Technical Memorandum 1
Receiving Water and Watershed Inventory Mapping

Inventory and mapping of available geographical data was necessary to support efforts of the Stormwater Quality Standards Study (SWQSS) Task Force. Geographical data relating to physical attributes of Santa Ana Basin waterbodies was collected from a variety of agencies to construct a Geographical Information System (GIS) for the SWQSS (Study GIS). Monitoring locations, recreational use information, and structural BMP information and associated data was also collected, as described in other Technical Memoranda and included in the Study GIS. This technical memorandum describes the geographical data collected and reviews the integration of different layers into a common Study GIS. Geographic data collected and compiled include:

- Listed waterbodies and other unnamed tributaries
- Storm drain system information
- Land use information for the years 1990, 1993, and 2000
- Publicly Owned Treatment Works (POTWs) and groundwater recharge basins
- Meteorological, climatic, hydrological, and water quality data monitoring locations
- Various base map layers

Data Collection and Integration

Geographical data layers were collected from multiple sources and compiled into a single GIS to facilitate overlay and analysis (Table 1). Many of the spatial data layers presented in this inventory are included in a base map of the Santa Ana Basin (Figure 1). A digital elevation model (DEM) of the Santa Ana Basin was provided to the Stormwater Standards Study by SAWPA. This is a raster, grid based, layer of elevation data for 10 meter squared cells for the entire Santa Ana Basin. All other GIS layers collected were vector data, points, lines, or polygons.

The data was provided in a variety of forms and therefore integration into a common GIS was necessary. ArcGIS® [ESRI, 2003], a multi-component geographical data management and analysis tool was used to integrate each layer, complete analyses, and prepare descriptive maps for technical reports. All GIS layers were converted to the same coordinate system, UTM projection NAD 1927 Zone 11N, to accurately overlay the data. In some instances, shapes were provided for the entire state of California or for all of San Bernardino, Orange, or Riverside Counties. These shapes were clipped to only include data that exists within the boundary of the Santa Ana Basin. Map layers included are listed in Table 1.

Table 1
GIS Map Layers Compiled

Layer	Source(s)	Description
Watershed	SAWPA	Boundary of Santa Ana Basin
Basin Plan Reaches	California Spatial Information Library (CaSIL) and Regional Water Quality Control Board (RWQCB)	Named inland surface streams in Basin Plan compiled from; • CaSIL - Statewide Hydrography, National Hydrography Dataset (NHD) • RWQCB - 2002 303(d) Rivers
Other Reaches	CaSIL	Streams of National Hydrography Dataset (NHD) prepared by the USGS and EPA for the Santa Ana Region
Lakes	CaSIL	Lakes and other waterbodies of NHD prepared by the USGS and EPA for the Santa Ana Region
Flow Stations	USGS, Orange County, San Bernardino County, Riverside County	Flow gauging stations within the Santa Ana Basin
Water Quality Monitoring Stations	Santa Ana Regional Water Quality Control Board, Coast Keeper, Elsinore Valley Municipal Water District, Big Bear Lake Municipal Water District, San Bernardino County Flood Control District, Orange County Health Care Agency, Riverside County Flood Control District, USGS	Bacteria sampling locations along inland surface waterbodies
County	CaSIL	County boundaries
Roads	CaSIL	Roads within the Santa Ana Basin
Land Use	Southern California Associated Governments (SCAG)	Land use areas within the Santa Ana Basin with land use type data for 1990, 1993, and 2000
Modified Channels	Orange, Riverside, and San Bernardino County Flood Control Districts	Modified channels in the parts of Riverside and San Bernardino counties that exist within the Santa Ana Basin
Rainfall Stations	National Climatic Data Center (NCDC)	Rainfall stations used to distinguish wet weather days
Wastewater Treatment Plants	SAWPA	Locations of wastewater treatment plants in Santa Ana Basin
Sawpa_dem	SAWPA	Raster elevation map of the entire Santa Ana Basin – 30 meter grid cell

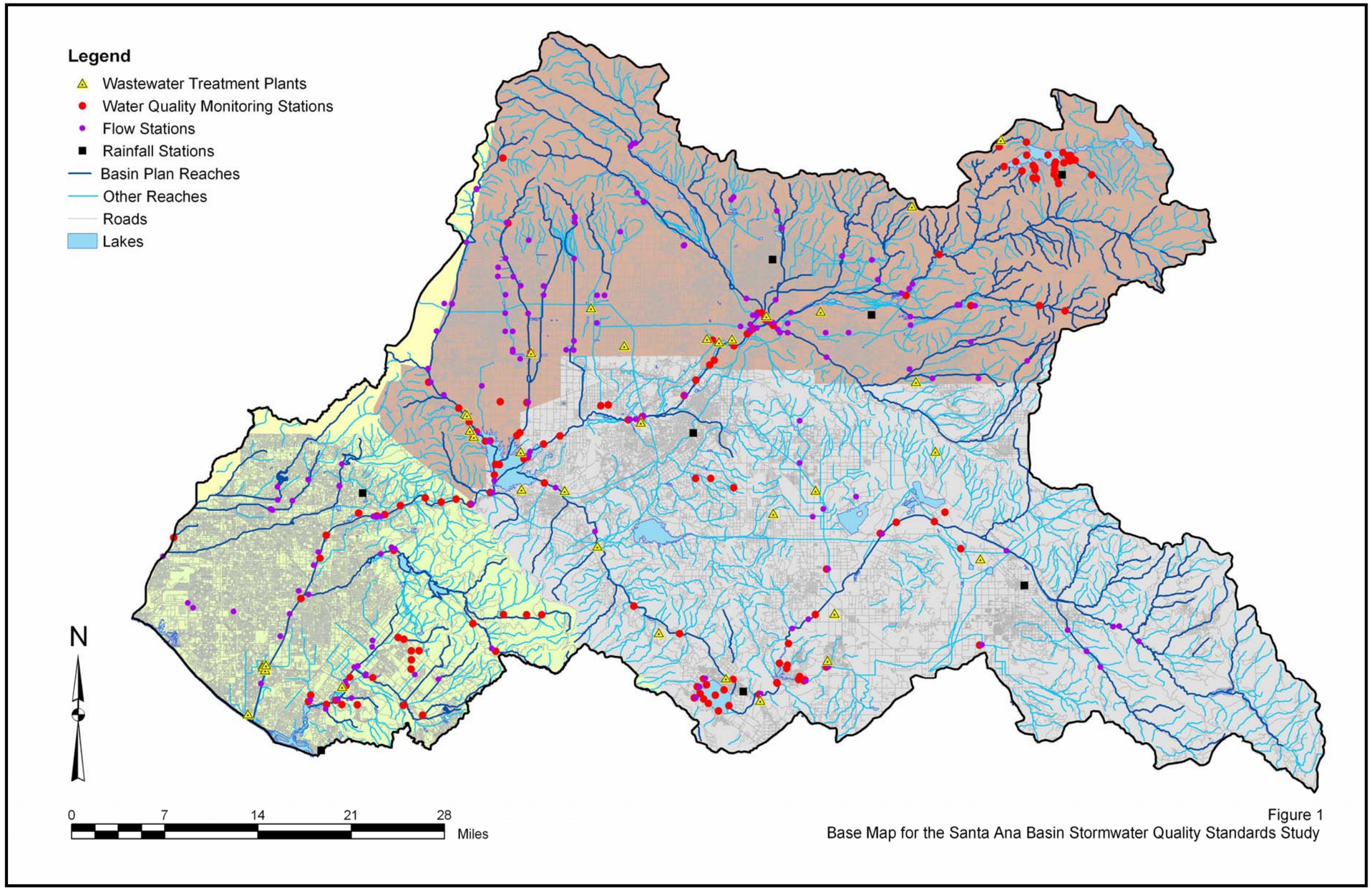

Figure 1
Base Map for the Santa Ana Basin Stormwater Quality Standards Study

Study GIS

Receiving Waterbodies

Several GIS layers were used to compile a single layer of named waterbodies with designated recreational use in Table 3-1 of the Santa Ana River Basin Water Quality Control Plan (Figure 2). The national hydrography dataset (NHD), which is a combination of USGS blue line streams digitized from topographic maps and the USEPA Reach File Version 3 (RF3) was used as well as a draft layer of all 303(d) listed waters being compiled by the Santa Ana Regional Water Quality Control Board (SARWQCB). Tributaries to the named waterbodies were equated to waters in the NHD that are unnamed, in the Basin Plan (Figure 3). Some of these waterbodies are improved engineered channels. In addition, there is an extensive network of storm drainage facilities (pipes, culverts, and channels) that are tributary to the waterbodies shown in Figure 3. The layer contains the majority, but not all small channels within the basin.

Channel Properties

Stormwater drainage facility information for Orange, Riverside, and San Bernardino counties is available in a variety of different forms. Therefore, different GIS approaches were employed to incorporate channel characteristics for each county into the Study GIS. The primary goal of a watershed wide assessment of channel properties was to extract from county facility map the open channels that have been modified or have engineered improvements.

San Bernardino County Flood Control District facility information is organized into a polyline layer with descriptive attribute data (Table 2). These attribute data are described briefly in Table 2, which summarizes a metadata file that accompanied the map layer. Features that were classified as lined or which were type C (channel) or Z (trapezoidal/rectangular) were exported to a new polyline layer of modified channels in San Bernardino County.

Table 2
Attributes of San Bernardino County Flood Control District Facilities Layer

Item	Description	Values	
PSIZE	Pipe Size (in)	Diameter	
BSIZE	Box Size	Base, Height	
CSIZE	Channel Size	Base, Side Slope	
TYPE	Type Code	P – pipe B- box **C – channel** W – water course L – levee S – designed street	**Z – trapezoidal/rectangular** T – transition E – easement G – curb and gutter A – arched conduit V – v-gutter
Lining	Channel Material	**Lined**, Unlined	
STATUS	Current condition	Existing, Proposed	
Owner	Jurisdiction maintaining facility	County, Cities, Private, Other	

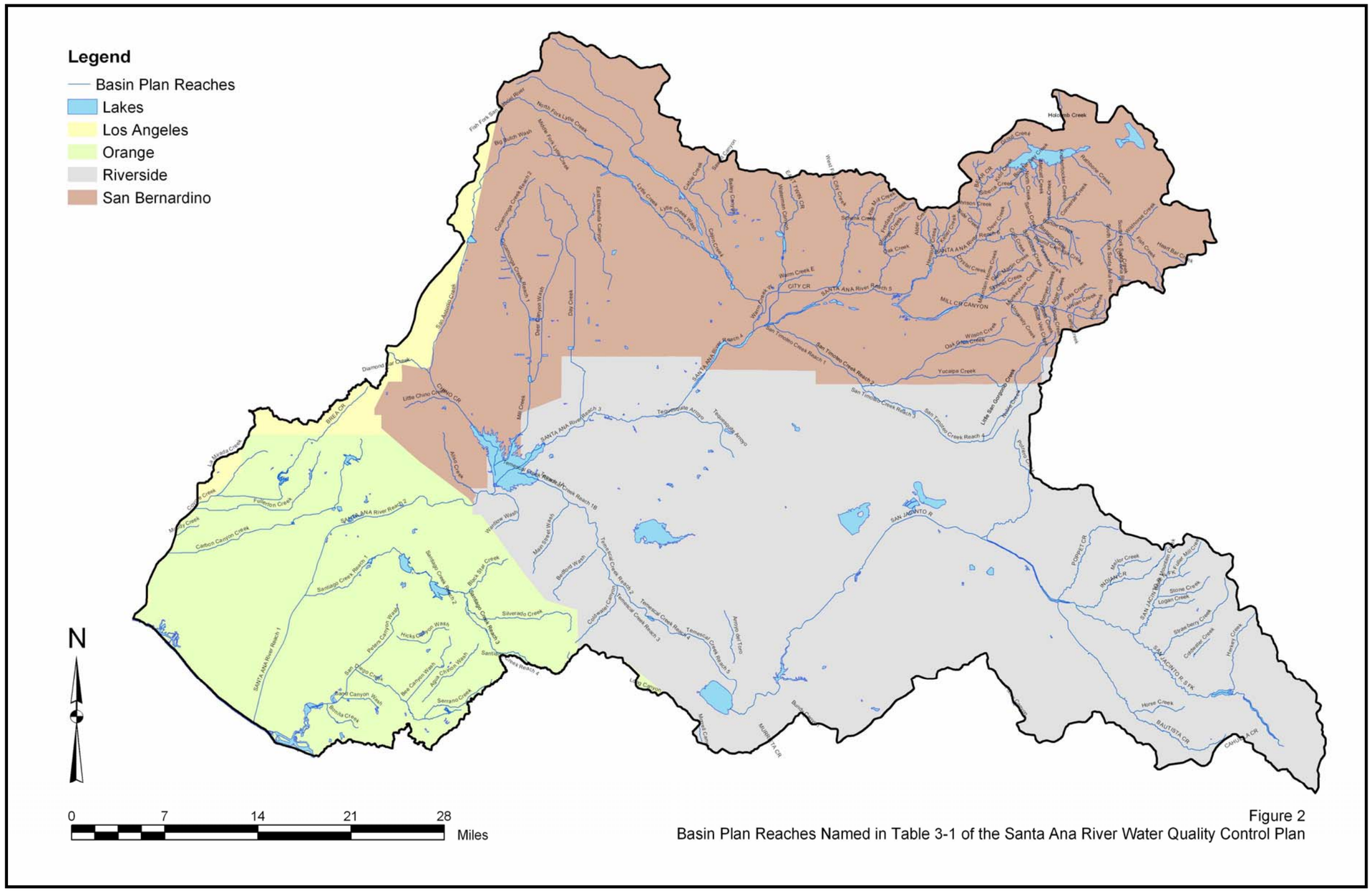

Figure 2
Basin Plan Reaches Named in Table 3-1 of the Santa Ana River Water Quality Control Plan

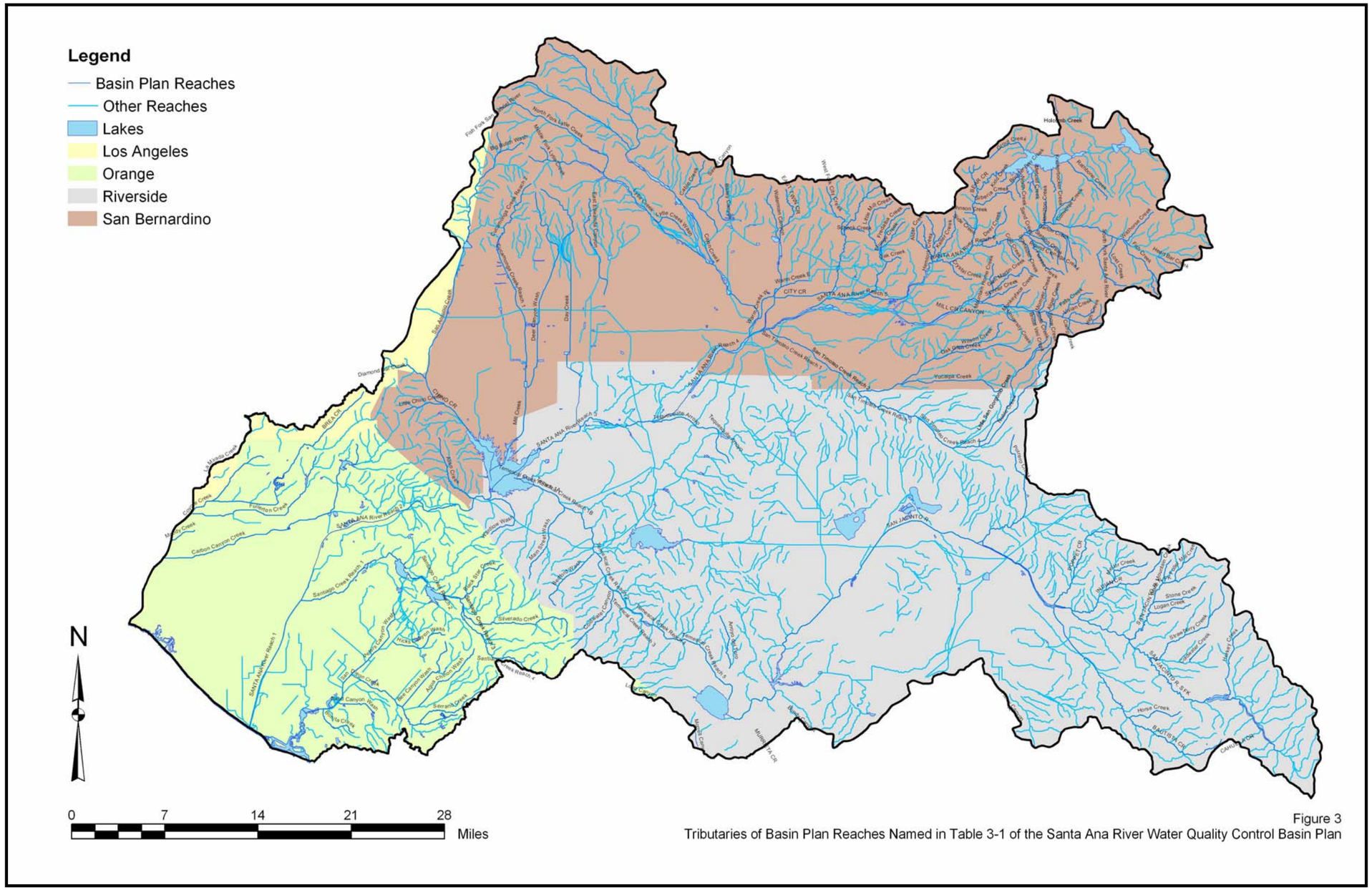

Figure 3
Tributaries of Basin Plan Reaches Named in Table 3-1 of the Santa Ana River Water Quality Control Basin Plan

Riverside County Flood Control District submitted a polyline layer of drainage projects with attribute data as shown in Table 3. Consequently, all open channels in this layer could be considered modified channels. To distinguish between open channels and closed conduits, the ORTYPES field in the attribute table was utilized. The YESORTP field included up to five different drainage types listed in order of most predominant to least. This field in the attribute table was exported to a spreadsheet and delimited to create five distinct fields representing the different drainage types. The new fields were then joined back into the polyline attribute table using the unique project number of each feature. All features which included drainage types CONC, DIKE, LVEE, RECT, ROCK, or TRAP, in either the first or second most predominant ORTYPE fields (ORTYPES and ORTYPE2) were exported to a new polyline layer of modified channels in Riverside County.

Table 3
Attributes of Riverside County Flood Control Facilities Layer

Item	Description	Values
Project identifiers	Name, Developer, NOC, ID, GDO ID, STRMDRN ID	Unique
Project location	Tract, DWG Number, ROW DWG Number	Unique
ORTYPES	Types of drainage facilities	AC, BASN, CIP, CMP, **CONC**, CP, **DIKE, EAR, LVEE**, PVC, RCB, RCP, **RECT, ROCK**, SP, **TRAP**, V

Digital drainage facilities maps provided to the Stormwater Standards Study by the Orange County RDMD were converted from Micro Station format into GIS layers to facilitate overlay. The conversion process generated four GIS layers of Orange County's drainage system; points, polylines, polygons, and annotations. Attribute tables for these layers are generated during the conversion process, however these tables do not include detailed properties of the drainage facilities. Drainage facility information describing point, polyline and polygon features are held within the annotation layer. The attribute table of the annotation layer does distinguish channel types. This facilitated the extraction of lined open channels from the polyline layer by selecting only those polylines within a small distance from annotation types identifying a channel as earth trapezoidal channel, reinforced concrete trapezoidal channel, or reinforced concrete rectangular channel.

The modified open channels that are extracted from Orange, Riverside, and San Bernardino county facility maps are then merged into a single polyline layer and clipped to include only those portions within the Santa Ana Basin (Figure 4).

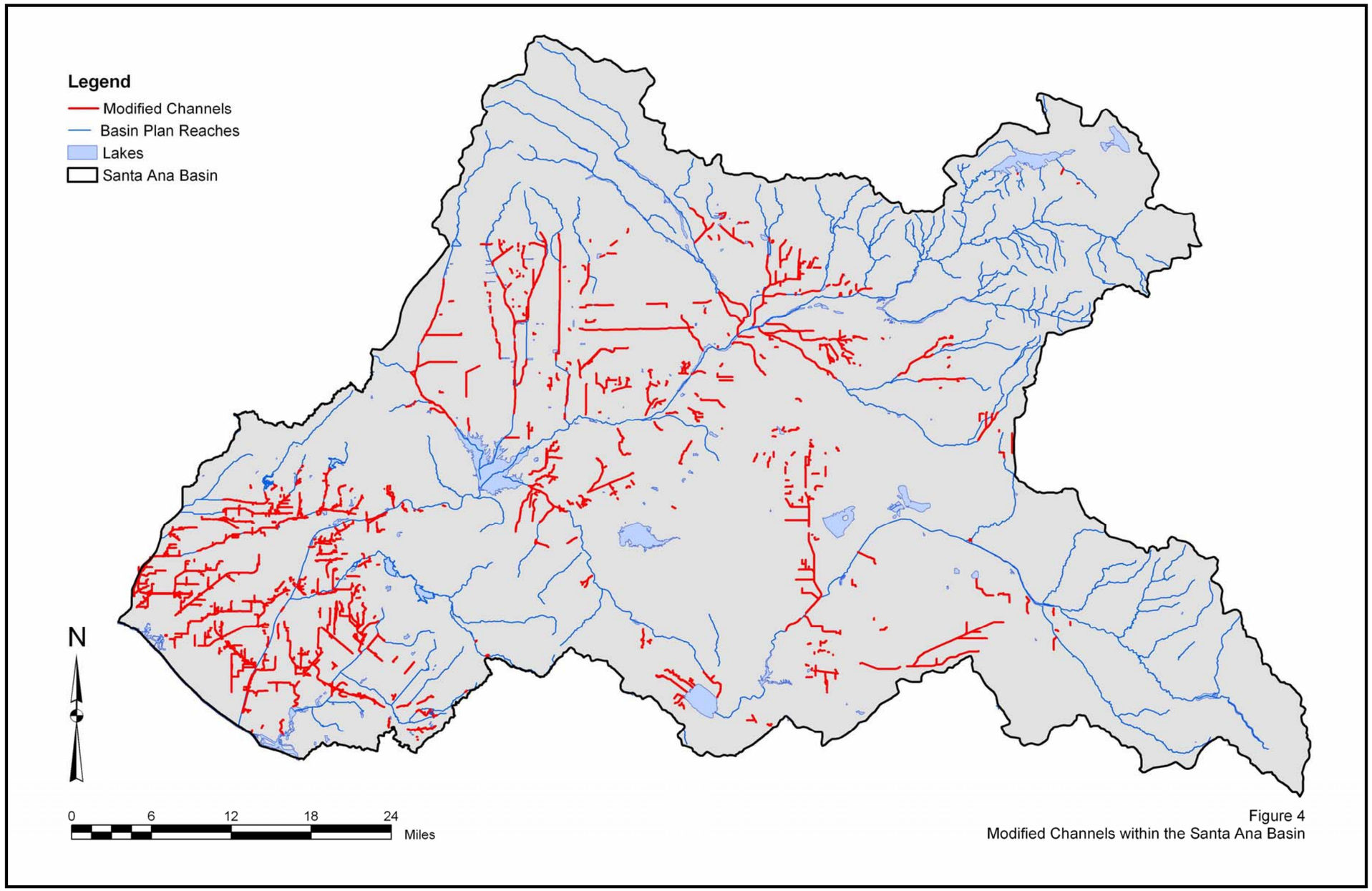

Figure 4
Modified Channels within the Santa Ana Basin

Water Quality Monitoring Stations

Bacteria data compiled from a variety of agencies included information about the location within the Santa Ana Basin where samples were collected. These locations where merged into a layer called "Water Quality Monitoring Stations" (Figure 5). The format of information includes:

- GIS layers
- GPS coordinates
- Notations on paper maps
- Descriptive location names

GIS layers of bacteria monitoring locations were integrated into the Study GIS. Bacteria monitoring locations that were provided in the form of GPS coordinates were imported into a new GIS map with the same coordinate system (typically WGS 1984 for most GPS receivers) and then converted into a GIS layer for integration into the Santa Ana Basin GIS model. Bacteria monitoring locations that were shown on a paper map were added to the GIS model by comparing surrounding features, such as specific roads or waterbodies. Lastly, bacteria monitoring locations that did not include any geographical information aside from the descriptive name were added to the Study GIS by interpreting the narrative description. This scenario often involved locations described by a cross-street or bridge overpass near the water body, (i.e., Santa Ana River (SAR) at Imperial Highway, SAR at Van Owen). Some bacteria monitoring locations were sampled by multiple entities. These bacteria monitoring locations were aggregated together in the GIS model. However, the entity or source of specific bacteria records is included as an additional field in the Stormwater Quality Standards Study database.

Flow Monitoring Stations

Flow in inland surface waterbodies is monitored by the USGS and by the counties or flood control districts of Riverside, Orange, and San Bernardino Counties. Coordinates of USGS flow monitoring stations were imported into a new GIS map with the same coordinate system (WGS 1984) and then converted into a GIS layer for integration into the Study GIS. San Bernardino County flow monitoring station coordinates were extracted from the county's Hydrology web page and integrated into the Study GIS using the same method. Flow monitoring station coordinates were provided in this same format by the Riverside County Flood Control District. These stations were integrated into the Study GIS. Flow monitoring stations in Orange County are described and mapped in the annual Resources and Development Management Department (RDMD) Hydrology Report. This map was used to locate and add the flow monitoring stations maintained by the RDMD to the Study GIS. Figure 6 shows flow monitoring stations within the Santa Ana Basin.

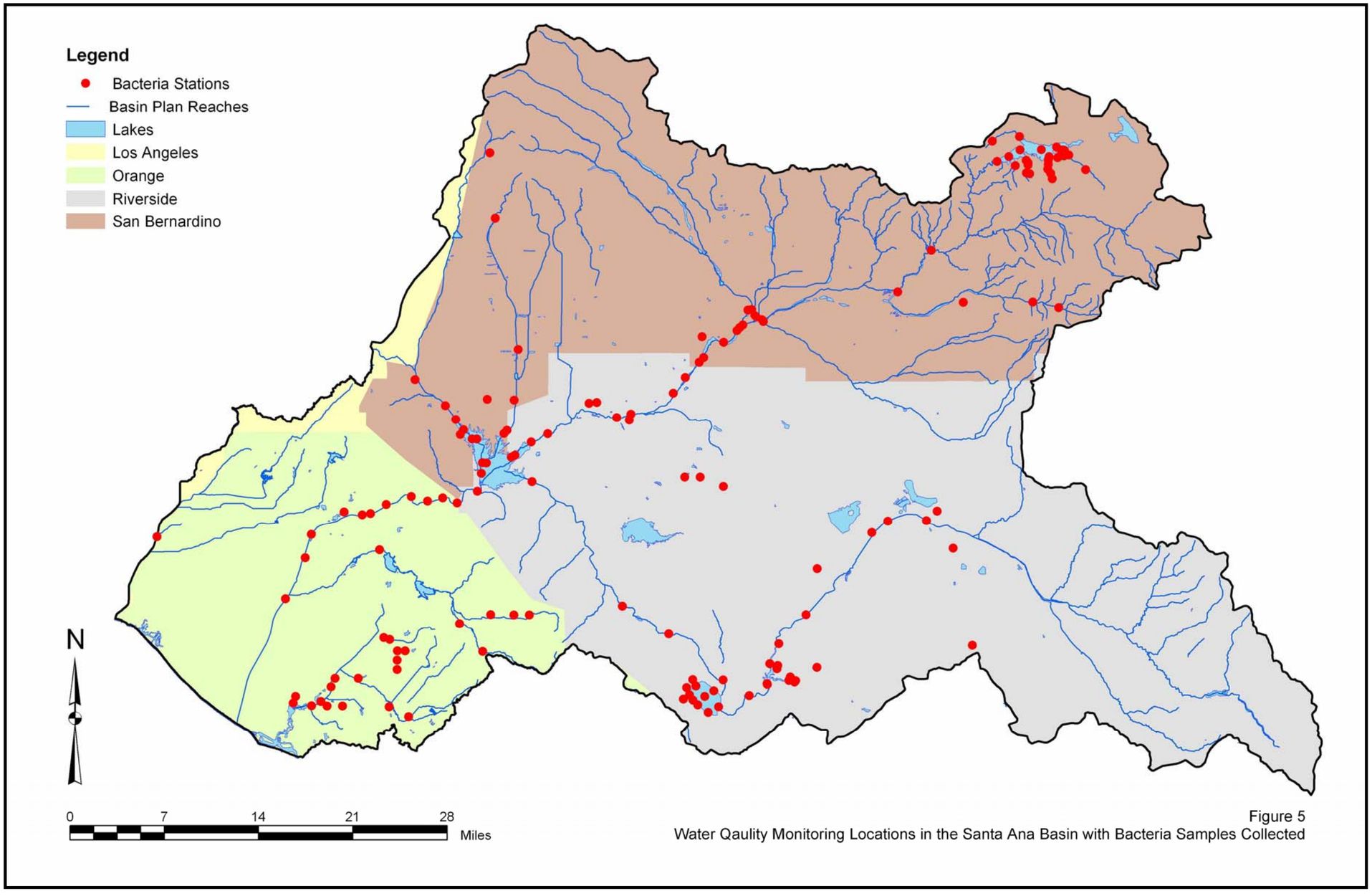

Figure 5
Water Qaulity Monitoring Locations in the Santa Ana Basin with Bacteria Samples Collected

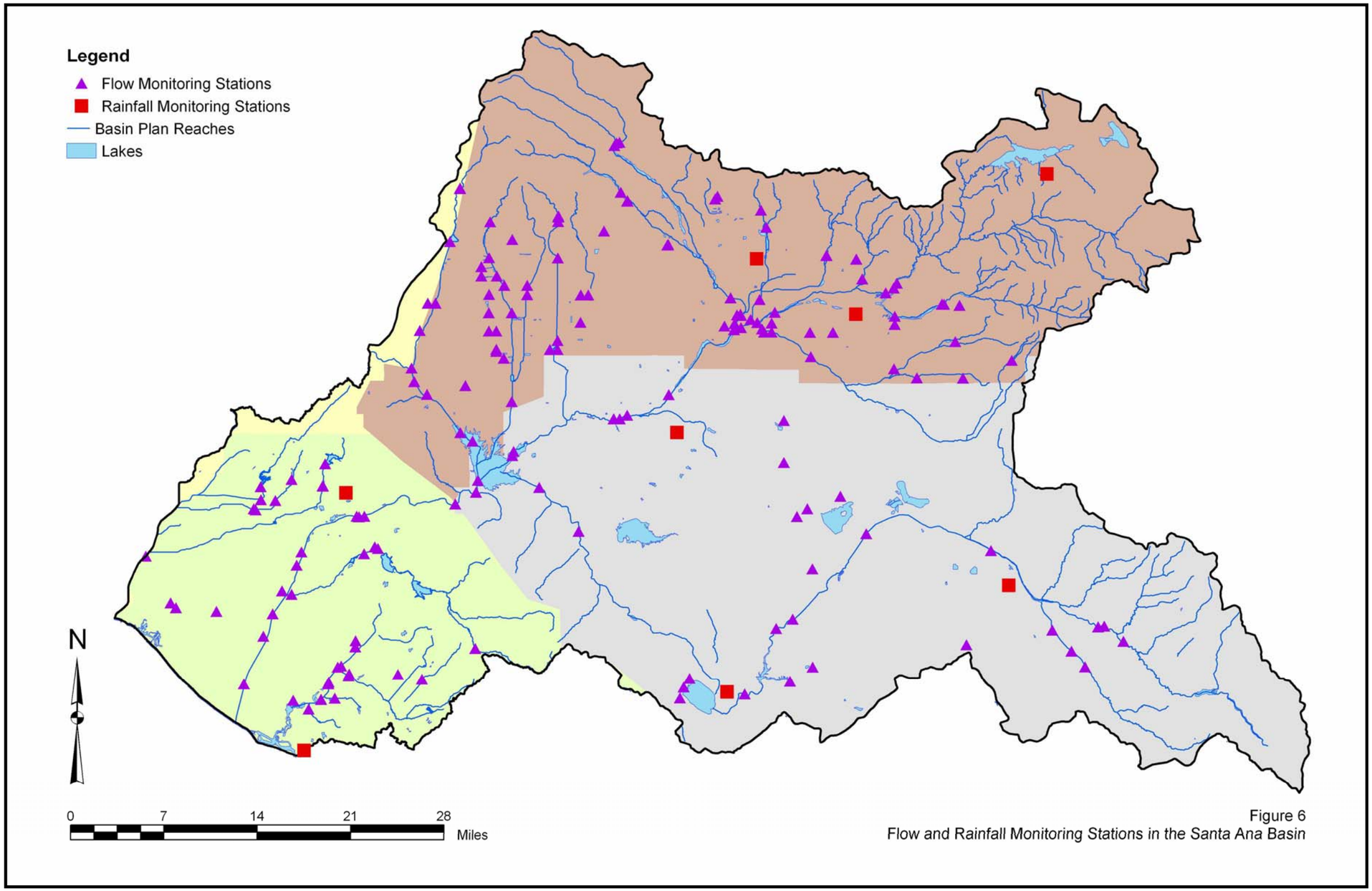

Figure 6
Flow and Rainfall Monitoring Stations in the Santa Ana Basin

Figure 6 also shows selected long term rainfall stations located within the Santa Ana Basin that can serve as a surrogate to missing or unavailable flow data or to assess wet weather conditions for regional analyses.

Land Use

Land use data of the Santa Ana Basin in 1990, 1993, and 2000 was provided by Southern California Associated Governments (SCAG). Figure 7 shows the year 2000 SCAG land use dataset, which is the most recent land use information available for the Santa Ana Basin. Land use in the immediate vicinity of Santa Ana Basin waterbodies may play a role in the likelihood of recreational use in nearby segments of the reach. Land use within small drainage areas also suggests potential sources of bacteria levels in receiving waterbodies with REC-1 use designations.

Existing Treatment and Structural Control Measures

There are numerous control and treatment measures located throughout the basin. Mapping coverage is not available for the entire magnitude of facilities that are designed and installed or have the potential to address bacteria water quality. Two types of bacteria treatment and control measures for which mapping currently exists or has been compiled for this study are publicly owned treatment works (POTW) and recharge basins.

There are 42 publicly owned treatment works (POTW) within the Santa Ana Basin that treat wastewater and either recycle the water or discharge effluent to inland surface waterbodies. POTW discharges that are released into waters with a designated recreational use are required to meet Title 22 standards for filtration and disinfection (Figure 8).

Recharge basins exist within the watershed to capture runoff by infiltration. Removal of bacteria can be achieved in such basins through groundwater infiltration/treatment. The location of these basins was provided by SAWPA (Figure 8). Attribute information for each basin is included in a GIS layer, including the monitoring agency, name of the basin, and for some basins, size and source water.

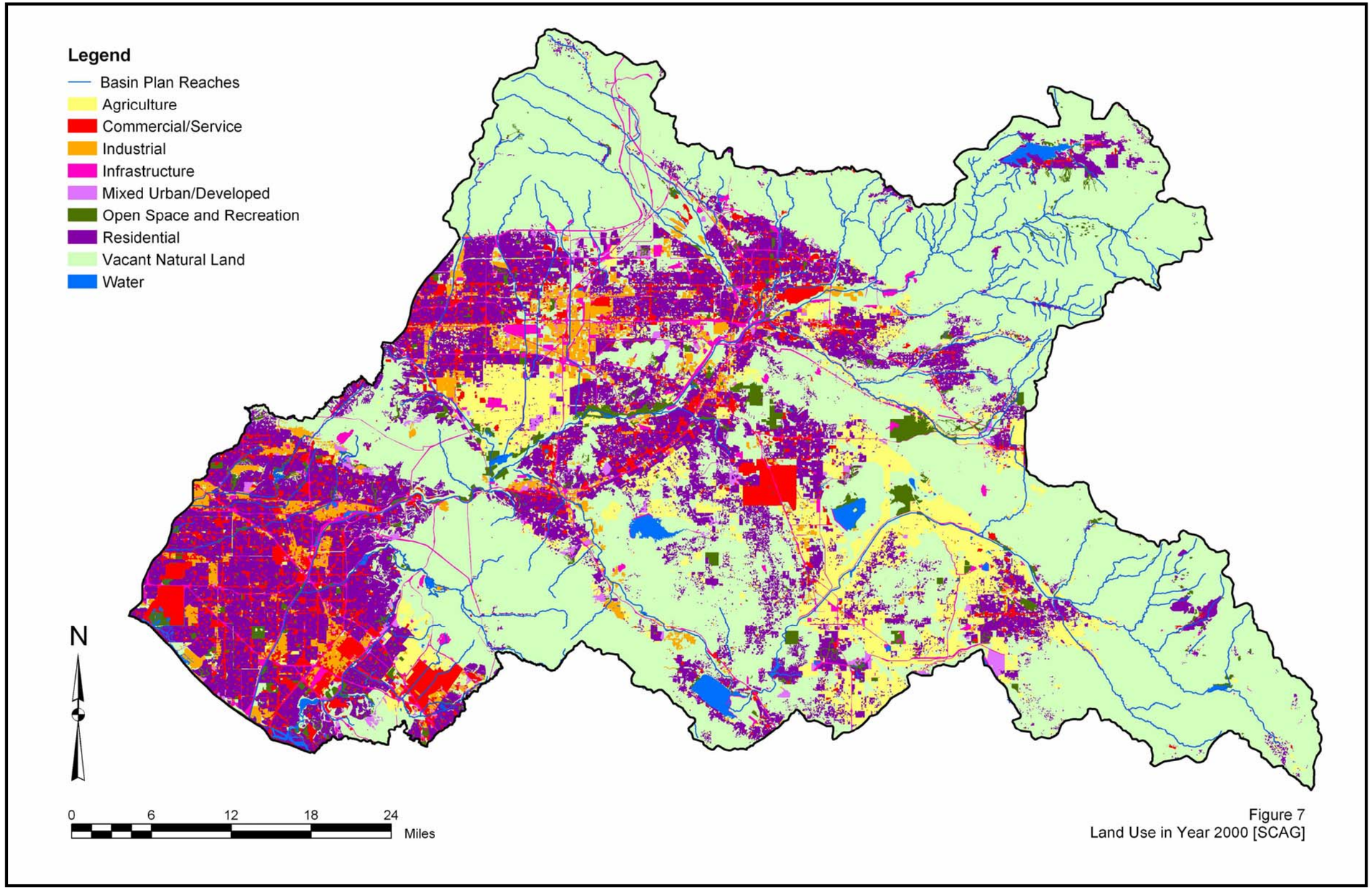

Figure 7
Land Use in Year 2000 [SCAG]

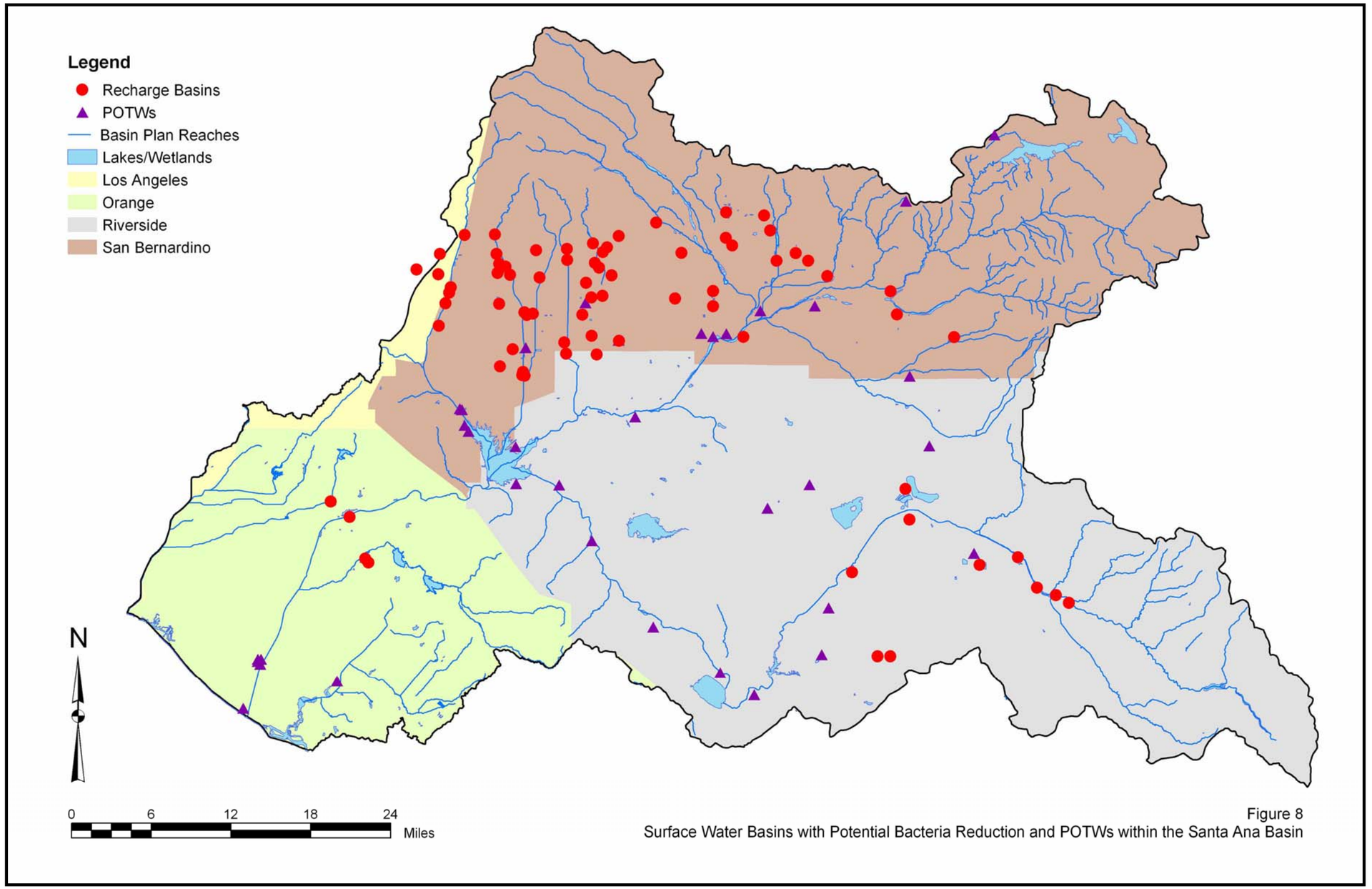

Figure 8
Surface Water Basins with Potential Bacteria Reduction and POTWs within the Santa Ana Basin