TETRA TECH

Example Modeling Application: City of San Diego Comprehensive Load Reduction Plans

October 17, 2013

Overview

- Background on TMDL and Approach
- Load Reduction Goals
- Modeling Approach
  - Non-structural BMPs
  - Distributed BMPs
  - Regional BMPs

Comprehensive Load Reduction Plans

- Project I – Beaches and Creeks Bacteria TMDL
  - Adopted February 2010
  - Addresses 13 watersheds in Orange and SD Counties
  - If agencies develop a multi-pollutant TMDL implementation plan, then wet weather implementation schedule extended to 20 years.
- CLRPs
  - "shall demonstrate how the BMPs/water quality projects will address all water quality problems in the impaired waterbody and result in achievement of water quality standards"
  - City of San Diego led CLRPs for 4 watersheds

Modeling Approach

- Watershed Model
  - Loading Simulation Program – C++
  - Peer-reviewed, process-based EPA model
  - Hydrology and water quality of runoff and receiving water
    - Also used to simulate some non-structural BMPs
- BMP Model
  - SUSTAIN – System for Urban Stormwater Treatment Analysis and Integration
  - Peer-reviewed, process-based EPA model
  - Includes cost optimization algorithms

Pollutant Load Reduction Goals – Chollas Creek

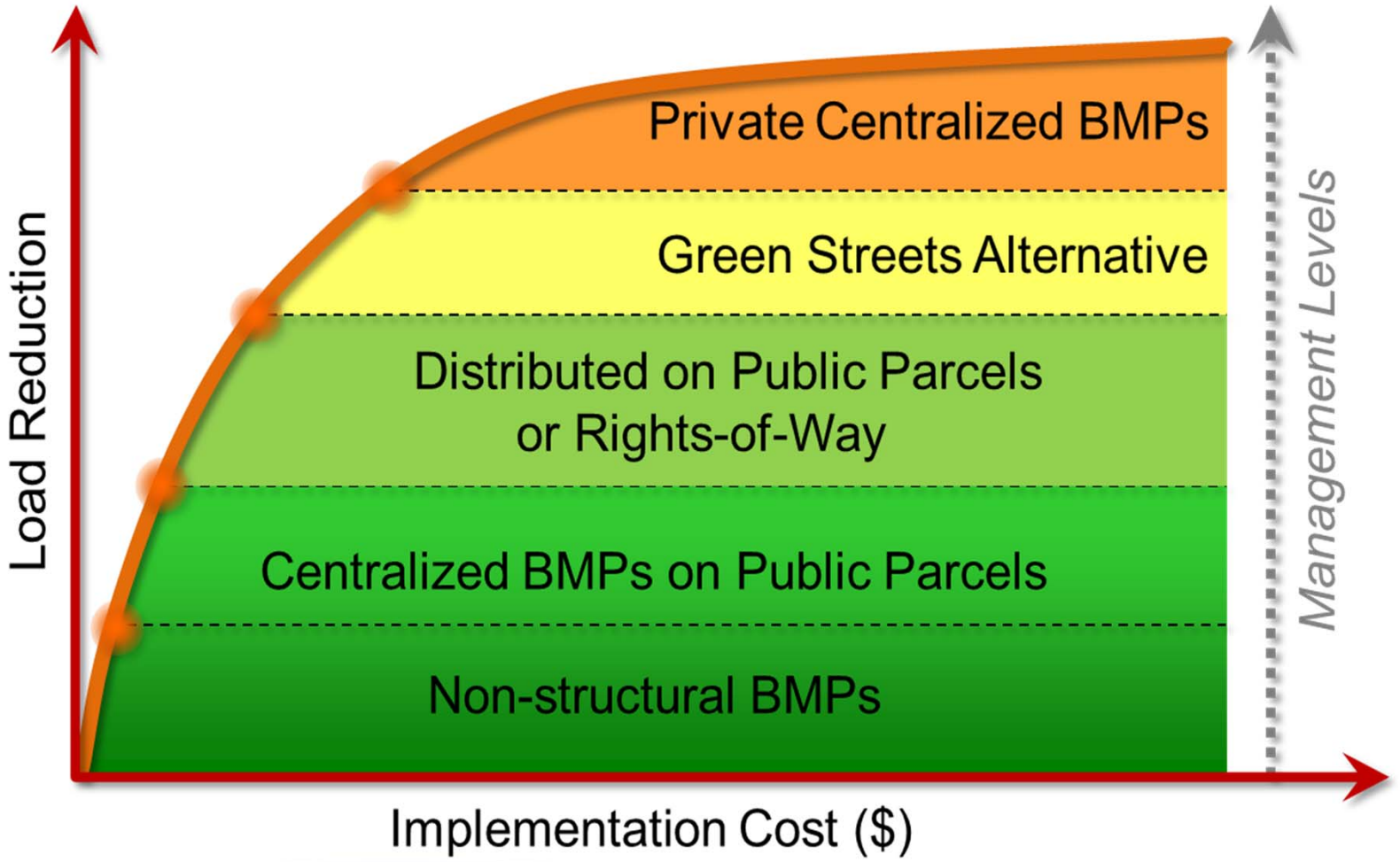
Wet Weather

Pollutant	Existing Load	Allowed Load	Allowed Exceedance Day Load	Required Reduction	
Fecal coliform (Billion #/year)	939,537	41,275	628,115	270,147	28.8%
Enterococcus (Billion #/year)	7,280,200	5,532,655	5,532,655	1,741,230	23.9%
Copper (lbs/yr)	1,116.1	299.1	n/a	817.0	73.2%
Lead (lbs/yr)	961.5	961.5	n/a	0	0.0%
Zinc (lbs/yr)	7,220.0	2,557.6	n/a	4,662.4	64.6%
PAHs (g/yr)	33,648.54	14,492.89	n/a	19,155.65	56.9%

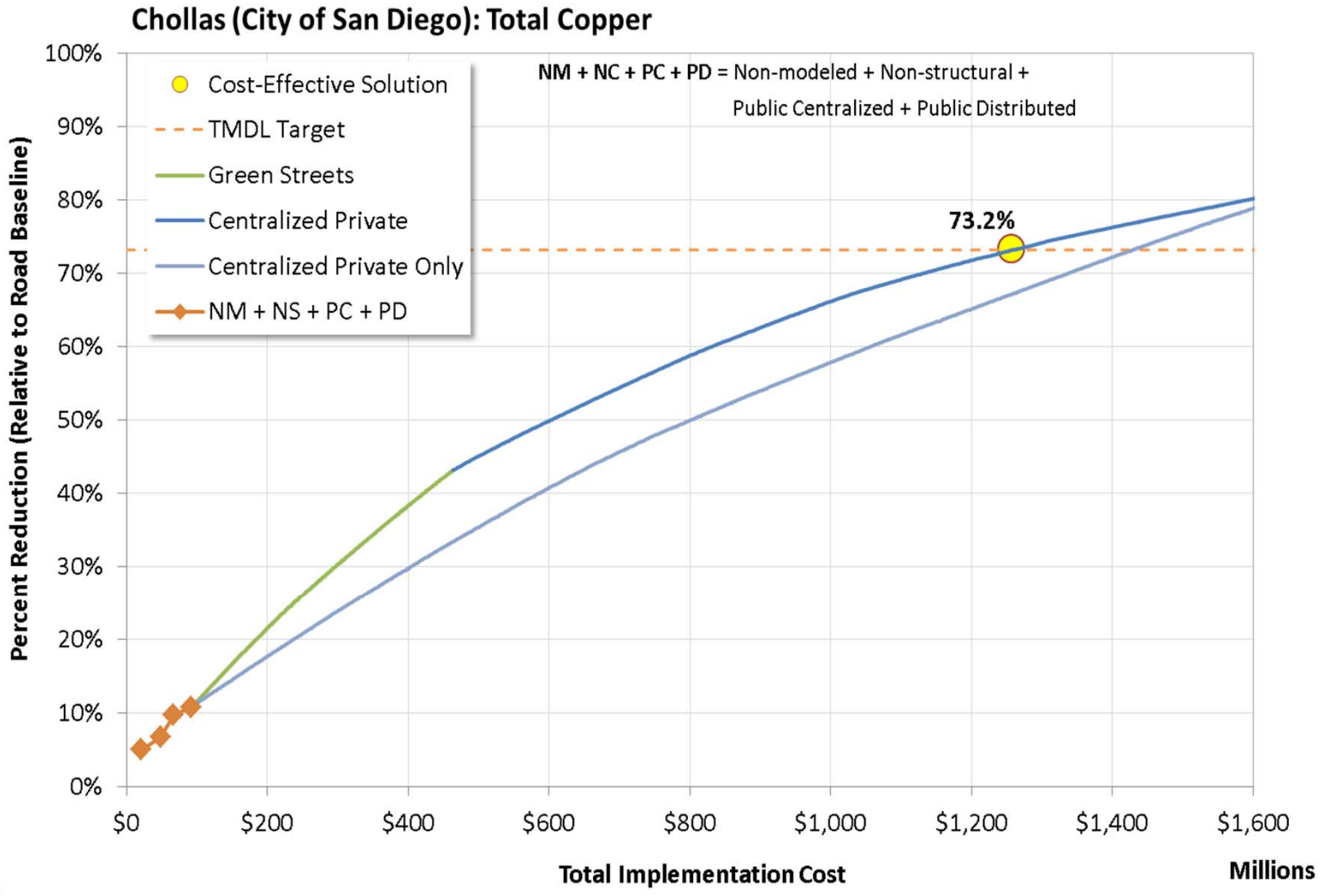
Dry Weather

Pollutant	Existing Load	Allowed Load	Required Reduction	
Fecal coliform (Billion #/year)	64,095	769	63,326	98.8%
Enterococcus (Billion #/year)	724,346	5,070	719,276	99.3%
Copper (lbs/yr)	45.0	19.8	25.3	56.1%
Lead (lbs/yr)	39.0	11.5	27.5	70.4%
Zinc (lbs/yr)	293.4	242.2	51.3	17.5%

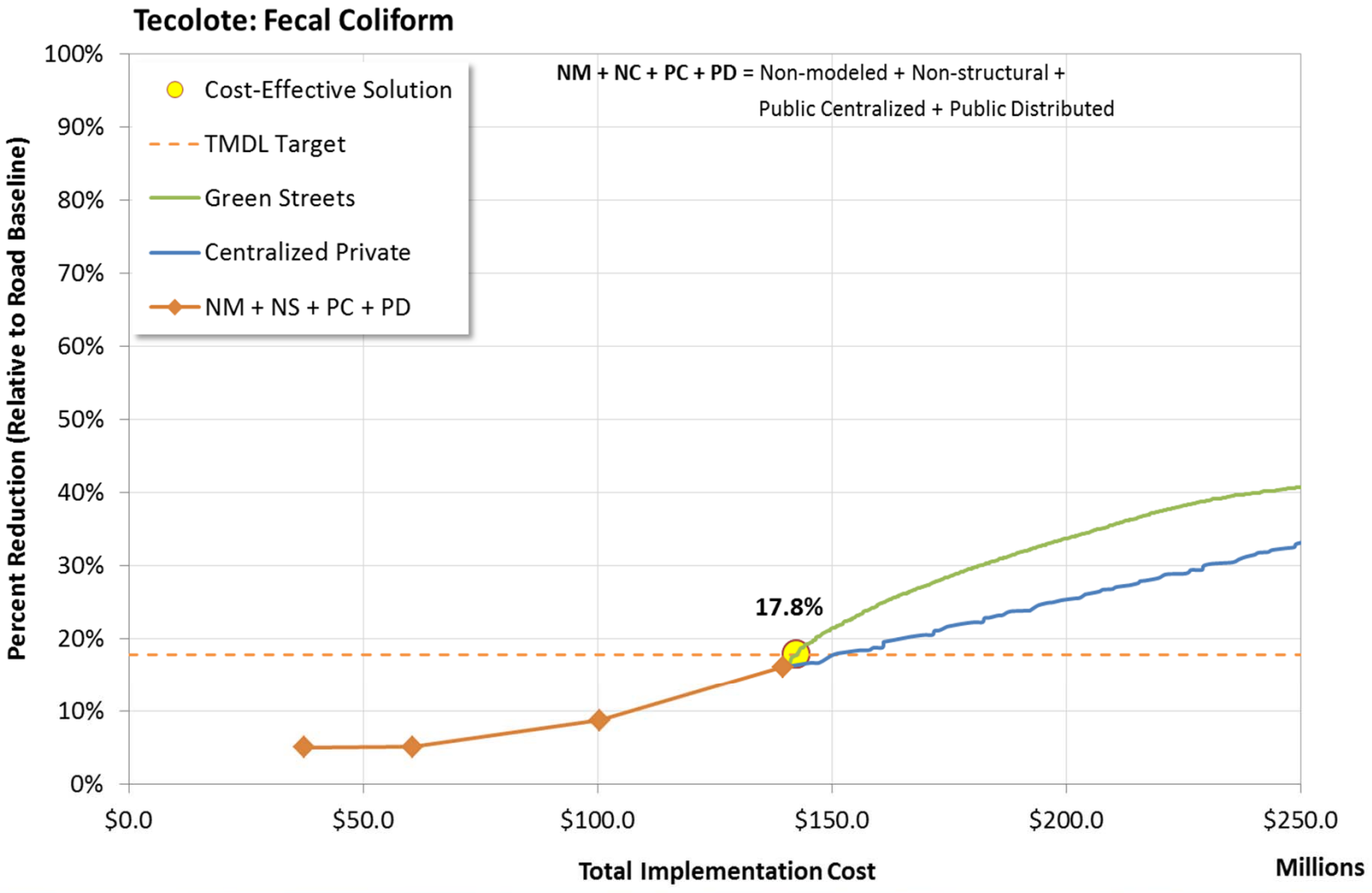
Conceptual Cost-Effectiveness Curve



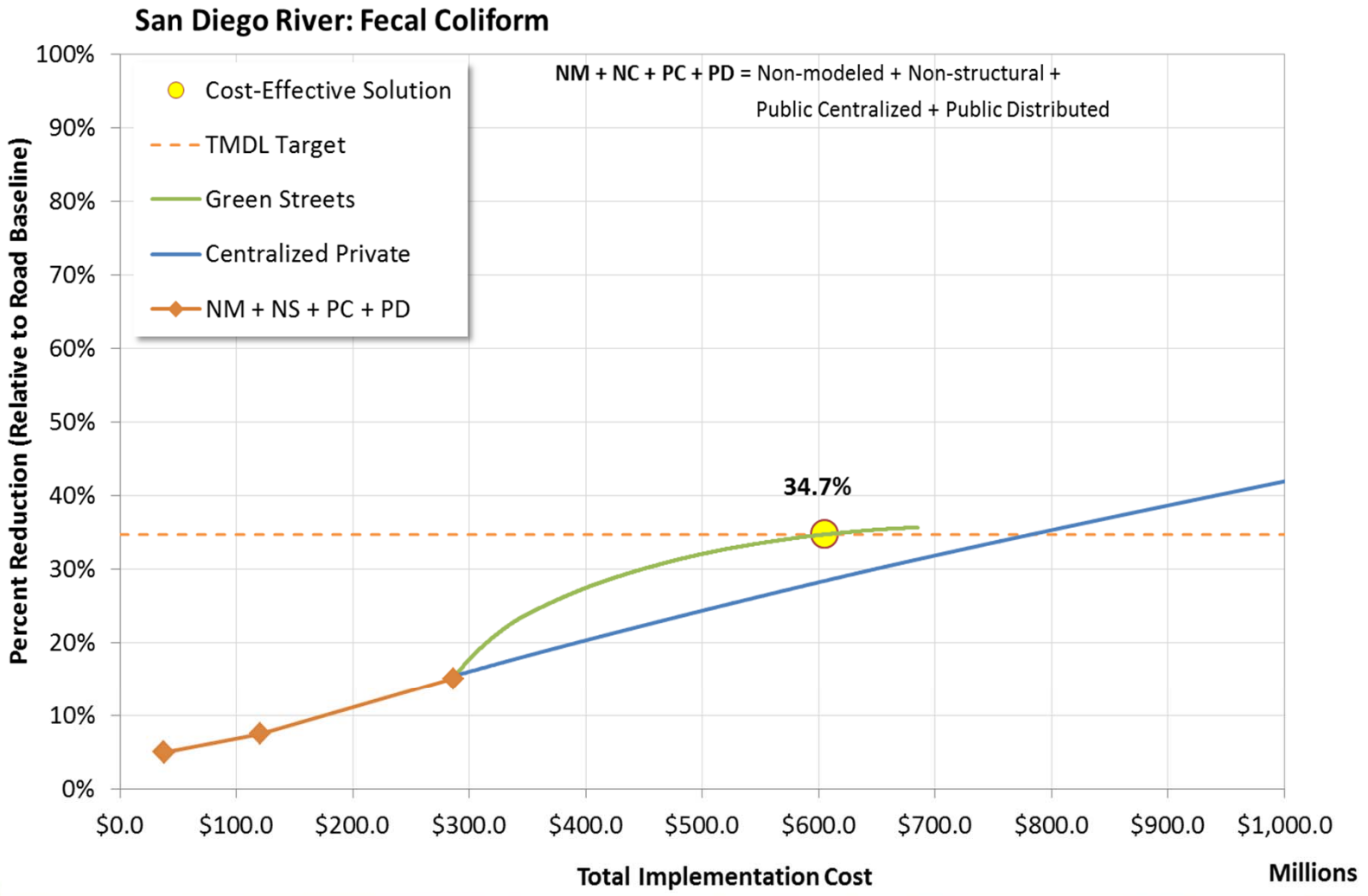
Chollas Creek



Tecolote Creek

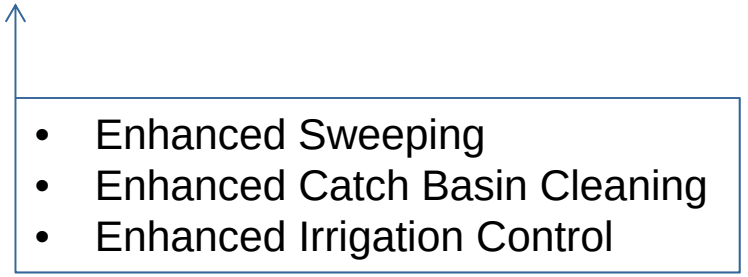


San Diego River



Wet Weather Copper Reduction Achieved

RP	Enhanced Non-structural (not modeled)	Enhanced Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total*
City of La Mesa	5.00	2.58	0.44	1.68	40.00	23.5	73.20
City of Lemon Grove	5.00	1.65	n/a	1.56	39.58	25.41	73.20
Port of San Diego	5.00	n/a	n/a	68.2	n/a	n/a	73.20
San Diego County	5.00	0.01	n/a	1.27	28.90	38.02	73.20
City of San Diego	5.00	3.15	3.65	1.32	32.36	27.72	73.20
Caltrans	5.00	0.01	68.19	n/a	n/a	n/a	73.20



Dry Weather Copper Reduction Achieved

RP	Enhanced Non-structural (not modeled)	Enhanced Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total*
City of La Mesa	5.00	58.72	0.15	0.15	35.98	0.00	100.0
City of Lemon Grove	5.00	58.55	n/a	0.19	36.26	0.00	100.0
Port of San Diego	5.00	n/a	n/a	95.00	n/a	n/a	100.0
San Diego County	5.00	59.10	n/a	0.01	35.89	0.00	100.0
City of San Diego	5.00	56.87	1.27	1.28	35.58	0.00	100.0
Caltrans	5.00	0.00	95.00	n/a	n/a	n/a	100.0

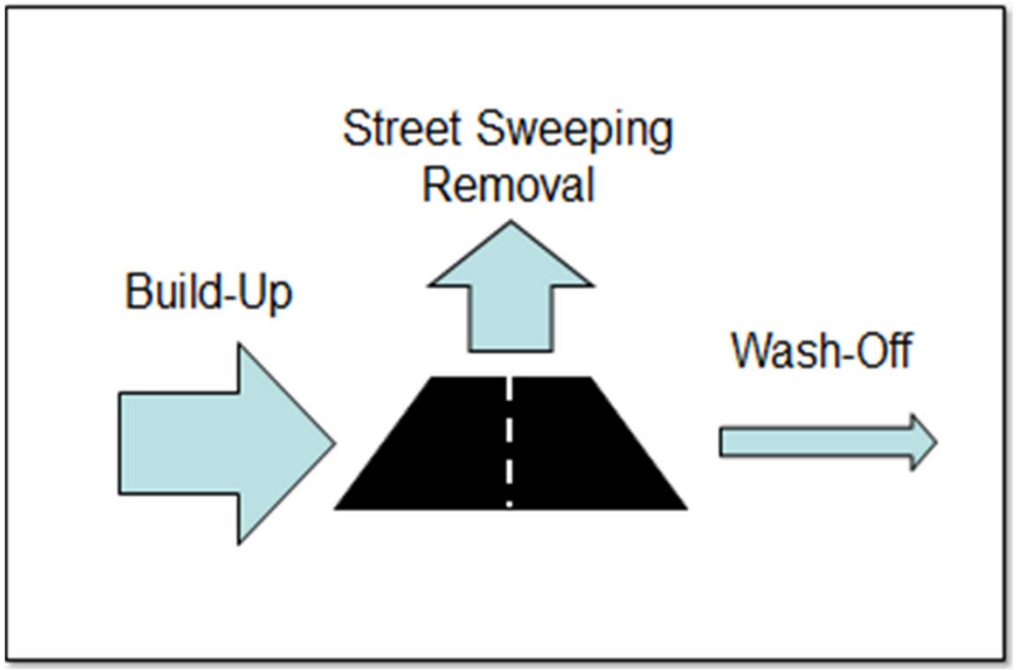
- Enhanced Irrigation Control

Non-structural BMPs

Enhanced Street Sweeping

RP	Non-structural (modeled)
City of La Mesa	2.58
City of Lemon Grove	1.65
Port of San Diego	n/a
San Diego County	0.01
City of San Diego	3.15
Caltrans	0.01

- Optimization Results
  - Effective on metals
  - Regen-air/max frequency
- Implementation
  - Commercial 2x/week
  - Residential 2x/month
  - Regen-air all



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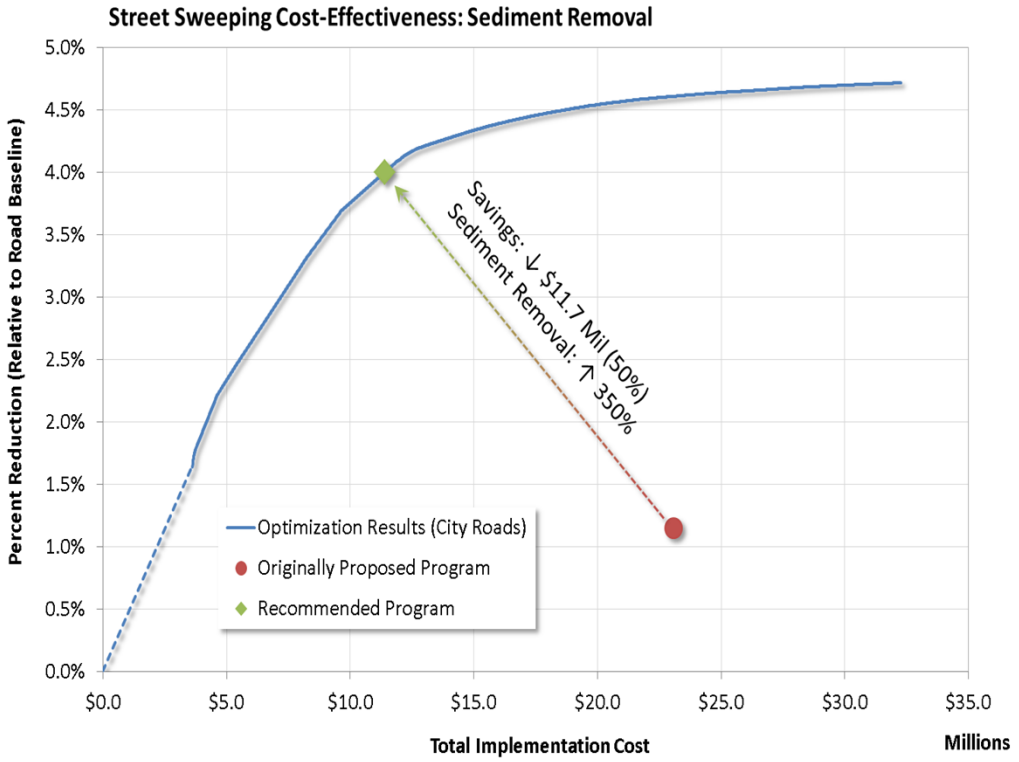
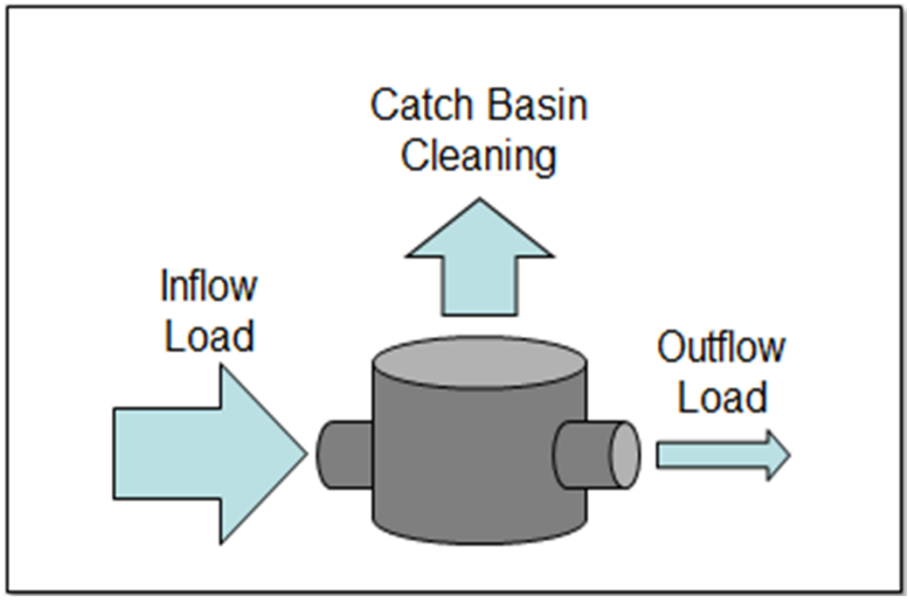


Catch Basin Cleaning

RP	Non-structural (modeled)
City of La Mesa	2.58
City of Lemon Grove	1.65
Port of San Diego	n/a
San Diego County	0.01
City of San Diego	3.15
Caltrans	0.01



- Optimization results
  - Increase frequency in high-yield areas
  - Clean during wet weather
  - Reduce metals
- Implementation
  - Clean 4x year (wet weather)

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City of La Mesa	2.58
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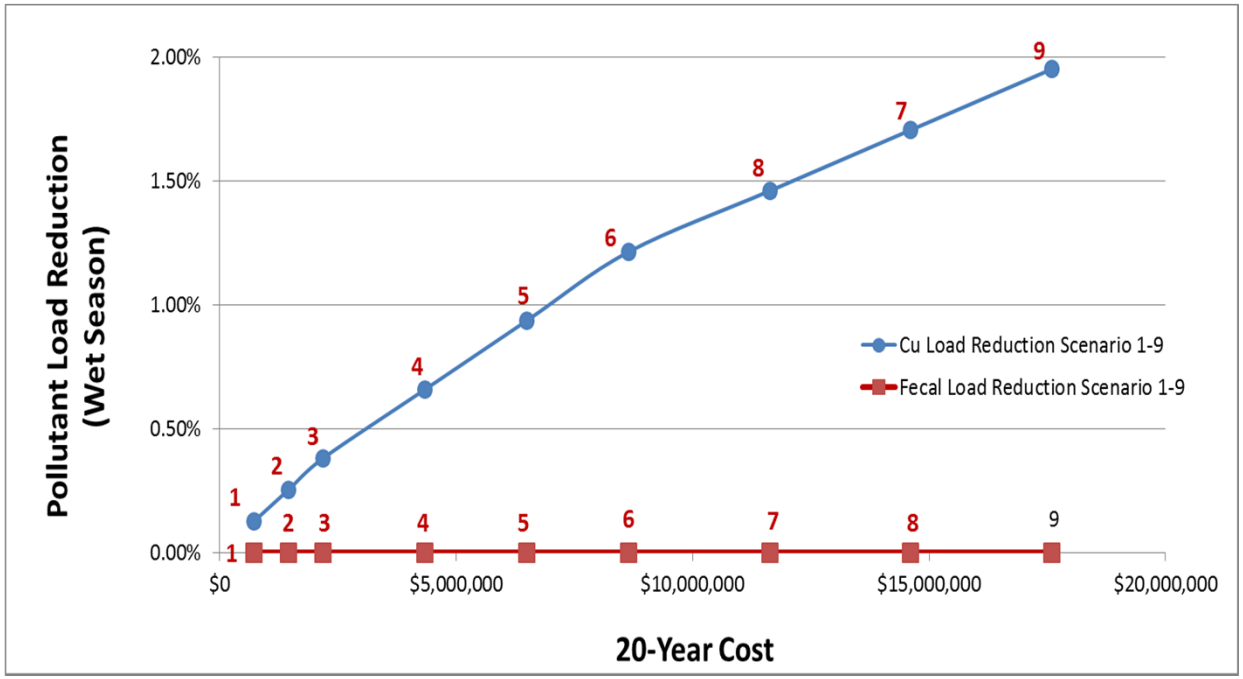
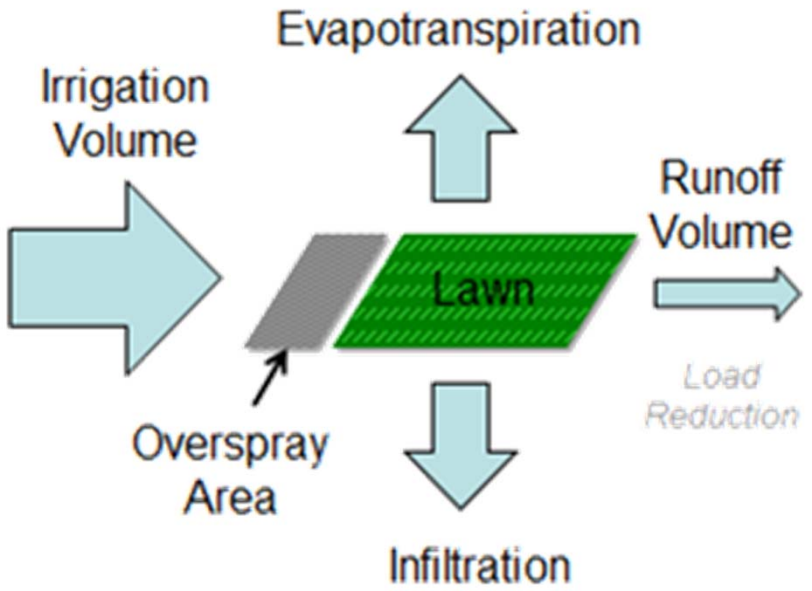


- Optimization results
  - Increase frequency in high-yield areas
  - Clean during wet weather
  - Reduce metals
- Implementation
  - Clean 4x year (wet weather)

Irrigation Control

RP	Non-structural (modeled)
City of La Mesa	58.72
City of Lemon Grove	58.55
Port of San Diego	n/a
San Diego County	59.1
City of San Diego	56.87
Caltrans	0.00

- Goal-oriented:
  - Eliminate overspray
  - 25% irrigation reduction

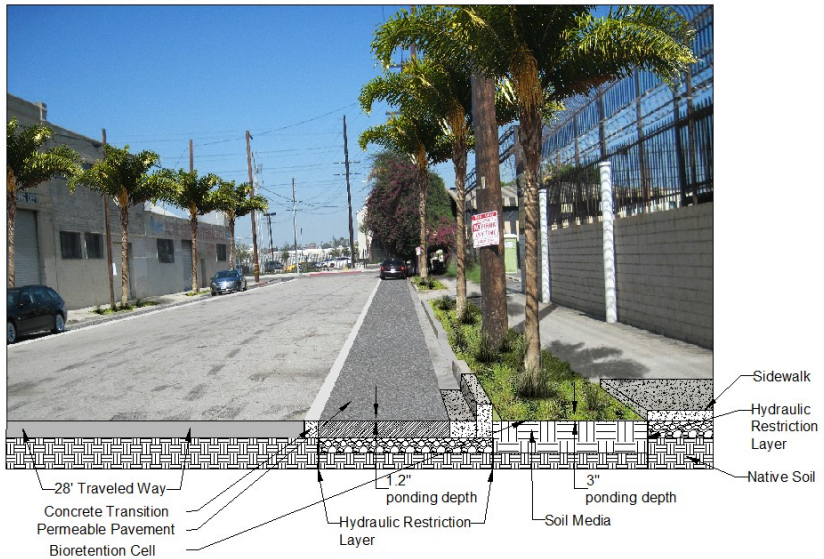


Distributed BMPs

Green Streets

RP	Green Streets
City of La Mesa	40.00
City of Lemon Grove	39.58
Port of San Diego	n/a
San Diego County	28.90
City of San Diego	32.36
Caltrans	n/a

- Candidate Streets
  - Process to screen feasible streets (slopes, utilities, driveways, etc)
- Contributing Areas
  - Land use controls surrounding parcel drainage to ROW
  - 15% drains to Permeable Pavement (Road surface only)
  - 85% drains to Bioretention (Road surface + percentage of parcel)
- Implementation
  - Permeable Pavement in on-street parking stalls
  - Bioretention in parkway (between the back of curb and sidewalk)



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City of La Mesa	40.00
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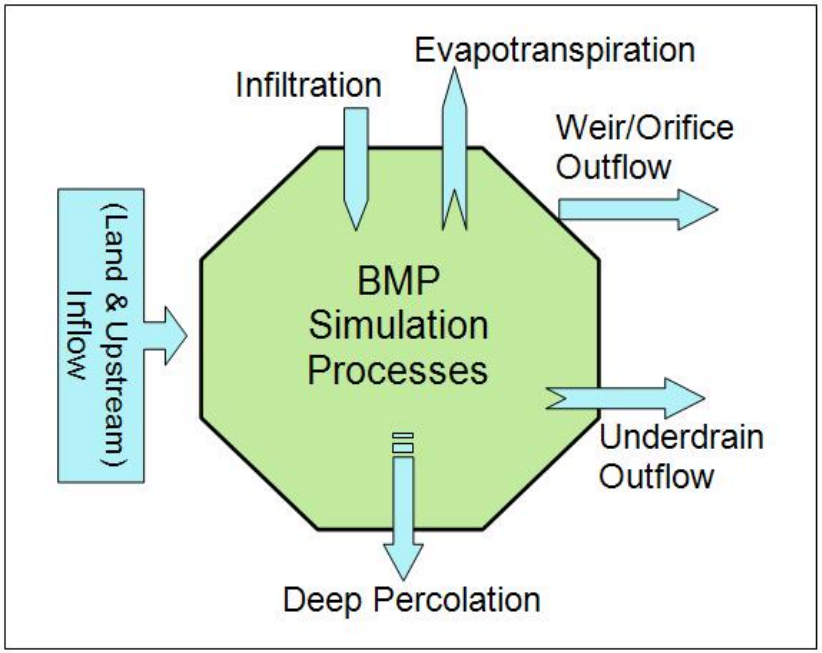
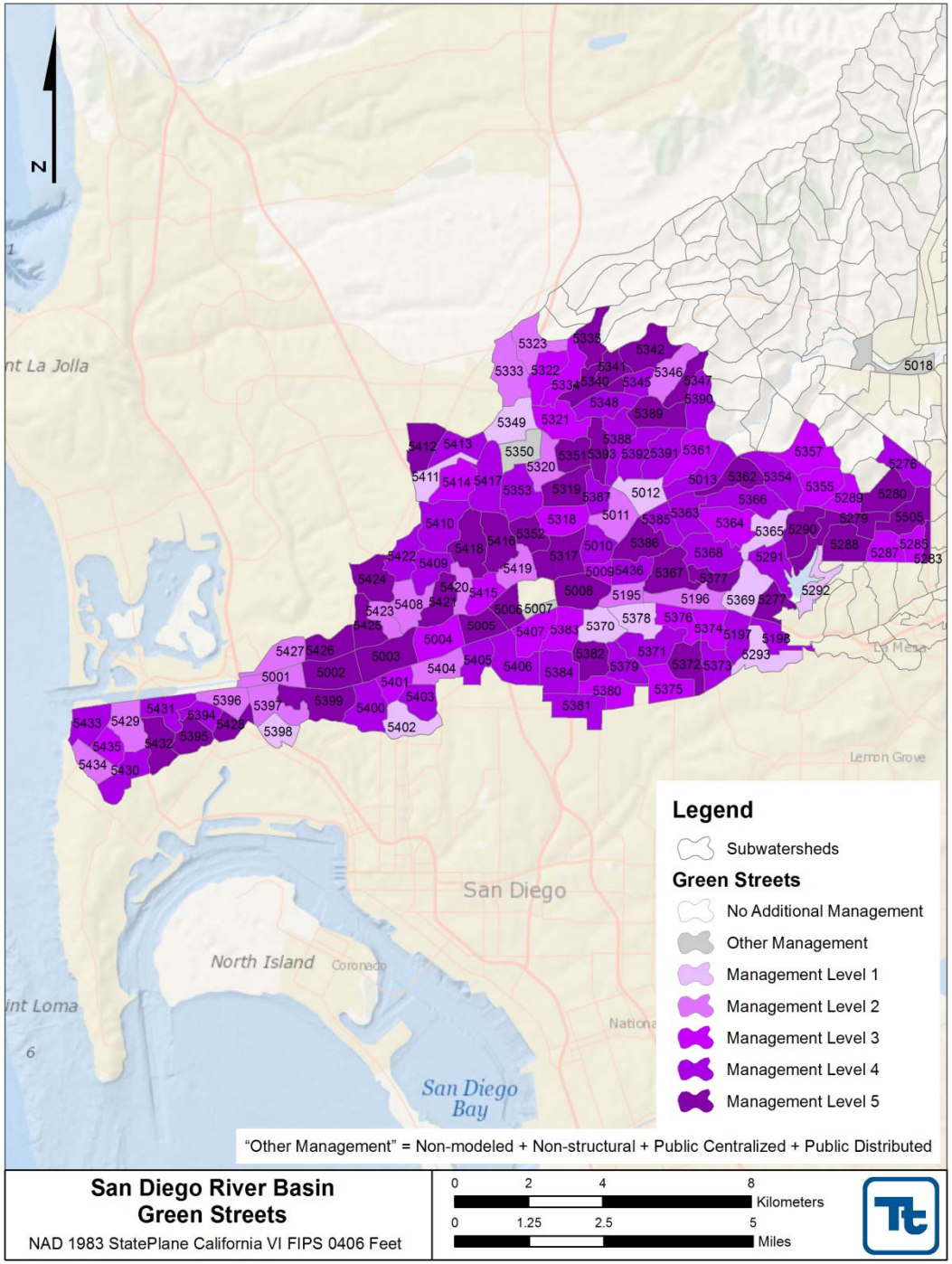


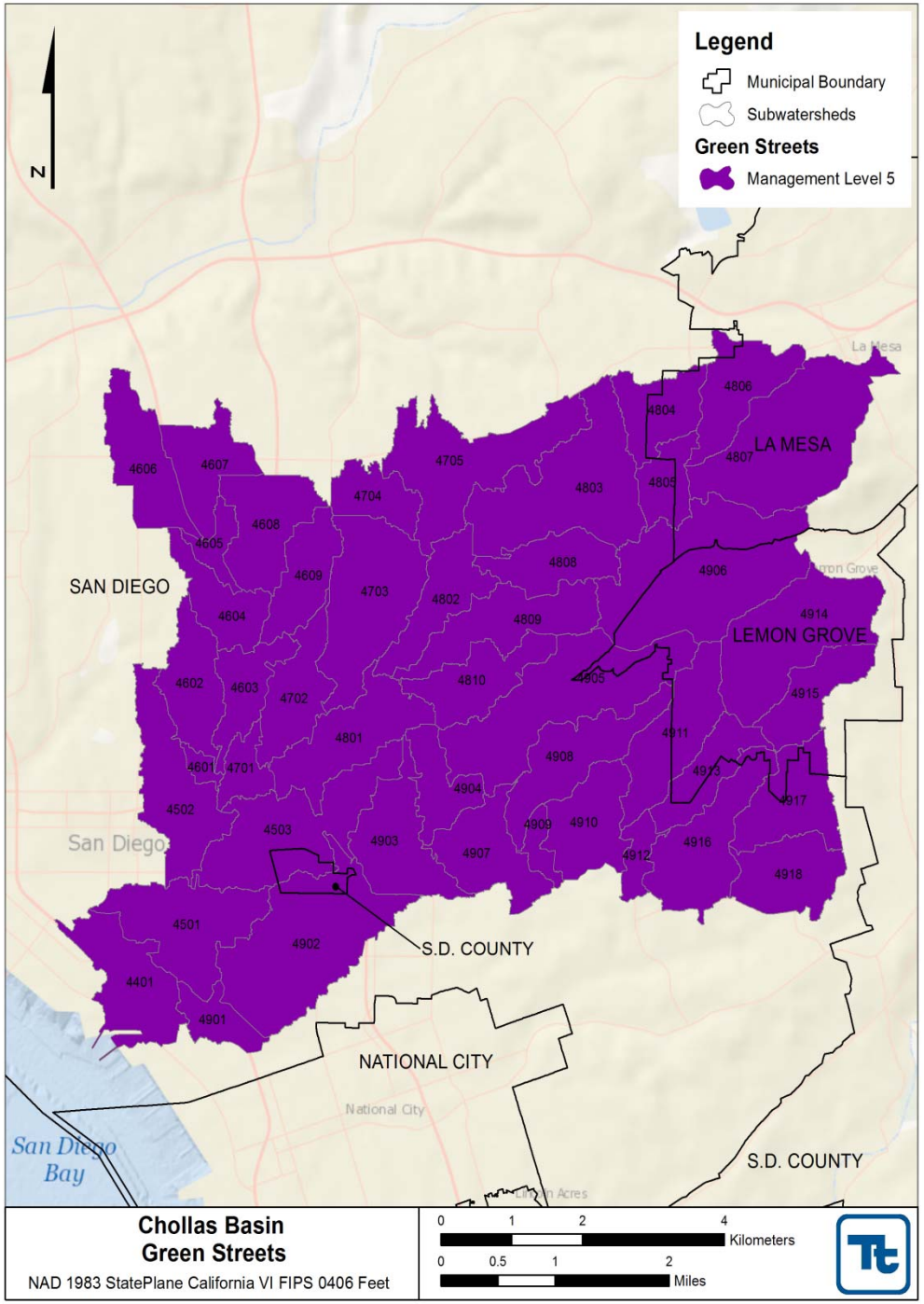
Distributed BMP Information

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
5001	1,184	0
5002	2,444	180
5003	5,465	426
5004	2,837	858
5005	2,576	0
5006	1,743	130
5007	0	0
5008	3,497	792
5009	610	221
5010	733	0
5011	60	3
5012	15	0
5013	1,209	0
5017	0	0
5018	0	0
5195	1,572	123
5196	2,032	0
5197	5,871	37
5198	5,714	158
5271	0	0
5276	5,545	353
5277	3,854	509
5279	4,142	838



Distributed BMP Information

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
4401	11,350	8,957
4501	22,832	18,643
4502	17,129	1,560
4503	21,512	17,975
4601	1,142	0
4602	12,973	12,966
4603	6,966	6,918
4604	9,916	9,923
4605	3,307	3,306
4606	19,144	6,985
4607	15,119	14,589
4608	16,447	10,010
4609	11,982	9,694
4701	3,183	689
4702	10,697	10,600
4703	23,252	22,920
4704	10,247	10,219
4705	29,299	27,676
4801	9,516	9,294
4802	13,680	13,680
4803	29,406	23,173
4804	11,514	11,538
4805	9,018	9,018

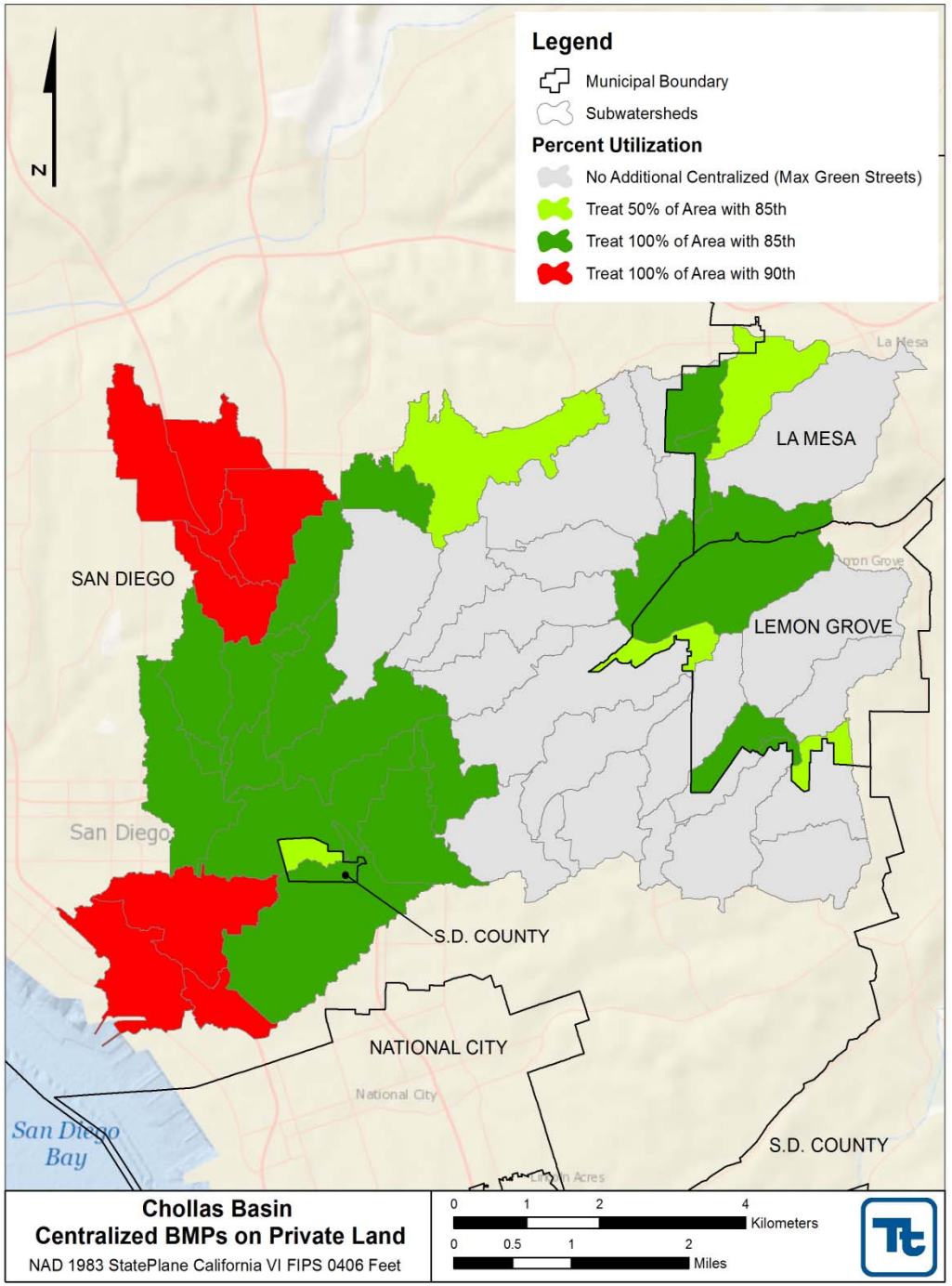


Regional BMPs

San Diego River – Centralized Structural on Private Land

- Spatially optimized
- Priority subwatersheds identified

RP	Centralized on Acquired Private Land
City of La Mesa	23.5
City of Lemon Grove	25.41
Port of San Diego	n/a
San Diego County	38.02
City of San Diego	27.72
Caltrans	n/a



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Regional Project Information

- Description of project site and features
- Design summary
- Performance
- Costs

Park De La Cruz and Cherokee Point Elementary School Centralized BMP Fact Sheet

Site Overview

Park De La Cruz and Cherokee Point Elementary School (Site) catchment is located in the northwest portion of the Chollas Watershed, just west of State Road 15. The 81-acre drainage area consists of predominantly single-family residential but also includes multi-family residential; an urban, densely-situated shopping district; and educational institutions. The only green space on Site is the athletic field and small adjacent park (Park De La Cruz). Based on NRCS data, the predominant soil type of the Site is urban soils (HSG U); therefore, pending a geotechnical investigation by a licensed geotechnical engineer, a dry extended detention basin (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Dry Extended Detention Basin

Photo Source:
http://www.fixbrowse.com/html/newsletters/July_2010/news_jul10_st.htm

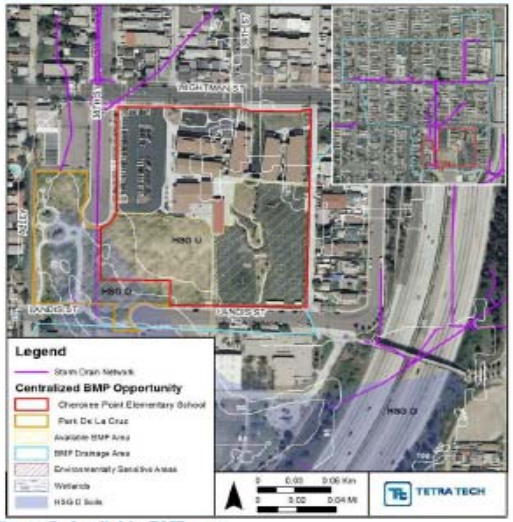


Figure 2. Available BMP area

BMP Design Considerations – Dry Extended Detention Basin

BMP design information for Cherokee Point Elementary School is summarized in Table 1. With this BMP type, flows in the creek could be diverted into the open space area for detention and treatment. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Dry Extended Detention Basin	
BMP Drainage Area (Acres)	81
Available BMP Area (Acres)	5.5
Treatment Volume Capacity (Ac-Ft)	2.9
BMP Surface Area (Acres)	1.5
Recommended Design Depth (Ft)	2.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	5.40E+04	81.0%
Fecal Coliform	6.36E+03	76.6%
Total Coliform	1.39E+05	78.8%
Nitrogen	496.02	65.1%
Phosphorus	83.45	63.8%
Cu	6.5	51.3%
Pb	4.9	50.9%
Zn	41.9	51.5%
Sediment	6,019.8	55.7%
Flow Volume	1,807,986	53.6%

Estimated Costs

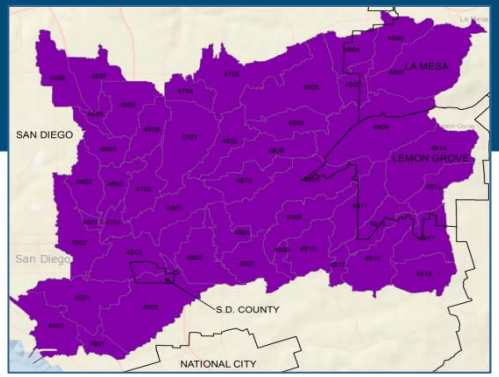
Table 3. Implementation Costs

Cost Estimate	
Planning	$97,200
Design	$276,300
Permits/Studies	$15,000
Construction	$972,113
Annual Operation & Maintenance	$125,814
Total	$1,486,427

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

BMP Modeling Output

Cumulative RAA Output



Chollas Creek

Subwatershed ID	Distributed BMPs		Regional BMPs		Nonstructural BMPs		
	Bioretention (ft)	Permeable Pavement (ft)	Treatment area (acres)	Design storm	Enhanced Sweeping	Enhanced Catch Basin Cleaning	Enhanced Irrigation Control
4401	11,350	8,957	457	85th	Yes	Yes	Yes
4501	22,832	18,643	543	85th	Yes	Yes	Yes
4502	17,129	1,560	298	90th	Yes	Yes	Yes
4503	21,512	17,975	123	85th	Yes	Yes	Yes
4601	1,142	0	231	85th	Yes	Yes	Yes
4602	12,973	12,966	464	85th	Yes	Yes	Yes
4603	6,966	6,918	342	85th	Yes	Yes	Yes
4604	9,916	9,923	115	85th	Yes	Yes	Yes
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4805	9,018	9,018	345	85th	Yes	Yes	Yes


QUESTIONS?