APPENDIX G

Checklist Worksheets and Tables

Prepared for:
San Diego Regional Storm Water Copermittee
County of San Diego Department of Public

APPENDIX G

Checklist Worksheets and Tables

List of Worksheets and Tables and the Corresponding Checklist Question

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Examples of Community Plans

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Water Quality Benefit Worksheet

List of TMDLs

Watershed	Water Body	Constituent	Adopted Date	Source
Santa Margarita	Rainbow Creek	Nitrogen and Phosphorus	February 9, 2005	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/rainbowcreek/final_docs/rctmdlfinaltechrpt032206.pdf
Santa Margarita	Santa Margarita River Estuary	Nutrients	In progress	
Multiple in North County	Several Lagoons and Agua Hedionda Creek	Nutrients, Bacteria, Sediment, TDS	In progress	
Carlsbad	Loma Alta Slough	Phosphorus	June 26, 2014	http://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2014/R9-2014-0020/Draft_TMDL_Report.pdf
Los Peñasquitos	Los Peñasquitos Lagoon	Sediment and Siltation	June 13, 2012	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/los_penasquitos_lagoon/updates071212/Staff_Report_Attch1-Tech_Report.pdf
San Diego River	Famosa Slough	Nutrients	In progress	
San Diego Bay	Chollas Creek	Diazinon	August 14, 2002	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/chollascreekdiazinon/finaltechtmdl042903.pdf
San Diego Bay	Chollas Creek	Dissolved Copper, Lead, And Zinc	June 13, 2007	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/chollascreekmetals/update011509/Technical_Report.pdf
San Diego Bay	Chollas Creek, Paleta Creek, Switzer Creek	Toxic Pollutants	In progress	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/sediment_toxicity/updates021913/CPS_Toxics_TMDL_Draft_Rpt_19Feb2013.pdf
San Diego Bay	Shelter Island Yacht Basin	Dissolved Copper	February 9, 2005	http://www.waterboards.ca.gov/sandiego/water_issues/programs/watershed/docs/swu/shelter_island/techrpt020905.pdf
San Diego Bay	Baby Beach and Shelter Island Shoreline	Indicator Bacteria	June 11, 2008	http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/tmdls/docs/bacteria_project2/Final_Technical_Report_rev1.pdf
Multiple	Twenty Beaches and Creeks in San Diego Region	Indicator Bacteria	February 10, 2010	http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/docs/bacteria/updates_022610/2010-0210_Final_Technical_Report.pdf
Tijuana	Tijuana River and Estuary	Sediment and Trash	In progress	

Water Quality Benefit Worksheet – Example Projects and Calculations

For Items:

- *WQ-1: Estimates of Expected Pollutant Load Reduction:* Report pollutant load reductions in **lbs./year or MPN (or # colonies)/yr.** for each high priority and priority water quality conditions or constituents identified in the applicable WQIP and/or watershed plan. Projects designed to meet the minimum pollutant removal requirements under the MS4 Permit using the 85th percentile design storm event, the metric for load reduction can be reported as **lbs./design storm event** or **MPN (or # colonies)/design storm event**.

- *WQ-2: Estimates of Storm Water Runoff Volume Reductions through increased Infiltration, Filtration and Evapotranspiration:* Report storm water runoff volume reductions in **gallons/year.**

Example Projects:

Example #1: Multi-Benefit Treatment Wetland Project

Example Project #1 consists of a proposed wetland treatment system that has been conceptually designed to include both inlet and outlet controls. These controls maximize the pollutant removal capacity of the wetland treatment system by limiting the flow-through to 1.5-2.0 cubic feet per second (cfs), which corresponds to available literature values on the effectiveness of these systems to remove constituents and indicator bacteria in urban runoff. Flows above 1.5 cfs will by-pass the system. The specific design of the system will be completed during the project design, but at this conceptual stage the maximum flow-through rate, size of the system and drainage area are known. The project has a water quality and water supply benefit focus, and will be designed to treat and infiltrate storm water flows to the capacity of the wetland system based on the required retention times. It will therefore not be designed to a specific design storm event, but rather based on historical rainfall data that routes these historical rainfall events through the treatment wetland.

The total acreage of the treatment wetland is 4 acres. The treatment wetland drainage area is 1000 acres that has several different land use types.

The treatment wetland is proposed to be designed to address priority water quality conditions consistent with the Water Quality Improvement Plan (WQIP) for this watershed and State 303d listings where applicable. Storm flow pollutant loadings are expected to be reduced through infiltration within the wetland footprint and through retention mechanisms. The project proposes to also collect and treat urban dry weather flows and use these flows beneficially to maintain the wetland vegetation and infiltrate into the subsurface soils that recharge a groundwater aquifer that has been identified as a potential water source. Infiltration of storm flows will also provide a beneficial use in recharging this groundwater basin. The project includes environmental benefits with enhancement of adjacent riparian habitat and community benefit through new trails and signage on the water quality benefits of wetlands and the importance of water quality and conservation in the community. These additional multi-benefits result in high overall scoring for this project.

Example #2: Green Street Retro-fit Project – Bioretention Facility

Example #2 is an 8,712 SF, green street retro-fit project that diverts stormwater from the roadway to a series of bioretention areas design to treat the design capture volume based on the 85th percentile storm event. This design approach is taken for this project to be consistent with the MS4 Permit for Priority Development Projects. This project is a retro-fit of an existing street and therefore provides added pollutant removal to this watershed and therefore has water quality benefits. The project was able to gain additional points by creating a park around the bioretention area and providing added community benefit with additional green space in this urban area. The project also reduces peak flows and flooding along the roadway providing an additional flood management benefit. A portion of stormwater flows are also infiltrated into the subsoils that recharge the groundwater to re-establish the natural hydrology which provides both an environmental and water supply benefit.

Example Calculations:

The steps in determining the Water Quality metrics for Benefit WQ-1 and WQ-2 are presented in this Worksheet for the two example projects that include the Treatment Wetland (Example #1 and the Green Street Retro-fit Bioretention facility (Example #2):

1. ***Priority Constituents:*** The first step in the water quality benefits metric calculations is to identify the priority constituents for the project. The priority constituents are based on which Watershed Management Area (WMA) the project is located, the Priority Water Quality Conditions identified in the Water Quality Improvement Plans (WQIPs), and consideration of State 303d listings. A description and maps of the WMAs are provided in Section 3 of the SWRP and also on the OPTI website. The Priority Water Quality Conditions are also listed under each of the WMAs in Section 3. Table G-1 below lists priority constituents for each WMA and hydrologic unit subject to the Permit. These generally represent the highest priority pollutants from the WQIPs modified as appropriate to

reflect other considerations such as 303(d) listings. This list is consistent with the priority pollutants of concern listed in the San Diego County Water Quality Equivalency Manual (http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/stormwater/docs/wqip/Final_WQE_Guidance.pdf).

Hydrologic Unit	Watershed Management Area	TSS	TP	TN	TCu	TPb	TZn	FC
San Juan (901.00)	**South Orange County**	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Santa Margarita (902.00)	**Santa Margarita River**		X	X				X
San Luis Rey (903.00)	**San Luis Rey**		X	X				X
Carlsbad (904.00)	**Carlsbad**	X	X	X				X
San Dieguito (905.00)	**San Dieguito River**		X	X				X
Penasquitos (906.00)	**Penasquitos**	X	X	X				X
Penasquitos (906.00)	**Mission Bay**	X	X	X				X
San Diego (907.00)	**San Diego River**		X	X				X
Pueblo (908.00)	**San Diego Bay**		X	X	X	X	X	X
Sweetwater (909.00)	**San Diego Bay**		X	X	X			X
Otay (910.00)	**San Diego Bay**	X		X	X			X
Combined (908.00-910.00)	**San Diego Bay**	X	X	X	X	X	X	X

Table G-1: Pollutants of Concern by Watershed Management Area and Hydrologic Unit

a. **Example #1**: The treatment wetland example #1 project is located in the San Diego River WMA and therefore the priority constituents are: total phosphorus (TP), total nitrogen (TN) and fecal indicator bacteria in the form of fecal coliform (FC).
b. **Example #2:** The green street retro-fit bioretention example #2 project is located in the San Diego Bay WMA and therefore the priority constituents are: total suspended solids (TSS), TP, TN, total copper (TCu), total lead (TPb), total zinc (TZn) and FC.

2. ***BMP Removal Efficiencies:*** The second step is to determine the pollutant removal efficiency for each priority constituent based on published data for the BMP. BMP pollutant removal efficiencies for many structural BMP may be found in the BMP data base http://www.bmpdatabase.org/ . These are reported as percent reductions of initial concentrations for specific BMP types and configurations. Removal efficiencies will depend on retention times and flow through thresholds for BMPs that do not retain and infiltrate storm flows. Structural BMP should meet the minimum standards as specified in the MS4 Permit and defined in the County of San Diego BMP Design

Manual (BMP DM):
(http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html).

a. **Example #1**: For the example wetland treatment project, the conceptual design assumes a maximum flow rate of 1.5 cfs in order to achieve a higher retention time for pollutant removal. Using available literature, the removal efficiencies for wetland treatment systems are show on Figure G-1 for fecal bacteria and Table G-2 for nutrients and metals. Using these literature values the anticipated removal efficiencies for the treatment wetland retention mechanisms for the priority constituents identified in Step 1 are as follows: Fecal Indicator Bacteria- 50%; Total Phosphorus - 50%; and Total Nitrogen - 40%. The removal efficiency for infiltration is assumed to be 100%.

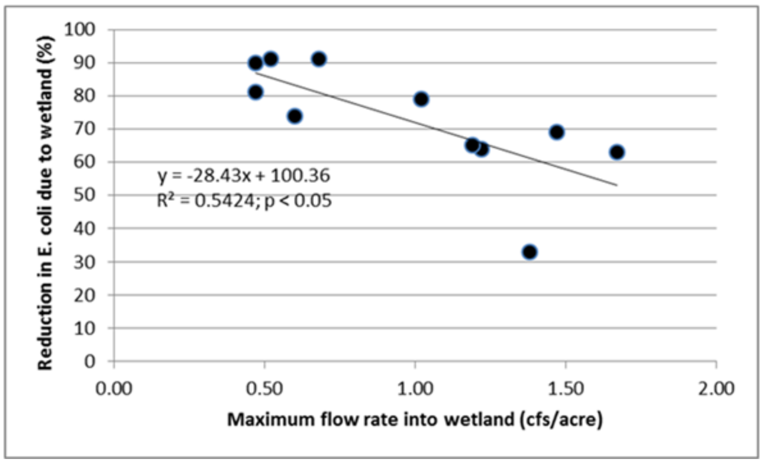


Figure G-1: Relationship between Reductions in E. coli Abundance vs. Maximum Inflow Rate (cubic feet per second (cfs) per acre). Data from Knox et al. (2007)

Constituent	Published Removal Efficiency (%) Based on Source Literature for Retention
Total Nitrogen (TN)*	40%
Total Phosphorus (TP)	50%

*Nitrate as Nitrogen (67%), Nitrite as Nitrogen (67%), and Total Kjeldahl Nitrogen (15%)

Table G-2. Published Wetland Removal Efficiencies

b. **Example #2**: The removal efficiency for a bio-retention facility is accounted for in the design requirements under the MS4 Permit that are addressed in the San Diego BMP Design Manual. A factor of .667 is applied to account for the lower removal efficiency than a retention and infiltration BMP that has a removal efficiency of 100%.

3. ***Annual Volume Treated***: The next step is to determine the annual volume treated by the BMP based on the design capacity of the BMP and the annual volume of runoff treated. The method of determining the annual volume will depend on the type of BMP and configuration, and the drainage area characteristics. Annual volume shall be based on estimated drainage area runoff that is captured and treated by the project using methods presented in the BMP DM, or using modeling/calculation tools to simulate storm events using historical data sets and then averaging the results to an annual volume. This annual volume metric is needed to allow for comparison of projects on a watershed, regionally and statewide basis. In addition to BMP DM, the San Diego Hydrology Model (SDHM) (https://www.clearcreeksolutions.com/ProductDetails.asp?ProductCode=SDHM) is another tool that can be used to simulate continuous storm flow based on historical storm event data. This model was developed to size and design stormwater BMPs in accordance with the San Diego County Hydromodification Plan (HMP). This model may be used for water quality and hydromodification projects with larger drainage areas and that are not designed to meet the design storm event (e.g. 85^{th} percentile storm event). Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of the checklist submittal. In addition, the San Diego County Hydrology Manual (http://www.sandiegocounty.gov/content/sdc/dpw/flood/hydrologymanual.html) provides local precipitation data and methods, such as the rational method, for determining annual volume of runoff for projects that may not be water quality focused and/or do not correspond to structural BMP types in the BMP DM. The rational method is more appropriate to projects with a smaller drainage area and have water quality as secondary benefit.

   a. **Example Project #1**: For the treatment wetland project, the drainage area of 1,000 acres is characterized by these land surfaces and soil types: 109 acres of grass cover and soil Type D; 628 acres of open areas of little or no vegetation and Soil Type D; 156 acres of urban landscape; and, 107 acres of impervious surfaces. In order to determine annual volumes and the percent of the total volumes that were either infiltrated or retained for treatment in the wetland, the San Diego Hydrology Model (SDHM 3.0) was used with the inputs of the drainage area and the specific land surface types and soils. The SDHM 3.0 output provides hourly runoff rates and volume using 40 years of precipitation data. The wetland project infiltration was calculated using the output from the SDHM and then inputting into a continuous model in Matlab. The low flows were assumed to infiltrate in the wetlands at a rate of 1 inch per day. The wetland project was set up as a simple box model allowing 1 foot of inundation from tributaries. From there the water was either evaporated or percolated. If water entered the wetland when it was at full capacity, the flow passed through the wetland with longer retention time (up to 1.5 cfs). The output from the modeling provides an overall infiltration and retention rate for the 4-acre treatment wetland as a percent of total rainfall. The model also provides the estimated evapotranspiration rate that is much lower than the other rates but provided for use in estimating total volume of runoff reduced for ***WQ-2***. In order to get to an annual volume and rates, the average of the flows was determined. The results of the volume calculations are summarized tabular form as follows:

Annual Average Flow entering Wetland per Model	Wetland Infiltration Rate per Model	Wetland Retention Rate per Model	Wetland Evapo-transpiration Rate per Model	Annual Volume of Infiltration	Annual Volume that is Treated by Retention Mechanisms
8.62E06 cf/yr	21%	29%	1.5%	1.81E06 cf/yr	2.5E06 cf/yr

Table G-3: Example #1 Wetland Calculated Annual Volumes

4. ***Volume Treated using Design Storm Volume***: For projects that are designed to meet the minimum pollutant removal requirements under the MS4 Permit using the 85th percentile design storm event, the metric for load reduction may be reported as lbs/design storm event or MPN (or # of colonies)/design storm event. The method for determining this load reduction metric follows the steps for the annual load reduction metric except that the *volume treated* step includes determining the volume of storm water runoff from the drainage area that is treated for the 85th percentile design storm event. This is approximately 0.6 inches/24 hours. The design storm event is defined in the San Diego Regional BMP Design Manual (http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html). The Design Storm Event Load Reduction is then determined by multiplying the volume of the design storm treated by the BMP by the concentration reduction achieved. This calculation is presented in Step 7.
    a. **Example #2**: The green street retro-fit bioretention BMP is designed to meet the requirements of the MS4 Permit for priority development projects, that uses the capture volume based on the 85th percentile storm event and multiplied by 1.5 to accommodate the lower removal efficiency than a retention and infiltration BMP. For the example #2 project the Design Capture Volume was determined using the spreadsheets provided in the BMP Design Manual for bioretention facilities. Table G-4 provided the calculation spread sheet from the BMP Design Manual for determination of the treated volume based on the 85th percentile storm event for the BMP location. The 85th percentile storm event intensity can be found on the San Diego isopleths for this design storm event: http://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/susmppdf/susmp_85precip.pdf. Based on this calculation in Table G-4, the volume treated is 29,496 cubic yards which is equivalent to the design storm event.

	B	C	D	E	O
1	**Automated Worksheet B.1-1: Calculation of Design Capture Volume (V1.3)**				
2	Category	#	Description	i	Units
3	Standard Drainage Basin Inputs	0	Drainage Basin ID or Name		unitless
4		1	Basin Drains to the Following BMP Type	Biofiltration	unitless
5		2	85th Percentile 24-hr Storm Depth	0.83	inches
6		3	Design Infiltration Rate Recommended by Geotechnical Engineer	0.100	in/hr
7		4	Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	281,300	sq-ft
8		5	Semi-Pervious Surfaces Not Serving as Dispersion Area (C=0.30)	175,083	sq-ft
9		6	Engineered Pervious Surfaces Not Serving as Dispersion Area (C=0.10)		sq-ft
10		7	Natural Type A Soil Not Serving as Dispersion Area (C=0.10)		sq-ft
11		8	Natural Type B Soil Not Serving as Dispersion Area (C=0.14)		sq-ft
12		9	Natural Type C Soil Not Serving as Dispersion Area (C=0.23)	500,832	sq-ft
13		10	Natural Type D Soil Not Serving as Dispersion Area (C=0.30)	11,995	sq-ft
14	Dispersion Area, Tree Well & Rain Barrel Inputs (Optional)	11	Does Tributary Incorporate Dispersion, Tree Wells, and/or Rain Barrels?	No	yes/no
15		12	Impervious Surfaces **Directed to Dispersion Area** per SD-B (Ci=0.90)		sq-ft
16		13	Semi-Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.30)		sq-ft
17		14	Engineered Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.10)		sq-ft
18		15	Natural Type A Soil **Serving as Dispersion Area** per SD-B (Ci=0.10)		sq-ft
19		16	Natural Type B Soil **Serving as Dispersion Area** per SD-B (Ci=0.14)		sq-ft
20		17	Natural Type C Soil **Serving as Dispersion Area** per SD-B (Ci=0.23)		sq-ft
21		18	Natural Type D Soil **Serving as Dispersion Area** per SD-B (Ci=0.30)		sq-ft
22		19	Number of Tree Wells Proposed per SD-A		#
23		20	Average Mature Tree Canopy Diameter		ft
24		21	Number of Rain Barrels Proposed per SD-E		#
25		22	Average Rain Barrel Size		gal
26	Treatment Train Inputs & Calculations	23	Does BMP Overflow to Stormwater Features in Downstream Drainage?	No	unitless
27		24	Identify Downstream Drainage Basin Providing Treatment in Series		unitless
28		25	Percent of Upstream Flows Directed to Downstream Dispersion Areas		percent
29		26	Upstream Impervious Surfaces Directed to Dispersion Area (Ci=0.90)	0	cubic-feet
30		27	Upstream Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	0	cubic-feet
31	Initial Runoff Factor Calculation	28	Total Tributary Area	969,210	sq-ft
32		29	Initial Runoff Factor for Standard Drainage Areas	0.44	unitless
33		30	Initial Runoff Factor for Dispersed & Dispersion Areas	0.00	unitless
34		31	Initial Weighted Runoff Factor	0.44	unitless
35		32	Initial Design Capture Volume	29,496	cubic-feet
36	Dispersion Area Adjustments	33	Total Impervious Area Dispersed to Pervious Surface	0	sq-ft
37		34	Total Pervious Dispersion Area	0	sq-ft
38		35	Ratio of Dispersed Impervious Area to Pervious Dispersion Area	n/a	ratio
39		36	Adjustment Factor for Dispersed & Dispersion Areas	1.00	ratio
40		37	Runoff Factor After Dispersion Techniques	0.44	unitless
41		38	Design Capture Volume After Dispersion Techniques	29,496	cubic-feet
42	Tree & Barrel Adjustments	39	Total Tree Well Volume Reduction	0	cubic-feet
43		40	Total Rain Barrel Volume Reduction	0	cubic-feet
44	Results	41	Final Adjusted Runoff Factor	0.44	unitless
45		42	Final Effective Tributary Area	426,452	sq-ft
46		43	Initial Design Capture Volume Retained by Site Design Elements	0	cubic-feet
47		44	Final Design Capture Volume Tributary to BMP	29,496	cubic-feet
49	**Worksheet B.1-1 General Notes:**				
50	A. Applicants may use this worksheet to calculate design capture volumes for up to 10 drainage areas User input must be provided for yellow shaded cells, values for all other cells will be automatically generated, errors/notifications will be highlighted				

Table G-3: Example #2 Bioretention Calculated Event-Based Design Capture Volume

5. ***BMP Rates of Infiltration, Filtration and/or Evapotranspiration:*** Determine the rates of infiltration, filtration and/or evapotranspiration - whichever is applicable - that will result in a reduction of volume of storm water runoff that will result in the restoration of natural hydrology. Determining these rates separately is important as these estimates are used for both ***WQ-1: Estimates of Expected Pollutant Load Reduction and WQ-2: Estimates of Storm Water Runoff Volume Reductions through increased Infiltration, Filtration and Evapotranspiration***. The rates of these volume reduction factors will depend on BMP type, configuration, soil infiltration rates and design capacity. These factors can be determined using the design tools listed under the volume calculations above that include the County of San Diego BMP Design Manual and the SDHM.

    a) **Example #1**: For the example wetland project, the rates of infiltration and evapotranspiration determined from the SDHM model outputs and Matlab model are presented in **Table G-3**.

    b) **Example #2**: For the example bioretention facility designed for the 85th percentile storm event, the results of the BMP Design Manual for infiltration and evapotranspiration are presented in **Table G-4.**

6. ***Volume Reduced:*** Determine the volume reduced by the BMP based on the design of the BMP and the annual or event based volume of runoff treated. The volume reduced is based on the either the annual or event based total runoff volume and the portion of that total volume that is lost to infiltration and evapotranspiration calculated from Step 5.

    a) **Example #1**: For the wetland project, the total volume reduced is based on the infiltration and evapotranspiration rates determined from the continuous hydrology model based on average annual volume and rates. The volume reduce is equal to: Total Average Annual Volume * (rate of infiltration + rate of evapotranspiration). This volume is: 8.63E06 cf/yr*(.21 +.015) = 1.94E06 cf/yr. Using a conversion rate of 7.481 gallons/cubic foot, the annual volume reduction is 14.5E06 gallons/year.
    b) **Example #2:** For the bioretention BMP, the volume reduced is based on the event volume for an 85th percentile storm and the infiltration determined from the BMP Design Manual work sheet. For this example the underlying soils were assumed to be a type C soil with an infiltration rate of 0.1 in/hr. Based on the worksheet output the infiltration volume is 1,742 cf/event ((8,712 sf)*(0.1 in/hr)*(24 hr)/(12 in/ft)) or 13,031 gallon/event.

7. ***Pollutant Concentrations prior to Treatment***: The concentration of pollutants prior to treatment can be estimated using the drainage area land use types and published data on the event mean concentrations (EMC) for these land uses. Table G-5 provides the EMC for various land use types from the San Diego Water Quality Equivalency Manual. The event mean concentrations are then multiplied by the percent of each land type within the drainage area. The EMC for each of the priority constituents and land use type identified in previous steps are used to determine pollutant loads before treatment. For example, if total suspended solids (TSS) is a priority constituent and commercial land use is 20% of the total area of the project drainage area, then the EMC for total suspended solids of 240.71 mg/L would be multiplied by 0.20. The total TSS concentration would then be determined by adding up the EMC for each land use multiple by the percentage of the total area (up to 100% of the drainage area). The pollutant load to be treated for each constituent is then determined by multiplying the treated volume determined from Step 3 for annual volume and Step 4 for event volume with the total EMC adjusted for each land use.

Land Use Category	TSS (mg/L)	TP (mg/L)	TN(mg/L)	TCu (ug/L)	TPb (ug/L)	TZn (ug/L)	FC (#/100mL)
Agriculture	817.42	2.76	37.20	97.76	30.18	270.17	50,705
Commercial	240.71	0.43	6.13	54.35	14.40	458.72	44,068
Education	243.64	0.54	4.11	13.29	7.44	179.28	6,340
Industrial	239.06	0.53	5.43	53.11	20.51	408.80	25,074
Multi -Family Residential	182.63	0.36	5.00	13.36	4.52	135.05	13,704
Orchard	323.40	0.46	25.06	97.76	30.18	270.17	5,727
Rural Residential	1826.27	1.41	5.36	9.78	21.37	57.51	9,801
Single Family Residential	237.89	0.56	5.62	26.66	13.03	160.49	31,828
Transportation	207.71	0.71	4.30	51.82	9.21	286.51	5,983
Vacant / Open Space	299.55	0.28	3.72	11.92	3.02	45.87	5,071
Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table G-5: Adjusted EMCs Scaled Toward Mean with Equivalent Proportionality

a. **Example #2**: Table G-6 for the bioretention BMP presents the adjusted EMCs based on the percent land uses. For this project the priority constituents are all those listed. The table also provides the total pollutant loading estimate for the 85th percentile storm event volume for these priority pollutants of concern.

8. **Pollutant Loading and Pollutant Reduction**: The amount of the load reduction achieved by the project is then based on multiplying the annual treated volume by the pollutant concentrations before treatment with the BMP removal efficiency specific to each priority pollutant of concern. For projects that have determined treated volume on an annual basis, the pollutant reduction is determined as lbs/yr or MPN (or #colonies)/yr. For projects that are designed using a treated volume based on a design storm event, the design capture volume is multiplied by the EMC total and then by the removal efficiency of the BMP for each constituent to determine pollutant load reduction as lbs/event or MPN (or #colonies)/event.

   a. **Example #1**: The treatment wetland project pollutant removal quantification is based on the annual rate of retention and infiltration shown on Table G-3. The volume of storm flows retained on an average annual basis as shown in Table G-3 is 2.5E06 cf/yr. This treated volume is then multiplied by the average concentration of each priority constituent that in this case is based on monitoring data, and then multiplied by the removal efficiency rate shown in Figure G-1 and Table G-2. The results of these calculations result in a load reduction reported in lbs/yr or #colonies/yr for each of the priority pollutants of concern.
   b. **Example #2**: For the green street retro-fit project, the pollutant load reduction is based on the design capture volume for the 85th percentile storm event from Step 2, multiplied by the

pollutant concentration from the EMC analysis in Step 7, and then multiplied by the removal efficiency. The San Diego Region MS4 Permit established an efficiency of 0.667 for bioretention BMPs. The results of this calculations are shown on Table G-6 below that includes the original pollutant load for each of the priority pollutants of concern, the design capture volume based on the BMP Design Manual calculations for the 85th percentile storm event, the total pollutant load, and the load reduced after applying the removal efficiency of 0.6667 to the total load. The loads have been converted to lbs/event and #colonies/event as required for entering into the online checklist.

			Event Mean Concetratations Multiplies by Percent of Land Use Type						
Land Use Acreages	**Land Use**	**Example #2 Land Use Percentages**	**TSS (mg)**	**TP (mg)**	**TN (mg)**	**Tcu (ug)**	**TPb (ug)**	**TZn (ug)**	**FC (#)**
0.0	**Agriculture**	0%	0	0	0	0	0	0	0
0.0	**Commercial**	0%	0	0	0	0	0	0	0
9.3	**Education**	42%	85,248,467	188,943	1,438,069	4,650,107	2,603,220	62,729,212	22,183,355,789
0.0	**Industrial**	0%	0	0	0	0	0	0	0
0.0	**Multi -Family Residential**	0%	0	0	0	0	0	0	0
0.0	**Orchard**	0%	0	0	0	0	0	0	0
0.0	**Rural Residential**	0%	0	0	0	0	0	0	0
9.8	**Single Family Residential**	44%	87,711,654	206,476	2,072,132	9,829,723	4,804,249	59,173,750	117,351,991,296
3.1	**Transportation**	14%	24,225,577	82,809	501,516	6,043,856	1,074,178	33,416,158	6,978,076,639
0.0	**Vacant / Open Space**	0%	0	0	0	0	0	0	0
0.0	**Water**	0%	0	0	0	0	0	0	0
Total Concetration (EMC)			**197,185,698**	**478,228**	**4,011,718**	**20,523,686**	**8,481,648**	**155,319,120**	**146,513,423,724**
Removal Efficiency of 0.667 multipled by Total			131,522,861	318,978	2,675,816	13,689,299	5,657,259	103,597,853	97,724,453,624
Total (lbs/event)*			435	1	9	45	19	342	
0.667 (lbs/event)			**290**	**1**	**6**	**30**	**12**	**228**	
* Total Design Capture Volume multiplied by total EMC									
Example #2 Treated Volume		29,496	CF						
		835,234	L						

Table G-6: Example #2 Pollutant Concentrations and Loading for Treatment Event-Based Volume

Water Quality Benefit Worksheet

WQ-3a: Estimates of Changes to Coarse Sediment Delivery

- **Metric Reporting Units**: Report whether project **will result in any reduction in coarse sediment delivery from a critical coarse sediment area**. Projects must not reduce sediment supply or transport within these designated areas.

- **Key Steps in Determining Metric:**
  - *Changes to coarse sediment delivery*: Preservation of coarse sediment supplies from designated critical coarse sediment areas to downstream receiving waters is required by the San Diego Hydromodification Management Plan. When critical coarse sediment yield areas are identified adjacent to the project site (e.g. hillsides that will drain through the site), protection of these areas is similar to protection of undisturbed critical coarse sediment yield areas onsite. These areas must not be routed through detention basins or other facilities with restricted outlets that will trap sediment. The project storm water conveyance system shall be designed to bypass these areas to ensure that critical coarse sediment can be discharged to receiving waters, such that there is no net impact to the receiving water. The bypass shall be designed with sufficient capacity and slope to convey sediment from undisturbed areas and not result in sediment accumulation atop developed areas of a site, for example by sustaining flows exceeding 6 feet per second through BMPs during the two-year flow event.
  - Locate the potential project relative to the coarse sediment areas shown in the San Diego Regional Potential Coarse Sediment Yield Areas. Projects that are not in the mapped Potential Coarse Sediment Areas are exempt from further analysis. For potential projects within mapped areas, follow the procedure outlined in Chapter 6.2 of the San Diego BMP Design Manual to verify whether the project is in a critical coarse sediment area, or if the receiving water is not sensitive to reduction of coarse sediment, or if the area is not producing sediment that is critical to receiving streams.
  - Report whether the proposed project does or does not reduce supply or transport of coarse sediment.
- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego Regional Potential Coarse Sediment Yield Areas: http://www.projectcleanwater.org/download/reg-ccsya-mapping/

Water Quality Benefit Worksheet

WQ-3b: Estimates of Changes to Increased Subsurface Soil Residence Time.

- **Metric Reporting Units**: Report changes to subsurface flow residence time as the **percent increase in lag time between rainfall and peak stormwater outflow from a BMP during the 85th percentile rainfall event**.
- **Key Steps in Determining Metric**:
  - *Increased subsurface flow residence Time:* Determine the increase in subsurface soil residence time by calculating the time lag between the middle of the 85th percentile rainfall event and the peaks in the inflow and outflow hydrographs for the BMP. Model the proposed BMP using standard sizing tools e.g. SDHM, HEC-HMS, Pond. Report the existing and proposed time lags and the percent increase. If using continuous hydrologic models such as SDHM select a rainfall event from the time series that is similar in size and duration to the 85th percentile event and calculate the difference between the existing and proposed conditions peak hydrographs.
- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego 85th percentile isopluvials: http://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/susmppdf/susmp_85precip.pdf
  - Water Quality Equivalency Report**:** http://www.projectcleanwater.org/images/stories/Docs/WQE/Final%20Water%20Quality%20Equivalency%20Guidance%20for%20Region%209%20-%20December%202015.pdf
- **Example Metric Calculation**:

Parameter: percent change in lag time

Middle of rainfall = 4am

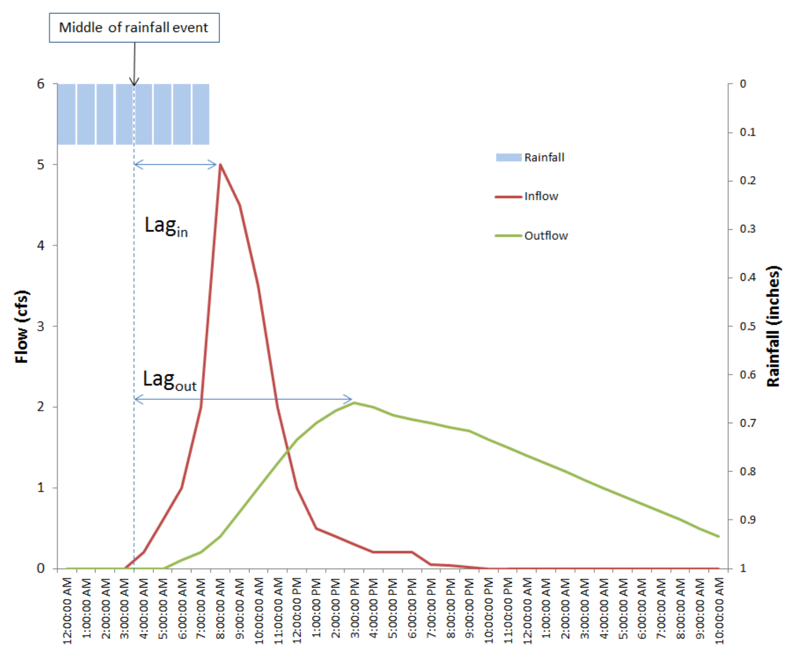
Peak inflow = 8am

Inflow lag = 4 hours

Peak outflow = 3pm

Outflow lag = 11 hours

Percent change in lag time
= 11/4 = 275%



Water Quality Benefit Worksheet

List of Priority Water Quality Conditions from WQIPs

Watershed	Priority Conditions	Weather	Level
Santa Margarita			
San Luis Rey	Bacteria at San Luis Rey River Mouth	Dry/Wet	Highest
	Bacteria in Lower San Luis Rey River	Dry/Wet	Highest
	Nitrogen and Phosphorus	Dry/Wet	
	Total Dissolved Solids	Dry/Wet	
	Eutrophic Conditions	Dry	
	Index of Biological Integrity	Dry	
	Chloride	Dry	
	Toxicity	Dry/Wet	
Carlsbad	Bacteria at Loma Alta Slough	Dry/Wet	
	Toxicity at Loma Alta Creek	Dry	
	Bacteria at Loma Alta Creek Mouth	Dry/Wet	
	Bacteria at Buena Vista Lagoon	Dry/Wet	Highest
	Sediment/ Siltation at Buena Vista Lagoon		
	Bacteria at Agua Hedionda Creek	Dry/Wet	Highest
	Toxicity at Aqua Hedionda Creek	Wet	
	Sediment Erosion at Aqua Hedionda Creek	Wet	
	Nitrate and Nitrite at Buena Creek	Dry	
	Bacteria at Pacific Ocean Shoreline	Dry/Wet	
	Phosphorus at San Marcos Creek	Dry	
	Toxicity at Encinitas Creek	Dry	
	Bacteria at Escondido Creek	Wet	Highest
	Toxicity at Escondido Creek	Dry	
	Bacteria at San Elijo Lagoon	Dry	Highest
	Sediment/Siltation at San Elijo Lagoon		
	Bacteria at Moonlight Beach	Dry/Wet	Highest
	Eutrophic conditions at Loma Alta Slough	Dry	
	Eutrophic conditions at San Elijo Lagoon	Dry	
San Dieguito	Enterococcus at San Dieguito River	Dry	
	TDS at San Dieguito River	Dry/Wet	
	Total Nitrogen at San Dieguito River	Dry	
	Poor to very poor IBI at San Diequito River	Dry	
	Fecal Coliform at San Dieguito River	Dry/Wet	
	Phosphorus at San Dieguito River above Lake Hodges	Dry/Wet	
	Toxicity at San Dieguito River below Lake Hodges	Wet	

	Bacteria at San Diequito River	Dry/Wet	Highest
	Chloride at San Diequito River	Dry	
	Sulfate at San Diequito River	Dry	
	TSS at San Dieguito River above Lake Hodges	Wet	
Watershed	**Priority Conditions**	**Weather**	**Level**
Los Peñasquitos	Enterococcus, poor IBI, TDS, dissolved copper, and Toxicity at Carroll Canyon	Dry	
	Bifenthrin, fecal coliform, poor IBI, pH, TDS, TSS, and turbidity at Carroll Canyon	Wet	
	Benthic Algae, enterococcus, poor IBI, total nitrogen, phosphorus, TDS, and Toxicity at Los Peñasquitos Creek	Dry	
	Bifenthrin, diazinon, fecal coliform, very poor IBI, TDS, TSS, toxicity, and turbidity at Los Peñasquitos Creek	Wet	
	Benthic algae, enterococcus, poor IBI, nitrogen, phosphorus, TDS, toxicity at Los Peñasquitos Lagoon	Dry	
	Bifenthrin, fecal coliform, poor IBI, TDS, TSS, and turbidity at Los Penñasquitos Lagoon	Wet	
	Hydromodification, Siltation/Sedimentation	Dry	Highest
	Freshwater Discharges	Wet	Highest
	Bacteria	Dry/Wet	Highest
	Poor IBI, TDS, phosphorus, nitrogen, fecal coliform, and toxicity at Rose Canyon	Dry	
	Enterococcus, poor IBI, phosphorus, and toxicity at Tecolote Creek	Dry	
	Arsenic, chlordane, copper, dichloro-diphenyl-trichloroethane (DDT), mercury, and zinc at Mission Bay	Dry	
	Bifenthrin, fecal coliform, permethrin, TDS, TSS, and turbidity at Rose Canyon	Wet	
	Bifenthrin, fecal coliform, TSS, and turbidity at Tecolote Creek	Wet	
	Copper, fecal coliform, total coliform, and sediment at Scripps	Wet	
	Bacteria at Tecolote Creek	Dry/Wet	Highest
	Sediment at Scripps	Wet	Highest
	Bacteria at Scripps	Dry/Wet	Highest
San Diego River	Enterococcus, and TDS at El Capitan	Dry	High
	TN,TP, and Fecal Coliform at El Capitan	Dry	
	Nitrat, N/N, TN, TP, DP, TDS, fecal coliform, enterococcus, chloride, sulfate, and DO at San Vincente	Dry	High
	TN,TP,TDS, fecal coliform, enterococcus, and DP in Lower San Diego	Dry	High
	Nitrate, N/N, TP, TSS, enterococcus, DP, and TDS in Loser San Diego	Dry	
	Fecal coliform, TSS at El Capitan	Wet	High
	Fecal coliform at Lower San Diego	Wet	High
	S. capricronutum in San Diego River	Wet	
	TDS in San Diego River	Dry/Wet	
	Poor IBI, Nitrogen in the form of TN, TP, TD, enterococci, and selenestrum acute in San Diego River	Dry	

Watershed	Priority Conditions	Weather	Level
San Diego Bay	Metals, bacteria, phosphorus, nitrogen, trash, PAHs, chlordane, diazinon, and PCPs at Chollas Creek		
	Metals, and Bacteria at Shelter Island Yacht Basin		
	PAHs, mercury, PCBs, and zinc at San Diego Bay shoreline		
	PAHs, PCBs, and chlordane at Switzer Creek		
	PAHs, PCBs, and chlordane at Paleta Creek		
	Bacteria, nutrients, and trash at Sweetwater River		
	Bacteria at Pacific Ocean Shoreline		
	Nitrogen at Lower Otay Reservoir		
Tijuana	TSS and Fecal Colifrorm at San Ysidro	Wet	High
	Elevated Bacteria and Turbidity Levels at San Ysidro	Wet	
	Nitrogen, Phosphorus, Enterrococcus, MBAS, and DO in San Ysidro	Dry	High
	TSS in San Ysidro	Dry	
	TSS, turbidity, and dissolved copper in Water Tanks	Wet	High
	Nitrogen, Phosphorus, Enterrococcus, and DO in Water Tanks	Dry	High
	Fecal Coliform at Barret Lake	Wet	High
	TSS and Fecal Colifrorm at Cottonwood	Wet	High
	Nitrogen, TSS, and Enterrococcus at Cottonwood	Dry	High
	Phosphorus, TDS, and Enterrococcus at Canyon City	Dry	High
	TSS at Hill	Wet	High

List of Priority Strategies from WQIPs

Watershed	Jurisdiction	Strategy
Santa Margarita	San Diego County	
San Luis Rey	City of Oceanside, City of Vista, San Diego County, and Caltrans	Appendix B of San Luis Rey WQIP
Carlsbad	City of Carlsbad, City of Escondido, City of San Marcos, City of Encinitas, City of Oceanside, City of Vista, City of Solana Beach, and San Diego County	Section 2.4.2 of Carlsbad WQIP
San Dieguito	City of Del Mar, City of Poway, City of Escondido, City of Solana Beach, City of San Diego, and San Diego County	Appendix I of San Dieguito WQIP
Los Peñasquitos	City of Del Mar, City of Poway, City of San Diego, San Diego County, and Caltrans	Appendix I of Los Peñasquitos WQIP
Mission Bay	City of San Diego and Caltrans	Appendix J of Mission Bay WQIP
San Diego River	City of El Cajon, City of La Mesa, City of San Diego, City of Santee, San Diego County, and Caltrans	Section 3.2, Appendix 3b of San Diego WQIP
San Diego Bay	San Diego Regional Airport, City of San Diego, City of Chula Vista, City of Coronado, National City, City of La Mesa, City of Lemon Grove, City of Imperial Beach, San Diego County, Caltrans, and San Diego Port	Appendix I of San Diego Bay WQIP
Tijuana	City of Imperial Beach, City of San Diego, San Diego County	Appendix H of Tijuana WQIP

Water Quality Benefit Worksheet

Examples of High Priority Drainage Area Maps (Los Peñasquitos WQIP, Appendix K)

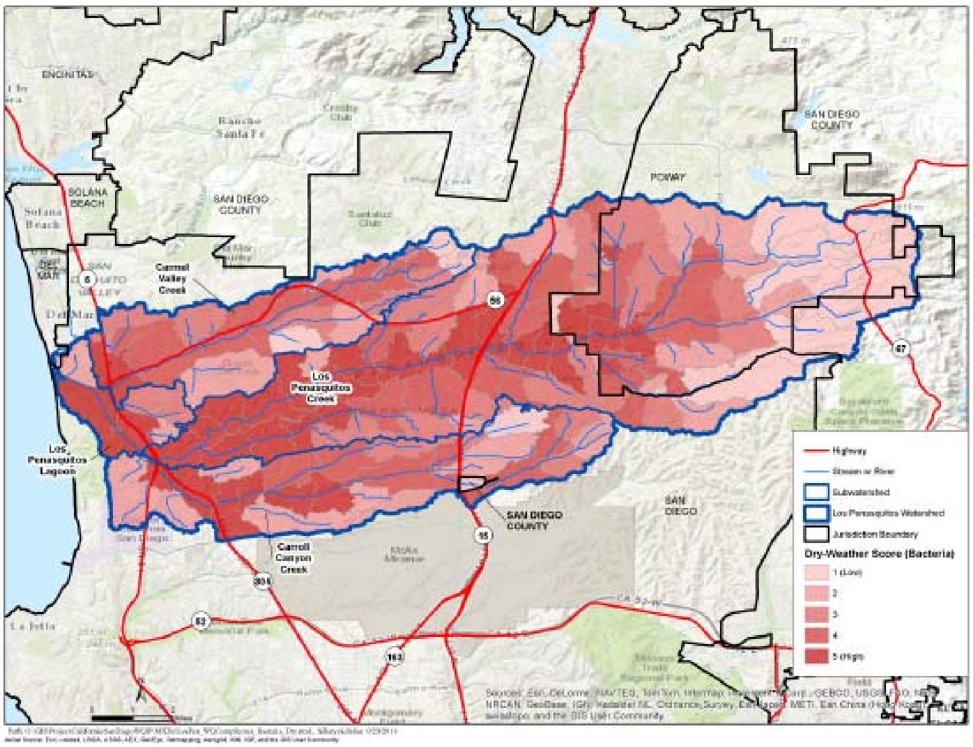


Figure K-2
Water Quality Dry-Weather Composite Score for Bacteria

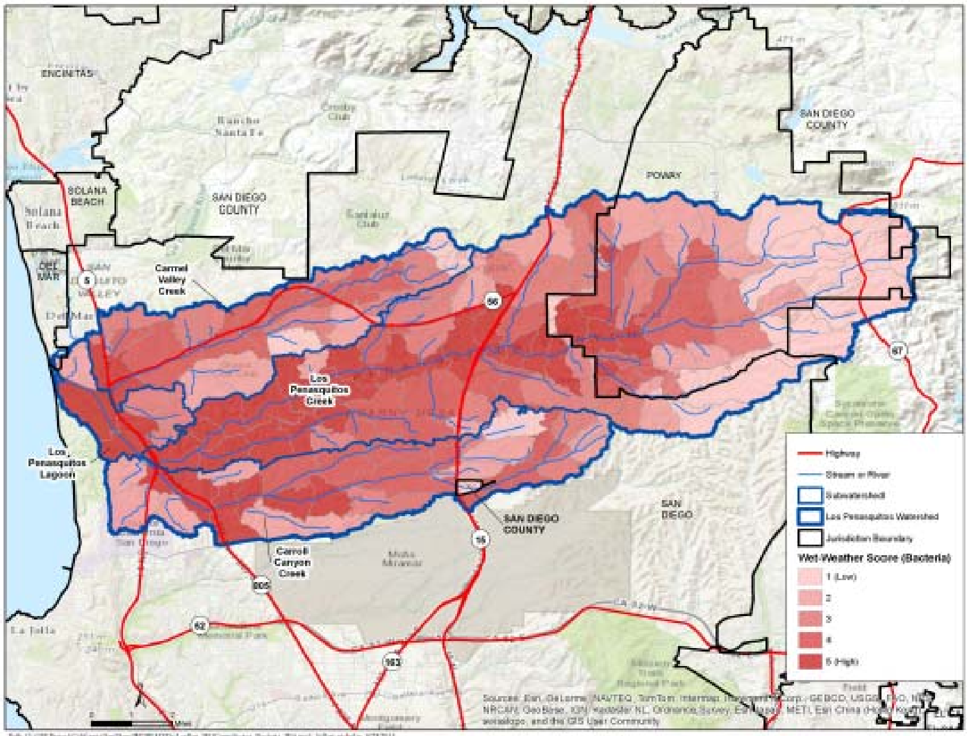


Figure K-3
Water Quality Wet-Weather Composite Score for Bacteria

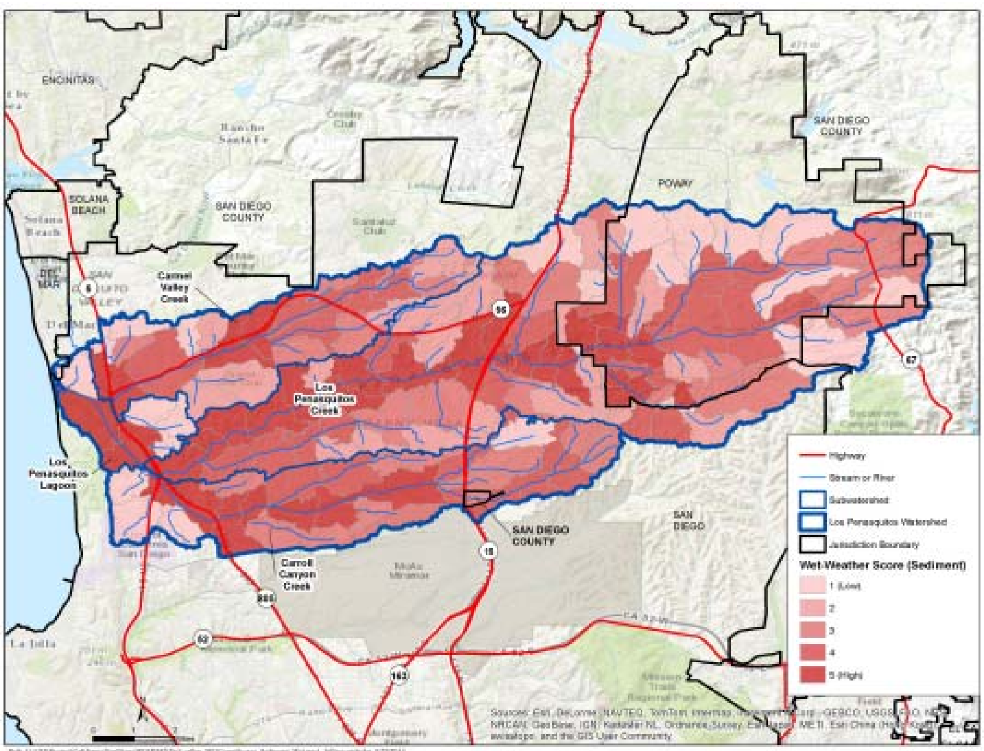


Figure K-4
Water Quality Wet-Weather Composite Score for Sediment

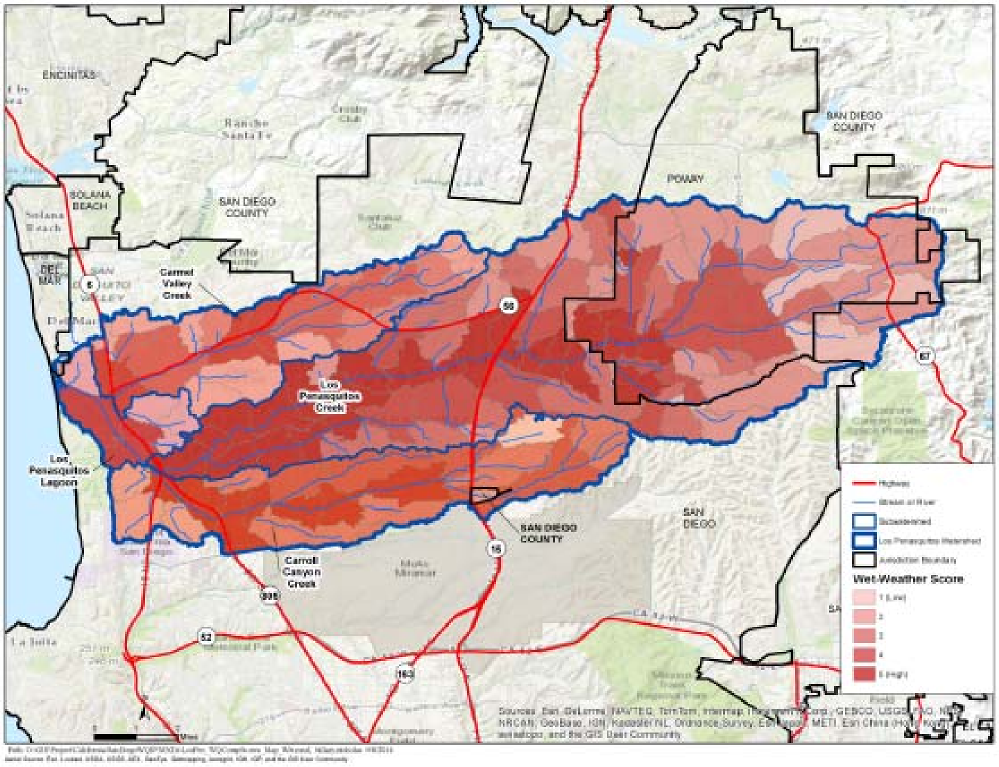


Figure K-5
Total Water Quality Wet-Weather Composite Score for Bacteria and Sediment

Water Supply Benefit Worksheet

WS-2: Estimates of Storm Water and /or Dry Weather Flow Volume that will be collected, stored, and beneficially used.

- **Metric Reporting Units**: Report storm water and/or dry weather flow runoff volume diverted, stored and then used beneficially and/or conserved in **AF/year.**

- **Key Steps in Determining Metric:**
  - *Project Rates of Stormwater and/or Dry Weather Runoff Diversion and Storage:* The volume of stormwater and/or dry flow diverted and stored for irrigation will depend on the project type, configuration, design capacity and measured and anticipated flows into the project. Prior to estimating the amount of these flows that are then beneficially used for irrigation, the capacity of the system to store, treat and distribute storm water and/or dry weather flows needs to be determined. The design storage can either be achieved through above or below ground retention of storm flows or storage/direct diversion of dry weather flows to treatment and distribution. As these flows are not consistent, storage is likely needed for these projects to allow for treatment and then distribution for irrigation when needed. The amount of storm water flow to be diverted and stored should be based on the hydraulic analysis of the drainage area(s) from which the storm water will be captured and conveyed to the project. Flows from existing MS4 outfall(s) may be used and the amounts controlled by inlet devices. The storage capacity shall be reported as part of these calculations as storage may be greater than annual rates of actual wet weather and dry weather flow diversion. Storage may be more a function of the end use needs and therefore important to the overall measurements of benefit achieved.
  - *Annual Volume Use for Beneficial Use (Irrigation)*: Determine the volume that is used beneficially on an annual basis for irrigation on-site, local park, golf course, habitat restoration or natural treatment wetland. Annual volumes shall be based on average annual runoff or measured flows that include data over a timeline that captures dry, wet and average precipitation years. Dry weather flows measurements should include at least 2 weeks of continuous flow monitoring during wet and dry weather seasons. Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of the checklist submittal. These guidelines are provided for greater regional consistency, but are not required.

- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego Precipitation Database: http://www.projectcleanwater.org/download/rainfall-data/

- Western Regional Climate Center: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7740
- County of San Diego Evapotranspiration Rates: http://www.itrc.org/etdata/etmain.htm
- Water Quality Equivalency Report: http://www.projectcleanwater.org/images/stories/Docs/WQE/Final%20Water%20Quality%20Equivalency%20Guidance%20for%20Region%209%20-%20December%202015.pdf

- **Example Metric Calculation**:

The example project would divert stormwater and dry weather runoff from the storm drain into underground storage beneath a parking lot, with the water subsequently used to irrigate landscaping.

1. Estimate potential water supply
    a. Delineate storm drain watershed
    b. Estimate available stormwater draining to the storm drain using Rational Method or other stormwater calculations
    c. Estimate dry weather runoff using appropriate per unit area dry weather runoff rates for San Diego County multiplied by the area of developed land draining to the storm drain system
    d. Estimate total potential water supply per year in AF/yr
2. Estimate potential beneficial reuse demand
    a. Delineate area of landscaping requiring irrigation
    b. Calculate irrigation demand using tools such as City of San Diego Landscape Watering Calculator http://apps.sandiego.gov/landcalc/
    c. Calculate total volume of water needed for irrigation in AF/yr
3. Estimate storage volume available beneath parking lot in AF and estimate frequency that store can be filled based on Step 1 to yield potential volume in AF/yr.
4. Estimate stormwater and dry weather beneficial reuse
    a. Volume beneficially reused is the limiting factor (smallest volume) from Steps 1, 2 and 3 above, reported in AF/yr
    b. Provide the volume and flow that has been approved in the agreement with the agency that will be accepting the flows and using them for beneficial use.

Water Supply Benefit Worksheet

WS-2a: Estimates of Water Conservation.

- **Metric Reporting Units**: Report the amount of potable water conserved in **AF/year.**

- **Example Metric Calculation**:

As an example project and calculation, the Turf Replacement and Agricultural Irrigation Efficiency Program proposed in the IRWMP provides education and outreach regarding the incentive program with an emphasis on dry weather runoff prevention and water quality protection that are achieved with improvements to irrigation efficiency within the City. This program component has been implemented by the Water Authority and the City for several years.

Estimates for the amount of water conversion from turf to water-efficient landscaping were made using a combination of expertise and scientific studies. Tim Schaadt, an Associate Resources Specialist from Metropolitan Water District (MWD), was consulted as an expert, given his experience with a similar rebate program and his experience with water use in Southern California. Tim Schaadt estimated that conversion from turf to water-efficient landscaping is expected to save 0.00014 AFY per square foot. He cites two sources to justify this value, an *Evaluation of the Synthetic Turf Pilot Program* by MWD and a *2005 Xeriscape Conversion Study* by Kent Sovocool of the Southern Nevada Water Authority. The MWD study found water savings of 0.00014 AFY per square foot when turf was converted from natural to synthetic. This study only looked at conversion of natural turf to synthetic, not conversion from natural turf to water efficient landscaping. The Xeriscape study found a savings of 55.8 gallons per square foot when lawns were converted to xeriscape (water-efficient) landscaping in southern Nevada. This is equivalent to 0.00017 AFY per square foot. This represents savings in a more extreme climate, but allows 0.00014 AFY per square foot to remain a reasonable estimate of water savings.

Method Used to Determine Water Conservation:

Using water meter records, the MWD study that showed water savings achieved when converting a natural grass field to a synthetic turf of 0.00014 AFY per square foot. This program plans to provide incentives for conversion of approximately 320,000 square feet of turf to water-efficient landscaping. At a savings of 0.00014 AFY per square foot, this would result in water savings of approximately 45 AFY.

Note that slight variations in calculations may occur due to rounding. Note that for the Turf Replacement component, we assumed a “phasing in” of physical benefits based on the budget: 10% in 2013, 50% in 2014 (60% cumulatively for benefits), and 40% in 2015 (100% cumulatively for benefits). This results in a “phasing-out” of benefits as well: 90% in 2033 and 40% in 2034.

Turf Replacement and Agricultural Irrigation Efficiency Program

(a)	(b)	(c)	(d)	(e)
Year	**Type of Benefit**	**Without Project***	**With Project**	**Change Resulting from Project**
2013	Water Conservation	4.5 AFY	0	4.5 AF
2014	Water Conservation	27 AFY	0	27 AF
2015-2032	Water Conservation	45 AFY	0	810 AF
2033	Water Conservation	40.5 AFY	0	40.5 AF
2034	Water Conservation	18 AFY	0	18 AF
** Annual volume of water conserved*				

Water Supply Benefit Worksheet

WS-3 & WS-4: Estimates of Storm Water and /or Dry Weather Flow Volume that will be collected, stored, and infiltrated for beneficial use to recharge a groundwater aquifer.

- **Metric Reporting Units**: Report storm water and/or dry weather flow runoff volume diverted, stored and then infiltrated into a groundwater aquifer in **AF/year.**

- **Key Steps in Determining Metric:**
  - *Project Rates of Stormwater and/or Dry Weather Runoff Diversion and Storage:* The volume of stormwater and/or dry flow diverted and stored for infiltration into a groundwater aquifer will depend on the project type, configuration, design capacity and measured and anticipated flows into the project. Prior to estimating the amount of these flows that are then beneficially used for groundwater recharge, the capacity of the system to store storm water and/or dry weather flows needs to be determined. The design storage can either be achieved through above or below ground retention of storm flows or storage/direct diversion of dry weather flows that will infiltrate into the subsurface to the groundwater aquifer. As these flows are not consistent, storage is likely needed for these projects to allow for slower infiltration rates into the sub-surface. The amount of storm water flow to be diverted and stored should be based on the hydraulic analysis of the drainage area(s) from which the storm water will be captured and conveyed to the project. Flows from existing MS4 outfall(s) may be used and the amounts controlled by inlet devices. The storage capacity shall be reported as part of these calculations. Project storage capacity should also account of infiltration rates and drawdown of the system before the next storm event. ***In addition, all projects that store runoff need to meet the requirements under the San Diego Department of Environmental Health Vector Mitigation Design Guidelines (see reference below) to control mosquitos breeding habitats. This requires ponded water to be eliminated or sufficiently disturbed with flowing water within 72 hours.***
  - *Infiltration Rates for Groundwater Recharge:* Rates of infiltration into existing soils shall be determined through geotechnical investigations and testing as part of the design process. Concept level designs may use existing soil maps that provide soil types and expected infiltration rates. Projects that include the addition of engineered soil layers to promote infiltration shall account for these installed material infiltration rates.
  - *Annual Volume Use for Beneficial Use (Groundwater Recharge for Direct Use as Potable Water Supply)*: Determine the volume that is used beneficially on an annual basis for groundwater recharge. Annual volumes shall be based on average annual runoff or measured flows that include data over a timeline that captures dry, wet and average precipitation years. Dry weather flows measurements should include at least 2 weeks of continuous flow monitoring during wet and dry weather seasons. Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of

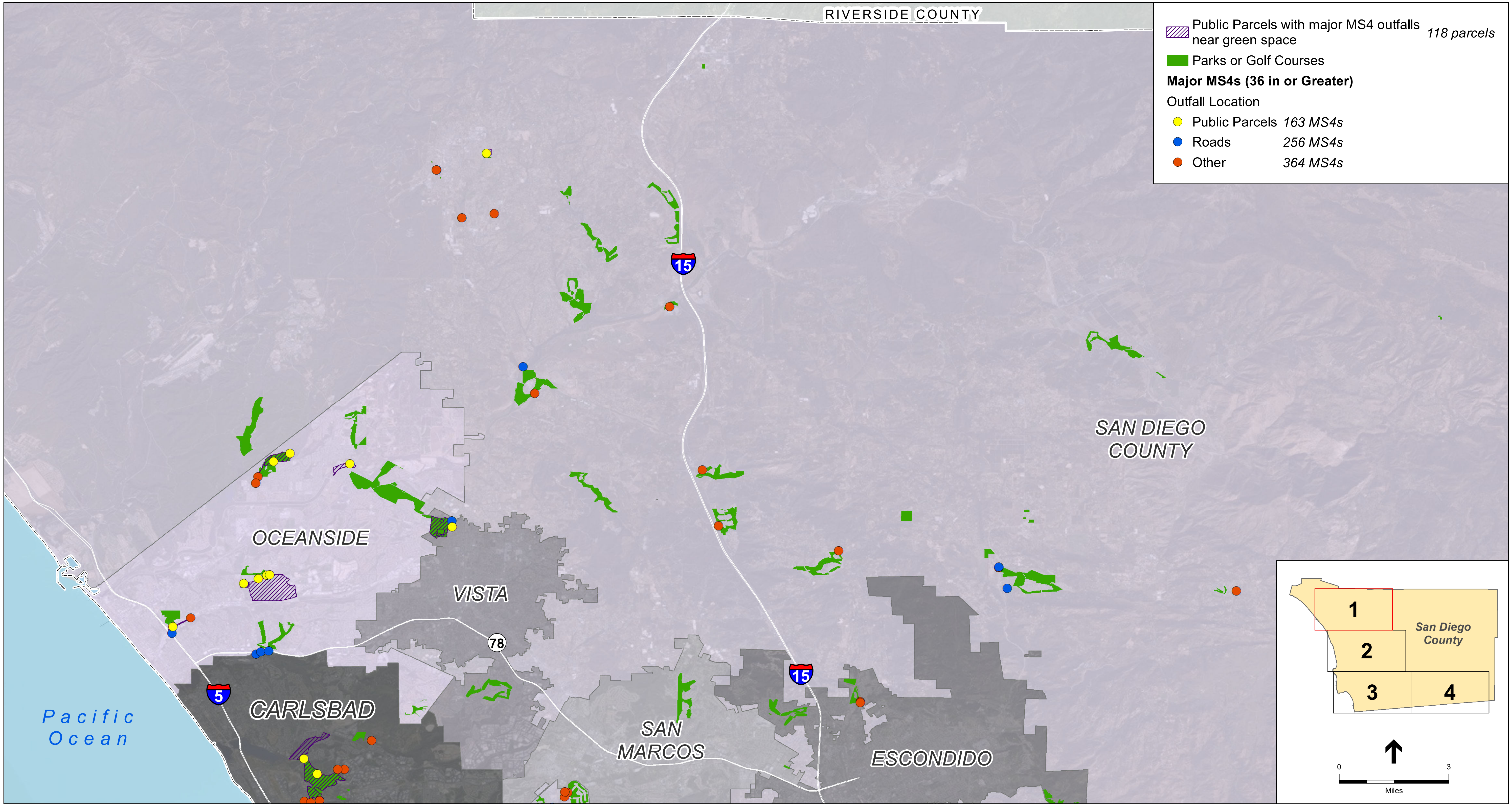
the checklist submittal. These guidelines are provided for greater regional consistency, but are not required.

- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego Precipitation Database: http://www.projectcleanwater.org/download/rainfall-data/
  - Western Regional Climate Center: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7740
  - County of San Diego Evapotranspiration Rates: http://www.itrc.org/etdata/etmain.htm
  - Water Quality Equivalency Report**:** http://www.projectcleanwater.org/images/stories/Docs/WQE/Final%20Water%20Quality%20Equivalency%20Guidance%20for%20Region%209%20-%20December%202015.pdf
  - County Department of Environmental Health Vector Habitat Mitigation Design Guidelines: http://www.sandiegocounty.gov/content/dam/sdc/pds/docs/vector_guidelines.pdf

- **Example Metric Calculation**:

The example project would divert stormwater and dry weather runoff from the storm drain into underground storage and infiltration facility.

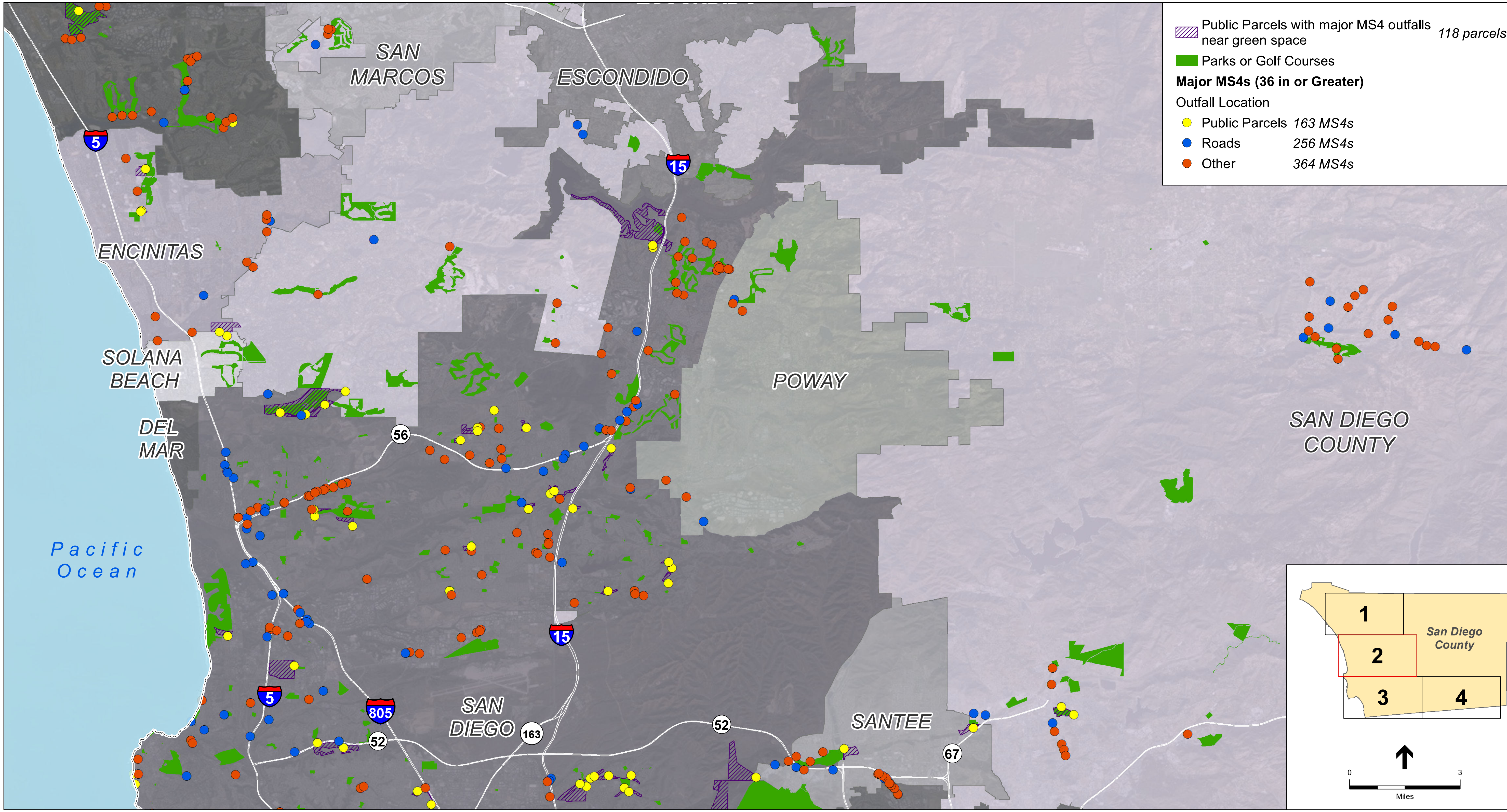
1. Estimate potential water supply
   a. Delineate storm drain watershed
   b. Estimate available stormwater draining to the storm drain using Rational Method or other stormwater calculations
   c. Estimate dry weather runoff using appropriate per unit area dry weather runoff rates for San Diego County multiplied by the area of developed land draining to the storm drain system
   d. Estimate total potential water supply per year in AF/yr
2. Estimate potential infiltration rate
   a. Delineate footprint of potential infiltration facility
   b. Calculate soil infiltration potential
   c. Calculate total volume of water that could be infiltrated in AF/yr
3. Estimate storage volume available in facility in AF and estimate frequency that store can be filled based on Step 1 to yield potential volume in AF/yr.
4. Estimate infiltration reuse potential
   a. Volume infiltrated is the limiting factor (smallest volume) from Steps 1, 2 and 3 above, reported in AF/yr



SOURCE: ESRI, 2016; SanGIS, 2016

SWRP . 160618

Figure 5-1
Public Parcels with Major MS4 Oufalls
Located within 1/4 Mile of Green Space

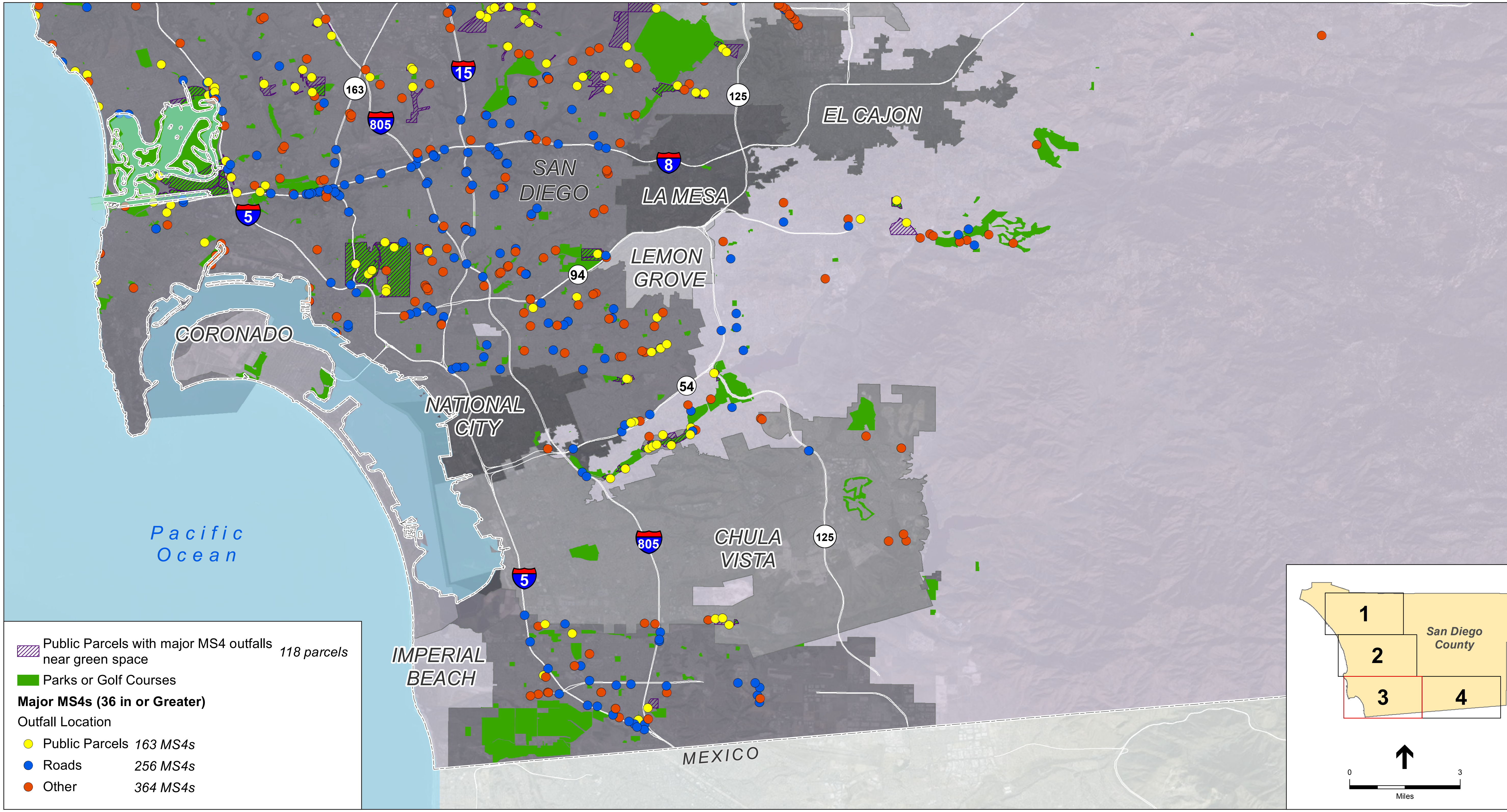


SOURCE: ESRI, 2016; SanGIS, 2016

SWRP . 160618

Figure 5-2b

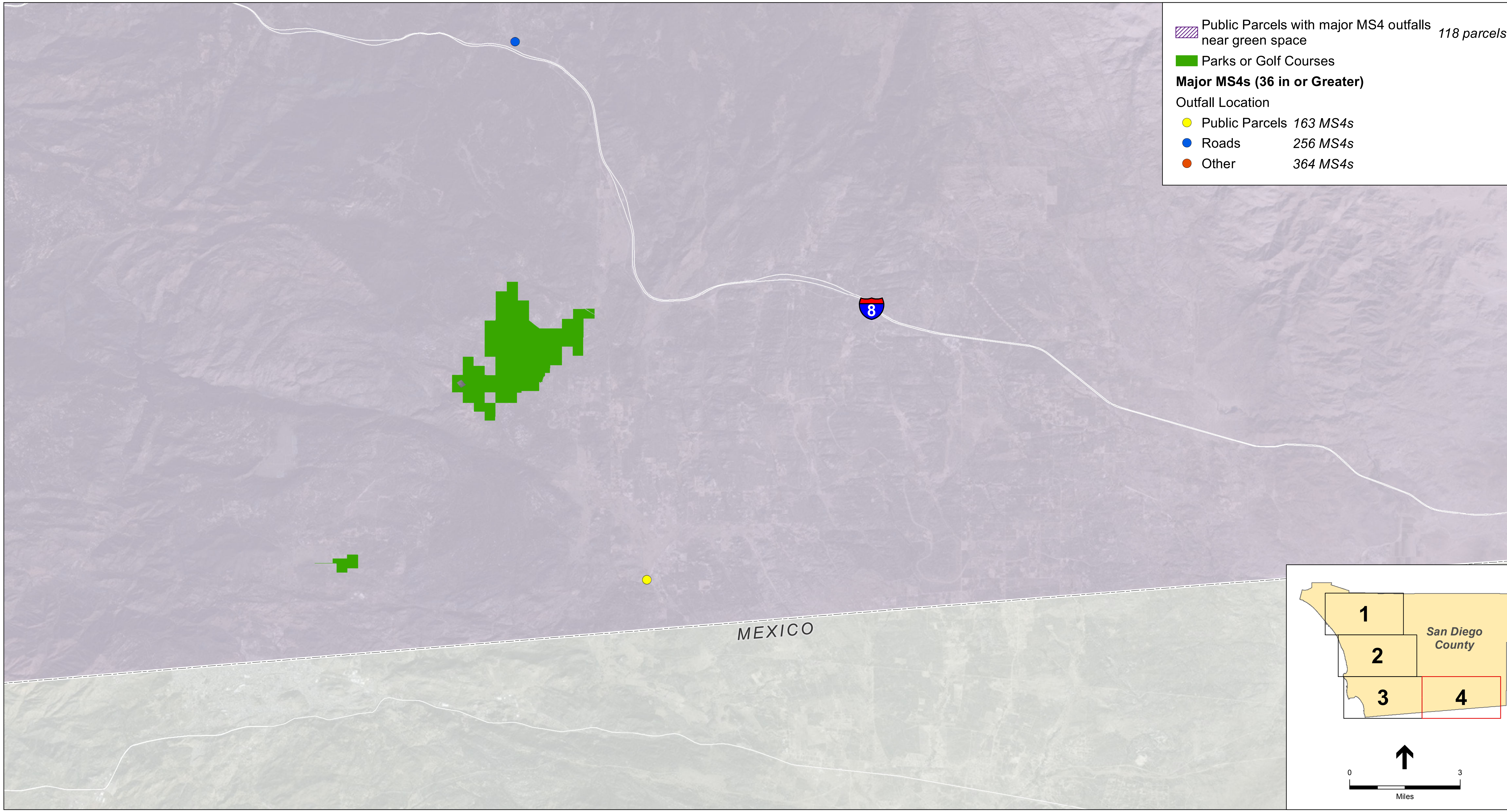
Public Parcels with Major MS4 Oufalls Located within 1/4 Mile of Green Space



SOURCE: ESRI, 2016; SanGIS, 2016

SWRP . 160618

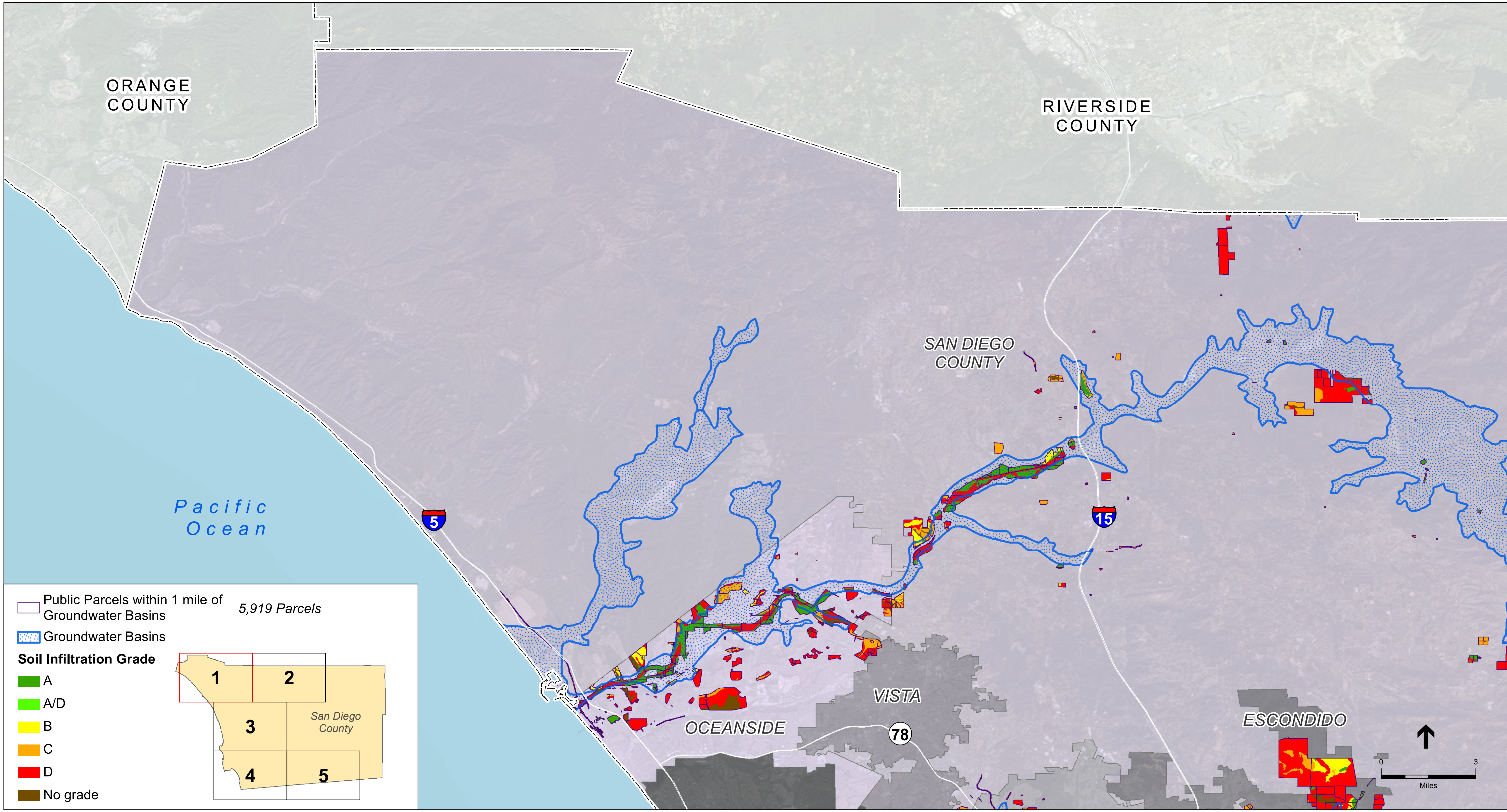
Figure 5-2c
Public Parcels with Major MS4 Oufalls
Located within 1/4 Mile of Green Space



SOURCE: ESRI, 2016; SanGIS, 2016

SWRP . 160618

Figure 5-2d
Public Parcels with Major MS4 Oufalls
Located within 1/4 Mile of Green Space

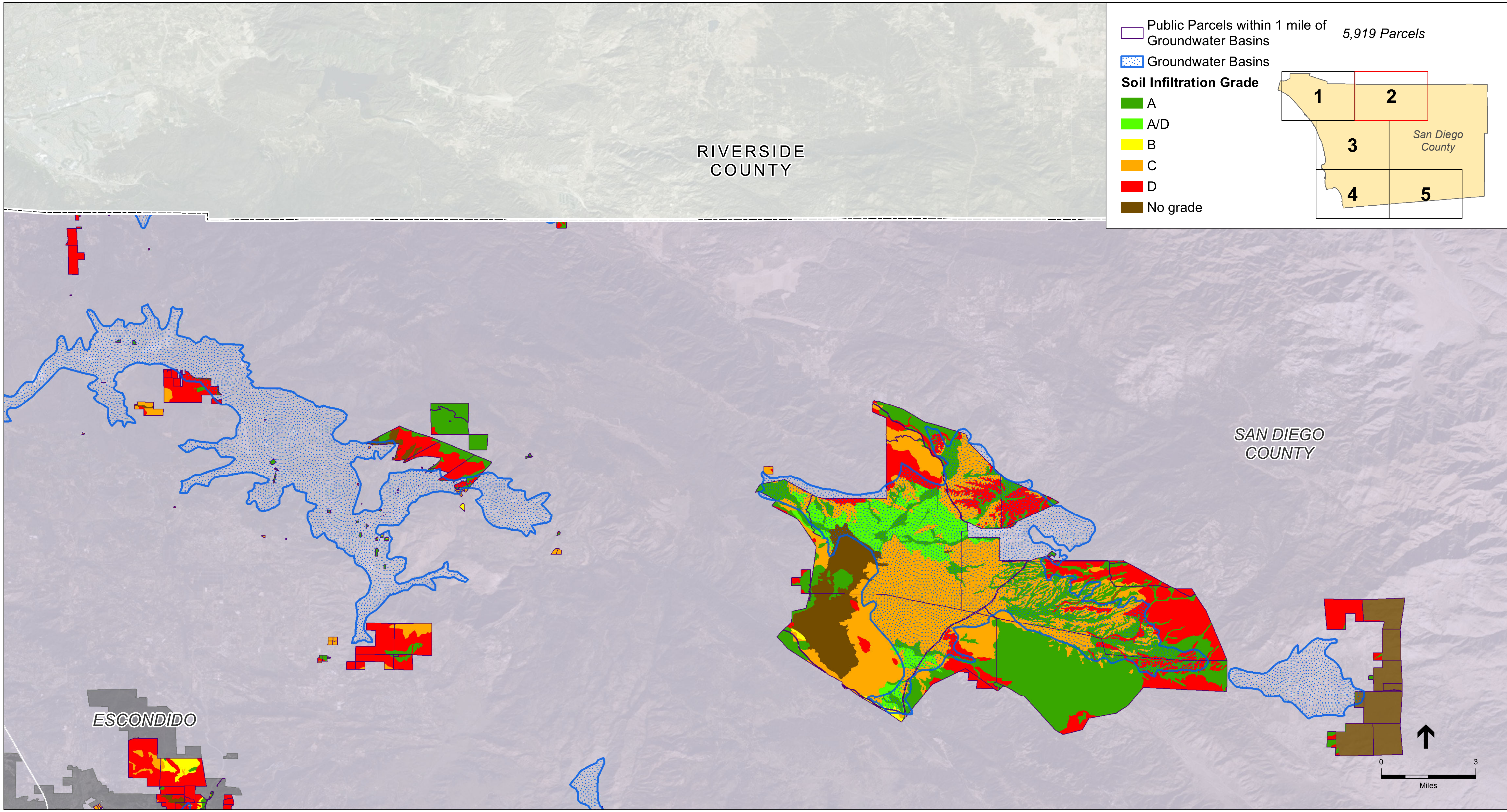


SOURCE: ESRI, 2016;SanGIS, 2016; NRCS, 2016

SWRP . 160618

Figure 5-3a

Public Parcels Within a Mile Of a Groundwater Basin

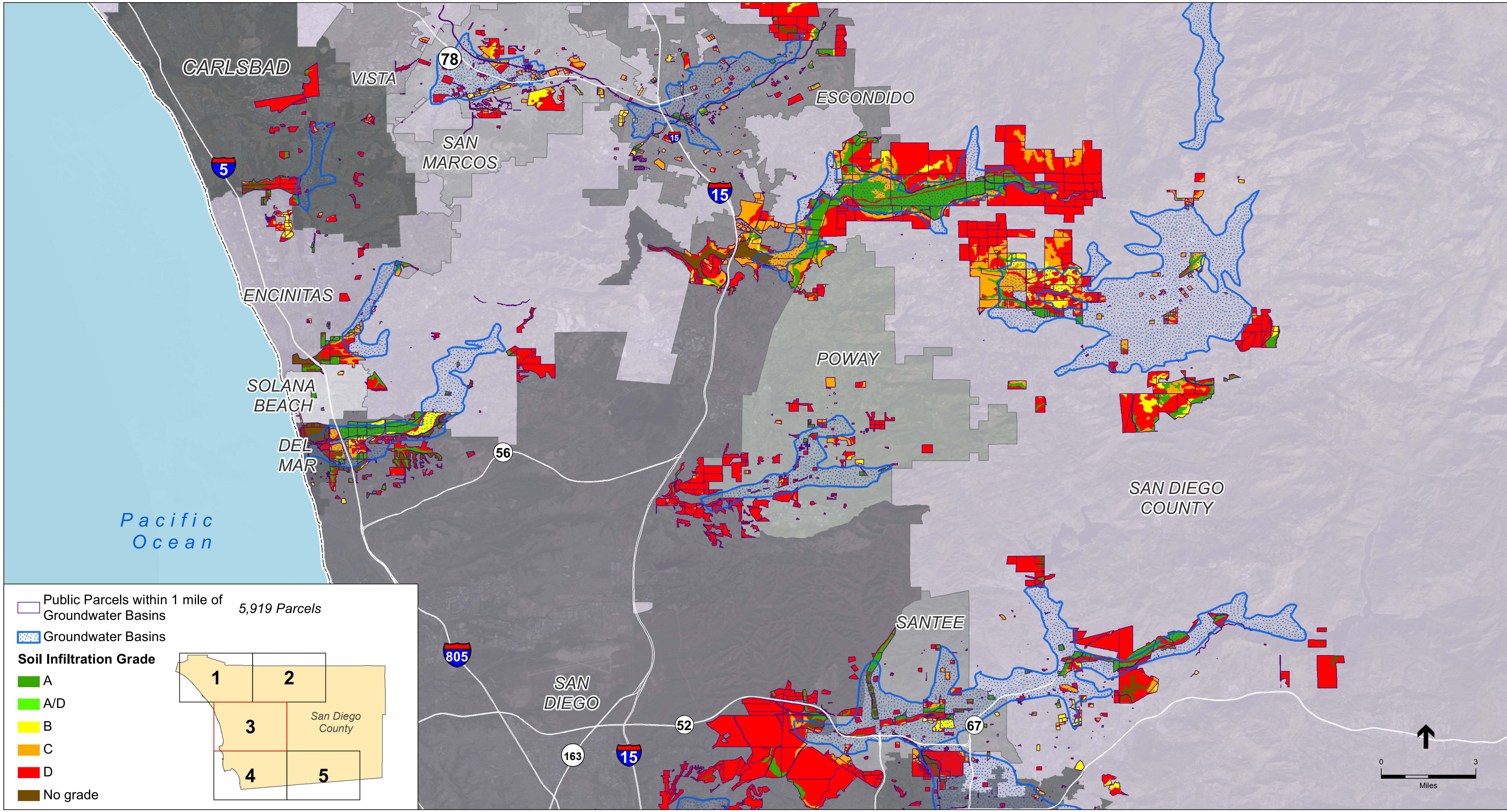


SOURCE: ESRI, 2016;SanGIS, 2016; NRCS, 2016

SWRP . 160618

Figure 5-3b

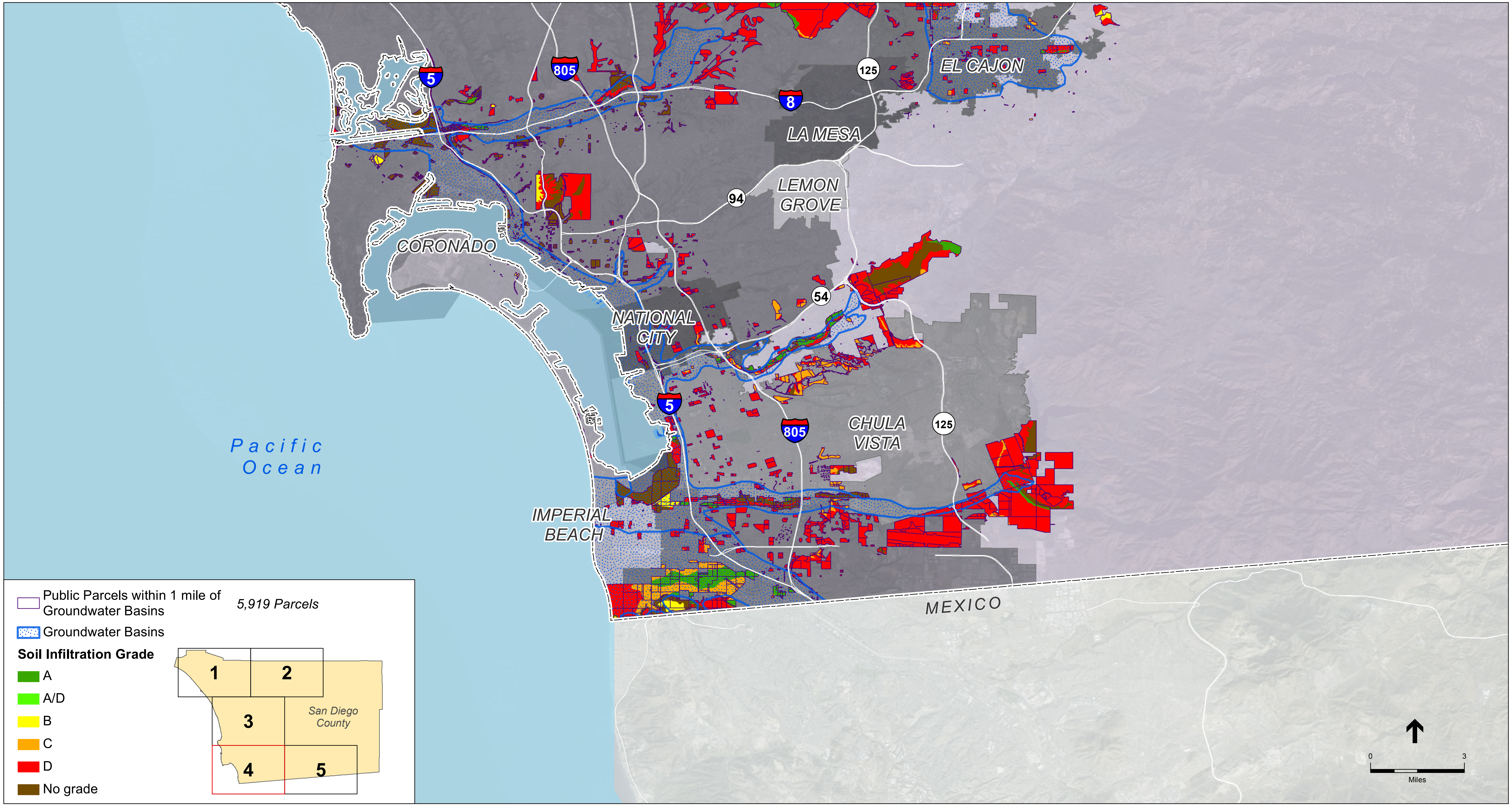
Public Parcels with Major MS4 Outfalls Located Within ¼ Mile of Green Space



SOURCE: ESRI, 2016;SanGIS, 2016; NRCS, 2016

SWRP . 160618

Figure 5-3c
Public Parcels Within a Mile Of a Groundwater Basin

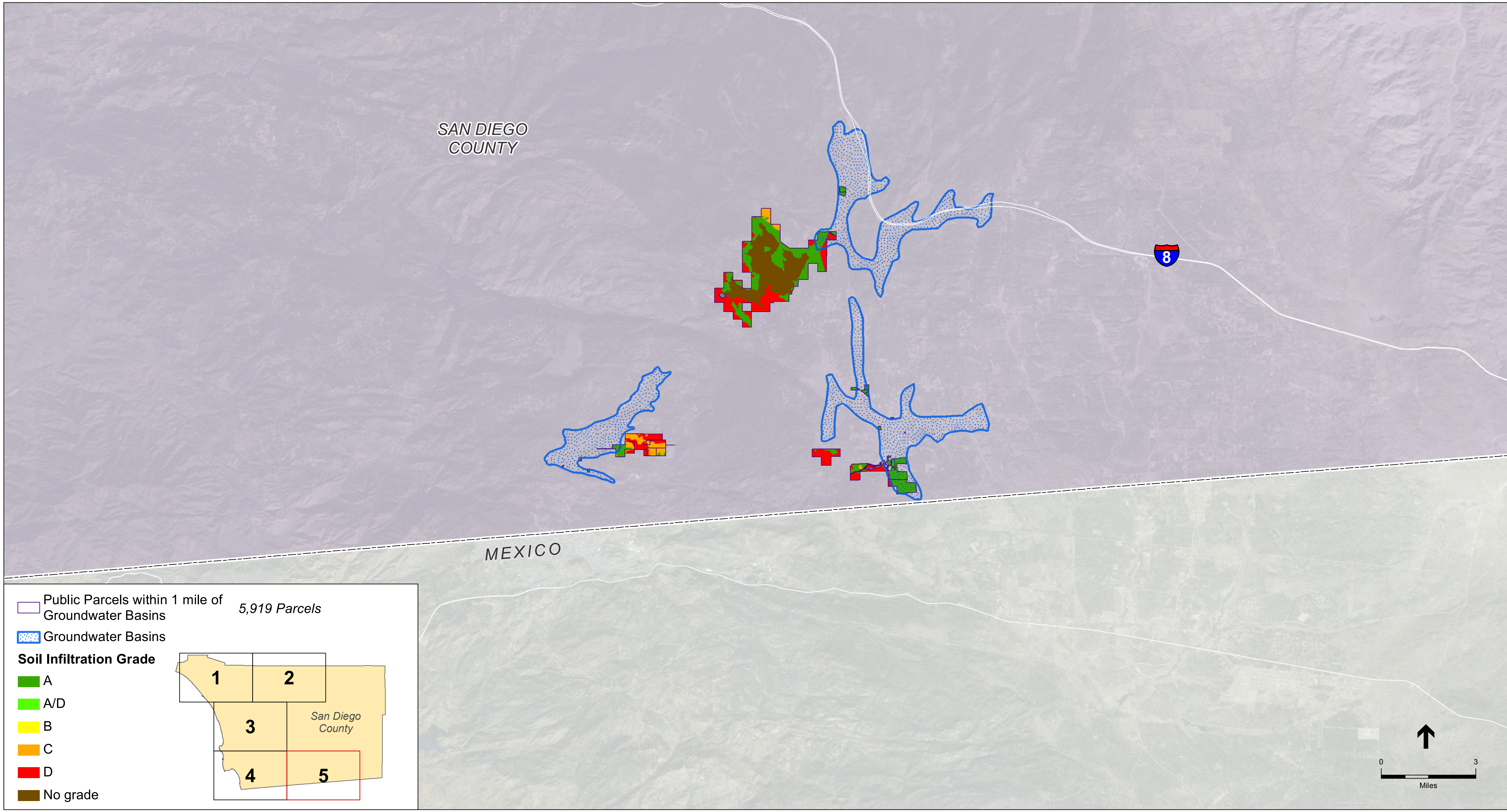


SOURCE: ESRI, 2016;SanGIS, 2016; NRCS, 2016

SWRP . 160618

Figure 5-3d

Public Parcels Within a Mile Of a Groundwater Basin

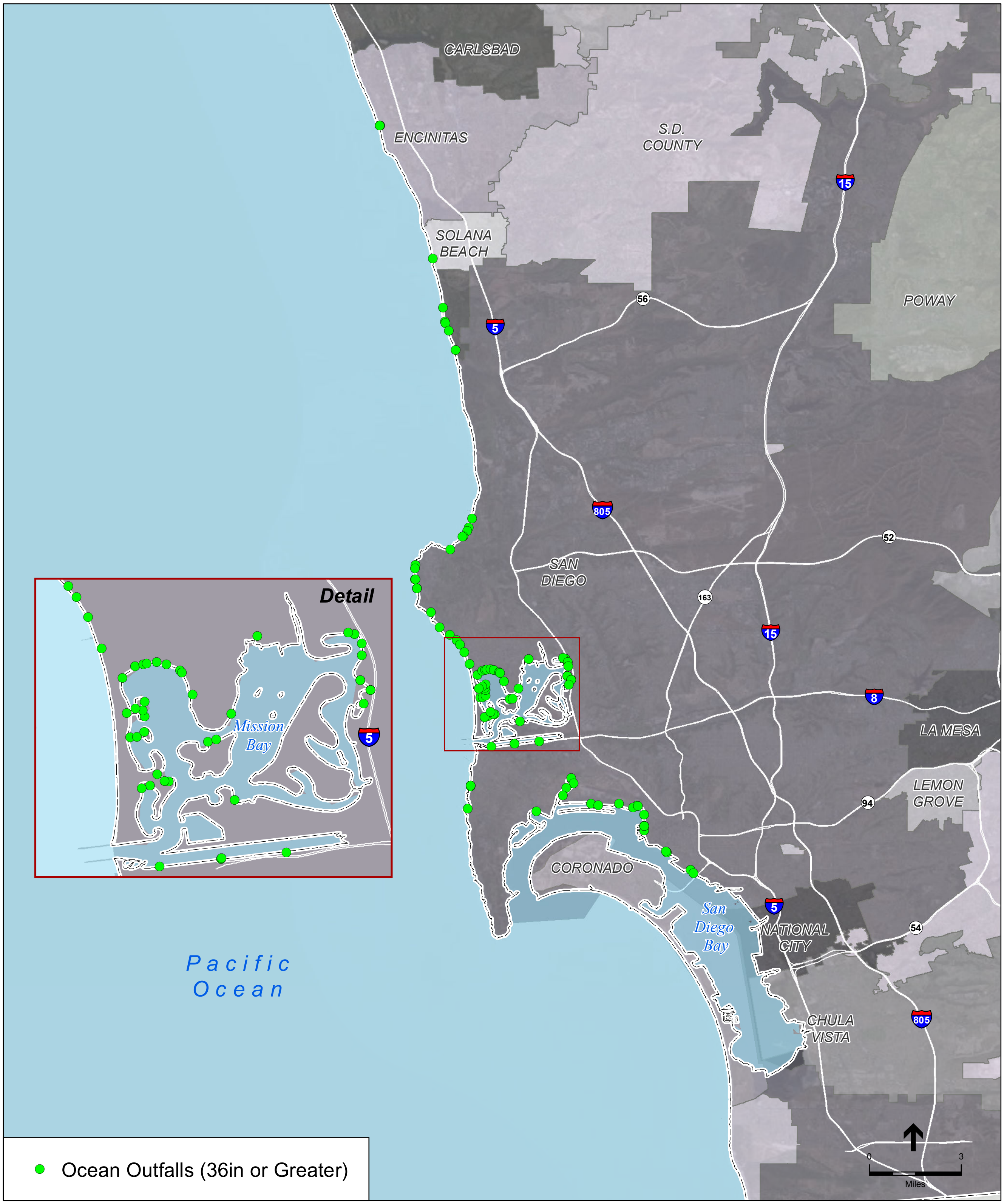


SOURCE: ESRI, 2016;SanGIS, 2016; NRCS, 2016

SWRP . 160618

Figure 5-3e

Public Parcels Within a Mile Of a Groundwater Basin

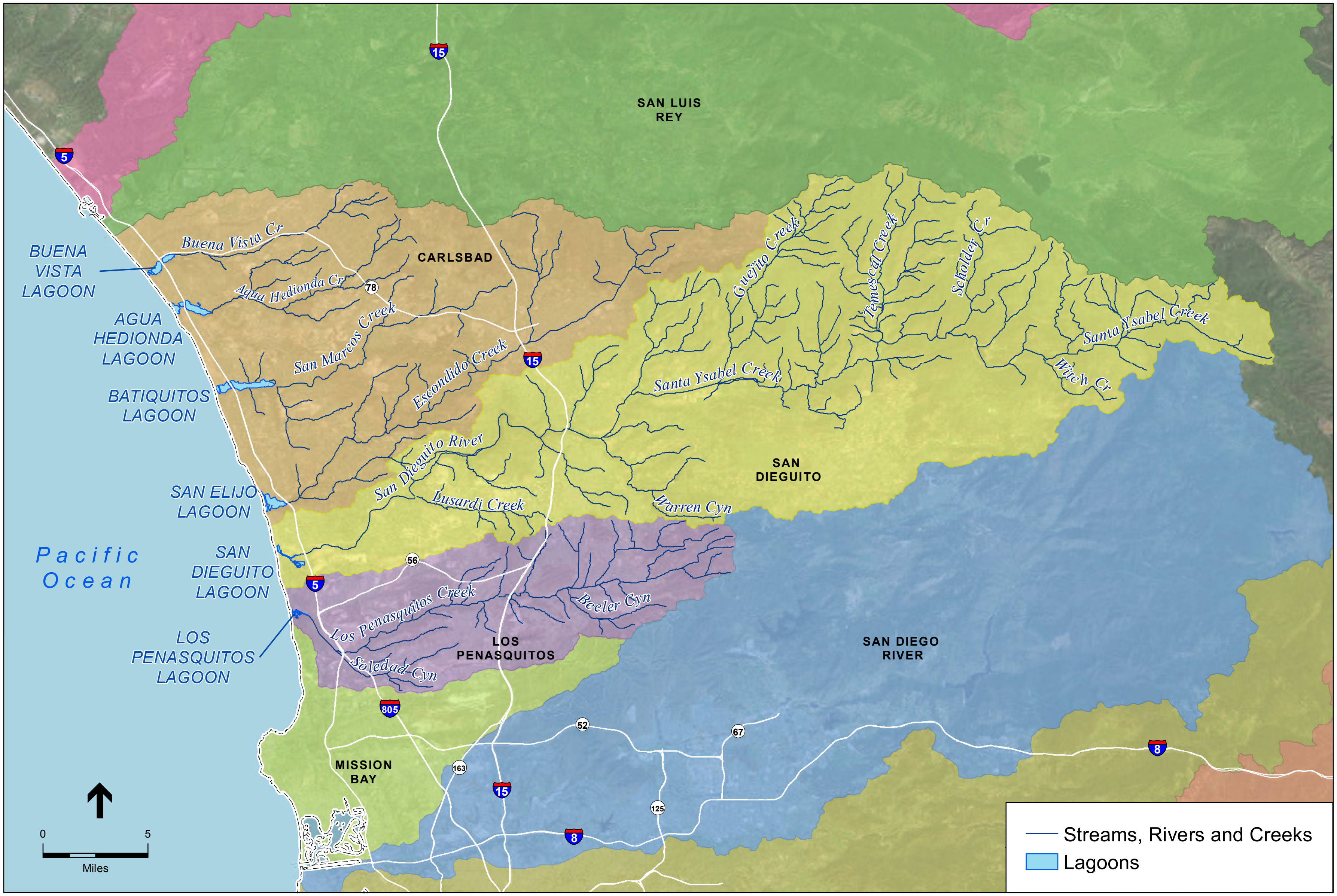


SOURCE: ESRI, 2016; SanGIS, 2016; IRWM, 2016

SWRP . 160618

Figure 5-4

Major MS4 Outfalls to the Ocean



SOURCE: ESRI, 2016; SanGIS, 2016

SWRP . 160618

Figure 5-5

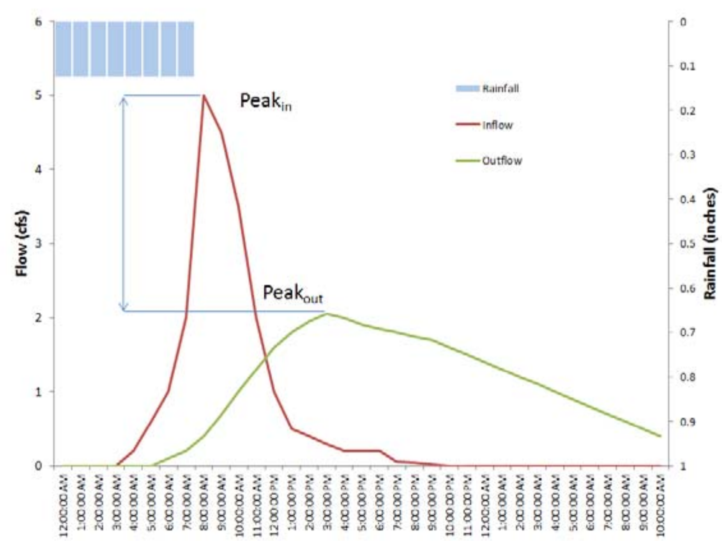
Creeks Systems with Lagoon Outlets

Flood Management Benefit Worksheet

FM-2: Estimates of the reductions of storm water runoff peak flow and peak flow duration resulting in reductions in flood risk.

- **Metric Reporting Units**: Report reductions in percent of peak flow for 25-, 50- and 100-year storm frequency.
- **Key Steps in Determining Metric:**
  - *Project Outflow Peak Flows:* The percent reduction of peak flows will depend on project type, configuration, soil infiltration rates and design capacity. The percent reduction should be determined comparing the pre and post-project implementation peak flows for the 25-, 50- and 100-year storm events using applicable hydraulic and hydrology models. Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of the checklist submittal. These guidelines are provided for greater regional consistency, but are not required.
- **Guidelines and References for Calculating Metric:**
  - County of San Diego Precipitation Database: http://www.projectcleanwater.org/download/rainfall-data/
  - County of San Diego Evapotranspiration Rates: http://wwwcimis.water.ca.gov/WSNReportCriteria.aspx
  - County of San Diego Hydrology Manual http://www.sandiegocounty.gov/content/sdc/dpw/flood/hydrologymanual.html
- **Example Metric Calculation**:

The example shown here represents the results of hydrology modeling to determine the pre- and post-peak flows that can be compared to determine the percent change.



Flood Management Benefit Worksheet

FM-1 & FM-3: Estimates of storm water runoff volume reductions through increased infiltration and evapotranspiration to reduce flood risk

- **Metric Reporting Units**: Report storm water runoff volume reductions in **gallons/year.**

- **Key Steps in Determining Metric:**
  - *BMP Rates of Infiltration and/or Evapotranspiration:* Determine the rates of infiltration and/or evapotranspiration whichever is applicable, that will result in a reduction of volume of storm water runoff that will results in the restoration of natural hydrology. The rates of this volume reduction factors will depend on BMP type, configuration, soil infiltration rates and design capacity. These factors can be determined using the design tools in the County of San Diego BMP Design Manual (BMP DM). Structural BMP shall meet the minimum standards as specified in the MS4 Permit and defined in the BMP DM for both pollutant removal and hydromodification as applicable.
  - *Volume Reduced*: Determine the volume reduced by the BMP based on the design of the BMP and the annual volume of runoff treated. The method of determining the annual volume will depend on the type of BMP and configuration, and the drainage area characteristics. Annual volume shall be based on estimated drainage areas runoff that is captured and infiltrated, filtered and/or lost to evapotranspiration using methods presented in the BMP Design Manual and using the continuous rainfall runoff SDHM 3.0 model used to size and design stormwater BMPs in accordance with the San Diego County Hydromodification Plan (HMP). The pro-version of SDHM 3.0 allows for alternate precipitation and evaporation time series input and is incorporated in the Western Washington Hydrologic Model version 4 (WWHM4). WWHM4 allows for time series, land-use basins, and BMP and hydraulic structure "elements" to be arranged and connected to represent the design or in-field setup. Note that while the model is referred to as the Washington model, San Diego County climatic, soil and land-use parameters are used in the SDHM 3.0. For methods and projects that may not be applicable for these tools, annual runoff volumes shall represent an average annual rainfall based on a timeline that covers dry, wet and average annual rainfall recorded near the project. Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of the checklist submittal. These guidelines are provided for greater regional consistency, but are not required.
  - *Annual Volume Reduction*: Determine the expected annual volume of storm water runoff reductions based on the results of the calculations and/or modeling guidelines that represent continuous modeling and/or average annual rainfall based on a timeline that covers dry, wet and average annual rainfall recorded near the project.

- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego Precipitation Database: http://www.projectcleanwater.org/download/rainfall-data/
  - SDHM 3.0 Model: http://www.clearcreeksolutions.com/SearchResults.asp?Cat=64
  - County of San Diego Evapotranspiration Rates: http://wwwcimis.water.ca.gov/WSNReportCriteria.aspx
  - Water Quality Equivalency Report: http://www.projectcleanwater.org/images/stories/Docs/WQE/Final%20Water%20Quality%20Equivalency%20Guidance%20for%20Region%209%20-%20December%202015.pdf

Flood Management Benefit Worksheet

Examples of Flood Management Plans

Watershed	Flood Plans
All Watersheds	http://www.sdirwmp.org/pdf/Integrated_Flood_Mgt_Planning.pdf
San Luis Rey	https://marinemitigation.msi.ucsb.edu/documents/wetland/sce_reports/san_dieguito_final-planting-plan_spec-cond_080506.pdf

Environmental Benefit Worksheet

E-2: Estimates of the reductions of storm water runoff peak flow and peak flow duration resulting in restoration of hydrology.

- **Metric Reporting Units**: Report reductions in percent of peak flow and peak flow duration for design storm event and 10-year storm event (if different than design storm).

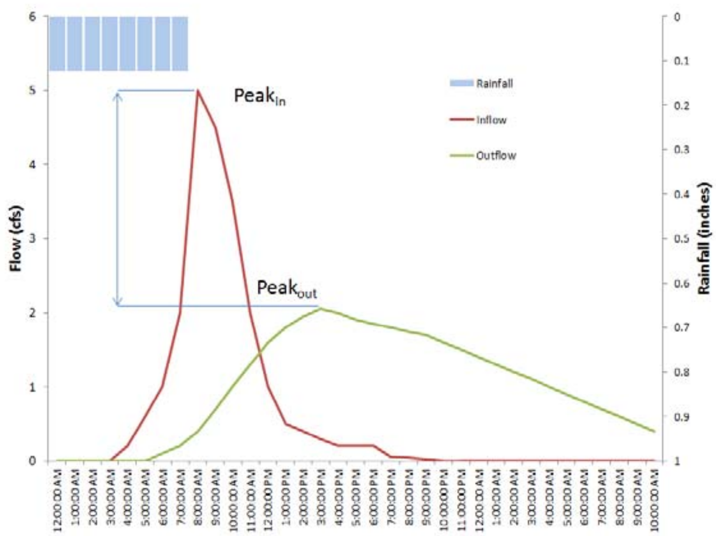
- **Key Steps in Determining Metric:**
  - *Project Outflow Peak Flows and Duration:* The percent reduction of peak flows and the duration of peak flows will depend on project type, configuration, soil infiltration rates and design capacity. These factors can be determined for storm water management measures using the design tools in the County of San Diego BMP Design Manual (BMP DM). Structural BMP shall meet the minimum standards as specified in the MS4 Permit and defined in the BMP DM for both pollutant removal and hydromodification as applicable. The percent reduction should be determined comparing the pre- and post-project implementation peak flows and flow durations for the design storm, 10-year storm event and/or the requirements of the HMP, where applicable. Peak flows shall be based on estimated drainage areas runoff that is captured and infiltrated, filtered and/or lost to evapotranspiration using methods presented in the BMP Design Manual and using the continuous rainfall runoff SDHM 3.0 model used to size and design stormwater BMPs in accordance with the San Diego County Hydromodification Plan (HMP). The pro-version of SDHM 3.0 allows for alternate precipitation and evaporation time series input and is incorporated in the Western Washington Hydrologic Model version 4 (WWHM4). WWHM4 allows for time series, land-use basins, and BMP and hydraulic structure "elements" to be arranged and connected to represent the design or in-field setup. Note that while the model is referred to as the Washington model, San Diego County climatic, soil and land-use parameters are used in the SDHM 3.0. Other methods and approaches for annual volume estimates are allowable, but shall be explained as part of the checklist submittal. These guidelines are provided for greater regional consistency, but are not required.

- **Guidelines and References for Calculating Metric:**
  - County of San Diego BMP Design Manual: http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/DevelopmentandConstruction/BMP_Design_Manual.html
  - County of San Diego Precipitation Database: http://www.projectcleanwater.org/download/rainfall-data/
  - SDHM 3.0 Model: http://www.clearcreeksolutions.com/SearchResults.asp?Cat=64
  - County of San Diego Evapotranspiration Rates: http://wwwcimis.water.ca.gov/WSNReportCriteria.aspx

- o Water Quality Equivalency Report: http://www.projectcleanwater.org/images/stories/Docs/WQE/Final%20Water%20Quality%20Equivalency%20Guidance%20for%20Region%209%20-%20December%202015.pdf

- **<u>Example Metric Calculation</u>**:

The example shown below represents the results of hydrology modeling to determine the pre- and post-peak flows that can be compared to determine the percent change.



Environmental Benefit Worksheet

E-4: Estimates of GHG Emissions

- **Metric Reporting Units**: Report GHG emissions reductions or carbon sink increase in **tonnes CO_2/year**.
- **Key Steps in Determining Metric:**
    - *Collect flux data from the field or from the literature*: Carbon aboveground biomass densities, soil sequestration rates (for wetlands), as well as emission rates of methane (for wetlands) need to be collated for the site or region.
    - *Determine change in carbon stocks*: The IPCC Wetlands Supplement to the 2006 accounting guidelines (IPCC 2014) identifies three carbon stocks important to calculating CO_2 removals: biomass (aboveground and belowground), dead organic matter (DOM), and soil carbon. To calculate CO_2 removals, each land cover type is assigned an aboveground biomass density (biomass stock density combined with carbon percentage of dry matter), a soil carbon sequestration factor, and a dead organic matter sequestration rate (mangrove habitat only). The soil carbon sequestration rate is often assumed to include belowground biomass.
    - *Determine change in methane emissions:* Methane emissions are produced when microorganisms in wet, poorly aerated soils, such as in freshwater marshes, decompose organic matter. However, high salinities reduce this methane production, so salt marsh is assumed to have negligible emissions (Poffenbarger et al. 2011). Methane has a 100-year Global Warming Potential (GWP) of 28-34 relative to CO_2, which means the effect of each tonne of CH_4 on the atmosphere in 100 years is 28—34 times greater than that of a tonne of CO_2 (IPCC 2014).
    - *Determine change in overall flux*: The IPCC 2006 GHG accounting framework is based on the following equation:

      Emissions=-Sequestration=Activity Data*Emissions Factor

      According to IPCC 2006, activity data are data on the magnitude of human activity resulting in GHG emissions and removals. For restoration projects, the relevant activity data are changes in land cover over time. Emissions factors are the rates of GHG emissions and removals associated with a unit of activity data. A removal is a negative emission.
- **Guidelines and References for Calculating Metric:**
    - IPCC Guidelines (2006): http://www.ipcc-nggip.iges.or.jp/public/2006gl/
    - IPCC Wetland Update (2014): http://www.ipcc-nggip.iges.or.jp/public/wetlands/

- **Example Metric Calculation**:

Carbon Reduction and Emission Facts for a Wetland in Los Angeles:

	Biomass Stock Factors			Carbon Reduction Factors		Methane Emission Factors	
Habitat type	Biomass Stock (tonnes dry matter/ha)	Notes	Aboveground carbon stock (tonnes C/ha)	C Removal Rate (tonnes C/ha/yr)	Notes	CH_4 Emission Rate (kg Ch_4/ha/yr)	Notes
Subtidal	0	Assumed unvegetated	0	0	Assumed unvegetated	0	Assumed unvegetated
Mudflat	0	Assumed unvegetated	0	0	Assumed unvegetated	0	Assumed unvegetated
Low salt marsh	0	Assumed unvegetated because cordgrass is uncommon in this system	0	0	Assumed unvegetated because cordgrass is uncommon in this system	0	Assumed unvegetated because cordgrass is uncommon in this system
Mid salt marsh	5.5		2.6	0.60		0	Assumed 0 for saline conditions
High salt marsh	5.5		2.6	0.60		0	Assumed 0 for saline conditions
Brackish marsh	5.5		2.6	0.60		193.7	
Salt pan	0.4	Assumed 7% cover	0.2	0.04	Assumed 7% cover	0	Assumed 0 for saline conditions
Transition zone	5.5	Assumed equal to other wetlands	2.6	0.60		0	Assumed 0 for saline conditions
Seasonal wetland	5.5		2.6	0.60		0	Assumed 0 for saline conditions
Upland	1.6	Assumed grassland for warm temperate – dry regions	0.8	0.09	Assumed value for non-rice annual cropland	0	Assumed dry

1. Aboveground Biomass

Biomass densities can be used to calculate aboveground carbon stock, using a habitat-specific carbon percentage of dry matter for all land covers. The carbon stock is then converted to CO_2 by multiplying by the ratio of molecular weights:

$$ST_A = CF * AB_A * A * \frac{MW_{CO_2}}{MW_C}$$

Where:

ST_A = Aboveground carbon stock (tonnes CO_2)

CF = Carbon fraction of dry matter

AB_A = Aboveground biomass, per area (tonnes dry matter/ha)

A = Habitat area (ha)

MW_{CO2} = Molecular weight of carbon dioxide (44)

MW_C = Molecular weight of carbon (12)

2. Soil Stock and Belowground Biomass

The change in soil carbon stock can be calculated by multiplying the restored habitat area by the soil sequestration rate (Table 11) and then subtracting the initial habitat area multiplied by the corresponding sequestration rate. This is then multiplied by the number of years since the habitat change occurred. The soil carbon stock is converted from tonnes C to CO_2 equivalents by multiplying by the ratio of molecular weights:

$$\Delta ST_B = (A_{restored} * SS_{restored} - A_{initial} * SS_{initial}) * T * \frac{MW_{CO_2}}{MW_C}$$

Where:

ΔST_B = Change in belowground carbon stock, per area (tonnes CO_2/yr)

$A_{restored}$ = Restored habitat area (ha)

$SS_{restored}$ = Soil sequestration rate for restored habitat type (tonnes C/ha/yr)

$A_{initial}$ = Initial habitat area (ha)

$SS_{initial}$ = Soil sequestration rate for initial habitat type (tonnes C/ha/yr)

T = Time since habitat was restored (yr)

3. Total Carbon Sequestration

The aboveground biomass, soil carbon stock, and DOM carbon stock can then be combined to calculate the cumulative CO_2 equivalents sequestered:

$$\Delta ST_{ALL} = \Delta ST_A + \Delta ST_B + \Delta ST_{DOM}$$

Where:

ΔST_{ALL} = Change in total carbon stock (tonnes CO_2)

4. Methane

To calculate CH_4 emissions, each land cover type is assigned a methane emission rate. The IPCC recommends using an emission factor of 0 for salinities greater than 18 ppt and a factor of 193.7 kg CH_4/ha/yr for lower salinities (Table 11, IPCC 2014).

$$\Delta E_{CH4} = \frac{tonnes\ CH4}{kg\ CH4} * (A_{restored} * ER_{restored} - A_{initial} * ER_{initial}) * T * \ GWP$$

Where:

ΔE_{CH4} = Change in methane emissions (tonnes CO_2)

$\frac{tonnes\ CH4}{kg\ CH4}$ = Unit conversion (0.001)

$ER_{restored}$ = Methane emission rate for the restored habitat (kg CH_4/ha/yr)

$ER_{initial}$ = Methane emission rate for the initial habitat (kg CH_4/ha/yr)

GWP = Global Warming Potential (28)

5. Total Flux

Total flux is calculated by combining the

$$\Delta GHG = \Delta ST_{ALL} - \Delta E_{CH4}$$

Where:

ΔGHG = Change in GHG sequestrations (positive) and emissions (negative), (tonnes CO_2)

Environmental Benefit Worksheet

Examples of Environmental Plans

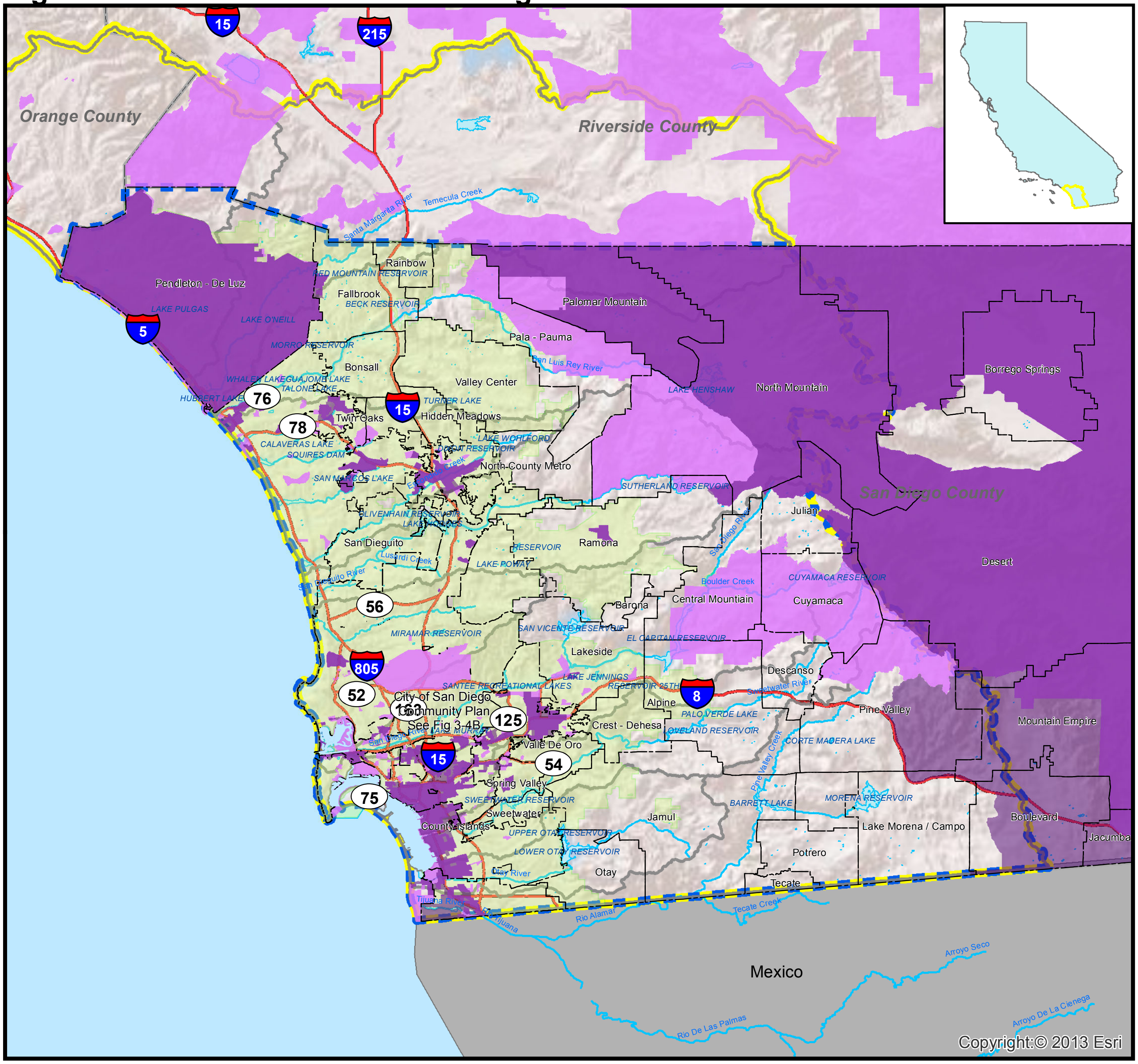
Watershed	Restoration	(source)
San Dieguito	San Dieguito Wetlands	https://marinemitigation.msi.ucsb.edu/documents/wetland/sce_reports/san_dieguito_final-planting-plan_spec-cond_080506.pdf
Los Peñasquitos	Los Peñasquitos Lagoon	http://scc.ca.gov/webmaster/ftp/pdf/sccbb/2012/1205/20120524Board3F_Los_Penasquitos_Lagoon.pdf
San Diego Bay	San Diego Bay Oysters	http://scc.ca.gov/webmaster/ftp/pdf/san_diego_bay_native_oyster_restoration_plan_final_reduced
San Diego Bay	City Heights	https://www.sandiego.gov/sites/default/files/final_city_hts_urban_greening_plan.pdf
San Diego Bay	Otay River	http://www.spl.usace.army.mil/Portals/17/docs/regulatory/Projects/SAMP/Riparian_Ecosystem_Restoration_Plan_for_the_Otay_Watershed.pdf
Tijuana	Tijuana Sewage Ponds	Sewage Ponds Restoration — Tijuana Estuary : TRNERR
Tijuana	Tijuana Estuary	Tijuana Estuary Tidal Restoration Program — Tijuana Estuary : TRNERR
Tijuana	Tijuana River	Napolitano Restoration Site — Tijuana Estuary : TRNERR

Community Benefit Worksheet

Examples of Community Plans

Watershed	Project	(source)
Santa Margarita	Rainbow Creek	http://www.sandiegocounty.gov/pds/docs/CP/Rainbow_CP.pdf
Carlsbad	Valley Center	http://www.sandiegocounty.gov/content/dam/sdc/pds/docs/CP/Valley_Center_CP.pdf
San Dieguito	San Dieguito	http://www.sandiegocounty.gov/content/dam/sdc/pds/docs/CP/San_Dieguito_Community_Plan.pdf
San Diego	Ramona	http://www.sandiegocounty.gov/pds/docs/CP/Ramona_CP.pdf

Figure 3-4A: Location of Disadvantaged Communities



Legend
- 2013 Disadvantaged Communities
- 2010 Disadvantaged Communities
- San Diego County Water Authority
- Community Planning Area
- Watershed
- San Diego IRWM Region
- Funding Area Boundary
- Ocean
- Waterbody
- County
- River
- Freeway

Community Planning Areas (CPA) Containing Disadvantaged Communities (DAC)

Alpine CPA***
Bostonia County/Lakeside CPA***
Central Mountain CPA*
City of Carlsbad***
City of Oceanside***
County Islands CPA
Cuyamaca CPA*
Descanso CPA***
Desert CPA
Fallbrook CPA***
Fallbrook CPA***
Julian CPA
Mountain Empire CPA**
North County Metro CPA*
City of Escondido
City of San Marcos
North Mountain County CPA
Pala-Pauma CPA*
Palomar Mountain CPA
Pendleton-DeLuz CPA
Pine Valley CPA
Ramona CPA***
Spring Valley CPA
Twin Oaks CPA***

**Areas meeting 2010 DAC criteria but not 2013 criteria*
***Areas meeting 2013 DAC criteria but not 2010 criteria*
****Areas contining small pockets of DAC*

N

0 3 6 12
Miles

RMC

Sources: San Diego Association of Governments (SANDAG) - GIS Data Warehouse, 2010 Census Data.
DAC defined as a block group with a median household income (MHI) of less than $48,706 (80% of the Statewide MHI).
\\rmcsd\RMCSD\Projects GIS\0188-003 SDIRWM Plan Update\AdminDraftMaps\060713_JD\Fig3-4A_Location of DACs 060713.mxd