Valuing Stormwater as a Resource

Results from the Los Angeles Basin Water Augmentation Study

Presentation to the Los Angeles Regional Water Quality Control Board
Salt & Nutrient Management Planning Workshop
Research Manager Mike Antos - November 15, 2012

Council for Watershed Health

The region's hub for watershed research and analysis

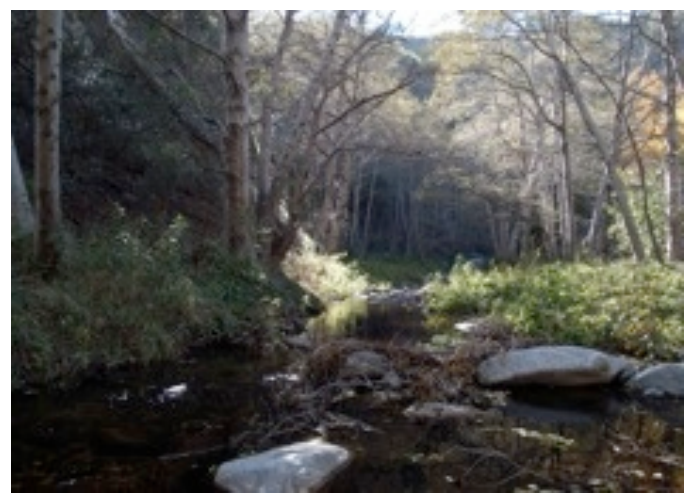
- Working at the intersection of research and policy
- Driving applied research to improve policy and practice
- Connecting diverse perspectives to address timely issues

A Vision for 2025:

Sustainable Southern California

Managing at the watershed scale for economic vitality, social and environmental health

- Clean waters
- Reliable local water supplies
- Restored native habitats
- Ample parks & open spaces
- Integrated flood protection
- Revitalized rivers & communities



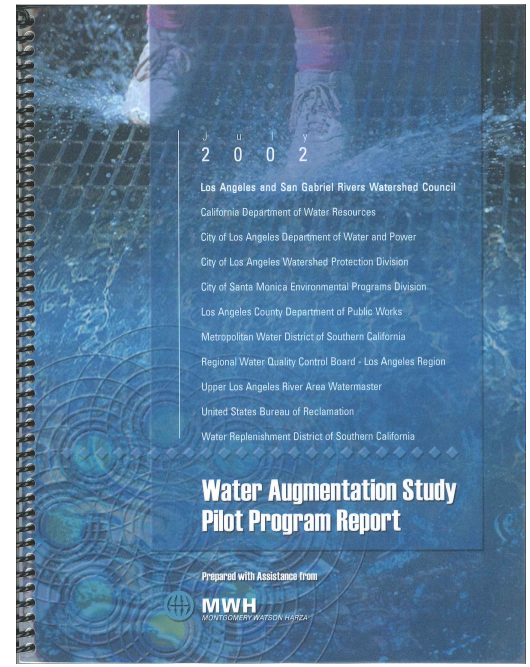
The Los Angeles Basin Water Augmentation Study

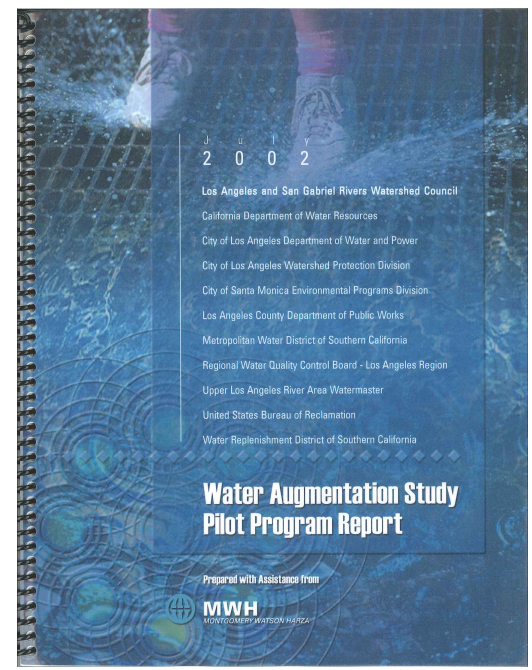
- Initiated in 2000
  - Led by CWH (then LASGRWC)
  - Multi-partner funding
  - Technical Advisory Committee

Can we safely and effectively infiltrate stormwater to augment our groundwater?

WAS Research & Monitoring

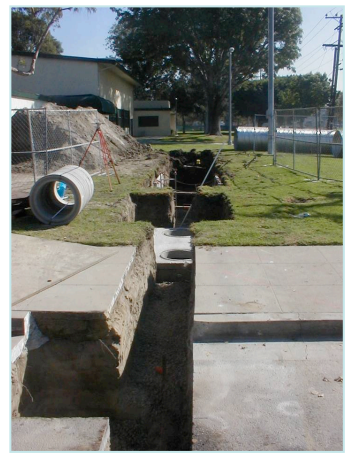
- Phase One (2000-2002)
  - Developed Monitoring Plan, initiated pilot monitoring
- Phase Two (2002 - 2005)
  - Installation of BMP, monitoring
- Phase Three (2005 - 2010)
  - Regional Assessment (GWAM)
  - Elmer Avenue Demonstration Project
  - Research, Strategy & Implementation Report

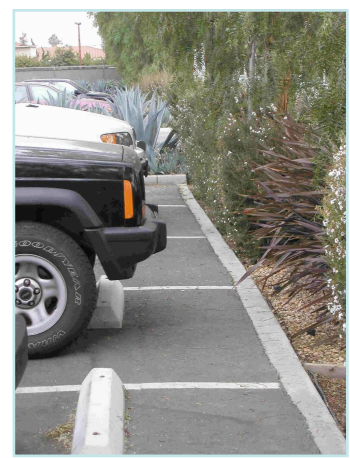




Monitoring Program

- Constituent list included pollutants of concern for stormwater/groundwater
  - Trace Metals
  - Volatile Organic Compounds
  - Bacteria
- Sampling plan:
  - 3-4 storm events/season for 2-5 years
  - Sample site runoff during storm
  - Sample lysimeters and wells after storm
  - Monitor infiltration rates
- Continued subsurface monitoring
  - (2 storm events/yr for 2 years)





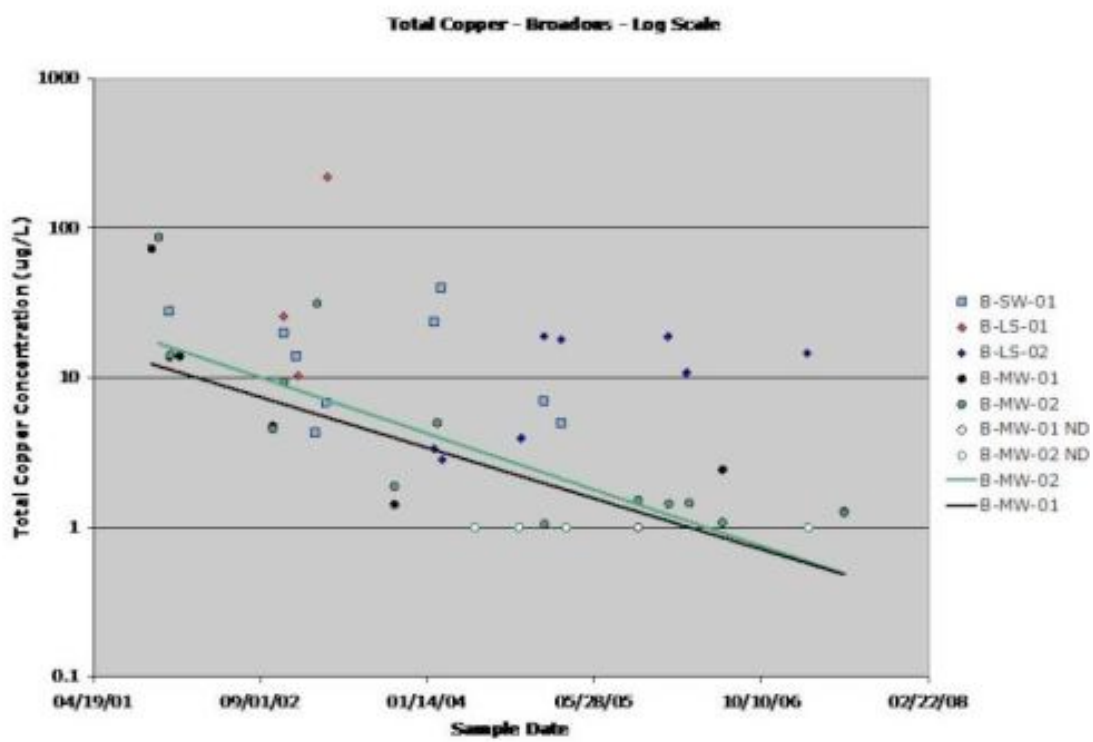
Trend Analyses

- Tests Whether Apparent Increasing or Decreasing Trends are Statistically Significant

- Of 600+ Tests for Trend Conducted, Less than 80 Trends were Detected in Subsurface (lysimeter and groundwater) Samples

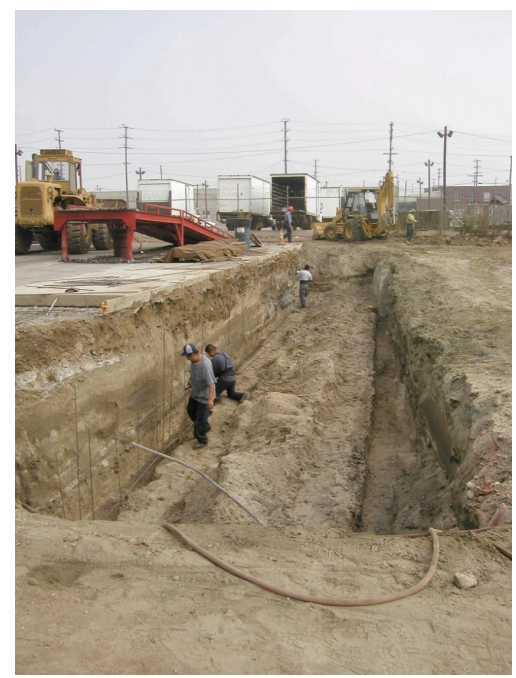
  - Most (84%) were negative trends

  - In groundwater samples, only 4 positive trends were detected



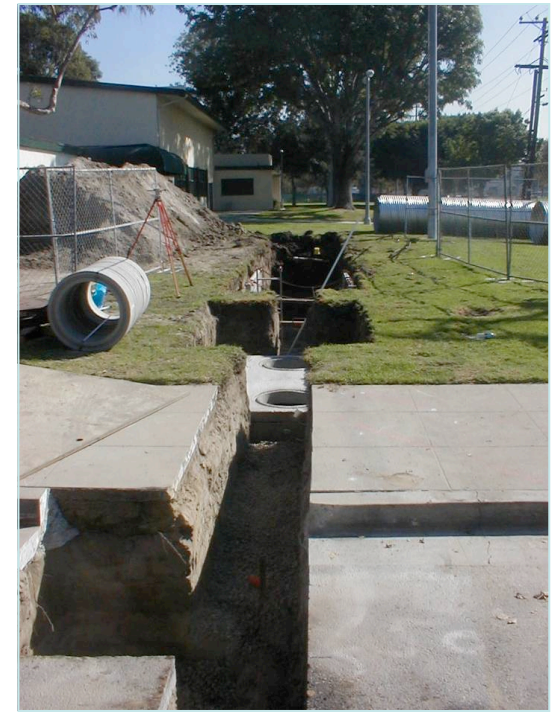
Significant Increasing Trends

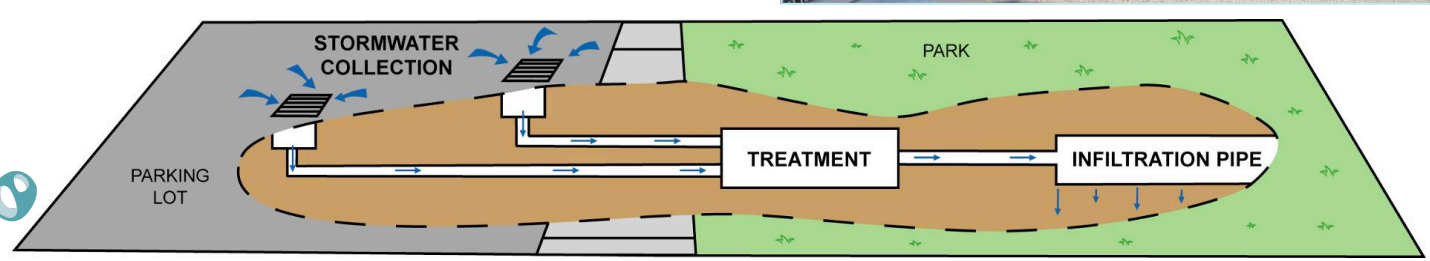
- Chloride in monitoring well at scrap yard
  - Depth to groundwater >70m
  - Lysimeters at location detected no similar trend



Significant Increasing Trends

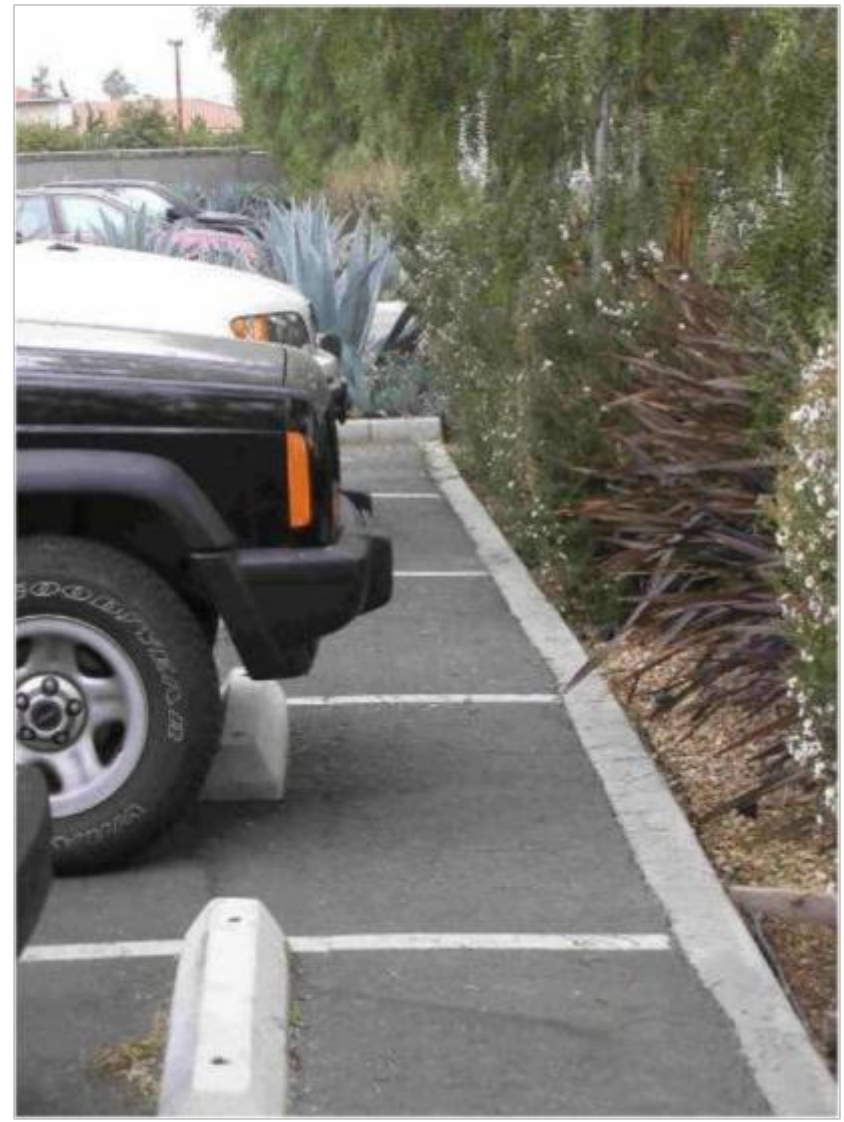
- Chloride in monitoring well at the park
  - Only one of four wells and two lysimeters
  - Trend well furthest from BMP
- Nitrate in monitoring well at the park
  - Increasing trend though at lower levels than other three wells
  - Lysimeters show decreasing trend
- Dissolved zinc in monitoring well at the park
  - Plausible as infiltration-based trend
  - Concentration never more than two orders of magnitude below drinking water MCL.





Conclusions from WAS Phase 1 & 2

- **It is safe to infiltrate Urban stormwater to augment groundwater supplies**
  - Constituents of concern for groundwater generally occur at low concentrations or are "non-detect" in stormwater runoff
  - No clear evidence linking stormwater flow quality to groundwater quality at any of the monitored locations.
  - No evidence of metals accumulation in post-project soil samples



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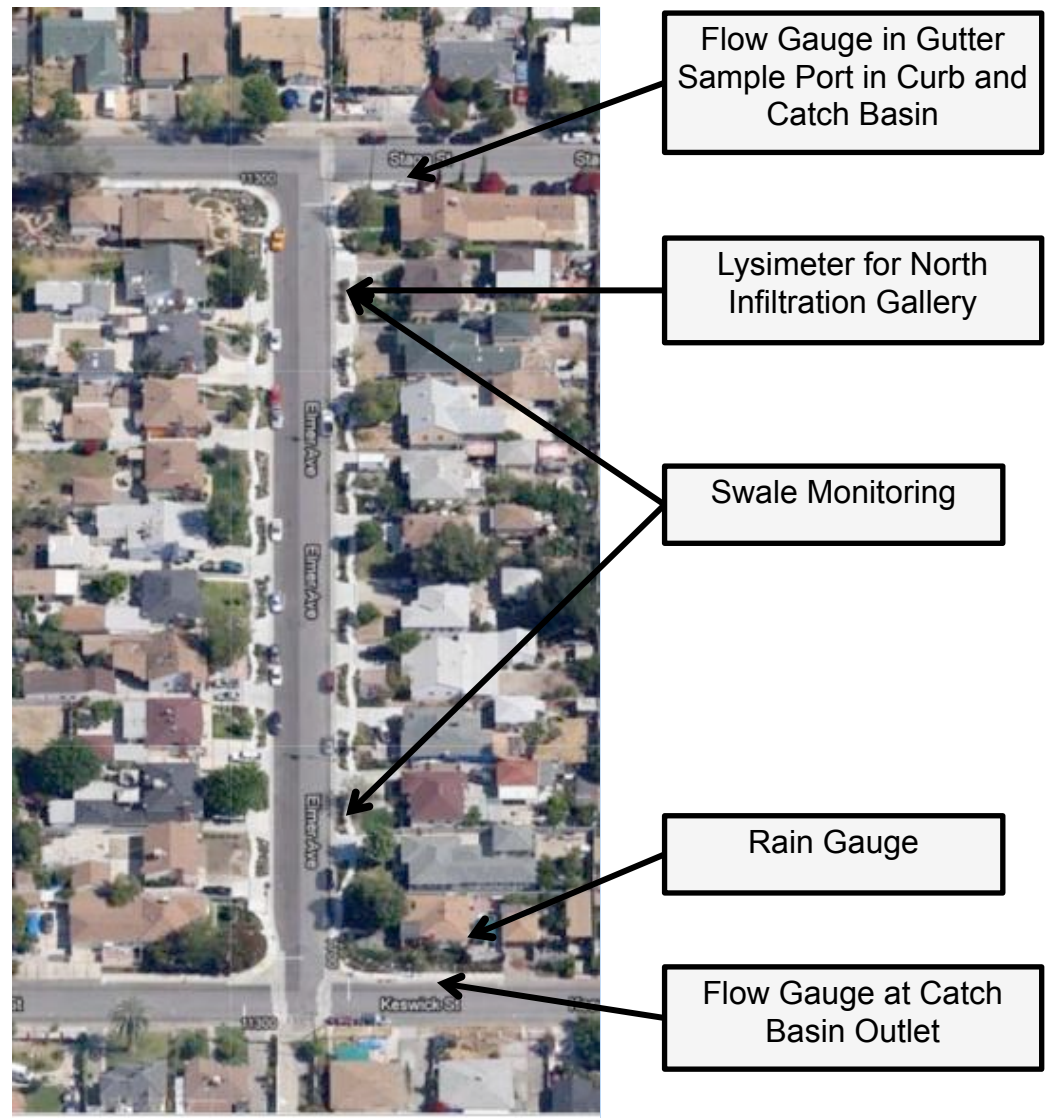
Elmer Avenue Neighborhood Retrofit Demonstration Project

Elmer Avenue:
Performance Monitoring 2010-2012

- Water Quality
- Water Quantity
- Soil Quality
- Vegetation Success
- Watershed Relationships
- Maintenance Needs
- Habitat Value



Elmer Avenue: Performance Monitoring 2010-2012

Constituent	Urban Runoff (mg/L)			
	Elmer Infiltration Gallery		Separate Sewers	
	Range	Average	Range	Typical
COD	158-251	190	200-275	75
TSS	84.5-150	117	20-2,890	150
Total P	0.98-1.33	1.15	0.02-4.30	0.36
Total N	0.97-1.53	1.23	0.4-20.0	2
Lead	0.013-0.03	0.018	0.01-1.20	0.18
Copper	0.038-0.073	0.051	0.01-0.40	0.05
Zinc	0.153-0.293	0.203	0.01-2.90	0.02

Research, Strategy & Implementation Report

Future Initiatives:

- Stormwater infiltration design, operation and maintenance procedures
- Determination of the value of benefits and costs
- Identifying the fate of pollutants
- Siting decentralized infiltration strategies

Research, Strategy & Implementation Report

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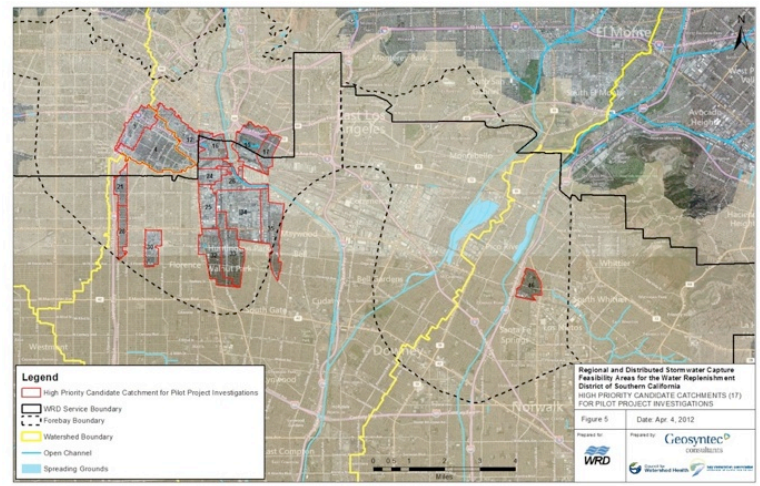
CWH Projects / Efforts:

- **Elmer Ave monitoring, Elmer Paseo retrofit, GI Stewardship Study**
- **Quantifying value of infiltration projects, Valuing Green Infrastructure Project**
- **SWRCB Prop 84 Monitoring & Research**
- **Stormwater Recharge Feasibility Studies**

Stormwater Recharge Feasibility Studies:

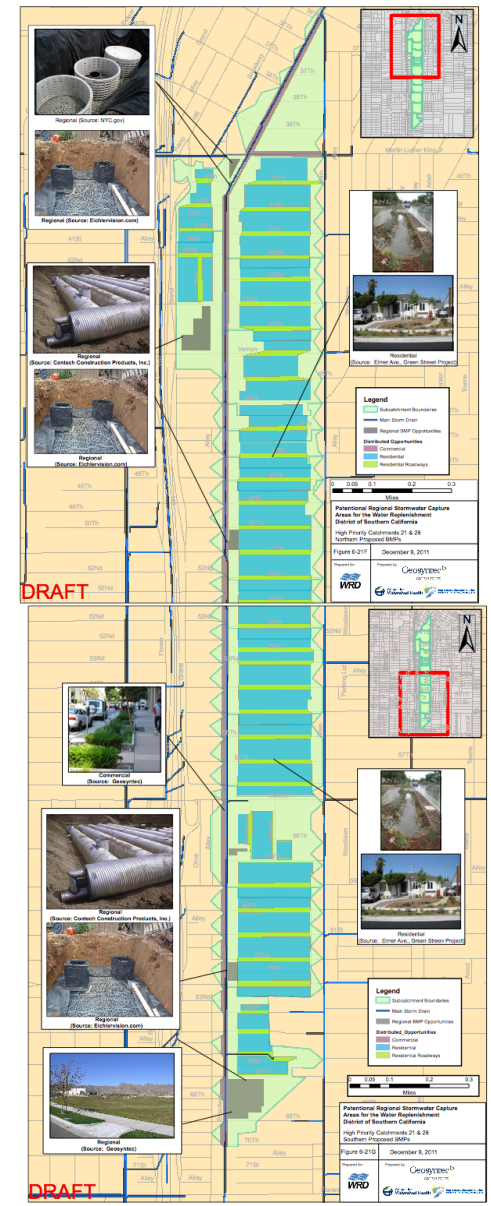
Findings: West Coast & Central Basins



- Seventeen catchments (*approx. 470 acres/catchment*) show greater feasibility for stormwater capture to augment Central and West Coast Basins
  - Implementation of distributed and subregional BMP could capture **4,300 AF** during an average rainfall year
  - Thirty-two additional opportunity catchments show potential for another 12,700 acre-feet/yr of stormwater capture with appropriate projects

A theory of Phased Implementation

- Design reflects catchment-wide system of component green infrastructure elements
- Single elements can be implemented alone without fear of degradation
- System tuned to theoretical full-implementation
- Implementation can be opportunistic
- Full-implementation realizes peak efficiency of all included elements



Stormwater Recharge Feasibility Studies:

Findings: Pilot Design Systems

- **Four BMP Locations:**
  - ✓ **Residential Property (capture 3/4" storms)**
  - ✓ **Residential Streets (capture 3/4" storms)**
  - ✓ **Commercial Street (capture 3/4" storms)**
  - ✓ **Subregional Infiltration (capture 2" storms)**

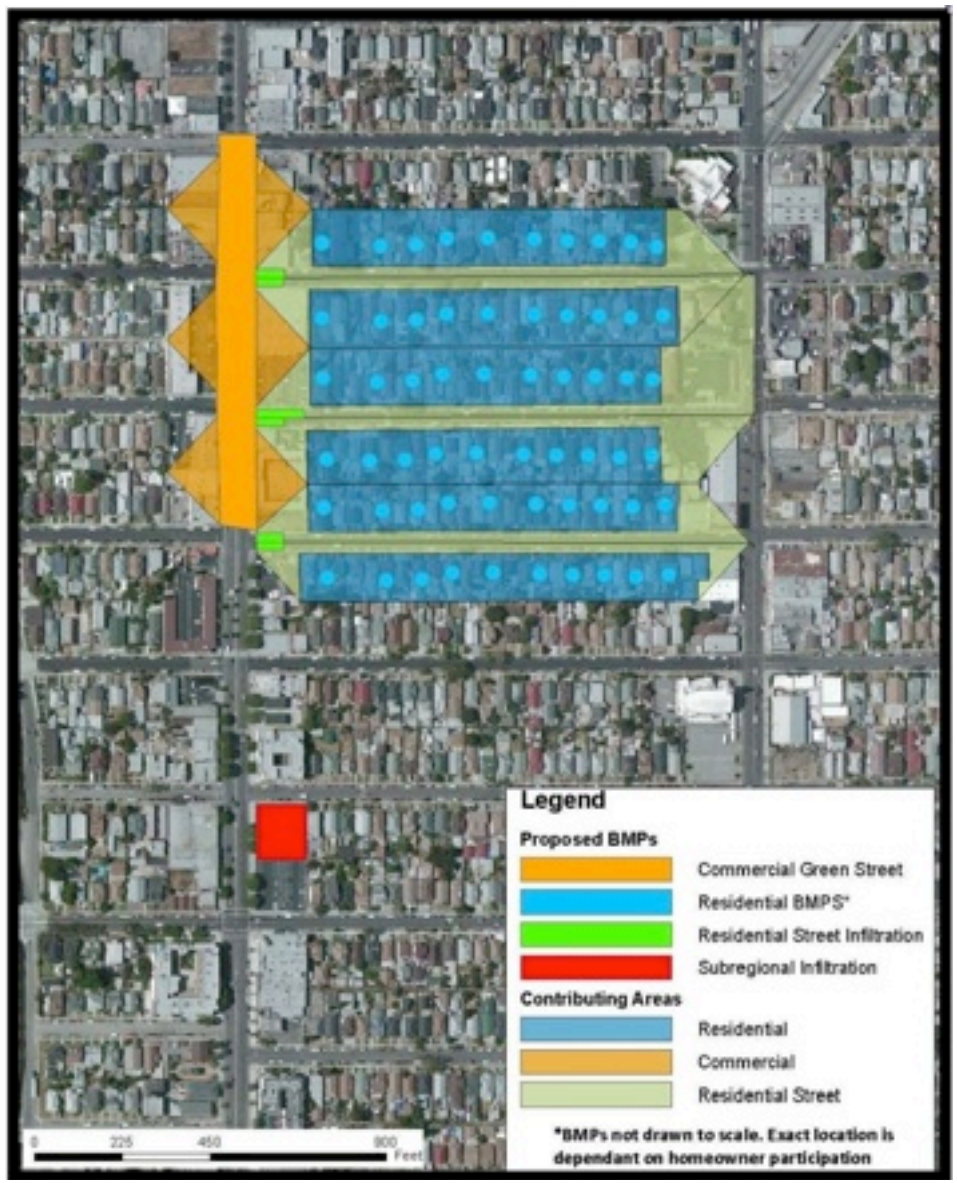
Stormwater Recharge Feasibility Studies:

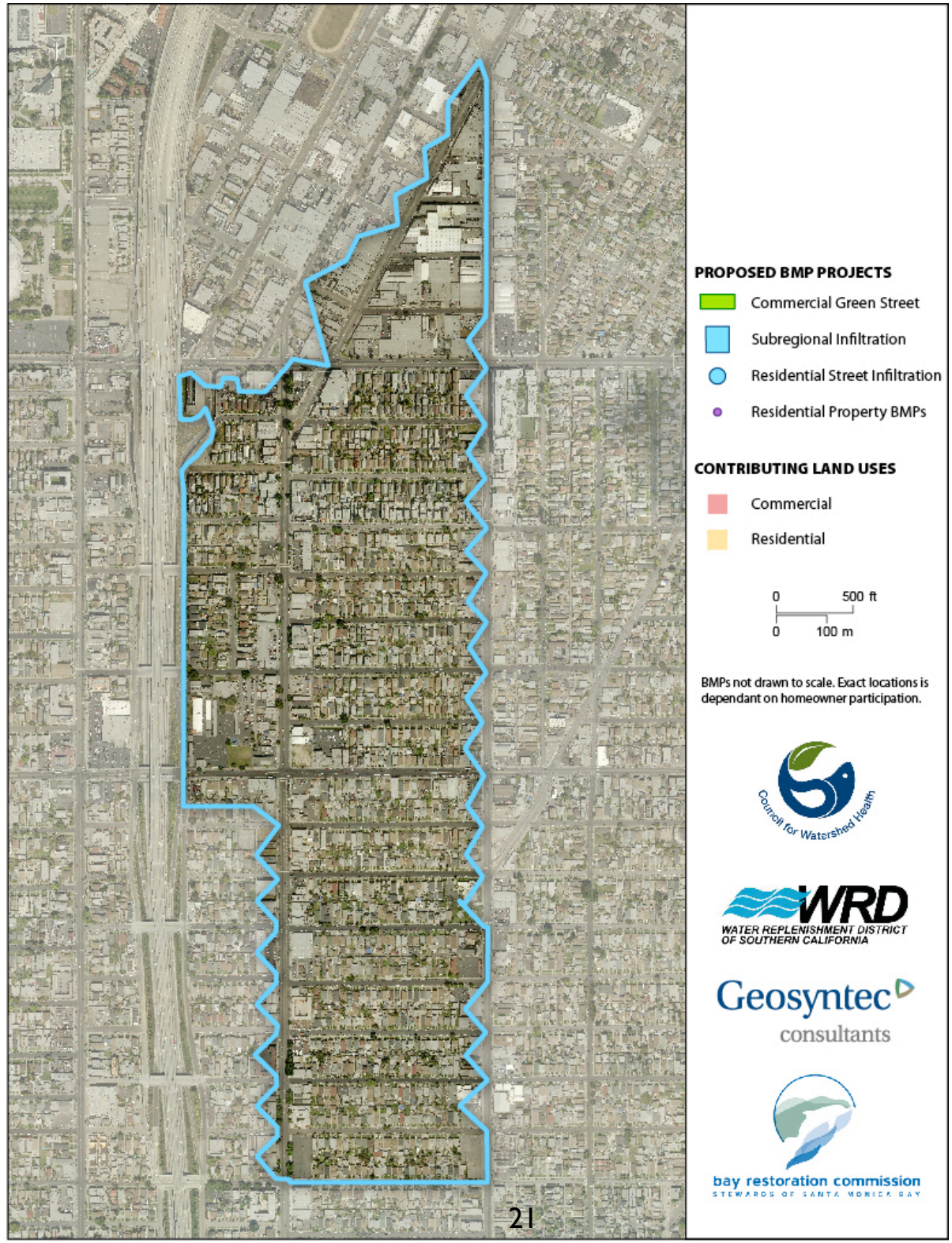
Findings: Pilot Project Design

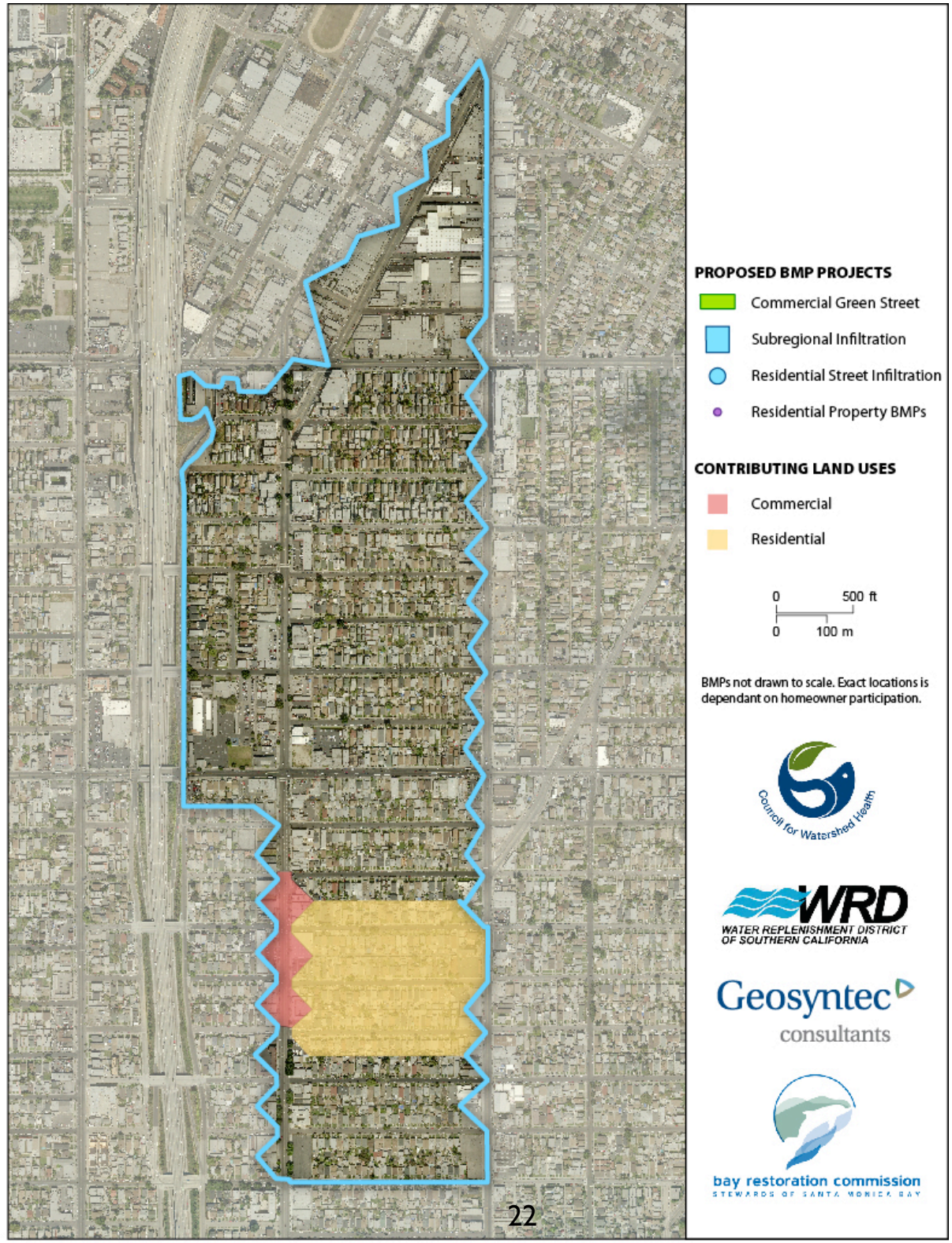
Stormwater Recharge Feasibility Studies:

Findings: Water Quality Benefit from Pilot Project Design

Load Reduction					
Bacteria	Metals			Nutrients	
Fecal Coliform	Tot Cu	Tot Pb	Tot Zn	TP	TKN
MPN/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr
6.40×10^{12}	3	1	23	42	238




PROPOSED BMP PROJECTS
Commercial Green Street
Subregional Infiltration
Residential Street Infiltration
Residential Property BMPs
CONTRIBUTING LAND USES
Commercial
Residential
0 500 ft
0 100 m
BMPs not drawn to scale. Exact locations is dependant on homeowner participation.
Council for Watershed Health
WRD
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA
Geosyntec
consultants
bay restoration commission
STEWARDS OF SANTA MONICA BAY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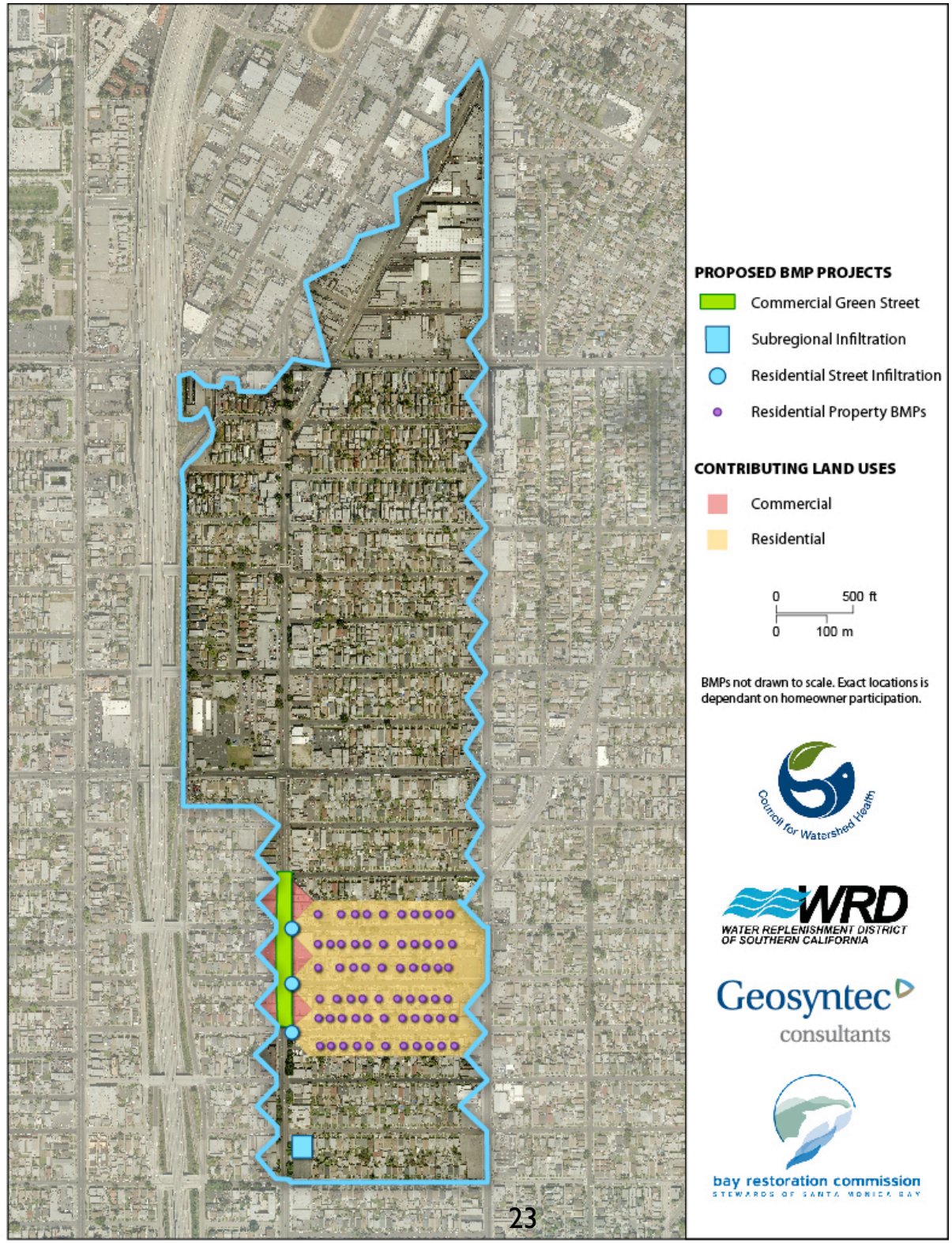
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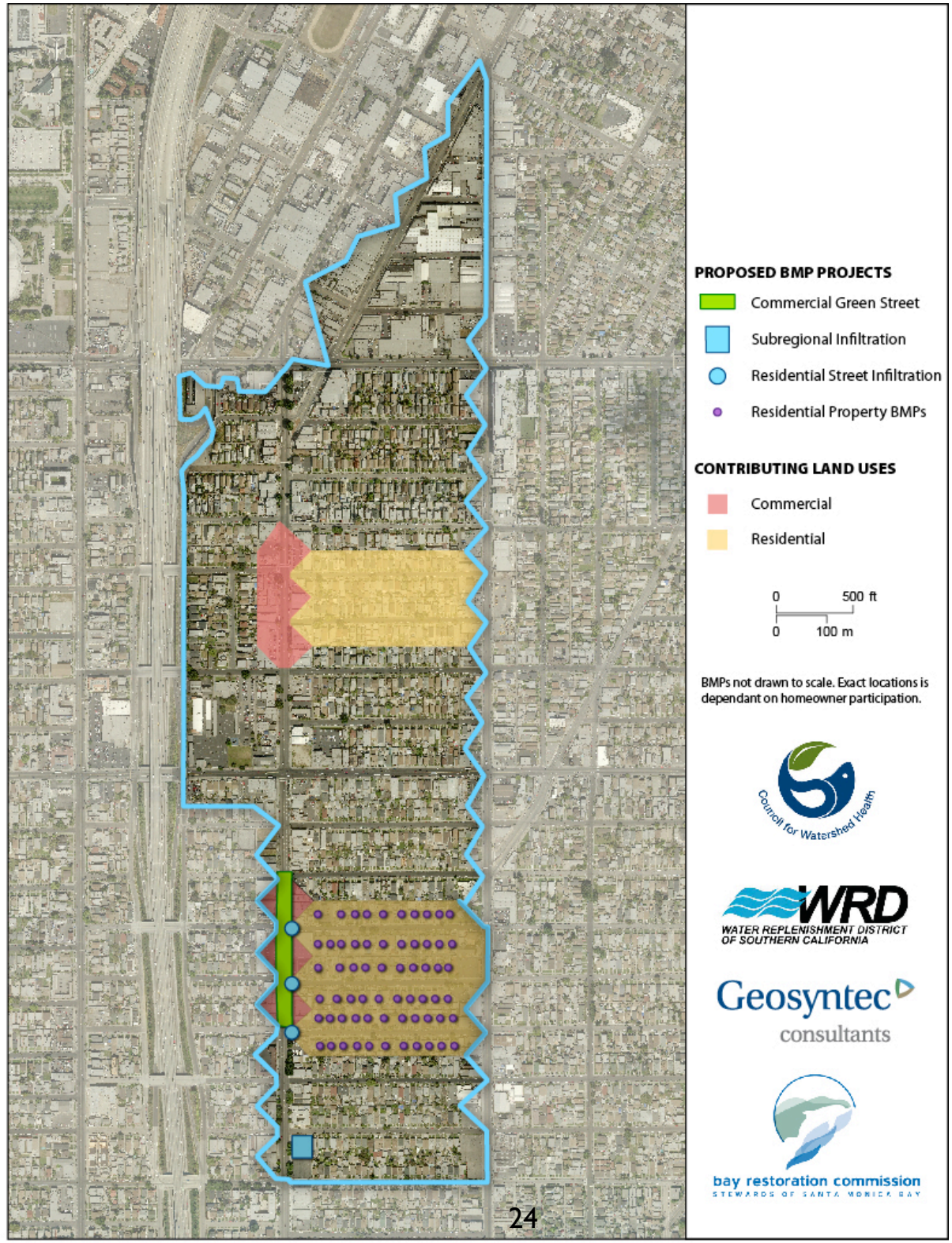
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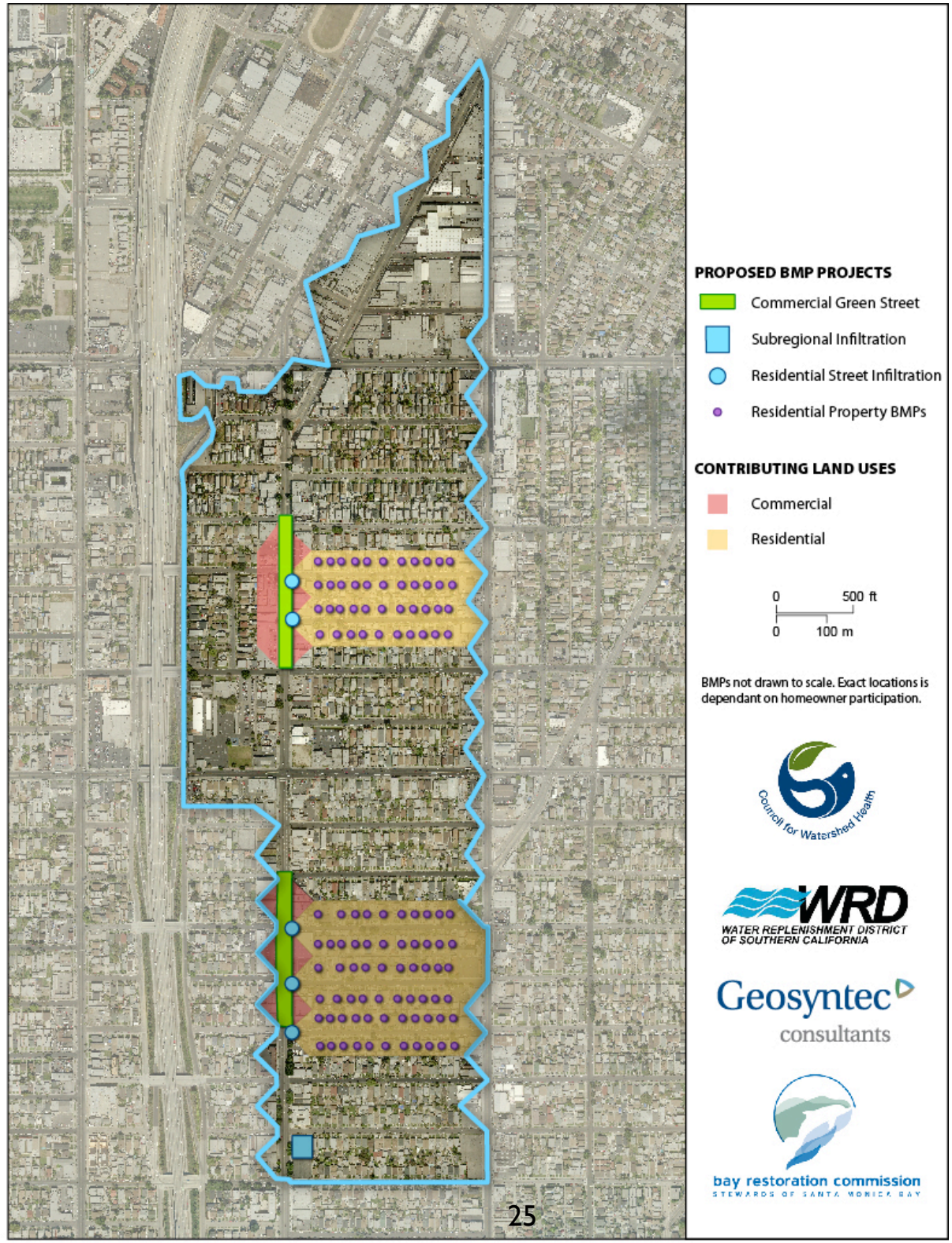
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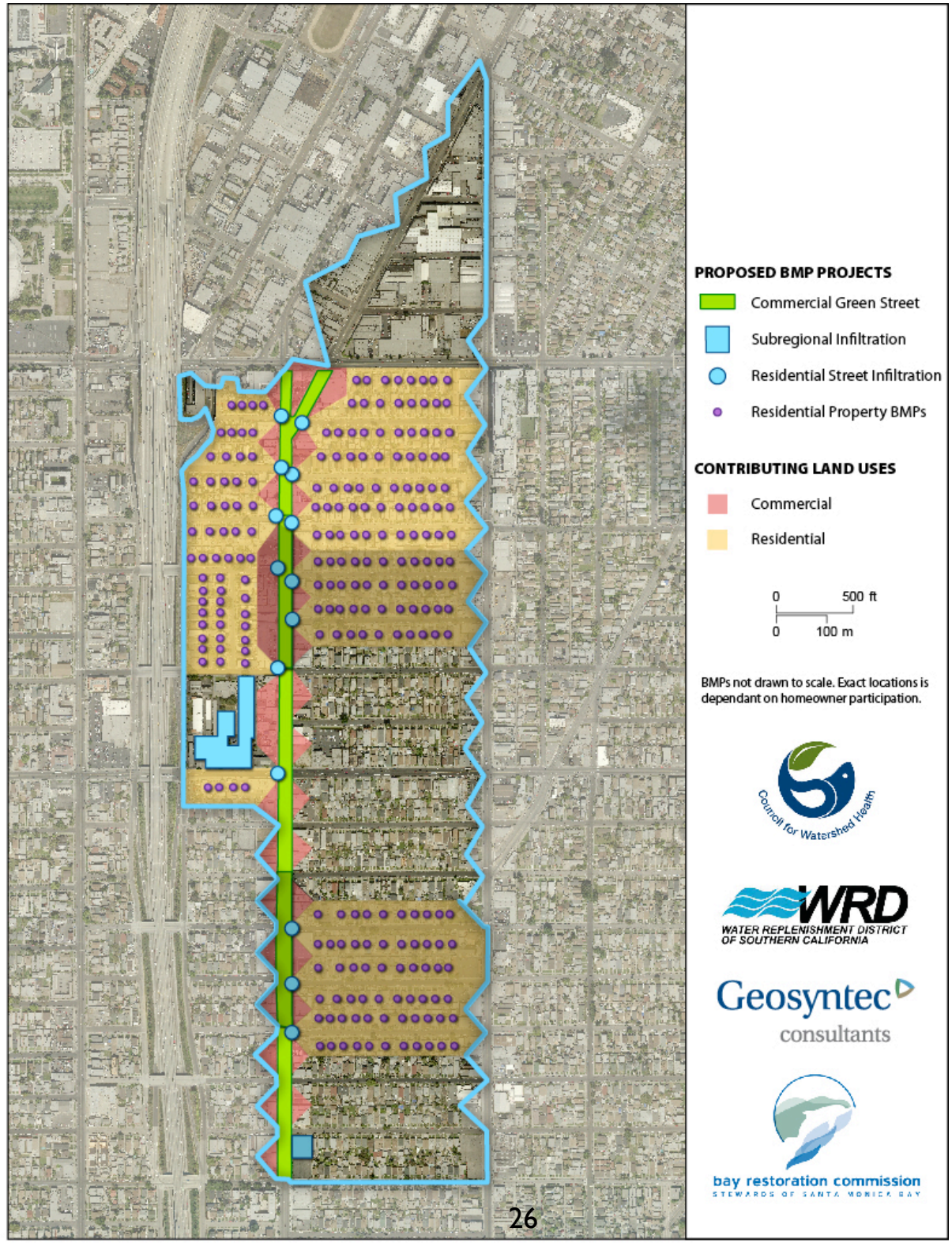
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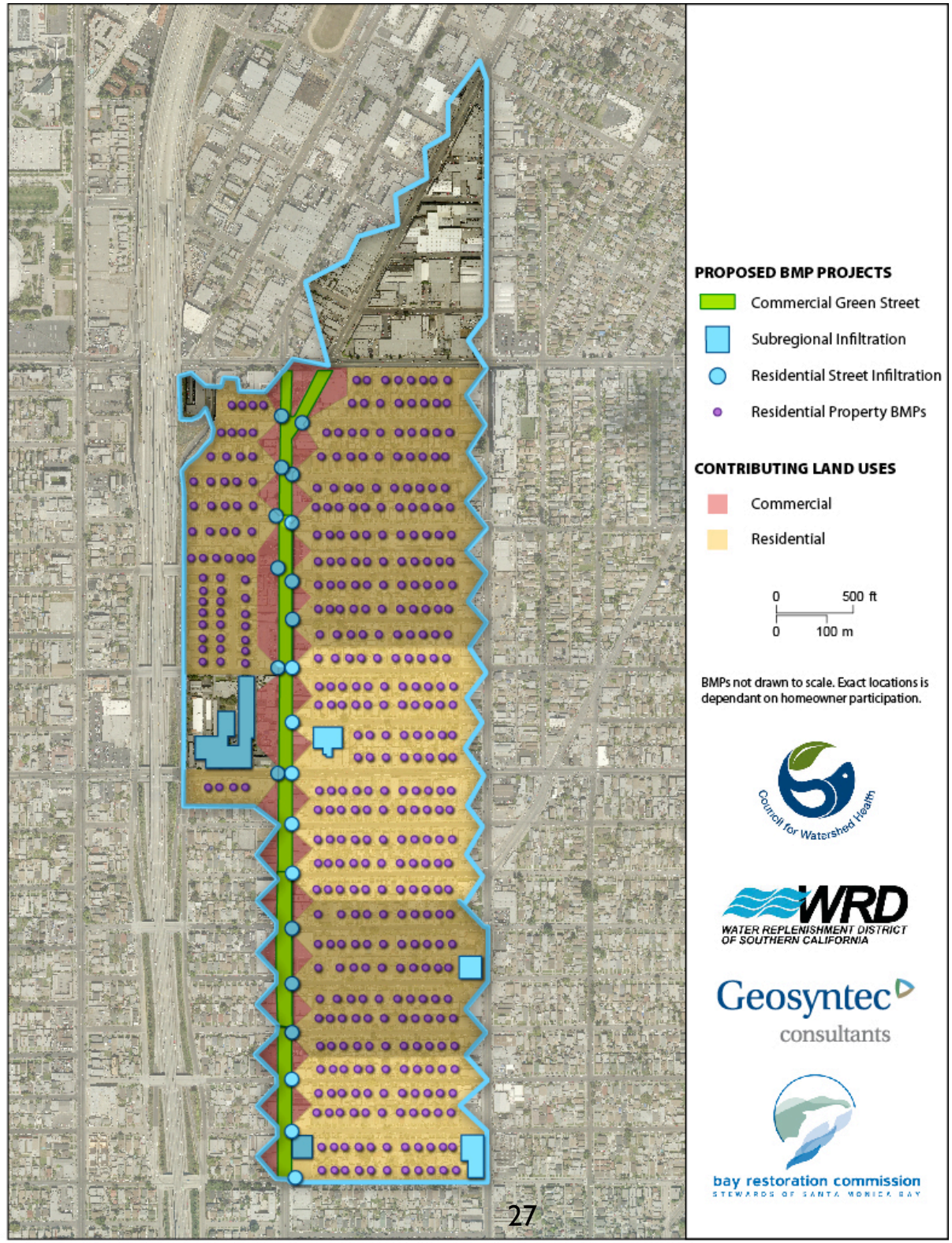
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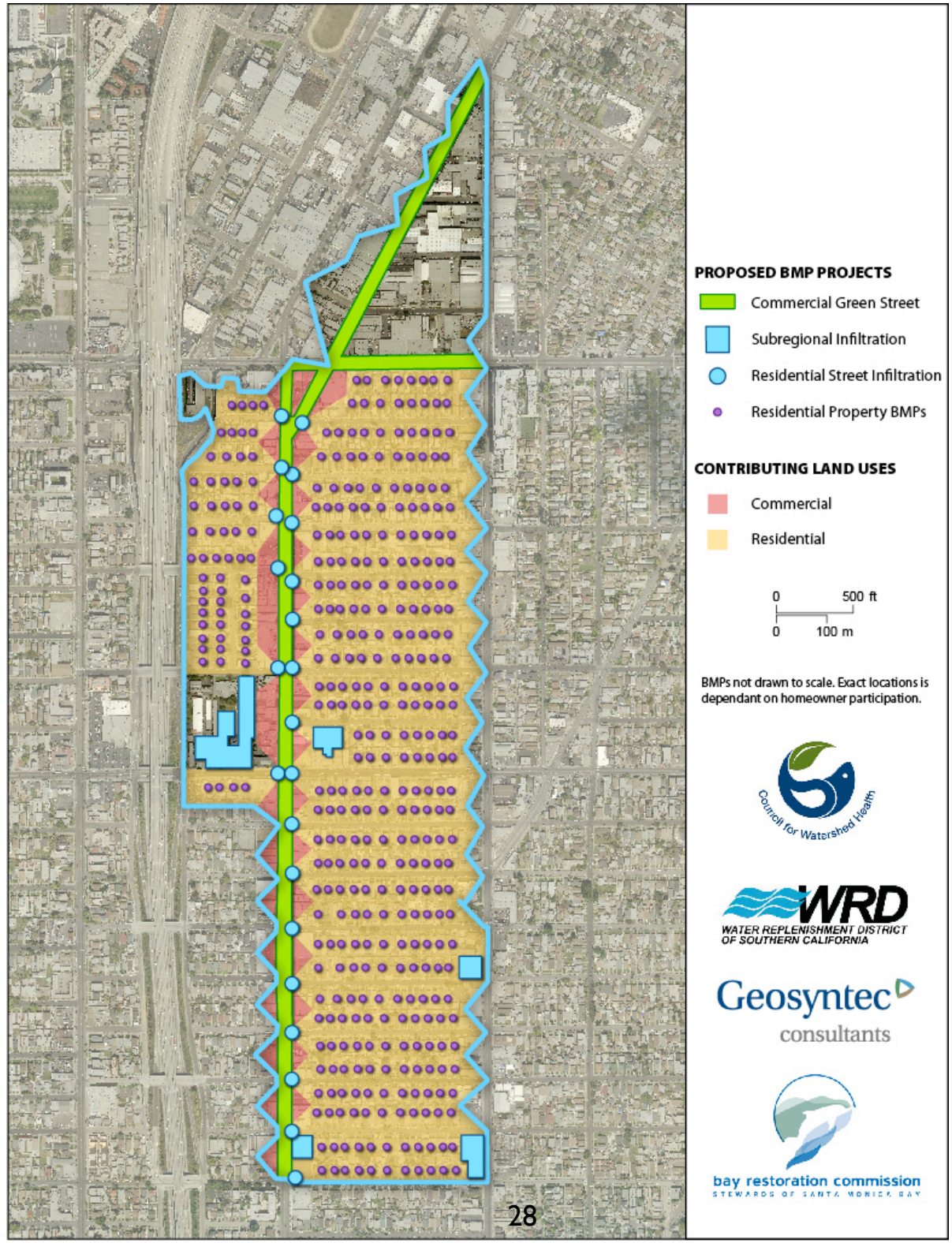
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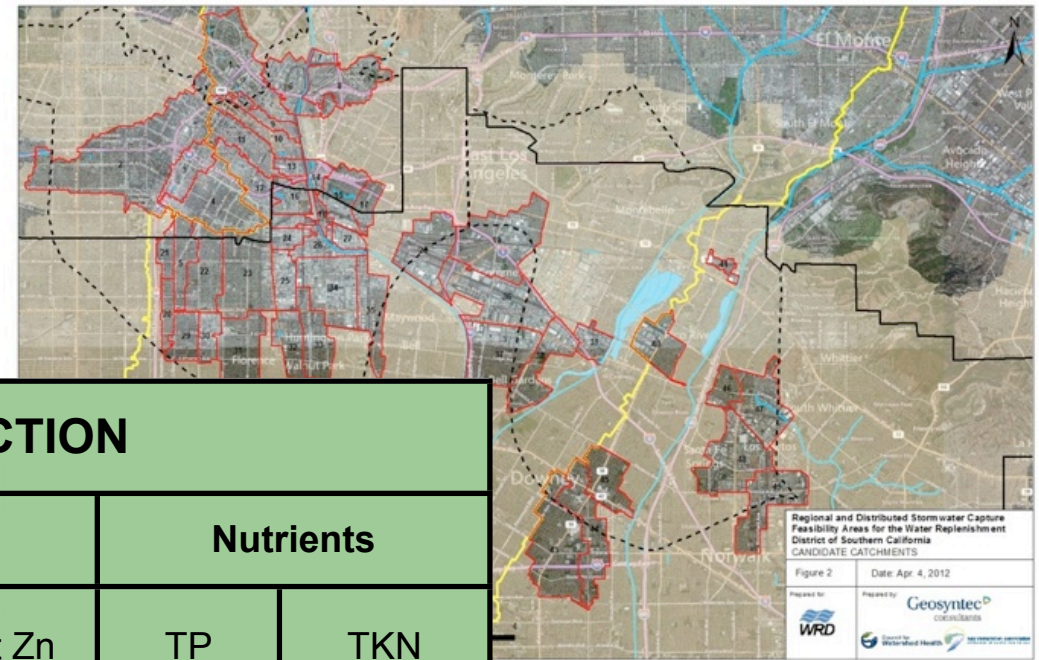
Stormwater Recharge Feasibility Studies:

Findings: Pilot Design Systems



Catchment	LOAD REDUCTION					
	Bacteria	Metals			Nutrients	
	Fecal Coliform	Tot Cu	Tot Pb	Tot Zn	TP	TKN
Units:	MPN/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr
21/28	9.1×10^{13}	14	6	117	209	1,669
4	2.0×10^{14}	42	16	480	560	3,900
30	7.8×10^{13}	14	6	190	160	1,200
All 49 HPC	6.7×10^{15}	1,400	540	14,000	18,000	123,000

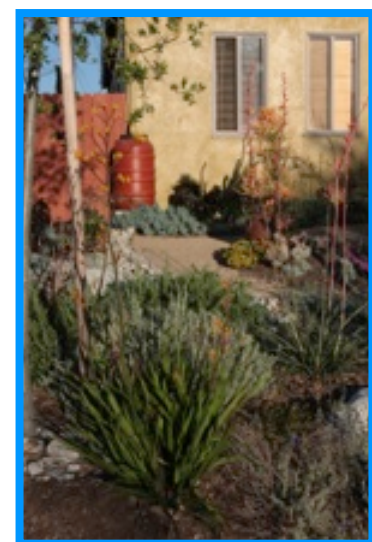
Quantifying value of infiltration projects

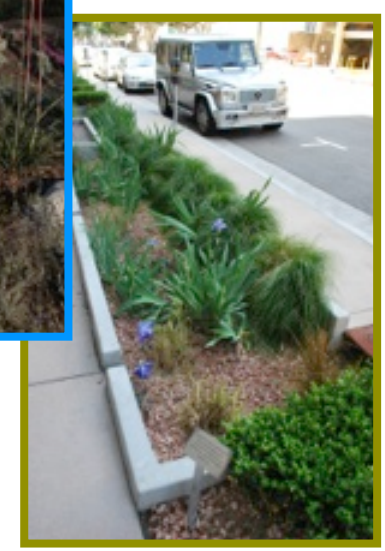
Grey Infrastructure

- Single-purpose
- Single-managed / maintained
- Cost calculation leverages 100+ years of investment

Green Infrastructure

- **Multi-purpose**
- **Multi-managed / maintained**
- **Internalizes historic externalities, raising *apparent* costs**





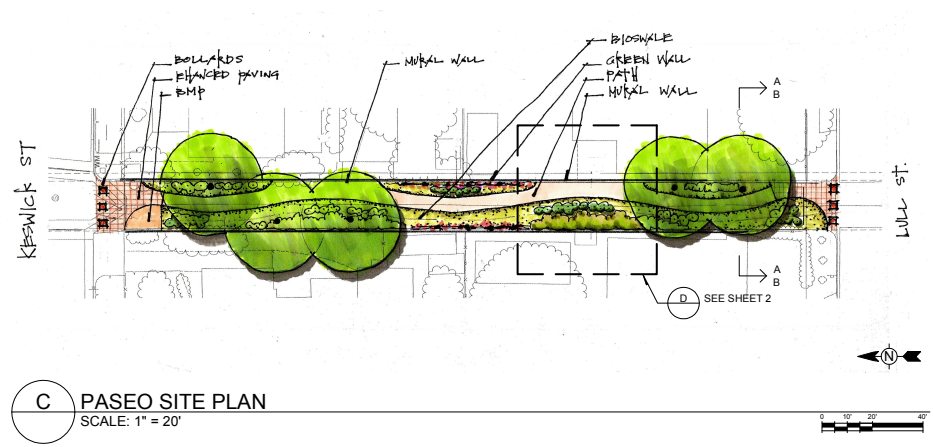
Quantifying value of infiltration projects

Summary Benefits

BMP Type	Pilot Design & Construction Cost Estimation	Quantity Benefit	Quality Benefit	Economic Benefit	Energy Reduction Benefit	CO2 Reduction Benefit	Total Benefit Value	Benefit - Cost Ratio
Rain Garden	$111,600	$60,984	$69,912	$222,382	$44,476	$644	$398,398	**3.57**
Intersection Catch-basin BMP	$425,256	$172,788	$188,436	$847,397	$169,479	$1,824	$1,379,924	**3.24**
Multiple	$2,279,400	$78,771	$100,232	$4,542,101	$908,420	$832	$5,630,356	**2.47**
Subsurface Infiltration	$1,432,080	$729,267	$1,082,506	$2,853,669	$570,734	$7,700	$5,243,876	**3.66**

Next Steps for WAS

- Return to Phase 2 Sites
- Elmer Paseo Retrofit
- Elmer Phase 2 Enhancements
- Elmer Projects Monitoring
- San Gabriel River Watershed LID Monitoring
- EPA Green Infrastructure Community Partners Project
- Stewardship of Green Infrastructure Study *(currently unfunded)*



Thank you

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