The background features a stylized illustration of the Los Angeles skyline and surrounding mountains. The mountains are depicted in light green and tan tones, while the city skyline is shown in shades of grey and tan. The sky is a solid light blue. The text is overlaid on this background.

The City of Los Angeles Biodiversity Index & Ecotopes Framework

Dr. Isaac Brown – Senior Scientist, Stillwater Sciences

4/7/22

L.A.'s GREEN NEW DEAL

Sustainable City pLAn
2019

Environment
Economy
Equity



Target

Achieve and maintain 'no-net loss' of native biodiversity by 2035

Baseline: Will be established in 2019 Biodiversity index
Source: City of Los Angeles Bureau of Sanitation

MAYOR ERIC GARCETTI

LA City Council Motion CF-15-0499



- Protect & enhance Biodiversity
- Increase park and open space access, especially in park-poor areas
- Enhance ecosystem functioning and services
- Restore, create, and strengthen linkages between habitats
- Engage & outreach to the community

Biodiversity Definition

Convention on Biological Diversity 1992

the variability of living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

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LA Sanitation & Environment Operational Definition 2020

the flora, fauna, and ecosystems that enrich and sustain natural and urban areas in Los Angeles.

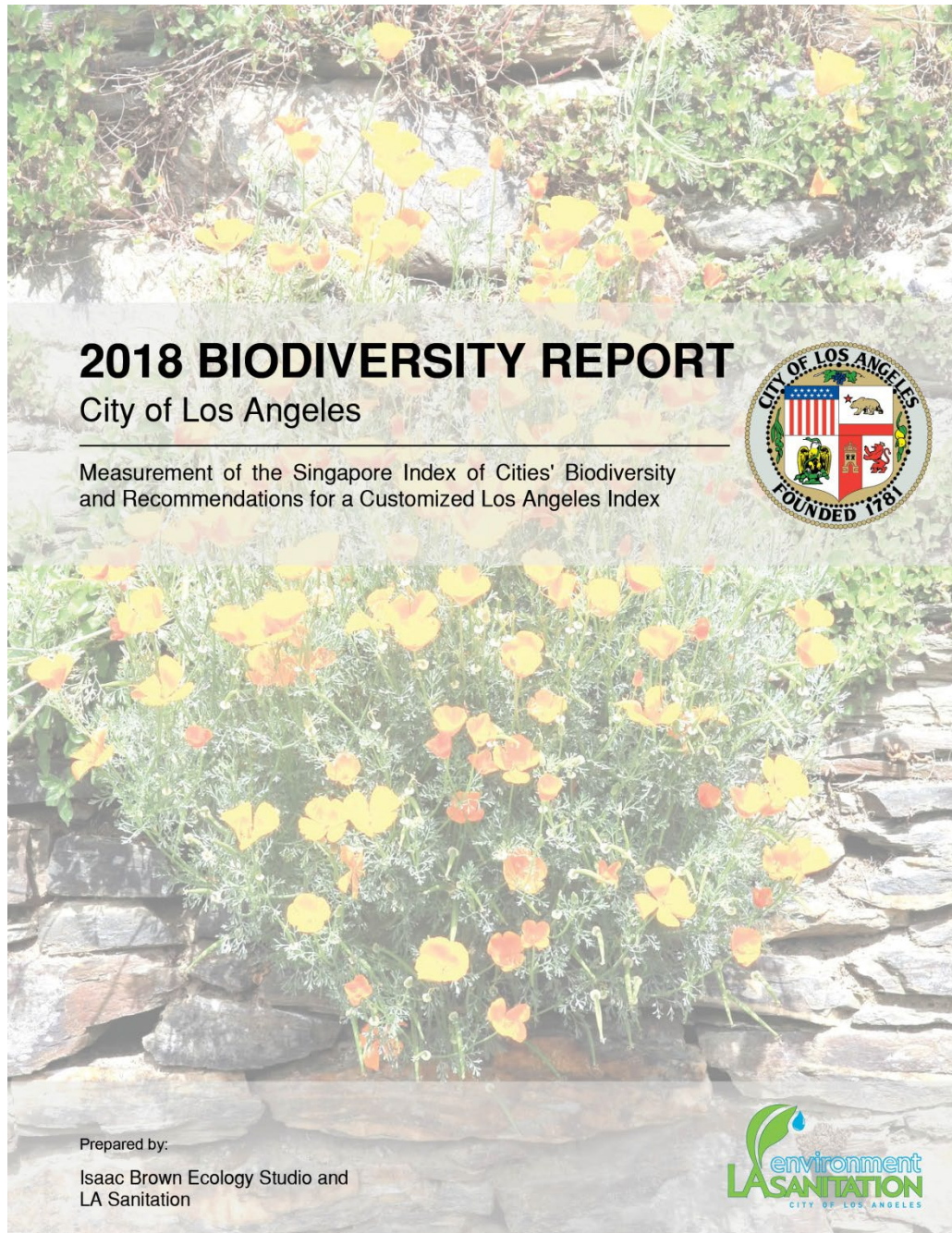


Table 1: Singapore Index of Cities' Biodiversity score summary for Los Angeles 2016

Indicator	Numeric Result	Index Score (0 weak, 4 strong)					Total
		0	1	2	3	4	
1. Natural Areas	20.5% of City (~62,000 acres)					4	4
2. Connectivity Measures	738 ha. effective mesh			2			2
3. Native Birds in Built Areas	306 native species recorded					4	4
4. Native Vascular Plants Change	461 native species recorded	NA in year 1					
5. Native Birds Change	325 native species recorded	NA in year 1					
6. Native Butterflies/Moths Change	218 total species* recorded	NA in year 1					
7. Native Freshwater Fish/BMI Chg.	6 fish/291 BMI native spp. recorded	NA in year 1					
8. Native Reptiles/Amphibians Chg.	69 total species* recorded	NA in year 1					
9. Protected Natural Areas	12.2% of City (~36,800 acres)				3		3
10. Invasive Species	~19% invasive plant species			2			2
11. Pervious Surfaces	~62% pervious surfaces			2			2
12. Urban Forest Canopy	~19% tree canopy		1				1
13. Access to Natural Areas	3.33 ha/1000 population					4	4
14. Natural Area Educational Visits	0.09 visits/student/year	0					0
15. Biodiversity Budget	1.2% of budget (\$110M)		1				1
16. # Biodiversity Projects	117 projects/programs					4	4
17. Biodiversity Strategy/Action Plan	no Biodiversity Action Plan	0					0
18. # Biodiversity Related Institutions	>3 functions					4	4
19. Interagency Cooperation	5 agencies cooperate on bio.				3		3
20. Public Consultation Process	proposed as routine process			2			2
21. # City Biodiversity Partnerships	40+ partners					4	4
22. School Curricula	included					4	4
23. Public Outreach Events	550+ events per year					4	4
Total (72 potential points in year 1)		average = 2.67					48

* native vs. non-native species of reptiles and butterflies/moths to be determined

<https://www.cbd.int/article/2021-singapore-index>

Indicator 1: Proportion of Natural Areas

Isaac Brown Ecology Studio provided data analysis for this indicator, and Dr. Travis Longcore, Faculty Member at USC, provided guidance.

CALVEG 2000-2010 dataset (see Figure 4) was used to estimate natural areas in the City. The dataset relies on satellite remote sensing to estimate vegetation alliances and is the only complete, uniformly sampled dataset covering the entire city area. Alliances were classified as “natural” based on consensus of the Expert Council (see Appendix B1, Table 1.2). See Appendix B1 for additional detailed methods and data discussion.

Results Discussion

LA has a relatively high proportion of natural areas according to the Index. Most of these are in the large, high quality open spaces of the Santa Monica and San Gabriel Mountains. Of the 55 vegetation alliances mapped in CALVEG, 34 have been classified as “natural”; three alliances as “degraded natural areas” comprised of mostly non-native annual grasses and forbs; five as “non-native shrubs and trees”; five as agricultural; four as “water” that are mostly reservoirs and artificial lakes, however, may include some more natural water bodies that require further investigation; two as urban; and one as “non-native perennial grasses” (see Figure 7). This remotely sensed data is not able to capture smaller urban natural areas, and there is some level of error in the original classification. Fires, land development, and other disturbance events since around year 2000, when the data was collected, may have contributed to a reduction in vegetated lands and changes in land cover character that are not captured in this assessment. These impacts may have also resulted in further degradation of natural areas. While tracking the total amount of natural areas is an important indicator, measurement of the quality of natural areas and changes between alliance types is also important going forward.

Management Implications and Recommendations for the LA Index

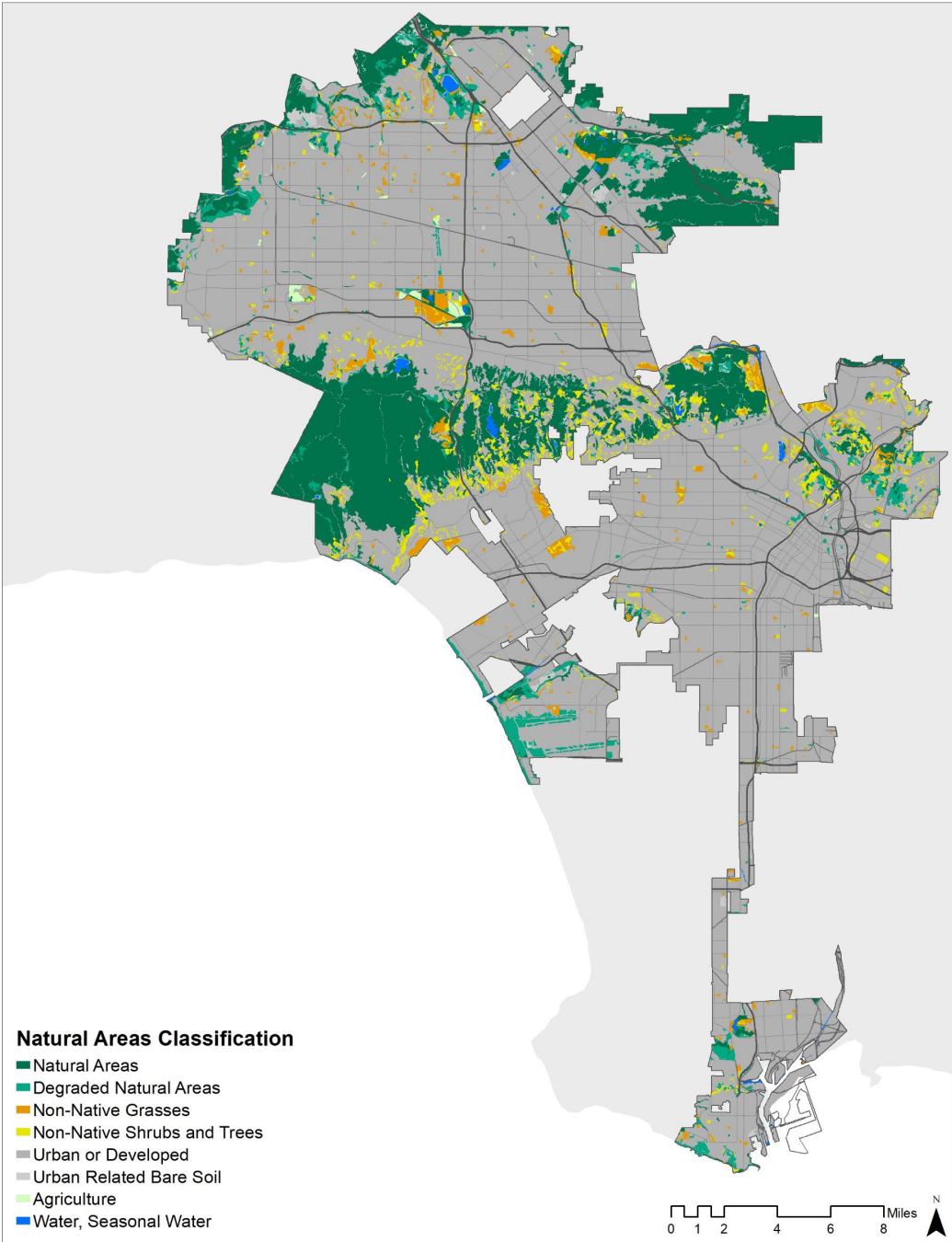
1. Quality and extent of natural vegetation is a key indicator for any city biodiversity index and should be incorporated and modified in the LA Index.
2. Since the CALVEG dataset is over 15-years old, updated data is needed to provide a more accurate characterization of the current vegetation conditions across the City. Additionally, higher resolution imagery is currently available, which could greatly improve the quality of measurement.
3. An updated assessment should also attempt to map and classify smaller urban natural areas.
4. Numerous smaller-scale projects, such as vegetation mapping in Griffith Park and Ballona Wetlands, EIRs, and other project areas, have been completed and may be assembled and processed to provide additional clarity on existing conditions. Feasibility of such a compilation process should be evaluated.
5. Urban areas and non-natural areas should also be classified and evaluated for native biodiversity value. A preliminary list of “areas of obvious biodiversity” has been collected by stakeholders in Council Districts across the City and should be evaluated for biodiversity value.
6. A ranking system to better differentiate the gradient of natural to non-natural, and high to low biodiversity value areas should be developed. This system should be capable of assessing all landscapes, parks, and open spaces and could become the basis for indicators.
7. Vegetation classification and mapping protocols should be identified for future project-specific (suitable site to regional scale projects) to ensure that the quality of data continues to improve over time. The Survey of California Vegetation Classification and Mapping Standards (June 30, 2015), produced by the CDFW Veg CAMP should be referenced. Such mapping would help address the need to better differentiate the quality of natural areas based on association and alliance-level classification at finer resolutions (i.e., smaller minimum map units for natural and semi-natural vegetation types).

Singapore Index Score

4/4

20.55% natural areas
(61,931 acres natural areas of
301,345 acres measured)

0 points: <1.0%
1 points: 1.0%-6.9%
2 points: 7.0% - 13.9%
3 points: 14.0%-20.0%
4 points: >20%



Indicator 6: Change in Butterflies & Moths

Isaac Brown Ecology Studio provided data analysis for this indicator.

Observations of moths and butterflies documented in the citizen scientist web-based tool iNaturalist were collected for years 2011 to 10/31/2017. All observations occurring within a rectangle representing the City boundary extents were included (therefore, there is a chance that some species may occur outside of the City; however, the City is likely suitable range). Native status is not classified in iNaturalist, so all species were included. See Appendix B6 for detailed methods and data discussion, including Tables 6.2 and 6.3 for lists of butterfly and moth species recorded.

Results Discussion

(Note: change in butterfly species is measured over time; therefore, the initial Singapore Index measurement is considered the “baseline”.) Many of our local native butterflies are closely associated with native plant species that provide habitat, especially coastal sage scrub and other herbaceous species. Enhancement of these plant species in city landscapes may help expand distribution of butterflies and moths in the City.

As of 2006, LA was home to two federally endangered butterfly species, the El Segundo blue butterfly and the Palos Verdes blue butterfly. These species inhabit a very limited range within the Los Angeles Plain and Palos Verdes, so management of habitat in the City is critical to their survival. These species have become endangered due to loss of coastal dune habitat (El Segundo blue) and coastal sage scrub habitat within favorable microclimates of Los Angeles and a few nearby areas. Protection of habitat is key; however, these butterflies associate closely with host plants (locoweed, *Astragalus trichopodus* var. *lonchus*, and deerweed, *Acmispon glaber*, for the Palos Verdes blue, and dune buckwheat, *Eriogonum parvifolium*, for the El Segundo blue) and expansion of these plant species in favorable areas of the City may also provide new suitable habitat, potentially even within yards, parks, or other green infrastructure. In this way, Los Angeles may contribute to the sustainability of broader ecosystem functions and biodiversity.

Management Implications and Recommendations for the LA Index

1. A scientific field survey, or more extensive verification of citizen science observations by experts to expand “research grade” observations in the City, would improve this assessment approach.
2. Smaller scale surveys exist for parts of the City, including the Griffith Park butterfly survey (Dan Cooper - includes extirpated species); UCLA/NHM re-survey of butterflies of the Santa Monica Mtns; and the NHM BioSCAN data review (Elizabeth Wong); and the NHM BioSCAN (Brian Brown). Aggregation of these surveys and others into a citywide assessment would improve accuracy.
3. Distribution and abundance are also important indicators of butterfly biodiversity and should be considered.
4. Extirpated, threatened, and endangered species and their recovery efforts should be addressed in an indicator. This will help to identify species that have the potential to be re-established or be lost, which would impact this indicator.
5. Butterfly species may be an indicator of habitat connectivity due to their movement characteristics.
6. Native plant species that provide habitat for butterflies and moths should be considered and promoted for planting in parks, yards, landscapes, and green infrastructure.
7. Associations between butterflies, land use types, and land use patterns could help identify important urban and landscape design-biodiversity relationships and should be researched.
8. Climate change impacts on butterfly species should be considered. Populations present in potential climate “refugia” (e.g., areas above projected sea level rise areas, north slopes, species/genotypes at southern edge of range, etc.) should be identified and considered for enhanced conservation.
9. Potential species range shifts with climate change (northward and coastal) may be impacted by the ability of species to migrate through the City, so means to enhance movement through the City should be examined.

Singapore Index Score

Baseline

215 native and non-native butterfly and moth species observed

0 points: maintaining or decreasing the number of native species
1 points: 1 native species increase
2 points: 2 native species increase
3 points: 3 native species increase
4 points: 4+ native species increase

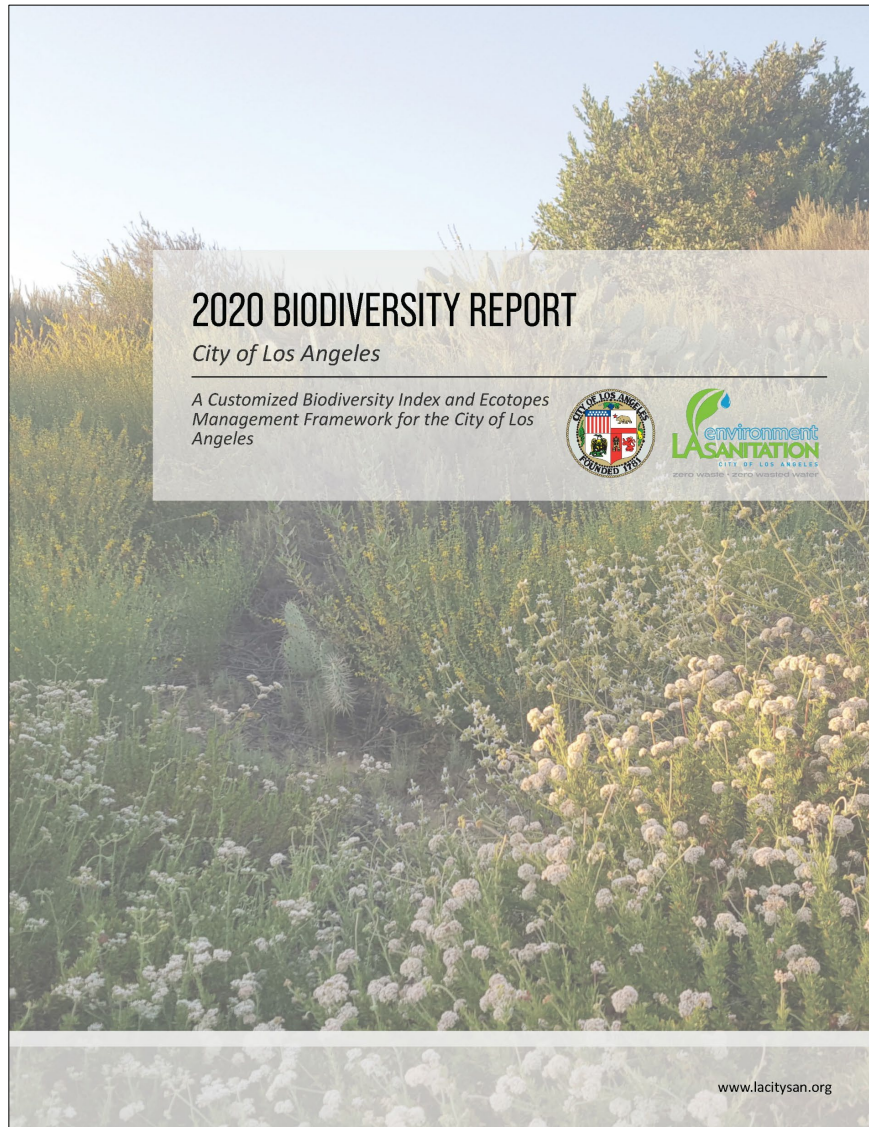


Figure 14: Example Native Butterflies and Moths of Los Angeles
TL: *Monarch*; © Thomas Bresson; <https://www.flickr.com/photos/computerhotline/3877362343/>
TR: *White line sphinx*; © Adam Searcy; <https://www.inaturalist.org/photos/4822175>
BL: *Palos Verdes blue butterfly* (Federally Endangered); © Travis Longcore; <https://www.inaturalist.org/taxa/236268-Glaucopsyche-lygdamus-palosverdesensis>
BRT: *Red admiral*; © Dmiss & Marionn; <https://www.inaturalist.org/taxa/49133-Vanessa-atalanta>
BRB: *Anise swallowtail*; © Peter Prehn; <https://www.inaturalist.org/taxa/51097-Papilio-zelicaon>

Objectives for the LA Index

- 1) Account for the distribution and abundance of biodiversity across the city**
- 2) Scoring strategy sensitive to reasonable thresholds for change**
- 3) Incorporate normalized values and percentages as scoring thresholds**
- 4) Tailor the index to the City-specific ecological context**
- 5) Improve applicability in local-scale decision making, make more spatially explicit**

LA City Biodiversity Index



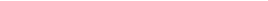
Theme	Indicator CODE	Indicators	Metric CODE	Metrics
1. Native Species Protection & Enhancement	1.1	Habitat Quality	1.1a	% Natural Areas
			1.1b	Habitat Quality of Urban Landscapes & Open Space
			1.1c	Habitat Quality of Streams & Freshwater Features
			1.1d	Connectivity of Natural Areas
			1.1e	Connectivity of Urban Landscapes & Open Space
			1.1f	Connectivity of Streams & Freshwater Features
	1.2	Indicator Species	1.2a	% Open Space with Charismatic Umbrella Species
			1.2b	Common Indicator Species Presence in Urban Areas
			1.2c	Sensitive Indicator Species Gained or Lost from Ecotopes
	1.3	Threats to Native Biodiversity	1.3a	Urban Edge Effects on Natural Areas
			1.3b	Presence & Spread of Invasive Plants
			1.3c	Wildfire Frequency Departure from Natural
2. Social Considerations & Biodiversity	2.1	Access to Biodiversity	2.1a	Access to Natural Areas
			2.1b	Neighborhood Landscape/Tree Canopy Footprint
	2.2	Education	2.2a	Schools (K-12) Biodiversity Topics
			2.2b	Off-Campus Natural Area & Biodiversity Educational Visits
			2.2c	Campus & Park Nature Education Gardens/Areas
	2.3	Community Action	2.3a	Community Scientist Activities and App Utilization
			2.3b	# and Acres Certified Biodiversity-Friendly Areas
3. Governance & Management of Biodiversity	3.1	Governance	3.1a	Biodiversity Vision/Action Plan
			3.1b	% Departments with Biodiversity Programs & Policies
	3.2	Management	3.2a	% Protected Natural Areas
			3.2b	Natural Areas Management and Monitoring
			3.2c	Management of Invasive Species & Pests
			3.2d	Management of Threatened, Endangered, & Species of Concern

Indicator 1.1c – Landscape Naturalness

Landscape Naturalness

- 0 Low
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9 High

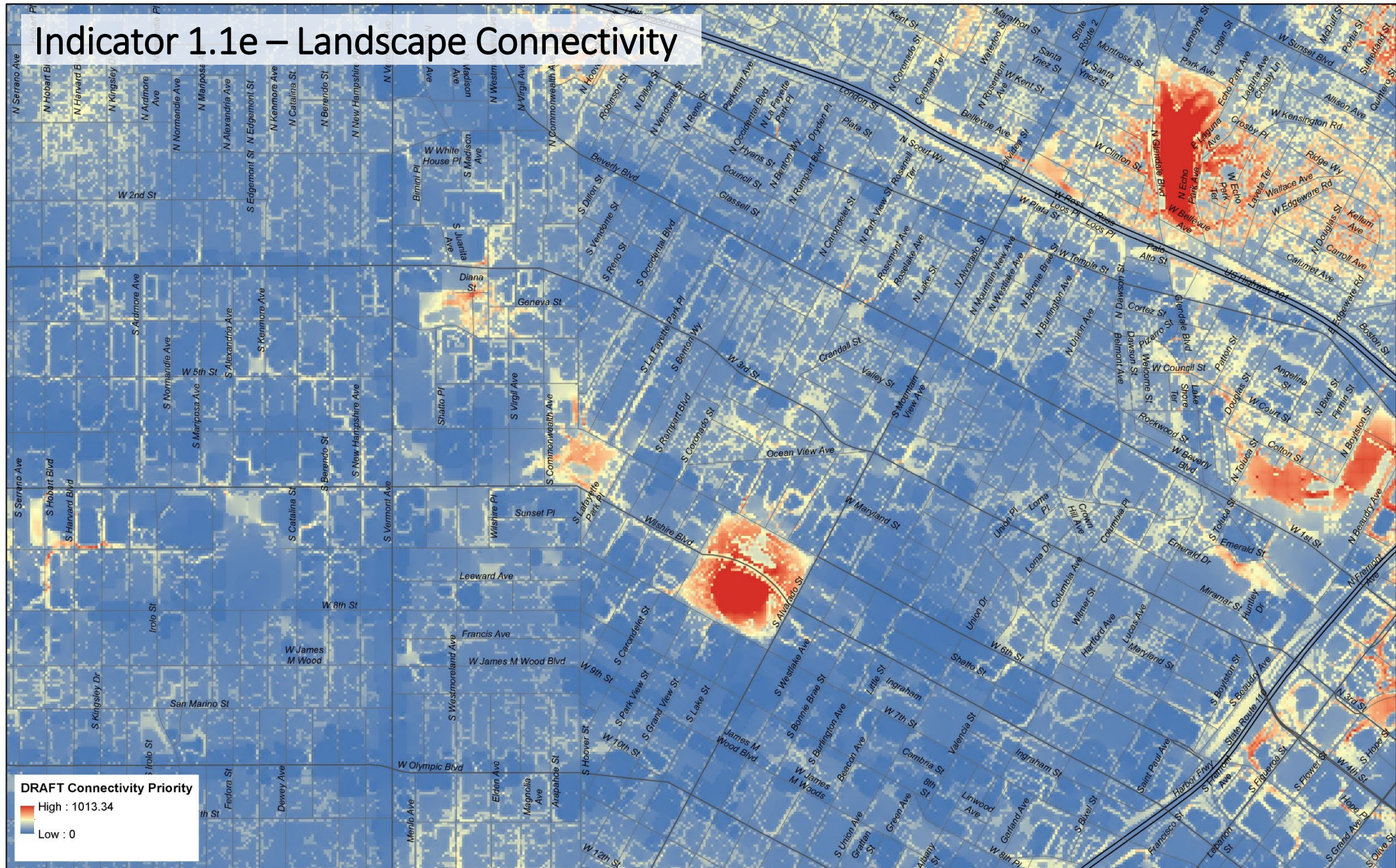
1 inch = 1,000 feet



0 450 900 1,800 Feet

N

Indicator 1.1e – Landscape Connectivity



Indicator 1.1e – Landscape Connectivity

GENERAL CONNECTIVITY PRINCIPLES

- Increases patch proximity
- Increase habitat stepping stones
- Create partial corridors
- Create continuous corridors

DRAFT Connectivity Priority

High : 1013.34

Low : 0

Indicator 1.1e – Landscape Connectivity

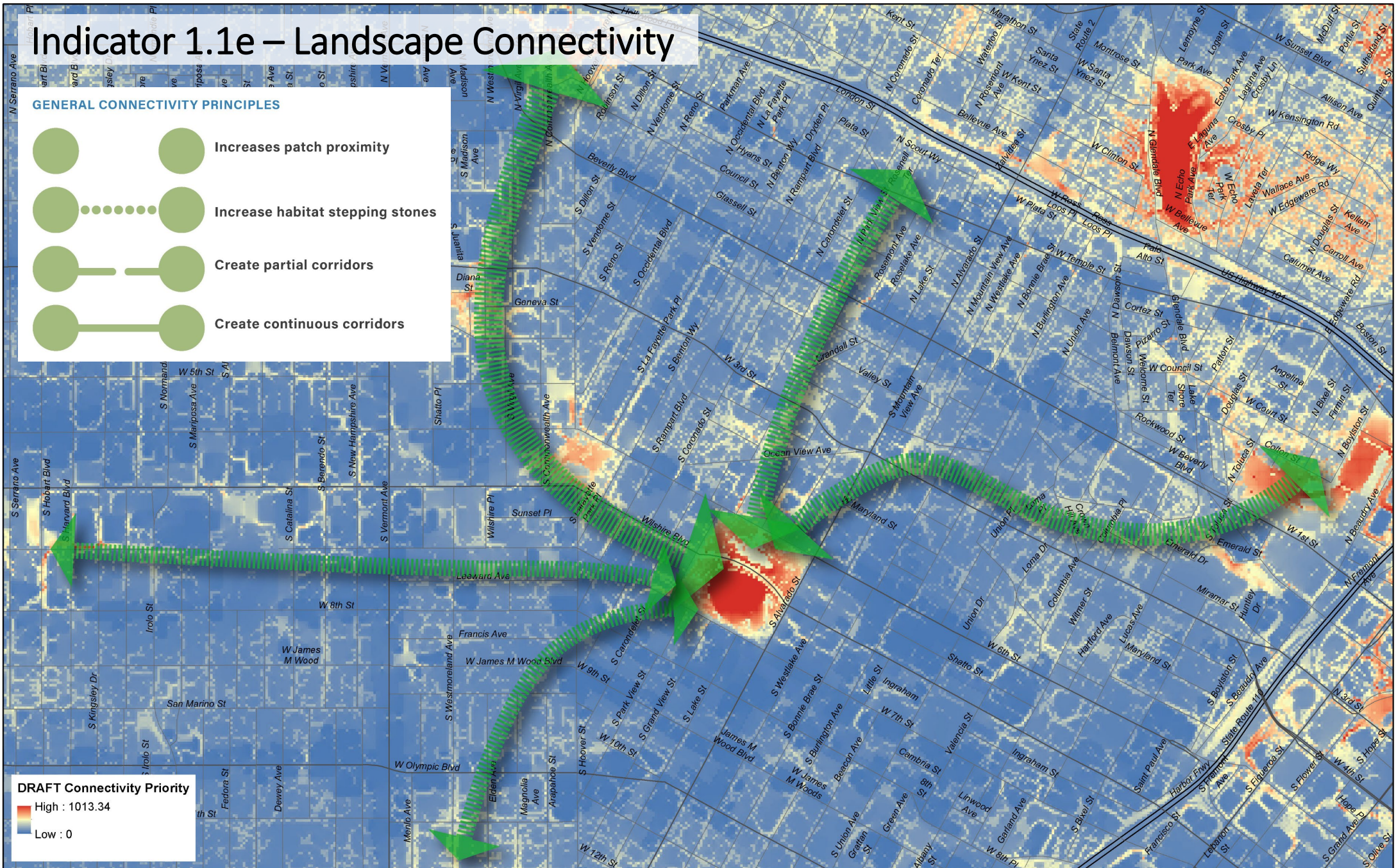
GENERAL CONNECTIVITY PRINCIPLES

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DRAFT Connectivity Priority

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Low : 0



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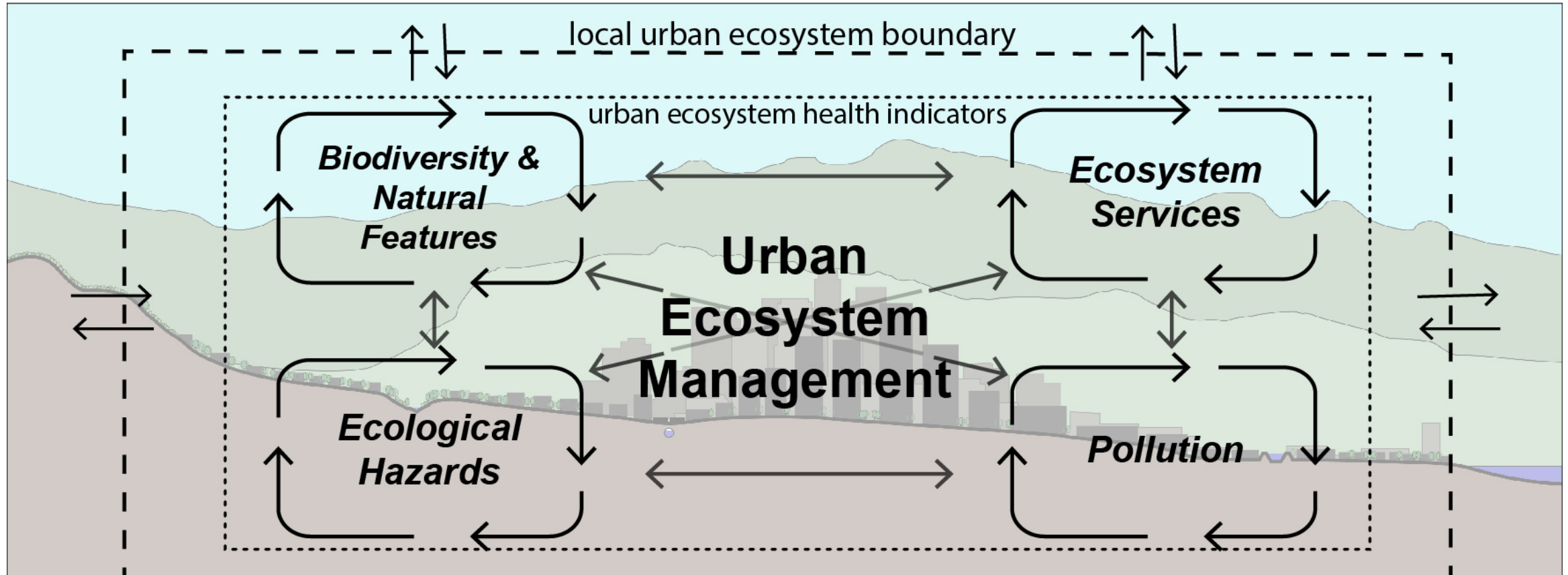
High : 1013.34

Low : 0

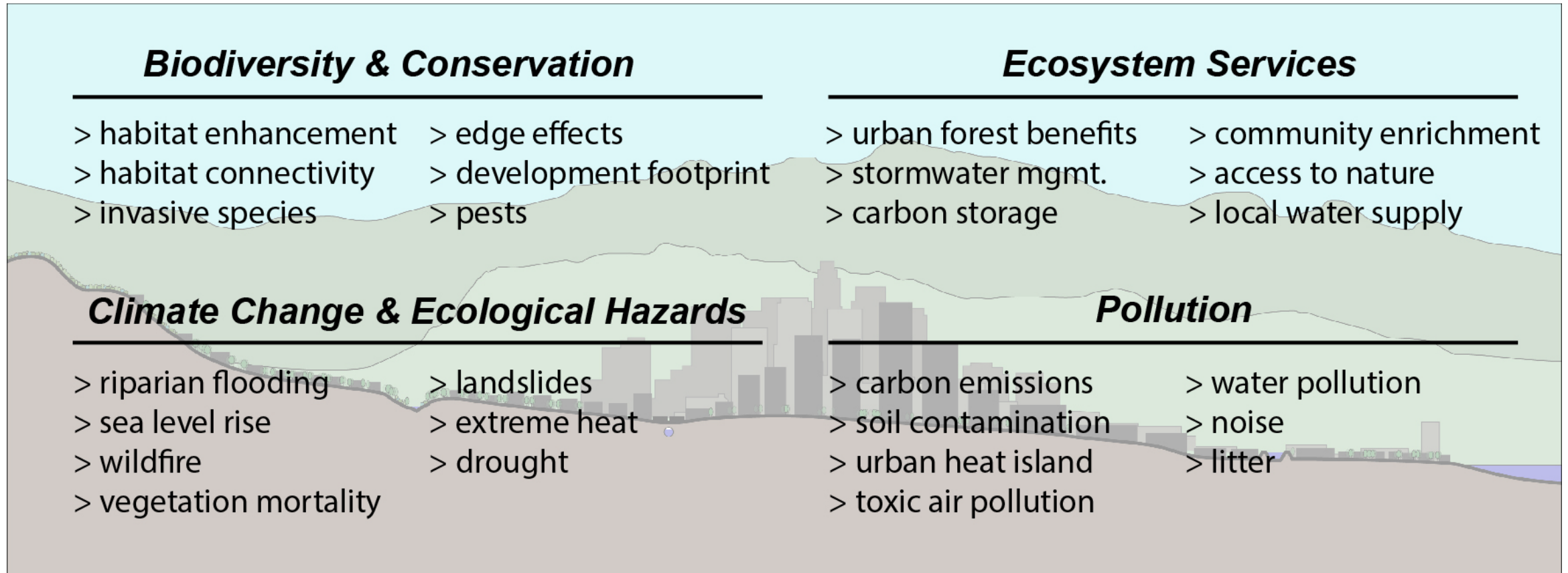
Los Angeles Ecotopes Framework

A Key Tool for Urban Ecosystem Management

Urban Ecosystem Management Themes

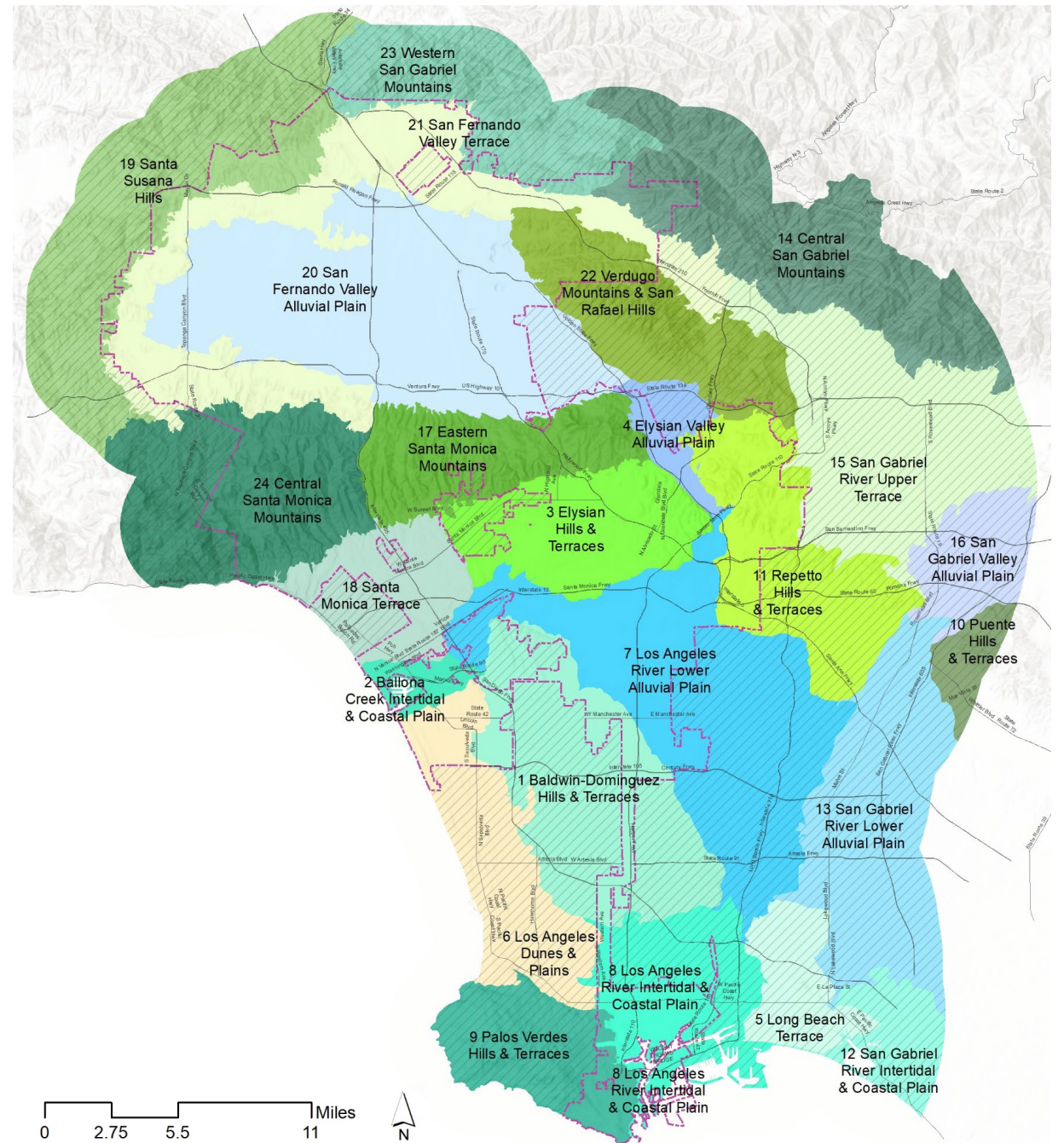


Urban Ecosystem Management Themes



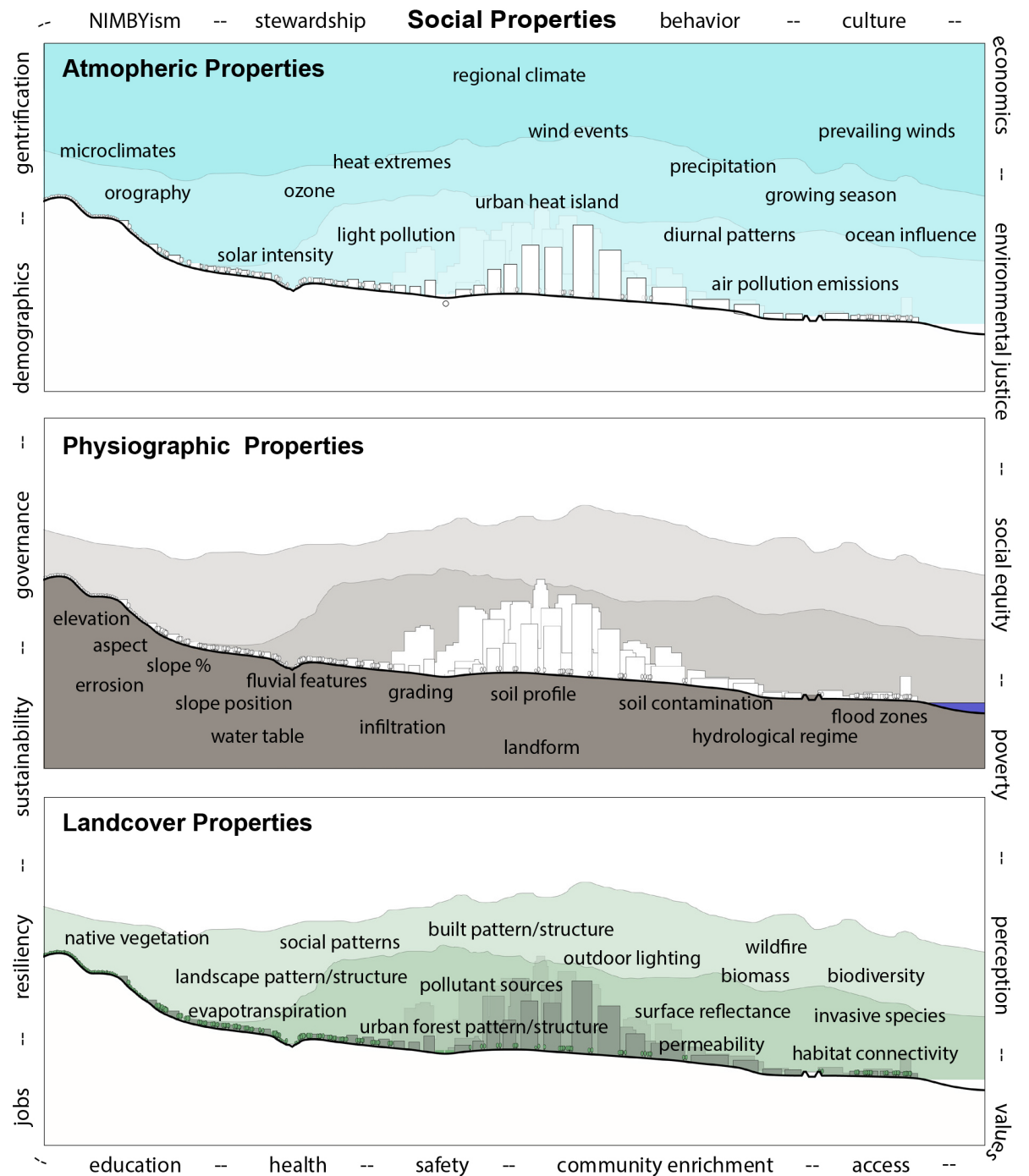
Los Angeles Ecotopes

- 1 Baldwin-Dominguez Hills & Terraces
- 2 Ballona Creek Intertidal & Coastal Plain
- 3 Elysian Hills & Terraces
- 4 Elysian Valley Alluvial Plain
- 5 Long Beach Terrace
- 6 Los Angeles Dunes & Plains
- 7 Los Angeles River Lower Alluvial Plain
- 8 Los Angeles River Intertidal & Coastal Plain
- 9 Palos Verdes Hills & Terraces
- 10 Puente Hills & Terraces
- 11 Repetto Hills & Terraces
- 12 San Gabriel River Intertidal & Coastal Plain
- 13 San Gabriel River Lower Alluvial Plain
- 14 Central San Gabriel Mountains
- 15 San Gabriel River Upper Terrace
- 16 San Gabriel Valley Alluvial Plain
- 17 Eastern Santa Monica Mountains
- 18 Santa Monica Terrace
- 19 Santa Susana Hills
- 20 San Fernando Valley Alluvial Plain
- 21 San Fernando Valley Terrace
- 22 Verdugo Mountains & San Rafael Hills
- 23 Western San Gabriel Mountains
- 24 Central Santa Monica Mountains
- City of Los Angeles Boundary
- Outside City of Los Angeles



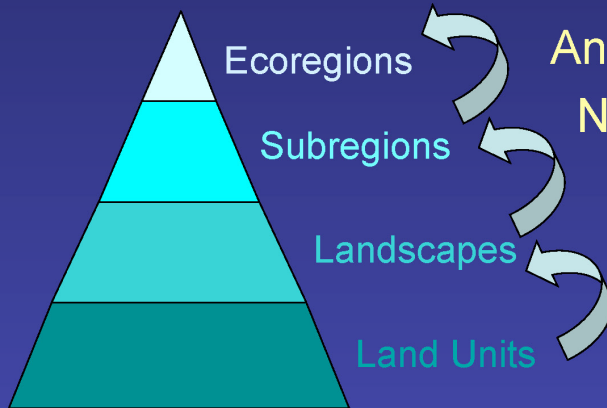
4 “Layers” of Urban Ecosystems

- Atmosphere Layer (AIR)
- Physiographic Layer (EARTH)
- Landcover Layer (BIOTA/BUILT)
- Social Layer (HUMAN)



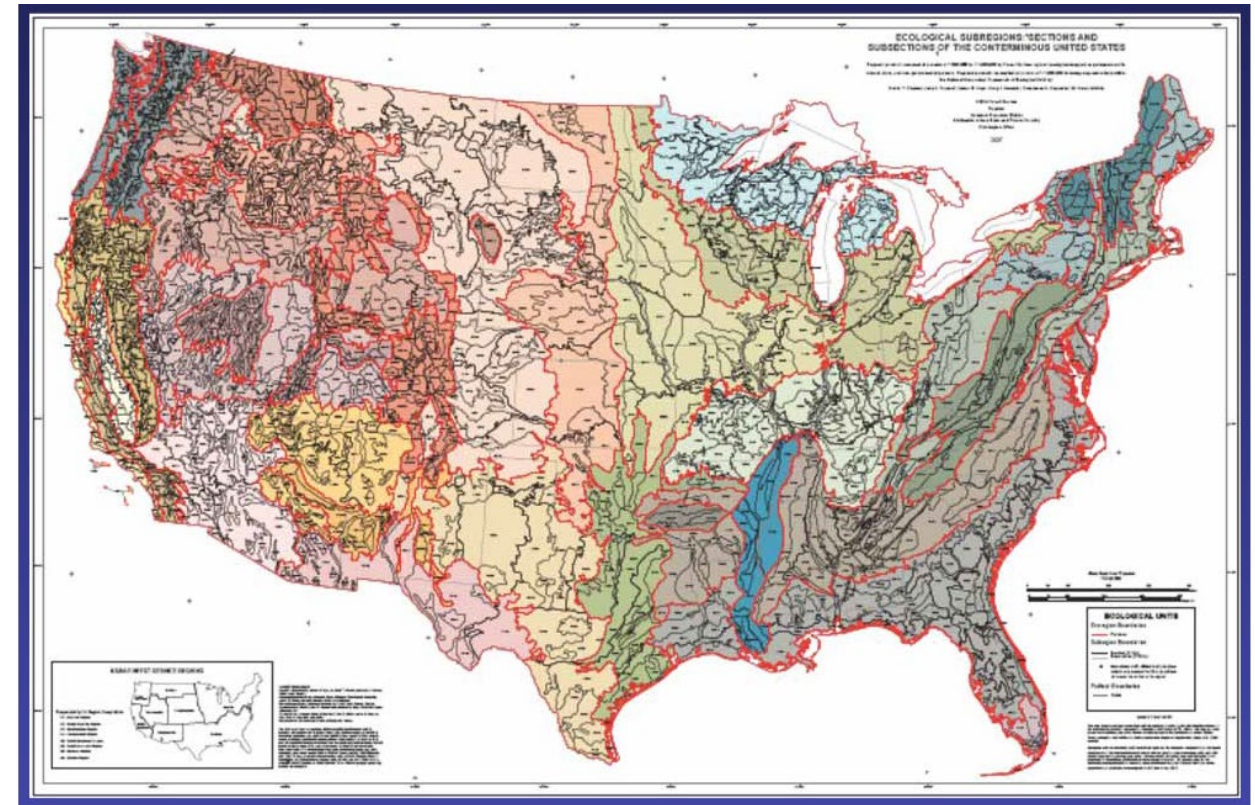
Delineation of Ecological Subregions of the Conterminous United States

David Cleland, James Keys,
and Henry McNab
U.S. Forest Service

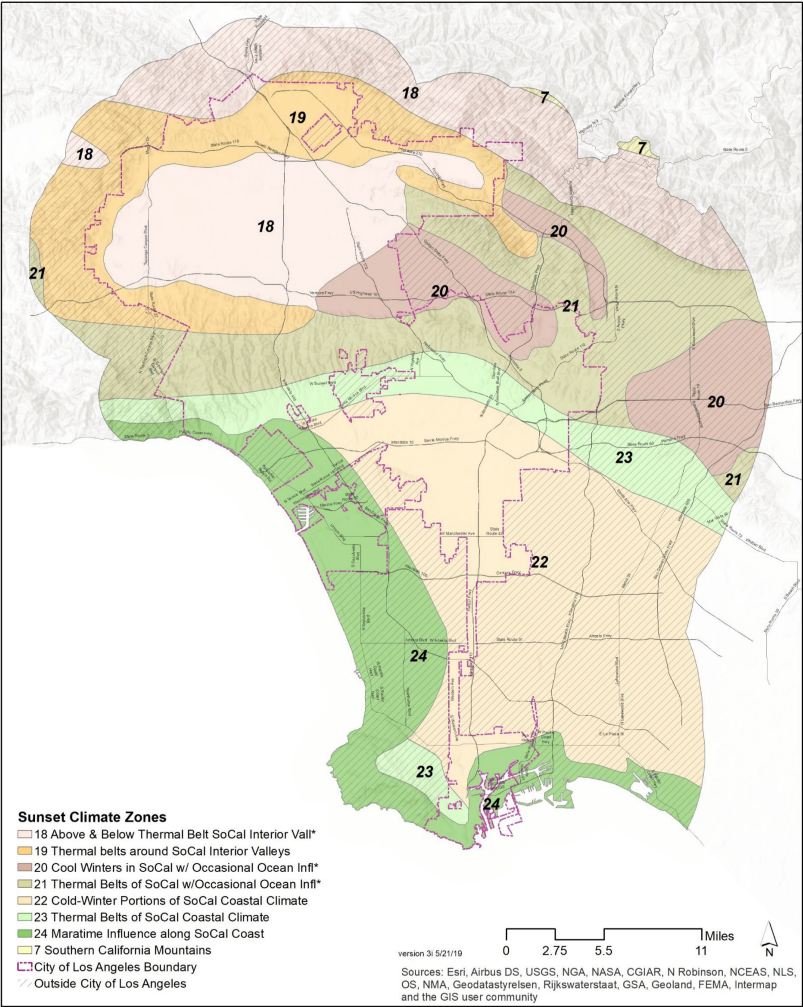


An application of the
National Hierarchical
Framework of
Terrestrial
Ecological Units

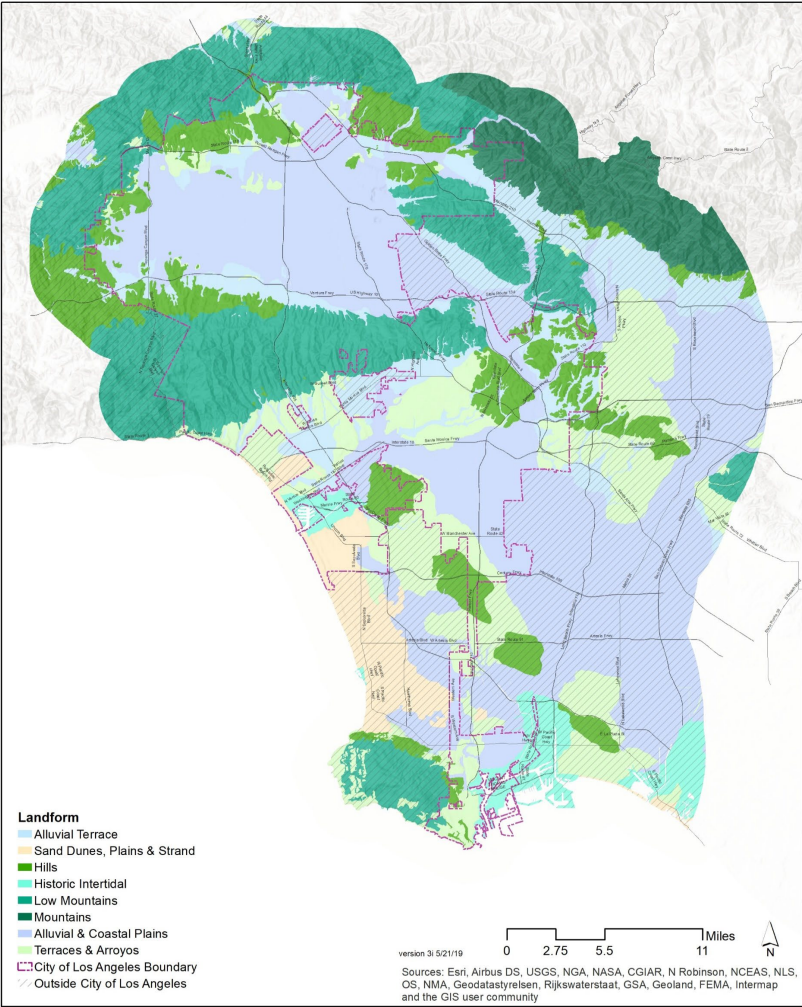
GJN 02



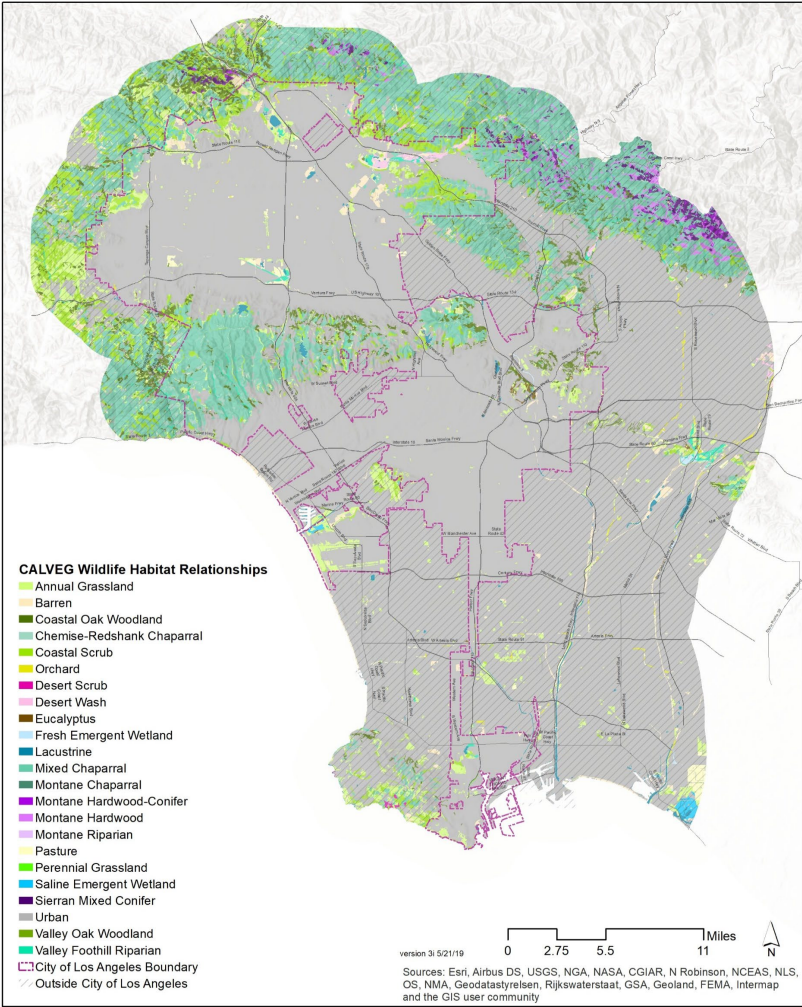
Principal Environmental Factors



1. Climate from
(*Sunset Climate Zones*)

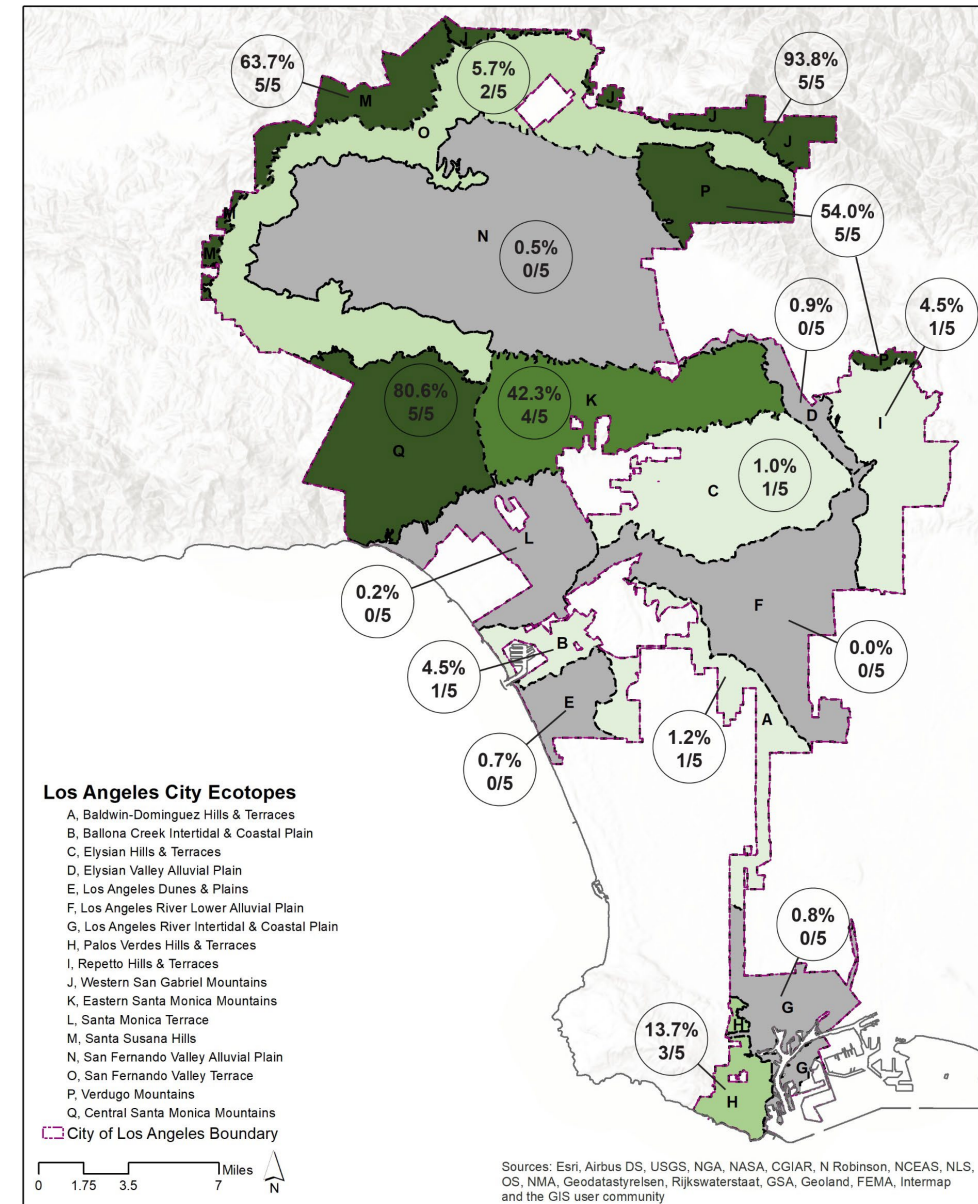
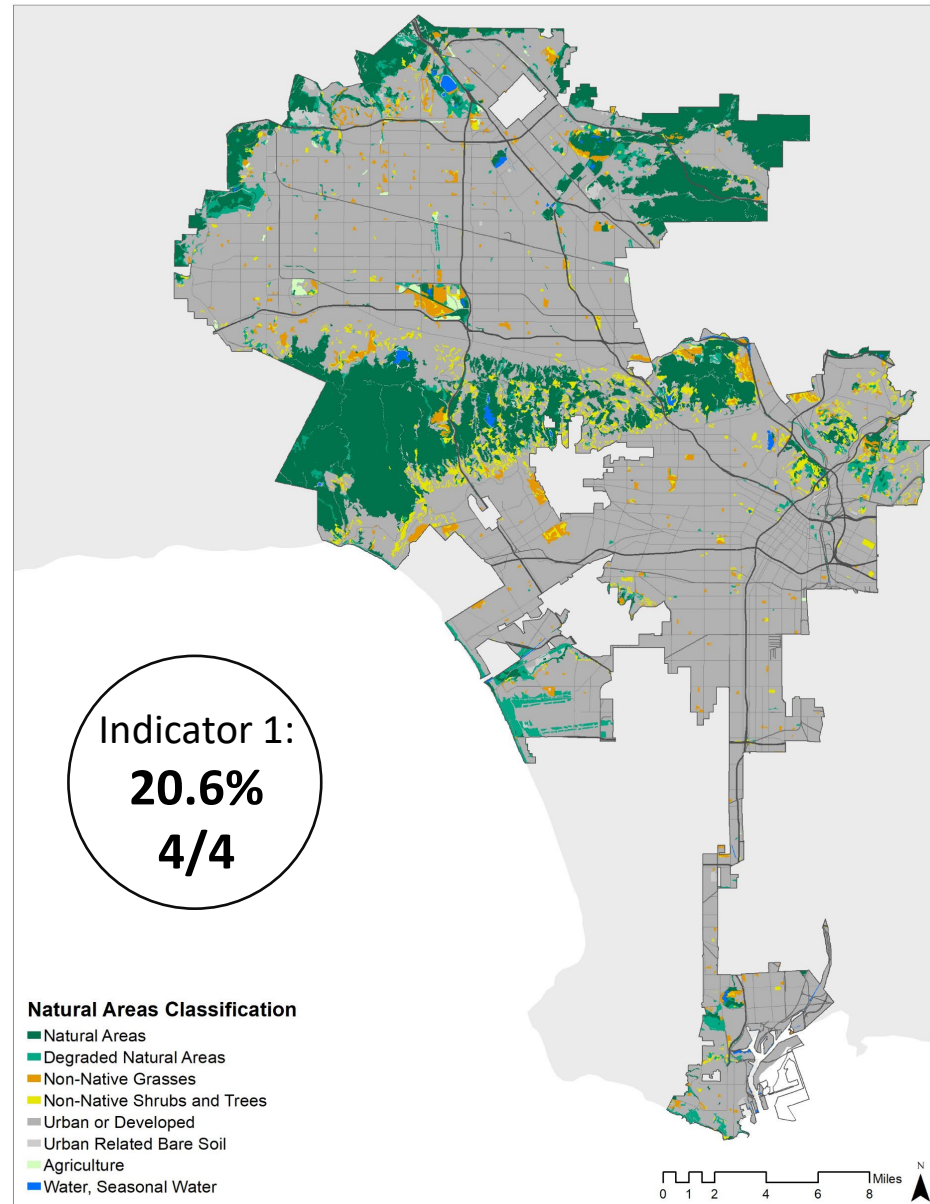


2. Landform (constructed)
(*based on SSURGO, topography*)



3. Wildlife Habitat Relationships &
Vegetation Alliances (*CALVEG*)

Application: Singapore Index vs. LA City Index for Indicator 1



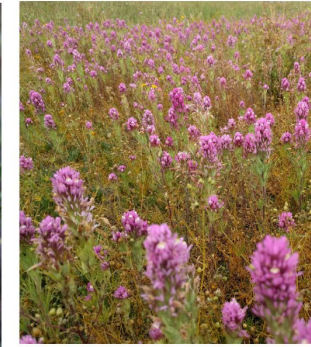
Chapter 2

Ecotope Management Units for Los Angeles

Tidy tips in a prairie, Carrizo Plain, San Luis Obispo County. Few prairies remain in Los Angeles, but large areas, similar to the Carrizo Plain, were likely historically present across of many of our flatter ecotopes, including the San Fernando Valley and near LAX (see Case Study 6 in Chapter 4).



Collared annual lupine - *Lupinus truncatus* (Photo: © Jeff Goddard) <https://www.inaturalist.org/photos/62922845>



Purple owl's-clover - *Castilleja exserta* (© Lee R. BenVau) <https://www.inaturalist.org/photos/56258852>



California goldfields - *Lasthenia californica* (Photo: Isaac Brown)



Tidy tips - *Layia platyglossa* (Photo: Isaac Brown)



Goldenstar - *Bloomeria crocea* (Photo: © J Kurylo) <https://www.inaturalist.org/photos/62348912>



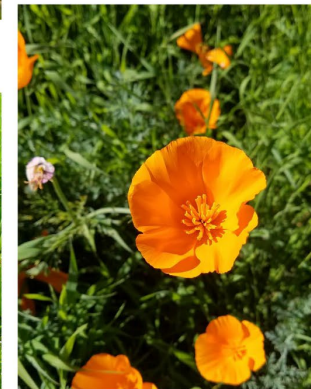
Nodding needle grass - *Nassella cernua* (Photo: © James Bailey) <http://www.inaturalist.org/photos/3488107>



Lemmon's canarygrass - *Phalaris lemmonii* (unconfirmed) (© jrebman) <https://www.inaturalist.org/photos/35161731>



Pacific foxtail (unconfirmed) - *Alopecurus saccatus* (Photo: © sweiser) <https://www.inaturalist.org/photos/37187269>



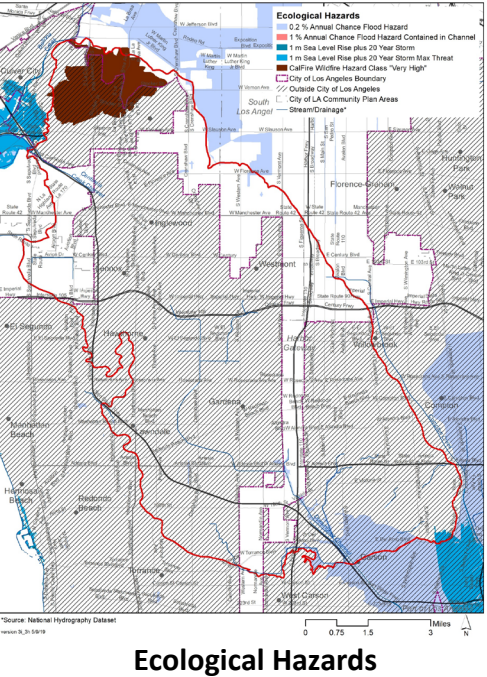
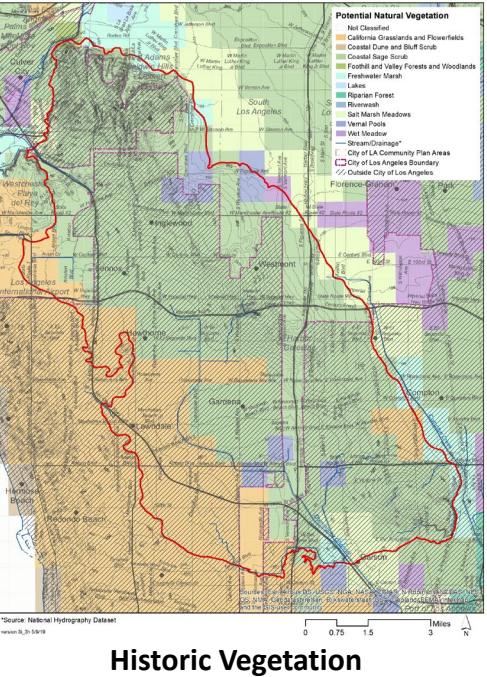
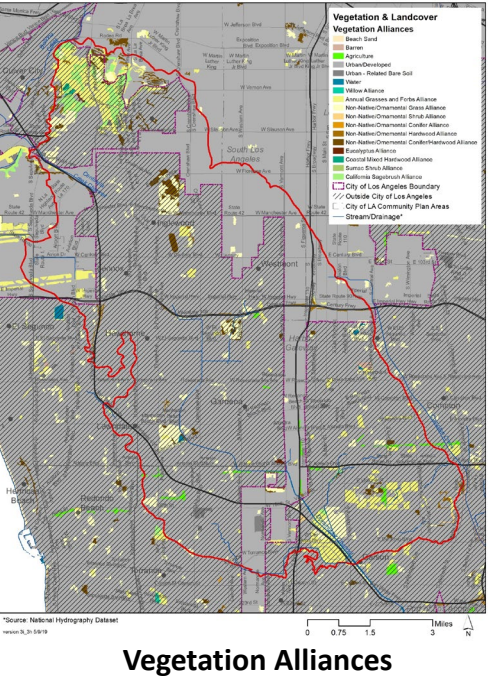
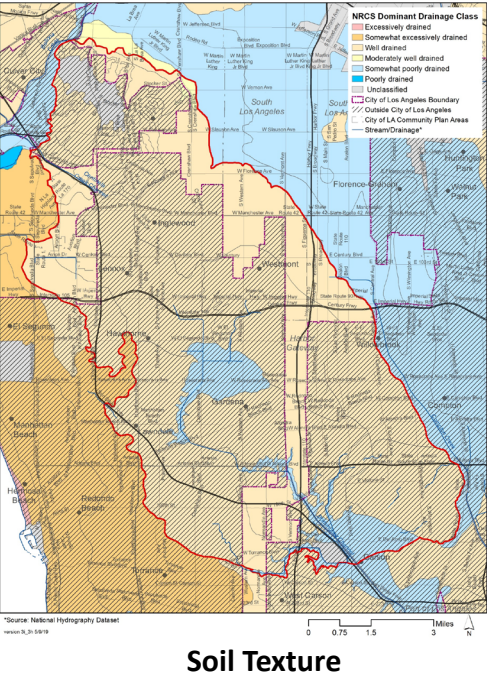
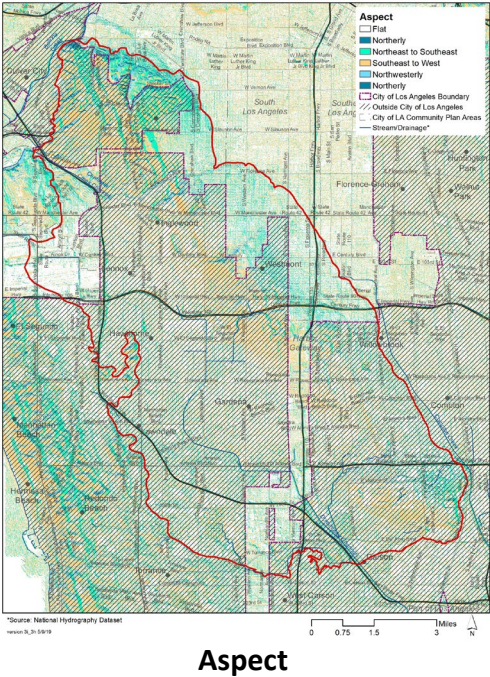
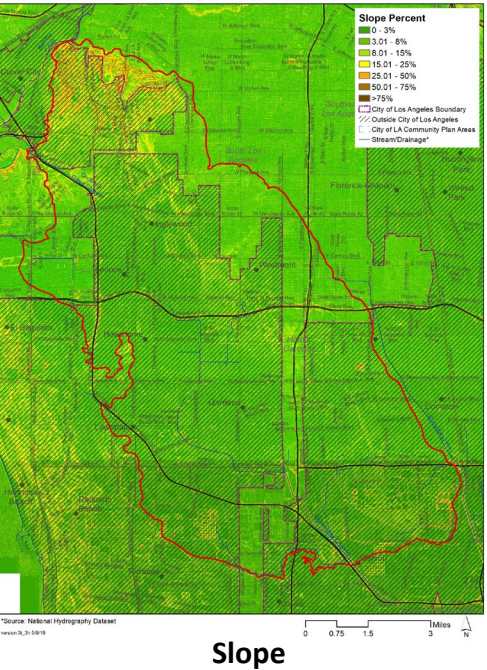
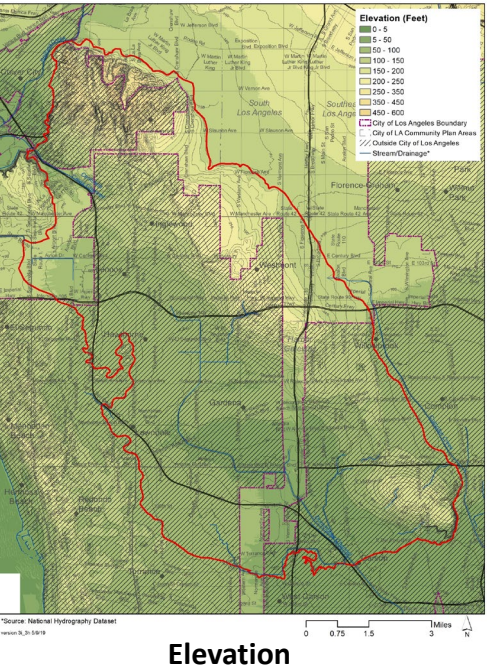
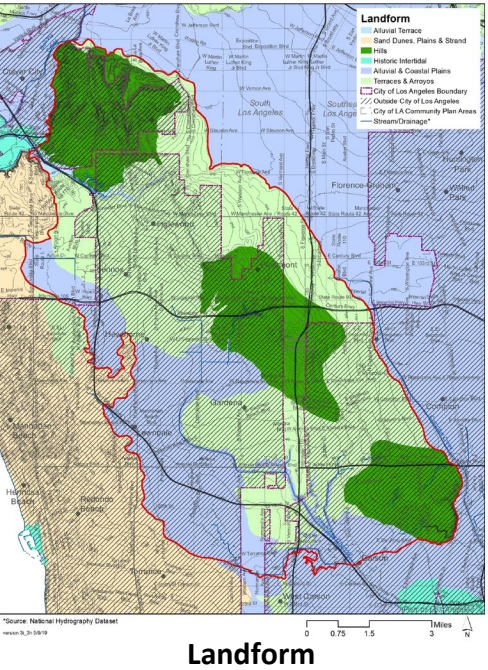
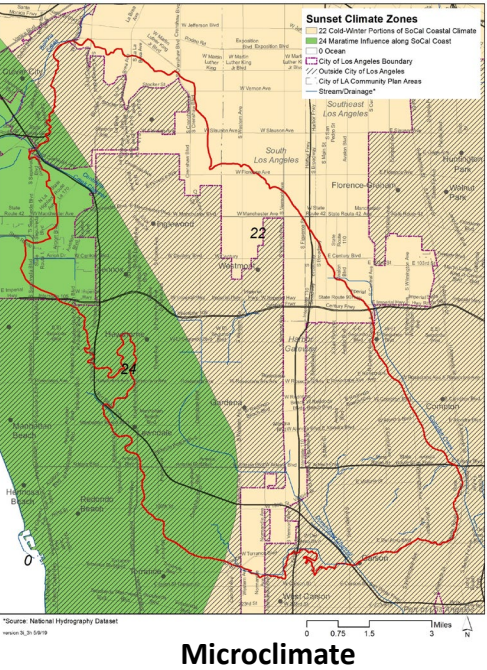
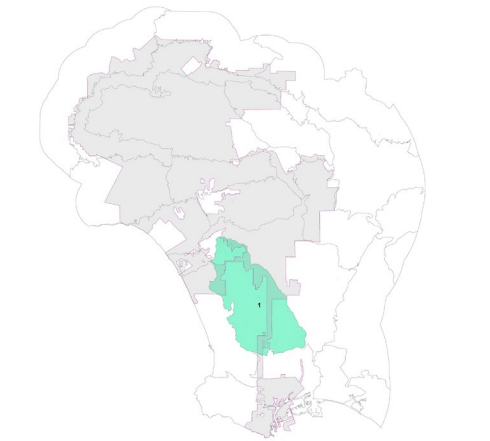
California poppy - *Eschscholzia californica* (Photo: Michelle Rogalski)



Fringed linanthus - *Linanthus dianthiflorus* (Photo: © Jeff S) <https://www.inaturalist.org/photos/57960332?size=original>

Figure 2-8: Native wildflowers and grasses of Los Angeles's coastal grasslands, prairies, and meadows. These species were selected from the literature review by Mattani and Longcore (1997) of historical observations covering portions of Ecotopes 1, 2, 6, 8, and 18.

Ecotope 1: Baldwin-Dominguez Hills & Terraces



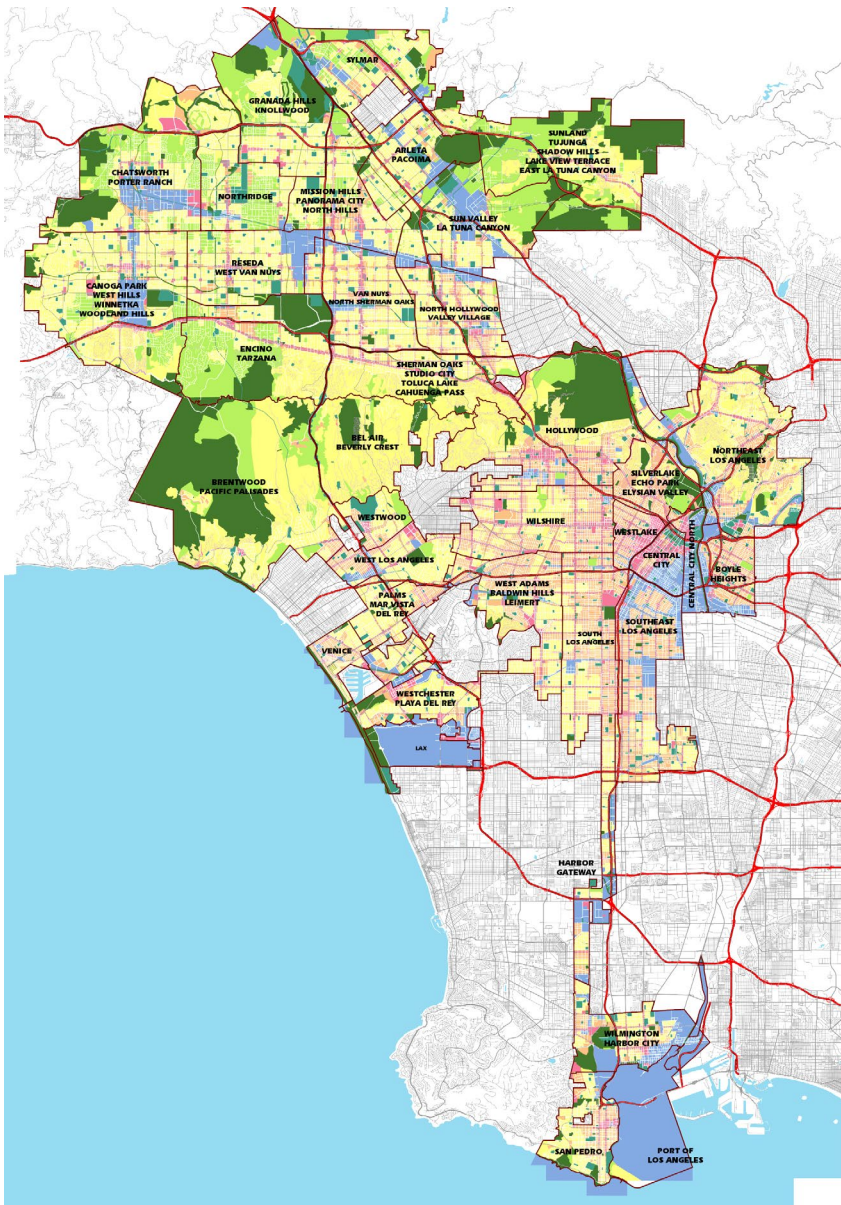
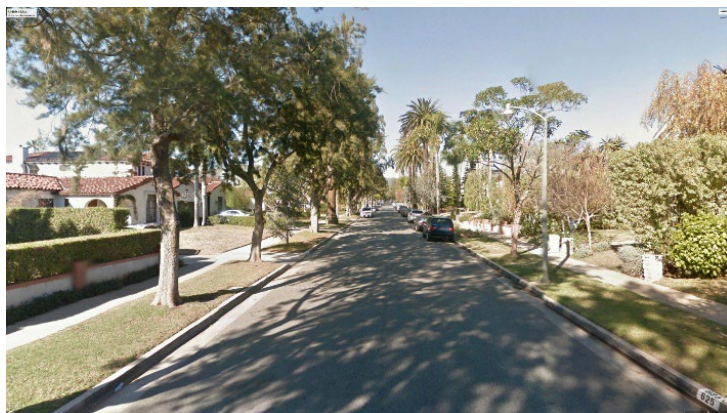
Urban Ecosystem Types Neighborhood Scale

Transition Alluvial Plain Subregion

- riparian urban industrial barren, high exposure
- riparian dense urban mixed use savanna, high exposure
- urban industrial barren, alluvial plain, high exposure
- urban industrial barren, alluvial plain, low exposure
- dense urban mixed use savanna, high exposure
- dense urban mixed use savanna, mod. exposure
- dense urban mixed use savanna, low exposure
- urban mixed use savanna, low exposure

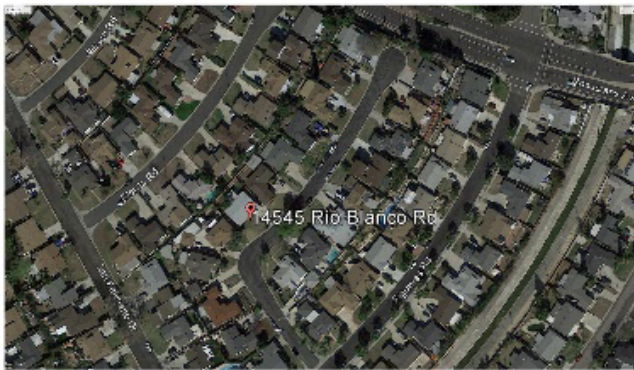
Coastal Terrace Subregion

- urban mixed use savanna, low exposure



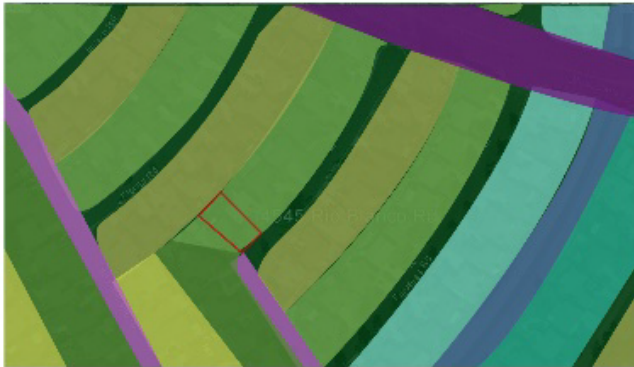
District Scale Ecotopes (applicable in General Plan, Zoning, Specific Plans, Masterplans)

Residential Parcel: Parcel ID, Address



Site Ecosystem Map

- Residential Parcels- Southeast Orientation
- Residential Parcels- Northwest Orientation
- Residential Parcels - Northeast Orientation
- Residential Parcels - Southwest Orientation
- Arterial ROW with Median - North/South Oriented
- Residential ROW- Northwest/Southwest Oriented
- Residential ROW - Northeast/Southeast Oriented
- Residential Parcels - Riparian Edge Northwest Orientation
- Residential Parcels - Riparian Edge Southeast Orientation
- Channelized and Sealed Urban Stream



Urban Ecosystem Description

Subregional Ecosystem Description

Coastal Transition Valleys & Terraces: moderately hot summers, moderate marine Influence, high priority habitat connectivity zone, air pollution receiving zone, moderate urban heat island.

Local Ecosystem Description

Suburban Savanna Terrace, Medium Low Density: South to Southeast Aspect, Gentle Slopes, Intact Native Soils, Single Story Structures, >50% landscape, <10% canopy, Moderately Poor Air Quality, Low Heat Island Contribution, Coastal Sage Scrub/Riparian Savanna Historic Ecosystem Types.

Site Ecosystem Description

Southeast Oriented Residential Parcel, Intact Soils: 0.15 acres, Loamy Clay Soils, Southeast Aspect, Frost Pocket (1 to 3 frosts per year), 2-9% slopes, 25% shaded, 90% turf/10% mixed shrubs, 2.5 miles to nearest major habitat patch, 0.7 miles to park, moderately poor air quality, high runoff.

Urban Ecosystem Health Enhancement **Opportunities & Constraints**

Indicator Category	Enhancement Measures	Priority Level
Hydrology/Water Quality	Provide bioswales	High Priority
Urban Heat Island/Climate Control	Low albedo roof materials	Low Priority
Native Biodiversity	Coastal Sage Scrub highly suitable	High Priority
Habitat Connectivity	Include habitat stepping stone	High Priority
Invasive Species	Minimal threat to natural areas	Low Priority
Landscape Carbon Cycling	Large, long lived, low maintenance trees	Low Priority
Ecological Hazards	Minor street flooding	Low Priority
Toxic Contamination	1.1 miles to toxic emitter	Low Priority
Air Quality	High receiving location for criteria pollutants	Low Priority
Parks/Open Space Accessibility	0.7 miles to nearest park	NA
Aesthetics/Community Enrichment	Promote alternative landscapes to lawn	High Priority

LA Sanitation & Environment Biodiversity Homepage (LA Index, Ecotopes, Etc.)

<https://www.lacitysan.org/biodiversity>

Managing Cities as Urban Ecosystems: Fundamentals and a Framework for Los Angeles

<https://digitalcommons.lmu.edu/cate/vol10/iss2/4/>

Managing Cities as Urban Ecosystems: Analysis Tools for Biodiversity Stewardship in Los Angeles

<https://escholarship.org/uc/item/4c81w4nr>

Singapore Index

<https://www.cbd.int/article/2021-singapore-index>

MacArthur Park Lake Case Study

<http://macarthurparknc.org/macarthur-park-lake-rehabilitation-project/>

LA River Fish Passage & Habitat Structures Design Project

<https://www.watershedhealth.org/larw-fish-passage>

Taylor Yard LA River Park Design

<https://tayloryardriverprojects.lacity.org/>

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