
ENGINEERING
Serving the Present; Designing for the Future
City of Los Angeles • Department of Public Works • Bureau of Engineering
Lake Rehabilitation Options for the Machado Lake Ecosystem Rehabilitation Project
NCER Conference
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CDM
in association with
PARSONS

Paper Authors

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Proposition O - City of Los Angeles Bond Measure

- Up to $500 million for projects to protect public health in order to meet Federal Clean Water Act requirements
- Will fund improvements to:
  - protect water quality
  - provide flood protection
  - increase water conservation
  - increase habitat protection

Topics

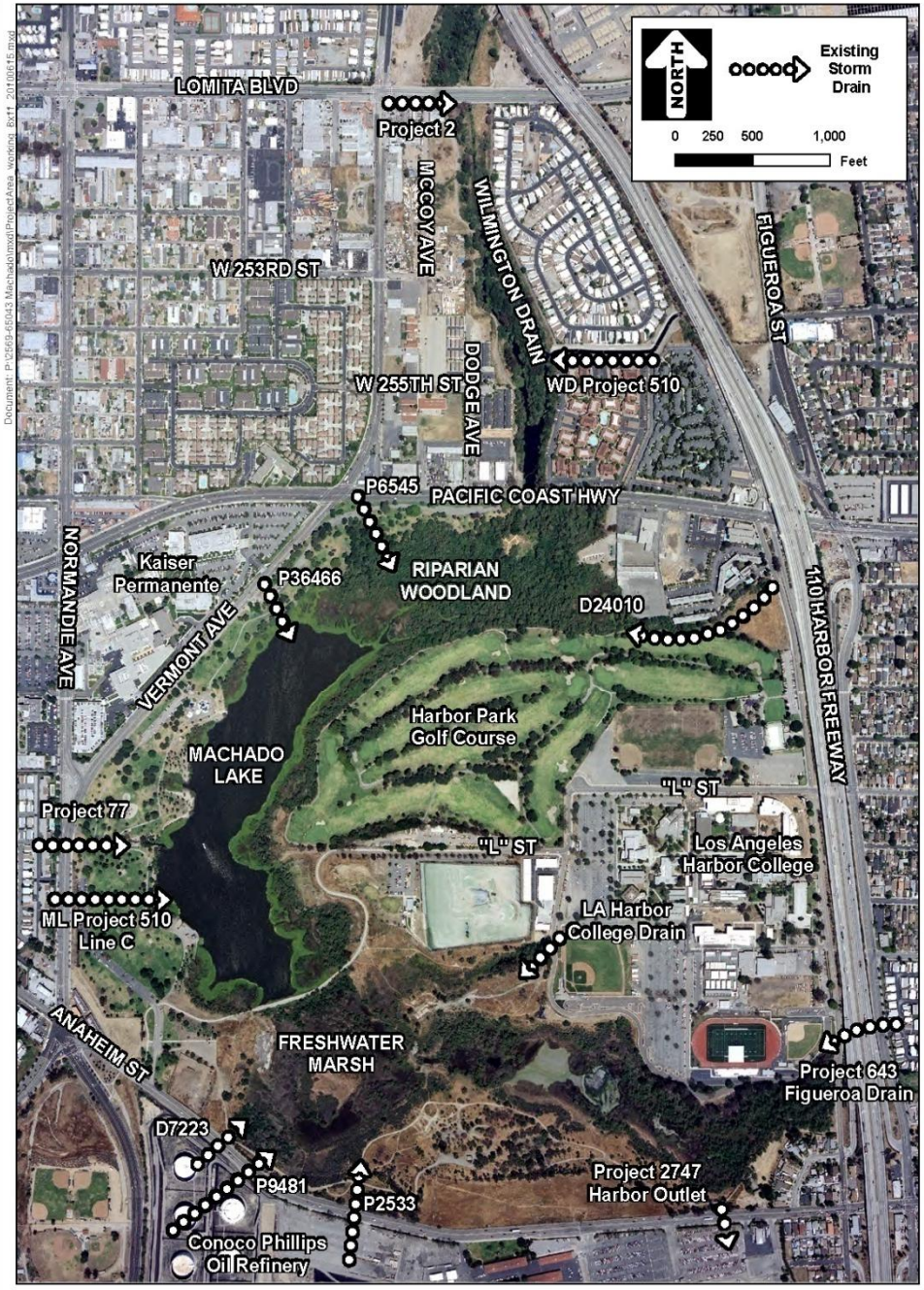
- Introduction
- Regulatory Background
- Project Goals
- Detailed Design Components
- Rehabilitation Management Strategies
- Conclusion

- Natural 40 acre lake
- Only inputs:
  - Stormwater
  - Urban runoff

Machado Lake holds a unique place in LA history.

Today, this park is a popular recreation destination for local residents…

…but now Wilmington Drain, Machado Lake, and the park are impaired.



Wilmington Drain and Machado Lake

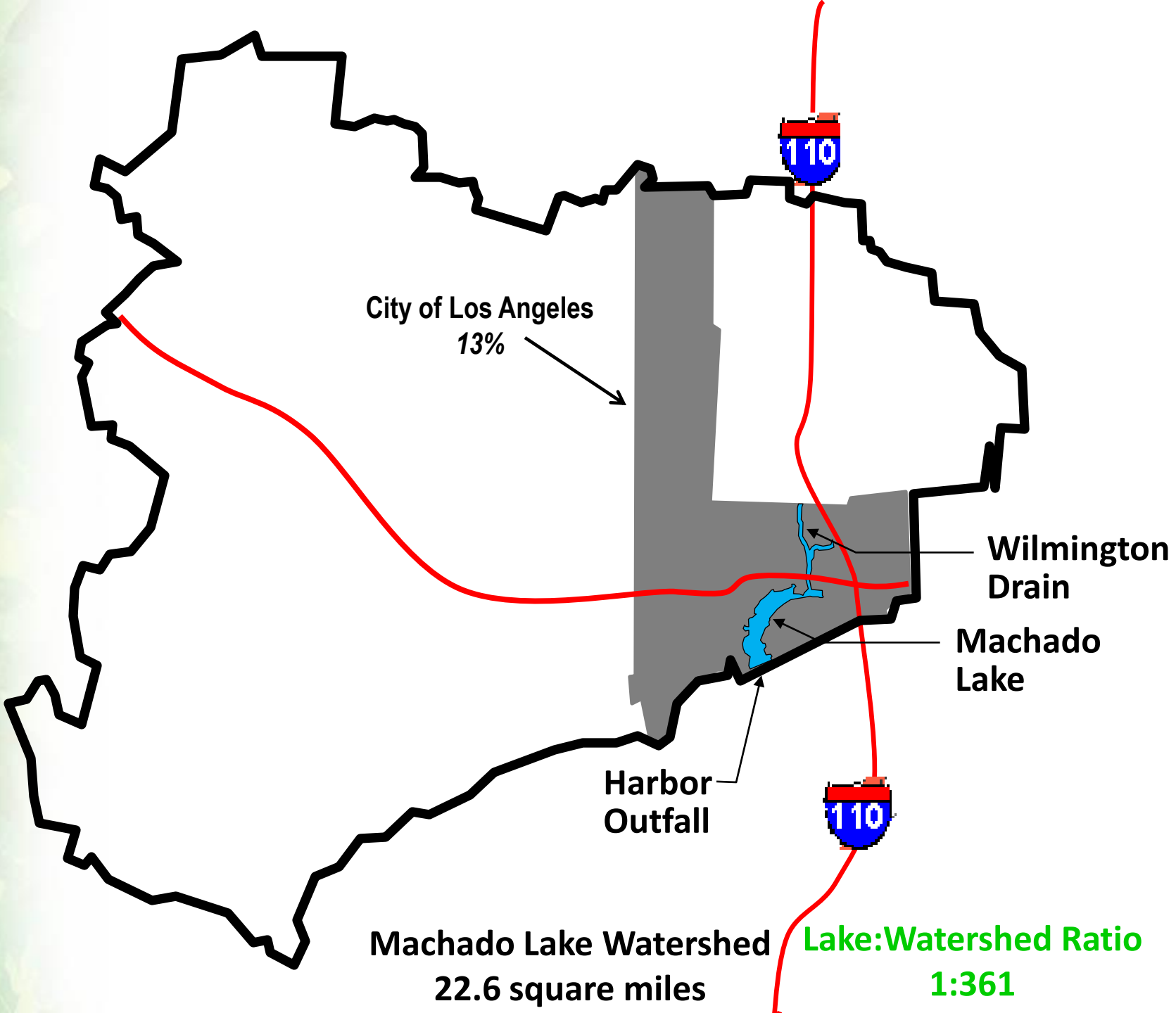
Over 90% of the original extent of freshwater habitat in California has been lost due to development

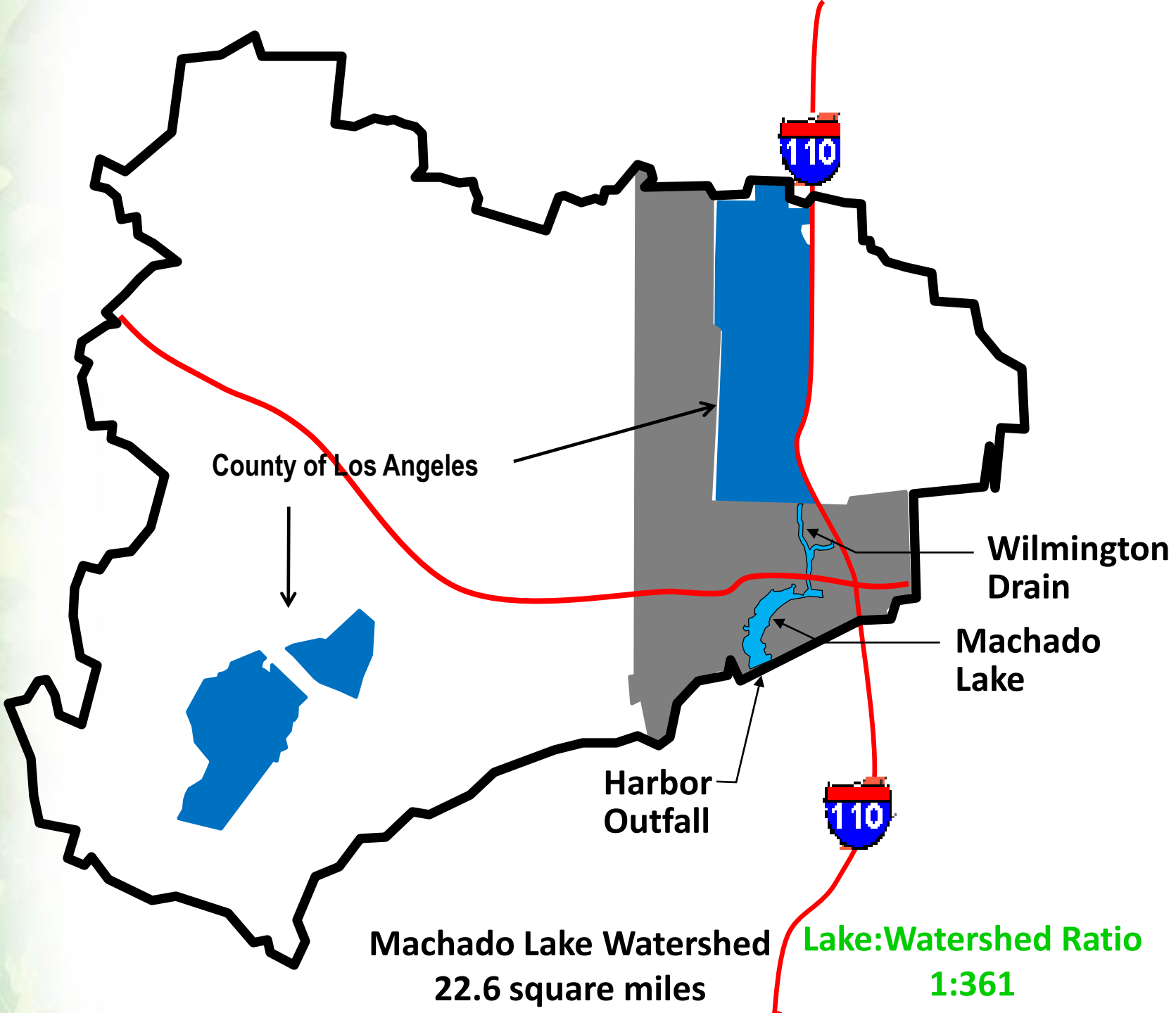
Project design must target pollutants of concern (POCs)

Wilmington Drain POCs
- Trash
- Nutrients/Bacteria
- Chromium, copper, lead
- Legacy Pollutants

Machado Lake POCs
- Trash
- Nutrients/Algae/Odors
- Lead
- Legacy Pollutants

Los Angeles Harbor POCs
- Beach Closures
- Copper, Zinc
- Legacy Pollutants
- Sediment Toxicity


110
City of Los Angeles
13%
Wilmington
Drain
Machado
Lake
Harbor
Outfall
110
Machado Lake Watershed
22.6 square miles
Lake:Watershed Ratio
1:361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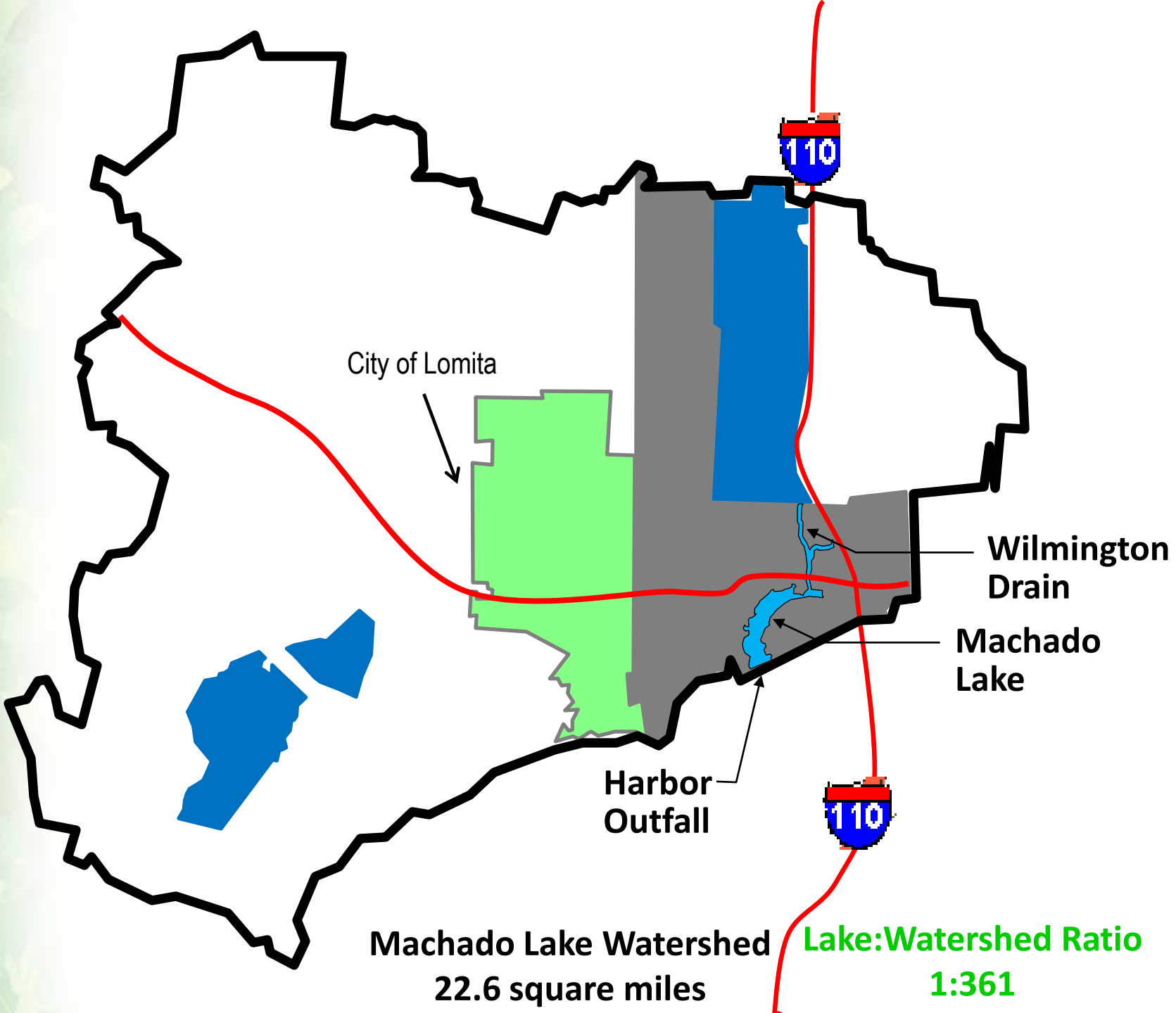
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Wilmington Drain
Machado Lake
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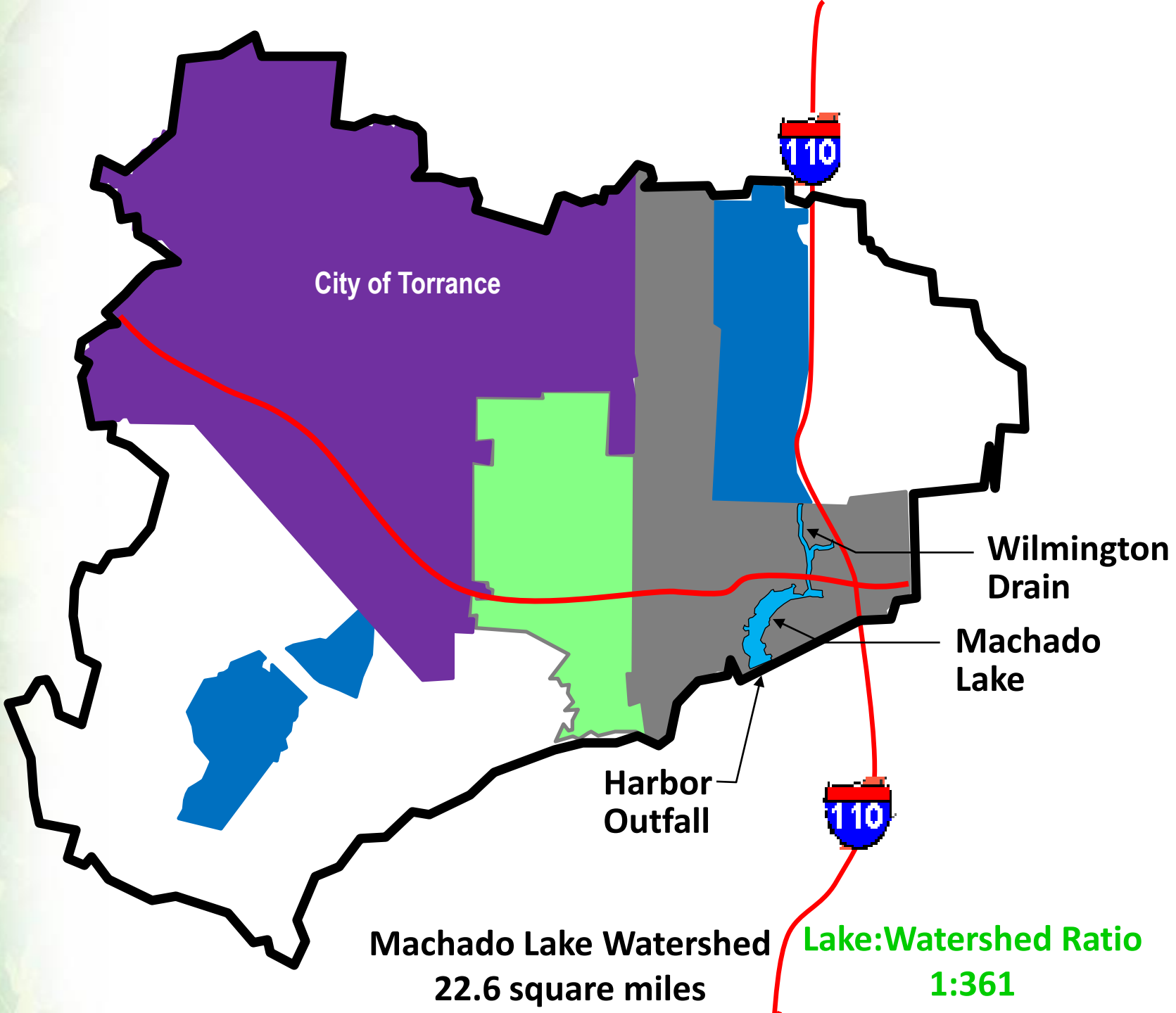
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Machado Lake
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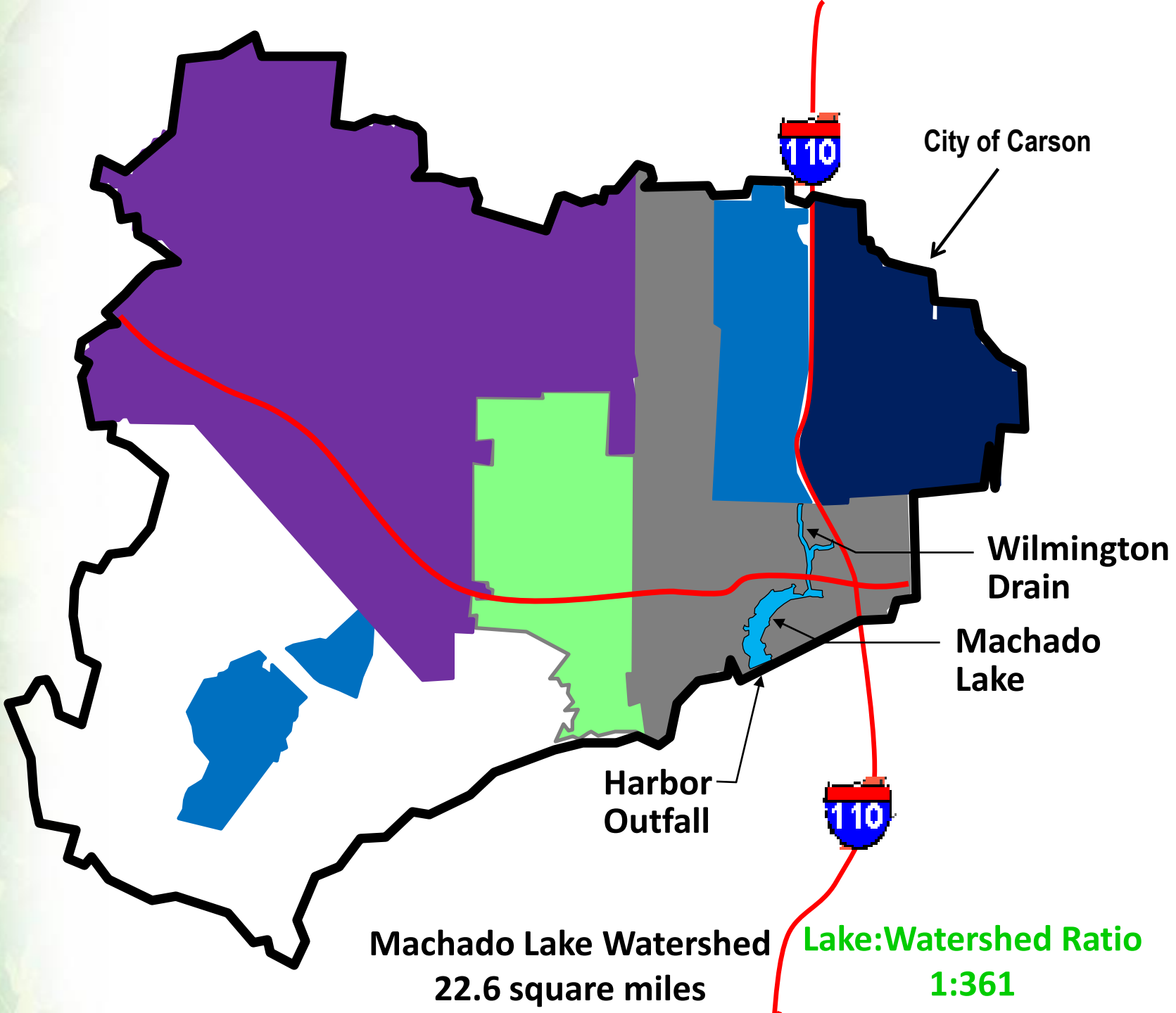
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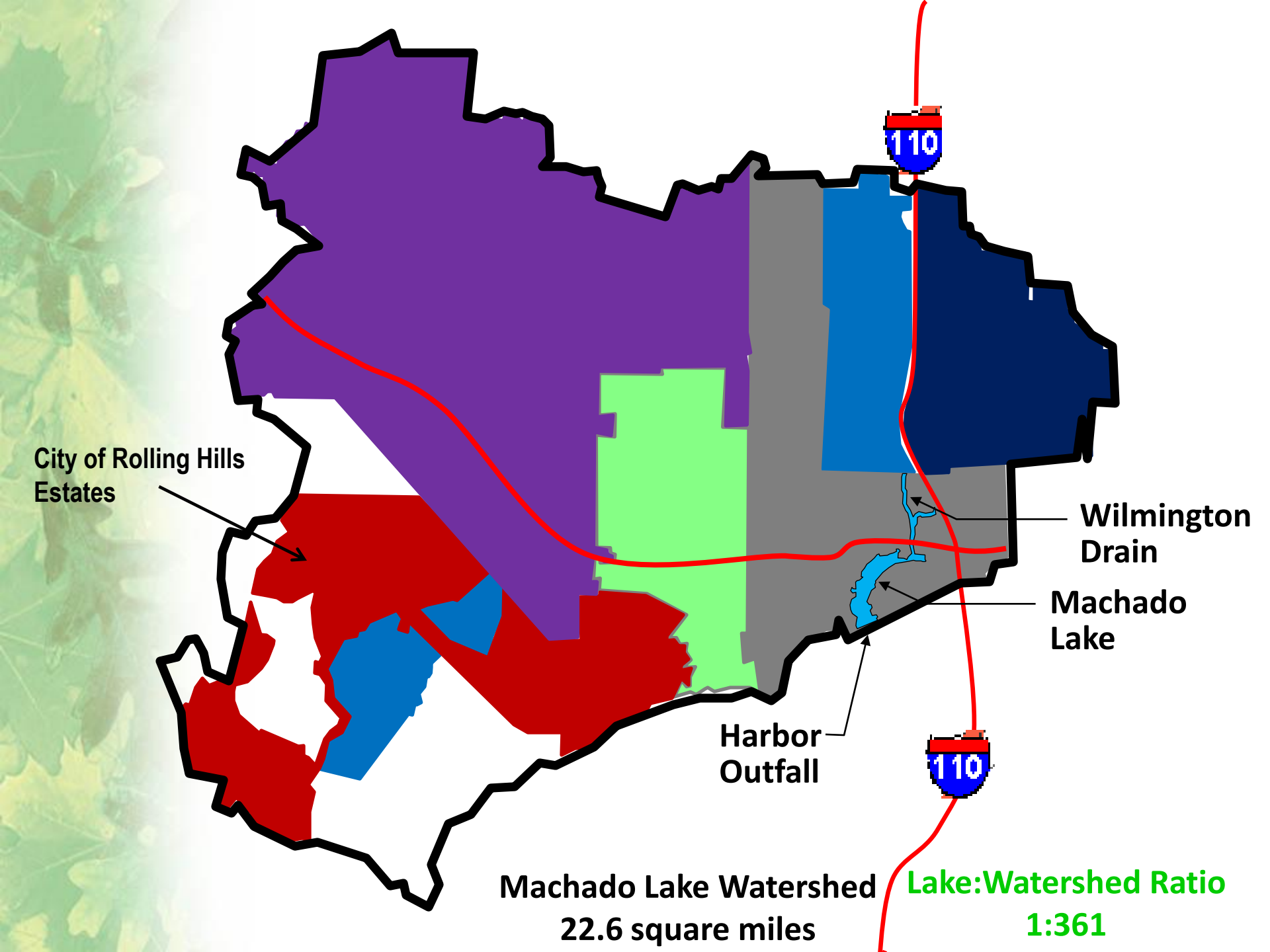
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Wilmington Drain
Machado Lake
Harbor Outfall
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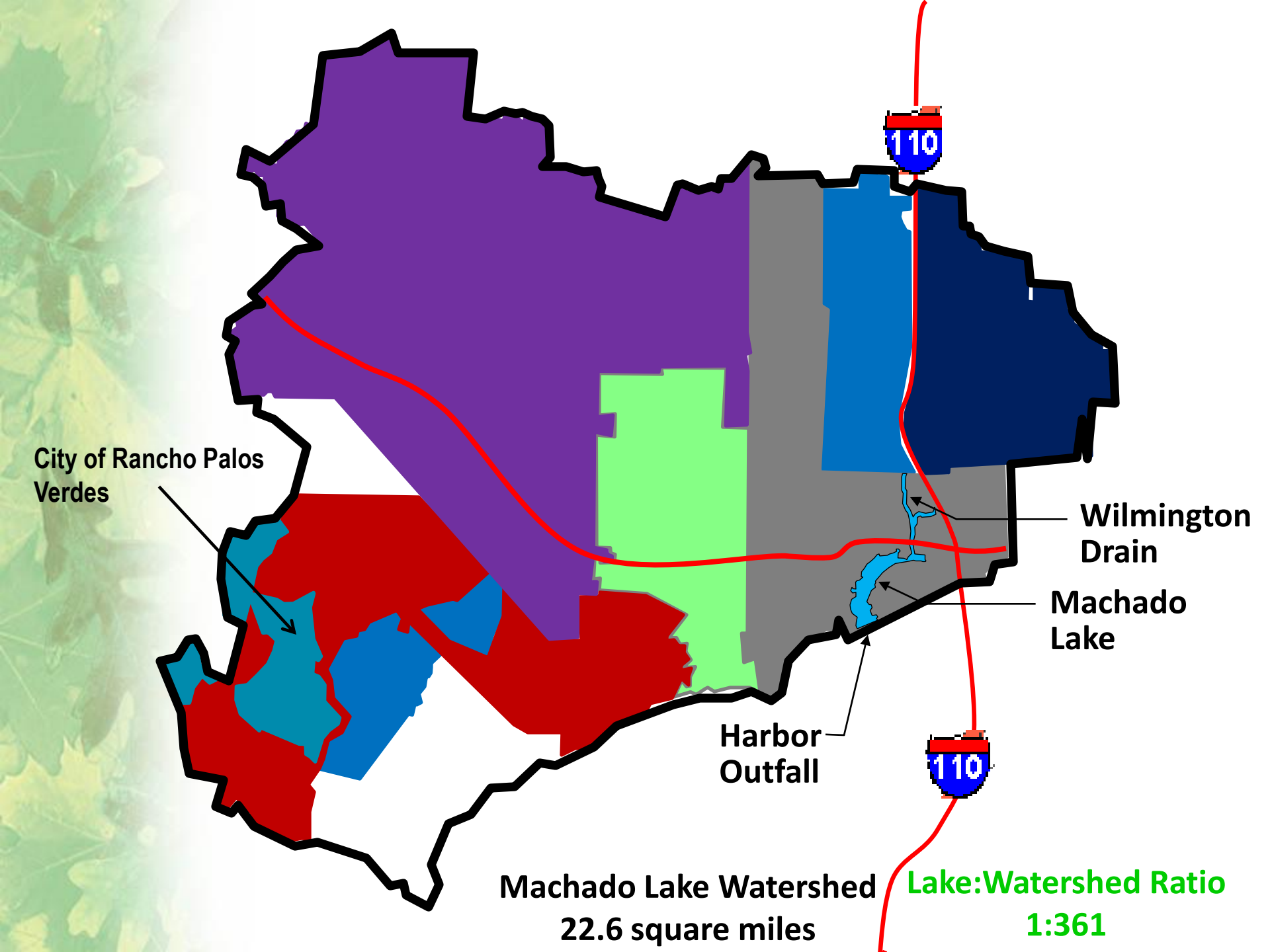
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Wilmington Drain
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Harbor Outfall
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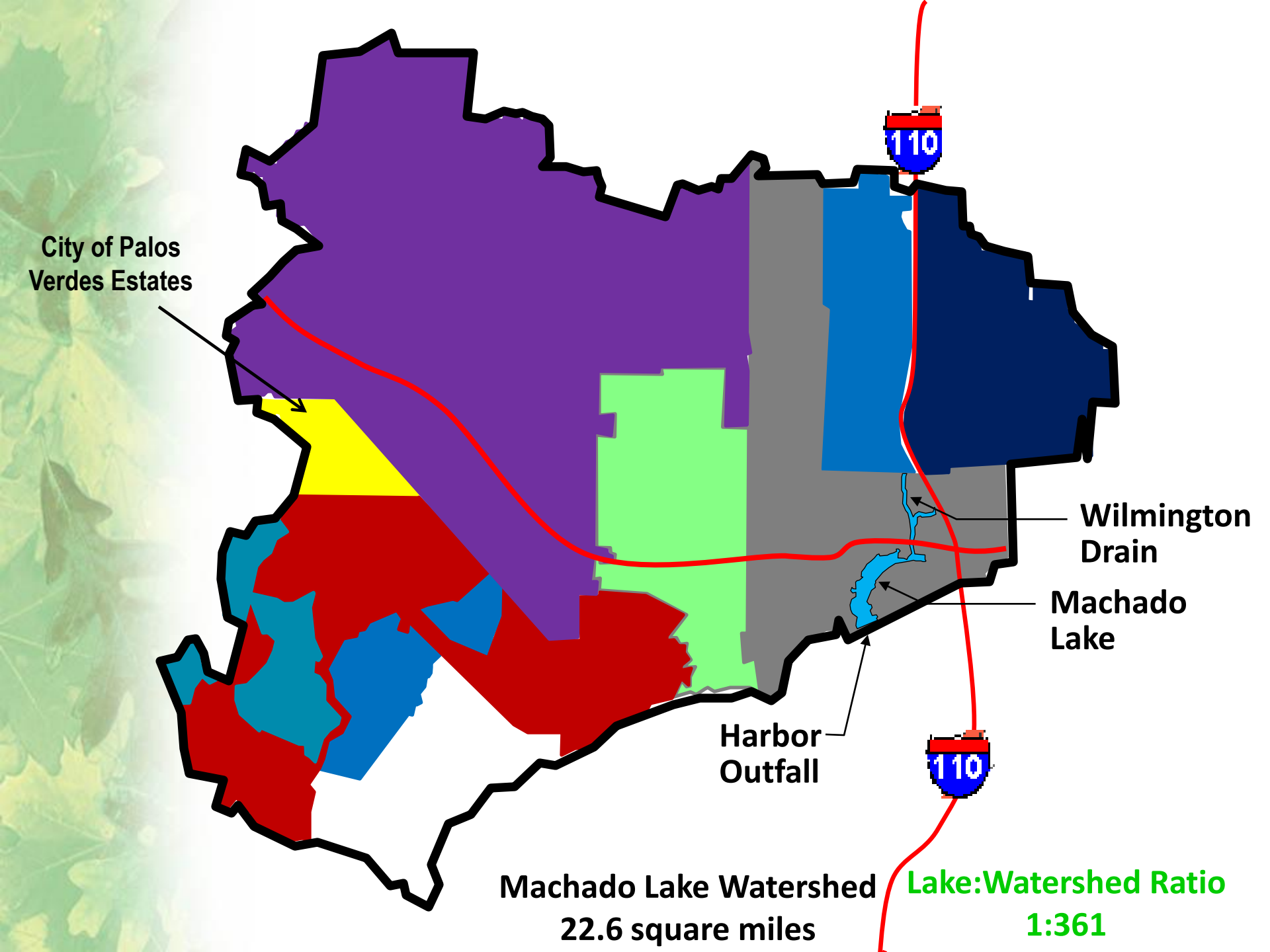
City of Palos Verdes Estates
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Wilmington Drain
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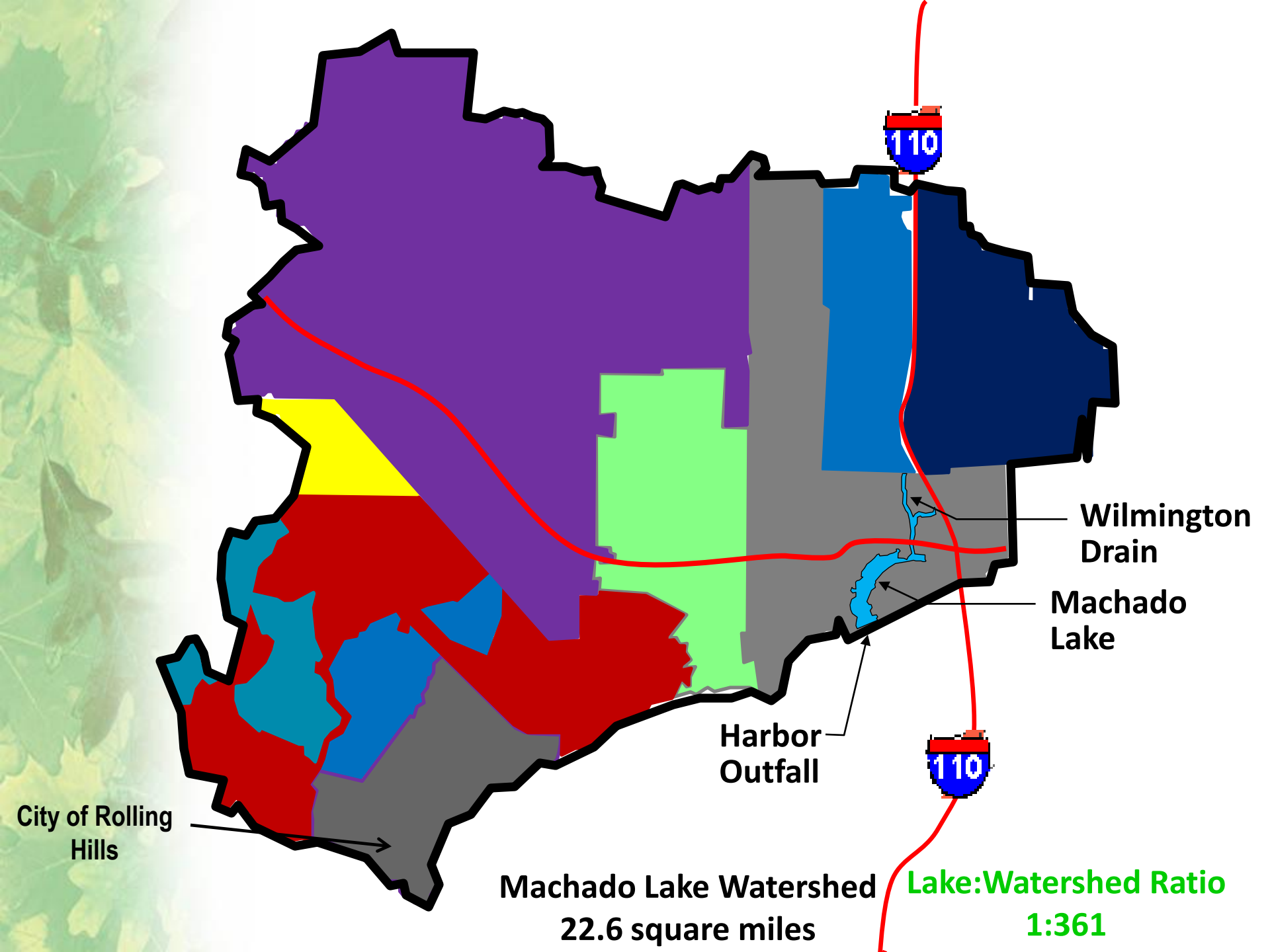
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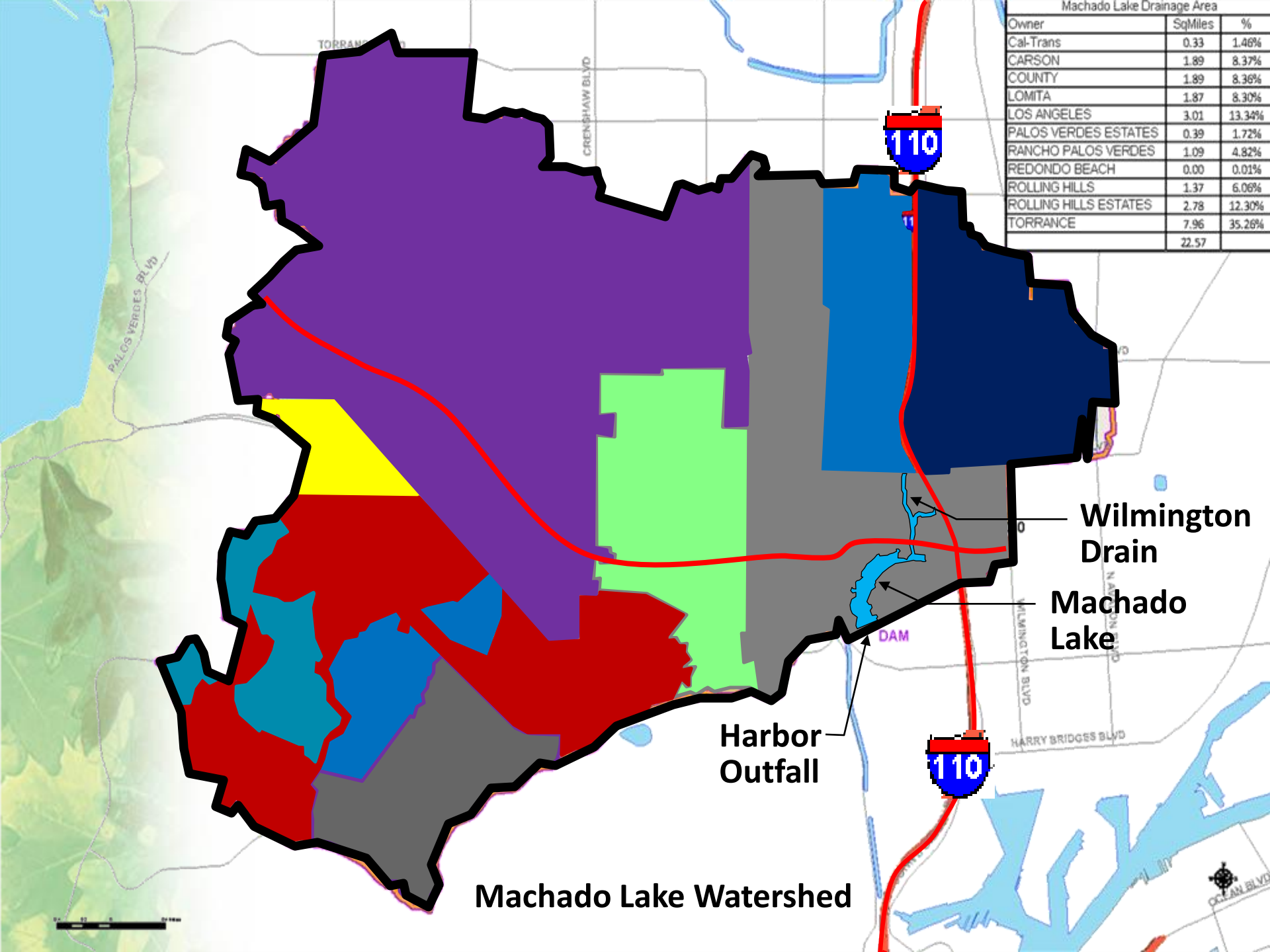
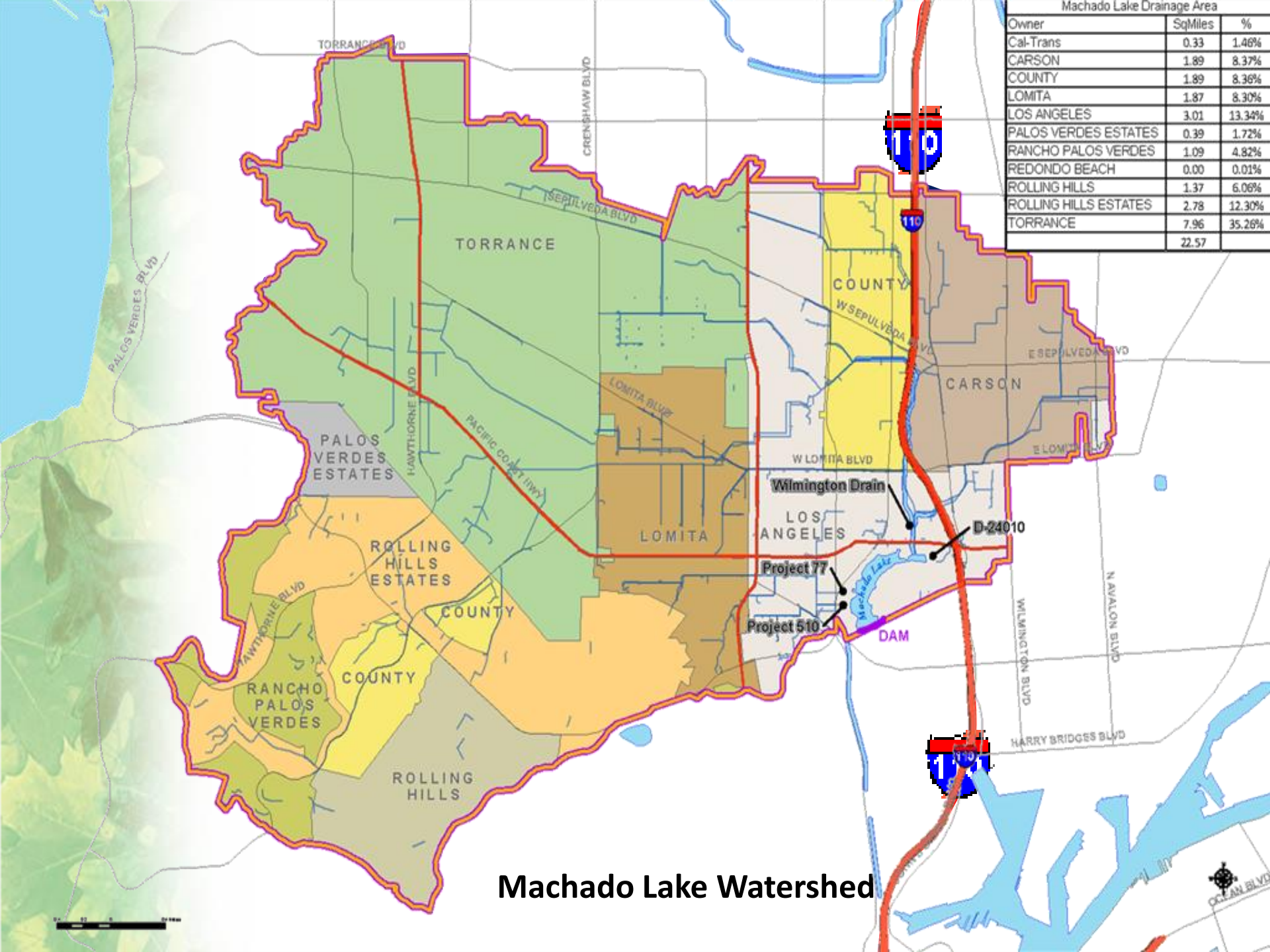

Machado Lake Drainage Area
Owner | SqMiles | %
Cal-Trans | 0.33 | 1.46%
CARSON | 1.89 | 8.37%
COUNTY | 1.89 | 8.36%
LOMITA | 1.87 | 8.30%
LOS ANGELES | 3.01 | 13.34%
PALOS VERDES ESTATES | 0.39 | 1.72%
RANCHO PALOS VERDES | 1.09 | 4.82%
REDONDO BEACH | 0.00 | 0.01%
ROLLING HILLS | 1.37 | 6.06%
ROLLING HILLS ESTATES | 2.78 | 12.30%
TORRANCE | 7.96 | 35.26%
22.57
Wilmington Drain
Machado Lake
Harbor Outfall
Machado Lake Watershed
DAM
110
CRENSHAW BLVD
PALOS VERDES BLVD
WILMINGTON BLVD
HARRY BRIDGES BLVD
OCEAN BLVD



Machado Lake Watershed

Regulatory Background

- Clean Water Act (CWA)
  - Requires listing of waterbody impairments (303(d) list)
- Regional Water Quality Control Board
  - Implements CA responsibilities under the CWA
  - Develops total maximum daily load (TMDL) numeric targets

Nutrients TMDL Numeric Targets vs. Existing Water Quality Conditions

Field Collected Monitoring Data (2006 – 2008)

Constituent	TMDL Numeric Targets			
		Minimum	Average	Maximum
Total Phosphorus (mg/L)	0.10	0.3	0.8	1.4
Total Nitrogen (mg/L)	1.0	0.3	1.8	4.6
Chlorophyll-*a* (ug/L)	20	3.4	72.6	337.7
Dissolved Oxygen (mg/L)	5	0.5	4.7	16.5

Overarching Goals for Machado Lake Ecosystem and Wilmington Drain Multi-Use Projects

Machado Lake – Detailed Design

- Lake dredging and shoreline stabilization
- Capping
- Sedimentation basins
- Lake augmentation with supplemental (recycled) water
- Lake aeration
- Wetlands
- Phosphorus removal
- Best management practices (BMPs)
- Floating islands
- Aquatic plant management
- Invasives removal and natives restoration
- Park improvements

Wilmington Drain – Detailed Design

- Channel dredging and shoreline stabilization
- Sedimentation basin north of Pacific Coast Hwy
- Best management practices (BMPs)
- Passive park
- Trails on west bank
- Access roads for maintenance activities
- Invasives removal and natives restoration

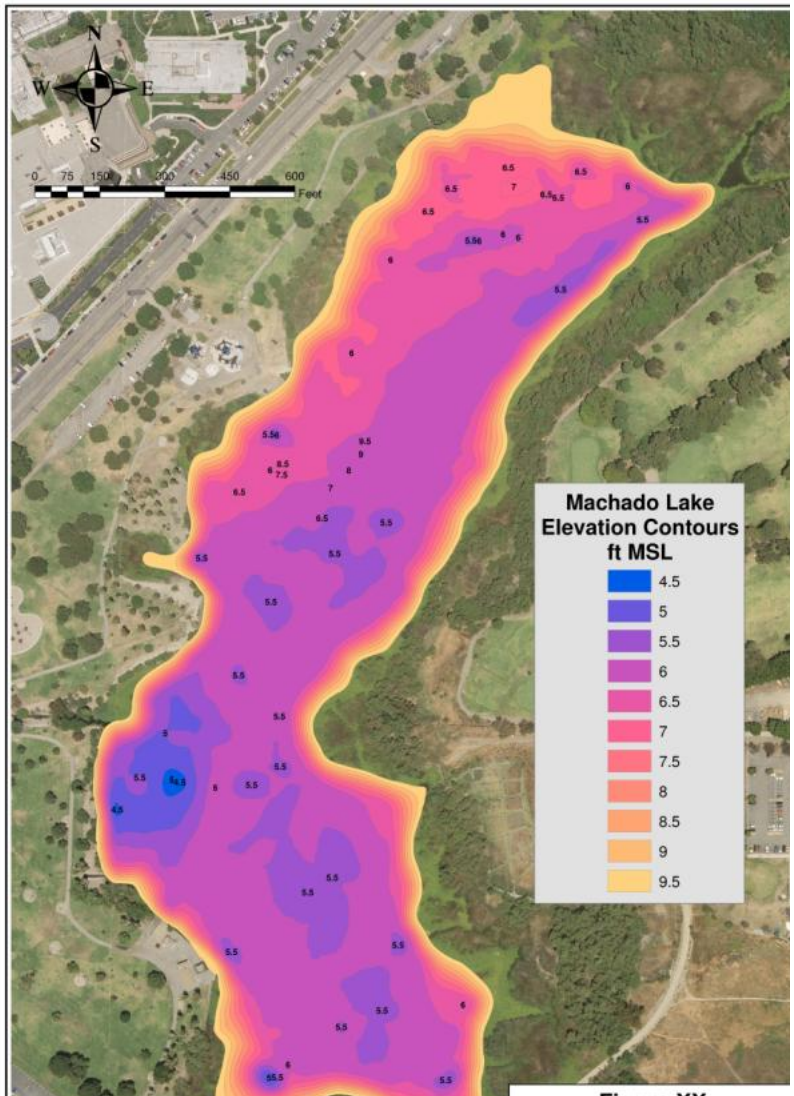

Selected Rehabilitation Management Strategies

Removal of Sediment

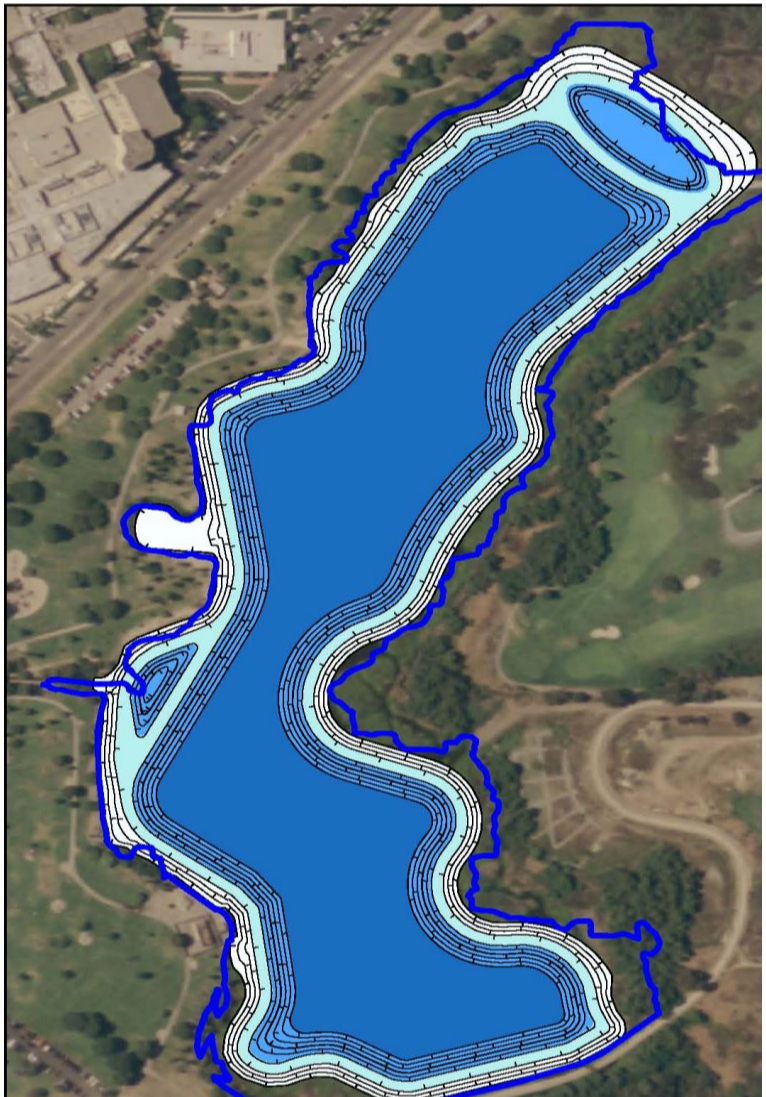
- Immediate removal of nutrients and legacy pollutants
- Increased lake depth
- Deepen areas for vector control
- Re-establish flood storage capacity
- Removal of invasive aquatic plants

Lake Depth

- Bathymetric survey, 2008

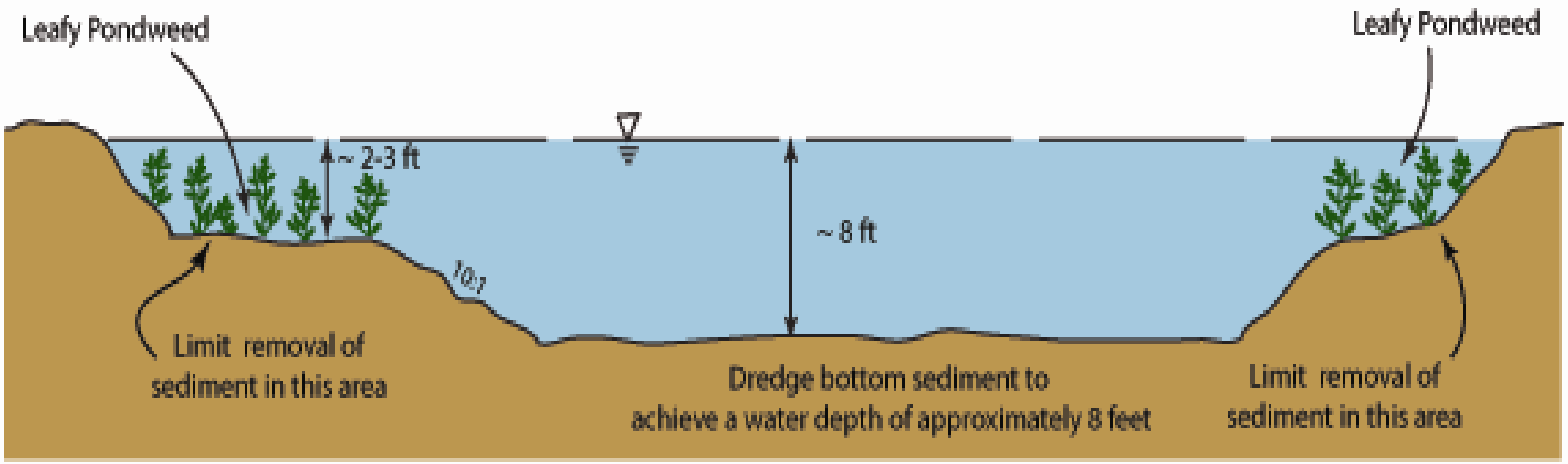


- Proposed contours



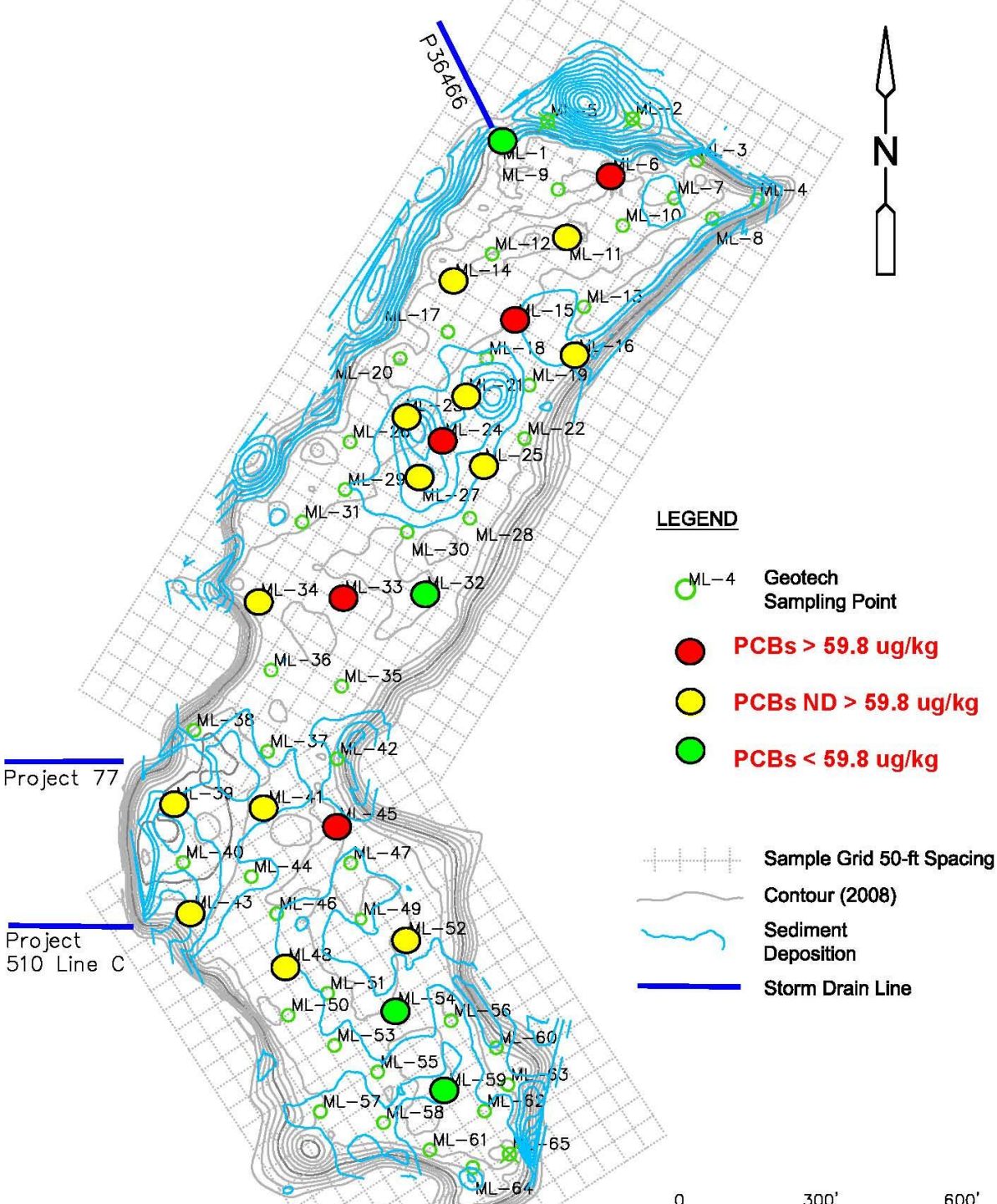
Shoreline Stabilization

- Designed lake bottom cross-section
  - Limit shoreline erosion
  - Planting of specific aquatic vegetation



PCBs

- Draft Toxics TMDL, Sediment Numeric Limit
  - 59.8 ug/kg
- Statistics
  - 180 ug/kg – maximum
  - 29 ug/kg – median
  - 4.8 ug/kg – minimum



Addition of Supplemental Water

- Keeps lake full during the summer
- Improves water quality
- Available source from nearby MF/RO water reclamation facility
- Limits growth of aquatic plants

Addition of Oxygen

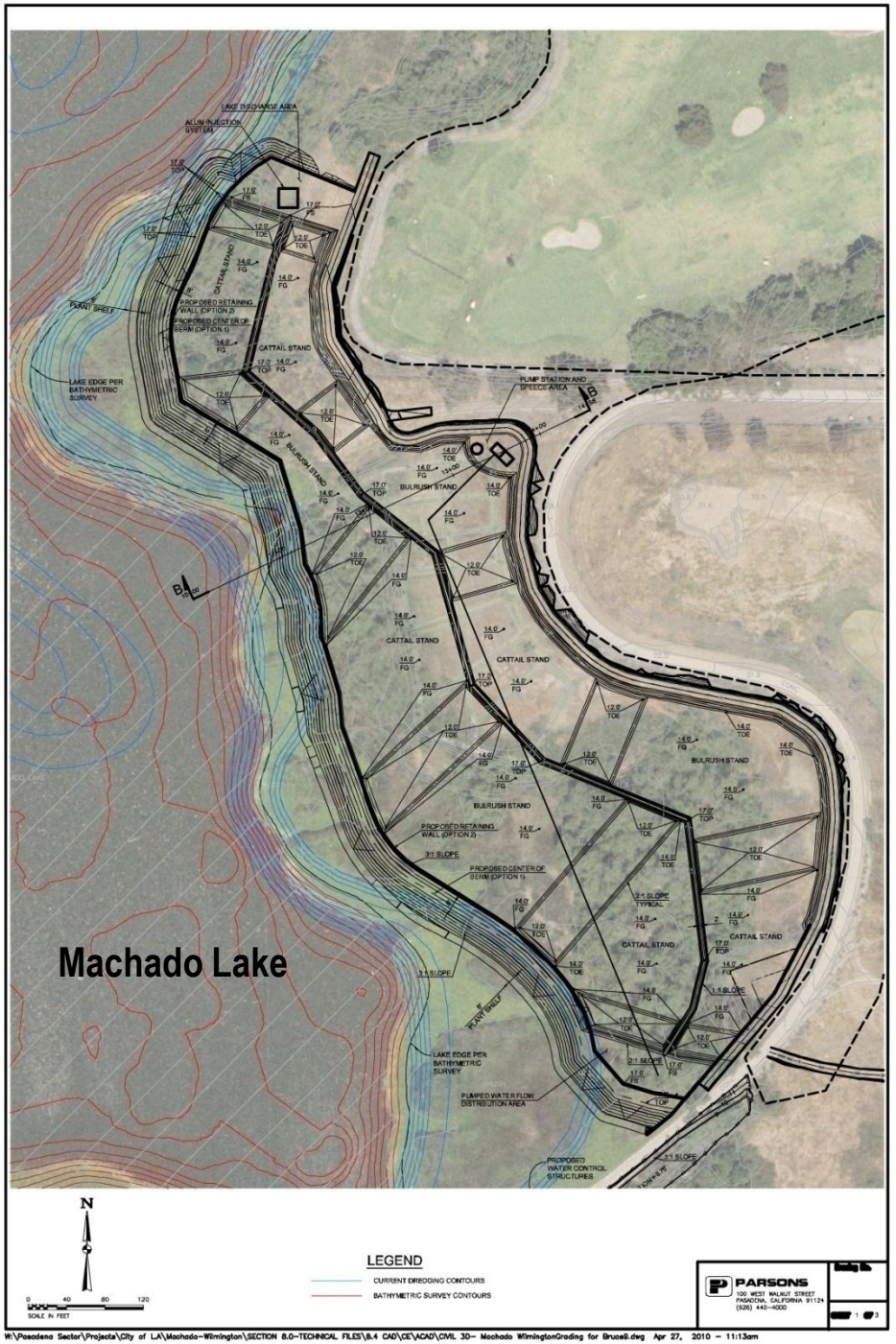
- Improves DO and pH levels throughout the water column
- Enhance circulation within the lake
- Reduce phosphorus releases by adding DO at the sediment-water interface
- Increase the aesthetic quality and beneficial uses of the lake, such as recreational fishing

Air Diffusers

Speece Cone (bubble swarm with pure O_2)

Wetlands

- Circulation of lake water through a constructed wetland
  - Removes nutrients and filters suspended sediments
- Potential for additional aesthetic and habitat enhancement
- Educational opportunity



Phosphorus Removal

- Alum Treatment
  - Commonly used lake restoration technique
  - One time treatment of entire lake following dredging
  - Controls phosphorous release from sediment
- Phosphorus Removal System Using Metal Oxide Media Adsorption
  - Used to remove phosphorus following the treatment wetland

Best Management Practices

Non-Structural BMPs

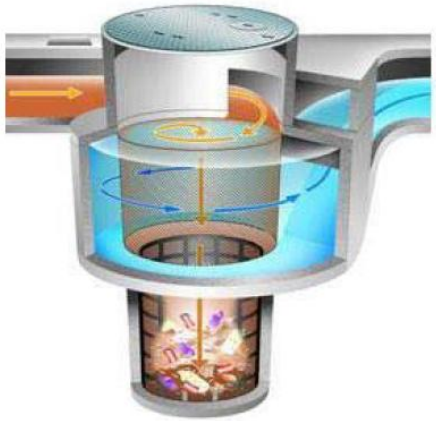
- Signage
- Irrigation Controllers

Site Design BMPs

- Porous Pavement
- Vegetated Swales/ Filter Strips
- Site Design

Treatment Control BMPs

- Coarse Solids Removal Devices
- Trash Netting System



Aquatic Plant Management

- Remove/control invasive aquatic vegetation (water primrose - ludwigia)
- Slow internal nutrient recycling
- Enhance emergent vegetation in littoral zone
- Vector control
- Increase biological diversity

Conclusion

- The water quality model for the design predicts the following:
  - 77% reduction in chlorophyll a
  - 85% reduction in phosphorus
  - 34% reduction in nitrogen
- Our detailed design will create a “healthy” lake and meet the City of Los Angeles TMDLs
- 87% off the watershed is outside of the City of LA jurisdiction
  - Substantial external loading from wet weather runoff
  - Other jursdictions will also need to meet their TMDLs

Least Bell's Vireo

- Riparian songbird that nests in dense willow and scrub thickets
- Nests entirely within California and northern Baja California
- Federally- and State-listed as Endangered


Questions?