Date: January 10, 2013

Recipient: Riverside County Flood Control and Water Conservation District

Project: Riverside County BMP Retrofit Study

Subject: Santa Ana Watershed BMP Retrofit Assessment – Technical Memorandum

1 Introduction

To support the Riverside County Flood Control District (District) and Co-permittees in complying with the MS4 permit for the Santa Ana Watershed (Order No. R8-2010-0033), Tetra Tech has developed the following Best Management Practice (BMP) Retrofit assessments for the Santa Ana Region.

- Identification and prioritization of possible parcel-based structural BMP retrofit opportunities
- Identification and prioritization of possible flood control facility BMP retrofit opportunities

The intent of this project was to identify a list of parcels and flood control facilities that are possible candidates for future BMP retrofits in the event that structural solutions are found to be necessary to address pollutant issues. Each opportunity was identified, evaluated, and ranked based on a suite of important characteristics, such as location in the watershed, soil types, and engineering feasibility.

This Retrofit Study is designed to support the permittee efforts in complying with adopted TMDL's, these efforts include but are not limited to Comprehensive Bacteria Reduction Plan (CBRP) and Comprehensive Nutrient Reduction Plan (CNRP) implementation. Both of these plans were submitted to the California Water Resources Control Board, and are at various stages of approval..

While not focused solely on bacteria and nutrients, this Retrofit Study identifies sites suitable for possible structural retrofits that can be coordinated with high priority areas identified in the CBRP and CNRP over time. Since a large number of potential sites have been defined over a range of municipalities and catchment areas, priority for assessing these potential sites can be reassigned as more details of the CBRP and CNRP implementation plans are developed.

Scoring criteria and the overall retrofit study approach to selecting and prioritizing sites was refined pursuant to discussions with the District and the Co-permittees. This document includes a discussion of the associated data summary review, site selection and prioritization criteria, watershed delineation criteria, BMP retrofit prioritization results, the various GIS maps used to support the discussion.

Parcel-based BMP retrofit prioritization results are located in Section 2 and flood control facility BMP retrofit prioritization results are located in Section 3.

2 Parcel-Based BMP Retrofit Assessment

At the direction of the District and Riverside County Santa Ana Region Co-permittees, the parcel-based BMP screening and prioritization process focused on public lands owned by the District, municipalities, and public school districts within the study area.

Since structural storm water BMPs involve identifying and setting aside land for storm water treatment, assessing opportunities on existing publicly-owned lands is important. Structural BMP treatment, especially in the case of centralized BMPs, can often be integrated into parks or playing fields without compromising function. Thus, opportunities for incorporating BMPs within recreation areas and other public open space areas were assessed as a first step in evaluating available possible BMP retrofit sites.

2.1 DATA SUMMARY

The site selection and prioritization process of parcel-based BMP retrofits involved GIS-based analyses using the best available reconnaissance level aerial imagery survey data. To support the retrofit site selection process, several geospatial and tabular data sets were used, including the following.

- Parcels data
- Slopes
- Soils (hydrologic soil groups)
- Land use
- Topography
- Regional watersheds
- Existing/proposed BMP locations
- School sites
- Park sites
- Aerial imagery
- Groundwater/soil contamination sites.

The majority of the data were obtained from the following sources.

- Riverside County Flood Control and Water Conservation District
- Riverside County Transportation & Land Management Agency (TMLA)
- Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO)
- California State Water Resources Control Board (SWRCB) Geotracker
- ESRI Maps and Data server.

Table 2-1 summarizes the data used in the site selection process.

Table 2-1 – Data Summary for Site Selection Process

Data Set	Type	Description	Source
Parcels	GIS Shapefile	Parcel boundaries and ownership from assessor's data	TMLA
Soils	GIS Shapefile	Spatial extents of hydrologic soils groups (HSG)	NRCS SSURGO
Topography	GIS Shapefile	Elevation DEM used to derive the slopes information	USGS
Watersheds (hydrography)	GIS Shapefile	Extent of NHD+ regional watersheds	NHD+
BMP Locations	GIS Shapefile	Existing BMP locations outlined in RBF 2005 Report	RCFCWCD
Schools	GIS Shapefile	School district property ownership extracted from parcel data	TMLA
Parks	GIS Shapefile	Active parks located within Riverside County	TMLA
Impervious Area	GIS Shapefile	NLCD Impervious 2006 data raster identifying percent imperviousness	NLCD
Waterbodies	GIS Shapefile	Streams, rivers, lakes and other waterbodies	RCFCWCD
Groundwater/soil contamination	Point Data	Past and current groundwater/soil remediation sites	California SWRCB Geotracker
Stephen's Kangaroo Rat (SKR) Area	GIS Shapefile	Stephen's Kangaroo Rat habitat and reserves areas	TMLA
Average Annual Precipitation	GIS Shapefile	Average Annual Precipitation (inches)	National Atlas

In addition to the data described above, Tetra Tech also referenced the 2005 *Riverside County Stormwater Program BMP Siting Study for the Santa Ana Permit Area*, prepared by RBF Consulting. This study used

a GIS-based methodology to identify potential retrofit sites that would treat drainage from sub-watersheds of 100 to 500 acres in size.

Drainage areas of this size require substantial land areas to provide adequate storm water treatment. The RBF study identified potential sites with sufficient land area for storm water treatment of the associated drainage area (see Figure 2-1). Additional sites were also identified by the Co-permittees. Tetra Tech used the information in the 2005 study[1] to the extent possible to incorporate the identified sites.

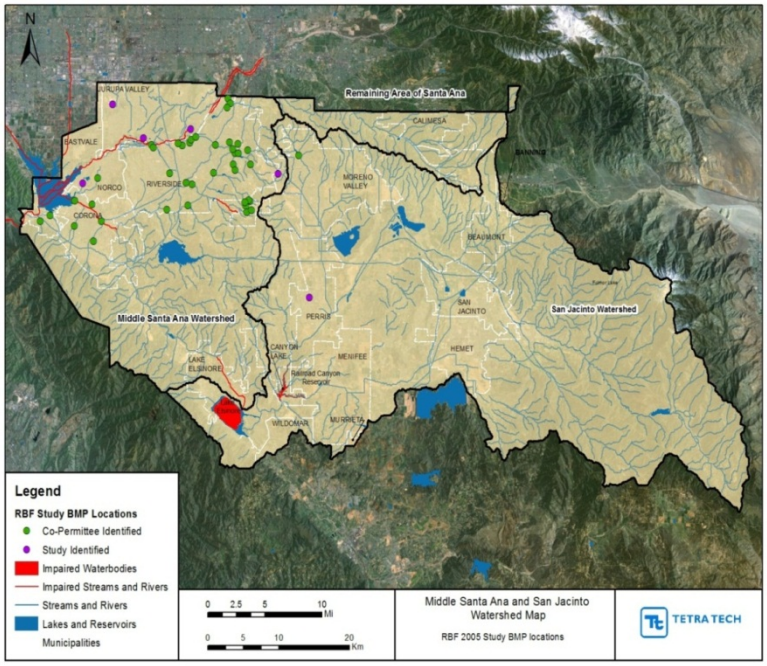

Figure 2-1 – BMP Locations Identified in 2005 Santa Ana Study

2.2 SITE SELECTION AND PRIORITIZATION CRITERIA

The site selection process identifies parcels potentially suitable for BMP implementation through the use of a primary screening to eliminate unsuitable parcels based on physical and jurisdictional characteristics. Parcels are then prioritized using a ranking system based on site characteristics to express the estimated feasibility for BMP implementation.

In the primary screening process, privately-owned parcels (as identified through owner name and taxability information in the Riverside County parcel database) and parcels with a slope greater than 10 percent were eliminated as possible sites. For this analysis, slope was determined on the basis of the digital elevation model (DEM).

The results of the primary screening provided a base list of 4,596 parcels potentially suitable for BMP implementation or retrofits. Evaluation of these parcels for potential BMP implementation is based on factors that gage the suitability of the site to implement an effective BMP. These factors were used to score or prioritize potential sites:

- **Infiltration capacity (Soil type):** The mapped hydrologic soils groups were used as an estimate for the infiltration rate and storage capacity of the soils. Sites where mapped hydrologic soils

[1] In a number of cases, the APN (parcel identification number) provided in the 2005 report was not associated with a current Riverside County APN and, as such, could not be located on the map.

groups have infiltration rates suitable for infiltration BMPs received higher priority as they allow for enhanced water quality treatment processes via infiltration. A geotechnical site investigation is encouraged to verify soil conditions.

- **Contaminated Sites:** Areas near contaminated sites received lower priority due to the potential for increased costs and complications during implementation.
- **Environmentally Sensitive Areas:** Areas designated as habitat or reserve areas for the Stephen's Kangaroo Rat were assigned lower scores to avoid BMP retrofits and potential associated mitigation issues in these sensitive areas.
- **Percent Parcel Imperviousness:** Parcels with a lower percentage of impervious area relative to the size of the parcel typically have more potential for centralized BMP implementation. Thus, parcels with lower percentages of impervious surface received a higher rank.
- **Parcel Size:** To determine if sufficient space is available to implement an appropriately sized BMP, the potentially available space on a parcel is evaluated based on the size of the parcel, the amount of existing impervious area, and the size of the contributing drainage area.
- **Proximity to the Storm Drainage Network:** Since centralized BMPs are especially effective in scenarios where runoff can be diverted from the existing drainage network for treatment, areas in close proximity to a storm drainage network received higher priority in the scoring matrix.
- **Depth to Groundwater Table:** Infiltration BMPs discharge treated stormwater to the soils underlying the BMP. Shallow groundwater tables can cause ponding to occur in the BMP and will subsequently adversely affect the function of the infiltration BMP. For infiltration BMP implementation, parcels with significant depth to groundwater tables are preferred.

The aforementioned factors were used in a scoring methodology to prioritize parcels for BMP implementation. Scoring methodology is based on a scale of 1 through 5 (with 5 being the highest score). Two sets of scoring thresholds are used to prioritize rural parcels (see Table 2-2) and urban parcels (Table 2-3separately. The distinction between rural and urban parcels is derived from the average imperviousness of the underlying NHD catchment (HUC-14).

Urban parcels are defined as HUC-14 catchments with an average imperviousness of 20% or greater based on NLCD coverage. Rural parcels are defined as HUC-14 catchments with an average imperviousness under 20%. The purpose of separate scoring thresholds for rural and urban parcels is to recognize the substantial spatial and infrastructure differences between the two settings.

For each parcel, these scores for each of the factors were added to result in a total score. Parcels with the highest total scores represent the best potential opportunities for a BMP retrofit or implementation. The scoring thresholds for rural and urban parcels are listed in Table 2-2 and Table 2-3, respectively.

Table 2-2 – Scoring Methodology for Prioritizing Rural Parcels for BMP Retrofits

Factor	Rural Area Scoring				
	5	4	3	2	1
HSG Soil Type	A	B	C	D	--
Proximity to contaminated soils (feet)	500+	300-500	250-300	100-250	<100
Proximity to SKR Habitat	Habitat outside parcel				Habitat within parcel
% Parcel Imperviousness	<5%	5-10%	10-15%	15-20%	>20%
Parcel Size (acres)	>100	50-100	25-50	5-25	<5

Factor	Rural Area Scoring				
	5	4	3	2	1
Proximity to storm drainage network (feet)	<100	100-250	250-500	500-1000	1000+
Proximity to surface water (feet)	<100 to impaired waterbody	<250 to all waterbodies (except impaired)	250-500 to all waterbodies	500-1000 to waterbodies	1000+ to all waterbodies
Depth to Ground water table (feet)			>20	15-20	< 15

Table 2-3 – Scoring Methodology for Prioritizing Urban Parcels for BMP Retrofits

Factor	Urbanized areas				
	5	4	3	2	1
HSG Soil Type	A,B	C	D		
Proximity to contaminated soils (feet)	500+	300-500	250-300	100-250	<100
Proximity to SKR Habitat	Habitat outside parcel				Habitat within parcel
% Parcel Imperviousness	<30%	30-40	40-50	50-60	60+
Parcel Size (acres)	>10	7 to 10	5 to 7	3 to 5	under 3
Proximity to storm drainage network (feet)	<50	50-100	100-200	200-300	300+
Proximity to surface water (ft)	<100 to impaired waterbody	<250 to all waterbodies (except impaired)	250-500 to all waterbodies	500-1000 to waterbodies	1000+ to all waterbodies
Depth to Ground water table (ft)			>20	15-20	< 15

2.3 PRIORITIZATION RESULTS

Results of the prioritization process for both rural and urban parcels are summarized in this section.

- Figure 2-2 depicts top rural parcel opportunities for possible BMP implementation and retrofit
- Table 2-4 summarizes information regarding the top rural parcel opportunities
- Figure 2-3 depicts top urban parcel opportunities for possible BMP implementation and retrofit
- Table 2-5 summarizes information regarding the top urban parcel opportunities

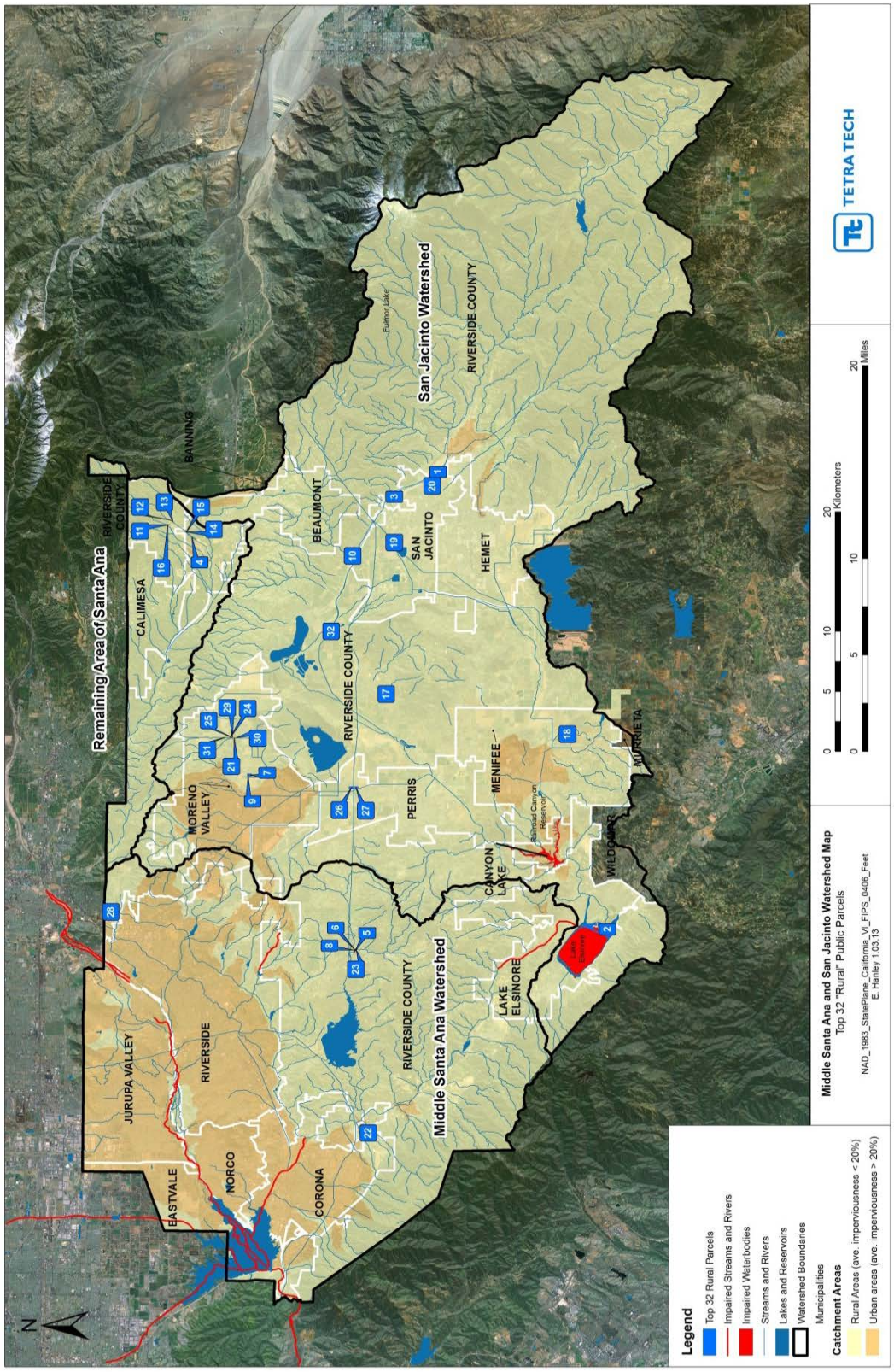

Figure 2-2 – Top Rural Parcel Opportunities for possible BMP Implementation and Retrofit

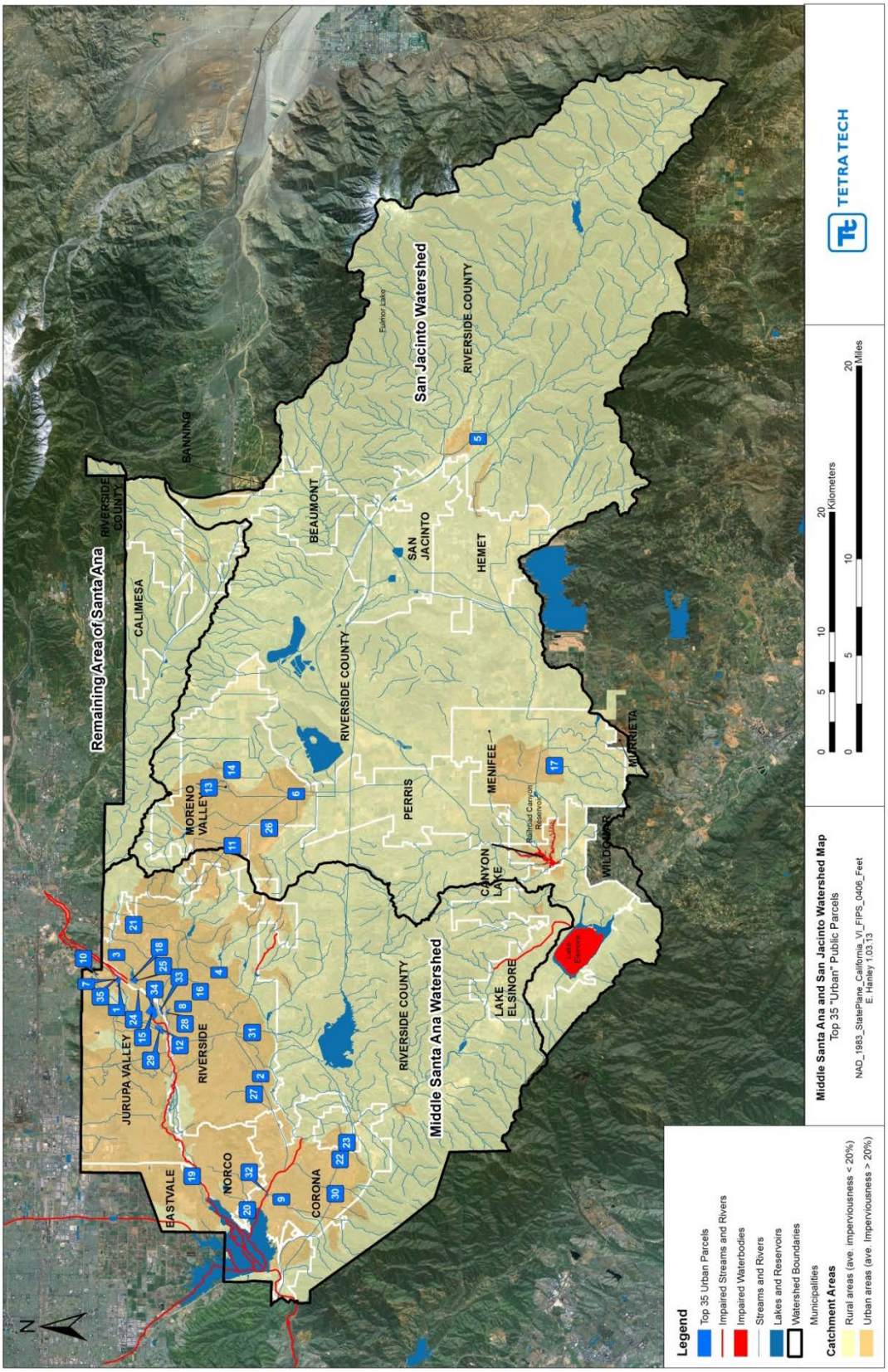

Figure 2-3 – Top Urban Parcel Opportunities for possible BMP Implementation and Retrofit

Table 2-4 – Top Rural possible BMP Implementation and Retrofit Opportunities

Rural Parcel Rank	Overall Parcel Rank	Watershed	APN	Municipality	Owner Name	Total Score
1	18	San Jacinto	547130016	San Jacinto	Riverside County Flood Control & Water Conservation District (RCFCWCD)	35
2	34	San Jacinto	381020005	Lake Elsinore	City Of Lake Elsinore	34
3	35	San Jacinto	433070045	San Jacinto	RCFCWCD	34
4	61	Remaining Area	400250009	Beaumont	City Of Beaumont	34
5	64	Middle Santa Ana	285190015	County	RCFCWCD	33
6	73	Middle Santa Ana	285190019	County	RCFCWCD	33
7	99	San Jacinto	486280026	Moreno Valley	County Of Riverside	33
8	113	Middle Santa Ana	285190020	County	RCFCWCD	33
9	117	San Jacinto	486280025	Moreno Valley	County Of Riverside	33
10	135	San Jacinto	430110017	County	County Of Riverside	33
11	136	Remaining Area	403252024	County	RCFCWCD	33
12	137	Remaining Area	403070012	County	RCFCWCD	33
13	138	Remaining Area	403070014	County	RCFCWCD	33
14	139	Remaining Area	404010011	Beaumont	RCFCWCD	33
15	140	Remaining Area	404010013	Beaumont	City Of Beaumont	33
16	141	Remaining Area	403262012	County	RCFCWCD	33
17	147	San Jacinto	427290021	County	RCFCWCD	32
18	148	San Jacinto	364070026	Menifee	Valley Wide Recreation & Park District	32
19	150	San Jacinto	436080010	San Jacinto	City Of San Jacinto	32
20	153	San Jacinto	433150024	San Jacinto	RCFCWCD	32
21	158	San Jacinto	478362003	Moreno Valley	RCFCWCD	32
22	168	Middle Santa Ana	279190046	Corona	Riverside County Transportation Commission	32
23	175	Middle Santa Ana	285200008	County	RCFCWCD	32
24	181	San Jacinto	478412035	Moreno Valley	RCFCWCD	32
25	191	San Jacinto	478412036	Moreno Valley	RCFCWCD	32
26	192	San Jacinto	303160006	Perris	City Of Perris	32
27	211	San Jacinto	303170010	Perris	City Of Perris	32
28	215	Middle Santa Ana	255070013	County	County of Riverside Redevelopment Agency	32
29	224	San Jacinto	478412037	Moreno Valley	Moreno Valley Community Services District	32
30	225	San Jacinto	478353003	Moreno Valley	RCFCWCD	32
31	242	San Jacinto	478400045	Moreno Valley	RCFCWCD	32
32	251	San Jacinto	425060010	County	County Of Riverside	32
33	252	Remaining Area	404010014	Beaumont	City Of Beaumont	32
34	253	Remaining Area	403070013	County	RCFCWCD	32
35	254	San Jacinto	300110014	Perris	RCFCWCD	32

Table 2-5 – Top Urban possible BMP Implementation and Retrofit Opportunities

Urban Parcel Rank	Overall Parcel Rank	Watershed	APN	Municipality	Owner Name	Total Score
1	1	Middle Santa Ana	178290006	Riverside	County Of Riverside	37
2	2	Middle Santa Ana	138030026	Riverside	Riverside County Transportation Commission	37
3	3	Middle Santa Ana	206070002	Riverside	City Of Riverside	37
4	4	Middle Santa Ana	241170001	Riverside	RCFCWCD	37
5	5	San Jacinto	552150042	County	Valley Wide Recreation & Park District	36
6	6	San Jacinto	312130010	Moreno Valley	Moreno Valley Community Services District	36
7	7	Middle Santa Ana	178290013	Jurupa Valley	County Of Riverside	36
8	8	Middle Santa Ana	187130004	Riverside	City Of Riverside	36
9	9	Middle Santa Ana	119190019	Corona	City Of Corona	36
10	10	Middle Santa Ana	175190029	Jurupa Valley	County Of Riverside	36
11	11	San Jacinto	291250005	Moreno Valley	City Of Moreno Valley	36
12	12	Middle Santa Ana	186270002	Jurupa Valley	County Of Riverside	36
13	13	San Jacinto	487021008	Moreno Valley	RCFCWCD	36
14	14	San Jacinto	487470013	Moreno Valley	City Of Moreno Valley	36
15	15	Middle Santa Ana	181220005	Jurupa Valley	Riverside County Regional Park & Open Space District	36
16	16	Middle Santa Ana	229070001	Riverside	City Of Riverside	36
17	17	San Jacinto	360050014	Menifee	City Of Menifee	35
18	19	Middle Santa Ana	207060012	Riverside	City Of Riverside	35
19	20	Middle Santa Ana	152050040	Eastvale	Jurupa Community Services District	35
20	21	Middle Santa Ana	121392006	Corona	City Of Corona	35
21	22	Middle Santa Ana	249130017	Riverside	Riverside County Transportation Commission	35
22	23	Middle Santa Ana	120130039	Corona	City Of Corona	35
23	24	Middle Santa Ana	277210008	County	County Of Riverside	35
24	25	Middle Santa Ana	179330008	Riverside	RCFCWCD	35
25	26	Middle Santa Ana	207050002	Riverside	City Of Riverside	35
26	27	San Jacinto	294090003	Moreno Valley	Moreno Valley Community Services District	35
27	28	Middle Santa Ana	142100015	Riverside	City Of Riverside	35
28	29	Middle Santa Ana	187130002	Riverside	County Of Riverside	35
29	30	Middle Santa Ana	186240003	Jurupa Valley	County Of Riverside	35
30	31	Middle Santa Ana	114070004	Corona	City Of Corona	35
31	32	Middle Santa Ana	239160001	Riverside	City Of Riverside	35
32	33	Middle Santa Ana	119190025	Corona	City of Corona Redevelopment Agency	35

Nine of the sites identified in the aforementioned 2005 *BMP Siting Study for the Santa Ana Permit Area* and associated Co-permittee BMP identification effort coincided with parcels identified in the primary screening detailed above. These parcels are listed in Table 2-6 and depicted in Figure 2-4. Eight out of the nine parcels had a total score of 31 or higher, with the lowest ranked parcel ranked 331 out of 4596 parcels.

Table 2-6 – Parcels Identified in 2005 BMP Siting Study

Rank	Watershed	APN	Municipality	Owner Name	Urban / Rural	Total Score	Source
15*	Middle Santa Ana	181220005	Jurupa Valley	Riverside County Regional Park & Open Space District	Urban	36	Study
29*	Middle Santa Ana	187130002	Riverside	County Of Riverside	Urban	35	Co-Permittee
55	Middle Santa Ana	120020002	Corona	City Of Corona	Urban	34	Co-Permittee
56	Middle Santa Ana	221220007	Riverside	City Of Riverside	Urban	34	Co-Permittee
80	Middle Santa Ana	246060010	Riverside	City Of Riverside	Urban	33	Co-Permittee
183	Middle Santa Ana	129341006	Norco	City Of Norco	Urban	32	Study
295	Middle Santa Ana	291440030	Riverside	RCFCWCD	Urban	31	Study
331	Middle Santa Ana	206070003	Riverside	City Of Riverside	Urban	31	Co-Permittee
2901	San Jacinto	311100023	Perris	RCFCWCD	Rural	24	Co-Study

*indicates 2005 study site that falls within the top 40 urban parcels.

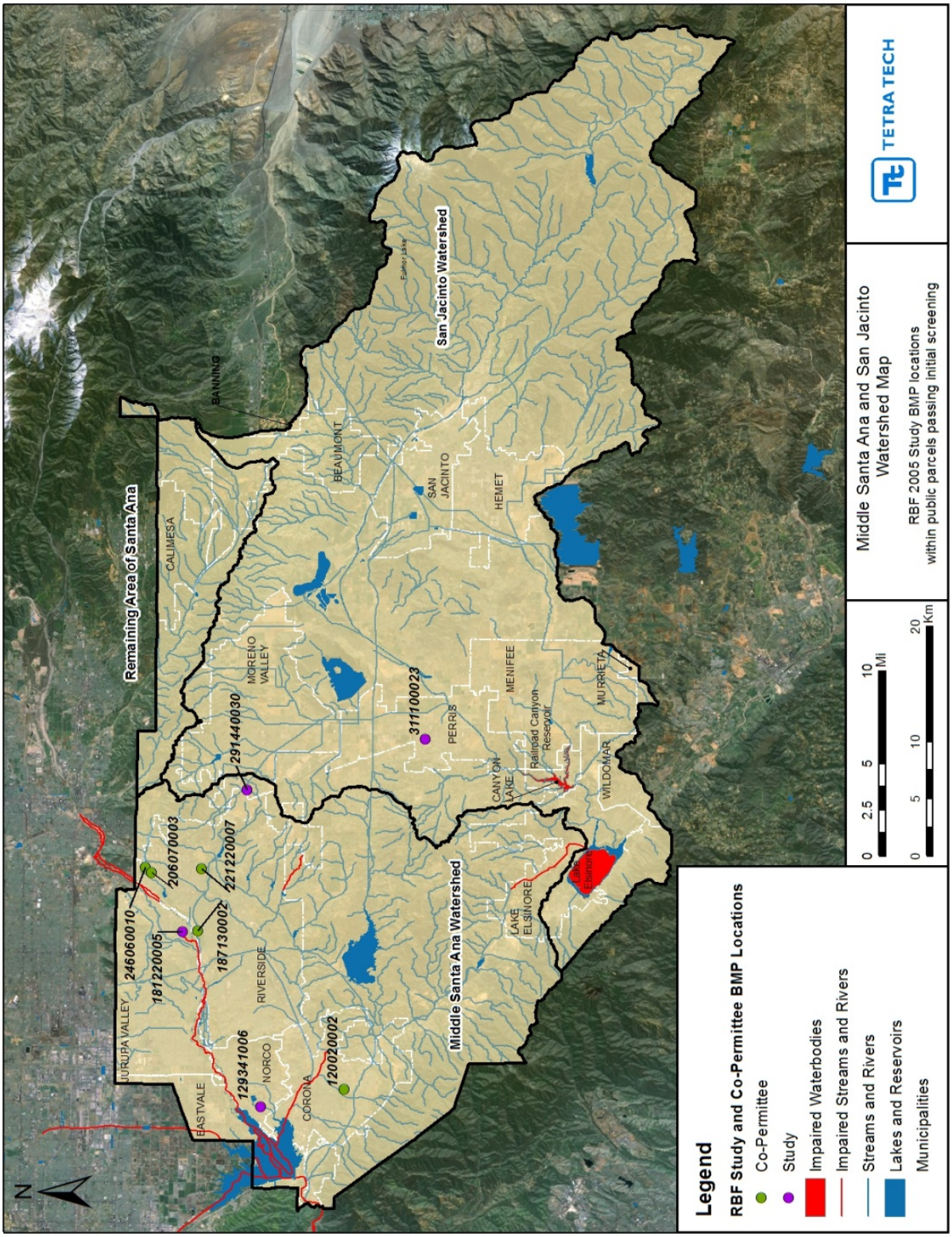

Figure 2-4 – Parcels Identified in 2005 Study (RBF and Co-permittee) as well as Parcel-Based Screening

3 Flood Control Facility BMP Retrofit Assessment

In addition to evaluating publicly owned parcels, existing flood control facilities were also investigated and prioritized for potential retrofitting opportunities. Such prioritization would focus on the feasibility of converting existing flood control facilities into dual-purpose structural BMPs to provide for future water quality treatment and aid in Total Maximum Daily Load (TMDL) compliance, in addition to maintaining the existing flood control peak flow attenuation function.

A preliminary screening identified 111 flood control facilities that could be considered for BMP retrofit. Locations of existing flood control facilities within the study area of the Santa Ana Region are illustrated in Figure 3-1.

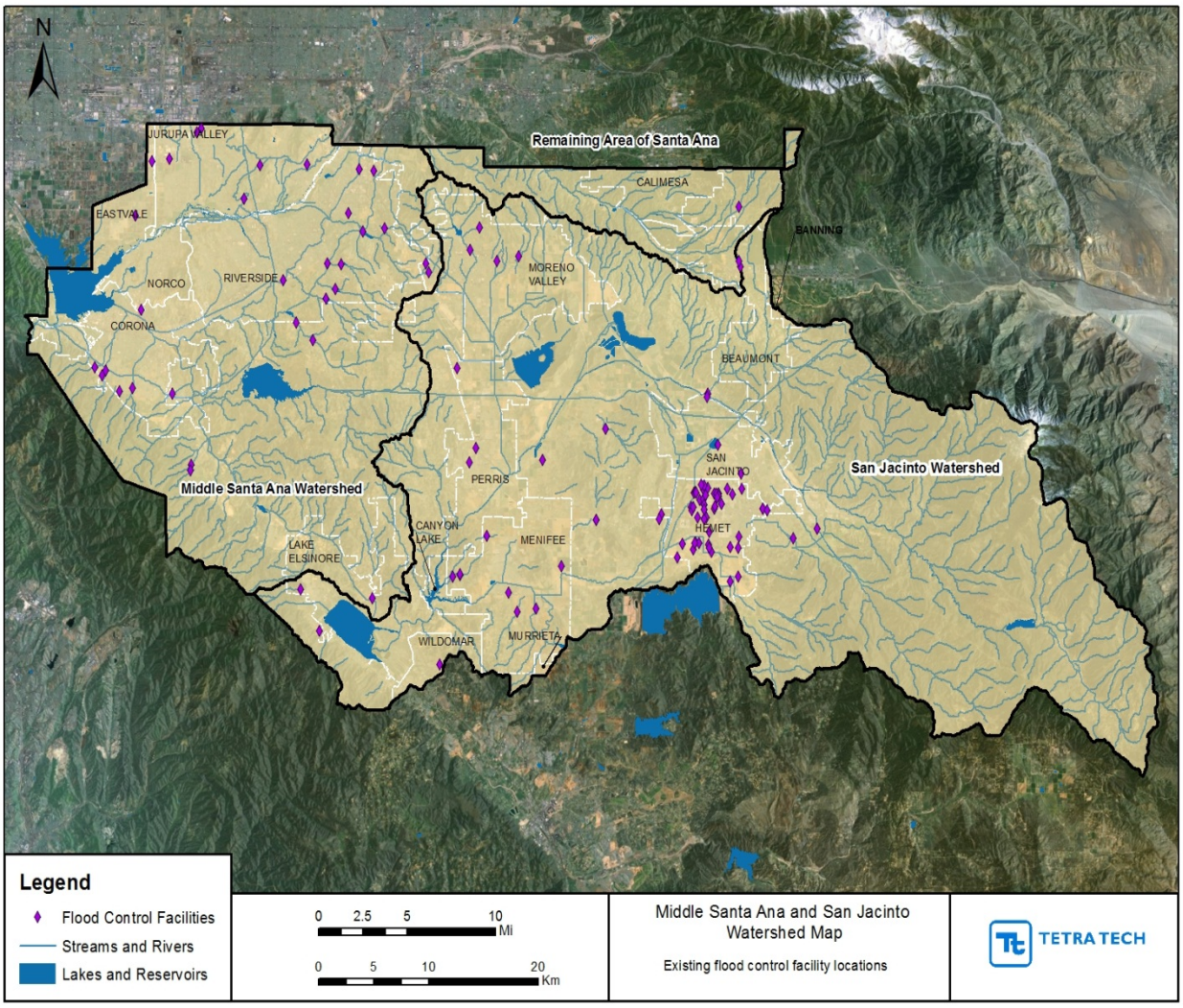

Figure 3-1 – Existing Flood Control Facility Locations

Based on discussions with the District, each of the existing flood control facilities is assumed to have the following characteristics.

1. Designed as a dry detention basin (no wet pond feature)
2. Constructed with an earthen basin bottom (no concrete lining of the basin bottom)
3. Only incidental infiltration provided (not currently designed as an infiltration facility)
4. Located on public land or have access via a maintenance easement

3.1 DATA SUMMARY

Information regarding existing flood control facilities in the region was provided by the District. Since specific design information was not available for each individual facility, it was necessary to evaluate the sites' potential for retrofit, based on the characteristics of the contributing drainage areas. Drainage area characteristics include the following.

- Contributing drainage area
- Percent imperviousness
- Precipitation zones
- Soils

Data sources for the drainage area characteristics are listed in Table 2-1.

3.2 WATERSHED DELINEATION METHODOLOGY

Drainage areas for the existing flood control facilities were delineated using arc-hydro GIS applications. Systematic delineations were derived from surface flow conditions based on Digital Elevation Model (DEM) topographic data with 3 meter resolution and watershed delineations provided by National Hydrography Dataset (NHD). Drainage areas to existing flood control facilities range from 0.22 acres to 168,500 acres.

In the event that drainage areas fell within the drainage areas of other flood control facilities, the drainage area of each flood control facility was considered in its entirety. In other words, the entire drainage area of a flood control facility was delineated despite the presence of other flood control facilities in the contributing watershed (no fragmentation of watersheds). The identification of these instances is relevant for prioritization efforts to avoid duplicative efforts in water quality treatment.

A facility treating a larger drainage area would generally be prioritized over the facility which treats a fraction of the same drainage area. Treatment of the entire drainage area by one facility would negate the need to retrofit other facilities within the same drainage area.

Contributing drainage areas to the existing flood control facilities are illustrated in Figure 3-2. As shown, a number of drainage areas overlap. Drainage areas with no interfering flood control facilities are highlighted in green. Flood control facility drainage areas containing drainage areas of other facilities are highlighted in red. The blue drainage areas indicate drainage areas of flood control facilities that fall within the drainage area of another facility.

The contributing drainage area metrics, pertinent to the Santa Ana Region, are illustrated in the following figures. Existing soils conditions are presented in Figure 3-3. Land use characteristics and impervious cover characteristics, with respect to the flood control facility contributing drainage areas, are presented in Figure 3-4 and Figure 3-5, respectively. Average annual precipitation amounts for the Santa Ana Region are illustrated in Figure 3-6.

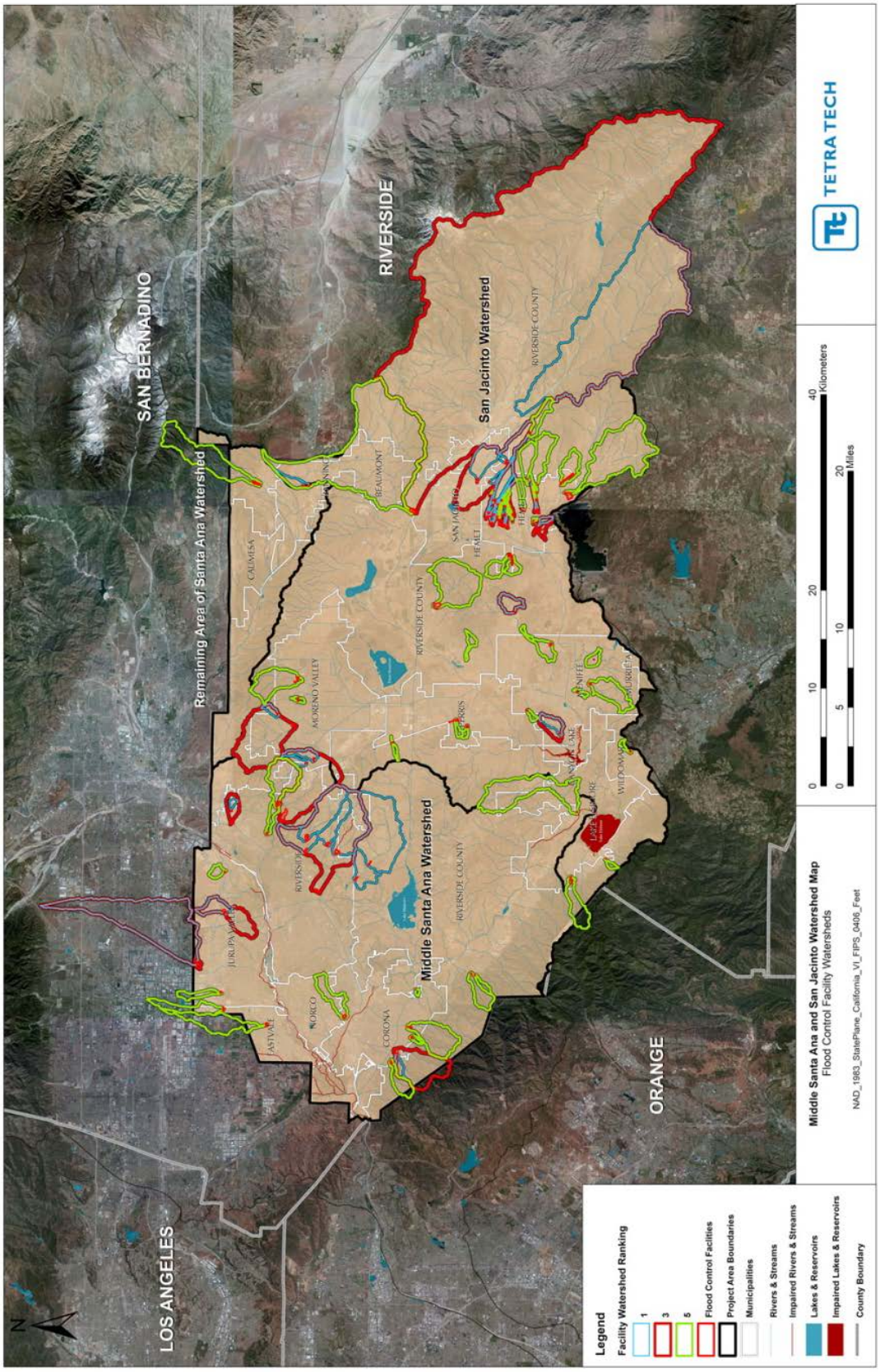

Figure 3-2 – Existing Flood Control Facility Watershed Delineations

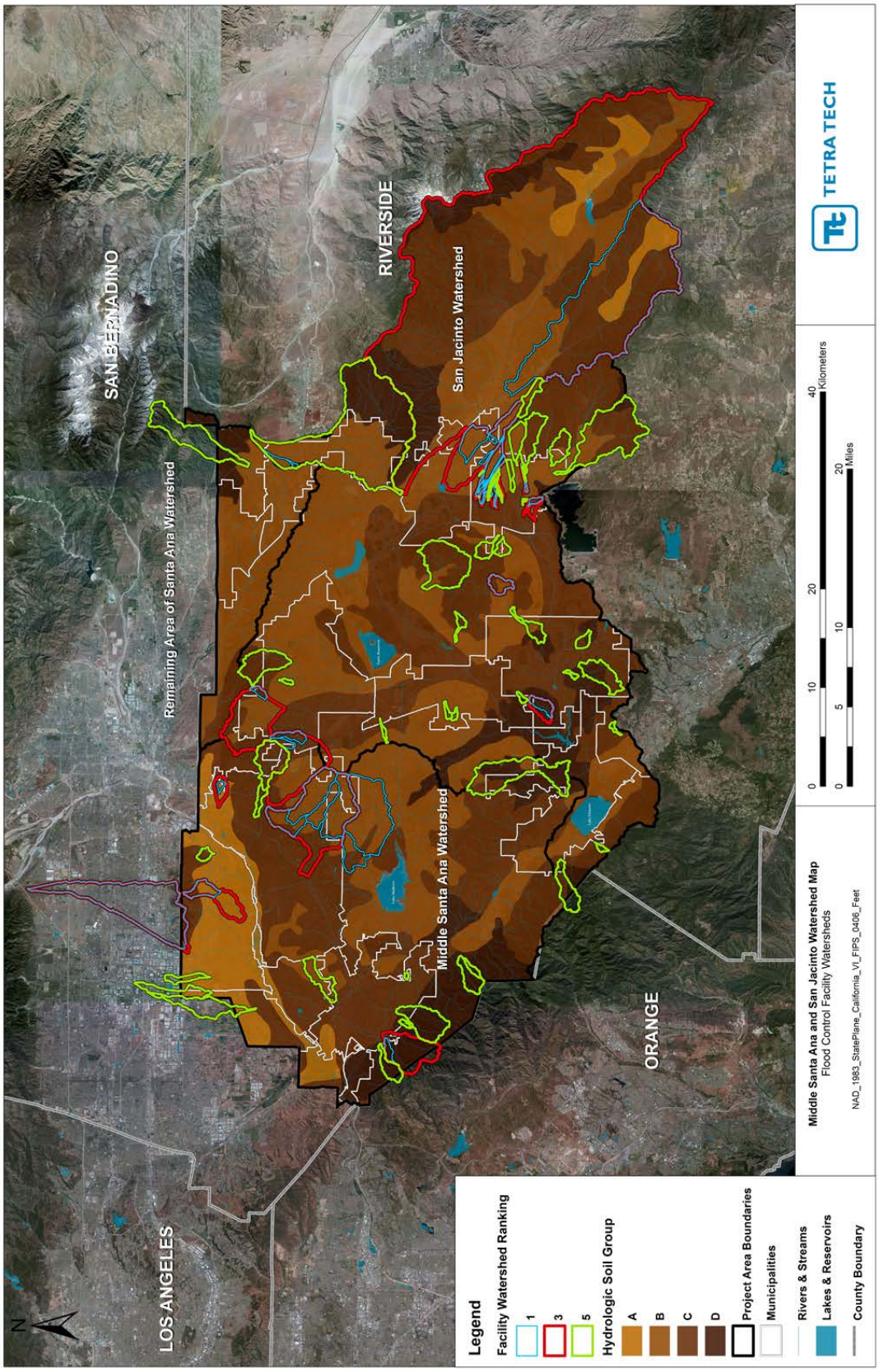

Figure 3-3 – Soils Data

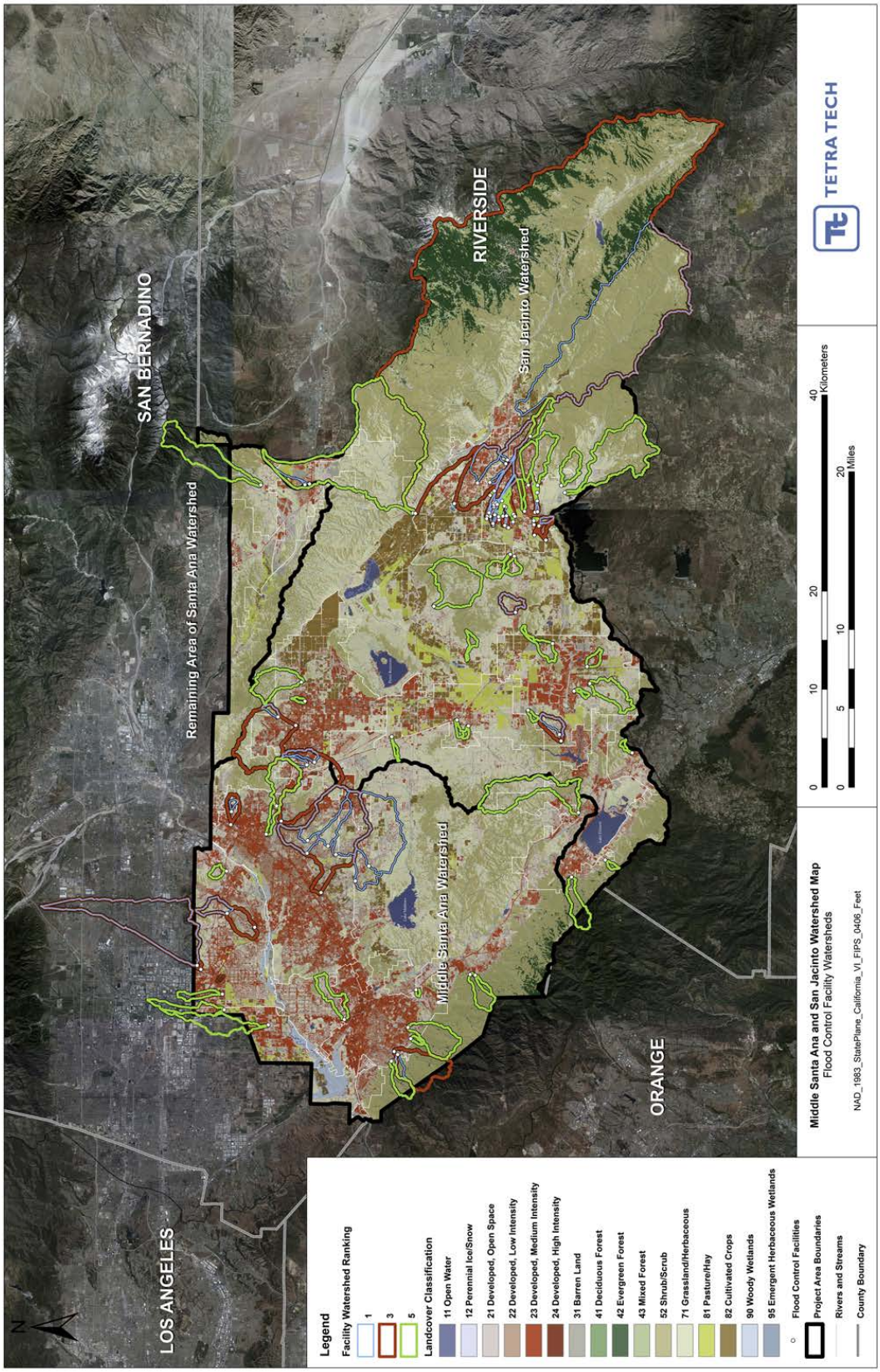

Figure 3-4 – Land Use Data

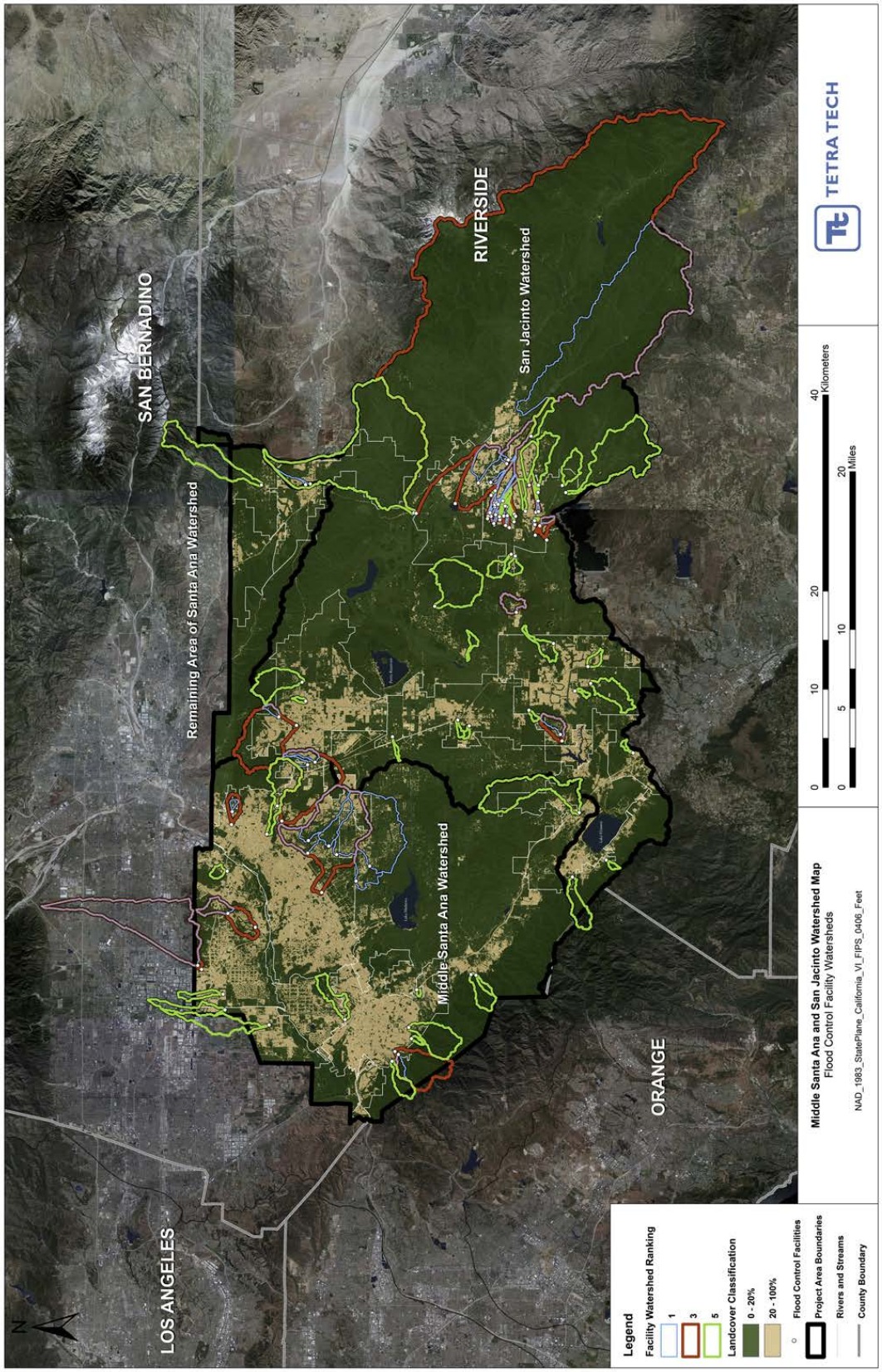

Figure 3-5 – Impervious Cover Data

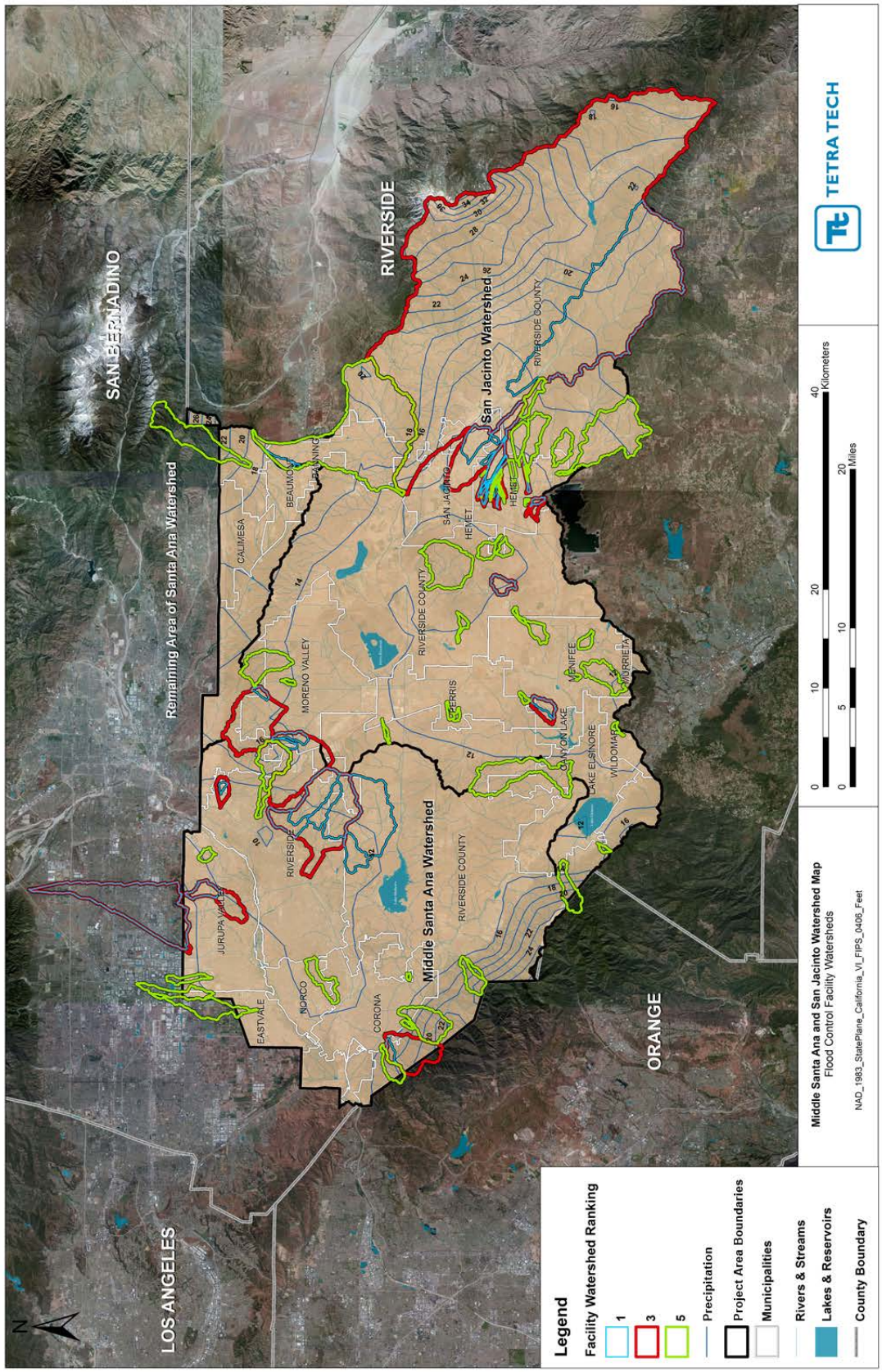

Figure 3-6 – Precipitation Data

3.3 SITE SELECTION CRITERIA FOR FLOOD CONTROL FACILITY RETROFIT OPPORTUNITIES

Existing flood control facilities were evaluated for possible retrofit opportunities using a scoring methodology approach. This approach used several factors to evaluate a flood control facility's potential for an effective BMP retrofit. Most of the scoring factors are related to the characteristics of the contributing drainage area of the flood control facility. These scoring factors are described below.

- **Drainage area size:** The potential for more significant water quality treatment and pollutant load removal increases with increasing contributing drainage area. Therefore, existing flood control facilities that collect runoff from larger contributing drainage areas are prioritized over flood control facilities that collect runoff from smaller drainage areas. Based on best professional judgment, large centralized BMPs effectively treat water quality of drainage areas less than 200 acres. For water quality treatment of drainage areas beyond 200 acres, further investigation is warranted to fully evaluate contaminant transport within the watershed and suitable BMP treatment.
- **Overlapping of drainage areas:** This criterion applies to flood control facilities that share drainage areas. Flood control facilities which collect outflows from upstream flood control facilities are prioritized over the upstream flood control facilities.
- **Percent imperviousness:** The mean percent imperviousness of the drainage area is considered to evaluate the expected amount of rainfall that will be converted to runoff. Typically, increased runoff is expected with increased impervious cover. An impervious percentage is used rather than an actual impervious acreage because an actual acreage may not accurately represent connectivity between the impervious covers. Although small in acreage, a high percent of imperviousness in a small catchment is often more likely to result in higher connectivity as compared to a significant acreage of impervious cover throughout a vast drainage area.
- **Infiltration Capacity (Soils):** Mapped hydrologic soil groups are used as estimates for the infiltration rate and storage capacity of the soils underlying the flood control facilities. Flood control facilities with highly infiltrative underlying hydrologic soils groups received higher priority as they provide maximum opportunities for water quality treatment via infiltration.
- **Average Annual Precipitation:** Average annual rainfall values provide insight on the amount of precipitation expected in a given drainage area. Drainage areas within high precipitation areas will be given higher priority as these areas will be more susceptible to high runoff conditions.

Scoring methodology is based on a scale of 1 through 5 (5 being the highest score). Scoring thresholds for each factor are presented in Table 3-1. For each flood control facility, the component scores are added to result in a total score. Flood control facilities with the highest total scores represent the best opportunity for a possible BMP retrofit. In instances where there are matching total scores, prioritization and ranking is ordered by drainage area in descending order. In other words, priority of flood control facilities with the same total score is given to the site with greater contributing drainage area.

In prioritizing potential flood control facility retrofitting, factors that played a key role include drainage area size, the relevancy of drainage area overlap, and the percent imperviousness of the drainage area. These key factors were given the highest possible of score of 5 when favorable conditions were met.

Table 3-1 – Scoring Methodology for Prioritizing Flood Control Facility Retrofit Opportunities

Factor	FCF Scores (5=best)				
	5	4	3	2	1
Avg. Annual Precip. (inches)		17-19	14-16	12-13	<11
Soil Type		A,B	C	D	
Percent Impervious	50+	30-50	20-30	10-20	<10
Overlapping Drainage Area	No	Catchment contains other FCF sub- catchments < 200 ac	Sub- catchment within another FCF drainage area < 200 ac	Catchment contains other FCF sub- catchments > 200 ac	Sub- catchment within another FCF drainage area > 200 ac
Drainage Area (acres)	100-200	10-100	1-10	200+	<1

Since the watershed delineation process was limited to systematic GIS-applications, storm drainage networks were not incorporated to account for some manipulated flow. Also, manual renderings were not made to account for some irregularities that can result from such automated processes.

Although a reasonably fine 3-meter DEM resolution was used, there are instances of catchments as small as 9 meters squared. There were three instances of irregularly small drainage areas as a result of the automated delineations. For these irregular delineations, a low drainage area score (score of 1) was used as the characteristics of the small area would not truly reflect the characteristics of the drainage area of that respective flood control facility. A detailed site survey or review of as-built drawings would be necessary to increase confidence in drainage delineations.

3.4 PRIORITIZATION RESULTS

Results of the prioritization process for flood control facilities are summarized in this section.

- Table 3-2 summarizes information regarding the top possible rural parcel opportunities
- Figure 3-7 depicts top flood control facility possible opportunities for BMP implementation and retrofit

Table 3-2 – Flood Control Facility Prioritization Results

Rank	Site ID	Data Source	Drainage Area (ac)	Total Score
1	4-0353	RCFCWCD	111.86	21
2	1653C	Hemet	140.77	19
3	16540	Hemet	50.26	19
4	2-0305	RCFCWCD	1343.70	18
5	1-0245	RCFCWCD	579.11	18
6	1EF8D	Hemet	146.33	18
7	1650A	Hemet	111.64	18
8	165AB	Hemet	68.27	18
9	2-0112	RCFCWCD	54.93	18
10	16515	Hemet	53.15	18
11	1EF70	Hemet	35.80	18

Rank	Site ID	Data Source	Drainage Area (ac)	Total Score
12	1EF74	Hemet	24.90	18
13	16520	Hemet	1052.15	17
14	2E3F3	Hemet	162.12	17
15	2E38A	Hemet	125.20	17
16	2E2A5	Hemet	101.41	17
17	1EF72	Hemet	94.07	17
18	1EF92	Hemet	83.84	17
19	16547	Hemet	39.36	17
20	5-0040	RCFCWCD	4495.92	16

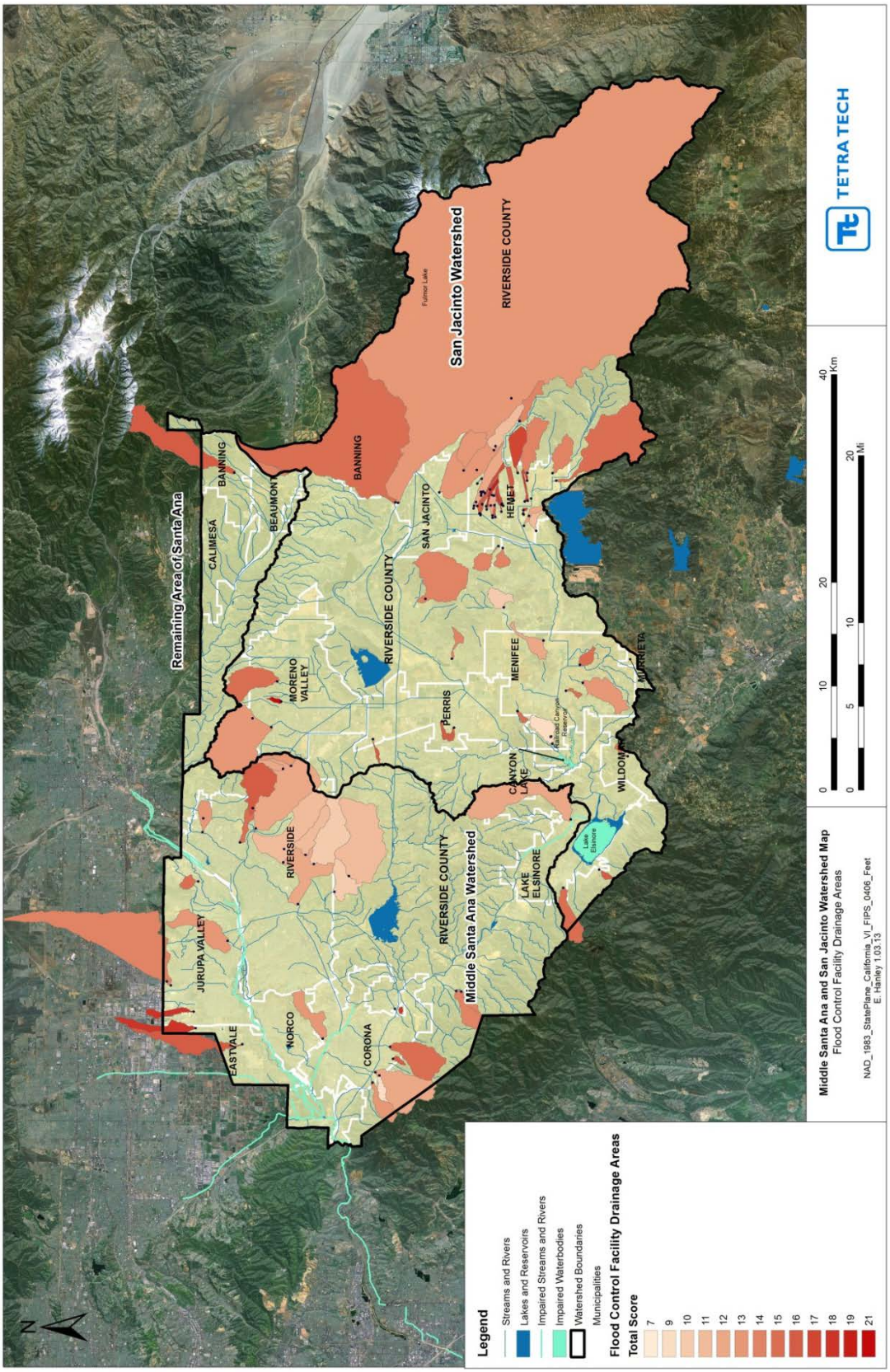

Figure 3-7 – Flood Control Facility Prioritization Results

4 Conclusion

As MS4 permit requirements shift focus from regional-scaled actions to site-scale Low Impact Development (LID) BMPs, watershed planning strategies need to emphasize the value in site-specific possible opportunities for BMP retrofit or potential BMP implementation. To support this shift in focus and provide potential alternatives, the Santa Ana Region Retrofit Study identifies potential opportunities for redevelopment to accomplish retrofits and new development to incorporate LID into initial design.

The Santa Ana Region Retrofit Study assessed and prioritized potential sites that are feasible for effective BMP retrofits or implementation. These sites are prioritized based on feasibility of that site to support a BMP which can be designed to address multiple benefits such as mitigating multiple water quality parameters and serving dual-purpose functions. Assessment of potential BMP opportunities in the Santa Ana Region relied on two approaches; a parcel-based approach and an approach using existing flood control facilities. Selection and prioritization processes of both approaches were performed using desktop analyses to evaluate physical characteristics of the sites. Although the most recent geospatial data was used in the analyses, field investigations are still warranted in order to comprehensively evaluate potential site restrictions and determine other potential multi-use or multi-benefit features.

The results of the parcel-based approach highlight publicly owned parcels, parks and recreational areas with favorable conditions for BMP implementation or possible retrofit. Most parcels are owned by RFCWCD or municipalities including the City of Lake Elsinore, Beaufort, San Jacinto, Perris, Corona, and Moreno Valley. Parcels were evaluated and prioritized differently depending on whether they fell within an urban or rural setting. This separation was performed to account for the varying characteristics that are inherently present in these areas. In addition, BMPs are designed to treat water quality which can also vary or be driven by the surrounding setting and land use. For the Santa Ana region, many impaired waterbodies are in urban settings; however, water quality concerns may be present in and exclusive to rural areas also in the region.

In addition to public parcels, existing flood control facilities in the Santa Ana Region were also evaluated for potential BMP retrofit opportunities. Flood control facilities attenuate peak flow from typically large drainage areas and may be retrofitted to provide water quality treatment benefits as well. Evaluation and prioritization of these existing facilities was based on drainage area characteristics using desktop analyses. Drainage areas were determined using GIS applications, and their resolution is limited by the 3-m DEM used. Similar to the parcel-based opportunities, a site investigation and a review of as-built drawings would be necessary to confirm or modify drainage delineations. Prioritization of flood control facilities emphasized facilities treating large drainage areas with high imperviousness and significant rainfall. Due to the close proximity of some facilities and to avoid duplicative efforts in treatment, facilities that treated drainage areas without interfering facilities were prioritized highest. Flood control facilities with drainage areas encompassing other facilities were prioritized next as one retrofit may be necessary to treat the entire area. Throughout the prioritization process a 200 acre drainage area was kept as a threshold for optimal water quality treatment. Although some flood control facilities may have large drainage areas (some exceeding 200 acres), confidence in their ability to serve as dual-purpose facilities can be confirmed through site investigations and review of as-built drawings.

Presented in the Retrofit Study are the top possible BMP retrofit opportunities in the Santa Ana Region. All the prioritized parcels and flood control facilities can be examined in the spreadsheet and GIS files enclosed. Within these attachments are all the site-specific characteristics and parameter scores used to determine the top priority sites. The top priority sites listed serve as starting points to efficiently navigate through all the potential retrofit sites throughout the Santa Ana Region. The attached results can be utilized with flexibility as other needs, focuses, or restrictions arise.

Although this Retrofit Study focused on publicly owned parcels and existing flood control facilities for potential retrofit opportunities, it is anticipated that the public will be encouraged to implement similar

practices on private property as more is learned regarding the functional and aesthetic value of the LID practices. Focusing water quality treatment on a site-specific scale alleviates the need for large spaces for centralized facilities and maximizes the opportunities for LID and BMP implementation. Incorporating LID and BMPs throughout the Santa Ana Region reduces pollutant load in runoff via natural hydrologic process while adding aesthetic value to the environment.