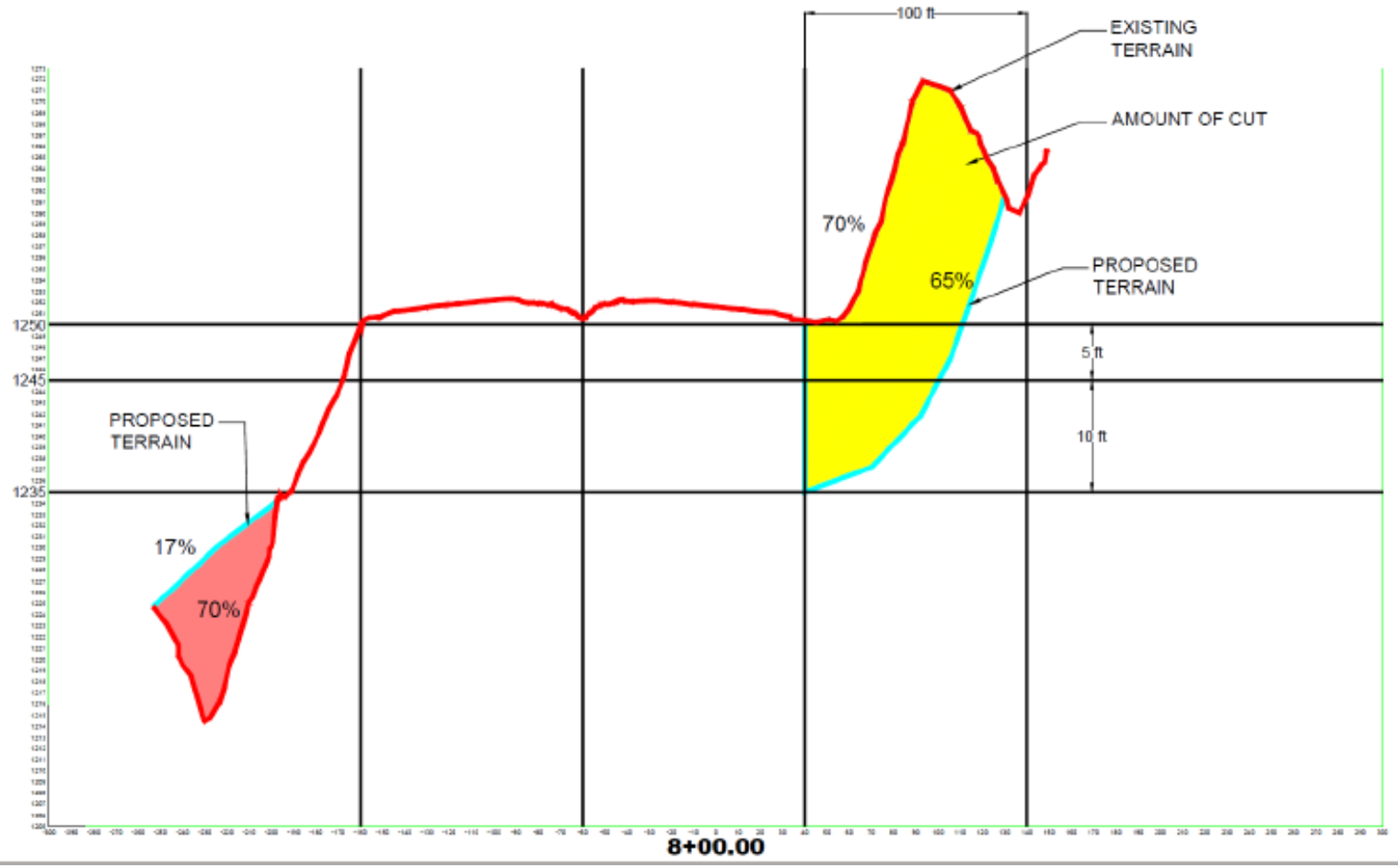


Underpass Culvert Overpass

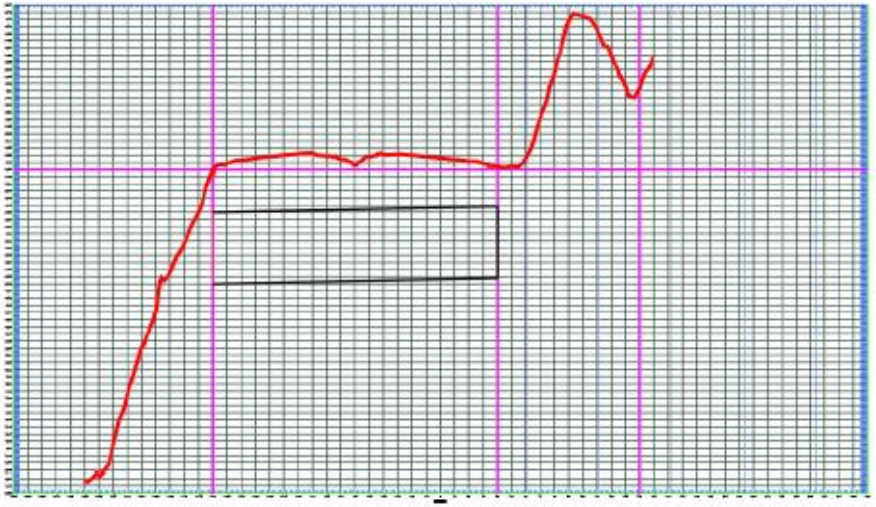
Earthwork


CUT AREA
FILL AREA
PROPOSED
CULVERT
100 ft
100 ft
100 ft
100 ft

Earthwork


100 ft
EXISTING TERRAIN
AMOUNT OF CUT
70%
65%
PROPOSED TERRAIN
1250
1245
1235
5 ft
10 ft
PROPOSED TERRAIN
17%
70%
8+00.00

Design Alternative 1: 210' Long Culvert without extension on West Side



What to do about depredation morts?

Areas of Sensitive Mountain Lion Populations
Stepwise Process for Mountain Lion Incidents

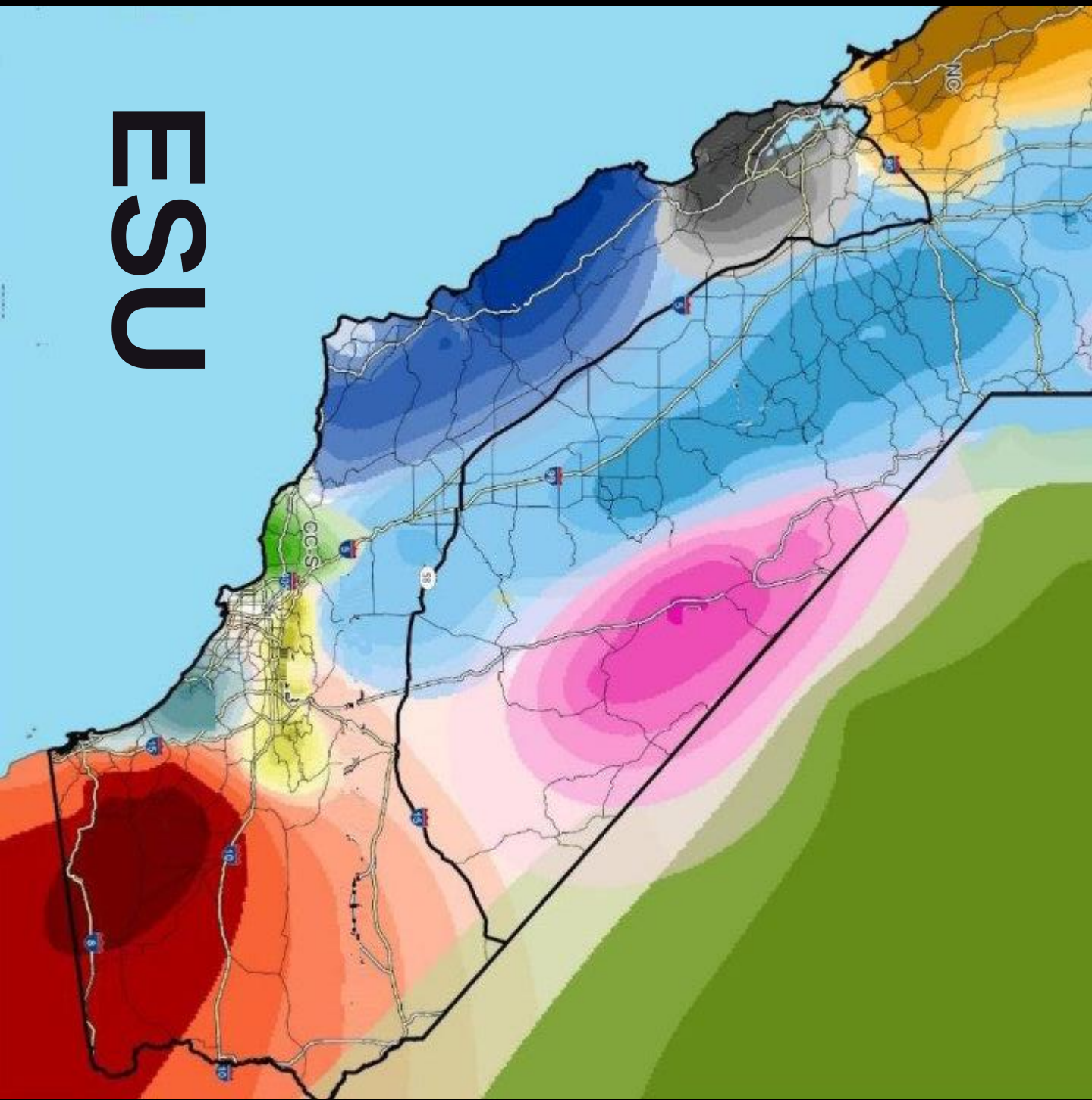
Amendment to the Human/Wildlife Interactions in California: Mountain Lion Depredation, Public Safety, and Animal Welfare Policy (2017)

California Department of Fish & Wildlife

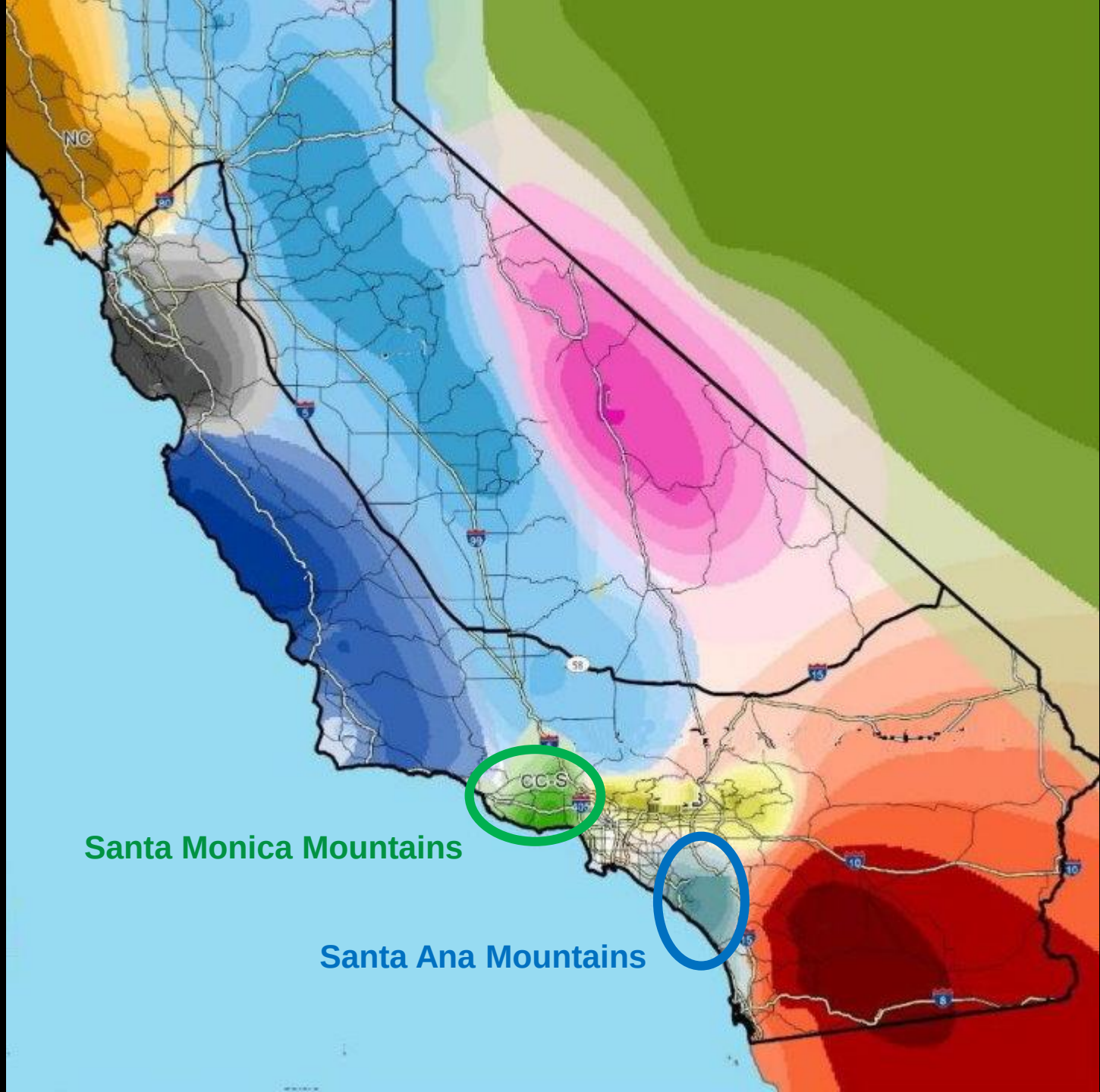
CESA petition

- BEFORE THE CALIFORNIA FISH AND GAME COMMISSION
- A Petition to List the Southern California/Central Coast Evolutionarily Significant Unit (ESU) of Mountain Lions as Threatened under the California Endangered Species Act (CESA)

ECOLOGICALLY SIGNIFICANT UNIT



MOST SENSITIVE SUBPOPULATIONS



New project

- Project Title: Estimation of the population of mountain lions in the Santa Ana Mountains and comparison of techniques for population estimation and DNA collection, wildlife photo technology development, and development of a long-term monitoring plan and collaborations for mountain lion populations in regional NCCP's.

What's next

Monitoring the population for negative trends in genetics and abundance – Working with USGS and others on this

Reducing other mortality of migrating males – researching tools and education for better livestock protection to reduce depredation permit mortalities

Educating the general public on the role of mountain lions in the ecosystem and the challenges they face with web-based mini-documentary series www.camountainlions.com

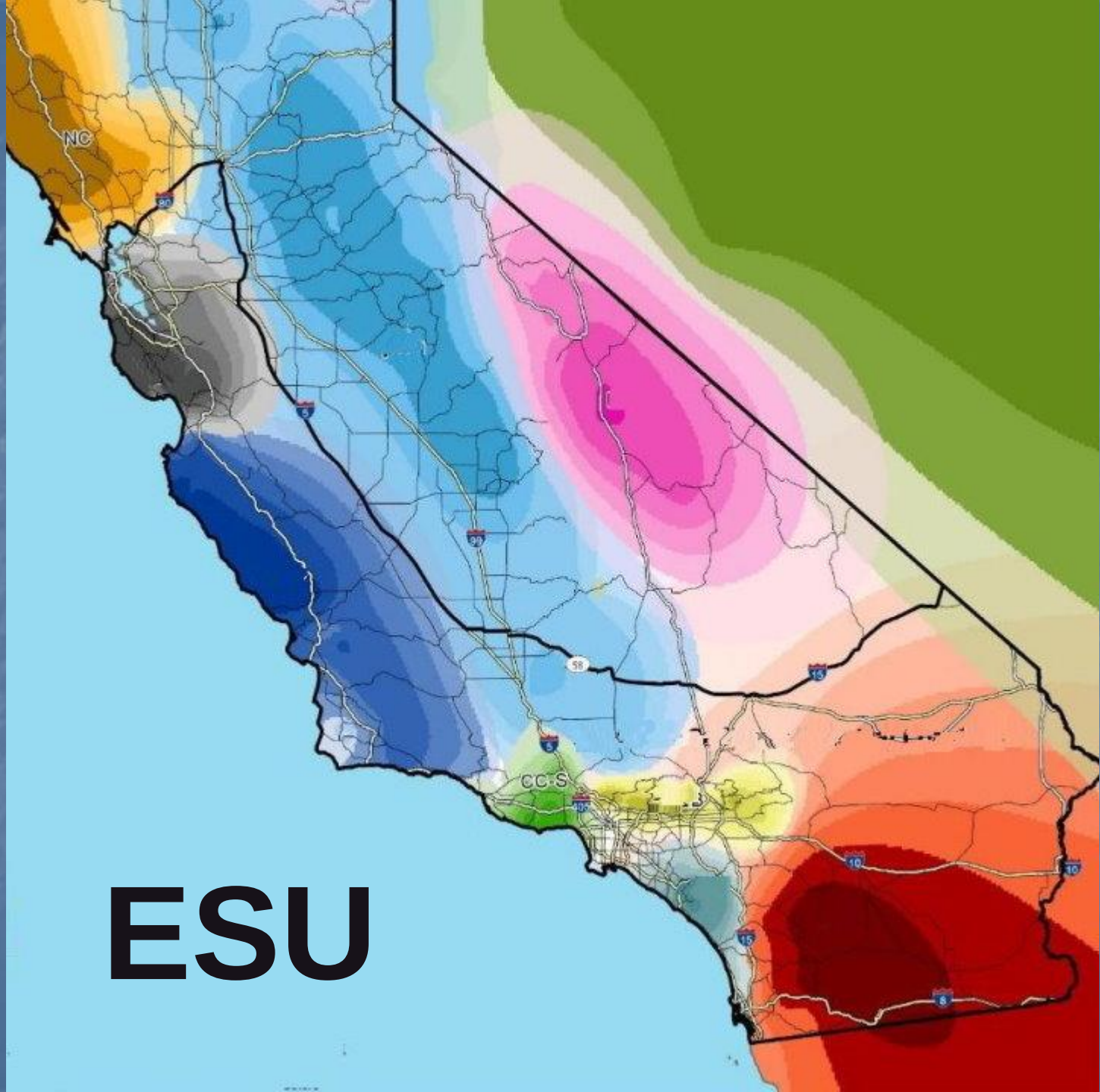
- Moving forward with Cal Trans I-15 fencing project and discussions re improving Temecula Creek Bridge and moving the ball down the field on new crossing structures

- Continuing camera monitoring along I-15 and adjacent properties – SMER and TNC Rainbow property

CESA petition

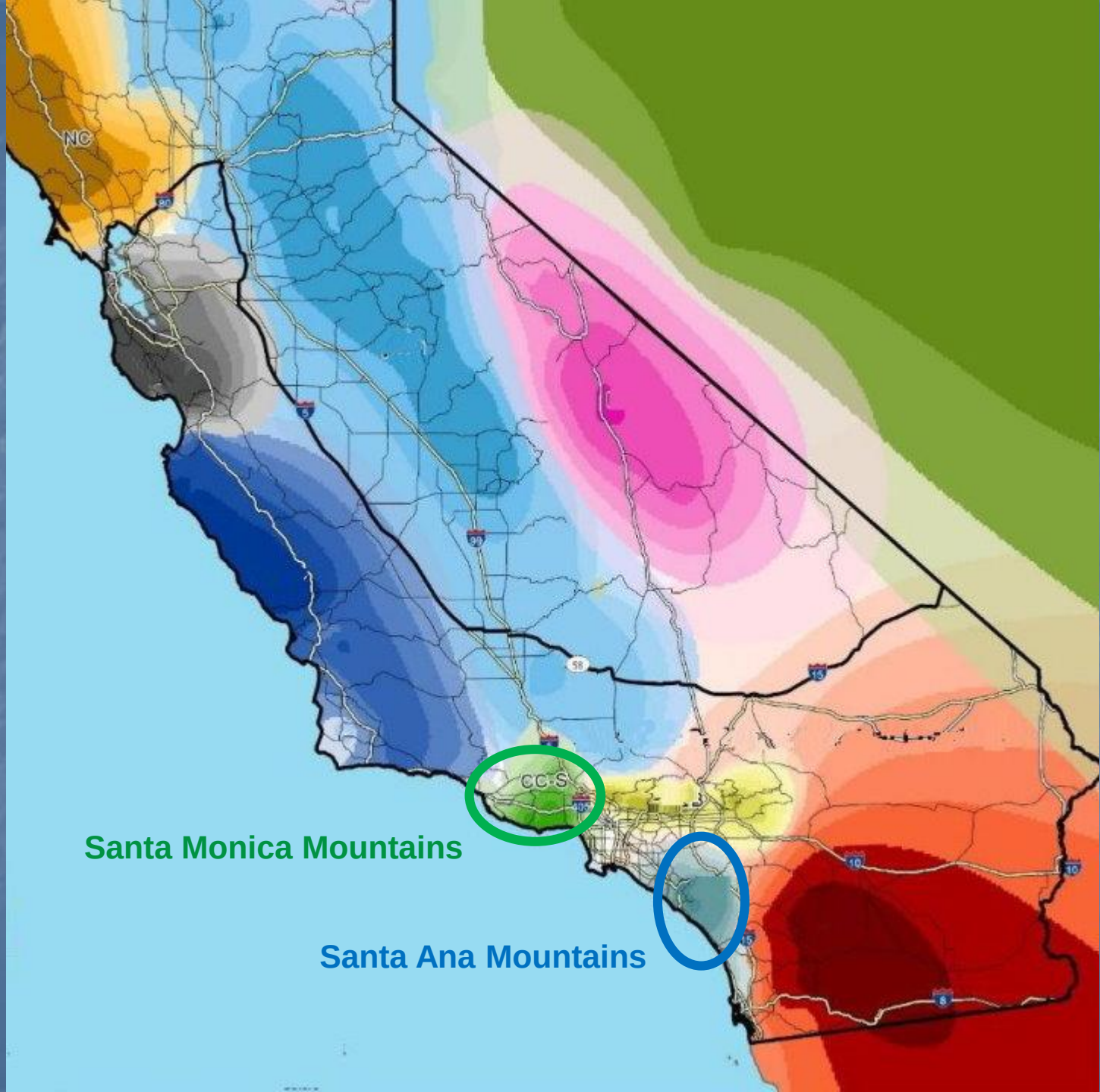
- BEFORE THE CALIFORNIA FISH AND GAME COMMISSION
- A Petition to List the Southern California/Central Coast Evolutionarily Significant Unit (ESU) of Mountain Lions as Threatened under the California Endangered Species Act (CESA)

ECOLOGICALLY SIGNIFICANT UNIT



ESU

MOST SENSITIVE SUBPOPULATIONS



New project

- Project Title: Estimation of the population of mountain lions in the Santa Ana Mountains and comparison of techniques for population estimation and DNA collection, wildlife photo technology development, and development of a long-term monitoring plan and collaborations for mountain lion populations in regional NCCP's.

Thank you - Questions?

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